Zbornik 18. mednarodne multikonference

INFORMACIJSKA DRUŽBA – IS 2015

Zvezek H

Proceedings of the 18th International Multiconference

INFORMATION SOCIETY – IS 2015

Volume H

Delavnica »Pametna mesta in skupnosti kot razvojna priložnost Slovenije«
Workshop »Smart Cities and Communities as a Development Opportunity for Slovenia«

Uredili / Edited by

Mihael Mohorčič, Ana Robnik, Dalibor Baškovč

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12. oktober 2015 / October 12th, 2015
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PREDGOVOR MULTIKONFERENCI INFORMACIJSKA DRUŽBA 2015

Multikonferenca Informacijska družba (http://is.ijs.si) je z osemnajsto zaporedno prireditvijo osrednji srednjeevropski dogodek na področju informacijske družbe, računalništva in informatike. Letošnja prireditev traja tri tedne in poteka na Fakulteti za računalništvo in informatiko in Institutu »Jožef Stefan«.

Informacijska družba, znanje in umetna inteligenca se razvijajo čedalje hitreje. V vse več državah je dovoljena samostojna vožnja inteligentnih avtomobilov, na trgu je moč dobiti čedalje več pogosto prodajanih avtomobilov z avtonomnimi funkcijami kot »lane asist«. Čedalje več pokazateljev kaže, da prehajamo v naslednje civilizacijsko obdobje, hkrati pa so konflikti sodobne družbe čedalje težje razumljivi.

Letos smo v multikonferenco povezali dvanajst odličnih neodvisnih konferenc. Predstavljenih bo okoli 300 referatov v okviru samostojnih konferenc in delavnic, prireditev bodo spremljale okrogle mize in razprave ter posebni dogodki kot svečana podelitev nagrad. Referati so objavljeni v zbornikih multikonference, izbrani prispevki pa bodo izšli tudi v posebnih številkah dveh znanstvenih revij, od katerih je ena Informatica, ki se ponaša z 38-letno tradicijo odlične znanstvene revije.

Multikonferenco Informacijska družba 2015 sestavljajo naslednje samostojne konference:

- Inteligentni sistemi
- Kognitivna znanost
- Izkopavanje znanja in podatkovna skladišča
- Sodelovanje, programska oprema in storitve v informacijski družbi
- Vzgoja in izobraževanje v informacijski družbi
- Soočanje z demografskimi izzivi
- Kognitonika
- Delavnica »SPS EM-zdravje«
- Delavnica »Pametna mesta in skupnosti kot razvojna priložnost Slovenije«
- Druga študentska konferenca s področja računalništva in informatike za doktorske študente
- Druga študentska konferenca s področja računalništva in informatike za vse študente
- Osma mednarodna konferenca o informatiki v šolah: razmere, evolucija in perspektiva.

Soorganizatorji in podporniki konference so različne raziskovalne institucije in združenja, med njimi tudi ACM Slovenija, SLAIS in Inženirska akademija Slovenije. V imenu organizatorjev konference se zahvaljujemo združenjem in inštitucijam, še posebej pa udeležencem za njihove dragocene prispevke in priložnost, da z nami delijo svoje izkušnje o informacijski družbi. Zahvaljujemo se tudi recenzentom za njihovo pomoč pri recenziranju.

V 2015 bomo tretjič podelili nagrado za življenjske dosežke v čast Donalda Michija in Alana Turinga. Nagrado Michie-Turing za izjemen življenjski prispevek k razvoju in promociji informacijske družbe bo prejel prof. dr. Jurij Tasič. Priznanje za dosežek leta je pripadlo dr. Domnu Mungosu. Že petič podeljujemo nagradi »informacijska limona« in »informacijska jagoda« za najbolj (ne)uspešne poteze v zvezi z informacijsko družbo. Limono je dobilo počasno uvajanje informatizacije v slovensko pravosodje, jagodo pa spletna aplikacija »Supervizor«. Čestitke nagrajencem!

Niko Zimic, predsednik programskega odbora
Matjaž Gams, predsednik organizacijskega odbora

FOREWORD - INFORMATION SOCIETY 2015

In its 18th year, the Information Society Multiconference (http://is.ijs.si) remains one of the leading conferences in Central Europe devoted to information society, computer science and informatics. In 2015 it is extended over three weeks located at Faculty of computer science and informatics and at the Institute "Jožef Stefan".

The pace of progress of information society, knowledge and artificial intelligence is speeding up. Several countries allow autonomous cars in regular use, major car companies sell cars with lane assist and other intelligent functions. It seems that humanity is approaching another civilization stage. At the same time, society conflicts are growing in numbers and length.

The Multiconference is running in parallel sessions with 300 presentations of scientific papers at twelve conferences, round tables, workshops and award ceremonies. The papers are published in the conference proceedings, and in special issues of two journals. One of them is Informatica with its 38 years of tradition in excellent research publications.

The Information Society 2015 Multiconference consists of the following conferences:

- Intelligent Systems
- Cognitive Science
- Data Mining and Data Warehouses
- Collaboration, Software and Services in Information Society
- Education in Information Society
- Facing Demographic Challenges
- Cognitonics
- SPS EM-Health Workshop
- Workshop »Smart Cities and Communities as a Development Opportunity for Slovenia«
- 2nd Computer Science Student Conference, PhD Students
- 2nd Computer Science Student Conference, Students
- 8th International Conference on Informatics in Schools: Situation, Evolution, and Perspective.

The Multiconference is co-organized and supported by several major research institutions and societies, among them ACM Slovenia, i.e. the Slovenian chapter of the ACM, SLAIS and the Slovenian Engineering Academy. In the name of the conference organizers we thank all societies and institutions, all participants for their valuable contribution and their interest in this event, and the reviewers for their thorough reviews.

For 2013 and further, the award for life-long outstanding contributions will be delivered in memory of Donald Michie and Alan Turing. The life-long outstanding contribution to development and promotion of information society in our country is awarded to Dr. Jurij Tasič. In addition, a reward for current achievements was pronounced to Dr. Domnu Mungosu. The information strawberry is pronounced to the web application "Supervizor, while the information lemon goes to lack of informatization in the national judicial system. Congratulations!

Niko Zimic, Programme Committee Chair
Matjaž Gams, Organizing Committee Chair

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KAZALO / TABLE OF CONTENTS

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PREDGOVOR DELAVNICI "PAMETNA MESTA IN SKUPNOSTI KOT RAZVOJNA PRILOŽNOST SLOVENIJE"

Z izrazom *"pametna mesta in skupnosti"* označujemo mesta in družbene skupnosti oziroma zaokrožena življenjska okolja, ki z uporabo informacijskih tehnologij dosegajo večjo učinkovitost rabe virov, omogočajo boljše počutje in višjo kakovost bivanja, zmanjšujejo stroške ter se aktivno odzivajo na potrebe prebivalcev, obiskovalcev, širše skupnosti, javnih služb in podjetij. Rešitve pametnih mest in skupnosti temeljijo na soodvisnosti okolja, infrastrukture in družbe. Soodvisnost različnih podsistemov in pozitivni učinki integriranega pristopa se kažejo na raznoterih področjih od prometa in logistike, učinkovite rabe energije, varnosti, poslovnega in industrijskega okolja pa vse do javnih storitev, osebnega počutja in zdravja.

Področje pametnih mest in skupnosti je v okviru Strategije pametne specializacije (SPS) prepoznano kot eno od pomembnih razvojnih priložnosti Slovenije. Področje je izrazito povezano z uporabo informacijskih in komunikacijskih tehnologij, njihovo integracijo in uvajanjem v širšo družbo. Zaradi tega smo delavnico "Pametna mesta in skupnosti kot razvojna priložnost Slovenije" umestili v širši vsebinski okvir, ki ga predstavlja krovna konferenca "Informacijska družba 2015". Z delavnico želimo identificirati nove možnosti sodelovanja in spodbuditi vsebinsko in strateško povezovanje akterjev na tem izrazito multidisciplinarnem področju.

Pri organizaciji delavnice sodelujejo partnerstva, ki so se spomladi 2015 s svojimi pobudami odzvala na poziv za identifikacijo najperspektivnejših tehnologij in produktnih smeri na področju pametnih mest in skupnosti. Preko teh partnerstev smo k sodelovanju na delavnici povabili akterje, ki se s svojimi rešitvami, razvojnimi cilji, usmeritvami in vlaganji prepoznajo na omenjenem področju. Veseli smo zelo širokega odziva na delavnico, od mikro in malih do srednjih in velikih visoko-tehnoloških podjetij, od raziskovalnih inštitutov in univerz do nevladnih organizacij. Predvsem pa smo veseli pozitivnega odziva vabljenih mest. Prepričani smo namreč, da imajo mesta izrazito pomembno vlogo v vseh fazah uvajanja rešitev pametnih mest in skupnosti, od sodelovanja pri njihovi zasnovi preko določanja potreb in zahtev ter umestitve v dejansko obratovalno okolje, do uvajanja v uporabo. Veseli pa smo tudi podpore Službe Vlade RS za razvoj in evropsko kohezijsko politiko (SVRK), ki je vodila pripravo Strategije pametne specializacije in v naši delavnici prepoznala potencial za krepitev sodelovanja in strateškega povezovanja oblikovanih pobud in njihovih partnerstev.

Zahvaljujemo se vsem udeležencem, ki so pripravljeni deliti svoje izkušnje, poglede in razvojne načrte na področju pametnih mest in skupnosti, kot tudi recenzentom za njihovo pomoč pri recenziranju prejetih prispevkov.

Upamo in verjamemo, da bo delavnica s tvornim sodelovanjem vseh udeležencev prispevala k povezovanju področja ter posledično k uvajanju novih rešitev za pametna mesta in skupnosti ne le v Sloveniji, ampak tudi v mednarodnem prostoru.

Mihael Mohorčič, predsednik programskega odbora

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Marko Hren, SVRK
Tomi Ilijaš, ARCTUR
Mitja Jermol, IJS
Gorazd Novak, Iskratel
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Pobuda PaMetSkup / The initiative PaMetSkup

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POVZETEK

Podjetniško raziskovalna pobuda za Pametna Mesta in Skupnost (PaMetSkup) se osredotoča na zagotavljanje ustrezne odprte infrastrukture in podatkovnih zbirk, podporne odprte IKT tehnologije in aktivnosti, učinkovito energetsko in komunalno oskrbo, mobilnost in dostopnost ter spodbujanje participacije javnosti pri upravljanju javnih prostorov. Nastala je kot odgovor na javni poziv za opredelitev perspektivnih tehnoloških področij in produktnih smeri Strategije pametne specializacije. Pobuda PaMetSkup združuje široko paleto partnerjev iz gospodarstva, raziskovalnih institucij, javnega sektorja in nevladnih organizacij ter preko partnerjev vrsto produktov, storitev ali prototipov na različnih nivojih tehnološke zrelosti. Partnerstvo odlikuje velika pestrost organizacij, ki lahko skupaj celovito nagovorijo izzive povezane z uvajanjem koncepta in tehnoloških rešitev pametnih mest in skupnosti. Posamezne rešitve pobude PaMetSkup imajo izreden razvojni potencial ne zgolj neposredno za partnerje pobude, ampak tudi posredno preko vzpostavljene osnovne infrastrukture, zagotovitve odprtih vmesnikov in podpornih modulov, odprtega spletnega trga aplikacij, in vzpodbujanja koncepta participativnosti.

ABSTRACT

Business & Research Initiative for Smart Cities and Communities (PaMetSkup) focuses on the assuring of appropriate infrastructure and open databases, supportive open technologies and ICT activities, efficient energy and utility supply, mobility and accessibility and promoting participatory activities to the public in the management of the public spaces. It was established following an open call for identifying perspective technology areas and product directions of smart specialization strategy. The initiative PaMetSkup combines a wide range of partners from industry, research institutions, public sector and NGOs, and through these partners also products, services and prototypes at different TRL levels. The partnership is distinguished by a large variety of organizations that together comprehensively address the challenges associated with the introduction of the concept and technology solutions for smart cities and communities. The solutions of the initiative PaMetSkup have enormous development potential, not only to the partners, but also indirectly with built infrastructure, assured open interfaces and support modules, open marketspace and promoting the participatory concept.

1. UVOD

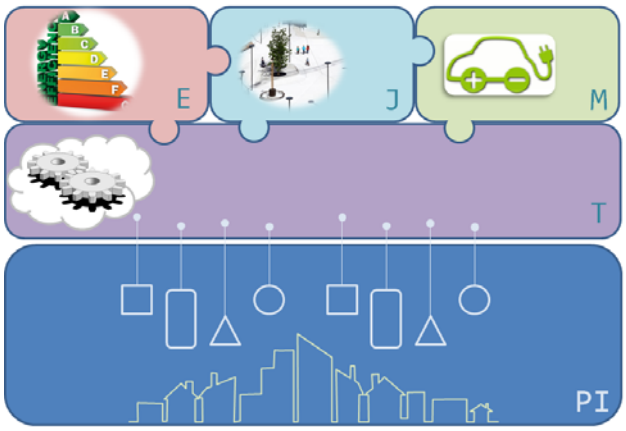
Pametno mesto temelji na soodvisnosti okolja, infrastrukture in družbe, ki se z uporabo digitalnih tehnologij dopolnjujejo, da tako zagotovi večjo učinkovitost storitev, boljše počutje, zmanjšuje stroške in rabo virov, ter se aktivno odziva na potrebe meščanov in obiskovalcev mesta. Vpliv soodvisnosti in pozitivnih učinkov njihovega dopolnjevanja se kaže pri transportu, energiji in zdravju. Za čim večji učinek mora pametno mesto zagotoviti ustrezno infrastrukturo in storitve, ki bodo povezali meščane, javne službe in podjetja v vlogi izvajalcev/ponudnikov storitev.

Dobrobit meščana ali obiskovalca (posameznika) v pametnem mestu se kaže v izboljšanem (povečanem) ugodju bivanja v mestu. To se kaže v bolj zdravem okolju, nižjih stroških komunalnih storitev ter energetske porabe in v lažji in hitrejši mobilnosti znotraj mesta.

Dobrobit javnih služb se kaže skozi učinkovitejši nadzor dogajanja v mestu, odzivanje na potrebe/želje uporabnikov njihovih storitev s čimer direktno vplivajo na ugodje bivanja v mestu. To zagotavljajo tudi preko ustrezne odprte infrastrukture in podatkovnih zbirk.

Dobrobit podjetij se kaže skozi razvoj in ponudbo ustreznih učinkovitih izdelkov in storitev, temelječih na potrebah meščanov in javnih služb in jih podjetja razvijajo na osnovi odprtih podatkovnih zbirk.

Pobuda PaMetSkup se osredotoča predvsem na zagotavljanje ustrezne odprte infrastrukture in podatkovnih zbirk (PI), podporne odprte IKT tehnologije in aktivnosti (T), učinkovito energetsko in komunalno oskrbo (E), mobilnost in dostopnost (M) ter spodbujanje participativne aktivnosti javnosti pri upravljanju javnih prostorov (J) (shematični prikaz podaja slika 1).



Slika 1. Povezanost podporne infrastrukture (PI) in tehnoloških področij (TP) v pobudi PaMetSkup.

V pobudi PaMetSkup sodeluje že skoraj 50 različnih organizacij, predvsem podjetij različnih velikosti, vključno s ponudniki različnih storitev, in inštitucij znanja, med katerimi ima močno osrednjo vlogo Institut "Jožef Stefan". V pobudi sodelujejo tudi

nevladne organizacije, ki lahko z neposrednim stikom z uporabniki identificirajo njihove potrebe ter prispevajo h graditvi novih modelov participativnega upravljanja. Sodelovanje mest, občin in zaokroženih skupnosti pa partnerjem omogoča dostop do gospodarske javne in zasebne infrastrukture in s tem umestitev razvitih rešitev ter njihov preizkus v specifičnih realnih okoljih.

Vsebinski sklopi, ki jih prikazuje slika 1 in okrog katerih so v pobudi PaMetSkup zbrani različni partnerji, so podrobneje predstavljeni v nadaljevanju.

2. PODROČJE PODPORNE INFRASTRUKTURE

Pri postavljanju pilotnih projektov je v pametnih mestih potrebno v kar največji meri izkoriščati obstoječo odprto infrastrukturo in nadgrajevati druge obstoječe ali pretekle projekte. Med ključno podporno infrastrukturo za uvajanje pilotnih projektov pametnih storitev na primer štejemo odprta brezžična WiFi omrežja z ustrezno povezavo v internet, razpoložljive in odprte polnilne postaje za električna vozila, podporo upravljavcev javne infrastrukture za dostop in souporabo drogov, javnih stavb, jaškov, itd., ter odprt dostop do javnih podatkovnih zbirk. Za podporo storitvam pametnega mesta bo na tem področju potrebno zagotoviti:

- interoperabilnost omrežij na ravni podatkov in informacij med različnimi deležniki, npr. za učinkovitejše delovanje in ukrepanje reševalnih služb v primeru nesreč;
- postavitev sodobnih komunikacijskih sistemov in omrežij, ki zadoščajo zahtevam po visoki varnosti, zanesljivosti in razpoložljivosti;
- nadgradnjo in posodobitev obstoječih sistemov brezžične komunikacije;
- rešitve računalništva v oblaku (IaaS, PaaS).

3. PODROČJE PODPORNIH ODPRTIH IKT TEHNOLOGIJ IN AKTIVNOSTI

Središče podpornih tehnologij za realizacijo pametnih mest in skupnosti predstavljajo odprte platformne storitve v oblaku. Odprtost, ob zagotavljanju varnosti in zasebnosti, je pri tem ključnega pomena, saj spodbuja lokalno gospodarstvo k razvoju in dodajanju novih storitev in aplikacij. Preko odprtih vmesnikov in ustreznih komunikacijskih modulov bodo v platformo povezane različne senzorske in aktuatorske naprave, ki predstavljajo most med fizičnimi objekti v realnem svetu (luči, semaforji, parkirišča, parki, trgi, merilne naprave, energetski elementi, itd.) in njihovo abstrakcijo v oblaku. V platformi lahko s pomočjo različnih modulov za analizo podatkov obdelujemo namensko zajete senzorske podatke, kot tudi participativno zajete podatke ter povezane podatke in sentiment na podlagi zapisov v medijih in na socialnih omrežjih. Na podlagi teh podatkov nadalje s pomočjo modulov za optimizacijo zagotavljamo podporo odločanju. Predobdelani podatki kot tudi na njih zasnovane storitve so na voljo preko odprtih spletnih in mobilnih aplikacij. V podporo spremljanju zelo specifičnih procesov ali parametrov, interakciji med prebivalci in objekti ter energetski učinkovitosti in zaščiti naprav in objektov je potrebno razviti tudi nove zaščitne premaze ter senzorske in aktuatorske materiale in tehnologije.

Za zagotovitev navedenih tehnologij so v pobudi PaMetSkup zbrani partnerji, ki pokrivajo vrsto raznolikih produktnih smeri kot so:

- novi senzorski materiali in tehnologije (fleksibilne sončne celice, nanosenzorji, elektromagnetni senzorji, itd.);
- povezane senzorske in aktuatorske naprave in vgrajeni komunikacijski moduli;
- odprte platformne storitve v oblaku;
- moduli za zajem podatkov, podatkovno analitiko, optimizacijo in podporo odločanju (metode optimizacije, ki omogočajo iskanje optimalnih strategij upravljanja in izboljšanje delovanja podsistemov pametnega mesta);
- odprte spletne in mobilne aplikacije, odprt spletni trg;
- tehnologije za zagotavljanje varnosti in zasebnosti (npr. vgrajeni varnostni elementi v senzorskih napravah za zagotavljanje enovite avtentikacije in varnega prenosa podatkov med končnimi točkami na aplikacijskem sloju, itd.);
- podporne aktivnosti za uvajanje naprednih rešitev in produktov ter opolnomočenje uporabnikov.

4. PODROČJE UČINKOVITE ENERGETSKE IN KOMUNALNE OSKRBE

Zagotavljanje energetske učinkovitosti in komunalne oskrbe predstavlja eno pomembnejših področij uvajanja novih storitev za pametna mesta. Glavni poudarek v večini mest je na zagotavljanju elektro-energetske samooskrbe zaključenih sosesk preko uvajanja mikro smart grid rešitev upravljanja z razpršenimi viri. V povezavi s področjem mobilnosti (Pogl. 5) se lahko rešitve s področja učinkovitega ravnanja z energetskimi viri preko naprednih poslovnih modelov kombinirajo s polnilnimi postajami za električna vozila. V okviru energetsko učinkovitih rešitev mora imeti osrednjo vlogo podpora integrirani energetski in komunalni oskrbi in nadzoru, kar vključuje tako integrirano zagotavljanje energetskih virov (električna energija, mestni plin, toplovod, skupinske toplotne črpalke in solarni paneli…) glede na specifične lokalne danosti kot integrirano (angl. multi-utility) spremljanje in nadzor porabe.

S stališča stroškov obratovanja in vzdrževanja predstavlja v primeru uporabe tradicionalnih tehnologij javna razsvetljava enega večjih porabnikov v mestnih in drugih skupnostih. Uvajanje sodobnih tehnologij, sistemov pametnega upravljanja in novih poslovnih modelov pri zagotavljanju javne razsvetljave je eno klasičnih področij pametnih mest in skupnosti.

Znanja, tehnologije in produktne smeri, ki jih na področju učinkovite energetske in komunalne oskrbe pokrivajo partnerji v pobudi PaMetSkup, obsegajo:

- mikro smart grid rešitve za zaključene soseske v smeri elektro-energetske samooskrbe s pomočjo sončnih elektrarn, hranilnikov energije, polnilnih postaj za električna vozila, sistemov za uravnavanje potreb in ponudbe energije, itd.;

- integrirano energetsko in komunalno oskrbo in nadzor s pomočjo merilno-krmilnih naprav, krmilnih modulov in ustreznih informacijskih sistemov;
- rešitve in sisteme uvajanja pametne javne razsvetljave z uporabo pametnih prižigališč, metod za dinamično prilagajanje delovanja javne razsvetljave, metod zaznavanja in napovedovanje okvar in napak na sistemih pametne razsvetljave, itd.

5. PODROČJE MOBILNOSTI IN DOSTOPNOSTI

Drugo tradicionalno področje uvajanja novih storitev za pametna mesta, poleg učinkovitejše energetske oskrbe, je področje zagotavljanja mobilnosti in dostopnosti. Slednje poleg tehničnih rešitev v veliki meri temelji tudi na spreminjanju življenjskih navad prebivalcev, uvajanju novih konceptov mobilnosti in novih poslovnih modelov, kot je npr. souporaba transportnih sredstev in spodbujanje uporabe čistih ("zelenih") transportnih sredstev. Pomemben segment pametnih mest in skupnosti predstavljajo napredne rešitve in optimizacija prometnih sistemov z uporabo pametne prometne signalizacije, interaktivnih tabel, urejanja mirujočega prometa, ipd.

V pobudi PaMetSkup so zbrani partnerji, ki že aktivno sodelujejo v različnih projektih ali ponujajo rešitve s področij:

- načrtovanja in optimizacije javnega potniškega prometa, kjer pričakujemo nadaljnje izboljšave z uporabo naprednejših tehnologij za spremljanje in analizo sentimenta uporabnikov, rešitev za pametno plačevanje uporabe javnega potniškega prometa, participativne optimizacije linij, postaj, urnikov, itd.;
- souporabe transportnih sredstev, ki omogoča znižanje stroškov mobilnosti;
- razvoja in vpeljevanja čistih transportnih sredstev in novih poslovnih modelov za boljšo izkoriščenost prevoznih sredstev;
- optimizacije prometnih sistemov z uporabo naprednih algoritmov za hitro izračunavanje optimalnih nastavitev in konfiguracij prometnega omrežja, avtonomnih pametnih prikazovalnikov, itd.

6. PODROČJE PARTICIPATIVNOSTI V JAVNIH PROSTORIH

Tretje aplikativno področje, ki ga v nekaterih tekočih projektih že naslavljajo partnerji pobude PaMetSkup, zajema spremljanje in (participativno) upravljanje javnih prostorov in infrastrukture kot so trgi, parki, ulice, razsvetljava, nabrežja, itd. V prihodnje je v tem okviru predvidena še močnejša podpora (1) participaciji prebivalcev v okviru koncepta '*citizen observatories*' pri soodločanju o razvoju in upravljanju javnih prostorov, (2) sistemskemu in participativnemu spremljanju parametrov kakovosti bivanja kot so hrup, onesnaženost zraka, prisotnost delcev v zraku, UV indeks, ipd., in (3) uvajanju lokalno-razpršenega '*on-spot/in-time*' zagotavljanja uporabnih informacij kot so vozni redi, odpiralni časi, opisi turističnih zanimivosti, ipd., preko ustreznih uporabniških terminalov. Navedene pametne rešitve bodo umeščene v realna okolja, kjer bodo služile kot samostojne storitve ali pa bodo v odprtih demonstracijskih in eksperimentalnih pilotih za testiranje in validacijo zagotavljale dodaten kontekst.

Na tem področju partnerji pobude PaMetSkup načrtujejo vrsto aktivnosti in razvoj produktov, ki med drugim obsegajo:

- postavljanje odprtih demonstracijskih in eksperimentalnih pilotov v industrijskem in komercialnem okolju, v skupnem demo centru, ipd.;
- podporo konceptu participacije prebivalcev in soodločanja pri razvoju javnih prostorov;
- storitve razpršenega zagotavljanja lokalno uporabnih informacij na uporabniške ali vgrajene terminale, zasnovane na sprejemu lokalno-omejene distribucije radijskega signala;
- spremljanje parametrov kakovosti bivanja v mestih in skupnostih na podlagi souporabe statičnih in participativnega zagotavljanja podatkov s prenosnih senzorskih naprav;
- optimizacija delovanja javne uprave in interakcije z občani.

7. SKLEP

Pobuda PaMetSkup si je kot izziv postavila kar se da celosten pristop k uvajanju koncepta pametnih mest in skupnosti, v prvem koraku v slovensko okolje za testiranje in potrditev ustreznosti posameznih rešitev, v drugem koraku pa preko partnerjev prisotnih v mednarodnem okolju in sklepanja novih partnerstev tudi v tujino. Prav celosten pristop nas je vodil pri sestavi širokega partnerstva tako po številu kot komplementarnosti partnerjev. Tako nastala pobuda PaMetSkup za partnerje predstavlja platformo za nadgradnjo obstoječih partnerstev in doseženih rezultatov. Predstavlja priložnost za pospešeno medsektorsko povezovanje in razvoj novih storitev ter proizvodov, njihovo uvajanje v realno okolje doma in po svetu

Raznolikost partnerstva pobude PaMetSkup zagotavlja veliko mero komplementarnosti vlog. Identificirane produktne smeri kažejo tudi precejšnjo raznolikost dosežene stopnje tehnološke pripravljenosti za trg.

8. ZAHVALA

Avtorja se zahvaljujeta vsem partnerjem, ki so sodelovali pri pripravi pobude PaMetSkup, katere opis je služil kot osnova temu dokumentu.

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POVZETEK

Napredne platformne storitve omogočajo v svoji vsebinski zasnovi in poslovnem pristopu korak bližje digitalizaciji javnega in industrijskih sektorjev. Te storitve so odprte za nadaljnjo uporabo v množici aplikacij, ki tečejo v odprtokodni oblačni infrastrukturi.

Temeljni cilj pobude je povečanje konkurenčnosti slovenske IKT industrije s pripravo oblačne infrastrukture in predintegriranih naprednih IKT (platformnih) storitev, ki so na voljo ostalim storitvam in aplikacijam preko odprtih vmesnikov ter se upravljajo in orkestrirajo po sorodnih principih. Opisana so tri področja uporabe platformnih storitev (E&M Zdravje, Rešitve za mala in srednja podjetja, Varna družba) in koristi, ki jih prinašajo platformne storitve za vsako od njih.

Nosilec pobude je podjetje Iskratel, d.o.o., Kranj, v pobudi sodeluje 15 partnerjev, od tega 12 industrijskih ter 3 Javne raziskovalne organizacije z 12 raziskovalnimi skupinami.

Platformne storitve so horizontalno orientirane in vključujejo omogočevalne tehnologije in storitve, ki pospešujejo učinkovit razvoj aplikacij in storitev v pobudah Varna družba, Pametna mesta in skupnosti PaMetSkup, Energetiki ter E&M Zdravje. Platformne storitve so zaradi naprednosti in obogatene vsebinske zasnove primerna IKT osnova za pametna mesta in skupnosti. Konzorcij partnerjev želi postati globalni partner za celovite projekte vitkih in inovativnih ponudnikih storitev ter skupnosti.

ABSTRACT

Advanced platform services enable in their rich content schema and business approach a step closer to the digitalization of the public and industrial sectors. These services are open for their further usage in a plethora of applications and run on open-sourced cloud infrastructure.

The main objective of this initiative is to increase the competitiveness of the Slovenian ICT industry by developing advanced ICT pre-integrated (platform) services, which are available via application programming interfaces to other services and applications, and they are managed and orchestrated using the cognate principles. The three areas of platform services usage (E&M Health, Solutions for Small and Medium Enterprise, Safe Society) are described and its benefits for each of these areas.

This program has been initiated by the company Iskratel, d.o.o., Kranj, and involves 15 partners, including 12 industrial and four public research institutes with their 12 research groups.

The Platform services are oriented horizontally, incorporating enabling technologies and services that allow faster and efficient development of applications and services within the initiatives Safe Society, Smart Cities and Communities PaMetSkup, Energetics and E&M Health.

The Platform Services are an excellent ICT basis for Smart Cities and Communities thanks to advanced and rich content and concepts.

The consortium of partners wants to become a global partner for integrated/comprehensive projects with flexible and innovative service providers

1. INTRODUCTION

The program "Platform Services" (Fig. 1) provides the following product directions:

- Cloud infrastructure and connectivity;
- Infocommunications and M2M services;
- Big data and analytics;
- Security, trust and privacy services;
- Generic domains services for verticals;
- Management and orchestration services (MANO).

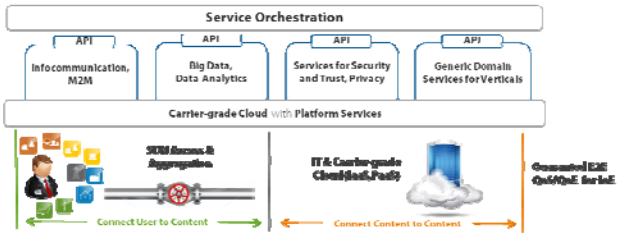

Figure 1: Platform Services

The ecosystem of partners with its innovative, open and pre-integrated solutions in the area of "Platform services" will contribute significantly to digitalization and usage of advanced services by end-users, as well as to the success and innovation of individual partners and their business clients in domestic and global markets.

Solutions include the results of R&D competencies and products (TRL 2-5) and their demonstration and commercial pilots (TRL 6-9) for the public and industrial sectors in the priority area »Healthy Living and Working Environment/Smart Cities and Communities« of the Smart Specialization Strategy in Slovenia. They also comply with the RRI thematic program objectives of the EU instruments and Digital Strategy of EU and Slovenia. The already existing prototypes or products will be upgraded with the essentially new features or built-in application programming interfaces (APIs), which transform them into easy-to-use services.

The realized business idea "Platform Services" comprises many positive multiplied impacts in: social and economic importance for the Slovenian/European society, states and businesses, development and deployment of new open digital services in the cloud that are usable in many domain areas (energetics, health, public safety, transport, smart cities and communities and others), assistance of the Slovenian ICT industry in developing complex solutions with high added value and thereby increasing export of high-tech products.

A phased approach incorporating R&D and V&V activities of pre-integrated solutions, and marketing and sales activities with the demonstration and commercial pilots will take place in the years 2016-2020.

2. PRODUCT DIRECTIONS OF "PLATFORM SERVICES"

2.1 Cloud infrastructure and connectivity

Requirement for modern Telecommunications and IT vendors is to offer more scalable, reliable and elastic products which enable faster integration of different types of applications into wide range of solutions with high added value. In order to meet these requirements, there is a need to build innovative application and service infrastructure by combining different technologies such as Virtualization, Cloud Computing, Software Defined Networking (SDN) for broad ecosystem of application providers. With this vision in mind Platform Services Infrastructure model is developed and will be upgraded with the essentially new features based on standards and open source solutions.

Broadband connectivity with guaranted SLA (Iskratel, d.o.o., Kranj - SI3000 Lumia, NIL d.o.o. – StreetFlow, Smart Com d.o.o. - SmartSNO) connects users to content and contains products/solutions with the following features:

- Assurance of broadband access service in line with the latest technology orientations and transformations such as Software Defined Network (SDN),
- Increase Network Availability and Operation, Improve Connectivity and Access Service to public or private ICT infrastructure,
- Effective and efficient maintanance of network and network infrastructure,
- Assurance of Service Level Agreement (SLA).

Cloud infrastructure covers the solution for data centers as shown in Figure 2 and the cloud platform as shown in Figure 3. Datacenter infrastructure provided by FMC d.o.o. and RC IKT d.o.o. is geo-redundant with Carrier-grade characteristics, where two datacenters are interconnected with dedicated, redundant, Gbit interconnections. The architecture of each datacenter is built around scalable, highly secure and high-availability configuration. Each datacenter provides essential IT resources, such as Server Farms, where all CPU resources are virtualized, SAN storage with storage and database resources, and backup devices. Connections to internet, and the routing between datacenter resources and the internet are provided by means of Bbit connections via at least two independent ISPs and with the use of Border Gateway protocol (BGP).

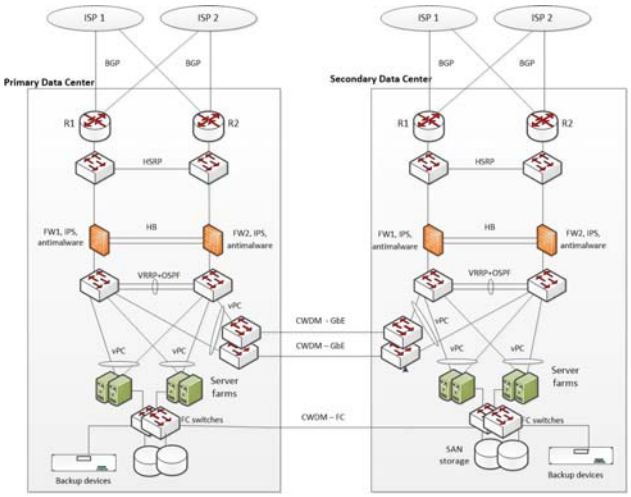

Figure 2: Data Center

For Platform Services, Iskratel has developed its own scalable infrastructure which brings framework for application installation in Data centers. This »Cloud Service Platform« (CSP) enables many deployment options from application virtualization scenario to cloud scenarios. All building blocks together offer a user to achieve availability and reliability of its services in many different ways with diverse solutions. Combining building blocks and their features in a proper way CSP can be used as Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Data as a Service (DaaS). In order to provide cost efficiency, scalability, flexibility and high reliability in a standardized way, the architecture of the Platform Services is built on the NFV concept.

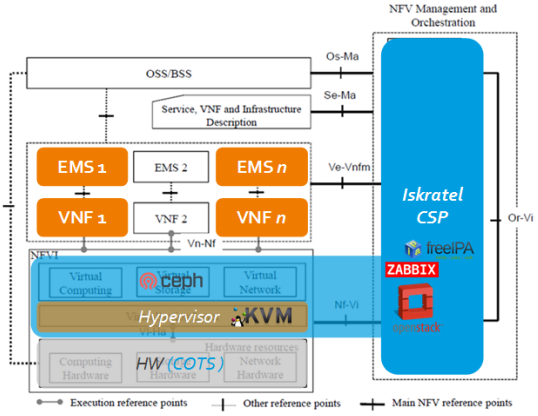

Figure 3: CSP in NFV Architecture

Network Function Virtualization, in short NFV, is a network architecture concept which, by using the technologies of IT virtualization, virtualizes entire classes of network node functions into building blocks that may be connected, or chained, to create communication services. It provides many benefits along the IT Services value chain, ranging from the cost benefits of using a generic purpose hardware and software, to the scalability, high reliability and flexibility to deploy variety of rather different IT services on the platform.

2.2 Infocommunications and M2M services

Infocommunications and M2M services fall into three major product categories, which help transform communications into such services that can be built easily in applications:

- Infocommunication servers providing H2H (Human to human), M2M (Machine to machine) in H2M (Human to machine) video, data and voice communications contain:

  Communication servers providing H2H and partially H2M communication that play a role of multimedia servers in the NGN or IMS architecture inside coverged operators networks or as (IP)PBX enterprise or community networks (Iskratel, d.o.o., Kranj - vIMS);

  The system for the electronic exchange and storage of messages, providing the exchange and storage of various kinds of standardized documents and the implementation of various business processes among partners on the basis of standard EDI (ZZI d.o.o. – bizBox, eHramba, SETCCE d.o.o. - eNvoices);

  Event-driven platform for M2M communication, (Iskratel, d.o.o., Kranj – SI5000 M2M platform);

- Application servers and applications in cloud with the following key representatives:

  Unified communications for advanced and converged multimedia communication and collaboration (Iskratel, d.o.o., Kranj - UC/FMC, Invida d.o.o. – MITV).

  Applications in cloud for storing and document sharing (XLAB d.o.o. – Koofer, RC IKT d.o.o - iktXplorer).

  Customer relationship and salesforce management applications in cloud (CRM) and *advance tools for marketing* (Pronet, d.o.o. – ProCRM, RC IKT d.o.o. – iktXmarketer, iktXDlist).

  Applications for 112/eCall and First responders Operational Centres (Iskratel, d.o.o., Kranj – 112/eCall).

  Applications for Operational communications and Information used by personnel or via automatized infocommunication processes in the industrial sectors (Iskratel, d.o.o., Kranj – Dispatching and Information systems).

  Applications for two-way communication among speakers in different languages (Alpineon d.o.o. – VoiceTRAN).

  Call center applications for direct multimedia contact with clients and for optimizing services at home (SmartCom d.o.o. – BeeSMART, CoreSignal, Iskratel, d.o.o., Kranj – Contact center).

  Application for business remote desktop (XLAB d.o.o. – ISL Online).

  Application using location services with the 3D GIS visualisation (XLAB d.o.o. – 3D GIS GEA, Smart Locator).

  Application for optimisation and automation of work in the field (i-ROSE d.o.o. – MSP).

  Application for maintaning the kowledge sharing and e-learning (Invida d.o.o. – MIT, UL/FE LTFE – e-CHO).

  Applications for the rapid production of interactive and sharing video content (Invida d.o.o. – MITV).

  Applications that enable communication with applications in natural language (Pronet d.o.o. – SIRIS);

- Devices and applications for end users:

  Customer Premises Equipment (CPE) used as universal user terminal device, which supports a variety of access technologies towards operator (ADSL2 +, VDSL, FTTH P2P / GPON, ETTH, 3G, 4G) and towards user (ETTH, Wifi, Zigbee, ...). and represents a point of entry for H2H, H2M and M2M (Iskratel, d.o.o., Kranj – Innbox).

  Virtual CPE built on standard x86 platform and virtualisation layer that could host applications for network connectivity and security (firewall, IPS, switchig, routing,…) and application server for other applications like Unified Communication (RC IKT d.o.o. – iktXBox).

  Application for multimedia communications running on Android, IOS and Windows in the field of H2H in M2M communications (Iskratel d.o.o. – i/A/W10, UL/FE LTFE – Komunikator).

2.3 Big data and analytics (IJS-E3, FRI)

The analytics and usage of Big Data is rapidly growing into an essential aspect of any successful endeavour, be it academic or industrial. As the amount of readily available and accessible data increases, the manipulation of that data into meaningful information offers a large competitive advantage to its users by

providing a tangible added value and threatens to make those actors who are not able to capitalize upon it uncompetitive.

According to the EU Commission Communication "Towards a thriving data-driven economy"1, we are witnessing a new industrial revolution driven by digital data, computation, and automation. Human activities, industrial processes, and research all lead to data collection and processing on an unprecedented scale, signalling a paradigm shift towards a data-driven socioeconomic model2. The resulting datasets are so large and complex that such "Big Data" is becoming difficult to process with the current data management tools and methods. If successfully processed and managed, Big Data has the potential to spur new products, services, and practices as well as new scientific methodologies. As pointed out by the Commission Communication, this "global trend holds enormous potential in various fields" and that "data-driven innovation brings vast new job opportunities".

Both the Slovenian economic and academic environments must be equipped with services that will enable them to remain competitive and at the top of the state-of-the-art as the approach to decision making and problem solving is altered due to the growing presence of Big Data and, ever more prominently the increasing importance of open data3. Slovenian experts in ICT fields such as artificial intelligence, machine learning and data analytics are well equipped to offer versatile and evolving platform solutions that will enable Slovenian economic and academic ecosystems to remain competitive and at the forefront of technological development in the area of Big Data analytics and its usage on a global scale.

The partners within the proposed consortium have a deep understanding of both the underlying principles as well as the technologies required to implement solutions that stretch across the entire data value chain, are versatile and flexible enough to be integrated across various sectors and are sustainable in the rapidly evolving technological environment.

Various solutions developed by the partners already exist and are ready to be integrated into a collective state-of-the-art platform (Josef Stefan Institute – Qminer, Faculty of computer and information science). These include state-of-the art analytics platforms for processing multimodal data including sensor data, textual data, video data, and structured data. The existing tools allow for the input of various types of data and support various data standards, enable data fusion across various types of data, enable the usage of various data and stream processing methods in a predictive environment that allows and offers:

- Semi-automatic decision making regarding the optimal model to be used in a given scenario;
- Data enrichment from internal and external sources;
- A rich collection of pre-defined calculated features across various modalities;
- Pre-defined data structures for merging multimodal data;
- Automatic building of chosen models with different time scales;
- GUI for interactive visualization of complex data.

Solutions also exist in the area of complex event processing, route cause analysis, case based reasoning, behaviour profiles, various types of clustering of multimodal data and reasoning, just to name a few.

The overall goal within this initiative is to bring these tools to true "Big Data" scales and to ensure they are ready to meet evolving industrial needs. Specifically, two primary goals within this initiative have been defined by the consortium as the development of:

- SI3000 DS/INS (Iskratel, d.o.o., Kranj) - a modular system that allows adaptation to various business models and is optimally set for the integration of components of existing 112 systems and consequently for expansion into future systems.
- IoT platform (UL/FE LTFE, FRI) - representing an intermediate layer for extraction, contextualization and visualization of information from various sources in the area of the Internet of Things and thus enabling the development of applications with added value across various domains.

2.4 Security, trust and privacy services

Security and privacy are one of basic requirements of the envisioned Smart Cities and Communities' ecosystem. They are straightforwardly provisioned at the level of information and communication technologies. Security provisioning in the envisioned ecosystem is very challenging. Technologies and administrative boundaries are heavily interwoven, mobility is a norm, number of devices can be immense and computing and communication resources are shared simultaneously among multiple users. Pervasiveness of the technology, substantial data collection and analytic and intermixture of technological and sociological aspects of human existence are tough challenges of privacy provisioning.

Proposed platform services address security and privacy challenges and requirements directly. They are optimally positioned in the ecosystem technological stack for provisioning the required services. Their positioning and scope enable a holistic approach to security and privacy provisioning on all information communication layers of the system; the services are exported to end user applications through a set of APIs.

The platform security services are provided either in hardware or software (FMC d.o.o. - RTsecureB 1.0, RTsecureA 1.0, SETCCE d.o.o. – Cloud Sign, S-CAAS, IJS-E5 – Safe and private cloud storage). Cryptographic mechanisms are used to secure communication between users and devices regardless of whether physical or wireless mode of communication or communication protocol is used. Trust is managed among user and among administrative domains involved. Vertical services, like identity, attributes, credentials, policy management and policy enforcement are available through platform APIs. Security services and APIs enable integration of other complex and more

[1] Towards a thriving data-driven economy, COM(2014) 442, http://ec.europa.eu/digital-agenda/en/towards-thriving-data-driven-economy.

[2] "European Big Data Value Strategic Research & Innovation Agenda", European Big Data Value Partnership, July 2014

[3] http://ec.europa.eu/digital-agenda/en/open-data-0

demanding services for the end users, such as biometric authentication (BioID – Alpineon d.o.o.).

The platform privacy services are provided by flexible and fine grain access control mechanisms to data or content exchanged, either among end users or business applications. Access control and cryptographic mechanisms are used to implement secure end user cloud storage and computation on encrypted data. Access control monitoring and enforcement of privacy policies as a service for end users and enterprises provide transparency of privacy provisioning and its compliance with current and future Slovenian and European regulation.

Security and privacy provisioning in the cloud inherit a number of cloud pertinent advantages like efficiency, elasticity and reliability. Quality improvement of overall basic security services, such as security management is possible both for enterprises and end users. Monitoring security events and incidents detection in the ecosystem can be significantly better and broader than in the case of a single-platform user. Collaboration with other platform services, such as monitoring of SND networking and content distribution, collection of sensors data and big data analytic can bring new security solutions and services to the platform users.

Platform approach to security and privacy ensures better compliance with current Slovenian and European legislation and regulation, as well as more flexibility in adapting to their foreseen changes. The services are directly usable for end users and enterprises. Multiple domains in Smart Cities and Communities can be supported, interweaved with public services, such as government, traffic management, environment management, health, education, etc.

Key security challenges of communication services (VoIP, video, messaging, collaboration) preventing Theft of Service, Invasion of Privacy and Denial of Service Attacks are addressed by using special Virtual Network Functions (VNF), which are offered in platform approach as VNF-as-a-Service model. One of them is the virtual Session Border Controler (Iskratel, d.o.o., Kranj - vSBC) used as a service, which is implemented in Border Gateway.

Typically, BGW is deployed as a border element at the edge of service provider´s network, at the edge of an enterprise network, or as the border element between different service provider networks. It provides secure interconnection for communication services and also enables Load Balancing of traffic and allows monitoring and supervision of QoS.

2.5 Management and orchestration services (MANO)

Orchestration in Management of Infocommunication services is one of the crucial features of information infrastructure, which will base on NFV architecture.

On this basis, the new infrastructure will be the common infrastructure for applications and for infocommunication services in the future. All modern platforms relay on paradigms of: virtualization, reliability, scalability and elasticity, security, multi-tenancy, device and location independence, agility, Service-oriented Architecture, increased utilization, higher performance, higher productivity etc. Therefore they will be deployed on Cloud-based platforms. For providing services according to new business models, such as XaaS, importance of the following functionalities and systems will be increased:

- Orchestration and Management for entities of platform and applications, systems for management and monitoring of Cloud infrastructure;
- Monitoring and management of failures in applications and infrastructure;
- Monitoring and management of Service Level Agreement, service quality and the quality of experience.

Within application infrastructure for Infocommunication services and application, applications and subsystems for Orchestration and Management of infrastructure and services shall be included, such as:

- Management system for applications and elements with open interfaces for integration purposes (Iskratel, d.o.o., Kranj –SI3000 Management Node System and the partners' management applications);
- Fault management system with the defined principles for developing fault access modules for applications and services (Iskratel, d.o.o., Kranj – SI3000 Fault Monitoring System, Fault Access Modules – provided by partners);
- Different management and orchestration components for applications for various vertical sectors (Iskratel, d.o.o., Kranj – SI3000 Cloud Services Platform, NIL d.o.o. – Orkestrator, RC IKT d.o.o. –IktX applications) and
- Systems for monitoring and management for Quality of Services and Quality of Experience of broadband connectivity and network features (UL/FE LTFE – Solution for QoE);

and subsystems for Orchestration of applications such as:

- Cloud service platform components for IaaS/PaaS/SaaS/DaaS;
- Process orchestration system and
- Special applications and modules for encryption of data and communication.

3. AREAS OF USAGE OF "PLATFORM SERVICES"

3.1 Platform Services for E&M Health

3.1.1 E&M Health Solutions

There are multiple electronic and mobile health related solutions that can take advantage of the platform services. Examples of such solutions are in the text below.

mHealth PCARD platform focuses on monitoring patients and the elderly and connecting them with caregivers and medical professionals in a secure and privacy transparent manner. The mHealth PCARD provides wearable sensor devices used in clinical environment for monitoring ECG, vital signs, as well as monitoring everyday activity of patients and elderly in home care or similar environment. The PCARD platform is used in scenarios for discovering arrhythmias, measuring the impact of drugs on arrhythmia, documenting ischemia, following up on the adherence

to the drug therapies, checking the results of ablation procedure, evaluating syncope and light-headedness[4] and other.

Home Care service is provided by the social care providers.

The service involves Care Signal monitoring and response application delivered for the elderly independently dwelling at home. The user's home is equipped with various sensors for the purpose of monitoring the environment and user activity, such as panic/SOS button, presence/motion detector, door/window contact detector, door barrier, smoke/heat detector, water leak detector, and temperature detector. The Care Signal backend system collects sensitive sensor data, processes them, providing reliable notifications and routes alerts to relevant stakeholders via an appropriate communication channel.

Remote Rehabilitation is intended for persons after stroke and is based on a patented standing frame, currently also equipped with integrated sensors (accelerometer, gyroscope – 2D tilt sensor) and actuators (horizontal translational standing platform), which are connected to the remote rehabilitation application. The system is used by the therapist to remotely set rehabilitation tasks, follow therapy execution and progress, guide the patient in the therapy, and prepare reports for assessment of the therapy by the physician. The system is used by the patient to execute regular therapies according to the prescribed tasks and guidance from the therapist. The information from different medical devices or/and developed sensor units is aggregated into balance ability measurement and presented to the physician.

Remote Diagnostics is intended for doctors and medical professionals to help them remotely diagnose patients, who are living independently. The service allows medical data to be visualized in a manner that is easily understandable by medical professionals. The service relies on input data collected from various sensors, i.e multisensory devices that are ready to assess functional vital parameters (heart rate, blood pressure, body temperature) personal health sensors. The service allows for the integration of diagnosis pattern recognition algorithms for different medical conditions that help doctors with the diagnosis of the patients and the elderly.

3.1.2 How do E&M health solutions benefit from the platform services

All the E&M health services and scenarios have strict requirements in the fields of Privacy and Security, since they rely on collecting and processing a considerable amount of sensitive medical and activity-related data. The common use cases for security and privacy platform services are the following:

- The transfer of sensitive data gathered by the sensing devices can be secured using strong encryption using RtsecureA platform service.
- For storing sensitive data in the cloud, the scenarios rely on the "Secure and Privacy-aware cloud storage" platform service, in which sensitive data are encrypted and stored on secure servers residing within the EU, to which the EU data regulations apply. The data relating to each end-user are separated and sandboxed to prevent them from being seen by any unauthorized parties. Accesses to the sensitive data are controlled using S-CAAS (see below). All the accesses to the sensitive data are logged using audit trails that contain information on who was accessing the data at what time, for what purpose and through which application.
- For accessing e-health applications and sensitive data, the S-CAAS platform service is used. Through it, the end-users / representatives of stakeholders can be authenticated for the required security level. S-CAAS assumes 4 levels of trusted authentication: the strongest being two-factor authentication using an EU-wide e-ID mechanism that is eIDAS compatible. An extra security level can be added to the existing one by integrating the BioID platform service (biometric authentication).
- Another functionality provided by the S-CAAS platform service to secure storage and medical applications is outsourced simple authorization. Thus, the appropriate stakeholders (physicians, relatives, medical professionals, caregivers) will only have access to the exact set of data that is needed for each medical or management application in need-to-know basis.
- In cases where it is needed to obtain explicit consent from the end user to be able to lawfully monitor and process the sensitive medical data or to get explicit consent from the end-user on certain medical practices, the solution is legally compliant signing of electronic documents. This is provided by the CloudSign platform service that enables legally (eIDAS) compliant signatures using electronic signatures and timestamps; it also provides long-term archiving of electronic contracts and documents.
- Management of medical sensors, devices and wearables that medical staff performs in terms of installation of devices in smart homes, their connection to the backend services or pairing of wearable devices with end-users can be handled and integrated by the IoT platform services.
- There is potential value in integration with big-Data and analytics platform services, but only for the non-sensitive data, such as data relating to work practices of medical professionals and the optimization of their working processes.

3.2 Platform Services for Small and Medium Enterprises

3.2.1 Solutions for Small and Medium Enterprises

In the knowledge society, firms need to develop competitive advantages based on an adequate and intensive use of information and communication technologies (ICTs), which is an essential element of success in today's market. This fact is especially relevant for small and medium sized enterprises (SMEs), whose survival depends, among other factors, on the use they make of ICTs to develop their business model. Modern ICT services make optimal usage of their internal resources and - at the same time - interconnects them to their customers, partners and government services and institutions. Many times SME companies have limited ICT budget compering to large Enterprises. In addition, many small businesses could not afford to employ IT specialist(s). In order to fill this gap Service providers of different size and background address SME market segment with service packages such as "Virtual Office", "Mobile cloud", "New IP-Centrex", "Office in the Cloud" and others.

3.2.2 How do SME solutions benefit from the platform services

Platform Services initiative brings platforms, tools and concrete application packages in order to enable quick and efficient work of Service providers.

The complete solution building blocks are as following:

- Communication services including Voice – Unified Communications, Broadband connectivity including Industrial Internet, Mobility by using Fixed-Mobile Convergence, Business connectivity, Communication devices for staff used also for personal needs
- Applications: Office in the cloud (E-mail, Web hosting), Mobile workplace, Electronic document storage, Electronic document sharing among business partners and with government;
- System services: Cloud platform, Billing and Accounting, Directories of system entities, employees, organisations, partners, Remote control, Single sign on, Single window, Central Provisiong, All-in-One CPE/UI, OoS/SLA control, Local Support, Local Data, Regulatory compliance.

3.3 Platform Services for Safe Society

3.3.1 Safe Society solutions

The program "Safe society" provides applications, services and networks solutions that cover the operational and tactical levels (Figure 4):

- Next generation Contact center 112;
- Next generation information and notification systems;
- Control center solutions;
- Critical communications;
- On-site emergency support systems;
- Public safety services and applications.

Figure 4: The Safe Society network, services and applications

The core application in this pre-integrated solution is the application Next generation Contact center 112, which supports mass contacts and 112 call handling by providing H2H and M2H interactions. The other applications within this program enable to generate additional information on the basis of gathering, collecting and processing such information from the different city areas. The collected information will be post-processed and transferred to citizens or visitors in cities and/or to key personnel and first responders.

The solution bases on the establishment of a control center, where the necessary infrastructure for the implementation of safe city services exists. An open architecture enables the integration of other information systems and the systems, which could process actions. The open architecture allows adaptation to the specific needs of individual regions and is future-safe for upgrading the system and adding the essentially new features in a simple way.

The key advantage of the solution is its flexibility in defining and implementing processes for public notification and/or alerting in case of emergency situations. The benefits of the solutions are the increased level of security for citizens during emergency situations and the increased quality of life for them because of relevant and important public information. Public notification shall be provided via the communication subsystem by using media, data and voice services.

A GIS- and Videogrid-driven environment in the control room gives the staff complete information about all events. In the action support subsystem it is possible to determine in advance which measures to take. The technology allows an easy integration of various action support systems. The actions are executed via the public information subsystems and/or via established links with the centers for emergency situations (e.g. 112). The operators are able to simultaneously communicate with various emergency departments and inform the citizens via public information and notification systems by defining various scenarios, which are automatically performed in such cases.

While supporting also the test scenarios this solution can be also used for training and improving the measures.

3.3.2 How do Safe Society solutions benefit from the platform services

Platform services provide a flexible communication platform for all types of communications, from H2H and H2M to M2M. The generic components and services are added that enable to create efficiently the safe city and society solutions. Using this principle the platform services will be used as a framework for the integrated services of the safe city solution.

By using the platform services it is possible to support cost- and technology-effectively complex business models of the safe city solutions. The establishment, upgrading and management of such solutions will also be optimal thanks to the platform services.

4. ACKNOWLEDGMENTS

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Varna družba / Safe Society

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POVZETEK

Pobuda »Varna družba« naslavlja vpeljavo najsodobnejših tehnologij IKT na področju omrežij, storitev in aplikacij za zagotavljanje koncepta varne družbe, družbe dobrega in varnega počutja, trajnega napredka in vsesplošne vključenosti vseh deležnikov. V ta namen pobuda združuje ekosistem industrijskih partnerjev in raziskovalnih organizacij, ki bo združil svoje kompetence za razvoj in trženje celovite rešitve. Iniciativa je utemeljena na poslovni ideji razvoja inovativnih aplikacij in rešitev za zagotavljanje varnosti prebivalstva in zaščite okolja, tako nastale rešitve pa realizirati v slovenskem prostoru za potrebe državljanov in kot referenčno demonstracijsko platformo za izvozne trge.

ABSTRACT

Initiative “Safe society” addresses introduction of state-of-the art ICT technologies in the area of communication networks, services and applications for providing the safe society concept - a society of welfare, sustainable development, and inclusion for everybody. For this reason the initiative unites an ecosystem of industrial partners and research institutions for joining their developing and marketing competences in providing end-to-end solutions in public safety area. The main aims of the initiative are providing innovative solutions for public safety as well as environment protection and establish them in Slovenia for the benefit of the citizens. At the same time, the established solutions will serve as the reference demonstration platform to support export efforts.

1. UVOD

Zaradi podnebnih sprememb se vse pogosteje pojavljajo naravne ujme, ki ogrožajo življenja ljudi in njihovo imetje. Nestabilna geostrateška situacija in številna krizna žarišča po svetu spodbujajo terorizem, ki postaja globalni pojav. Svetovno prebivalstvo se vse bolj koncentrira v urbanih središčih, kjer se povečuje potreba po storitvah kot so na primer učinkovita prometna povezljivost ali celovita podpora prireditvam, kjer se zadržuje veliko število ljudi. Velika koncentracija prebivalstva seveda povečuje tudi varnostna tveganja. Varnost in zaščita sta ključna dejavnika, ki vplivata na kakovost življenja ljudi. Zaščita ljudi in lastnine je osnovna dolžnost države in prva prioriteta pri zagotavljanju uspešnega poslovnega okolja in razvoja družbe v celoti.

V zadnjih letih se na vseh ravneh vlagajo veliki napori in pomembno povečujejo investicije v izpopolnjevanju sistemov za zagotavljanje varnosti in zaščite ljudi. Ti sistemi večinoma temeljijo na sodobnih informacijskih in komunikacijskih tehnologijah (IKT), ki so namenjeni preprečevanju, odkrivanju in reagiranju na incidente in krizne dogodke.

Varna družba je družba dobrega in varnega počutja, trajnega napredka in vsesplošne vključenosti vseh deležnikov ob spoštovanju njihove zasebnosti in regulacije. Pomembna dejavnika sta tudi splošno ozaveščanje in izobraževanje.

IKT sektor ponuja več kot le tehnologije v razširjeno vrednostno verigo deležnikov s področja javne in zasebne varnosti. Ponuja večnamenska »all-IP« omrežja ter povezuje storitve in aplikacije s področja IKT in samega domenskega področja javne varnosti v enotno digitalno okolje z zagotovljeno kakovostjo in visoko razpoložljivostjo storitev in aplikacij.

Slika 1: Tematska področja

Poslovna ideja iniciative Varna družba pokriva tematska področja za posamezne segmente rešitve, prikazane na sliki 1, ki lahko nastopajo posamično ali povezani v celovitih rešitvah:

- večnamenska omrežja »all-IP« z zagotovljeno ravnijo kakovosti storitev, ki nadgrajujejo obstoječa omrežja E112 za potrebe operativnega in taktičnega delovanja, v smeri:
  - namenskih IP omrežij najsodobnejših tehnologij (LTE, EPC, IMS),
  - prehodov z obstoječih omrežij (PSTN, TETRA, DMR),
  - senzorskih omrežij ter omrežij za povezljivost uporabnikov do aplikacij in podatkov,
- storitve naslednje generacije klica v sili NG112, ki nadgrajujejo obstoječe storitve klicnih centrov E112 in pri reševalcih (»first responders«), napredni sistemi

obveščanja in alarmiranja, vsebinsko pogojeno usmerjanje klicev in podatkov, tridimenzionalne geolokacijske storitve,

- napredne storitve in aplikacije pri reševalcih v vseh fazah taktičnega delovanja,
- napredne storitve in aplikacije za pametne naprave in zaposlene v varovanih objektih,
- napredne storitve in aplikacije NG112 na pametnih napravah namenjene prebivalstvu,
- združevanje zbranih podatkov in domeni sorodnih podatkov v odprti ekosistem je osnova za uporabo v inovativnih aplikacijah in storitvah, ki jih prvenstveno razvijajo mikro, mala in srednja podjetja (MSP).

2. CILJI IN POMEN POBUDE VARNA DRUŽBA

Pobuda »Varna družba« naslavlja vpeljavo najsodobnejših tehnologij IKT na področju omrežij, storitev in aplikacij za zagotavljanje koncepta varne družbe, družbe dobrega in varnega počutja, trajnega napredka in vsesplošne vključenosti vseh deležnikov. V ta namen je bil osnovan ekosistem industrijskih partnerjev in raziskovalnih organizacij s cilji:

- združiti v slovenskem prostoru najširši možni nabor kompetenc izjemno širokega področja rešitev in tehnologij, ki nastopajo na področju javne varnosti,
- razviti inovativne, sodobne in celovite rešitve ter jih implementirati v slovenskem okolju za potrebo državljanov Slovenije,
- tržiti rešitve tudi na izvoznih tržiščih kot plod slovenskega znanja, pri čemer so izjemno pomembni domači referenčni objekti, ki bi v ta namen služili tudi kot demonstracijska platforma.

Realizacija ciljev »Varna družba« bo imela številne pozitivne multiplikativne učinke, opisane v nadaljevanju.

Strateški in dolgoročen je pomen za slovensko družbo in državo:

- rešitve s področja javne varnosti so strateškega pomena za družbo in državo, saj bodo dodatno povečale učinkovitost reševalnih služb in skrajšale odzivne čase reševalcev,
- zmanjšanje števila smrtnih žrtev in blaženje posledic poškodb, ki nastajajo zaradi nesreč in izrednih dogodkov, posledično pa tudi zmanjšanje stroškov zdravstvene oskrbe in socialnih stroškov,
- manjša gmotna škoda na nepremičninah in drugi lastnini in s tem tudi manjši stroški odstranjevanja posledic nesreč in naravnih ujm ter
- večji občutek varnosti državljanov.

Razvoj in uvajanje novih sodobnih informacijskih in komunikacijskih tehnologij je uporaben tudi na področjih izven domene javne varnosti:

- koncentracija kompetenc v slovenskem prostoru pri razvoju celovitih in kompleksnih rešitev za varno družbo (iz industrije in raziskovalnega področja),
- sinergijski učinki pri uporabi razvojnih platform in orodij,
- sinergijski pristop pri načrtovanju novih inovativnih rešitev preko združevanja komplementarnih kompetenc sodelujočih deležnikov,
- možnost praktične uporabe (produktivizacije) znanj, rezultatov raziskav in inovacij, pridobljenih na slovenskih univerzah in inštitutih; ter
- možnost uporabe bogatih praktičnih izkušenj pri snovanju funkcionalnosti rešitev skozi sodelovanje s slovenskimi uporabniki (npr. URSZR) ter demonstracije tehničnih rešitev v realnem slovenskem okolju.

Iniciativa je tudi spodbuda slovenski IKT industriji pri razvoju kompleksnih rešitev z visoko dodano vrednostjo in posledično izvozu visoko-tehnoloških izdelkov:

- v Sloveniji realizirani projekti bodo predstavljali izjemno pomembno referenco pri nastopih na tujih trgih, imeli pa bodo tudi praktično demonstracijsko vlogo pri promociji potencialnim tujim kupcem.

Neposredni ekonomskemu učinek za vključena podjetja:

- rešitve zajete v pobudi »Varna družba« po definiciji vsebujejo visoko dodano vrednost (visoko-tehnološka delovna mesta),
- možnost hitrejše rasti in zagotavljanje dolgoročnega razvoja za v programu udeleženih podjetij predvsem iz naslova izvoza.

3. ŠEST TEHNOLOŠKIH PODROČIJ POBUDE »VARNA DRUŽBA«

Ker področje javne varnosti pokriva širok spekter področij in tehnologij, v pobudi pa sodeluje veliko število deležnikov, je ta zaradi lažje koordinacije razdeljena na šest zaokroženih področij:

- kontaktni centri 112 naslednje generacije,
- sistemi za obveščanje in alarmiranje naslednje generacije,
- sistemi in aplikacije nadzorne sobe,
- širokopasovne kritične komunikacije,
- sistemi za podporo dela reševalcev na terenu in
- aplikacije za končne uporabnike.

Slika 2: Tematski sklopi pobude »Javna varnos«

3.1 Kontaktni centri 112 naslednje generacije (NG112)

V EU vsako leto beležimo okoli 320 milijonov nujnih klicev. Ti so danes po večini običajni govorni klici iz stacionarnega in mobilnega omrežja.

Danes je uporaba sodobnih komunikacijskih naprav na osnovi VoIP tehnologije postala vsakdanja rutina. Izredno popularno je tudi komuniciranje preko tekstovnih sporočil (SMS, IM). Izmenjava fotografij in videa se uporablja vse bolj pogosto, kar omogočajo pametni telefoni in druge naprave, vozila pa so opremljena s telemetrijo, ki lahko zagotovi pomembne podatke, če je vozilo vpleteno v prometno nesrečo. Ljudje pričakujejo, da bodo tudi v nujnih primerih lahko poklicali pomoč z enakimi sredstvi komuniciranja kot jih uporabljajo med seboj, še posebej zato, ker sodobne tehnologije omogočajo tudi prenos pomembnih informacij kot je na primer prenos točne lokacije. Žal pa obstoječa infrastruktura nujnih služb ne omogoča izkoriščanja danih možnosti novih tehnologij.

Zaradi tega je potrebno uvesti nove tehnologije in novo arhitekturo centrov za sprejem nujnih klicev z arhitekturo naslednje generacije (NG112). NG112 bo omogočala prebivalstvu enak način komunikacije z nujnimi službami kot jo uporabljajo v vsakodnevnem življenju ob izkoriščanju dodatnih možnosti za prenos pomembnih informacij, ki lahko odločilno pomagajo pri ukrepanju. Sistemi 112 naslednje generacije bodo temeljili na konvergenčnem protokolu IP in bodo zagotavljali multimedijske nujne klice (slika, video, tekst, …), združljivost z obstoječim okoljem (javnim PSTN omrežjem, obstoječa operativna radijska omrežja), inteligentno usmerjanje nujnih klicev, preverjanje lokacijske informacije (validacija), združevanje podatkov, jezikovne in govorne tehnologije, eCall, itd.

V stebru »Kontaktni centri 112 naslednje generacije« sodelujejo:

- *industrijski partnerji:* Iskratel, d.o.o., Kranj, Alpineon d.o.o., Computel d.o.o., Mobili d.o.o., ResEvo d.o.o., XLAB d.o.o., Genis d.o.o., Rap-ing d.o.o., INVIDA d.o.o., *ponudnik omrežja in storitev* Telekom Slovenije d.d.,
- *raziskovalni partnerji:* Univerza v Ljubljani, Fakulteta za elektrotehniko (UL FE), Univerza v Ljubljani, Fakulteta za računalništvo in informatiko (UL FRI), Univerza v Mariboru, Fakulteta za elektrotehniko, računalništvo in informatiko (UM FERI).

3.2 Sistemi za obveščanje in alarmiranje naslednje generacije

Sistemi za obveščanje in alarmiranje so nujno potrebni za zaščito človeških življenj v primeru izrednih razmer kot so velike nesreče in narave katastrofe. V zadnjih 50-ih letih so se v ta namen uporabljale pretežno sirene in radio. Sirene so omejene zgolj na prenos posameznih sporočil, medtem ko je obveščanje preko radija omejeno zgolj na trenutne poslušalce. Danes so na voljo številne naprave in sistemi, ki jih je mogoče simultano uporabljati za obveščanje in alarmiranje prebivalstva (sirene, zvočniki, zasloni, »CellBroadcast« telefonski klici, SMS, družabna omrežja…). Posebno velja izdvojiti tehnologijo »CellBroadcast«, ki omogoča prenos alarmov in sporočil do prejemnikov preko mobilnih telefonov. Tehnologija CellBroadcast omogoča ciljano alarmiranje in obveščanje, ki je omejeno zgolj na ogrožena področja, informacija pa je zvokovna in tekstovna, kar je še posebej primerno za slabovidne in naglušne.

Naslednja generacija obveščanja in alarmiranja bo vključevala multimedijski način obveščanja in alarmiranja preko različnih razpoložljivih naprav in sistemov. Povečala se bo tudi učinkovitost procesa alarmiranja in obveščanja preko integracije z geolokacijskimi sistemi, meteo sistemi, sistemi za podporo odločanja ter drugimi informacijskimi sistemi. Hierarhična struktura, uporaba sodobnih tehnologij in visoka razpoložljivost in zanesljivost bodo nekatere od pomembnejših lastnosti.

V stebru »Sistemi za obveščanje in alarmiranje naslednje generacije« sodelujejo:

- *industrijski partnerji:* Iskratel, d.o.o., Kranj, Alpineon d.o.o., ResEvo d.o.o., XLAB d.o.o., Rap-ing d.o.o., Telekom Slovenije d.d., INVIDA d.o.o.,
- *raziskovalni partnerji:* UL FE, UL FRI, UM FERI.

3.3 Sistemi in aplikacije nadzorne sobe

Aplikacije nadzorne sobe vključujejo tridimenzionalni geoinformacijski sistem (3D-GIS), zavedanje položaja, (Situational Awareness), skupno operativno sliko (Common Operational Picture), računalniško podprto odpremo (CAD - Computer Aided Dispatch), sisteme za podporo odločanja (DSS - Decision Support Systems), sisteme za upravljanje poročanja (Report Management Systems), samodejno določanje lokacije vozil (AVL-Automatic Vehicle Location), video steno in analizo signalov v primeru avtomatskega klica na 112.

Osebje v nadzorni sobi ima na osnovi zbiranja podatkov in njihove vizualizacije popolno sliko o dogajanju oziroma posameznem dogodku. Na podlagi vnaprej določenih postopkov ukrepanja izvaja predvidene aktivnosti. Pri tem se opira na naštete namenske aplikacije in sodobna komunikacijska sredstva (klasične in operativne komunikacije, konferenčni sistemi) za koordinacijo. Tehnologija mora omogočati enostavno integracijo vseh namenskih sistemov za ukrepanje v enovito celoto.

V stebru »Rešitve in aplikacije nadzorne sobe« sodelujejo:

- *industrijski partnerji:* Computel d.o.o., ResEvo d.o.o., XLAB d.o.o, Rap-ing d.o.o., INVIDA d.o.o.,
- *raziskovalni partnerji:* UL FRI, Inštitut Jožef Stefan (IJS).

3.4 Širokopasovne kritične komunikacije

Sistemi za kritične komunikacije so bili razviti, da bi zadostili specifičnim potrebam uporabnikov, ki zagotavljajo javno varnost, in pri svojem delu potrebujejo zanesljivo in varno komunikacijo. Prav tako zagotavljajo obsežen nabor funkcionalnosti kot so skupinski klici, »push-to-talk«, zaščita s kriptiranjem, direktni način komunikacije neodvisno od omrežja, ipd. Današnji sistemi za kritične komunikacije temeljijo na 2G celični telefoniji in so omejeni predvsem na govorno komuniciranje ter omogočajo le prenos omejene količine podatkov.

Razvoj celičnih sistemov je napredoval od preko 3G/UMTS do 4G/LTE, ki danes omogoča neprimerljivo hitrejši prenos podatkov in multimedijsko komunikacijo, ki lahko bistveno izboljša komunikacije in poveča učinkovitost dela nujnih služb.

Osnovni izziv na danem področju je zagotoviti podobne storitve kot so na voljo na današnjih sistemih za govorno komunikacijo tudi v širokopasovnem okolju LTE in jih nadgraditi z novimi multimedijskimi storitvami. Prav tako pa je pomembno zagotoviti postopen prehod z obstoječih sistemov (Tetra, GSM-R, DMR, analogni radio,...) v novo okolje, kar bo mogoče doseči z njihovo integracijo v enovito omrežje kritičnih komunikacij.

Kritične komunikacije naslednje generacije bodo utemeljene na tehnologijah kot so širokopasovno dostopovno omrežje 4G/LTE-A, mobilno jedrno omrežje (EPC) in govorne komunikacije preko LTE (VoLTE).

V stebru »Širokopasovne kritične komunikacije« sodelujejo:

- *industrijski partnerji:* Iskratel, d.o.o., Kranj, FMC d.o.o., INVIDA d.o.o., ponudnik omrežja in storitev: Telekom Slovenije d.d.,
- *raziskovalni partnerji:* UL FRI, IJS.

3.5 Sistemi za podporo dela reševalcev na terenu.

V primeru nesreč ali naravnih katastrof večjega obsega lahko pride do razmer, ko je potrebno na samem mestu dogajanja zagotoviti delovanje mobilnega operativnega nadzornega centra in ustrezno komunikacijo s pripadniki nujnih služb na terenu na eni strani, ter glavnim operativnim nadzornim centrom na drugi strani.

Sistemi za nujno podporo na terenu (on-site emergency support systems) vključujejo uporabo in delovanje na taktičnem in operativnem nivoju, razširitve v smeri zahtev 3GPP za javno varnost, integracijo EPS/PCC/IMS (Evolved Packet System/ Policy and Charging Control/ IP Multimedia System) in SDN/NFV (Software Defined Network/ Network Functions Virtualization) nadzorne ravnine ter povezovalnih konceptov, ki omogočajo integracijo s profesionalnimi telekomunikacijskimi okolji (IMS) in industrijsko priznanimi razvojnimi okolji (Android, iOS, HTML5), uporabo namenskih in industrijsko razširjenega ekosistema pametnih terminalov, uporabo pristopov in algoritmov programirljivega radia »SDR, cognitive radio« na heterogenih brezžičnih in mobilnih sistemih za optimalno izrabo radijskih (spectrum sensing and sharing) in omrežnih kapacitet, podporo in optimizacijo sistema za storitve in aplikacije M2M (Machine to Machine) in IoT (Internet of Things), implementacijo in poslovne modele, ki temeljijo na združevanjem kapacitet in funkcionalnosti namenskih (Compact LTE/EPC, TETRA, Satelit, DMR) in komercialnih sistemov (3G, 4G, 5G), ki omogočajo nacionalno in mednarodno združljivost rešitev.

V stebru »Sistemi za obveščanje in alarmiranje naslednje generacije« sodelujejo:

- *industrijski partnerji:* FMC d.o.o., Rap-ing d.o.o., GENIS d.o.o., ResEvo d.o.o., Mobili d.o.o., ŠPICA INTERNATIONAL d.o.o., XLAB d.o.o., LOGOS d.o.o., Computel d.o.o., INVIDA d.o.o.,
- *raziskovalni partnerji:* IJS, UL-FE.

3.6 Aplikacije za končne uporabnike.

Za hitro ukrepanje nujnih služb je bistvena točna določitev kraja dogodka, kjer je potrebno ukrepati in čim bolj točna informacija o nastali situaciji. Predvsem določitev lokacije mesta dogajanja je danes šibka točka pri nujnih klicih iz mobilnega omrežja, saj jo je v večini primerov možno določiti le z natančnostjo pokrivanja signala bazne postaje, na katero je v času klica prijavljen kličoči.

Pametni telefoni, ki komunicirajo po kanalih celične telefonije, obenem pa tudi preko Interneta, lahko s svojo zmogljivostjo bistveno izpopolnijo komunikacijo med državljani in nujnimi službami. Ob nujnem klicu imajo možnost posredovanja svoje točne lokaciji in drugih informacij, ki so v dragoceno pomoč pri ukrepanju. Nanje je mogoče priključiti tudi namenske senzorske sisteme, ki dodatno prispevajo pomembne podatke. S pomočjo dodanih namenskih aplikacij so pametni telefoni lahko namenjeni državljanom in tudi pripadnikom nujnih služb.

Področje delovanja tega stebra so storitve in aplikacije javne varnosti, ki vključujejo telemetrijo in oddaljeno diagnostiko, nadzor dostopa do prostorov, geolokacijo, 112 aplikacije za pametne telefone za uporabnike s posebnimi potrebami z vključevanjem naprednih govornih tehnologij, podporne biometrične storitve za samodejno identifikacijo in sledenje oseb in vozil, spremljanje reševalcev med delovanjem na terenu, spremljanje stanja posameznih kategorij kroničnih bolnikov oz. rizičnih skupin v vsakdanjem življenju z uporabo pametnih naprav in triažo dogodkov.

V stebru »Aplikacije za končne uporabnike« sodelujejo:

- *industrijski partnerji:* Genis d.o.o., FMC d.o.o., Alpineon d.o.o., INVIDA d.o.o.,
- *raziskovalni partnerji:* UM-FERI, UL-FE.

4. ZAHVALE

Avtorja se zahvaljujeta vsem partnerjem pobude in koordinatorjem tehnoloških področij, ki so sodelovali pri pripravi poslovnega načrta, ki je bil osnova za dani dokument. Hkrati se zahvaljujeta tudi bralcem tega dokumenta za tehtne pripombe.

REFERENCE

[1] Varna družba - nova generacija omrežij, storitev in aplikacij klica v sili, Poslovni načrt, Iskratel in partnerji, 2014.

[2] VARNA DRUŽBA - nova generacija omrežij, storitev in aplikacij javne varnosti za evropsko tržišče in tržišče Skupnosti neodvisnih držav, Iskratel in partnerji, 2015.

[3] Dokumentacija produktov posameznih partnerjev.

Keramični mikrosistemi za povezane sodelujoče sisteme pri nadzoru zdravega bivalnega in delovnega okolja / Ceramic microsystems for clean and healthy environment

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POVZETEK

Raziskovalno-razvojni in inovacijski pobuda z naslovom »Keramični mikrosistemi za povezane sodelujoče sisteme pri nadzoru zdravega bivalnega in delovnega okolja« je predlog za vključitev nekaj članov v verigo vrednosti, ki bi (po našem mnenju) v okviru perspektivnih tehnoloških področij in produktnih smeri Strategije pametne specializacije (SPS) Republike Sloveniji za prednostno področje Zdravo bivalno in delovno okolje. Projekt je osnovan na očitni prednosti Slovenije na nišnem segmentu keramičnih mikrosistemov v povezavi s tehnologijo internet stvari. To je nišno pod-področje dveh izredno hitro rastočih področji mikrosistemi (okoli 8% letna rast) in internet stvari (okoli 15% letna rast 'hardware').

ABSTRACT

The initiative "Ceramic microsystems for clean and healthy environment" is a contribution of industrial and research-and-development partners to define prospective areas of technology and product direction for Smart specialization strategies of Slovenia, on the priority area ″Healthy living and working environment″. The initiative highlights the advantages of Slovenia in the field of ceramic microsystems technology in combination with the Internet of Things. This initiative is the intersection of the two rapidly growing areas: microsystems (around 8% annual growth) and the Internet of Things (about 15% annual growth of hardware)..

1. UVOD / INTRODUCTION

Trend razvoja na področju mikrosistemske tehnike je izrazito usmerjena v povezovanje in integracijo različnih funkcij, ki se jih realizira z različnimi tehnikami kot so: mikroelektronika, mikromehanika, mikrofluidika, mikrokemija, mikrooptika, mikroakustika, mikrotermika, mikromagnetika. Tipičen primer so t.i. pametni integrirani mikrosistemi (ang. Intelligent and Integrated Microsystems), ki poleg naštetega integrirajo še senzoriko, aktoriko, elektroniko, informatiko in komunikacije.

V Evropi je mikrosistemska tehnika pomembni del vrednostne verige v marsikaterem industrijskem segmentu. Tako na primer, približno tretjino svetovnega trga senzorjev, ki je eden pomembnejših delov mikrosistemske tehnike, regionalno pripada Evropi. V nekaterih belih knjigah in tržnih analizah (EPICA, PIDEA, NEXUS, Frost&Sullivan, Intechno Consulting, Yole Développement, IMS Research, AMA, ZVEI) napovedujejo temu segmentu povprečne letne tržne rasti okoli 18%. Nekateri avtorji Evropi pripisujejo strukturno prednost pred konkurenti (Azija, Amerika) na področju mikrosistemske tehnologije. Ta strukturna prednost naj bi izvirala iz izobraževalne (akademske) in industrijske kulture in tradicije.

2. POBUDA / INITIATIVE

Mikrosistemi so lahko izdelani iz različnih materialov in tehnologij. Večinoma je to silicij in polprevodniške tehnologije. Povečuje pa se uporaba drugih materialov. Med te materiale spadajo tudi keramični materiali in z njimi tudi debeloplastna tehnologija. Za izdelavo tridimenzionalnih keramičnih struktur z vgrajenimi debeloplastnimi elementi je primerna keramika z nizko temperaturo žganja imenovana LTCC (Low Temperature Cofered Ceramics).

Keramični materiali imajo določene prednost za uporabo v nekaterih primerih. Tipični primeri so miniaturni laboratoriji (ang. Lab-on-Ceramics). V teh keramičnih mikrosistemih lahko potekajo kemične reakcije tudi pri višjih temperaturah. V splošnem so keramični mikrosistemi praviloma večji, bolj robustni in največkrat primerni za delovanje v zahtevnejših pogojih okolice. Keramični mikrosistemi pokrivajo področje od posameznih elektronskih komponent do kompleksnih keramičnih mikrosistemov (senzorji, aktuatorji, MEMS, mikroreaktorji, Lab on Chip, µTAS (Micro Total Analysis System), itd). Za razvoj in izdelavo keramičnih mikrosistemov je potrebna t.i. mikrosistemska tehnologija, ki v splošnem obsega: mikrosenzoriko, mikroaktoriko, mikrofluidiko, mikromehanika, mikrooblikovanje, elektroniko (analogna, digitalna, IKT, RF, …). To pomeni, da je potrebno za razvoj in izdelavo keramičnih mikrosistemov izrazito multidisciplinarna dejavnost.

V zadnjem času so vedno bolj pomembni t.i. kemijski mikrosistemi. Kemijski mikrosistemi so skupina miniaturnih naprav v katerih lahko izvajamo kemijske reakcije ali analize in jih sestavljajo reaktorji, mešalniki, analizatorji, senzorji, aktuatorji itd. Zato kemijski mikrosistemi predstavljajo velik potencial kot orodje za kemijsko sintezo in analizo. Ker imajo mikro-kemijski sistemi veliko razmerje med površino in volumnom je prenos toplote zelo hiter, zaradi majhnega volumna pa je hiter tudi prenos

mase. V mikrosistemih so zadrževalni časi izredno kratki, prehod tekočin in plinov laminaren. Kemijske reakcije se izvajajo z manjšo potrošnjo energije.

Uporabnost mikrosistemov lahko najdemo na področjih od skrbi za čisto in zdravo bivalno okolje, medicinskih pripomočkov, pridelavi hrane, pridobivanju energije, mehatronskih in elektrokemijskih sistemi ter drugih sestavljenih in zahtevnejših izdelkih. V zadnjem času pa se njihova uporaba strmo vzpenja na področju 'internet stvari'.

V zadnjih petih letih se v Sloveniji ustvarja veriga vrednosti podjetij in raziskovalnih institucij na področju keramičnih mikrosistemov. Ravno tako je v Sloveniji vedno več podjetij in raziskovalnih institucij, ki se ukvarjajo s tehnologijo internet stvari.

Pobuda se navezuje na dva hitrorastoča razvojna področja v Evropi in Svetu. Prvo področje je mkrosistemska tehnika, drugo področje pa je internet stvari. Tržne analize 2015-2024 napovedujejo tehnologiji internet stvari strmo rast od leta 2016 dalje. Različni senzorji (od senzorjev za eno veličino do kompleksnih senzorjev za več veličin), analitski sistemi, krmilni in procesni sistemi in drugi mikrosistemi postajajo tudi del (hardware) tehnologije internet stvari. Za ta, z eno besedo senzorski del, tržne analize napovedujejo največjo rast (od 9,5 na 46 milijarde USD) v letih od 2017 do 2020. Ta segment naj bi se potem ustalil na vrednosti okoli 50 milijard USD.

Na preseku teh dveh hitrorastočih tehnologij ima Slovenija priložnost postati vodilna na ozkem, vendar pomembnem segmentu. Na hitro-rastočem mikrosistemskem področju je nišno pod-področje keramični mikrosistemi. Slovenski akterji imajo že sedaj pomembne reference na posameznih segmentih, ki so potrebni za to pod-področje. Povezanost akterjev bi multipliciralo uspešnost posameznikov. Zato ocenjujemo, da ima lahko Slovenija eno izmed vodilnih vlog na področju keramičnih mikrosistemov. Različni nivoji keramičnih mikrosistemov pa so (bodo) skupaj s tehnologijo internet stvari pomemben nišno pod-področje v prednostnem področju Zdravo bivalno in delovno okolje.

3. PARTNERJI / PARTNERS

V projektu, ki se bo oblikoval iz pobude, so pripravljene sodelovati javne in zasebne raziskovalne organizacije, Univerza v Ljubljani, podjetja in civilna družba. Vsi partnerji imajo RRI dosežke za katere so dobili strokovna ali družbena priznanja. Vsi partnerji znanstveno-raziskovalno, strokovno in poslovno sodelujejo z mednarodnimi partnerji. V nadaljevanju so na kratko opisani partnerji, njihove kompetence in RRI dosežki ter njihova mednarodna vpetost. Poleg opisanih partnerjev predvidevamo tudi vključitev novih, ki so primerni ali bodo celo potrebni za podaljšanje verige vrednosti pri nekaterih izdelkih oz. projektih. Nekateri potencialni partnerji so že potrdili tovrstno sodelovanje. Če bo veriga vrednosti potrebovala dodaten člen predvidevamo tudi ustanovitev novega podjetja.

3.1 Center odličnosti NAMASTE

V Centru odličnosti so združeni kompetentni strokovnjaki iz gospodarstva in raziskovalci z institutov in univerz s področja naprednih nekovinskih materialov t. j. keramičnih materialov s specialno načrtovanimi lastnostmi za uporabo v medicini, elektroniki, energetiki. Uporabljajo se v najrazličnejših vlogah, kot senzorji, zaščite, detektorji. Razvijamo materiale in procese/tehnologije, ki z novimi kombinacijami in inovativnim pristopom omogočajo razvoje novih področij, kot primer fotonike. Za pobudo je pomembno delovanje CO NAMASTE na področju keramičnih dvo- in tro-dimenzionalnih struktur na osnovi LTCC. (www.conamaste.si)

Bibliografski podatki za obdobje 2010-2014; izvirni članki: 228, pregledni članki: 1, strokovni članki: 1, vabljenih predavanj na konferencah: 144, objave prispevkov na konferencah: 176, prototipi: 22, testne strukture in demonstratorji: 86, patenti: 43 (6 z deležem CO), patentne prijave: 4, nacionalni projekti: ARRS-L7-4161, ARRS-L2-6768.

3.1 Odsek za elektronsko keramiko

Kompetence Odseka za elektronsko keramiko (Institut "Jožef Stefan") so na določenih področjih keramičnih materialov in procesov, uporabnih v elektroniki, energetiki, medicini. Vključujejo sintezo, lastnosti in uporabo kompleksnih materialov in struktur, ki lahko opravljajo več funkcij (multifunkcijski materiali), predvsem keramičnih piezoelektrikov, feroelektrikov in relaksorjov, ter materialov za 'prozorno' elektroniko: prevodnih oksidov n- in p- tipa ter dielektrikov. Poudarek raziskav je na kreiranju lastnosti s sintezo in strukturo na nano-, mikro- in makronivoju; osnove procesov, kot so sinteza (nano)-delcev, priprava tankih in debelih plasti in diskretnih struktur, ter tehnologije za pripravo debeloplastnih senzorjev tlaka, ultrazvočnih pretvornikov in keramičnih mikroelektromehanskih sistemov (MEMS) na osnovi keramike z nizko temperaturo žganja ('Low Temperature Cofired Ceramics' - LTCC).

Bibliografija skupine (2009-2014) obsega okrog 190 izvirnih znanstvenih člankih, 5 preglednih člankov, 17 poglavij v knjigah, souredništvo knjige (Springer), 5 plenarnih, 33 vabljenih predavanj na konferencah in več kot 40 predavanj na tujih univerzah. Organizacija dveh mednarodnih srečanj (simpozij EMRS, Poljska, 2011, konferenco MIDEM, Slovenija, 2012). Patenti: 6 slovenskih patentov in ameriški patent (2013), prijave ameriškega in 4 PCT patentov. Nacionalni projekti: nosilci programa, 6 temeljnih, 3 aplikativnih, 1 aplikativnega postdoktorskega ter 1 postdoktorskega projekta ARRS, Center odličnosti NAMASTE. Mednarodni projekti: 9 projektov EU (6. in 7. OP), 2 projekta ESA, projekt EUREKA, 4 projekti COST. Odsek je sodeloval oziroma sodeluje s podjetji HIPOT-RR d.o.o, KEKON d.o.o., ETI Elektroelement d.d., RC eNeM Novi materiali d.o.o., HYB d.o.o, v 2013-14 še s podjetjema KEKO-Oprema d.o.o. in KEKO-Varicon d.o.o. v skupno 5 projektih. Tesno sodelujemo tudi s Centrom odličnosti NAMASTE

3.2 HIPOT-RR d.o.o.

Majhna zasebna raziskovalna organizacija HIPOT-RR raziskave in razvoj tehnologij in sistemov, d.o.o. je bila ustanovljena 1996 in je v slovenski lasti. Družba deluje na področju trženja, raziskav in razvoja ter prenosa tehnologij in izdelkov. RR dejavnost je organizirana v HIPOT raziskovalni skupini, ki je usposobljena za raziskave, razvoj izdelkov in tehnologij ter za povezavo med industrijo in raziskovano sfero na področjih debeloplastne tehnologije in keramičnih mikrosistemov in to od enostavnih senzorjev do sistemov, ki vključujejo kemijske reaktorje, senzorje (tlak, temperatura, …), aktuatorje in ustrezno elektroniko. Največji dosežek raziskovalne skupine in partnerjev v obdobju 2010-2014 je izgradnja teoretičnih in eksperimentalnih podlag za razumevanje, konstruiranje in izdelavo različnih keramičnih mikroelektromehanskih in drugih sistemov. Reference na tem področju jo postavljajo ob bok vodilnim laboratorijem v Evropi.

Bibliografija raziskovalne skupine (2010-2014) obsega: 24 izvirnih člankov, 1 pregledni članek, 1 poljudni članek, 3 vabljenih predavanj na konferencah, 83 referatov z objavljenimi prispevki na konferencah, 3 predavanja na tujih univerzah.

Podatki na področju inovacij (2010-2014): 4 patenti, 2 patentni prijavi, 7 nacionalnih raziskovalnih projektov, 5 mednarodnih projektov (7FP, EUREKA, ESA, dvostranski), 8 industrijski razvojnih projektov in 1 industrijski RR program, sodelovanje v Razvojnem centru Slovenskega gospodarstva IN-Medica in Centru odličnosti NAMASTE, 62 izdelkov (testnih, demonstracijskih, prototipov). HIPOT se je leta 2010 skupaj s partnerji predstavil, med izbranimi inovatorji, na Slovenskem forumu inovacij

3.3 KEKON d.o.o.

Podjetje KEKON d.o.o. je bilo ustanovljeno leta 1995. Trenutno ima 16 zaposlenih in je v slovenski lasti. Podjetje KEKON je izkušen razvijalec in proizvajalec večplastnih keramičnih elektronskih komponent po naročilu. Podjetje je specializirano za posebne izdelke, kjer je potrebno razviti tako material, kakor tehnologijo in sam izdelek. Največja prednost družbe je visoka strokovnost na področju materialov in tehnologij ter dobra opremljenost na eni strani in poznavanje trga na drugi strani. To podjetju omogoča, da od ustanovitve deluje v Evropi v posebni tržni niši – specialne elektronske komponente na osnovi večplastne keramike. Družba je majhna in fleksibilna, zato potrebe po dodatnih raziskovalno-razvojnih virih rešuje s sodelovanjem z različnimi raziskovalnimi in znanstvenimi institucijami, kot na primer Institut Jožef Stefan in Univerza v Ljubljani. Na področju RR dejavnosti družba sodeluje tudi z mednarodnimi partnerji v okviru projektov (7OP in EUREKA).

3.4 KEKO Oprema d.o.o.

Podjetje KEKO Oprema d.o.o. je bilo ustanovljeno leta 1995. Podjetje trenutno zaposluje 49 delavcev in je v slovenski lasti.. Podjetje razvija, izdeluje in prodaja opremo za večplastne keramične tehnologije, izdelke na osnovi te tehnologije in tudi samo tehnologijo pod svojo blagovno znamko. Podjetje je vodilni proizvajalec opreme in ima impresivno referenčno listo strank v Aziji, Ameriki in Evropi. Za večino naročnikov družba konstruira in izdela opremo po naročilu, kar lahko obsega od izdelave posamezne naprave do postavitve cele avtomatizirane linije. Poleg tega ima družba razvejano tržno in servisno mrežo, kar omogoča tudi uspešno nadgradnjo njihovih naprav. Družba ima jasno dolgoročno strategijo vlaganja v razvoj in inovacij na področju materialov, tehnologij in opreme. V letu 2014 je družba vložila v RR dejavnost okoli 13% prihodkov od prodaje, ki znaša okoli 7,9 mio EUR, od tega 95% na tujih trgih. Družba dokazuje svojo uspešnost na tujih trgih tudi z visoko dodano vrednostjo na zaposlenega (63.385 EUR). Podjetje KEKO Oprema je prejelo nagrado GZS za izjemne gospodarske in podjetniške dosežke za leto 2014.

3.5 ATech d.o.o.

Podjetje ATech Elektronika d.o.o. je ustanovljeno 1990. Trenutno ima 69 zaposlenih in je v slovenski lasti. Podjetje ATech, eden od vodilnih evropskih ponudnikov elektronskih sklopov na področju elektronske motorske regulacije, zahtevne elektronike ter drugih namenskih elektronskih naprav. Podjetje ima tri glavne produktne smeri. Prva smer je SmartMove. To so tehnično najsodobnejša elektronska krmilja elektromotorjev, ki omogočajo natančno regulacijo hitrosti, položaja in navora ter izboljšujejo energetsko učinkovitost. Druga smer je SmartLine. Izdelki so namenjeni gradnji sistemov inteligentnih zgradb in povezovanju različnih naprav, kar omogoča zanesljiv daljinski nadzor ter zajem, prenos in obdelavo podatkov. Tretja smer je Fumis. To je celovita družina izdelkov za krmiljenje ogrevalnih sistemov na lesno biomaso od kaminskih peči na palete do velikih kotlov na lesne sekance. Nekatere izdelke podjetje ATech trži ne samo po Evropi ampak tudi globalno. Primer je krmilnik, ki ga kupujejo tudi v Novi Zelandiji ter južni in severni Ameriki. Pred leti je revija Gospodarski vestnik za najhitreje rastoče podjetje na območju Notranjske in Primorske izbrala podjetje ATech. Podjetje je prejelo tudi nagrado za 'Najpodjetniško idejo' in na Slovenskem forumu inovacij je bilo izbrano med 40 najbolj inovativnih slovenskih podjetij.

3.6 L-TEK d.o.o.

Podjetje L-TEK Elektronika d.o.o. je že 15 let prisotno na področju razvoja mikro-krmilniških elektronskih vezij in naprav. Podjetje s 63 zaposlenimi je v slovenski lasti in na področju elektronike ponuja celovite rešitve od razvoja, dizajna, zasnove, izdelave modulov, razvoja programske opreme in programiranja, testiranja do pakiranja in odpreme končnim kupcem. V ta sklop spadajo najnovejše pametne krmilno-merilne naprave (že podpirajo glavne smernice Industrije 4.0 in interneta stvari), sodelujoči sistemi z različnimi žičnimi in brezžičnimi komunikacijskimi vmesniki in specifična elektronika za spremljanje, krmiljenje in upravljanje senzorike. S svojimi produkti in storitvami je zanesljiv partner številnim podjetjem iz Anglije, Nemčije, Švice, Italije, Hrvaške, Avstrije in Slovenije. Tako L-TEK aktivno sodeluje z enim od največjih dizajnerjev mikro-elektronike, angleškim podjetjem ARM. Poleg programa elektronike, L-TEK aktivno razvija, proizvaja in trži pasivne 2-fazne prenosnike toplote - toplotne cevi, ki omogočajo izkoriščanje toplotnega potenciala za izredno hiter odvod oz. porazdelitev toplotne energije - vse to brez zunanjega vira energije. Na področju toplotnih cevi je L-TEK med dvema največjima podjetjema v Evropi. Končni uporabniki teh produktov so velika podjetja kot npr. Siemens in ABB ter vrsta malih specializiranih podjetji. Podjetje hkrati obvladuje tehnologijo izdelave keramičnih uporov visokih energetskih gostot in visokih stabilnosti in je skupaj z Avstrijskim partnerjem prvi ponudnik visoko-zahtevnih rešitev na svetu. Podjetje L-TEK Elektronika je leta 2013 dobilo dve priznanji, Dolenjsko-posavska gazela 2013 in Srebrna gazela 2013.

3.7 DropSens L.R.

DropSens, Lianera, Španija je majhno podjetje z 35 zaposlenimi. Družba razvija proizvaja in trži biosenzorje, ki delujejo na elektrokemičnem principu in so narejeni v debeloplastni tehnologiji. Izdelki so od enostavnih senzorjev za enkratno uporabo, do zahtevnih sistemov za kemijsko analizo. Ker se večino izdelkov uporablja v medicini je podjetje certificirano (ISO13485) za proizvodnjo senzorjev za medicinske pripomočke. Poleg medicine so izdelki namenjeni za prehrambno industrijo in za nadzor in varovanje okolja proti eventualnemu onesnaževanju (npr: nadzor pesticidov v zemlji, kakovost pitne vode). Podjetje DropSens je tržno usmerjeno tehnološko-inovativno podjetje in kot tako išče nove tržne niše in partnerje za nove inovativne izdelke. DropSens prodaja svoje izdelke po vsem svetu (v več kot 60 državah na 5 kontinentih: ZDA, Velika Britanija, Kitajska, Brazilija, Indija ...), preko svojih distributerjev (26) ali pa neposredno strankam. S prodajo izdelkov podjetje dosega okoli 12 mio EUR letnega prihodka. Pred leti je bil DropSens nagrajen kot najboljše špansko tehnološko inovativno podjetje.

3.8 OZS

Obrtno-podjetniška zbornica Slovenije (OZS) je krovna organizacija, ki skupaj z 62 območnimi obrtno-podjetniškimi zbornicami, tvori obrtno-podjetniški zbornični sistem. OZS je leta 2006, za potrebe povezovanja gospodarstva, še zlasti malih in mikro podjetji, z razvojno-raziskovalnimi inštitucijami, ustanovil Odbor za znanost in tehnologijo. Odbor skrbi za prenos novih in aktualnih tehnologij iz akademske in znanstvene sfere v drobno gospodarstvo, organizira strokovna izobraževanja, (tehnološke dneve, energetske dneve, strokovne seminarje, nanotehnološke dneve) in druge dogodke. Odbor za znanost in tehnologijo kot predstavnik civilne družbe aktivno sodeluje pri povezovanju na področju naprednih tehnologij, kot so: mehatronika, elektronika, avtomatika, robotika, energetika, IKT – informacijsko komunikacijske tehnologije, bionika, mikro in nanotehnologije, 3D tehnologije, ter vesoljske tehnologije in tehnologije za vojaške aplikacije. Odbor za znanost in tehnologijo pri OZS je skupaj s partnerji prejel srebrno priznanje Celjskega sejma na sejmu MOS 2014. Priznanje je bilo podeljeno za celovito predstavitev novih tehnologij in inovacij

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Zahvaljujemo se tudi posameznikom in institucijam, ki so omogočili in podpirali delovanje na področju keramičnih mikrosistemov. Osebno se zahvaljujem sedanjim in nekdanjim sodelavcem, ki so s svojim delom dvignili kompetence skupine na zavidljiv nivo tudi v svetovnem merilu.

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Pametno urejanje prometa in prostorsko načrtovanje

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POVZETEK
Pametno urejanje in organizacija prometa ter ustrezno prostorsko načrtovanje z vidika cest in ostale prometne infrastrukture lahko bistveno zmanjša emisije in izboljša pretočnost prometne infrastrukture. To rešuje tako družbene in okoljske, kot tudi tržne izzive trajnostne mobilnosti. Sodobne tehnologije optimiranja in načrtovanja namreč temeljijo na visokem deležu vgrajenega znanja s področja IKT. V okviru pobude za pametna mesta se kot izziv postavlja celosten pristop k uvajanju koncepta pametnih mest in skupnosti, tako v slovensko okolje kakor tudi v tujino.

ABSTRACT
Smart control and management of transport, and an appropriate spatial planning, in terms of roads and other transport infrastructure, can significantly reduce emissions and improve the traffic flow. This solves social, environmental, as well as the market challenges of sustainable mobility. Modern technologies of optimization and planning are based on the high degree of integrated ICT knowledge. As part of the Smart Cities initiative, a challenge is put on a holistic approach to the introduction of the concept of smart cities and communities, both in Slovenia as well as abroad.

1. UVOD
Naša podpora se umešča v prednostno področje »Zdravo bivalno in delovno okolje« in področje uporabe »Pametna mesta in skupnosti«.

Pametno mesto temelji na soodvisnosti okolja, infrastrukture in družbe, ki se z uporabo digitalnih tehnologij dopolnjujejo, da se doseže večja učinkovitost, boljše počutje, zmanjšuje stroške in rabo virov, ter se aktivno odziva na potrebe meščanov. Vpliv soodvisnosti in pozitivnih učinkov dopolnjevanja se kaže tudi pri transportu. Za čim večji učinek mora pametno mesto zagotoviti ustrezno infrastrukturo in storitve. Naša opisana podpora se osredotoča predvsem na zagotavljanje ustrezne podporne odprte IKT tehnologije in aktivnosti za zagotavljanje učinkovite mobilnosti.

S pametnim urejanjem in organizacijo prometa ter z ustreznim prostorskim načrtovanjem z vidika cest in ostale prometne infrastrukture lahko bistveno zmanjšamo emisije in izboljšamo pretočnost prometne infrastrukture. S tem rešujemo tako družbene in okoljske, kot tudi tržne izzive trajnostne mobilnosti.

2. NAŠA VLOGA V PAMETNEM MESTU
Dobrobit posameznika v pametnem mestu se izraža v izboljšanem (povečanem) ugodju bivanja v mestu. To se kaže tudi v lažji in hitrejši mobilnosti znotraj mesta. Dobrobit javnih služb se kaže skozi učinkovitejše planiranje s čimer direktno vplivajo na ugodje bivanja v mestu. Dobrobit podjetij se kaže skozi razvoj in ponudbo ustreznih učinkovitih izdelkov in storitev na osnovi odprtih podatkovnih zbirk.

Pametna mesta združujejo različna področja s katerimi se raziskovalno ukvarja Odsek za računalniške sisteme na Institutu »Jožef Stefan«. Ta področja obsegajo učinkovito upravljanje in analitično obdelavo odprtih podatkovnih zbirk, napredne algoritme za optimiranje, reševanje večkriterijskih problemov, zmogljive in natančne simulacije, vzporedne implementacije algoritmov za njihovo pospešeno izvajanje, ter razvoj spletnih storitev in mobilnih aplikacij.

V razvoj pametnega mesta lahko odsek prispeva naslednje raziskovalno-razvojne storitve:

- skalabilne programske rešitve za obdelavo kompleksnih podatkov v realnem času,
- človeku razumljive, intuitivne in nemoteče uporabniške vmesnike in naravne uporabniške izkušnje (human-computer interaction).

3. NAŠE RAZISKAVE IN DOSEŽKI

3.1 Omrežja
V okviru teoretskih raziskav modeliranja omrežij obravnavamo različne vidike velikih grafov [1]. Prvi vidik predstavljajo mere in indeksi, ki služijo predstavitvi strukturnih lastnosti grafov. V ta namen smo vpeljali novi meri središčnosti. Drugi vidik se nanaša na modeliranje socialnih omrežij. Vpeljan je nov model, ki upošteva teorijo uravnoteženosti in stigmergijo, kot način interakcije med posamezniki. Tretji vidik se nanaša na robustnost hiperkocke, pogoste topologije vzporednih omrežij.

3.2 Samonastavljivi sistemi
V okviru razvoja samoorganizirajočih sistemov se ukvarjamo z brezparametrskim krmiljenjem optimizacijskih algoritmov ter s samonastavljivimi algoritmi [2]. Uporabnost tovrstnega načina, pri katerem uporabnik ne potrebuje specifičnih znanj nastavljanja krmilnih parametrov za učinkovito delovanje algoritma, smo pokazali pri uporabi z večkriterijskim optimiranjem. Dodatno uporabnost vidimo v navezavi s samoorganizirajočimi emergentnimi sistemi. V ta namen preučujemo stigmergijo, to je

koordinacijo, kjer se kolektivno delovanje sistema doseže s posrednim vzajemnim delovanjem med elementi sistema. Raziskujemo tako sematektonično, kakor tudi na znakih temelječo stigmergijo. Pri prvi poteka komunikacija preko spremembe fizičnega okolja, pri drugi pa s signalnim mehanizmom.

Princip samoorganizirajočih stigmergičnih sistemov uporabljamo tudi pri implementaciji rešitev za optimizacijske postopke v okviru ARTEMIS projekta Adaptive Cooperative Control in Urban (sub) Systems – ACCUS [3], kjer razvijamo platformo za integracijo in koordinacijo urbanih sistemom (transport, razsvetljava, energetika), ki bo zagotavljala prilagodljivo in enotno krmiljenje urbanih podsistemov ter omogočala optimalno delovanje njihovega kombiniranega sklopa. V ta namen smo razvili spletne storitve in aplikacijo (slika 1), ki omogočajo udobno vožnjo ob upoštevanju spremenljivih dejavnikov v mestu (zastoji, zapore, nesreče…).

Slika 1. Mobilna aplikacija za izračun optimalne poti, upoštevajoč spremenljive dejavnike.

3.3 Simulacija prometa

Razvijamo okolje za simulacijo prometnih tokov, ki temelji na OpenDRIVE logičnem zapisu cestnega omrežja. Okolje vsebuje opis cestnega omrežja s semaforiziranimi križišči, in simulira tok vozil, ki se obnašajo po modelu IDM (Intelligent driver model). Vsako prevozno sredstvo ima svoje lastne karakteristike obnašanja v prometu in začrtano pot. Karakteristike obnašanja vključujejo tip vozila, tip voznika, ki je lahko umirjen, zmeren ali agresiven, ter delež onesnaženosti, ki ga vozilo povzroča. Obstoječi odprtokodni večmodalni simulator prometa MovSim smo nadgradili v namen konstruiranja kompleksnih cestnih omrežij. Nadgrajeni simulator [1] omogoča konstrukcijo omrežja z večpasovnicami in kompleksnimi križišči. Vsako semaforizirano križišče vsebuje svoj režim signalizacije, ki je ustrezno umeščen znotraj signalizacije celotnega omrežja (primer je prikazan na sliki 2). Nadgradnja simulatorja obsega tudi implementacijo urejevalnika prometa, ki omogoča enostavno in uporabniku prijazno rekonstrukcijo cestnega omrežja in njegove signalizacije. S tem lahko enostavno predvidimo učinek vzpostavitve novih cestnih povezav in podobnih sprememb v cestnem omrežju. Simulator smo nadgradili tako, da se lahko nad danim omrežjem uporabi za optimizacijo prometnega toka, saj z optimizacijo časovnih intervalov semaforjev lahko dosežemo boljši pretok prometa.

Slika 2. Izsek cestnega omrežja s podrobnim opisom prometnih pasov ter semaforjev.

3.4 Prenos informacij

Pri razvoju simulatorja in aplikacije usmerjanja v prometu nam je bilo v pomoč pridobljeno teoretično znanje o optimalnem prenosu informacij skozi omrežje [5][6]. Teoretični dosežki na tem področju obsegajo konstruktiven dokaz maksimelnega števila medsebojno neodvisnih Hamiltonskih ciklov v n-dimenzionalni hiperkocki s prepovedanimi povezavami ter dokaz o maksimalnem številu informacij, ki jih lahko sočasno prenesemo v najkrajšem možnem času skozi hiperkocko pri pogoju, da se posamezne informacije ob istem času nikoli ne srečajo v skupnem vozlišču. Dane raziskave nam nudijo temelj za teoretičen vpogled v to, kako zagotoviti veliko pretočnost danega omrežja in hkrati neobremenjenost posameznih vozlišč (križišč).

4. PODPORA PAMETNEMU MESTU

Pobuda PaMetSkup, v katero ponuja svoje rešitve Odsek za računalniške sisteme si je kot izziv postavila celosten pristop k uvajanju koncepta pametnih mest in skupnosti, v prvem koraku v slovensko okolje za testiranje in potrditev ustreznosti posameznih rešitev, v drugem koraku pa tudi v tujino.

Preko odprtih programskih in strojnih vmesnikov in ustreznih komunikacijskih modulov bodo lahko v pametnem mestu povezane različne senzorske in aktuatorske naprave, ki predstavljajo most med fizičnimi objekti v realnem svetu (luči, semaforji, parkirišča, parki, trgi, merilne naprave, energetski elementi, itd.) in njihovo abstrakcijo v oblaku.

Na področju zagotavljanja energetske učinkovitosti in komunalne oskrbe bo imela osrednjo vlogo podpora integrirani energetski in komunalni oskrbi in nadzoru, kar vključuje tako integrirano zagotavljanje energetskih virov glede na specifične lokalne danosti kot integrirano spremljanje in nadzor porabe. Uvajanje sodobnih tehnologij, sistemov pametnega upravljanja in novih poslovnih modelov pri zagotavljanju javne razsvetljave je eno klasičnih področij pametnih mest in skupnosti.

Za zagotavljanje mobilnosti in dostopnosti bo v pametnem mestu poudarek na spremljanju življenjskih navad prebivalcev ter uvajanju novih konceptov mobilnosti in novih poslovnih modelov.

V okviru mesta bomo s ciljem izboljšanja učinkovitosti pomagali pri uvajanju souporabe transportnih sredstev in uporabe čistih transportnih sredstev. Pomemben segment pametnih mest in skupnosti predstavljajo tudi napredne rešitve in optimizacija prometnih sistemov z uporabo pametne prometne signalizacije, interaktivnih tabel, urejanja mirujočega prometa, ipd. Optimizacija prometnih sistemov pa je v veliki meri vezana tudi na optimizacijo javnega potniškega prometa.

4.1 Urejanje prometa in prostorsko načrtovanje

Skupek raziskovalnih (Institut »Jožef Stefan«, Odsek za računalniške sisteme; Fakulteta za matematiko in fiziko, Univerza v Ljubljani) ter gospodarskih organizacij (Xlab d.o.o.; Abelium d.o.o.; Iskra Sistemi, d.d.) je skupaj izoblikoval idejo pametnega urejanja prometa in prostorskega načrtovanja.

Raziskovalna področja za dosego zastavljenega cilja obsegajo: vzpostavljanje in učinkovito upravljanje (odprtih) podatkovnih zbirk o stanju prometnega omrežja; vzpostavitev skalabilne infrastrukture za fuzijo senzorskih podatkov, napredno analitiko na velikih podatkovjih; napredne algoritme za optimiranje in usmerjanje transporta/logistike, ki omogočajo reševanje večkriterijskih in večmodalnih transportnih/logističnih problemov; zmogljive in natančne simulacije prometnih tokov; aplikacije teorije kompleksnih sistemov ter teorije iger; vzporedne implementacije algoritmov za njihovo pospešeno izvajanje.

Rezultat dela bo obsežna podatkovna zbirka z odprtimi vmesniki ter simulacijsko in optimizacijsko okolje za prometne tokove z integriranimi naprednimi algoritmi za hitro izračunavanje optimalnih nastavitev in konfiguracij prometnega omrežja. V osnovi bo simulacijsko okolje omogočalo učinkovito izrabo ter načrtovanja novih prometnih povezav, saj bo moč enostavno predvideti učinek sprememb v prometnem omrežju. Sodobne tehnologije načrtovanja namreč temeljijo na visokem deležu vgrajenega znanja s področja IKT. To bo omogočalo vzpostavitev novih inovativnih trajnostnih poslovnih modelov, ki temeljijo na bistvenem izboljšanju učinkovitosti in dostopnosti javnega prevoza. Večji del rešitev bo zaradi učinkovitosti realiziranih v računalniškem oblaku.

Identificirane sodelujoče organizacije združujejo tovrstne potrebne tehnološke kompetence in so povezane v celotno vrednostno verigo od temeljnega znanja do konkurenčnih tržnih produktov in storitev.

V okviru aktivnosti Odseka za računalniške sisteme lahko doprinesemo najmanj k naslednjim rešitvam v pametnem mestu:

- moduli za iskanje optimalnih strategij upravljanja podsistemov,
- odprte spletne in mobilne aplikacije z učinkovitimi, človeku razumljivimi in intuitivnimi uporabniškimi vmesniki,
- rešitve pametne javne razsvetljave z inteligentnimi metodami za dinamično prilagajanje delovanja javne razsvetljave ter napovedovanje pametne razsvetljave glede na promet,
- podporne aplikacije za znižanje stroškov mobilnosti pri souporabi transportnih sredstev,
- podpora za napovedovanje prometa in najbolj varnih poti pri razvoju in vpeljevanju čistih transportnih sredstev,
- optimizacija prometnih sistemov z naprednimi algoritmi za hitro izračunavanje optimalnih nastavitev in konfiguracij prometnega omrežja v navezavi s samozadostnimi pametnimi prikazovalniki za vgradnjo v prometne znake.

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Referenčno energetsko ekološki model kot podpora trajnostnega razvoja mest

Reference energy ecological model as support for sustainable urban development

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POVZETEK

Ob današnjem hitrem razvoju energetskih in prometnih tehnologij je strateška opredelitev EU in Slovenije kot države članice zgodnje privzemanje novih ter naprednih tehnologij in sicer zlasti na področjih učinkovite rabe energije in lokalne oskrbe z energijo. Nove energetske tehnologije bodo ključnega pomena za uspešen boj proti podnebnim spremembam in morajo omogočati doseganje ciljev s stroški, ki jih bo gospodarstvo lahko preneslo. Za doseganje zadanega cilja je potrebno izkoristiti vse možnosti ublažitve negativnih okoljskih učinkov, da so ukrepi tehnično izvedljivi ter, da koristi prevladujejo nad stroški. Ob tem je potrebno poudariti, da sta učinkovito gospodarjenje z energijo in kontinuirana skrb za okolje obvezna pogoja za trajnostni razvoj vsake države in posameznega mesta.

Prispevek predstavlja referenčni energetsko ekološki model (REES) kot orodje trajnostnega razvoja mest ter druge referenčne dosežke v sklopu aktivnosti Instituta »Jožef Stefan«, Center za energetsko učinkovitost (IJS - CEU).

ABSTRACT

At today's rapid development of energy and transport technologies a strategic definition of the EU and the Slovenia as a member state is early uptake of new and advanced technologies and particular in the fields of energy efficiency and local energy supply. New energy technologies will be crucial at dealing successfully with challenges of the climate changes and at enabling objectives within the suitable economy expenses. To achieve the target, it is necessary to take advantage of all opportunities to mitigate the negative environmental effects and to enable measures technically feasible. It has to be noted that effective energy management and continuous care for the environment obligatory are condition for the sustainable development of each country and each city. This paper presents the Reference Energy Ecological Model (REES) as a tool for sustainable urban development and other reference achievements within the activities of the Jožef Stefan Institute – Energy Efficiency Centre (JSI-EEC).

1. UVOD

Danes so mesta v največji meri odgovorna za številne okoljske probleme, s katerimi se sooča človeštvo. V evropskem merilu so mesta osnovni element sodobnih družb in držav, saj okrog 80% evropskega prebivalstva živi v urbanih območjih.

Popolnoma je jasno, da globalnih ciljev trajnostnega razvoja ne moremo doseči brez učinkovite in trajnostne mestne infrastrukture. Na žalost, mesta pogosto nimajo zadostnih finančnih ali človeških virov, s katerimi bi lahko prevzela bolj aktivno vlogo v izboljševanju vsesplošne kakovosti življenja.

Najbolj pogosta napaka v trajnostnem razvoju mest je neupoštevanje posebnosti lastnega mesta in s tem povezano slepo prevzemanje, oziroma kopiranje, tujih strategij in rešitev. Vsako mesto je drugačno in si mora za trajnostni razvoj razviti lastno strategijo.

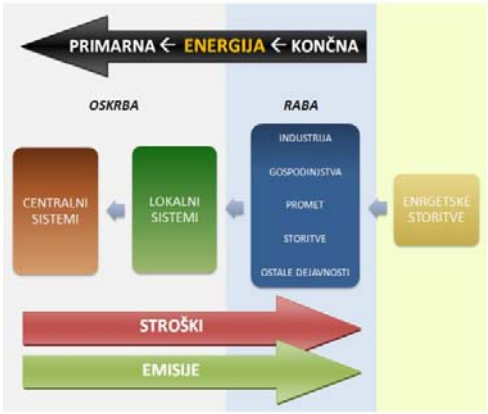
Seveda je sodelovanje z drugimi mesti ter izmenjava izkušenj več kot zaželeno in jih je potrebno spodbujati, konkretne rešitve pa morajo temeljiti na prednostih in posebnostih vsakega posameznega mesta. Vsako mesto ima namreč svojo potrošniško kulturo in zgodovinsko dediščino, ki je različna od ostalih

prestolnic in katero je potrebno upoštevati pri izdelavi strategije trajnostnega razvoja.

2. VLOGA IJS-CEU PRI TRAJNOSTNEM RAZVOJU MEST

V sklopu študije »Trajnostna mestna infrastruktura – Ljubljana – pogled do leta 2050«, je razvito orodje – referenčno energetsko ekološki model (REES-MOL). Orodje je namenjeno izračunu energetskih bilanc, emisij in stroškov rabe ter oskrbe z energijo v Mestni občini Ljubljana. Model REES-MOL je izdelan v okolju za načrtovanje referenčnih energetskih sistemov (MESAP) v obliki linearnega mrežnega modela procesov in povezav, kar omogoča konsistentno modeliranje rabe energije na podlagi potreb po energetskih storitvah ter izračune emisij, stroškov in drugih učinkov.

Uporaba referenčnih energetskih modelov je v energetiki že ustaljena praksa, tako da je tudi REES-MOL načrtovan po tej metodologiji. Gre za prvo tovrstno uporabo linearnega mrežnega modela procesov in povezav za načrtovanje v energetiki na mestni ravni v Sloveniji in širši regiji. V osnovi je referenčni model energetskega sistema skupek programov in orodij, s katerimi je matematično opisan posamezni podsistem v korelaciji z vsemi parametri, ki na tovrstni podsistem vplivajo. Ti podsistemi so medsebojno povezani v ustrezno celoto, ki predstavlja realni energetski sistem.



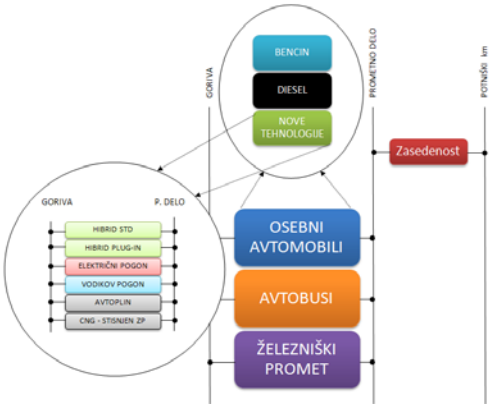
Slika 1. Shematski prikaz koncepta izračuna in sektorske strukture modela REES-MOL.

Model REES-MOL je kalibriran na statističnih podatkih (standardno klasifikacijo dejavnosti SKD – 2008) in tako povezan z indikatorskim sistemom statističnih kazalcev in kazalcev, razvitih za spremljanje energetskih politik v Sloveniji. Model omogoča tudi primerjave po metodologijah Statističnega urada Republike Slovenije (SURS), Evropskega statističnega urada/Organizacije za gospodarsko sodelovanje in razvoj (EUROSTAT/OECD) in UNFCCC. V modelu REES-MOL se izračunavajo:

- bilance rabe energije (končne ter primarne energije in sicer po podsektorjih, energentih, tehnologijah);
- emisije škodljivih snovi iz energetskih pretvorb (po sektorjih, energentih, tehnologijah, po nivojih pretvorb ter skupne);
- stroški, povezani z rabo energije (dezagregirani po sektorjih oziroma nivojih pretvorb, stroške deli tudi na investicijske stroške, stroške za programe pospeševanja URE, stroške za energijo oz. goriva, model loči tudi med davki in drugimi stroški).

Poleg osnovnega modela referenčnega energetskega sistema za izračun energetskih bilanc, emisij in stroškov za energijo se v MOL integrirano uporablja še model tržnega prodora naprednih ter energetsko varčnih tehnologij (PET SLO).

V prvem koraku se z modelom PET SLO izračunajo tržni deleži posameznih tehnologij URE pri končnih uporabnikih, kot odziv na spremenjene cenovne signale, finančne spodbude in komunikacijske akcije. Tehnologije, ki se uveljavljajo kot posledica predpisov o minimalnih zahtevah energetske učinkovitosti (stavb, naprav, izdelkov) so modelirane posebej. Posebej so modelirani tudi ukrepi URE v energetsko intenzivnih dejavnostih. Ocene tržnih deležev posameznih tehnologij in njihovih stroškov so vhodni podatek za osnovni model REES-MOL. Z REES-MOL izračunamo perspektivne bilance končne rabe energije ter ocenimo lokalno proizvodnjo električne energije na osnovi deležev različnih tehnologij v strukturi končne rabe in povezav z vplivnimi parametri (stopnjami gospodarske aktivnosti po panogah, številom gospodinjstev idr.) [2].



Slika 2. Shema REES-MOL za sektor prometa.

3. REFERENČNE AKTIVNOSTI

Večina referenčnih aktivnosti IJS–CEU na področju pametnih mest ter skupnosti so fokusirani na mednarodne IEE projekte (Intelligent Energy Europe), transnacionalne programe MED ter projekte sedmega okvirnega programa za raziskave - FP7:

- Krepitev politik urbane trajnosti (Empowering Policies on Urban Sustainability - UrbanEmpathy);
- Inteligentni informacijski sistem za spremljanje in verifikacijo upravljanja z energijo v mestih (Intelligent information system for monitoring and verification of energy management in cities - ISEMIC);
- Energetska učinkovitost v gospodinjstvih z nizkimi prihodki v Sredozemlju (Energy Efficiency in Low-Income Households in Mediterranean – ELIH-Med);
- Krepitev sredozemskih pobud, ki majhna in srednje velika podjetja usmerjajo k inovacijam pri razvoju in rabi energijsko učinkovitih tehnologij (Enhancing Mediterranean Initiatives Leading SMEs to Innovation in building Energy efficiency technologies - EMILIE);
- Kontekstualizacija rabe energije za podporo varčevanju z energijo in trgovanju z izpusti v industriji (Context

sensitive monitoring of energy consumption to support energy savings and emissions trading in industry - LifeSaver);

- Krepitev energetske učinkovitost v MSP (Central Environmental and Energy Management as a kit for survival – CEEM);
- Optimizacija delovanja energetskih sistemov in vedenja uporabnikov v obstoječih nestanovanjskih stavbah s poudarkom na zdravstvenem sektorju, univerzah in pisarniških stavbah (Re-Commissioning);
- Razvoj eko-inovativnih in energetsko učinkovitostih izdelkov in storitev. (ECOFUNDING).

4. TEHNOLOŠKI IN SOCIALNI IZZIVI

V naslednjih letih je pričakovati pospešen prehod iz obstoječega pasivnega v novo, aktivno distribucijsko omrežje, ki bo z informacijsko in komunikacijsko tehnologijo omogočilo povezave odjemalcev, dobaviteljev in proizvajalcev ter razvoj novih storitev, namenjenih zlasti optimizaciji stroškov, povečanju zanesljivosti in zmanjšanju okoljskih vplivov pri ravnanju z energijo.

Razvoj izrabe obnovljivih virov energije bo usmerjen zlasti v nižanje stroškov za proizvodnjo teh tehnologij in povečevanje njihovih izkoristkov. Na znižanje stroškov bo vplivala zlasti ekonomija obsega pri proizvodnji naprav ob povečanem povpraševanju po teh tehnologijah. Velik prodor razpršenih, od vremenskih razmer odvisnih tehnologij, bo zahteval sočasen razvoj in nadgradnjo upravljanja omrežij v aktivna omrežja, vključno z optimizacijo proizvodnje električne energije [1].

V okviru razvoja trajnostne mestne infrastrukture je potrebno sisteme za oskrbo z energijo in vodo, kanalizacijo ter druga omrežja pravočasno izboljšati in prilagoditi spreminjajočim se potrebam, s ciljem doseganja čim večje gospodarske učinkovitosti njihovega delovanja in posledično višje kakovosti mestnega življenja. Temeljni predpogoj za trajnostno energetsko oskrbo mest sta energetska učinkovitost in ekonomična raba naravnih virov [2].

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Napredni nanosenzorji vlage in kisika za pametna mesta / Humidity and oxygen nanosensors for applications in smart cities

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POVZETEK

Nanosenzorji vlage in kisika imajo pomemben vpliv na kakovost življenja, zaradi miniaturnosti, ekonomičnosti in prijaznosti izdelka do okolja (majhna količina odpadnega materiala in okolju prijazni materiali). Procesiranje nanosenzorjev vlage in nanosenzorjev kisika, ki lahko delujejo v zahtevnih in zaostrenih pogojih v okolju, je zelo pomembno zaradi njihove oblike in končne teže. Omenjeni senzorji imajo tudi zelo zaželeno visoko stabilnost, ponovljivost in hiter odziv.

ABSTRACT

Humidity and oxygen nanosensors have a significant impact on the quality of life, due to their miniaturization and economy and last but not least the use of environmentally user-friendly materials (reducing the pollution by a small amount of waste material and use of ecologically-friendly materials). Processing of humidity and oxygen nanosize sensors that can operate under severe environmental conditions is of great relevance due to their small size and small weight. These sensors also possess high stability, fast response times and reproducibility.

1. INTRODUCTION

Our contribution focuses on gas-sensing device formation of one-dimensional (1D) metal oxide materials such as $BaTiO_3$ and Fe doped $SrTiO_3$ nanostructures.[1-3] The final products are humidity and oxygen nano-sized gas-sensing devices. Processing of humidity and oxygen nanosize sensors that can operate under severe environmental conditions is of great relevance due to their small size and small weight. These sensors also possess high stability, fast response times and reproducibility. Furthermore, gas sensor properties are not only interesting in terms of device applications, but also pave the way to study in deep ionic and electronic conduction mechanisms in individual nanorod-based devices.

Direct impact of our product is in their applicability and usefulness. The development of humidity and oxygen nanosensors will lead to the valuable technological know-how which is strategic intellectual property. A working prototype device will be a product which can be directly used in various types of industries and smart cities. There will be a possibility for the cooperation with a variety of Slovenian companies such as EUROMIX Ltd., Bosch Rexroth AG, Cinkarna and others. The humidity or oxygen nanosensor prototypes will be also suitable for their integration into devices for consumer products. In the frame of the proposed research we will bring the development stage of the product to the point where it will be possible to transfer it into technology. Humidity and oxygen nanosensors will also have a significant impact on the quality of life, due to their miniaturization and economy and last but not least the use of environmentally user-friendly materials (reducing the pollution by a small amount of waste material and use of ecologically-friendly materials).

2. RESULTS

The main objectives are synthesis of 1D metal oxide nanomaterials via template-assisted sol-gel electrophoretic deposition (EPD) and their integration into simple and complex circuit devices. The synthesized 1D nanostructures will possess the form of nanorods and/or nanotubes with defined chemical composition, crystal structure and morphology that will enable their use in technologically applications. First step is the optimization of the processing parameters for the most efficient EPD of stoichiometric sols into the pores of the templates in order to obtain 1D $BaTiO_3$ and Fe doped $SrTiO_3$ nanostructures with the highly uniform morphology.[1,2] To characterize the produced nanostructures various analytical techniques (especially electron microscopy techniques) will be used. The aim is to monitor the produced nanorods and nanotubes processing parameters, as well as to determine their structure and chemical composition on the micro, nano and atomic scales.

In order to investigate their potential use for proof-of-concept nanosensors, Focused Ion Beam (FIB) nanolithography will be used to construct prototype devices made of a single nanorod or nanotube which will be further introduced to measure their electrical properties and responses under different environmental conditions. Single $BaTiO_3$ nanorods will be tested for humidity nanosensors, while single Fe-doped $SrTiO_3$ nanotubes will be tested for oxygen nanosensors.[4]

Figure 1 shows an example of $BaTiO_3$ nanorod integrated into simple circuit architecture and the electrical characterization of the prototype device. Four-probe electrical measurements performed on individual $BaTiO_3$ nanorods revealed the resistivity values between 10 and 100 ohm·cm, which corresponds to typical values for oxygen-deficient $BaTiO_3$. The measurements of electrical resistivity of single nanorods in varying humidity environment showed reproducible response, thus demonstrating that $BaTiO_3$ nanorods can be integrated in more complex circuit architectures with functional capacities of a humidity nano-sensor.

3. FIGURES/CAPTIONS

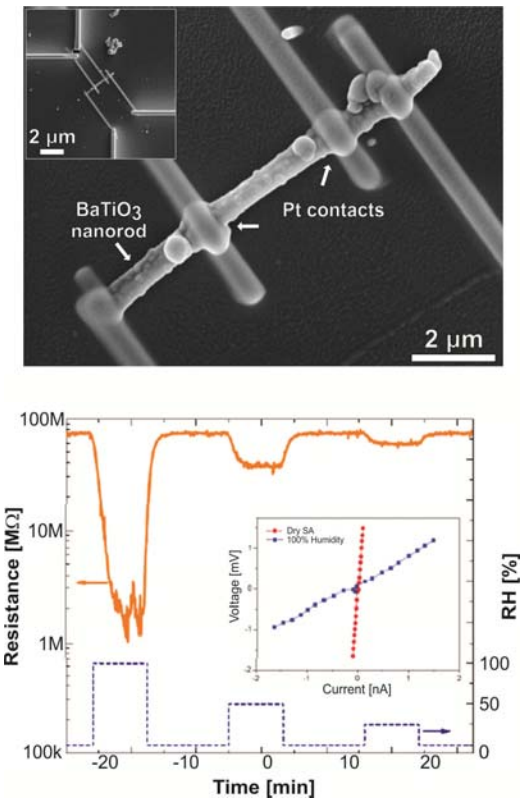

Figure 1. Top image: $BaTiO_3$ nanorod electrically contacted in 4-probe configuration using FIB lithography. Bottom image: Sensing response of a $BaTiO_3$ nanorod towards pulses of 100, 50 and 25 % of relative humidity (RH) measured at room temperature. Synthetic air was used herein as carrier gas. The inset shows I-V curves obtained in dry and humid (100 % RH) air. A sharp and reversible modulation of the electrical response was observed.

4. ACKNOWLEDGMENTS

The research was also supported by the European Union Seventh Framework Programme [FP7/2007-2013] under grant agreement n°312483 (ESTEEM2).

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Okolju prijazne tehnološke aplikacije na osnovi TiO_2 / Environmentally friendly TiO_2-based technological applications

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POVZETEK

Titanov dioksid (TiO_2) v obliki nanostruktur/nanodelcev izkazuje zanimive fizikalne lastnosti, ki so posledica velikega razmerja površina/volumen, velike specifične površine, kristalne strukture in/ali modificirane kemijske sestave. Zaradi tega je možna uporaba TiO_2 nanostruktur/nanodelcev v številnih tehnoloških aplikacijah, ki so potencialno vezane na razvoj okolju prijaznega delovanja. V prispevku so predstavljene tri aplikacije s stopnjo TRL4 na osnovi TiO_2 nanocevk in sicer fotokatalitski reaktor, merilec celokupne potrebe po kisiku (KPK) in upogljivo DSPEC sončno celico.

ABSTRACT

Titanium dioxide (TiO_2) in the form of nanostructures/nanoparticles exhibits interesting physical properties that are a consequence of a large surface/volume ratio, large specific surface area, crystal structure and/or modified chemical composition. This is what enables TiO_2 to be used in many technological applications potentially oriented to clean environment as well. In our contribution we describe the following three applications (TRL4 level) based on TiO_2 nanotubes: photocatalytic reactor, COD measuring device and flexible DSPEC solar cells.

1. UVOD

Fotokataliza je eden izmed najbolj obetavnih naprednih oksidacijskih procesov (AOP - Advanced Oxidation Process), kjer se med fotokatalitsko reakcijo organske snovi razgradijo do ogljikovega dioksida, vode in anorganskih ionov brez uporabe nevarnih kemikalij [1]. Za uspešnost fotokatalitske reakcije so ključne fotokatalitske lastnosti aktivnega polprevodnika, ki s pomočjo UV ali vidne svetlobe razgrajuje organske nečistoče v vodi in/ali zraku. Kot eden izmed najbolj uporabljanih in preiskovanih fotokatalitskih materialov je tudi titanatov dioksid (TiO_2), ki je zaradi svoje relativno nizke cene, visoke fotokatalitske aktivnosti in inertnosti najpogosteje uporabljen material v fotokatalitskih reaktorjih, izkazuje pa tudi visoko stopnjo hidrofilnosti [2]. V fotokatalitskih reaktorjih na osnovi TiO_2 se ta praviloma uporablja v obliki suspendiranih nanodelcev. Po končani reakciji je potrebno iz suspenzije odstraniti TiO_2 nanodelce, kar postopek razgradnje organskih snovi pri procesu čiščenja vode močno podraži. Še bolj problematično pa je, da je skoraj nemogoče odstraniti vse nanometrske delce TiO_2 iz vode po končanem čiščenju. Tudi če se namesto suspendiranih TiO_2 delcev uporabljajo premazi, ki vsebujejo nanodelce TiO_2, je skoraj nemogoče preprečiti njihovo izpiranje in s tem izločevanje v tekoči medij. Vse to predstavlja v praksi ne samo velik ekološki problem, ampak tudi omejuje uporabo tovrstnega postopka čiščenja odpadnih vod. Rešitev tovrstnega problema je potemtakem uporaba fotokatalitskih reaktorjev, v katerih je TiO_2 trdno vezan na nosilec. V okviru naših raziskav smo zato razvili dve tehnološki aplikaciji, ki temeljita na fotokatalitskih lastnostih TiO_2 nanocevk, ki so trdno vezane na kovinsko podlago in ki smo jih sintetizirali z metodo anodne oksidacije titana.

Fotovoltaika je v vseh naprednih ekonomijah pomembno področje, v katerega se vlagajo velika sredstva. Osnovni namen in cilji raziskovalno-razvojnega dela na tem področju je doseči večji delež alternativnih virov energije v primerjavi s klasičnimi viri energije pri proizvodnji razpoložljive energije. Največ raziskav v fotovoltaiki je bilo do sedaj namenjenih razvoju sončnih celic na osnovi polprevodniškega silicija, vendar se razvijajo in uporabljajo tudi drugi materiali, kot npr. TiO_2, ki je postal osrednji material za uporabo v tako imenovanih DSPEC fotoelektrokemijskih (dye-sensitized photoelectrochemical cells – DSPEC) celicah, ki temeljijo na uporabi fotoelektrode z visoko-poroznim TiO_2 filmom, na katero se nanese fotoaktivno barvilo ter doda elektrolit. Za DSPEC celice je značilno, da fotoaktivno barvilo zajema vpadno svetlobo in jo prevede v usmerjen tok vzbujenih elektronov, ki se preko TiO_2 porozne mreže nanodelcev, ki imajo vlogo prenašalcev elektronov, prenesejo na zunanji porabnik, kjer opravijo električno delo ter preko elektrolita povrnejo nazaj na fotoaktivno barvilo. Trdne DSPEC fotoelektrokemijske celice so že pokazale izkoristke nad 10%. Zaradi relativno enostavne sestave (nanokristaliničen TiO_2 na trdni elektrodi, elektrolit, Pt protielektroda) in razmeroma nezahtevne tehnologije (sitotisk) za njihovo proizvodnjo, so DSPEC celice potencialno najbolj primerne za tehnološko eksploatacijo, še posebno v primeru izvedbe fleksibilnih DSPEC celic. V okviru naših raziskav pa smo izdelali DSPEC sončno celico na osnovi fotoanode, ki je bila narejena iz TiO_2 nanocevk.

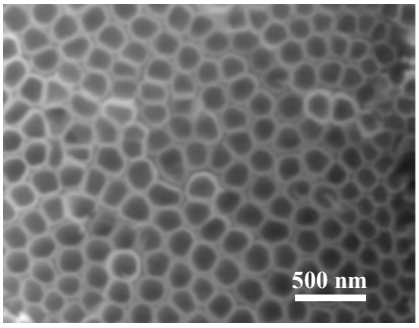
2. REZULTATI

2.1. Fotokatalitski reaktor

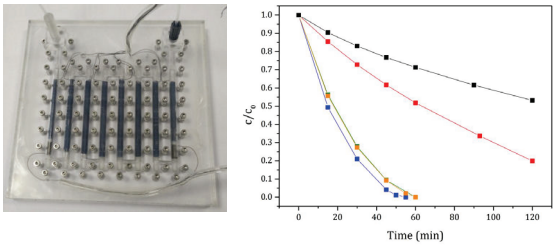
Fotokataliza je eden izmed najbolj obetavnih naprednih oksidacijskih procesov, kjer se med fotokatalitsko reakcijo organske snovi razgradijo do ogljikovega dioksida, vode in anorganskih ionov brez uporabe nevarnih kemikalij. V primeru, da so v vodi prisotne škodljive bakterije (legionela, itd.) pa ima fotokatalitsko čiščenje vod tudi biocidni učinek. Za uspešnost

fotokatalitske reakcije so ključne fotokatalitske lastnosti aktivnega polprevodnika, ki s pomočjo UV ali vidne svetlobe razgrajuje organske snovi v vodi in/ali zraku. V fotokatalitskih reaktorjih se zaradi svoje relativno nizke cene, visoke fotokatalitske aktivnosti in inertnosti najpogosteje uporablja titanov dioksid (TiO_2). V zvezi s tem smo razvili nov tip fotokatalitskega reaktorja, ki smo ga tudi patentirali, in v katerem je TiO_2 trdno vezan na nosilec, kar smo dosegli s postopkom anodne oksidacije različnih oblik kovinskega titana. Naši fotokatalitski reaktorji imajo zelo velik izkoristek razgradnje organskih snovi v vodi in veliko stopnjo biocidnosti in kot taki predstavljajo pomemben doprinos pri odstranjevanju neželenih in potencialno škodljivih organskih kemikalij in bakterij iz vode. Načrtujemo tudi izvede fotokatalitskih reaktorjev, ki bodo omogočali odstranjevanje organskih molekul iz zraka in bodo kot taki vgrajeni v klimatske naprave v prostorih.

Stopnja tehnološke izvedbe: TRL4
Tehnologija: Dostopna na IJS, K7



Slika 1. Površina poroznih TiO_2 nanocevk, ki jih uporabljamo v fotokatalitskih reaktorjih.



Slika 2. (a) Fotokatalitski (mikro)reaktor na osnovi TiO_2 nanocevk. (b) Primer poteka časovne razgradnje kafeina v odvisnosti od napetosti med anodo in katodo.

2.2. Merilec kemične potrebe po kisiku (KPK)

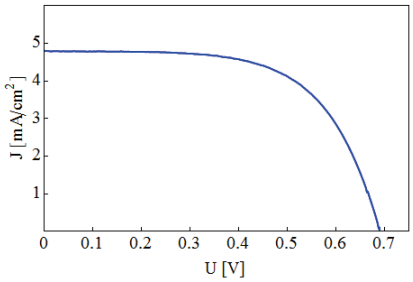
Kemična potreba po kisiku (KPK) je množina kisika, ki je potrebna za kemijsko oksidacijo organskih snovi prisotnih v odpadni vodi. Za določevanje KPK lahko uporabimo različne metode, ki se razlikujejo predvsem po vrsti uporabljenega oksidanta. Največ se uporabljata kalijev dikromat ($K_2Cr_2O_7$) in žveplena kislina (H_2SO_4). Postopek traja več ur pri povišani temperaturi in je zaradi uporabe dragih, korozivnih in strupenih kemikalij neprijazen do okolja. Zaradi tega smo razvili postopek za določevanje KPK, ki temelji na določevanju KPK z uporabo fotokatalitskega senzorja na osnovi (TiO_2) nanocevk. Velika prednost nove metode je v tem, da senzorja ni potrebno umerjati ter da poteka proces brez uporabe kemikalij. Fotoelektrokemični sistem za določevanje KPK smo sestavili iz treh elektrod, pri čemer je anoda, na kateri poteka oksidacija organskih snovi iz TiO_2 nanocevk, ki smo jih sintetizirali z metodo anodne oksidacije. Metoda je hitra in omogoča analizo zelo majhnih volumnov vode. Zaradi tega je zelo primerna za analizo na terenu.

Stopnja tehnološke izvedbe: TRL4
Tehnologija: Dostopna na IJS, K7

2.3. Upogljiva DSPEC sončna celica

Nanocevke TiO_2 s kristalno strukturo anatasa smo uporabili kot fotoanode v t.i. DSPEC sončnih celicah, ki delujejo na osnovi pretvorbe sončne energije v električno z absorpcijo vidnega dela spektra s foto-občutljivim barvilom, ki je nanesen na tanko plast poroznega filma dvo-dimenzionalno urejenih TiO_2 nanocevk. Glede na to, da je TiO_2 razmeroma poceni in ekološko nesporen, predstavljajo upogljive DSPEC sončne celice na osnovi TiO_2 v prihodnje predstavljajo enega pomembnih virov alternativne energije. V zvezi s tem, smo razvili in osvojili postopek sinteze TiO_2 fotoanod z metodo anodne oksidacije titanovih folij in sestavili upogljive DSPEC sončne celice, ki so imele izkoristke pretvorbe v električno energijo pod standardiziranim izvorom svetlobe okoli 6%. Pri navedenih upogljivih DSPEC sončnih celicah je pomembno, da jih lahko nanesemo na neravne površine.

Stopnja tehnološke izvedbe: TRL4
Tehnologija: Dostopna na IJS, K7



Slika 3. (a) Merjena tokovno-napetostna karakteristika sestavljene upogljive DSPEC sončne celice.

Tabela I. Osnovni parametri upogljive sončne celice.

V_{OC} [V]	J_{SC} [mA/cm^2]	FF	R at V_{OC} [Ω]
0.69	4.79	62.19	25

3. ZAHVALA

European Union Seventh Framework Programme [FP7/2007-2013] under grant agreement n°312483 (ESTEEM2).

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Električna vozila in vetrne elektrarne / Electric cars and Wind turbines

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POVZETEK

Na področju trajno magnetnih materialov za visokoenergijske aplikacije kot so motorji za električna vozila in vetrne elektrarne ima skupina strokovnjakov na IJS, Odsek za Nanostrukturne materiale, dolgoletne in bogate izkušnje kar dokazuje, da avtorica prispevka koordinira evropski projekt na to temo v vrednosti 4 mio EUR. Za električna in hibridna vozila ter vetrne elektrarne so primerni le trajni magneti z najvišjimi do sedaj doseženimi energijskimi produkti, kar pa je mogoče doseči le z osnovno sestavo magnetnega materiala, ki vsebuje do 11 ut.% težke redke zemlje (Dy, Tb), ki je na lestvici kritičnih surovin na samem vrhu. Z inovativnim postopkom izdelave smo na IJS to vrednost zmanjšali na 0.6 ut% kar je izjemen dosežek in velik finančni prihranek. Male vetrne turbine ob hiši ali v naselju bi pomenile ogromen prispevek k prihranku energije in čistemu okolju. V shemi PaMetSkup sodi ideja v poglavje Učinkovita energetska in komunalna oskrba **TP E (E.2).** Razvoj in vpeljevanje čistih transportnih sredstev to je električnih/hibridnih vozil pa sodi v poglavje Mobilnost in dostopnost **TP M (M.3).**

ABSTRACT

The group of experts at Jožef Stefan Institute, the Department for Nanostructured materials has many years' experience in the field of permanent magnets for high energy applications such as electric vehicles and wind turbines. The author of this contribution is the Coordinator of 4 mio EUR European project on this subject. For electric vehicles and wind turbines only the magnets with highest energy products are appropriate and this is enabled with the addition of 11 wt.% of heavy rare earth (Dy, Tb), which are on the top of the list of critical raw materials (published by EC in 2014). With highly innovative process we decreased the amount of heavy rare earth to 0.6 wt. % for better performances and substantial savings on critical raw materials. Small wind turbines next to the smart house or in a small smart settlement would bring renewable energy and contribute to the environment TP E(E.2), Electric/hybrid vehicles would contribute to clean transportation in smart cities.

1. INTRODUCTION

The basic idea of the proposed project is focused on acquiring of clean energy with micro VAWT turbines (self-supply of small cottages, individual houses or small settlements) and silent and ecological transport in cities and settlements. The trend of electric cars is exponentially growing, but Slovenia as a European country is in using the electric or hybrid vehicles as well as wind turbines well behind the other European countries (Germany, France, Austria etc.). Natural conditions in Slovenia are favorable for the wind turbines, but also the development in the direction of electric vehicles is inevitable.

The main idea of the proposed project is to be involved in the frame of the initiative PaMetSkup (Smart houses and Smart cities) and contribute in the direction towards **clean and cheap energy**. The basic components of electric motors (for electric vehicle and wind turbine) are high energy permanent magnets for which Slovenia has two producers: Kolektor Group d.o.o. and Magneti d.o.o. Ljubljana. Since the Department of Nanostructured materials has developed a new, much cheaper technology for production of high energy Nd-Fe-B magnets with 25 times lower content of critical raw material - heavy rare earth and put it into the pilot production of a factory in Germany (**TRL6**) we could easily do the same in Slovenia with Slovenian companies. The other important aspect is that Slovenian factory Iskra Zaščite developed a special protective element for wind turbines (**TRL6**) (protection against the lightening), which gives the added value to the producers of turbines. With the partnership of two other European companies, which of course would not be financed form Slovenian resources, but would participate with their own funds (e.g. Enercon GmbH for turbines and Valeo for cars) we could built a successful partnership in the production chain of small wind turbines (VAWT) and electric cars with high added financial and ecological value.

2. PROJECT BACKGROUND

Department of nanostructured materials at Jožef Stefan Institute has many years' experience in the field of permanent magnets for high energy applications and is currently involved in 5 European projects on renewable energy and mobility, two of which we coordinate:

ROMEO (Replacement and Original Magnet Engineering Options) (S. Kobe)
(http://www.romeo-fp7.eu/romeo.htm)

MAG-DRIVE (New Permanent Magnets for Electric- Vehicle drive application) (M. Komelj)
(http://mag-drive-fp7.eu/)

NANOPYME (Nanocrystalline Permanent Magnets Based on Hybrid Metal- Ferrites)
(http://nanopyme-project.eu/)

REProMag (Resource Efficient Production of Magnets)
(http://www.repromag-project.eu/)

DEMETER (Training Network for the Design Recycling of Rare-Earth Permanent Magnet Motors and Generators in Hybrid and Full Electric Vehicles) (http://etn-demeter.eu)

In the existing European projects we attracted two Slovenian industrial partners: Kolektor Group d.o.o. and Magneti Ljubljana d.o.o. The ROMEO project involves besides Slovenian company Kolektor Group d.o.o., also 3 industrial partners from Germany (Siemens, Daimler, and Vacuumschmelze) and 1 form France (Valeo). Kolektor and Vacuumschmelze are producers of permeant magnets based on rare earths; Valeo and Daimler are producers of motors and electric cars, Siemens is involved as the end-user for wind turbines.

Experts at Jožef Stefan Institute together with our Slovene industrial partners are highly qualified to produce magnets as the first link of the value chain. We have close connections with the end-users for electric cars and wind turbines outside Slovenia, but in the proposed initiative we are planning to attract a Slovenian or reginal partner for the wind turbines production. For the electric vehicle we have partner from France (Valeo), which already expressed interest.

3. PROJECT IDEA

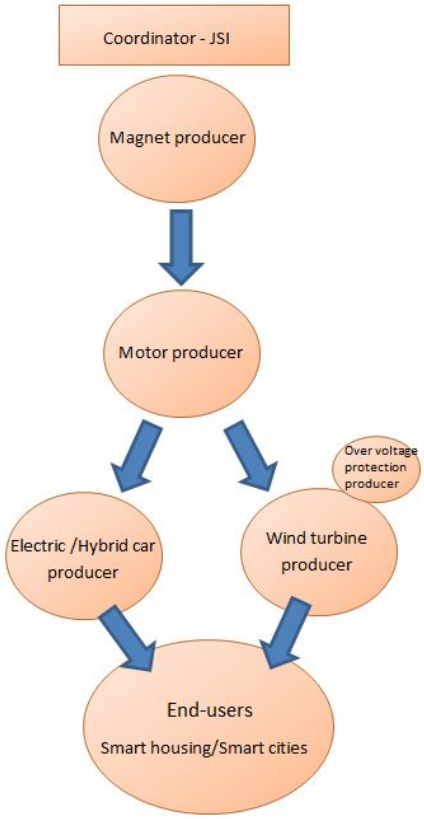

Figure 1. Schematic view of the project structure.

Magnets production: Kolektor Group d.o.o.,
Motors production: Letrika d.o.o.
Over-voltage protection producers: Varsi d.o.o., Iskra Zaščite d.o.o.
Electric car / Hybrid car producer: Valeo France
Wind Turbine producer: if not in the region, Enercon GmbH

4. ACKNOWLEDGMENTS

The European Commission is acknowledged for the financial support in the frame of FP7-NMP-2012-SMALL-6 Grant No.: 309729

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Visoko učinkovita magnetna toplotna črpalka za klimatiziranje nizko energijskih stavb / High efficient magnetic heat pump for air conditioning of low-energy buildings

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POVZETEK

Naš cilj je razvoj magnetne toplotne črpalke za gretje, prezračevanje in hlajenje stavb. Magnetna toplotna črpalka deluje na principu magnetokaloričnega efekta, ki omogoča 30 % boljšo učinkovitost kot toplotne črpalke s kompresorji. Da to dosežemo bomo razvili magnetokaloričen kompozitni material, ki bo vgrajen v novo razvito magnetno toplotno črpalko z novo razvitim regeneratorjem in izvora magnetnega polja. S tem bi dosegli boljš energijsko učinkovitost nizko energijskih hiš.

ABSTRACT

Our goal is to develop a magnetic heat pump for the heating, ventilation, and air conditioning (HVAC) systems of buildings. The magnetic heat pump uses the magnetocaloric effect, making it 30% more efficient than compressor based heat pumps. To do this we will develop the magnetocaloric composites material that will be used in a newly constructed magnetic heat pump with a special focus on regenerator design and the magnetic field source. This would lead to a more efficient energy use in low-energy buildings.

1. INTRODUCTION / UVOD

There are several different technologies available today to meet the refrigeration and cooling demand resulting from increased living comfort and substantial number of energy sources that we apply in our daily life. Most of them are based on vapour compression of gas refrigerants, characterised not only by the low exergy efficiency (e.g. between 20% for small devices to maximum 60% for large scale, optimized devices) [1], but also by the use of either environmentally harmful refrigerants (CFCs, HCFCs) or different, also harmful substitutes (FCs and HFCs). The use of alternatives like CO2, highly purified propane, Hydrofluoro-olefin, HFO-1234yf [2], Ammonia (R744), etc. solves the problem of ODP (ozone depletion potential) and GWP (global warming potential), but leads sometimes to lower energy efficiency [2] and problems related to very high pressures, flammability, explosion hazards, etc.

Today's arguably most promising alternative, [3], especially for small scale refrigerators or heat pumps with the cooling or heating power up to 5 kW, is the magnetic refrigeration. This technology applies the magnetocaloric effect (MCE), similar as gas refrigeration is based on the compressibility of a refrigerant (Figure 1). [4]

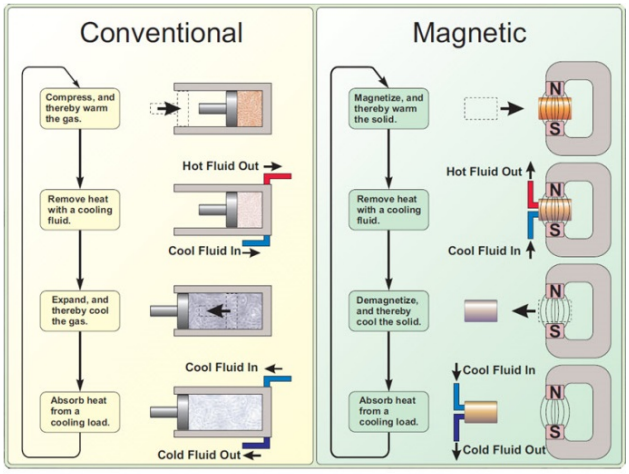

Figure 1 Comparison of a vapor compressor and a magnetic refrigerator

The magnetocaloric materials have GWP (Global Warming Potential) and ODP (Ozone Depletion Potential) potentials equal to zero. Analogue to vapour compression and expansion are the processes of the magnetization and the demagnetization. The last two processes are reversible. Therefore the energy efficiency of a magnetic refrigerator may be up to 30% higher than that of conventional technologies. Furthermore the operation of magnetocaloric devices is silent and without vibrations.

Today's MC heat pumps suffer from low manufacturability of magnetocaloric material, low power density, and the high cost of rare earth magnetic materials. The low manufacturability can be resolved by introducing new techniques of producing magnetocaloric materials, like melt spinning, spark plasma sintering and the production of composites, that will produce dimensions and properties, both magnetocaloric and mechanical, to fulfil the requirements needed to produce a stable and efficient magnetic heat pump with a temperature range between -20 °C and 40 °C. To achieve faster and more efficient heat transfer we would develop devices which are based on thermal diodes with embodied magnetocaloric materials. The thermal diode is a thermal switch or »heat semiconductor«, which can manipulate the direction of the heat flow. This would be totally new approach

on the magnetocaloric energy convection, which has not been used up to date. To reduce the cost of the magnetic material used to magnetize the magnetocaloric material, one can substitute Nd-Fe-B magnets with AlNiCo magnets and use different design principles of the magnetic field source to achieve magnetic fields by rotating only certain parts to avoid the rotation of large masses. All the suggested new technologies will be tested in a prototype assembly in cooperation with the Faculty of Mechanical Engineering, which will generate 2 kW of cooling or 3 kW of heating power, in order to experimentally prove the market potential of such a device.

According to the Reportbuyer.com the global heat pumps market is estimated at 58.3 million units in 2013 and forecasted to grow at a 2014-20 with the rate of 10.6%. The heat pumps market worldwide is further projected to reach 116.9 million units by 2020. There is a strong interest in this technology by different Slovenian manufacturers of heat pumps (e.g. Termo-Tehnika d.o.o.), household refrigerators and freezers (e.g. Gorenje d.d.), as well as the manufacturers of air conditioning systems (e.g. Kolektor d.o.o.). These represent a broad variety of different products which could be enhanced with magnetocaloric energy conversion. Furthermore these products will have of high added value because they will be characterized by high efficiency, environmentally friendly operation and components, and silent operation. Additionally they will provide a better energy efficiency of buildings, which would help them being energy independent.

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Večfunkcionalne (nano)naprave za detekcijo in odstranjevanje patogenov iz bivalnih okolij

Multifunctional nanodevices for detection, elimination and killing of pathogens from living enviroments

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ABSTRACT

We propose to use multifunctional nanotube/nanowire-based arrays composed of magnetic and optic segments to detect, eliminate and kill pathogens from liquid environments. The combination of experiments including synthesis, detection, capture and killing of pathogens will lead to a versatile microfluidic lab-on-chip device to be used for purifying liquid/air environments in collaboration with Institute for Environmental Protection and Sensors Ltd.

Za namene zazanavanja in eliminacije patogenih organizmov iz zraka in vode, ponujamo izdelavo bioreceptorskih elementov za senzorje. Nadgradjo v senzorske sisteme bomo vršili v sodelavi z Institutom za Okoljevarstvo in Senzorje d.o.o.

1. INTRODUCTION / UVOD

Enodimenzionalne magnetne nanostrukture, t.j. magnetne nanodelce ali nanožičke, lahko aktiviramo in manipuliramo na daljavo z uporabo nizkih zunanjih magnetnih polj, pri čemer je mogoče njihovo velikost in obliko natančno eksperimentalno določiti in nadzorovati v razponu od nekaj nm do nekaj sto nm. **V tem velikostnem razredu pa so tudi biološki subjekti kot so: celice, bakterije, virusi, encimi, geni ali celičnimi receptorji, zato so magnetne nanožičke za primerne za uporabo v senzorskih tehnologijah ter za eliminacijo patogenov (bakterij, virusov) iz različnih okolij uporabno tako za gospodinjstva kot nadalje za izobraževalno in infrastrukturo, šole, vrtci, domovi za upokojence, bolnišnice itd.**

Tu vidimo tudi prednost uporabe hibridnih magneto-plazmnonskih nanostrukturiranim materialov katere razvijajmo na Oseku za Nanostrukturne materiale, za uporabo v aspektu pametnih mest in pametnih skupnosti z vizijo razvoja občutljiv senzorskih naprav, ki bodo hkrati detektirale, kot tudi eliminirale možne patogene iz življenskih okolij: voda, zrak. Prednost uporabe nanomaterialov je v njihovi specifični zgradbi iz katere izhajajo posebne fizikalne in kemijske lastnosti, ki nadalje omogočajo izboljšanje karakteristike naprav v občutljivosti detekcije in učinkovitosti eliminacije.

Tematika se umešča v Strategijo PAMETSKUP, in sicer v Tehnološka področja.

Podporne odprte tehnologije in aktivnosti: T.1 Novi senzorski materiali ter v Javni prostori in participativnost: J.4 Spremljanje parametrov kakovosti bivanja.

Reference s področja uporabe hibridnih nanostruktur:

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2. PROPOSED PROJECT IDEA

The interest in functional materials of the order 1-100 nm is associated with their novel physical and chemical properties and their potential for introducing highly innovative and marketable technologies with major applications in health, diagnostics and therapies, environmental, information and communication, engineering, energy, electronics, chemical and living environment industries among others.

By exhibiting large aspect ratios and quasi-one-dimensional features nanowires and nanotubes can be built into light weight and portable but still high-density devices, with optical, optoelectronic, electric and magnetic properties diverging from bulk counterparts, due to quantum confinement and thermal effects. While optical properties were found to be particle size and shape dependent, the superparamagnetic limit has been recognized to depend on the systems crystal anisotropy, which can be overcame by induced anisotropy coming from nanomaterial's shape. This translates that the optical and magnetic properties of nanowires/nanotubes can be customized by controlling their morphology and size. The optical part finds applications in bio sensing since it is known that so called hot-spots, which are represented by localized regions formed within the interstitial cavities in metallic nanostructures, provide extraordinary enhancements (of up to 1015) of signals due to surface enhanced Raman scattering (SERS) [2] which results in very small detection limits; and furthermore in phototherapies where pathogens' killing is triggered with light-to-heat energy conversion at visible or near infrared wavelength.

Proposed bottom up synthesis approach via electrochemical or chemical reduction offers broad flexibility regarding the nanowires' or/and nanotubes' material and surface functionalization; before assembly on the chip surface. However, the ability to magnetically manipulate and extract such structures makes them appealing and well suited for controlled assemblies of multifunctional nanostructures for complex networks for sensor devices. The length of each nanotube/nanowire segment can be controlled the synthesis parameters, with further functionalization being dependant on the chemical affinity between the metallic parts and the targets/pathogens used. For instance, Au, Ag, Cu, Hg and Fe are known to have strong affinity with the thiol groups, Pt and Pd on the other hand have strong affinity with the cyanides and metal oxides bonds with the carboxylic group as well as oligonucleotides or antibodies therefore they are well suited as sensors for multicomplexed assays. By combining two entities in a single nanosystem composed of optically active Ag and Au segments aiming at hot spots, which will be realized via selective etching for enhanced sensitivity and photoinduced therapy; with Fe-based alloys enabling the magnetic manipulation, we are going to construct a multifunctional detection-, extraction- and killing-based nanodevice founded on the model system of a pathogenic bacteria E. coli in collaboration with Seoul National University, Mechanical and Aero space engineering, Department Member, Seoul, South Korea. The bacterial detection and capture experiments will be performed by multifunctional nanotubes/nanowires functionalized with carboxylic groups on which NH2 modified anti- E.coli aptamer will be bound which will be proved by using SERS and extracted from the system using the means of external magnetic fields which will be followed by a subsequent bacteria killing triggered via light induced heating in the visible or near infrared spectra.

3. REFERENCES

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Platforma za sodobno raziskovalno umetnost (BLACK BOX) – Ustvarjalnost, znanost in tehnologije pred izzivi pametnih mest in družbe prihodnosti / Contemporary Investigative Arts Platform (BLACK BOX) – Creativity, Science and Technologies confronting challenges of the Smart Cities and the Future Society

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POVZETEK

V tem prispevku opisujemo vizijo in poslanstvo Platforme za sodobno raziskovalno umetnost, obstoječe in načrtovane aktivnosti ter reference, s katerimi se umeščamo na področje pametnih mest in skupnosti.

Vloga Platforme za sodobno raziskovalno umetnost je, da navdihuje znanstvenike, spodbuja industrijo in omogoči razvoj umetnosti. Razvojno sodelovanje bo prispevalo k razvojno naravnani, napredni družbi, ki bo omogočala posameznikom, da živijo polno ustvarjalno in do novosti strpno življenje. Le taka družba je namreč lahko enakopraven sogovornik in partner pri nastajanju in organiziranju mednarodnih dogovorov o tem, kako bomo pametno navigirali med nevarnostmi, izzivi in vizijami prihodnosti.

Pomemben del je tudi delo z mladimi in izobraževalna dejavnost. Mladi bodo v okolju in pogojih, ki jih omogoča Platforma za sodobno raziskovalno umetnost z raziskovalnim učenjem sledili dinamiki razvoja sodobne znanosti, tehnologijam in umetnosti in razvijali potrebno zavest in sposobnosti razumevanja ter reflektiranja dinamik sodobne družbe in družbe prihodnosti.

ABSTRACT

In this contribution we describe the vision of the Platform for Contemporary Investigative Arts (Black Box), as well as running and planned activities and references, in the area of smart cities and communities.

The main objectives of the 'Platform' are to inspire scientists, to encourage industry and to facilitate the development of the arts. Collaborative practices will contribute to the development-oriented, progressive society that allows individuals to live full creative and tolerant to new life. Only society like this is entitled to partner in the creation and organization of international agreements on how to wisely navigate the dangers, challenges and visions of the future.

Important parts of the 'Platform' are educational activities for young people. In the inspiring open learning environment young people will take part in investigative learning processes. In cooperation with artists, scientists, engineers and educators they will have the opportunity to research and make in the area of state-of-the art scientific, artistic and social knowledge as to fulfil their wildest aspirations. This will enable young people to develop the necessary awareness and the ability to understand and to reflect the contemporary society.

1. UVOD

Platforma za sodobno raziskovalno umetnost je sodobna oblika združevanja umetnikov, znanstvenikov, inženirjev in podjetnikov, ki ustvarjajo za družbo prepleteno s sodobnimi tehnologijami, materiali in ustvarjalnimi protokoli. Znanost in umetnost sta v dinamičnem razmerju že od renesanse dalje. Pri tem se v znanosti dogaja produkcija vednosti v umetnosti pa produkcija pomenov, s čimer umetniki preizprašujejo širši smisel in vrednote, ki vznikajo iz tehnologizirane družbe. Institucionalni okvir, v katerem se te različne razvojne prakse srečujejo, je t.i. sodobna raziskovalna umetnost, ki znanstvenike in inženirje navdihuje za vizionarske prispevke v ontologijo človeštva, podjetnike pa spodbuja, da z razumevanjem razmerij med človekom in tehnologijo proizvaja človeku, družbi in naravi uravnotežene rešitve.

Na podlagi, že leta 1999 spisanega, osnutka projekta se je Platforme za sodobno raziskovalno umetnost prijel vzdevek 'Black Box'. Projekt 'Black Box' predlaga konzorcij organizacij[1] s področja kulture, ki združujejo kulturno-umetniško in raziskovalno dejavnost, z dolgoletnimi izkušnjami transdisciplinarnega povezovanja in sodelovanja s številnimi mednarodno uspešnimi projekti in razvejano mrežo partnerjev,

[1] Zavod Kersnikova, KSEVT in Zavod Projekt Atol skupaj s pridruženimi sodelujočimi partnerji: C-Astral, UNIKI, Univerza v Novi Gorici, Biotehniška fakulteta UL, Inštitut za biokemijo MF UL, NIB (Nacionalni inštitut za biologijo), Inštitut za biologijo celice MF, Zavod za transfuzijsko medicino RS, Biobanka popkovnične krvi, EDUCELL podjetje za celično biologijo, European Space Research and technology Centre (ESTEC), Space University, Center za usposabljanje kozmonavtov Jurija Gagarina (GCTC), Ruska akademija znanosti, Ruski muzej, Sibirska aeronavtična univerza (SibSA)

kjer sodelujejo razvojno-raziskovalni inštituti, izobraževalne ustanove, podjetja v Sloveniji in v tujini.

2. UMEŠČANJE BLACK BOXA NA PODROČJE PAMETNIH MEST IN SKUPNOSTI

V Sloveniji imamo nekaj manjših intermedijskih organizacij (nekatere med njimi že dvajset let predstavljajo najbolj napredne umetniške produkcije), ki so nastajale v sodelovanju med umetniki, znanstveniki in podjetniki. Seznam intermedijskih produkcij vključuje številne slovenske in tuje avtorje, ki so angažirani v raziskovanju sodobne družbene stvarnosti, in za svoja orodja uporabljajo tehnološki in znanstveni repertoar ter z njimi tematizirajo eksplicitne učinke na družbo in posameznika. Pogoji delovanja teh organizacij so ves ta čas bolj kot ne zasilni, vendar z zavidljivimi rezultati (Dosežki so podrobneje predstavljeni v poglavju 3. Dosežki, produkti in storitve organizacij na področju pametnih mest).

Predlagatelji projekta, vključno s partnerji, v trenutni situaciji ne morejo zagotavljati ustreznih pogojev za trajnejša sodelovanja med kulturnimi in kreativnimi, raziskovalnimi in gospodarskimi subjekti, zato se jasno kaže potreba po vzpostavitvi nove osrednje platforme, ki bi omogočila sistemske rešitve transdisciplinarnih povezav in sodelovanj vseh udeleženih partnerjev ter spodbudila k bolj poglobljeni in prebojni izmenjavi znanj, idej in rešitev, ki bodo implementirana v pametna mesta in skupnosti.

Z ustanovitvijo osrednje platforme bi v Sloveniji omogočili primerno okolje za optimalno sodelovanje med znanstveniki, podjetniki in umetniki. Rezultati sodelovanj pa prehod na večje merilo in s tem še večja prepoznavnost v Sloveniji in mednarodnem prostoru ter še večja kapaciteta povezovanj z mednarodnimi partnerji. Na skupni platformi bi v sodelovanju z razvojno-raziskovalnimi inštituti in institucijami znanja lahko razvijali produkte za MSP in tudi večje gospodarske subjekte, ki bi na enem mestu lahko dostopali do strateško pomembnih refleksij sodobnosti in bližnje prihodnosti pametnih mest in skupnosti, za katero ustvarjajo svojo ponudbo.

3. DOSEŽKI, PRODUKTI IN STORITVE ORGANIZACIJ NA PODROČJU PAMETNIH MEST

Leta 2008 je iniciator projekta, Zavod Kersnikova v okviru Featured Art Scene pod naslovom 'Ekologija tehno uma' predstavil izbor umetniških del slovenskih in nekaj tujih avtorjev, ki so angažirani v raziskovanju sodobne družbene stvarnosti, in za svoja orodja uporabljajo tehnološki in znanstveni repertorij ter z njimi tematizirajo eksplicitne učinke na družbo in posameznika. Od takrat dalje tesno sodeluje na festivalu Ars Electronica[2], ki je svetovno najpomembnejša platforma za umetnost, tehnologijo in družbo. Kakšna bodo mesta in habitati prihodnosti, je bila osrednja tema letošnjega festivala Ars Electronica, ki je v začetku septembra potekal v Linzu. Skupaj z Ars Electronico Zavod Kersnikova sodeluje pri evropskem projektu European Digital Art & Science Network (2015-2017), ki umetnikom omogoča nekajtedensko delo z raziskovalci v dveh največjih in najpomembnejših razvojno-raziskovalnih platformah na svetu – CERNu in ESO – European Southern Observatory v Čilu.

Še pred tem je v letih med 2006 in 2010 Zavod Kersnikova vodil galerijo LJU Cosinus BRX v prostorih komisariata za znanost in raziskave v stavbi Evropske komisije v Bruslju, kjer so bili predstavljeni opusi slovenskih avtorjev, ki v svojem delu združujejo umetnost in znanost ter umetnost in tehnologije.

Zlata Nica, glavna nagrada najprestižnejšega mednarodnega tekmovanja na področju raziskovalnih umetniških praks, je bila podeljena dvema projektoma, ki sta nastala v produkciji Zavoda Kersnikova (Art Oriente Objet, 2011; Koen Vanmechelen, 2013) in projektu, ki je bil izveden v produkciji Zavoda Projekt Atol (Marko Peljhan & Carsten Nikolai, 2001). Častne omembe pa so bile dodeljene še nekaj projektom slovenskih avtorjev, nastalih v produkciji Zavoda Kersnikova (Tao G. Vrhovec Sambolec, 2010; Maja Smrekar, 2013, Saša Spačal, 2015; Špela Petrič, 2015). Posamezni projekti, ki so bili (ko)produkcijsko izvedeni v sodelovanju z znanstveno raziskovalnimi institucijami in podjetji ter predstavljeni v okviru Zavoda Kersnikova, so prejeli tudi druge mednarodne nagrade: Maja Smrekar - 1. nagrada CYNETART Festival 2012 (Hu.M.C.C. projekt, razvit v sodelovanju z Inštitutom za biokemijo, Medicinsko Fakulteto Univerze v Ljubljani); Špela Petrič - 1. nagrada BAD / Bio Art & Design Award (Naval Gazing projekt, razvit v sodelovanju z Inštitutom za biokemijo, Biobanko, AlgEn - Algae technology center, Royal Netherlands Institute for Sea Research). V okviru triletnega evropskega projekta ‘KiiCS‘ / ‘Knowledge Incubation in Innovation and Creation for Science' (www.kiics.eu), kjer je Zavod Kersnikova sodeloval kot partner, je 1. nagrado za inovativno idejo v znanosti za projekt 'Slave for Love' prejel Petja Skomina, gimnazijec iz Nove Gorice, ki jo je razvil v sodelovanju z mentorico dr. Špelo Petrič in s podporo Inštituta za biokemijo MF UL. Ideja za projekt je vzniknila po seriji delavnic, ki jih je Zavod Kersnikova pripravil za mlade z namenom, da bi k znanosti pristopili na kreativen način.

Kot nadaljevanje projekta ‘KiiCS’ je Zavod Kersnikova razvil program za otroke in mlade ‘Petkova akademija – platforma za navduševanje, raziskovanje in ustvarjanje z otroki in mladostniki, da bi bolje razumeli najsodobnejša dognanja v znanosti, umetnosti in družbi’, ki je bil na pobudo Ministrstva za izobraževanje, znanost in šport ter Ministrstva za kulturo predlagan kor primer dobre prakse v Republiki Sloveniji na področju kulturno umetnostne vzgoje in na področju dela z mladimi. Predstavnica Zavoda Kersnikova je bila imenovana kot nacionalna koordinatorka kulturno umetnostne vzgoje za področje intermedijske umetnosti. Zavod Kersnikova vodi tudi iniciativo za vzpostavitev 'Nacionalne mreže inovativnih in odprtih učnih okolij za krepitev ustvarjalnosti in izvajanje raziskovalnega učenja (Akademija brez hiše)'. Iniciativo podpira tudi iniciativa OpeningupSlovenia, ki jo je kot primer dobre prakse prepoznala Evropska komisija in vodi UNESCO katedro o odprtih tehnologijah za prosto dostopne izobraževalne vire in odprto učenje.

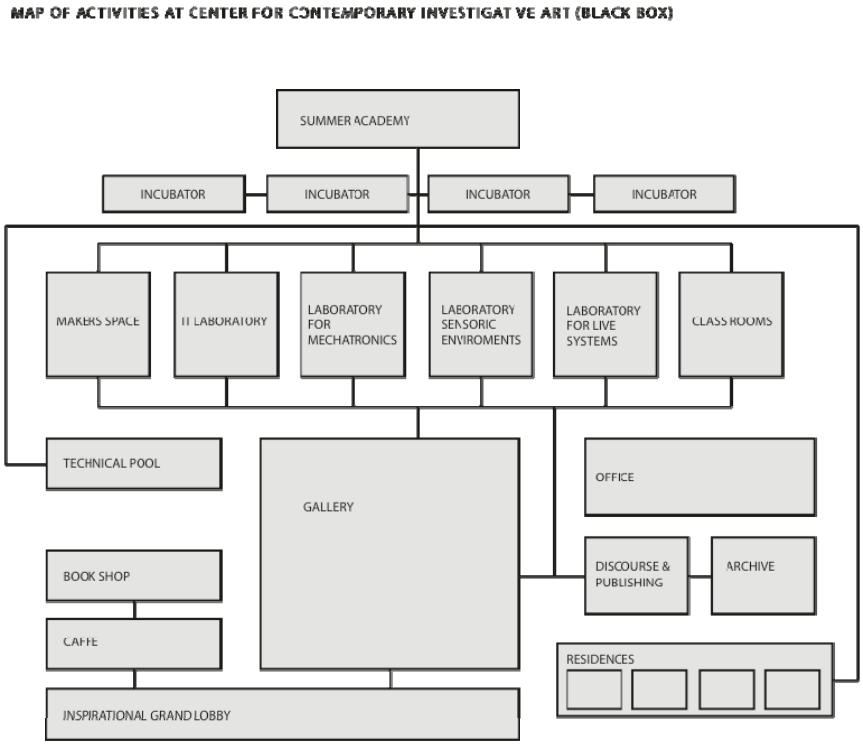
[2] Festival Ars Electronica poteka vsako leto že od 1979 dalje. Leta 1995 je mesto Linz v Avstriji ustanovilo podjetje Ars Electronica Linz GmbH, ki je odgovorno za organizacijo in izvedbo festivala ter prestižnega tekmovanja Prix Ars Electronica, kot tudi za delovanje Ars Electronica Centra in Ars Electronica Futurelab-a, kjer sodelujejo strokovnjaki z najrazličnejših področij. Znotraj Ars Electronice je vzpostavljen tudi oddelek Ars Electronica Solutions, ki je usmerjen v razvoj izdelkov in storitev za trg (npr. Merceds, Nokia …). http://www.aec.at/news/

Zavod Kersnikova, iniciator projekta, in ostali partnerji se povezujejo v močne mednarodne konzorcije (ECSITE, ECSA …) s ključnimi institucijami tako z razvojno-raziskovalnega in kulturno-umetniškega področja kot tudi z izobraževalnega in gospodarskega sektorja. Vključeni so še v druge evropske konzorcije za izvajanje projektov v okviru programov Kreativna Evropa in Obzorje 2020.

'Platforma Black Box' bi s svojo raziskovalno, produkcijsko in izobraževalno zasnovo mnogo lažje omogočala tovrstna vključevanja v velike mednarodne infrastrukture in bila strateško bolj zanimiva za ostale večje in pomembnejše mednarodne partnerje, s katerimi bi se skupaj prijavljali na razpise Obzorje 2020, ter tako vsem vključenim partnerjem omogočala dostop do opreme in prostorov, obenem pa sodelovanje z vrhunskimi mednarodnimi strokovnjaki na skupnih umetniških, raziskovalnih ali podjetniških projektih, ki se uvrščajo na področje pametnih mest in skupnosti.

4. VSEBINSKA POBUDA IN RAZPOLOŽLJIVE KOMPETENCE ZA OBLIKOVANJE PROJEKTOV NA PODROČJU PAMETNIH MEST

Z namenom, da bi Platforma za sodobno raziskovalno umetnost povezovala vse pomembne in čim več manjših akterjev na področju sodobne raziskovalne umetnosti, so se Zavod Kersnikova, Zavod Projekt Atol in KSEVT povezali v konzorcij, ki deluje na diagonali Nova Gorica (Primorska regija), Ljubljana (Osrednjeslovenska regija), Vitanje (Savinjska regija). Vsi trije partnerji sodelujejo s številnimi znanstvenimi in univerzitetnimi platformami ter razvojnimi oddelki visokotehnoloških podjetij. Po zgledu MIT MediaLab-a in Ars Electronica Futurelab Solutions bi 'Platforma', omogočila druženje skupnosti najbolj kreativnih in inovativnih umetnikov, znanstvenikov, tehnologov in inženirjev, ki bodo v inspiracijo industriji in razvojno naravnani družbi, ki bo gradila pametna mesta in skupnosti.



Slika 1: Shematski prikaz prostorov in aktivnosti Platforma za sodobno raziskovalno umetnost (BLACK BOX)

'Platforma' ima potencial nadgradnje že obstoječih razvojno-raziskovalno-ustvarjalnih projektov in programov (push). V atraktivnem programu bi obiskovalci lahko spremljali najsodobnejša dogajanja na presečišču umetnosti, znanosti in tehnologij. Z novimi prostori bi bilo središče namenjeno tudi najširši javnosti, kjer bi lahko napovedi visoko tehnologizirane realnosti tudi izkustveno doživljala (pull). Kot centralna razvojno produkcijska platforma bi 'Black Box' omogočal velikopotezne in drzne projekte, primerne za sodelovanja z najeminentnejšimi prizorišči v mednarodnem prostoru (izvoz), obenem pa tudi projekte, ki se bodo predstavljali v manjših, že obstoječih organizacijah. Program 'Platforme' bi poleg centralnega prizorišča za nagovarjanje najširše (domače in mednarodne) publike ponujal celostno podporno okolje za raziskave in razvoj ter program za vse slovensko senzibiliziranje otrok, mladine in študentov ter širše javnosti za nove materiale in tehnologije, nove rešitve in nove

načine proizvodnje. Partnerjem bi 'Platforma' omogočala optimalne pogoje za raziskave in razvoj robnih vsebin in dostop do najbolj vizionarskih del umetnikov, ki sodelujejo z znanstveniki in tehnologi z vsega sveta. V duhu programov, ki jih deležniki izvajajo v manjšem obsegu že vsaj dvajset let, se bi na 'Platformi' križala področja biologije, biotehnologije, astrobiologije, sintetične biologije, vse oblike robotike, nove in obsoletne telekomunikacije, umetne inteligence, umetno življenje, emotivne komputacije, monitoring migracij, vesoljske tehnologije ... in najnovejše teme, ki vznikajo iz sodobnih znanstvenih dognanj in naprednih tehnologij

4.1 Razvojno – tehnološka tržna področja

V novo vzpostavljenem prostoru 'Black Box' bi poleg raziskovalne, galerijske in izobraževalne dejavnosti, izvajali inkubacijske projekte, kjer bi kreativni sektor kataliziral razvoj inovativnih rešitev na spodaj naštetih razvojno – tehnoloških tržnih področjih. Pri vsakem razvojno-tehnološkem tržnem področju (1.-4.) so navedene možne produktne – aplikativne smeri ter potencialni partnerji za sodelovanje.

4.1.1 Odprte podporne tehnologije IKT

4.1.1.1 Novi senzorski materiali in tehnologije

Bioprevodniki, biosenzorika (miceliji, geli…) / Partnerji: Medicinska fakulteta UL / Biomedicina, Dr. Mirjan Švagelj (samostojni raziskovalec na področju biotehniških ved/biotehnologije/bioinženirstva), lesno-predelovalna industrija, Inštitut za gozdarstvo in ostali partnerji, s katerimi smo sodelovali v dosedanjih RRI projektih

4.1.1.2 Povezane senzorske in aktuatorske naprave in vgrajeni komunikacijski moduli

Nosljiva tehnologija (wearable technologies), droni, brezpilotne naprave… / Partnerji: Fakulteta za računalništvo in informatiko, C-Astral, NAPRAVE d.o.o. in ostali partnerji, s katerimi smo sodelovali v dosedanjih RRI projektih

4.1.1.3 Moduli za optimizacijo in podporo (participativnemu) odločanju

Svetovanje pri inovacijah (Innovation consulting), innovation design, citizen science projekti, simpoziji, konference… Partnerji: Zavod Kersnikova, ECSA, Hackteria in ostali partnerji, s katerimi smo sodelovali v dosedanjih RRI projektih

4.1.1.4 Vesoljske aplikacije

Dostop do podatkov in njihova uporaba/ Partnerji: Evropska vesoljska agencija (ESA), European Space Research and technology Centre (ESTEC), Graz University of Technology, Technical Universitet Delft, MIT Kavly Institute for Astrophysics and Space Research

4.1.2 Energetska učinkovitost

4.1.2.1 Energetska učinkovitost v ekstremnih pogojih

Vesoljska tehnologija, astrobiologija, brezpilotna letala (droni), energetska učinkovitost v ekstremno hladnih pogojih, pridobivanje energije iz živih rastlin in mikroorganizmov… / Partnerji: NIB (Nacionalni inštitut za biologijo), Inštitut za biokemijo MF UL, Inštitut za biologijo celice MF UL, Evropska vesoljska agencija in ostali partnerji, s katerimi smo sodelovali v dosedanjih RRI projektih

Orbitalni in planetarni bivalni moduli: Techical university Delft, Evropska vesoljska agencija (ESA), European Space Research and technology Centre (ESTEC), AA School

4.1.3 Mobilnost in dostopnost

4.1.3.1 Optimizacija prometnih sistemov (pametna prometna signalizacija, interaktivne table, semaforizacija, urejanja mirujočega prometa, multimodalnost)

Gibalna interakcija, interakcija na daljavo, teleprezentnost, obogatena resničnost (augmented reality), nosljiva tehnologija (wearable technologies / psychoplastic theatre…), zaznavanje prostora in objektov s pomočjo fizičnih dražljajev – povratne sile / Partnerji: Zavod Kersnikova, UNIKI, Fakulteta za računalništvo UL in ostali partnerji, s katerimi smo sodelovali v dosedanjih RRI projektih

4.1.4 Javni prostori in participativno upravljanje

4.1.4.1 Odprti demonstracijski in eksperimentalni piloti

Interakcije: človek-stroj, človek – žival, človek - rastlina..., delavnice, gojenje hrane v ekstremnih pogojih (vesolje, Antarktika…) / Partnerji: Zavod Kersnikova, Zavod Projekt Atol, KSEVT, UNIKI in ostali partnerji, s katerimi smo sodelovali v dosedanjih RRI projektih

4.1.4.2 Podpora konceptu "citizen observatories" (participacija prebivalcev) in soodločanju pri razvoju javnih prostorov (trgi, parki, peš cone, obrežja ...)

Citizen (Shops, Cafes, Science) …, spremljanje s hands-on zbiranjem podatkov, aplikacijami za zbiranje podatkov, daljinsko zbiranje podatkov, interpretacija podatkov / Partnerji: Zavod Kersnikova, Zavod projekt Atol, KSEVT, UNIKI, ECSA in ostali partnerji, s katerimi smo sodelovali v dosedanjih RRI projektih

4.1.4.3 Storitve razpršenega zagotavljanja uporabnih informacij (odpiralni časi, turistične zanimivosti ...)

Obogatena resničnost (augmented reality) – povezovanje v mreže kulturno – umetniških institucij, projektov (umetnostne zgodovine, arheologije, razstave, dogodki…)… / Partnerji: Zavod Kersnikova, UNIKI in ostali partnerji, s katerimi smo sodelovali v dosedanjih RRI projektih

4.1.4.4 Spremljanje parametrov kakovosti bivanja (hrup, kvaliteta zraka, UV indeks ...)

Naredi sam (DIY) nizkocenovni principi za gradnjo svetlobnih, zvočnih, prašnih senzorjev, CS biosenzorji, množično zbiranje informacij & podatkov (information & data crowdsourcing), urejanje in vizualizacija podatkovnih zbirk / Partnerji: Kersnikova, ECSA, UNIKI in ostali partnerji, s katerimi smo sodelovali v dosedanjih RRI projektih.

5. PRIPOROČILA ZA NADALJNJE BRANJE

[1] Girão, L. M., Valgaeren, P. J, and Van Passel, E. 2015. ICT Art Connect. Activities linking ICT and Art: past experience – future activities. Final report. European Union.

[2] ICT Art Connect […]. ICT Art Connect Study. 2014. Pridobljeno z: http://issuu.com/mycitylab/docs/ictartconect.study_brochure.

6. PRILOGA

[1] Razvojna diagonala iniciative za sodobno raziskovalno umetnost (BLACK BOX)

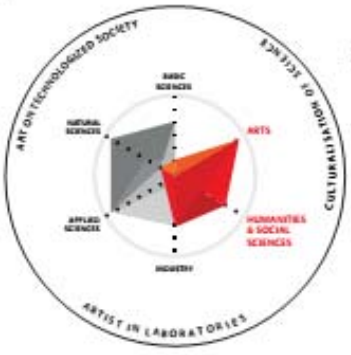
PRILOGA

Razvojna diagonala iniciative za sodobno raziskovalno umetnost (BLACK BOX)

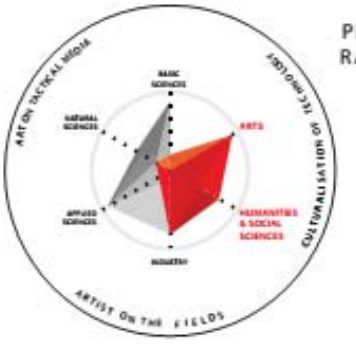
INICIATIVA ZA SODOBNO RAZISKOVALNO UMETNOST

Na pobudo Zavoda Kersnikova in Galerije Kapelica je bil sestavljen konzorcij treh partnerjev (Projekt Atol v sodelovanju z Univerzo v Novi Gorici, Galerije Kpelica v sodelovanju z Zavodom Kersnikova in javnim zavodom KSEVT), ki so skupno Platformo za sodobno raziskovalno umetnost uvrstili v Strategijo pametne specializacije, ki ga je pripravla Služba vlade republike Slovenije za razvoj in evropsko kohezijsko politiko.

KULTURNO SREDIŠČE EVROPSKIH VESOLJSKIH TEHNOLOGIJ



PLATFORMA ZA SODOBNO RAZISKOVALNO UMETNOST LJUBLJANA



ZAVOD PROJEKT ATOL / UNIVERZA V NOVI GORICI

Ljubljana, 25.5.2015

XLAB research: Experiences on Applications for Smart Cities and Future Society

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POVZETEK

Podjetje XLAB ima močno raziskovalno skupino na področju porazdeljenih sistemov, računalništva v oblaku, varnosti, vizualizacije podatkov (medicinskih, 2D/3D GIS, senzoričnih) in procesiranja slik (3D rekonstrukcija, segmentacija, zlivanje GIS podatkov). Omenjene vsebine predstavljajo ključne kompetence, ki so potrebne za razvoj storitov za pametna mesta. Vizija podjetja XLAB je uporaba lastnega znanja in zagotavljanje varnih storitev, naprav in varne komunikacije za rešitve pametnih skupnosti in pamentnih mest.

ABSTRACT

XLAB is an R&D company with strong research background in the fields of distributed systems, cloud computing, security, information visualization (medical, 2D/3D GIS, sensors) and image processing (3D reconstruction, segmentation, GIS data fusion). Presented topics are the key competences, required for the development of smart city services. The XLAB's vision is to exploit the in-house know-how and provide secure services, devices and intercommunication for smarter society and smart cities.

1. INTRODUCTION

Our research team is recognized as one of the strongest computer science research teams outside the academic world in Slovenia. The knowledge and experiences were shaped during the contribution to the numerous European funded research and innovation projects. Our company, XLAB d.o.o., as a whole employs approximately 65 people and closely collaborates with 34 external experts, providing the whole company with access to almost 100 experts in the fields of computer science, electronics and mathematics as well as design and marketing.

Figure 1. Company logo.

Our primary expertise is in field of distributed systems followed by business and visualization software. Beside the contribution to the research projects, we work as a small incubator for ideas, where the main goal is transforming the know-how into the products and services. Small teams shape their ideas and convert them into the final product or new research and innovation opportunity. Our success in EU projects and products in figures is presented in Table 1.

Table 1. Research projects in XLAB

Type of the project	Number of past and ongoing projects
EU FP6 – FP7	19
H2020	11
National	8
LPP (Lifelong Learning)	9
Own products	10+

Working on new technologies and implementing them into various products creates a pleasant environment for gaining skills and fostering new ideas. During the past decade our team gained and improved skills in areas of cloud computing, security, IoT devices, user experience and machine to machine communication. The skills have been applied in product ideas or projects in IT, medical, energy, GIS and marine solutions. Our vision is to exploit gained in-house know-how and provide secure services, devices and intercommunication for smarter society and smart cities.

2. XLAB's role

The smart cities and smart society have clearly shaped their goals which tailor the requirements of future smart services. Smart cities strive for wise management of resources, citizen well-being, safety, efficiency and thoughtful planning for the future [1]. Achieving this fundamental goals is possible with monitoring current state of the smart city vibe, analyzing it and implementing improvements. The ongoing process lifecycle common to smart city services is presented in Figure 2.

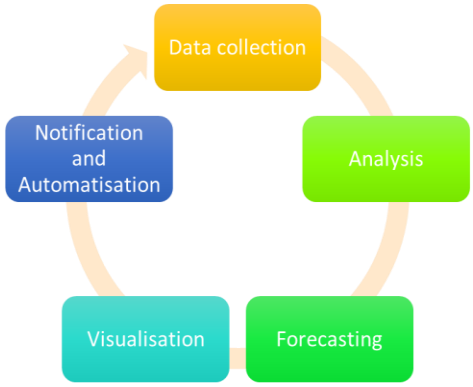

Figure 2. Stages in smart city application cycle.

The monitoring depends on data collection which relies on sensor networks based on proprietary sensors and/or universal mobile devices (e.g. mobile phones). Data from mobile devices greatly improve collection capability and allows citizen participation [2] in shaping the smart city of the future, but it introduces new challenges on citizen privacy. The privacy and secure data handling are a must-have in all stages of the process from Figure 2. Finally, from the technical aspect, the smart application has to be built, deployed and maintained. Mastering these technical skills for each smart application stage is crucial for fast and efficient smart application development and deployment.

Our core competences cover all stages of the smart application process including the crucial technical skills. Most of the stages and related issues are similar as those regarding the automatization of resource provisioning in cloud computing and overlying services, which has been deeply investigated in our research team. Shortly, our experiences in each area gained from previous and ongoing projects are presented in Table 2.

Table 2. Table of XLAB's gained experiences that can be potentially applied in Smart City solutions

Area	Project and main XLAB's contribution or references
Data collection	**Apricot** – Sensor networks **Giraff+** – eHealth sensor network **Sentinel** – Marine sensor network **eBadge** – Energy sensor network
Analysis	**LiaaS** – Logistic optimization **SPEU** – Energy consumption
Forecasting	**LiaaS** – Logistic planning **xHPA** – Simulation platform **MANTIS** – Maintenance planning
Visualization	**SPEU** – Energy consumption monitoring **Gaea+** – 2D and 3D GIS visualization **FINESCE** – Standardized visualization widgets for energy monitoring
Notification and Automatization	**SPEU** – Energy consumption monitoring **Sentinel** – Vessel monitoring system
Security	**Wiser** – Cyber security assessment **SPECS** – End-to-end encryption and secure data handling **WITDOM** – Privacy preserving platform
Development	**DICE** – Quality-driven development methodology definition **CloudScale** – Application scaling prediction **TIMON** – Service API definition **MIKELANGELO** – Application packing and Cloud resource management **Contrail** – Elastic cloud infrastructure management **XtreemOS** – Grid computing resource management

During our work on the FINESCE project and our FIWARE [3] product development we gained knowledge on exploiting and developing FIWARE infrastructure, which has been designed to foster the Smart City application development. We have our internal deployment of FIWARE Lab for testing and development. Our team has skilled people able to deploy and maintain various open source solutions as, for example, OpenStack [4] (for private cloud) or CKAN [5] (for open data collection and management).

3. PROJECTS AND PRODUCTS ON THE FIELD OF SMART CITIES

Our research team contributes in research and development of Smart City solutions with participation in the projects or product development shortly described in this chapter. More information about the projects reader can find on the XLABs web site[1] or project sites. The past and current projects are:

- **Apricot** - project's aim is to contribute a few building blocks to the grand vision of IoT interconnected devices. The final aim was to design and build an Internet of Things compliant advanced prototype that can be integrated with similar prototypes developed by other research teams worldwide.
- **CloudScale (www.cloudscale-project.eu)** – CloudScale provides an engineering approach for building scalable cloud applications and services. CloudScale supports Software as a Service (SaaS) and Platform as a Service (PaaS) providers (a) to design their software for scalability and (b) to swiftly identify and gradually solve scalability problems in existing applications. CloudScale will enable the modelling of design alternatives and the analysis of their effect on scalability and cost.
- **Contrail (www.contrail-project.eu)** – Contrail provides a full PaaS stack based on both open source solutions and the open standards, breaking you free from a specific cloud computing provider.
- **DICE (www.wp.doc.ic.ac.uk/dice-h2020/) –** The project will offer a novel UML profile and tools that will help software designers reasoning about reliability, safety and efficiency of Big Data applications. The DICE methodology will cover quality assessment, architecture enhancement, continuous testing and agile delivery, relying on principles of the emerging DevOps paradigm.
- **eBadge (www.ebadge-fp7.eu)** – eBADGE project's overall objective is to propose an optimal pan-European Intelligent Balancing mechanism, piloted on the borders of Austria, Italy and Slovenia, that is also able to integrate Virtual Power Plant Systems that can assist in the management of the electricity Transmission and Distribution grids in an optimized, controlled and secure manner.
- **Finesce (www.finesce.eu)** – FINESCE is the smart energy use case project, the part of Future Internet Public Private Partnership Programme (FI-PPP). Its

[1] www.xlab.si/rd

objective is to contribute to the development of an open IT-infrastructure to be used to develop and offer new app-based solutions in all fields of the Future Internet related to the energy sector. The project runs a series of field trials at trial sites in 7 European countries.

- **Giraff+ (www.giraffplus.eu)** – Giraff+ is a complex system for social interaction and monitoring which can monitor activities in the home using a network of sensors, both in and around the home as well as on the body. The sensors can measure e.g. blood pressure or detect e.g. whether somebody falls down.
- **LiaaS** – Through the development of selected logistical problems LiaaS project aims to build a prototype of a modern, secure, reliable, flexible and scalable-platform solution in the cloud, which will be the basis for the development of new services in the smart logistics networks using logistic infrastructure as a service – LiaaS.
- **MANTIS** – The overall concept of MANTIS is to provide a proactive maintenance service platform architecture based on Cyber Physical Systems that allows to estimate future performance, to predict and prevent imminent failures and to schedule proactive maintenance. Maintenance is no longer a necessary evil that costs what it costs, but an important function that creates additional value in the business process as well as new business models with a stronger service orientation.
- **MIKELANGELO (www.mikelangelo-project.eu)** – MIKELANGELO project targets to disrupt the core underlying technologies of Cloud computing, enabling even bigger uptake of Cloud computing, in particular, HPC in the Cloud and Big Data technologies under one umbrella.
- **TIMON (timon-project.eu)** – The main objective of TIMON project is increasing safety, sustainability, flexibility and efficiency of road transport systems by taking advantage of cooperative communication and by processing open data related to travel through a cooperative open web based platform and mobile application, developed with the purpose of delivering information and services to drivers, businesses and Vulnerable Road Users in real time.
- **SPECS (www.specs-project.eu)** – SPECS is developing an open source framework to offer Security-as-a-Service and enable user-centric negotiation of security parameters in Cloud SLAs.
- **SPEU** - The main purpose of this application is to analyze the user's energy consumption using different criteria for energy efficiency. These can be standardized, generally used or determined by the tool with the help of statistic methods of the user's average values. Such criteria would be energy efficiency of individual production departments and manufacturing or buildings energy consumption.
- **Wiser (www.cyberwiser.eu)** – delivers a cyber-risk management framework able to assess, monitor and mitigate the risks in real time, in multiple industries. WISER incorporates socio-economic impact aspects, building on current state of the art methodologies and tools, and leveraging best practices from multiple industries and international initiatives.
- **WITDOM (www.witdom.eu)** - aims at protecting the privacy and security of data outsourced to untrusted ICT providers, such as clouds. By protecting sensitive data cryptographically and by applying the privacy-by-design paradigms, WITDOM will provide a holistic framework that addresses end-to-end security for sensitive data. WITDOM's data protection methods will be tailored to the risks associated with different classes of data, so that users remain immune to the threats, vulnerabilities, and risks that may affect remote data processing.
- **xHPA** - The objective of xHPA project is to build a dynamic framework which would enable small and medium sized enterprises to perform complex computational tasks in the public or private cloud, implementation of which would otherwise only be possible with high performance computers.
- **XtreemOS (www.xtreemos.org)** – XtreemOS system installed on each participating machine should provide the Grid with what an operating system offers to a single computer: abstraction from the complex new generation grid hardware and resource sharing between different users.

Our company together with partner companies develop products that can be tailored to fulfil the requirements or used to extend the functionality of temporary smart city solutions. Most representative products are:

- **ISL Online (www.islonline.com)** is a remote desktop support and web conferencing software. Used worldwide by more than 200.000 businesses and holds 10 million remote assistance and maintenance sessions, live chats and online meetings in 30+ languages every year.
- **Sentinel (www.sentinel.hr)** is a simple yet sophisticated marine solution that provides more security to boat owners. Comprised of a network of sensors and central information hub it ensures that the boat is monitored at all times. When an issue is detected the boat owner immediately receives a specific alert via the mobile or web application.
- **Olaii Cashless (cashless.olaii.com)** is a fast and flexible cashless payment system that helps organizations and businesses manage sales accounts at their events in real time.
- **TeleTransfusion (www.teletransfusion.com)** is a solution for remote interpretation of pre-transfusion tests. The system enables experienced physician to be virtually present at any remote location and to offer a

second opinion on complicated cases. 24/7 availability of transfusion specialist results in improved clinical care and lower costs.

- **Gaea+ (http://www.gaeaplus.eu)** is fully customizable and standards compliant 2D and 3D Geographic Information System providing emergency management system, spatial planning and analysis tools.

4. FUTURE OPPORTUNITIES AND ENROLEMENT

The Smart Cities and Smart Society paradigms require new services capable of providing rich lifestyle and obeying citizen needs, privacy and safety. Our future work anticipates possible contribution to this services, focusing on the areas of:

- Designing backend and frontend software for elastic services including suggestions for appropriate API design.
- Obtaining the data and intelligent processing of the data from large and heterogeneous sensor networks.
- Providing secure data handling and privacy preserving solutions.
- Designing hardware for vessels and extending its functionality (e.g. smart city traffic organization and optimization – sea/river traffic monitoring, drawbridges and canal lock management, etc.).
- Data visualization.
- Data fusion.
- Providing tools for remote server or client device management.
- Expanding our products with IoT devices and wearables.
- Developing tools for modeling and simulation.

To reach our goals we would like to collaborate with partners that obtain or provide:

- Large sensor networks (Energy, environmental, communicational, vehicles.
- Sensors (sensor development and related research).
- Infrastructure providers (smart network management companies, city councils, public or private organizations that possess infrastructure where sensors can be deployed, etc.).
- Domain specific knowledge.

For fluent collaboration we can provide the necessary tools for communication (ISLOnline), document sharing (koofr.net), collaboration (OwnCloud, wiki, etc.), continuous integration (Gitlab, Redmine, Jenkins, etc.), cloud deployment (OpenStack), FIWARE deployment and serve other development tools pre-arranged with the partners.

5. REFERENCES

[1] Neirotti, P., De Marco, A., Cagliano, A.C., Mangano,G., and Scorrano, F. 2014., Current trends in Smart City initiatives: Some stylised facts, *Cities*, Volume 38, June 2014, 25-36.

[2] Benouaret, K.; Valliyur-Ramalingam, R.; Charoy, F., 2013. CrowdSC: Building Smart Cities with Large-Scale Citizen Participation, in *Internet Computing, IEEE* ,17, 6, (Nov.-Dec. 2013), 57-63.

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Trends and requirements shaping passenger transportation in smart communities

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Trendi in zahteve uporabnikov, ki oblikujejo potniški promet v pametnih skupnostih

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POVZETEK

Nova podjetja z učinkovitimi inovativnimi poslovnimi modeli, vse od ponudnikov luksuznega prevoza do platform ki ponujajo t.i. deljene prevoze, so prevzela pomemben delež prevozov potnikov na krajših in daljših relacijah ter s tem zapolnila luknje neučinkovitega potniškega prometa po vsem svetu. V prispevku bodo predstavljeni delni rezultati študije zahtev kupcev in drugih poslovnih razlogov za uspeh izbranih uspešnih ponudnikov cestnega potniškega prevoza, ki so nastali v zadnjih nekaj letih, skupaj s trendi, ki se oblikujejo. Ti trendi sooblikujejo tudi večkrat nagrajen poslovni model evropskega ponudnika pametnega transporta na zahtevo na daljših razdaljah, GoOpti, ki ima sedež v Sloveniji.

ABSTRACT

From luxury transport providers to ridesharing platforms, efficient matchmaking firms with innovative business models took over a share of daily commuters and hub-to-hub travelers and filled the holes of passenger transport inefficiency around the world. The preliminary results of the on-going research study of the customer requirements and business reasons for success of representative road passenger transportation providers in past few years and trends that are shaping will be presented. These trends are influencing the award-winning business model of an European provider of demand responsive intelligent transportation on long distances - GoOpti - operating also in Slovenia.

1. THE SUPPLY SIDE IN PASSENGER TRANSPORTATION IS CHANGING

Back in 1994, the Italian physicist Cesare Marchetti hypothesized that throughout the history, the average amount of time that people spend travelling each day is about 1 hour [1]; this number - 1 hour - is now known as *Marchetti's constant*. More recent researches (mostly) support the existence of Marchetti's constant and state that commuters are willing to sacrifice about an hour a day to get to work and back, regardless the distance they have to travel [2].

Of course time and distance travelled are related to the speed with which we commute and if we introduce few more variables like waiting times, cost, safety and comfort of travel in the equation, we can talk about the efficiency of transport (from commuter's point of view). Today's leading modern passenger transport service providers strive to ensure efficiency of their service by maximizing safety, comfort and reliability, which allows them to raise prices even above conventional transport fares.

In the "early days" (the beginning of 2012) of smart passenger transport services, having a simple smartphone application made a big difference for the service providers. People were able to hail a taxi or a private driver with a tap on their smartphone. They could then follow the location of their ride and pay for the fare within the app itself. The smartphone application reduced the friction of process from hailing to payment of fare. It also enabled transport providers to finish more rides than ever before. As providers of a win-win situation for drivers and passengers, service providers took up to 25% of each fare paid. Transport providers were in no position to negotiate, because service providers channeled sales through their in-app payment system.

On the other hand, ensuring safety and comfort for passengers was as important (if not even more) as building a smartphone app which simplified the transportation experience. Since it is harder to control safety and customer' comfort than control the development of a smartphone app, adoption of strict internal rules for transport providers and (less strict) rules for passengers, regarding these two values, posed a challenge to the transport service providers.

At the same time, culture of sharing things was experiencing global expansion through the rise of digital marketplaces like Airbnb[1], Uber[2], TaskRabbit[3], Liazon[4], RelayRides[5], Lyft[6] etc.

[1] Airbnb - a trusted community marketplace for people to list, discover, and book accommodations around the world, http://www.airbnb.com

[2] Uber - international tranportation network company, https://www.uber.com

[3] TaskRabbit - online and mobile marketplace that allows users to outsource small jobs and tasks to others in their neighborhood, https://www.taskrabbit.com

[4] Liazon – operating industry-leading private benefits exchanges for large and small businesses, http://liazon.com

People systematically started to rent their apartments, their spare time and other things, previously considered personal by many, to make money on the side. The rise of so-called "*sharing economy*" also resulted in change of daily commuting and traveling.

Sharing a ride with a stranger and splitting the cost is called *ridesharing*. It started to gain public notice as well as the notice of big passenger transport service providers. Some of them, like BlaBlaCar[7] for example, are pure ridesharing platforms, connecting riders and drivers who happen to share the same route (and are willing to travel within the same time window), when other organize shared and non-shared rides along popular hub-to-hub routes, like e.g. GoOpti[8]. Such organized ridesharing matchmakers (providers) contributed to the growth of global sharing economy and many of their peers followed by adding ridesharing options to their offer after testing concept's profitability.

Inconvenience and the rigidity of taxi services and public transport in terms of a combination of affordability, quality, comfort and reliability presented another opportunity for smart passenger transport pioneers on the roads. Passengers knew what to expect from existing public transport providers (regular routes, fixed time schedules, fixed pricing) and taxi services (varying quality of services), and were hence positively surprised about demand responsive customer-centric alternatives.

Apparently, vehicle and driver standards, ride insurances, smartphone apps and successful scaling of business models did the trick, since nobody wants to ride in an untidy cab or with a careless driver. Today, according to Wall Street Journal, the transportation market leader Uber, which didn't exist six years ago, is valued at over $50 billion [3], a direct result of properly addressing such opportunity.

With more and more players emerging on the scene, ensuring efficiency and customer satisfaction becomes harder and consequently business models of the big players are changing. The main question for them is hence, which transport services people need.

Changes in ways people travel were also noticed by car-manufacturing companies, some of which showed their interest in new technologies, services and data [12]. Some of their investments were made directly into smart passenger transport service providers. For example, BMW invested in a public transportation app called Moovit[9] and GM Ventures invested in a smart rent-a-car platform RelayRides[5]. Such service providers can be of great value to manufacturing firms, as they acquire large amount of data on how, when and where people travel.

[5] RelayRides - peer-to-peer carsharing marketplace, https://relayrides.com

[6] Lyft - American smart passenger transportation service provider, https://www.lyft.com

[7] BlaBlaCar – European ridesharing platform, https://www.blablacar.com

[8] GoOpti - European demand responsive passenger transportation system on long-distances, http://www.goopti.com

[9] Moovit – public transportation information and planning application, http://moovitapp.com

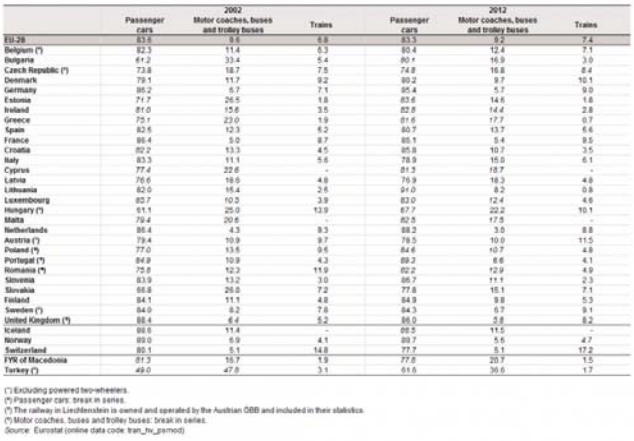
2. THE DEMAND SIDE IS CHANGING, TOO

Since most people need to travel for various reasons every day, the need for efficient passenger transport services is big. For example, in China alone, there are more than 800 million urban residents with a car ownership rate of only 10%, where in USA, New York is the city with least cars owned by households, with 56% of households not owning a car [4].

Success of smart luxury transport providers like Uber also exposed the passenger transport market's lack of options, leaving passengers unable to choose between a wider range of services, regarding quality, comfort and speed. Uber seized the presented opportunity and launched it's fast luxury ride service already in 2010. Today one of Uber's premium products is UberPop, a disruptive[10] ridesharing platform which proves that demand for different kinds of transportation options differs among regions majorly. Statistics show that market is changing and involved service providing firms are changing with it. Let us look at the facts and figures that reflect commuting and traveling behavior of people worldwide.

Table 1 shows modal split of inland passenger transport for 33 European countries in years 2002 and 2012. On average, residents of EU-28 countries made 83,6% in 2002 and 83,3% in 2012 of all inland kilometers traveled with passenger cars. The percentages for motor coaches, buses and trolley buses were 9,6% in 2002 and 9,2% in 2012, while for trains the shares of all inland kilometers traveled raised slightly from 6,8% in 2002 to 7,4% in 2012. Additionally, percentages of modals differ a lot between different European countries, with Turkey, Hungary and FYR of Macedonia forming a special group favoring shared transportation.

Table 1: European inland passenger transport statistics, Eurostat, see [5].



	2002			2012		
	Passenger cars	Motor coaches, buses and trolley buses	Trains	Passenger cars	Motor coaches, buses and trolley buses	Trains
EU-28	83.6	9.6	6.8	83.3	9.2	7.4
Belgium (*)	82.3	11.4	6.3	80.4	12.4	7.1
Bulgaria	61.2	33.4	5.4	80.1	16.9	3.0
Czech Republic (*)	73.8	18.7	7.5	74.8	16.8	8.4
Denmark	79.1	11.7	9.2	80.2	9.7	10.1
Germany	86.2	6.7	7.1	85.4	5.7	9.0
Estonia	71.7	26.5	1.8	83.6	14.6	1.8
Ireland	81.0	15.8	3.5	82.8	14.4	2.8
Greece	75.1	23.0	1.9	81.6	17.7	0.7
Spain	82.6	12.3	5.2	80.7	13.7	6.6
France	86.4	5.0	8.7	85.1	5.4	9.5
Croatia	82.2	13.3	4.5	86.8	10.7	3.5
Italy	83.3	11.1	5.6	78.9	15.0	6.1
Cyprus	77.4	22.6	-	81.3	18.7	-
Latvia	76.6	18.5	4.9	76.9	18.3	4.8
Lithuania	82.0	15.4	2.6	91.0	8.2	0.8
Luxembourg	83.7	10.2	3.9	83.0	12.4	4.6
Hungary (*)	61.1	25.0	13.9	67.7	22.2	10.1
Malta	79.4	20.6	-	82.5	17.5	-
Netherlands	86.4	4.3	9.3	86.2	3.9	9.8
Austria (*)	79.4	10.9	9.7	78.5	10.0	11.5
Poland (*)	77.0	13.5	9.5	84.6	10.7	4.8
Portugal (*)	84.9	10.9	4.3	89.2	6.6	4.1
Romania (*)	75.8	12.3	11.9	82.2	12.9	4.9
Slovenia	83.9	13.2	3.0	86.7	11.1	2.3
Slovakia	86.8	26.0	7.2	77.8	15.1	7.1
Finland	84.1	11.1	4.8	84.9	9.8	5.3
Sweden (*)	84.0	8.2	7.8	84.3	6.7	9.1
United Kingdom (*)	88.4	6.4	5.2	86.0	5.8	8.2
Iceland	88.6	11.4	-	88.5	11.5	-
Norway	89.0	6.9	4.1	89.7	5.6	4.7
Switzerland	80.1	5.1	14.8	77.7	5.1	17.2
FYR of Macedonia	81.3	16.7	1.9	77.8	20.7	1.5
Turkey (*)	49.0	47.6	3.1	61.5	36.6	1.7

(*) Excluding powered two-wheelers.
(*) Passenger cars: break in series.
(*) The railway in Liechtenstein is owned and operated by the Austrian ÖBB and included in their statistics.
(*) Motor coaches, buses and trolley buses: break in series.
Source: Eurostat (online data code: tran_hv_psmod)

Similarly, approximately 90% of long distance (more than 80 km) travels in USA are made with cars, 7% are made by air, 2% by bus and 1% by train. Undoubtedly cars are the most commonly used transportation means around the world and personal vehicles

[10] UberPOP's was recently banned in France and some European cities, due to it's impact on local market [7]

represent most of world's road traffic. The historical worldwide trends of using cars are shown on Figure 1.

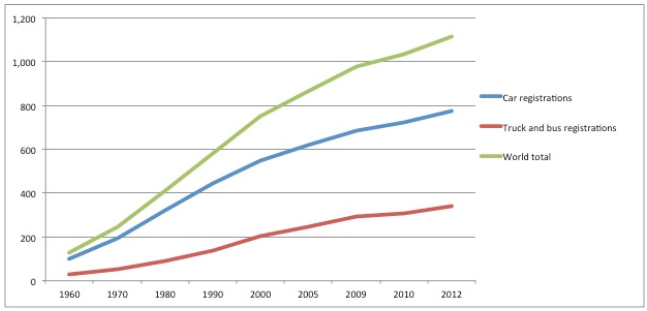


Figure 1: Historical trends of worldwide vehicle registrations from years 1960 to 2012 (in millions); note that cars registrations do not include USA light trucks (SUV's, minivan and pickups) that are used for personal travel, these vehicles are accounted among truck, see [5] for more details.

Although the number of car ownership is steadily increasing worldwide, studies show that people in Europe and USA are driving less. The main reasons for not using their cars as much as before are: good public transportation and efficient alternative transportation options. Other reasons people don't use their cars as much as they used to, are because they choose not to (or don't need to) commute/travel at all, mostly due to:

- working from home,
- traffic conditions,
- internet, telecommunication and technology in general,
- online shopping,
- home entertainment,
- shift to urban living,
- unemployment.

Aside from rent or mortgage payments, transportation costs are the single biggest weekly outlay, and most of those costs normally come from owning a car. The costs are one of the main reasons of pre-recession declines in per-person travel that were recorded in France, Spain, Italy, Australia, New Zealand and Belgium. But as can be seen from Figure 2, in USA the costs of the gasoline, beside being volatile, don't correlate well with population adjusted estimated vehicle miles traveled.

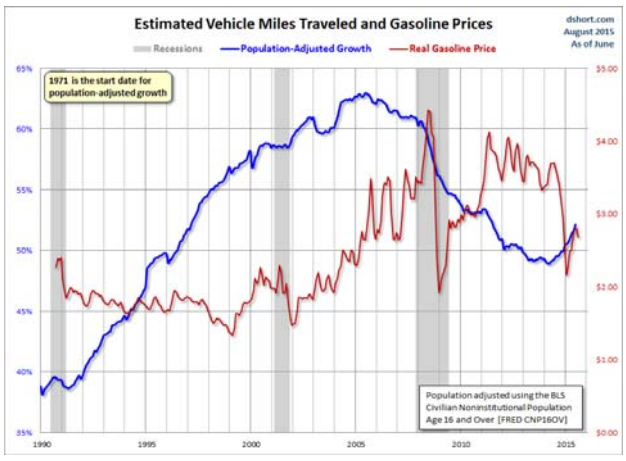


Figure 2: Vehicle miles traveled in comparison with gasoline prices in USA show that other trends determining the use of the cars are in motion [9].

There are of course significant differences among geographic regions. In most western countries car use has been stable or increasing in rural areas, while it has been decreasing in cities, although city living is on the rise [10]. Comparison of motorization rates (number of vehicles per 1.000 people) by region is shown in Table 2, see [6].

Table 2: The comparison of vehicle ownership rates by region with the USA, the country with the highest motorization rate in the world. The numbers in the table represent the number of vehicles per 1.000 people.

Country/Region	1999	2009
Africa	20,9	24,9
Asia, Far East	39,1	157,7
Asia, Middle East	66,2	101,2
Canada	560,0	620,9
Central and South America	133,6	169,7
Eastern Europe	370,0	363,9
Western Europe	528,8	583,3
Oceania	513,9	560,9
USA	790,1	828,0

People in less developed countries buy more cars than people in richer countries (and they tend to buy them sooner), relative to their income and cost of vehicles they are buying. Beside the global trends, also the micro trends exist; some cities, like Helsinki for example, are systematically decreasing the value of car ownership by introducing a mobility-on-demand services which combine public and shared transport in a single payment network [11].

Then there is the age factor, which shows that driving was more popular in the past than now. In Britain 79% of people in their 60s hold driving licenses, which is higher than the figure for the driving-age population as a whole, where in USA more than 90% of people aged 60-64 have driving licenses, a larger share than for any other age group [10]. All over the EU and USA, young people are getting their licenses later than they used to — in America and also in Britain, Canada, France, Norway, South Korea and Sweden. Even in Germany, the share of young households without cars increased from 20% to 28% between 1998 and 2008 [10].

Though real gas prices were not much of a factor in USA, American youngsters with jobs drive less far and less often than before the recession, where 16- to 34-year-olds in American households with incomes over $70,000 increased their public-transport use by 100% from 2001 to 2009, according to the Frontier Group [9], [10]. Internet use is positively correlated with youth, getting their driving licenses later, University of Michigan states in a survey. A global survey of teen attitudes by TNS, found that young people increasingly view cars as appliances not aspirations, and say that social media give them the access to their world that would once have been associated with cars. Another research has shown that in America far more 18- to 34-year-olds

than any other age group say socializing online is a substitute for some car trips, according to The Economist [10].

3. CONCLUSION

There are different trends shaping how people travel, among them the generational shift becoming the most important. Younger generations (especially in OECD countries) do not care about cars the way their parents do; they want to move from A to B as effortlessly as possible, while their parents still view their cars as something they have to own and drive by themselves. The change is happening not because of the cost of the ownership of the vehicle but because of different lifestyle of the younger generation and because the use of technology is replacing needs for commuting, socializing and travelling.

As a result to these trends, cities, municipalities, car manufacturers and private ventures are already innovating in the field of passenger transportation with ambitions to provide more efficient services that will upgrade existing (outdated) alternatives by offering intelligent, demand responsive, customer centric alternatives to public transportation, focusing on convenient, affordable, comfortable, reliable and quality transportation services.

4. ACKNOWLEDGMENTS

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Energy-efficient electronic paper signage, the key driver of Smart City mobility and living

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POVZETEK

Medsebojno povezani digitalni znaki lahko pomembno prispevajo h kakovosti življenja v pametnem mestu. Elektronske označbe mestu namreč omogočajo nadgradnjo standardnih informacijskih in komunikacijskih rešitev ter postavitev platforme za izboljšanje storitev za meščane in učinkovitejše komuniciranje z uporabniki mestnih servisov. E-označbe so odlična priložnost za razvoj mesta, vendar pa njihova implementacija ni trivialna. V resnično pametnem, torej trajnostnem in okolju prijaznem urbanem središču, morajo biti digitalni prikazovalniki 1. energetsko varčni, 2. primerni tudi za lokacije, kjer priklop na električno omrežje ni možen, ter 3. vidni v vseh svetlobnih razmerah. Prav vsakega izmed teh pogojev izpolnjujejo pametni znaki iz elektronskega papirja.

Prispevek nudi pregled potencialne uporabe e-papirja v pametnem mestu in osvetljuje dva primera implementacije prikazovalnikov v sektorju trajnostne mobilnosti po svetu, kjer uporabljajo Visionectovo tehnologijo za razvoj pametnih in energetsko varčnih znakov iz elektronskega papirja.

ABSTRACT

Interconnected digital signage is an important driver of enhancing the experience of living in a Smart City, as it creates a transparent and accessible platform to help a city translate information and communication technologies into better public services for citizens. But just as e-signage presents an opportunity for a city's development, it is not without its challenges: to enable a truly smart, and therefore sustainable and green urban living space, digital signs should 1. support energy saving features; 2. be implementable even at the most demanding of locations, power grid or no; and 3. feature superb visibility in all light conditions. Ticking all of these boxes are smart signs developed on electronic paper technology.

Following is an overview of potential e-paper implementations in a Smart City as illustrated by examples of signage that Visionect, a high tech company developing the technology for smart and sustainable e-paper signs, has helped implement in the mobility sector across the globe.

1. THE CHALLENGE OF SMART CITIES

While many definitions of the term ‘Smart City’ exist, in its most basic meaning a Smart City is taken to mean a city whose services have been made more efficient with the use of digital and telecommunication technologies for the benefit of its inhabitants and businesses [4]. Enabled by technological development and urban migration – numbers show that 78% of Europeans [1] and 54% of the total global population now live in cities, with this number expected to grow approximately 1.84% per year by 2020 alone [3] – the Smart City has emerged from the perfect storm of economic conditions and communication tools ushering in a new, interconnected way of living.

2. SMART CITIES AND DIGITAL SIGNAGE

But this transition is not without its challenges. In addition to successfully linking and upgrading existing infrastructures, technologies and services, a true Smart City should venture beyond the mere use of information and communication technologies and translate into not only better public services for citizens, but also better use of resources and less impact on the environment – a demanding task when it comes to many key urban sectors, among them city mobility.

Key to a holistic Smart City approach that proves sustainable while also improving the management of urban flows, tailoring services to the individual and enabling real time responses to challenges, is smart digital signage deployed on electronic paper technology.

2.1 Digital Signage, the Tool of Integrated Infrastructures for a More Efficient Living Space

Bridging the gap between the theoretical – the information and tools available to make a service more efficient and user friendly – and the practical – the implementation of smart integrated solutions that result in a usable and transparent system – are smart e-signs, driving the development of modern, interconnected living.

Connected into a central system that updates across platforms and services, digital signage helps provide a seamless city experience, displaying real-time information on the go and ensuring the transparency and accessibility of this information. Think smart maps that update with traffic congestions, bus stops that display real-time arrival information, billboards that change with upcoming city events, and more.

2.2 Implementing a Sustainable Solution – Electronic Paper

When implementing a digital display solution in a city scheme, however, several important issues and questions should be considered. Is the digital signage well-suited to use outdoors? Will it showcase the message clearly? How will you power the displays installed on location? What is the environmental and monetary cost of implementing the e-sign?

Electronic paper technology has two key features that fit perfectly into the production of city information systems: visibility and low energy consumption. An electronic paper display will feature perfect readability also in less than ideal light conditions, such as under direct sunlight. An additional advantage is the fact that the screen will use electricity only when changing content and will use no power to retain an image already displayed.

This allows for a solution that has extremely low power consumption and is independent from the power grid. Powered by a rechargeable battery, these signs allow for cordless installation even at the most remote of locations, seamlessly integrating with the existing information kiosk, information panel, bus shelter or train stop. If running on a solar cell, e-paper even supports the creation of completely self-sustainable signage systems.

An affordable technology tailored to the user, e-paper signs connect through the cellular network, refreshing the information displayed in real-time in a hassle-free online process taking place at a central location and requiring very little extra effort and cost on the city operator's part – with even the most demanding of city services.

3. E-PAPER, DRIVING SMART MOBILITY

Widely cited as one of the most universal challenges faced by cities, the question of how to meet the rising demands for efficient mobility within the limitations of already existing (often outdated) infrastructure remains one that is of utmost importance to communities world over.

Driving the creation of intelligent transport and mobility solutions, electronic paper is the enabler of a city's transition into a complete Internet of Things (IoT) ecosystem, one that evolves through progressive strategies that transform urban living from analogue to truly interconnected.

3.1 Digitalization of Existing Content: Implementation of E-Paper Passenger Information in Ljubljana, Slovenia

In the initial step of updating city services while reducing congestion and pollution and streamlining city operations such as traffic and public transportation, a city will find it necessary to transition from traditional information systems – printed public transport schedules, maps, detours – to digitalized ones, realized on smart, effective displays. In this phase centralization is key, creating a platform that can be updatable from a single location and that lowers city maintenance expenses by avoiding the use of stick-on paper notices altogether.

This is how the City of Ljubljana, the EU Green Capital for 2016, digitized passenger information on its bus stops in the very heart of the city centre. Energy efficient, sustainable electronic paper displays running on Visionect technology show static bus schedules, as well as exact bus arrival times and passenger information – such as notifications about line detours or new routes. They feature minimal environmental impact by enabling extremely low power consumption.

Image 1. Digitizing existing city services: electronic paper displays with passenger information at Ljubljana's bus stops.

3.2 Improving City Services: Sydney's Sustainable Eink Traffic Signs

After modernizing already existing infrastructures and services, the city has at its disposal a platform that makes it easy to improve these services by introducing advanced features and uses. In this way the city not only further integrates the data at its disposal across different key sectors, but also makes these sectors more appealing and user friendly, increasing the number of citizens that actually use them. In urban mobility this is the public transport ridership, the number of people who forgo cars in favor of buses and trains, supporting green living and increasing public transport profitability.

In terms of digital signage, this phase means not only providing easily updatable static information, but also dynamic real-time information: not only bus schedules, but also estimated times of arrival, on-the-spot traffic updates or driving rules displayed on intelligent traffic signs.

Advanced digital traffic signs are exactly what the Australian Road and Maritime Services implemented on Sydney roads. A unique interconnected system of E Ink's electronic paper displays running on Visionect's platform was created to overcome the usual visibility, powering and connectivity issues of traffic signalization. The 100% self-sustainable traffic signs powered by solar energy communicate over the cellular network, 'waking up' for certain pre-scheduled windows of time when the content on the sign – denoting parking rules and the timeframe in which they hold true – is changed via the cellular network. Outside of the 'waking' time, the traffic signs use no power.

3.3 Advanced, Multi-Sector Services Creating an IoT Ecosystem

In the third step, the city can use smart signage to connect its services to the Internet, opening up a whole new horizon of usability and innovative personalized communication with citizens. In providing end users with customizable, user-triggered information, the transport and mobility sector can transcend its boundaries, integrating with other services at a city's disposal and fully connecting people, processes, data and events.

Responding to real-time and context-specific need for information, electronic paper signage in such a Smart City can be used to provide anything from tourist information, interactive wayfinding, weather updates, city-wide security notices, live social media feeds and more. The eink technology is remotely updatable, energy efficient, battery-powered and independent from the electrical grid – and as such installable at even the most demanding of locations.

4. FUTURE IMPLEMENTATIONS OF SMART E INK SIGNAGE

Just like the provision of mobility sector information in an interconnected city does not mean mobility alone, the use of electronic paper in a Smart City is not limited to just transportation and traffic.

Propelling an interconnected city forward, electronic paper signs provide the city's services with a level of transparency and usability benefiting both user and operator: the former because the

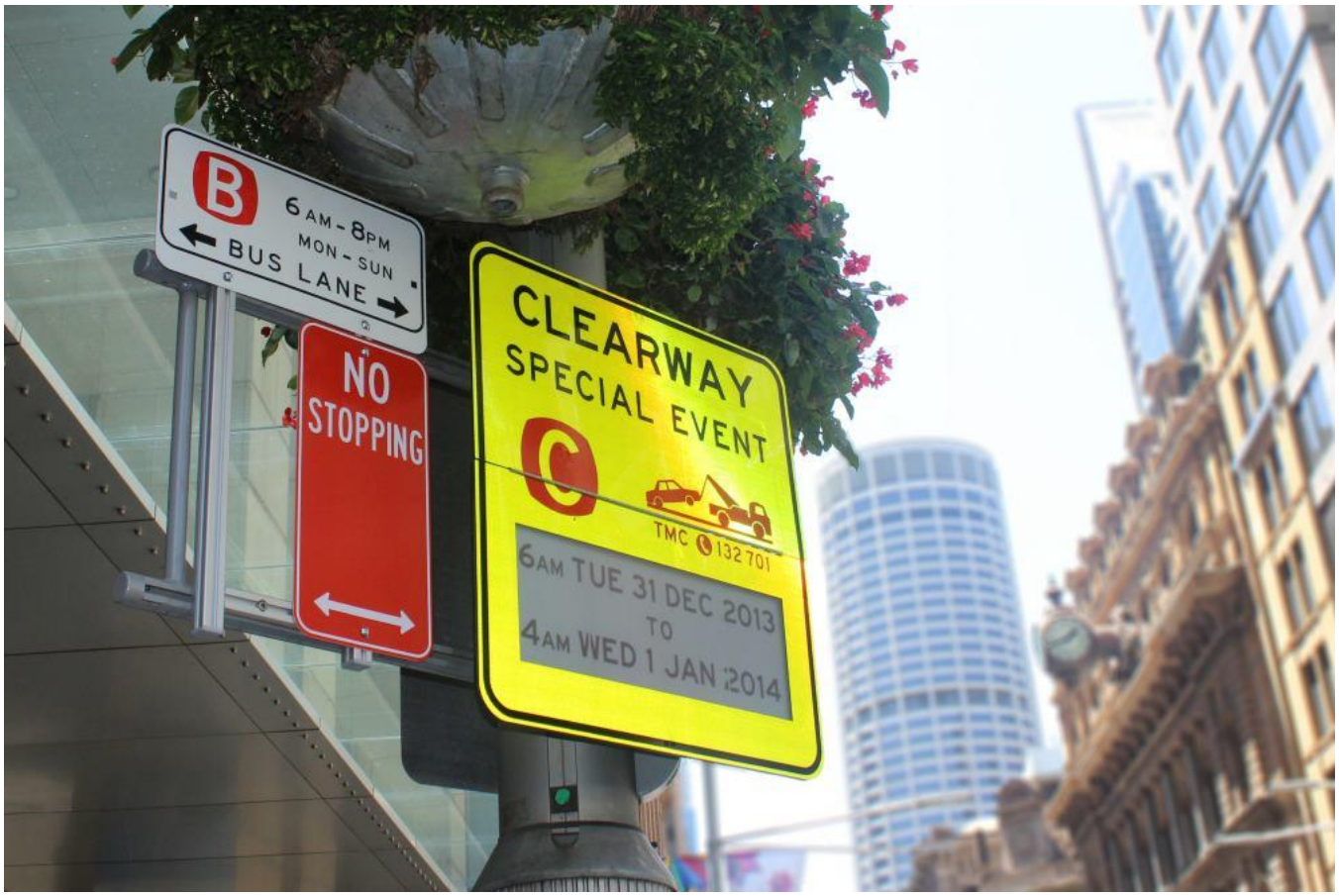

Image 2. Improved city services in Sydney - parking rules displayed on interconnected e-paper traffic signs.

content displayed is clear, provided in real time, and user- and event-triggered; the latter because an electronic paper sign goes the distance when it comes to energy efficiency, counting its battery lifetime in months and years and offering a green and cost-efficient signage solution.

Electronic paper signage helps improve urban living by providing a successful communications tool between the city and its inhabitants, thriving without being a burden on existing city resources – no overtasking the power grid or city personnel, and all without having an adverse effect on the environment. A non-intrusive and elegant medium, eink signs emit no glare or light pollution, enabling the technology to transcend its role of signage and become a medium of city innovation.

With technological advancements turning electronic paper into a thin, affordable, low power and versatile medium perfectly suited for creating the efficient cities of tomorrow, look for cordless displays that are able to flawlessly integrate every nook and corner of a town into a unified, IoT whole: from shopping bags with subtle, real-time ads, to interactive and customizable taxi signs, table tops that change with content uploaded and even fully programmable architectural surfaces.

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Procesiranje vsebine za sisteme pametnih mest in skupnosti / Content processing for smart cities and communities

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POVZETEK

V prispevku bomo predstavili različne rešitve za procesiranje vsebine, ki smo jih razvili na Inštitutu za elektroniko in telekomunikacije Fakultete za elektrotehniko, računalništvo in informatiko Univerze v Mariboru. Rdeča nit predstavitve je možnost uporabe teh rešitev v sistemih pametnih mest in skupnosti, s poudarkom na pobudi Varna družba. Procesiranje vsebine ima pomembno vlogo zaradi velikega povečanja količine informacij, kar je predvsem rezultat spremenjenega načina komuniciranja uporabnikov v zadnjem desetletju. Govor, zvok, besedilo, video in slike tako predstavljajo pomemben vir informacij za nadaljnje odločanje v primeru nujnega dogodka. Metode in zaključeni projekti procesiranja vsebine, ki jih bomo predstavili, so: avtomatsko razpoznavanje govora, avtomatska sinteza govora, detekcija zvoka in govora, procesiranje naravnega jezika ter zaznavanje objektov.

ABSTRACT

The paper will present various solutions for content processing, which were developed at Institute of Electronics and Telecommunications at University of Maribor, Faculty of Electrical Engineering and Computer Science. The focus of the presentation is concentrated around the possibilities of using content processing in the scope of smart cities and communities, especially in the case of Smart Society initiative. Content processing is important to be able to cope with the increased amount of information, which results from the new ways of communication evolved in the last decade. Speech, sound, text, video and image are valuable sources of information in case of an emergency event. Content processing methods and projects presented are: automatic speech recognition, text to speech synthesis, acoustic detection, natural language processing and object detection.

1. UVOD

Sistemi pametnih mest predstavljajo pomembne generator različnih tipov informacij, ki pokrivajo širok spekter namembnosti. Tukaj lahko navedemo tako merilne podatke zbrane s pomočjo senzorjev na infrastrukturi, vrednosti, ki jih posredujejo različne naprave interneta stvari (IoT Internet of Things), posnetke različnih nadzornih kamer in sistemov, različnih medijskih oziroma komunikacijskih virov,… Množica takšnih virov informacij posledično privede do potrebe po avtomatskih postopkih njihove obdelave, kjer ima lahko veliko vlogo prav procesiranje vsebine govora, zvoka, besedila, videa in slik.

Pobuda Varna družba (predstavljena na delavnici v samostojnem prispevku) tvori enega izmed pomembnih konceptov pametnih mest in skupnosti. Z razvojem naslednje generacije sistemov za podporo kriznim dogodkom (NG112) prihajajo v ospredje tudi različne nove tehnologije, ki bistveno širijo načine sporočanja, obveščanja in pridobivanja informacij. Tukaj ima pomembno vlogo razširjenost uporabe pametnih telefonov in tablic, ki podpirajo povezljivost, hkrati pa imajo tudi močno multimedijsko podporo. Dodaten razmah v prihodnosti lahko pričakujemo z uveljavitvijo interneta stvari. Zraven klasičnega telefonskega klica, lahko tako pri sporočanju in obveščanju o kriznih dogodkih srečamo uporabo sporočil SMS oz. MMS, elektronske pošte, fotografij, videa, obveščanja preko družbenih omrežij… Hkrati predstavljajo različni mediji (TV, radio, spletni portali) pomemben vir dodatnih informacij o kriznem dogodku.

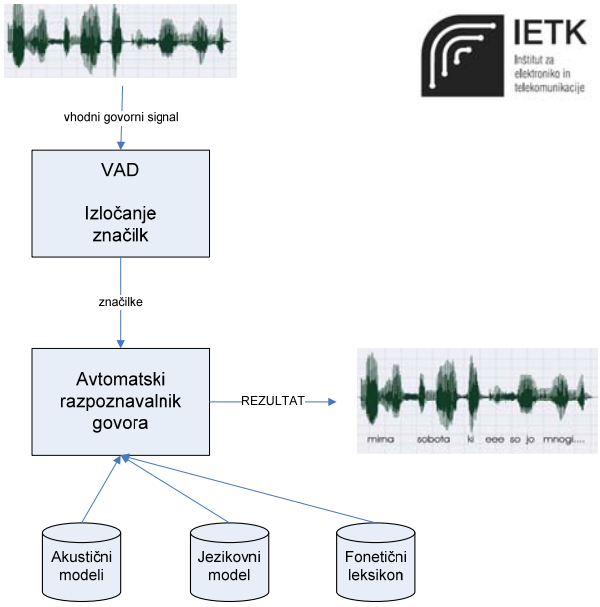
V nadaljevanju prispevka smo predstavili različne pristope in rešitve s področja procesiranja vsebine, ki so rezultat dela na Inštitutu za elektroniko in telekomunikacije (IETK) [1] Fakultete za elektrotehniko, računalništvo in informatiko Univerze v Mariboru. Predstavljeni pristopi sicer delno izhaja iz pobude Varna družba, vendar so lahko rešitve tudi širše uporabne v sistemih pametnih mest in skupnosti ter v rešitvah pametnega doma.

2. PRISTOPI PROCESIRANJA VSEBINE

Kateri način procesiranja vsebine uporabiti, je v veliki meri odvisno od medija ter vrste informacije, ki jo želimo pridobiti.

Nekatere izmed metod procesiranja vsebine, ki smo jih uporabili tudi v predstavljenih projektih IETK, so:

- **avtomatsko razpoznavanje govora (ASR, automatic speech recognition)** predstavlja postopek, kjer iz zajetega govornega signala s postopki digitalnega procesiranja signalov in statističnega modeliranja razpoznamo govor in ga pretvorimo v besedilo.



Slika 1. Blokovna shema avtomatskega razpoznavalnika govora.

Na sliki 1 so prikazani ključni gradniki avtomatskega razpoznavalnika govora. Takšen sistem lahko deluje v različnih scenarijih, od najpreprostejšega razpoznavanja ukaznih besed, do kompleksnega razpoznavanja spontanega govora. Pri izdelavi avtomatskega razpoznavalnika govora ima pomembno vlogo tudi podprti jezik, ter jezikovni viri, ki so zanj na razpolago.

- **avtomatska sinteza govora (TTS, text to speech synthesis)** je postopek, kjer iz vhodnega besedila avtomatsko tvorimo govorni signal, ki mora biti razumljiv, hkrati pa mora zveneti tudi čim naravneje. Samo na takšen način lahko zagotovimo visoko kakovost uporabniške izkušnje. Praviloma so pri sintezi govora v uporabi različni pristopi digitalnega procesiranja signalov, statističnega modeliranja in strojnega učenja. Uporaba sinteze govora iz besedila omogoča izdelavo dinamičnih uporabniških vmesnikov storitev in aplikacij.
- **detekcija zvoka in govora** praviloma temelji na algoritmih digitalnega procesiranja zvoka. Kot rezultat dobimo analizo dogajanja v posnetku, tako s stališča govorcev in zvočnih dogodkov, kot tudi s stališča zvočnega ozadja.
- **procesiranje naravnega jezika (NLP, natural language processing)** predstavlja segment procesiranja vsebine, kjer je v ospredju besedilo. Primeri uporabe so avtomatsko tvorjenje besedila na osnovi zajetih podatkov, strojno prevajanje besedila, jezikovno modeliranje.
- **zaznavanje objektov** je pristop procesiranja videa ali slike, kjer z uporabo algoritmov digitalnega procesiranja signalov na zajeti vsebini iščemo specifične objekte, ki ustrezajo določenim značilnostim, imajo na primer kožno barvo. Na takšen način je možno nadzirati dostop do objektov, spremljati dogajanje na nadzorovanem območju ali pa zaznavo objektov uporabiti za učinkovito rokovanje z uporabniškim vmesnikom napredne storitve.

3. MOŽNOSTI UPORABE PROCESIRANJA VSEBINE

Predstavljeni pristopi procesiranja vsebine imajo različne možne načine uporabe v sistemih pametnih mest in skupnosti. V nadaljevanju bomo predstavili nekatere izmed predlaganih rešitev procesiranja vsebine, ki izhajajo iz pobude Varna družba.

3.1 NG 112 Kontaktni center

Sistem NG112 PSAP (Public Safety Answering Point) mora omogočati tudi sprejem različnih kategorij multimedijskih nujnih klicev in sporočil (video, medijski kanali, družbena omrežja, avtomatsko zajeti podatki), kar posledično poveča dotok informacij o dogodku. Da bi lahko takšno povečano količino informacij ustrezno obdelali v ustreznem času je smiselno uporabiti pristope procesiranja vsebine. Z uporabo postopkov kot so avtomatsko razpoznavanje govora [2], detekcija zvoka in govora, procesiranje naravnega jezika [3], zaznavanje objektov, je možno takšna multimedijska sporočila ustrezno analizirati in pridobljene informacije na ustrezen način predstaviti operaterju. Hkrati je možno postopke procesiranja vsebine (predvsem avtomatsko razpoznavanje govora) uporabiti tudi za skupino klasičnih nujnih telefonskih klicev [4], kjer lahko nudijo ustrezno podporo operaterju, predvsem v primeru velikega povečanja števila klicev v primeru izrednih dogodkov večjih razsežnosti.

3.2 Sporočanje in obveščanje

Z naslednjo generacijo sistemov 112 pričakujemo tudi različne načine multimedijskega obveščanja in alarmiranja v primeru izrednih dogodkov. Postopki procesiranja vsebine, predvsem procesiranje naravnega jezika in avtomatska sinteza govora [5] tako omogočajo pripravo ustreznih multimedijskih obvestil. Generirana multimedijska obvestila se lahko potem posredujejo prizadetemu prebivalstvu preko različnih kanalov obveščanja.

3.3 Aplikacije za končne uporabnike

Sistem Varne družbe predstavlja dobro osnovo za razvoj širokega nabora aplikacij in storitev javne varnosti. S prihajajočimi demografskimi spremembami bodo pomembno vlogo dobivala podporna življenjska okolja z internetom stvari, ki bodo omogočila lažje spremljanje nekaterih kategorij kroničnih bolnikov oz. rizičnih skupin v vsakdanjem življenju. Pri tem bodo imeli pomembno vlogo pametni telefoni ter različni podatki zajeti s senzorji, ki jih bo potrebno ustrezno analizirati s postopki digitalnega procesiranja signalov in razpoznavanja vzorcev [6].

3.4 Druge možnosti uporabe v pametnem mestu

Avtomatsko razpoznavanje govora, sintezo govora ter ostale predstavljene metode procesiranja vsebine je možno učinkovito in uporabniško prijazno uporabiti tudi v različnih drugih sistemih pametnih mest in skupnosti, saj njihova namembnosti ni vezana zgolj na koncept varne družbe. Tako lahko na primer s pomočjo avtomatskega razpoznavanja govora spremljamo različne medijske tokove in jih ustrezno indeksiramo. Z detekcijo objektov ter detekcijo zvoka lahko opremimo različne nadzorne kamere, ki

niso neposredno del koncepta varne družbe. Z njihovo pomočjo lahko spremljamo dogajanje, ter se po potrebi tudi ustrezno odzovemo, kar prinaša presek s področjem podpornih življenjskih okolij in pametnega doma. Sisteme govornega dialoga je možno uporabiti za dostop prebivalcev do različnih vrst javnih informacij (vozni redi, delovni čas, spored dogodkov…), ki so na voljo skupnosti. Z naprednimi pristopi sporočanja in obveščanja lahko vzpostavimo tudi sisteme, ki na osnovi IoT prebivalce sprotno obveščajo o stanju v pametnem mestu (kakovost zraka in vode, prometni zastoji, zamude pri javnem prevozu, prosta parkirišča in polnilna mesta).

4. PRETEKLI PROJEKTI

V nadaljevanju bomo predstavili nekatere izmed zaključenih projektov Inštituta za elektroniko in telekomunikacije UM FERI [1] s področja procesiranja vsebine, katerih rešitve bi bilo možno uporabiti za različne funkcionalnosti v sistemih pametnih mest in skupnosti. Predstavljeni projekti so bili razviti vsaj do nivoja demonstratorja tehnologije, nekateri izmed njih pa so še danes v praktični uporabi.

4.1 BNSI - Razpoznavanje tekočega govora v televizijskih oddajah

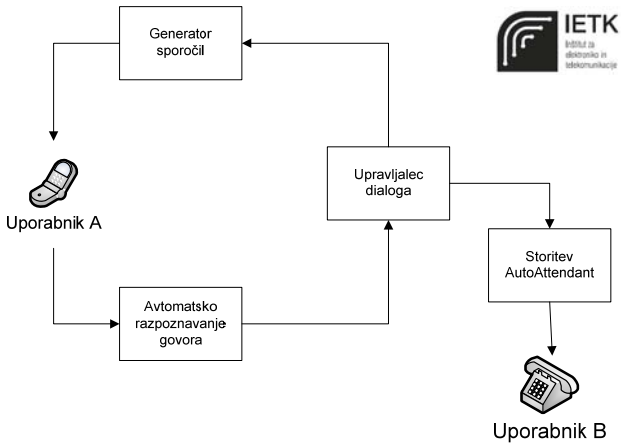
Avtomatsko razpoznavanje tekočega govora neodvisnega govora še vedno predstavlja velik izziv, saj so rezultati tudi močno odvisni od kompleksnosti jezika. Cilj rešitve je govor poljubnega govorca spreminjati v besedilo. Možnosti uporabe takšen rešitve so predvsem odvisne od dveh kriterijev, ki sta med seboj praviloma obratnosorazmerna: pravilnosti razpoznanega besedila in hitrosti delovanja.

Slika 2. Primer podnaslavljanja TV oddaj.

Na IETK samo tako v sodelovanju z RTV Slovenije izvedli projekt BNSI Broadcast News, katerega osnovni cilj je razpoznavanje tekočega govora v dnevno-informacijskih televizijskih oddajah. Iz tekočega govora razpoznano besedilo je možno uporabiti za indeksiranje posnetkov, iskanje ključnih besed v posnetkih, ter nadaljnjo obdelavo besedila iz posnetka. V primeru ustrezne adaptacije na domeno in govorce, s čimer delno omejimo kompleksnost scenarija za avtomatski razpoznavalnik govora, pa je možno razpoznano besedilo uporabiti tudi za podnaslavljanje oddaj (Slika 2) oziroma posnetkov, kar je še posebej aktualno za različne medijske zbirke [10]. Z uporabo metod detekcije zvoka oz. govora, ter segmentacije in grozdenja govorcev, pa lahko analiziramo posnetke tudi s stališča zajetega zvoka in zvočnega ozadja.

4.2 AAT - Sistem avtomatskega govorno vodenega telefonskega operaterja

Na IETK smo v sodelovanju s podjetjem IskraTel razvili sistem avtomatskega govorno vodenega telefonskega operaterja (AAT, AutoAttendant), ki opravlja naloge prevzema in usmerjanja klicev v podjetju. Sistem predstavlja tipično rešitev interaktivnega govornega odzivnika (IVR, Interactive Voice Response) v kombinaciji z avtomatskim razpoznavanjem slovenskega govora za izolirane besede. Njegova ključna prednost je možnost govornega izbiranja klicanih oseb po imenu in priimku, kar predstavlja učinkovito rešitev v primeru imenikov podjetij in organizacij z nekaj 100 do nekaj 1000 vnosi.



Slika 3. Projekt avtomatskega govorno vodenega telefonskega operaterja (AAT).

Ključni gradniki sistema AAT (Slika 3) so zasnovani neodvisno, tako da jih je možno prilagoditi na različne nove scenarije, ki jih lahko vključimo v sistem IVR. V primeru, da so na voljo ustrezni jezikovni viri, je možno sistem prilagoditi tudi za različne druge jezike.

4.3 SUMAT - Sistem za strojno prevajanje podnapisov

SUMAT [3] je s strani Evropske unije financiran projekt okvirnega programa, v katerem je sodeloval IETK. Cilj projekta SUMAT je bil, razviti sistem strojnega prevajanja podnapisov filmov in oddaj, ki ga bodo lahko uporabljali predvsem prevajalci v obliki spletne storitve. Tako se bo povečala količina oddaj, ki bodo gledalcem dostopni v njihovem materinem jeziku. Sistem SUMAT podpira prevajanje besedila med različnimi pari devetih evropskih jezikov, slovenščina je vključena v kombinaciji s srbščino. Projekt predstavlja tipičen primer procesiranja besedila z uporabo statističnih modelov, ki za svoje učinkovito delovanje potrebujejo ustrezne dvojezične besedilne korpuse.

4.4 SIPINA - Storitve interaktivnega posredovanja informacij uporabnikom s posebnimi potrebami

Projekt SIPINA [8] je potekal v sodelovanju med IETK in Društvom študentov invalidov Slovenije, ki predstavljajo skupino končnih uporabnikov. SIPINA je primer realizacije e-storitve za potrebe uporabnikov s posebnimi potrebami, predvsem slepe in slabovidne. Upoštevaje specifične zahteve uporabnikov s posebnimi potrebami, je bil cilj projekta razviti dve storitvi. Prva storitev je upravljanje osebnega računalnika preko pametnega mobilnega telefona ali tablice (SIPINA Virtual) [7]. Druga storitev pa je dostop do e-vsebin z uporabo taktilne in govorne komunikacije z mobilno aplikacijo SIPINA E-bralnik [5]. Obe mobilni aplikaciji delujeta na štirih mobilnih platformah: Android, Symbian OS, Blackberry in Windows Mobile.

S stališča pristopov procesiranja vsebin, ki jih je možno uporabiti v sistemih pametnih mest in skupnosti je pomembnejša storitev SIPINA E-bralnik, ki med seboj kombinira upravljanje mobilne aplikacije z uporabo avtomatskega razpoznavanja slovenskega govora in taktilne komunikacije. Ker se e-vsebine, do katerih lahko z mobilno aplikacijo dostopajo slepi in slabovidni uporabniki, dinamično spreminjajo, je v storitev vključen avtomatski sintetizator slovenskega govora PLATTOS, ki je rezultat razvoja na IETK [9]. Osnovo avtomatskega sintetizatorja govora predstavlja korpusna sinteza, poleg slovenščine pa sintetizator govora podpira tudi druge jezike.

5. ZAKLJUČEK

V prispevku smo predstavili, kako je možno postopke procesiranja vsebine učinkovito vključiti v različne scenarije pametnih mest in skupnosti, kjer lahko z njihovo uporabo povečamo nabor funkcionalnosti, ter obdelamo vire informacij, ki bi jih brez tega bili prisiljeni zanemariti. Kot konkreten scenarij sistema pametnega mesta smo se osredotočili na pobudo Varna družba, ki je na delavnici predstavljena v samostojnem prispevku. Ključna prednost predstavljenih rešitev procesiranje vsebine je, da so praviloma zasnovani toliko fleksibilno, da jih je možno z ustreznimi spremembami prilagoditi na različne nove scenarije, ki bodo postali aktualni v prihodnosti.

6. ZAHVALA

Delo je bilo delno sofinancirano s strani ARRS po pogodbi št. P2-0069.

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POVZETEK

Slovenska tiskovna agencija (STA) je osrednji in najbolj izčrpen vir informacij v Sloveniji. V tej vlogi predstavlja dobro izhodišče za vzpostavitev sistema, ki bi prek sodobnih digitalnih kanalov državljane obveščal o vseh, za njihovo vsakdanje življenje pomembnih, informacijah. Gre za informacije o razmerah na cestah, motnjah v elektroenergetskem omrežju, naravnih nesrečah, iskanju pogrešanih itn. S svojo razvojno ekipo in izkušnjami iz številnih, tudi mednarodnih projektih lahko, v sodelovanju z zainteresiranimi partnerji, pomembno prispeva k vzpostavitvi takšnega pametnega informatorja.

ABSTRACT

The Slovenian Press Agency (STA) is the main and most comprehensive source of news in Slovenia. As such it represents an excellent basis to create a system, which would inform citizens about all events, relevant for their everyday life, by using modern digital channels. The system would provide information about traffic accidents, disruptions in the energy and water infrastructure, natural disasters, missing people etc. STA with its development team and experiences from numerous national and international projects can be an important partner in creating such a smart informer system.

1. UVOD

Slovenska tiskovna agencija (STA) je osrednji, najhitrejši in najbolj izčrpen vir informacij v Sloveniji. Z mrežo okrog 100 novinarjev in dopisnikov ter z izmenjavo novic s tujimi tiskovnimi agencijami dnevno pripravi več kot 300 vsebin o aktualnem dogajanju v Sloveniji in po svetu. Svoje novice v slovenskem in angleškem jeziku posreduje tako rekoč vsem slovenskim medijem, poleg tega pa tudi vladnim in nevladnim ustanovam, podjetjem, tujim veleposlaništvom in tiskovnim agencijam.

STA zagotavlja tudi glavni servis novic v angleškem jeziku v Sloveniji, bogat foto servis, avdio servis in medijski napovednik dogodkov, video storitve, servis originalnih sporočil, organizacijo dogodkov in druge storitve. V zadnjih letih je močno okrepila svojo razvojno dejavnost, tudi s sodelovanjem v mednarodnih projektih. Pri slednjem sodeluje s slovenskimi raziskovalci, še posebej z Laboratorijem za umetno inteligenco na Institutu Jožef Stefan (IJS).

2. VIZIJA VLOGE STA V PAMETNIH SKUPNOSTIH

STA kot nacionalna tiskovna agencija, ki je kot družba v 100-odstotni državni lasti, igra ključno vlogo pri osveščanju slovenske javnosti o dogajanju v Sloveniji in po svetu. Enega glavnih elementov te dejavnosti predstavlja obveščanje o najbolj elementarnih dogodkih, kot so naravne nesreče, razmere na cestah, vremenski pojavi, delovanje elektroenergetskega in komunalnega omrežja, izbruhi bolezni, iskanje pogrešanih oseb, volilni roki, uveljavitve novih zakonov itn.

Gre za informacije, ki lahko pomembno vplivajo na vsakdanje življenje državljanov oziroma delovanje družbe kot celote. Primeren sistem zbiranja, obdelave in distribucije teh informacij državljanom, s pomočjo sodobnih tehnoloških orodij, lahko znatno prispeva k vzpostavljanju bolje delujočih, pametnih skupnosti. Vključenost STA v tovrsten sistem je pomembna tudi z vidika njene obstoječe vloge posredovalca ključnih informacij praktično vsem medijem v slovenskem prostoru. S tem je namreč zagotovljen najširši možen doseg in učinek omenjenega sistema informiranja državljanov.

3. PAMETNI INFORMATOR

Uresničitev omenjene vizije je možna z vzpostavitvijo naprednega sistema zbiranja in distribuiranja elementarnih informacij državljanov – pametnega informatorja. Na enem koncu te informacijske verige bi, v sodelovanju z institucionalnimi viri informacij ter ob tehnološki podpori raziskovalnih ustanov, vzpostavili dogovorjen in avtomatiziran način zbiranja informacij z vsemi ustreznimi meta podatki, od geografske lokacije oziroma obsega do časovne dimenzije.

Gre za informacije, kot so motnje v cestnem in drugih vrstah prometa, opozorila v zvezi z naravnimi nesrečami, motnje v delovanju elektroenergetskega in vodooskrbnega omrežja, policijska obvestila, pozivi in sporočila zdravstvenih ustanov, pomembna obvestila lokalnih skupnosti, informacije o volilnih in referendumskih postopkih, uveljavitev pomembnejših zakonskih aktov, humanitarne akcije itn.

Te podatke bi posredovali splošni javnosti oziroma državljanom prek namensko razvitega spletnega mesta in z njim povezane mobilne aplikacije, spletnih družbenih omrežij in morebitnih drugih identficiranih primernih kanalov. Na račun opremljenosti zbranih informacij z meta podatki bi spletna stran in mobilna aplikacija uporabnikom omogočala filtriranje informacij glede na lokacijo, čas, tip dogodka, nujnost in druge relevantne parametre.

Takšen sistem bi državljanom na enem mestu zagotavljal pravočasne in njihovim potrebam prilagojene informacije. To bi izboljšalo kakovost življenja in delovanje celotne družbe ter posledično prispevalo k vzpostavitvi pametne skupnosti.

Sistem bi lahko v naslednji fazi nadgradili tudi z zbiranjem in avtomatizirano analizo informacij iz neinstitucionalnih virov, kot so neposredna sporočila uporabnikov prek pametnih mobilnikov ali njihove objave na spletnih družbenih omrežjih. Za

institucionalne vire bi to bil vir potencialnih prvih informacij o zanje pomembnih dogodkih. Na podoben način bi ta sistem olajšal tudi izvajanje enega ključnih poslanstev medijev, to je informiranja javnosti. Raziskovalni skupnosti pa bi po drugi strani zagotovil bogato bazo podatkov, s pomočjo katere bi lahko razvijala nove rešitve za napredne napovedne in druge analize.

4. KOMPETENCE

STA že sedaj zbira oziroma prejema obsežen nabor informacij, ki bi bile relevantne za sistem državljanskega informatorja. Z institucionalnimi viri teh informacij je v rednih stikih, tako da bi lahko sodelovala pri vzpostavljanju stikov in dogovarjanj s temi viri informacij.

Zaradi svoje vloge ene osrednjih stičnih točk celotnega slovenskega medijskega prostora, lahko STA v omenjenem projektu nastopa tudi kot ponudnik spletnega mesta za sistem državljanskega informatorja ter promotor njegove uporabe.

V zadnjih letih je s sodelovanjem pri več nacionalnih in mednarodnih projektih vzpostavila učinkovito razvojno ekipo z bogatimi izkušnjami na področju zasnove, razvoja in oblikovanja spletnih strani, mobilnih aplikacij in uporabniških vmesnikov. Z znanjem, pridobljenim pri izvedbi številnih medijskih partnerstev in organizacijo lastnih dogodkov, pa lahko zagotovi tudi podporo pri diseminacijskih aktivnostih.

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UL-FE, LMMFE/LTFE: Smart Media for Smart Cities

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POVZETEK

Predstavljamo vizijo, ekspertna znanja ter področja interesa z navedenimi ustreznimi projektnimi in znanstvenimi referencami Laboratorija za telekomunikacije in Laboratorija za multimedijo, Fakultete za elektrotehniko, na področju pametnih medijev za pametna mesta in skupnosti.

ABSTRACT

We present the vision, expertise and areas of interest with relevant project and scientific references of the Faculty of Electrical Engineering's Laboratory for Telecommunications (LTFE) and Laboratory for Multimedia (LMMFE) in the area of smart media for smart cities and communities.

1. SMART ENVIRONMENTS, MEDIA and SMART CITIES

The exponential growth of Internet and Communication technologies in combination with multimedia, and the focus on the end user gave birth to new and often disruptive paradigms. One such paradigm is the Internet of Things (or Everything), where a myriad of interconnected smart devices and sensors allow for collecting, storing and processing of enormous quantities of data (the BigData paradigm), and thus allow for gaining new insights into data patterns. According to the IDC [1], the market of the IoT is exponentially growing, with a forecast of more than 28 billion of interconnected smart devices in 2020, representing a market worth more than 7000 billion USD. The second paradigm represents smart environments and cities, utilizing the IoT platform. According the Forbes [2], this market represents a 1500 billion USD market opportunity. The third paradigm shift represents a strong focus from the technology to the end user itself, encompassing usability, accessibility and the overall user experience aspects (UX).

There are various key aspects (Figure 1), building the so-called smart cities. Most often these encompass:

- Smart Governance,
- Smart Education,
- Smart Healthcare,
- Smart Buildings,
- Smart Mobility & Transport,
- Smart Energy & SmartGrids,
- Smart Communications & Infrastructure,
- Smart Entertainment & Media, and finally,
- Smart Citizens & Accessibility & User eXperience.

Figure 1: Aspects of Smart Cities

The communication flows are basically threefold; in the first case a communications between the devices (machine2machine), in the second case between devices and users (human2machine) or finally between users themselves (human2human).

Nevertheless, whenever the users are involved in the process, the biophysical strengths and limitations of users' capabilities should be taken into account in order to provide usable and enjoyable solutions. The visual interface in combination with various interaction modalities represents on the prime ways to convey the information, rendering display based devices especially important.

Finally, the right combination of technology, content, context and media forms the so-called smart environment.

2. AREAS of EXPERIENCE

The following are the areas of interest and expertise of the LMMFE/LTFE:

- the smartTV ecosystem (IPTV, HbbTV, AndroidTV and others) development and the mobile app ecosystem (iOS, Android, Microsoft) development,
- the user interface and interaction design process by using the User Centred Design paradigm in accordance with the state-of-the-art design guidelines, and finally,
- incorporating the usability, accessibility, visual and emotional design aspects with the state-of-the-art evaluation methodology, ensuring good overall user experience for any end-user target group.

The smartTV ecosystem (AndroidTV, smartTV, HbbTV) in the combination with the mobile application platforms (MS, iOS, Android) is an important part of nearly all smart city key aspects, shown in from Figure 1. It also represents an important expertise of the partner, as evident from past and current project references (see Projects and References).

Due to the specifics of content consumption on the smart TV, the applications need to be adapted for optimal viewing on the TV screen. The interactions need to be designed for usage of TV remote control, or in combination with other advanced input gesture and voice input modalities, which are fundamentally different from touch screens or traditional keyboard /mouse interaction modes. Smart TV applications also need to be implemented and tailored to most representative TV brands (e.g. Samsung), which demands a lot of additional domain knowledge and expertise.

Nevertheless, usability and the overall user experience (UX) with a product or a service, especially in a case of the multimedia and interaction rich TV applications, are often a deciding factor of success or failure of a specific service. Therefore, designing a service, targeting a broad and diverse audience, including users who potentially have no previous experience with technology or even show aversion toward it, is challenging, at the least. Beside the requirements for the technology–wise mature solution, effective human-to-human design and communication, human/user centred design, the user interface, interaction method, usability and user experience in general, play a paramount role in the final service's success and acceptance.

To minimize these risks the users should ideally be involved at all stages of the development process. This approach is commonly referenced by the term User Centred Design (UCD) [3]. The final goal of the UCD approach is not only to develop a useful service (usability aspect), but also to provide a service that is easy and enjoyable to use with a low cognitive demand and low learning curve, thus ensuring a good user experience. Usability is usually denoted as the ability of the user to use the device or service in order to successfully carry out a task at hand, whereas the user experience takes a broader view, looking at the users' entire interaction with the device or service, as well as the thoughts, feelings and perceptions that result from that interaction [4].

Choosing the right methodology and measuring the user experience [5], however, is not a trivial task, dependent on the product or service itself, and also heavily influenced by the target user group. Therefore the user experience, interaction and visual design should take in to account the specifics of each end-user target group, where a special care should be given to the elderly, the young and the disabled persons [6].

Activities within the UX process usually consist of (i) design for selected application domains, (ii) analysis of APIs providing data, (iii) design of the user interface, wireframes and optimisation with end users' feedback.

3. PARTNER PROFILE - The University of Ljubljana (UL), Faculty of Electrical Engineering (UL FE), Laboratory for Multimedia (LMMFE) and Laboratory for Telecommunications (LTFE)

The University of Ljubljana (UL, PIC 999923240) [7] is a very diverse research institution with core competencies in all major fields of science and is ranked as one of the best 500 research universities in the world by all major rankings, such as ARWU, THE QS and Webometrics. The UL is also renowned for its strong commitment to applicative research for industry partners, as well as catering to the needs of other knowledge users, including its 60.000 enrolled students.

Its member institution, the Faculty of Electrical Engineering has extensive and internationally recognized competencies in the arena of telecommunications, computer information sciences and multimedia. More specifically, the Faculty of Electrical Engineering's Laboratory for Telecommunications (LTFE) and Laboratory for Multimedia (LMMFE) [8] are propulsive research teams with more than 40 employees and a strong base of external associates and industry partners.

UL FE has the largest share of industry and project collaboration among all UL members. It has vast experience with research programs and projects of the European Commission (FP7, FI-PPP, CIP, H2020, Interreg IVC) and other national and international funding bodies (SEE, AAL, Tempus, Erasmus+, PHARE, COST, IFIP, IEICE, RIPE NCC, Ministry of Defence, Slovenian Research Agency, Slovenian Technology Agency, etc.).

Both LTFE and LMMFE are highly committed to the research, development, pilot integration and trials of technologies and system solutions in the areas of multimedia enabled knowledge sharing, ICT-based healthcare applications and services, Internet of Things (IoT), User-Centered Design and Human-Computer Interaction and have rich experiences in the development of advanced applications for various operation systems and devices (iOS, Android, Windows Phone 8, HbbTV/SmartTV).

The results of applicative and research work of both laboratories are published in highly ranked SCI journals and protected with patents, just as they are implemented in several mass market industrial solutions and applications.

An important area of activities is the development of complete e-learning solutions, comprising of multimedia learning strategic and action plans preparation; multimedia e-learning software development (Learning Management Systems, e-learning portals and other e-learning applications); multimedia e-learning content instructional design and knowledge assessment development; and pedagogy/didactics consulting and e-learning personalization. Over fifteen years of our work, provided us with valuable experience in implementing complete e learning solutions in various corporate environments (e.g. banking sector, Telecommunication operators) in Slovenia and abroad as well as in school and academic environments. LTFE has approximately 50 collaborators that include technical, didactical and other experts that can ensure successful e-learning implementations in any environment. An important result of LMMFE research and development activities is a cloud based multimedia knowledge exchange product names E-CHO that is already used by various industries, academic and educational environments in Slovenia, with more than 50.000 active users.

The proposed projects focus on next generation solutions, which must be delivered to citizens in a convenient fashion if they are to be of lasting and measurable impact. Our research expertise and applicative projects in the field of SmartTV, multimedia and knowledge sharing platforms will bridge the gap from smart city applications and outputs and the end user, in this case both the

citizen and the officials responsible for city management and strategic planning.

LMMFE has also extensive experience in designing and organizing different motivational mechanisms for activating and including youth (aging 16 - 24) in project within this domain. It has both the knowhow and the infrastructure to actively promote youth engagement, including complete ecosystems (real spaces, virtual spaces, knowledge transfer and collaborative project team work). Within this domain, workshops for youth are organized, where young people get the skills needed to help build sustainable cities of the future with ICT solutions. Training programme and know-how is transferred in "OpenLab"-like (http://www.openlab.si/en) and "MakerLab"-like innovative environments.

LMMFE has considerable experience with research programs and projects of the European Commission (FP7, FI-PPP, CIP, H2020, Interreg IVC) and other national and international funding bodies (SEE, AAL, Tempus, Erasmus+, PHARE, COST, IFIP, IEICE, RIPE NCC, Ministry of Defence, Slovenian Research Agency, Slovenian Technology Agency, etc.).

4. PROJECTS and REFERENCES

Selected relevant projects and scientific references are briefly described.

PROJECT REFERENCES

SEE TV-WEB project: Project leadership and development of an HBBTV application and backend solution, which includes the design of the TV user interface, implementation of an HBBTV compliant application, development of a STB receiver, development of a CMS system providing Internet content for broadcasting over DVB-T.

SmartTV application for national TV and radio broadcaster RTV Slovenia, providing end users with latest news, archived video on demand and radio on demand.

HbbTV application for national TV and radio broadcaster RTV Slovenia (Figure 2), providing end users with latest news, video and radio on demand, participation in surveys, EPG, twitter broadcasts, weather information, second screen functionality, etc.

SmartTV application for Philips providing up to date weather information in textual, graphical, audio and video form.

iOS and Android smart phone application for the national TV and radio broadcaster, providing live TV and radio broadcasts, news, archived on demand content and second screen functionality.

STORY is a Horizon 2020 project in LCE 8 -2014 (Local/ small-scale storage) project with a focus on the added value that thermal and electrical storage can bring, showing the inter-relations between technologies and stakeholders as well as the potential and impact of policy and regulation.

The strategic research project **SUPERMEN**, co-financed by the European Regional Development Fund, provides the information infrastructure of a "virtual power plant" that uses innovative ways to manage connection, control, regulation and operation optimization of power sources.

E-CHO is a cloud based multimedia e-learning platform enabling provisioning of any kind of knowledge exchange (http://e.fe.uni-lj.si/). It is intensively used by the staff and students of the Faculty of Electrical Engineering, University of Ljubljana as well as by Slovenian larger corporate environments.

Figure 2: RTV 4D smartTV & smart phone application

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INOVATIVNA REŠITEV ZA PODPORO ODLOČANJU / SOLUTION FOR DECISION SUPPORT SYSTEMS IN SMART CITY SOLUTIONS

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POVZETEK

Zgodovinsko so sistemi za podporo poslovnemu odločanju iskali različne načine, kako uporabniku na učinkovit in hiter način odgovoriti na njegova poslovna vprašanja. Google je kot iskalnik po svetovnem spletu najprej spremenil način iskanja na osebni ravni, sedaj pa se je ta način iskanja začel uporabljati tudi v poslovne namene. Pokazali bomo kako smo v več podjetjih implementirali inovativno disruptivno tehnologijo, ki je plod slovenskega znanja: ResEvo.ASK BI, s katero popolnoma spremenimo dostopnost informacij v podjetju, s postavitvijo nove ali z dopolnitvijo katerekoli obstoječe IT implementirane rešitve.

ABSTRACT

Through the history, all kinds of Business Intelligence tools have tried to find different ways how to quickly provide answers to the users business questions. Google as a search engine for the World Wide Web first changed the way search on a personal level, but now, this search method began to be used also for commercial purposes. We will show how we implemented disruptive technology in several companies, an innovative approach to self-service BI as the result of Slovenian knowledge: ResEvo.ASK BI, which completely changed the accessibility of information within the company and can be implemented as an update, embedded or standalone BI solutions to any information system (ERP, specialized IS, …).

1. UVOD

Eden izmed ciljev platforme – informacijskega sistema pametnega mesta je izboljšati procese odločanja.

Slika 1: Koncept pametnega mesta [13]

2. INFORMACIJSKI SISTEMI, SISTEMI ZA PODPORO ODLOČANJU - SPO

Informacijski sistem (IS) je skupek medsebojno povezanih komponent, katerih namen je zbiranje, obdelava podatkov in distribucija informacij, namenjenih uporabnikom. Je le en od podsistemov vsake organizacije. Poleg informacijskega sistema organizacija ima še operativni in upravljalni podsistem. V informacijski sistem so vključeni tehnologija in ljudje [4].

Obstajajo različne delitve informacijskih sistemov, ki so narejena glede na različne kriterije [4]:

- organizacijsko strukturo (oddelčni, IS podjetja, medpodjetniški IS)
- funkcijsko področje (računovodstvo, finance, proizvodnja, marketing, ..)
- sistemsko arhitekturo (mainframe, osebni računalniki, distribuirani /omrežni)
- aktivnosti, ki jih podpirajo (operativni, managerski, strateški)
- podporo (transakcijski, upravljalni, vodstveni, IS za podporo odločanju, ekspertni sistemi, za podporo pisarniškemu delu, za podporo skupinskemu delu,..)

Informacijski sistemi za podporo odločanju *(DSS angl. decision support system))* nudijo podporo vodstvu v edinstvenih situacijah sprejemanja strateških odločitev. Pri odločanju je treba za dani primer ugotoviti katere dejavnike je potrebno upoštevati in v kolikšni meri. Obdelave podatkov so zelo zahtevne, odzivni časi so lahko tudi daljši. Za uporabnike je pomembno, da so rezultati prikazani na razumljiv, uporabnikom prilagojen način[4].

2.1 Procesi in načini odločanja

Odločanje je sestavni del procesa reševanja problemov. Pri odločanju med več možnostmi (variantami) izbiramo tisto, ki naj čim bolj ustreza danim ciljem.

Rezultat je odločitev t.j. izbira najboljše oziroma najoptimalnejše možnosti iz množice razpoložljivih. Elementi pri odločanju so kriteriji, zaloga vrednosti kriterijev, odločitvena (preferenčna) funkcija, variante in ocene variant.

Pri odločanju se srečujemo z vrsto težav [4]:

- ne poznamo vseh faktorjev, ki vplivajo na odločitev,

- variante, med katerimi se odločamo, niso natančno definirane,
- obstaja veliko število dejavnikov, ki vplivajo na odločitev,
- obstaja velika količina variant, zato za natančno študijo odločitvenega problema in variant zmanjka časa,
- vsi podatki niso vedno dosegljivi,
- celo cilji različnih odločevalcev so lahko različni,
- nepoznavanja odločitvenega problema in ciljev odločitve,
- omejena sredstva (čas, denar, strokovnjaki, ...),
- nesoglasje med ljudmi, ki sodelujejo pri odločanju.

Poznamo tudi več načinov odločanja [4]

- naključno odločanje,
- intuitivno odločanje (Ne vemo natančno utemeljiti naše odločitve, pri odločanju smo uporabili intuicijo.),
- sistematično odločanje (Uporabimo in organiziramo podatke, informacije in znanje.).

Noben od navedenih načinov odločanja ne zagotavlja 100% pravilnosti odločitve, vendar je verjetnost za pravilno odločitev pri sistematičnem odločanju veliko večja, kakor pri naključnem ali intuitivnem odločanju. Sistemi za podporo odločanju olajšajo trud v odločitvenem procesu in pomagajo preseči človekove omejitve pri procesiranju informacij. Omogočajo hitrejše sistematično odločanje.

Sistemi za podporo odločanju so torej dandanes nepogrešljiv del programske opreme pri procesih odločanja. V prispevku se bomo osredotočili predvsem na funkcije učinkovitega in hitrega pridobivanja kvalitetnih podatkov iz informacijskega sistema. Tehnologija ResEvo ASK BI nam na edinstven način omogoča,, da so vsi podatki dosegljivi enostavno in hitro ter hkrati izpostavi funkcionalnosti vrtanja po različnih dimenzijah in merah samega vprašanja. ResEvo ASK BI nam omogoča dobesedno »pogovor o poslovnih podatkih.«

V prispevku prikazujemo tehnologijo, ki je uporabna v zelo širokem spektru informacijskih rešitev, obstajajo tudi ekspertni sistemi, ki se obnašajo kot strokovnjaki na ozkem strokovnem področju. Vendar so praviloma takšni sistemi zelo dragi za razvoj in vzdrževanje in imajo na današnjem zahtevnem in stroškovno občutljivem konkurenčnem trgu omejene možnosti za implementacijo.

2.2 Samopostrežna analitika

Pristopi samopostrežne analitike (*angl. self-service business intelligence*) omogočajo končnim uporabnikom ustvarjanje prilagojenih poročil in nudijo odgovore na njihova analitična vprašanja, medtem ko hkrati sprostijo delo IT oddelka, da se le-ti lahko osredotočajo na druge naloge - koristne za celotno podjetje [5].

Glavni izziv teh sistemov je poleg odzivnih časov uporabniški vmesnik, oziroma kako uporabniku na učinkovit in hiter način odgovoriti na njegova poslovna vprašanja preko programske opreme.

2.3 Tehnologija ResEvo ASK BI

Zamislite si danes svetovni splet brez iskalnikov?

Tudi v podjetjih imamo nek »splet« poslovnih podatkov iz katerih vsak dan luščimo informacije in na podlagi le-teh sprejemamo odločitve? Pomembno je:

- Ali te odločitve sprejemamo naključno, intuitivno ali sistematično?
- Ali te odločitve sprejemamo na podlagi ažurnih podatkov ali starih poročil?
- Ali potrebujemo za dostavo poročil od zahteve nekaj sekund, minut, ur ali dni?
- Ali lahko podatke pridobimo sami, ali moramo angažirati v pripravo podatkov dragocenega časa več posameznikov?

Zamislite si tehnologijo, ki bi nam omogočala tudi v podjetjih »googlanje« po podatkih?

SLIKA 2: Evolucija sistemov za podporo odločanju [3]

Ali veste, da se po podatkih TDWI (*angl. The Data Warehousing Institute*) 75% programske opreme za poslovno analitiko ne uporablja?

Ali veste, da po podatkih Forrester Research podjetja uporabljajo samo 12% podatkov, ki so na voljo [12]?

Vprašanj, ki se nam ob tem porajajo je ogromno. In najmanj zgoraj navedena vprašanja so bila izhodišča pri snovanju tehnologije ResEvo ASK BI, ki skuša odgovoriti na vsa ta zastavljena vprašanja uporabnikov. S pomočjo tehnologije lahko sprejemamo odločitve sistematično na podlagi hitro dostopnih ažurnih podatkov preko enostavnega vmesnika, preko katerega dostopamo do podatkov na podoben način kot »googlamo« po spletu.

ResEvo ASK BI ne rešuje samo enostavnost uporabe in problem hitrosti, ampak učinkovito spodbuja k uporabi sistema in k sistematičnemu odločanju, ker z enostavnim iskanjem hitro najdejo odgovore na svoja vprašanja. Brez strahu, brez učenja kompleksnih uporabniških vmesnikov ERP sistemov (*angl. Enterprise resource planning*), ki so zahtevni že v osnovni rabi. V praksi se izkaže, da je tudi potreba po stalnem osveževanju znanja

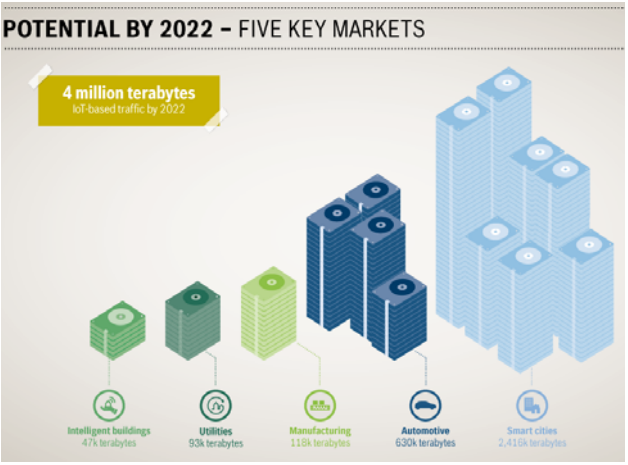
pri rabi programov, za uporabnike in IT oddelke zahteven in drag proces.

Tehnologija ResEvo ASK BI nam omogoča, da uporabnik v naravnem jeziku postavi vprašanja, kot so:

- stroško po letih po kupcih čez mesece,
- kartica šola Kranj Elektro
- terjatve včeraj po vsebini,
- poraba energije po letih za šola Kranj Elektro,
- ipd., po vseh dimenzijah merah in podatkih, ki jih imamo v informacijskem sistemu!

ResEvo ASK BI pretvori vprašanje postavljeno v naravnem jeziku v odgovor vedno v realnem času v več dimenzijski poizvedovalni jezik, če sistem odgovora na pozna, nam to sporoči, zato ne moremo dobiti napačne informacije. Uporablja tudi mehanizme mehke logike iskanja (*angl. fuzzy search*) [9]. ResEvo ASK BI »govori« tudi več jezikov, od slovenščine, nemščine, angleščine itd.

Pri iskanju nam izdatno inteligentno pomaga s ključnimi besedami in vsebino, ki je v sami podatkovni zbirki (primer: imena podjetja, imena izdelkov, stroškovnih mest), tudi to preko sistema iskanja, iskanja preko mehke logike (*angl. fuzzy search*). Sistem si tudi ves čas beleži statistiko iskanja, na podlagi zahtev uporabnikov tudi določa prioritete odgovorov na vprašanja.



SLIKA 3: Pametna mesta bodo generirala ogromno količino podatkov, ki so osnova za odločanje [14]

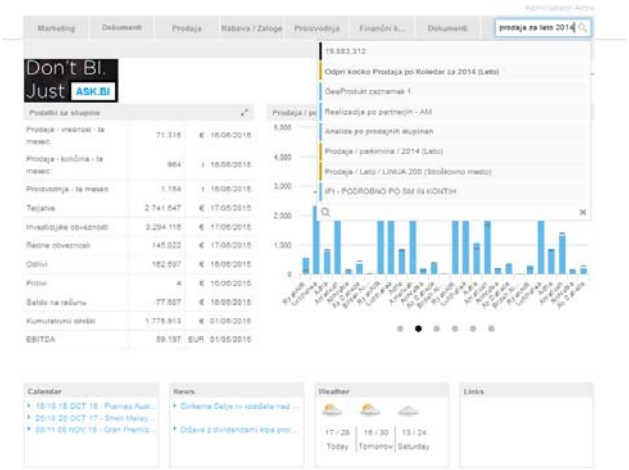
Poizvedba v več dimenzijskem poizvedovalnem jeziku se nato intepretira v OLAP (*angl. online analytical processing,*) strežniku, ki je lahko od poljubnega proizvajalca programske opreme (IBM, SAP, INFOR, ORACLE, PENTAHO, …), ki podpira industrijski standardni protokol XMLA (*angl. XML for Analysis*) [6] [7] [8].

Tehnologija se lahko integrira v katerekoli drugo rešitev (Microsoft SHAREPOINT, intranet portali različnih proizvajalcev, v vse klasične ERP aplikacije, …), saj je grajena po načelih SOA [11], ter ima vso funkcionalnost dosegljivo preko varnih in vsem programskim jezikom dostopnih REST spletnih storitev [10]. Enostavno lahko tudi v vašo že obstoječo aplikacijo dodamo še okence za iskanje ter uporabnikom, ki jih lahko črpamo iz centraliziranega imenika - LDAP sistema (*angl. Lightweight Directory Access Protocol*) kot je Microsoft Active Directory in podobni, omogočimo unikaten učinkovit samopostrežni sistem za podporo poslovnim odločitvam.

Iz vidika uporabnika ter oddelka za informatiko in iz vidika implementacije rešitve pa ta odprtost pomeni, da tehnologijo lahko uporabimo samo kot nadgradnjo že obstoječega sistema za podporo poslovnemu odločanju (primer: če imamo že zgrajene kocke na Microsoft OLAP tehnologiji, INFOR OLAP, ali ORACLE OLAP tehnologiji ipd., potem je stvar nekaj ur, da rešitev ResEvo ASK BI integriramo in preizkusimo na že obstoječih, že modeliranih kockah, podatkovnemu skladišču, ETL-ih, brez kakršnekoli dodatne investicije). Brez velikih sprememb v informacijskem okolju dosežemo zelo veliko dodano vrednost, ker na enostaven in dokazano učinkovit način končnim uporabnikom omogočimo pristop k samopostrežnemu analitičnemu sistemu za podporo odločanju. Spreminjamo kulturo odločanja iz naključnega, intuitivnega ali časovno in iz vidika virov potratnega v učinkovito sistematično odločanje.

3. SKLEP

Enostavnost in uporabnost ter učinkovita vsakdanja uporabniška izkušnja so težko združljivi pojmi. Vedno je prisotno tehtanje med kompleksnim uporabniškim vmesnikom, primerno količino podatkov, poročil in analiz, specializiranih rešitev ipd. , ki bodo zadostovali za učinkovito delovanje v informacijskem sistemu na eni strani in enostavno, hitro in učinkovito uporabo programske opreme na drugi strani. Če nam to uspe uravnovesiti, uporabniki programsko opremo sprejmejo z veseljem in navdušenjem.



SLIKA 4: "Googlajte" po vaših podatkih

Dodana vrednost tehnologije ResEvo ASK BI, kot približek uporabniške izkušnje, ki nam jo danes nudijo spletni iskalniki za krmarjenje po svetovnem spletu, se je izkazala na prvih projektih za zelo dragoceno. Za nas implementatorje, za IT oddelke v smislu razbremenitve in zmanjšanje njihovega dela, za končne uporabnike, kateri so dobili samopostrežni analitični sistem in v celoti za podjetje, kjer se odločitve sprejemajo veliko bolj

učinkovito, na podlagi izluščenih informacij iz centraliziranega urejenega podatkovnega vira – ene same resnice. Odzivi uporabnikov so zelo pozitivni, orodje jim je »domače«, enostavno za uporabo, tehnologija jim je postala nepogrešljiv del vsakdana, zato je posledično vse več odločitev sistematičnih, na podlagi ažurnih kvalitetnih podatkov, ki odražajo realno stanje v podjetju. Verjamemo, da bodo združbe, ki posedujejo to tehnologijo zaradi nje konkurenčnejša in uspešnejša.

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Zakaj smo v zadnjih 7 letih opremili že 34 nadzornih centrov?
Why have we equipped 34 control centers in the last 7 years?

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POVZETEK

RAP-ing d.o.o. je na trgu sodobnih tehnologij in avtomatizacije sistemov ter multimedijskih rešitev prisotno že več kot 25 let. Uspešno implementiramo najzahtevnejše sistemske rešitve za naše stranke, ki zaupajo nesporni kvaliteti naših izdelkov ter celovitim rešitvam, ki jih ponujamo za njihove »mission-critical« projekte v komandno kontrolnih centrih, predstavitvenih in korporativnih prostorih ter broadcasting okoljih.

Naša ekipa za **raziskave in razvoj** nenehno stremi k inovativnim pristopom pri integraciji strojne in programske opreme, ter na ta način dopolnjuje in izboljšuje naše rešitve. Sami oblikujemo, testiramo in integriramo vse tehnološke rešitve, kar nam zagotavlja popolno kontrolo nad njihovo kvaliteto in funkcionalnostjo.

Zavedamo se specifičnosti posameznega projekta, zato posvečamo posebno pozornost željam naših strank in njihovi viziji, da v sodelovanju z njimi poiščemo najustreznejšo rešitev. Naš ciljno usmerjen pristop tako spremeni kompleksen inženirski sistem v intuitivno ter po meri narejeno rešitev, ki omogoča našim strankam jasnejši pogled, enostavno kolaboracijo in posledično sprejemanje boljših odločitev.

Zagotavljamo celovite rešitve za sisteme na področju:

- Analize
- Svetovanja
- Oblikovanja
- Integracije
- Inženiringa
- Vzdrževanja

ABSTRACT

RAP-ing d.o.o. has been present on the market of contemporary technologies, system automation and multimedia solutions for over 25 years. We successfully implement the most demanding system solutions, so our customers can rely on our field-proven pedigree of powerful technologies and turn-key services for their most “mission-critical” projects in command and control centers, presentation and corporate spaces and broadcasting environments.

Our advanced **research and development** team continually drives innovation, working to develop and enhance our services for customers with hardware and software solutions. We design, test and integrate all of our technologies, giving us full control over their quality and functionality.

Recognizing that every project is unique, so we fully engage and collaborate with our customers to meet their operational requirements and vision. Our solutions-based approach transforms complex engineering into intuitive, custom-tailored solutions that empower our customers to see more clearly, collaborate more fluidly and ultimately, make better decisions.

We ensure perfect service on turn-key basis:

- Analysis
- Consulting
- Design
- Integration
- Engineering
- Maintenance

1. DESIGN PROCESS / R&D

Our expertise and knowledge on latest technologies and audiovisual communications market and our effort to study customer's requirements allows us to adapt new technologies within the spaces, furniture and ergonomics, in such a way that we can provide the best solution possible.

On the Slovenian and Adriatic market we represent world renowned manufacturers with whom we are able to offer our customers operational reliability and highest solution quality, with an ear for customer's specific wishes.

We carry out total integration of the necessary hardware and develop our own software systems to operate the equipment. Innovative design process together with the research and development and creativity of our experts enables us to anticipate your dreams and immerse them in latest technologies, even in environments where space is a luxury.

1.1 Architectural design

The creative imagination of our team of designers combines with the constant search for innovation on the part of the engineering team results is a combination of functionality, ergonomics and esthetics adapted for all kinds of customized solutions.

Figure 1: Architectural design (ELES – DAC)

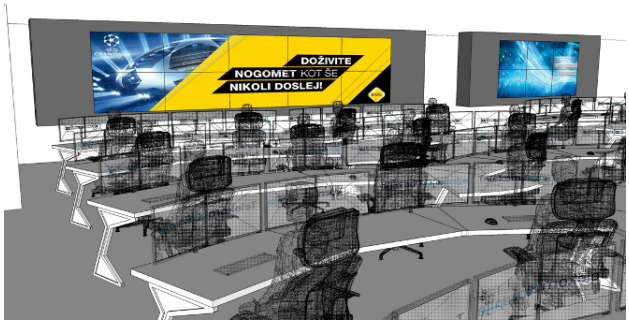

Figure 2: Architectural design (Telekom Slovenije)

1.2 Multimedia design

Depending on the architectural design we provide sophisticated multimedia design those suites all the needs we have identified in the design process with customer. The result is technical documentation used for tender documentation or further project development.

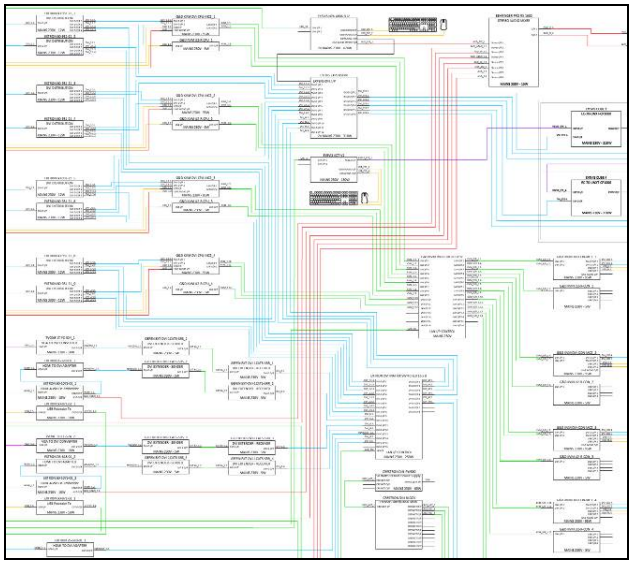

Figure 3: Multimedia design (TEŠ6)

1.3 Automation design

Our smart automation solutions make our products helpful, elegant, fun and easy to use. Businesses experience increased productivity, enhanced environments for employees and customers, and simple control, all tailored to costumers design.

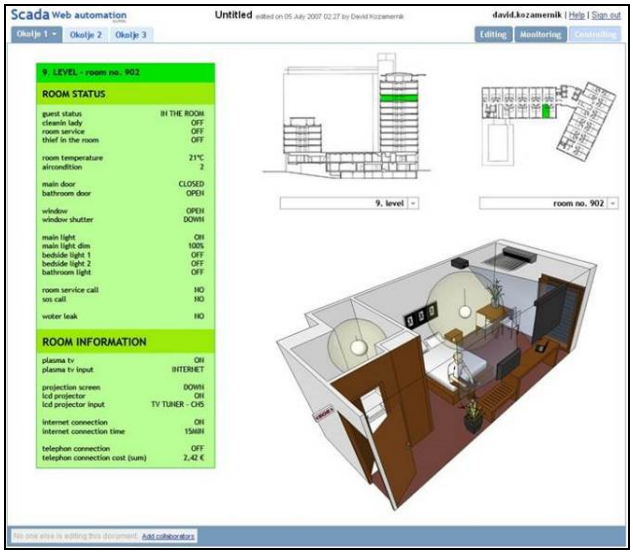

Figure 4: Automation design (KISS)

2. AREAS OF FOCUS

RAP-ing mission is to cooperate with our customers from an early stage in the project and help them develop their ideas into future proof solutions.

2.1 Command and control centers

We offer special solutions for control centers that deal with huge amount of important data and need to have them visualized on one display that is seen to all the users in the control room. This is especially important for costumers in energy, water and public utility's, telecommunication and data centers, traffic and transportation control rooms, security, defense and crises rooms and industrial and process control rooms.

Figure 5: Command and control centers (JPEP BiH - NC)

2.2 Broadcasting environments

We offer solutions based on standard multimedia infrastructure solving the needs of creation, distribution and management of audiovisual contents in TV channels, public institutions, IPTV, universities, content distributors and news agencies.

Figure 6: Broadcasting environments (RTV Slovenija)

2.3 Presentation spaces

We dedicate ourselves to creating the right setting in which to present your company and solutions, carefully selecting our most technologically advanced equipment. We provide appropriate multimedia equipment and display technologies to make an impact on visitor, with limitless display sizes, resolutions and interactivity.

Figure 7: Presentation spaces (Mercedes - Eyevis)

2.4 Corporate spaces

In multimedia reach environment we provide convergence solutions that allows users to freely collaborate threw all the present devices. In the other hand we provide solutions to communicate the company's core values externally.

Figure 8: Corporate spaces (Crestron)

3. REFERENCES

Bigger projects since 1989:

3.1 Control Centers

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- CGES (MN)
- TE Pljevlja (MN)
- Elektro Gorenjska (SI)
- GEN energija (SI)
- DARS (SI)
- MORS (SI)
- HŽPP (CRO)
- KZPS Slovenia air control (SI)
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- Telekom Slovenije, GSM (SI)
- VOKA Ljubljana (SI)
- JANAF Krk (CRO)
- KONČAR, OI Zagreb (CRO)
- HEP, NC Petruševac (CRO)
- HEP, NC Varaždin (CRO)
- TENT, Obrenovac (RS)
- TE-TO, Zagreb (CRO)
- Alban control (AL)

3.2 Commercial / National Television

- RTV SLO (SI)
- POP TV (SI)
- PLANET TV (SI)
- Aljezeera (BIH)

3.3 Local broadcasters

- R Kanal Ribnica (SI)
- GluhiTV (SI)
- Anstat TV Krško (SI)
- Studio 12 (SI)
- Čarli TV (SI)
- MTV Adria (SI)
- TV Galeja (SI)
- KTV Dravograd (SI)
- TV Komenda (SI)

3.4 Convention Centers

- Cankarjev Dom (SI)
- Gospodarsko razstavišče (SI)
- Hotel Mons (SI)
- M Hotel (SI)
- Hotel Bernardin (SI)

3.5 Educational Institutions

- Elektro fakulteta UNI LJ (SI)
- Tehniška šola Ljubljana (SI)
- School of Economics Radovljica (SI)
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3.6 Coorporate Spaces

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- Porsche Interauto (SI)
- Sava Tires (SI)

3.7 Conference Halls / Meeting Rooms

- APEK (SI)
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POVZETEK

Vizija Pošte Slovenije je biti najpomembnejši in največji izvajalec poštnih in z njimi povezanih logističnih storitev v Sloveniji. Naše poslanstvo temelji na zagotavljanju razvoja ter kakovostnega, konkurenčnega in zanesljivega izvajanja poštnih storitev, logističnih storitev, denarnih storitev, varnih elektronskih poštnih storitev, storitev uporabe globalnega poštnega informacijskega in komunikacijskega omrežja in prodaje trgovskega blaga za prebivalstvo in pravne subjekte v domačem in mednarodnem okolju. Aktivnosti Pošte Slovenije v okviru pametnih mest so usmerjene v področje dodatne podporne infrastrukture in odprtih podpornih tehnologij IKT, kjer lahko ponudimo kakovostne in zanesljive rešitve in storitve računalništva v oblaku (IaaS, PaaS,SaaS), kot tudi svoje logistične storitve in mrežo. Z rešitvami računalništva v oblaku želimo uporabnikom predvsem omogočiti uporabo storitev po najemnem modelu, ki jih bodo skupaj s stroški lahko prilagajali svojim trenutnim potrebam in rasti poslovanja. S svojimi logističnimi storitvami pa delujemo v segmentu obvladovanja celovitih oskrbovalnih verig, ki uporabnikom prinašajo celovite rešitve.

ABSTRACT

Post of Slovenia's vision is to be the most important and largest provider of postal and associated logistics services in Slovenia. The company's mission relies upon the development and high-quality, competitive and reliable provision of postal, logistics, financial, secure electronic postal services, global postal IT and communication network services, and sales of merchandise to private individuals and legal entities in Slovenia and the rest of the world. Post of Slovenia's activities within the Smart Cities Project are directed towards additional support infrastructure and ICT support technologies. The company provides a range of high-quality and reliable services, services in the cloud (IaaS, PaaS,SaaS), as well its logistics services and the network. The cloud service solutions are available for the use through the leasing model. They are tailor-made in terms of affordable expenditure, current needs and business expansion. Logistic services, on the other hand, offer comprehensive solutions for the complete supply chain logistics.

1. INTRODUCTION / UVOD

Pošta Slovenije je usmerjena v razvoj moderne poslovne družbe, kar je pogojeno tudi z razvojem na področju novih tehnologij in logistike.

V okviru strateškega programa prestrukturiranja in reorganizacije smo že pred časom izvedli vrsto prilagoditev za zagotavljanje novih, tehnološko naprednih rešitev na področju informacijske tehnologije. Tako namesto pretekli regionalni oziroma teritorialni organiziranosti tudi sami sledimo produktni in centralizirani organiziranosti, ki so jo uspešni evropski poštni operaterji uvedli že pred leti,. Pri informacijskih storitvah, kjer že beležimo rast prihodkov, stavimo na povezovanje s poslovnimi partnerji in razvoj vrhunskih rešitev na področju storitev računalništva v oblaku tako za vsakodnevno rabo kot za zahtevne uporabnike. Z rešitvami, ki jih nudi eden največjih in najsodobnejših informacijskih sistemov, lahko opravljamo moderne in tehnološko najbolj zahtevne storitve tudi za državo oziroma njene organizacijske enote. Ocenjujemo, da je priložnosti, ki jih v Pošti Slovenije prepoznavamo na področju ponudbe informacijskih storitev, še veliko. S tem namenom bomo v naslednjih letih nadaljevali z vlaganji v nadaljnji razvoj informacijskega sistema kot tudi v strokovno izobraževanje zaposlenih, da bodo lahko razvijali konkurenčne in kakovostne informacijske storitve.

Sicer pa se Pošta Slovenije že več let zaporedoma uvršča v sam vrh evropskih operaterjev po doseganju standardov kakovosti v poštno-logističnem sektorju. V skladu s strateškim razvojnim programom izvajamo prestrukturiranje, ki ga narekujejo razvoj in trendi v poštno-logistični dejavnosti na domačem in evropskem trgu. Pri tem smo usmerjeni v ohranjanje vodilnega tržnega deleža na področju poštnih storitev, v utrditev položaja vodilnega izvajalca paketnih storitev in v oblikovanje prepoznavnega izvajalca na trgu logističnih storitev. Na področju distribucije blaga in poslovnih paketov smo tako že v letu 2013 vstopili v segment obvladovanja celovitih oskrbovalnih verig, ki zajemajo celovite rešitve od skladiščenja in komisioniranja do dostave na prodajna mesta doma in na tujem. Največ uspeha trenutno beležimo na področju avtomobilske panoge.

2. KOMPETENTNI PONUDNIK IT IN LOGISTIČNIH REŠITEV

Pošta Slovenije uvršča v izbor svojih ključnih in strateških razvojnih področij tudi razvoj:

- storitev na področju IT, kjer želimo postati eden od vodilnih ponudnikov varnih IT storitev (digitalna identiteta, varna e-hramba, e-vročanje, IT-infrastruktura, digitalna pisarna itd.),
- storitev in na področju paketov in logistike, kjer želimo utrditi položaj vodilnega izvajalca paketnih storitev in

postati prepoznaven izvajalec na trgu logističnih storitev.

Svoje rešitve in storitve želimo v okviru projekta pametna mesta ponuditi različnim drugim partnerjem kot tudi uporabnikom, ki jih projekt naslavlja bodisi iz privatnega ali javnega sektorja, ter tako sodelovati in prispevati svoje dosežke in znanje predvsem v okviru tehnološkega področja podpornih odprtih tehnologij in aktivnosti. Ocenjujemo, da smo kompetenten, kakovosten, zanesljiv in zaupanja vreden partner na področju IT in logistike.

Z lastno IT-infrastrukturo zagotavljamo varno e-poslovanje tako za lastne potrebe kot za potrebe strank. Z informacijsko tehnologijo smo prisotni na vseh lokacijah – na več kot 1.500 poštnih (bančnih) okencih, več kot 250 zalednih delovnih mestih in na več kot 850 delovnih mestih na upravi družbe in v PE. Upravljamo več kot 15.000 kosov IT-opreme ter več kot 5.000 km komunikacijskih povezav, hkrati pa imamo še okoli 100.000 zunanjih uporabnikov.

Slika 1. Mreža podatkovnih centrov in kolokacij Pošte Slovenije.

V notranjem in zunanjem transportu uporabljamo več kot 3.000 transportnih enot (lahka in srednja dostavna vozila ter tovorna vozila, transportni vozički, viličarji, dvokolesa itd.). Za izvajanje logističnih procesov dodatno uporabljamo še zabojnike, mobilne ovijalce palet, stroje za vezanje svežnjev in drugo logistično opremo.

Slika 2. Utrip pred logističnim centrom Pošte Slovenije v Ljubljani.

Za ohranjanje dobre kondicije logističnega in informacijskega sistema izvajamo kontinuirana finančna in razvojna vlaganja.

3. PONUDBA ZA PAMETNA MESTA

3.1 Oblačne in druge IT storitve

Pošta Slovenije skladno s tipsko delitvijo računalništva v oblaku ponuja storitve na vseh predmetnih področjih (IaaS, PaaS in Saas), ki zagotavljajo vse tehnične, tehnološke in varnostne zahteve za hibridni oblak kot tudi za razvojni oblak. Na področju IaaS lahko ponudimo sistemske prostore in virtualizirano okolje, na področju PaaS pa najem aplikacijsko-razvojne platforme (operacijski sistemi Microsoft, Linux, Oracle). V okviru IaaS in PaaS tako uporabnikom omogočamo popolnoma avtomatiziran, samopostrežen, avtonomen in varen sistem za delo v računalniškem oblaku. Rešitev je finančno učinkovita, saj ponujamo več možnih oblik najema (npr. plačilo po dejanski uporabi, ki uporabniku omogoča dinamičen najem storitev). Uporabnik tako lahko najema storitve v skladu s trenutnimi potrebami, predvsem pa raste z njimi in temu primerno tudi plačuje. Namesto modela CAPEX (klasična investicija, kjer največji strošek nastopi takoj in se šele v naslednjih letih niža), je uporabniku na voljo model CAPEX (za polno funkcionalnost rešitve se plača toliko, kolikor je uporabljena in se lahko povečuje sorazmerno z večanjem obsega najema). S poslovnega vidika pomeni to za uporabnike znižanje stroškov poslovanja, plačilo storitev po dejanski uporabi (Pay-per-use model), krajši čas do začetne uporabe, višjo donosnost naložbe (ROI), model brez visokih začetnih investicij.

V okviru SaaS področja lahko Pošta Slovenije ponudi najem aplikacij iz oblaka. Gre za ponudbo informacijskih storitev iz oblaka preko spletnega portala, ki predstavlja za uporabnike enotno vstopno točko v svet informacijskih storitev po sistemu t.i. »samopostrežništva«. Rešitev omogoča, da uporabniki za ugodno mesečno naročnino in z nekaj kliki poskrbijo za svojo informacijsko opremljenost, medtem ko za brezhibno delovanje in varnost sistema ter za sledenje tehnološkemu razvoju poskrbi Pošta Slovenije oz. njeni sodelujoči partnerji in ponudniki rešitev/storitev. Uporabnikom želimo preko portala omogočiti enostaven dostop do storitev, pri čemer so ključna opravila avtomatizirana, storitve pa se obračunavajo samodejno, skladno z njihovo uporabo. Rešitev je torej zastavljena v smislu tržnice najrazličnejših aplikacij, v kateri bodo uporabniki lahko glede na svoje potrebe najemali rešitve za izbran čas, v izbranem obsegu itd. Med rešitvami, ki so predvidene v ovkiru takšne tržnice so npr. dokumentni sistemi, poslovno računovodski informacijski sistemi, informacijski sistemi za podporo prodajnemu procesu ipd.

V sklop projekta umeščamo tudi rešitev za e-vročanje PoštAR, ki jo je Pošta Slovenije uvedla v letu 2015. Rešitev predstavlja digitalno preslikavo pošiljanja nekaterih pisemskih pošiljk v fizičnem svetu, kot so navadna pisma, priporočena pisma z oz. brez povratnice in pisma po posebnih zakonih kot je ZUP. Bistvene značilnosti in prednosti rešitve z uporabniškega vidika so:

- pošiljanje in prejemanje pošte (ePisem) brez časovnih (24/7/365) in geografskih omejitev,
- enostavna uporaba na obstoječih e-poštnih rešitvah (uporaba z najrazličnejšimi priljubljenimi e-poštnimi odjemalci),
- hitro in cenovno ugodno pošiljanje pošte (prihranek pri stroških tiskanja, kuvert in papirja, ter ugodnejša poštnina),

- okolju prijazno pošiljanje pošte (zmanjšanje škodljivih emisiji in odpadkov, saj ni porabe energije in emisij za izdelavo papirja, barv za tiskalnik, lepil za kuvert, za prevoz pošiljk itd.)
- uporaba številnih dodatnih in koristnih storitev (npr. prevzem s SMS kodo, nastavitev roka za prevzem).
- varnost na najvišji ravni in v skladu z vso pristojno zakonodajo v Sloveniji in EU (vsi dokumenti sistema PoštAR so elektronsko podpisani v skladu z ZEPEP-Zakon o elektronskem poslovanju in elektronskem podpisu in imajo enako veljavnost ter dokazno vrednost kot papirni dokumenti).

3.2 Logistične storitve

Pri razvoju in ponudbi logističnih storitev, stremimo k zadovoljitvi potreb uporabnikov v različnih segmentih trga oskrbovalnih verig. V ovkiru logistične ponudbe smo še posebej tržno aktivni na sledečih segmentih:

- Oskrba maloprodaja/veleprodaja - priprava in oblikovanje modelov logistike in skladiščenja ter s tem povezane tehnološke rešitve.
- Logistika rezervnih delov oz. logistika tehničnega blaga in materialov - priprava in oblikovanje modelov logistike in skladiščenja ter s tem povezane tehnološke rešitve.
- Logistika živil in pijač - model logistike, ki omogoča prevzem pripravljenih in ustrezno embaliranih pošiljk na dogovorjenem prevzemnem mestu in njihovo dostavo do naslovnikov oz. prodajnih mest.

4. DOSEŽKI, REFERENCE IN SODELOVANJA

4.1 Dosežki in reference na IT področju

IaaS – Varni sistemski prostori – V obdobju 2002-2015 smo vzpostavili pet visokotehnoloških varnih podatkovnih centrov skladnih s standardi na tem področju. Gre za več kot 500 m2 prostora z visokim nivojem zaščite pred vlomi in okoljskimi vplivi in vzpostavljenim fizičnim varovanjem ter tehnično varnostjo.

IaaS, PaaS, SaaS – Projekt HP PS – V obodbju 2013-2014 smo v ovkiru partnerskega programa Cloud Agile v sodelovanju s podjetjem Hewlett-Packard (HP) vzpostavili avtomatizirano okolje za kreiranje in uporabo hibridnega oblaka. Rešitev omogoča najrazličnejšo paleto možnosti tako pri oblikovanju virtualnih strežnikov (glede virov) kakor tudi operacijskih sistemov (dve različici na platformi Windows - 2008 R2 in 2012 R2, ter kar tri Linuxove različice - RedHat, Debian in CentOS).

Med referenčnimi uporabniki IaaS, PaaS in SaaS rešitev so: MJU, Intenzz (NL), Toyota Adria (SLO, HR, ČG), LPKF Laser (Nemčija), SPAN (HR), PBS, Časnik Finance, IZUM, Logos, Hakl IT, Si.Mobil, podjetja iz SMB segmenta.

Digitalna pisarna – V letu 2012 smo uvedli SaaS rešitev najema strojne opreme - HW (PC-ji, laptopi, tiskalniki itd.) in programske opreme – SW (uporaba e-pošte, skupinsko delo, komuniciranje, hramba podatkov na oddaljenem disku ipd.). Rešitev predstavlja fleksibilno IT platformo, ki se prilagaja trenutnim poslovnim potrebam uporabnika, omogoča dostop od koderkoli, ne zahteva začetne investicije in potreb po IT strokovnjakih in omogoča plačevanje po mesečni (u)porabi (pay-as-you-go). Med uporabniki storitve so manjša in srednje velika podjetja kot tudi nekateri uporabniki v javni upravi.

Digitalizacija fizičnega dokumentarnega gradiva – V obdobju 2013-2014 smo uvedli rešitev celovite in zakonsko skladne storitve masovnega zajema in digitalizacije fizičnega dokumentarnega gradiva. Rešitev je bila razvita v lastni režiji brez zunanjih partnerjev, uporabljamo pa jo tudi za lastne potrebe. Med uporabniki beležimo uporabnike iz bančnega sektorja in druge poslovne uporabnike.

E-vročanje – rešitev PoštAR – V obdobju 2014-2015 smo razvili sodobno in uporabnikom prijazno rešitev elektronskega vročanja, ki predstavlja preslikavo določenih storitev fizičnega prenosa v digitalno obliko in pri čemer vključuje še številne dodatne funkcionalnosti in dodane vrednosti. Rešitev je bila razvita v sodelovanju z zunanjim slovenskim partnerjem in je v fazi implementacije na trg.

4.2 Dosežki in reference na logističnem področju

Med rešitve na logističnem področju od leta 2103 umeščamo rešitve oskrbe za maloprodajo in veleprodajo, logistiko rezervnih delov, tehničnega blaga in materialov ter logistiko živil in pijač. Vse rešitve so plod internega razvoja.

Reference v okviru logističnih storitev:

- opravljamo celovito distribucijo gospodinjskih aparatov, obutve in tekstila za priznane blagovne znamke,
- za večino zastopanih avtomobilskih znamk v Sloveniji opravljamo tako distribucijo iz tujine kot nočno (t.i. brezkontaktna dostava) in dnevno dostavo rezervnih delov do servisnih centrov, opravljamo pa tudi skladiščno manipulacijo,
- za priznane blagovni znamke opravljamo distribucijo brezalkoholnih in alkoholnih pijač.

4.3 Mednarodna vpetost in sodelovanja

Pošta Slovenije je kot nacionalni poštni operater vpeta v številna mednarodna sodelovanja iz naslova opravljanja svoje osnovne dejavnosti:

- PostEurop (Združenje evropskih javnih poštnih operaterjev) – kot člani združenja aktivno sodelujmo na različnih tematskih področjih (regulativa, marketing, operativa, kakovost, mednarodni obračun, razvoj novih storitev).
- UPU (SPZ - Svetovna poštna zveza) – aktivno sodelujemo na zasedanjih in sestankih Evropske komisije kot tudi v EMS in telematski kooperativi ter skupini AESUG (Advanced Eelctronic Services Sub Group).
- IPC (International Post Corporation) – sodelujemo v projektnih skupinah v zvezi s kakovostjo storitev, mednarodnim obračunom in izmenjavo paketnih pošiljk.

- Interconnect – sodelujmo v projektu, ki na pobudo Evropske komisije uvaja novosti na področju poenostavitve poslovanja v okviru spletne trgovine;
- PRIME – sodelujemo v projektu za izmenjavo podatkov o prenosu priporočenih in ekspresnih pošiljk.
- Organizacija PUMED – smo ustanovni člani združenja poštnih operaterjev na območju Sredozemlja, ki vključuje tako evropske kot tudi afriške in bližnjevzhodne poštne operaterje.

V skladu s strateškim in vse bolj pomebnim področjem IT storitev, lahko kot velik in pomemben dosežek navedemo sodelovanje v okviru kataloga Cloud28+ (Helion Network), ki predstavlja skupni storitveni katalog ponudnikov oblačnih storitev v več kot 28 državah. Pošta Slovenije je v katalog vključena na podlagi vzpostavljenih rešitev in sodelovanja v partnerskem programu HP Cloud Agile.

Energetske rešitve za objekte in optimizacijo sistemov

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POVZETEK

Skupina Petrol je vodilni regijski ponudnik učinkovitih in celovitih rešitev upravljanja z energijo v objektih ter celotne energetske in vodne infrastrukture v mestih. Petrolovo udejstvovanje na področju celovitih rešitev za učinkovito rabo vseh virov energije, vzpostavlja tesnejše in predvsem dolgoročne odnose z odjemalci energije oz. energentov. S svojimi kupci gradimo partnerski odnos in jim, tako v javnem, kot tudi zasebnem sektorju, ponujamo celovite rešitve, kar posledično zmanjša rabo primarnih virov energije ter znižanje stroškov za energetsko oskrbo.

ABSTRACT

The Petrol Group is a leading regional provider of complete efficient solutions for energy management in buildings and also for energy and water infrastructure in urban areas. Participation in the field of integrated solutions for the efficient use of all energy sources, creates stronger and long-term relationships with customers of energy. We build a partnership and we offer our customers (public as well as the private sector) comprehensive solutions, which in turn reduces the use of primary energy sources and a reduction in the costs of energy supply.

1. UVOD

V okviru energetskih rešitev za objekte in optimizacijo sistemov ponujamo celovite rešitve oskrbe in upravljanja z energijo v objektih ter storitve s področja optimizacije delovanja sistemov daljinske energetike, vodovodnih sistemov ter razsvetljave v številnih mestih v regiji. Izvedba teh kompleksnih projektov se praviloma izvaja na podlagi dolgoročno sklenjene pogodbe o oskrbi z energijo oz. zagotavljanju prihrankov, kjer Petrol poleg same izvedbe različnih ukrepov, jamčenja za doseganje dogovorjenih obratovalnih parametrov in upravljanja z energetskimi sistemi, zagotavlja tudi financiranje izvedbe investicijskih ukrepov. Prodajni programi v tem segmentu so: daljinska energetika, vodovodni sistemi, učinkovita razsvetljava ter energetsko upravljanje objektov.

1.1 Daljinska energetika

Na področju daljinske energetike ponujamo celovite rešitve ekonomičnega načrtovanja gradnje, obnove in upravljanja proizvodnih virov, distribucije in rabe plina, toplote ter hladu. Nudenje storitev tehnične in ekonomske optimizacije obstoječih sistemov daljinske energetike, z vzpostavitvijo sistema v realnem času med drugim zagotavljamo znižanje toplotnih izgub za 10-20%, znižanje rabe primarnega energenta za 2-5%, optimizacijo vklapljanja proizvodnih virov in znižanje stroškov primarnega energenta, itd.

1.2 Vodovodni sistemi

V sklopu celovitih rešitev na segmentu upravljanja ter tehnične in ekonomske optimizacije vodovodnih sistemov zagotavljamo znižanje vodnih izgub do 30 %, optimizacija črpališč in izkoriščanja vodnih virov, možnost predvidevanja obratovalnih pogojev v prihodnosti ter prikaz analiz obratovanja v preteklosti, itd.

1.3 Učinkovita razsvetljava

Trženjske aktivnosti so na področju učinkovite razsvetljave med drugim usmerjene tako v pridobivanje novih koncesij oz. pogodb za upravljanje z obstoječo in novo javno in notranjo razsvetljavo (npr. v proizvodnih in športnih objektih). Cilj storitve je optimizacija stroškov naročnika ter zagotavljanja optimalnega nivoja osvetljenosti prostora.

1.4 Energetsko upravljanje objektov

Pri energetskem upravljanju objektov, upoštevamo cilje trajnostnega razvoja bivanja. Trženjske aktivnosti so usmerjene v nudenje storitev tehnične in ekonomske optimizacije proizvodnje, distribucije in odjema potrebne energije v objektih javnega (šole, vrtci, občine, bolnice…) in komercialnega segmenta (trgovski centri, hoteli, poslovni objekti, proizvodni obrati…). Ponujena storitev je dobava toplote/hladu/pare/svetlobe oz. zagotavljanje 22°C v prostoru, pri tem pa jamčiti naročniku doseganje dogovorjenih obratovalnih parametrov ter prihrankov pri porabi primarne energije in stroških vzdrževanja/upravljanja. Cilj storitve energetskega upravljanja objektov, je naročniku pomagati doseči optimalno udobje pri minimalnih stroških.

2. PRETEKLI IN TEKOČI DOSEŽKI ORGANIZACIJE

Nekaj izvedenih projektov na področju učinkovite rabe energije, obnovljivih virov energije in projektov energetske sanacije stavb:

- ZPO Celje, izvedba ukrepov za znižanje rabe energije (energetska sanacija objektov) na dveh objektih z jamstvom;
- Letni in zimski olimpijski bazen Kranj, izvedba ukrepov za znižanje rabe energije (energetska sanacija objektov) z jamstvom;
- izvedba ukrepov za znižanje rabe energije z jamstvom na sledečih projektih: Javna razsvetljava Gorje OŠ Helena Puhar Kranj, OŠ France Prešeren Kranj, Tehnična fakulteta Maribor, objekti Mestne občine

Kranj (14 objektov), Občinska stavba Mestne občine Kranj, Občinski objekti občine Koper, Občinski objekti občine Jesenice;

- Študentski kampus Maribor, izvedba ukrepov na področju URE na 8 objektih z jamstvom;
- Biomasni sistem daljinskega ogrevanja Preddvor – izvedba in upravljanje sistema DO na lesno biomaso;
- izvedba ukrepov za znižanje rabe primarne energije z jamstvom: sistem daljinskega ogrevanja Planina, Kranj ter sistem daljinskega ogrevanja Murska Sobota, jamstvo znižanja rabe primarne energije;
- Ogrevanje Piran izvedba ukrepov na sistemu daljinskega ogrevanja za znižanje rabe primarne energije z jamstvom.

Tehnična in ekonomska optimizacija daljinskih energetskih sistemov:

- uvedba vodenja sistema daljinskega ogrevanja-znižanje rabe primarne energije: mesta Beograd, Ljubljana, Zagreb, Maribor;

Tehnična in ekonomska optimizacija sistemov za oskrbo s pitno vodo:

- TEOVS Velenje, tehnična in ekonomska optimizacija oskrbe s pitno vodo v Šaleški dolini, hidravlična analiza, oddaljeni nadzor in kontrola (občine Velenje), financirano po modelu pogodbenega zagotavljanja prihrankov ter iz Kohezijskega sklada.
- TEOVS Kranj, tehnična in ekonomska optimizacija oskrbe s pitno, hidravlična analiza, oddaljeni nadzor in kontrola, financirano po modelu pogodbenega zagotavljanja prihrankov.

Izvedene rekonstrukcije kotlovnic s prehodom iz kurilnega olja na zemeljski plin in prigrajeno kogeneracijsko napravo:

- obnova kotlovnice in vgradnja mikrokogeneracije: Občina Tržič, OŠ Pohorski odred Slovenska Bistrica, OŠ Pod Goro Slovenske Konjice, Dom Petra Uzarja, Poslovno-stanovanjski objekt, Gornja Radgona, OŠ Bistrica pri Tržiču, Harmonija Mengeš, OŠ Trzin, OŠ 2. Slovenska Bistrica, večstanovanjski objekt v Radovljici, Občina Slovenska Bistrica, OŠ Vodice, OŠ Mengeš, Kulturni dom Mengeš, Biotehniška fakulteta Domžale, Večstanovanjski objekt Obala - Lucija, Večstanovanjski objekt Šolska - Lucija,

Izgrajeni sistemi daljinskega ogrevanja

- Sistem daljinskega ogrevanja na lesno biomaso: v Ribnici, v Metliki, v Ivančni Gorici, na Rogli, v Oplotnici
- Sistem daljinskega ogrevanja na zemeljski plin: v Hrastniku ter na Ravnah na Koroškem
- Sistem daljinskega ogrevanja na kurilno olje v Luciji (Občina Piran)

Izgrajena distribucijska omrežja zemeljskega plina

- Petrol d.d. je skupaj s hčerinsko družbo Petrol Energetika d.o.o. nosilec 28 koncesij na zemeljski plin in UNP od tega: 17(ZP) Petrol d.d., Ljubljana; 5 (ZP) Petrol Energetika; 6(UNP) Petrol d.d., Ljubljana).

3. PRODUKTNE SMERI SODELOVANJA

Z velikim številom kupcev ter širokim asortimanom produktov in storitev, imamo znanja in izkušnje s področja uvajanja digitalnega poslovanja ter participacije uporabnika. Petrol vidi svojo vlogo kot soustvarjalec ter uporabnik odprtih spletnih in mobilnih aplikacij.

V sklopu polnilnih postaj za električna vozila, lahko Petrol ponudi lastnikom polnilnih postaj storitev upravljanja preko svojega IT centra za upravljanje ter vzdrževanje polnilne infrastrukture.

Na področju energetske učinkovitosti, v katerem Petrol preko modela pogodbene oskrbe z energijo, s katerim zagotavljamo tudi potrebno financiranje za implementacijo projektov, vidimo sodelovanje oz. vlogo kot sistemski integrator ter ponudnik celovite storitve.:

- mikro smart grids rešitev za zaključene soseke v smeri elektro-energetske samoooskrbe, kjer lahko Petrol nudi mestom in različnim uporabnikom v regiji rešitve za lokalno oskrbo z vso potrebno energijo.
- Podpora integrirani energetski in komunalni oskrbi in nadzoru, kjer nudimo uporabnikom celovite rešitve za tehnično in ekonomsko optimizacijo sistemov daljinske energetike in vodovodnih sistemov.
- Rešitve in sistemi pametne javne razsvetljave: nudimo rešitve za pametno javno razsvetljavo. Pri celoviti rešitvi je smiselno namestiti dodatno senzoriko na obstoječo infrastrukturo ter tako dodati novo uporabno vrednost obstoječi infrastrukturi.

V sklopu dostopnosti, ima Petrol izkušnje in kompetence za načrtovanje in optimizacijo logistike dostave goriv ter kosovnega blaga. V okviru svojih celovitih energetskih in okoljskih storitev za trg razvija tudi produkte za optimiranje logističnih poti tretjih. Petrol bo, kot sistemski integrator in ponudnik celovitih energetskih ter okoljskih rešitev za mesta, v povezavi z multimodalnostjo ter obstoječo energetsko infrastrukturo potreboval produkte, ki bodo omogočali doseganje sinergij pri opravljanju različnih dejavnosti ter večjo dodano vrednost za kupca. Izkušnje in kompetence pri prehodu iz produktnega v storitveni poslovni model, lahko razvijamo tudi različne produkte za prihodnje storitve na področju mobilnosti.

V okviru celovitih rešitev za mesta in druge kompleksne naročnike nudimo sisteme in proizvode (tehnično ekonomsko optimizacijska orodja in storitve, celovito upravljanje ELTEC Energy Watch, daljinski nadzor in upravljanje toplotnih postaj ELTEC SCADA,…), ki izvajalcu ali naročniku omogočajo nadzor in optimizacijo rabe energije: znižanje toplotnih izgub, znižanje rabe primarnega energenta, optimizacijo vklapljanja proizvodnih virov in znižanje stroškov primarnega energenta, itd.

Petrol potrebe po opremi in prostorih za opredeljene rešitve zagotovi deloma v okviru lastne obstoječe oz. planirane infrastrukture, po potrebi pa tudi z nabavo dodatnih namenskih razširitev glede na zaznane potrebe.

Urbanizem pametnih skupnosti / Urbanism for Smart Communities

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POVZETEK

Sodobna tehnologija pametnih mest omogoča, da so številne delovne faze v postopku priprave in sprejemanja urbanističnih rešitev izdelane bolje. V podjetju LUZ, d.d. se lahko pohvalimo z izkušeno interdisciplinarno skupino strokovnjakov, ki že več let razvija lastne rešitve in samostojno preizkuša sodobne metode dela razvite v mednarodnem okolju za potrebe urbanističnega in prostorskega načrtovanja in varstva okolja. Na področju pametnih rešitev v urbanističnem načrtovanju je ključnega pomena razvoj in uporaba tehnologij geografskih informacijskih sistemov. V prispevku so navedeni nekateri dosedanji domačih in mednarodni projekti, kjer so že implementirane rešitve, ki se lahko ponašajo z nazivom **pametne rešitve za pametne skupnosti**. Ambicija LUZ-a je, da postane vodilni urbanist za načrtovanje in razvoj pametnih skupnosti v regiji.

ABSTRACT

Modern Smart Cities technologies have enabled that many work phases in the process of preparation and adoption of urban planning solutions are designed better. In the company LUZ we are proud of our experienced interdisciplinary team of professionals who have many years developing and testing its own solutions and independent modern methods, developed in the international environment for the needs of urban and spatial planning and environmental protection. In the field of smart solutions for urban planning the development and use of technologies of geographic information systems is crucial. This article lists some of our current domestic and international projects with already implemented solutions that can boast the title of **smart solutions for smart communities**. LUZ ambition is to become the leading urban planner for the planning and development of smart communities in the region.

1. UVOD

Glede na naraščajoče število prebivalstva se smatra mesta kot ključni element v populacijski strukturi prihodnosti: že 54% celotnega svetovnega prebivalstva v letu 2014 je bilo urbanega (v Evropi je delež njenega prebivalstva, ki živi v urbanih okoljih še višji in sicer 73%). Po trenutnih projekcijah bo do leta 2050 66 % svetovnega prebivalstva (več kot 80% Evropskega) živelo v urbanih območjih [6]. Mesta so lahko visoko produktivna in učinkovita ampak se hkrati srečujejo tudi z nekaterimi negativnimi vidiki [2] kot so prometni zastoji, varnost, koncentracija nezaposlenosti, socialna segregacija in revščina. Ti izzivi so skupaj s hitrim razvojem tehnologije pripeljali do novih pristopov k načrtovanju mest in vodenju mest ter delovanju mestne infrastrukture in storitev.

Termin pametna mesta je večinoma povezan z novimi tehnološkimi rešitvami, ki v mestih omogočajo učinkovitejšo energetsko in komunalno oskrbo, nove koncepte in poslovne modele na področju mobilnosti, dostopnosti in prometnih sistemov ter tehnološko podporo k učinkovitejšemu izvajanju javnih storitev. Zgolj sledenje ciljem razvoja pametnih mest bi povzročilo izgradnjo zelo sofisticiranih in razvitih sistemov mestne infrastrukture [1], ki lahko pomagajo pri obvladovanju pritiskov naraščajočega prebivalstva v mestih. Ampak takšen predvsem ekonomski pristop od zgoraj navzdol ne upošteva vseh ciljev vzdržnega razvoja skupnosti. Koncept pametnih mest je nadomestil koncept pametnih skupnosti, ki uporabljajo tehnologije pametnih mest zato, da omogočijo svojim meščanom pri uresničevanju njihovih zasebnih in tudi skupnih pričakovanj po kakovostnem bivanju [1]. Nov tehnološki razvoj ponuja premik pri načrtovanju skupnosti od “vrha navzdol” k načrtovanju od “spodaj navzgor”.

Pri prehodu na model pametnih skupnosti se mnoga mesta soočajo s skupnimi izzivi v zvezi z uskladitvijo različnih prednostnih nalog, upoštevanjem različnih interesnih skupin ter izpolnjevanjem obveznosti in strategij na lokalni, regionalni in nacionalni ravni, ki bi hkrati zagotavljale tudi preglednost in vključenost ključnih deležnikov v vseh fazah razvoja [4][5].

2. URBANIZEM PAMETNIH SKUPNOSTI

Implementacija začrtanih ciljev skupnosti v mestnem okolju je običajno naloga prostorskih načrtovalcev - urbanistov. Tudi pri izvajanju ciljev pametne skupnosti ne pričakujemo razlik. Izjema je le dejstvo, da so nam pametne tehnologije že na stežaj odprla svoja vrata, kar od načrtovalcev, arhitektov in oblikovalcev prostora zahteva, da izkoristijo priložnosti pametnih tehnologij pri reševanju mnogih vprašanj s katerimi se soočajo današnja mesta [3].

Urbanistične rešitve temeljijo na analizah, interpretacijah, modeliranju procesov in napovedovanju sprememb v urbanem okolju. Sodobna tehnologija pametnih mest omogoča, da so številne delovne faze v postopku priprave in sprejemanja urbanističnih rešitev izdelane bolje: vključujejo več prostoriziranih informacij, vključijo več zainteresiranih deležnikov, bolj transparentno podpirajo procese usklajevanja in omogočajo sodelovanje na daljavo. Pri tem sta ključnega pomena odprtost stroke za nove metode dela in razvoj tehnologij geografskih informacijskih sistemov (GIS). GIS se lahko uporablja kot platforma za integracijo podatkov, sistem za prostorske analize, razvoj modelov za vizualizacijo in odločanje ter učinkovitejše upravljanje mestnih struktur.

V podjetju LUZ, d.d. se lahko pohvalimo z izkušeno interdisciplinarno skupino strokovnjakov, ki že več let razvija lastne rešitve in samostojno preizkuša sodobne metode dela razvite v mednarodnem okolju za potrebe urbanističnega in prostorskega načrtovanja in varstva okolja.

LUZ, d.d., je največje podjetje na področju prostorsko razvojnega inženiringa in urbanističnega ter prostorskega načrtovanja v Sloveniji. Tradicionalna strategija podjetja je združevanje znanja iz različnih delovnih področij za ustvarjanje novih in obstoječih proizvodov in storitev z visoko dodano vrednostjo. Ambicija LUZ-a je da postane vodilni urbanist za načrtovanje in razvoj pametnih skupnosti v regiji.

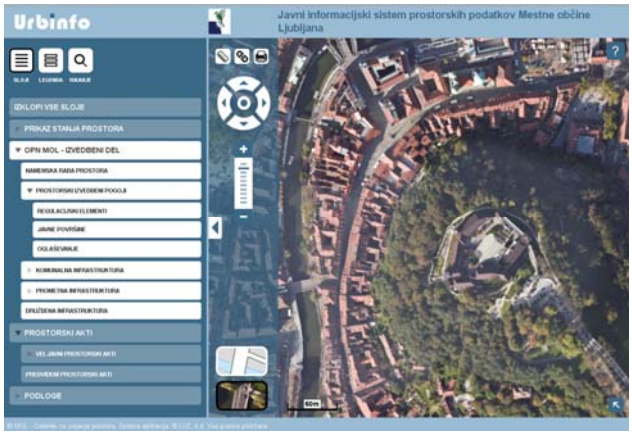
3. PAMETNE REŠITVE LUZ, d.d.

3.1 Načrtovanje

Na področju urbanizma je zaposlenih 17 strokovnjakov: urbanistov, krajinskih načrtovalcev in arhitektov. LUZ, d.d. je kompetenten partner pri pripravi strokovnih podlag in primerjalnih študij za prostorsko načrtovanje, pripravo prostorske dokumentacije na občinski, regionalni in nacionalni ravni. LUZ je sodeloval pri razvoju strateških in podrobnih prostorskih aktov za državo, Mestno občino Ljubljana in več občin (Vrhnika, Idrija, Radovljica, Piran, Bohinj, Bled, Gorje, …). Podjetje sodeluje tudi v različnih evropskih projektih in je ponosni dobitnik nagrade Evropskega sveta prostorskih načrtovalcev za posebnega zasluge za ciljne raziskovalne študije pri izdelavi novega prostorskega načrta za Mestno občino Ljubljana (2008). Družba je bila tudi dvakrat nagrajena z nagrado Društva urbanistov in prostorskih planerjev Slovenije (DUPPS) Maks Fabiani (2008, 2013) za posebne dosežke na področju urbanizma in tri krat z nagrado slovenske Zbornice za arhitekturo in prostor (ZAPS) Zlati svinčnik za področje urbanističnega načrtovanja (2007, 2009, 2011).

Oddelek informatike in GIS sistemov z 8 strokovnjaki deluje na področju vodenja sistemov zbirk prostorskih podatkov, izgradnje informacijskih sistemov prostorskih podatkov in prostorskih informacijskih sistemov za podporo državnim in lokalnim upravam, komunalnim in drugim podjetjem za obravnavo prostorskih podatkov preko interneta, intraneta ali samostojnih enot. LUZ, d.d. je razvil napredno spletno GIS platformo. Razvita je za uporabo z .NET in AJAX tehnologijami, ki uporabljajo jezik XML kot standard za komunikacijo med procesi. Temelji na tri stopenjski arhitekturi: predstavitvenem sloju, sloju poslovnih pravil in na podatkovnem sloju. Razvit je bil za optimizacijo in t.i. *stream-lining* delovnih procesov in deluje kot nadgradnja obstoječih spletnih sistemov GIS. Zasnovan je tako, da podpira večuporabniške in večjezične procese.

Za potrebe Mestne občine Ljubljana je bil razvit informacijski sistem URBINFO (https://srv3dgis.ljubljana.si/Urbinfo) ki omogoča vpogled javnosti v vse informacije o obstoječih prostorskih in urbanističnih dokumentih in v druge relevantne baze podatkov o prostoru, kot so informacije o prostorskih pogojih in omejitvah, ki izvirajo iz varstvenih režimov (kulturna dediščina, zavarovana območja, območja za varstvo narave, zavarovani gozdovi, ipd). Sistem omogoča tudi sledljivost že izdelanih urbanističnih dokumentov skozi čas. Za potrebe vzpostavitve sistema je bilo skeniranih in geolociranih več kot 3.000 različnih analognih prostorskih aktov.



Slika 1. Spletni portal URBINFO

3.2 Sodelovanje

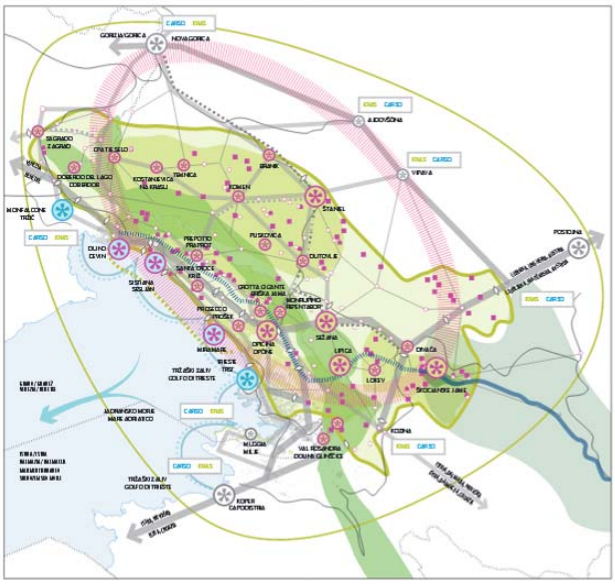
Vključevanje prebivalcev je eden temeljnih načel v urbanističnem planiranju. Kako aktivno vključiti reprezentativno število prebivalcev, še vedno ostaja nerešeno vprašanje. S tehnološkimi rešitvami pametnih mest se na tem področju odpirajo številne nove možnosti. V podjetju LUZ, d.d. se zavedamo pomena vključevanja prebivalcev v razvojno načrtovanje in urejanje prostora in spodbujamo naročnike, da prepoznajo vsestranske koristi sodelovanja. Hkrati za potrebe vključevanja prebivalcev v procese priprave urbanističnih rešitev in prostorske dokumentacije razvijamo različne nove rešitve in preizkušamo znane tehnike sodelovanja z zainteresiranim deležniki, kjer so na prvem mestu vsekakor številne delavnice, ki so bile izvedene za strateške in podrobnejše projekte, ki npr. zajemajo prenovo sosesk, mestnih jeder ali drugih površin v mestih.

S pridom smo izkoristili tehnološki razvoj in omogočiti meščanom, vlagateljem in drugim deležnikom, da sodelujejo preko t.i. *public participatory GIS* portala že v letu 2009. Rešitev je v postopku izdelave občinskega prostorskega načrta za Mestno občino Ljubljana prebivalcem ponudila enostaven način, da podajajo svoje pobude in pripombe preko spleta ter tako podprla komunikacijo med zainteresiranimi deležniki, pristojnimi organi občine in prostorskimi načrtovalci. Tako je bilo v letu 2010 ob sprejemanju novega prostorskega akta prejetih in obravnavanih preko 6.000 pripomb, v letu 2012 preko 200 pobud in 400 pripomb in ob zadnji novelaciji prostorskega akta leta 2015 preko 2.300 pobud in 1.300 pripomb. Več kot polovico pripomb in pobud so občani že podali v elektronski obliki.

LUZ, d.d. je bil na pobudo Ministrstva za okolje in prostor RS slovenski projektni partner v projektu R.A.V.E Space (http://www.rave-space.org) (2005-07, Interreg IIIB – CADSES), ki je bil razvit z ambicijo prispevati h krepitvi sposobnosti družbe za sodelovanje v prostorskem načrtovanju pri čemer se je osredotočil na izobraževanje v osnovnih in srednjih šolah. LUZ je bil pristojen za pripravo Strategije izobraževanja, ki jo je izdelal v sodelovanju z zunanjimi strokovnjaki s področja izobraževanja

V okviru čezmejnega projekta KRAS–CARSO (http://www.krascarso-carsokras.eu/) je bilo obravnavano območje Krasa - pomembno čezmejno območje med Slovenijo in Italijo. V projektu so bile izvedene aktivnosti, ki podpirajo trajnostno upravljanje naravnih virov in teritorialno povezovanje. LUZ je kot zunanji partner sodeloval pri izdelavi čezmejnega celovitega strateškega načrta. V okviru projekta so bile

organizirane številne delavnice in javne obravnave za prebivalce, strokovnjake in druge deležnike.



Slika 2. Celovit strateški načrt za prostorski razvoj Krasa

Za Regionalno razvojno agencijo Ljubljanske urbane regije smo razvili GIS portal GREMO NA POT (http://www.gremonapot.si) z grafično vsebino številnih turističnih informacij. Spletni portal vključuje tudi modul pregleda avtobusnih prog in lokacij avtobusnih postajališč mestnega prometa. Poleg prikaza izbrane poti na zemljevidu, portal ponuja vpogled v vzdolžni profil poti. Vse poti in oznake na poteh so geokodirane in napredni uporabniki, ki uporabljajo GPS naprave, si lahko prenesejo podatke na svoje naprave.

3.3 Promet in infrastruktura

Oddelka prometa in komunale na LUZ, d.d. zaposlujeta 17 strokovnjakov, ki sodelujejo v interdisciplinarnih projektih za prostorsko, urbanistično in krajinsko načrtovanje, pripravo strokovnih podlag ter v končni fazi tudi izdelavo celotne projektne dokumentacije za predlagane rešitve prometne in komunalne infrastrukture.

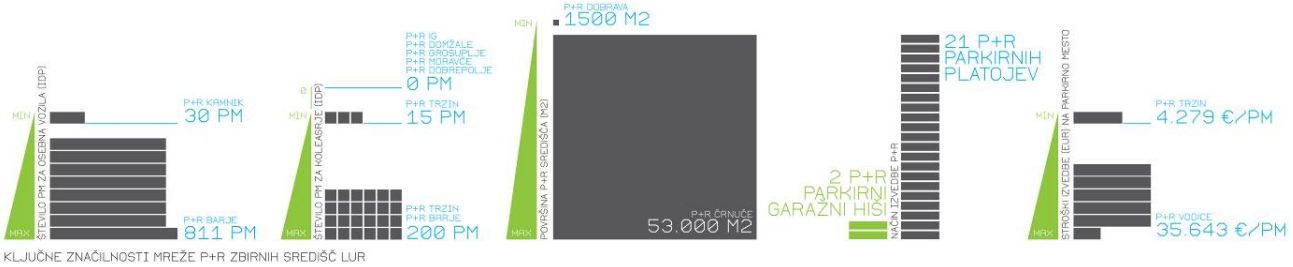
R mreža centrov v Ljubljanski urbani regiji, kjer je LUZ sodeloval kot projektni partner.

Za spodbujanje in promocijo trajnostnih načinov prevoza in mobilnosti v mestih na jadranski obali, so bile v okviru projekta **Adria.MOVE IT!** izdelane prometne študije in načrti mobilnosti za občino Piran (SI), Dubrovnik (CRO) in Kotor (CRO). Poleg spodbujanja trajnostne mobilnosti je bil poudarek tudi na izboljšanju kakovosti življenja, učinkovitosti in varnosti v cestnem prometu. Projekt je zajemal tudi izobraževanja, delavnice, izmenjavo znanj in manjše naložbe (sistemi izposoje koles, izdelava logističnih platform, nakup električnih vozil, kolesarske poti, avtobusna postajališča itd).

Za optimizacijo potrebe po parkirnih površinah, prostorsko optimizacijo in uporabo trajnostnih načinov mobilnosti, je bil izdelan načrt mobilnosti za stavbo Inštituta Jožef Stefan v Ljubljani. Predlagani so bili konkretni mehki ukrepi, ki spodbujajo k uporabi trajnostnih načinov prevoza.

LUZ je sodeloval v dveh evropskih projektih s področja kritične infrastrukture. In sicer RiskGIS, kjer so bila na podlagi integriranega geografskega informacijskega sistema obravnavana tveganja na področju kritične infrastrukture in RMTHS, kjer je bilo obravnavano tveganje pri prevozu nevarnih snovi na glavnem cestnem omrežju. Ključna inovacija in doprinos obeh projektov je razvit analitični modul, ki temelji na soodvisnosti kritičnosti in oceni tveganja v integrirani bazi podatkov GIS.

Na področju načrtovanja in upravljanja javne infrastrukture so bili razviti številni produkti med katerimi naj omenimo: 1) interni Prostorski informacijski sistem "Komunala Kočevje", ki omogoča napredno spremljanje in izvajanje rednega in izrednega vzdrževanja, kar upravljavcem omogoča tudi podrobnejše stroškovne analize in napovedi, 2) interno aplikacijo za kataster prometnih znakov in drugih oznak na voziščih za družbo DRSC, ki jo lahko uporabljajo različni pristojni organi (službe za načrtovanje, podizvajalci, nadzorniki), omogoča sledenje vseh faz od načrtovanja do vzdrževanja in tudi prikaz zgodovinskih podatkov, 3) operativni program gradnje gospodarske javne infrastrukture v Mestni občini Ljubljana, ki omogoča usklajevanje različnih deležnikov v prostoru pri odločitvah o prihodnjih investicijah v GJI, 4) GIS sistem za vzdrževanje in zemljiškoknjižno urejanje občinskih cest na območju Mestne občine Ljubljana in 5) GIS za 600 km distribucijskega omrežja



Slika 3. Ključne značilnosti mreže P+R zbirnih središč LUR

Ljubljanska urbana regija beleži veliko število delovnega prebivalstva z visoko stopnjo motorizacije. Ker je prisoten trend upadanja števila potnikov javnega mestnega prometa je bilo 16 občin Ljubljanske urbane regije (LUR), vključenih v projekt P +

zemeljskega plina družbe Petrol d.d. ki omogoča povezavo prostorskih podatkov s poslovno podatkovno zbirko družbe.

Pri razvoju GIS baze podatkov in spletne GIS aplikacije za dostop, vstop in upravljanje podatkov o nezakonitih odlagališč v Istri, je bil razvoj mobilne aplikacije GIS, ki omogoča odgovornim osebam, da lahko nezakonita odlagališča registrirajo preko mobilnega telefona med obiski na terenu. Aplikacija poleg

vpogleda v druge podatke o prostoru omogoča tudi določanje lastništva obravnavane lokacije. Aplikacija omogoča hitrejši pretok informacij in stalno spremljanje trenutnega stanja, lokacij v urejanju, že urejenih območij ter enostavnejšo opredelitev prioritet.

3.4 Drugi primeri pametnih rešitev

LUZ je bil partner v evropskem projektu VITAL LANDSCAPES (http://www.vital-landscapes.eu) (2010-2013, Central Europe). Glavni cilj projekta je bil podpreti bolj produktivno prakso sodelovanja udeležencev pri trajnostnem razvoju edinstvenih kulturnih krajin srednjeevropskega prostora. V projektu je LUZ skupaj s pristojnimi slovenskimi partnerji za pilotno območje izbral Krajinski park Ljubljansko barje in sodelovanje lokalnih prebivalcev podprl z internetno stranjo, ki je bila povezana tudi z GIS sistemom. Sistem je kot delovno orodje omogočil geolocirano samoregistracijo zainteresiranih ponudnikov lokalnih programov in izdelkov ter s tem prispeval k ozaveščanju prebivalcev sedmih občin o pripadnosti skupnemu prostoru zavarovane izjemne krajine. V projektu je LUZ, d.d. tako nadaljeval delo, ki ga je na obravnavanem območju začel na pobudo Ministrstva za okolje in prostor RS leta 2007 v času ustanavljanja Krajinskega parka. Proces ustanavljanja je LUZ med drugim podprl z odprtim GIS portalom (http://ljubljanskobarje.gisportal.si) v katerem je za potrebe odločanja zbral številne formalne in neformalne relevantne podatkovne zbirke ter sodelujočim ekspertom omogočil tudi ustvarjanje novih podatkovnih slojev. Sistem je bil po ustanovitvi pripravljen za podporo dela uprave Krajinskega parka, kjer prek internetne strani omogoča vpogled v javne zbirke podatkov, upravi pa omogoča delo na internem portalu. Sistem vključuje več kot 120 različnih slojev od zavarovanih območij in prostorskih načrtov do turističnih vsebin.

Na področju varovanja naravne dediščine smo razvili informacijski sistem NATURA (www.naravovarstveni-atlas.si), kompleksen GIS sistem, ki vključuje številne vsebine: območja Natura 2000, naravne vrednote, zavarovana območja, ekološko pomembna območja, zaščitne ukrepe in izdajo naravovarstvenih smernic. Atlas je sestavljen iz javnega portala, ki je namenjen širši javnosti, in internega portala, ki je namenjen posameznim strokovnjakom in strokovnimi institucijami.

Atlas Okolja (http://gis.arso.gov.si/atlasokolja) je spletni GIS okoljski informacijski sistem s prostorskimi podatki iz področja narave, okolja, vode, pokrovnosti tal, klimatskih pogojev, infrastrukture in drugih podatkov na celotnem območju Slovenije. Podatkovna baza je primer visoko kakovostne in uporabne vsebine, ki je podprta z obsežnimi metapodatkovnimi opisi. Okoljski atlas dnevno uporablja več kot 4.000 različnih uporabnikov.

4. KREPITEV PODROČIJ PAMETNIH REŠITEV

4.1 Mobilnost in dostopnost

Na področju mobilnosti in zagotavljanja dostopnosti bo LUZ, d.d. nadaljeval v začrtani smeri razvoja produktov in storitev, ki poleg izdelave projektne dokumentacije zajemajo izdelavo prometnih študij, načrtov trajnostne mobilnosti in izdelavo celostnih prometnih strategij za mesta in občine v okviru katerih se je koncept tradicionalnega načrtovanja za promet preusmeril na koncept načrtovanja prometnih ureditev za ljudi. Tehnologije pametnih mest omogočajo vzpostavitev različnih prometnih portalov, sistemov vodenja prometa in parkiranja, ki spodbujajo uporabo trajnostnih prevoznih sredstev. Monitoring in analize številnih podatkov, pridobljenih na podlagi vgrajeni pametnih tehnologij (poleg štetja prometa še meritve emisij, hrupa ipd.) vodijo do boljših in bolj premišljenih odločitev ter spremljanje učinkov že izvedenih celostnih rešitev.

4.2 Participacija prebivalcev

Za bolj aktivno participacijo prebivalcev bomo na LUZ-u nadaljevali razvoj lastnih produktov na področju *public paricipatory GIS* storitev s spletnimi in mobilnimi rešitvami. Zavedamo se, da je z osredotočanjem participacije preko spletnih in mobilnih aplikacij del prebivalcev lahko le še bolj izključen iz aktivnega sodelovanja. Zato bomo nadaljevali v smeri razvoja inovativnih načinov vključevanja vseh slojev prebivalstva v odločanje o prihodnjem razvoju njihovih mest s pomočjo drugih pametnih rešitev.

4.3 Mestna infrastruktura in storitve

Že razviti produkti in implementacije v prakso so pokazali, da spletna naša spletna in mobilna GIS orodja omogočajo enostavno, pregledno, prilagodljivo načrtovanje in upravljanje omrežij in objektov različnih infrastrukturnih sistemov. Tudi v prihodnje bomo nadaljevali z intenzivno implementacijo že razvitih storitev in produktov v realno okolje pametnih mest. Še naprej jih bomo nadgrajevali z novo pridobljenimi znanji in izkušnjami.

5. ZAHVALE

V posameznih navedenih projektih je sodelovalo več partnerjev, podrobnejši seznam zaradi omejenega prostora ni naveden in je razpoložljiv na spletnih straneh posameznega projekta ali na spletni strani LUZ, d.d.

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Prenapetostne zaščitne naprave / Surge Protective Devices (SPDs)

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POVZETEK

Iskra Zaščite d.o.o. smo vodilni ponudnik rešitev na področju **prenapetostnih zaščitnih naprav** v Evropi, kot tudi na svetu in pomemben nišni igralec na trgu specializiranih rešitev na področju kvalitetne električne energije in daljinskega nadzora. S svojim proizvodi ščitimo električne naprave pred prenapetostmi v napajalnih, signalnih in telekomunikacijskih omrežjih, v industriji, poslovnih stavbah, domovih.

Z lastnim razvojem z lahkoto sledimo svetovnim trendom. V središču naše pozornosti so **varnost**, **zanesljivost** in **zelena tehnologija**. Verjamemo, da bo podjetje dolgoročno raslo samo na podlagi lastnega razvoja. Prav zato posvečamo neskončno pozornost inovacijam in nenehno spodbujamo nove rešitve. Naša lastna R&R oprema ter **laboratorij za testiranje** nam omogočata hitre in kakovostne R&R procese. Zato lahko ponudimo maksimalno prilagajanje in **po meri izdelane rešitve**. Dinamična razvojna ekipa vključuje izkušene člane in motivirano mlado osebje s številnimi idejami. Njen glavni interes je razvoj na področju distribucijskih omrežij električne energije, telekomunikacijskih omrežij in omrežij informacijske tehnologije.

ABSTRACT

Iskra Zaščite is one of Europe's and world´s leading manufacturer of **Surge Protective Devices** for a variety of systems. It takes pride in its extensive coverage of products for the protection of electrical and electronic devices in the industry, commercial buildings, homes and utilities.

We easily keep pace with the world trends. Our main interests are **safety, reliability and green technology**. We believe that in long-term company will grow only on the basis of its own development. Therefore, unlimited attention is paid to innovations and new solutions are constantly encouraged. Our own R&D equipment and **testing laboratory** is enabling us to have fast and quality R&D processes. Because of that we can offer maximal flexibility and **custom made solutions**. Dynamical development team includes experienced members and young staff with many initiatives and ideas. Its main interest is development in fields of power distribution systems, telecommunication systems and information technology systems.

1. INTRODUCTION / UVOD

Področje prenapetostnih zaščit rešuje težave s prenapetostmi v (med drugimi) elektro-energetskem omrežju predvsem zaradi **udarov strele** v elektro-energetsko infrastrukturo ali njeno neposredno bližino. Udari strele so posledica razlike v potencialu med zemljo in »oblakom«, oziroma med oblaki in nastajajo predvsem v času izrednih vremenskih pojavov (nevihte). Z globalnim segrevanjem oziroma spreminjanjem podnebja se je v zadnjih dveh desetletjih število nevihtnih dni na zemlji povečalo za več kot 100% (povzeto po podatkih National Geographic). Vse več je ekstremnih vremenskih pojavov in postajajo vse bolj nepredvidljivi. Drugi fenomen ki se dogaja je vse večja uporaba naprav, ki so **izredno občutljive** na vse motnje, ki prihajajo izven naprave, kamor spadajo tudi prenapetosti zaradi udarov strel. In tretji trend je vse večja (geografska – lokacijska) **razpršenost virov** električne energije (sončne in vetrne elektrarne) in tudi **porabnikov** (bazne postaje mobilne telefonije, oddajniki, podatkovni centri,..), ki hkrati uporabljajo moderno opremo, ki bazira na elektroniki in je posledično **občutljiva na prenapetosti** in je ob tem dostikrat postavljena izven strnjenih naselij, kar poveča verjetnosti udarov strel.

Vsi trije trendi močno vplivajo na razvoj prenapetostnih zaščit, predvsem na zahteve po novih funkcionalnostih, ki jih morajo omogočiti. Prenapetostne zaščite za elektro-omrežja glede na obstoječe mednarodne standarde delimo na **tri razrede**, ki se glede na izvedbo objektov inštalirajo v zaporedju Razred 1 (groba zaščita), Razred 2 (zaščita v podrazdelilnih elektro omaricah), Razred 3 (fina zaščita uporabljena pred napravami). Odvodne sposobnosti merjene v kilo amperih sproščene energije so predpisane po standardih in jih večina ponudnikov dosega. V zadnjih letih pa se poleg odvodnih sposobnosti pojavlja vrsta drugih zahtev.

2. VLOGA SPD V ELEKTRIČNIH INŠTALACIJAH

Evropski trg prenapetostno zaščitnih naprav (SPD) je ocenjen na obseg 350 mio EUR, v ZDA in preostali svet pa vsak na 400 mio EUR. Iskra Zaščite d.o.o. s svojimi 20 mio EUR predstavlja 5% trga Evrope in 2% globalnega trga.

Izkoriščanje alternativnih virov za pridobivanju električne energije je na pohodu. Povišane napetosti v hladnih sončnih dneh v fotovoltaičnih sistemih, vpliv hitrih, sunkovitih sprememb vetra v vetrnih postrojih so problemi, ki jih danes rešujemo inženirji iz področja prenapetostnih zaščit. Z razvojem kompleksnejših polprevodniških tehnologij se znižuje tudi prag občutljivosti na prenapetosti, zato je potreben stalen napredek tudi na področju prenapetostnih zaščit. Cilj je razvoj izboljšanih in **novih materialov**, **novih znanj** in **tehnologij**, ki bodo podpirali razvoj elementov, oziroma gradnikov prenapetostnih zaščitnih naprav (SPD). Pri tem pa je seveda potrebno upoštevati splošno pravilo, ki velja za zaščitne sisteme. To je, da morajo **ščititi varno**, **zanesljivo** in **učinkovito**, pri tem pa ne smejo vplivati na delovanje naprave/sistema, ki jo/ga ščitijo. Slednje pa je možno le, ko se zaščitni sistem povsem ujema s napravo, ki jo ščiti.

Pomembna element sta tudi **miniaturizacija** in **višja raven integracije** zaščitnih elementov in sistemov z drugimi električnimi/elektronskimi komponentami in napravami – napredna omrežja.

3. POVEZOVANJE, PARTNERSTVA

Iskra Zaščite d.o.o. že sedaj sodeluje z obstoječimi Centri Odličnosti, Kompetenčnimi centri in Razvojnimi centri v Sloveniji, mednarodno se povezuje predvsem preko hčerinskih družb, posameznih partnerjev in preko kupcev iz EU

S sodelovanjem v RRI skupnih projektih zadnjih pet let (NODISEA 2, NAMASTE, MINIGDT, RCeNeM) smo ustvarili razvojne in prodajne sinergije z naslednjimi Slovenskimi podjetji: **Eti Elektroelementi d.d.**, **Varsi d.o.o., Iskra Mehanizmi d.d., Iskra d.d.** in institucijami: **Institutom »Jožef Stefan«** (**Odsek za elektronsko keramiko**, IJS-K5; **Odsek za nanostrukturne materiale**, IJS-K7; **Odsek za fiziko trdne snovi**, IJS-F5; **Odsek za inženirsko keramiko**, IJS-K6), **Univerza v Ljubljani** (**Fakulteta za elektrotehniko**, UL-FE (**Laboratorij za mikroelektroniko**, LMFE; **Laboratorij za mikrosenzorske strukture in elektroniko**, LMSE.

Prenapetostne zaščitne naprave (SPDs – Surge Protection Devices) nove generacije bomo razvijali skupaj z našimi tujimi partnerji (za tuje partnerje): Nemški **Weidmüller**, Ameriški **General Electric**, Ameriški **ERICO**, Grški **ELEMKO.**

Nadaljevali bomo sodelovanje v strokovnih delovnih skupinah **SIST**, **CENELEC**, **IEC**, **IEEE. SPDC 3.0**, **UL**.

Uporabljali bomo prodajne kanale naših dosedanjih in novih partnerjev. Tržno komuniciranje bo usmerjeno na strokovno javnost kar so (po prioriteti): razvojni **inženirji** in **strokovnjaki** pri potencialnih OEM proizvajalcih opreme, panel builderjih, integratorjih, ki poznajo problematiko prenapetosti, **elektro projektanti**, ki se ukvarjajo s projektiranjem sistemov (WT, PV, specialni, zahtevnejši infrastrukturni projekti državnega značaja, objekti, kjer je pomembna varnost in neprekinjeno delovanje, telekom sektor,...), **mednarodni strokovnjaki** na področju SPD in **podjetji**, **ki se ukvarjajo s problematiko prenapetosti** (potencialni distributerji, samostojni partnerji).

4. NOVE ZAŠČITNE IN KONTROLNE NAPRAVE V ELEKTRIČNIH INŠTALACIJAH

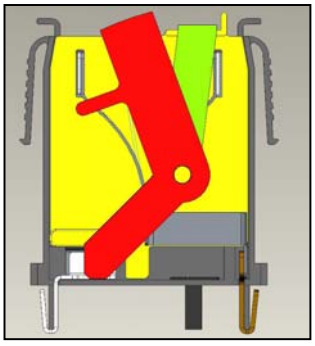
Prenapetostne zaščitne naprave (SPDs) v električnih inštalacijah v zgradbah nudijo uporabniku zgradbe poleg osnovne zaščite pred kvarnimi vplivi električnega toka tudi povečano udobje v smislu splošne uporabnosti električne energije ter s ostalimi komplementarnimi produkti (nad-tokovna zaščita, zaščita na diferenčni tok, nadzor in merjenje večjega števila električnih parametrov v električni inštalaciji, ipd) omogočajo **racionalno rabo električne energije**, tako neposredno z zmanjšanjem lastne rabe, kot tudi posredno z uvajanjem konceptov informatizacije stikalnih in zaščitnih naprav v smislu združevanja funkcij dveh izdelkov v enega, vse s ciljem konkurenčne prednosti: **enostavnost vgradnje** ter **ne-kompleksnost priklopa na daljinski sistem** in **učinkovitosti rabe naravnih virov**.

V naslednjih letih na področju električnih inštalacij pričakujemo znatno konvergenco naprav v enotne sisteme, ki bodo omogočali tako **merjenje/zaščito** kot **avtomatizacijo** oziroma **upravljanje priključenih sistemov**, zato želimo z našimi obstoječimi (in novimi) partnerji izdelke približati novim smernicam za uporabo tako v gospodinjstvih in industriji. Izdelke nameravamo v okviru pobude Pametna mesta in skupnosti razvijati v smeri pametne nadgradnje in podpore ostalim produktom (produktom sončne/vetrne energije, ki za pogone uporabljajo DC napetosti, produktom pametnega doma kot npr. ogrevanje, razsvetljava, klimatizacija, varnost, multimedia, produktom s področja Interneta). Ker v področje električnih inštalacij vse bolj prodira tudi področje **energetskega managementa** DSM (Demand Side Management) s strani uporabnika ali strani ponudnikov energije, pričakujemo na področju električnih inštalacij nove zahteve in smernice za razvoj tovrstnih produktov. V okviru pobude se želimo v tem kontekstu predvsem fokusirati na nove zaščitne in kontrolne naprave za obstoječa električna omrežja.

Za **novo generacijo SPD z izboljšanimi električnimi lastnostmi** bo potrebno razviti ZnO varistorsko keramiko **posebne oblike**, z bistveno **izboljšano tokovno-napetostno** in **energijsko karakteristiko**, ter **visokimi prebojnimi napetostmi** (varistor iz **nano materialov, votla oblika,** varistor z »**Vročo točko**« [3]). Te bomo v implementirali v novo generacijo SPD, ki bo imel zato izboljšane električne karakteristike.

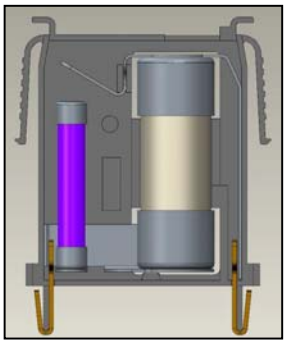
Slika 1. »Vroča točka« je načrtno povzročeno šibko mesto na keramiki, kjer tako načrtno formiramo zanesljivo mesto termičnega odklopa. Še posebej uporabno na DC sistemih (PV)!

Prenapetostne zaščitne naprave na osnovi varistorske tehnologije morajo imeti vgrajeni termični odklop z vizualnim in/ali daljinskim indikatorjem delovanja. Naloga termičnega odklopnika je da, zaradi prenapetosti ali preobremenitve z odvodnim tokom poškodovano prenapetostno zaščitno napravo varno odklopi iz električne inštalacije in tako prepreči izpad napajanja in poškodbe električne inštalacije. Novi/izboljšan termični odklop bo odklopil **hitreje**, **zanesljivo** in **dokončno** brez možnosti ponovnih prebojnih vklopov (**varen odklop**).



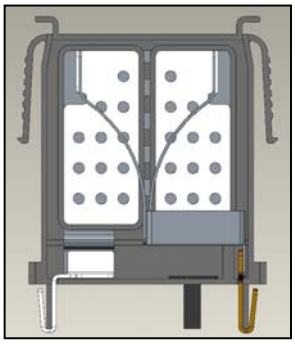
Slika 2. Koncept novi/izboljšan termični odklop, ki bo v primeru degradacije varistorja odklopil hitreje, zanesljivo in dokončno brez možnosti ponovnih prebojnih vklopov.

V ekstremnih situacijah se prenapetostna zaščita s pomočjo predvarovalke odklopi iz sistema in tako prepreči večje poškodbe tako sebe kot inštalacije. **Integrirana varovalko** konkurenca že pozna, mi jo bomo razvili v ločenem modulu enakega izgleda in ji dodali indikacijo stanja. Konkurenčna prednost je v smeri enostavnosti, uporabnosti, fleksibilnosti ter predvsem koordiniranosti z inštalacijskim sistemom.



Slika 3. Integrirana varovalka v ločenem modulu z indikacijo stanja.

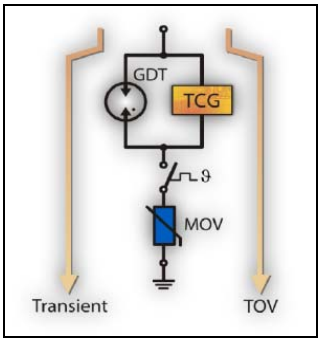
Z novo generacijo SPD bomo približali uporabniku trenutno stanje prenapetostnih zaščitnih naprav (stanje degradacije varistorja) in s tem nakazati možne težave in opozorilo za pregled inštalacije zaradi očitnega dogajanja prenapetostnih težav v sistemu. Konkurenčna prednost je predvsem v uporabi »**Vroče točke**« (slika 1) kot **mesto zanesljivega prvega odklopa** ter segmentacija oz. **redundanca** temelječ na dveh ločenih varistorjih »TWO STAGE«, ki sta funkcionalno povezana – v smeri evolucijskega razvoja naprednih sistemov z možnostjo obveščanja sprememb stanj.



Slika 4. Redundanca na dveh ločenih varistorjih s prikazovanjem stanja odvodnika (life status).

Za primere kjer uporabnik nima napeljave tokokroga za možnost priklopa daljinskega **obveščanja stanja sprememb prenapetostne zaščitne naprave** »RC« (Remote Contacts), pa tudi **stanja varovalke v sistemu**, bomo razvili posebno PLC komunikacijo (Power Line Communication), kjer se za podatkovno linijo o statusih izkorišča napajalne vode. Konkurenčna prednost je **enostavnost vgradnje**, ter **ne-kompleksnost priklopa na daljinski sistem**.

Glavni vzrok uničenja SPD so povišane napetosti v omrežjih. Te povzročijo prehod varistor iz visoko-omskega stanja v trajno nizko-omsko stanje (kratek stik). Z vgrajenim **tokovnim omejevalom** bo SPD v primeru povišane napetosti dalj časa, omejil tok skozi varistor na vrednost, ki zanj ne bo usodna in tako omogočil, da bo SPD po prenehanju povišanih napetosti še vedno **uporaben** in **funkcionalen** (višja imunost na TOV) - **učinkovitost rabe naravnih virov**.



Slika 5. Omejevanje toka, posebnost družine Safetec ter nadaljevanje linije prenapetostnih zaščitnih naprav višjega razreda.

Eden od osnovnih trendov na področju prenapetostnih zaščit je razvoj inovativnih pristopov k **integraciji** predvsem iz vidika vgradnje ter odpovedi odvodnika. Z višanjem zahtev delovanja in po drugi strani višanjem pričakovanj končnih uporabnikov (**višja zanesljivost**, **manjše dimenzije**, **dodatne zmožnosti**) se povečuje tudi pritisk na optimizirano in inovativno načrtovanje samih komponent ter tudi celotnih sklopov. Zaradi višanja zanesljivosti proizvajalci sistemov močnostne elektronike vedno bolj pričakujejo celovite rešitve (rešitev na ključ), ki so pripravljene na vgradnjo in že rešujejo problematiko mehanske konstrukcije za vgradnjo, nadzora odpovedi, za zmanjšanje števila povezav pa se načrtujejo tudi povezovanja celotnih podsklopov. V okviru pobude želimo razvijati inovativne rešitve bazirajoč na **volti formi** primerne za integracijo/enostavnost vgradnje.

Novi proizvodi SPD bodo »pisali« najnovejše verzije standardov EN, IEC, UL, oziroma bodo morali sami biti Certificirani po njih.

Nove produkte bo potrebno razvijati na zgornjih mejnih vrednostih toleranc, z **najboljšimi karakteristikami**, **pri manjših proizvodnih stroških**.

5. LITERATURA

[1] SPS pobuda Razvojnega centra RC eNeM Novi Materiali d.o.o., *Nova dimenzija proizvodov za električne inštalacije v zgradbah, stekleni izdelki in zaščitni premazi*, maj 2015.

[2] Interni dokument Iskra Zaščite d.o.o., *Usmeritve in projekti 2015-2020 - strateške usmeritve v višji nivo kompleksnosti izdelkov, ekspertiza novih strateških področjih*, sept. 2015.

[3] Patent Varsi d.o.o., *Varistor z definirano šibko točko v strukturi,* SI 23040, objava 29.10.2010.

Resnično inteligentna mesta

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POVZETEK

Raziskave na področju pametnih mest so čedalje bolj pogoste. Trenutne rešitve pa še niso tako inteligentne, kot bi uporabniki pričakovali. Razvoj se osredotoča le na posamezna področja in ponuja rešitve le za posamezne podsisteme. Končni cilj razvoja takih mest je enotno okolje in podpornih servisov, ki bodo omogočali enostavno povezljivost med različnimi komponentami mesta in olajšali razvoj ter izvajanje aplikacij za pametno mesto. Odsek za inteligentne sisteme ima številne izkušnje na tem področju, saj razvijamo številne servise in aplikacije, ki jih je mogoče vključevati v pametne domove in mesta. Poleg tega smo pomemben partner v evropskem projektu, ki se ukvarja s to tematiko.

ABSTRACT

The research in the field of smart cities is gaining more and more interest in recent years. However, current solutions are not as intelligent as users would expect. The development is focuses solely on individual areas and offers solutions only for specific subsystems. The final goal of this research field should be the development of environments and support services that will enable easy connectivity between various components of the city and facilitate the development and deployment of applications. The Department of Intelligent Systems has extensive experience in this field, since we are already developing services and applications that can be integrated into smart homes and cities. In addition, we are an important partner in the European project, which deals with such topics.

1. UVOD

V modernih mestih je običajno veliko obsežnih podsistemov, ki skrbijo za nadzor pomembnih storitev, ki jih mesto ponuja. Javna razsvetljava, javni prevoz, dobava toplotne in električne energije, plin, vodovod ipd. je le nekaj takih podsistemov. Večinoma ti podsistemi delujejo neodvisno, kar prinaša neučinkovito vodenje le-teh. S povezovanjem teh podsistemov, souporabo podatkov in optimizirano vodenje bi lahko bistveno izboljšali delovanje celotnega mesta. Prilagajanje prometne signalizacije glede na stanje na cestah, preusmerjanje prometa ob prometnih konicah in s tem izboljšanje pretočnosti skozi cestno omrežje, prilagajanje porabe energentov glede na razpoložljivost in onesnaženje v mestu je le nekaj primerov, ki bi občutno izboljšali delovanje mesta in povečali zadovoljstvo prebivalcev.

Ključna lastnost takih sistemov je povezljivost, komunikacija in dostop do podatkov iz različnih podsistemov. Poleg tega pa mora sistem ponujati različne servise, ki rešujejo določene naloge (npr. optimizacija, pogajanja ipd.) in ki jih lahko različne aplikacije večkrat uporabijo.

Vizija odseka na področju pametnih mest je razvoj oblačne platforme, ki bi integrirala / združevala obstoječe samostojne podsisteme in omogočala uporabo podpornih servisov vključenim aplikacijam.

Glavne prednosti takega pristopa so:

- **neodvisno delovanje**, kjer vsak podsistem in aplikacija ima svoje naloge in cilje ter lahko deluje neodvisno od ostalih.
- **neodvisen razvoj.** Vsak podsistem ali aplikacijo se lahko razvija neodvisno od drugih.
- **lokacijska neodvisnost.** Sistemi so lahko geografsko in številsko poljubno porazdeljeni, kar prinaša številne prednosti v primerjavi s centraliziranim pristopom.

Razviti sistem mora omogočiti robustno in varno delovanje ter omogočati delovanje po principu »Plug-and-play«, kar pomeni, da platforma ponuja že vse storitve, ki jih aplikacije ali podsistemi potrebujejo. Hkrati pa omogoča sprotno optimizacijo parametrov ter algoritmov upravljanja komponent.

2. KOMPETENCE

Odsek za inteligentne sisteme ima obsežne izkušnje na področju razvoja inteligentnih sistemov. Aktivno sodelujemo s podjetji, ki ponujajo rešitve za pametne zgradbe, upravljanje z energijo, inteligentno pohištvo ipd. V okviru številnih nacionalnih in evropskih projektov smo razvili sisteme, ki optimizirajo porazdeljevanje bremen pri dobavi električne energije. Na ta način lahko različni manjši ponudniki električne energije vstopajo na trg in ponujajo proizvedene viške. Tak sistem bi lahko nadzoroval elektrodistribucijsko omrežje večjih mest in omogočal do neke mere samozadostnost dobave električne energije. V sodelovanju z domačim podjetjem smo razvili sistem za pametne zgradbe, ki omogoča prilagajanje delovanja zgradbe navadam stanovalcem s zamikom vklopa in izklopa bremen, dinamičnim spreminjanjem stopnje ogrevanja ali hlajenja v stavbi, predčasnim vklopom ali izklopom ogrevanja in inteligentnim upravljanjem s toplotno črpalko. Celoten sistem pa temelji na hierarhični agentni arhitekturi (Slika 1), ki smo jo razvili za potrebe projekta. Glavna prednost je hierarhična urejenost agentov, kar omogoča učinkovitejšo kontrolo in upravljanje s fizičnimi aktorji. Na ta način smo dosegli občutne prihranke pri stroških zgradbe.

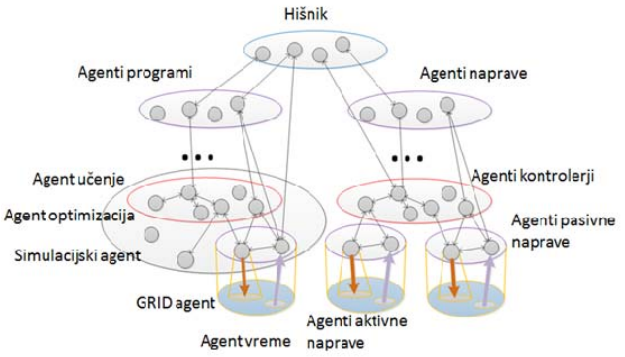


Figure 1: Agentna arhitektura sistema OpUS

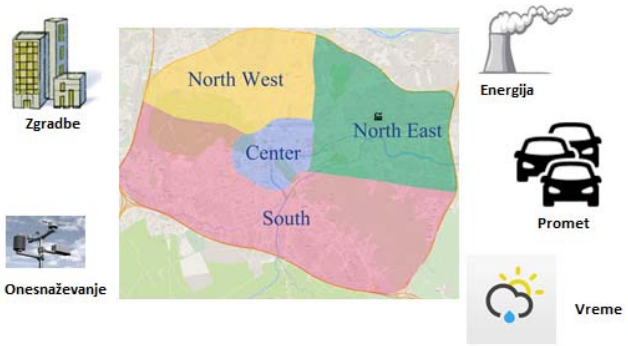
Odsek je aktivno udeležen v evropskem projektu na temo razvoja platforme za upravljanje pametnih mest. V okviru projekta smo razvili prototipno verzijo sistema, ki omogoča združevanje številnih podsistemov mesta in razvoj namenskih aplikacij, ki uporabnikom ponujajo različne storitve. Z združevanjem informacij, ki jih platforma pridobi iz podsistemov je mogoče hkratno upravljanje z različnimi podsistemi in doseči učinkovito izvajanje kompleksnejših kontrolnih procedur.

3. VSEBINSKA POBUDA

V tem poglavju bomo predstavili vsebinsko pobudo za razvoj, prilagoditev platforme za pametna mesta in implementacijo v večjih slovenskih mestih. Aktivnosti znotraj pobude bodo obsegale razvoj senzorjev, ki bodo nameščeni v mestu, implementacijo naprednih kontrolnih algoritmov za posamezne podsisteme, algoritmov za optimizacijo delovanja večjega števila podsistemov in implementacijo mobilnih ter spletnih aplikacij namenjenih končnim uporabnikom v mestu.

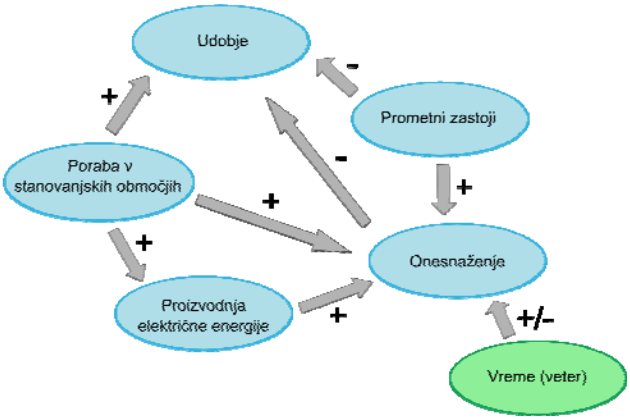
3.1 Domena

V okviru predloga nameravamo predlagati razvoj oblačne platforme za upravljanje s pametnim mestom in dejansko integracijo v nekaj slovenskih mestih. V platformo bo mogoče povezati različne podsisteme mesta in preko namenskih aplikacij izvajati napredne kontrolne algoritme. Primeri podsistemov, ki bi jih bilo mogoče vključiti v platformo so prikazani na Sliki 2. Med pripravo predloga bomo s pomočjo partnerjev opravili analizo zahtev in sestavili nabor podsistemov, ki bodo vključena v platformo. V okviru projekta bo potrebno razvijati strojno opremo, senzorje, merilce ter adapterje za nemoteno komunikacijo z oblačno platformo. Poleg tega pa bo potrebno pripraviti seznam aplikacij, ki bodo namenjene prebivalcem mesta. Primer take aplikacije je mobilna aplikacija, ki skrbi za obveščanje o pomembnih dogodkih v mestu, zaporah ipd.



Slika 2. Prikaz potencialnih podsistemov pametnega mesta.

Pri optimizaciji delovanja celotnega mesta je potrebno modelirati medsebojni vpliv različnih dejavnikov na stanje v sistemu in ugotoviti kako sprememba nekega dejavnika vpliva na stanje drugega. Na Sliki 3 je prikazan primer modela za scenarij onesnaževanja. Vozlišča predstavljajo različne dejavnike, ki jih je moč meriti v mestu, povezave pa predstavljajo vpliv enega dejavnika na drugega. Ta vpliv pa je lahko pozitiven ali negativen. Na primer, onesnaževanje v mestu povečuje proizvodnja električne energije v toplarni, večja poraba v stanovanjskih območjih, povečan promet in neugodne vremenske razmere. Hkrati pa povečana onesnaženost negativno vpliva na udobje prebivalcev.



Slika 3. Prikaz potencialnih podsistemov pametnega mesta.

S tako definiranim modelom in uporabo algoritmov iz teorije iger (Nashevo ravnovesje) je mogoče definirati kontrolne ukaze, ki minimizirajo negativni vpliv med vsemi dejavniki v modelu. Uporaba takega principa omogoča optimizirano delovanje celotnega sistema ter dinamično prilagajanje na nepredvidljive dogodke.

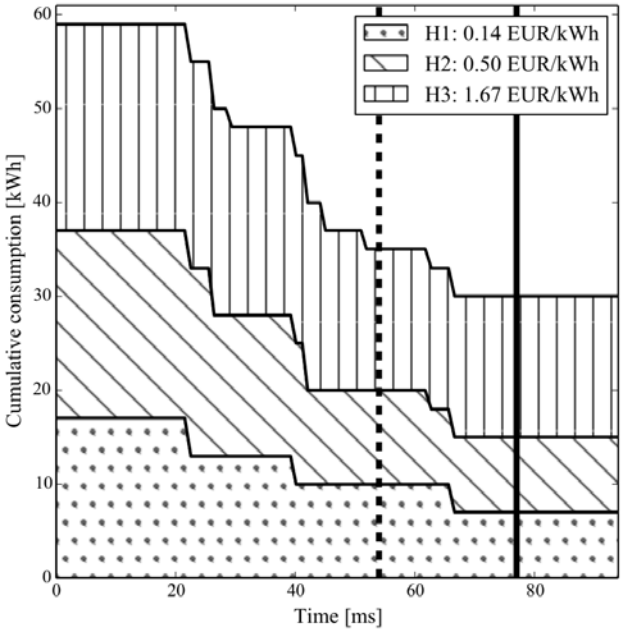
3.2 Inteligentna mesta in teorija iger

Podsistemi v mestu niso centralizirani in običajno ne prejemajo ukazov za delovanje od ene centralne entitete. Sistem sestavljen iz samostojnih podsistemov ima željene lastnosti, kot so neodvisen razvoj, lokacijska neodvisnost, večja varnost in robustnost. Slabost takega sistema pa je, da ga ni mogoče globalno optimirati z uporabo standardnih optimizacijskih metod (numerična

optimizacija, evolucijski algoritmi ipd.) z ozirom samo na globalne pokazatelje učinkovitosti delovanja mesta. Za vodenje procesov v mestu, ki je sestavljen iz neodvisnih sistemov, ter iskanje optimalnih stanj delovanja mesta se lahko uporabi teorija iger ter koncepti iskanja rešitev, ki privedejo do ugodnih stanj za vsakega od udeleženih podsistemov (npr. Nashevo ravnovesje). Inteligentni podsistemi namreč sodelujejo pri izvajanju ukazov oz. navodil samo v primeru, če jim tako sodelovanje prinese prednosti.

Primer problema v inteligentnem mestu je npr. nadzorovanje povpraševanja po naravnih virih, kot so npr. voda, elektrika, čisti zrak, toplota itd. [2, 3]. Cene virov za običajne uporabnike so največkrat določene vnaprej po različnih shemah. Električna energija se obračunava po tarifnem sistemu, pri porabi vode je cena enotna, pretirano onesnaževanje je lahko kaznovano itd. Slabost takih shem je, da ne omogočajo dinamičnega prilagajanja potrošnje virov zmožnostim proizvodnje virov, kar povečuje ceno virov, saj morajo distributerji v vsakem trenutku zagotavljati dovolj rezerve za morebitno povečano povpraševanje po viru. Delna rešitev tega problema bi bila uvedba dinamičnih cen. Ravno inteligentna platforma, ki bi povezovala podsisteme (in s tem distributerje virov) s končnimi uporabniki ter omogočala interakcijo med njimi, je ključnega pomena pri uvedbi dinamičnih cen. Lažja dostopnost podsistemov za nadzorovanje porabe virov ter njihovo povezovanje omogoča možnost določanja individualne cene za vsakega porabnika v odvisnosti od količine porabljenega vira praktično v realnem času. Z uporabo primernih mehanizmov oz. algoritmov za določanje cen bi lahko spodbudili uporabnike h gospodarnejšemu ravnanju z viri ter tako zmanjšali razlike med povpraševanjem in ponudbo v realnem času.

Na Odseku za inteligentne sisteme smo razvili mehanizem za dinamično določanje cen virov. Mehanizem spodbuja zmanjševanje porabe vira z uporabo serijske funkcije za deljenje stroškov uporabe vira, spodbuja porabnike, da sporočajo svojo resnično željeno porabo, določa manjšo ali enako ceno vira za porabnike, ki porabijo manj, ne razkriva informacije o porabi



Slika 4. Primer uporabe mehanizma za določanje dinamičnih cen.

virov drugim porabnikom, cene določi tako, da je strošek nakupa vira enak dobičku od prodaje in se zagotovo zaključi ob predpostavki, da je porabnikov končno in imajo končno možnih stopenj porabe vira. Mehanizem je sestavljen iz dveh delov, pogajanja in odpovedi. V delu pogajanja porabniki postopoma zmanjšujejo lastno porabo vira, dokler ne dosežejo cene, ki jim ustreza. V delu odpovedi se porabniki lahko odpovejo delu porabe za dodatno znižanje cene. Primer izvajanja mehanizma na domeni porabe električne energije v pametnih hišah je prikazan na sliki 4. Slika prikazuje stanja pogajanj za določanje individualne dinamične cene. V prvem delu (od začetka do črtkane pokončne črte) se izvajajo pogajanja, v drugem delu (med pokončno črtkano in odebeljeno črto) pa se porabniki odpovedujejo porabi električne energije za primerne nagrade.

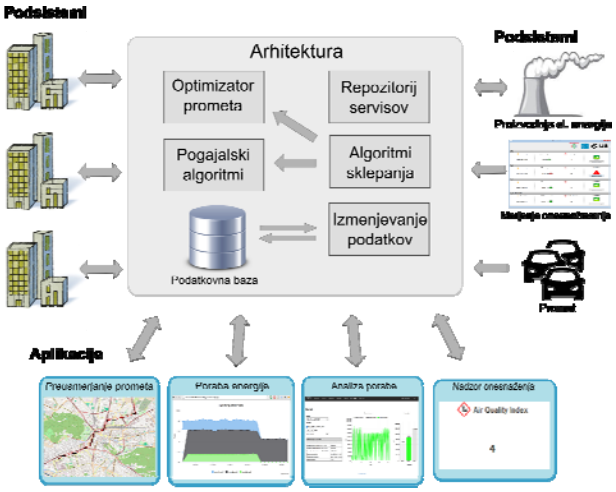
Uporaba platforme za inteligentna mesta, preko katere se lahko povezujejo različni podsistemi, bi omogočila dinamično odločanje podsistemov, ki so se zmožni v kratkem času prilagoditi drug drugemu ter stanju v mestu. Poleg dinamičnega določanja cen, bi odločitve podsistemov lahko zajemale še druge kontrolne akcije v mestu, kot npr.: usmerjanje oz. preusmerjanje prometa s prometno obremenjenih cest, zmanjšanje generiranja toplotne ter električne energije v obdobjih visoke stopnje onesnaženosti, zapiranje vodovodnih sistemov ob času suše ipd.

Čeprav povezovanje sistemov ter iskanje splošnega ravnovesnega stanja v mestu zelo poveča kompleksnost in zahtevnost problema, je možno uporabiti tehnike, ki bistveno zmanjšajo preiskovalni prostor stanj, rešitve zmanjšanega problema pa niso bistveno slabše od originala [6]. Za implementacijo takih metod je potrebno analizirati dinamiko mesta ter poiskati povezave med različnimi podsistemi. To bi omogočalo gradnjo modela mesta. Z uporabo metod iz [6] bi nato reducirali problem iskanja ravnovesnega stanja in dobili ravnovesna stanja mesta (oz. njihove dobre približke), ki bi bila ugodna za vsak podsistem povezan s platformo za inteligenta mesta. Ravno zaradi izboljšanja stanja vsakega podsistema, se bodo podsistemi nato prilagodili izvajanju procesov, ki privedejo v ravnovesno stanje.

Tako platforma bi omogočala resnično inteligentno mesto, ki bi se bilo zmožno dinamično odzivati na spremembe, pri tem pa bi zagotovilo ugodno delovanje vsakega podsistema.

3.3 Arhitektura sistema

Izvajanje naprednih kontrolnih algoritmov in aplikacij zahteva določene podporne servise znotraj platforme. Sem spada repozitorij vseh servisov, aplikacij in podsistemov, določeni algoritmi, ki jih lahko različne aplikacije večkrat uporabljajo ter podatkovna baza, ki hrani ključne podatke o mestu. Enostavna arhitektura platforme je prikazana na sliki 5.



Slika 5. Prikaz potencialnih podsistemov pametnega mesta.

Urbane podsisteme običajno sestavljajo posamezni namenski sistemi, ki opravljajo različne funkcije (npr. javna razsvetljava, prometna signalizacija ipd.) na v naprej določen način. Zaradi različnosti takih sistemov direktna komunikacija ni mogoča in mora platforma omogočati metode adaptacije in semantično povezljivost (platforma razume storitve in obliko podatkov, ki jih sistem ponuja).

Z arhitekturo, ki bo omogočala enostaven nadzor in detekcijo pojavov preko različnih podsistemov, bo mogoče semantično ovrednotiti delovanje celotnega sistema in ukrepati na več nivojih hkrati. Posledica tega je vpeljava koncepta sistem sistemov, s čimer dosežemo hitrejšo in boljšo odzivnost ter varno in robustno delovanje podsistemov.

4. ZAKLJUČEK

V tem prispevku smo predstavili vizijo Odseka za inteligentne sisteme glede prihodnjega razvoja storitev za pametna mesta. Odsek lahko ponudi številne reference na področju razvoja inteligentnih sistemov. Med drugimi sodelujemo s podjetji pri razvoju novih sistemov za upravljanje pametnih zgradb. Med večje projekte spada optimizacija povezovanja ponudnikov in porabnikov na elektrodistribucijskem omrežju. Odsek pa ima tudi izkušnje pri razvoju sistemov za pametna mesta, saj sodelujemo pri enem večjih evropskih projektov na to temo.

Razvili smo metode za naslednje naloge:

- izvajanje vnaprej opredeljenih scenarijev, kjer pametno mesto sledi strateškim usmeritvam in sam prilagaja ukrepe odzivom na delovanje mesta
- optimiranje homogenih virov potrošnje, npr. porabnikov in proizvajalcev električnega toka ali vode
- delno razvito optimiranje heterogenih virov na nivoju mesta, tj. razsvetljave, elektrike, vode itd.
- optimiranje tekočega delovanja mesta
- ukrepanje mesta ob vnaprej predvidenih in nepredvidenih dogodkih.

Predstavili smo vsebinsko pobudo, ki obsega razvoj in namestitev oblačne platforme za nekaj slovenskih mest. Platforma bi povezovala podsisteme mesta in omogočala vključevanje aplikacij, ki ponujajo različne servise prebivalcem mesta.

V okviru pobude smo odprti za sodelovanje s slovenskimi mesti, organizacijami in podjetji, ki se ukvarjajo z izdelavo naprednih senzorjev, razvijalci mobilnih aplikacij, sistemski integratorji ipd.

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Varna interoperabilna infrastruktura za pametna mesta
/
Secure Interoperability Infrastructure for Smart Cities

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POVZETEK

V tem prispevku opisujemo vidike varnosti in zasebnosti interoperabilne infrastrukture za organizacije javne varnosti v povezavi s pametnimi mesti.

ABSTRACT

In this contribution we describe security and privacy aspects of the data interoperability infrastructure for public safety organizations in relation to smart cities.

1. UVOD

Izredni dogodki z vplivi na varnost prebivalcev bodo čedalje pogostejša stalnica v večjih mestih prihodnosti in eden izmed ključnih problemov [1]. Koncept pametnega mesta odgovarja na probleme modernih mest, med katerimi je vprašanje varnosti osrednjega pomena [2]. Koncept pametnega mesta omogoča nadzor ključne infrastrukture in nadzira varnostne vidike z namenom zagotovitve visoke varnosti prebivalcem [3].

Z vidika zagotavljanja javne varnosti bodo pametna mesta z množico senzorjev zagotavljala številne prednosti. Zbiranje prej nedosegljivih podatkov, deljenje in ponovna uporaba ter sprejemanje odločitev na podlagi podatkov, pridobljenih v realnem času, so zgolj nekatere od njih.

Službe javne varnosti, kamor med drugimi spadajo policija, nujna medicinska pomoč, civilna zaščita, protiteroristične enote in drugo, so in bodo ključnega pomena pri zagotavljanju varnosti. Med omenjenimi službami še posebej prevladujejo potrebe po dostopu do podatkovnih baz, senzornih sistemov in kamer. S konceptom pametnih mest bodo pridobljene številne nove prednosti. Te prednosti bodo v primeru odziva ob nesreči oziroma incidentu vplivale na učinkovitejši in bolj kakovosten odziv. To pa se bo zgodilo, če se bo zagotovila varna in dovolj prilagodljiva infrastruktura za povezovanje različnih virov podatkov.

V tem prispevku je predlagan koncept interoperabilne infrastrukture, kakršna se razvija v okviru projekta REDIRNET, s poudarkom na zagotavljanju informacijske varnosti kot ene od nujno potrebnih sestavin za zagotavljanje nemotenega delovanja ključne infrastrukture pametnega mesta, varovanja prebivalcev in ne nazadnje njihove zasebnosti.

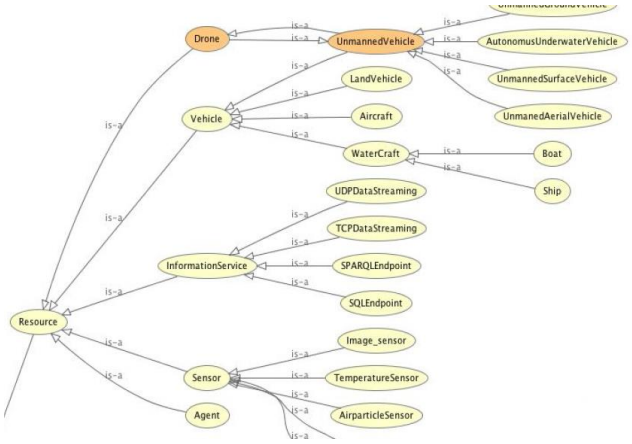
2. VARNA INTEROPERABILNA INFRASTRUKTURA

Kot smo že omenili v uvodu, je naš predlog razvoj varne infrastrukture za izmenjavo meritev, podatkov in informacij med službami javne varnosti. Namen takšne infrastrukture je povezati različne senzorne sisteme, kar bo razširilo zmogljivosti komandno nadzornih zmogljivosti omenjenih služb. S tem bosta zagotovljeni večja učinkovitost in kakovost odziva ob incidentu ter kasnejših analiz. Rešitev ima tudi stroškovni učinek.

Interoperabilna infrastruktura je decentralizirano ogrodje za interoperabilnost sistemov. Infrastruktura temelji na javnem metapodatkovnem prehodu, ki bo nadzorovan s strani posameznih lastnikov podatkovnih virov preko strokovnega družbenega omrežja. To bo omogočilo povezovanje partnerskih organizacij glede na njihove želje in operativne potrebe, hkrati pa omogočilo določanje obsega takšne interoperabilnosti. Podpora s semantičnimi spletnimi metodami bo v pomoč za vzpostavitev takšnega povezovanja.

Obravnavana infrastruktura bo službam javne varnosti zagotovila medsebojno povezovanje komunikacijskih sistemov in izmenjavo informacij. Takšna komunikacijska rešitev bo omogočila izmenjavo in deljenje podatkov, slik, videa, CCTV in informacij z oddaljenih senzorjev.

Namenska ontologija bo zagotovila temeljne koncepte in podatkovne strukture podatkovnega modela platforme. Njen namen je prevzeti vlogo pri odkrivanju razpoložljivih virov določene organizacije in podpirati semantično interoperabilnost med organizacijami z različnimi podatkovnimi viri in informacijskimi sistemi. Slika 1 prikazuje del osnutka osrednje ontologije v okviru projekta REDIRNET, slika 2 pa rezultate poizvedbe na podlagi testnega primera varnostnega incidenta.



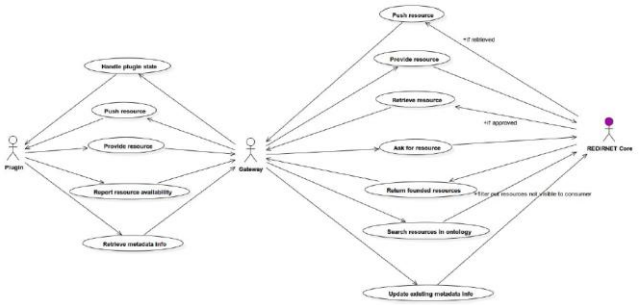
Slika 1. Del osrednje ontologije.

agency	operator	resource	capability	event
BelgianPolice	BrabantWallon_Command	CCTV_Waterloo_Lion13	video_stream	WaterlooLionFire
Waterloo_Police	BrabantWallon_Command	CCTV_Waterloo_Lion13	video_stream	WaterlooLionFire
BelgianPolice	BrabantWallon_Command	Hero4	video_stream	WaterlooLionFire
Waterloo_Police	BrabantWallon_Command	Hero4	video_stream	WaterlooLionFire

Slika 2. Rezultati poizvedbe.

Organizacije javne varnosti in tudi druge poslovne entitete bodo imele občutne koristi z dostopom do podatkovnih virov partnerskih organizacij. Za ta namen se bo treba registrirati v strokovno družbeno omrežje in preko ontološkega iskalnika poiskati želene podatkovne vire ter vzpostaviti partnersko povezavo.

V fazi integracije pri končnem uporabniku je treba prenesti izvirno kodo prehoda in ustvariti virtualnega uporabniškega agenta za podatkovne vire. Slednji bo implementiral abstrakten vmesnik, ki bo služil kot vtičnik za prehod, ki bo omogočal komunikacijo med podatkovnimi viri in infrastrukturo oziroma njenim sistemom.



Slika 3. Obratovalni model prehoda.

Prehod je vmesni sloj med jedrom sistema in vtičniki. Obratovalni model prehoda ima z vidika delovanja dva načina – porabniški in ponudniški.

3. ZAHTEVE VARNOSTI IN ZASEBNOSTI PAMETNIH MEST

Informacijska tehnologija, glavni pospeševalnik koncepta pametnih mest, ustvarja številne ekonomske in družbene priložnosti. S tem pa prinaša tudi dodatne izzive na področju varnosti in zasebnosti. Z vidika zasebnosti lahko, na primer, lokacijski podatki, vezani na posameznika, predstavljajo velik poseg v zasebnost, če se ti podatki analizirajo in predstavijo v različnih kontekstih [4]. Avtorji v [3] predstavijo varnost in zasebnost kot eno od treh dimenzij IKT-infrastrukture pametnih mest. Naštejejo naslednje izzive: grožnje s strani hekerjev in vsiljivcev, grožnje s strani zlonamerne programske kode, varovanje osebnih podatkov ter visoke stroške varnostnih aplikacij in rešitev.

Eden izmed ključnih dejavnikov, s katerimi se bodo soočila pametna mesta, je razvoj zaupanja vrednega ogrodja, ki bo zagotavljal storitve brez prikritih, škodljivih namenov [5]. Sem lahko uvrstimo kršitve varnosti in zasebnosti, ki se nanašajo na osebne podatke prebivalcev, prepoznavanje skritih vzorcev in izvajanje drugih analiz podatkov, kot so vzorci uporabe storitev in podobno. Nadalje se zastavljajo vprašanja o pravilnosti zaznanih podatkov, skladnosti obdelave podatkov z zakonodajo, dostopu do podatkov in kontroli nad deljenjem le-teh. Ta in še mnoga druga vprašanja zadevajo ponudnike storitev in prebivalce.

Danes se med drugim srečujemo s sledečimi problemi, za katere ne sme biti prostora pri razvoju interoperabilnih infrastruktur pametnih mest:

- Varnostne pomanjkljivosti pri zasnovi sistemov, ki ustvarjajo mnoge, še neznane ranljivosti.
- Nameščanje že kompromitirane informacijsko-komunikacijske opreme.
- Pomanjkljiva znanja na strateški in koordinacijski ravni upravljanja z informacijsko varnostjo.

Informacijska varnost je temelj zagotavljanja zasebnosti. V povezavi z vseprisotnim internetom znotraj koncepta pametnih mest se tako srečujemo s številnimi informacijskimi komponentami in njihovimi vmesniki, katerih površna varnostna zasnova odpira vrata posegom v zasebnost.

V pobudi predlagamo uporabo kompetenc na področju modeliranja napadov in vzpostavitev ustreznega okolja z naborom temu primernega kadra za izvajanje varnostnih presoj IK-tehnologij, ki bodo imele ključno vlogo v pametnih mestih z vidika zagotavljanja varne interoperabilnosti.

Modeliranje napadov je eden izmed najpomembnejših načinov, kako najti šibke točke. Pomembno je za dvig zavedanja o realni situaciji, ki se nam lahko zgodi. Modeliranje napadov pripomore k temu, da se pripravimo na možne scenarije, ki jih v praksi ne želimo preizkusiti. Če se nanje pripravimo, lahko ustrezno zaščitimo sistem, da do dejanskega incidenta ne pride [6].

Predpogoj za modeliranje napadov je zagotoviti okolje, ki obravnava varnostna vprašanja z vidika agentov grožnje in spremlja ter analizira nove tehnike napadov. Slednje pomeni, da je treba zagotoviti dostop do ustreznih laboratorijskih sistemov.

4. PROJEKT REDIRNET

V okviru EU FP7 projekta REDIRNET[1] nastaja panevropska platforma, namenjena izmenjavi meritev, podatkov in informacij med službami javne varnosti. V projektu sodeluje devet partnerjev iz sedmih držav. Med partnerji je tudi Laboratorij za odprte sisteme in mreže na Institutu »Jožef Stefan«. Konzorcij sestavljajo še: Združenje strokovnjakov s področja informacijskih in komunikacijskih rešitev za službe javne varnosti (British APCO), razvijalci profesionalnih komunikacijskih rešitev in druge raziskovalne institucije.

Ključni cilji projekta so:

- Vzpostavitev registra interoperabilnih problemov in potreb s strani končnih uporabnikov.
- Priprava interoperabilnega ogrodja, skladnega s postopkovnimi in tehnološkimi standardi.
- Zagon interoperabilne platforme.
- Integracija prvih končnih uporabnikov.
- Vzpostavitev vseevropskega sodelovanja in zavedanja o projektu REDIRNET s ciljem standardizacije koncepta.

Poleg partnerjev v projektu Laboratorij za odprte sisteme in mreže na Institutu "Jožef Stefan" sodeluje z Generalno policijsko upravo ter Upravo za zaščito in reševanje. Namen sodelovanja je prepoznati potrebe končnih uporabnikov in s pomočjo raziskav poiskati ustrezne rešitve.

Na tem mestu velja pozvati industrijske partnerje v Sloveniji, naj aktivno sodelujejo pri pametni specializaciji z možnostjo smiselne uporabe rezultatov dela v projektu.

[1] Spletna stran projekta: www.redirnet.eu

5. ZAKLJUČEK

Varna interoperabilna infrastruktura bo pomembno orodje za službe javne varnosti pri zahtevni nalogi zagotavljanja varnosti pametnih mest in njihovih prebivalcev. Informacijska varnost bo imela ključno vlogo v konceptu pametnih mest tako z vidika neprekinjenega delovanja ključnih sistemov kot tudi z vidika zasebnosti.

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POVZETEK

Podjetje Iskratel, d.o.o., Kranj je s svojo lastno blagovno znamko, lastnim razvojem in lastno proizvodnjo tradicionalno prisoten na področju infokomunikacijskih omrežij, storitev in aplikacij. V skladu s strateškimi usmeritvami podjetja ponuja - in bo tudi v bodoče nadgrajevalo - napredne rešitve s področja železniškega in cestnega prometa, javne varosti in energetike za javni in industrijske sektorje.

Usmerja se tudi na področje zahtevnejših infrastrukturnih projektov, kjer je skupaj s partnerji in podizvajalci ponudnik celovite rešitve s področja prometa, javne varnosti, širokopasovnih omrežij in informacijske infrastrukture, vse bolj pa se usmerja tudi na področje energetike. Vsa zgoraj omenjena področja so tudi pomembna domenska področja pametnih mest, ki vključujejo poleg najprimernejše izbranih rešitev tudi celovit pristop k izvedbi tako zahtevnih projektov.

ABSTRACT

The company Iskratel, d.o.o., Kranj, with its own brand, its own development and its own production, is traditionally present in the area of info-communication networks, services and applications. In accordance with its strategic guidelines, the company offers—and will continue developing—advanced solutions in the fields of rail and road transport, public safety, and energy for public and industrial sectors.

It focuses on complex infrastructure projects and offers, in cooperation with its partners and subcontractors, comprehensive solutions for transport, public safety, broadband networks and IT infrastructure, increasingly focusing on the energy sector as well. All the above-mentioned areas are also important domains of Smart Cities, which include not only the most appropriate solutions, but a comprehensive approach to the implementation of such complex projects.

1. INTRODUCTION

Iskratel, d.o.o., Kranj is a high-tech enterprise and the leading European manufacturer and provider of info-communication solutions in the Central European area. It stands out with its own research and development department, production, 65 years of experience and local presence in over 30 countries, and with more than 70% of exports in 2014. Iskratel leverages solution development and ICT expertise in delivering integrated solutions across telco, transportation, public safety and energy industries. Its solutions help people and communities, ensure safety, increase efficiency and business innovation. In collaboration with its partners, Iskratel provides a comprehensive project approach: from consulting, design, equipment supply and implementing complete solutions to training, maintenance and after-sales support. This approach is also used in infrastructure projects in the above fields, which are important components of Smart Cities and Communities.

Iskratel is developing its Smart City and Community solution based on the Safe City comprehensive solution. Broadband network and IT infrastructure services are added to that solution, ensuring advanced user experience. It enters the transport domain with comprehensive solutions for rail and road transport, which include equipping stations and stops, adding to them solutions for the energy efficiency of the Smart City.

2. ISKRATEL SOLUTIONS IN THE AREA OF SMART CITY AND COMMUNITY

2.1 Safe City

2.1.1 Safe City - a step-by-step comprehensive approach

Ensuring the safety and security of citizens in smart cities is one of the key challenges for governments, mayors and policy makers. "Safe City" is an open and reliable solution that provides a variety of integrated operational services for a highly complex operational chain and effective deployment, not only at the level of an individual municipality, but also allowing integration into a single federal structure. This solution also supports the smart integration of services for safety and security at the city level into federal infrastructure. With this approach, local characteristics and global trends are equally important; they slightly differ on our markets (i.e., the European market and the market of Common Independent Countries - CIS, especially Russia).

Providing a large-scale centralized system for all the above-mentioned areas in one step is unrealistic; there are usually considerable problems with the budget and the lack of appropriately trained and experienced staff. As a result of such an approach, very often the autonomous, not-interoperable systems are introduced, each of which essentially solves private, local problems.

City authorities develop and introduce urban mission-critical/monitoring centres, centralized urban systems like 911/112, alarm and notification systems and evacuation in the city, secure telecommunications/communications systems. All the above-mentioned systems incorporate centrally-managed areas of life in the urban environment such as:

- City management and its administration;
- Law enforcement and its support for policy features;

- Civil defence and emergency situations (including environmental monitoring);
- Medical services management;
- Public transport management;
- Housing and utility services;
- Other urban structures (depends on the development of infrastructure of the city).

2.1.2 *The Solution "Safe City"*

The solution entitled "Safe City" offers the best answers to all above-mentioned requirements and challenges by using a step-by-step approach with full support for the phase implementation.

The figure below illustrates the inter-relationships among the different technology stack layers of the "Safe City" solution, which are the following:

- Secured network infrastructure and integration sources;
- Infrastructure as a Service and Platform as a Service for "Safe City" Services in a cloud;
- Information space including federated data, system enablers, services logic and enablers for visualization;
- API for openness towards various services and applications at the regional and federal levels.

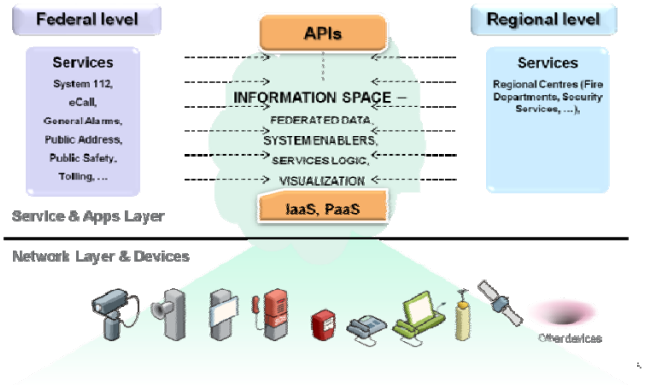

Figure 1: The "Safe City" technology stack

On the top of this stack applications and new services can be built by various stakeholders for consumers, public organizations or businesses.

"Safe City" offers, with its comprehensive set of information-management tools, multi-dimensional coverage for complex and multi-functional operational tasks, a diversity of integrated systems (video surveillance and video analytics, chemical control, emergency communications, public address and general alarm, media, etc.) and support for the sustainable expansion of present and future services (e.g., eCall, connection of public objects, telephone notification).
The solution builds a comprehensive and intelligent view of what is happening in the smart city by unifying and integrating the events and contextual information from heterogeneous information systems into a single information space, by visualizing such information and open communications with other systems. The decision-support subsystem makes it possible, in its automatic mode, to estimate the parameters of the system as a whole and respond efficiently to changes in the operational environment.

The open and reliable solution "Safe City" consists of the following functional systems and features:

- Intelligent video surveillance/ local video surveillance systems;
- Emergency communication/ Local security systems;
- Public address, general alarm/ Local notification systems;
- Environmental monitoring and forecasting/ Local fire and chemical control systems;
- Spotting, position location/ eCall, ERA-GLONASS services;
- Communications and mass media.

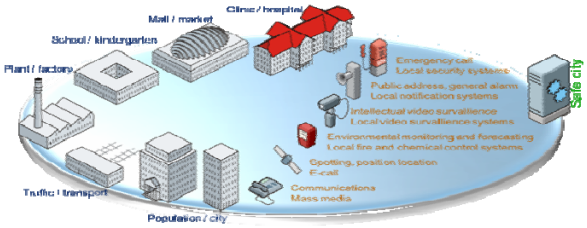

Figure 2: The solution "Safe City" and its features

2.1.2.1 *Video surveillance system*

Most safe city projects start with a video surveillance system, which is used for the observation of traffic/ transport, public places, areas of criminal activity, social facilities and facilities of the residential sector. The intelligence inside video analytics brings added-value to the complete solution, including face recognition, shape detection and license plate reading. Video analytics enables the connectivity of the additional systems into the platform (e.g., malls, hospitals, schools, factories, railway stations).

Video surveillance can be used by residential and business users. With this service, public and private safety is guaranteed to a greater extent. Firstly, it increases the efficiency of the system by increasing the number of potential operators. Secondly, it allows the residents to monitor various situations themselves at home, in a trusted and secure way.

2.1.2.2 *Emergency communication system*

The emergency communication system supports the organization of information and emergency terminals in public places and also a close relationship with the local security service. The solution "Safe City" takes into account the specifics of the incorporated facilities, which require special realization, such as being vandal- or explosion-proof. From the personal safety perspective, the integration of a mobile alarm device with positioning, used by elderly or disabled people, is of great importance.

2.1.2.3 *E112 service*

The E112 service is one of the emergency communications services. The eCall service in Europe and ERA-GLONASS in Russia are additional services based on the existing E112 service, the first one uses GPS, and the latter, GLONASS satellites. They

fulfil European and Russian standards and also respect the national and local specificities in terms of emergency services. Vehicles equipped with eCall and ERA-GLONASS-compliant In-Vehicle Systems (GPS/GLONASS, GSM modem) send the "minimal set of data" via a cellular network to the eCall subsystem as a part of the "Safe City" solution, which sends it further to the relevant services (e.g., Public Safety Answering Point). This data can also be used for other commercial purposes.

2.1.2.4 Public address system

The public address system offers public announcements and general alarm signals. The "Safe City" solution supplements it with additional features, such as telephony, SMS or mass media notifications. The solution can integrate various local public address systems in the organizations (e.g., malls, hospitals, schools, factories, railway station) according to the regulations.

The public address system interoperates through the "Safe City" with fire-alarm systems in order to provide a more reliable and faster response, and consequently minimizes potential damage.

"Safe City" provides the ability to connect chemical sensors in order to control high-risk production and mass-visited public areas. Fire and chemical control data together with meteorological, ecological and flood data give a full picture of the situation.

The mass media are one of the main channels of information today. Ensuring full interaction with the mass media (e.g. television, radio) is one of the functions of the platform "Safe city". Providing information with or without moderating and ensuring the transmission of content is just one of the required features today.

2.1.2.5 Secured interconnected systems, services and data

All the above-mentioned subsystems and features are inter-connected with each other and with the external world via a secured data network by using southbound interfaces, called adapters, and northbound interfaces, called APIs. The adapters integrate various sources of data (e.g. legacy equipment, automation controllers, sensors, detectors, measuring elements) into a common information space. In most cases there is a one-way communication from the source to the information space, but there also exist some special cases, where the two-way communication is needed.

There are core features in the "Safe City" solution, which are used by all subsystems. We call them enablers. We distinguish two sorts of enablers, functional enablers and common system enablers. Both are presented in the figure below.

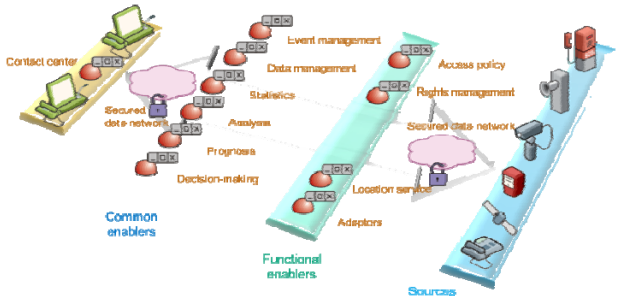

Figure 3: The "Safe City" solution – enablers and sources of information

The "Safe City" solution serves multiple clients (e.g., customers, public organizations, enterprises, etc.) sharing the same sources, therefore the multi-tenancy paradigm is respected in all areas:

- Access policy;
- Data protection and accessibility;
- Secured Data Network.

The Access Policy and Rights Management aims to grant authorized users the right to use a service dynamically, while preventing access to non-authorized users. The data is protected using various mechanisms and also accessed and exchanged in a secure manner. Since all kinds of users are an integral part of the secure and trusted solution "Safe City", technological elements on their own are not sufficient in guaranteeing a high degree of trust and security. A complete solution must also include legal and social regulations.

Besides functional enablers there is a set of common system enablers, which are closely connected with exchanging a great number of events and large amounts of simple text data in addition to complex multimedia and web data. These data are usually stored in databases. Therefore, the Event and Data Management Enablers are the core enablers and architectural components.

New technologies, new forms of storing and accessing data, and the ability to retrieve information from different data sources are a part of the "Safe City" solution (data federation).

The analysis of large amounts of data in real time also requires new techniques. In doing this, statistics, semantic techniques, machine learning and logical reasoning methods are required for the semantic enrichment of data to employ. By analyzing data streams, texts, video and web data, simple and advanced analysis is made.

Correlating the current data with its history the Prognosis enabler can predict the future events and circumstances based on existing information. To more easily understand the circumstances and interpret information the decision-making systems are also a part of the "Safe City" solution.

Service Oriented Architecture (SOA) principles and its key elements Enterprise Service Bus (ESB) and integration bus are the foundation for a modular approach to software development, which allows you to build information interaction in heterogeneous environments based on components with standardized interfaces and protocols. These technological concepts allow us to integrate various systems in a secure and efficient way.

"Safe City" is a future-oriented solution that is prepared for further adaptations according to the market and regulatory needs. It is a basis for the broader solution for Smart City and Community.

2.2 Broadband Network Solutions

Iskratel has rich experience in designing and implementing public and private broadband network projects using a variety of technologies, from Wi-Fi, mobile and fixed technologies to private LANs. Its portfolio features broadband optical access, xDSL access and aggregation network products that support services of various quality grades, precisely customized per user and per service.

When developing a broadband solution, Iskratel employs a two-phase approach. In the first phase of the project, Iskratel proposes carrying out a study to analyze the needs and define the requirements for the services and infrastructure, and then find a long-term sustainable business model for the financing of the project. The result of the study may include nominal radio planning of the project solution on the basis of the requirements established, as well as geographical and other specifics.

In the second phase of the project, Iskratel can act as the project contractor (see the infrastructure projects section) or as a solution provider for broadband networks.

For Phase 1, Iskratel offers consultancy services, within which it can carry out the analysis of needs and requirements of the Smart Community regarding wireless and fixed IT infrastructure. Based on data collected, it assesses which type of network and technology is most suitable. The planning is performed in a way that covers as many as possible various types of services that are in the Smart Community portfolio and require a communication path that the network would provide. The study may include nominal radio planning in addition to planning network services for the selected technology.

In the second part of the first phase of the project, Iskratel finds a suitable business model that would provide funding and long-term financial sustainability of the project.

Upon completion of the first phase of the project, Iskratel can offer its services as a contractor for network implementation, based on the specifications from Phase 1.

In the case of a long-term sustainable business model, Iskratel together with its subsidiary RC IKT can assume the role of the public Wi-Fi network manager.

2.3 Information and Notification System for Railways

Designed using best-of-breed technologies, Iskratel Railway Information Solution is the natural evolution of the Connected (Integrated) Railway Infocommunication philosophy, which continues to provide an Iskratel framework to promote efficiency and reduce the complexity and cost of communications, IT and operations in railways.

Railway Information Solution realizes Connected Railway Infocommunication vision that can help achieve the railways' need for business transformation and public safety, while also ensuring the best possible experience and attainment of financial objectives. This vision is realised by using the IP network as a platform to unite and optimise the entire spectrum of communications and operations to maximise the shared use of communication, information and resources across all railway functional groups.

By using this approach, railways can start to turn information into a valuable resource and create new revenue models. For example, whereas in the past CCTV images were the sole property of the local security department, converged IP CCTV systems sitting on the IP network platform allow the images to be accessed from anywhere across the railway. If these images can help an operator to optimize its operations and reduce costs or improve the security for passengers, they are valuable and can become a revenue source for the operator and potentially change the way in which these organizations work. The solution supports the centralization of processes in fragmented railway organizational structures, which accelerates information and communication flows, improving performance and operational effectiveness.

The Passenger Information System is an integrated part of the Iskratel Railway Information Solution, with an effective system architecture that covers all rail transport environments: stations, railway infrastructure, trains, depots and control centers. It is designed to work with other features including security, network & telecoms and control & monitoring to maximize operational efficiency. The entire solution is controlled via a single platform and provides real-time monitoring for all devices and equipment to optimize service management, administration and improve security.

2.4 The programs Platform Service and Safe Society

These two programs have been initiated by Iskratel in the year 2014. Within these programs it offers together with the Slovenian partners a set of already existing prototypes and products in the areas of ICT enabling technologies and safe society. They will be upgraded with the essentially new features and APIs in order to use them as services and also to build the pre-integrated solutions.

Each program is presented in a separate document.

3. INFRASTRUCTURE PROJECTS AND SERVICES

The Iskratel company has demonstrated with numerous positive references it has all the competences and capacities for the successful implementation of technologically, organizationally and operationally demanding projects for ICT, the public sector and other industrial sectors. Its medium-term strategy focuses on the area of infrastructure projects for the domestic and foreign markets, mainly the European, Russian and Central Asian markets.

Within the scope of infrastructure projects, Iskratel provides comprehensive management of complex projects in the domains of telecommunications, energy management, transport and solutions for Safe Communities and Smart Cities.

We have all the necessary expertise and resources to conduct various forms of partnerships: a consortium of equal partners, a subcontracting model or a public-private partnership.

We cover all phases of the project life cycle, from pre-sales to the query phase, including all standard and customized services.

Activities are normally divided into the following stages:

- The pre-sale phase, focused on market research, identifying customer needs, developing solutions and creating partnerships;
- The sales phase, in which activities related to the preparation of tenders, forming sales consortia and the provision of financial resources are carried out;
- The implementation phase, in which installation and integration of partial or complete solutions is executed in accordance with the approved order and actual partnership model;
- The query phase, in which system maintenance and servicing, complete or partial system management and consulting services regarding the further development of the system are performed.

Our ability to lead and coordinate complex infrastructure projects is evidenced by our successful projects, such as: establishing the Simobil GSM network and setting up the GSM-R network for the Slovenian Railways.

4. Iskratel References

4.1 Safe City

Iskratel has a good record of positive references in the area of Safe City, including the following:

- Unified Information Management System in Emergency and Crisis Situations in the Kyrgyz Republic (System-112 and Statewide Integrated System of Informing and Warning the Population) - the first phase consists of Emergency Operations Center with 23 operator desks and public warning system;
- Unified Information Management System in Emergency and Crisis Situations in the Kyrgyz Republic (System-112 and Statewide Integrated System of Informing and Warning the Population) - the second phase extends the Emergency operations center with 54 additional operator desks;
- System-112 Ryazan region of Russian Federation - the first phase consists of Emergency operations center with 16 operator desks;
- System-112 Ryazan region of Russian Federation - the second phase extends the Ryazan Emergency operations center with 26 additional operator desks.
- System-112 Krasnodar and Sochi region of Russian Federation - the first phase consists of the Emergency operations center with 87 operator desks.
- eCall Service for Slovenia - Modernization of existing 112 emergency operation centers. The solution is designed to cover the territory of the whole country.

4.2 Broadband Network Solutions

Iskratel has designed many networks and solutions, both in Slovenia and abroad, in the area of public network operators and closed private networks as well. Let us mention just some of them:

- Si.mobil: turn-key project for the second largest mobile operator in Slovenia, 1998–2003,
- Elektro Gorenjska: designing and setting up a wireless backbone network for the connection of transformer stations, aggregation of traffic from smart meters and management of communication nodes, 2011–2012,
- Open broadband networks in Slovenia: Creating solutions for several Slovenian open broadband networks, 2011–2012.

As a manufacturer of communication equipment and supplier of comprehensive solutions, Iskratel has supplied the equipment and carried out many projects based on complete solutions both in Slovenia and abroad, in the area of public network operators and closed private networks as well. Let us mention just some of them:

- Si.mobil: Iskratel has implemented a turn-key project for a mobile operator in Slovenia, Phases 1–5 in 1998–2004,
- Comprehensive broadband access (xDSL/optics) projects for Telekom Slovenije, Telemach, OŠO Vahta d.o.o., KabelNoord Netherlands, OnlyCable Spain, Netia Poland, Ukrtelekom Ukraine, Rostelecom Russia, Kazakhtelekom Kazakhstan, etc.,
- Comprehensive projects in the core network area: Over 500 call servers and gateways set up in Slovenia, Croatia, Bosnia, Serbia, Macedonia, Spain, Mexico, Argentina, Bolivia, Ukraine, Russia, and Kazakhstan.

4.3 Transportation

Iskratel has a good record of positive references in the area of Transportation (especially Railways), including the following:

- Comprehensive projects in the area of business communications and operational communications for large dedicated networks in the fields of transport, energy and public safety, for example, Deutsche Bahn (DB), Željeznice Rep. Srpske (ŽRS), Russian Railways (RZD), Kazakh Railways, ELES, HSE, Elektro Primorska, Elektroprivreda BiH, Gazprom, Transneft Russia, KievEnergo Ukraine.
- Vast experience in the design and construction of complex, safe and time-critical IT and communications solutions for the needs of e-tolling, eCall.

4.4 Infrastructural projects and services

Currently, the main infrastructure project is the project of Slovenian Railways, where Iskratel as a leading partner in the consortium is overseeing the entire GSM-R project, which is now approaching completion, 2014–2015.

Iskratel implemented a turn-key project for the mobile operator Si.mobil, Phases 1–5 in 1998–2004. Other projects are listed in the Broadband Network Solutions section.

5. ACKNOWLEDGMENTS

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Pomen prostorskih kazalcev in geostoritev za pametna mesta

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IZVLEČEK

Objektom, osebam, informacijam, in dogodkom je možno določiti položaj v prostoru (geolokacijo). Geolocirane entitete lahko geovizualiziramo s kartami, prostorskimi modeli ali simulacijami. V članku opisujemo kako lahko prostorski podatki, geolokacija in geovizualizacija pripomorejo tako k razvoju pametnih mest, kakor tudi k ocenjevanju pametnosti mest. Vseh šest ključnih karakteristik pametnega mesta (gospodarstvo, ljudje, vodenje, mobilnost, okolje, življenje) je v posredni ali neposredni povezavi s prostorom in prostorskimi podatki. V prispevku bodo opisane lastnosti storitev za potrošnike in upravljalce pametnih mest, ki so povezane s prostorskimi podatki in lokacijo, pa tudi objektivno merljivi kazalci za ocenjevanje mest.

Ključne besede
pametno mesto, geolokacija, geovizualizacija, karakteristike, kazalci, geo-storitve

ABSTRACT

Objects, persons, information and events could be tagged by position in the space, ie. by geolocation. The geolocated entities could be further geovisualized by maps, spatial models and spatial simulations. In this article we describe the ways to augment the performances of a smart city with the aid of spatial data, geolocation and geovisualization. We also discuss how we could assess the smartness of a city with spatial tools. We argue that all the six key characteristics of a smart city (ie. economy, people, governance, mobility, environment and living) are directly or indirectly related to space and spatial data. We describe the characteristics of geoservices for users and managers of smart cities. We also show how spatial data contribute to provide objective and measurable indicators which are used to assess smartness of a city.

Keywords
smart city, geolocation, geovisualization, characteristics, indicators, geoservices

1. UVOD

Za večino objektov, oseb, informacij in dogodkov je možno določiti položaj v prostoru ali geolokacijo. Geolokacijo je mogoče na več načinov prikazati ali geovizualizirati, in sicer s klasičnimi kartografskimi sredstvi, kot tudi s sodobnimi geomediji.

Določitev in prikaz položaja lahko opravimo za urbano ali naravno okolje. V konceptu pametnih mest seveda prikazujemo urbano okolje, vendar z elementi naravnega. Urbano okolje ima glede na naravno nekaj pomembnih razlikovalnih lastnosti tako glede prostorske, kot tudi vizualne strukture. Je geometrično relativno dobro organiziran prostor s ponavljajočimi prostorskimi vzorci in vizualno razpoznavnimi orientacijskimi točkami (angl. landmarks). Mesta vsebujejo tudi eksplicitno "znanje v okolju" (angl. knowledge in the world). S tem izrazom poimenujemo fizične lokacijske oznake za navigacijo, orientacijo in informiranje v mestnem okolju, npr. hišne številke, oznake ulic, smerokaze, znake in napise ob cesti ter na stavbah (Montello 1998). Že sam termin "znanje v okolju" nakazuje, da so mesta "pametna", saj se znanje v mestu (o mestu) manifestira tudi vizualno.

Eno ključnih del o diferenciaciji izgleda mesta, ki vpliva tudi na kakovost življenja in pametnost mesta, je objavil Lynch (1960). Če k temu klasičnemu pogledu na urbano okolje dodamo še informacijsko-komunikacijsko (IK) tehnologijo, lahko znanje v urbanem okolju virtualiziramo in ga uporabniku ponudimo tako preko spleta ali mobilno.

2. GEOINFORMACIJSKA INFRASTRUKTURA MESTA

Mesta se od naravnega okolja razlikujejo tudi po infrastrukturi: prometni, stanovanjski, komunalni, poslovni in čedalje bolj tudi informacijsko-komunikacijski. Infrastruktura omogoča in oblikuje lokalne bivanjske, navigacijske in splošne življenjske navade. V konceptu pametnih mest je ne glede na izbrano definicijo pametnega mesta IK infrastruktura temelj vseh karakteristik, ki zaznamujejo sodobno pametno mesto.

Del IK infrastrukture je tudi geoinformacijska infrastruktura ali prostorska podatkovna infrastruktura (angl. spatial data infrastructure, SDI). Medtem, ko je večina splošne IK infrastrukture namenjene mestom in mestnemu prebivalstvu, kjer je tudi največ poslovnih in zasebnih uporabnikov, pa je geoinformacijska infrastruktura vseprisotna po celotnem državnem ozemlju, zato ni le del pametnih mest, je pa univerzalna podpora za definiranje, merjenje in prikazovanje karakteristik pametnega mesta. Evropska direktiva INSPIRE ureja tovrstno infrastrukturo za celotno Evropo (URL1).

V članku argumentiramo, da je v vseh karakteristikah pametnega mesta kot vplivni dejavnik vseprisotna tudi geolokacija. Pametnost mesta je torej tudi lokacijsko pogojena.

3. DEFINICIJE PAMETNEGA MESTA

Definicij pametnega mesta je več in nihajo med koncepti informacijsko-komunikacijske opremljenosti, trajnostnega razvoja in gospodarske konkurenčnosti. Vse definicije so mehke in se prekrivajo. Določiti, kaj je pametno mesto, je stvar presoje različnih strokovnjakov, še bolj pa prebivalcev, saj so vsakodnevni uporabniki mesta, ki lahko na različne načine izražajo ali ocenjujejo zadovoljstvo z življenjem v mestu. Prav tako je težko vsa mesta ocenjevati z istimi parametri in mesta primerjati med seboj, saj je bistvena razlika med delovanjem manjšega občinskega središča in večmilijonske prestolnice. Večina virov pa navaja, da pametno mesto določa šest ključnih karakteristik:

- pametno gospodarstvo oz. konkurenčnost,
- pametni ljudje oz. družbeni in človeški kapital,
- pametno vodenje oz. družabništvo,
- pametna mobilnost oz. promet in IK tehnologija,
- pametno okolje oz. naravni viri,
- pametno življenje oz. kakovost življenja.

Namenoma so na drugem mestu navedene tudi pojasnjevalne različice vsake karakteristike, ki pa so subjektivne, saj bi tehnično usmerjen ocenjevalec pametnega mesta lahko

upravičeno trdil, da npr. IK tehnologija ni le del pametne mobilnosti, temveč vseh šestih karakteristik.

Pri ocenjevanju pametnosti mesta je za teh šest karakteristik potrebno določiti merljive cenilke, ki pa se od tu naprej lahko razlikujejo glede na pristop k definiranju pametnega mesta. Eden od načinov ocenjevanja je s pomočjo hierarhično definiranega sistema faktorjev in kazalcev (podfaktorjev), ki sledijo iz osnovnih šestih karakteristik, vsak od njih pa je lahko lokalno, regionalno ali nacionalno signifikanten. V referenčnem projektu (Giffinger at al., 2007), je bilo npr. za 70 evropskih srednje velikih mest ocenjevanih 33 faktorjev, ki jim pripada 74 indikatorjev, rezultati pa so dokaj realistični in objektivni.

3. KAZALCI ZA OCENJEVANJE PAMETNEGA MESTA

Naštete osnovne karakteristike so odraz koncepta pametnega mesta, ocenjevalcem pa je prepuščeno, kakšne mere za oceno bodo uporabili. Mnoge mere so subjektivne in kulturološko ter družbeno pogojene z vrednotami, ki veljajo v določenem okolju, zato si želimo, da bi bilo čim več ocen objektivno merljivih in neodvisnih od približne presoje in preferenc ocenjevalcev.

Geolocirani podatki so zaradi široke javne dosegljivosti in eksaktnosti primerno sredstvo za številne prostorske kazalce pametnosti mest ali za kombinacijo z drugimi kazalci (Barborič et al., 2014). Nekateri primeri prostorskih mer, ki so posredno ali neposredno uporabne za oceno pametnosti mest so za vseh šest karakteristik navedeni spodaj.

- Pametno gospodarstvo:
  - lokacija delovnih mest, lokacijska borza delovnih mest,
  - dolžine optimalne poti do delovnih mest,
  - prostorski razpored podjetij glede na tip dejavnosti,
  - gostota in razpored (ne)zaposlenih,
  - lokacijska razpršenost oz. koncentracija kapitala,
  - lokacijska razpršenost potrošnje,
  - oddaljenost gospodarskih središč od drugih regionalnih centrov.
- Pametni ljudje:
  - geolocirani splošni demografski podatki,
  - položaj, distribucija in gostota prebivalcev glede na infrastrukturo,
  - izobrazbena struktura glede na lokacijo stanovanj in zaposlitve,
  - lokacija in razpored izobraževalnih ustanov in programov,
  - prostorska razporeditev starejših prebivalcev, njihova inkluzija in mobilnost.
- Pametno vodenje:
  - politična in družbena angažiranost glede na lokacijo,
  - zadovoljstvo prebivalcev z ekonomsko-političnim stanjem glede na lokacijo.
- Pametna mobilnost:
  - gostota in lokacija prometnega omrežja,
  - dostopnost prevoznih sredstev in optimalne poti,
  - lokacija in pogostost dostopa do IK infrastrukture,
  - lokacija nevarnih točk v prometu in njihova gostota,
  - topologija in dolžina mreže javnega potniškega prometa,
  - oddaljenost med mesti, bivalnimi enotami in delovnimi mesti,
  - prometna povezanost prebivalcev s storitvami, trgovinami in lokacijami za preživljanje prostega časa.
- Pametno okolje:
  - razgibanost terena in tip krajine,
  - gostota urbaniziranosti,
  - vegetacijska pokritost, raba tal in degradacija okolja,
  - bližina gozda, vode, morja, gora, rekreacijskih površin,
  - izpostavljenost lokacije različnim vremenskim in okoljskim razmeram,
  - kakovost okolja glede na lokacijo,
  - lokacije energetsko varčnih objektov in potencialnih objektov za trajnostno pridobivanje energije.
- Pametno življenje:
  - lokacije, cene in kakovost nepremičnin,
  - lokacije športnih, kulturnih in rekreacijskih objektov,
  - gostota in lokacija zdravstvenih objektov,
  - uporaba lokacijskih in drugih IK storitev glede na lokacijo,
  - geolocirani demografski podatki o zdravju, varnosti, revščini in zadovoljstvu prebivalcev,
  - bližina in gostota turističnih znamenitosti, turistična obiskanost lokacij.

Vse navedene kazalce je mogoče vizualizirati s klasičnimi ali spletnimi kartami (tematska kartografija), prostorskimi plani, 3D modeli, prostorskimi in časovnimi simulacijami, multimedijo in drugo grafiko.

V tem poglavju je bil nakazan pomen lokacijskih podatkov pri ocenjevanju pametnosti mest. V nadaljevanju pa se osredotočimo še na uporabo prostorskih podatkov in geovizualizacij za geostoritve, ki vsaj s stališča naprednih IK tehnologij lahko povečajo pametnost mesta. To so lahko aplikacije za prebivalce, pa tudi za upravljalce pametnih mest.

4. GEOSTORITVE ZA PREBIVALCE PAMETNIH MEST

Geostoritve za prebivalce pametnih mest so predvem spletne in mobilne narave. Večina mobilnih aplikacij izkorišča vgrajeno tehnologijo GPS sprejemnika, žiroskopa in/ali digitalnega kompasa, pa tudi kamere in drugih zmožnosti pametnega telefona. Vse navedeno je povezano z lokacijo, orientacijo, navigacijo ali fotografijo objektov v prostoru. Uporabnik pri tem lahko postane hkrati tudi proizvajalec podatkov in slik o prostoru ter se spremeni v takoimenovanega Državljana 2.0 (angl. Citizen 2.0 ali tudi prosumer). Kolaborativni ali sodelovalni podatki so pomemben del tako prostorskih kot tudi drugih atributnih ali grafičnih baz (Triglav, Radovan, 2013).

Mobilne geostoritve zmorejo v določeni meri prepoznavati kontekst storitve, če je znana lokacija. Večina uporabniških mobilnih pa tudi spletnih apikacij, ki povečujejo pametnost mesta je odvisna od lokacije, npr. izposoja javnih koles, časi prihodov avtobusov, vodič po turistični tematski poti (Geodetski inštitut Slovenije, 2015), avtomatski navigator v avtu, svetovalec gostinskih storitev in trgovin, pa tudi pomočnik za slepe ali gibalno ovirane osebe (Rener et al., 2012). Storitve so torej občutljive na zaznano lokacijo v prostoru.

Tudi aplikacije z izboljšano resničnostjo (angl. augmented reality) so vedno povezane z orientacijo in položajem telefona uporabnika, ponavadi ob vklopljeni kameri, pri čemer se trenutna slika prostora obogati z nevidnimi informacijami, npr. z vsebino pod zemljo, za objektom ali o samem objektu. Pri tem je lokacija primarna informacija, na osnovi katere se ustvari prekritje z besedilom, dodatno grafiko, transparentno sliko, zvokom in podobno (Berk et al., 2013, Mesner et al., 2013).

Spletne storitve so večkrat podložene s kartami, zaradi brezplačnosti predvsem s produkti Digitalne Zemlje (npr. Google Earth, Google Maps, Geopedia). Večina jih deluje po principu več ravni kartografskega detajla, prostorski podatki pa so v osnovi povzeti po državnih geodetskih oz. topografskih bazah. Ker so mobilne aplikacije oplemenitene s karto, ki ob prenašanju naprave na drugo lokacijo lahko samodejno spreminjajo tudi

detajlnost prikaza, ima uporabnik občutek o vseprisotnosti kartografije (angl. ubiquitous cartography), še posebno, če je na lokacijah na razpolago tudi druga naprava ali pano s karto ali če ima s seboj še druge kartografske prikaze, digitalne na telefonu ali pa analogne na publikacijah.

Velika podrobnost prikazovanja je pomembna pri storitvah NFC (angl. near field communication), če je ciljni stacionarni ali premični aparat potrebno najti z navigacijo. Pri tem so lahko podrobnosti prikaza večje, kot jih omogočajo standardni državni topografski podatki, ki običajno segajo do merila 1:5000. Prihajajoči internet stvari bo zahteval še mnogo podrobnejše podatke o prostoru za različne tipe objektov in storitev, pa tudi 3D podatke za zunanjost in notranjost stavb. Trenutna slabost storitev v pametnih mestih je fragmentirana dostopnost storitev in omejenost omrežij, ki bi omogočala vseprisotne storitve (Workshop, 2009), pa tudi pomanjkanje zelo podrobnih podatkov, ki bi bili ažurirani v skoraj realnem času.

5. GEO-APLIKACIJE ZA UPRAVLJALCE PAMETNIH MEST

Za upravljalce pametnih mest so pomembne geostoritve, ki optimizirajo delovanje fizične in virtualne mestne infrastrukture, zagotavljajo trajnostno rabo energije, varovanje okolja, e-demokracijo in delovanje e-uprave. Razen s spletnimi in mobilnimi aplikacijami lahko tovrstno problematiko mesto rešuje tudi z aplikacijami s področja GIS (geografskimi informacijskimi sistemi). Pri tem je pomembno, da so podatki odprti in na razpolago za ponovno uporabo tudi izven upravljalskega kroga (angl. open data, re-use of data), da so po možnosti zapisani v državnem koordinatnem sistemu in da so semantično harmonizirani, kar pomeni, da so objektne definicije nedvoumne in usklajene z drugimi povezanimi bazami (Radovan, 2015, Kete et al., 2014). Aplikacije z odprtimi prostorskimi podatki so med najpogostejšimi primeri prakticiranja principov odprtih inovacij, živih laboratorijev in participacije prebivalstva (Lemke, Luotonen, 2009).

Pomemben del prostorskih aplikacij je namenjen ožji odločevalski strukturi v mestu (angl. Smart Mayors), za katero je pomembna možnost izdelave avtomatskih poročil, geostatistik in izdatna geovizualizacija kazalcev (Žagar et al., 2014).

6. ZAKLJUČEK

Kartografija in geodezija sta med najstarejšima vedama. Obe sta z digitalizacijo prostora, geografskimi informacijskimi sistemi, spletnimi in mobilnimi tehnologijami ter satelitskimi navigacijskimi sistemi, le pridobili na pomenu, saj vizualizacija realnega sveta skupaj z virtualnim pomeni dodano vrednost. Geolokacija je postala del aplikacij v skoraj vseh strokah, tudi v humanističnih.

Obvladovanje mestnega okolja je glede na številne funkcije mesta nemogoče brez prostorskih podatkov, analiz in prikazov. Z novimi mobilnimi storitvami je uporabnik neprestano v stiku z navigacijo in določanjem položaja, zato se povečuje občutek vseprisotnosti kartografije in geolokacije v vsakdanjem življenju. To se odraža tudi pri sodelovanju uporabnikov geostoritev, ki prostovoljno prispevajo prostorske podatke, izdelujejo prostorske prikaze in delijo informacije z drugimi uporabniki. Pametni upravljalci pametnega mesta zato takšne podatke uporabljajo za povečanje pametnosti mest, s čimer se zagotavlja vedno boljše storitve, ki so del vseprisotnega računalništva.

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Platforma za informacijsko podporo participativnemu načrtovanju javnih storitev v pametnih mestih

An IT support platform for participative design of public services in smart cities

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Povzetek

V razvitem svetu naraščajo težnje po razvoju urbanih središč, ki bodo svojim prebivalcem omogočala čimbolj udobno, obenem pa tudi okoljsko vzdržno in učinkovito življenje. Ključni element za dosego tega cilja so tudi informacijske in komunikacijske tehnologije. V prispevku predlagamo izdelavo informacijske platforme za podporo pri načrtovanju javnih storitev, ki bo omogočala in podpirala sodelovanje uporabnikov pri načrtovanju, razvoju in vodenju javnih storitev kot je na primer javni potniški promet.

Abstract

In the developed world there are growing tendencies for the development of urban centers, which will provide its residents with a comfortable, as well as environmentally sustainable and efficient living environment. A key element for achieving this objective are the information and communication technologies. In this paper we propose the development of an information platform to support the design of public services, which will enable and encourage the participation of users in design, development and control of public services such as public transport.

1. Uvod

Sodobne informacijske in komunikacijske tehnologije nam na področju načrtovanja in vodenja pametnih mest in skupnosti omogočajo izvedbo mnogih inovativnih storitev in rešitev. Omogočajo nam relativno enostavno zbiranje množice podatkov in njihovo avtomatsko analizo. Na tej osnovi lahko gradimo nove in inovativne storitve, ki izboljšujejo kvaliteto življenja v urbanih središčih. Omogočajo pa nam tudi vzpodbujanje participacije uporabnikov na način, ki je bil še do nedavnega nemogoč. S pojavom spletnih storitev kot sta Facebook in Twitter se zasebna komunikacija vse bolj seli na splet ter hkrati postaja vse bolj javna. Po drugi strani so spletne storitve bistveno poenostavile javno komunikacijo in jo naredile bolj dostopno množicam. Posledično nam tako splet nudi obilo različnih informacij in z njihovo analizo lahko na primer zaznavamo javno mnenje o določenih tematikah, ki ga nato lahko uporabimo za izbor uporabnikom prilagojenih rešitev - tradicionalno se za to uporabljajo ankete, ki pa jih je težje in dražje izvesti.

V prispevku predlagamo izdelavo informacijske platforme za podporo pri načrtovanju javnih storitev, ki bo omogočala in podpirala sodelovanje zainteresirane javnosti. Uporaba predlagane platforme bo na primer prispevala k bolj učinkovitemu in kakovostnemu delovanju sistema javnega prometa ter večjemu zadovoljstvu uporabnikov. Sodelovanje uporabnikov bo prispevalo tako k boljšim rešitvam kot k dvigu občutka participacije uporabnikov in posledično boljši sprejetosti novih rešitev v javnosti. Platforma bo uporabna tudi za načrtovanje in izboljšave druge podobne javne infrastrukture kot so kolesarske steze, javne mreže izposojevalnic koles, medkrajevne avtobusne povezave, javne razsvetljave in podobno.

2. Vloga pametnih mest in skupnosti

Evropa se z leti vse bolj urbanizira in trend preseljevanja v (velika) mesta se po predvidevanjih strokovnjakov ne bo ustavil, ne glede na težave, ki jih to lahko prinaša [1]. S tem naraščajo tudi težnje po načrtovanju razvoja takšnih mest, ki bodo svojim prebivalcem omogočala čimbolj udobno, obenem pa tudi vzdržno in učinkovito življenje. Velika pozornost razvoju na področju tako imenovanih pametnih mest in skupnosti ter s tem povezana pričakovanja zato niso presenetljiva. Temu področju je namenjene precej pozornosti tudi v aktualni evropski razvojni politiki ter razpisih za raziskovalne in razvojne projekte.

Sodobna informacijska orodja in tehnologije za zajem in analizo podatkov nam omogočajo izvedbo inovativnih javnih storitev, ki bodo bistveno vplivale na kvaliteto življenja v urbanih središčih. Poseben potencial tako predstavlja uporaba sodobnih metod rudarjenja podatkov in

napovednega modeliranja, ki nam omogočajo avtomatsko analizo velikih količin podatkov prisotnih v sodobnih mestih ter njihovo uporabo za napovedovanje obnašanja procesov, tudi v realnem času. Omeniti je potrebno tudi možnosti, ki nam jih informacijske tehnologije nudijo pri spodbujanju participacije javnosti v procesu razvoja urbanih središč ter pri odločanju in izbiri optimalnih rešitev raznovrstnih problemov v sodobnih mestih.

3. Dosedanji dosežki in izkušnje naše skupine

Na Odseku za tehnologije znanja Instituta Jožef Stefan imamo dolgoletne izkušnje z razvojem metod in orodij za analizo podatkov, napovedno modeliranje, podatkovno rudarjenje in podporo odločanju ter njihovo uporabo na različnih področjih, vključno s področji povezanimi s pametnimi mesti.

V okviru mednarodnih in domačih projektov smo tako na primer razvili ali še razvijamo metode, prototipe in študije za analizo novic [5] in sentimenta [2,3], podatkov iz senzorskih in socialnih omrežij [4] ter učinkovito uporabo znanja množic (angl. crowdsourcing).

Odsek za tehnologije znanja je bil v zadnjih petih letih vključen v 28 mednarodnih projektov, med njimi so s področjem pametnih mest in predlaganega projekta najbolj povezani naslednji:

- Projekt FP7 FOC (Forecasting Financial Crises), v okviru katerega smo analiziral vpliv novic in Twitterja na predvidevanja dogajanja na finančnih trgih.
- Projekt FP7 FIRST (Large scale information extraction and integration infrastructure for supporting financial decision making) v okviru katerega smo med drugim razvili metodologijo za analizo sentimenta v tokovih kratkih spletnih sporocil v realnem casu.
- Raziskovalni vavčer - Shallow semantic analyses for selected European languages (Razvoj semantičnih analiz za evropske jezike): partnerstvo s podjetjem Gama System d.o.o.
- Koordiniramo mednarodni projekt MAESTRA (Learning from Massive, Incompletely annotated, and Structured Data), v okviru katerega so kot primer uporabe obravnavana tudi senzorska in socialna omrežja.
- V sklopu projekta FP7 WHIM (The What-If Machine) za potrebe strojnega učenja ocenjevalnih modelov med drugim preučujemo procese uporabe odzivov in znanja množic (crowdsourcing) in razvijamo metode analize sentimenta prilagojene subjektivnim ocenam, vrednotenju, oziroma vrednostnim sodbam.
- Projekt FP7 MULTIPLEX (Foundational Research on MULTIlevel comPLEX networks and systems), v okviku katerega analiziramo strukturne in vsebinske lastnosti (npr. sentiment o določenih področjih) socialnih omrežij.
- Projekt H2020 DOLFINS (Distributed Global Financial Systems for Society), v okviru katerega analiziramo medsebojni vpliv politike, lobistov in zakonodaje na podlagi informacij zbranih v socialnih omrežjih.

4. Predlagani projekt: Informacijska podpora participativnemu načrtovanju javnih storitev

Predlagamo izdelavo informacijske platforme za podporo pri načrtovanju javnih storitev kot je na primer javni potniški promet, ki bo omogočala in podpirala sodelovanje zainteresirane javnosti. Platforma bo nudila podporo tako pri zasnovi in izbiri novih idejnih rešitev kot tudi pri izboljšavah že obstoječih storitev. Delovanje platforme bo temeljilo na uporabi naprednih metod za analizo podatkov kot so podatkovno rudarjenje, strojno učenje, analiza sentimenta in metode za gradnjo večparametrskih odločitvenih modelov. Jedro platforme bo sestavljeno iz množice različnih modulov, ki bodo lahko po potrebi uporabljeni v posameznih namenskih rešitvah.

4.1 Moduli za zajem podatkov, podatkovno analitiko, optimizacijo in podporo participativnemu odločanju

Posamezni moduli bodo omogočali različne funkcije kot na primer:

- pasivno spremljanje spletnih omrežij, forumov in blogov ter aktivno zbiranje podatkov prek namenskih mobilnih aplikacij;
- analizo ter odkrivanje zakonitosti v tako zbranih podatkih (npr. potovalnih vzorcev uporabnikov potniškega prometa, sentimenta do predlaganih rešitev, ...);
- participacijo javnosti pri oblikovanju novih rešitev s pomočjo spletnih in mobilnih aplikacij (npr. predlaganje novih povezav potniškega prometa, kolesarskih stez, ...);
- optimizacijo javnih sistemov na osnovi tako zbranih podatkov in zgrajenih modelov.

4.2 Praktični primeri storitev

V nadaljevanju podajamo nekaj praktičnih primerov uporabe predlagane platforme.

Participativno načrtovanje in optimizacija javnega potniškega prometa

Z uporabo zgoraj omenjenih modulov za spletno rudarjenje in analizo sentimenta bomo spremljali in analizirali spletna omrežja, forume in bloge ter zaznavali pereče probleme (npr. pomanjkanje povezav v določenih soseskah,

premajhne frekvence določenih prog, pomanjkljivosti določenih postajališč, itd.), (ne)naklonjenost predlaganim novim rešitvam ter tudi razloge za morebitno (ne)naklonjenost. Za optimiranje delovanja celotnega sistema je nujno poznavanje potovalnih navad uporabnikov. Z uporabo tehnologij strojnega učenja lahko zaznavamo in analiziramo navade prek analize krajevnih in časovnih vzorcev zbranih v iskalnikih prometnih povezav (npr. GoogleMaps, LPPbus, ipd.) in senzorjih na avtobusih (kartica Urbana), predvsem pa lahko analiziramo podatke zbrane s pomočjo namensko razvite mobilne aplikacije. Ta bo uporabnikom omogočala, da sodelujejo pri nadgrajevanju sistema z avtomatskim ali ročnim beleženjem vsakodnevnih potovalnih vzorcev (seveda ob upoštevanju predpisov s področja varstva osebnih podatkov). Z uporabo te aplikacije bodo lahko uporabniki tudi posredno 'glasovali' za npr. uvedbo novih povezav ali spremembo urnika. Platforma bo vključevala tudi spletno orodje za aktivno predlaganje novih rešitev (npr. novih avtobusnih linij).

Uporaba platforme bo v tem primeru prispevala k bolj učinkovitemu in kakovostnemu delovanju sistema javnega prometa ter večjemu zadovoljstvu uporabnikov. Sodelovanje uporabnikov bo prispevalo tako k boljšim rešitvam kot k dvigu občutka participacije uporabnikov in posledično boljši sprejetosti novih rešitev v javnosti.

Takšna rešitev bo z minimalnimi dopolnitvami uporabna tudi za načrtovanje in izboljšave druge podobne javne infrastrukture kot so kolesarske steze, javne mreže izposojevalnic koles (BicikeLJ), medkrajevne avtobusne povezave in podobno.

Participativno načrtovanje razvoja javnih prostorov

Platformo bomo uporabili tudi za podporo t.i. konceptu "citizen observatories" (participacija prebivalcev) z namenom spodbujanja soodločanja prebivalcev pri razvoju javnih prostorov kot so mestni trgi, parki, pešcem namenjene zone, obrežja, ipd. Module za zajem podatkov, podatkovno analitiko, optimizacijo in podporo (participativnemu) odločanju bomo v tem primeru uporabili tako za pasivno spremljanje mnenja javnosti o posameznih javnih prostorih, zaznavanja problemov in predlogov rešitev kot tudi za aktivno podajanje novih pobud in predlogov prek v ta namen razvite spletne aplikacije.

Sistemi pametne javne razsvetljave

Platforma bo uporabljena tudi za načrtovanje in upravljanje sistemov pametne javne razsvetljave. Na podlagi različnih senzorskih in vremenskih podatkov bomo s pomočjo metod podatkovnega rudarjenja razvili napovedne modele, ki bodo uporabljeni za regulacijo javne razsvetljave. Napovedni modeli bodo npr. napovedovali količino prometa (število avtomobilov, kolesarjev, pešcev, ...) na osnovi česar bomo lahko določili potrebni nivo osvetljenosti (če je prometa malo ali nič, je potrebno le malo ali nič razsvetljave). Z zajemanjem želja prebivalcev bo možno tudi zaznati kje in kdaj prebivalci res potrebujejo razsvetljavo ter, ob upoštevanju strokovnih argumentov (kje je npr. razsvetljava potrebna zaradi prometne varnosti), na preostalih lokacijah ustrezno zmanjšati razsvetljavo ter tako varčevati z električno energijo in zmanjšati svetlobno onesnaževanje.

4.3 Sodelujoče organizacije

V predlaganem projektu predvidevamo sodelovanje naslednjih partnerjev:

- Institut Jožef Stefan,
- Ljubljanski urbanistični zavod d.d.,
- Mestna občina Ljubljana,
- Javno podjetje Ljubljanski potniški promet, d.o.o.,
- Javna razsvetljava d.d.,
- BTC d.d.

Poleg navedenih ustanov so potencialni partnerji tudi druga podjetja, ki se ukvarjajo s potniškim prometom, preučevanjem javnega mnenja in načrtovanjem urbanega prostora ob participaciji javnosti.

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Storitve prožnosti prorabnikov za upravljanje pametnih omrežij / Prosumer flexibility services for smart grid management

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POVZETEK

Električno omrežje je izredno pomembno za delovanje in upravljanje pametnih mest. Električna omrežja postajajo vedno bolj pametna, veča se uporaba informacijsko komunikacijskih tehnologij, število pametnih števcev, porazdeljenih virov električne energije ter pametnih električnih naprav. Pametna omrežja morajo biti učinkovita in zanesljiva. K tema ciljema lahko pomagajo končni uporabniki, proizvajalci električne energije ali porabniki . skupaj jih bomo imenovali prorabniki. Osamljen prorabnik težko prispeva k učinkovitosti ali zanesljivosti omrežja, ta cilj veliko lažje doseže v skupnosti. V tem predlogu bomo predstavili upravljanje prožnosti uporabnika in storitve, ki so potrebne, da lahko prožnost prorabnika izkoritimo za učinkovitejše delovanje električnega omrežja. Predstavili bomo pilotna testiranja, v katerih se bodo te storitve evalvirale. Podali bomo nekaj idej, ki bi lahko izkoristile sinergijo predloga in iniciative Pametnih Mest in Skupnosti.

ABSTRACT

Electrical grid is of vast importance for the operation and management of Smart Cities. The grid is becoming increasingly smart and involves more and more information and communication technologies, smart meters, distributed renewable energy resources and smart appliances. It is important that the grid is resilient and efficient. These goals can be achieved with the help of end users, either consumers or producers - often referred to as prosumers. Single prosumer can do little good for the grid and himself; as a community of prosumers a lot can be achieved and gained. In this proposal we will discuss prosumer flexibility management and needed services for utilizing prosumer resources for more efficient grid operation. We will report on initial efforts for the services validation in Slovenia. Some ideas will be proposed how developed services can be reused and additionally enhanced through the concept of Smart Cities and Communities.

1. INTRODUCTION

Electrical grid is currently being transformed into a smart grid. Regulation stimulates increasing a share of renewable energy sources, penetration of smart meters and usage of common information communication technologies for smart grid operation and maintenance. All together, with more decentralized production, advent of electric cars and electric storage, increased electrical domestic heating/cooling and consumers increasingly becoming producers are changing the grid from unidirectional towards multidirectional system. The situation is calling for introduction of new actors and services that can be provided in the grid, for the grid and grid stakeholders interest.

Smart cities on the other hand uses information communication technologies to bridge between city government, citizens and urban environment with an aim to improve the environment, urban services, quality of living, reduce costs and stimulate citizens engagement. Smart cities promise an ecosystem of seamlessly communicating entities, services, sensors and things as a platform for new innovative services implementation.

Proposal as presented is centered on the prosumer and elements at the edge of the smart grid. Internal information about the grid operation will be used whenever meaningful, possible and applicable. The aim of proposal is to define the services needed to manage prosumer flexibility and to validate such services in real world pilots. Prosumer flexibility is an ability of electrical grid users to adapt their electricity consumption or generation according to the needs or suggestions of other electrical grid stakeholders. By utilizing the flexibility the load can be shifted and electrical peaks in the grid can be reduced. The potential of such flexibility are reduced operational costs and investments in future electrical grid distribution, transmission and generation. The electrical grid can become more resilient. A number of services need to be provided before the flexibility can be fully utilized. The services will be further discussed in next section.

For most stakeholders in interaction, provisioning and consummation of flexibility services is actually new. Virtual Power Plant concepts are well know and already implemented in Slovenia, but they involve only business and commercial sector. On the other hand the relationship between the distribution and prosumers is quite rigid and weak. Other stakeholders like aggregators are only beginning to emerge. At this point the goal of this proposal is close to Smart Cities one; bridging the gap between stakeholders.

2. PROSUMER FLEXIBILITY MANAGEMENT SERVICES

A number of prosumer flexibility management services are needed to utilize the prosumers flexibility. Currently identified are being developed in the Flex4Gird project[1]. They will be presented through the main elements implementing them, giving some details on possible implementation. Envisioned elements and their services are:

- *Simple and prosumers kit*: two set of kits to be used at end user home as a system gateway, one intended for simple measurement and control of individual sockets and the other more sophisticated for prosumer and more,
- *Communication and APIs*: communication is mostly based on REST APIs aa well on messaging platform,
- *Data collection and storage*: cloud based services for data collection and storage, suitable for both end-users as well other stakeholders like DSOs (Distribution System Operator), data analytic or aggregators. Based on this element Prosumer Cloud Service will be built serving the end user devices like smart phones or tablets,
- *Security and privacy*: one of the core requirements of the system, end user information collected and stored in the cloud needs to be shared with the other stakeholders only with the user agreement. Both access control and cryptographic mechanisms will be used to provide confidentiality of the user information. Most of the information will be encrypted at user gateway and stored as such in the storage. Novel ways to build the services will be researched based on partial clear-text information and encrypted information,
- *Data analytic*: based on agreement with the end users part of the end user data will be available for analysis together with the data obtained through DSO interface. Early targets are profiling of the users, their flexibility estimation and peak usage prediction,
- *Prosumer flexibility management*: a collection of information on prosumers, grid topology and flexibility information. Multiple ways to stimulate the prosumer are envisioned, from common based on pricing to utilizing games,
- *DSO interfaces*: the interfaces for collection of relevant grid information from the DSO mainly for data analytic usage, reporting on prosumer flexibility utilization for incentives and for triggering the signals for load balancing.

The elements and services will be developed up to the TRL 7, see European Commission specification of technological readiness level for details. They will be evaluated in live, six months pilots in Germany and Slovenia in 2016 and 2017. Slovenian pilot will engage up to 1000 prosumers with a simple kit, the number can be even higher if the pilot will involve end users with smart meters only.

3. FURTHER POSSIBILITIES FOR COLLABORATION UNDER SMART CITIES AND COMMUNITIES INITIATIVE

Smart Cities and Communities and presented proposal both share same goal of bridging the gap between the stakeholders. Most specific and hard to involve right stakeholder are the end users. More work is needed to study and compare their ways to interact with the system, different means to incentivize their cooperation and willingness to participate actively in the flexibility management. Particularly interesting to study are communities of end users sharing their expertise on participation in the system or even technological "scripts" of recommended or optimal behavior.

Smart Cities sensors and things ecosystem can be fruitfully used for better analytic and end user modes of engagement estimation. On the other hand the city itself can act as a large resource of flexibility that can be utilized through the same system as is presented in the proposal for even better smart grid operation.

Proposal partners are always interested to discuss further possibilities and opportunities for cooperation in mentioned or new areas with any stakeholder involved in the Smart Cities and Communities initiative.

1 Flex4Grid - Prosumer Flexibility Services for Smart Grid Management is EU Innovation Action project from Horizon 2020, reference number 646428, see http://www.flex4grid.eu for details. Partners in the project are from Finland (VTT, coordinator), Germany (Fraunhofer Institute for applied Information, Stadtwerke Bonn Energie und Wasser GmbH and Bocholter Energie und Wasserversorgung GmbH), Slovakia (SAE Automation) and Slovenia (Jožef Stefan Institute, Elektro Celje d.d. and Smart Com d.o.o).

Sodelovanje pisarn za prenos tehnologij v projektih pametne specializacije za Pametna mesta in skupnosti

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POVZETEK

V prispevku smo predstavili pomen prenosa tehnologij v pripravi in izvedbi projektov pametne specializacije za Pametna mesta in skupnosti (PAMSKUP), kjer Center za prenos tehnologij Instituta Jožef Stefan s svojimi znanji, orodji in utečenimi procesi prenosa tehnologij lahko odigra pomembno vlogo, predvsem na področjih priprave projektnih predlogov, poslovnih načrtov, preverjanja poslovnih modelov, raziskavah trga in tehnologije, medsebojnih dogovorih o sodelovanju in pripravi pogodb, zaščiti intelektualne lastnine in sklepanju partnerstev za vključitev v različne faze verig dodane vrednosti v Sloveniji in tujini.

Ključne besede

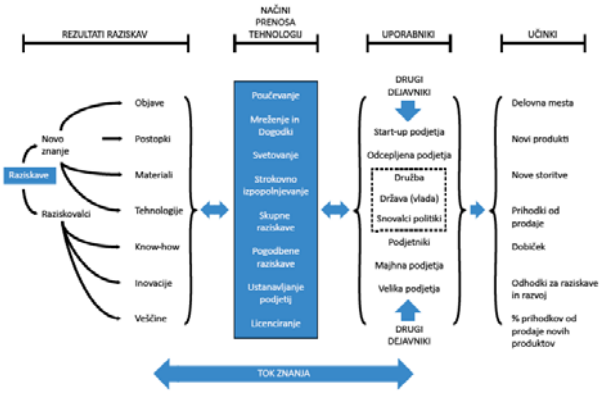
Prenos tehnologij, komercializacija, intelektualna lastnina, licenciranje, pogodbeno sodelovanje, odcepljeno podjetje.

1. UVOD

Prenos znanja in tehnologij iz (javnih) raziskovalnih organizacij (JRO) v gospodarstvo predstavlja ključni element kompleksnega cikla, ki se prek javnega financiranja raziskovalnega dela zaokroža v spodbujanju tehnološkega razvoja in razvoja družbe, ki zopet omogoča financiranje znanosti. Model prenosa znanja in tehnologij v inovacijskem ekosistemu prikazujemo v Sliki 1. Ustrezna povezava rezultatov dela raziskav s potrebami trga povečuje konkurenčnost gospodarstva in blaginjo prebivalcev, hkrati pa se del tega prihodka nameni tudi za financiranje novih raziskav. S tem je krog, ki generira socialni, ekonomski in znanstveni napredek družbe, sklenjen [1].

Prenos znanja in tehnologij je tudi v skladu z Resolucijo o raziskovalni in inovacijski strategiji Slovenije 2011–2020 opredeljena kot eden od ključnih strateških poslanstev JRO, ki naj bi skladno s strategijo pametne specializacije (SPS) ta cilj dosegale s pospešenim prehodom dosežkov znanstvenega raziskovanja v gospodarstvo prek pogodbenega sodelovanja, prodaje in licenciranja intelektualne lastnine ter ustanavljanja novih podjetij [2].

Številni raziskovalci in podjetniki že delijo prepričanje, da predstavlja sodelovanje z gospodarstvom eno od poglavitnih funkcij JRO, in so v povezovanju s podjetji na področju izvajanja skupnih raziskav ali trženja intelektualne lastnine že dolgo samostojni, proaktivni in uspešni. Prav tako so v zadnjem času tudi v slovenskem prostoru že vidni rezultati dela posameznih pisarn za prenos tehnologij, ki na različne načine pospešujejo ali dodatno omogočajo prelivanje raziskovalnih rezultatov gospodarsko sfero [3], [4], [5].



Slika 1. Model prenosa znanja in tehnologij v inovacijskem ekosistemu [1], [11].

2. PRENOS TEHNOLOGIJ V CIKLU RAZVOJA PAMETNIH MEST

Za učinkovit razvoj rešitev pametnih mest (PAMSKUP) je ključno sodelovanje javnih raziskovalnih organizacij (JRO), ki zagotavljajo temeljna znanstvena in tehnična dognanja, ter podjetji, ki te rezultate ob upoštevanju okoliščin na trgu (dodatno) razvijejo v nove produkte in storitve. Pisarne za prenos tehnologij to sodelovanje nadgrajujejo z nudenjem specifičnih znanj, mrež in orodij, kar omogoča ustrezno vrednotenje rezultatov razvoja rešitev PAMSKUP, zavarovanje s pravicami intelektualne lastnine in komercializacijo. Prenos tehnologij običajno poteka v okviru naslednjih treh oblik sodelovanja: pogodbeno sodelovanje, licenciranje/prodaja intelektualne lastnine in ustanavljanje odcepljenih podjetij [6].

Pri pogodbenem sodelovanju gre za različne oblike sodelovanja med podjetji in JRO, kot so (a) svetovanje, (b) pogodbene raziskave ter (c) pogodbeno raziskovalno sodelovanje, izhajajoči rezultati pa se razlikujejo glede na obseg in zahtevnost del ter aktivnost podjetja pri izvajanju pogodbe.

Druga oblika prenosa tehnologij je licenciranje/prodaja intelektualne lastnine poslovnim partnerjem ali lastnim

odcepljenim (spin-out) podjetjem na podlagi licenčne pogodbe ali prodaje intelektualne lastnine.

Tretja oblika prenosa tehnologij je ustanavljanje odcepljenih podjetij, kjer raziskovalci z JRO z namenom izkoriščanja novonastalega znanja JRO ustanovijo odcepljeno podjetje sami ali v solastništvu s tretjimi osebami (spin-out podjetje).

Projekti razvoja PAMSKUP bodo nedvomno vsebovali v vse tri navedene oblike sodelovanja med JRO in podjetji, pri čemer pisarne za prenos tehnologij s svojimi utečenimi procesi, znanji in povezavami s podpornim okoljem za inovacije in podjetništvo v Sloveniji in tujini predstavljajo pomembnega potencialnega partnerja.

Ob tem velja upoštevati tudi specifiko rešitev PAMSKUP, in sicer dejstvo, da v veliki meri temeljijo na informacijsko-komunikacijskih tehnologijah, tako v smislu strojne kot tudi programske opreme. Ustreznemu upravljanju s pravicami intelektualne lastnine je torej potrebno posvetiti še posebno pozornost, vključno z izbiro licenčnega režima, povezanega s programsko opremo. V nekaterih primerih so namreč primernejše lastniške licence, v drugih, predvsem upoštevaje širšo družbeno korist in nižanje kasnejših investicijskih stroškov, pa odprtokodne. Odločitev mora temeljiti na določitvi ustrezne strategije, ki upošteva namen programske rešitve, že nastale in prihodnje stroške ter priložnosti, ki jih ponuja trg. Tudi pri pripravi tovrstnih ocen so v veliko korist pisarne za prenos tehnologij, ki na podlagi specializiranih znanj svetujejo o izbiri specifičnega licenčnega režima ter pripravijo ustrezne dokumente. Hkrati pa – v primerih, kjer je to mogoče - ne gre pozabiti niti na ustrezno patentno varstvo tehnoloških rešitev, kjer lahko pisarne za prenos tehnologij ponovno ključno pomagajo, predvsem z oceno, ali je tehnologija patentibilna ter ali je patentna zaščita v konkretni situaciji smiselna in stroškovno upravičena.

3. CENTER ZA PRENOS TEHNOLOGIJ INSTITUTA JOŽEF STEFAN

Center za prenos tehnologij in inovacij na Institutu „Jožef Stefan“ deluje kot finančno neodvisna notranja enota. Primarna naloga Centra za prenos tehnologij in inovacij (CTT) Instituta „Jožef Stefan“, kot najuspešnejše slovenske raziskovalne organizacije, je prenos tehnologij in inovacij iz Instituta „Jožef Stefan“ v gospodarstvo, tako s pridobivanjem novih sodelovanj z industrijo kot z ustanavljanjem novih spin-out podjetji. CTT nudi pomoč pri patentnih prijavah, izdelavi tržnih analiz ter aktivno povezuje znanost z gospodarstvom ter šolstvom [7].

Na CTT je zaposlenih enajst strokovnjakov iz različnih strokovnih in znanstvenih področij: naravoslovne vede (6), ekonomija (3), pravo (1), družbene vede (1), od teh so štirje doktorji znanosti, trije magistri znanosti, en patentni zastopnik, trije certificirani strokovnjaki za prenos tehnologij (vir CLP). Med drugimi, so člani CTT vključeni v različne mreže in strokovna združenja, kot so ASTP in LES.

Kot nacionalni koordinator Enterprise Europe Network (EEN) za Slovenijo ima CTT dostop do mreže podpornih organizacij za podjetništvo in inovacije v preko 50 državah sveta s preko 4000 člani, kar predstavlja pomembno priložnost za promocijo, trženje in iskanje mednarodnih partnerstev in izkušenj na področju ponudnikov, razvijalcev in potencialnih mednarodnih kupcev rešitev, ki bodo nastale, kot rezultat projektov PAMSKUP [8], [9], [10].

3.1 Pomoč CTT projektnim skupinam na JRO

Strokovnjaki CTT nudijo pomoč v naslednjih fazah. Pred ustanovitvijo/uporabo intelektualne lastnine (IP); Center pomaga posameznikom pri izrabi pravic, ki izhajajo iz intelektualne lastnine, poleg tega pomaga pri sklepanju pogodb z industrijo, pri ustanovitvi spin-out podjetij ter njihovem prodoru na trg ter nudi nasvete in pomoč pri patentnih prijavah in poslovnih načrtih.

V drugi fazi Center ponuja konkretne nasvete za optimizacijo IP primerov. V okviru te dejavnosti izvaja strokovno pravno svetovanje, zlasti na področju intelektualne lastnine in mnenj o možnostih izkoriščanja pravic intelektualne lastnine (tehnološke presoje in ocene trga).

3.2 Pomoč razvojnim in tržnim oddelkom podjetij

Sodelovanja kot so meritve, svetovanja, izobraževanja, priprava in/ali oddaja projektov, izmenjava osebja, skupne publikacije, najemi opreme in podobno so pogoste oblike sodelovanja raziskovalcev s podjetji. Kot začetno aktivnost na poti k pogodbenemu sodelovanju CTT izvaja naslednje storitve:

- Organizacija srečanj med podjetji in raziskovalci, kjer CTT izvaja individualno svetovanje in pomoč pri definiranju teme in načina sodelovanja, vodi oziroma sodeluje pri pogajanjih in pri oblikovanju pogodb o sodelovanju, svetuje o pripravi projektov za slovenske in EU razpise, svetuje o analizi stanja določene tehnologije in pregled patentnih baz, ocenah in implementaciji tehnologij ter upravljanju z inovacijami, o pripravi pogodb o varovanju poslovnih skrivnosti (NDA).

CTT nudi informacije o dogodkih in izobraževanjih, o mednarodnem razvojnem in poslovnem povezovanju, informacije o odprtih nacionalnih in EU razpisih ter informacije o odprtih projektnih partnerstvih. Poleg tega preko mreže Enterprise Europe Network nudi:

- pomoč pri iskanju komercialnih partnerjev v tujini (distribucija, transport, franšiza, skupna vlaganja, podizvajalska dela) preko spremljanja tujih ponudb in povpraševanj in vpisa lastne ponudbe ali povpraševanja v bazo Enterprise Europe Network [8];
- pomoč pri iskanju razvojnih partnerjev v tujini (licenčno sodelovanje, tehnično sodelovanje, skupna vlaganja, proizvodno sodelovanje, komercialno sodelovanje s tehnično asistenco, finančni viri) preko spremljanja tujih ponudb in povpraševanj in vpisa lastne tehnološke ponudbe ali povpraševanja v bazo Enterprise Europe Network;
- pomoč pri iskanju projektnih partnerjev v tujini preko spremljanja tujih povpraševanj in preko vpisa lastnega povpraševanja po projektnih partnerjih.

3.3 Rezultati in uspešnost

Rezultati in uspešnost pisarn za prenos tehnologij so pomemben vzvod za uspešno uvajanje rezultatov razvojno raziskovalnega dela v gospodarsko izrabo in javno dobro. Projekti na področju pametnih mest bodo vključevali veliko število različnih deležnikov, ki imajo v odvisnosti od svoje vloge v procesu

uvajanja novih rešitev različne interese (raziskovalci, razvijalci, ponudniki izdelkov in storitev, njihovi kupci ter uporabniki, javne službe, finančne institucije in drugi). Vse te različne skupine deležnikov bo potrebno povezovati in z njimi dosegati dogovore v zvezi s pravicami intelektualne lastnine, ki izvirajo iz skupnih rezultatov projektov, kot posledica različnih vlog in obsega doprinosa posameznih deležnikov pri uvajanju, uporabi, vzdrževanju, nadgradnjah in nadaljnjemu trženju rešitev. Za uspešno izvedbo projektov je torej nujna vpetost pisarn za prenos tehnologij v mednarodna omrežja ter zagotavljanje ustreznih znanj s področja upravljanja z intelektualno lastnino, zaščite, relevantne zakonodaje in pravnih znanj, trženja intelektualne lastine, ustreznih orodij in podpore pri razvoju novih poslovnih modelov, iskanju partnerjev, sklepanju mednarodnih partnerstev, nenazadnje pa tudi ustrezne komunikacije z domačo in tujo javnostjo.

Po mnenju OECD (oktober 2014) je CTT največja in najuspešnejša enota za prenos tehnologij v tem delu Evrope, ki na osnovi dosedanjih rezultatov dela lahko pomembno doprinese k uspešnemu izvajanju projektov na področju pametnih mest. CTT je v letu 2014 dosegel naslednje rezultate dela:

- sklenjenih 7 licenčnih pogodb;
- ustanovljena 4 nova odcepljena podjetja;
- identificiranih 29 novih razvojnih tem s podjetji;
- izvedenih 64 posamičnih sestankov med podjetji in raziskovalci;
- vodenje 2-krat po 5 podjetij na sejme v tujino;
- prispevek k 20 prijavam novih projektov raziskovalcev z novimi projektnimi partnerji;
- 1.500 obiskovalcev na Dnevu odprtih vrat;
- organizacija 50 obiskov šol na Institutu "Jožef Stefan";
- izvedba 2 podjetniških izobraževanj za po 90 mladih raziskovalcev;
- organizacija 7. Mednarodne konference o prenosu tehnologij [3].

4. ZAKLJUČEK

Center za prenos tehnologij Instituta Jožef Stefan s svojimi znanji, orodji in utečenimi procesi prenosa tehnologij lahko odigra pomembno vlogo v projektih razvoja pametnih mest in skupnosti (PAMSKUP), predvsem na področjih priprave projektnih predlogov, poslovnih načrtov, preverjanja poslovnih modelov, raziskavah trga in tehnologije, medsebojnih dogovorih o sodelovanju in pripravi pogodb, zaščiti intelektualne lastnine in sklepanju partnerstev za vključitev v različne faze verig dodane vrednosti v Sloveniji in tujini.

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POVZETEK

Slovensko razvojno in raziskovalno podjetje Alpineon razvija robustne sisteme za obdelavo govornih in slikovnih podatkov, ki so namenjeni širokemu spektru uporabe, vključno s *pametnimi skupnostmi*, *pametnimi mesti* ter *inteligentnimi transportnimi sistemi*. Alpineon že sodeluje v več pobudah na področju pametnih mest (Varna družba, Platformne storitve, KC Class) in je član Tehnološke mreže ICT. Alpineon zanima vključevanje v nadaljnje pobude, ki so skladne z vizijo in vrednotami podjetja ter se nanašajo na pametne skupnosti ter pametna mesta.

Eden izmed tovrstnih produktov sistem je SmartPARK, ki omogoča nadzor dostopa s pomočjo samodejne prepoznave vozil na podlagi registrske tablice vozila z uporabo strojnega vida in razpoznavanja vzorcev. Nadzor dostopa SmartPARK omogoča in učinkovito sprotno spremljanje ter upravljanje območij z dostopno kontrolo, kot so plačljiva parkirišča, parkirišča podjetij in hotelov. Analitika SmartPARK pa omogoča analizo *navad uporabnikov* na območjih prostega dostopa. Sistem analizira trajanje in ponovljivost parkiranja ter prehode vstopno/izstopnih točk. Sistem SmartPARK predstavlja primer t.i. »privacy enhanced technology« oziroma tehnologije, ki je načrtovana po načelu *vgrajene zasebnosti* (»privacy by design)«, kar pomeni, da zagotavlja minimizirano obdelavo osebnih podatkov in visoko stopnjo varnosti zbranih podatkov.

ABSTRACT

Slovenian RTD-performing SME Alpineon is working towards building compact and robust speech and image processing solutions for a wide range of application domains, including smart communities, smart cities and intelligent transport systems.

The latest product in the area of interest for Smart Cities is SmartPARK - a system for vehicle identification by their license plates using image-processing technology. The SmartPARK access-control system enables effective ongoing monitoring and management of areas with access-control, such as parking lots, corporate campuses, hotels. SmartPARK analytics enables effective ongoing monitoring and management of areas with no access-control, such as shopping malls and open public parking lots. The system provides statistical information on entry and exit points of a vehicle, when and for how long a vehicle has been parked, and frequency of visits to the facility. The SmartPARK statistics is a privacy enhanced technology based on the *privacy by design* principle where data are collected while privacy is assured at the same time.

1. UVOD

Prevozna sredstva omogočajo več svobode, krajše potovalne čase in boljši izkoristek delovnega in prostega časa, hkrati pa predstavljajo izzive za urbani promet ter povzročajo dodatno onesnaževanje okolja. Ceste je potrebno širiti, potrebno je urejati promet v križiščih in prilagajati prometna pravila. Eno izmed pomembnih prometnih področij, na katerih je možno hitro in učinkovito izboljšati razmere z uporabo sodobne tehnologije, je področje parkiranja in preučevanje prometnih tokov na omejenih območjih.

Optimizacija prometa na parkirnih površinah vpliva tudi na pretočnost ostalih prometnih površin v urbanem okolju. Slabo vodenje prometa na parkirnih površinah povzroči zastoje pri uvozih na parkirne površine, ki se odražajo v zastojih v prometu izven parkirnih površin.

2. Sistem SmartPARK

Sistem SmartPARK omogoča energetsko učinkovito in okolju prijazno optimizirano upravljanje pametnih parkirnih sistemov in pametnih mest.

SmartPARK je sistem za avtomatsko prepoznavo vozil s pomočjo namenskega senzorja za zaznavo registrske številke vozila. Ko vozilo pripelje na območje, sistem najprej zazna prisotnost vozila, nato pa izvede postopek identifikacije. Postopek identifikacije poteka s prepoznavanjem registrskih tablic s postopki strojnega vida.

Registrska številka vozila je osebni podatek, zato je potrebno posebno pozornost posvečati varovanju zasebnosti v celotnem postopku zbiranja, shranjevanja in obdelovanja podatkov. Varovanje zasebnosti je ena temeljnih vrednot podjetja Alpineon.

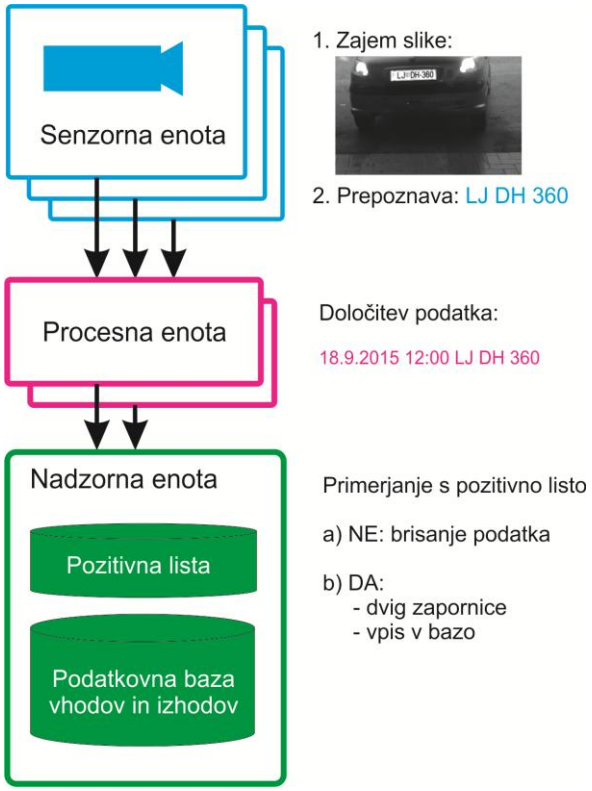
2.1 Nadzor dostopa SmartPARK

Nadzor dostopa SmartPARK omogoča in učinkovito sprotno spremljanje ter upravljanje območij z dostopno kontrolo, kot so abonenti plačljivih javnih parkirišč, parkirišča podjetij, hotelov, letališč in bolnišnic. Upravljavec parkirišča ima v tem primeru seznam registrskih tablic uporabnikov in specifikacije omogočenega dostopa. Dostop je lahko časovno omejen, torej da lahko uporabnik vstopi na območje samo v določenem časovnem oknu (npr. med 8:00 in 16:00 uro). Možno je, da ima en uporabnik na seznamu več registrskih številk, vendar mu sistem omogoča hkraten vstop le z enim vozilom.

Koncept delovanja prikazuje slika 1. Ko vozilo pripelje na kontrolno točko območja nadzora dostopa, sistem najprej zazna prisotnost vozila, nato pa izvede postopek identifikacije. V kolikor se prepoznana registrska tablica nahaja na t.i. pozitivni listi, se zapornica dvigne in omogoči dostop brez aktivnosti uporabnika, kar zmanjša potreben čas za dostop in tako pohitri celoten postopek.

Sistem poleg nadzora dostopa brez aktivnosti uporabnika omogoča tudi sprotno oddaljeno upravljanje in izvajanje analitike.

Upravljavec ob zbiranju registrskih številk od uporabnikov pridobi njihovo soglasje o uporabi za namen kontrole dostopa, sistem pa zagotavlja visoko stopnjo varovanja zbranih podatkov in onemogoča dostop nepooblaščenim osebam.



Slika 1. Koncept nadzora dostopa SmartPARK.

2.2 Analitika SmartPARK

Analitika SmartPARK omogoča analizo navad uporabnikov na območjih prostega dostopa, kot so javna parkirišča, nakupovalna središča in bencinski servisi. Z analizo trajanja, ponovljivosti parkiranja ter prehodov vstopno/izstopnih točk sistem preučuje *navade uporabnikov*, kar omogoča optimizacijo upravljanja parkiranja in prilagajanje ponudbe uporabnikom.

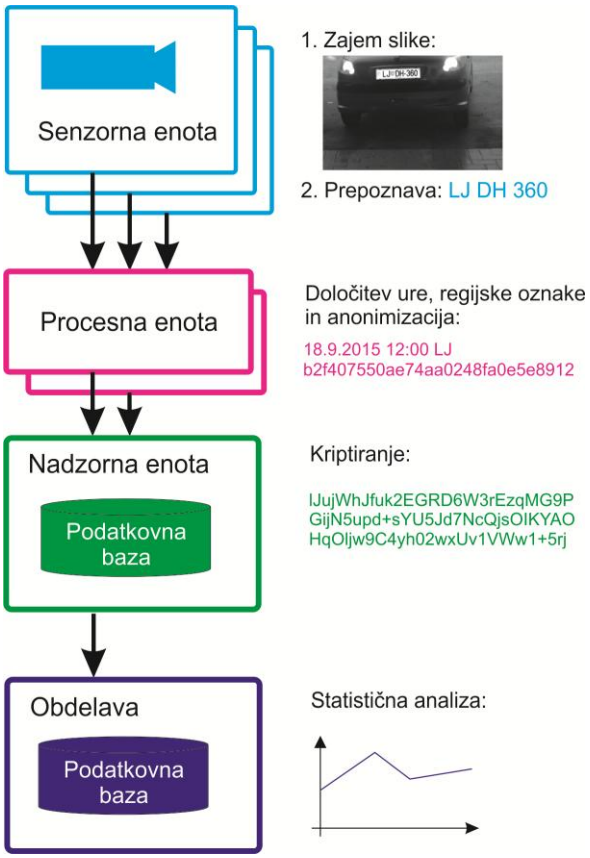
Koncept delovanja prikazuje slika 2. Podatki se pridobivajo z namenskim senzorjem za zaznavo registrske številke vozila. Senzor zazna prisotnost vozila, začasno zajame sliko, prepozna registrsko številko vozila, podatek o registrski številki posreduje procesni enoti in izbriše sliko.

Procesna enota iz zaznane registrske številke povzame regijsko oznako (npr. LJ, MB, KR,…), nato pa zaznano registrsko številko vozila z enosmerno kriptografsko zgoščevalno funkcijo pretvori v kriptografsko kodo, ki je nereverzibilna, kar pomeni, da iz nje ni mogoče rekonstruirati originalne registrske številke vozila.

Procesna enota podatek o regijski oznaki, psevdonimizirani registrski številki vozila in čas zajema shrani v dodatno kriptirani elektronski obliki v podatkovni bazi na računski enoti sistema.

Na predvidene časovne enote se izvedejo **statistične analize** (dnevne, tedenske, mesečne, letne), ki obsegajo predvsem:

- **Trajanje parkiranja:** razlika med časom zajema pri odhodu in časom zajema pri prihodu vozila iz območja (npr. povprečni čas parkiranja v določenem časovnem obdobju).
- **Ponovljivost parkiranja:** kako pogosto v časovni enoti (tedensko, mesečno, letno) se določeno število vozil zazna na vhodu v območje (npr. delež/število vozil, ki parkira petkrat v tednu).
- **Regijska zastopanost vozil:** koliko vozil je imelo enako regijsko oznako v časovni enoti.
- **Vstopne in izstopne točke:** Pri analizi se analizira pogostost uporabe vstopnih in izstopnih točk iz območja. Tovrstna analiza pride v poštev predvsem na mestih, kjer je več možnih vstopnih in izstopnih točk iz območja.



Slika 2. Koncept analitike SmartPARK.

Analitika SmartPARK informacije zbira transparentno in predstavlja primer t.i. »privacy enhanced technology« oziroma tehnologije, ki je načrtovana po načelu vgrajene zasebnosti (»privacy by design)«, kar pomeni, da zagotavlja minimizirano obdelavo osebnih podatkov in visoko stopnjo varnosti zbranih podatkov.

Sistem SmartPARK je pridobil pozitivno mnenje Informacijskega pooblaščenca RS. Alpineon je tudi prejemnik priznanja *Ambasador zasebnosti za leto 2014*, ki ga podeljuje Informacijski pooblaščenec RS za napore na področju t.i. vgrajene zasebnosti, ki poudarja proaktivno varstvo osebnih podatkov.

OHS -Odprte hiše Slovenije / OHS -Open House Slovenia

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POVZETEK

Odprte hiše Slovenije - OHS, ki ga vodi in organizira zavod aFRONT, je največji nepremičninsko arhitekturni festival namenjen najširši javnosti in hkrati največji portal sodobne slovenske arhitekture. OHS so del svetovne mreže Open House Worldwide, v katero je vključenih že trideset mest po celem svetu (London, New York, Melburne, Dunaj, Tel Aviv...). Poslanstvo svetovne mreže je približati dobro arhitekturo širšim množicam, uveljavljati odličnost v arhitekturni stroki in visoke standarde v praksi. Mednarodni dogodek Open House Worldwide na leto pritegne milijon obiskovalk in obiskovalcev po celem.

OHS so se v šestih letih razvile v platformo za praktično izmenjavo znanj s področja graditve objektov in urejanja prostora. S tem spodbujajo zavedanje o različnih vidikih trajnostne gradnje. Trajnostni pristopi niso omejeni zgolj na energetsko varčne hiše, temveč vključujejo pristope pri načrtovanju in gradnji, ki so prijazni do človeka in okolja, hkrati pa so ekonomsko in poslovno učinkoviti. S platformo OHS spodbujamo načrtovalsko stroko, strokovnjake v industriji, politike, gospodarstvo in širšo javnost k učinkovitejšemu dialogu na področju gradnje objektov in urejanja prostora.

Več o projektu je dostopno na www.odprtehiseslovenije.org in http://www.openhouseworldwide.org

ABSTRACT

Open House Slovenia (OHS), organized by non-profit organization Afront, is the biggest real estate and architectural festival in Slovenia, aimed at general public and also the largest showcase of contemporary Slovenian architecture. OHS is part of the international Open House Worldwide network, spanning across 30 cities (London, New York, Melbourne, Vienna, Tel Aviv...). Its mission is to bring outstanding architecture closer to the general public, encourage excellence in architecture and high standards in its practice. Each year, the international Open House Worldwide events attract a million visitors worldwide.

In the past six years, OHS has evolved into a platform for the exchange of practical knowledge on building construction and space planning, and awareness raising on different aspects of sustainable building. Sustainability is not limited to energy-efficient buildings, but includes user- and environment-friendly planning and building solutions, which are also cost-effective. OHS platform encourages a dialogue on building and space planning between planners, industry professionals, decision makers and the general public.

More on OHS project: www.odprtehiseslovenije.org and www.openhouseworldwide.org.

1. UVOD

Odprte hiše Slovenije OHS so preprost in enostaven koncept informiranja, komuniciranja in neformalnega izobraževanja javnosti o odličnosti arhitekture in pomenu grajenega prostora. Močnega vpliva grajenega prostora se v vsakdanjem življenju malo ali skoraj ne zavedamo. Vendar ljudje preživimo v grajenem prostoru 90% časa. Prostor pa je omejena dobrina in zaradi povečanja negativnih vplivov, ki jih z gradnjo povzročamo, se vedno bolj aktivno vzpostavlja zavedanje o pomembni vlogi trajnostnega pristopa v gradbeni industriji. Ta naj bi naši družbi zagotavljala bolj kakovosten bivalni in delovni prostor, s ponovnim zagonom gradbeništva omogočila gospodarsko rast, zmanjševala naj bi negativne vplive na okolje in s tem pozitivno vplivala na podnebne spremembe. Brez trajnostnih pristopov pri načrtovanju, razvoju ter upravljanju stavb in mest ne moremo slediti težnji po pametnih mestih in skupnostih .

Celovito presojanje prostorske trajnosti (tako stavb kot mest in skupnosti) pa mora temeljiti na vrednotenju njihovega celotnega življenjskega cikla, kakovosti interakcij in učinkovitem delovanju sistema. Upoštevati mora ekologijo, ekonomijo, sociološko-kulturne in funkcionalne vidike, tehniko, procese kot tudi lokacijo.

Stavbe, ki jih načrtujejo, uporabljajo, upravljajo, v njih delajo ter živijo ljudje, tvorijo naselja in mesta. Njihovo kakovostno (so)bivanje je predsvem odvisno od učinkovitosti vsakega posameznega deležnika, ki je vključen v sistem – okolje, družba, tehnologija.

Zaradi hitrega tehnološkega in informacijskega razvoja naše družbe, so se spremenile tudi stavbe, mesta in sistemi, ki jih povezujejo. Način načrtovanja, gradnje in upravljanja stavb in mest bistveno spreminja podobo sodobnega sveta. Visoko kakovosten grajen prostor omogoča bolj inspirativno in inovativno delovno, poslovno in bivalno okolje, privlačen mestni utrip ter hkrati predstavlja močan temelj za odgovorne trajnostne skupnosti. ki soustvarjajo napredno gospodarsko rast. Zavedanje o teh ključnih učinkih in tehnoloških novosti v grajenem prostoru, pa je vsakodnevni izkušnji navkljub, pri najširi množici uporabnikov večinoma skromno in površno.

Festival **Odprte hiše Slovenije** ponuja najširši javnosti izkušnjo v kakovostno grajenem prostoru. V času festivala, ki sedaj v Sloveniji poteka že 6 leto, omogočimo zainteresirani javnosti brezplačen vstop v odlične stavbe ter strokovno vodenje po arhitekturi in prostorskih ureditvah. S tem neformalno izobražujemo in informiramo o možnostih, ki jih kakovosten prostor ponuja posamezniku, podjetjem, odločevalcem in mestnim. OHS je torej največji slovenski nepremičninsko arhitekturni festival v živo in hkrati največji spletni arhitekturni

vodnik slovenske sodobne arhitekture. Doslej je odprl vrata 380 objektom, ki si jih je ogledalo skoraj 15.000 ljudi.

2. VPLIV PAMETNIH STAVB NA POSLOVNO USPEŠNOST IN PAMETNIH MEST NA GOSPODARSKO RAST

Investicije v nepremičnine predstavljajo enega največjih finančnih vložkov, stroškov in tudi tveganj tako za zasebne kot javne investitorje. Mednarodno poročilo organizacije World Green Building Conucil o pregledu stroškov in prednosti za načrtovalce, investitorje in uporabnike opozarja, da trajnostna gradnja ne prispeva samo k reševanju našega planeta ampak ima številne merljive in ovrednotene prednosti. Vpliva na izboljšano počutje, zdravje in s tem večjo učinkovitost ljudi, je ekonomsko upravičena, zmanjšuje tveganja, prinaša gospodarske koristi, trajnostno grajene ali obnovljene stavbe imajo manjše obratovalne in vzdrževalne stroške… To posledično podaljšuje življensko dobo nepremičnin in pomeni višjo vrednost pri prodaji.

Pravilna trajnostna gradnja torej povečuje vrednost in ne stroškov. Trajnostni pristop pri načrtovanju in izvedbi gradenj pa se po svetu kaže kot nuja in istočasno kot velika priložnost.

Poleg visoke družbene odgovornosti, ki jo s tem izkaže investitor prinesejo trajnostno grajene stavbe še mnoge druge ekonomske učinke. Uporabnikom nudijo boljše in bolj zdrave bivalne in delovne razmere, imajo manjši negativni vpliv na okolje in na zdravje ter počutje ljudi ter dosegajo na trgu višjo tržno vrednost, tako pri prodaji kot najemu. V trajnostno grajenih oz. prenovljenih delovnih prostorih se zmanjša odsotnost iz dela, kar znižuje porabo sredstev v zdravstvu in sociali, poveča se učinkovitost in uspešnost pri delu zaposlenih.

Mednarodne raziskave so dokazale, da trajnostne prenovljene stavbe z veliko naravne svetlobe, lepimi razgledi in obilico svežega zraka bistveno izboljšajo produktivnost (do 11% višja zaradi svežega in do 23% višja zaradi dobre osvetlitve) in delovanje spomina (do 25%) zaposlenih. V trajnostno prenovljenih šolah učenci hitreje napredujejo pri tehničnih predmetih in branju, v izboljšanih razmerah pa se do 65 odstotkov zniža število obolelih študentov z astmo. Prijetnejši in bolj zdravi so tudi trajnostni domovi z obilico svežega zraka, nestrupenimi materiali, brez vlage in plesni, ki so tudi energijsko manj potratni.

Primeri mednarodnih podjetij s področja nepremičninskih storitev in upravljanja naložb (kot npr JLL), ki so trajnostnost uvedla kot ključni element svoje razvojne strategije kažejo uspešne poslovne rezultate. Trajnostnost je vgrajena v vsako področje njihovega delovanja od vpeljave inovativnih raziskav na nepremičninskem področju, izobraževanja klientov in naročnikov o pridobivanju dodane vrednosti z vpeljavo trajnostnih standardov, prenovo poslovnih prostorov, ki dosegajo standarde ISO 14001 in z energetsko učinkovitimi rešitvami zmanjšujejo porabo energije do 10% do leta 2017 do vključevanja v projekte širše družbene skupnosti s katerimi ustvarjajo nove skupne vrednote.

Ključ njihove uspešnosti in rezultatov o boljši učinkovitosti zaposlenih je tudi skrb za zdravo delovno okolje, kar hkrati vključuje tudi varčevanje z energijo, porabo vode in zmanjševanje stroškov. Po podatkih Green Building Councila že manjše izboljšave delovnega mesta prinesejo velike prihranke.

Pametne stavbe torej zagotavljajo bistveno večje bivalno ugodje in zmanjšujejo stroške. Naloga pametnih mest pa je, da svojim prebivalcem z uporabo ik tehnologij omogočijo večjo blaginjo in zadovoljijo različne potrebe različnih uporabnikov. Z merjenjem in spremljanjem spremenljivih situacij v mestu ponujajo prebivalcem večjo kakovost življenja. Pametno prostorsko načrtovanje uporablja najsodobnejšo tehnologijo, ki se odziva na potrebe prihodnosti že danes.

Sika 1. OHS 2013 – Krisperjeva hiša, arhitektura: OFIS, foto: Bronja Brinovec

3. INFORMIRANI IN OZAVEŠČENI UPORABNIKI

Po podatkih Ministrstva za infrastrukturo, stavbe v lasti slovenskih javnih organov predstavljajo okrog 10 % celotnega stavbnega fonda. Od 1. januarja 2014 naprej, Direktiva o energetski učinkovitosti (2012/27/EU) zahteva, da bo potrebno vsako leto prenoviti 3 % površine stavb v lasti ožjega javnega sektorja ali pa sprejeti alternativne stroškovno učinkovite ukrepe, s katerimi se doseže enako izboljšanje energetske učinkovitosti državnih stavb. Lahko pa se država odloči, da bo prenavljala tudi širše. V obdobju 2014-2020 je za sanacijo stavb javnega sektorja v Sloveniji predvidenih 214 mio kohezijskih sredstev. Od tega se pridevideva, da se bo zaradi energetske sanacije stavb letno ustvarilo 6 mio EUR prihrankov.

Dejstvo je, da stavbe predstavljajo tudi 40 % končne porabe energije. Zato Direktiva o energetski učinkovitosti zahteva tudi, da je potrebno do leta 2020 doseči 20 % izboljšanje energetske učinkovitosti stavb. Po besedah Mininistrstva za infrastrukturo, je treba njuno povečati stopnjo prenove stavb, saj obstoječi stavbni fond predstavlja sektor z največjim potencialom za doseganje prihrankov energije. Prav tako je v koalicijski pogodbi med prioritetnimi ukrepi navedena potreba po energetski sanaciji stavb v državni, občinski in zasebni lasti, v oklepaju pa je naveden termin “trajnostna gradnja”.

V Sloveniji še nimamo sprejetih kriterijev za trajnostno gradnjo. Slovenski gradbeni sektor in različni deležniki na področju nepremičnin pa gotovo še niso ustrezno pripravljeni na trajnostno gradnjo, v pravem pomenu. Sodobni koncepti trajnostne gradnje obsegajo široko vrsto ukrepov, ki so vezani na najširši vpliv in presegajo ukrepe vezane zgolj na energetsko sanacijo in učinkovitost stavb. Trajnostnost, sicer v preteklosti in žal tudi danes vse prevečkrat zlorabljen pojem predvsem v komercialne namene, zato potrebuje merljive standarde - predvsem v gradbeništvu, kjer so investicije največje. Prednostne stavbe pri katerih lahko država sedaj uvede trajnostna merila, so javne stavbe (upravne, izobraževalne in vzgojne stavbe vrtcev in šol) v državni lasti. Vsa javna arhitektura bi morala biti grajena najbolj kakovostno. Izobraževalni, zdravstveni, kulturni, infrastrukturni ter poslovni javni objekti bi morali biti zgled kakovosti, ki vsem zagotavlja najboljše prostorske in bivalne pogoje.

Torej imamo v Sloveniji priložnost, da poleg energetske učinkovitosti začnemo uvajati tudi druga merila za celostno vrednotenje in izvajanje trajnostne gradnje. To pomeni, da se z izvajanjem načrtovanih ukrepov in vzpostavitvijo standardov približujemo zastavljenim ciljem pametnih mest in skupnosti.

OHS že danes predstavljajo največjo povezovalno platformo v kateri se povezujejo uporabniki grajenega prostora - prostorski načrtovalci, arhitekti, urbanisti in politični odločevalci (tako na občinski kot državni ravni), gospodarske družbe in nepremičninski sektor z namero, da ustvarjajo nove strategije, povezave in vzpostavljajo učinkovit dialog z nameno prenosa znanj, poslovnih priložnosti in dviga blaginje širše družbe.

Z mednarodnimi povezavami preko organizacije Open House Worlwide OHS omogoča strokovni dialog in prenos znanj do najširših uporabnikov. Z organizacijo dogodkov preko celega leta– izobraževanj, konferenc, strokovnih ekskurzij in ogledom najsodobnejših dobrih praks OHS odgovarja potrebam intersnih skupnosti, partnerjev in odločevalcev. OHS so v šestih letih postale zanesljiv in pomemben partner različnih dogodkov in vrste inštitucij, ki so udeležene v procesu načrtovanja in upravljanja s prostorom: Fakultete za Arhitekturo Ljubljanske univerze, Fakultete za gradbeništvo, Biotehniške fakultete, oddelka za lesarstvo, Mariborske fakultete za gradbeništvo in Arhitekturo, Muzeja za arhitekturo in oblikovanje MAO, Sveta za odpravo arhitekturnih in komunikacijskih ovir MOL, Društva arhitektov Ljubljana, Ministrstva za kulturo, Ministrstva za gospodarski razvoj in tehnologijo, Green Building Council Slovenija, ZRMK, Stanovanjskega Sklada RS, IEDC Poslovna šola Bled..., Naši partnerji so tudi pomemebne gospodarske družbe in podjetja, ki so usmerjena v trajnostni razvoj tehnologij in materialov s področja gradbeništva in arhitekture.

OHS komunicira in svetuje, povezuje in krepi znanje in širi informacije o odličnosti v arhitekturi in grajenem prostoru tudi z namenom, da se neformalno okrepi prepotrebno zavedanje o nujnosti inkluzivnega trajnostnega razvoja z izgradnjo primerov najsodbnejših dobrih praks. Strateško povezujemo javni in zasebni sektor s poudarkom na trajnostnem razvoju mest in skupnosti z organiziranimi dogodki in poslovnimi konferencami.

V programu OHS dajemo poseben poudarek tudi neformalnemu izobraževanju in opolnomočenju širše javnosti kot spodbudo za participacijo pri odločanju o nadaljnem razvoju javnega prostora v mestih in naseljih.

V mednarodni mreži OHWW se koncept Odrtih Hiš Slovenije povezuje z mesti in odločevalci širom sveta z namenom promocije in širjenja znaj o odličnosti v arhitekturi, prostorskem planiranju in upravljanjem s prostorom, ki dviguje bivalno ugodje in kulturo in vpliva na življenje ljudi. Mednarodni dogodek Open House Worldwide na leto pritegne milijon obiskovalk in obiskovalcev po celem.

4. ZASLUŽIMO SI BOLJŠI PROSTOR

Vključevanje trajnostnosti v vse plasti razvojno raziskovalnih projektov in produktov pri načrtovanju in izgradnji pametnih mest in skupnosti ključno vpliva na novo poslovno učinkovitost vseh deležnikov in bistevo spreminja njihovo poslovanje ter posledično pomeni višjo kakovost življenja in dvig družbene blaginje.

V današnjem, vedno bolj digitalnem svetu, predstavljajo realizacije odličnih primerov pomemeben način za spodbujanje razvoja in uveljavitev razvojno raziskovalnih dosežkov v praksi. Te primeri so redki, vendar toliko bolj pomembni za razvoj. Koncept OHS povezuje ključne akterje: ljudi, mesta in dobre primere z namenom ustvarjanja pametnih mest in skupnosti, ki uspevajo v socialnem, ekonomskem in okoljskem smislu – so torej pametnejša in bolj trajnostna. To povezovanje in ozaveščanje ima pomembno vlogo za razumevanje »izmuzljivega« pomena trajnostnosti in pametnosti, ker informira in opolnomoči politike, kupce in javnost pri njihovem odločanju.

OHS delujejo na področju svetovanja, informiranja in promocije odličnosti v arhitekturi, ki predstavlja perspektivno področje tako z vidika podjetniškega potenciala kot gospodarskega razvoja.
Uvajanje novih načel v družbo je tesno povezano s spreminjanjem navad ljudi, ki posledično vplivajo na spremembe širše družbene, socialne in podjetniške skupnosti in vplivajo na možnost in moč aktivnega soodločanja o razvoju njihove skupnosti.
OHS so del nevladnega, zasebnega zavoda, ki ga vodita arhitektki Ana Struna Bregar in Lenka Kavčič skupaj z drugimi strokovnimi sodelavci, vodji projektov in prostovoljci (le-ti sodelujojo le v času festivala po celi Sloveniji) v sodelovanju s ključnimi strokovnimi, izobraževalnimi, podjetniškimi in strateškimi organizacijami.
Kot nevladna strokovna organizacija smo v okviru perspektivnih tehnoloških področij in produktnih smeri Strategije pametne specializacije "PaMetSkup" prepoznali možnosti za :

PS J.1 - Razvoj odprtih demonstracijskih in ekperimentalnih pilotov za Trajnostno certificiranje stavb, ki bi predstavljal pripravo za certificiranje stavb in prilagoditev kriterijev (DGNB) za trajnostno gradnjo v Sloveniji.

Razlogi za certificiranje trajnostnosti stavb v celotnem življenjskem ciklu (LCA):

- energetska sanacija stavb ponuja priložnost za trajnostno prenovo stavb v lasti države
- celovit pristop omogoča trajnostne rešitve
- slovenija nima prilagojenih kriterije sistema certificiranja
- velika potreba po pilotnem certificiranju, ki bi predpisal končne kriterije za certificiranje stavb v Sloveniji

Predvidene aktivnosti:

- izobraževalne delavnice za stroko
- promocija
- strokovni seminarji in konference za javni sektor in strokovno javnost
- pilotna informacijska pisarna za trajnostno certificiranje

Potencilani partnerji:

- IBM
- Smartis
- CGS
- DGNB German Sustainable Building Council

Potencialna višja tržna vrednost (po primerih v tujini) certificiranih stavb bistveno poveča povpraševanje na nepremičninskem trgu, obudi gradbeni sektor in celotno gradbeno industrijo.

PS J.2 - Podpora konceptu "citizen observatories" (participacija prebivalcev) in soodločanju pri razvoju javnih prostorov (trgi, parki, peš zone, obrežja, …)

Na osnovi programa ODPRTE HIŠE SLOVENIJE ponuditi izkušnjo najširši javnosti za spoznavanje pomena kakovostno in trajnostno grajenih prostorov, sosesk in mest. Dvig zavedanja o pomenu kakovostnega prostora, možnost soodločanja in spodbujanje participacije glede posegov v javnem prostoru.
Način načrtovanja, gradnje in oblikovanja naših mest ne vpliva zgolj na njihov zunanji izgled temveč visoko kakovostno grajeno okolje, ki v veliki meri prispeva k razvoju močnih trajnostnih

skupnosti in spodbuja ekonomsko rast. Vpliva na način življenja vseh prebivalcev v mestu, izpostavlja vrednote dobro načrtovanih prostorov in vodi k nastanku in oblikovanju mest, ki so prijazna do vseh ljudi (inkluzivno načrtovanje in trajnostni pristopi, spremljanje in vrednotenje zastavljenih ciljev in ukrepov).
Odprta mesta vidijo možnost sodelovanja z **(partnerji**):

- odločevalci na nivoju naselja, skupnosti, mesta
- povezovanje z gradbenim in nepremičninskim sektorjem, strokovnimi združenji (ZRMK, NEPREMIČNINSKA ZBORNICA SLOVENIJE, **IBM Smarter Cities Innovation center, Smartis d.o.o.)**
- najširša javnost (s pomembno povezavo z lokalnim prebivalstvom, ranljivimi skupinami
- mednarodni partnerji (Open City London)

Pobuda ODPRTA MESTA povezuje različne deležnike, ki so vključeni v proces sooblikovanja prostora in deluje pri:

- povezovanje z nepremičninskim sektorjem in mreženje
- prenos znanja
- raziskovanje (in analiziranje novih povezav znotraj grajenega prostora
- izobraževanje (javnosti in odločevalcev o pomenu kakovostno grajenega prostora)
- oblikovanje vzorčnih primerov kakovostnih prostorov
- izvedbi orodij za pridobivanje znaja in vključevanja v pogovor o prostoru
- neodvisno svetovanje kot pomoč odločevalcem, mestnim svetom, investitorjem
- s primeri dobre prakse se dviguje znanje, izobrazba in splošna razgledanost o pomenu kakovostno načrtovanega grajene prostora

Glede na izjemno dobro sodelovanje in vpetost projekta Odprte hiše Slovenije v **Open House Worldwide**, projekt ODPRTA MESTA ponuja nadgradnjo in nadaljevanje **pobude** o ozaveščanju, o formalnem in neformalnem izobraževanju in participaciji pri oblikovanju in soodločanju pri posegih v javni prostor, vpeljavo ik tehenologij pri vrednotenju in spremljanju posegov v prostor.
Projekt ima velik tržni potencial, zmanjšuje/rešuje problematiko nestrokovnih posegov v javni prostor, ponuja nova delovna mesta in nove komunikacijske kanale za stroko in odločevalce in pomeni **velik tržni potencial** pri načrtovanju sodobnih trajnostnih mest, obujanju in povrnitvi zaupanja v gradbeni sektor.

PS J.4 – Spremljanje parametrov kakovosti bivanja (hrup, kvaliteta zraka, UV indeks, …)
Zdrave stavbe zgrajene iz zdravih materialov – smart living
Kakovost življenja posameznika tako doma kot pri delu ali v javnih prostorih je odvisna od kakovosti grajenega prostora v katerem se nahaja. Odločilno vlogo igra inovativni potencial, ki se nanaša na zdravje, varnost in dobro počutje ter delovno uspešnost in učinkovitost. Posebno pozornost je potrebno nameniti potrebam ranljivih skupin – prostorom, ki so namenjeni izobraževanju mladih, delovnim prostorom in prostorom za starejše. Smart living torej pomeni razvoj in spremljanje trenutnih prostorskih situacij, ki vplivajo na trenutni položaj posameznika, na varnost, kakovost življenja v mestnem prostoru – tako znotraj doma kot delovnega okolja.
Zbiranje, analiziranje, spremljanje in vrednotenje parametrov kakovosti bivanja bi tako omogočilo izboljšanje počutja ljudi v grajenem prostoru, povečano uporabo senzornih elementov in tehnologije. S pomočjo analize, raziskave obstoječih parametrov kakovosti bi se izdelale smernice za izvedbo zdravih bivalnih in delovnih prostorov.
Partnerji in potencialni partnerji: Inštitut za varovanje zdravja, Inštitut za medicino dela, na mednarodnem nivoju se pobuda vključuje v raziskavo WORLD GREEN BUILDING COUNCILa na temo zdravih pisarn in na raziskavo o vplivu iz lesa in v lesu opremljenih šol na učence, ki jo je izvedel PROHOLZ iz Avstrije in s katerim dobro sodelujemo tudi preko Avstrijskega gospodarskega predtsavništva.
Tržni potenciali aplikacije rezultatov raziskav in izdelanih smernic bi klasificiranim gradbenim proizvodom in storitvam, ki pozitivno vplivajo na zdravje in počutje ljudi v grajenih prostorih, povečalo vrednost na trgu, izpostavile njihovo dodano vrednost in pozitiven učinek. Vzajemno s tem bi upravljanje neremičnin sledilo ciljem trajnostnosti. Spremljanje in upravljanje stavb v celotnem življenskem ciklu (LCA) s pametno analitiko predstavlja velik potencial za družbo in okolje.

Sika 2. OHS 2014 – Kompaktna hiša na Krasu Pertot, Dekleva Gregorič arhitekti, foto: Teja Mrzek

5. ZAKLJUČEK - GRADIMO PAMETNO

Popolnoma jasno je, da se mora v dobro vseh nas, nekaj spremeniti. Arhitekti, kot vodilni oblikovalci stavb, imajo pomembno vlogo pri tej spremembi. Vendar je to samo del enačbe. Arhitekti oblikujejo stavbe, ki preneseno gledajo ustvarjajo veliko bogastvo. Dolgoročna vrednost sredstev naloženih v stavbah je odvisna predvsem od njihove sposobnosti, da zadovoljijo potrebe uporabnikov v hitro spreminjajočih se okoljskih pogojih in razvijajočih se pričakovanjih o kakovosti oblikovanja.

Communication and Sensor Solutions for Smart Cities and Communities / Komunikacijske in senzorske rešitve za pametna mesta in skupnosti

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POVZETEK

Vse večja urbanizacija vpliva tako na povečano onesnaževanje okolja mest in skupnosti kot na potrebe po zagotavljanju zadostnih virov in ustreznih storitev za življenje in dobro počutje v mestih. To zahteva uvajanje inovativnih rešitev, s katerimi bodo mesta in skupnosti omogočala visoko kakovost življenja in razvoj novih, uporabniško usmerjenih javnih storitev. Pri tem koncept pametnih mest vse bolj izpostavlja pomen informacijskih, komunikacijskih in senzorskih tehnologij in infrastrukture za zajem in spremljanje različnih pojavov. Namen prispevka je predstaviti raziskovalne in razvojne aktivnosti Odseka za komunikacijske sisteme, Instituta Jožef Stefan na področju brezžičnih komunikacijskih, vgrajenih in senzorskih sistemov, s katerimi je odsek uspešno sodeloval v več EU in slovenskih projektih. Raziskave odseka so med drugim rezultirale v razvoj dveh lastnih tehnologij, (1) modularne, senzorske platforme VESNA, katere zasnova omogoča podporo in prilagodljivost različnim aplikacijam, in (2) ogrodja za upravljanje senzorske infrastrukture in posredovanje sporočil VIDEK, ter v prototip osebnega merilca EKG in drugih telesnih signalov PCARD. Pri tem VESNA predstavlja osnovni funkcionalni gradnik vrste pilotnih postavitev in eksperimentalnega senzorskega omrežja LOG-a-TEC, ki igra pomembno vlogo pri testiranju rešitev in razvoju funkcionalnih gradnikov za storitve pametnih mest in skupnosti.

ABSTRACT

Rapid urbanization affects both, increased environmental pollution of cities and communities as well as the need to ensure sufficient resources and adequate services for the living and well-being in cities. This requires the development and introduction of innovative solutions to cities and communities, that will preserve/ensure the high quality of life and will enable the development of new, user-oriented public services. The concept of smart cities is largely based on information, communication and sensor technologies and infrastructure for capturing and monitoring various phenomena. The purpose of this article is to present the research and development activities of the Department of Communication Systems at Jozef Stefan Institute in the fields of wireless communications, embedded and sensor systems with which it has been successfully participating in several EU and national projects. The research activities resulted, among others in the development of two own technologies, (i) modular sensor platform VESNA, whose flexible design allows its adaptation and use in different application areas, and (ii) a lightweight infrastructure management and message broker framework VIDEK, as well as functional prototype of personal ECG and other body signals measurement device PCARD. VESNA also represents the basis for several sensor network pilot deployments and LOG-a-TEC experimental testbed, which plays an important role in research and development of functional building blocks for new smart cities services.

1. INTRODUCTION

In modern conceptions, cities are perceived as complex systems of essential infrastructures built to facilitate interaction between people and businesses. Traditionally, the term infrastructure refers to utility, transport and energy infrastructure. Besides these, the information and communication infrastructures as well as sensorial infrastructure have gained in importance in the last decade or so, especially in line with the Smart Cities paradigm. Due to the growing environmental challenges and fast pace of urbanization, cities and communities are compelled to develop integrated, cheaper and environmentally friendly solutions. In order to ensure the high quality of life for its citizens and attractive environment for the business, cities and communities started to implement *smart city* solutions. That is to say, they try to capitalize on new, particularly the ICT and sensor technologies, to transform their infrastructures and service delivery. To facilitate the transformation of modern cities towards smart cities, further research and development is needed in the fields of next-generation telecommunication networks, wireless communication, embedded and sensor systems **Error! Reference source not found.**, **Error! Reference source not found.**.

The mentioned are being the core activities of the Department of Communication Systems at Jožef Stefan Institute. The Departments' research activities are carried out by approximately 30 researchers in three laboratories, the *Communication Technology Laboratory,* the *Parallel and Distributed Systems Laboratory* and the *Networked Embedded Systems Laboratory*. The work of the laboratories is complementary, which is reflected in several joint projects.

The Department has successfully participated in more than 20 EU research projects since FP4, acted as a research partner in several large national projects including the Centre of Excellence in ICT (2004-6), OPCOMM and CLASS Competence Centres (both 2010-13), carried out many technology development projects for/with industrial partners,

and has developed extensive international cooperation with partners from research organizations and industry.

2. COMPETENCES IN THE AREA OF SMART CITIES

2.1 Projects and programs

Smart cities and communities are described as places where information and communication technologies are used to make traditional infrastructure and services more efficient. Underlining technologies and services address areas such as utilities management, transportation, energy efficiency, smart buildings, public safety as well as responsive public administration **Error! Reference source not found.**.

Researchers from the Department of Communication Systems have developed expertise in many of the before mentioned areas by successfully participating in various projects and two basic research programs. The projects and research results most applicable to Smart City solutions development are briefly outlined in the following.

ABSOLUTE project (FP7) researched into requirements for designing a rapidly deployable mobile communications and sensor networks to provide broadband services in the aftermath of an emergency, disaster or related unexpected events. Department participated in the development of modular sensor nodes for emergency situations, their integration and validation as well as in activities aiming at system requirements definitions, study and implementation of advanced cognitive radio and networking techniques. Among others it developed and demonstrated a geolocation database approach for determining exclusion zones for the operation of ad hoc emergency communication systems. The project is directly relevant to smart city initiative Secure Society.

The main aim of the **APRICOT** national basic research project was to annotate, discover and reason upon sensor and associated communication resources and compose those resources into dynamic global sensor infrastructure. By allowing supporting searching, discovering and sharing of sensor resources the results of this project are directly relevant to smart cities supporting infrastructure.

CITI-SENSE project (FP7) aimed to develop "citizens' observatory" to empower citizens to contribute to and participate in environmental governance and enable them to influence the societal priorities and associated decision-making. It developed, tested and validated community based environmental monitoring and information system. The case studies focused on a range of services related to environmental issues and were based on distributed and/or participatory data collection using innovative static, portable and personal air quality monitoring devices. The Department mainly contributed in the area of sensor and communication technologies by developing a portable/personal air quality monitoring unit (see Fig.1) and a related mobile app for collecting, visualizing and forwarding measurements to remote data center for further processing and provision of advanced services. Air quality monitoring and participatory data collection are directly relevant to the concept of smart cities, where they can empower citizens and support policy and decision makers.

Figure 1: A mobile portable sensor pact developed for the CITI-SENSE project

SUNSEED, another FP7 project, proposed an evolutionary approach to converged exploitation of communication infrastructures provided by telecom operators for future smart energy grids offering open services. By doing this, the project will lower the investments and total cost of ownership for future smart energy grids that will cover large, dense distributed energy generation and e-car charging infrastructures. The Department contributed with the design of wide-area measurement units and power metering and control units, both based on the VESNA platform, and their deployment in a large scale real-world smart grid pilot in Slovenia, as well as with a platform for distribution system state estimation and prediction. The experience and results from the project are directly applicable to improving energy efficiency in smart cities.

The **CREW** project (FP7) established an open federated testbed platform, which facilitates experimentally-driven research on advanced spectrum sensing, cognitive radio and cognitive networking strategies in view of horizontal and vertical spectrum sharing. The Department developed a cognitive radio networking component to its wireless sensor network testbed LOG-a-TEC and is in the phase of extend it to support experimentation with low power long range wireless technologies, particularly well-suited to utility metering, infrastructure monitoring and similar applications. As an open testbed LOG-a-TEC is also suitable for testing and validation of functional building blocks for new smart cities services.

The Department also participates in the **Fed4FIRE** project (FP7) with the target to fully integrate the existing wireless sensor network testbed LOG-a-TEC into the Fed4FIRE federation. In doing so it is adapting the existing interfaces and components, creating the adapters between LOG-a-TEC and the Fed4FIRE federation platform and validating the newly federated testbed. It is an experimentally driven project, aiming to promote virtual experimentation in realistic set-ups and will make the LOG-a-TEC testbed even more accessible to external experimenters.

PROASENSE project (FP) enhances business processes through integration of sensing capabilities. The main aim of the project is to develop methodologies and tools that support proactivity in digital enterprises, making them able to anticipate problems and opportunities. It showcases its results in manufacturing domain and in oil and gas sector. The Department is involved in the development of smart sensing services, feeding into probabilistic data stream processing and

goal-driven complex event processing, particularly in the indoor manufacturing environment, but the approach taken is adaptable either to various indoor public spaces in the city or to outdoor environments.

Additionally to the mentioned EU projects, the Department carries out research in radio propagation, wireless access architectures for heterogeneous wireless networks (from low power long range to mobile, stratospheric and satellite), mesh and ad hoc wireless networks, management of radio and network resources, cognitive communications, parallel and distributed computing, complex system modeling and simulation, computer simulations supporting biomedical procedures and specialised equipment and procedures for advanced bio-signal processing and interpretation.

Research activities in the area of wireless sensor networks have materialized in two own technologies, both suited to support the development and deployment of various solutions for Smart Cities, namely:

- **VESNA –** custom developed, fully flexible, modular, networked embedded system platform. It is used as a baseline for sensing natural phenomena, channel propagation in difficult environments and radio spectrum occupancy as well as for testing and validating new communication protocols and cognitive radio networking solutions. VESNA consists of the VESNA core module and a set of special feature modules (sensor node radio, sensor node expansion and sensor node power), which are used in accordance with the needs of particular application. More information about VESNA can be found at SensorLab website[1].

Figure 2: VESNA platform

- **VIDEK -** data handling and device management FI-WARE compatible enabler, supporting a variety of APIs and protocols for integration with other software components.

VESNA and VIDEK represent the main building blocks of the deployed wireless sensor network testbeds for experimentally-driven research and piloting.

Furthermore, we developed a personal wearable device for monitoring ECG, vital signs, and activity of patients, older persons in home care or other settings, etc., that is particularly well suited for monitoring user's everyday activities regardless of its current location. As such and in combination with other location-based services in smart city it may benefit user's well-being and if necessary healthcare support.

[1] http://sensorlab.ijs.si/hardware.html

2.2 Experimentally driven research - testbeds and pilots

In order to successfully implement the Smart Cities paradigm, a need for testing and validating the newly developed technologies has been widely recognized in the research community. It is emphasized that only real-life, large scale test beds can offer the appropriate environment to design robust, heterogeneous systems that will meet the growing needs of the future Smart Cities **Error! Reference source not found.**.

Supporting this conclusions, the Department of Communication Systems has set up a LOG-a-TEC testbed. The testbed was set up in close cooperation between Jozef Stefan Institute, the Municipality of Logatec and utility company Komunalno podjetje Logatec. It primarily consisted of two clusters, one cluster of nodes located in the industrial zone and another cluster of nodes in the city center of Logatec. Most of the sensors were installed on street lighting poles while others were mounted on buildings or roofs and the user interface to the physical experiments was provided by a web application.

However through various projects, the LOG-a-TEC testbed has been enhanced and extended to other locations, operating environments (including indoor) and has, through CREW and Fed4FIRE projects become one of the FIRE/FIRE+ facilities, thus made open to all researchers and available for different experimental investigations.

One of the extensions of the LOG-a-TEC is the semantic sensor network testbed at Jožef Stefan Institute campus. This testbed consists of VESNA platforms equipped with Contiki OS and is used for experimentation with cognitive networking on MAC and higher layers. It uses the ProtoStack[2] tool for remote composition, reconfiguration and reprogramming of Crime protocol stack.

The LOG-a-TEC experimental infrastructure was also used for testing and validation of the air quality monitoring within the CITI-SENSE project, where the VESNA platform was chosen as one of the sensor platforms for air quality monitoring.

Additionally, a pilot developed in collaboration with Telekom Slovenije and Elektro Primorska also forms a distinctive part of the LOG-a-TEC experimental infrastructure. Using the VESNA platform, a sensor network was developed for detailed real time monitoring of operating parameters in a photovoltaic systems.

3. FUTURE RESEARCH AND COLLABORATION IN THE AREA OF SMART CITIES AND COMMUNITIES

Smart Cities and Communities paradigm builds on developing value added through the development of new, users-oriented services, especially in the areas of integrated public infrastructure, sustainable urban mobility and reduced energy consumption. Thus the Department of Communication Systems will, in line with the business and research initiative for Smart

[2] More on ProtoStack tool can be found on the SensorLab internet site; http://sensorlab.ijs.si/publication/43/protostack:-a-tool-for-remote-composition-reconfiguration-and-reprogramming-of-modular-protocol-stacks-on-the-vesna-platform

Cities and Communities, focus its future research and development activities to support the following areas:

- Open wireless communication networks;
- Networked sensor and actuator devices and embedded communication modules;
- Modules for data acquisition;
- Open web applications and mobile apps;
- Micro smart-grids for energy self-sufficient communities;
- Power quality monitoring in sustainable smart-cities distribution energy systems
- Integral energy and utility provision;
- Smart public lighting systems;
- Support for electric vehicles;
- Set up of open demonstration and experimental testbeds;
- Support to participatory sensing;
- Environmental monitoring.

For successful implementation of smart city solutions, the Department will strive to strengthen its collaborations with public infrastructure providers, utility operators and public administrations as well as private service providers in order to develop tailor-made Smart City solutions. It will, through national and international projects, look into possibilities to endorse the partner cities from Slovenia as demonstration centers for newly developed Smart City solutions hence opening new opportunities for sustainable development and inclusive economic growth.

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DF:Lab – Infrastrukturne storitve LAB:UM za izboljšanje informacijske varnosti

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POVZETEK

Informacijska varnost predstavlja enega ključnih elementov za uspešno realizacijo konceptov pametnih mest in skupnosti. V prispevku so predstavljene storitve DF:Lab – laboratorija za digitalno forenziko, ki je načrtovan v sklopu izgradnje infrastrukturnega dela razvojnega programa Inovativne odprte tehnologije (IOT). LAB:UM kot eden izmed stebrov programa IOT bo zagotavljal skupne infrastrukturne storitve, potrebne za uspešno raziskovalno-razvojno delo vključenih akterjev. V prispevku so povzeti nekateri ključni dosežki in rezultati, ki bodo nadgrajeni skozi vzpostavitev infrastrukturnih storitev osrednjega nacionalnega laboratorija za digitalno forenziko.

1. UVOD

Informacijska varnost je vezana na več ključnih področij in pobud v okviru Strategijo pametne specializacije Slovenije. S stališča pametnih skupnosti in mest pomen informacijske varnosti in z njo povezanih področij dokazuje tudi množica prispevkov, konferenc in dogodkov, ki naslavljajo prav izzive zagotavljanja ustrezne informacijske varnosti, preprečavanja zlorab, vzpostavljanja zaupanja itd. v kontekstu naprednih IKT storitev [1,2,3,4].

V prispevku bomo najprej predstavili značilnosti programa IOT (Inovativne odprte tehnologije) ter koncept infrastrukturnega centra LAB:UM. V tretjem poglavju bodo povzete osnovne značilnosti razvojnega programa Enote za IKT. Sledi podroben opis storitev enega izmed načrtovanih laboratorijev – laboratorija DF:Lab, vključno s preteklimi izkušnjami in rezultati na področju delovanja tega laboratorija.

2. PROGRAM INOVATIVNE ODPRTE TEHNOLOGIJE

Inovativne odprte tehnologije (IOT) je regionalni razvojni projekt oz. program, katerega glavni cilj je ustvariti simbiozno povezavo med univerzo oz. raziskovalnimi organizacijami, gospodarstvom, podpornimi oz. razvojnimi organizacijami in lokalnimi skupnostmi skozi odprte inovacije in tehnologije [5]. Nosilni partnerji tega programa so Univerza v Mariboru, Mariborska razvojna agencija in Znanstveno-raziskovalno središče Bistra Ptuj. Pod nosilstvom Univerze v Mariboru (kot največje institucije znanja v vzhodni Sloveniji) v projektu sodelujejo partnerji iz vrst gospodarstva, podpornih institucij in lokalnih skupnosti [6].

Z mednarodnimi partnerji je bila projektu IOT že dodana podonavska dimenzija. Iniciativa DO-IT (Dannube Open Innovative Technologies) je bila decembra 2014 potrjena kot t.i. »flagship« oz. vzorčni projekt Strategije EU za Podonavsko regijo v prioriteti 7: Knowledge Society. V sklopu DO-IT je bila Univerza v Mariboru, konkretneje Fakulteta za elektrotehniko, računalništvo in informatiko, izbrana za koordinacijo dela na področju IKT **[7]**.

Program IOT povezuje tri dele oz. stebre (Slika 1), ki se med seboj dopolnjujejo in prepletajo ter nudijo celostno podporo raziskovalnemu in inovacijskemu procesu [8]:

- *vsebinski raziskovalno-razvojni steber*
  namenjen razvoju novih proizvodov in storitev z višjo dodano vrednostjo
- *infrastrukturni steber*
  vzpostavitev raziskovalno-razvojnega infrastrukturnega središča z več raziskovalno razvojnimi enotami
- *inovacijsko-podporni sreber*
  vzpostavitev inovacijske podpore in vstopnih točk IOT, spodbujanje inoviranja ter prenos znanja in tehnologij, podjetništvo, internacionalizacija.

Slika 1. Trije stebri programa IOT [8]

Razvoj sodobnega infrastrukturnega središča LAB:UM v Mariboru bo raziskovalcem z Univerze v Mariboru in širše regije omogočal dostop do raziskovalne opreme in zmogljivosti za raziskovalno in razvojno delo na področju novih, naprednih in ključnih tehnologij [9].

Raziskovalno-razvojne enote bodo povezovale znanost in razvojne dejavnosti ter pospeševale prenos znanja v inovacije, le-te pa bodo osnova za nova zagonska podjetja (start-up-e), oz.

bodo na voljo za potrebe podjetij ter ponujale celostno interdisciplinarno povezovanje in načrtovanje rešitev [9].

3. LAB:UM IN ENOTA ZA IKT

Po Operativnem programu za izvajanje Evropske kohezijske politike v obdobju 2014-20201 je program IOT primarno umeščen v tematski cilj 1: Krepitev raziskav, tehnološkega razvoja in inovacij, sekundarno pa v tematski cilj 3: Povečanje konkurenčnosti MSP.

Enega od elementov uspešne krepitve in izvajanja raziskovalno-razvojnega dela, tehnološkega in drugega inoviranja vsekakor predstavlja vzpostavitev infrastrukturnega dela – LAB:UM. Tega sestavlja več enot in sicer [6]:

- Enota za strukturno in površinsko mikro in nano-analizo,
- Enota za mikro in nano-elektroniko ter fotoniko in nano tehnologije,
- Enota za napredne materiale in tehnologije,
- Biotehnološki center,
- Enota za informacijske-komunikacijske tehnologije,
- Enota za medkulturni razvoj in izmenjavo idej,
- Nevropsihološki laboratorij,
- Skupna infrastruktura in
- Inovacijski ekosistem.

LAB:UM bo deloval integracijsko in sledil načelu komplementarnosti s kolokacijskimi IOT centri v partnerskih podjetjih, organizacijah, regijskih središčih in občinah. Raziskovalna oprema bo namenjena odprti uporabi za skupne raziskave UM in partnerskih podjetij. Raziskovalno in razvojno delo bo potekalo med drugim po » principu Demola «, kjer bodo sodelovali študenti, raziskovalci UM in podjetja. [9] Skladno s svojo pametno, trajnostno in vključujočo strategijo, ki omogoča dolgoročen razvoj, bodo infrastrukturne raziskovalne enote v LAB:UM-u organizirane v skladu s smernicami pametne specializacije.

Ena izmed enot LAB:UM je tudi Enota za informacijsko-komunikacijske tehnologije. Raziskovalno-razvojni program te enote, imenovan “Varen in uporabniško prijazen internet stvari”, sestavljajo trije medsebojno povezani podprogrami in sicer [10]:

1. Digitalna forenzika (DF:Lab:UM).

2. Uporabniška izkušnja in kakovost izkušnje v IKT (QUX LAB:UM).

3. Masovna obdelava (geometrijskih) podatkov.

Ti podprogrami vključujejo tudi vzpostavitev ustreznih laboratorijev. V naslednjem poglavju se bomo osredotočili na laboratorij DF:Lab, ki je tesno povezan z zagotavljanjem ustrezne informacijske varnosti. Uspešno naslavljanje izzivov tega laboratorija pa pogojuje uporabo spoznanj in dosežkov ostalih dveh podprogramov Enote za IKT.

Ustvarjanje velike količine raznolikih podatkov in heterogenih podatkovnih tokov vodi v tako imenovan fenomen masovnih podatkov (ang. Big Data), njihova učinkovita analiza pa danes predstavlja enega največjih izzivov. Z uporabo učinkovitih algoritmov za obdelavo teh podatkov lahko odkrijemo pomembne zakonitosti, ki izhajajo iz vedenja naprav in njihovih uporabnikov, to pa vodi do novih spoznanj tudi na področju varnosti.

Prav tako sodobne rešitve ter nove naprave in ekosistemi intenzivno spreminjajo način kako človek uporablja in dostopa do personaliziranih storitev. Pametne naprave (telefon, očala, ura, zapestnica, sistem navidezne resničnosti, avtomobilski informacijsko-zabavni sistem itd.) v vse večji meri samodejno dostopajo do interneta in storitev in v povezavi s senzorji omogočajo razvoj inovativnih rešitev za povečanje kakovosti življenja uporabnika na osnovi spremljanja in analize aktivnosti in stanja uporabnika ter njegove okolice. Pametne naprave so praviloma povezane in postajajo nepogrešljiv pripomoček v vsakodnevnih aktivnostih in življenju uporabnika. Senzorji, vgrajeni v pametne naprave, obleko in/ali obutev, bivanjsko okolico, vozilo, itd., nudijo pomembne kontekstne informacije, ki so osnova za razvoj pametnih rešitev. Ponudniki rešitev so pred izzivom, kako učinkovito in varno povezati pametne naprave in predvsem kako zagotoviti učinkovito interakcijo z njimi, pri čemer ni nujno, da naprave zagotavljajo klasične oblike uporabniškega vmesnika. Učinkovita interakcija čez različne povezane naprave predstavlja osnovni izziv na področju načrtovanja bogate uporabniške izkušnje. To področje bomo naslavljali v sklopu QUX LAB:UM.

4. DF:Lab – Laboratorij za digitalno forenziko

4.1 Motivacija in strateška usmeritev

Vseprisotnost naprav in naprednih informacijskih storitev povečuje nabor varnostnih tveganj glede zaščite, zaupnosti, celovitosti, zasebnosti, zaupanja, zanikanja dejanj, odgovornosti in sledljivosti. Digitalna forenzika zato postaja nepogrešljivo znanstveno področje pri preiskovanju zlorab in prevar. Izsledki digitalne forenzike s poznavanjem načina delovanja naprav in ljudi, še posebej v okoliščinah zlorabe, dajejo ključne vhodne informacije za izdelavo novih rešitev na področju varnosti. Z izboljševanjem varnosti, predvsem zaupnosti podatkov, pa nastaja povratna zanka, saj je zaradi močne zaščite podatkov vse težje izvajati forenzične analize nad šifriranimi zaseženimi podatki in elektronskimi napravami. Digitalna forenzika ima zato dvojno vlogo, tako na področju preiskovanja, kot področju zagotavljanja varnosti naprav in storitev. Število zlorab se povečuje, v letu 2012 smo samo v Sloveniji imeli primer množične okužbe računalnikov, ki so obsegali več kot 1 milijon naprav in v letu 2013 v Sloveniji primer zlorabe elektronskega bančništva, ki je dosegel 2 milijona EUR. Pomen informacijskih sistemov narašča zaradi prodora mobilnih rešitev, računalništva v oblaku in naporov države za pospeševanje elektronskega poslovanja.

Digitalna forenzika ne uspe dohajati novega razvoja, tehnologij in pristopov, ki jih uporabljajo kriminalci. Družbi grozi, da bo v nekaj letih izjemno težko, z visokimi stroški ali celo nemogoče preiskovati kazniva dejanja, izvršena s pomočjo elektronskih naprav. S širjenjem interneta stvari in novimi storitvami, temelječimi na IKT, bo izguba nadzora, preventive in represivnih ukrepov pri uporabi omreženih elektronskih naprav postal eden najbolj perečih problemov družbe v naslednjih nekaj letih.

Prav zato bo potrebno v interesu nadaljnje pravne varnosti uporabe vseprisotnih v omrežje povezanih naprav in storitev izboljšati njihovo varnost na način, ki bo omogočal ne samo preprečevanje varnostnih incidentov, temveč tudi njihovo zaznavanje in kasnejšo učinkovito analizo. Pri tem pa bo varnostno središče in osnovni vir podatkov o odkritih pomanjkljivostih in izzivih pri preiskovanju incidentov postal digitalni forenzični laboratorij.

Laboratorij DF:Lab bo na skupnem mestu združeval raziskovalce, uporabnike in dovršene tehnološke rešitve za najzahtevnejše forenzične preiskave. Te zahtevajo interdisciplinaren pristop, saj je pri forenziki sodobnih naprav nujno sodelovanje pravnikov, elektronikov, razvijalcev, sistemskih inženirjev, strokovnjakov s področja omrežij, kriptografije, digitalnega procesiranja signalov ipd. Organi pregona in podjetja vse težje vzdržujejo lastne heterogene in ozko specializirane skupine strokovnjakov.

Preiskave v digitalni forenziki so vse bolj zapletene, saj so zanje potrebni posebej varovani prostori, ki omogočajo strokovno ravnanje z dokazi ter uporaba namenskih strojnih in programskih rešitev za zajem in preiskavo zaseženih podatkov, kar je povezano tudi s specialističnimi znanji na področju elektronike, programske opreme, statistike, digitalnega procesiranja signalov, omrežij in kriptografije, ki jih enota zagotavlja z bogatim naborom lastnih raziskovalcev, ki so že aktivni na vseh navedenih področjih. Pri tem je ključen prenos znanja iz prakse v raziskovalni sektor z namenom prepoznavanja realnih problemov digitalne forenzike in obratno, prenos znanja, izkušenj, novih metodologij, pristopov in rešitev zasega podatkov in njihovega preiskovanja iz raziskav v prakso.

Laboratorij bo zagotavljal ustrezne prostore za izvajanje forenzičnih preiskav in omogočal souporabo prostorov in opreme tudi partnerjem in drugim zunanjim uporabnikom. S tem bodo prostori in oprema polno izkoriščeni. Trenutno v Sloveniji ne obstaja neodvisen vrhunsko opremljen laboratorij za digitalno forenziko. Posledica tega je tudi otežen prenos identificiranih izzivov k raziskovalcem in prenos znanja od raziskovalcev v prakso.

4.2 Dosedanji dosežki in rezultati

Na podlagi bogatih izkušenj pri izvedbi interdisciplinarnih projektov v povezavi s pravno stroko (Pravna fakulteta UM), na podlagi obstoječih teoretičnih raziskav in objav, izvedenih praktičnih forenzičnih preiskav ter bogatega nabora strokovnjakov na področju vseh ključnih strokovnih področij za sodobne forenzične analize, ki že delujejo v sklopu Fakultete za elektrotehniko, računalništvo in informatiko UM, predstavlja vzpostavitev digitalnega forenzičnega laboratorija v takšnem okolju najboljši sinergijski učinek povezovanja uveljavljenih raziskovalcev in industrije. Fakulteta ima bogate izkušnje tehničnega sodelovanja s Kriminalistično policijo v Mariboru in sodišči v Sloveniji na področju preiskovanja računalniških kriminalnih dejanj [11,12]. Policijski kriminalistični računalniški laboratorij v Mariboru je z omejeno opremo in številom strokovnjakov skupaj s Fakulteto v zadnjih treh letih preiskoval najtežje oblike računalniškega kriminala in pri tem dosegel mejo zmogljivosti tako v prostorih, opremi, kot kadrih.

Pobudniki in nosilci vzpostavitve enote za IKT imamo bogate izkušnje tudi na interdisciplinarnem področju računalniške forenzike. Sodelovali smo npr. s Pravno fakulteto Univerze v Mariboru in sicer na področju varnosti in elektronskega poslovanja v notariatu, s policijo, tožilstvom in sodišči na področju preiskovanja z računalništvom povezanih kaznivih dejanj. Nosilci vzpostavitve Enote za IKT in DF:Lab aktivno sodelujemo pri izvajanju visokošolskega študijskega programa »Informacijska varnost« Fakultete za varnostne vede ter smo vodilni aktivni člani združenj na področju revizije informacijskih sistemov (Slovenski odsek ISACA, Odbor sekcije preizkušenih revizorjev informacijskih sistemov pri Slovenskem inštitutu za revizijo). Na raziskovalnem področju smo aktivni z mnogimi objavami na področju varnosti in računalniške forenzike v uglednih znanstvenih revijah [13,14,15,16] kot tudi patentov (npr. [17]).

4.3 Storitve in potencial

Ključne storitve, vzpostavljene znotraj DF:Lab, bodo [10]:

- *Forenzične podatkovne analize* z osredotočenjem na prepoznavanje vzorcev, zakonitosti in odkrivanje prevar v velikih podatkovnih zbirkah. Potencialna uporaba za odkrivanje prevar v zavarovalnicah, bankah, telekomunikacijskih družbah. Zaznavanje zlorab in potencialnih vdorov v informacijskih sistemih s souporabniki (računalništvo v oblaku). Algoritmi in statistične metode za zaznavanje potencialno pomembnih podatkov v forenzičnih preiskavah, z namenom učinkovite uporabe forenzičnih virov, npr. policija, tožilstvo, FURS, gospodarske družbe, ki se ukvarjajo z zaznavanjem in preiskovanjem prevar
- *Forenzična analiza signalov različnih modalnosti* (govor, zvok, video) z uporabo postopkov in metod digitalnega procesiranja signalov za potrebe policije, tožilstva in podjetij, ki se ukvarjajo z varovanjem. Aktivnost je še posebej pomembna v primerih, ko je potrebno preiskati velike količine zajetega materiala.
- *Forenzična revizija* s poudarkom na metodologijah, pristopih in orodjih, ki so skladna s standardi finančne revizije, notranje revizije in revizije informacijskih sistemov v sodelovanju z revizijskimi družbami in Slovenskim inštitutom za revizijo.
- *Računalniška forenzika in varnost*, ki je v krizi zaradi tehnološkega napredka: neobvladljive količine podatkov, veliko število nestandardnih vmesnikov naprav, vse večje število različnih operacijskih sistemov, formatov zapisov, oddaljeno shranjevanje podatkov (računalništvo v oblaku), močno šifriranje in pravne omejitve. Raziskave za napredek na tem področju so ključne za organe pregona (policija, tožilstvo), SI-CERT in podjetja, ki se ukvarjajo s preiskavami, Združenje preizkušenih preiskovalcev prevar.
- *Forenzika in varnost vgrajenih sistemov* s sodelovanjem z raziskovalci na področju elektronike. Vgrajeni sistemi so vse bolj dovršene in zmogljive elektronske naprave, ki lahko posledično izvajajo vse bolj zapleteno programsko opremo. Forenzika teh naprav je specifična, ker naprave niso standardizirane, zato je vsaka preiskava teh naprav trenutno unikatna in brez podpore v obliki splošno namenskih metodologij in orodij. Ciljni uporabniki so razen organov pregona proizvajalci vgrajenih naprav (ki danes segajo od avtomobilske industrije do ponudnikov termostatov za ogrevanje in bele tehnike), ki bodo potrebovali forenzične analize pri analizi odpovedi, nepravilnega delovanja ali zlorabe lastnih naprav (tudi dokazovanja odgovornosti) ter načrtovanju varnostnih izboljšav pri razvoju novih naprav.

- *Forenzika in varnost mobilnih naprav* je hibrid računalniške forenzike in forenzike vgrajenih sistemov. Mobilne naprave praviloma uporabljajo razširjene operacijske sisteme in programsko opremo, ki pa se izvaja na opremi, ki je bolj podobna vgrajenim napravam, zato ni mogoče vedno uporabiti forenzičnih pristopov, ki se uporabljajo za računalniške naprave. Podpora forenziki mobilnih naprav je ključna za organe pregona, interne preiskave, proizvajalce mobilnih naprav, podjetja, ki se ukvarjajo z zagotavljanjem varnosti lastnih naprav, ki jih uporabniki uporabljajo v službene namene (BYOD), podjetja, ki se ukvarjajo s preiskovanjem prevar, goljufij, zlorab in odtekanja podatkov.
- *Omrežna forenzika in varnost* postajata vse bolj razširjeno orodje pri preiskavah prestreženih omrežnih podatkov, saj nadomeščata pomanjkljiv razvoj ostalih področij forenzike, vendar pa bo treba v prihodnosti vzdrževati intenzivnost raziskav na vseh področjih digitalne forenzike, da bo mogoče zbrane indice združiti v celovit in verodostojen dokaz. Omrežna forenzika je pomembna za organe pregona, kot podpora preiskovanju zlorab informacijskih sistemov v podjetjih, preiskovanje zlorab, goljufij, odtekanja informacij in podatkov, ki jih izvajajo specializirana podjetja, SI-CERT.
- *Mednarodni študijski program Digitalna forenzika* bo pokrival potrebe industrije in organov pregona po visoko specializiranih kadrih s praktičnim znanjem na področju vseh vrst digitalne forenzike. Hkrati bo podlaga za pridobitev industrijskih certifikatov (GCFA, CCFP, CFE, CEH ipd.). Diplomanti bodo visoko zaposljivi in predstavljajo odgovor na prihodnje povpraševanje po specifičnih kadrih za organe pregona in industrijo digitalne forenzike ter informacijske varnosti.

5. SKLEP

Program in storitve laboratorija DF:Lab v sklopu infrastrukturnega stebra LAB:UM programa IOT se vključujejo v verigo vrednosti kot ključni mehanizem za podporo preiskovanja najtežjih primerov zlorab in goljufij ter varovanja naprav, povezanih z internetom stvari ter sodobnimi na informacijsko-komunikacijskih tehnologijah temelječimi storitvami. Laboratorij DF:Lab bo na razpolago preiskovalcem iz industrije za izvedbo najtežjih preiskav in hkrati omogočal stik z raziskovalci, ki bodo na podlagi realnih primerov z raziskavami razvijali nove pristope, metodologije in rešitve za podporo digitalni forenziki in varovanju naprav. Na podlagi novih spoznanj se bo z vgradnjo najnovejših varnostnih mehanizmov v nove naprave povečevala mednarodna konkurenčnost in prepoznavnost gospodarstva.

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Trajnostne in pametne stavbe - gradniki pametnih mest / Sustainable and smart buildings - building blocks of smart cities

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POVZETEK

Trajnostne in pametne stavbe predstavljajo osnovne gradnike pametnih in trajnostnih mest. Slovenska industrija je skupaj z raziskovalnimi organizacijami v preteklosti že večkrat dokazala sposobnost razviti izdelek, ki bo odličen na EU nivoju. V zadnjem času izpostavljamo nekaj pomembnih tehnologij in primerov:

- Lesene stavbe;
- Na lesu temelječe gradbene proizvode;
- Elemente ovoja stavbe;
- Napredna okna.

Obstoječe izkušnje in demonstracije na področju trajnostne gradnje dokazujejo potencial za razvoj naprednih izdelkov in rešitev. Vendar je za uspešno trženje potrebno več – potrebna je tudi sistemska podpora. Eden od elementov te podpore je tudi v EU sprejet sistem dokazovanja okoljskih lastnosti proizvodov – program EPD.

Napredek na področju lahko temelji na individualnih, že razvitih rešitvah in konceptih, ki so na nivoju TRL 6 ali višje. Nekatere take primere lahko identificiramo iz preteklega raziskovalnega dela in demonstracijskih projektov. S povezavo teh rešitev najprej v centralni nadzorni sistem (CNS) stavbe tako, da omogočimo povezavo na informacijski oblak omogočimo vzpostavitev digitalne slike soseske ali mesta; s to tehnologijo omogočimo resnična pametna mesta prihodnosti.

ABSTRACT

Sustainable and smart building represents a basic building block for smart and sustainable city. Slovenian industry and research organizations provide extended knowledge on the area and have proven in the past the ability of developing an excellent product. Recently several technologies are found and some are exposed here:

- Wood based buildings;
- Use of wood based materials in building industry;
- Envelope elements;
- Advanced windows.

Existing experience and demonstrations in the field of sustainable construction prove the potential for the development of advanced products and solutions. For successful marketing, however, also systemic support is necessary. One important pillar of this support in proving the environmental characteristics in an EU accepted manner through EPD programme.

Possible advances can be based on available individual solutions at TRL 6 or higher, identified in previous research and demonstration projects. By linking these solutions first to building management system (BMS) and then provide a possibility to link different systems via cloud into a digital representation of a district truly enable sustainable and smart city of the future.

1. INTRODUCTION / UVOD

In last decade sustainable construction is more and more recognized as the right way of building and maintaining buildings. Slovenian National Building and Civil Engineering Institute (ZAG) has been strongly involved in the area, both on the conceptual and on the particular level.

First pronounced area of past and current research, connected to sustainable building is in use of cellulose based materials. Development of new technologies, in which ZAG is involved in different research projects involve topics as use of nano crystalline cellulose (NCC) or use of cross laminated timber (CLT) in buildings. ZAG is also part of the Inno Renew Centre of Excellence.

Together with various partners we were also involved in development and research in frames of the Competence centre TIGR, where for example advanced elements of glazed façade – system QBISS Air, produced by Trimo d.d. was upgraded. Within the same competence centre ZAG has also established an important service for the industry, providing life cycle assessment and EPD program for all construction products.

Another example is cooperation with Kovinoplastika Lož on project UNISASH. We took part in technical development of hidden frame window concept.

Both mentioned products – QBISS Air and Unisah window concept reached high TRL levels (TRL 7 and above) and represent a strong ground for further development, including integration of ICT.

Energy efficiency in buildings and assessment of construction products as building blocks of sustainable construction is another important competence of ZAG. Recently finished project *Cost effective* led to a demonstration of ability to realize solar heating and cooling system with demonstration of complete retrofit and advanced radiation ceiling elements at ZAG building.

2. PAST AND CURRENT ACHIEVEMENTS, PRODUCTS, SERVICES

2.1 Research and development in the field of cellulose based materials

Involvement of ZAG in the BRIMEE project provides insight to possibilities on production of nano crystalline cellulose (NCC) based products that can be produced from waste of paper industry or directly from wood. The role of ZAG in the project is primarily assessment of performance of different formulations and products, in particular with regard to energy, acoustics and fire. To that respect also necessary measuring equipment has been developed, that can be used also in other, similar research.

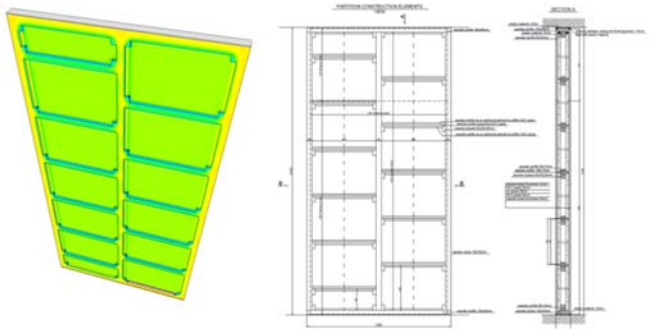

Figure 1. 3D calculation of heat flow in the wall element.

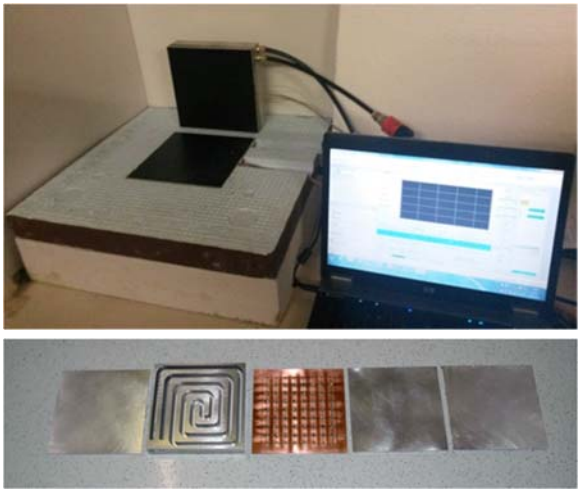

Figure 2. The apparatus for measuring thermal conductivity (BRIMEE project).

The materials under development in BRIMEE project can be used in different applications in buildings: as inner lining, as external insulation and in partition walls. The NCC foam can provide a very good basis for further functionalization of surfaces, e.g. for VOC abatement, self-cleaning or humidity control.

2.2 Technical assistance in development of building envelope elements

As industrial research partner ZAG provides services and cooperates in research in the area of advanced building envelopes. Recently two developed products can be exposed:

Advanced window UNISASH, developed by Kovinoplastika Lož and QBISS Air glazing system, produced by Trimo. In both cases ZAG contributed knowledge and testing abilities in product assessment and the improvement of the initial design.

In the case of UNISASH window system (www.unisash.eu) ZAG was involved in the design optimization, including functional testing, numerical evaluation and sustainability assessment of the product. One of the first produced pieces are installed in ZAG building as demonstration. Long term behaviour is being monitored for few years, now. The results are proving the expected performance is met, except for minor durability failure, observed in the last year.

The second highlighted product is QBISS Air by Trimo (www.qbiss.eu/unitised-single-skin-for-double-skin-performance), with variations and upgrade being developed in frames of the competence centre TIGR. The role of ZAG in the project is multiple: cooperation in the development of modified base models, environmental evaluation of the models.

2.3 Demonstration and monitoring of solar heating and cooling system

The demonstration was realised at ZAG building in frames of FP7 project Cost-effective, aiming to develop and demonstrate new solar energy solutions, the solar thermal collectors in a cost effective manner. Two types of developed technologies are demonstrated in Ljubljana.

Although primary goal of the pilot is demonstrating the two technologies: 1) transparent solar thermal collector and 2) air heating vacuum tube collector the design of the pilot included complete energy retrofit of the building part, installation of solar heating/cooling system, full monitoring of all operational parameters, stored in SQL database and building solar thermal collector (STC) test field, where at the same time three types of STC can be tested and their performance monitored at real load conditions. The pilot concept consists of: thermal insulation outside, high performance windows, external shading fixed, external shading moveable, internal glare protection moveable, transparent (glazing integrated) solar thermal collectors (TSTC), air-heating vacuum tube collectors (VTC), thermally activated building system, smart lighting and building management system (BMS).

The idea of the pilot is to drive the heating and cooling of 108 m^2 of office premises on solar energy from the solar collectors mounted on the façade using the so called thermally activated building system (TABS) at the ceiling of the offices. The collectors are installed at two different orientations and different locations on the building envelope: TSTCs on the upper part of the fire escape staircase façade with the orientation 30° SE and gross area of

27.8 m^2 and VTCs on the whole length of the catwalk fence of the 5th floor with the orientation 15° SW and gross area of 24.2 m^2.

Figure 3. Air-heating vacuum tube collectors on the pilot site.

The solar energy from the collectors is used for both heating and cooling of the offices. In the heating season the heat gained from the sun is stored in a heat storage tank and transferred to the heating/cooling ceiling elements. In summer conditions, the heat is first transformed into cold via an adsorption chiller and then stored in a cold storage tank to be used for cooling in the heating/cooling ceiling elements. For both operating modes a backup energy supply is assured and test field of TSC is linked to the system.

The objective of the project and the demonstration is to show the potential of new components and the two newly developed collectors. The primary purpose of the collectors in general is in delivering the solar energy and decreasing the non-renewable primary energy demand of the building. In this particular case two types of collectors are studied which can be incorporated into the building façade. They are not only interesting because of their façade integration capability and providing solar heat, but also because of their protection against overheating, glare protection and visual transparency. Since they are semi-transparent, both types of newly developed collectors contribute in the visual transparency of the envelope if integrated into the façade as a part of the window. Besides being energy efficient and cost effective, the challenge for new collectors with façade integration capability is to be at least semi-transparent.

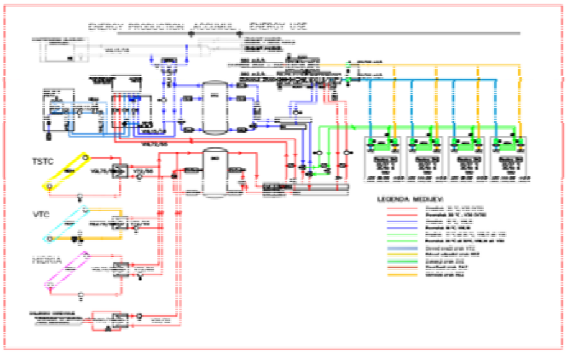

Figure 4. The HVAC conceptual scheme with three test STC connections.

The pilot intention was also to demonstrate the energy efficient and user friendly heating and cooling system. It is made of heating/cooling radiation ceiling elements. Panels covering approximately 60% of the ceiling are delivering energy for heating or cooling to the rooms by radiation, by conduction to the concrete ceiling (which activates the thermal mass of the concrete) and by natural convection. Working at relatively low heating and relatively high cooling temperatures (35°C/16°C) this system is among the most energy efficient. Furthermore the low temperature heating and high temperature cooling provides very good thermal comfort for the users.

Figure 5. Heating/cooling ceiling panels in refurbished offices.

The system is complex and needs to be controlled by a Building management system (BMS). The BMS is managing all the essential elements of heating, ventilation and cooling (HVAC) systems and room automation via a computer-based control system installed in the building. It is also collecting measured values and giving commands to each part according to those measured values and in synchronization to logic and automation built into the BMS. The pilot is therefore equipped with all the required measurement devices, energy meters, controllers, operation parameters, etc. and is gathering data to be processed, stored and used in the BMS. The data is available for post processing and for the determination of control strategies. These can be altered, enabling research and development of advanced, yet stable control protocols that could partly be transferred in new concepts, e.g. remote control of building.

The measurements are used to evaluate the energy consumption of the building before renovation regarding the improvement of the building envelope, integrated HVAC system, electrical systems, lighting as well as to know the indoor environment quality associated to the opening/closing of the door and windows by the end user. The system itself is based on data, measured with permanent measurement systems integrated into the BMS and additionally measured data for performance evaluation.

The objective of the monitoring is to compile and analyse energy consumption of the pilot and the users comfort level during a given period of time and in addition to that, studying the building performance and its operating characteristics. All the measures taken allow the energy efficiency evaluation of the refurbished part of the building.

The monitoring system combines different platforms, added for the purpose of monitoring. WEB export is already integrated. The pilot presents also a demonstration of a building block for smart city concept and offers very good platform for further research in smart city domain. In the next step an opportunity is sought to connect the data to cloud interface for gathering and processing as a model data for district level.

2.4 Assessment of the environmental sustainability of products and buildings

Last activity to be mentioned addresses sustainability assessment of building products and buildings. Both elements are necessary for successful marketing of the developed products (e.g. windows, roofing and also whole prefabricated houses). The environmental sustainability can be calculated using techniques and tools for assessment of life-cycle of a product.

ZAG has developed and operates a service for calculations of LCA with very broad database available. Furthermore it also operates EPD programme "ZAG EPD" which is a member of ECO platform, an association of EPD programmes with mutual recognition in the EU as final target. This program provides for higher competitiveness of sustainable construction products in particular of demanding markets.

Figure 6: ZEG EPD logo.

The tools can be used also for calculation of buildings. The implementation has been tested in calculation of environmental footprint of prefabricated demonstration house by Lumar (http://www.aktivnahisa.si/). The house is timber frame house, but most materials used in the calculation are classic materials. The results show calculated GWP_{100} 5.6 kg CO_2eq/m^2year. In Figure 7 comparison of embodied emissions and operational emissions is shown, clearly demonstrating the importance of the attention given to the use of materials.

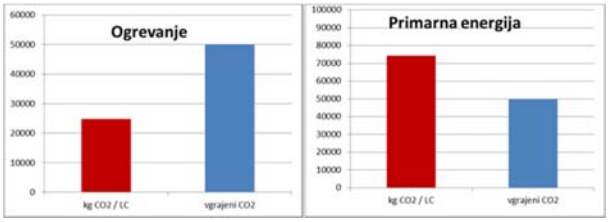

Figure 7: importance of embodied emissions in the case of high energy efficient houses.

Although basic calculations are standardized, still substantial research is needed in particular in the field of scenarios.

The demonstration building is equipped with monitoring system which enables us research and real advances in assessment of true environmental footprint. The data can in certain points, in particular energy related efficiency be compared with the pilot at ZAG building. This will be done via dynamic simulations using TRNSYS software. Findings will be considered regarding the implementation to control strategy of both systems.

The research starts in October 2015.

3. PROPOSALS

Sustainable construction requires different activities to develop and successfully market sustainable construction products. Although numerous sustainable construction products are available the solutions are often not linked flawlessly in a perfectly functioning building, while link to higher level (e.g. district) is not yet accomplished.

The activities that are needed in order to advance in this area comprise research and innovation on one hand and IT support on the other hand. Based on the experience ZAG has in research three groups of future development and innovations are identified.

On the conceptual level of sustainable building solutions need to be found to enable:

- sustainable buildings with flexible architecture made possible by new (wood-based) construction elements
- use of environmentally friendly and healthy materials, considering direct and indirect impacts to humans

The development in the area of building envelope should focus on:

- advanced (bio-based) building skin elements with functionalized surfaces
- multifunctional building skin elements with the integration of energy harvesting mechanisms
- integration of sensorics the building fabric (e.g. printed sensors) to enable smart control and diagnostics.

Currently demonstrated and developed solutions at high TRL levels (TRL 6 or higher are readily available). Therefore substantial part of the R&D process should focus to scale up in element production and automation.

IT support needed in sustainable smart building should address:

- support in prefabrication processes as these generally lower the environmental burden
- support in advanced design process, using BIM
- gathering and processing data from multiple buildings' BMS (building management systems)

Demonstrated solutions provide for a starting point. In the next development cloud potential for data processing should be explored to achieve next level of optimized control, including controlling smart interaction.

4. CONCLUSIONS

Sustainable smart building represents the basis for smart cities. In order to fully exploit the potential of IT on district level building blocks must be ready for this task. Therefor sufficient sensorics, supported by interactive BMS, accepting external guidance must be integrated.

At ZAG a demonstration pilot is capable of providing some of the required functions. With an upgrade and minor adaptations the "district ready building" can be demonstrated.

First sustainable building must respect holistic approach to sustainability. Architecture and used materials must provide the environmental burden as low as possible otherwise focusing on the use phase of building is insufficient. Once use of components with optimized footprint is assured the use phase of building life-cycle

becomes of prime interest. Connecting the use phase to IT provides tools provides for high efficiency regarding energy use, maintenance, and comfort and health in building

Basic functions that need to be embedded in the BMS are therefore dealing with energy flows to and out of the building, smart control driven by accurate (cloud) forecasting not realizable at building level ad of course passive and active comfort and health control.

Existing knowledge and experience in Slovenia represents a very solid basis for advances on the EU level in the mentioned field.

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POVZETEK

Podpiramo razvojne aktivnosti znotraj iniciative Open & Agile Smart Cities, ki temelji na principu oz. podlagah FIWARE tehnologij, saj je ta tehnologija v nekaterih pametnih mestih že široko uporabljana.

ABSTRACT

We support experimental activities within the Open & Agile Smart Cities initiative, which relies on the following implementation principles – *with specific references to FIWARE, for the convenience of those already using this architecture.*

1. INTRODUCTION / UVOD

The digital evolution of cities is a multifaceted process with a clear focus on the citizen," says Mário Campolargo, Director of Net Futures for the European Commission's DG CONNECT. "We need to be prepared to take a holistic approach towards smart cities, involving IT technologies but also sociologists and architects for all-encompassing solutions. Very few mechanisms are in place to support the digital transition of cities and societies, which in complexity is on the scale of the green transition, if not bigger," explains Martin Brynskov, chair of the Connected Smart Cities (CSC) Network Board which oversees the OASC Task Force. "Open & Agile Smart Cities shows a very concrete way forward with mechanisms that everyone can implement, for the benefit of everyone.

This important agreement encourages cities to take concrete actions. Cities adopt an initial open-licensed standard API (Application Programming Interface), FIWARE NGSI, which provides lightweight and simple means to gather, publish, query and subscribe context-based, real-time information. The cities will also use and improve standard data models based on experimentation and actual usage. The initial data models were chosen by mature European smart cities in the CitySDK initiative, forming the basis for a joint City Service Development Kit. Cities in the OASC Task Force will further harmonise the data models, extending the work to other domains in constant dialog with the developer community.

ConnectedSmartCities would therefore like to express its strong support for the proposal of Zavod e-Oblak (alias EuroCloud Slovenia) towards Slovene Smart Specialization fields such as well being within smart cities&communities and smart buildings&home activities.

ConnectedSmartCities agrees to deliver orientation, guidance and best practices, as well as to provide supporting services such as networking, knowledge sharing as part of promoting Europe-wide use and international conformance of service, which will be developed within Slovene Smart Specialization activities.

Approach: Adoption of a "driven by implementation" approach towards experimental consolidation of initial standard data models as well as specification of new standard data models. The goal is that communities and developers can (1) co-create their services based on basic but commonly-defined data models, (2) influence the definition of new models by implementing and experimenting, and (3) help "curate" existing data models. *Specifically, this will mean engaging organisations and communities, leveraging relevant initiatives, e.g. startups/SMEs selected through the FIWARE Accelerator Programme (projects focused on Smart Cities), the OrganiCity Experimentation-as-a-Service facility and open calls, Code for Europe and/or other relevant programmes, including national networks, that may help to engage wider communities of stakeholders and developers. It will also mean leveraging the FIWARE Lab, OrganiCity facility etc. as joint, major hubs for experimentation with the proposed APIs, data models and platforms.*

Most of the cities throughout Europe are in a period of transition towards a new paradigm known as smart city or connected city. This paradigm is characterized by the intensive use of technology as a means to provide better services to the citizens whilst making the city management much more efficient and sustainable.

The smart city concept does not limit its range of action to just providing better services. It is tightly correlated with many other aspects associated with the city ecosystem and its stakeholders. Hence, the availability of a platform which enables the support of capabilities beyond service exploitation and optimization is perceived as a unique opportunity for the definitive acceptance of the smart city phenomena. The consideration of issues related to citizen participation, SME involvement and entrepreneurship support are just a few examples of key aspects to be prioritized.

In this context, Europe is placed in a privileged position in terms of both successful smart city projects [SmartSantander, CitySDK, OUTSMART] and platform perspective [FIWARE]. As an open platform, developed with the contribution of hundreds of developers across Europe and supported by reference industrial players, universities and research institutions the FIWARE platform may play a key role in the cities of the future. Its massive adoption may help to speed up the replication of key components for setting up and consolidating the smart city ecosystem. However, for succeeding in such an endeavor it is of utmost relevance to be aware of the potential limitations of the present platform with the aim of identifying a set of actions for overcoming them. Thus, the next section provides some insights into what FIWARE is as well as its main characteristics in the city use domain.

API: Adoption of a lightweight, open-license standard API to gather, publish, query and subscribe-to in-time context information describing the state of the city. *Specifically, the FIWARE NGSI API will serve as a first common API which the supporters will implement.*

Data model: Adoption of a simple initial standard data model required for effective interoperability when exchanging context

information. *Specifically, CitySDK, which is available through the FIWARE NGSI API, functions as a basis.*

Open Data Platform: Adoption of a flexible, easily-distributable open data publication platform which any organisation can set up at a low cost if it is not already being used. *Specifically, CKAN will serve as the initial standard platform for publication of datasets or NGSI API resources. CKAN is already integrated and extended as part of the FIWARE Reference Architecture*

We believe that the Open & Agile Smart Cities initiative will be instrumental in the organic adoption and further development of a common set of standard APIs, data models and open data platforms for smart cities which – by providing adequate flexibility in implementation and an appropriate level of loose/tight coupling – will ultimately fuel city-driven innovation and transform cities into hearts of economic growth and enablers of sustainable wellbeing of citizens.

Initiative is supporting publishing Open Data from our data portal on the FIWARE Lab, in order to facilitate standardization of smart city data models following a "driven by implementation" approach. We acknowledge that open data published through the Open & Agile Smart Cities initiative will be made available to cities, communities and developers worldwide for free experimentation based on open licenses.

Specifically, we have already taken decisions, which will lead to our support of the Open & Agile Smart Cities implementation principles above.

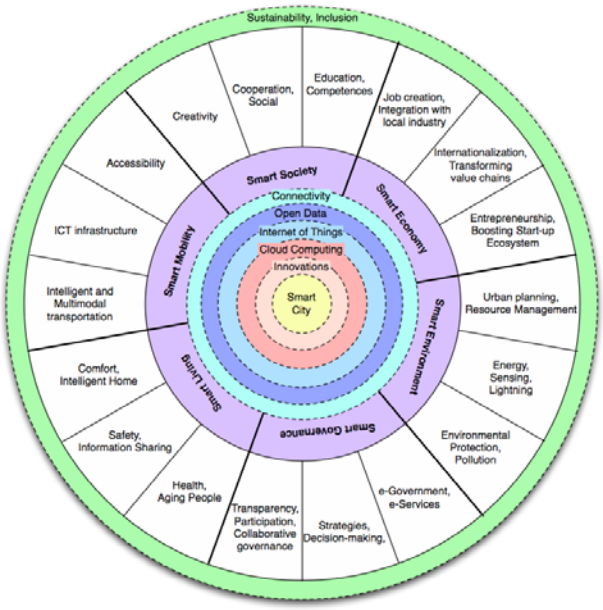

Figure 1. Smart Cities concept

2. SMART CITIES NEEDS

The model of Slovene Smart City initiative is built on 6 pillars, aligned to the EU Smart City vision:

Smart economy: Economy represents one of three key areas of sustainable developments based on economy driven ecosystem, enabling creativity, innovation and collaboration towards new jobs. Once this eco-system partners work hand in hand, economy models on local but also on global scale of economy change, as new global opportunities arise via new innovative business models. Local industry gets involved as well, start-ups get involved as well and internationalization becomes key economy driver, new investments readiness gets higher visibility through by local players.

Smart environment: lower energy consumption is one of key goals future cities have to dedicate their activities/programs/services. By that we mean from smarter lightning systems to alternative energy usage enablement, optimize power consumption based on distributed power provider systems of alternative energy sources, such as solar energy, etc. Other very important field of smart environment is smart planning of resources, such as water consumption, loss control, waste management and recycling capabilities, pollution control, connected with smart mobility, smart buildings, connected with smart city environment via new technology enablement in smart city environment, based on sharing data on city/community level, provided by city authorities, based on infrastructure sharing, etc.

Smart management: presents efficient and transparent public services, which enable safe and stable environment for business and industry development with enablement of public collaboration of managing cities (public proposal offering, open innovation platforms, etc). It means simpler, ICT supported public services for citizens. Smart management is enabled via e-services, which have public interfaces towards users. E-services on all levels enables paperless communication, supports better mobility and quickens city processes. It opens the fields of open innovation, where citizens are invited to participate within the transformation into smart-city. Also innovation management support is crucial to bring innovation as part of core system, which enables new smart city services in place, which a close to real needs. Terms like open data, open processes and open services get in use at this point, which support transparency, collaboration and participation, which in the end brings new innovative solutions into real life situations.

Smart living: On the level of individual and the quality of his life at home and outside, public need of the citizen need to be addressed. Therefore it is important that we enable innovation potential on personal level in the fields of health, security and wellbeing. Special car needs to be considered towards elderly people, which is getting bigger and bigger, due to long-life, which again, gives a huge potential of bringing new innovative services towards elderly people especially in respect to their health-care, which needs to be enabled from their home, based on their personal needs, which will in the future even be more important due to demographic changes. Furthermore, smart-living also means information on a specific situation you might be in at current time, which is relevant for you at that time, which can also influence on the quality of living in city environment at important events, such as accidents, social events, activities important to your lifestyle and age, etc. And in the end also bring all this information into your homes, to ease the living within our homes, houses, apartments within smart home environment.

Smart mobility: Mobility is a key element of successful city life, therefore optimization of traffic is of utmost importance. Smart mobility wants to get to very smooth traffic within city centres, lower personal traffic need and use public transportation means instead, integrated multimodality is key aspect, which can help extensively towards this goal, meaning integration of different public transportation means (time management, integrated tickets for all public transportations within one area, integration of all information on public transportation services). In the end this means transformation of public transport services, which becomes much more citizens friendly and time and also economic

efficiency becomes very important in comparison towards private car transportation. To enable such as transportation system, one must think of developing better and much more real time traffic control in respect to lowering the traffic jams, car accidents and consequently quicker response mechanisms for avoiding jams on your way.

Smart society: smart society is a society, which needs collaboration with others an also new ways of learning experiences. It proposes open space collaboration places where people can meet and exchange new creative ideas on all levels of education. Smart society is targeting toward raising the technological competences of people, leaving within city, better access to internet and usage of digital technologies into learning processes – it is open and inclusive society, adopted to their citizens as well as tourists (different services, multilingual services, etc); the main vision here is to enable social and cultural gathering, which enables support to individuals and create environment for creativity and cooperation. From the social point of view smart society means cooperative society, which embraces differences and intercultural dialog and open mind creativity.

Basic conditions for smart city environment is technological environment, which needs to consist of:

- Scalable sensorial network, which can be controlled efficiently and is two-way communication enabled (internet of things
- Scalable program modular platform, which enables complex data analysis (analysis of huge sets of multimodal real-time datasets (hi-performance computing – HPC) from the user perspective it runs in the cloud
- High speed network connectivity (wireless, other)
- Interoperability and integration of interfaces which enable connectivity with sensors, IOT devices, internal and external services and applications and systems
- Monitoring control and KPI control enablement and metric for information delivery
- Open authentication and authorisation mechanisms
- Human-computer interaction systems

Targeted impact

If smart city's vision is to provide smart and sustainable components in place, on the level of individual buildings one most provide components, which are:

- Energy efficient, from the user as well as provider viewpoint.
- Comfort to people living in buildings.
- Building block, which are coming from materials, enabling long term sustainability of a city.
- Strong clean environment policy support towards city sustainability.
- Services, which enable interconnection on the city level.

"Smart city outputs within proposal therefore consist of:

- "Open datasets", which enable wider user under secure measure in place, which support safe data exchange.
- Development platform (PaaS – development tools), which will serve public usage for integration between services and interoperability of those services, which enable big data management of all events within ("SmartCity" ecosystem).
- Set of public services, which deliver data towards user in user context way towards citizens on all level of city living.
- A city with lower energy consumption due to efficient consumption management in place.
- A city with high energy independency (city energy performance certificate).
- City with high usage of alternative materials with low impact on environment (smart waste recycling, higher usage of renewable materials).
- Public services, which enable optimized city management; efficient two-way communication enablement (between city management and city residents).
- Synergy between services, managed directly by city management with so called secondary services, which enhance the experience of resident or tourist, such as "smart taxi services", etc.
- Interoperability (Interoperability is needed on all levels to avoid vendor lock in. Standards needs to be demand driven generated by the cities and the citizens).
- Standards are needed.

3. CERTIFICATION SCHEMES

The introduction of the scheme known as EuroCloud Star Audit (ECSA) will help establish "a sound and trustworthy environment" for developing the cloud computing sector in Slovenia and benefiting cloud users as a whole. ECSA certification scheme goes beyond cloud security and data privacy protection by also emphasizing the importance of service operation management.

The ECSA scheme enables EuroCloud to act as ECSA Embassy to more effectively team up with Slovenia cloud vendors and service providers and help them offer total cloud services with a quality level ensured by the market. The main goal of certification scheme is to help companies to continually improve within the field of digital services, which are cloud enabled.

The trend of cloud service provisioning and up taking from European, North American, and Asian markets arouses concerns with security and data privacy protection which are also critical issues need to be tackled together with the expectation from the user side for compliance to cloud service SLA.

The reason why Euro Cloud Slovenia decided to introduce EuroCloud Star Audit* (ECSA) was to help establish a sound and trustworthy environment for developing the cloud computing industry in Slovenia, but also help SMEs taking into account considerations raised when moving their existing business models to fast growing digital economy. This cooperation helps paving a road for Slovene cloud computing related businesses exploring European and global markets by obtaining ECSA certificates. ECSA scheme was developed for a balance care-taking of issues in respect of security, data privacy protection and compliance, SLA and operation service management. This globally recognized 3rd party certification scheme could better help establish a sound and trustworthy environment of the cloud service industry and assure to the users for security, service continuity and protected data privacy according to the quality level certified by ECSA. We tend to support with it also for public procurement of cloud products and services within Slovenia and in the region around.

Companies from IT services, banking and financing, telecoms, internet and mobile service fileds, who recognize ECSA values proposed by EuroCloud Europe and want to know how to compare and select cloud services from different providers and

also to perform self-assessment, are most welcome to join our activities in this area see https://eurocloud-staraudit.eu/sl.html.

4. DIGITAL SINGLE MARKET

The Internet and digital technologies are transforming our world – in every walk of life and in every line of business. Europe must embrace the digital revolution and open up digital opportunities for people and businesses. How? By using the power of the EU's Single Market. Today, the European Commission unveiled its detailed plans to create a Digital Single Market, thereby delivering on one of its top priorities.

At present, barriers online mean citizens miss out on goods and services: only 15% shop online from another EU country; Internet companies and start-ups cannot take full advantage of growth opportunities online: only 7% of SMEs sell cross-border (see Factsheet for more figures). Finally, businesses and governments are not fully benefitting from digital tools. The aim of the Digital Single Market is to tear down regulatory walls and finally move from 28 national markets to a single one. A fully functional Digital Single Market could contribute €415 billion per year to our economy and create hundreds of thousands of new jobs.

The Digital Single Market Strategy adopted today includes a set of targeted actions to be delivered by the end of next year (see Annex). It is built on three pillars: (1) better access for consumers and businesses to digital goods and services across Europe; (2) creating the right conditions and a level playing field for digital networks and innovative services to flourish; (3) maximising the growth potential of the digital economy.

5. ACKNOWLEDGMENTS

Acknowledgement goes to members of Open & Agile Smart Cities - http://connectedsmartcities.eu/open-and-agile-smart-cities/

I would like to express acknowledgment to the ECSA development team (https://eurocloud-staraudit.eu/home/about.html).

Also, acknowledgement on certification goes to main contributors to the development of this well developed program and professional as well-more can be seen on: https://eurocloud-staraudit.eu

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Big Data and Analytics for Smart City Applications
"Big Data" in analitika za aplikacije pametnih mest

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POVZETEK

"Big Data" in analitika velikih podatkov predstavljata ključna področja za razvoj pametnih mest. Dokument Evropske komisije "Towards a thriving data-driven economy"[1] opisuje novo industrijsko revolucijo, kjer so gonilna sila digitalni podatki, računstvo, in avtomatizacija. Človeške aktivnosti, industrijski procesi ter raziskave proizvajajo podatke nezaslišanih razsežnosti, ki nakazuje premik proti družbeno-ekonomskemu modelu, ki temelj na podatkih[2]. Podatkovne baze postajajo tako velike in kompleksne, da trenutna orodja in metode za vodenje in urejanje podatkov kmalu ne bodo več uporabna.

Laboratorij za umetno inteligenco Instituta Jožef Stefan s svojim ekspertizam na področju analitike in "Big Data" ima velik potencial ter želi znatno prispevati k razvoju slovenskih pametnih mest.

ABSTRACT

Big Data and analytics represent one of the cornerstones required for the realization of Smart Cities. According to the EU Commission Communication "Towards a thriving data-driven economy,"[1] we are witnessing a new industrial revolution driven by digital data, computation, and automation. Human activities, industrial processes, and research all lead to data collection and processing on an unprecedented scale, signalling a paradigm shift towards a data-driven socioeconomic model[2]. The resulting datasets are so large and complex that such "Big Data" is becoming difficult to process with the current data management tools and methods.

The **Artificial Intelligence Laboratory of the Jožef Stefan Institute** has the necessary expertise to significantly contribute to the development of Smart Cities through the use and analysis of Big Data.

1. INTRODUCTION / UVOD

The **Jožef Stefan Institute** (JSI - http://www.ijs.si/ijsw) is the leading research institution for natural sciences in Slovenia with over 900 researchers within 25 departments working in the areas of computer science, physics, chemistry and biology.

Artificial Intelligence Laboratory [AILAB, http://ailab.ijs.si/si/], with approximately 40 researchers, is one of the largest European research groups working in the areas of machine learning, data-mining, text-mining, web-mining, multimedia-mining, language technologies, natural language processing, multi-lingual and cross-lingual technologies, scalable real-time data analysis, data visualization, knowledge reasoning, social network analysis, semantic technologies and sensor networks. The team is involved in many RTD projects and initiatives that introduce AI approaches and technologies to the field of Big Data analytics. The key research direction is combining modern statistical data analytic techniques with more semantic/logic based knowledge representations and reasoning techniques with the purpose to make progress in solving complex problems such as text understanding, large scale probabilistic reasoning, building broad coverage knowledge bases, and dealing with scale.

In collaboration with the **Department of Communication Systems** and with the **Centre for Knowledge Transfer in Information Technologies**, we have established a cross-departmental laboratory for wireless sensor networks **[SensorLab]**. The goal is to combine technologies for sensor data acquisition, communication between sensor devices, statistical real-time data analysis, semantic technologies, and to enable a wide range of research and development in different application areas, such as energy, ecology, health, transport, security, and logistics.

The AILAB has participated in 14 FP6 projects, 28 FP7 projects and in 2015, has kicked-off four H2020 projects, amounting to 14 on-going EU-funded projects. We have coordinated three of those projects in addition to scientific services provided to the industry. The AILAB has ongoing collaborations with various research institutions and industry, including: Stanford University, University College London, Jožef Stefan International Postgraduate School, Quintelligence, CycorpEurope, LifeNetLive, Modro Oko and Envigence. The department collaborates strongly with its spin-out companies that are providing real-life Big Data analytics solutions to companies like Bloomberg, New York Times, British Telecom, Google and many others.

The AILAB strategy is to create novel solutions for real problems that are then incorporated into real applications. The department strategy is to include all applications in a common textgarden library. This code is then used for various other research and commercial projects. In particular, the AILAB is interested in the cognitive infrastructure deployment since this will add value to the existing intelligence framework. Furthermore, we are interested in the continuation of research of large scale networks and complex systems.

2. VISION

Smart cities encompass a diverse range of areas including:

- Smart mobility
- Smart society
- Smart economy

[1] Towards a thriving data-driven economy, COM(2014) 442, http://ec.europa.eu/digital-agenda/en/towards-thriving-data-driven-economy.

[2] "European Big Data Value Strategic Research & Innovation Agenda", European Big Data Value Partnership, July 2014

- Smart environment
- Smart government
- Smart living

While the construction of Smart Cities will rely heavily on the use of Big Data as a basis for providing meaningful information, it will also produce large amounts of data, that if properly analyzed will create information that will have considerable added value.

The Artificial Intelligence Laboratory has the tools and expertise to ensure useful, meaningful and directed information is generated from Big Data and properly integrated into the architecture, thus fully exploiting the potential Big Data has to offer.

Some of the challenges that are currently being addressed and fall within the expertise of the AILAB team are summarized below:

Tagging Indexing and searching - Up to now, the overall approach has been to integrate all data into a unique metadata repository / data model. This approach, proven successful on limited scopes (e.g. in business intelligence applications), has repeatedly failed when addressing a larger scope: it is expensive, lacks flexibility – it defines a data model pre-supposing a certain use of data and so potentially hinders future uses of the data. Hence in practice, users often rely on multiple internal and external data silos and sources that evolve over time without preconceived ideas about the future use of the collected data. These various data sources are stored in a database, in their original format. When a data source is needed, the user must go to the database and extract the data. However, as Big Data becomes a reality, the size of the database will expand rapidly, making it nearly impossible to know which data sources are in the database or what they mean, and thus making it difficult to retrieve the relevant data. How to search and navigate the dataspace has thus become a crucial problem to be addressed.

Anomaly detection - Anomaly detection, also known as outlier detection, is the task of identifying data points or groups of data points that in some sense diverge from normal behavior. This is the topic of an active area of research which draws on concepts and techniques from fields such as machine learning, data mining, statistics, information theory, etc. (examples of such techniques include support vector machines, neural networks, nearest-neighbor methods, clustering, rule-based approaches, etc.). Various approaches to anomaly detection have been proposed, depending on the type of anomaly, type of data (numeric data, unstructured text, images, networks, sensor data, etc.), underlying technique, and intended application domain. Anomaly detection is used in numerous application domains, including security (intrusion detection), finance (fraud detection), medicine and public health, manufacturing (fault detection), science (astronomy, ecology), etc.

Data stream mining - Data stream mining is an increasingly important area of data mining as data streams arise naturally in many application domains. It poses new challenges as traditional data mining approaches have to be adapted to a situation where a never-ending amount of new data points keeps arriving and it is often impossible to store all the data or make multiple passes to it. Furthermore, data streams are often volatile and exhibit changes in the distribution of data (also known as concept drift). Examples of data mining approaches that have been extended to cover streaming data include classification, clustering, frequent pattern and frequent itemset mining, and anomaly/outlier detection. To cope with the large volume of incoming data, stream mining techniques often rely on parallel processing, multithreading, distributed computation, GPU computation and on paradigms such as sliding-window computation and the map-reduce model. Stream mining often occurs in the context of sensor data, in applications including healthcare, earth sciences, traffic management, internet of things, network management, etc.

Data Analytics, as an area of research and as a part of a fast evolving Big Data initiative, is a one of the key building blocks in any modern IT setup. The 'data driven' approach allows an inexpensive and yet efficient approach to extract value from the collected data. The area of extracting useful knowledge from intensive multi-modal sensor streams is not researched well and therefore needs to be extended with the use of novel approaches – this includes multi-resolution data analytics, unsupervised anomaly detection with a rich class of anomaly models, introducing soft notion of causality in the data streams, smart sampling of data, cross-modal analytics and real-time stream data visualization.

Multi-resolution analytics - Traditional data analytics fields (statistics, data mining, machine learning) use an implicit assumption that data are observed and analyzed on a fixed scale. This is suitable from a computational perspective but has limitations in scenarios where a signal can appear on different levels of aggregation. Therefore, modelling and simulation are very appropriate, together with mathematical formalism, to build a theoretical framework about multi-level, multi-scale complex systems. Real-world data can be analyzed with standard methods such as time series analysis, principal component analysis, autocorrelation function, etc. Those are top-down approaches, which reveal little about the underlying mechanisms responsible for the observations. On the other hand, devising a micro-scale model of phenomena offers a bottom-up description, where the building mechanisms must be identified, based on our theoretical knowledge of the system. Thus, modelling and simulation offers a complementary way to interpret real data.

Topological Data Analysis is one such approach, which applies the qualitative methods of topology to problems of machine learning, data mining and computer vision. Persistent homology, especially, is an area that identifies a global structure by inferring high-dimensional structure from low-dimensional representations. This makes studying an underlying space possible through the analysis of a discrete sample of the space, assembling discrete points into global structure. A natural parameter is the notion of scale. By considering the space at different scales, important features are persistent whereas noise appears as small features, which appear and disappear at different scales. The basic technique encodes the topological features of a dataset by diagrams representing the multi-scale structure. A good introduction to topological data analysis can be found in ref[3].

3. ACHIEVEMENTS

3.1 Data analytics and tools

AILAB has extensive research facilities and equipment for performing research and development in areas of machine learning, data mining, language technologies, semantic technologies and sensor networks. Some examples of software tools for multimodal data analysis developed at AILAB are summarized below. The flexibility of the developed technology

[3] G. Carlsson (2009). Topology and data. Bulletin of the American Mathematical Society 46.2 : 255-308.

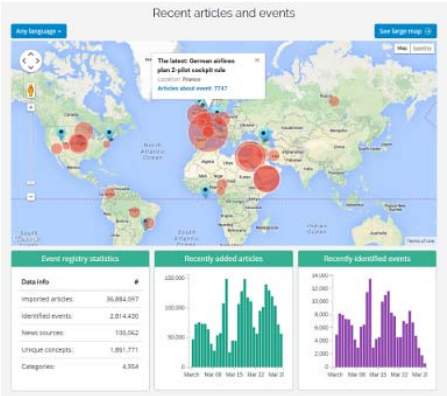
permits adaptation to specific applications within the required needs of Smart City applications.

Enrycher – (http://enrycher.ijs.si) - web service for linguistic and semantic enrichment of textual data.

QMiner (http://qminer.ijs.si/) - QMiner is a data analytics platform for processing large-scale real-time streams containing structured and unstructured data. - is an analytics platform for large-scale data stores and real-time streams containing structured and unstructured data. It is designed for scaling to millions of instances on high-end commodity hardware, providing efficient storage, retrieval and analytics mechanisms with real-time response.

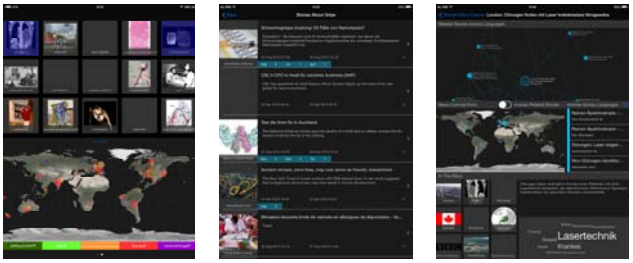
NewsFeed (http://newsfeed.ijs.si), multilingual global media crawler - an on-line media monitoring system that monitors thousands of web sites and is currently processing around 150,000 news articles daily in many languages. Article text is extracted from web pages and then analyzed and annotated in order to produce structured data suitable for further processing. Based on extracted categories, links to Wikipedia entries, grouping of similar articles into stories and linking across languages, trends can be detected and spikes reported. A description of the most relevant products built on top of NewsFeed follows.

Event Registry (http://eventregistry.org) is a system for global media monitoring that groups articles into structured events and allows their exploration. It interlinks articles written in different languages, thus assigning them to the same event. For each event, core information is extracted, such as event location, date, who is involved and what it is about. Users can explore events using extensive search options, visualize and aggregate search results, inspect individual events and identify related events



Curious Cat is an AI that learns from its users asking intelligent questions related to the current context and proving answers with the community. It tries to understand what the user tells it, and to integrate it in a growing knowledge base; it reasons about what is in that knowledge base in order to decide what to ask and what to suggest, and it turns the results of that reasoning into English, communicating it back to the user (in collaboration with Curious Cat company).

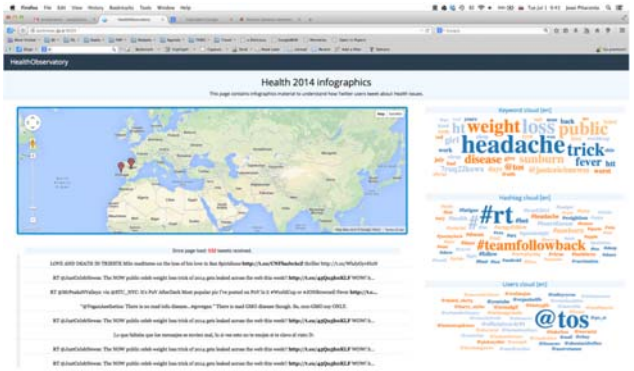
3XL News is a mobile (iOS) application that provides instantaneous global news monitoring and analysis across several languages on-the-go. It shows how semantic technologies are used in a real-world scenario.



3.2 Social Media

Social media mining refers to data mining of content streams produced by people through interaction via the Web. Although social media data are noisy, dynamic and unstructured, mining social media has been found useful for solving a number of research tasks. For example, Twitter appears to be an efficient tool from the nowcasting point of view.

3.3 Past Projects



AILAB has extensive experience in participating in EU projects, where the main goal of the project is to develop meaningful and useful tools for various fields of application.

Some past projects are summarized below:

ProaSense: *the Proactive Sensing Enterprise* (FP7-ICT-612329) addresses the challenge of designing an innovative and comprehensive approach to proactive intelligence, information management, problem solving and decision support. It aims to address several issues in the application of proactive intelligent information technologies and information visualization of large amounts of data, the definition and monitoring of the contextual factors of decision making procedures, the efficient implementation of proactive intelligence environments within enterprise organizational structures and the application of socially-aware collaboration environments, and networks within enterprise environments. (http://www.proasense.eu/)

TOPOSYS: *Topological Complex Systems* (FP7-ICT-318493-STREP), coordinated by JSI-AILab, proposes the use of computational topology, which takes notions from algebraic topology and adapts and extends them into more algorithmic forms, to enrich the study of the dynamics of multi-scale complex systems. With the algorithmic approach, we are able to consider inverse problems, such as reconstructing dynamical behaviors from discrete point samples. This is the right approach to take for complex systems, where the precise behavior is difficult if not impossible to analyze analytically. (http://toposys.org/)

OPTIMUM: *Multi-source Big Data Fusion Driven Proactivity for Intelligent Mobility* (H2020-MG-636160) will establish a largely scalable, distributed architecture for the management and processing of multisource Big Data, enabling continuous monitoring of transportation system needs and proposing proactive decisions and actions in an (semi-) automatic way. The project follows a cognitive approach based on the Observe, Orient, Decide, Act loop of the big data supply chain for continuous situational awareness.

NRG4Cast: *Energy Forecasting* (FP7-ICT-600074), coordinated by JSI-AILab - developing real-time management, analytics and forecasting services for energy distribution networks in urban/rural communities. The work within the project focuses on analyzing information regarding network topology and devices, energy demand and consumption, environmental data and energy prices data. The services that will be integrated in a software module pipeline will provide predictions and a decision support system based on network monitoring, anomaly detection, route cause analysis, trend detection, planning and optimization. (http://nrg4cast.org/)

SYMPHONY: *Orchestrating Information Technologies and Global Systems Science for Policy Design and Regulation of a Resilient and Sustainable Global Economy* (FP7-ICT-611875), aims at providing a set of innovative ICT tools, integrated in a platform designed to tackle issues concerning complex global dynamics of our economic and social system. The main objective of the project is to develop a framework for designing and testing policies and regulatory measures regarding: preventing and mitigating economic and financial crises;- fostering an economically and ecologically sustainable growth path. (http://projectsymphony.eu/)

MOBIS: *Personalized Mobility Services for energy efficiency and security through advanced Artificial Intelligence techniques* (FP7-ICT-318452) - The main goal of MobiS is to create a new concept and solution of a federated, customized and intelligent mobility platform by applying novel Future Internet technologies and Artificial Intelligence methods that will monitor, model and manage the urban mobility complex network of people, objects, natural, social and business environment in real-time. (http://www.mobis-euproject.eu/)

SOPHOCLES: *Self-Organised information PrOcessing, CriticaLity and Emergence in multilevel Systems* (FP7-317534-STREP) contributes to a theory of dynamics of multi-level complex systems by developing mathematical and computational formalisms for information processing in such multi-level systems. The project develops the formalism in the context of criticality, emergence, and tipping points in multi-level systems and apply it to real data. This will lead to a better understanding, but more importantly, to an improvement in predictive power for early warning. (http://sophocles.eu/)

4. ACKNOWLEDGMENTS

The authors would like to acknowledge the support of the EU in all the projects listed in Section 3.

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Uporaba monitoringa v pametnih mestih / Use of monitoring in smart cities

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POVZETEK

Zavod za gradbeništvo Slovenije (ZAG) je eden od glavnih akterjev na področju razvoja gradbenih materialov in tehnologij v Sloveniji in tudi širše v Evropi. ZAG razvija tudi monitoring grajenega okolja, vključno z zgradbami, inženirskimi objekti in infrastrukturo. Monitoring je bil vključen tudi v številne pretekle nacionalne in evropske raziskovalne projekte z ZAGom kot partnerjem ali koordinatorjem (npr. SPENS, ARCHES, SMART RAIL, SENSE, TRIMM, COST EFFECTIVE). Ogromno količino tako pridobljenih podatkov je uporabilo omejeno število končnih uporabnikov za potrebe podrobnih analiz določenih vrst gradbenega okolja. V splošnem pa so ti podatki primerni tudi za razvoj inovativnih aplikacij, ki podpirajo varno, prilagodljivo, avtomatizirano, udobno, ipd bivanje v pametnih mestih. ZAG bo s celovitim strokovnim znanjem lastnih strokovnjakov s področja gradbeništva v prihodnjih pobudah podprl zainteresirane subjekte pri razvoju inovativnih aplikacij pametnih mest, prispeval in interpretiral podatke iz obstoječih ter vzpostavljal nove merilne sisteme.

ABSTRACT

Slovenian National Building and Civil Engineering Institute (ZAG) is one of the main players on the field of development of building materials and technologies in Slovenia and also widely in Europe. ZAG is developing monitoring of building environment, including buildings, engineering structures and infrastructure. Monitoring was included in a number of national and EU research projects with ZAG being coordinator or partner (eg. SPENS, ARCHES, SMART RAIL, SENSE, TRIMM, COST EFFECTIVE). A huge amount of data from these activities were used by a limited number of end-users for detailed analysis of particular building environment, but could also be used by any other entity for development of innovative applications supporting safe, adaptable, automated, comfortable, resilient, etc. smart cities. ZAG will support interested entities with comprehensive expert knowledge from the field of civil engineering, will continuously contribute data from existing monitoring systems and will also create new ones.

1. INTRODUCTION / UVOD

In the past, ZAG has been involved in a number of international activities that fulfil the objective of a smart city, in the areas of buildings and infrastructure. ZAG's research activities on this field were mainly focused on various kinds of monitoring, data logging and analysing, as well as interpretation of data. Monitoring results, whether it is building or infrastructure monitoring, were used for the optimization of building/infrastructure use as well as for the related maintenance activities.

2. PAST AND CURRENT ACHIEVEMENTS, PRODUCTS, SERVICES

2.1 Monitoring data from buildings

With a respect to buildings, ZAG was involved in several research projects involving monitoring of various physical parameters of building structure, building skin and technical installation within the building. Particularly, our activities were focused on development of concepts and components to convert the facades of 'high-rise buildings' into multifunctional, energy gaining entities, aiming to have a substantial effect on the energy conservation potential in the EU25 and the associated CO_2 mitigation.

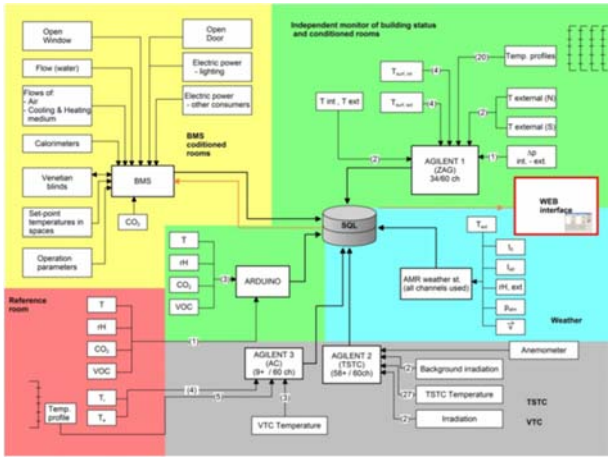

Figure 1. General scheme of the monitoring system

2.1.1 COST EFFECTIVE project

Monitoring of the system performance was based on measurements of all relevant parameters. The measurements were used to evaluate the energy consumption of the building after renovation regarding the improvement of building envelope, integrated HVAC system, electrical systems, lighting as well as to assess the thermal comfort of the indoor environment.

The system itself was based on:

1. Data, measured with permanent measurement system integrated in Building Management System (BMS).
2. Additional measured data, not necessary for the BMS but useful for performance evaluation.

General scheme of the system is shown on **Error! Reference source not found.**.

A Building Management System (BMS) in the case of COST EFFECTIVE project [1] was a computer-based control system installed in the building that monitored and controlled all building's subsystems. It was managing the HVAC system and room automation. It collected measured values and gave commands to each part according to measured values and logic build in BMS automatically. It allowed data exchange between CAD (Computer aided measuring system), control system, automation stations and elements of room automation. Logic and set values were changeable by operator.

Monitoring of the system performance was based on measurements of parameters with measuring devices. The measurements were be used to evaluate the system as described in monitoring protocol. The site was equipped with all necessary measurement devices, energy meters, controllers, operation parameters, etc. for gathering processing and storing the data in the BMS to be shifted to SQL base. Measuring devices (sensors) were installed according to general scheme of the monitoring system and included:

- *Energy (heat/cold) & temperature sensors;* Power release for each part of the heating and cooling system was monitored by energy calorimeter Allmess CF-E II together with PT 100. The same device combination was used in the heating/cooling ceiling elements (radiation panels) of each office and in all other devices for providing the energy: in the installed solar-thermal components (VTCs and TSTCs), in adsorption machine, in compressor chiller (back-up for cooling), in district heating pipe (back-up source for heating), etc.
- *Ventilation;* Mechanical ventilation system (with the recuperation of energy) for fresh air supply to the offices was equipped with integrated electronic air flow rate controllers ERP-1 and sensors DPWT011000.
- *Electricity;* Installed electricity meters in electric distribution nodes measured electricity consumption separately.
- *Room temperature, humidity and CO2 measurement and regulation;* Room temperature and humidity measurement and regulation was done by DPWT011000 sensor, CAREL DP series electronic probe, which was designed to be used in combination with the corresponding CAREL controllers. Installed LC-WRF04 sensors measures CO_2 level.
- *Additional indoor environment parameters;* Each office was additionally equipped with digital humidity and temperature sensors Sensirion SHT21 for indoor air temperature (ºC) and relative humidity (%rH), Carbon Dioxide Sensor for CO2 concentration (ppm), air quality Control sensor MQ135 (VOC), thermocouples type T sensors for the indoor/outdoor air temperature and surface temperature (internal, external) and 5 thermocouples type T sensors on stack for indoor air temperature gradient. All sensors are connected to Arduino based board.
- *End user behaviour in the offices;* Opening of the office windows was controlled by magnetic on/off contact (MS CR4 – KU6). Opening of the entrance door was controlled and recorded by electronic access (magnetic lock).
- *Weather;* AMR 2890 (5 channels) weather station measured external conditions: air temperature (ºC), relative humidity (%), air pressure (hPa), wind speed (km/h), rainfall (mm) and global and diffuse irradiation (W/m2). The AMR meteo multisensor FMA-510 and Kipp-Zonnen pyranometer were placed on the roof of the building.

2.2 Monitoring data from infrastructure

As regards infrastructure, ZAG has in recent years contributed to the *Forever Open Road* (FOR) programme, developed by the FEHRL association (European National Road Research Centres). This revolutionary concept is built around common understanding that *advanced* and *affordable* transport infrastructure is one of the keys to improve mobility of people and goods and to create the economic opportunities of tomorrow.

Basic drivers of FOR [2] are that infrastructure has to be:

- *adaptable*, as being able to adapt to increasing travel volumes and to changes in demand for public transport, cycling and walking;
- *automated*, as incorporating a fully integrated information, monitoring and control system; communicating between road users, vehicles and operators, and
- *resilient*, as being capable to adapt itself to the impacts of extreme weather conditions and climate change, and

ensuring adequate service levels of the road network under extreme weather conditions.

An example of a conceivable automated road of the near future is given in Figure 2.

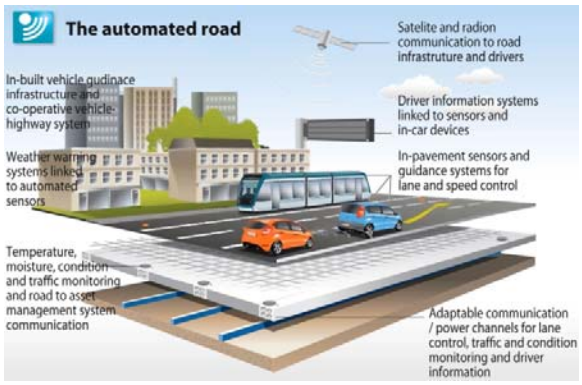

Figure 2. Automated road conceived in the FOR programme

A number of projects with concrete ZAG involvement have already been labelled as FOR activities, including FP7 projects TRIMM and BridgeMon, which are described in following text.

2.2.1 TRIMM project

TRIMM (Tomorrow's Road Infrastructure Monitoring and Management) was a FP7 project that ended in 2014. It investigated and developed a number of road infrastructure monitoring and management techniques that could, in short term, improve functionality of road infrastructure (pavements and bridges) and thus increase safety, environmental friendliness and mobility of road transport. ZAG was a leading partner who was in charge for three working tasks.

The following two areas, pavements and bridges, are related to smart cities and smart infrastructure.

One of the project objectives in the area of pavement quality was to equip several standard vehicles with equipment that allows ride quality to be assessed without the need to install specialised high-tech sensors. The approach draws on the use of measurements provided on the vehicle CAN Bus and on data provided by smartphones. Test drives have then been carried out with these vehicles and data collected from these devices. In addition the work has asked passengers about their opinions on the quality of the roads that was driven over. The recorded data has been assessed and the work carried out to identify a potential KPI (Key Performance Indicator) that can be obtained from the data.

In the area of bridges, sensing technologies can in combination with advanced procedures for evaluation of monitoring data provide additional information about bridge condition, which can be used for more accurate assessment of structural performance and decision making in the maintenance. The real-time information can provide early warning of occurring damage and therefore allows reducing the traffic jams and repairing costs, since the repair measures can be executed at a stage that requires lower investment.

The monitoring systems can be designed to monitor corrosion progress, material fatigue, mechanical functionality of load-bearing elements, functionality of joints and bearings, amount of cracking activity in the bridge, etc. Socio-economic impact of occurrence of defects or of structural collapse should also be considered.

Within TRIMM ZAG was involved into development of the following bridge monitoring techniques [3]:

- *Corrosion monitoring;* Corrosion monitoring systems are intended for concrete bridges and provide information on corrosion rates and reduction of reinforcement bar diameters. Using this information, the reduced load-bearing capacity can be calculated. If the monitoring system operates over a longer period, prediction of future corrosion rates, diameter reductions and reductions of load-bearing capacity can be produced.
- *Monitoring of material fatigue;* It can provide more accurate assessment of fatigue damage accumulation when compared to design calculations. The procedure includes identification of actual traffic loads using bridge weigh-in-motion (BWIM) systems developed by ZAG and its SME partner and/or strain measurements at affected locations. The monitoring system provides information only about fatigue damage accumulated within the monitoring period. Past and future fatigue damages must be estimated.
- *Monitoring of functionality of joints and bearings.* It aimed to detect presence of movement restrictions at these elements and thus change in their performance. The methodology applies a BWIM system and can be recommended on single span bridges with span length up to 40 m. The system provides a warning that triggers recommendation to preform visual inspection that results in potential rehabilitation measures.
- *Cracking activity;* Cracking activity can be monitored using Acoustic Emission technique to provide information about level of traffic load, at which the bridge damage is progressing. The technique can be used on bridges with serious damage and traffic limitations or when bridge closure is being considered.

2.2.2 BRIDGEMON project

Bridgemon was another FP7 project that finished in 2014. It involved 2 Slovenian partners, ZAG and a SME Cestel d.o.o. ZAG was one of the two main research providers in the project and Cestel was the beneficiary of the results in the area of improved BWIM technology [4].

Traffic loading is one of the key parameters governing the design and assessment of bridges and pavements. As such, the ability to monitor the actual traffic loading on a particular bridge or road can be of great benefit to infrastructure managers who, with limited budgets, are required to make informed decisions regarding repair or maintenance strategies for road infrastructure. BWIM is a weighing technology that, by instrumenting the existing bridges, provides real-time and accurate traffic loading information in a form of *axle loads of all vehicles* that pass the bridge at normal speed. This information is used to fill the traffic databases that are used for various traffic and infrastructure applications and to prevent overloaded vehicles from damaging the infrastructure and causing unfair competition to the hauliers that follow the rules. Overloaded vehicles also drive with considerably higher risks which can end tragically (figure 3).

Figure 3. Overloaded vehicle crashing into a house

The BWIM technology has been developed at ZAG since the early 1990s and has been for the last 15 years, after the cooperation with Cestel started, implemented in over 20 countries around the world. The objective achieved within Bridgemon project was to improve accuracy and long-term stability of the results and to adopt it to railway bridges [5].

3. PROPOSALS FOR E-CITIES

Structure and infrastructure monitoring, which in our opinion is very important subject for smart cities and communities is mostly done by trained inspectors but is highly subjective and results in inconsistency of results. In addition, these results are used inefficiently, with remedial measures being slow and often causing disruption to traffic. Today only a small number of large structures are monitored electronically, while smaller structures that can also cause major traffic disruptions and pose safety issues are not monitored at all. Two major reasons for such situation are:

- Cost of conventional monitoring campaigns and
- Amount of data that monitoring is generating and is difficult to assess.

This could change if monitoring systems would:

- Give more consistent results, less reliant on human judgement,
- Cause less traffic disruptions and
- Be far less expensive to potentially allow monitoring of most transport infrastructure in the future.

These objectives could be achieved using (amongst other things):

1. Smart sensors on infrastructure that are interrogated using drones, i.e., pilotless drones would download the condition data from the infrastructure on a regular basis.
2. High number of low-cost sensors built into infrastructure that would send data to the cloud.
3. Crowd Sourcing, i.e. accessing sensors in the smart phones of the travelling public and using them to detect the condition of infrastructure.

The most near to implementation is the crowd sourcing concept, using smart phones of users connected into social GPS and traffic networks. In particular, it could be used to monitor pavement roughness and sound levels around bridge joints which can change dramatically if the condition of joints deteriorates. It is important that defective expansion joints are identified and repaired quickly as failure to do so can lead to serious problems that may require the joints to be replaced which is very expensive and disruptive to road users. The same is valid for ruts and pit-holes in pavement. Collecting large amount of relatively low-quality data (accelerations, geo locations) would detect changes in condition of pavement and structures and, as a result, trigger inspections that would result in timely interventions. It has been estimated that maintenance costs can be reduced by as much as 30% as a result of early detection of defects. It shall be pointed out that today infrastructure monitoring activities are rarely pursued in cities.

Implementing this concept would allow more traffic infrastructure to be kept in service for longer – in effect, the life of infrastructure will be extended. Maintenance cost will be optimised through better monitoring as this would lead to preventive actions and better planning of major works. All of this would result in less traffic jams, higher safety and cleaner environment, which will have a positive impact on citizens living in and commuting to or from the cities.

4. CONCLUSIONS

Focusing on intelligent buildings and intelligent infrastructure (i.e. innovative monitoring systems integrated into building environment) in Smart cities aims at providing a step change in the use of technology to manage our cities, including buildings, engineering structures and infrastructure buildings, as well as to contribute towards providing safety, comfort, healthy and mobility. This kind of integrated monitoring systems combined with other data acquisitions (e.g. crowd sourcing) enable a huge amount of information which can be used for analyses of city communities and further development of various innovative applications, supporting better life in cities.

The research in area will enable communications systems linking building environment with its user (e.g. building, residents and building manager; road, driver, vehicle and the road operator, etc). It is expected that in this way, the city network management will be improved (e.g. a higher efficiency of passenger and freight transport with less energy consumption and less GHG emissions, etc).

The work approach includes a very high frequency of monitoring passages over a particular length of road, much more often than with highly sophisticated monitoring devices or by dedicated inspections. A real-time monitoring produces very large amounts of the data collected making the communication of the information to the road manager rather difficult. Here, the e-cloud service and support seem to be more than appropriate for the treatment and the first interpretation of these data.

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Vesoljske tehnologije za pametna mesta
Space technologies for smart cities

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POVZETEK
Uporaba satelitskih tehnologij pri načrtovanju trajnostnih mest in skupnosti ima velik potencial. Število delujočih velikih in malih satelitov je v porastu. V kombinaciji z množično zbranimi podatki satelitski posnetki predstavljajo bazo podatkov za številne analize in aplikacije, ki predstavljajo podporo pametnemu urbanističnemu načrtovanju, prilagajanju podnebnim spremembam in izboljšujejo kvaliteto življenja znotraj pametnih skupnosti.

VESOLJE-SI s svojim mikro satelitom za opazovanje Zemlje, zemeljsko postajo, multidisciplinarnim laboratorijem, avtomatskim procesiranjem satelitskih posnetkov ter distibucijskim sistemom, ki temelji na spletnih in mobilnih aplikacijah, zagotavlja celovito verigo od vesoljskih tehnologij do končnemu uporabniku prijaznih podatkov in izvedenih informacij. Ažurne geolocirane informacije so ključnega pomena za dobro organizirana pametna mesta in skupnosti. Naše strokovno znanje omogoča obdelavo satelitskih posnetkov v skoraj realnem času ter ekstrakcijo iskanih informacij iz tega hitro rastočega vira podatkov.

ABSTRACT
Satellite technologies have a huge potential to help design more sustainable cities. Combination of Earth observation imagery and crowdsourced data enables a creation of a series of data analyses and applications to support smart urban planning, climate change mitigation and to enhance the quality of life in smart cities and communities.
SPACE-SI with its micro satellite for multispectral Earth observation, ground station, multidisciplinary laboratory, satellite data processing chain and a distribution system based on web and mobile applications ensure the whole chain from the space technologies to the end user friendly data and derived information. Timely geolocated information is crucial for well-organized smart cities and communities. Our expertise is near-real-time processing of space-borne data and the extraction of the needed information from this ever-growing data source.

1. INTRODUCTION
Increasing urbanization and ever-growing urban population are opening new challenges to be addressed to ensure sustainable development of the cities offering a good quality of life for the citizens. To effectively plan and manage the urban areas accurate and timely geolocated data is essential. Space-borne Earth observation provides up-to-date spatial information on various topics supporting smart urban planning and enabling sustainable development of the cities and the climate change mitigation.

2. SPACE-SI IN AND FOR SMART CITIES
The research and development strategy of the Centre of excellence for Space sciences and technologies (SPACE-SI) is based on two global breakthroughs in the aerospace industry in the field of small and large satellites that will provide new, extremely reach data sources for the development of satellite applications needed to support the development of smart cities and communities.

Radical miniaturization of the micro and nano satellite subsystems has reduced the costs for developing, launching and operating satellites. Due to lower costs more satellites can be launched and consequently, the larger areas can be observed with better temporal resolution (images are acquired more often). Thanks to those radical changes space technologies are not anymore reserved only for large research and development institutions from economically strong countries. They have opened the door for the satellite development and operation also in new small countries and on fast growing markets. With its excellent staff and infrastructure network SPACE-SI is ready for the new wave of opportunities. SPACE-SI has developed the first Slovenian micro satellite for interactive remote sensing, built the ground station, equipped multidisciplinary laboratory for the integration and testing of satellite components and has prepared a wide range of mobile and web applications prototypes to be used by companies, government offices, and general public. With the current achievements SPACE-SI is planning active engagement in the very perspective international markets regionally and globally.

European Commission and European Space Agency (ESA) have developed a family of large satellites missions called Sentinels. These missions carry a range of technologies, such as radar and multi-spectral imaging instruments for land, ocean and atmospheric monitoring. Sentinels will provide massive amounts of global satellite high and medium resolution images which will be freely and openly accessible for the users. This will greatly increase the potential for development of new services based on satellite data and open new employment opportunities. Due to extremely large amount of data it will also pose a big data processing challenge.

SPACE-SI will integrate the new data sources into a single system for data processing and management and for web and mobile applications development for the end users. These data and applications have a huge potential to help design more sustainable and smart cities and communities.

Furthermore, to be able to make better use of fast growing amount of satellite data SPACE-SI has developed and implemented a complete fully automatic processing chain (called STORM) that includes all necessary processing steps from sensor-corrected (Level 1) optical satellite image up to web-delivered map-ready products.

3. CURRENT SMART PRODUCTS

SPACE-SI's current activities related to the area of smart cities and communities can be divided in three main groups:

- Providing the **infrastructure** for data acquisition and transmission from the satellite to the ground (micro satellite, laboratory for satellite integration and testing, ground station), as well as providing the Sentinel data,
- Automatization of satellite **data processing** from sensor-corrected (Level 1) optical satellite image up to web-delivered map-ready products (automatic processing chain), and
- **Applications** using information derived from satellite data, combining Earth observation data with in-situ data (web and mobile applications).

The scheme of our activities is presented in the Figure 1.

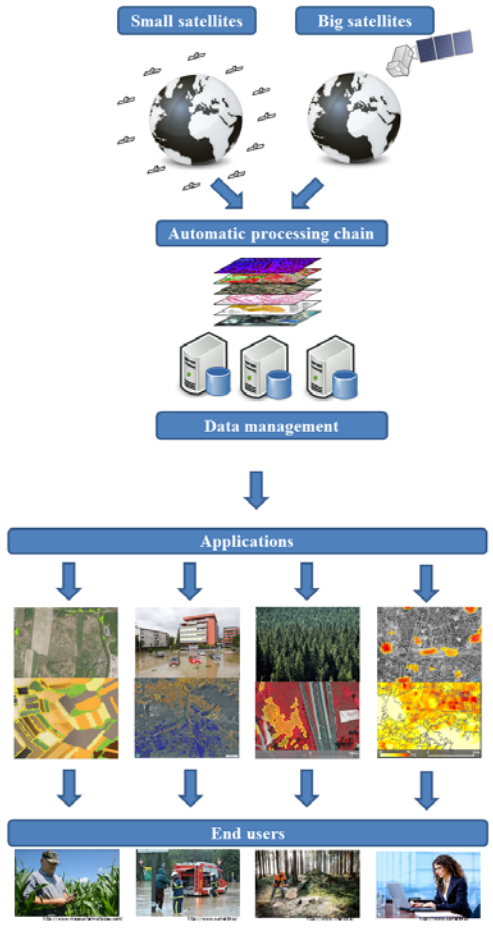

Figure 1: Schematic representation of SPACE-SI's activities - from technologies to end user services.

3.1 Infrastructure

SPACE-SI has the key infrastructure to ensure the whole chain from the space technologies to the end user friendly data. The main infrastructure consists of the micro satellite for multispectral earth observation, multidisciplinary laboratory for satellite systems integration and testing, ground station for retrieving the data from satellites to the ground, automatic data processing chain and web GIS.

3.2 Data processing

Space-SI has developed an automatic image processing chain that performs all processing steps from sensor-corrected (Level 1) optical satellite images to web-delivered map-ready products. It is a near-real-time processing workflow that operates fully automatic with no operator's intervention required. It performs several steps, starting with automatic geometric and radiometric pre-processing, followed by a variety of automatic interpretations and analyses. In the preparation for the processing of the Sentinel satellites data we are proposing a regional data archiving and processing center. Data processing chain makes use of cloud computing, which makes remarkable scientific results also supporting Earth observation.

To enhance the data processing chain our future scientific work will still be focused on the development of algorithms for automatic processing of multi-spectral images from remote sensing satellites. A number of highly specialized algorithms will be developed for monitoring drought, mapping of invasive plant species and plant diseases as well as for mapping of natural resources and various indicators for analyzing natural disasters.

3.3 Web and mobile applications

To optimize the use of spatial data acquired with our satellite system or other data sources (partner satellites, governmental data, etc.) we have built a distribution system based on web and mobile applications. The system is based on Geopedia, a cloud-based web GIS viewing and editing solution.

SPACE-SI has developed also a mobile application called Moč množic (the power of the masses) for data crowdsourcing with the help of general public. This mobile application allows any smart phone user to report data on unusual events, especially in the case of natural disasters. The web application allows users to enter the necessary data (which vary according to the type of the event) in real time and on the spot. All data is collected on a shared server where they are analyzed with the assistance of the operator and the final product is produced (e.g. identification of areas with hail, flooded areas, etc.).

Applications enable support in responding to the societal challenges, such as:

- adaptation to climate change,
- management of renewable energy sources,
- improve food self-sufficiency, and
- protection against natural disasters.

Current applications based on the spectral analysis of high resolution satellite images for the user cases related to smart cities and communities are:

- change detection in urban areas,
- determination of heat islands in cities,
- insolation modeling,

- continuous drought mapping and early warning,
- natural disasters mapping (e.g. floods, landslides, fires),
- mapping of agricultural areas (crop state, prediction, needs),
- invasive plants mapping (e.g. Japanese knotweed),
- detection of plant diseases,
- advanced maritime surveillance, and
- crowd sourcing – Earth observation, modeling, mobile data input and output.

4. SUGGESTIONS FOR JOINT PROJECT PROPOSALS

SPACE-SI can support the proposed joint projects with up-to-date satellite images in high spatial, spectral and temporal resolution. Our satellite will offer in addition to still high resolution images also the real time interactive high resolution HD video of the area of interest. All satellite images are processed for sensor, geometric, atmospheric and topographic correction and therefore ready to be used by the end users. There are enormous amounts of satellite data generated every day. Our expertise is to enable their near-real-time processing and to derive from them the needed information. Geolocated information is crucial for well-organized smart cities and communities.

We can offer a series of web and mobile applications (see chapter 3.3) to support the sustainable and green development of the cities and a GIS-based decision making support tool.

Mobile application Moč množic for the crowdsourcing of the data with the help of general public originally developed to observe the natural disasters can be adapted to any smart case study where the crowdsourcing is relevant enhancing the quality of life and human well-being within the smart city or community.

5. CONCLUSION

Earth observation data and the applications based on it offer a powerful tool for smart city planners and for citizens. They give accurate information on what and where is going on in near real time. Satellite images provide a comprehensive view of the subject matter for the whole area at the same time. Real time monitoring eliminates the need for regular inspections and therefore reducing costs. Costs are not only saved in the collection of data but also in the analysis of the satellite images as compared to other methods.

Advanced applications are combining Earth observation data with in-situ data and/or with crowdsourced data gathered by the general public users with their smart phones.

These data and applications have a huge potential to help design more sustainable and smart cities and communities. SPACE-SI can offer smart solutions for smart cities.

6. ACKNOWLEDGMENTS

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Virtual Power Plant for optimization of Microgrid operation

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POVZETEK

V prispevku opisujemo tehnični in poslovni vidik virtualne elektrarne na podlagi upravljanja odjema za optimizacijo delovanja mirkomreže. V uvodu je razložen pravni vidik harmoniziranega električnega trga v Evropi. Predstavljeni so ključni igralci elektro-energetskega trga in njihove vloge.

ABSTRACT

In this contribution we describe technical and business case for demand side based virtual power plant for optimization of Microgrid operation. The legal aspect of European harmonized electrical market is described in the introduction section. We describe key players and roles on electrical market.

1. INTRODUCTION / UVOD

The increasing share of renewable energy sources and dispersed energy production are placing new challenges for maintaining the stability of the electrical grid. In pursuing this goal, demand side management (DSM), combined with energy storage, is progressively gaining in importance as one of the measures that acts both locally and on the system level. In order to benefit optimally from DSM, both market and technology drivers have to take full effect; - structuring of the vertically integrated electrical power system has to be carried out in practice, and the concept of electricity trading has to be introduced on the prosumer level to generate strong incentive for demand response.

In such a system, the DSM can be used both to reduce the energy disbalance in the Balance Group by the Balance responsible party (BRP) and as part of the ancillary services such as system reserves of the System operator (SO) to maintain the stability of the grid, with the reserves being "negative", i.e. on the demand side; similar approach can be used also for other ancillary services for SO, in particular congestion management of local Distribution network. These two objectives largely define the target business cases: supply tertiary reserves to SO; optimize operation of the Balance group or its part for its BRP or scaled down equivalent. One subset of the latter is a micro-grid based on DSM.

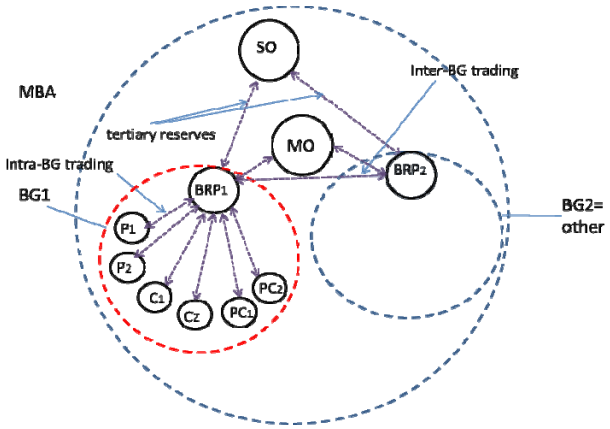
The structuring of the system and the roles of the players are in accordance with the structure of the system, roles and processes in harmonized electricity market model in Europe, joint model by ENTSO-E, EFET and EbIX, which is the common basis and lighthouse for all the evolving national models in Europe. [1],[4]

With inclusion of intra-BG automatic trading, the different trading processes and the roles (players) involved in the bottom two levels of the decomposed electricity market in the Harmonized Electricity Market model in Europe are sketched in Fig.1.

2. DSM enabling technologies

2.1 Automatic trading with prosumers in the Balance group

Because of the large number of prosumers in the Balance group, the energy trading with them has to be carried out automatically using appropriate algorithms.



Legend:
P,i … Producer
C,i … Consumer
PC,i … Prosumer
MO …Market Operator

Figure 1. Intra-BG trading of BRP with parties connected to the grid as part of the MBA trading

This concept places the prosumer into an active role and stimulates its proactive behavior – with stimulating the internal measures for augmenting its demand response.

The prerequisite of the concept of trading is introduction of WIN-WIN business model into relationships of involved players, in particular between the BRP and the party connected to the grid. Such a model has already been developed in implemented in 2010 by a Slovenian SME, and successfully demonstrated in 2011 in a pilot demonstration project [2].

The evolution of this model and solution involves a radical novel approach for active demand (and supply) side management in which electricity consumers and producers issue explicit so-called flex-offers indicating their available flexibilities in time and electricity amount. The concept puts the prosumer into an active position and enables its pro-active behavior – stimulating internal measures to augment the demand response [3].

2.2 Augmented Demand response of prosumers

Based on price incentive, the size of demand response in prosumers can be augmented using advanced Demand Response Management (DRM) in prosumers, a set of technologies and methodologies which influence the demand response based on cost-benefit algorithms. To enable net economic benefit, the consumption scheduling at prosumer is based on concept of energy reservoirs in ambient and production processes coupled with internal energy production. Such technology adapts the size of DR to the cost-effect consideration taking into account collateral cost incurred by prosumer for peak demand reduction. The external variable is cost of energy (purchased or sold).

3. MICROGRID

3.1 General description

Project will be carried out in the frame of suitable locations with variable available prosumers and producers of EE, including with RES systems, business and industrial prosumers, public and residential buildings and including a network system of electrical vehicle charging stations.

Two sub-cases are planned: micro-grid system is connected to the electrical grid (basic case), and isolated operation of the micro-grid system (auxiliary scenario).

The project location will be on the geographical territory of the DSO distribution company where the selected local community is situated. The Micro-grid responsible (MGR) will be the designated leading BC carrier.

3.2 Business case

The business case is defined by the following boundary conditions:

- DSM vs open contracts
- DSM vs RES losses
- SO penalties (scale down of BRP use case)

Business case will grow with RES share.

Identified non-industrial or end-user partners: DSO, MGR (Microgrid Responsible)

3.3 Players - roles, processes and relations

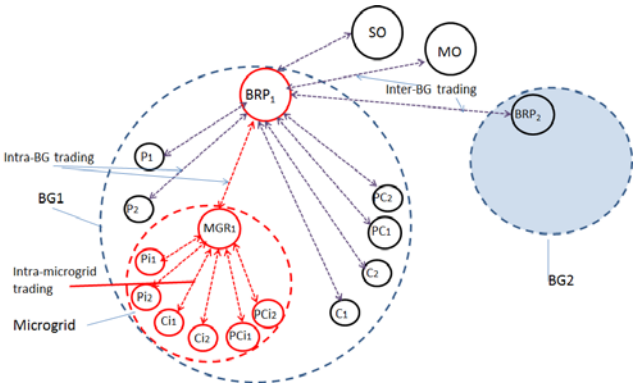


Figure 2. Players - roles, processes and relations

4. INTELLIGENT TRADING INTERFACE

Intelligent trading interface (ITI) represents a structured interfacing system for exchange of data for communication in automatic energy trading between prosumer's DRM system and the aggregating subsystem of a BRP, MGR or aggregating service. It is connected with Smart meter with both open and closed contract metering functionality for RES and other energy sources. On the trading side, it will be implemented for KIBERnet FLEX automatic trading technology and on the DRM side for KIBERnet DRM and for Smart Grid DRM systems, but its structured concept will allow to use it as a kernel system for other methodologies of dynamic pricing by automatic energy trading with standardized exchange of data between stakeholders in the process of production, transfer, consumption and trading of energy.

Virtual Power Plant consists of several elements, as depicted in Figure 3. Main building blocks are: Control Centre, Intelligent Trading Interface and Energy Management System. Intelligent Trading Interface (ITI) is a core solution that enables existing prosumers to become a part of Demand Side Management program and take advantage of his/hers flexibility in electrical energy consumption and production. ITI is an IoT device installed on top of existing EMS at prosumer and acts as an interface between VPP and prosumer.

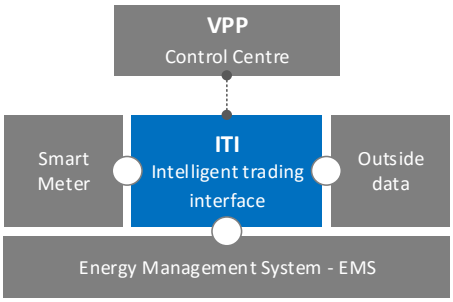


Figure 3. Virtual Power Plant architecture

5. PROSUMER – THE DRIVING FORCE FOR DSM IN SMART GRIDS

The interdependence and relations between DSM and EMS in the Comprehensive Smart Community can be described by the following statements:

- The case of DSM is built on DR of prosumers.
- In the concept of vertically nested systems, prosumer is the lowest level – and potentially the most complex one.
- The business case of EMS depends largely on DSM.
- The use case of DSM depends largely on EMS.
- The DSM cases are all also EMS cases.

The function of internal EMS of the prosumer is to manage the processes of consumption, production and storing of energy, with two main objectives:

- Provide reliable and secure operation of these processes, especially energy supply

- Optimize operation of these processes, to increase their economic effectiveness by reducing the costs and increasing the revenue

The controlling concomitant and driver is increasing share of energy production at the prosumer by inflexible renewable energy sources.

Micro-grid case is »local community or city centric«, implying an active strategy and role played by local authority directly or through ESCO models; the intent is to deploy the system to a dominant part or to a large part of community prosumers. Thus, it is the basic case for increasing local energy supply and balancing, the backbone of the second pillar of growth of RES - dispersed energy production.

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Integration and Interoperability of Services and Devices for Smart Cities

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POVZETEK
Pametna mesta zahtevajo popolno integracijo in interoperabilnost interneta storitev (IoS) in interneta stvari (IoT). Ta gradijo na trenutnih zmožnostih povezovanja in omogočajo razvoj sistemov prihodnosti. Laboratorij za integracijo infomacijskih sistemov razvija pomemben del predlagane IoS/IoT arhitekture pametnih mest z izgradnjo platforme, ki omogoča integracijo in interoperabilnost med fizičnimi napravami, senzorji in oblačnimi storitvami, ki porabljajo podatke za pridobitev višje nivojskega znanja.

ABSTRACT
Smart cities require seamless integration and interoperability of Internet of Services (IoS) and Internet of Things (IoT), which is the enabler for developing future systems build upon current connectivity possibilities. Laboratory for Integration of Information Systems is developing an important part of the proposed IoS/IoT Smart City architecture by building integration platform that enables integration and interoperability between physical devices, sensors and cloud based services that consume gathered data to obtain higher level knowledge from it.

1. INTRODUCTION
Ideas about smart cities of the future predict that billions of IoT devices will communicate and interact in order to bring better experience of living to its inhabitants. Nowadays many questions about connectivity of the devices have been solved, jet we have not seen breakthrough of IoT. Many of the devices sold on the market have connectivity options but devices lack in communication and interaction process. Missing link that will fill the gap between connection- enabled-devices and IoT is integration platform. Unified integration platform will enable data providers to serve data to data consumers; applications in the cloud will be able to consume data obtained through integration platform.

2. IMPORTANCE OF INTEGRATION IN SMART CITIES
In the past years we observed rise of the products that have connectivity options build into and have documented application programming interfaces. Product developers expose these interfaces to enable end-users to leverage product capabilities through the internet. Unfortunately end-users usually lack in knowledge to use products and their services to their full potential. With the rise of mobile technologies companies are solving this issue by developing mobile applications to aid the users. This brought us to present when everywhere around us are smart products that can communicate with specific (mostly mobile) applications. We believe that the potential of smart services and devices can be improved with seamless integration and interoperability.

Implementation of such systems in smart city paradigm might not be around corner just yet but the need for such integration platform is already present in enterprise systems [1]. For example we all know city transportation systems have busses equipped with tracking devices so they can monitor the system and predict the arrivals of the busses to the stations. Similarly, there are many businesses that would benefit from information about congested roads. Taxi drivers, delivery services and even emergency services would all benefit from such information. Architecture of smart cities have to provide functionalities concerning the integration of business process management systems with the IoT infrastructures [2].

3. INTEGRATION PLATFORM
Our integration platform enables easy integration of the data providers and data consumers within and beyond smart city limits. Our integration platform enables cloud based applications to consume data offered by data providers. Applications then model, fuse and integrate data to produce higher level information from it.

Example application is one developed by our team that takes raw data from accelerometers of mobile device and uses this data to identify person holding the device while walking. This system can be used for user authentication in future smart cities. This is just a sample application that demonstrates how we can use integration platform to integrate IoT devices, IoS services and cloud based application for user authentication. Integration platform has benefits for application provider and consumer. Application provider can offer its services to the public while integration platform provide security and monetization options to the developers, platform also allows developer to publish standard interfaces to interact with the application. To application consumer (e.g. company implementing such authentication feature) integration platform is the key for implementing authentication service while it can provide unifying access and control.

Integration platform (see Figure 1) enables data providers a set of standardized possibilities to interact with IoT devices, services and databases. Interfaces exposed to providers must support many protocols to enable integration to wide range of devices because there is no standard protocol defined for the IoT. Communication protocols can vary between any standard protocols like query based REST that is built on top of HTTP

to different streaming oriented protocols. IoT oriented protocols like MQTT and AMQP can be supported too [3]. Out integration platform than applies data to connected components, services and cloud hosted applications. Integration platform outputs fused data and higher level information that can be stored, used by other services and devices publically or shared privately with specified data consumers.

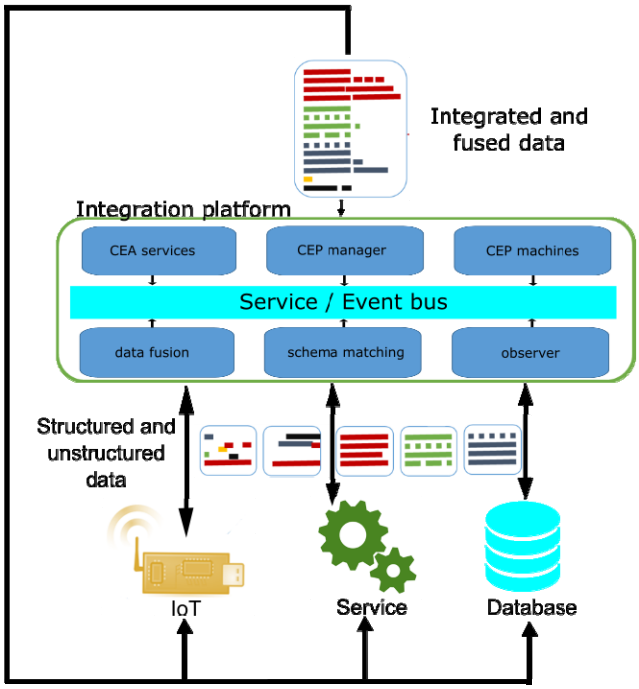

Figure 1. Architecture for integration platform.

Another possibility for cloud based applications for smart city are applications that will work on top of integration platform and will enable easier and unified access to the data for others to consume. We are working on improving schema matching algorithms that enable automatic matching of the data.

We are also working on cloud based services that provide localization information to the service consumers. Smart city can benefit greatly if its applications can determine position of the IoT devices and people. There are countless possibilities for cloud based applications that can be build on top of data provided by integration platform; platform will gave developers standard and unified access to the data from IoT devices, databases and other services.

4. CONCLUSION

Smart devices currently on the market are big step forward from devices in the past. They enable us to control them from mobile phones and other devices but they hide even greater potential, which will be unveiled when devices wills communicate between each other and exchange information. To enable exchange of information integration platform must be developed that will be secure, easy to use and allow number of protocols for communication.

Our platform is developed with smart cities in mind. It offers multiple interfaces for data providers to offer gathered data through the platform and use cloud based applications that developers publish. It enables developers unified data sources for their applications to consume and standardized way of publishing results while providing security and monetization options.

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MyWay 1.0

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POVZETEK

MyWay je cloud platforma, namenjena zbiranju podatkov o času, lokaciji in dogodku. Triger za zapis teh treh podatkov je vstop osebe z mobilnim telefonom v določeno območje – cono. Tipično se zadeva uporablja na mestnih površinah, notranjih prostorih ali kjerkoli se nahaja BLE žolna. Sistem se lahko uporablja za povečanje učinkovitosti in agilnosti terenskega dela. Uporabljajo ga tako vodje kot končni uporabniki. Njegova uporaba ni omejena le na delovna okolja, ampak se lahko uporabi tudi za druge namene, recimo kot platforma za turistične informacije.

ABSTRACT

MyWay is a general cloud platform service aimed at data collection of time, locations and events. Trigger for this data collection is when person enter or exit zone with mobile phone. Typically it is use in urban environment or in-house where BT4.0 beacons are present. Application on this platform boosts agility and efficiency. It can be used by managers and end-users (employees and free-lancers). Moreover, its usage can be extended outside the working environment, for example, as a platform for tourist information.

1. INTRODUCTION

Time and space has become one of the greatest and most precious commodities in the rushing and fast-moving environment of today's life. Business is getting more and more demanding. Many times we hear each other say "If I only had more time and more space," or "I'm running out of time and space!" Time is precious, and therefore it is very important to manage it efficiently.

Time and space management has a very clear business case. Time management is needed by virtually anyone doing more than one task a day and any organization employing more than one person. Bigger the organization, higher the cumulative benefit of time management. If the government is involved, they want it. If unions are involved, they require it. If the business owners are involved, they know the benefits. If it is a large organization, there is almost no way to bypass it.

The workforce of the 21st century is getting increasingly mobile. Advanced technologies (Internet, wireless communications), prompted by globalization, have allowed the workforce to become truly mobile. In today's business climate, companies have become more geographically and culturally widespread, and frequently work across time, space, and organizational boundaries. The nature of teams has also changed significantly. Teams are now commonly made up of on-site employees as well as consultants, vendors and others working in a variety of geographical locations: in offices, on the road, from home, at client sites, and even on the other side of the globe. The number of people working every single day of the working week in the same office is almost zero. Nowadays we are facing a mobile workforce, performing multiple tasks for multiple employers in multiple places. Time and space management is therefore crucial and has a clear tendency to grow even more important.

2. APPLICATION

MyWay is a new service platform for business and personal time and space management that is based on BLE (BT4.0) technology. Built on the solid ground of more than 30 years of Spica experience in time management and access control market, MyWay provides full service for mobile people, enabling smooth and efficient automatic collection, management, tracking and reporting of time and space events. Web-based technology combined with wireless communications and fresh mobile tech. make MyWay service available anytime and anywhere, enabling workers to be truly mobile. It is also very useful for tourists, as they will get fully all the desired information about the places of interest in a particular area.

By using MyWay service platform, one can easily clock the time spent on various activities, tasks, projects and clients or places. The interactivity of the service allows the users to select options on the spot. Pre-defined parameters like clients, projects and tasks (which are usually covered by agreements and have defined attributes) make the usage of MyWay even simpler. However, users have the ability to add tasks, projects and clients on the go and thus increase their mobility. Default linking of activities with physical places can even speed up the clocking process, enabling seamless integration of devices and services – "Click&Go".

3. REAL USERS

The mobile workers (free-lance consultants, instructors, revisers, project managers, salesmen, technicians, maintenance, physical workers, even tourists in city, you name it) use a BT4.0 enabled mobile phone for identification, information collection and transmission. All three ways of usage are based on the BLE (Beacon) concept. When mobile workers visit a particular BLE beacon zone, mobile device will alerted and start or complete different activities. The intelligent part of the system automatically detects the entrance or exit of the zone and start an app. Other options may also be chosen as they usually affect results, based on business logic. Besides time management, there is a whole range of services available to the mobile worker while registering at access or exit of zone. For instance, while finishing a delivery of goods / services to a certain point of activity (check-out), a mobile worker could be given instructions to approach new point of activity (considering path optimization of multiple mobile workers).

4. KEY BENEFITS

The benefits of MyWay go into many directions, since there are many groups that benefit from MyWay. Let's examine the end-users first, previously referred to as mobile workers. MyWay assures a universal time tracking service that allows mobile workers to efficiently and precisely track the time they spent on tasks performed for a specific client/project. Freelancers, outsourced workforce and others can easily integrate the billing of services, and do it right away, when the service is done. If additional information needs to be entered at the point of activity, it can be done via a mobile phone. Identifying the zone upon arrival / departure provides physical evidence that the worker was present and that they spent a certain amount of time at the point of activity. The traditional clocking application was office-oriented, while the new concept MyWay enables a mobile, user-oriented approach to personal and business time management.

The second group that benefits from MyWay service are the managers who hire mobile workers. MyWay allows effective job-costing with detailed and automatic reporting. All information is available in real time on the web, which allows managers to have a reliable overview of the current situation at any time. The best thing is that all this information is available with no additional infrastructure or specialized hardware (unlike traditional clocking systems). And hardware and infrastructure are always associated with high costs. In this way, time management is not only integrated into the existing environment, but it becomes a standard and effective service that is always available.

5. TEHNICAL SOLUTION

The technical solution MyWay consists of BT4.0 enabled devices (mobile phones), mobile network, BLE tags - Beacons and a web application (myHours.com/MyWay.com). Due to BT4.0 technology and mobile phone interactivity, part of MyHours functionality can be transferred to the mobile phone and thus provide on-line and on-site service for the end-user. All mobile workers have their own BLE-enabled mobile phones, which provide unique identification. All the facilities where mobile workers work are equipped with BLE tags. When the worker approaches the premises, time is registered by entering the zone with the mobile phone. Sometimes the work is not performed on the premises, but in open spaces or just anywhere, where a meeting can be held. MyWay supports also this type of situation, since tags are not costly and new places can be easily marked (e.g. construction sites). Check-in time can be started also by clicking a BLE phone (e.g. meeting a person). The business logic behind MyWay may use myHorus.com platform to interpret the meaning of the clocking (arrival, departure), but other options can be chosen by the mobile user as well (education, sick leave, and next task, work at home…). There is a specialized APP running on the mobile phone that retrieves data from the central server and handles the communication with the end-user.

A very important component of the system is also the Cloud application that provides administration and reporting services to end-users and company-level users. User level defines administration rights. Each end-user can review and compare reports of his data, prepare standard data format exports (e.g. ERP) and integrate collected data with other services (e.g. billing). Graphical presentation helps users to easily compare time consumed for specific clients / projects / tasks. Company-level users benefit even more from the reporting tool, since they have a real-time overview of the situation available all the time. Company-level users can check time consumption per client or project, drilling down until the task level. The variety of time reporting views available provides the company with a deep insight into the project and resource time management. What is of the crucial importance is the fact that the collected data is transparent, since both mobile workers and company-level users can access them anytime.

6. PROCESS DESCRIPTION

MyWay is a general platform service that may be used in different vertical markets. We believe that practical examples can describe and demonstrate the process the best, therefore we present three application areas of MyWay.

6.1 Mobile elderly care service

The proportion of the population classified as elderly is increasing and will be around 30% by the year 2025 (Europe). As the number of beds in old people's homes does not meet the increasing demand, any people are being assisted and serviced by mobile professionals at home (doctors, nurses, social workers, kitchen-maids, cleaners…). These mobile workers can easily record their working (travelling) time by clicking the BLE tags near the door-ring or simply by clicking the BLE-enabled mobile phone of the assisted person. A special mobile client allows the mobile worker to enter more information about the assisted person (body temperature, health conditions…). When the mobile worker finishes the visit, he/she performs a check-out on the BLE tag. In future development we plan to automatically perform checks for new messages at check-out (where to go next, additional tasks …).

6.2 Mobile operators field force service

The main task of mobile operator's field force service is to perform regular / ad-hoc checks and repairs of the base stations and repeaters in the mobile network. As they are all equipped with the mobile phone, they can check-in and check-out by clicking the BLE tag on the base station / repeater. The mobile worker can perform various tasks on the base stations and clock the time of each task with the mobile phone. When he checks-out (finishes the work), all the data are transferred to the central server (in case there would be no connection inside the facilities).

6.3 Freelancer @ work

Freelancers may work for many clients at the same time, doing different projects and performing various tasks. With MyWay, a freelancer can easily track time for each client individually and sort out work project-by-project. Clocking tasks times becomes important where tasks have different value per time unit. MyWay assures an imperceptible time management environment. Tracking time becomes as natural as breathing just by Clicking BLE tags and BLE phones.

7. BUSINESS POTENTIAL

MyWay has a clear business potential. It has a vast target market as virtually anybody can benefit from using MyWay services. It improves the traditional processes enabling more interactivity, real-time time management and support for truly mobile

workforce. Using the BLE technology and mobile network for data communication, MyWay reduces costs of time attendance systems by lowering the costs of the hardware and infrastructure. Benefits for all stake-holders assure that MyWay has a bright future.

8. TARGET MARKETS

The target market of MyWay can be grouped into two user groups: end-user (mobile workforce, personal usage) or company-level user. Mobile workers want it to ease time management and allow truly mobile work. Company-level users need it to effectively perform time tracking and job costing while lowering the costs in traditional time/attendance systems that are tied to physical presence and facility location. As mobile workforce is getting more and more mobile and most of the organizations have at least one organizational unit working in the field, there are a lot of potential users on the market:

- Project managers;
- Consultants;
- Trainers and instructors;
- Field service force;
- Field maintenance force;
- Field sales representatives;
- Merchandisers;
- Revisers and lawyers;
- City visitors.

9. CREATIVITY & INNOVATIVENNESS

MyWay presents the case where proven solutions meet emerging technologies in a new niche service that bring many advantages. The new time management service increases the usability and lowers the costs of the traditional time management process. MyWay is innovative by definition as it brings a valuable service where traditionally there was no service at all. Everybody benefits from MyWay. Unlike other well-known application areas of BLE technology (like ticketing and cashless payments), MyWay covers a completely new market and segment. Seamless integration with legacy and traditional systems for time attendance and access control allow MyWay to be quickly accepted and effortlessly distributed among potential users. MyWay assures a low risk and high gain approach towards popularizing BLE technology in general public.

10. PROCESS IMPROVEMENTS

There are several process improvements using MyWay:

- Real-time data availability.
- Truly mobile time management solution available everywhere, anytime.
- Measurement efficiency of mobile workforce.
- Measurement productivity of mobile workforce.
- My Way as '*e-signature*' and confirmation of work done or physical presence.
- Better costs control.
- Seamless integration with other systems (billing, reporting, ERP integration…).
- Better time and "journey/route" planning of mobile workforce.
- Better time segmentation for further analysis.

11. IMPROVEMENTS OF SERVICE

MyWay enters in a segment where traditionally there was no service at all, enabling time management for a truly mobile workforce. Using MyWay, all services can be managed better (time consumption, costs, planning, and optimization). Better managing of services allows also better service quality.

12. COST SAVINGS

An important part of MyWay improvement that cannot be neglected is cost savings. By moving time management and attendance to a service, companies could save costs of traditional hardware and software (purchase & maintenance). The real cost savings go to trustful and precise time tracking for all resources working in an organization. Efficient time tracking and management helps managers to get rid of the overhead work costs and brings transparency to the business.

13. FUTURE IDEAS

MyWay has grown from existing and proven solutions (myHours.com) and emerging technologies NFC, BT4.0. However, we foresee many more features and application areas that will allow MyWay to become a widely spread platform for time and space management. Just to mention a few ideas to be implemented soon:

- City visitors.
- Integration with access control systems (access rights)
- "who's been here" function - supervisors view history of registered events from a tag.
- "Who's here" function - current overview of the presence in a workplace.
- "Where am I" function – display info about location.
- CRM functions.
- Integration with Google maps ("how to get there" function).

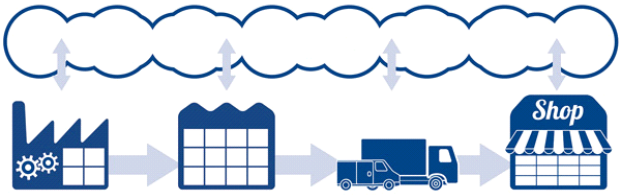

Figure 1. MyWay 1.0 F2F (from factory to fork).

14. REFERENCES

Špica has developed a fruitful cooperation with technologically-oriented companies and R&D institutions (Josef Stefan Institute, University of Ljubljana, The Faculty of Electrical Engineering and Faculty of Computer and Information Science). We are active members of:

- Technological network: Process Management Technology.
- The Center of Excellence: Process Management Technology.

- Technological network: Information and Communication technologies.
- E-mobility technological platforms.

Together with Jozef Stefan Institute, we have submitted one patent application (SiPO) and we are in the process of preparing European Patent Application (EPO). In 2007, we were recognized by the Slovenian Innovation Forum as one of the 10 top innovative companies in Slovenia while our MobileTime solution was selected into the top 30 innovative ideas.

Intellectual property is an integral part of our R&D innovations and results, its value being marketed as a software license or calculated into the hardware price. In the last five years, we have sold over thousand licenses for our in-house developed software, the total value of the business reaching about 3 mio EUR. Thousands of our own hardware items in a total value of 5 mio EUR have been purchased all over the world. These numbers are undisputable proof of our marketing and disseminating abilities.

In cooperation with our technological partners, we have carried out a series of referential R&D projects, co-financed from different sources:

- RR project promoter; E-content , MVZT 2009-2010 (UVID – Universal Interface for Intelligent Home) in cooperation with Jozef Stefan Institute, Iskratel and Amebis
- Project promoters CRP MORS ZVM 2007-2010 (M3-0233 Commander's Right Arm) in cooperation with Jozef Stefan Institute and Faculty for Electronical Engineering
- Project promoters CRP MORS ZVM 2006-2010 (M2-0156 Comprehensive Intelligent Security Biometrics System)) in cooperation with Jozef Stefan Institute and Faculty for Electrical Engineering
- Cooperation in CO1-/in project »The Center of Excellence for Modern Management Technologies« (IJS, Špica, Robotina)
- Cooperation on RR project Ak3-1/RR6 »The concept of logistics process support including mobile computing technology and setting up the automatic identification technology tracing (Špica, IJS, S&T Hermes Plus).
- Cooperation on RR demonstration project Ak3-1/DP6 »Development and implementation mobile computing technology support system for logistics processes and setting up tracing).

Optični senzorji za pametne sisteme / Optical Sensors for Smart Systems

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POVZETEK

Naš prispevek k projektu "Pametna mesta in skupnosti kot razvojna priložnost Slovenije" temelji na aplikacijah senzorskih sistemih, ki so danes pravzaprav nepogrešljivi na različnih področjih našega življenja – kontrola onesnaževanja voda, zraka, biotehnologija, obramba, analiza vode, medicina, kontrola kvalitete hrane, itd. Sem se vključujejo tudi optični senzorji, ki lahko temeljijo na različnih optičnih principih (absorpcija, fluorescenca, refleksija, itd.), omogočajo pa izvedbo meritev na licu mesta in kontinuirano, enostavno se miniaturizirajo, niso občutljivi na interference električnega in magnetnega polja ter omogočajo varnost pri delu z vnetljivimi in eksplozivnimi snovmi. V prispevku je nakazana vizija in možnosti uporabe optičnih senzorjev v okviru omenjenega projekta.

ABSTRACT

Our contribution to the project "Smart cities and communities as a development opportunity for Slovenia" is based on sensor systems, which are nowadays indispensable in various areas of our lives – control of water pollution, air, biotechnology, defense, water analysis, medicine, food quality control, etc. There may be included the optical sensors, which can be based on different principles (absorption, fluorescence, reflection, etc.); they enable on-line, in-situ measurements, can be easily miniaturized, they are not sensitive to interferences of electric and magnetic fields and offer safety when working with flammable and explosive materials. The article highlights some perspectives of applications of such sensors within the framework of the project.

1. O NAS

IOS, Inštitut za okoljevarstvo in senzorje , d.o.o. je raziskovalno razvojna organizacija, ustanovljena 2006. Ukvarjamo se z izvajanjem meritev, raziskav, izobraževanjem, podajanjem znanstvenih in strokovnih mnenj ter implementiranjem tehnoloških aplikacij na področju senzorjev, novih materialov, čiščenja komunalnih, tehnoloških in industrijskih odpadnih voda, okoljevarstva in obnovljivih virov energije.

Na področju senzorjev razvijamo nove senzorske receptorje s poudarkom na optičnem zaznavanju različnih tipov analitov v različnih medijih (zrak, voda). Glede na senzorski receptor pripravimo celoten senzorski sistem (merilni prototip), ki vključuje tudi vir vzbujanja, pretvornik in detektor. Prav tako izvajamo fazo testiranja na modelnih in realnih vzorcih s končnim ciljem implementacije izdelka za končno uporabo v industrijskih in drugih aplikacijah.

Na področju okoljevarstva znanstveno in strokovno povezujemo znanja iz ekologije in varovanja okolja s poudarkom na problematiki voda. Izvajamo okoljske meritve in analitiko, pilotne preskuse čiščenja voda in razvijamo nove metode za določanje ekoloških in procesnih parametrov. Razpolagamo s pilotnimi napravami za anaerobno čiščenje odpadnih voda, membransko filtracijo (ultra, nano in reverzno osmozo), uvajanje plina v vodo, termo-kemijski razklop in oksidativne kemijske procese (ozoniranje, $H_2O_2\backslash O_3$, $TiO_2\backslash O_3$, $H_2O_2\backslash UV$ in UZ) za obdelavo odpadnih, komunalnih, industrijskih, kopalnih in pitnih voda. Izvajamo preliminarne študije na realnih vodah, ki so osnova za pripravo elaboratov, tehničnih ali zaključnih poročil raziskav. Svetujemo na področju čiščenja in analitike voda. Uvajamo preizkušene in nove postopke čiščenja odpadnih voda in novih merilnih metod, senzorjev, instrumentov.

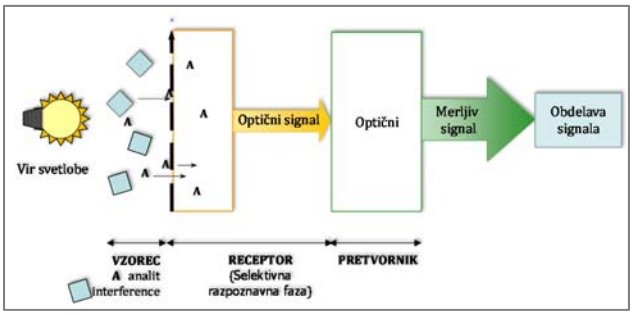
Razvijamo nove nanomateriale in nanotehnologije, ki so usmerjene v razvoj in študij tehnološko zanimivih anorganskih (kovinskih in nekovinskih) oksidnih materialov s posebnimi fizikalnimi lastnostmi, ki izhajajo iz strukturnih in kemijskih pojavov na nanostrukturnem in atomarnem nivoju, ter vključujejo preiskave in analize kristalne strukture, fazne in kemijske sestave, morfologije in mikrostrukturnih lastnosti keramičnih materialov. Cilj teh raziskav je predvsem izboljšanje lastnosti materialov, ki omogočajo razvoj sodobnih aplikacij, miniaturizacijo obstoječih sistemov, boljše izkoristke pri konvertiranju energije in razvoj okolju prijaznih tehnologij. Ponujamo tehnološko zanimive materiale, kot so:

- magnetni nanomateriali, magnetne tekočine in
- koloidni sistemi,
- polprevodniški in keramični materiali na osnovi
- ZnO, Al_2O_3, SiO_2, TiO_2, ZrO_2, quantum-dots,
- nanokompozitni in večfunkcionalni materiali s
- katalitskimi lastnostmi,
- organsko-anorganski hibridni materiali s
- prilagojenimi površinskimi lastnostmi,
- specialni materiali za visokotemperaturne
- senzorske sisteme,
- materiali za antibakterijsko zaščito.

2. KARAKTERISTIKE OPTIČNIH SENZORJEV

Pri optičnih senzorjih se za generiranje analiznega signala uporablja elektromagnetno (EM) valovanje. Interakcijo valovanja z vzorcem ocenimo iz spremembe optičnega parametra, kar lahko povežemo s koncentracijo analita. Navadno, optični kemijski senzor sestavlja kemijsko razpoznavna faza (zaznavni element ali receptor) povezana s pretvornim elementom (Slika 1). Receptor je tisti, ki identificira parameter (npr. koncentracijo dane komponente, pH itd.) in nadalje poskrbi za tvorbo optičnega signala, ki je proporcionalen velikosti oz. jakosti tega parametra. Funkcijo receptorja v večini primerov opravi tanka plast oz. film, ki lahko reagira z molekulami analita, katalizira selektivne reakcije ali pa sodeluje pri kemijskem ravnotežju skupaj z analitom. Pretvornik je tisti, ki pretvori optični signal proizveden na receptorju v merljiv signal (npr. napetost, tok), ki ga lahko nadalje procesiramo [1].

Optični senzorji lahko temeljijo na različnih optičnih principih (absorbanca, refleksija, luminescenca, fluorescenca) pri čemer zavzemajo različna področja elektromagnetnega spektra (UV, vidni del spektra, IR) in omogočajo meritve ne samo intenzitete svetlobe, ampak tudi drugih optičnih lastnosti (življenjska doba luminescence, lomni količnik, sipanje svetlobe, difrakcija in polarizacija).



Slika 1: Shematski prikaz zgradbe in funkcije optičnega kemijskega senzorja

Priprava ustreznega senzorja je odvisna od različnih dejavnikov, predvsem pa od izbire primernega indikatorja, polimerov in tehnik imobilizacije pri razvoju senzorske membrane. Sistem optične zaznave sicer lahko temelji na neposredni zaznavi analita, če ima le-ta lastne optične lastnosti, običajno pa so te lastnosti slabe in premalo selektivne. Zato pri razvoju senzorske membrane običajno uporabimo indikatorsko barvilo, ki z analitom reagira in posledično spremeni svoje optične lastnosti.

Senzorske karakteristike se lahko spreminjajo ne samo z izbiro ustreznega indikatorja, polimera in imobilizacijske tehnike, ampak tudi z zmanjšanjem dimenzij na nanovelikost (< 100 nm – na primer s pripravo na analit občutljivih nanodelcev) [2]. Nanomateriali pogostokrat razkrivajo nove kemijske in fizikalne lastnosti, kar vodi do njihovih novih lastnosti; predvsem pride do spremembe v razmerju površina-volumen.

Razvoj nanomaterialov za optične kemijske senzorske aplikacije je v zadnjih preteklih desetletjih precej napredoval. Nanomateriali tako kažejo precej prilagodljive kemijske in fizikalne lastnosti z vidika spremembe njihove velikosti in oblike, kažejo edinstvene površinske kemijske lastnosti, termične in električne lastnosti, visoko specifično površino in veliko volumsko poroznost na enoto mase. Zaradi njihovih edinstvenih in prednostnih lastnosti omogočajo boljšo občutljivost, odzivni čas in nižjo detekcijsko mejo senzorjev. Primerni so tudi za in-vivo meritve.

3. VKLJUČEVANJE V RAZVOJNE STRATEGIJE PROJEKTA

Koncept pametnih mest temelji na povezovanju ekonomskega in socialnega kapitala pri razvoju storitev in infrastrukture na podlagi (IKT) tehnologij, informacij in politične vizije s ciljem izboljšati kakovost izvajanja urbanih storitev, zmanjševanja stroškov in rabe virov ter aktivnega vključevanja uporabnikov – prebivalcev mesta. Izvajanje strategije pametnega mesta se v praksi odraža na različnih področjih upravljanje mesta, transport, prometna ureditev, okoljski vplivi, mobilnost, energija, osebna varnost in zaščita, skrb za zdravje,…

Stavbe pod vplivom zakonitosti moderne arhitekture in tehnološkega napredka predstavljajo danes kompleksen niz raznih struktur, sistemov in tehnologij. Tehnološki napredek je prinesel visoko stopnjo kakovosti notranjih komponent stavb, kar uporabnikom omogoča zelo neodvisen izbor osvetlitve, varovanja, ogrevalnih, prezračevalnih in klimatskih naprav. Danes ni več dovolj, da so v stavbe samo vgrajeni sistemi, ki zagotavljajo udobje, svetlobo in varnost, ampak mora zgradba prihodnosti povezovati različne komponente na integriran, dinamičen in funkcionalen način. Vizija prihodnosti je stavba, ki neopazno izpolnjuje svoje naloge in zagotavlja visoko kakovost bivanja ob čim manjših stroških energije in ima hkrati čim manjši vpliv na okolje. Pametna stavba omogoča uporabnikom kakovost bivanja (npr. osvetljenost, toplotno udobje, kakovost zraka, fizično varovanje, sanitarije in še veliko več) po najnižji ceni in minimalnih okoljskih vplivih glede na življenjski cikel objekta.

Senzorski sistemi imajo potencial, da predstavljajo povezovalni člen med različnimi sistemi tako na ravni pametnih mest kot tudi pametnih objektov v smislu zagotavljanja zdravih bivalnih razmer, bivalnega udobja, varnosti, varčevanja z energijo, vplivov na okolje, ipd.. V konceptu pametnih mest in objektov imajo senzorji vlogo zaznavanja škodljivih, neželenih in nevarnih agensov v realnem času, kar omogoča pravočasno opozarjanje, preventivno delovanje in primerno ukrepanje. Posledično to prinese preprečitev negativnih in škodljivih posledic za zdravje, poškodovanja živih bitij in materialnih dobrin ter negativnih okoljskih vplivov.

Naša znanja in izkušnje na področju optičnih kemijskih senzorjev nam omogočajo vključevanje na področju razvoja senzorjev za zaznavanje tako plinskih analitov (npr. O_2, NH_3, razni amini), kot tudi analitov, ki jih lahko zasledujemo v vodnem okolju (npr. pH, raztopljen NH_3, ioni težkih kovin, …). Možno je vključevanje v razvoj novih senzorskih (nano)materialov s specifičnimi funkcionalnimi skupinami za zaznavanje oz. vezavo tarčnega analita. Uporaba optičnih vlaken omogoča prenos signala na daljše razdalje, senzorski sistem pa je lahko miniaturen in prenosljiv.

Integracija senzorskih sistemov v pametne sisteme za mesta in objekte predstavlja dodano vrednost in uresničevanje strategije trajnostnega razvoja pametnih objektov.

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Towards Orchestrated Smart City Infrastructure

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POVZETEK

Prispevek povzema aktivnosti organizacije na področju interneta stvari (IoT). Opisane rešitve so umeščene v splošno IoT arhitekturo, podana pa so tudi izhodišča za virtualizacijo virov naprav in komunikacijske infrastrukture.

ABSTRACT

This contribution summarizes the company activities related to the Internet of Things. The described solutions are positioned within a common IoT architecture and a basic discussion on the virtualization of device resources and communication infrastructure is provided.

1. INTRODUCTION

The Internet is traditionally perceived as communication and services infrastructure for web and mobile applications that are primarily intended for human interaction. The rapidly emerging Internet of Things (IoT) represents its extension, whereby the applications can run on any computing-enabled object and over its communication interface enable not only human but also direct objects' interaction. The simplest way to illustrate IoT is to think of a 'connected sensor device', providing for example information on location, movement, temperature, air quality, heart rate etc. and thereby enabling applications of environmental surveillance, vital signs and activity tracking or other connected object monitoring and management.

This paper presents the ComSensus company profile and discusses the common IoT architecture, implementation of particular application-specific building blocks, their integration with the overall system and end-user application, and the necessity for virtualization of IoT object resources in smart city applications taking advantage of the shared infrastructure.

2. COMSENSUS PROFILE

ComSensus is a high tech start-up company founded in 2011, focused on the development of highly customizable products and solutions for remote monitoring, tracking and control. The founders have a strong research background and have collaborated on several EU funded projects, especially on the setup and maintenance of testbeds for remote experimentation. Some of these include FP7 CREW, FP7 eBadge, FP7 NRG4Cast, FP7 Proasense and FP7 SUNSEED. The portfolio of ComSensus products includes the BEEP system for remote monitoring of beehive conditions, the PMC system for energy metering and control and a modular and fully flexible networked embedded system platform VESNA, developed in collaboration with Jozef Stefan Institute (JSI).

3. COMMON IOT ARCHITECTURE

While there is no single, universal architecture that would fulfil the various requirements of different applications, the specifics of IoT are mostly related to the limited capabilities of connected devices in terms of computing power and available energy as well as the way the devices are manufactured and used. In this respect, the overall requirements can be summarized with the following categories: (i) device capabilities (processing, connectivity, energy), (ii) device and users management, (iii) data handling (storage, processing, analytics), (iv) scalability, and (v) security provisioning. A commonly used high-level illustration of IoT architecture, capturing devices, connectivity and data aggregation, as well as server-side (cloud) infrastructure to interact with and manage the devices, handle the data and serve the end applications, is depicted in Figure 1.

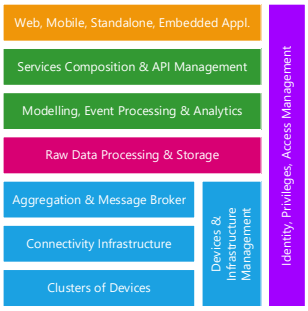

Figure 1. Common IoT architecture.

4. VESNA-BASED DEVICE PROTOTYPES

In the following sub-sections three VESNA platform based IoT device prototypes, well suited also for smart city solutions, are briefly described from the perspective of functionalities, way of use, and integration with other components of the architecture.

4.1 Power Metering and Control Device

Exploiting the modular concept of the VESNA platform the device depicted in Figure 2 can be used to perform power quality measurements on the level of a particular load or connection point, phasor estimation within the distribution system operator power network, and also the control of end loads. At the same time, the device can combine different communication interfaces for either (i) its own connectivity towards the host application or (ii) towards the connected measurement and control nodes for which it acts as a gateway.

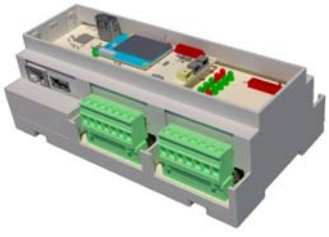

Figure 2. VESNA platform based CP-PMC/SPM device.

4.2 Implementation of LoRa LPWAN End-Node and Gateway Devices

Recently, several Low-Power Wide-Area Networking (LPWAN) technologies were introduced to fill the niche between short-range, low power and low data rate technologies, such as those based on IEEE 802.15.4 radio interface, and the cellular technologies based on e.g. GPRS or LTE, providing long range and typically low data rate, but relatively high power connectivity. In this respect, VESNA platform modules for LoRa connectivity have been developed and allow the implementation of end-nodes as well as gateways towards cellular or Ethernet based network. Figure 3 depicts one such sample module.

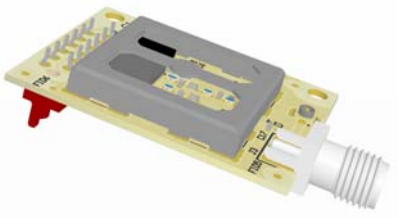

Figure 3. VESNA platform LoRa network module.

While in LoRa the implementation of end-nodes is generic and only comprehends the physical and MAC layer of the protocol stack, the implementation of gateway can either be proprietary (like the solution from Link Labs) or respecting the LoRaWAN architecture. The benefits of this approach include the LoRa end-nodes being (i) agnostic on the network infrastructure, (ii) suitable for resource constrained devices and (iii) ready to combine cellular and capillary networking paradigms. These benefits however come at the price of end-node IP connectivity and applicability of standard security provisioning mechanisms. In this respect a custom LoRa compliant gateway, message broker, device (end-node) management and security framework is being developed and planned for trial in smart city scenarios considering open IoT data networks, as currently launched in Amsterdam and Boston.

4.3 Beacon-enabled Location-based Services

Location-based services are traditionally applied using the geo-fencing principle, in which the combination of known end-user geo-location (typically provided via GPS positioning) and predefined area around the point of interest drive the service triggering. In real operating environments it is not always straight forward to estimate the exact geo-location of an end-user (especially indoors), the geo-location information is not shared with the service trigger, or application requires service triggering based on relative proximity to a point of interest. To cater for this, a number of communication technologies, including Bluetooth, Wi-Fi and LTE, introduced the so called beaconing services. At the moment Bluetooth is experiencing the strongest momentum, which is also driving several corporations to introduce their own beaconing profiles (i.e. Apple iBeacon, Google PhysicalWeb and Eddystone, Radius Networks ALT beacons), however Wi-Fi Alert and LTE Radar are according to some market studies expected to emerge in 2016.

At the moment service triggering using beacons typically requires a dedicated application on the mobile phone, while the beaconing devices are usually implemented in simplest possible form, serving during their lifetime a unique, simple and one time purpose. In this respect a market niche for technology agnostic beaconing service management and remotely configurable beacon devices has been identified and is currently piloted for the Bluetooth beacons. The solution will allow a single beacon device to advertise a beacon message in different (vendor-specific) formats, to simultaneously advertise different beacons and to also act as beacon receiver device, detecting beacons in its proximity. The beacon device prototypes are based on the VESNA platform, while for interaction with and management of the devices a VIDEK framework provided by JSI is being adopted.

Figure 4 depicts possible use cases and establishment of beaconing infrastructure on top of open smart city infrastructure.

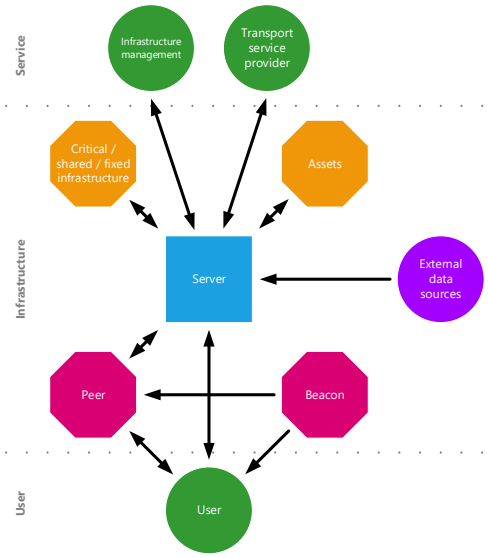

Figure 4. Beaconing service in the context of smart city.

5. CONNECTIVITY AND DEVICE RESOURCE VIRTUALIZATION

By (i) focusing on devices, connectivity and data distribution part of the common IoT architecture depicted in Figure 1, (ii) considering a smart city environment, in which devices and connectivity resources are desired to be shared among different applications and stakeholders, and (iii) having in mind the different roles of classical gateways (featuring full protocol stacks of the supported technologies) and gateways considered with the LPWAN design concepts, one can imagine the complexity and required effort to manage setups with scalable number of devices. In this respect we should consider how IoT deployments can benefit from the concepts of Software Defined Networking (SDN), aimed at decoupling of control plane from data plane, and Network Function Virtualization (NFV), aimed at decoupling of network elements from the underlying hardware. The benefits of SDN manifest in simplified configuration and management of entire network, while NFV eases the deployment of new services and increases the network agility and scalability.

In other words, smart city infrastructure should no longer rely on quasi-static (vertically separated) network provisioning and pre-defined role of network elements and connected end devices, but should benefit from re-configurability and therefore inherent support of diverse services.

On top of this, open and standardized data and information models should be adopted, to offer public and third parties true open access and full exploitation of city generated (sensor) data.

Avtonomne okoljske meritve kot del infrastrukture pametne skupnosti / Autonomous environmental monitoring as part of smart community infrastructure

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POVZETEK

Prispevek podaja vizijo Odseka za znanosti o okolju (O2) v sodelovanju z Odsekom za komunikacijske sisteme (E6), ki delujeta v okviru Instituta "Jožef Stefan", na področju razvoja, testiranja in integracije pametnega okoljskega monitoringa kot integralnega dela koncepta pametne skupnosti, in sicer s povezavo novih senzorskih tehnologij, IKT ter modelnih orodij. Koncept temelji na povezovanju naslednjih glavnih gradnikov: kontinuirano spremljanje stanja okolja v realnem času - upravljanje podatkov - ovrednotenje - poročanje. Eden od pomembnih izzivov, ki jih želimo naslovili, je validacija novih avtonomnih senzorskih tehnologij s klasičnimi pristopi ter, enako pomembno, integracija metrološke podpore v celostno IKT infrastrukturo. Pomemben segment je tudi vpetost različnih javnosti ter razvoj orodij, ki bodo omogočala njeno vključitev v upravljavske procese.

ABSTRACT

In this contribution we describe the vision of Department of Environmental Sciences together with Department of Communication Systems, both part of the Jozef Stefan Institute, in developing, testing and integrating a smart environmental monitoring as part of the overall smart community platform; by linking new technological sensing solutions, information and communication technologies (ICT) and environmental modeling tools. The methodological approach rests on linking the following pillars: continuous environmental monitoring in real time - data management - assessment - reporting. One of the important challenges that we intend to address includes validation of new sensor technologies with classical analytical methods and equally important integration of this metrological support into overall ICT infrastructure. Another important novelty in our vision is strong public participation and development of tools for their engagement in environmental governance.

1. INTRODUCTION

In recent years municipalities all over the world started to build their development strategies based on the concept of "Smart Communities" [1]. An important component of this concept is also environmental protection and management of ecosystems. It is recognized that efficient environmental monitoring and protection, based on precautionary or timely actions, could be realized only if there are appropriate environmental diagnostic systems that are capable of collecting and analyzing all information relevant to the environmental status [2]. However, monitoring of environment as usually implemented does not fully meet these needs. Therefore, our vision builds on recognized limitations of traditional approaches in environmental monitoring conducted currently in Slovenia, and consequent research and development needs for its integration in the overall sustainable urban infrastructure, as follows.

Current monitoring of environmental status is based on indicators that are derived from usually very sparse and sporadic measurements (both in space and time). The main drawbacks are that this approach (i) is often still very labor intensive, time consuming and expensive; (ii) does not provide any insight into the processes that lead to a particular state; (iii) does not meet modeling data needs; and as such (iv) does not properly support environmental management and decision making requirements. Perhaps most important drawback of this traditional approach is absence of citizens' involvement in the overall process. Namely, in order to achieve sustainable results it is increasingly recognized that citizens should be involved beyond just giving them access to passive lists of figures or spreadsheets that only experts can interpret [3].

2. RELEVANCE OF SMART CITIES AND COMMUNITIES FOR OUR ORGANISATION

Within the Jozef Stefan Institute, Department of Environmental Sciences focuses on multidisciplinary research with emphasis on combination of physical, chemical and biological processes that influence the environment, man and human activities. The work is based on three main areas: (i) development, optimization and validation of analytical methods; (ii) study of geochemical processes that influence cycling and transformations of substances and elements; and (iii) environmental impact assessment which evaluates the risk that human activities present for human health and for the environment (www.environment.si). Along these lines, our contribution to the development of smart environmental monitoring as part of the smart cities and communities rests on the following pillars:

- *Environmental monitoring sensor devices:* Deployment and long-term use of environmental monitoring sensing devices in stand-alone manner or as distributed network based on the understanding of pollutants' behavior in various environmental departments, most significant pollution sources and their spatial distribution.
- *Metrological support*: Prior to deployment, sensor devices need to be calibrated and validated in laboratory conditions using classical analytical procedures. In the

operational phase, we can contribute to the integration of the metrological support into overall ICT infrastructure.

- *Interpretation, data visualization and presentation*: Advanced tools are used for visualization and interpretation of all the collected data. In addition, we can contribute to the development of distribution models of pollutants that will support visualization and forecasting, available in the near-real time mode.

- *Empowerment and public participation*: The involvement of interested public and stakeholders is essential throughout the process of building the environmental monitoring platform. Our experiences build on integrating the smart environmental monitoring concepts based on the concept of *Citizens' Observatories*, which is recognized as increasingly essential tool that provides an approach for better observing, understanding, protecting and enhancing our environment [4].

- *Individual exposure assessment - exposome concept*: In order to get an insight into individual exposure, the outcome of the smart environmental monitoring needs to be integrated with the concept of exposome. The exposome represents the totality of exposures from conception onwards, simultaneously identifying, characterizing and quantifying the exogenous and endogenous exposures and modifiable risk factors that predispose to and predict diseases throughout a person's life span [5].

The concept of *Citizens' Observatories* and participatory sensing largely depend on the availability of low cost and easy to use monitoring devices. This requirement motivated closer collaboration of the Department of Environmental Sciences with the Department of Communication Systems, the latter being concerned among other also with the design of wireless sensor devices (both static and portable/personal), their integration in remote sensing and monitoring platforms and development of appropriate visualization tools and applications. By joining the environmental domain expertise with skills in sensor, information and communication technologies the departments became able to support continuous low-cost real-time distributed and/or participatory monitoring of environmental parameters and meet the modeling data needs.

3. RELEVANT PAST AND ONGOING ACTIVITIES

In the following we list a selection of past and ongoing projects that are most relevant to the area of autonomous environmental monitoring in smart cities and communities along with involved partners and most important achievements and outcomes.

3.1 Selected national projects

ARRS applied project L1-5446: Optimization and validation of new indicator systems in complex environmental matrices (Partners: IJS as coordinator, IFB - Inštitut za fizikalno biologijo, NIB – Nacionalni inštitut za biologijo, IOS - Inštitut za okoljevarstvo in senzorje). Within the project we developed an efficient and robust in-line sensor technology for detecting mercury in the aquatic environment, which can operate autonomously and provide real-time data.

ARRS applied project L1-0367: An integrated methodology for the remediation of an area impacted by the past mining activity (Partners: IJS as coordinator, UL FGG – Fakulteta za gradbeništvo, Rudnik živega srebra v zapiranju). In this project modeling approaches were integrated with measurement systems in contaminated system at the catchment level.

National human biomonitoring: (www.biomonitoring.si) Acquisition of data for the assessment of health risks from long-term exposure to harmful substances in the environment.

3.2 Selected international projects

FP7 - CITI-SENSE: Development of Sensor-based Citizens' Observatory Community for Improving Quality of Life in Cities (Partners: Norwegian Institute for Air Research as coordinator + others http://www.citi-sense.eu/Project/Consortium.aspx). CITI-SENSE is developing "citizens' observatories" to empower citizens to contribute to and participate in environmental governance, to enable them to support and influence community and societal priorities and associated decision making. CITI-SENSE is developing, testing, demonstrating and validating a community-based environmental monitoring and information system using innovative and novel Earth Observation applications. JSI is involved in activities concerned with methodological and technological aspects of air quality monitoring, including the development of portable sensor units VESNA AQA/PAQ and corresponding mobile app for collecting and forwarding data to the remote database [6], as well as in deployment and operation of Ljubljana outdoor and indoor-school air quality-empowerment pilots.

FP7 – GMOS: Global Mercury Observation System (Partners: CNR-Institute of Atmospheric Pollution Research as coordinator + others www.gmos.eu/index.php/partners). The overall goal of the project is to develop a coordinated global observation system for mercury. This will then provide high quality data for the validation and application of regional and global scale atmospheric models, to give a firm basis for future policy development and implementation.

FP7 – HEALS: Health and Environment-wide Associations Based on Large Population Surveys (Partners: UMPC and AUTH as coordinators + others www.heals-eu.eu/index.php/participants). The goal of the project is to assess individual exposure to environmental stressors and predict health outcomes. This implies that both environmental exposures and epi/genetic variations are reliably measured simultaneously, and in this way efficiently support exposome studies.

CROME-LIFE: Cross-Mediterranean Environment and Health Network (Partners: AUTH as coordinator + others www.crome-life.eu/index.php/about/participants). The aim of the project is to demonstrate technically feasible integrated methodology for interpretation of human biomonitoring (HBM) data that will allow to quantitatively assess the impact on human health due to acute/chronic exposure to chemicals from various sources.

FP7 – HydroNet: Floating Sensorised Networked Robots for Water Monitoring (Partners: Scuola Superiore Sant'Anna as coordinator + others http://cordis.europa.eu/project/rcn/88876_en.html). The main outcome of the project is an autonomous environmental monitoring system operating in real time on the basis of purposely developed sensor technologies combined with robotics and concepts of "ambient intelligence".

EMRP – MeTra: Traceability for Mercury Measurements. Metrological support with an emphasis on traceability and validation of analytical techniques for the determination and speciation of various forms of mercury in different matrices.

FP7 – CIVITAS ELAN: Mobilising citizens for vital cities (Partners: MOL as coordinator + others www.civitasljubljana.si/o-projektu/sartnerji-civitas-elan-ljubljana). The development of sustainable, cleaner and energy efficient transport system in five European cities, including Ljubljana.

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Upravljanje z energijo in pametna omrežja

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POVZETEK

V tem prispevku opisujemo vizijo podjetja Solvera Lynx d.d., obstoječe in načrtovane aktivnosti ter reference na področju pametnih mest in skupnosti. Podjetje Solvera Lynx, d.d. od svoje ustanovitve leta 2002 razvija in ponuja napredne informacijske in komunikacijske rešitve na področjih oskrbe z energijo in vodo, pametnih omrežij, industrije, zgradb ter transporta.

1. UVOD

Podjetje Solvera Lynx d.d. je bilo ustanovljeno leta 2002 in že vse od svoje ustanovitve ustvarja napredne informacijske in komunikacijske rešitve na področjih oskrbe z energijo in vodo, industrije, zgradb ter transporta. Lastna strojna in programska oprema, ki jo razvijajo energetski in računalniški strokovni kadri, omogočajo energetskim in drugim podjetjem, da izkoristijo prednosti, ki jih ponuja odprt trg z energijo, vzpostavijo napredne informacijsko-komunikacijske rešitve za ter z uporabo sistema za upravljanje z energijo (energetski menedžment) zmanjšajo stroške za energijo iz razloga izboljšane in učinkovitejše rabe energije.

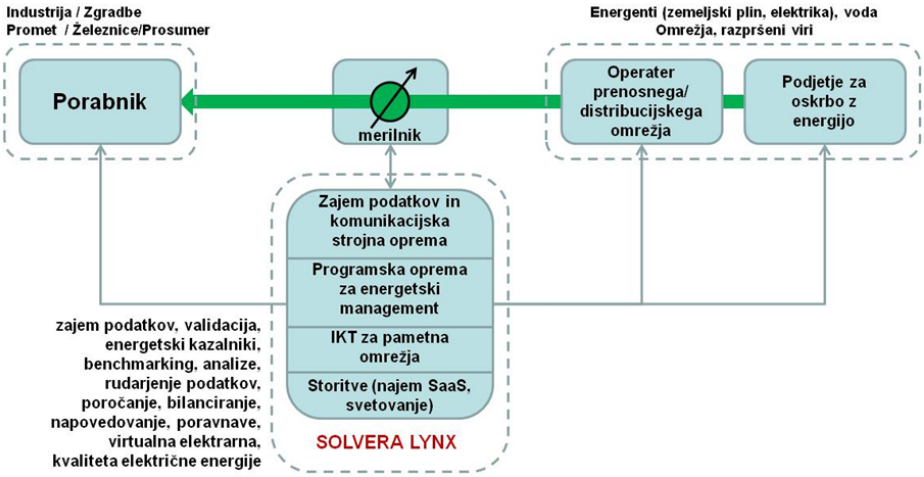
Hkrati podjetje razvija storitve na področju pametnih omrežij, svoje rešitve pa ponuja projektno ali kot najem storitev. Podjetje Solvera Lynx torej vidi svoje mesto na križišču informacijsko-komunikacijskih poti med podjetji za oskrbo oz energijo (tako tržni kot regulirani deli) in porabnikom.

Reference podjetja pokrivajo številne vidike, na katerih je bilo podjetje Solvera Lynx d.d. zaradi svoje raznolikosti v preteklih letih aktivno, in jih ne navajamo v celoti. Glavna področja, v katera so bile usmerjene aktivnosti podjetja na energetskem področju, so:

- zajem energetskih in drugih podatkov, validacija podatkov, obdelave, analize in izmenjave podatkov,
- pametna omrežja,
- nadzora in poročanja o kvaliteti električne energije v omrežju,
- inteligentna platforma za upravljanje razpršenih virov in drugih elementov elektroenergetskih omrežij,
- napovedovanje, bilanciranje, poravnava in obračunov v energetskih sistemih,
- uvajanje sistemov (programske opreme) za upravljanje z energijo (energetski menedžment), analiza učinkovitosti rabe energije, benchmarking na področju oskrbe in rabe energije.

Prednosti podjetja Solvera Lynx d.d. so predvsem:

- večletne izkušnje na vseh področjih delovanja,
- visoko izobraženi zaposleni z multidisciplinarnimi znanji – energetika, IKT tehnologije, komunalne dejavnosti, promet,
- ažurnost na spremembe na trgu z energijo in fleksibilnost delovanja,
- uporaba sodobnih IKT tehnologij z možnostjo uporabe na različnih platformah,
- poznavanje karakteristik energetskih in računalniških (IKT) sistemov in medsebojne odvisnosti.



Slika 1. Pozicioniranje podjetja Solvera Lynx.

2. POMEN PODROČJA PAMETNIH MEST IN SKUPNOSTI

Področja, ki jih podjetje Solvera Lynx v okviru svojega razvoja v letih 2016/2017 ocenjuje kot primerne s stališča priložnosti na trgu, trendov v Evropi in svetu in strokovnega znanja cv podjetju, lahko strnemo v naslednja področja:

- pametna mesta z razvojem produktov in storitev za zajem podatkov, analizo podatkov, obdelavo podatkov – rešitve morajo postati del vsakdana v pametnem mestu in vsem akterjem ponuditi dodano vrednost (prebivalstvo in podjetja). V okviru področja predvidevamo razvoj naslednjih celostnih rešitev na področju omrežja, naprav, storitvev in poslovnih modelov.
- pametna omrežja z funkcionalnimi rešitvami:
  a) alternativni komunikacijski sistemi za potrebe v energetiki,
  b) daljinsko upravljanje pretokov energije – demand side management – nove storitve na področju upravljanja z energijo pri gospodinjstvih in v industriji,
  c) sistemi samooskrbe - rešitev s hranilniki energije,
  d) polnilna infrastruktura za električna vozila.
- razvoj naprav za potrebe internet of things (IoT) – senzorji, števci in druge naprave za zajem podatkov, komunikacijske naprave za prenos velike količine podatkov v realnem času:
  a) razvoj poslovnih modelov za uporabo IoT,
  b) področje energetike in učinkovita rabe energije,
  c) povezave z drugimi sistemi, kot so varnostni sistemi, nadzorni sistemi, zdravstvene storitve.
- razvoj programskih rešitev na področju upravljanja z energijo (energetski management), na osnovi standarda ISO 50001 in uporabe rudarjenja podatkov.

Tovrstni projekti imajo več delov oziroma faz, ki vključujejo najmanj razvojno-demonstracijske projekte, razvoj in preizkušanje poslovnih modelov ter inovativnih rešitev...

3. VSEBINSKE POBUDE IN RAZPOLOŽLJIVE KOMPETENCE

Podjetje ima med svojimi RR dosežki veliko prepoznavnih referenc, in sicer:

- Več projektov v gospodarstvu za področje sistemov za upravljanje z energijo. Razvojni projekti na področju upravljanja z energijo in pametnih omrežij so bili izvedeni v okviru razpisov ministrstev oziroma agencij (INFRAGEN-JAPTI, SUPERMEN – Ministrstvo za gospodarstvo…).
- mednarodna vpetost podjetja se izkazuje na ravni sodelovanja v mednarodnem okolju na trgu ter izvajanju različnih RR projektov (7. okvirni program – AmiMOSes in LifeSaver, program EU Intelligent Energy for Europe, projekt Trainer, program EU Intelligent Energy for Europe, projekt EFFI…).
- Podjetje ima široko partnersko sodelovanje z različnimi tujimi podjetji, s katerimi izvaja skupne nastope na trgu pri projektih na področju daljinskega zajema podatkov in obračuna, sistemi vodenja v energetiki (Knorr Bremse in Microelectricca Scientifica na področju železniškega transporta, Končar Hrvaška, ISA Portugalska, merilni in komunikacijski sistemi…).

4. OBLIKE FINANCIRANJA

Projekti v okviru pametnih skupnosti morajo biti financiranji v okviru pridobivanja razvojnih sredstev v okviru javnih razpisov ministrstev ali agencij, odgovornih za razvoj, in sicer v naslednjih oblikah:

- sofinanciranje razvoja, ki praviloma vedno vključujejo demonstracijo – z demonstracijo se lahko neposredno pokaže in dokaže, da je produkt razvit in uporaben na trgu – zato se podjetje usmerja v pretežno razvoje in ne pretežno raziskovalne projekte.
- sofinanciranje razvoja poslovnih modelov – trendi na področju pametnih omrežij kažejo, da se bo izredno hitro vzpostavila infrastruktura teh omrežij, poslovni modeli uporabe omrežij in razvoja rešitev pa zaostajajo za tem hitrim razvojem. Zato je izjemnega pomena razviti nove poslovne modele, ki bodo kratkoročno uspešno plasirali rešitve na trg in izkoristili začetni zagon na področju. Slovenska podjetja bodo morala takoj pristopiti k razvoju poslovnih modelov, sicer se bodo rešitve pripravile drugje.
- sofinanciranje trženja produktov in storitev v tujini – slovensko poslovno okolje je premajhno za intenziven razvoj podjetništva, zato je treba trženje produktov in posebej storitev v čimvečji meri prenesti v tujino (s posebnim poudarkom na tretjem svetu) ter tako doseči rast dodane vrednosti slovenskih podjetij na tujih trgih tudi na področjih, kjer tradicionalno slovenska podjetja niso bila prisotna.

Indeks avtorjev / Author index

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Delavnica »Pametna mesta in skupnosti kot razvojna priložnost Slovenije« / Workshop »Smart Cities and Communities as a Development Opportunity for Slovenia«

Mihael Mohorčič, Ana Robnik, Dalibor Baškovč