Šestintrideseta delavnica o telekomunikacijah

Thirtysixth workshop on telecommunications

Vloga tehnologije 5G v vertikalah in vloga vertikal v omrežju 5G

The Role of 5G Technologies in Verticals, and the Role of Verticals in 5G Networks

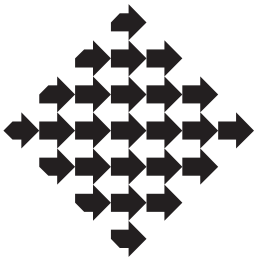
17. in 18. maja 2021

17 and 18 May 2021

Slovensko društvo za elektronske komunikacije

Elektrotehniška zveza Slovenije

SLOVENSKO DRUŠTVO ZA ELEKTRONSKE KOMUNIKACIJE
ELEKTROTEHNIŠKA ZVEZA SLOVENIJE



Šestintrideseta delavnica o telekomunikacijah

36th Workshop on Telecommunications

Vloga tehnologije 5G v vertikalah in vloga vertikal v omrežju 5G

The Role of 5G Technologies in Verticals and the Role of Verticals in 5G Networks

ZBORNIK REFERATOV

PROCEEDINGS

17. - 18. 5. 2021

36. delavnica o telekomunikacijah VITEL

ZBORNIK REFERATOV

36 Workshop on Telecommunications VITEL

PROCEEDINGS

Organizirata / *Organised by*: Slovensko društvo za elektronske komunikacije

Elektrotehniška zveza Slovenije

Pokrovitelj / *Sponsored by:* IEEE Communications Society

Uredil / *Editor*: Tomi Mlinar

Naslovnica / *Cover design:* Nikolaj Simič, Filip Samo Balan, Aleksander Vreže

Izdajatelj / *Publisher:* Slovensko društvo za elektronske komunikacije

ISSN 1581–6737

Programski in organizacijski odbor delavnice

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Zgodovina delavnic o telekomunikacijah VITEL

History of Workshops on Telecommunications VITEL

1993: 1. *ISDN omrežja in storitve v Sloveniji*, Brdo pri Kranju
1994: 2. *Mobilne in brezvrvične telekomunikacije*, Brdo pri Kranju
1995: 3. *Podatkovna omrežja in storitve v Sloveniji*, Brdo pri Kranju
1995: 4. *Načrtovanje, upravljanje in vzdrževanje komunikacijskih omrežij*, Brdo pri Kranju
1997: 5. *Varnost in zaščita v telekomunikacijskih omrežjih*, Brdo pri Kranju
1997: 6. *Zbliževanje fiksnih in mobilnih omrežij ter storitev*, Brdo pri Kranju
1998: 7. *Telekomunikacije in sprejetje Slovenije v Evropsko unijo*, Brdo pri Kranju
1999: 8. *Omrežja IP, internet, intranet, ekstranet*, Brdo pri Kranju
1999: 9. *Upravljanje omrežij in storitev*, Brdo pri Kranju
2000: 10. *Mobilnost v telekomunikacijah*, Brdo pri Kranju
2001: 11. *Dostop do telekomunikacijskih storitev*, Brdo pri Kranju
2002: 12. *Poslovne telekomunikacije*, Ljubljana
2002: 13. *Kakovost storitev*, Brdo pri Kranju
2003: 14. *Varnost v telekomunikacijskih sistemih*, Brdo pri Kranju
2003: 15. *Mobilni internet*, Brdo pri Kranju
2004: 16. *Pametne stavbe*, Brdo pri Kranju
2005: 17. *Telefonija IP (VoIP)*, Brdo pri Kranju
2005: 18. *Storitev trojček = Triple play*, Ljubljana
2007: 19. *Brezžični širokopasovni dostop*, Brdo pri Kranju
2007: 20. *Optična dostopovna omrežja*, Brdo pri Kranju
2008: 21. *Povsem IP–omrežja*, Brdo pri Kranju
2009: 22. *Širokopasovna mobilna omrežja*, Brdo pri Kranju
2009: 23. *Konvergenčne storitve v mobilnih in fiksnih omrežjih*, Brdo pri Kranju
2010: 24. *Prehod na IPv6*, Brdo pri Kranju
2011: 25. *Internet stvari*, Brdo pri Kranju
2011: 26. *Komunikacije in računalništvo v oblaku*, Brdo pri Kranju
2012: 27. *Telekomunikacije in zasebnost,* Brdo pri Kranju
2012: 28. *Pametna mesta,* Brdo pri Kranju
2013: 29. *Infrastruktura za izpolnitev digitalne agende in kaj po tem – primer Slovenije;* Brdo pri Kranju
2014: 30. *Omrežja prihodnosti,* Brdo pri Kranju
2015: 31. *Kritična infrastruktura in IKT,* Brdo pri Kranju
2016: 32. *Pametna omrežja informacijske družbe,* Brdo pri Kranju
2017: 33. *Omrežja 5G za digitalno preobrazbo,* Brdo pri Kranju
2018: 34. *Zaupanja vreden internet,* Brdo pri Kranju
2019: 35. *Uporabna vrednost interneta vsega,* Brdo pri Kranju

Zgodovina mednarodnih simpozijev VITEL

History of International Telecommunication Symposium VITEL

1992: *VITEL*, Ljubljana
1994: *Subscriber Access*, Ljubljana
1996: *Broadband Communications Prospects and Applications*, Ljubljana
1998: *Mobility and Convergence Communication Technologies*, Ljubljana
2000: *Technologies and Communication Services for the Online Society*, Ljubljana
2002: *NGN and Beyond*, Portorož
2004: *Next Generation User*, Maribor
2006: *Content and Networking*, Ljubljana
2008: *DVB–T and MPEG4*, Bled
2010: *Digital Television Switchover Process*, Brdo pri Kranju

Uvodnik

Predhodne generacije mobilnih tehnologij so bile namenjene predvsem osebni komunikaciji v obliki govora, prenosa podatkov in dostopa do interneta. Tehnologija 5G bo na drugi strani v enaki meri namenjena industrijski komunikaciji, ki bo omogočila digitalizacijo ekonomije ter prispevala h globalni digitalni transformaciji. Pričakuje se, da bodo prvi uporabniki nove tehnologije v transportu, medijih in industriji, sledili pa jim bodo v medicini, energetiki in ostalih vertikalah.

Evropa išče tehnološke rešitve in primere uporabe, ki bodo v prihodnjih letih implementirane v omrežjih 5G, v obliki raziskovalnih projektov, kot so *Horizont* in drugih javno-zasebnih projektov. Dobavitelji opreme že promovirajo svoje rešitve. V naslednjih letih bodo mobilni operaterji v Sloveniji gradili in razvijali samostojna omrežja 5G, skrbeli za ustrezno pokritost s signalom in hitro odzivnost omrežja.

Zbrani prispevki v tem zborniku poskušajo odgovoriti na vprašanja, kot npr. ali bodo omrežja 5G mobilnih operaterjev dejansko lahko izpolnila pričakovanja vertikal, tako glede tehnoloških potreb, kakor tudi glede varnosti, zanesljivosti in razpoložljivosti, ali so vertikale v Sloveniji že identificirale svoja pričakovanja glede prihodnjih tehnologij, ki bodo omogočile njihovo digitalno transformacijo, ali bodo tehnološke rešitve zagotavljali zgolj ali še vedno mobilni operaterji ali kdo tretji, kakšna partnerstva se bodo ob tem razvila, kakšne bodo potrebe po kibernetski varnosti in kako jo bomo zagotavljali, kako bodo tehnološke rešitve pripomogle k naprednim rešitvam javne varnosti in zaščite in podobno.

Tehnološke rešitve vertikal prihodnosti ne bodo uporabljale zgolj enostavne povezljivosti mobilnih omrežij ampak bodo postale kompleksen ekosistem povezljivosti, IoT, oblačnih storitev ter informacijske tehnologije.

Ključno vprašanje pa je, ali državne institucije, ki pripravljajo strateške usmeritve in strategije razvoja v državi, razumejo prihodnjo kompleksnost nastajajočega ekosistema. Elektronske komunikacije namreč niso več domena enega sektorja, temveč so vedno bolj vpete v vse sektorje vertikal, od gospodarstva, zdravstva, energetike, transporta do javne varnosti in seveda javne uprave.

Pred vami je zbornik prispevkov 36. delavnice o telekomunikcijah Vitel 2021. Avtorji prispevkov, kot so predstavniki vertikal, operaterji omrežij, ponudniki opreme in državni odločevalci, so poskusili najti odgovore na bistvena vprašanja, ki se zastavljajo, če želimo v Sloveniji ostati v tehnološkem koraku z razvito Evropo in svetom, nenazadnje pa tudi, če želimo s tehnologijo 5G na trajnostni način uresničevati Strategijo Republike Slovenije do leta 2030.

mag. Vesna Prodnik,
Slovensko društvo za elektronske komunikacije

Ljubljana, 17. maja 2021

Foreword

The previous generations of mobile technologies were, in the first place, used for personal communication in the form of voice telephony, data transfer and internet access. On the other hand, 5G technologies will in the same way be used for industrial communication which will enable digitalisation of the economy, and thus contribute to global digital transformation. It is expected that the first users of the new technology will be in the area of transportation, media and industry followed by medicine, energetics and others.

Europe is in search of technological solutions and applicable examples of industrial use which will, over the following years, be implemented in 5G networks in the form of research projects such as Horizon and other private-public-partnership projects. Equipment suppliers are already promoting their solutions. In the following years, mobile operators in Slovenia will build and steadily develop independent 5G networks with adequate coverage and guaranteed rapid response.

A number of questions that are covered in the proceedings of the 36th VITEL provide answers to the following questions: will the 5G networks of mobile operators be indeed able to meet the expectations of verticals regarding technological needs as well as security, reliability and availability, have verticals in Slovenia already identified their expectations regarding future technologies which will enable their digital transformation, will the technological solutions of verticals in the future be provided by mobile operators or by third parties, what kind of partnerships will evolve, what will be the requirements regarding cyber security and how will it be ensured, how will technological solutions contribute to advanced solutions in the area of public safety and protection, etc.

The key question is, however, if state institutions, which prepare strategic directions and the development strategy at state level, understand the future complexity of the emerging ecosystem. Electronic communications are no longer the exclusive domain of one sector, but they are increasingly embedded in all sectors from the economy, health, energetics, and transportation to public security and, of course, public administration.

In front of you is the Proceedings of the 36th Workshop on Telecommunications Vitel 2021. The authors of the papers, such as representatives of verticals, network operators, equipment providers and state decision-makers, tried to find answers to crucial questions which need to be answered if we, here in Slovenia, would like to keep up with developed Europe and the world, and last but not least, if we want, by means of 5G technologies, to implement Slovenia's development strategy 2030 in a sustainable manner.

mag. Vesna Prodnik
Slovenian Electronic Communications Society

Ljubljana, 17 May 2021

Kazalo prispevkov

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2030 digitalni kompas: evropska pot za digitalno desetletje

2030 Digital Compass: the European way for the Digital Decade

Zoran Stančič

Evropska komisija, Generalni direktorat za komunikacijska omrežja, vsebino in tehnologijo (GD CNECT)

POVZETEK

Marca 2021 je Evropska komisija predstavila vizijo, cilje in poti za uspešno digitalno preobrazbo Evrope do leta 2030. To je ključnega pomena tudi za prehod na podnebno nevtralno, krožno in odporno gospodarstvo. Ambicija Evropske Unije je biti digitalno suverena v odprtem in medsebojno povezanem svetu ter voditi digitalne politike, ki opolnomočijo ljudi in podjetja, da se usmerijo v na človeka osredotočeno, trajnostno in uspešnejšo digitalno prihodnost. To vključuje obravnavanje ranljivosti in odvisnosti, kot tudi pospeševanje naložb. Ta dokument o politikah predlaga sklop digitalnih načel za hiter zagon pomembnih projektov, kjer je vključenih več držav, in za pripravo zakonodajnega predloga, ki določa trden okvir upravljanja za spremljanje napredka - digitalni kompas.

SUMMARY

In March 2021 the European Commission presented a vision, targets and avenues for a successful digital transformation of Europe by 2030. This is also critical to achieve the transition towards a climate neutral, circular and resilient economy. The EU's ambition is to be digitally sovereign in an open and interconnected world, and to pursue digital policies that empower people and businesses to seize a human centred, sustainable and more prosperous digital future. This includes addressing vulnerabilities and dependencies as well as accelerating investment. This policy document proposes a set of digital principles, to rapidly launch important multi-country projects, and to prepare a legislative proposal setting out a robust governance framework, to monitor progress – the Digital Compass.

O AVTORJU

Zoran Stančič se je pridružil Evropski komisiji leta 2004 kot namestnik generalnega direktorja za raziskave (GD RTD). Leta 2009 je bil imenovan za namestnika generalnega direktorja za komunikacijska omrežja, vsebino in tehnologijo (GD CNECT), v obdobju 2016–2020 pa je delal kot vodja predstavništva Evropske komisije v Sloveniji. Leta 2021 se je vrnil v GD CNECT kot posebni svetovalec. Pred svojo kariero v Evropski komisiji je g. Stančič od leta 2000 do 2004 bil slovenski državni sekretar za znanost. Pred tem je bil na vodstvenih in raziskovalnih ter pedagoških položajih v Znanstvenoraziskovalnem centru Slovenske akademije znanosti in umetnosti, Univerzi v Ljubljani, Univerzi Sorbonne v Parizu in Univerzi v Trstu.

ABOUT THE AUTHOR

Zoran Stančič joined the European Commission in 2004 as Deputy Director General for Research (DG RTD). In 2009 he was appointed Deputy Director General for Communication Networks, Content and Technology (DG CNECT), and in the period 2016–2020 he worked as the Head of the European Commission Representation in Slovenia. In 2021, he returned to DG CNECT as a special adviser. Before his career at the European Commission Mr Stančič served from 200-2004 as the Slovenian State Secretary for Science of the Republic of Slovenia. Prior to that, he held managerial, research and pedagogical positions at the Scientific Research Center of the Slovenian Academy of Sciences and Arts, the University of Ljubljana, the Sorbonne University in Paris and the University of Trieste.

2030 digitalni kompas: evropska pot za digitalno desetletje

36. delavnica o telekomunikacijah VITEL

Zoran Stančič, posebni svetovalec

DG CNECT, Evropska komisija

Kontekst (I): Digitalna transformacija po COVID-19

- Med pandemijo: **Digitalne tehnologije omogočale nemoteno delovanje gospodarstva in življenja**
- Hkrati so se izpostavile **digitalne ločnice in poudarile odvisnosti EU**
- Odločilen dejavnik za **podnebno nevtralno, krožno in odporno gospodarstvo**
- Odločilen dejavnik za **pravice, svobodo in nove vire blagostanja**

Naša odgovornost: opolnomočiti državljane in podjetja da izkoristijo priložnosti trajnostne digitalne prihodnosti v globalnem kontekstu po meri človeka

Kontekst (II): politične okoliščine

- Ustvarjanje digitalne prihodnosti Evrope
- Politične prioritete komisije Ursule von der Leyen – govor Stanje v Evropi
- Evropski svet: Kompas
- Poziv k zagotavljanju evropske suverenosti na osnovi naših vrednot in naše moči ter naslavljanje naših strateških šibkosti in odvisnosti
- Listina digitalnih pravic
- 20% sredstev iz Načrta za okrevanje in odpornost

Usklajene komponente s skupnim ciljem

Sporočilo Digitalno desetletje
Vizija 2030 s cilji, postopki za doseganje rezultatov, digitalna načela

Javna posvetovanja in diskusije z državami članicami in deležniki

Začeti procese digitalnega desetletja z obstoječimi instrumenti (DESI, priporočila evropskega semestra, načrt za okrevanje in odpornost...)

Program politik in predlog Digitalnih načel

Delovanje Digitalnega desetletja
Kompas: monitoring, upravljanje in instrumenti za podporo
medinstitucionalna deklaracija Evropska digitalna načela

Veščine

IKT strokovnjaki: 20 milijonov + ravnotežje spolov
Osnovne digitalne veščine: min 80% prebivalcev

Vlada

Ključne javne storitve: 100% online
e-Zdravje: 100% dostopnost zdravstvenih kartotek
Digitalna identiteta: 80% državljanov uporablja digitalno identiteto

Infrastruktura

Povezljivost: Gigabit za vse, 5G v gosto poseljenih območjih
Vrhunski polprevodniki: podvojiti delež EU v globalni proizvodnji
Robna vozlišča in oblak: 10,000 podnebno nevtralnih varnih robnih vozlišč
Računalništvo: prvi računalnik s kvantnim pospeševanjem

Podjetja

Uporaba rešitev: 75% EU podjetij uporablja oblake/UI/velike podatke
Inovacije: podpora za rast, financiranje, podvojiti EU samorogov
Sledilci: več kot 90% EU MSP doseže vsaj osnovno stopnjo digitalne intenzitete

European Commission

Digitalno državljanstvo

Svoboda izražanja, dostop do različnih, zaupanja vrednih in transparentnih informacij	Možnost ustanavljanja in delovanja podjetij online	Varstvo osebnih podatkov, zasebnost in pravica da si pozabljen	Varovanje avtorskih stvaritev v online okolju
Splošen dostop do internetnih storitev	Varno in zaupanja vredno online okolje	Splošna digitalna izobrazba in veščine omogočajo aktivno državljanstvo	Dostop do okolju prijaznih digitalnih storitev in strojev
Dostopne in človeku prijazne digitalne javne storitve in uprava	Etična načela za algoritme	Zaščita in opolnomočenje otrok v online okolju	Dostop od digitalnih zdravstvenih storitev

European Commission

Doseganje rezultatov: trdno upravljanje

- Letna poročila Svetu in Evropskem parlamentu
  - Napredek k skupnim ciljem (vključno s cilji in načeli)
  - Sistem prometne luči pokaže na nujnost ukrepanja v primeru odstopanj
- Ohranjanje napredka in odpravljanje napak: sodelovanje Evropske komisije in držav članic v analizah in iskanju rešitev za ciljane ukrepe (regulatorni okvir, združevanje virov za skupne projekte, podpora investicijam....)
- Delo s konsenzom: upravljanje bo opredeljeno v zakonodajnem predlogu za politični program, ki bo sprejet s strani zakonodajalca na EU ravni

Doseganje potrebne ravni: več-državni projekti

- Digitalna EU odpornost: potrebujemo **kritično maso financiranja z združevanjem virov**
- Uspešnost: samo skupaj, **EU / države članice / zasebni sektor**
- Zagon: **Načrt za okrevanje in odpornost (NOO)** odpira pot za **več-državne iniciative**
- EU orodja: Samo z raziskavami in inovacijami dosežemo **strukturno zmožnost za povezovanje in scale up**

→ **Ocena možnosti za več-državne projekte v NOO**

Mednarodno sodelovanje v digitalnem desetletju

- Odraža naše vrednote in poudarja naše interese vključno z zavezo k multilateralizmu
- Odprta trgovina na osnovi pravil in enakih pogojev
- Orodja za mednarodno sodelovanje
  - sodelovanje na področju regulative
  - raziskave in inovacije
  - Investicije v povezljivost
- EU z Afriko, sosedstvom in globalnimi partnerji
- Gradimo na potrjenih čezatlantskih odnosih in koaliciji s podobno mislečimi partnerji

2030 ambicije – Kje smo zdaj ?

		EU izhodišče	2030 cilj
Veščine	IKT strokovnjaki (št. zaposlenih)	7.844.100	20.000.000
	Spolna razporeditev	18% žensk	ravnotežje spolov
	Osnovne digitalne veščine	56%	80%
Infrastruktura	Gigabit pokritost	59%	100%
	5G v gosto poseljenih območjih	14%	100%
	Polprevodniki (EU delež v globalni proizvodnji)	10%	20%
	Robna vozlišča/oblak (št. vozlišč)	0	10.000
	Quantum računalnik	0	1
Podjetja	Uporaba storitev v oblaku	26%	75%
	Uporaba velikih podatkov	14%	75%
	Uporaba UI	25%	75%
	MSP z vsaj osnovno stopnjo digitalne intenzitete	61%	90%
	EU samorogi (št.)	122	250
Vlada	Ključne javne storitve online	75	100
	Dostopnost zdravstvenih kartotek	N.A.	100%
	Uporaba digitalne identitete	N.A.	80%

Naslovi poenostavljeni zaradi lažje predstavitve – celostni prikaz in viri v COM(2021) 118

Hvala za pozornost!

Več informacij na: @DigitalEU

https://digital-strategy.ec.europa.eu

5G v Sloveniji – strateški pogled

5G development in Slovenia – a strategic view

Peter Jenko

Ministrstvo za javno upravo, Direktorat za informacijsko družbo

POVZETEK

Peta generacija mobilnih telekomunikacij nedvomno predstavlja strateško pomembno tehnologijo ter je temelj za prihodnost digitalnega gospodarstva in družbe. Pri tem je usklajen vseevropski pristop ključen za skladen razvoj in implementacijo nove tehnologije. Takšen pristop omogoča tudi utrditev in krepitev dobrega izhodišča evropskega prostora, polno izkoriščenje potencialov tehnologije ter uveljavitev obstoječih konkurenčnih prednosti Evrope. Prispevek poskuša podati odgovor na vprašanja, kako evropske države izvajajo akcijski načrt za 5G, kje je pri tem Slovenija ter kakšni so nadaljnji načrti EU za pospešeno implementacijo 5G omrežij.

SUMMARY

The fifth generation of mobile telecommunications ceirtanly represents a strategically important technology and is the foundation for the future of the digital economy and society. Harmonized European approach is essential for the balanced development and implementation of new technology. At the same time, coordinated approach enables the consolidation and strengthening of a good starting point for the European region, the full exploitation of technology potentials and the realization of Europe's existing competitive advantages. How European countries are implementing the 5G action plan and what are the EU's further plans for the accelerated implementation of 5G networks?

O AVTORJU

Peter Jenko je vršilec dolžnosti generalnega direktorja Direktorata za informacijsko družbo pri Ministrstvu za javno upravo. Kot univerzitetni diplomirani pravnik je poklicno pot začel v tedanji Davčni upravi RS. Po združitvi davčne in carinske uprave je zasedal več vodstvenih položajev v okviru Generalnega finančnega urada, kot generalni direktor Finančne uprave RS pa je razvijal organizacijo v smeri servisa za davkoplačevalce, ki temelji na kakovostnih elektronskih storitvah javne uprave.

ABOUT THE AUTHOR

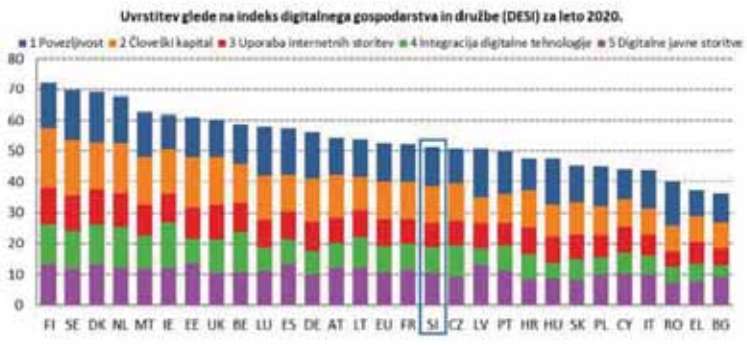
Peter Jenko is the Acting Director General of the Information Society Directorate at the Ministry of Public Administration. As a university law graduate, he began his career in the then Tax Administration of the Republic of Slovenia. After the merger of the Tax and Customs Administrations, he held several management positions within the General Finance Office. As a Director General, he set the strategic direction and lead the Administration's work towards digitalization and better services for taxpayers.

Peter Jenko, v.d. generalnega direktorja
Direktorata za informacijsko družbo

RAZVOJ 5G V SLOVENIJI – STRATEŠKI POGLED

VITEL 2021, 17. in 18. maja 2021

	Slovenija		EU
	uvrstitev	ocena	ocena
DESI 2020	16	51,2	52,6
DESI 2019	17	48,7	49,4
DESI 2018	16	45,9	46,5



Slovenija na Indeksu digitalnega gospodarstva in družbe (DESI)

1 Povezljivost

1 Povezljivost	Slovenija		EU
	uvrstitev	ocena	ocena
DESI 2020	16	50,2	50,1
DESI 2019	10	48,6	44,7
DESI 2018	10	43,8	39,9

2

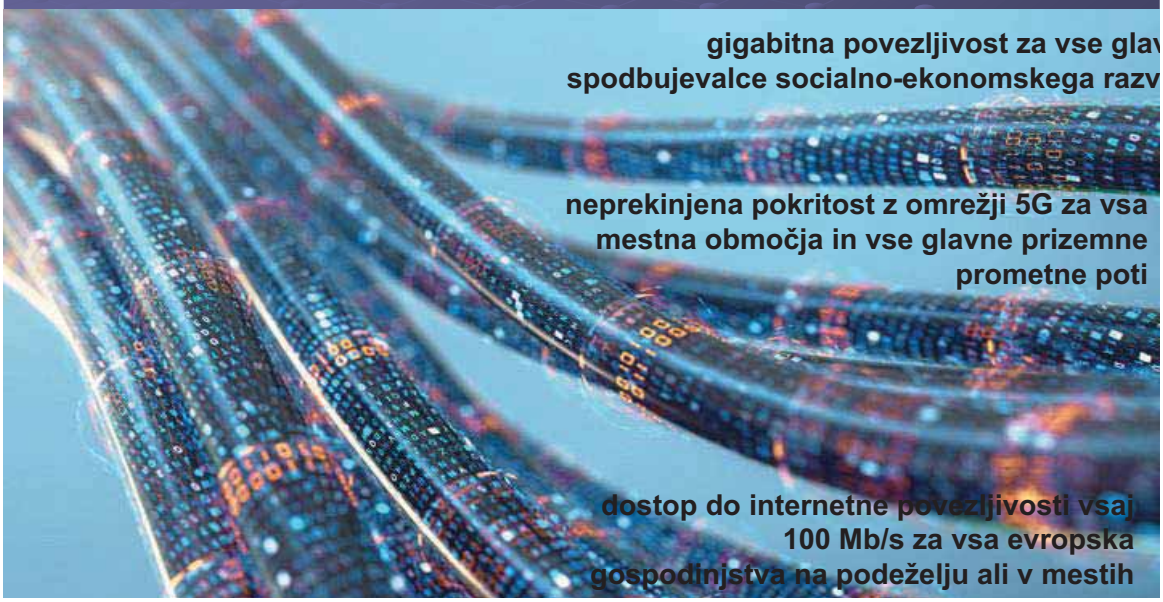
CILJI EU

- **Povezljivost za konkurenčen enotni digitalni trg – evropski gigabitni družbi naproti**, COM(20176) 587
- **Akcijski načrt za 5G v Evropi**, COM(2016) 588
- **Digitalni kompas do leta 2030: evropska pot v digitalno desetletje**, COM(2021) 118, 11.3.2021

3

CILJI EU

Povezljivost za konkurenčen enotni digitalni trg – evropski gigabitni družbi naproti, COM(20176) 587



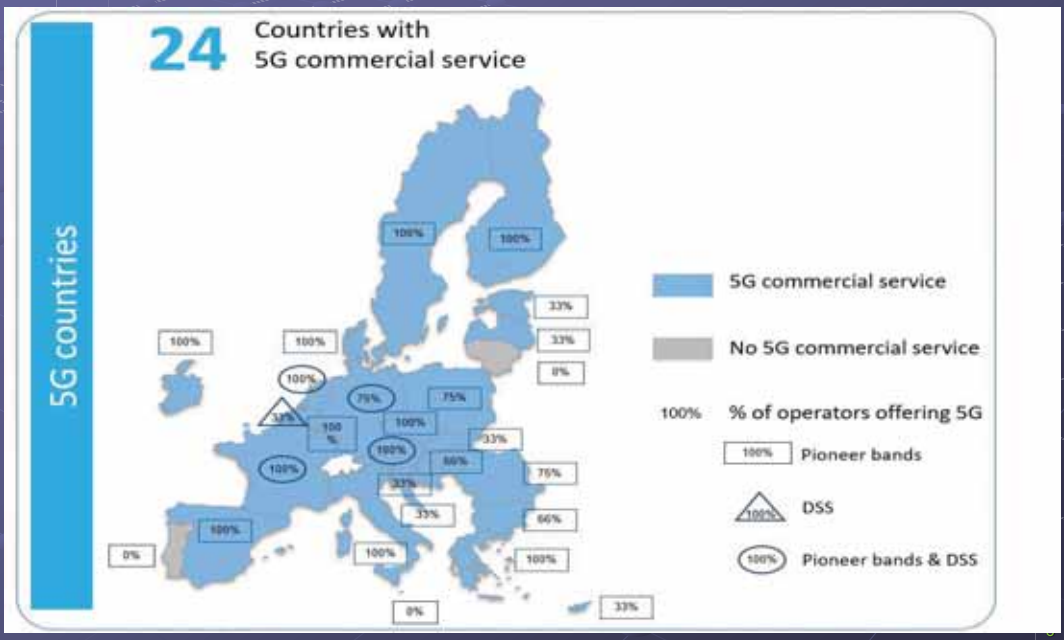
CILJI EU

Akcijski načrt za 5G v Evropi

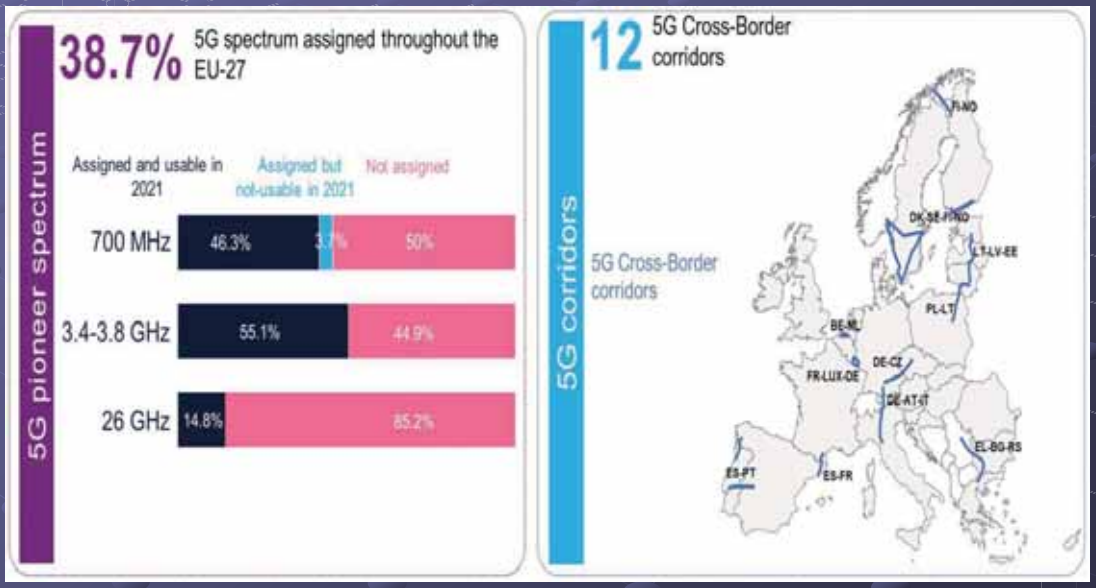
- oblikovanje začasnega seznama pionirskih frekvenčnih pasov (do konca leta 2016)
- dogovor (do konca leta 2017) o celotnem sklopu frekvenčnih pasov za prvo uvedbo komercialnih omrežij 5G
- zgodnja uvedba omrežja do 2018
- komercialna uvedba do 2020

5

SPREMLJANJE RAZVOJA 5G NA RAVNI EU – EUROPEAN 5G OBSERVATORY



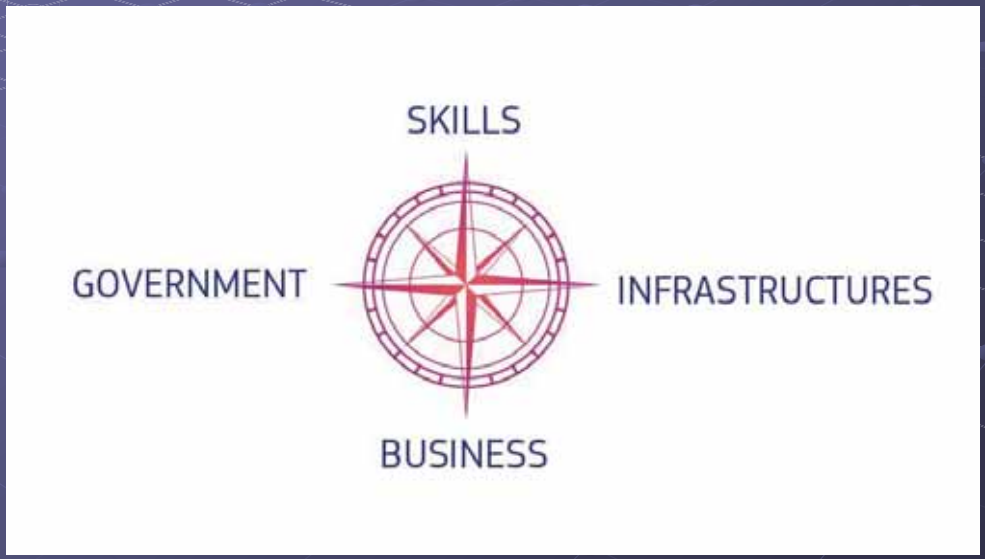
SPREMLJANJE RAZVOJA 5G NA RAVNI EU – EUROPEAN 5G OBSERVATORY



7

CILJI EU

Digitalni kompas do leta 2030



8

CILJI EU

Digitalni kompas do leta 2030

Do leta 2030 želimo v EU zagotoviti gigabitne povezave za vsa gospodinjstva ter omogočiti 5G v vseh naseljenih območjih.

PROGRAM DIGITALNE POLITIKE

Evropska komisija bo do konca leta 2021 predlagala

PROGRAM DIGITALNE POLITIKE

z namenom vzpostavitve okvirja za uresničitev zadane vizije digitalnega prehoda do 2030

IMPLEMENTACIJA ORODIJ ZA POVEZLJIVOST

Države članice imamo obveznost implementacije orodij za povezljivost

Glede pravočasne zagotovitve dostopa do 5G frekvenčnega spektra so vključene:

- Finančne vzpodbude
- Vidiki upravljanja radijskega spektra
- Najboljše prakse za povečanje javne preglednosti in zaupanja v uvajanje 5G v zvezi z zaščito javnega zdravja

FINANCIRANJE

CEF Digital predvideva dve pomembni področji uvajanja 5G infrastrukture na ozemlju celotne EU, in sicer:

- pokritost s 5G infrastrukturo vzdolž prometnih koridorjev

CEF2 Digital 5G corridor deployment calendar

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Early Wave	Call		Deployment (CEF/RRF)							
1st big Wave	Calls	Study	Deployment (CEF/RRF)							
2nd big Wave			Calls	Study	Deployment (CEF)					
Last Wave (TBD)										

- 5G infrastruktura za pametne skupnosti

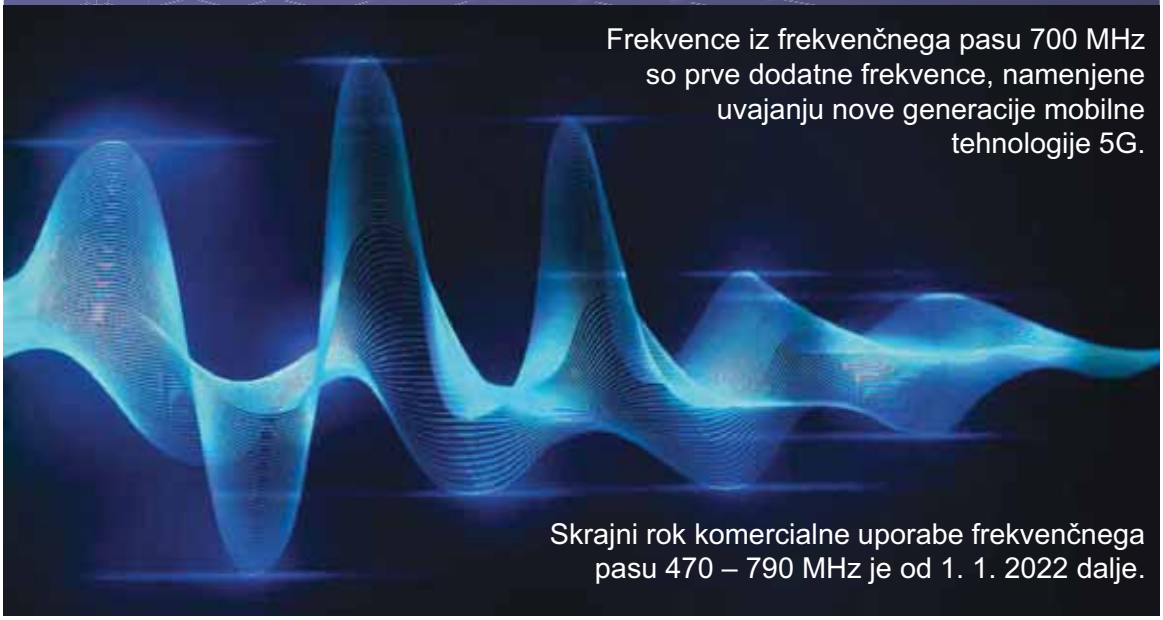
12

FINANCIRANJE

Sprememba Uredbe EU št. 651/2014 o razglasitvi nekaterih vrst pomoči za združljive z notranjim trgom pri uporabi členov 107 in 108 Pogodbe

STANJE V REPUBLIKI SLOVENIJI

Načrt uporabe frekvenčnega pasu 470 – 790 MHz v Republiki Sloveniji



Frekvence iz frekvenčnega pasu 700 MHz so prve dodatne frekvence, namenjene uvajanju nove generacije mobilne tehnologije 5G.

Skrajni rok komercialne uporabe frekvenčnega pasu 470 – 790 MHz je od 1. 1. 2022 dalje.

STANJE V REPUBLIKI SLOVENIJI

Strateške usmeritve AKOSu s področja upravljanja z radiofrekvenčnim spektrom

AKOS
AGENCIJA ZA KOMUNIKACIJSKA OMREŽJA IN STORITVE REPUBLIKE SLOVENIJE

V kontekstu 5G je relevanten naslednji del strateških usmeritev:

- **Agencija naj nadaljuje s postopki dodeljevanja radijskih frekvenc** ob upoštevanju veljavnih nacionalnih in predpisov EU vključno s spremembami Načrta uporabe frekvenčnega pasu 470 – 790 MHz v Republiki Sloveniji iz prve polovice 2020.
- **Agencija naj v okviru javnega razpisa v skladu z veljavno zakonodajo izbere najprimernejši format za dodeljevanje radijskih frekvenc**, pri čemer naj upošteva opravljeno analizo stanja glede števila razpisanih radiofrekvenčnih pasov ter lastno strokovno presojo.

15

STANJE V REPUBLIKI SLOVENIJI

Strateški cilji Republike Slovenije – Digitalna Slovenija 2030/osnutek:

- **gigabitna povezljivost za vse glavne spodbujevalce socialno-ekonomskega razvoja**
- **neprekinjena pokritost z omrežji 5G za vsa mestna območja in vse glavne prizemne prometne poti - 2025**
- **dostop do internetne povezljivosti z navzdolnjo hitrostjo vsaj 100 Mb/s, ki se lahko nadgradi v gigabitno hitrost, za vsa gospodinjstva na podeželju in v mestih**

STANJE V REPUBLIKI SLOVENIJI

Strategija upravljanja z radiofrekvenčnim spektrom 2021 – 2023:

- **obravnavano tudi upravljanje z radiofrekvenčnim spektrom za javne komunikacijske storitve**
- **AKOS ugotavlja, da se izrazito veča delež uporabnikov mobilnega širokopasovnega dostopa do interneta**
- **Eden od večjih generatorjev rasti uporabe mobilnih omrežij so tudi novi poslovni modeli.**

STANJE V REPUBLIKI SLOVENIJI

Analiza ocen zdravstvenih in okoljskih tveganj

Domača zakonodaja je strožja od mednarodnih smernic in narekuje določene omejitve nameščanja omrežja 5G na obstoječe lokacije baznih postaj in nalagajo operaterjem dodatne ukrepe za optimalno umeščanje 5G tehnologije.

Predlagali smo ukrep izdelave analize ocen morebitnih zdravstvenih in okoljskih tveganj ob uvajanju nove tehnologije 5G v Sloveniji, da bi javnosti objektivno podali informacije o ugotovitvah izvedene ocene.

Regulatorni vidik uvajanja 5G

Regulatory aspect of 5G deployment

Tanja Muha

Agencija za komunikacijska omrežja in storitve Republike Slovenije

POVZETEK

Agencija za komunikacijska omrežja in storitve je v zaključni fazi postopka javnega razpisa z javno dražbo za podelitev večfrekvenčnih pasov za zagotavljanje javnih mobilnih storitev, med katerimi so tudi pionirski pasovi za razvoj tehnologije 5G. Slednja je ključna za nadaljnjo digitalizacijo celotne družbe, tudi tistih segmentov, ki se do sedaj v tovrstnih zgodbah niso pojavljali. Navedeno pred regulatorja postavlja nove izzive, ki jih je potrebno ustrezno nasloviti in se nanje pravočasno odzvati da se zagotovi predvidljivo in vzpodbudno regulatorno okolje. Podelitev frekvenc je šele začetek zgodbe; velik del aktivnosti še sledi.

SUMMARY

The Agency for Communication Networks and Services is in the final phase of the procedure of the public tender for allocation of multiband frequencies for the provision of public mobile services, including pioneer bands for deployment of 5G technology. The latter is crucial for the further digitalisation of the entire society, also the segments that have not appeared in such stories so far. In the view of that, the regulator is facing with new challenges, which need to be properly addressed and responded to in a timely manner to ensure a predictable and stimulating regulatory environment. The allocation of frequencies is just the beginning of the story; much of the activity still follows.

O AVTORJU

Mag. Tanja Muha je direktorica Agencije za komunikacijska omrežja in storitve RS od leta 2017. Pred tem je bila v letu 2016 imenovana za vršilko dolžnosti direktorja. Diplomirala je na Ekonomski fakulteti v Ljubljani in magistrirala na Fakulteti za javno upravo. V letu 2019 je bila podpredsednica Organa evropskih regulatorjev za elektronske komunikacije - BEREC. S področjem regulacije telekomunikacij se ukvarja že od leta 2005. V okviru svojega dela več leti sledi trendom in regulatornim pristopom, ter aktivno sodeluje pri oblikovanju in izvajanju regulatorne politike tako na slovenskem kot tudi mednarodnem nivoju, na področjih, ki so v pristojnosti agencije: elektronske komunikacije, mediji, pošta, železniški promet in upravljanje z radiofrekvenčnim spektrom.

ABOUT THE AUTHOR

Tanja Muha, MSc, is Director General of the Agency for communication networks and services of the Republic of Slovenia from 2017. Before that, she was in 2016 appointed as Acting Director. She graduated from University of Ljubljana, Slovenia in Economics and Business and she has Master degree from Administration – Public Sector Governance. In 2019, she was BEREC Vice-Chair. She has been involved in the field of telecommunications since 2005. As part of her work, she has been following trends and regulatory approaches for several years, and actively participates in the formulation and implementation of regulatory policy at both the Slovenian and international level, in areas within the Agency's competences: electronic communications, media, post, railways and frequency management.

AKOS

Regulatorni vidik uvajanja 5G

Mag. Tanja Muha, direktorica Agencije za komunikacijska omrežja in storitve

VITEL 2021, 17.-18.5.2021

AKOS

Digitalizacija družbe in 5G

AKOS

Vpliv 5G na družbo

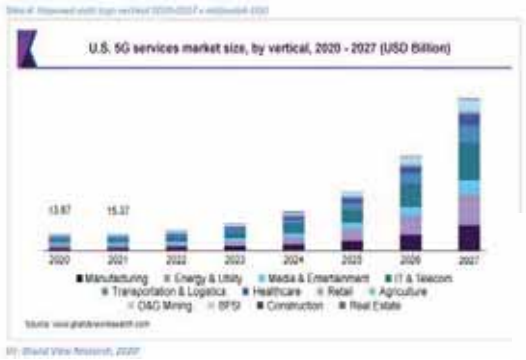
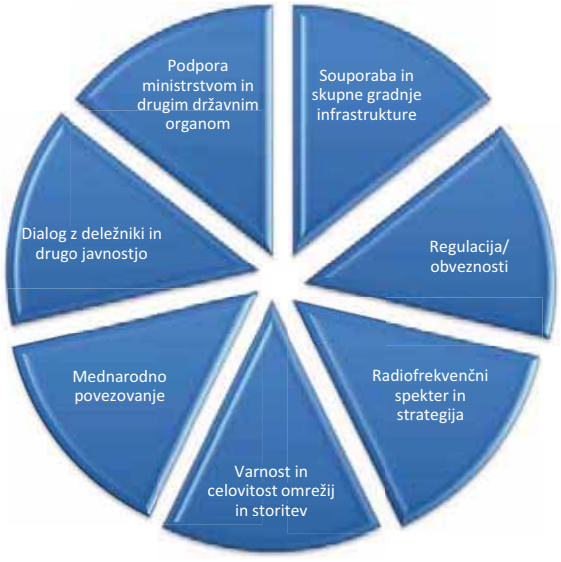


Exhibit C.17. 5G-enabled industry digitalisation breakdown by industry in 2030 (Source: Arthur Consulting, based on Ericsson report[18])

AKOS

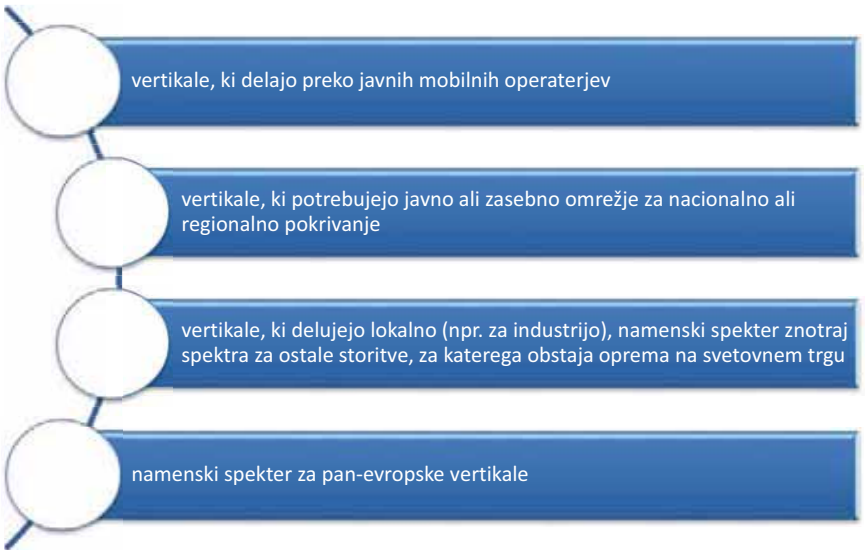
Vloga regulatorja pri uvajanju 5G



AKOS

Možne izvedbe vertikal

Tretje mnenje RSPG



AKOS

Potrebna izhodišča

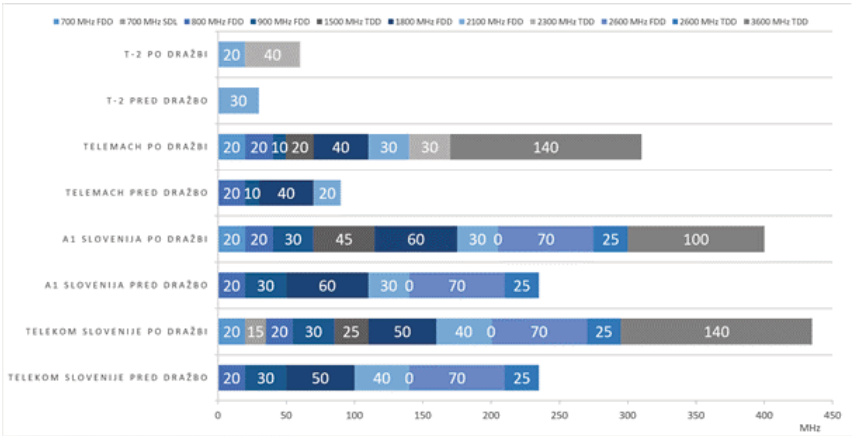
- Razpoložljivost radiofrekvenčnega spektra in izražen interes
- Nove strateške usmeritve Vlade april 2020
- Strategija upravljanja z radiofrekvenčnim spektrom (zaključena konec leta 2020)
- Potrditev izhodiščnih cen za javne razpise z javno dražbo

Podelitev frekvenc šele začetek

Zaključek javne dražbe za podelitev frekvenc za javne mobilne storitve:

Radijske frekvence v frekvenčnih pasovih 700 MHz FDD, 700 MHz SDL, 1500 MHz SDL, 2100 MHz, 2300 MHz, 3600 MHz in 26 GHz

Količina spektra, ki ga imajo in ga bodo imeli operaterji po dražbi (26 GHz: Telekom Slovenije, A1 in Telemach):



Obveznosti pokrivanja

- **v vsakem pridobljenem radiofrekvenčnem pasu** komercialno omogočati javno dostopne širokopasovne storitve na mobilnih prizemnih sistemih na način, da bodo:
  - v roku enega leta od razpoložljivosti posameznega radiofrekvenčnega pasu začeli uporabljati te frekvence in ponujati storitve končnim uporabnikom na teh frekvencah vsaj v enem večjem mestu iz spodnje tabele;
  - v roku petih (5) let od razpoložljivosti posameznega radiofrekvenčnega pasu že uporabljali vse frekvence v celotnem pridobljenem radiofrekvenčnem pasu in ponujali storitve končnim uporabnikom na vseh teh frekvencah vsaj v vsakem večjem mestu iz spodnje tabele.
- v prioritetnih pasovih za 5G (700 MHz FDD in/ali 3600 MHz, ter zaradi omogočanja primerljivih storitev tudi v pasu 2100 MHz):
  - v roku 3 mesecev po izdaji odločbe začeti ponujati storitve končnim uporabnikom preko 5G tehnologije na vsaj enem od pridobljenih frekvenčnih pasov vsaj na področju enega večjega mesta iz seznama;
  - do 31. 12. 2025 ponujati storitve končnim uporabnikom preko 5G tehnologije in zagotavljati funkcionalnost in podporo izboljšanemu mobilnemu širokopasovnemu dostopu, če ima najmanj 70 MHz zveznega spektra, ter zagotavljati podporo množičnim senzorskim (IoT) omrežjem na pridobljenih frekvencah vsaj v vsakem večjem mestu iz seznama zgoraj. V primeru, da razpoložljivost zahtevanih funkcionalnosti ni podprta, mora operater predložiti dokaze. Agencija prouči dokaze in v kolikor so ti upravičeni, preloži rok za izpolnjevanje obveznosti.

Ponujanje storitev pomeni, da je ta storitev omogočena preko baznih postaj, ki pokrivajo vsaj 75 % prebivalstva posameznega mestnega naselja, pri čemer se za sam začetek uporabe radijskih frekvenc in ponujanja storitev zahteva, da je ta omogočena vsaj preko ene bazne postaje na področju posameznega mestnega naselja.

Obveznosti pokrivanja

- Operaterji A1 Slovenija, Telekom Slovenije in Telemach, ki so pridobili frekvence v pasu 700 MHz, bodo morali z vsem radijskim spektrom, s katerim razpolagajo, komercialno omogočati javno dostopne širokopasovne storitve na mobilnih prizemnih omrežjih, na način, da bodo do 31. 12. 2025 zagotovili pokrivanje:
  - 99 % prebivalstva Republike Slovenije zunaj zgradb,
  - 99 % avtocest (AC) in hitrih cest (HC),
  - vsaj 60 % glavnih in regionalnih cest I. in II. reda,
  - vsaj 60 % aktivnih železnic s potniškim prometom, pri čemer je pokrivanje znotraj vlakov v pristojnosti železniških deležnikov;

in sicer z uporabniško izkušnjo najmanj 30 Mb/s od bazne postaje do mobilnega uporabniškega terminala (DL) in 3 Mb/s od uporabniškega terminala do bazne postaje (UL), ker so pridobili vsaj 2 x 25 MHz spektra pod 1 GHz.

Večja mesta			
Celje	Koper	Kranj	Ljubljana
Maribor	Murska Sobota	Nova Gorica	Novo mesto
Ptuj	Slovenj Gradec	Velenje	

Souporaba infrastrukture

- Z namenom zagotavljanja učinkovite uporabe radiofrekvenčnega spektra, za izboljšanje pokritosti in čim manjšega poseganja v okolje
- naslednje možnosti souporabe: souporaba pasivne ali aktivne infrastrukture, ki temelji na radiofrekvenčnem spektru, ali souporaba radiofrekvenčnega spektra, poslovni dogovori o dostopu do gostovanja in skupna postavitev infrastrukture za zagotavljanje omrežij in storitev, ki temelji na uporabi radiofrekvenčnega spektra.
- Souporaba aktivne opreme in frekvenčnega spektra, vključno z dinamično souporabo spektra, bo dovoljena v okviru, ki ne omejuje infrastrukturne konkurence. Pri tem sta souporaba aktivne opreme in souporaba frekvenc dovoljeni, kadar pasivna souporaba ne zadostuje, na primer v zahtevnih območjih pokrivanja in v primeru zgostitve omrežij.
- Souporaba frekvenc in aktivne opreme, vključno z dinamično souporabo spektra, je dovoljena na zahtevnih območjih Republike Slovenije, kot so: Triglavski narodni park, naselja v težko dostopnih območjih, v cestnih in železniških predorih, na kritičnih odsekih cest, na območjih državne meje in v Piranskem zalivu; v območjih, ki presegajo 60 % aktivnih železnic s potniškim prometom; v območjih, ki presegajo 60 % pokrivanje glavnih in regionalnih cest I. in II. Reda; na objektih s spomeniškim varstvom; za maloobmočne dostopovne točke, če je omejitev posegov v prostor, ter v notranjosti objektov; in v primeru zgostitev omrežij zaradi potreb zagotavljanja zelo visokih kapacitet baznih postaj, zmožnih nudenja gigabitnih prenosnih hitrosti: na cestni in mestni infrastrukturi (npr. ulične svetilke, semaforji), na železniški infrastrukturi in energetskih objektih/infrastrukturi, v območjih z veliko gostoto ljudi (npr. kongresni centri, koncertne dvorane, stadioni, avtobusne in železniške postaje, nakupovalna središča, tovarne, pristanišča, letališča).
- Pri tem bo souporaba dovoljena le na način, da pri tem ne prihaja do izkrivljanja konkurence. V 26 GHz pasu bo dovoljena souporaba frekvenc in aktivne opreme, vključno z dinamično souporabo spektra, povsod, med vsemi imetniki odločb, ter imetniki odločb in najemniki, pri čemer ima vsak imetnik odločbe prednost pri uporabi resursov v svojem podpasu. Pri souporabi pa bodo morali operaterji spoštovati tudi vso relevantno zakonodajo na področju gradnje in umeščanja infrastrukture v prostor, pri čemer bo lahko agencija pogoje souporabe ustrezno prilagodila s spremembo odločb.
- Agencija bo lahko imetniku odločbe, ki ima na določenem območju zgrajeno infrastrukturo, v času veljavnosti odločbe naložila obveznosti v zvezi s souporabo pasivne infrastrukture ali obveznosti sklenitve lokaliziranih sporazumov o gostovanju, kadar bo to utemeljeno iz razlogov, da na določenem območju obstajajo nepremostljive gospodarske ali fizične ovire za tržno postavitev infrastrukture za zagotavljanje omrežij ali storitev in zato ni možnosti za dostop končnih uporabnikov do omrežij ali storitev

Zagotavljanje varnosti

Operaterji bodo morali vzpostaviti, izvajati, vzdrževati in nenehno izboljševati ustrezne in sorazmerne organizacijske, tehnične in druge ukrepe, s katerimi bodo morali zagotovil ustrezno obvladovanje tveganj za varnost informacijskih sistemov, omrežij, storitev in informacij. Z namenom obvladovanja varnostnih tveganj in zagotavljanja visoke ravni razpoložljivosti, avtentičnosti, celovitosti ali zaupnosti omrežij in storitev operaterja, shranjenih, prenesenih ali obdelanih podatkov ali povezanih storitev, ki so preko njegovega omrežja dostopne, bodo morali pred uvajanjem ukrepov, povezanih z zagotavljanjem varnosti, izvesti in sistematično izvajati analizo tveganj z oceno sprejemljive ravni tveganj in to ustrezno dokumentirati.

Frekvence za poslovno kritične komunikacije M2M preko namenskih omrežij v 700 MHZ

Zaključna dodelitev radijskih frekvenc **za zagotavljanje poslovno kritičnih komunikacij M2M preko namenskih omrežij v 700 MHz** radiofrekvenčnem pasu

- Za gospodarske panoge (vertikale, kot npr. promet, energetika...ipd.), ki za delovanje potrebujejo visoko zanesljivost delovanja omrežja, ne potrebujejo pa visokih prenosnih hitrosti. Lahko bo gradil omrežje za svoje lastne potrebe ali za druge uporabnike poslovno kritičnih komunikacij.
- Imetnik: BeeIN
- Obveznosti pokrivanja:
  - zgraditi namensko omrežje, ki pokrije vsaj 75 % ozemlja Republike Slovenije (občin), za uporabnike poslovno kritičnih komunikacij oziroma
  - Na geografskem območju velikosti vsaj 10 % ozemlja Republike Slovenije preko namenskega omrežja, ki bo uporabljalo predmetne radijske frekvence, uporabnikom omogočati poslovno kritične komunikacije M2M na način, da bo:
    - do 31. 12. 2021 začel uporabljati dodeljene radijske frekvence (postavi vsaj 1 bazno postajo) in
    - do 31. 12. 2025 z dodeljenimi radijskimi frekvencami pokril vsaj 90 % ključnih lokacij posameznega uporabnika storitev namenskega omrežja.
    - ostala območja, ki morajo geografsko pokrivati (občine skupaj) vsaj 75 % ozemlja Republike Slovenije, mora pokriti v časovnih rokih skladno z obrazcem, ki opredeljuje ključne lokacije uporabnikov poslovno kritičnih komunikacij, vendar ne kasneje kot 31. 12. 2030.
- tudi določene obveznosti glede varnosti, neprekinjenega poslovanja in kakovosti storitev (nadgradnja tistih iz večfrekvenčnega javnega razpisa).

Strategija in akcije v povezavi z vertikalami

V obdobju 2021 - 2022 podeliti del spektra v radiofrekvenčnih pasovih **2300 MHz in 3600** MHz za lokalno uporabo, in sicer za zagotavljanje javnih komunikacijskih storitev končnim uporabnikom ali za vertikale preko javnih mobilnih ali zasebnih mobilnih omrežij

V obdobju 2021 - 2022 v primeru pobude izvesti podelitev radijskih frekvenc v radiofrekvenčnem pasu **410-430 MHz** za podelitev spektra za vertikale oziroma za tehnološko/storitveno nevtralno podelitev za področje RS

V primeru prejema pobude v obdobju 2021 - 2023 izvesti podelitev radijskih frekvenc v pasovih **28 GHz in 32 GHz** za vertikale oziroma za tehnološko/storitveno nevtralno podelitev za lokalno uporabo ter pri tem zaščititi ostale storitve skladno z EC/CEPT

V primeru prejema pobude v obdobju 2021 - 2023 izvesti postopek podelitve radijskih frekvenc v pasu **3800 – 4200 MHz** za vertikale oziroma za tehnološko/storitveno nevtralno podelitev za lokalno uporabo ter pri tem zaščititi ostale storitve skladno z EC/CEPT

V obdobju do konca 2025 izvesti prehod iz uporabe frekvenc v spektru 450 MHz na uporabo harmoniziranega spektra v okviru CEPT/EU (**874,4-880 MHz/919,4-925 MHz in 1900-1910 MHz**) na podlagi vloge po upravnem postopku ali pa te storitve vključiti v PPDR vertikalo

Pregled radiofrekvenčnega spektra za mobilne storitve

Digitalizacija industrije z močjo zasebnih omrežij 5G

Industry digitalisation with the power of 5G Private Networks

Janez Öri, Ana Robnik, Jure Zajc, Urban Zaletel
ISKRATEL

POVZETEK

Podjetje Iskratel, ki šteje skoraj 75 let odličnosti in izkušenj na področju zagotavljanja telekomunikacijskih rešitev, že več kot desetletje zagotavlja tudi inovativne rešitve za digitalizacijo industrij. Z uvajanjem najsodobnejših tehnologij in izvajanjem nizko tveganih migracij, Iskratel že dolgo pomaga svojim strankam v telekomunikacijskem in industrijskem sektorju preiti na naslednji nivo poslovne preobrazbe. Na podlagi izkušenj in znanja pri zagotavljanju rešitev pLTE za kampusna omrežja, je Iskratel dognal, da je tehnologija 5G popolnoma primerna za digitalizacijo industrij in B2B sveta v prihodnjih letih. Iskratel bo s svojim prispevkom na konferenci delil svojo vizijo in strateško usmeritev, obravnaval ustrezne tržne trende na področju 5G, raziskal primere dejanske uporabe in ponudil vpogled v to, kako najbolje izkoristiti tehnologijo 5G in izkoristiti zasebna omrežja, ko se odloča za digitalizacijo. Na podlagi Iskratelove strategije izdelkov 5G, njihove arhitekture ter različnih scenarijev uvajanja 5G, bodo udeleženci prejeli veliko odgovorov na vprašanja, ki se pojavljajo glede na tržne potrebe na tem področju.

SUMMARY

Counting almost 75 years of excellence in delivering telecommunications solutions, Iskratel has expanded its reach by innovating and offering solutions for industry digitalisation for over a decade. By deploying cutting-edge technologies and executing low-risk migrations Iskratel has brought their customers to the next level of transformation in telco and vertical sectors. Leveraging experience and know-how by providing Private LTE solutions for campus networks, Iskratel has recognised 5G technology to be a perfect fit for industry digitalisation in the coming years and beyond in the B2B world. With its contribution at the conference Iskratel will share its vision and strategic orientation, addressing relevant market trends with 5G, exploring real use cases, and offer an insight how to best utilise 5G technology and benefit from private networks when opting for digitalisation. The participants will also benefit from Iskratel's 5G product strategy, its high-level architecture, and various core deployment scenarios to answer the variety of customer needs.

O AVTORJIH

Janez Öri je v Iskratelu odgovoren za strateški razvoj. Na več kot 20-letni profesionalni poti v telekomunikacijski industriji je delal na različnih delovnih mestih, začenši z raziskavami in razvojem v Iskratelu, razvojem tehničnih rešitev na področju IP in širokopasovnih omrežij za stranke v podjetjih Cisco in Iskratel ter vodil skupine za produktno vodenje, razvoj poslovanja in trženje. V zadnjih letih soustvarja strategijo Iskratela za preoblikovanje iz klasičnega ponudnika telekomunikacijskih produktov in rešitev v ponudnika celovitih digitalnih rešitev za različne vertikalne industrije. Diplomiral je s področja telekomunikacij/elektrotehnike na Fakulteti za elektrotehniko Univerze v Ljubljani.

Ana Robnik je svetovalka za raziskave in strateški razvoj, koordinira delo v standardizacijskih organiza¬cijah in sodeluje v raziskovalnih projektih podjetja Iskratel. Svojo poklicno pot je po univerzitet¬nem študiju uporabne matematike na Fakulteti za matematiko, fiziko in mehaniko Univerze v Ljubljani in opravljenem magisteriju iz računalništva na Fakulteti za računalništvo Univerze v Ljubljani nadaljevala v razvojno raziskovalni enoti Iskra Kibernetika, nato pa v IT-oddelku Iskratela. Svojo profesionalno pot je nadaljevala na področju razvoja telekomunika¬cijskih produktov SI2000 in nato SI3000 ter do leta 2009 vodila sektor za upravljanje in nadzor omrežnih elementov. S prehodom v pisarno tehničnega direktorja je razširila svoje področje delovanja na domene energetike, javne varnosti ter pametnih in varnih mest. Je koordinatorka vertikale Varnost v Strateškem razvojnem inovacijskem partnerstvu Pametna mesta in skupnosti.

Jure Zajc se kot produktni vodja v Iskratelu ukvarja s področjem upravljanja omrežij 5G, predvsem z vlogo upravljanja omrežij v primeru privatnih postavitev (ang. Private campus deployments). Glede na trende v industriji mobilnih omrežij, vedno večjo raznolikost uporabe ter vedno večje število deležnikov z različnimi potrebami v omrežju, bosta upravljanje in avtomatizacija omrežij zavzela ključno

vlogo pri načrtovanju, optimizaciji in fleksibilnosti celotnega (ang. end-to-end) omrežja. Jure v vlogi produktnega vodje deluje že več kot desetletje ter je v tem času delal v različnih industrijah in z različnimi produkti, največ izkušenj pa je pridobil na področju telekomunikacij.

Urban Zaletel je vodja oddelka za razvoj pete generacije mobilnih omrežij v Iskratelu. V zadnjih desetih letih je bil v različnih vlogah in pridobljene izkušnje pridoma uporablja pri implementaciji strategije v vseh ekipah podjetja, vključno z marketingom in produktnim vodenjem. Je tudi organizator največje tehnološke konference za Oracle tehnologije (Java, APEX, podatkovne baze, …).

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Private 5G networks

Digitalisation of industries

J. Öri, J. Zajc, U. Zaletel, A Robnik, Vitel 2021

Agenda

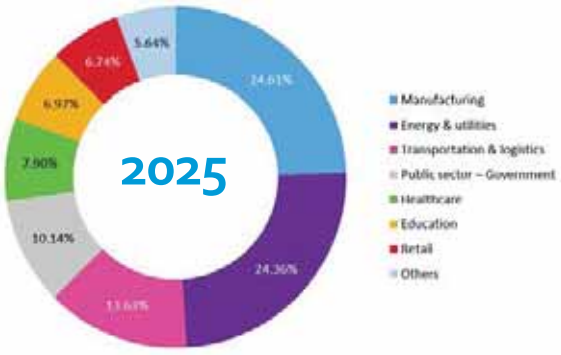
- Industry trends & market potential
- Private networks value chain
- Iskratel answering industry trends
- Telco & Vendor partnership
- What we learned from p/LTE
- 5G as opportunity for transformation
- Iskratel 5G core
- Network planning (example)

Industry Trends

- **Investments in traditional** ICT **slowing down** – „classical" **digitalisation** used to be the main driver
- But **physical industry sectors** projected to have big **growth** in **investments** in ICT
- **Process/cost optimisation** and business agility as the **main value** preposition

Private networks highly demanded in:

- Manufacturing
- Transport industry
- Mission critical communications
- Utilities



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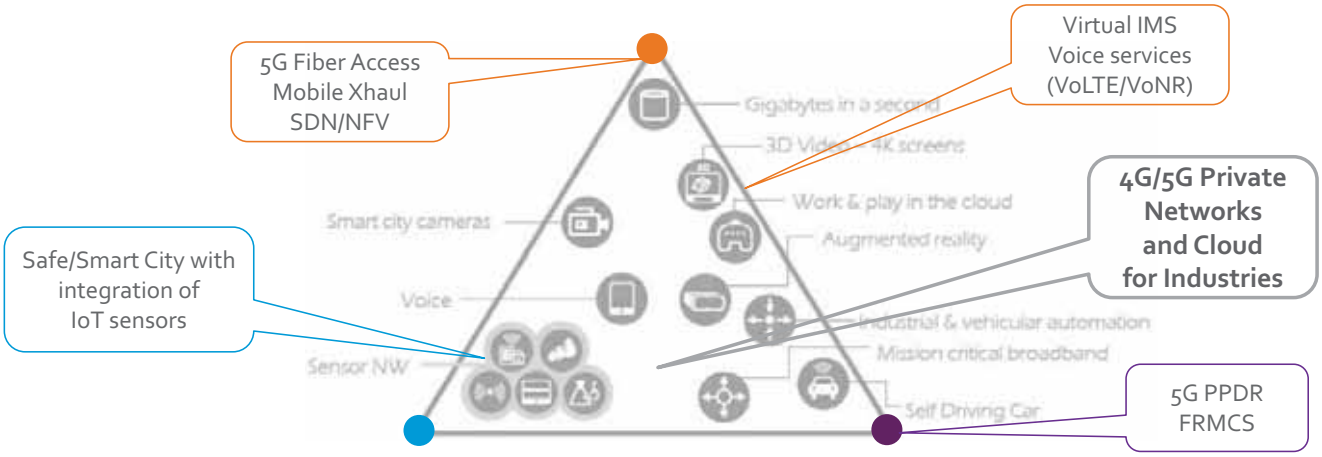
5G Applications and Technologies

Enhanced Mobile Broadband | ***eMBB***

\\\ Capacity Enhancment



Massive Machine Type Comms | ***eMTC***

\\\ Massive IoT Connectivity

Ultra-Reliable and Low Latency Comms | ***URLLC***

\\\ Reliable with Low Latency

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Why do we need Private networks (pLTE/5G)?

Availability of private local spectrum

„Germany decided to create a location advantage for German industry by reserving 100 MHz from 3.7 to 3.8 GHz"

Industrial grade coverage and reliability

Unified and secure network

Supporting the needs of industry digitalisation

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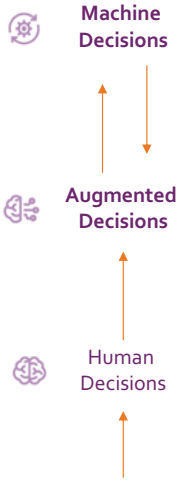
Industry 4.0 and the road to Smart Factory

Industry 4.0



Adaptability	Smart Factory, RPA
Predictability	AI and ML
Transparency	Digital Twin
Visibility	AR / VR / MR, Advanced Analytics
Connectivity	5G, IoT Platforms, API
Computerisation	ERP, SCADA, CRM

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Private networks as Digitalisation enabler

- 5G is **unlocking digitalisation**
- **End-goal:** re-usable, re-sellable, scalable solution catering to industry vertical use case
- **The process:** agile co-development

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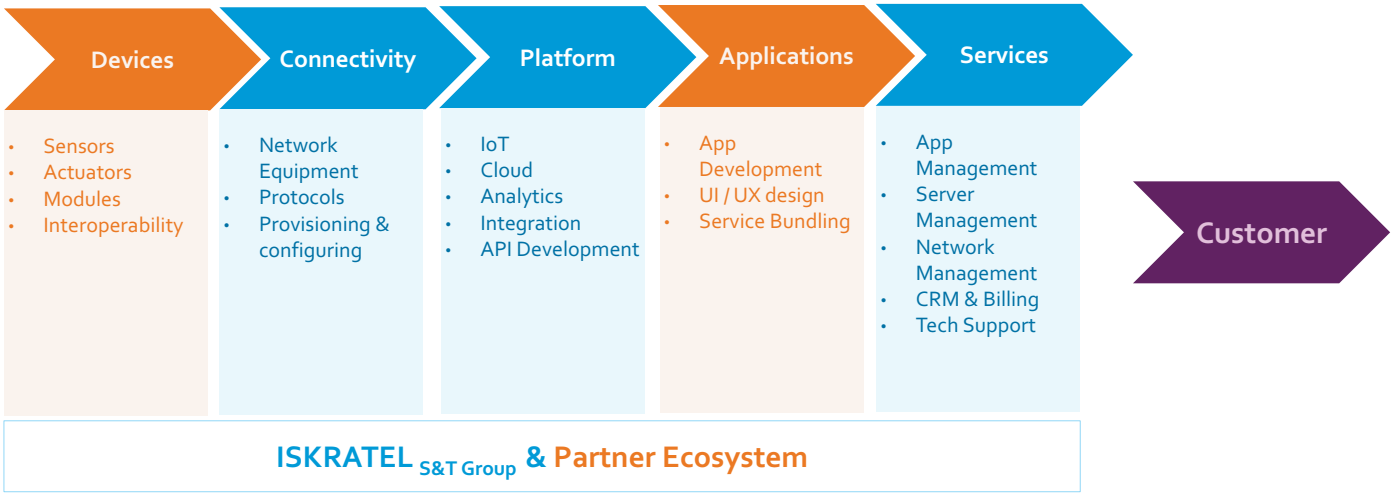
Private networks Value Chain



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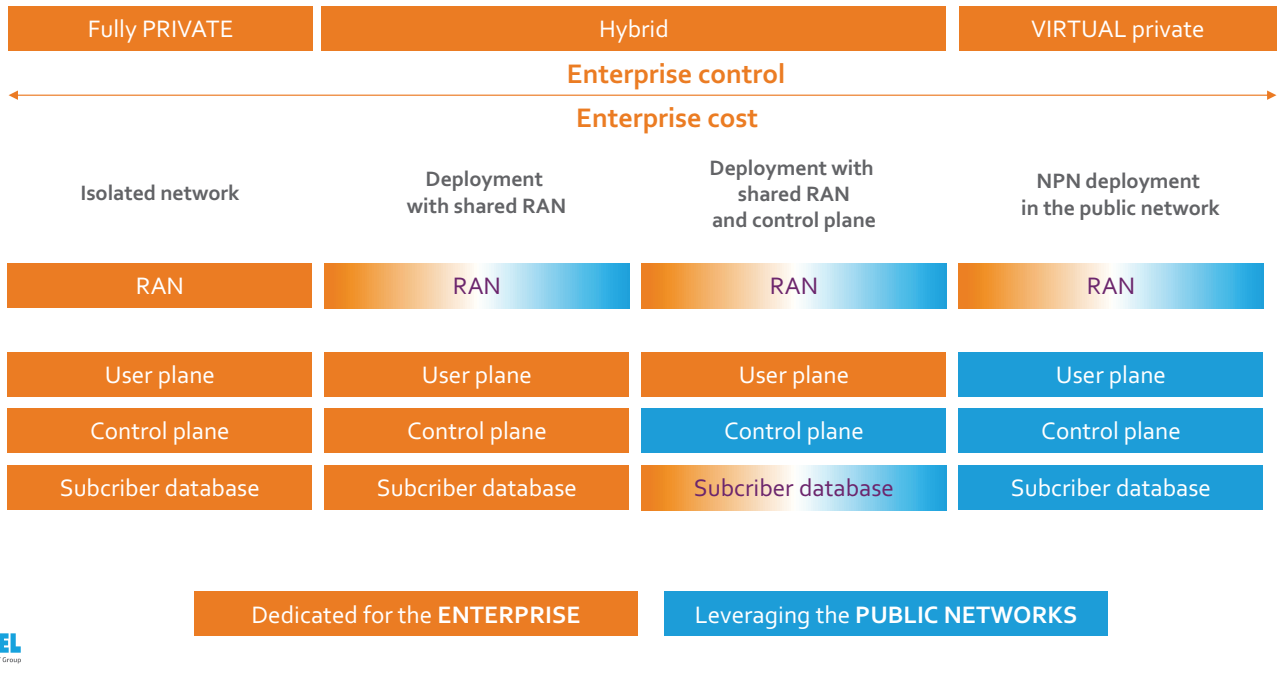
Deployment options for Private networks



Dedicated for the **ENTERPRISE**

Leveraging the **PUBLIC NETWORKS**

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Telco vs. Vendor

PARTNERSHIP

We believe that **Telco/Vendor partnership** is the **best approach** to develop IIoT market.

Each partner brings its strengths.

Telco (CSP)

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Telco vs. Vendor | PARTNERSHIP

Vendor and System integrator (Iskratel)

System integrators and Tech vendors (S&T group)

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Our Competences aligned with Industry Trends

- As a Telecommunications vendor:
  - **Regional leader** (Top 3) in Broadband, Communications and System 112
  - **Experience** and **Know-how** in building **turnkey** mobile **networks** *(Simobil/A1 Slovenia, GSM-R Slovenia, founded BeeIN)*
- **Industry** vertical **presence** and growth strategy
  - Customers with big private networks (oil & gas, railways, energy…)
- pLTE/5G → basis for next generation of Communications in industries
- 5G ecosystem → platform for digitalisation

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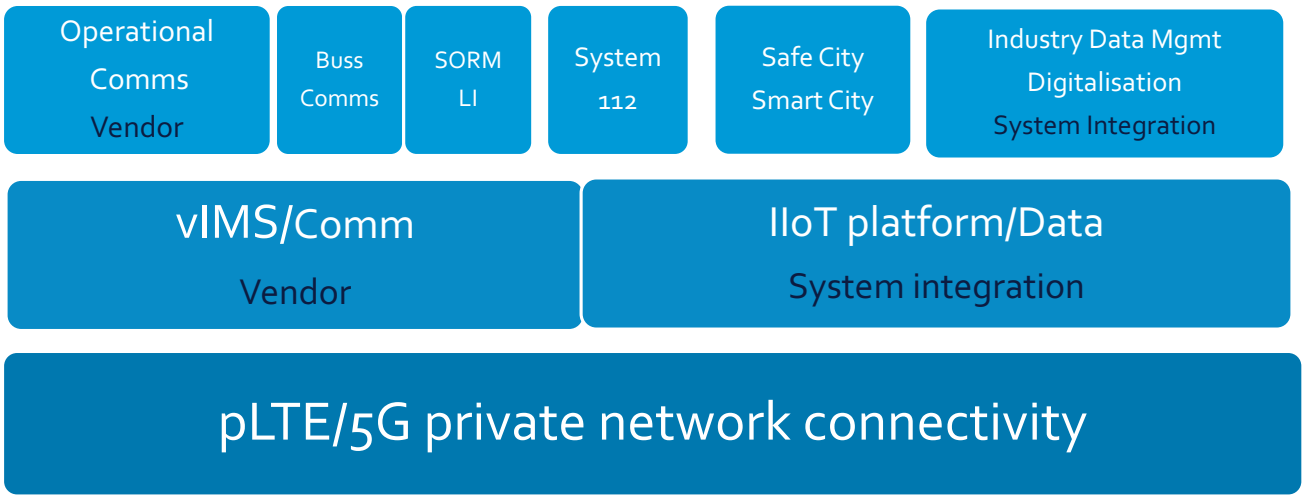
Iskratel Digital Solutions portfolio



Iskratel can realise complex projects for its clients!

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5G Safety Project for PPDR domain as a Learning curve

The strategic goal: to deliver **research and innovation** towards a **new generation of 5G-ready products and services** tailored to the needs of the **PPDR sector**.

The **first** Slovenian 5G research project coordinated by Iskratel

The **first** Slovenian 5G Ecosystem

Leasons learned:

- Broadband Networks **(4G/5G)** will shape the PPDR future, gradual **Migration Scenarios** from existing to future PPDR systems is a fact in Europe, USA and South Korea
- Dispatching Solutions with **Standardized Mission-Critical Service** (MC X) will agile the PPDR operations and enable Pan-European **Operational Mobility**
- **PEMEA** and **OTT applications** will augment the PPDR future
- Business Models and Pan-European Framework for **PPDR Agency** in Slovenia

ISKRATEL S&T Group Telekom Slovenije osi.si

This project has received funding from the European Union's ERDF under Contract no. C3330-18-952019.

What have we learned from pLTE projects?

Key drivers in (pLTE or pre-5G) projects:

1. **Mission Critical Communications** (MCx: PTT, PTV)
2. Integration of **Legacy Communications** (PBX, TETRA) with VoLTE.
3. Early stages of interest **for NB-IoT** (research phase)

Interest in 2020
- 30+ projects
- 80% from CIS

Key industries
- Oil & Gas
- Mines
- Railways
- Airports
- Manufacturing
- Public institutions
- Test beds for Telco operation

Frequency lease
- Partnering with regional Telcos

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5G as Opportunity for Transformation

Network modernisation

- From **HW-Centric** to Cloud-native, Software-defined and SW-Centric infrastructure
- **Simplifying Deployments** with Pre-integrated and Tested Open Solutions

Operational excellence

- **Automated**, real-time data analysis for optimal customer experience
- **Orchestration** (MANO) umbrella for operational-friendly solution
- **Capacity planning** for MC and BC Operations, fully prepared for Service Continuity

Innovative new and differentiated services

- **Flexible** and **responsive** to digitalisation of (physical) Industries And Gigabit Society demands with strong security/privacy and X DevOps/NetOps support
- **Real-time** applications dependent on the combination of 5G and edge computing

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Iskratel 5G Core | Initiatives

3 key initiatives based on industry trends and market research:

1. Basic **5G core is fully standardised** and generic to cover most connectivity needs for private networks.
2. **Adjustment and configuration**, using orchestration and configuration, can enable Iskratel to fine-tune the network to specific needs of the customers
3. With **partner ecosystem** Iskratel offers an E2E solution, customised to a specific industry (including RAN or IoT platform)

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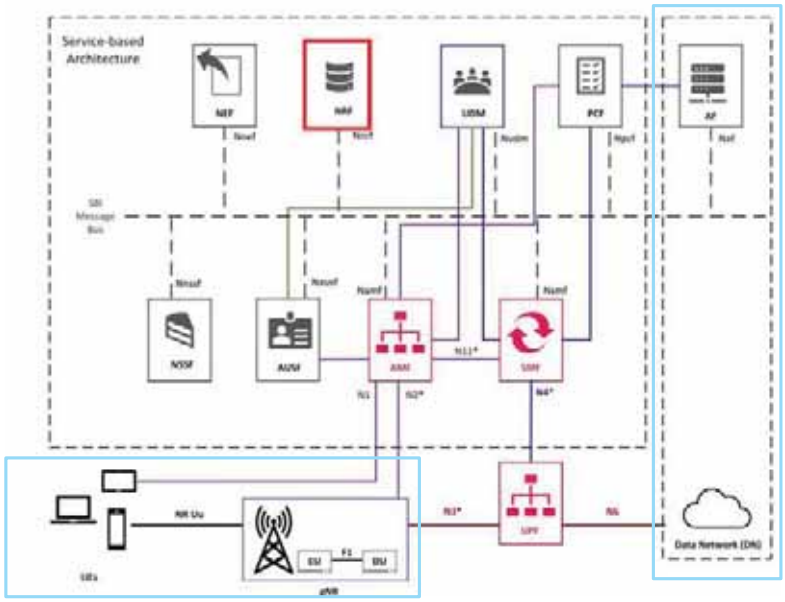
Iskratel 5G

5G SBI arhitecture



Benefits of Service-based Architecture

- Based on optimised internet protocols
- Following the micro-service approach (easy to add new services)
- Using uniform, easy-to-automate protocol in the control plane (HTTP2/JSON)
- Easy to interact with the service administrator and application functions
- Maintains most of the complexity (due to the interaction with RAM and data patch)

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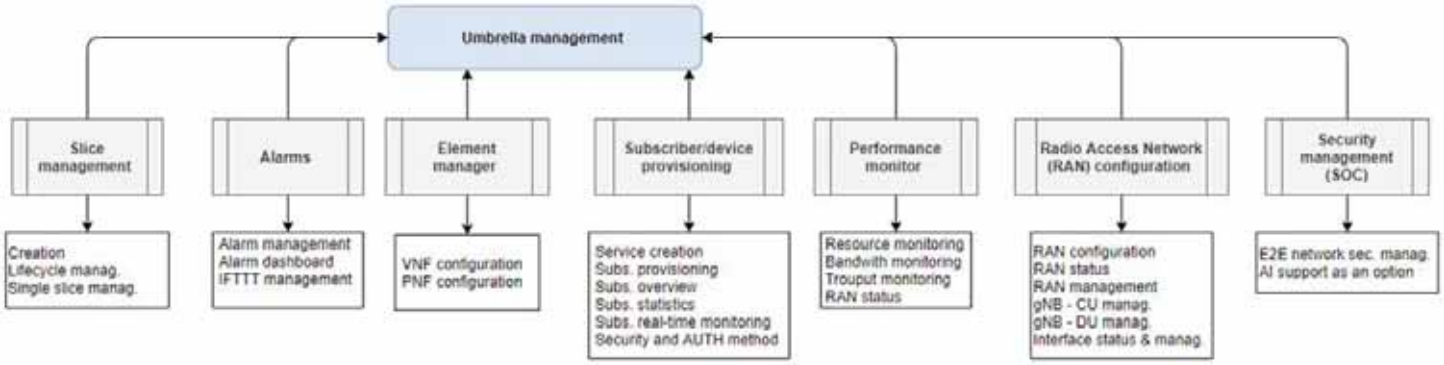
Iskratel 5G

Automation management

Iskratel 5G management platform is designed as an Umbrella management system, consisting of Element manager at it's core. Other management modules are all connected to an Umbrella system, so they can easily interact with each other.



Iskratel 5G

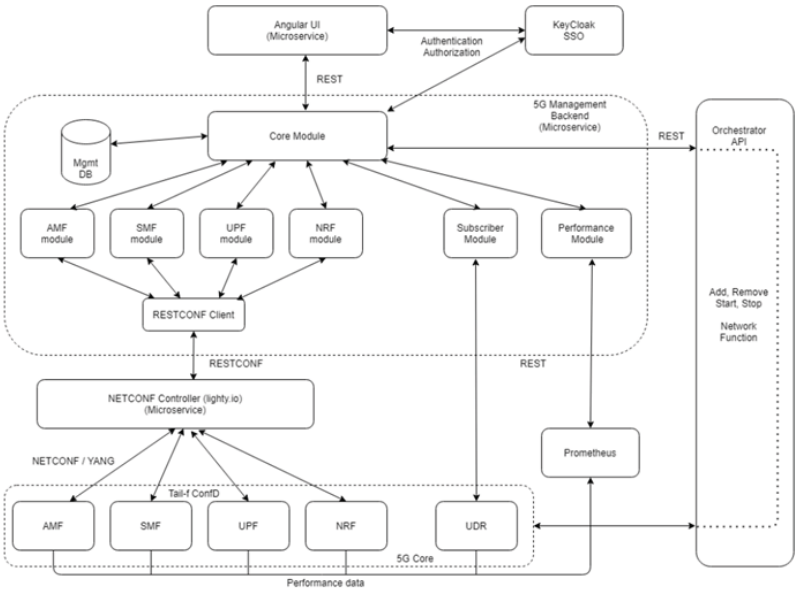
Automation management

Key performance metrics for automation

- Resource assurance
- Optimal resource utilization
- Quality of service (QoS)
- Alarm and performance monitoring
- Security management

Phase 1

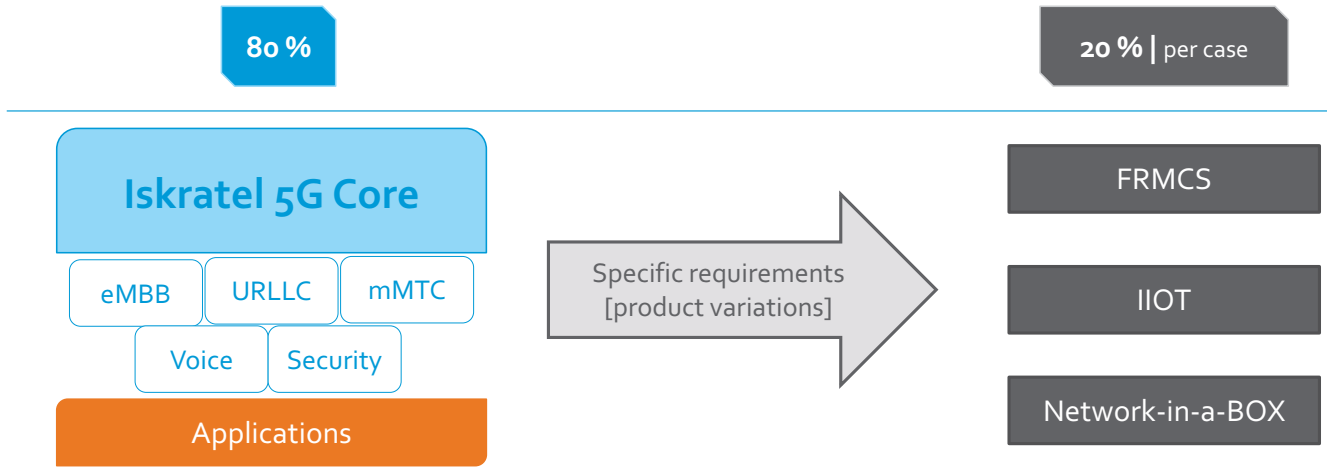
- Performance collection
- NVF configuration
- Orchestration
- Alarm monitoring
- Subscriber management
- IFTTT automation



Iskratel 5G | Variations

80% of **generic solution** is enough to work out-of-the-box

+20% for **customisation** to work with **specific** cases



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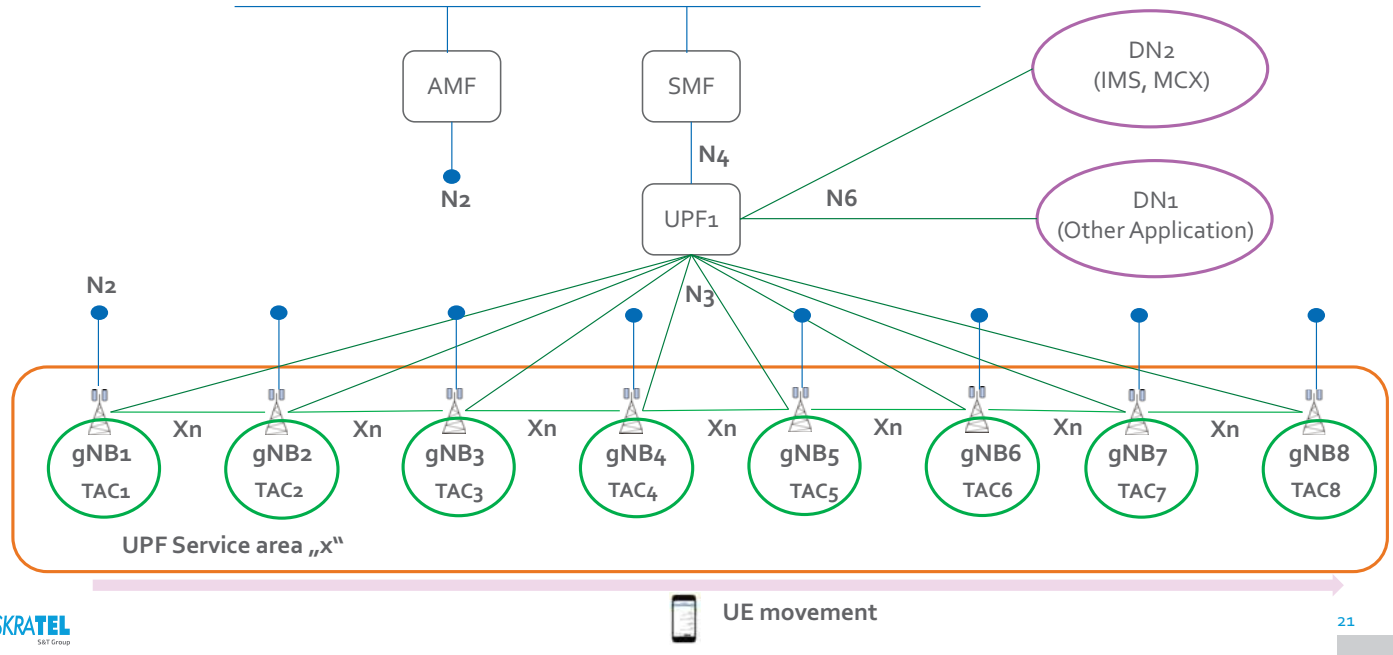
Network planning

Basic Configuration (user plane)



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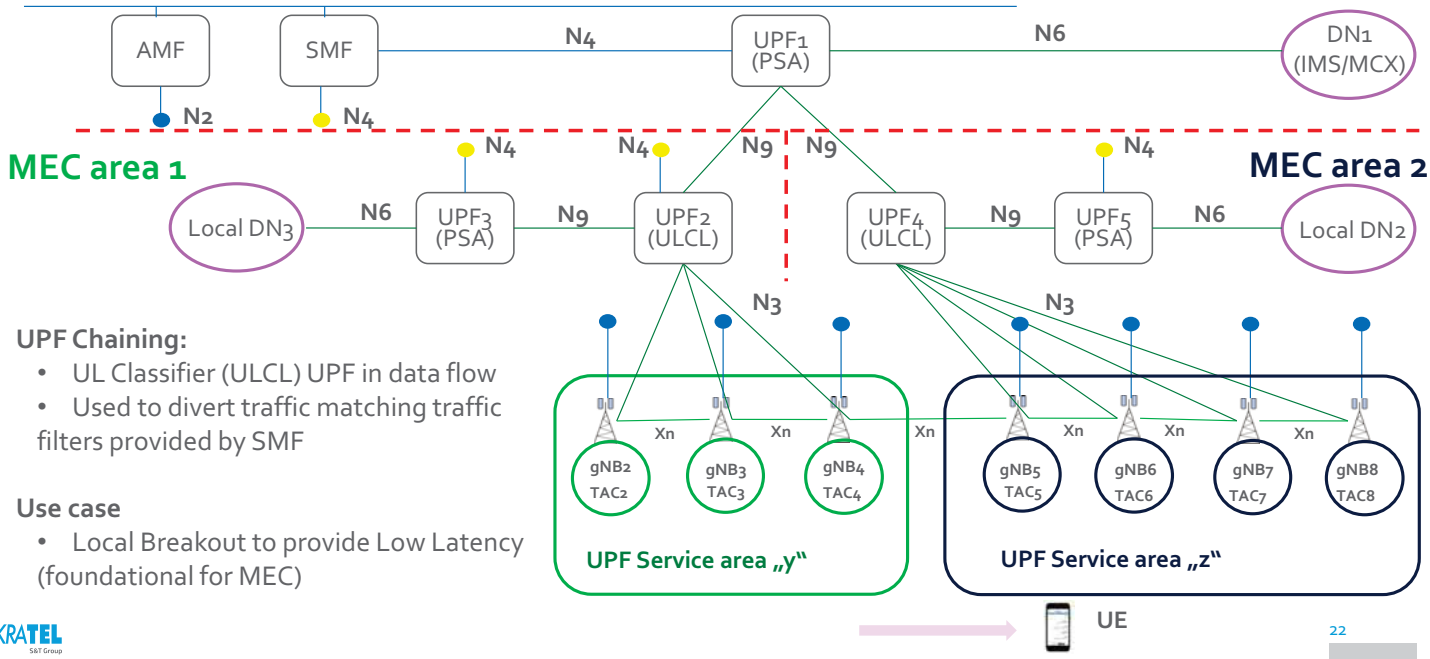
Network planning

Configuration with Edge areas (MEC)



- **UPF Chaining:**
  - UL Classifier (ULCL) UPF in data flow
  - Used to divert traffic matching traffic filters provided by SMF
- **Use case**
  - Local Breakout to provide Low Latency (foundational for MEC)

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Iskratel 5G | Value proposition

For use cases like:

- Public safety and Transportation
- 5G NR private deployments
- Industrial IoT related use cases
- Network-In-a-box solutions (for „small" setups)

Support 3GPP defined standard interfaces:

- Easy to integrate with third-party vendor solution

Support multiple deployment options:

- Easy to setup on any COTS platform to minimizes the CAPEX
- On a private or public cloud-based infrastructure

Designed:

- With Service-based Architecture (HTTP 2.0/JSON)
- Cloud-native Architecture
- Scale as per deployment requirements
- In-build load balancing mechanisms

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*Comprehensive **digital solutions** for a **safe** and **smart future***

EU-based R&D and manufacturing
Global footprint in **50+ countries**
100 million satisfied users
30 locations worldwide
900 employees
Over **70 years** of experience

*The leading European ICT provider for the digital transformation of the **telecommunications**, **transport**, **public safety** and **energy** industries, and in the field of **electronics manufacturing services**.*

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TV over Mobile Network – capacity challenges

Nenad Zeljković

A1 Serbia and A1 Slovenia

SUMMARY

Telecommunication services have different network requirements. On the other side frequencies through which services are provided, have different characteristics in terms of signal coverage and service capacity. FWA, with TV service, is one of the most demanding service from NW capacity point of view, so high frequencies with wide bandwidth are needed. The challenge is service availability in rural area where site2site distance requires low band deployment. The presentation presents possible scenarios of service deployment with different offered capacities.

ABOUT THE AUTHOR

Nenad Zeljković graduated from the School of Electrical Engineering in Belgrade, majoring in telecommunications. He completed his Master degree at the same faculty in the field of mobile radio systems. He completed his EMBA studies in 2013 as part of the Cotrugli Business School program. Following his undergraduate studies, in 1997 he joined Telekom Srbija, where he was mainly in charge of planning and optimization of radio mobile network. From 2008 to 2012 he was holding the position of Head of Access network development and planning department, including the landline network. He joined Vip mobile (now A1 Serbia) in 2012 as a Director of Access and Transport Network, with responsibilities in the area of network planning and construction. In the period from 2015 to 2017, his responsibilities extended to Si.mobile (now A1 Slovenia). Since 2017 he has been in charge of planning, construction and maintenance of Vip mobile access and transport network. Since November 2019, he has been holding the position of Senior Technology Director Officer at A1 Serbia and A1 Slovenia.

TV over Mobile Network capacity challenges

Nenad Zeljkovic

A¹ Slovenia

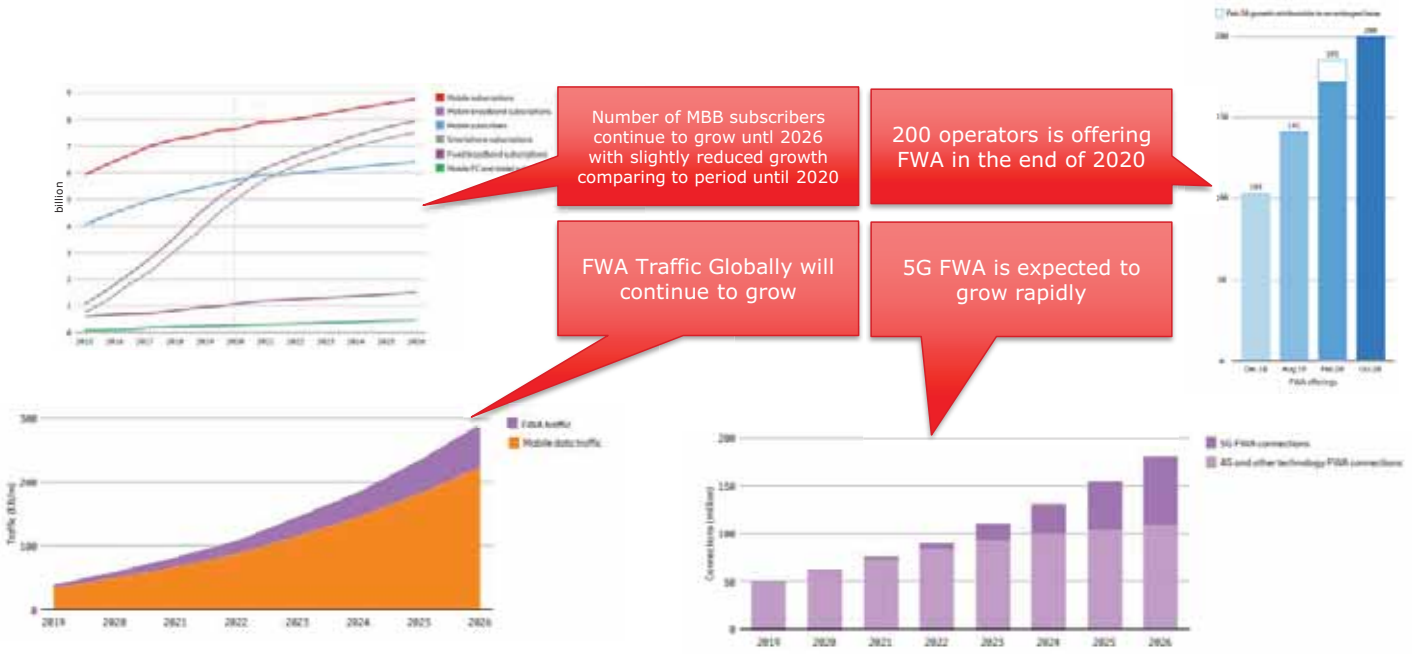
Service Technical Requirements

KPI	Voice	IOT/MTC	FWA	MBB	V2X
Data Rate	2	1	9	8	2
Mobility	9	2	1	4	9
Low Latency	7	3	5	5	9
Density	4	9	2	2	5
Reliability	6	8	5	5	9
Coverage	7	9	6	6	8
Positioning Accuracy	1	2	3	4	5

Priority 1 2 3 4 5 6 7 8 9

	Typical Throughput	Typical Required Coverage	Latency (RTT) Requirements	Connectivity per sector
Voice	~ 10 kbps	>-120 dBm	<200 ms	~200-300
IOT/MTC	<1 kbps	**>-135 dBm**	<100s	~2000
FWA	**10-20 Mbps**	>-105 dBm	<50 ms	~10-20
MBB	5-10 Mbps	>-115 dBm	< 50 ms	~50
V2X	<1 Mbps	>-100 dBm	**<5 ms**	~50

Global Trends for FWA



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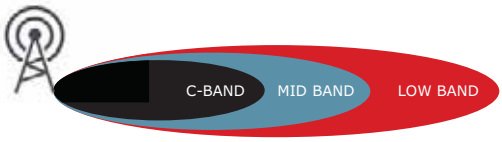
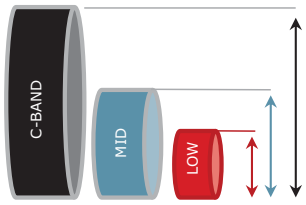
ericsson.com/ mobility-report

Best service footprint



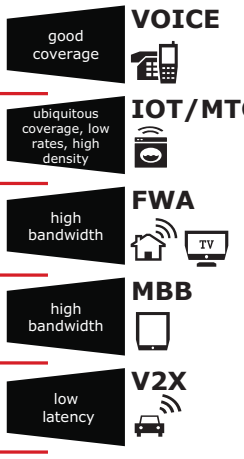
COVERAGE PER BAND



CAPACITY PER BAND

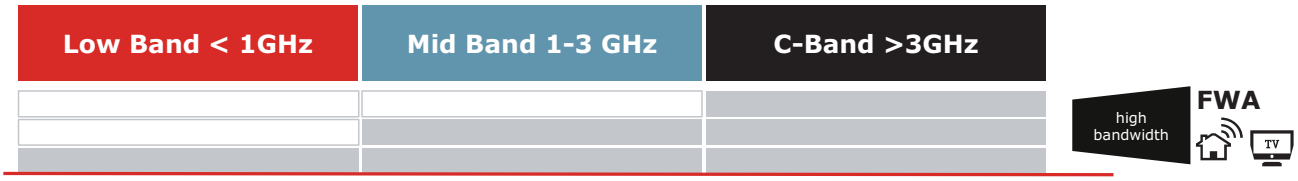
Low Band < 1GHz	Mid Band 1-3 GHz	C-Band >3GHz

Service preference matrix based on band – bandwidth combination



FWA and TV over the mobile NW

- Most demanding service from capacity perspective
- One **FWA without TV** consumes like **27** smart phone users
- One **FWA with TV** consumes like **105** smart phone users



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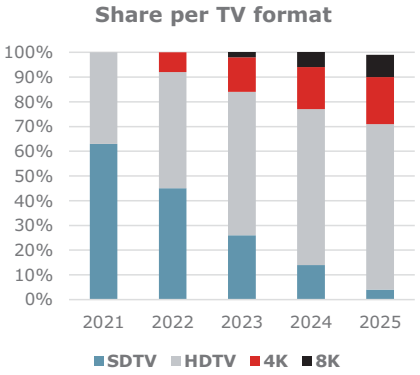
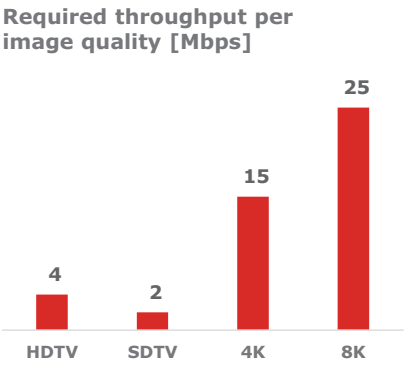
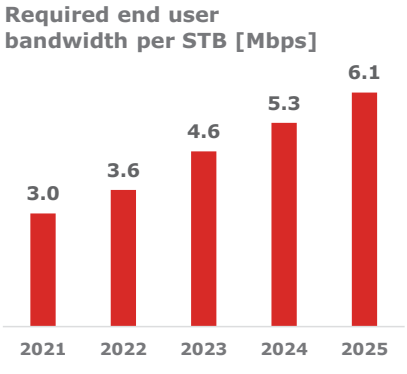
TV service will be even more demanding over the years



HD/4K huge uptake expected



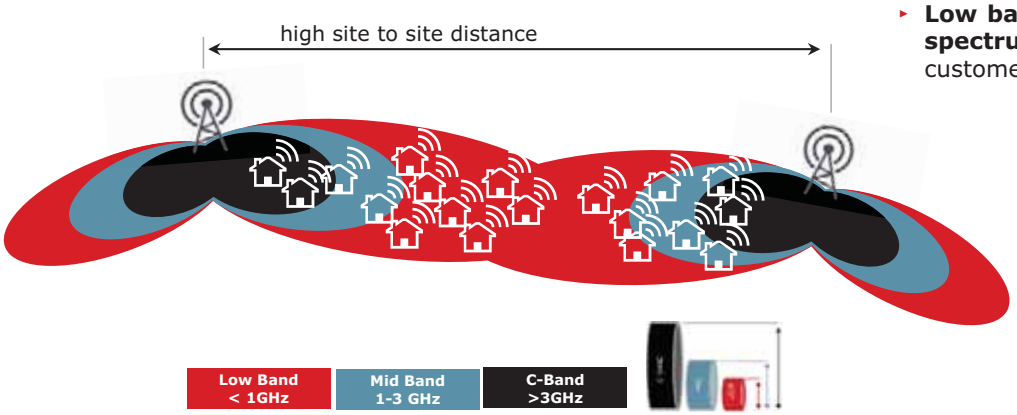
4K requires almost **4 times more bandwidth** comparing to HDTV



In 4 years end user required throughput will be doubled for TV service due to increased higher image definition usage

6

Challenges in rural area

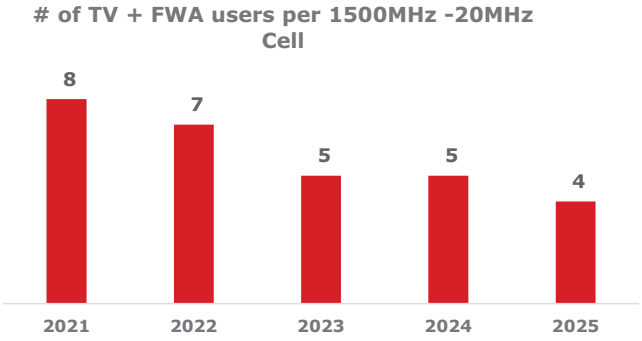


- Due to site to site distance and NW topology, the most loaded part of the NW is rural area
- Cell edge predominantly on low band coverage. Higher bands cannot cover big part of the NW
- **Low band is overloaded with rather poor spectrum efficiency** (15% lower because customers are on cell edge)

In average the same number of customers in rural are served with 10MHz on low band and with 20MHz on mid band -> **Cell load on low band is 30% higher compering to mid band cells**

7

Offered capacity in Rural, high vs low band



- In Rural area out of total available capacity for additional FWA users 2/3 is offered on high band and 1/3 in low (800 MHz) band. Same logic can be applied in case of FWA + TV users
- **In 4 years available capacity for additional users will reduce 2 times only due to increased TV usage**
- As example – one 1500MHz cells (20MHz BW) cell is able to support 8 TV + FWA users in this moment while in 2025 only 4 users per cell will be supported

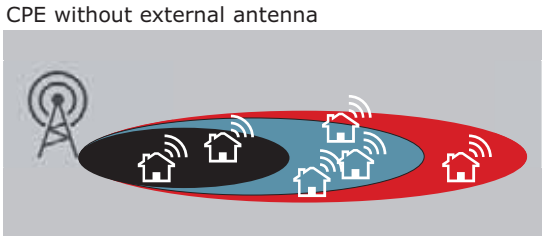
8

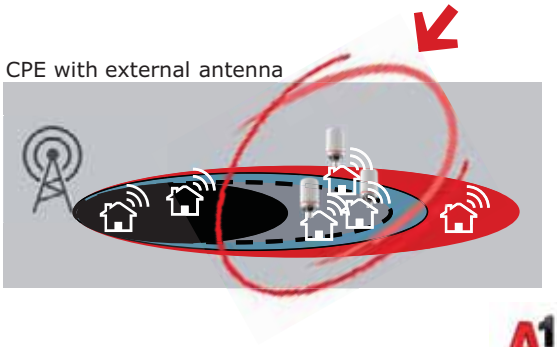
Long term capacity needed

LTE on low/mid bands with additiononal 1500MHz SDL (20MHz BW) could be short term solution
Additinal capacity on 5G is needed to support long term requirements

What are the options?

- **Option 1** – **deployment of NR 700MHz + 1500 MHz** (30MHz of spectrum on top)
- **Option 2** – Deployment of **c-band solution (NR 3600MHz) and CPE with external antenna** (modem installed outdoor with directive antenna)





9

Benefits and challenges for options 1 and 2

OPTION 1

- Does not require outdoor CPE antenna
- Offers same capacity as existing low band (double capacity)

- Requires upgrade of all sites to support 700Mhz in next few years
- TV traffic per customer grows and reduction of offered capacity by 35% is expected in next 2 years

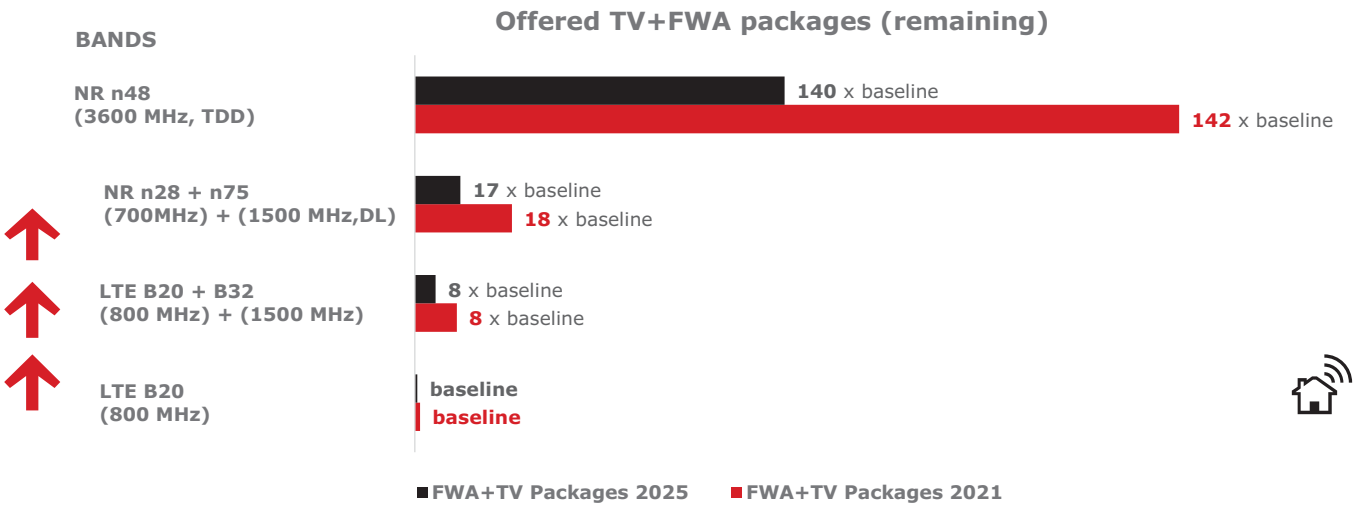
OPTION 2

- NR 3600MHz TDD offers vey high capacity with 100MHz bandwidth
- Better spectrum efficiency

- Issue is weak propagation capability
- It requires external antenna from UE side (result from one trial is that only 15% - 20% customers accept installation works)

10

Capacity ratio per deployed band combination for TV services



11

*Based on smart analytic tool (SARA)

Strateška vpeljava 5G v vertikale

Strategic implementation of 5G in verticals

Primož Kučič
TELEKOM SLOVENIJE

POVZETEK

Javno mobilno omrežje načrtujemo tako, da bomo znotraj ene pametne fizične infrastrukture (poleg komunikacijskih storitev) omogočil številna virtualizirana namenska omrežja za različne vertikale, kot so logistika, transport, zdravje, energija, industrija, pametna mesta, skupnosti ipd. Kot popolnoma virtualizirana ali pa kot hibridna javno-zasebna namenska oz. t. i. »kampus« omrežja bodo namenjena potrebam posameznega okolja, ki bo na ta način pridobilo zanesljivo povezljivost za svoje procese.

SUMMARY

We plan our public mobile network in such way that within one smart physical infrastructure (in addition to communication services) we will enable many virtualized dedicated networks for various verticals, such as logistics, transport, health, energy, industry, smart cities, communities, etc. As a fully virtualized or as a hybrid public-private dedicated or. "Campus" networks will be dedicated to the needs of an individual environment in order to obtain reliable connectivity for its processes.

O AVTORJU

Primoz Kučič je magister poslovnih ved in je trenutno zaposlen v podjetju Telekom Slovenije d. d. Pred tem je izkušnje pridobival v različnih prodajnih funkcijah v mednarodnih podjetjih. V zadnjih letih (2014-2019) se je v Telekom Slovenije d. d. kot vodja IKT poslovnih rešitev ukvarjal z razvojem in prodajo celovitih IKT rešitev za poslovni trg. Ima izkušnje s širokim portfeljem storitev iz področja omrežnih rešitev, data centrov in oblačnih rešitev, upravljanja IT, prodaje programske opreme, telekomunikacij in varnostnih rešitev. V zadnjih letih je sodeloval tudi pri razvoju in prodaji aplikativnih rešitev za končne uporabnike. Od julija 2019 je direktor Poslovnega trga in od februarja 2020 direktor podjetja Avtenta d.o.o. Njegove glavne usmeritve so prodaja in razvoj celovitih IKT rešitev ter digitalizacija poslovanja.

ABOUT THE AUTHOR

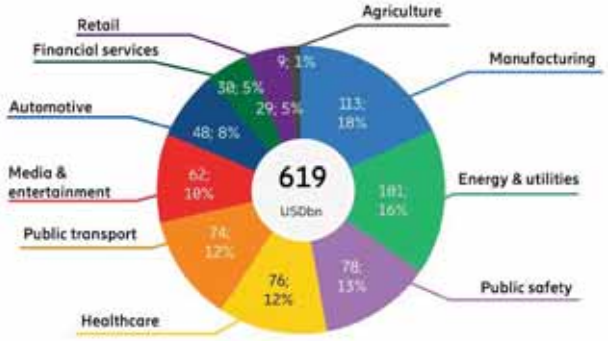
Primoz Kučič has a master's degree in Marketing and is currently employed by Telekom Slovenije d.d. Prior to joining Telekom Slovenije d.d. he has gained experience in various sales functions in international companies. In recent years (2014-2019) in Telekom Slovenije d.d. as a manager of ICT business solutions, he was engaged in development and sales of comprehensive ICT solutions for the business market. He has experience with a wide portfolio of services in the field of network solutions, data center and cloud solutions, IT management, software sales, telecommunications and security solutions. In recent years, he has also been involved in the development and sales of application solutions for end users. Since July 2019, he has been Director of B2B in Telekom Slovenije d.d. and since February 2020 he has been director of Avtenta d.o.o. His main orientations are sales and development of complete ICT solutions and the digitalization of business.

Strateška vpeljava 5G v vertikale

TelekomSlovenije

Strateške vertikale, ki jih poganja 5G

- Industrija
- Energetika
- Transport
- Logistika



- Kmetijstvo
- Javna varnost
- Zdravstvo
- Finančne storitve

*Digitalization revenues for ICT players from 10 key industries
Source: Ericsson and Arthur D. Little

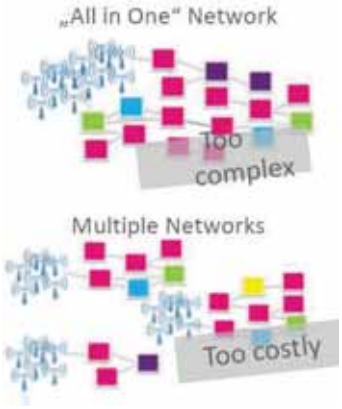
TelekomSlovenije

Rezinjenje omrežja za pokrivanje potreb vertikal

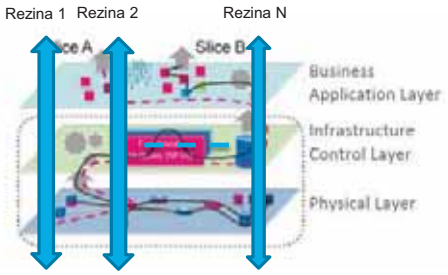
Obstoječe stanje: različni uporabniški primeri
– potreba po fleksibilnosti

5G omrežja omogočajo različne nivoje:
Mobilnosti
Zakasnitev
Odzivnosti
Pokrivanja
Hitrosti prenosa
Funkcionalnosti
Varnosti

Izziv: omejitve obstoječih rešitev!



Rešitev: logična omrežja znotraj enotne fizične infrastrukture

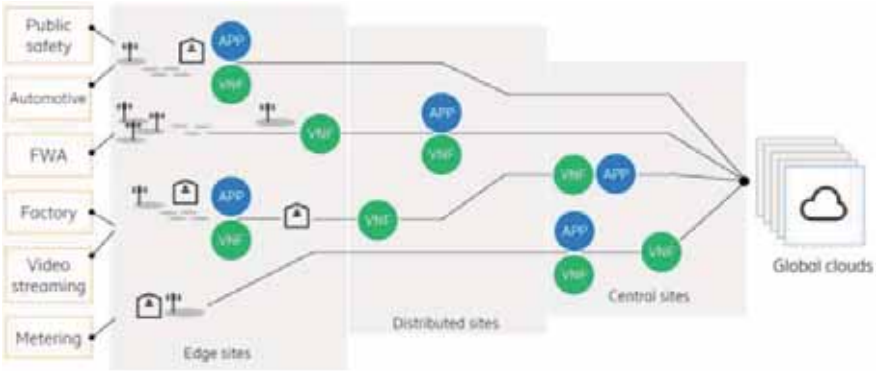


Prilagodljive rešitve
Zagotovljeni viri
Poenoteno upravljanje
Time-to-market
Vertikale
Vrednostna veriga
Inovativnost

TelekomSlovenije

Prilagodljivost omrežja in rešitev

- Zagotavljanje celovitih rešitev znotraj partnerskega ekosistema
- Omogočanje časovno kritičnih storitev s premikom aplikacij proti robu omrežja
- Prilagodljiva programsko definirana omrežna in infrastruktura (SDN: Software Defined Network)

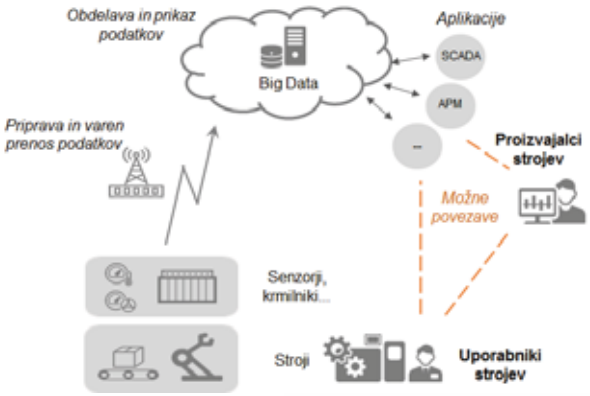


Časovno kritične aplikacije ⟷ Časovno ne-kritične aplikacije

TelekomSlovenije

Zasebna industrijska omrežja

- Industrija je tipično zadržana do novosti
- Vlaganja v digitalizacijo se morajo neposredno pretvoriti v:
  - Nižje proizvodne stroške
  - Boljše poznavanje kupca
  - Večjo prodajo izdelkov in storitev



- 5G omrežja, v okviru industrijskih rešitev omogočajo:
  - Računalniške simulacije z digitalnimi dvojčki
  - Obogatena resničnost z VR napravami
  - Simulacija razvoja novih izdelkov
  - Avtonomni roboti in vozila
  - Optimizacija delovanja strojev in vzdrževanja
  - Odkrivanje in odprava napak v proizvodnji
  - Krmiljenje dronov preko „pameti na tleh“

TelekomSlovenije

Zasebna energetska omrežja

- Energetika in javne dobrine so geografsko razvejane storitve, ki vključujejo:
  - Elektro distribucije
  - Distributerje plina
  - Vodovodna podjetja
  - Komunalna podjetja

- Za optimalno delovanje potrebujejo stalen nadzor, kontrolo ter povratne informacije

- 5G omrežja v tem segmentu omogočajo:
  - Zanesljivo, varno in hitro komunikacijo velike količine senzorjev, merilnikov, preklopnikov, stikal, ipd., s centralnimi sistemi
  - Rezinjenje omrežja, ki omogoča ločen podatkovni promet za različne aplikacije, za različna podjetja
  - Podvojene komunikacije za primere katastrofičnih izpadov

TelekomSlovenije

IoT in M2M

- Rešitve za „pametno mesto“:
  - Upravljanje parkirišč in usmerjanje na prosta mesta
  - Polnilna infrastruktura za E-vozila
  - Štetje in kategorizacija prometa
  - Pametna razsvetljava
  - Merjenje kakovosti zraka
  - „Pametne smeti“

- Rešitve za mobilnost in logistiko:
  - Optimalna povezljivost za upravljanje koridorjev za avtonomno vožnjo in V2X povezave
  - Rešitve za povečevanje varnosti in učinkovite intervencije na prometnicah
  - Umirjanje prometa in avtomatizirano štetje prometa na vseh vrstah cest

- Rešitve za agrikulturo:
  - Optimizacija porabe gnojil in vode
  - Sledenje živine in drobnice
  - AI prepoznavanje škodljivcev za optimalno uporabo škropiv
  - Spremljanje uporabe kmetijske mehanizacije za optimalno izkoriščenost

TelekomSlovenije

Javna varnost in reševanje

- Posredovanje ob nesrečah in izrednih dogodkih je lahko učinkovitejše
- Avtomatski zajem informacij in obogatitev s kontekstom
- Takojšnja komunikacija med posredovalci
- MCPTT (Push-to-Talk)

- Vključitev strokovnjakov
- Multimedijska sporočila in videoklic (MCVideo, MCData)

- Vključitev senzorjev, telemedicina.
- Napredne rešitve in storitve

- 5G prinaša ključne tehnološke lastnosti za kritične komunikacije (MC - Mission Critical).
- Zagotovljeni kvalitativni parametri prenosa (QoS).

- Ločen PPDR frekvenčni spekter, ločena rezina na komercialnem spektru
- Široko pokrivanje, visoka zanesljivost, razpoložljivost in varnost

TelekomSlovenije

5G in platforme – omogočitvena tehnologija za različne uporabniške scenarije pametnih vasi, mest in skupnosti

5G and platforms – enabling technology for different user scenarios of smart villages, cities and communities

Zoran Vehovar[1], Blaž Peternel[2]

[1]TELEMACH, [2]SMARTIS

POVZETEK

Tehnologija 5G obeta zagon veliko novih uporabniških scenarijev pametnih vasi, mest in skupnosti ter industrije in ostalih družbenih storitev. Ponovno se soočamo z zlivanjem tehnologij, različnih ponudnikov rešitev (senzorika, platforme, 5G komunikacijski sistemi, itd.) ter interdisciplinarnimi izzivi, ki izvirajo z različnimi pristopi deležnikov k reševanju in načrtovanju istih uporabniških scenarijev. Prispevek bo skušal podati odgovore in hkrati osvetliti principe načrtovanja rešitev na način, ki združuje priložnosti ter predstavlja dodano vrednost za operaterje komunikacij, ponudnike platform in ostalih nišnih vertikalnih rešitev ter so hkrati odziv na realne uporabniške potrebe. Veliko smo se naučili v okviru pravkar aktualnega razpisa za Pametna mesta in skupnosti!

SUMMARY

5G technology is evolving into global network & integration service platform aiming to serve the needs of automation in wide range of verticals. The purpose of the presentation is to provide an insight into integration platform from the viewpoint of the vertical or its service development. We'll take a look into key technologies and enablers which are required for successful development and concrete benefits and automation targets of the vertical. To materialize that we'll depict some concrete examples where the development already takes place. 5G will be presented as an interconnecting and enabling technology for deployment of local developers' IoT solutions and long-term development of various verticals.

O AVTORJIH

Zoran Vehovar se je Telemachu pridružil z začetkom leta 2021 kot član poslovodstva družbe, odgovoren za tehniko (CTO). Pred tem je v banki NLB vodil področje IT infrastrukture ter kibernetske varnosti, sicer pa svoje obširne vodstvene in strokovne izkušnje s področja telekomunikacij, informacijske tehnologije in kibernetske varnosti nabiral v družbi Mobitel, Telekom Slovenije in Northwestel v Kanadi. Po izobrazbi je magister elektrotehnike, certificiran pa je tudi na področju revizije informacijskih sistemov in kibernetske varnosti.

Blaž Peternel se je SmartISu pridružil leta 2016 kot vodja raziskav in razvoja. Doktoriral je iz področja telekomunikacij in deset let vodil raziskovalno skupino v okviru nacionalnega operaterja. Njegove raziskovalno-razvojne aktivnosti so usmerjene na različna področja Interneta stvari (pametna omrežja, eZdravje, povezan/pameten dom, pametna mesta, agro in bio senzorika). Tekom kariere je pridobil veliko izkušenj z aktivnim sodelovanjem v projektih Sedmega okvirnega programa (FP7), programa Obzorje 2020 in drugih nacionalnih ter mednarodnih RR projektih, kjer je vodil delovne sklope ter druge organe upravljanja velikih mednarodnih projektov.

ABOUT THE AUTHORS

Zoran Vehovar joined Telemach in January 2021 on the position of Chief Tehnology Officer. Before joining he worked at NLB Bank as IT Infrastructure and Cybersecurity director. Zoran posess extensive experience gathered while working on various management positions in telecommunications, IT and cybersecurity in Slovenia and abroad, at Mobitel, Telekom and Northwestel Canada. He holds Masters degree in Electrotechnical Engineering, he is also certified in IT audit and cybersecurity.

Blaž Peternel joined SmartIS in 2016 on the position of Head of Research and Development. He was awarded with a Ph.D. degree in the field of Telecommunications and has more than ten years of experience as a telecommunication operator's research group leader. His research interests focus on various deployments of IoT ecosystems (e.g.: Smart Grid, eHealth, Connected/Smart Home, Smart City, Agro, Bio/Nature and Environment sensoring). Throughout his career, he has gained extensive knowledge and experience in FP7, H2020 and national R&D projects and has become one of the key personnel involved in these projects.

Zoran Vehovar, Blaž Peternel

5G in platforme – omogočitvena tehnologija za različne uporabniške scenarije pametnih vasi, mest in skupnosti

VITEL 2021, 17. in 18. maja 2021

telemach

SmartIS PAMETNI INFORMACIJSKI SISTEM

Uvod

- 5G postaja vodilna globalna omrežna odprta integracijsko/storitvena platforma za širok nabor vertikal (industrij) v prihajajočem desetletju
- Namen te prezentacije je ponuditi pogled na *integracijsko platformo 5G z vidika vertikale oziroma programskega razvijalca aplikacije*
- Ključno je

A: tesno sodelovanje IT razvojnih firm ter ponudnikov 5G omrežnih tehnologij, da bi pokrili celoten digitalni ekosistem vertikale

B: 3GPP standardizacija podlaga za tesno integracijo 5G in digitalnega ekosistema vertikale, primer je izbira REST API

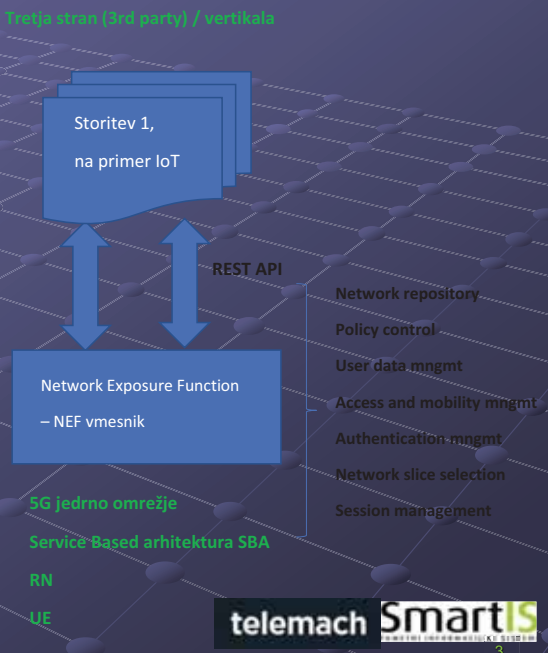
- Pogledali bomo, katere ključne tehnologije in omogočevalniki bodo potrebni za uspešen razvoj integracijsko storitvene platforme za vertikale – rezinjenje, virtualizacija oz navidezna zasebna omrežja, programsko upravljana omrežja (SDN), Kubernetes, obdelava podatkov v oblaku, internet stvari, RESTful API, NEF, SBA
- Predstavili bomo konkretne primere uporabe, katerih razvoj že poteka

telemach SmartIS

2

RESTful API za 5G Service Based Architekturo

- REST arhitekturni stil: Representational State Transfer – nabor design principov v IT, ki uporabljaljajo URI, HTTP, strežnik/odjemalec, stateless… načine – podlaga za razvoj odprtih vmesnikov API, ki spreminja način kako so SW aplikacije razvite in implementirane
- 3GPP: RESTful za vse storitvene vmesnike, tudi interne v jedru
- *NEF*: Network Exposure function: 3GPP definiran vmesnik (exposure of network funcionalities) med mobilnim jedrom in tretjo stranjo, na primer proti programskim razvijalcem platform, na primer spletnih tehnologij
- SBA: Service based arhitektura – 5G Core



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3

Navidezna zasebna 5G omrežja - zakaj

- Ravno zaključena večfrekvenčna dražba prinaša dovolj RF spektra
- Govorimo o milijonih povezanih naprav – tradicionalni način upravljanja naprav in uporabniških profilov ne pride več v poštev
- Identiteta naprave prehaja iz fizične v e-obliko (SIM v eSIM / vSIM)
- Kako bo vertikala upravljala s 5G in uporabniškimi napravami – preko NEF, SBA, z uporabo REST API vmesnikov
- Da bi lahko 5G izrabili učinkovito, se bo MNO moral prilagoditi in velik del kontrole prepustiti vertikalam v obliki navideznih zasebnih omrežij / rezin – avtentikacija naprav, nadzor, varnost, upravljanje rezin
- Omrežno rezinjenje v 5G (slicing) bo tista tehnologija ki bo omogočila zasebna navidezna mobilna omrežja
- Navidezna zasebna omrežja bodo omogočala različno stopnjo neodvisnosti, karakteristik storitve, varnosti / izolacije, načina upravljanja, odvisno od narave in zahteve vertikale

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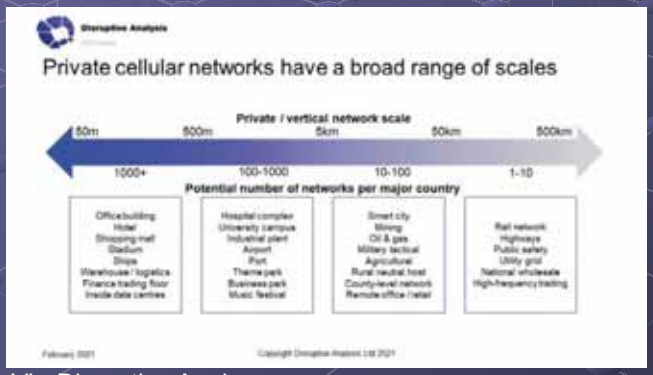
4

Upravljanje zasebnih omrežij

- Upravljanje zasebnih omrežij – omogočitev upravljalske platforme ki bo v domeni vertikale, na primer pametnega mesta ali regije – partnerski razvoj
- Namen: Omogočitev in nadzor storitve (Provisioning and service enablement), konfiguriranje storitve, nadzor kakovosti
- Upravljanje kakovosti storitve (SLA) v življenjski dobi, analitika in orkestracija
- Nadzor na informacijsko varnostjo E2E – nadzor nad šifrirnimi mehanizmi in hranjenje šifrirnih ključev



Vir: Disruptive Analyses

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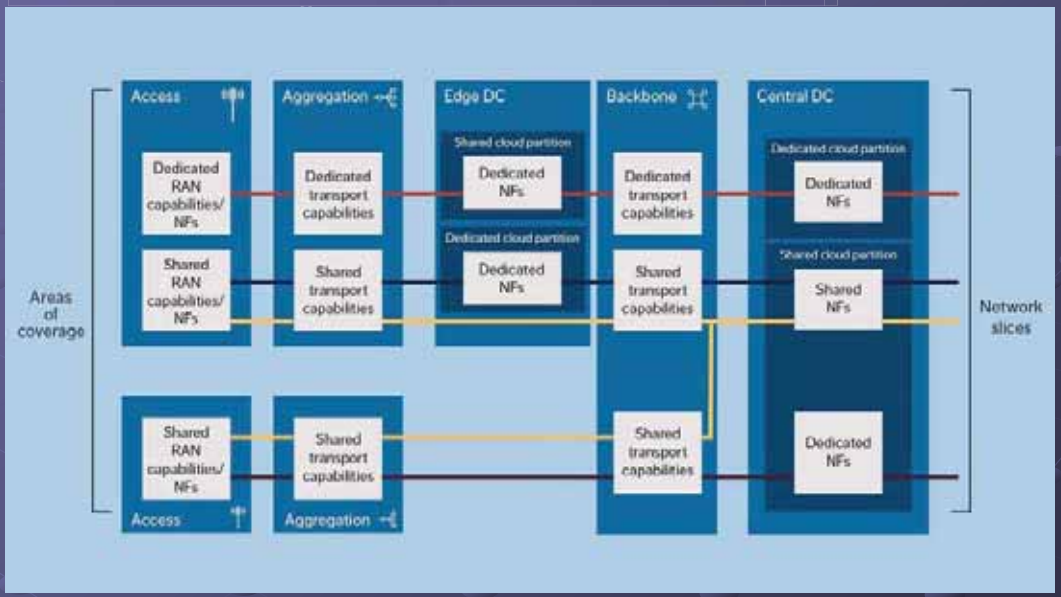
5

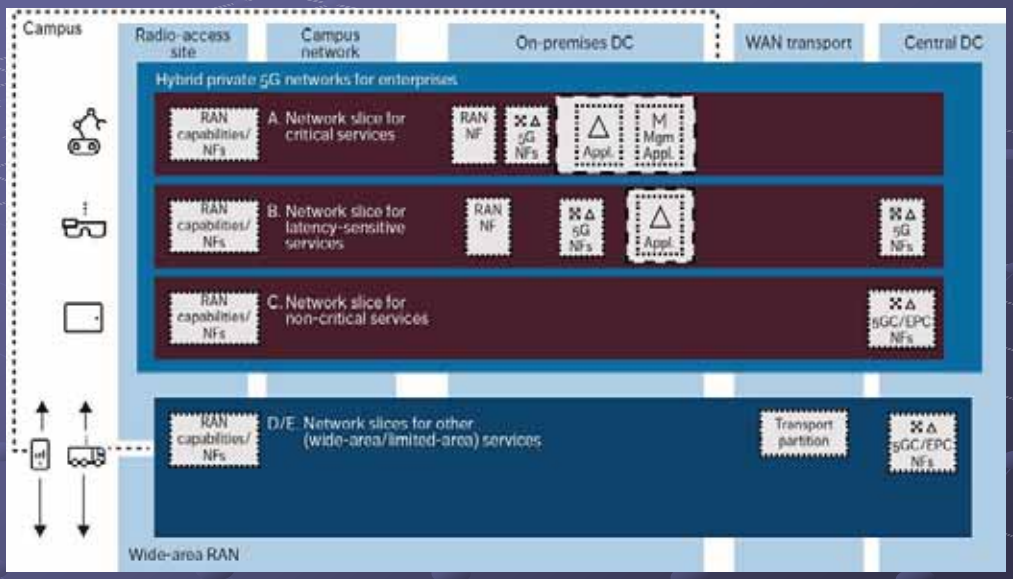
Namenski in deljeni 5G omrežni viri



Vir: Ericsson

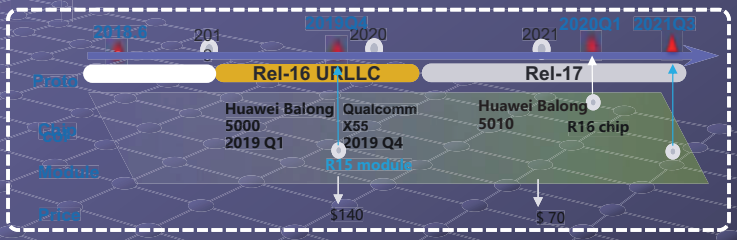
6

Omrežne rezime – različne vertikale



Vir: Ericsson

B2B industrijski ekosistem postaja zrel s prihodom 5G Modulov, s ceno enote <US$70 konec 2020



The module uses Qualcomm X55 and HiSilicon Balong 5000 chips.

Huawei launched the first industrial 5G module in 2019 Q4 and other 5G modules in batches in 2020 H1

QUECTEL: RG500Q/RG510Q/RM500Q/RM510Q
Fixed wireless access, mobile hotspot, cloud PC, public security, and video surveillance

China Mobile IoT: F02X and F03X
VR/AR, video surveillance, Industrial Internet, and PC

Sunsea AIoT: SIM8200EA-M2/SIM8200G/EX510
Mobile terminals, hand-held devices, cloud PCs, and fixed wireless access gateways

SIMCom: SIM8200,SIM8300,SIM8200-M2,SIM8300-M2
Fixed wireless access, multimedia video, security surveillance, and cloud PC

Fibocom: FB101/FB150
Cloud PC, gateway, industrial monitoring, telemedicine, UAV, VR/AR

WINGTECH: WM518
Industrial Internet, smart transportation, smart healthcare, public security, new media, and smart living

Sierra Wireless: AirPrime 5G module
Industrial Internet, smart transportation, smart healthcare, and smart driving

Huawei: MH5000
VR/AR, V2X, smart manufacturing, energy Internet, UAVs, and healthcare

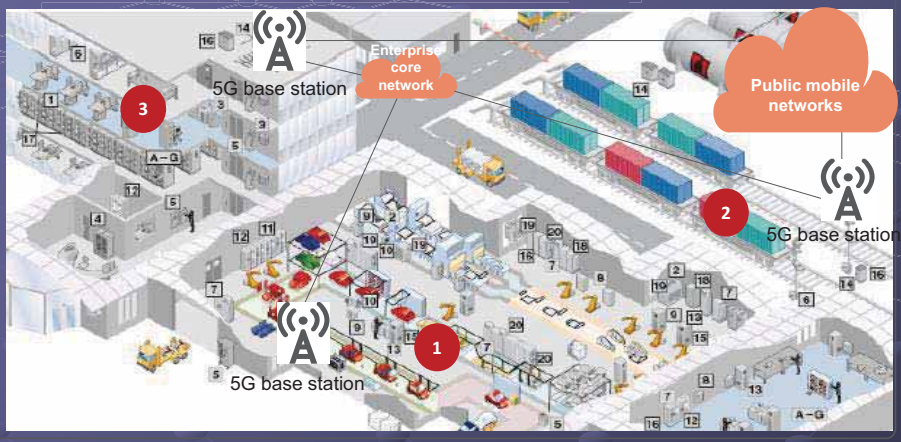
Vir: Huawei

Kdaj? Možna časovnica

Vir: Huawei

9

Deutsch Telecom: primer 5G Campus omrežja v industriji



- Glavna področja: 1 Proizvodnja, 2 Logistika in skladišče, 3 Pisarne in IT
- Ključne tehnologije: 5G logična rezina - Multi-Cloud, varna, zanesljiva, fleksibilna in odprta arhitektura

Vir: Huawei

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5G in IoT platforme

- IoT platforme že omogočajo upravljanje naprav preko različnih omrežij in so osnova za različne vertikalne rešitve

telemach SmartIS

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5G in IoT platforme

- IoT platforme v kombinaciji s 5G omogočajo:
  - „Provisioning“
  - Nadzor naprav
  - Upravljanje uporabniških pravic
  - Varnost in avtentikacijo
- •Dodatne funkcionalnost za uporabniške scenarije:
  - Razbremenitev deležnikov vertikalnih rešitev po potrebi za vzpostavitev lokalnih lastnih komunikacijskih rešitev
  - Možnost dodajanja naprav, ki bodo standardizirane
  - Možnost vzpostavitve domenskih skupnih omrežij za upravljavce različnih infrastruktur s skupno IoT platformo (npr.: vodovodi, železnice, …)
  - AI, poročanje, alarmiranje, asset management, itd.

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Poučne izkušnje razpis PMiS 2021

- Razpis: https://www.gov.si/zbirke/javne-objave/javni-razpis-za-demonstracijske-projekte-vzpostavljanja-pametnih-mest-in-skupnosti-jr-pmis/
- Kje bi 5G pomagal:
  - Regijske/konzorcijske mreže IoT naprav za različna področja – težave so z dostopovno tehnologijo, komunikacijskimi moduli in napajanjem
  - Projekti morajo živeti dalje: kdo bo upravljal z omrežnim delom, kdo bo zagotavljal vključevanje dodatnih naprav čez 5 let, kdo bo nadzoroval naprave
  - Pri projektih se vključujejo različni deležniki in prihajajo novi (upravljavci infrastruktur, občinske uprave, …): kdo bo upravljal dostopovne in uporabniške pravice

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Poučne izkušnje: Digitalizacija proizvodnih MSP

- Veliko MSP potrebuje IIoT rešitve
- Problem je dostopovna tehnologija in platforma, ki zagotavlja tudi upravljanje IoT naprav v širšem smislu (vključevanje, nadzor, itd.)
- Obstaja možnost združevanja sorodnih podjetij (skupna rezina v 5G)
- Priložnost je v razvoj celovitega modela za digitaliziranje proizvodnih MSP „na ključ“

telemach SmartIS

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Kaj pomeni biti operater omrežja?

What does it mean to be a network operator?

Iztok Saje

ŠC PET, Višja strokovna šola – telekomunikacije, Ljubljana

POVZETEK

Veliko je govora o 5G vertikalah, predvsem o tehnoloških rešitvah. Pripevek skuša operaterje vertikal opomniti, kaj vse je delo operaterja poleg izgradnje omrežja. Seveda so osnova storitve. Za veliko večino sedanja javna omrežja zadoščajo za razvoj in preiskušanje.

SUMMARY

Technology is a main topic while discussing 5G verticals. Article tries to remind possible operators what is real operator work besides network building. Applications are main driver. Current public networks are good enough for development and testing of applications.

O AVTORJU

Iztok Saje je kot mlad radioamater zašel na FE. Po Iskri Telematiki in IJS (robotika) se je 1992 leta zaposlil na Mobitelu. Ukvarjal se je z načrtovanjem, gradnjo in optimizacijo radijskega dela mobinih omrežij, od NMT do 5G. Pogosto predava na domačih konferencah ter na Višji strokovni šoli za TK v Ljubljani.

ABOUT THE AUTHOR

Iztok Saje studied telecommunications in Ljubljana University. He started his career in Iskra and then spent several years in Robotic department of Jožef Stefan Institute. He joined Mobitel in 1992. He used to work on planning, building and optimization of RAN, from NMT to 5G. He is also lecturer at Vocational College - Telecommunications in Ljubljana.

Kaj pomeni biti operater omrežja?

Iztok Saje
E-mail: iztok.saje@telekom.si še letos . . .
Vitel, Brdo-Zoom, 17. maj 2021

Uvod

Veliko je govora o 5G vertikalah in množici neodvisnih omrežij. Na kaj vse mora pomisliti novi navpični operater?

- katera so prava vprašanja,
- kako močna mora biti ekipa?

Iztok Saje: še letos na Telekomu.

- Vodil je RAN na Mobitelu in TS,
- predavatelj na Višji strokovni šoli za TK v Ljubljani.

Današnje predavanje bolj sodi na VSŠ-TK.

Kaj je operater?

Operater ima omrežje. Lastno, najeto, navidezno ...
Uporabnikom omogoča uporabo lastnih in tujih storitev.
Skrbi za:

- vzdrževanje omrežja in storitev,
- upravljanje z omrežjem in storitvami,
- upravljanje z uporabniki,
- povezave z drugimi omrežji,
- terminalsko opremo,
- zakonske zahteve.

Izgradnja omrežja je še najenostavnejša naloga.

Ali se razumemo?

Isti termin ima lahko različen pomen: ali smo usklajeni?
Različni svetovi: javna in zasebna omrežja, industrija itd.
Zelo veliko pomenov:

- QoS: kakovost storitev. Lahko je parameter, storitev, meritev ...
- Prioritete uporabnikov in storitev.
- Zanesljivost: različni standardi in definicije. Kaj gledamo?
- SLA: ali enako tolmačimo pogodbe?

Težave so že med oddelki v istem podjetju.

3GPP omrežja

Standardizacija: nova izdaja standarda z novimi funkcijami omrežja.

- inačice starejših standardov s popravki.
- sočsno GSM, UMRS, LTE in 5G, tudi ne–3GPP omrežja

Omrežje in terminal se uskladita, uporabljata kar znata oba.
Izbirne funkcije: niso obvezne za omrežja in terminale.

- pogosto omrežje zna, vendar ni terminalov (MBMS, tudi VoLTE)

Razvoj čipsetov: velika naročila.
Ali res potrebujemo funkcije, ki jih (še) ni v terminalih?

Zahtevnost omrežij

2G: ISDN na radiu. GSM, GSM–R, TETRA. Dokaj enostavno.

- dokumentacija na papirju.

UMTS: ATM na radiu. 4G: ethernet na radiu.
5G zahteva vrsto specialistov.

- dokumetacija na DVD.

Poleg 3GPP je še dokumentacija proizvajalca opreme.
Tudi IETF standardi in oprema (Ethernet, optika).
Današnji pametni telefon je bolj zapleten kot prva GSM omrežja.

5G omrežja

4G: zlivanje fiksnih in mobilnih omrežij.
5G: zlivanje IT in TK. Na radiu ni bistvenih razlik s 4G.
Jedrno omrežje: virtualizacija, programirljiva omrežja (NV/SDN).

- Rezine (slice) omogočajo ločeno upravljanje navideznih omrežij in storitev.
- Edge computing: del jedra je pri uporabniku.

Tudi ne-3GPP omrežja (obstoječi WiFi in optična omrežja).

Radijsko omrežje

Povezava med terminali in bazno postajo.
Lasten spekter? Pasovna širina? AKOS.

- Ocena: 5 bit na Hz se deli med terminale v celici.

Postavitev baznih postaj in terminalov:

- ključna je pozicija anten.

Meritve pokrivanja, odpravljanje radijskih motenj.

- inštrumenti, izkušnje.

Sinhronizacija: GPS (kako v zgradbah?), PtP.

Souporaba radijske opreme

Poleg klasičnega gostovanja v omrežjih.
Dve ali več omrežij lahko uporabljajo isto opremo. Privlačno?

- kako se deli vršna moč oddajnikov?
- SW in HW licence: pogosto je primernejša ločena oprema.
- marsikaj (združevanje kanalov) ne deluje z opremo različnih proizvajalcev.

Souporaba pasivne infrastrukture je enostavna.
Kje so odprte bazne postaje?

O&M omrežij

FCAPS: okvare, konfiguracija, (zaračunavanje), zmogljivost, varnost omrežja.

- sodelovanje z ekipami drugih operaterjev.
- prvi nivo zazna napako, drugi in tretji so specialisti.
- 40 različnih ekip v pripravljenosti.

Orodja za

- načrtovanje in optimizacijo,
- spremljanje in preverjanje delovanja,
- diagnostiko in odpravljanje napak.

Kako zagotoviti dovolj podatkov, da se določi izvorna napaka?

- Odzivni časi,
- problem večih proizvajalcev, ki vsi trdijo, da je napaka drugje.

Samodejno upravljanje

Veliko govora o umetni inteligenci in avtonomnih omrežjih.

- kar je treba ustrezno nastaviti in
- spremljati delovanje.
- Sedanja omrežja so že v veliki meri avtomatizirana.

Ne nadomesti strokovnjakov, samo razbremeni jih rutinskih opravil.
Pogosto za težavo ne vemo. Ko jo znamo opisati in ponoviti, je rešitev blizu.
Telemenagemt forum: www.tmforum.org

Programska oprema

Enako kot pri IT: HW je poceni. Denar je v programski opremi.
Zahtevni modeli licenc za prepustnost in funkcije sistema.

- Aneksi k pogodbam so skoraj neizogibni.

Stabilen sistem: zrela verzija SW, samo pogosto uporabljane funkcije.

- Nadgradnje za odpravo pomankljivosti (novi terminali),
- nadgradnja na novo 3GPP verzijo omogoča nove funkcije.

Testiranje in preverjanje pred splošno nadgradnjo sistema.
Težave: bolj redko uporabljane funkcije na določenih terminalih.

Specifične storitve

Danes temeljijo na internet tehnologijah (IMS za govor).
Primer: EU projekt Nexes: navdušenje, in potem?
Kdo in kako lahko dostopa do storitev?

- Samo iz zasebnega omrežja ali tudi z javnih omrežij?

Povezovanje z obstoječimi aplikacijami in bazami podatkov.
Spremljanje delovanja, razhroščevanje, sledenje.
Javne stortve: zadoščajo javna omrežja.

Prometni tokovi

Nujno za nartovanje omrežja:

- Koliko navideznih omrežij potrebujemo? Število terminalov, prepustnost?
- Sedanji in pričakovani običajen in vršni promet,
- prometni profili po storitveh,
- povezljivost z drugimi omrežji.

Koliko se danes uporabljajo javna in zasebna omrežja?
Napovedi za nekaj let.
Zahteve za posamezne stortve.

Zasebnost podatkov in vsebin

Kje so strežniki in omrežni elementi?

- Oblak v Zagrebu ali izven EU (arbitraža?).

Kdo dostopa do omrežja in kaj počne?

- Vzdrževalci opreme.
- Oddaljeni dostop do omrežja.
- Ali poznajo naše omrežje?

Kako zagotoviti nadzor in sledljivost?
Prodobivanje ustreznih certifikatov.

Terminali

Preverjanje skladnosti z omrežjem in storitvami.

- Nadgradnje programske opreme,
- koliko časa so dobavljivi?

Ročni terminali, pametni telefoni.

- Povezljivost v WiFI omrežjem.
- Robustni ročni terminali.

Prenosni terminali: zunanja montaža, dodatna antena.
Terminali, vgajeni v naprave: antena?

- minimalne količine za nakup?

Upravljanje z uporabniki in terminali

Lastne SIM kartice? Upravljanje z SIM, menjave?

- E–SIM: strežniki za upravljanje.

Skupine uporabnikov:

- kakšne profile imajo,
- katere storitve lahko uporabljajo,
- sledenje spremembam, pritožbe,
- uvajanje novih storitev.

Primer storitve

Zbiranje podatkov o nesreči. IoT senzorji, pametni terminali. Kdo dostopa?

- slehernik prek javnih omrežij: določeni podatki

Reševalne ekipe: različni dostopi za različna navidezna omrežja

- ali so podatki ažurni, kdo sme kaj in kdo ima prednost?

Seveda: reševalec, ki si krajša čas na youtube, nima prednosti.

- sočasna povezava v več navideznih omrežij.

Izbira

Kaj bi pravzaprav želeli?

- uporabniki, terminali, storitve

Sami? Slovenski operaterji? Tujci?

- razvoj omrežij v naslednjih letih
- lastna in tuja oprema

Lastna ekipa: poznavanje 3GPP in IETF omrežij.

- je omrežje res moje, če ne nadzorujem izvajalcev?
- usposobljenost za hitre posege.

Danes

LTE zadošča za razvoj in preiskušanje novih storitev ter povezavo z obstoječimi sistemi.
5G potrebujemo za:

- veliko število terminalov,
- višje prenosne hitrosti čez nekaj let,
- manjše zakasnitve v omrežju.

AKOS dražba 2021: 4 operaterji zidajo 5G omrežja
Primer: počasnost pri PPDR strategiji kaže, da tudi za resnično kritične storitve sedanja omrežja zadoščajo.

Nemčija

Malce bolj resno branje na temo:
google: bmwi guidelines campus
dolg link, razbit:
//www.bmwi.de/Redaktion/EN/Publikationen/
Digitale-Welt/
guidelines-for-5g-campus-networks-orientation-
for-small-and-medium-sized-businesses.html

Na koncu

Velika podjetja in organizacije imajo tudi močne ekipe za 5G.

- Kako močne ekipe pripravljajo 5G vertikale v Sloveniji?

Napaka: zberimo denar, kupimo omrežje in bo že kako.
Veliko lažje je, če na začetku vemo, kaj vse je potrebno storiti in pripraviti.
Vsekakor: 99 % storitev deluje zadovoljivo danes na javnih omrežjih,

- kasneje bo prehod na večje število uporabnikov in lastna omrežja lažji.

Ericsson view on Dedicated Networks

Sebastian Elmgren
ERICSSON

SUMMARY

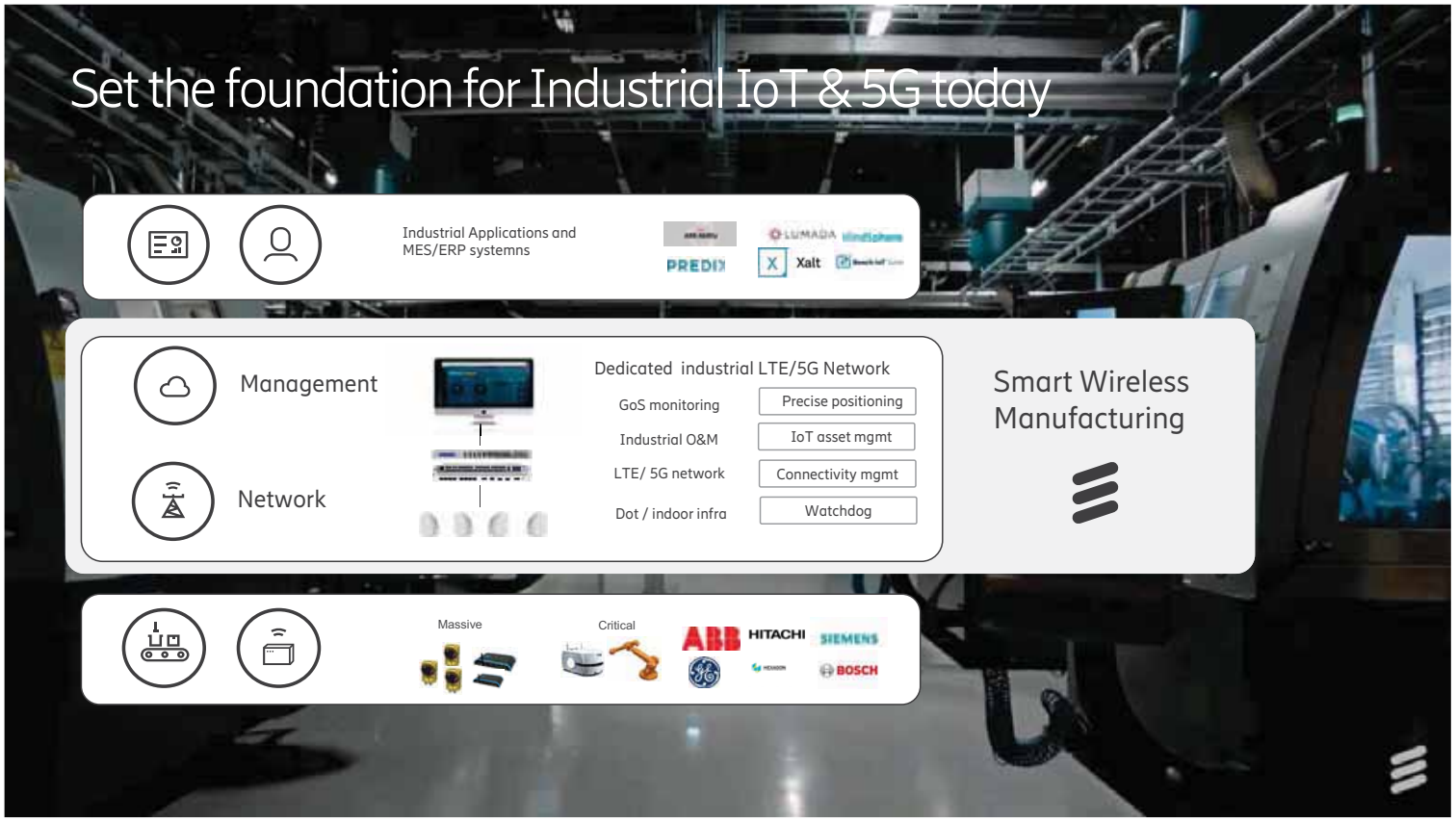
There is a seismic shift happening in industries as they advance towards automation and digitalization. Smart connectivity with dedicated networks (private cellular networks) liberates industrial enterprises to unlock the potential of automation, control, and exponential growth. Listen to Ericsson's approach to this growing area.

ABOUT THE AUTHOR

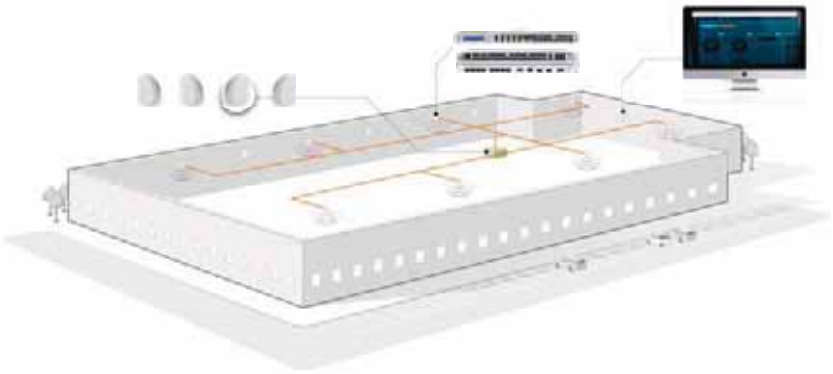
Sebastian Elmgren is portfolio manager for smart manufacturing and leads Ericsson's manufacturing vertical for dedicated 5G networks. Prior Sebastian has been working 10 years within Ericsson's supply organization in different positions and driven global improvement and smart manufacturing projects. Sebastian has a passion for new technology and the impact it has on society and has worked in Estonia, China, Spain, Greece and Cyprus. He holds a Master of Science in Automation and Mechatronics from Chalmers University of Technology.

Linkedin: https://www.linkedin.com/in/sebastian-elmgren-a658779/


Ericsson
Industry Connect

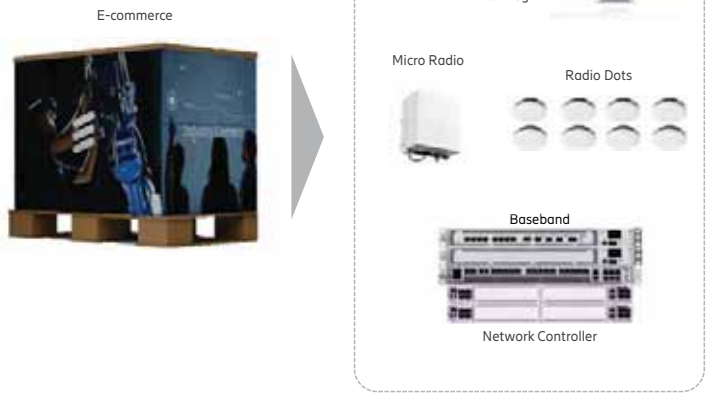

Set the foundation for Industrial IoT & 5G today
Industrial Applications and
MES/ERP systemns
PREDIX
LUMADA
mindsphere
Xalt
Management
Network
Dedicated industrial LTE/5G Network
GoS monitoring
Industrial O&M
LTE/ 5G network
Dot / indoor infra
Precise positioning
IoT asset mgmt
Connectivity mgmt
Watchdog
Smart Wireless
Manufacturing
Massive
Critical
ABB
HITACHI
SIEMENS
BOSCH

Dedicated network for the factory



Ericsson Industry Connect

Optimized turnkey “off the shelf” solution for CSP as reseller using e-commerce



Ericsson Industry Connect

Easy to order

Easy to learn

Easy to use

Channel ready

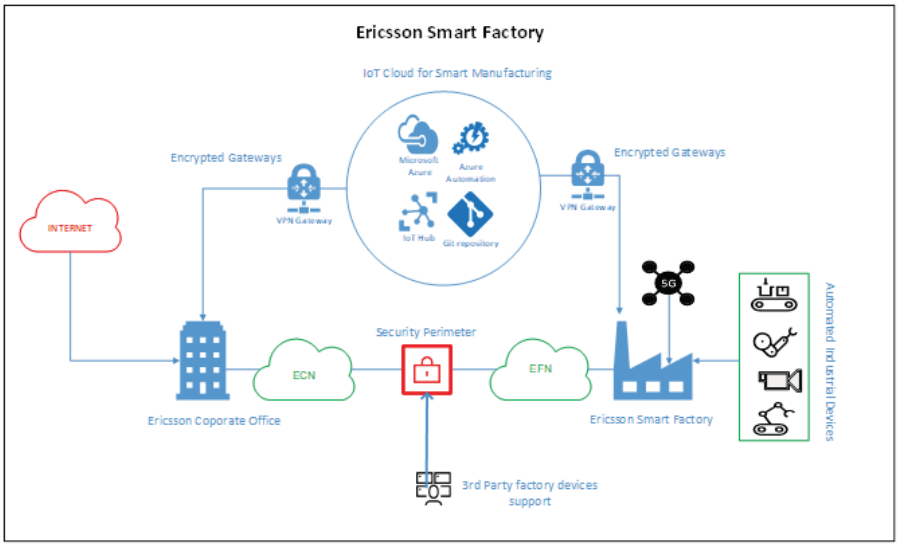
IT centric

Fast and secure wireless connectivity for Industry 4.0

Easy to manage

Easy to support

Ericsson Factory Network



Industry Connect - Wide range of Use Cases

- Connected sensors
  - Predictive Maintenance
  - Safer and healthier work environment
- Connected hand scanners for warehouse picking process

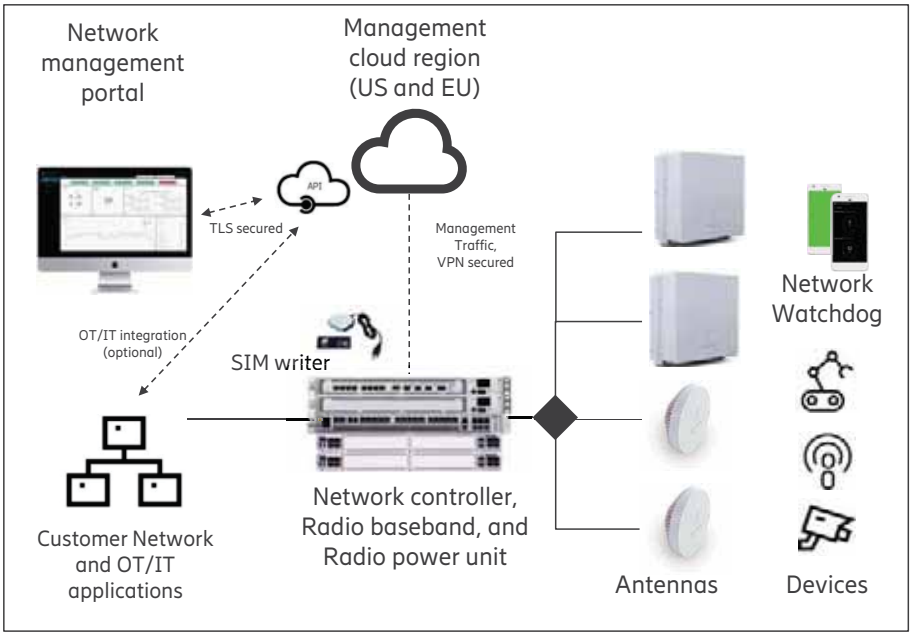
- Smart video surveillance
- AR-enabled tablets

- Remote operations
- Automated Guided Vehicles

- Industry protocols (e.g. Profinet) over wireless (PoC)

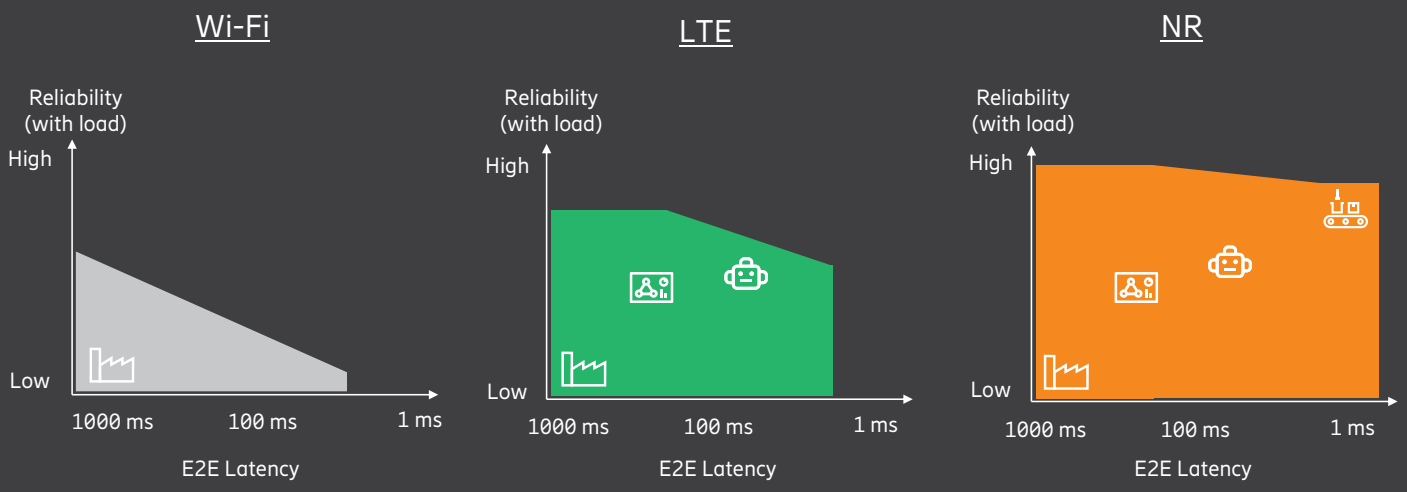
- And more ...

Industry Connect overview



- Plug & play LTE with evolution path to 5G
- Network in a box
- Self-sustained sites
- Leveraging proven Ericsson radio portfolio
- Centralized cloud backend with API integration layer

Move toward 5G



Industry 4.0 wireless ecosystem

ericsson.com/industry4.0

Independent software vendors
Applications ecosystem
Application enablement Platforms
Manufacturing Execution Systems (MES)
Enterprise Resource planning System (ERP)

SAP, ignitarium, crosser, ptc, HEXAGON, sas

Strategic OEMs
ABB, HEXAGON, Epiroc

Cellular Network 4G /5G (public, sliced, Private Network, Industry Connect)

Modules
QUECTEL, Telit, SIERRA WIRELESS, gemalto, SEQUANS

Cellular Gateways
Current loop
Ethernet
RS232
Analog I/O
Digital I/O

Machinery
Sensors
Actuators
Handhelds
Wearables
Wired via Gateway or Integrated Module, grid power
Integrated with Cellular Module or Chipset, battery

System Integrators
Capgemini, AFRY, TATA, FUJITSU, altran

Device partners
Gateways
Sensors
Actuators
Handhelds
Wearables
SIERRA WIRELESS, amit, ZEBRA, Westermo, msi, TELTONIKA, ORing, CISCO, AVI, DIGI, Beijer, MOXA, Hongdian, AAEON, PHOENIX CONTACT, hms, OPTION, ADLINK, Hewlett Packard Enterprise, DELL EMC, EUROTECH, HCFa

Port Deployment - Private LTE solution

Rotterdam Port, the Netherlands

Rotterdam World Gateway is a modern, highly automated container terminal. For data communications to their Automated Guided Vehicles, Terminal Trucks and Tablets, Wifi connectivity turned out to become unreliable, insecure and relatively high on OPEX.

Ericsson delivered a better alternative by means of a fully redundant, high available and secure private LTE network. The end-to-end solution, based on private owned spectrum in the 3.5Ghz range, enables robust and cost-effective data communication for around 100 clients on the container terminal.

365/24/7
operations

99,99%
availability

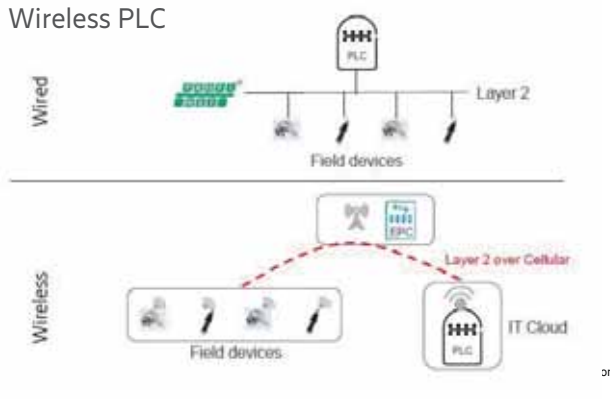
Guaranteed speed
>20Kbps
per client

Low latency
<50
milliseconds

FIR Center "Connected Industry"
5G enabled Industry 4.0 reference factory

1500 sqm of shop floor
Local RAN and PGw
2 x 20 MHz for all industry partners

Real ProfinetTraffic (16ms cycle)
Background MBB traffic via second device(146Mbit/s Downlink –fully loaded cell)

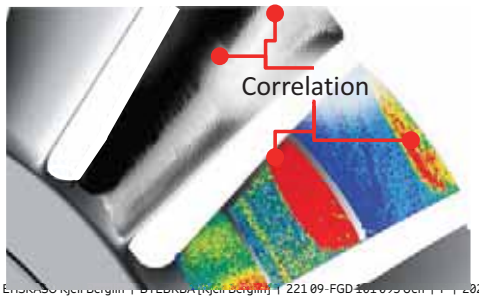


5G BLISK - Connected adoptable production

15-20 hours milling process on high value product component blade integrated disks

Ultra low latency control ~1ms in real-time acceleration sensor mounted directly on blisk

Enable prompt adjustment in production process for Jet engine production



World first 5G NR live use case testing!

Picture: Franhofer IPT

Comau flexible robotics

Reduction of cabling in new plants or existing plants with help of cellular

Remote monitoring of robots for preventive maintenance

Move nodes computing to reduce installation costs (remote virtual PLC)

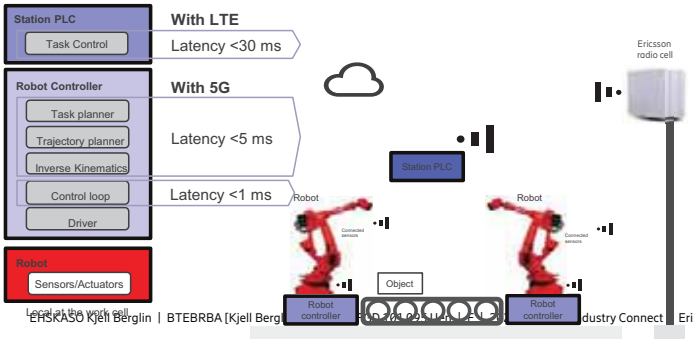


Photo: Comau Robotics

Connected mine

Industrial LTE and path to 5G test in Boliden mine Sweden (5G Research)

Increase efficiency and safety with remote control

Interconnected in and above mine (Radio Dots, core & cloud) and industrial IoT

Photo: Boliden and Volvo

AR assembly & testing

Tallinn Ericsson Factory - Complex to read instructions while performing testing

- AR guidance in testing
- VR remote support
- View of factory machines performance

50% improved efficiency
Full scale deployment in Ericsson factories world wide

EHSKASO Kjell Berglin | BTEBRBA [Kjell Berglin] | 221 09-FGD 101 095 Uen | F | 2020-01-13 | Industry Connect | Ericsso

Connected screwdrivers

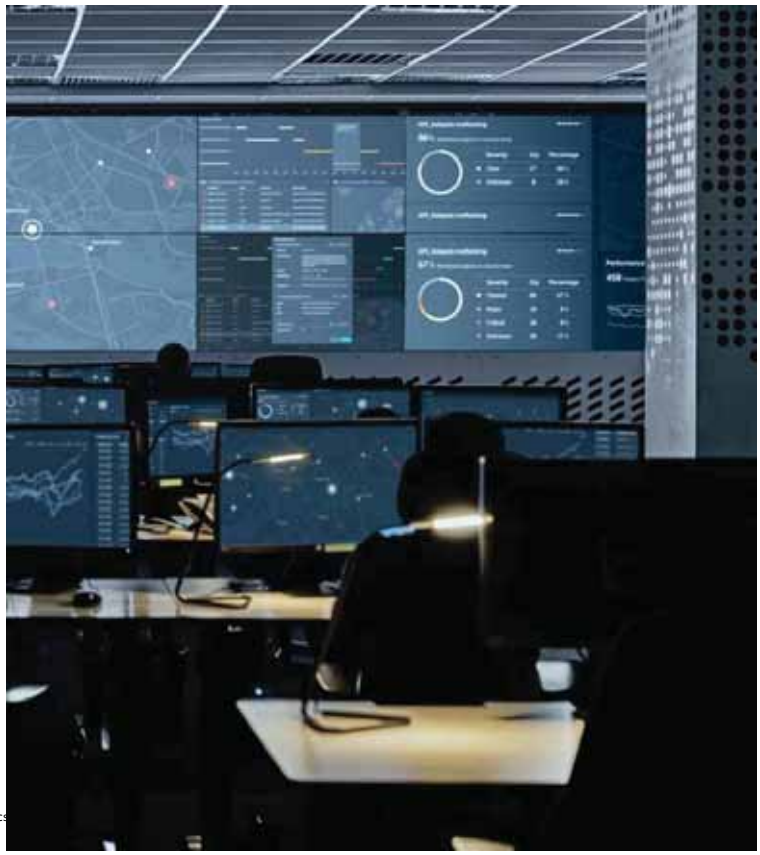
Nanjing Ericsson factory - Manual maintenance process
1000 high-precision screwdrivers

Automated solution with real-time motion sensor over cellular IoT (NB-IoT) & cloud

6 months break even, 210% ROI after 1 year
Completely phase out manual tracking

Ericsson

Energy monitoring and management



This 4G connected energy monitoring and management solution gathers data of all energy appliances in the factory for tracking.

Challenge

Lack of visibility into energy consumption at the device-level prevents optimization strategies

Solution

Enables monitoring of all energy appliances and ability to turn them on/off based on rules

Gathers data out of the building management systems (BMS) for tracking in the data lake and shows real-time energy consumption on big screen

Impact

Cost: 5 percent reduction in energy bill from better monitoring and control of energy consumption

Visibility: Better visibility into actual power consumption leads to increased ability to negotiate power consumption unit price from energy providers

EHSKASO Kjell Berglin | BTEBRBA [Kjell Berglin] | 221 09-FGD 101 095 Uen | F | 2020-01-13 | Industry Connect | Erics

Augmented reality for remote support

Maintenance in factories is difficult due to a lack of on-site expertise. Having maintenance labor maintained at each site, and flying the vendor out for repairs is expensive.

Challenge

With nearly 27 percent of US manufacturing workers set to retire over the next ten years, it will be increasingly difficult to complete certain repairs due to lack of on-site expertise and specialized knowledge

The cost is high for maintenance labor maintained at each site. Flying the vendor out for repairs is also costly.

Solution

Augmented reality headsets used by maintenance teams to troubleshoot and repair equipment by:

- Connecting to central or vendor support teams
- Getting step-by-step, system generated and knowledge-base powered guidance in real time

Impact

Labor: 10 percent decrease in plant maintenance labor

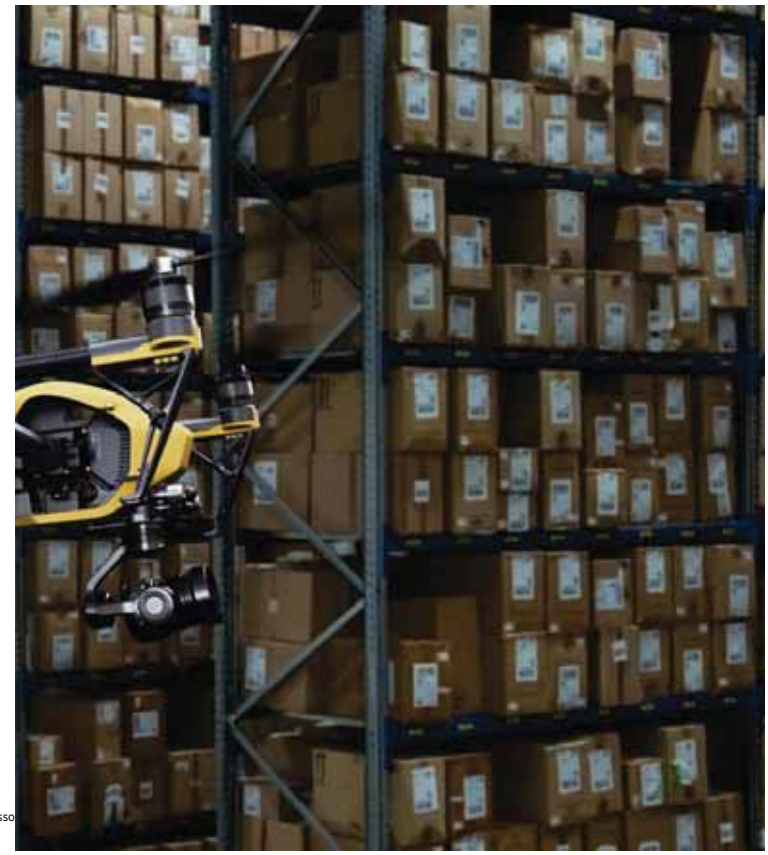
Downtime: 5 percent decrease in equipment downtime because of more efficient troubleshooting

Cost: 20-25 percent reduction in vendor service cost

Travel cost: 40-50 percent reduction in travel cost

EHSKASO Kjell Berglin | BTEBRBA [Kjell Berglin] | 221 09-FGD 101 095 Uen | F | 2020-01-13 | Industry Connect | Ericsso

Drones for inspection rounds



Surveillance in factories is a critical yet difficult and expensive part of managing a factory. Dispatching personnel is costly and it's challenging to have comprehensive security at large facilities.

Challenge

Difficult and expensive to provide comprehensive surveillance and inspection at large facilities using traditional means of dispatching people

Solution

Inspection drone patrols day and night, respond to alarms, transmits live video, lands, recharges — all by itself

24/7 increased surveillance coverage with lower personnel risk

Impact

Labor: 10 percent reduction in manpower

Cost: 10-15 percent reduction in inspection cost, e.g. personnel and vehicles

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Digital adherence for safety and quality

Helmets, electrostatic discharge jackets, eye protection, and shoe coverings—safety and security for both employees and visitors in facilities like factories are of the utmost importance. However, it is both time-consuming and cumbersome to manually check everyones adherence to safety and quality rules. The video analytics platform uses a camera to detect attire and objects and notifies whether safety attire is used or not. The right equipment could improve compliance and reduce incidents in the facility by 10 percent.

Challenge

As manufacturing becomes increasingly connected, enterprises need to find more modern ways to ensure safety and security for both employees and visitors

Manually checking that employees and visitors are adhering to safety and quality rules by, for example, wearing safety jackets and shoe covers is cumbersome

Solution

Video analytics platform with attire detection that notifies with a "yes" or "no" whether visitors and employees are wearing safety jackets, shoe covers, hearing and eye protection

The platform can detect people, objects and events

Impact

Compliance: 10 percent improvement in compliance and reduced incidents

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Environmental monitoring within the factory

Environmental factors impacting industry output can cost a manufacturing plant up to USD 10,000 in output and increased waste. Temperature and humidity can also affect production and the working environment for employees. The environmental monitoring solution collects environmental factors, such as humidity and temperature across the factory floor in a data lake for analysis purposes. These insights can lead to higher manufacturing quality and a 5 percent reduction in waste production conditions.

Challenge

Environmental factors are impacting industry output, for instance, a day of with temperatures above 90 degrees can cost a manufacturing plant up to USD 10,000 in output and increased waste

Difficult to understand exactly how the environment (e.g. humidity) impacts the production/working environment for employees

Solution

Collect environmental monitoring data, such as humidity and temperature, from across the factory floor and store it in the data lake for correlation purposes

Impact

Quality: 5 percent reduction in waste due to out of production conditions, such as high temperatures and humidity

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End-to-end digital thread for radio production

Machine downtime causes a significant cost for manufacturers. Lack of component history makes troubleshooting the root of the failure difficult, costly, and time-consuming. The end-to-end digital thread solution gathers and logs a complete history of each radio's components, supplier info, test results, and tracking from previous troubleshooting. The single source of truth enables a rapid root-cause analysis which reduced repair costs by approximately 20 percent

Challenge

Unplanned downtime costs USD 50 billion per year for manufactures globally

Lack of component history makes it difficult to identify root cause of failures leading to: machine downtime, more rework and higher repair costs, and recurring failures

Solution

A complete history of each radio's components and production including: supplier info, test results, troubleshooting and who it's performed by

Single source of truth (in the data lake) for the radio's history enabling rapid root-cause analysis

Impact

Cost: 15-20 percent reduction in repair costs from less machine downtime, rework and fewer recurring failures

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Alerting and escalation using wearable devices

To continuously check all appliances in a facility is time-consuming and leads to production loss. Smart Devices will provide real-time alerts to the service provider and suggest immediate action based on past actions taken. The faster response time enabled by the smart alerting system increases machine uptime.

Challenge

Operators/material set-up assistant gets no alert when there is an issue (e.g., material magazine is empty)
Immediate action not possible if operator is not around the production line computer, leading to production loss
No guidance on immediate next step available to operator

Solution

Smartwatch will provide real-time alerts or critical alarms to operator and suggest immediate workflow actions

Impact

Uptime: 5 percent increase in machine uptime from faster operator response time

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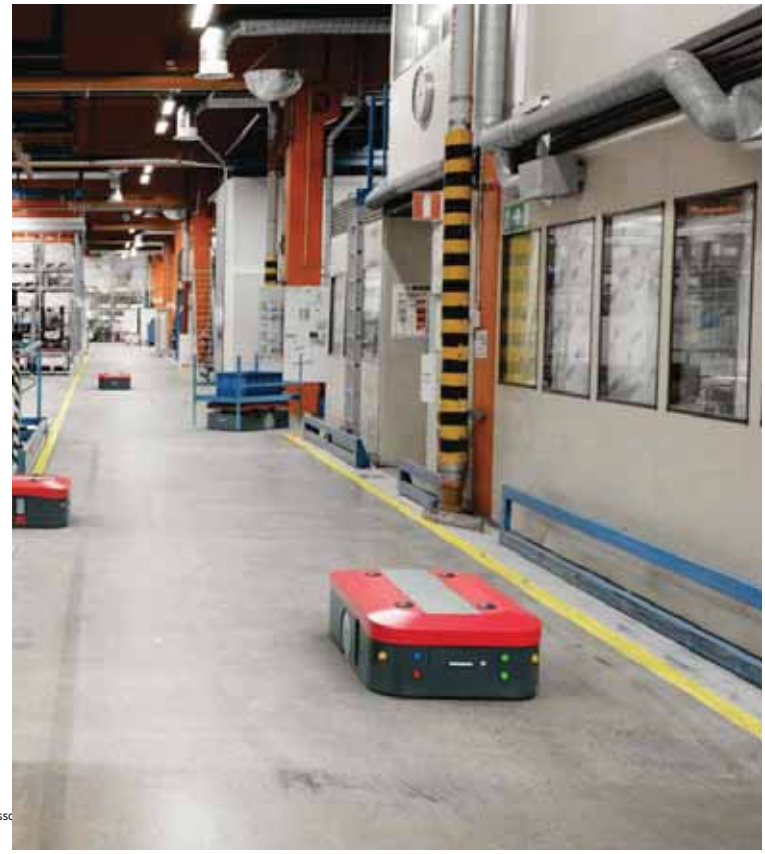
Digital material tracking and visualization within the factory



To continuously check all appliances in a facility is time-consuming, and material magazines can be empty for a while before it gets detected and refilled by a factory worker, which leads to production loss.

Challenge

Missing critical assets can have a considerable impact on production - one hour of industrial downtime has an average cost of USD 100,000
Low visibility of critical assets in real-time (within factory)
A lot of time spent in looking for assets in the factory leads to rework and waste

Solution

An asset-tracking solution that digitally integrates with factory floor sensors to track critical assets' location, condition and status in real-time
Provide production insights to operators and managers by tracking production progress
Real-time visibility of finished goods into the production floor

Impact

Labor: 10 percent increase in repair tech productivity
Cost: 5 percent reduction in rework and waste
Efficiency: 2-5 percent cost avoidance on indirect spare purchase item

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Machine learning based visual inspection

Visual inspections are often time-consuming and come with a high risk for error. Illumination conditions and background clutter impacts the ability of traditional machine vision inspections. By using a high-resolution camera and machine learning algorithms for visual inspections, the accuracy of the inspection is increased and inspection time is reduced.

Challenge

Visual inspections are time-consuming, and errors typically range from 20-30 percent

Traditional machine vision struggles to handle, for instance, illumination conditions and background clutter

High false positives and missing errors result in machine downtime and rework

Solution

Using a combination of high-resolution camera and machine learning algorithms, we improve the accuracy of the board inspection in the production area

Impact

Labor: 5 percent decrease in inspection time

Throughput: 5 percent increase in throughput based on reduced false positive failures

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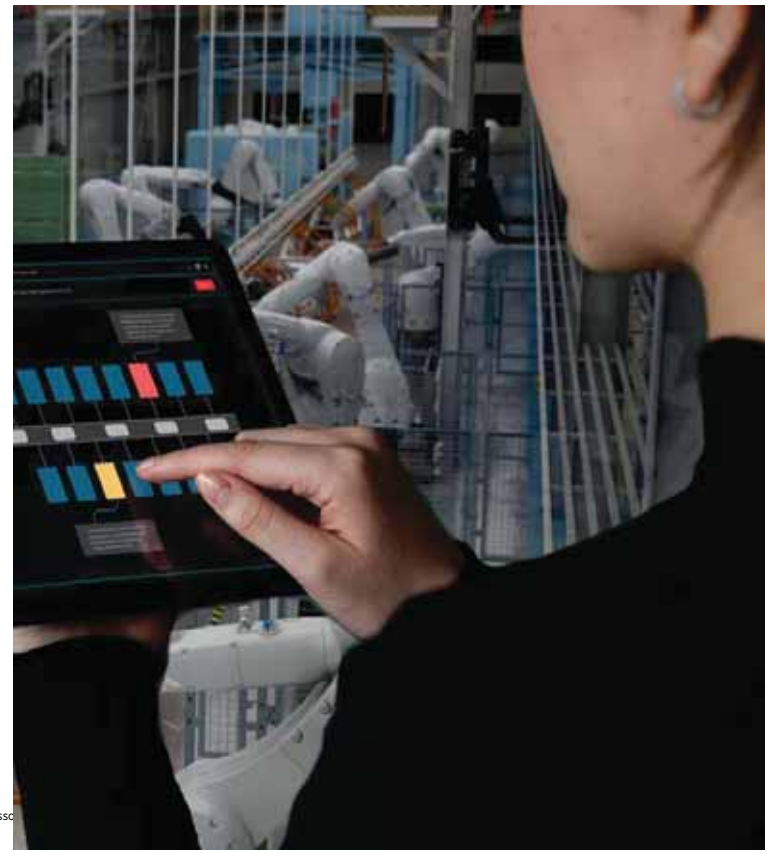
Automated unpacking process



Manual labor is traditionally used for 50-80 percent of factory activities. The decanting process, gradually unpacking and placing material from one container to another, is a labor-intensive activity. Material is not always delivered in uniform orders which is time-consuming to structure and organize. The automated robot identifies and picks up material from unstructured bins. The material is then placed onto trays in a particular orientation and location so it can automatically be received by production lines. Automation of the decanting process leads to a 50 percent decrease in labor kitting time and increases production uptime.

Challenge

A large share of factory activities (around 72 percent) are based on manual labor, such as unpacking and carefully placing components onto trays so that they can be picked up by automated lines

Material coming from overseas is not always delivered in uniform order

Solution

Pick up materials from unstructured bins and place them onto trays in a particular orientation and location so they can automatically be received by production lines

Impact

Labor: 50 percent decrease in warehouse operators doing kitting

Uptime: 5 percent increase from more efficient unpacking

EHSKASO Kjell Berglin | BTEBRBA [Kjell Berglin] | 221 09-FGD 101 095 Uen | F | 2020-01-13 | Industry Connect | Ericsso

Control tower to showcase plant dashboards

Up to one-third of the engineer's time in factories, is spent finding correct and updated production data. The data is often stored in silos and it is hard to get an overview of the data from the factory. The central control tower accesses all factory systems and provides a centralized, master-overview of what is going on in the factory.

Challenge

Finding the correct, up-to-date production data in a large factory is a cumbersome task that can consume 14-30 percent of an engineer's time
In many cases, process and production information is stored in siloed systems and it is difficult to compile a real-time master view

Solution

Central control tower with access to all information systems
Integrated with shop floor, security, building management and safety systems
Centralized system allows for flexibility and scalability of factory
Alerts raised centrally facilitating quicker response

Impact

Labor: 5 percent reduction in labor hours due to better communication and access to information

EHSKASO Kjell Berglin | BTEBRBA [Kjell Berglin] | 221 09-FGD 101 095 Uen | F | 2020-01-13 | Industry Connect | Ericsso

Connected screwdrivers

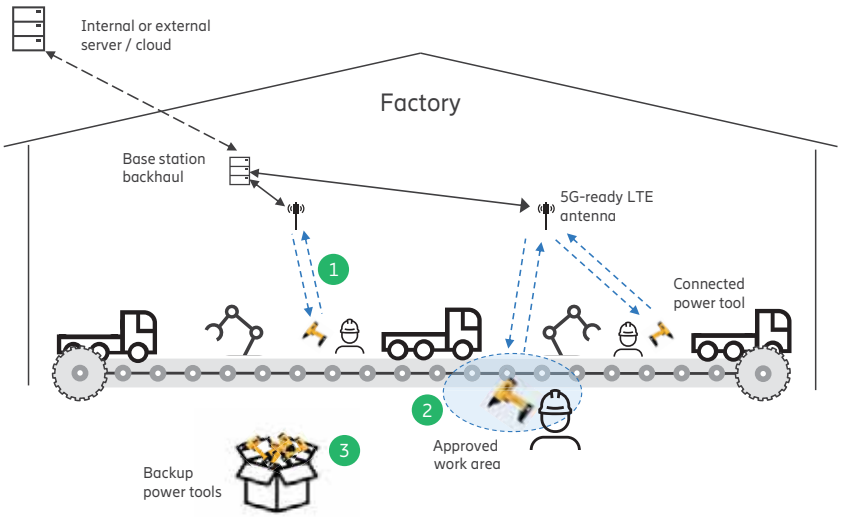
Nanjing Ericsson factory - Manual maintenance process
1000 high-precision screwdrivers

Automated solution with real-time motion sensor over cellular IoT (NB-IoT) & cloud

6 months break even, 210% ROI after 1 year
Completely phase out manual tracking

Ericsson

Connected tightening power tools transfer data in real time



Source: Scania, Atlas Copco, Arthur D. Little

Connected tightening power tools

- **Battery tightening power tools** transfer data to a **cloud control application** over a **cellular network** in the factory with
  - **Real-time data transmission**
  - **One network** with multiple antennas covers the entire factory
- This setup enables
  1. **Fast tool configuration** in case of tool task reallocation and automatic **software updates**
  2. Definition of an **approved work area** for each tool which tool lock when outside of
  3. **Rapid use** of back-up tools when needed
- Solution can be implemented in brownfield or greenfield environments

Ericsson.com/industry4.0

5G for Business Success

Jakub Borkowski
HUAWEI

SUMMARY

5G is developing faster than ever expected. Only through building differentiated capabilities, operators can monetize their networks while helping others to achieve success in their digitalization. We are glad to share the latest 5G commercialization insights in line with our solutions and vision of target mobile network enabling wide and diverse 5G business development.

ABOUT THE AUTHOR

Jakub Borkowski drives Huawei business development across CEE & Nordic region. After defending his doctorate in Finland, where he spent number of years, Jakub worked on cellular networks rollout and expansion projects for over 10 years in various countries. Then, together with Huawei, he worked in presales and delivery management of large service outsourcing projects in the UK. Last three years, Jakub together with his team on behalf of Huawei has been helping operators to modernize their networks to prepare for 5G and, most recently, to take 5G to commercial stage.

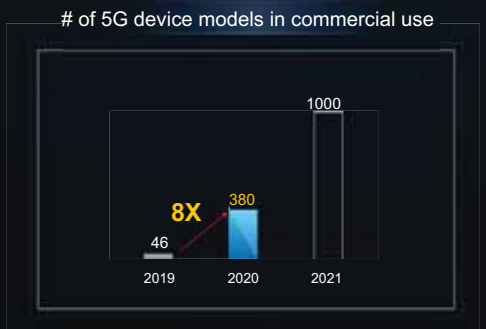
5G for Business Success

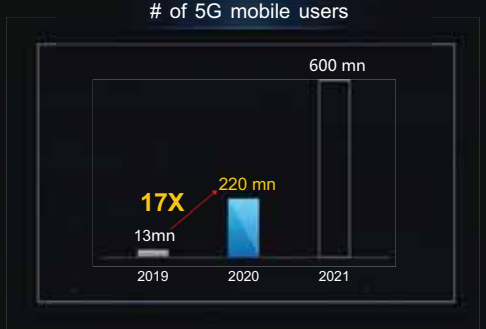
HUAWEI

VITEL, Slovenia, 17-18/05/2021

Dr Jakub Borkowski

5G Is Developing Faster than Expected





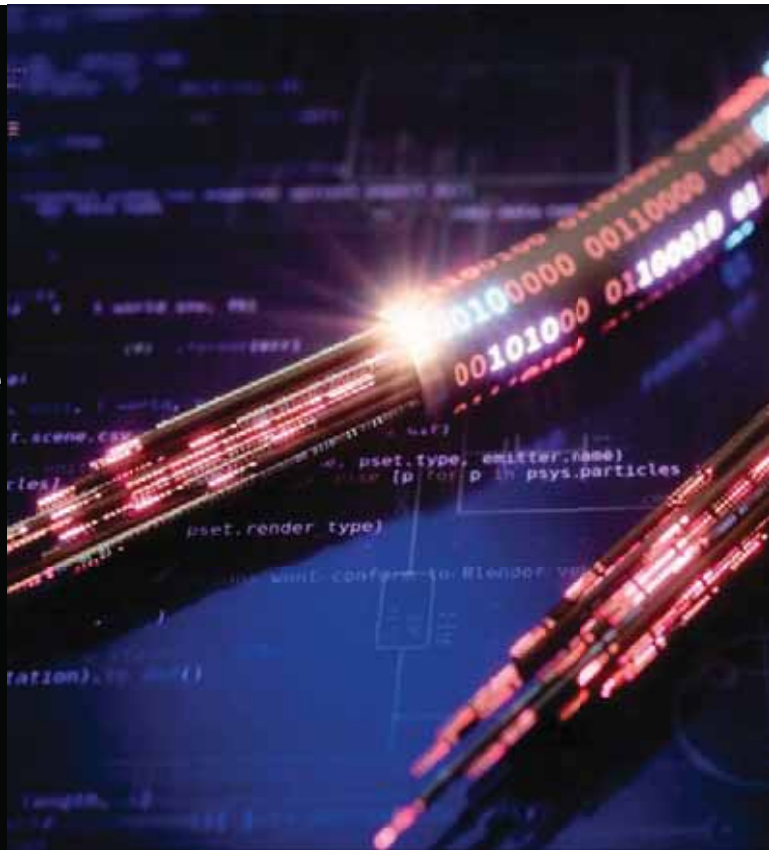
Source: GSA & Huawei

2020 Saw Commercial Returns from the First Wave of 5G Rollouts

Top 3 Chinese operators	LG U+	DNA	ZAIN
800k+ 5G sites	**90%+** of population covered	**32%** of population covered by C-band	**3000+** M-MIMO sites
200 mn 5G users	**18.7%** 5G user penetration	ARPU from mobile services ↑ **3%**	**6%** of revenue comes from 5G FWA
Annual revenue from telecoms services ↑ **3.6%**	Annual revenue from mobile services ↑ **5.8%**	Annual revenue from mobile services ↑ **3%**	Share price ↑ **46%**

Source: MIIT & CAICT & Carriers' annual reports & strategyanalytics & Huawei

Part I- 5G Brings New Value



5G, Bring New Value

To deliver an emotion you have to have higher bandwidth.

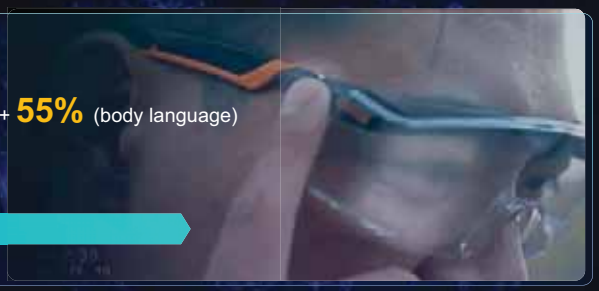
—Steve Jobs . 2001

Personal Communication

= 7% (spoken words) + 38% (voice, tone) + 55% (body language)

4G

5G

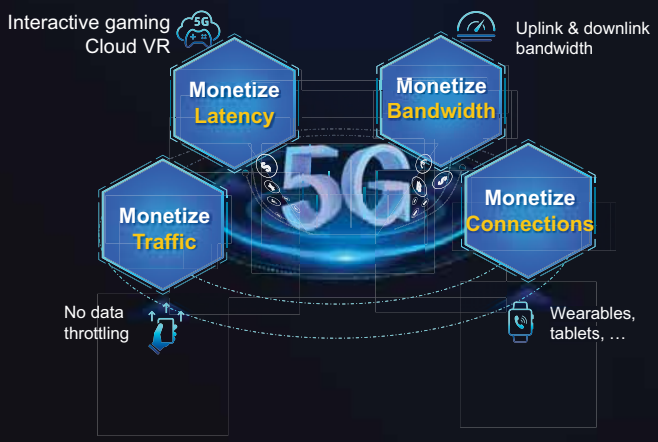


4G 480/720P Video (1 ~ 6Mbps) → Video on-demand (< 8Mbps)

5G 4K Video (15 ~ 40Mbps)* → Interactive VR (100 ~ 150Mbps)** → 5G: A new experience and a new source of value

Experience-driven 5G B2C Business Model

More Metrics to Monetize

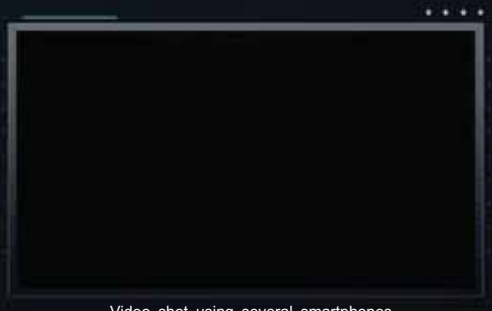


Exploring New Business Model

LGU+		vodafone	elisa
Entertainment + Sports	Football	Video	Cloud gaming
☑ Speed ☑ Multi-device	☑ Volume	☑ Speed	☑ Latency ☑ Speed

5G Inspires New Applications: Free-view Video Now Possible with Mobile Phones

TV Show: 100+ 4K professional video cameras

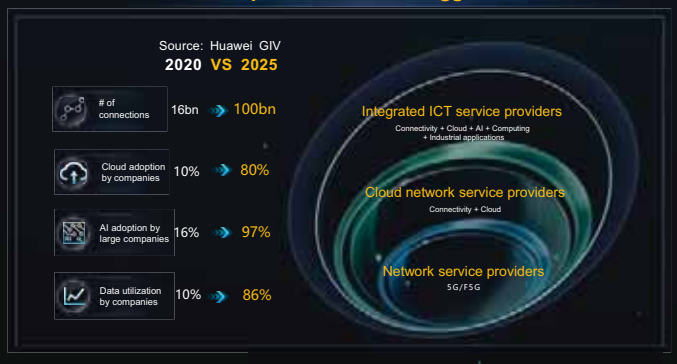


Video shot using several smartphones

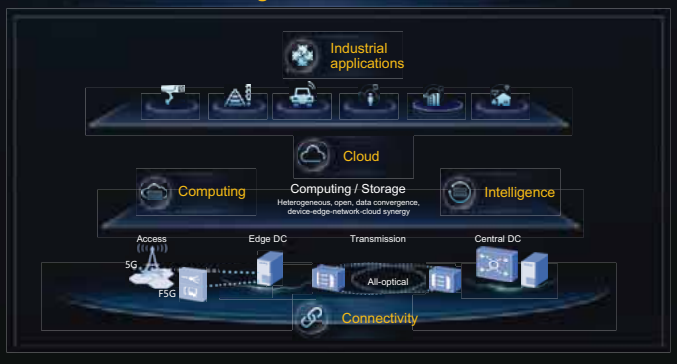
Professionally Generated Content (PGC)		User Generated Content (UGC)
Professional producer	Producer	Smartphone user
100+ cameras + Local servers	Equipment	5–30 phones + Cloud applications
Indoor studio	Environment	Anywhere with 5G coverage
Millions of RMB	Cost	Tens of thousands of RMB
Hundreds of thousands of TV viewers	Target audience	Billions of Internet users

Digital Transformation Is Accelerating Industry Upgrades

Embracing industrial digitalization: Greater capabilities mean a bigger role



Multi-domain collaboration to enable digital transformation



Identify the industries with the greatest need

Coal mine

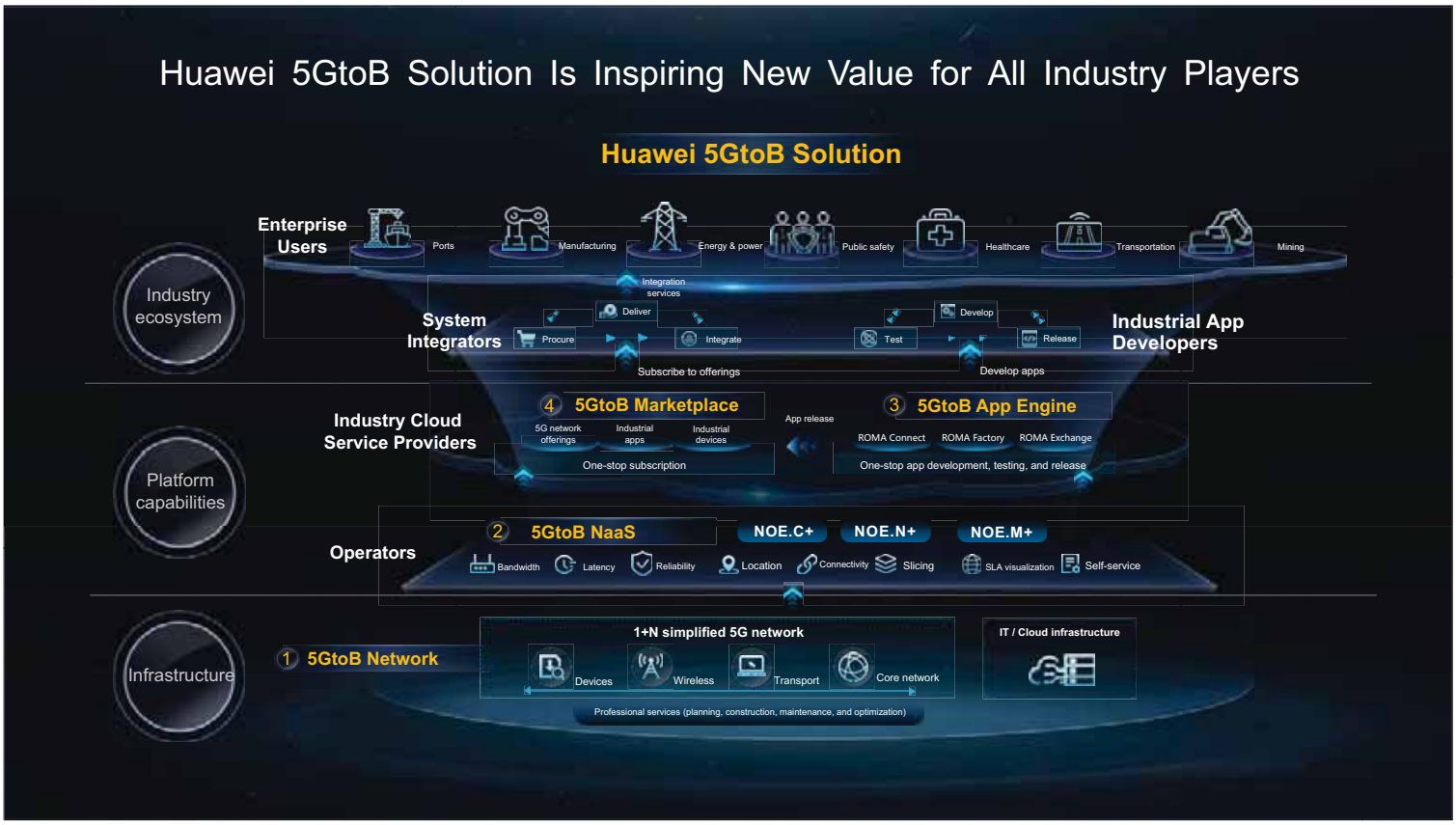
- Automatic inspection
- **10-20%** fewer workers needed underground

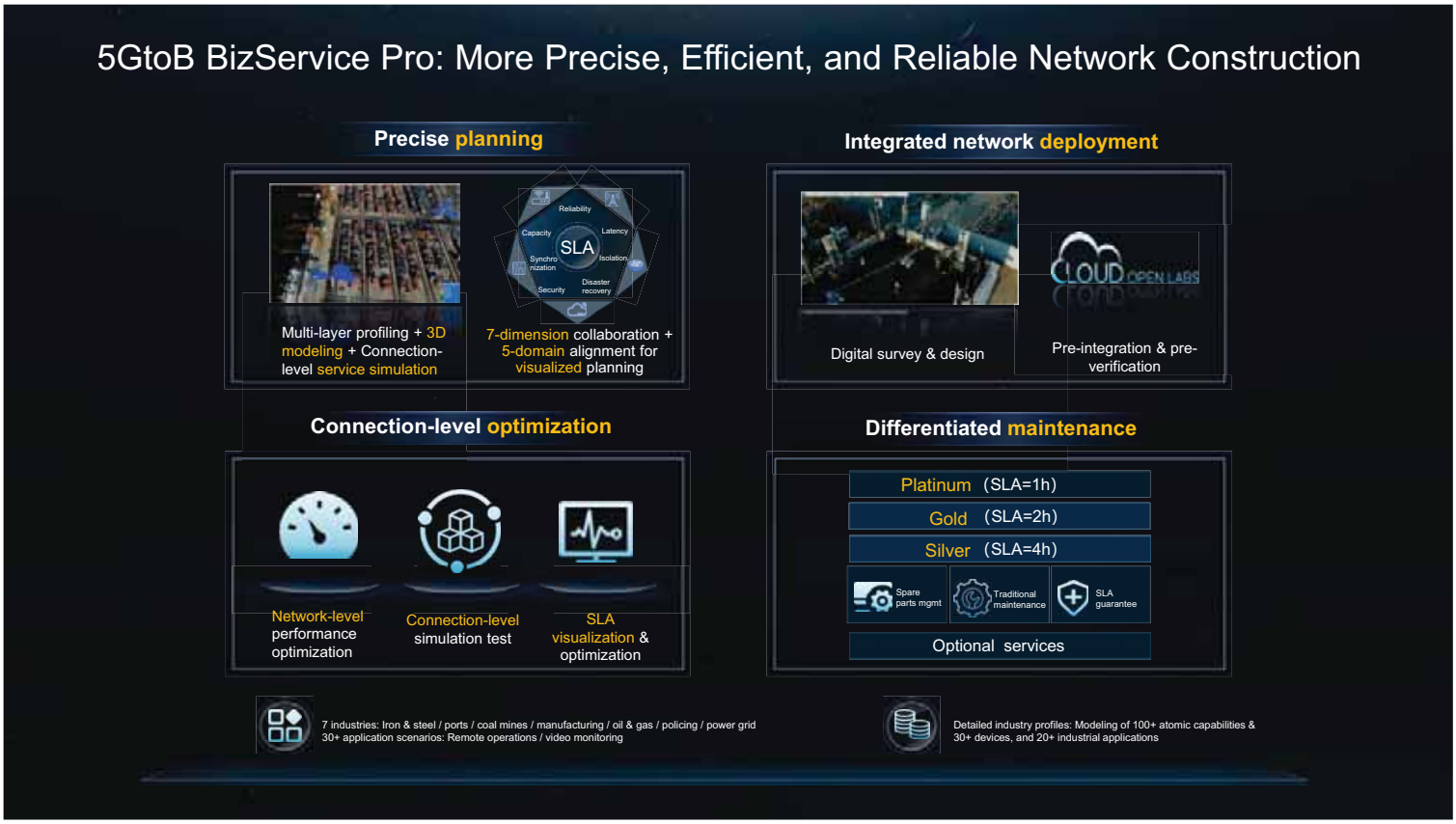
Steel

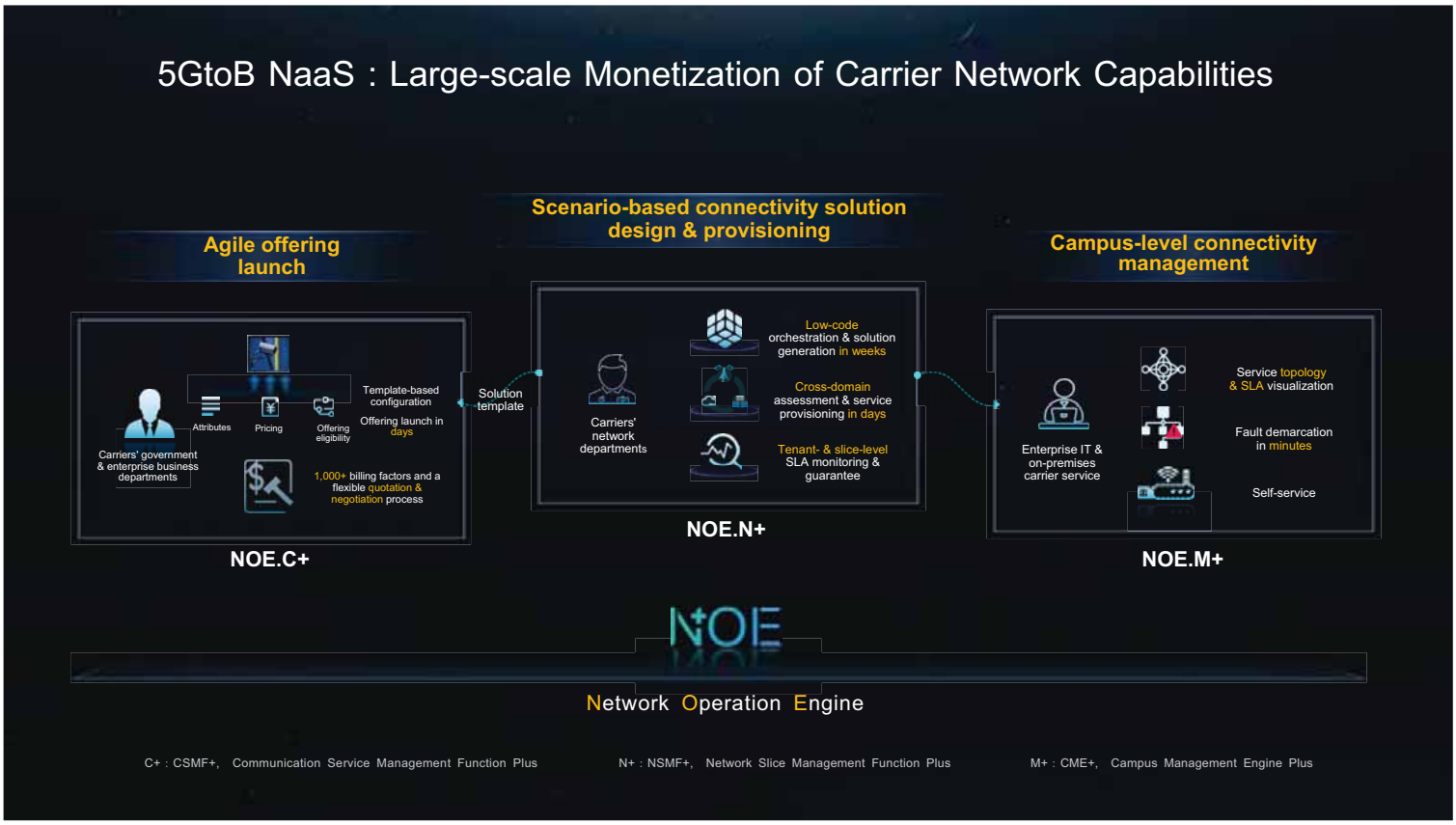
- Unmanned cranes make the workplace safer
- Productivity up **26%**

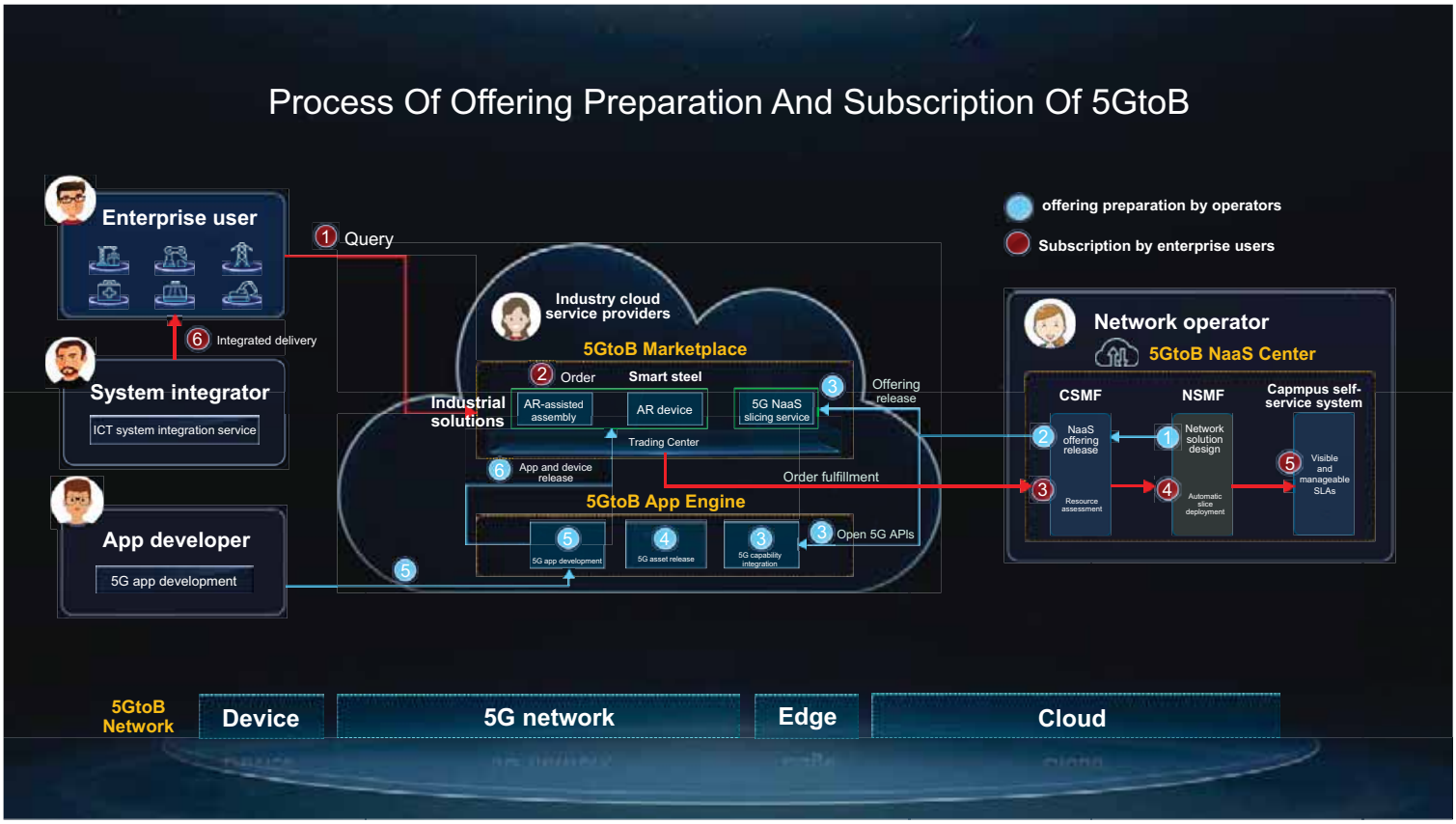
Innovation campus

- Quick provisioning for plug-and-play campuses
- Local cloud rendering; 10x+ increase in efficiency


Huawei 5GtoB Solution Is Inspiring New Value for All Industry Players
Huawei 5GtoB Solution
Industry ecosystem
Enterprise Users
Ports
Manufacturing
Energy & power
Public safety
Healthcare
Transportation
Mining
Integration services
System Integrators
Deliver
Procure
Integrate
Develop
Test
Release
Industrial App Developers
Subscribe to offerings
Develop apps
Platform capabilities
Industry Cloud Service Providers
4 5GtoB Marketplace
5G network offerings
Industrial apps
Industrial devices
One-stop subscription
App release
3 5GtoB App Engine
ROMA Connect
ROMA Factory
ROMA Exchange
One-stop app development, testing, and release
Operators
2 5GtoB NaaS
NOE.C+
NOE.N+
NOE.M+
Bandwidth
Latency
Reliability
Location
Connectivity
Slicing
SLA visualization
Self-service
Infrastructure
1 5GtoB Network
1+N simplified 5G network
Devices
Wireless
Transport
Core network
IT / Cloud infrastructure
Professional services (planning, construction, maintenance, and optimization)


5GtoB BizService Pro: More Precise, Efficient, and Reliable Network Construction
Precise planning
Reliability
Capacity
Latency
SLA
Isolation
Synchronization
Security
Disaster recovery
Multi-layer profiling + 3D modeling + Connection-level service simulation
7-dimension collaboration + 5-domain alignment for visualized planning
Integrated network deployment
CLOUD OPEN LABS
Digital survey & design
Pre-integration & pre-verification
Connection-level optimization
Network-level performance optimization
Connection-level simulation test
SLA visualization & optimization
Differentiated maintenance
Platinum (SLA=1h)
Gold (SLA=2h)
Silver (SLA=4h)
Spare parts mgmt
Traditional maintenance
SLA guarantee
Optional services
7 industries: Iron & steel / ports / coal mines / manufacturing / oil & gas / policing / power grid
30+ application scenarios: Remote operations / video monitoring
Detailed industry profiles: Modeling of 100+ atomic capabilities & 30+ devices, and 20+ industrial applications

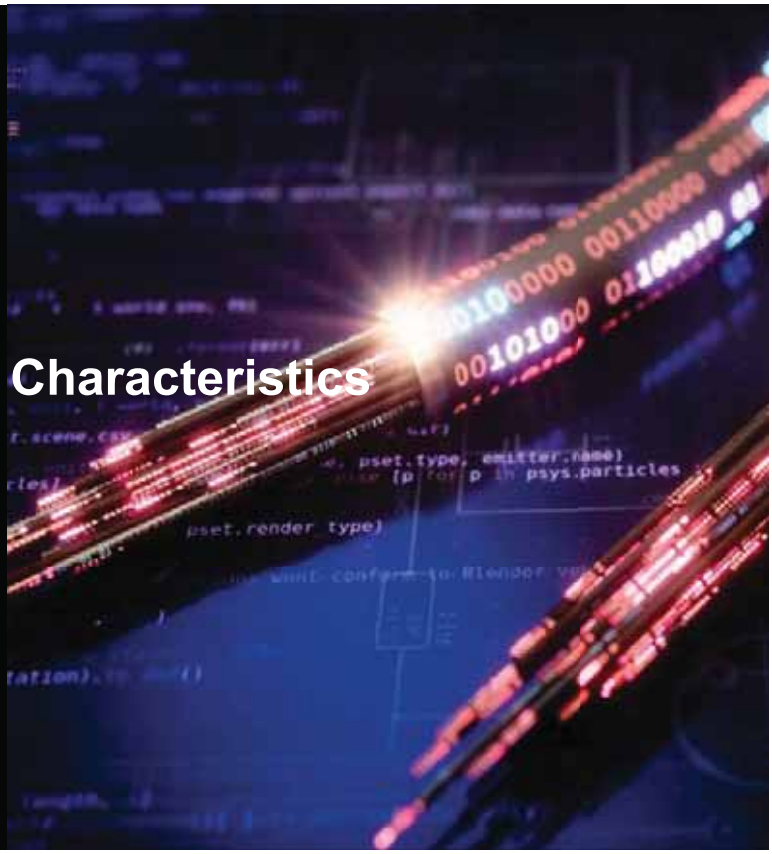

5GtoB NaaS : Large-scale Monetization of Carrier Network Capabilities
Agile offering launch
Scenario-based connectivity solution design & provisioning
Campus-level connectivity management
Template-based configuration
Offering launch in days
Attributes
Pricing
Offering eligibility
Carriers' government & enterprise business departments
1,000+ billing factors and a flexible quotation & negotiation process
Solution template
Carriers' network departments
Low-code orchestration & solution generation in weeks
Cross-domain assessment & service provisioning in days
Tenant- & slice-level SLA monitoring & guarantee
Enterprise IT & on-premises carrier service
Service topology & SLA visualization
Fault demarcation in minutes
Self-service
NOE.C+
NOE.N+
NOE.M+
NOE
Network Operation Engine
C+ : CSMF+, Communication Service Management Function Plus
N+ : NSMF+, Network Slice Management Function Plus
M+ : CME+, Campus Management Engine Plus


Process Of Offering Preparation And Subscription Of 5GtoB
offering preparation by operators
Subscription by enterprise users
Enterprise user
1 Query
6 Integrated delivery
System integrator
ICT system integration service
App developer
5G app development
Industry cloud service providers
5GtoB Marketplace
2 Order
Smart steel
Industrial solutions
AR-assisted assembly
AR device
5G NaaS slicing service
3 Offering release
Trading Center
6 App and device release
Order fulfillment
5GtoB App Engine
5 5G app development
4 5G asset release
3 5G capability integration
3 Open 5G APIs
5
Network operator
5GtoB NaaS Center
CSMF
NSMF
Cappmus self-service system
2 NaaS offering release
1 Network solution design
5 Visible and manageable SLAs
3 Resource assessment
4 Automatic slice deployment
5GtoB Network
Device
5G network
Edge
Cloud

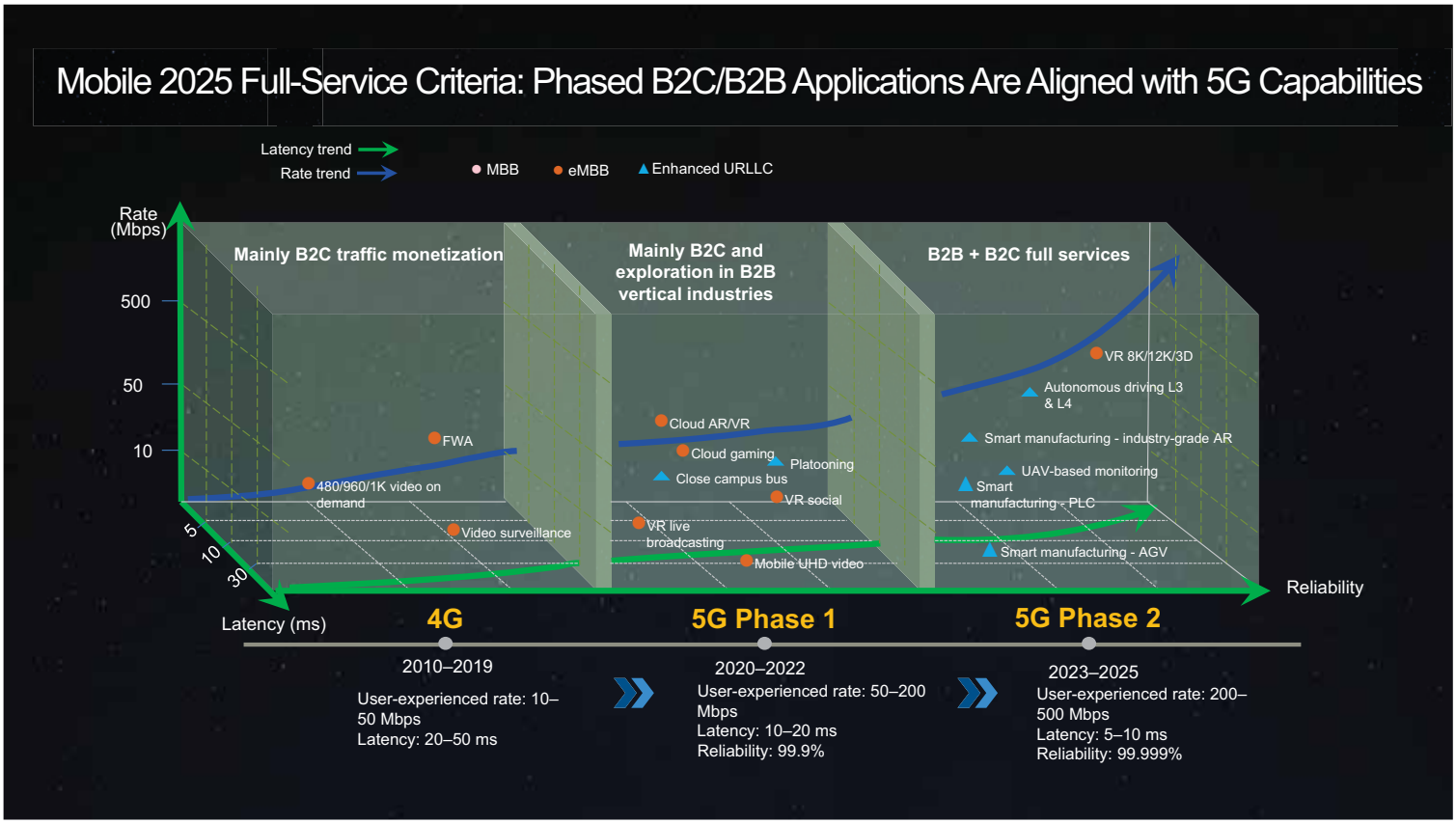

Huawei 5GtoB Solution Helps Enterprises Achieve Agile Service Provisioning And Promotes Steel Industry Upgrades
Remotely controlled crane
AR-assisted assembly
10 5G applications
5G collaborative design
5G remote O&M
5G automatic control
5G flexible production
5G transparent factory
5G AR-assisted commissioning
5G quality control
5G warehousing management
5G training guide
5G logistics supply
Building 5G innovation benchmarks
Asset buildup
10+ industry model assets
30+ service provisioning templates
Agile service provisioning
Weeks
Days
Enterprise self-service
Manageable and visible SLAs
Fault demarcation < 30 minutes

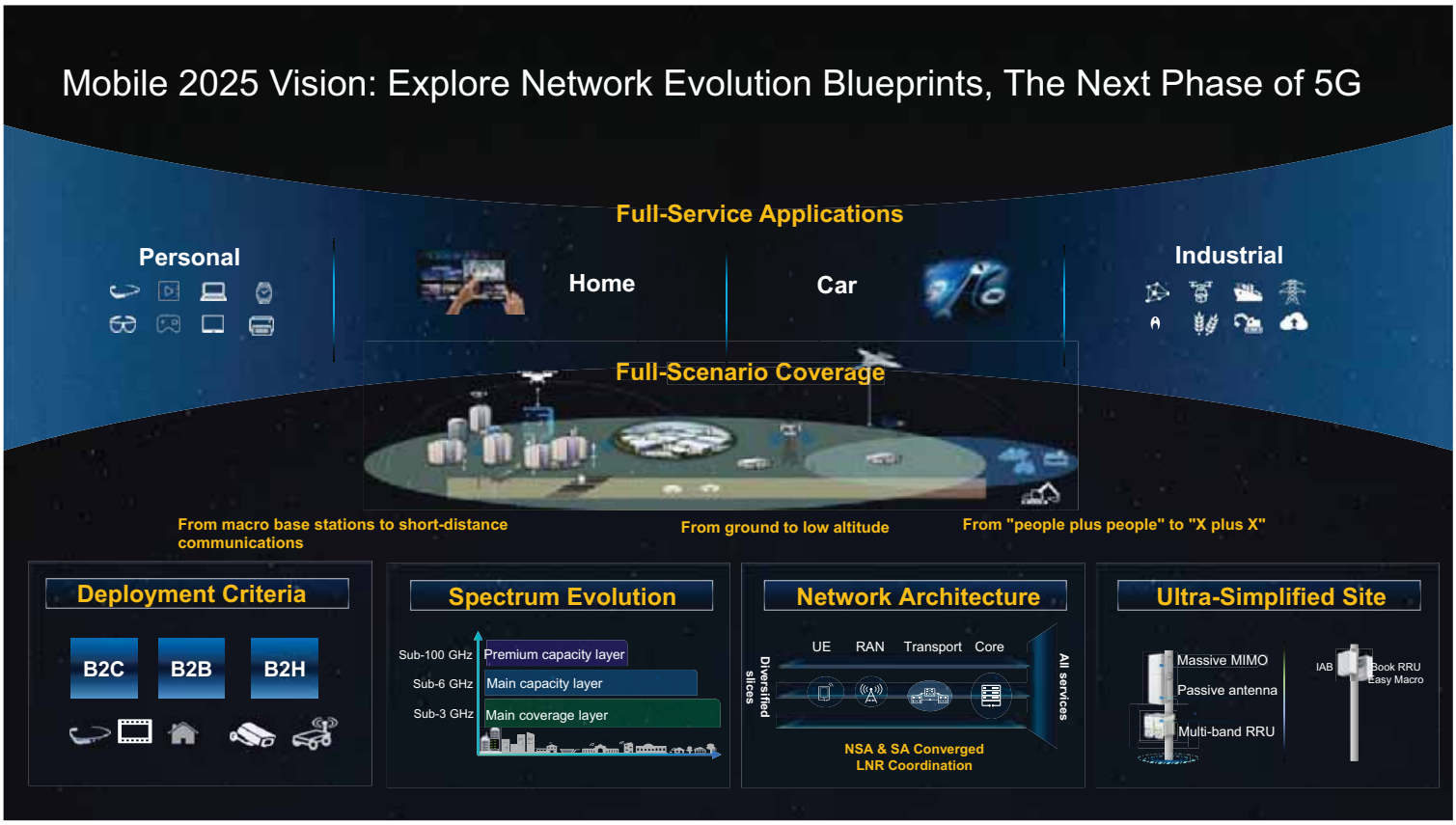

Unlocking the Full Potential of 5G Together
5G + Manufacturing
Huawei in UK
5G + Agriculture
Huawei in Switzerland
5G + Mining
Huawei in China

Part II- Mobile2025 Network Characteristics




From the Internet of Everything to the Intelligent Internet of Everything
eMBB
Mobile video
FWA
Uplink Centric Broadband Communication
UCBC
HD video uploading
Machine vision
AI
Spectrum
(< 100 GHz)
RTBC
XR-pro
Holographic
Real-Time Broadband Communication
Smart manufacturing
Smart mining
Smart campus
...
mMTC
REDCAP
NB-IoT
URLLC
Reliability, low-latency
IIoT Advanced
VR/AR
AR cloud
5G large screen
...
HCS
Harmonized Communication and Sensing
Positioning
V2X
5G connected UAVs
L4/L5 V2X
...


Mobile 2025 Full-Service Criteria: Phased B2C/B2B Applications Are Aligned with 5G Capabilities
Latency trend
Rate trend
MBB
eMBB
Enhanced URLLC
Rate (Mbps)
500
50
10
Mainly B2C traffic monetization
Mainly B2C and exploration in B2B vertical industries
B2B + B2C full services
FWA
480/960/1K video on demand
Video surveillance
Cloud AR/VR
Cloud gaming
Platooning
Close campus bus
VR social
VR live broadcasting
Mobile UHD video
VR 8K/12K/3D
Autonomous driving L3 & L4
Smart manufacturing - industry-grade AR
UAV-based monitoring
Smart manufacturing - PLC
Smart manufacturing - AGV
5
10
30
Latency (ms)
Reliability
4G
5G Phase 1
5G Phase 2
2010–2019
User-experienced rate: 10–50 Mbps
Latency: 20–50 ms
2020–2022
User-experienced rate: 50–200 Mbps
Latency: 10–20 ms
Reliability: 99.9%
2023–2025
User-experienced rate: 200–500 Mbps
Latency: 5–10 ms
Reliability: 99.999%


Mobile 2025 Vision: Explore Network Evolution Blueprints, The Next Phase of 5G
Full-Service Applications
Personal
Home
Car
Industrial
Full-Scenario Coverage
From macro base stations to short-distance communications
From ground to low altitude
From "people plus people" to "X plus X"
Deployment Criteria
B2C
B2B
B2H
Spectrum Evolution
Sub-100 GHz
Premium capacity layer
Sub-6 GHz
Main capacity layer
Sub-3 GHz
Main coverage layer
Network Architecture
UE
RAN
Transport
Core
Diversified slices
All services
NSA & SA Converged
LNR Coordination
Ultra-Simplified Site
Massive MIMO
Passive antenna
Multi-band RRU
IAB
Book RRU
Easy Macro


Vision and Mission
Bring digital to every person, home and organization
for a fully connected, intelligent Slovenia
HUAWEI

Accelerating industries digitalization with 5G Private Wireless Networking

David Pavlinic

NOKIA

POVZETEK

V tovarni prihodnosti bodo ljudje in stroji varno sodelovali pri povečanju produktivnosti in izboljšanju učinkovitosti. Ob zagonu četrte industrijske revolucije te organizacije že postajajo vse bolj odvisne od uporabe kibernetsko-fizičnih sistemov - računalniško vodenih robotov in strojev - za racionalizacijo in preoblikovanje svojih procesov. Četrta industrijska revolucija prinaša možnosti, ki se jih lahko s prednostmi zasebnih omrežij 5G v celoti izkoristi.

SUMMARY

The factory of the future will see people and machines working safely together to increase productivity and improve efficiency. As the fourth industrial revolution dawns, these organizations are already becoming more reliant on the use of cyber-physical systems – computer-controlled robots and machinery – to streamline and transform their processes. Fourth industrial revolution brings possibilities which are with the benefit of 5G Private networks coming to the full utilization.

O AVTORJU

David je odgovoren za prodajo rešitev za poslovni segment v Adriatic regiji. Ker ga zanimajo priložnosti povezanih tehnologij in digitalnih transformacij, osebno pozna vrednost varne in zanesljive brezžične povezljivosti industrijskega okolja in je aktivni evangelist vloge, ki jo bodo imela zasebna brezžična omrežja pri uvajanju četrte industrijske revolucije v industriji.

ABOUT THE AUTHOR

David is responsible for Enterprise solutions sales in Adriatic region. Being intrigued by the opportunities of connected technologies and digital transformations, he knows first-hand the value of secure and reliable industrial-grade wireless connectivity, and is an active evangelist on the role private wireless will play in helping industrials leapfrog into the 4th industrial revolution.

NOKIA

5G for Verticals

Accelerating industries digitalization to Industry 4.0
with Industrial-Grade Private Wireless Networking

David Pavlinic

Enterprise Sales Manager Adriatic

1st Step of industry 4.0

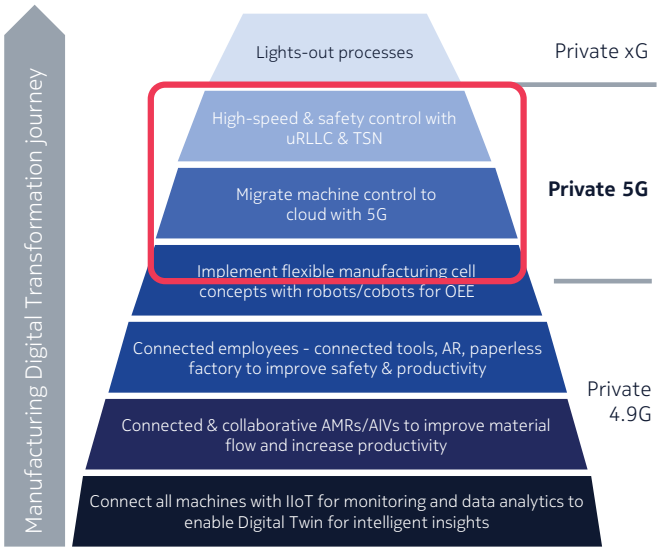
Digitalization by connecting
all assets...

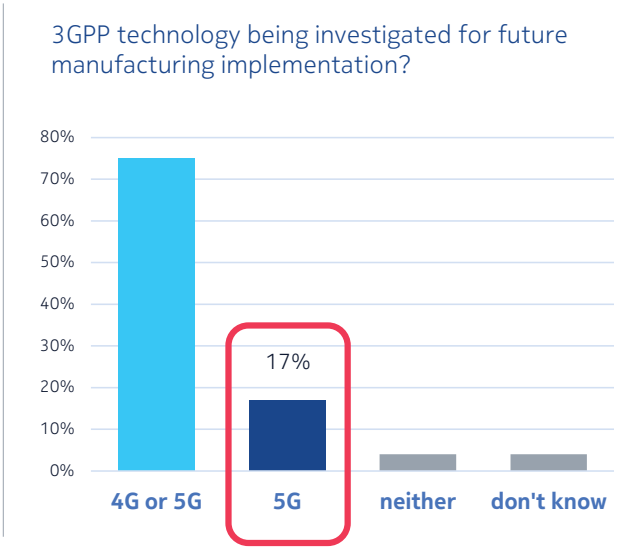
74% of today's data
not yet collected!

NOKIA

Why 5G SA Commercial system now?

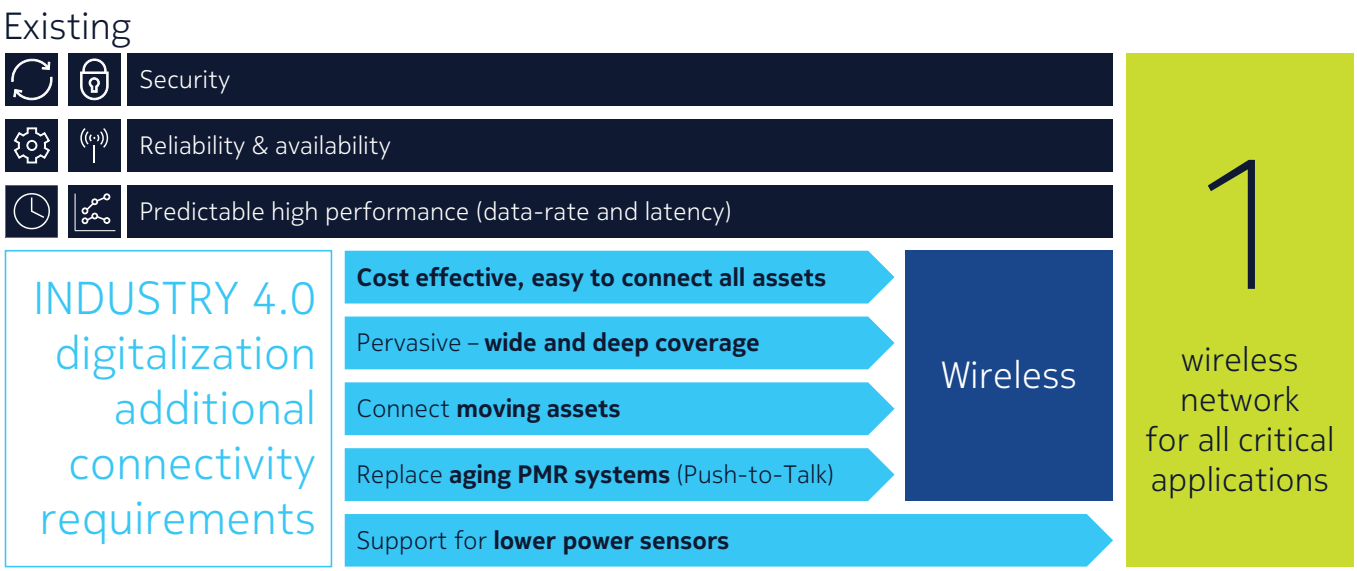
Manufacturing use cases shows the biggest demand for private 5G





**2020 Nokia-ABI research, 600+ manufacturers survey*

Critical operations requires industrial-grade connectivity

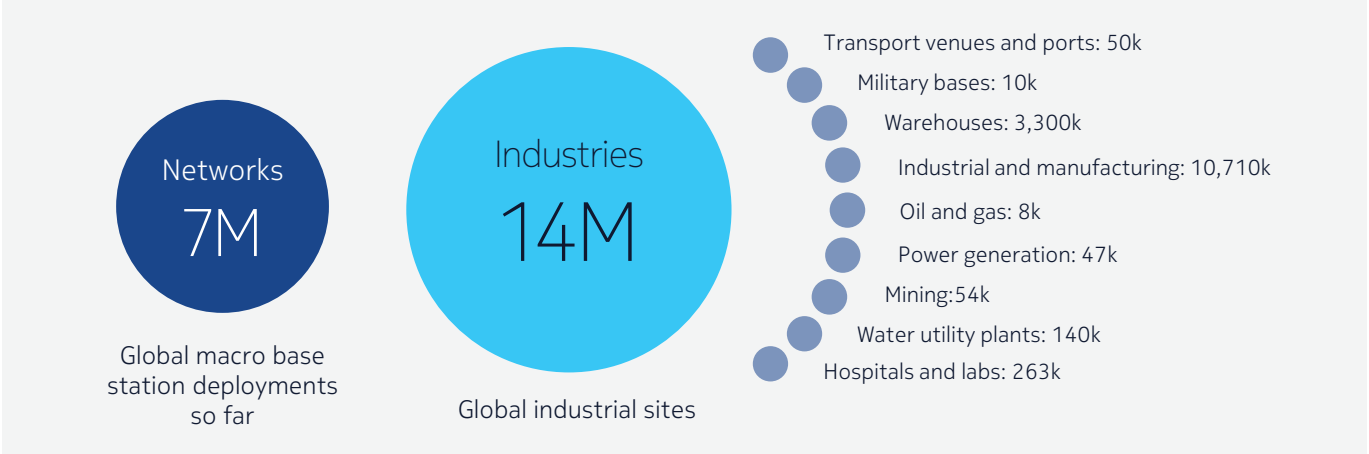


Private Wireless Network

Dedicated connectivity for critical use cases

5G wireless network focused solely on an enterprise's OT critical needs with tailored coverage & dedicated capacity to reliably and securely connect industrial assets (machines, sensors, tools, etc…) and workers

The market potential for industrial site private wireless is huge and we barely scratched the surface…



Different application domains in same industrial site

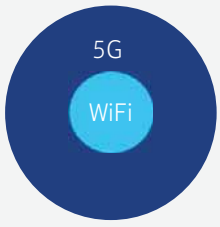
Different technologies for different requirements

Wi-Fi 6: better capacity, latency and data-rate but still IT centric…

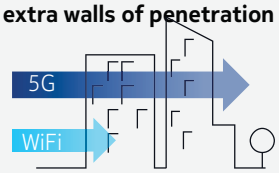
Private 5G fit for OT applications requirements

Wide and deep coverage

4-100x coverage



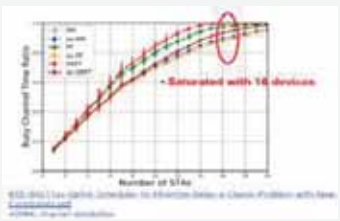
>3 extra walls of penetration



Predictable performance*

Stable <15ms latency

25x multi-user capacity



Military grade security

HACKED

Wi-Fi - WPA2/3

5G
SIM authentication
E2E encryption

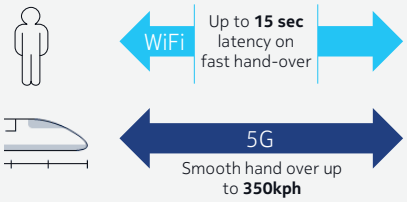
One network for all apps

Wi-Fi 5/6
- Does not include IoT capabilities

4.9G integrates LPWAN
- Narrow band, low power applications on same radio

LTE-M NB-IoT

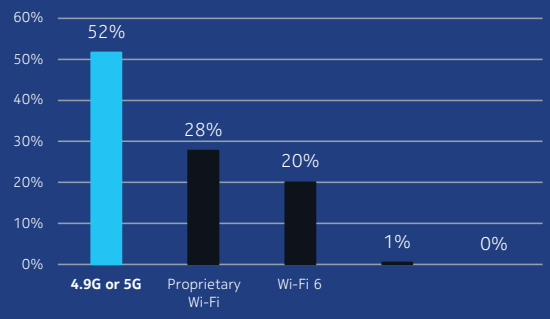
High speed mobility*



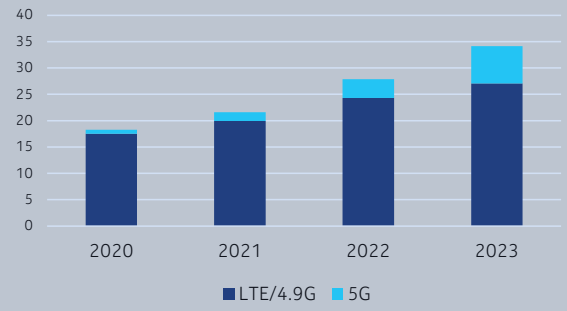
5G becoming wireless OT network technologies of choice

*"43% of European enterprises consider **network transformation to be a key challenge** [..] recognizing that **current networks cannot support the future growth** [...] in areas such as **IoT and digital transformation**"**

52% plan to leverage private LTE/5G for their future business/mission critical connectivity**



Global pWireless BTSes shipments (k)***



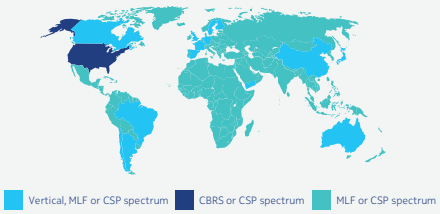
* IDC, European Enterprise Communications Survey, 2019
** 2020 Nokia-ABI research, 600+ manufacturers survey
*** Omdia 2020 - Global pWireless BTSes shipments. Results are not an endorsement of Nokia . Any reliance on these results is at the third-party's own risk.

Eliminating the barriers to adoption

Industrial-strength private wireless is here today and easier than ever

Spectrum availability

- CSP
- Vertical
- Unlicensed



Simple & easy to use

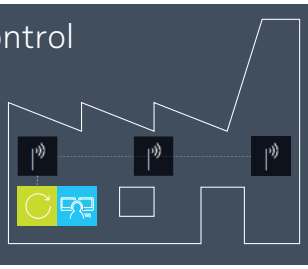
2-3 elements + Plug and Play

Ecosystem of LTE & 5G industrial devices

>6800 non-phone form factor LTE devices
GSACOM data, 12/2020

...while keeping full control

- Dedicated network
- Enterprise data stays local even in cloud architecture
- Full visibility and control from enterprise management interface



Private Wireless

For industrial sites/campuses/plants/FAN

14M Sites require reliable wireless connectivity for OT use cases

Public

NOKIA

Most common triggers to private wireless

Current wireless tech limitations	Introduction of new use cases	Incidents & External factors	Innovation & paradigm shift	Wireless connectivity...
• Issues with existing use cases on existing wireless tech (e.g. AGV on Wi-Fi) • Issue with existing wireless tech (e.g. aging PMR & PAMR network)	• Specific new use cases that require reliable wireless (e.g. Mine autonomous haulage) • Remote sites (e.g. Offshore sites)	• Worker safety (e.g. dangerous environments, ...) • Site security breach • Data privacy breach • Major disasters	• I4.0 "innovation" corporate projects • Industry segment paradigm-shift (e.g. Distributed power generation)	• Greenfield sites • Brownfield sites with no existing wireless networks





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What our customers need from us today

Automated falling conductor disconnect to avoid fire

Maintain **grid reliability** with growing **distributed renewables / storage**

Wind turbine monitoring for predictive maintenance

FAN convergence and automation

Fix Wi-Fi related **autonomous truck crashes,** downtime & resulting wear & tear

Drivers' **tiredness monitoring**

Increase safety with **remote drilling**

Introduce **wall-slope & environment sensors**

Connectivity inside the plane (pilots, crew, workers, etc..)

Plane departure time prediction using **cameras & analytics**

Replace Wi-Fi and PMR for reliable **airfield marshal work-orders & PTT**

Real-time **work- order system** for cranes & truck drivers

Automated site access system and perimeter **security**

Reefer monitoring

Remote control, autonomous cranes and AGV

Legacy assets digitalization for predictive maintenance

Fix **AGV Wi-Fi imposed low speed & reliability issues**

Digital twin **Machine connectivity**

Workers' **connected tools & safety**

"Lot-size one" manufacturing

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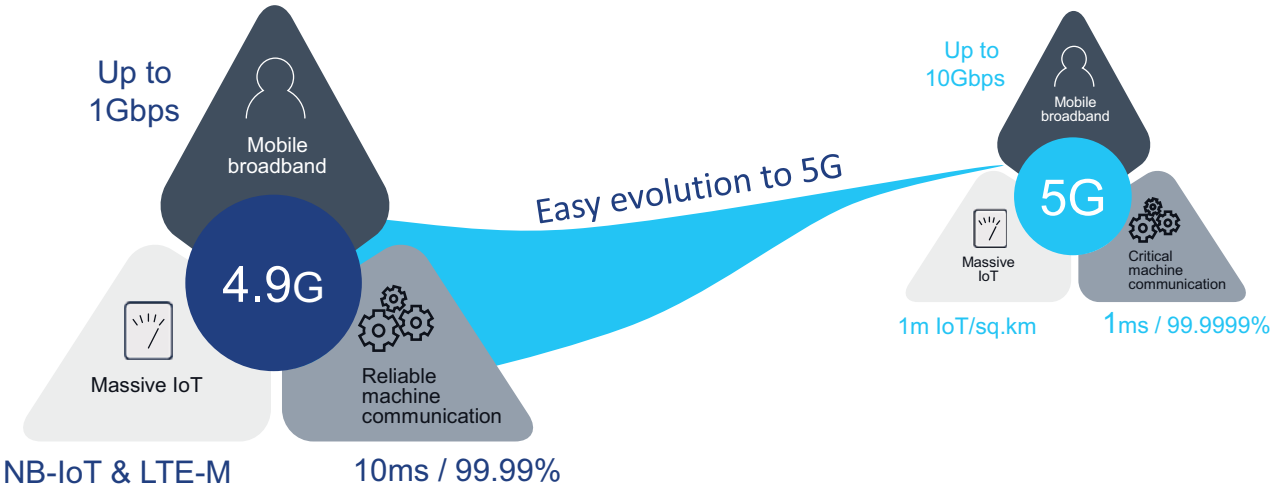
5G is often the catalyst that start the discussions...

but private 4.9G is creating value for industrials today



4.9G support most of today's industrial applications

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260+ private wireless customers

Uncontested market leader in private wireless*

*supported by latest publicly released data from key analysts' firms

Public references

Recent additions

NOKIA

Delivering many industry requirements with 5G TODAY

ELEKTRO

Brazil, World largest wind generator

- Grid monitoring to prevent illegal tapping and increase grid reliability
- Grid automation for maintaining quality

Regional private wireless network coverage (5% coverage from CSP network)

- 78,000 smart meters
- 1,300 load balancers
- 850 concentrators

LAS BAMBAS

Peru, World 9th biggest copper mine.

- PMR replacement for voice communications
- Improve worker safety with smart garments
- Future automation solutions (AHS)

Mining site coverage utilizing Telefonica core slice

- IP-MPLS over private LTE for enhanced reliability

Vienna International Airport

Austria, 24M passenger per year.

- Gates and airside operational efficiency for below-wing process (faster plane turn-around)
- Airside coverage for vehicles connectivity

Autonomous private wireless, with triple back up from A1 core

- % of private network also used for A1 subscriber capacity boost
- Triple core redundancy

KOKKOLAN SATAMA PORT OULU

Finland, 9th & 10th container port wins.

- Port digitalization
- One wireless network to replace all legacy networks and to support all operational applications

Hybrid edge cloud as-a-service private wireless via Ukkoverkot

- IT driven operation, looking for fast deployment and private wireless benefits without the complexity

Delivering many industry requirements with 5G TODAY

US, Critical IoT CSP focusing on O&G segments

- IoT communication for Drilling, completions, production and midstream operation e.g. 24/7 Well-head monitoring
- Worker communication in the field

Large regional coverage

- 130,000 miles across four major energy basins in the Continental U.S
- Permian/Delaware in West Texas and Southeast New Mexico; Eagle Ford in South Texas; Scoop/Stack in Oklahoma; and Bakken in North Dakota
- Evolution from LTE to 5G

Urban rail operator

Ultra high bandwidth LTE network to support fully automatic rail operations on new metro lines 15,16, and 17.

- Push to talk (PTT)
- Train to Ground to transfer big data at high speeds from the train to the station
- Mobile devices and on-board equipment (mobile access router)

Deployment covering 160 km of tracks, 50 stations, 4 depots &150 shafts

eCommerce warehouse automation

One of their largest warehouse complex with over 700 AGVs

- Private wireless mobile network set up in one of their 30,000sq.m warehouses, with 100 AGVs
- Unlicensed spectrum

LTE vs Wi-Fi

- Latency reduced from 40-1000ms to 12-20ms
- Bit error rate form 3% to zero
- 90% wireless AP saved

Japan, Largest car manufacturer & System integrator

Help accelerate digital transformation & factory automation

- Validate 4.9G and 5G performance
- Integrate next-generation manufacturing use cases & design innovative production processes for global manufacturing sites

Deployment in TEPC, Toyota Production Engineering facility in Fukuoka, Japan

Industry 4.0: The time is now

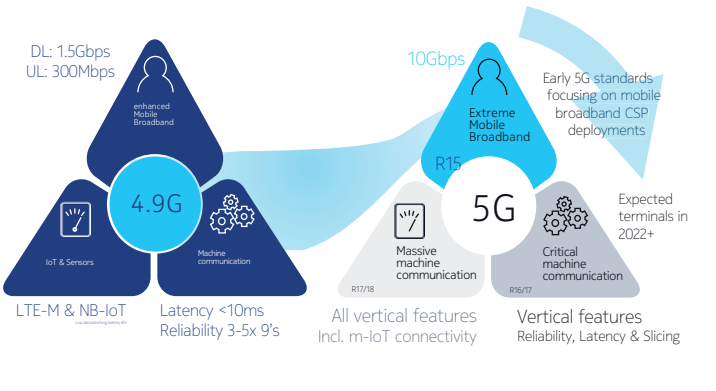
All stars align (digitalization needs, spectrum, ecosystem, solutions) to start NOW

Reliable wireless is critical for digitalization NOW!

Private 4.9G

- Major leap compared to Wi-Fi
- >85% of industrial applications

Deployable solutions are ready NOW, 5G ready for NEXT



Nokia industrial-grade private wireless

Helping industry accelerate their Industry 4.0 transformation

Enterprise requires

- Solution approach
- Richness in offers and capabilities
- Richness in coverage
- Richness in go-to-market options

Nokia's approach

Unmatched end-to-end capability
Private wireless is more than radio and core, 1st with 5G SA

Unmatched vertical expertise
Deep industrial experience, segment practice & GS offering

Trust and global reach
260+ customers in all markets, all segments

Flexible range of solutions
Easy to deploy (NDAC) or Bespoke (MPW)

Broad partnerships
CSP, Cloud, Industrial, SI & Consulting

Laser focused on industrial automation
Focused R&D and investment

From now to next

Bringing the most complete 5G industrial private wireless solutions that meets the critical connectivity application requirements for Industry 4.0 today and tomorrow

PRISPEVKI

ARTICLES

18. 5. 2021

Digitizing industry verticals with 5G, a software engineering perspective

Frank Amand

BEEIN

SUMMARY

The digitization of a manufacturing facility must carefully balance disruption and continuity. Disruption is inevitable, in the form of changing rules: it is the only way to reap the benefits of technological innovation, when the technology helps overcome previous process limitations. At the same time, processes are never reinvented from scratch and changes are introduced gradually through pilot projects and with continuous monitoring of the agreed KPIs. Where these are general truths for technical innovation in industry over the last decades, we can, in our project in Kranj, nevertheless perceive paradigm shifts through recent evolutions such as the emerging 5G communication technology and the concept of distributed and autonomous digital twins. This presentation looks at the ideas behind these technologies and shows how they work together to power a digital factory that is becoming increasingly cloudified, while remaining firmly rooted in the physical reality.

ABOUT THE AUTHOR

Frank Amand is Head of Product Management and Marketing at BeeIN, the first Slovenian operator dedicated to digitizing industries. He has been active for 25 years in the software business, ranging from consumer electronics at Philips, over nuclear accelerator control systems at Cosylab, to telecommunications at Iskratel and BeeIN. He likes to shape the intricacies of large software engineering work into a form that is most compelling to varied audiences, be it in the form of value propositions for business owners, improved user experience for people in operations, or inspiration and increased insight for the citizens we ultimately aim to serve.


BeeIN
2021
VITEL
Digitizing industry verticals with 5G
a software engineering perspective


5G =
Digital Transformation =
Software driven Innovation?
Photo by Shahadat Rahman on Unsplash

Overcoming tomorrow's societal challenges…

BeeIN

We need to interconnect systems, beyond boundaries of single companies, existing value chains, even industry verticals as we see them today… Fast! How?

Let's unlock the creativity, present in the new partnership eco-systems at all levels, with openness and transparency

Establish the level field, conditions to allow software engineers to "do their magic", for smarter cities, a smarter grid, smarter factories,…

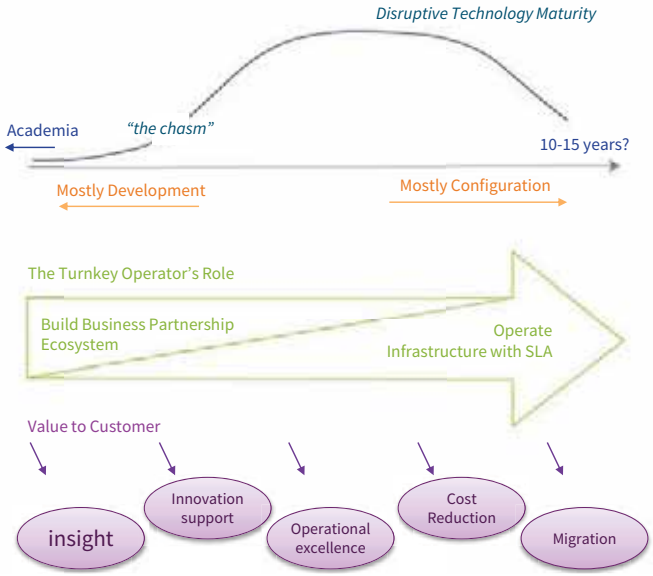
BeeIN is a Slovenian-based Network Operator, focused on the **digitization of Industry Verticals** like Electric Energy, Logistics and Manufacturing on a mission to a more **sustainable future** for those industries.

The *5G philosophy* binds together, as an enabler, the **latest technologies**: AI, AR, IoT, MEC, digital twins… at **industrial scale**. See the other speakers today

Cloud-based, SaaS apps will be strong part of DevOps realizations. BeeIN wants to be *one busy bee* in that hive.

Interconnection: Which Gaps to Bridge?

Building large control system solutions, vertical and horizontal (across time)



3 Application Examples and Illustrations

- **Logistics**, **Smart Ports**
  The most *open* one, every container port is international.
  Digital Twin applies locally

- **Energy Sector, Smart Grid**
  The most *demanding* one
  Open + Closed Loops

- **Industry 4.0, Smart Factory**
  The most *diverse* one
  Every factory is different

* Manufacturing is a significant % of GDP in Region
SLO: 21% and growing last 5 years, HU 18% ←→ EU average (14%), e.g. France, Spain, Belgium ~ 10%
https://data.worldbank.org/indicator/NV.IND.MANF.ZS?locations=EU

Digital Logistics

Loose Coupling vs tight coupling, merging IT and OT

Tightly coupled OT and Loosely coupled IT approaches have limitations where they meet or overlap

Digital twin in the port of Antwerp, Belgium*

Smart Port trends
- International logistics platforms**
- Receive Autonomous sailing vessels**
- Port Digital Twin: Flow management

No single bullets, but open standards will help. We have to look at the interfaces and how open they should be.

*https://www.porttechnology.org/
**What is a Smart Port? – Joyce Bliek, Port of Rotterdam

Electric Power

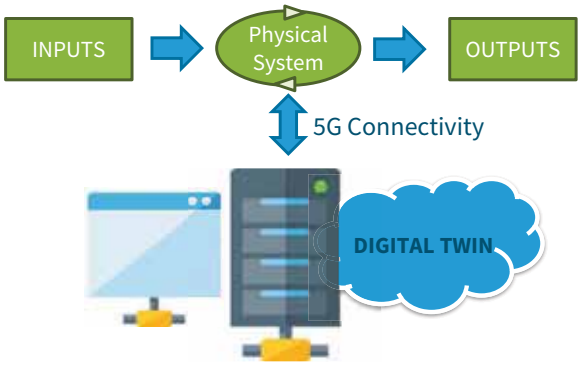
"In order to meet the climate goals, **Belgium needs to swiftly decarbonize its energy production**, while taking into account a huge increase in demand due to decarbonization of other sectors. The **growing importance of windmills and private solar panels** for energy production in Belgium on the one side and growth of **electric vehicles** and heat pumps on the other, creates the acute awareness that the **way energy is transported is changing drastically over the next decades**, and this in line with the European view on decentralization and **digitalization/smartening of our grids**. Supported by our academic research and innovation driven organizations like Flux50, **the Belgian industry has made decisive steps towards its implementation**.

Frederik Loeckx, General Director at Flux50

Electric power Applications
Asset Management
Smart Grid Management
Vegetation Control
Analytics (e.g. for predictive maintenance)
Etc.

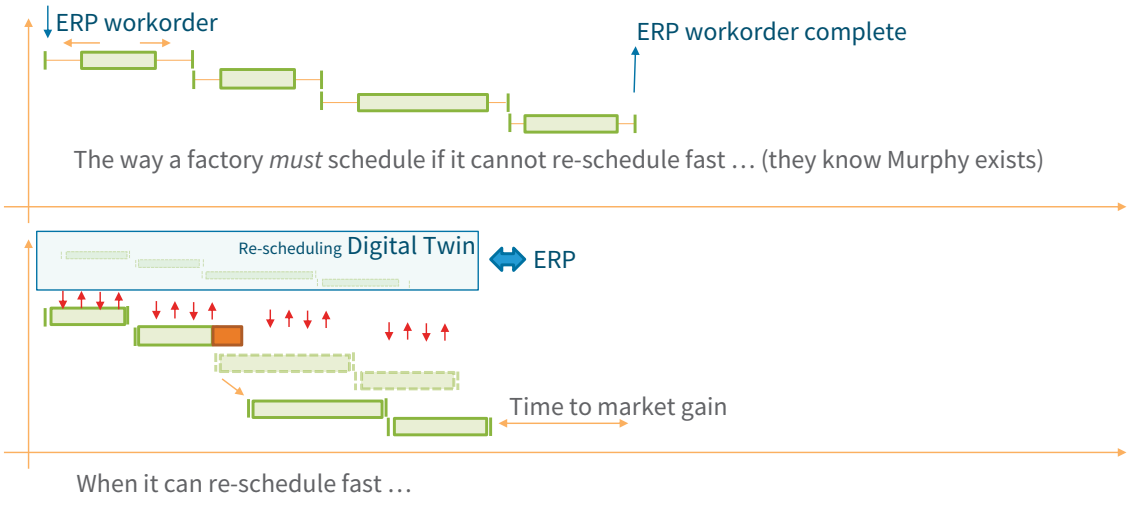
Provide connectivity to
Electric Vehicle charging stations
Smart Meters
HV Line Communications Coverage
Main Transformer Stations, Substations
Etc.

Smart Factory Project : Digital Twin Augmented Manual Assembly



The digital twin's purpose is to provide real-time routing and optimization of the production plan and resources, such as workers, machines, tools, equipment, …

How digital twin puts "SAP" on steroids



Take-aways

*Need for **highly tailored** services in close cooperation with partners and customers*

- **Mission Critical Smart Connectivity** (M2M, IoT)

Connectivity services are of key importance of all digitization use cases that depend on mission-critical communication. As a digital operator we offer private connectivity-as-a-service, covered by SLA agreements, driven to cover the required KPIs in terms of throughput, latency and density.

- **Digital Services and Applications**

From mission critical push-to-talk MCPTT operational communication, over digital twins, artificial intelligence machine learning AI/ML and augmented reality on the factory floor, and the automatic guided vehicles AGVs that drive tomorrow's logistics and supply chains, the needs of industry verticals are clear

- **Digital Solution Design and End-to-End Projects**

To enable customers to focus on optimizing their core business processes, the industry requires digitization initiatives as E2E projects, delivered with transparency and professionalism.
This requires drive, know-how and (software!) experience

References

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5G in obogatena resničnost – Ali bo 5G osnova za razmah obogatene resničnosti?

5G and Augmented Reality – Will 5G be the basis for an augmented reality boom?

Matjaž Breznik

TROIA, informacijske storitve

POVZETEK

Obogatena resničnost, kot tehnološki koncept, je bila razvita že pred desetletji vendar zaradi tehnoloških omejitev ni bila uporabna ali primerna za širšo množico in industrijsko rabo. V zadnjih letih pa je prišlo do izjemnega napredka v tehnologiji, kar je za masovno uporabo ključnega pomena. Z razvojem strojne in programske opreme za obogateno resničnost bomo v prihodnosti videli vedno več primerov uporabe v realnem življenju. Skozi prihajajoče desetletje bo obogatena resničnost prepletena z vsakodnevnim življenjem in omogočila precej bolj naraven in uporaben pregled digitalnih informacij. Aplikacije za obogateno resničnost, za vizualizacijo digitalnih komponent v realnem času in svetu potrebujejo veliko procesorsko moč, zmogljive kamere, vrsto naprednih senzorjev, dobro programsko opremo in odlično povezljivost. Vse te podatke pa je potrebno hitro obdelati in posredovati v realnem času, da lahko ustvarimo prepričljivo in odzivno uporabniško izkušnjo obogatene resničnosti. Ogromna količina podatkov, ki se obdelujejo v realnem času, pomeni, da so sodobne aplikacije obogatene resničnosti trenutno še lokalizirane, v bistvu "brez povezave", ker se večino obdelave odvije na lokalni napravi. Naša trenutna omrežja 4G ne bodo pokrivala potreb za vedno večje število AR naprav in prenosa večje količine podatkov ob primerni hitrosti in dovolj nizkih odzivnih časih za odlično izkušnjo. Mobilno omrežje naslednje generacije bo močno povečalo zmogljivosti prenosa podatkov in zmanjšalo odzivne čase. Organizacija ABI Research napoveduje, da bo 5G zagotovil "10-kratno povečanje pretočnosti, 10-kratno zmanjšanje zakasnitev in 100-kratno povečanje prometne zmogljivosti" v primerjavi z 4G, kar pomeni, da 5G ne bo samo izboljšal izkušnje AR ampak bo postal nujen za izvajanje naprednih AR aplikacij. 5G bo omogočil, da bodo AR aplikacije prenesle večji del procesiranja in obdelave podatkov v oblak in s tem odprle pot manjšim, ergonomsko prijaznejšim, zmogljivejšim in cenejšim AR napravam. V podjetju TROIA smo razvili platformo za obogateno in mešano resničnost, ki združuje realen in virtualen svet ter omogoča ogled digitalno ustvarjenih informacij v realnem času. TROIA AR je inteligentna spletna platforma, ki povezuje obogateno resničnost z informacijskimi sistemi, kot so EAM (sistem za upravljanje s tehničnimi sredstvi), ERP, IIoT platforme, GIS in drugi zaledni sistemi ter podatke pošilja na pametna AR/MR očala, pametne mobilne telefone in tablice. Namen platforme je podpora pri odločanju pri vzdrževalnih procesih, tako v pisarni kot na terenu z uporabo AR/MR podprtih naprav.

SUMMARY

Augmented reality, as a technological concept, was developed decades ago, but due to technological constraints was not useful or suitable for wider mass and industrial use. In the recent years however, there has been tremendous progress in technology, which is crucial for mass use. With the development of augmented reality software and hardware, we will see more and more real-life use cases in the future. In the next decade, augmented reality will be intertwined with everyday life, allowing a much more natural and useful overview of digital information. While embedding virtual components in a real-world view, AR applications require powerful processors, sharp cameras, a range of advanced sensors, progressive software equipment and great connectivity. All that data needs to be rendered in real time in order to produce a convincingly smooth and responsive AR experience. The huge amount of data being processed in real-time means that modern AR applications are localized, essentially "offline", because all the computing happens on a local device. Our current 4G networks do not have the capacity to support more connected AR devices, nor have the required speed and low latency for real-time responsiveness and immersion. The next generation mobile network will

massively increase capacity and lower latency. ABI Research predicts that 5G will provide a "10X increase in throughput, 10X decrease in latency, and 100X increase in traffic capacity" over 4G, which will mean that "5G will not only improve, but will also be a requirement for some of the most exciting AR applications". 5G will enable existing AR applications to offload much of the intensive processing to the cloud, opening a way for AR devices to a new, smaller, more energy efficient and cheaper form factors. At TROIA, we have developed an augmented and mixed reality platform that combines the real and virtual worlds with real-time viewing of digitally generated information. TROIA AR is an intelligent web platform that integrates augmented reality with backend information systems such as EAM (formerly IBM Maximo), ERP, IoT platforms, GIS and other back-end systems, and sends data to smart AR glasses, smartphones and tablets. End goal is to support in the office or on the field decision making in the maintenance operations by utilizing smart glasses or other AR-enabled devices.

O AVTORJU

Matjaž Breznik je sposoben prodajni zastopnik, izkušen na mnogih področjih. Ima visoke sposobnosti javnega nastopanja in vodenja sestankov ali konferenc katerega koli tipa. Med delom v oddelku za prodajo in razvoj obogatene resničnosti ter v tesnem sodelovanju z razvojno ekipo, je pridobili veliko znanja in izkušenj na področju inovativnih tehnologij. Naravne veščine komunikacije in sposobnost grajenja poslovnih odnosov sta pomembni kvaliteti, ki jih pri svojem delu vsakodnevno uporablja.

ABOUT THE AUTHOR

Matjaž Breznik is a capable sales representative, experienced in many fields. He has high public speaking abilities and is comfortable in leading meetings of any type. While working in Augmented Reality sales, he gained extensive knowledge in the R&D department, working closely with the development team. Building business relationships is his strength, using his natural communication and negotiation skills.

Connecting future and present features of operational management

TROIA

5G in obogatena resničnost

Ali bo 5G osnova za razmah obogatene resničnosti

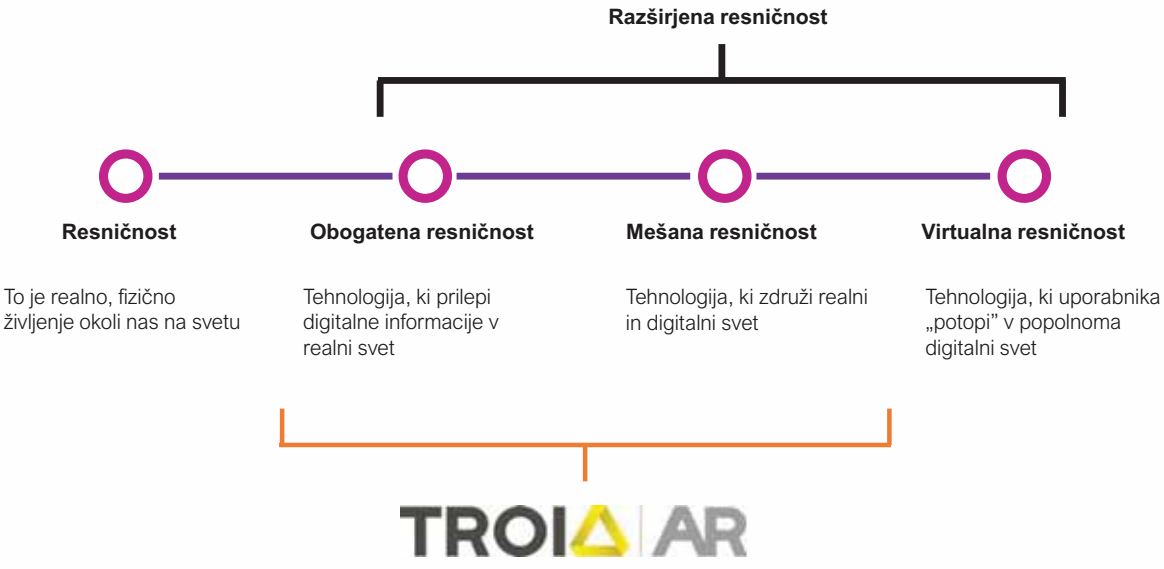
18.5.2021

VITEL

Matjaž Breznik, AR prodaja in razvoj

Definicija

TROIA 10 YEARS VITEL



Vpliv

TROIA 10 YEARS

VITEL

Obogatena in mešana resničnost bo spremenila način našega življenja in interakcije s svetom

Omogoča izjemno izkušnjo in povečano produktivnost

Vizualizacija prostorskih podatkov

TROIA 10 YEARS

VITEL

Vizualizacija prostorskih podatkov

Zakaj 5G?

5G Uporabniški primeri

Obogatena resničnost (AR) in mešana resničnost (MR)

Nenehen prenos/nalaganje podatkov na napravo, ki jo nosimo celi dan

Bogatejša vizualna vsebina

1 Mbps	2 Mbps	2 to 20 Mbps	5 to 25 Mbps	10 to 50 Mbps	50 to 200 Mbps	200 to 5000 Mbps
(Prenos slik in poteka dela)	(Video konference)	(3D model in vizualizacija podatkov)	(Dvosmerna teleprisotnost)	(Trenutni 360° video - 4k)	(360° video naslednje generacije (8K, 90+ FPS, HDR, stereoskopski)	(6 DoF video ali prost pogled)

Vir: ABI Research

Področja

AR/MR bo preoblikovala industrijo in organizacije

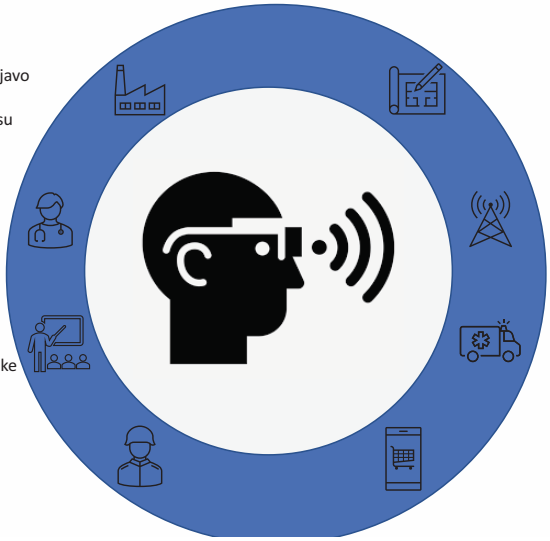
Povečana produktivnost, učinkovitost in varnost

Industrija in proizvodnja
- Vodeno usposabljanje in podpora na daljavo
- Vzdrževanje, inšpekcije, presoje
- Diagnostika in vizualizacija v realnem času

Zdravstvo
- Učinkovitejša oskrba pacientov
- Diagnostika in pomoč pri zdravljenju
- Vizualizacija operacij in kirurški trening

Izobraževanje
- Tempo učenja narekuje uporabnik
- Interaktivno vizualno učenje
- Kateri koli predmet, od zgodovine do fizike vključno s strokovnimi predmeti

Obrambno področje
- Oddaljena pomoč logistiki na misiji
- Vizualizacija bojišča in podatkov
- Vzdrževanje sredstev



Načrtovanje in inženiring
- 3D vizualizacija, CAD, BIM
- Oddaljeno sodelovanje pri načrtovanju
- Digital twin

Telekomunikacije
- Vizualizacija infrastrukture in opreme
- Virtualizacija omrežja
- Oddaljeni pregledi opreme in inšpekcije

Interventne in urgentne službe
- Vizualizacija stanja bolnikov
- Telemedicina
- Izboljšava varnosti in odzivnega časa

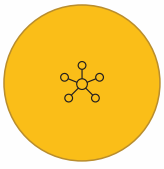
Prodaja in marketing
- Preizkus pred nakupom: oblačila, pohištvo...
- Navigacija do izdelkov
- Lokacijski oglasi

Prihodnost

AR/MR bo neopazno združil resnični svet z digitalnimi elementi

Poglobljeno dojemanje/izkušnja
Vizualni elementi, zvoki in interakcije so tako realistični, da se zlijejo z realnostjo

Inteligentna
Razume resnični svet, uči se osebnih Preferenc in zagotavlja varnost in zasebnost

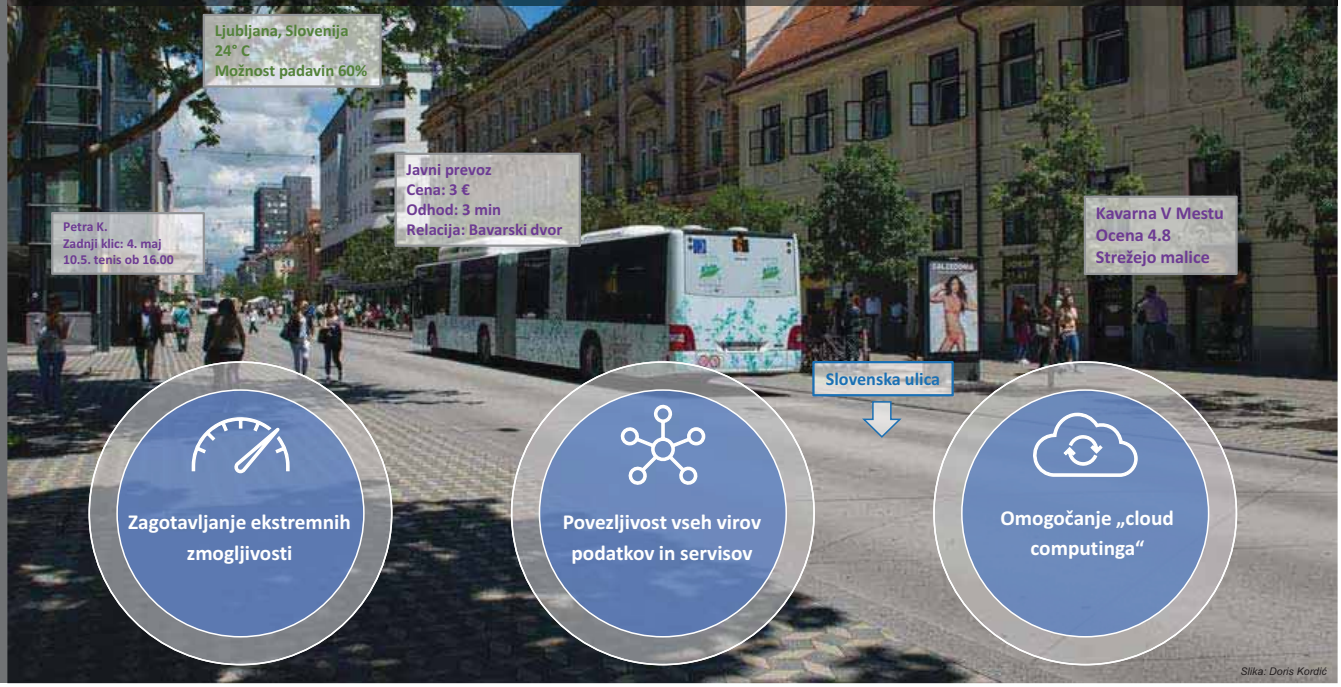


Povezana
Vedno prižgana, lahko nosljiva naprava s hitro brezžično povezljivost v oblak kjerkoli in kadarkoli

Prihodnost

AR/MR zahteva naslednjo stopnjo vseprisotne povezljivosti

Množična uporaba zelo mobilne, inteligentne, vedno vklopljene naprave

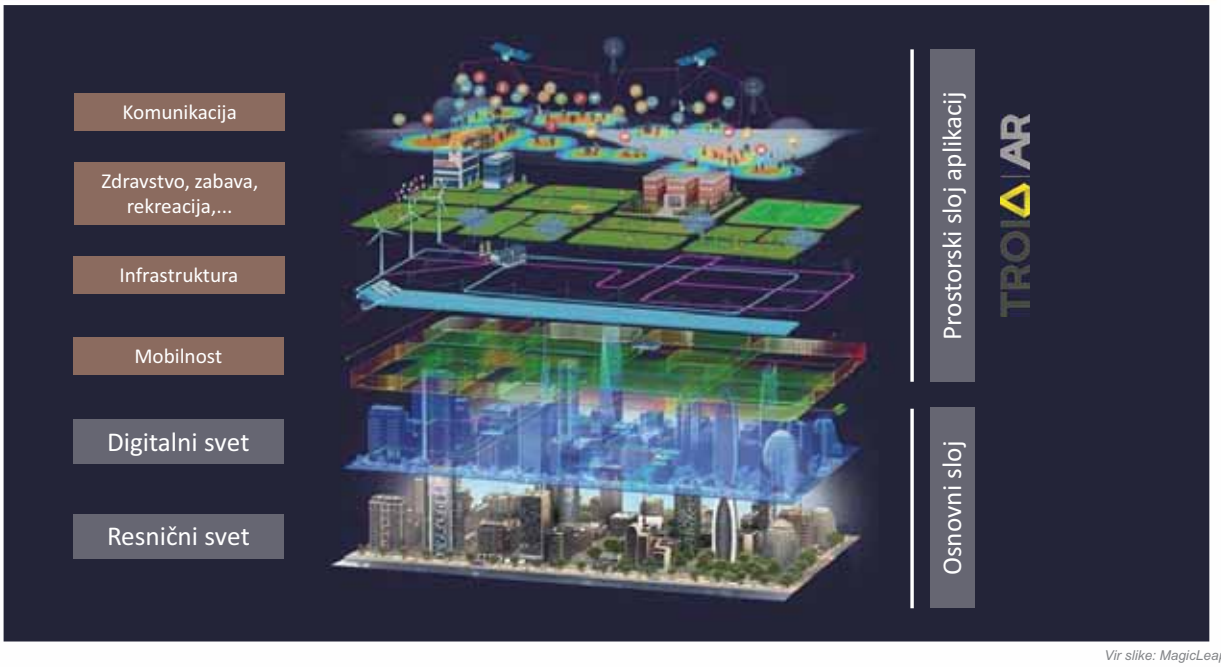


Slika: Doris Kordić

AR metaverse (cloud)

TROIA 10 YEARS

VITEL



Vir slike: MagicLeap

Pričakovanja

TROIA 10 YEARS

VITEL

Računalništvo v oblaku do dopolnjevalo obdelavo podatkov v napravi

Izkoriščanje povezljivosti za najboljše iz obeh svetov

Obdelava podatkov v napravi

- Varnost in zasebnost
- Nizka latenca za takojšnje procesiranje
- Razpoložljivost tudi izven pokritosti signala
- Učinkovita izraba pasovne širine in procesiranje

Potrebno bo oboje

Lokalne informacije in omejen kontekst

Javne informacije in širši kontekst

Računalništvo v oblaku

- Neomejena količina in shranjevanje podatkov
- Množično pridobivanje in združevanje podatkov
- „Bigdata“ obdelava brez omejitve moči
- Zanesljiva in globalna povezljivost z nizko latenco v oblak

Enterprise AR/MR

Vizualizacija ključnih podatkov

Vizualizacija 3D modelov

Potrebe iz trga

Vizualizacija ključnih podatkov sredstev, strojev, senzorjev....	Vizualizacija prostorskih podatkov in podzemne infrastrukture	Digital Twin Virtualizacija	Vizualizacija informacij in vsebin (PPT, PDF, video...)
Umeščanje 3D in BIM modelov infrastrukture na lokacijah	Učinkovito vzdrževanje in upravljanje sredstev	Oddaljena pomoč, Inšpekcije, Presoje	Izobraževanje in trening

Hitrost | Latenca | Zanesljivost | Varnost

cilj

TROIA 10 YEARS

VITEL

5G bo omogočil naslednjo stopnjo AR/MR izkušnje

Doživljanje AR/MR izkušnje kjerkoli
- Doma, v službi, v avtu, na sprehodu, v tovarni...

Deljenje interaktivne izkušnje
- Delovni procesi, dogodki, sestanki, teleprisotnost, rekreacija, zabava...

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TROIA 10 YEARS

OPTIMIZING FUTURE

Razvoj zasebnega omrežja 5G za industrijske vertikale

Development of a private 5G network for industrial verticals

Janez Sterle, Luka Koršič
INTERNET INSTITUTE

POVZETEK

5G je nova tehnologija namenjena reševanju najzahtevnejših izzivov industrijskih vertikal kot so logistika, pametne tovarne, avtomobilska industrija in kritične komunikacije. Ko se bodo, kot del novih nastajajočih trgov, začeli pojavljati novi primeri uporabe 5G, bodo potrebni tudi novi modeli uvajanja omrežij, kot je na primer »ne-javna omrežja« 5G, ki bodo lahko zadostili številnim tehnološkim in regulatornim zahtevam, zlasti tistim, ki so povezane z nizko zakasnitvijo, visoko razpoložljivostjo, fleksibilnostjo omrežja in njegovo kibernetsko varnostjo. V predstavitvi bomo podali najsodobnejše tehnološke koncepte (cloud native, VNF, CNF, MANO, K8s) in izkušnje z razvojem in uvajanjem zasebnih sistemov 5G, prilagojenim za potrebe najzahtevnejših industrijskih sektorjev, ki so rezultat lastnih tehnoloških raziskav in inovacijskih prizadevanj ter uspešnega mednarodnega sodelovanja (H2020 5G-LOGINNOV, Int5Gent, EVOLVED-5G, 5G-INDUCE, 5GASP).

SUMMARY

5G is a new emerging technology designed to address the most demanding needs of industrial verticals, such as logistics, smart factories, automotive and critical communications. As novel 5G use cases start to take place as part of the emerging markets, new deployment models will be required such as 5G Non-public Networks that will be able to cope with a myriad of demanding technical and regulatory requirements, in particular those related to low latency, high availability, resilience, system flexibility and cyber security. In this presentation, we will present selected state-of-the-art technological concepts (cloud native, VNF, CNF, MANO, K8s) and experience with development and deployment of private 5G systems tailored to the needs of the most demanding industrial sectors, which have resulted from own in-house research and innovation efforts as well as a range of international collaborations (H2020 5G-LOGINNOV, Int5Gent, EVOLVED-5G, 5G-INDUCE and 5GASP).

O AVTORJIH

Janez Sterle je soustanovitelj in direktor podjetja INTERNET INSTITUT d.o.o. Magistriral in doktoriral je s področja telekomunikacij na Fakulteti za elektrotehniko Univerze v Ljubljani. Njegovo glavno področje dela je načrtovanje, razvoj in upravljanje omrežij ter storitev, testiranje in in verifikacija tehnologij 4G/5G, NFV, IPv6, QoS in QoE; PPDR in NATO podprtih taktičnih komunikacijskih sistemov; preskušanje, merjenje in preverjanje najsodobnejših protokolov in tehnologij. Ima uveljavljene mednarodne izkušnje na področju raziskav in razvoja ter industrijskih projektov v različnih sektorjih (telekomunikacije, logistika, varnost in zaščita) vključno s projekti H2020 Evropske komisije na področju tehnologij 5G: 5G-LOGINNOV, Int5Gent, EVOLVED-5G, 5GASP, 5G-INDUCE, 5G-IANA, MATILDA-5G in 5GINFIRE. Tesno sodeluje z industrijskimi akterji, regulatornimi in zakonodajnimi organi tako na strateški kot tehnični ravni. Ima industrijske certifikate in različne ameriške patente na področju mobilnih sistemov.

Luka Koršič je soustanovitelj in vodja razvoja v podjetju INTERNET INSTITUT d.o.o. Magistriral je s področja telekomunikacij na Fakulteti za elektrotehniko Univerze v Ljubljani. Njegovo glavno področje dela je distribuirana oblačna omrežna in storitvena arhitektura, orkestracija in testiranje kvalitete storitev (QoS) v modernih omrežjih 4G/5G in virtualiziranih ter programabilnih omrežnih sistemih (SDN/NFV). Sodeloval je na več EU projektih sklopa H2020 (vključno z 5G-LOGINNOV, Int5Gent, EVOLVED-5G, 5GASP, 5G-INDUCE, 5G-IANA, MATILDA-5G and 5GINFIRE), predvsem v vertikalah kritične zaščite (PPDR) in pametnih tovarn.

ABOUT THE AUTHORS

Janez Sterle is a co-founder *and CEO of INTERNET INSTITUTE Ltd. He received his M.Sc. and Ph.D. degrees in telecommunications from the University of Ljubljana, Slovenia. His main area of work concerns network design, planning, service management, testing and implementation in production networks for 4G/5G, NFV, IPv6, QoS and QoE, PPDR and NATO enabled tactical communication system; testing, measurement and verification of state-of-the-art protocols and technologies. He has an established track*

record of R&D and production-grade projects in communications, safety and security sectors, including EC's H2020 projects 5G-LOGINNOV, Int5Gent, EVOLVED-5G, 5GASP, 5G-INDUCE, 5G-IANA, MATILDA-5G and 5GINFIRE on the topic of 5G, and cooperates closely with the respective industries, practitioners, regulatory and legislative bodies on strategic and technical levels. He holds industrial certification and various US patents in the field of mobile systems.

Luka Korsic is a co-founder and Head of R&D at INTERNET INSTITUTE Ltd. He received his M.Sc. degree in telecommunications from the University of Ljubljana, Slovenia. His main area of work concerns cloud-based distributed network and service architecture, orchestration techniques and QoS testing in modern 4G/5G and SDN/NFV-based systems. He collaborated in several H2020 projects in the area of 5G (including 5G-LOGINNOV, Int5Gent, EVOLVED-5G, 5GASP, 5G-INDUCE, 5G-IANA, MATILDA-5G and 5GINFIRE), where he was mainly involved in the PPDR and Smart Factory verticals.

Development of a Private 5G Network for Industrial Verticals

Janez Sterle & Luka Koršič
janez.sterle@iinstitute.eu

About Company

- Company facts
  - Startup established in 2014
  - Located in Ljubljana, Slovenia
  - Employee ownership
  - 100% IPR ownership
  - First employees Q4 2017
  - Trusted R&I partner in EU H2020
- Core Expertise: development, deployment and operation of telco grade Quality Assurance (QA) and Critical Communications Systems (CCS)
- Main technologies verticals
  - QA | Quality assurance of mobile, fixed and cloud systems | *www.qmon.eu*
  - CCS | Solutions for 5G/IoT-based critical communications | *5gsafety.net*

How we started with 5G | R&I

MATILDA matilda-5g.eu

5GLOGINNOV 5g-loginnov.eu

5GASP 5gasp.eu

5G INDUCE 5g-induce.eu

5GINFIRE 5ginfire.eu

Int5Gent int5gent.eu

EVOLVED-5G evolved-5g.eu

5G-IANA

2017	2018	2020	2021
PPDR	PPDR	PPDR | Ports | Smart Factories	| Industry 4.0 | Automotive

- Operational Private 5G network (SA mode)
- 5G qMON | 5G testing and verification solution
- 5G IoT System

This projects received funding from the European Union's Horizon 2020 research and innovation programme grant agreements No. 761898, 732497, 957400, 957403, 101016448, 101016608, 101016941 and 101016427.

5G (SA) Facilities | Testbeds in Slovenia

5GASP

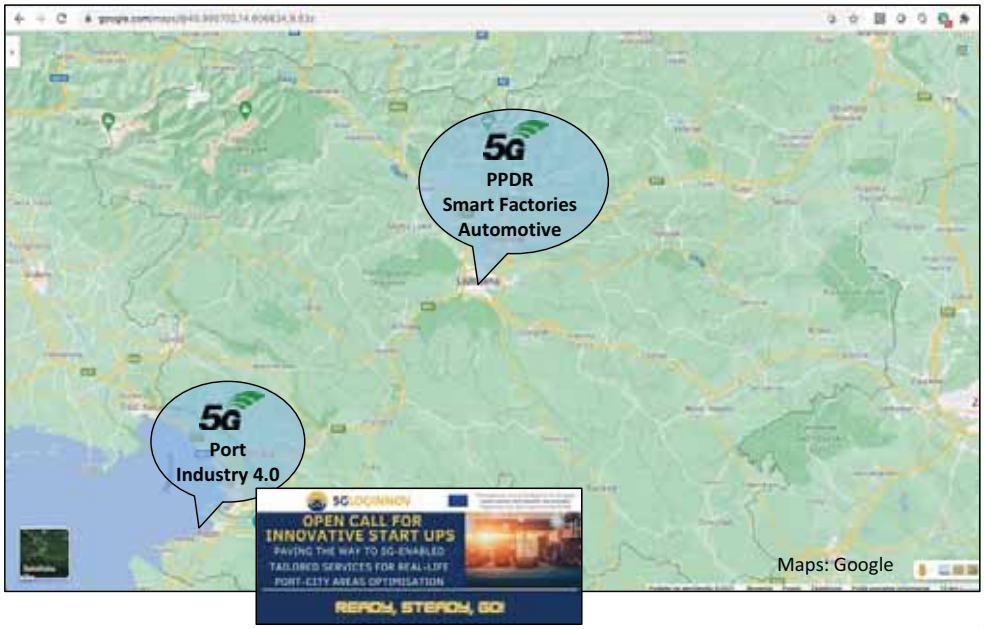
Int5Gent

EVOLVED-5G

5G INDUCE

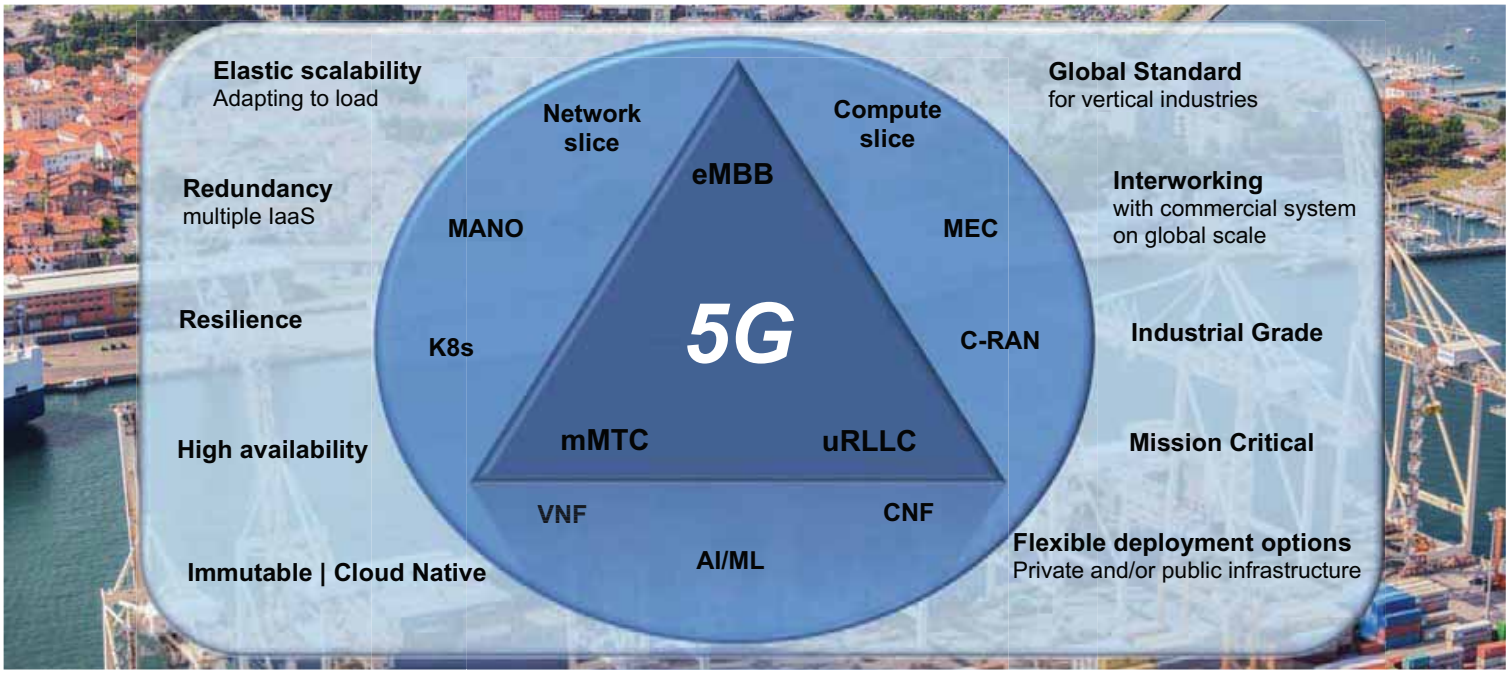
5G-IANA

5GLOGINNOV



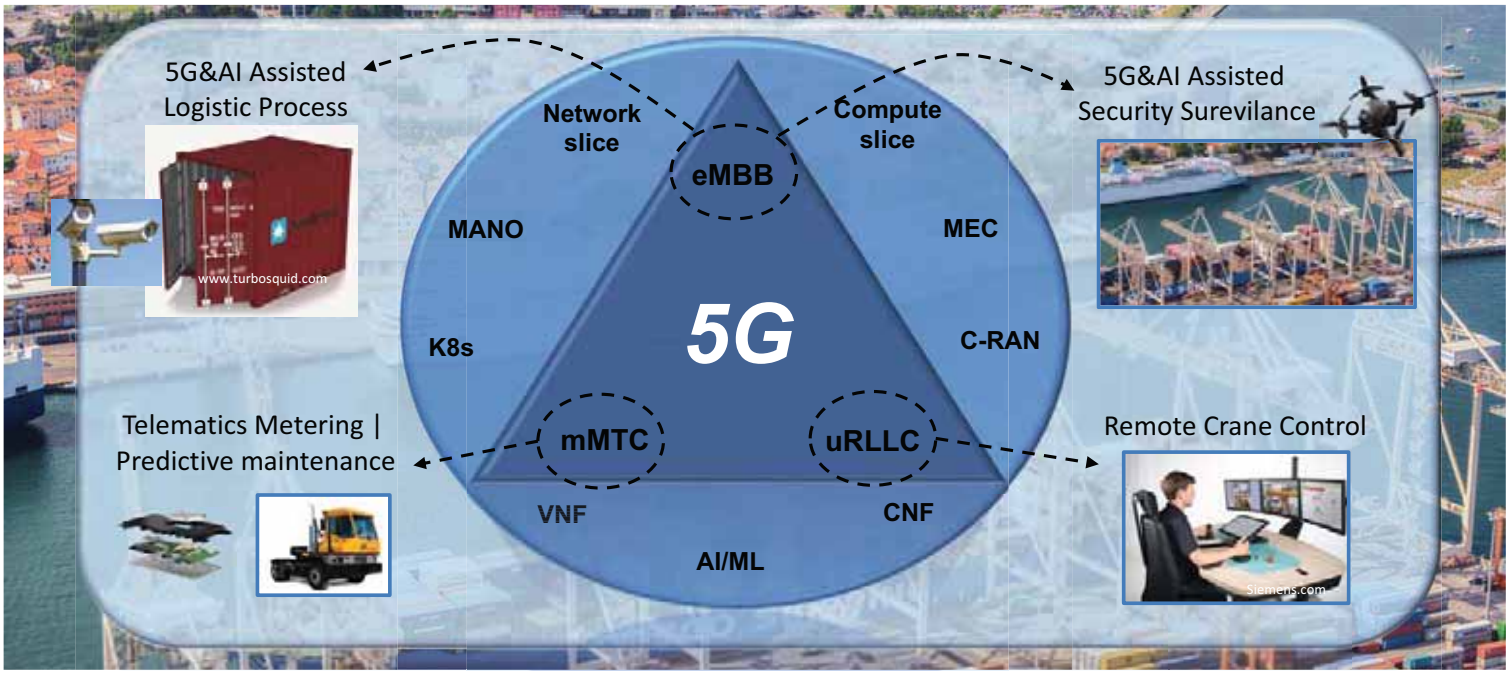
 https://5g-loginnov.eu/open-call/

5G for Industrial Verticals

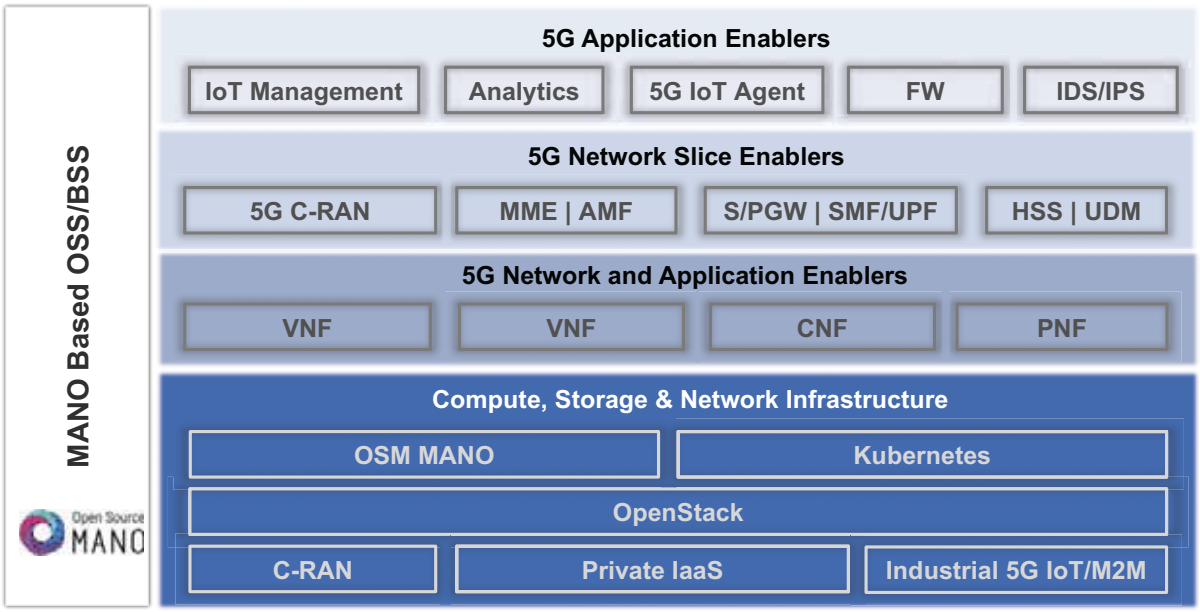


5G Assured Use Cases | Port examples

5GLOGINNOV



Private 5G Solution Architecture

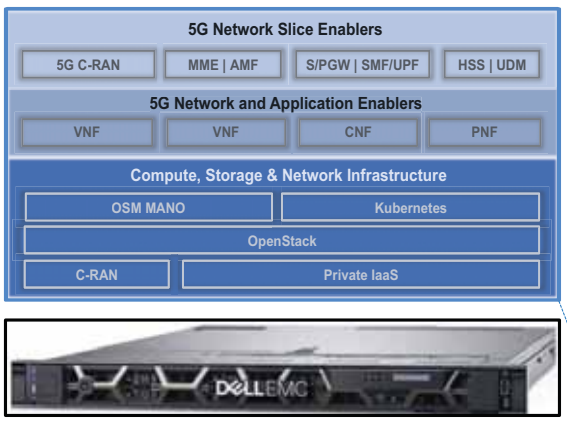


Private 5G Network | Modular Building Blocks

LTE-A | NR
420 Mhz
450 Mhz
700 Mhz
800 Mhz
900 Mhz
1400 Mhz
1800 Mhz
2600 Mhz
3500 Mhz
...

Ant + RRH
250 mW – 20 W
FDD | TDD
MIMO 2x2|4x4

BBU Signal Processing
CPRI PCIe
QAM256



x86 Commodity Hardware

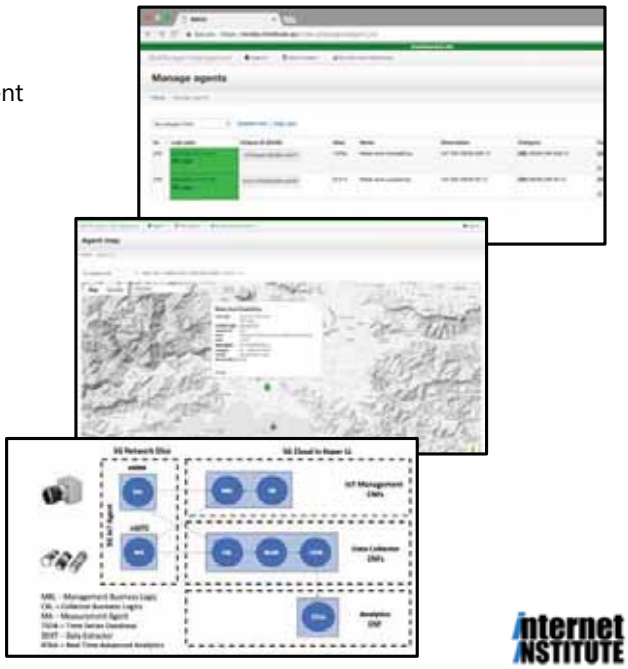
LTE/4G (R14) | NR/5G (R15)
EPC | 5GCN (NSA|SA)
eNb | gNb
VoLTE | VoNR
SMS
AES, SNOW, ZUC
LTE-M1
NB-IoT
QoS, QCI
IPv4, IPv6, IPv4&IPv6
Unstructured PDU
Rx & Cx external interfaces
...

Private 5G Network | At-a-glance

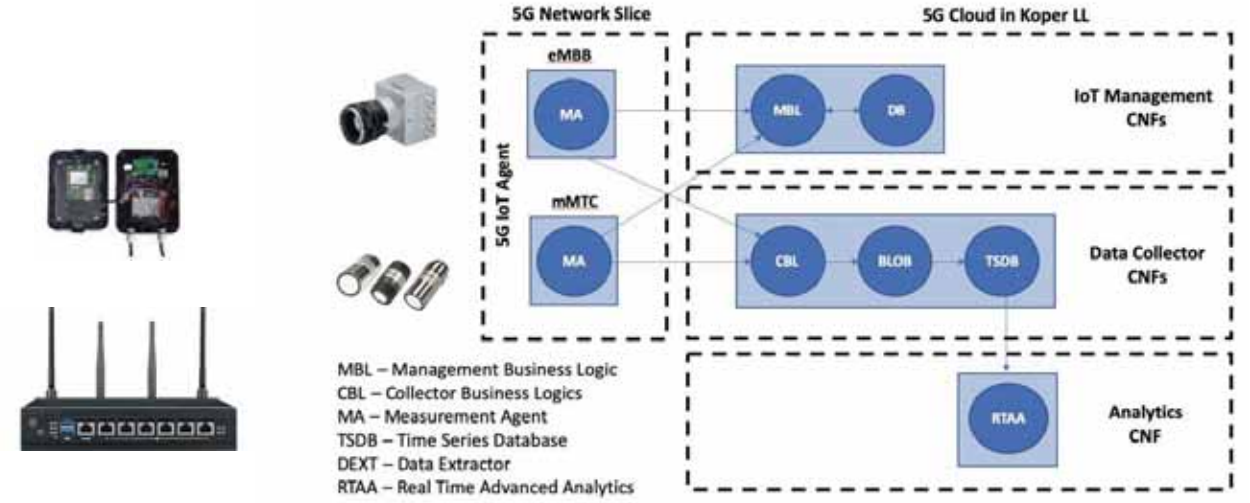
- Rapidly deployable 4G/5G Core & Cloud RAN
  - EPC & 5G CN | NSA and SA
  - 5G NR | NSA and SA
  - LTE | LTE-A Pro, VoLTE, Nb-IoT
- Technology highlights
  - MANO based network automation
  - Cloud Native & VNF/CNF
  - OpenStack, Kubernetes
  - x86 based network appliance
  - CPRI based RRH (500mW - 20W)
  - Scale as you grow – add new compute power | appliance
  - Innovative end-to-end application-based system keepalive (A-OAM)
- Targeted customers
  - Critical infrastructure | ports
  - Smart factories
  - Industry 4.0
  - Public Safety

5G IoT System | At-a-glance

- Industrial IoT sensing
  - Distributed architecture with centralized cloud management system
  - 5G IoT Gateway – Autonomous 5G enabled IoT/M2M gateway
  - Flexible sensor measurement and results exporting
  - Real-time monitoring, notification and alerting
  - Modular capabilities
- Technology highlights
  - MANO based network and services automation
  - Cloud Native & VNF/CNF
  - OpenStack, Kubernetes
  - Time series DB and analytics (ELK)
- Targeted customers
  - Critical infrastructure | ports
  - Smart factories
  - Industry 4.0
  - Public Safety



5G IoT System | Cloud-native approach



5G IoT GW | Capabilitites

5G Modem - New Form Factor | M.2 3050!

System Element	Feature	Supported Capabilities
5G IoT Gateway	Operational environment	- Industrial -20 °C ~ 60 °C - IP40 Fan-less design
	Mounting	- Rack Mount or Wall Mount
	Supported technologies	- 5G NR Sub-6: 4x4 DL MIMO, 256 QAM, - BW per CC (Up to 100 Mhz), SCS 15 Khz (FDD), SCS 30 Khz (TDD), - NSA mode, 3GPP R15, EN-DC, Option 3/3a - SA mode, 3GPP R15, Option 2 - Max DL speed 4500 Mbps - Max UL speed 660 Mbps - 5G Sub-6 bands SA (TDD): n78, n79 - 5G Sub-6 bands SA (FDD/TDD) with future SW release: n1, n2, n3, n7, n25, n28, n66, n71, n41 - 5G Sub-6 bands NSA (TDD&FDD): n1, n2, n3, n5, n7, n12, n20, n28, n41, n71, n77, n78, n79, n8, n25, n38, n40, n66, n48 - 4G LTE: CA, Cat-20, 4x4 MIMO, 256 QAM - LTE-A Pro, up to 7CC DL and up to 2CC UL - 4G/LTE bands (FDD&TDD): B1, B2, B3, B4, B7, B8, B12, B13, B14, B18, B19, B20, B21, B5, B25, B42, B38, B40, B43, B26, B28, B29, B34, B39, B41, B30, B66, B32, B46, B48, B71 - Ethernet interfaces with RJ-45 or SFP+ connector - 1GE or 10GE
	Protocols	- TCP/IP, PAP/CHAP
	Positioning	- GNSS: Galileo, GPS, GLONASS and BeiDou
	Network connectivity and services check/testing	- Data based: DNS, PING, FTP UL, FTP/HTTP DL, Web services - Synthetic traffic: IPERF UDP/TCP
	RAN check/testing	- 4G&5G: RSSI, RSRP, RSRQ, SINR, Tx Power - PLMN ID/name, EARFCN, Band, BW, Cell ID, PCI, Carrier Aggregation, RRC state

Private 5G Testing | RTT

Remote Crane Control

Industrial 5G GW

RTT 10-15 ms
(TDD mode!)

5G SA | n78 | TDD
BW 50 Mhz

NR gNb | n78

5G CN

gNb in 5G CN (n78 | TDD | BW 50 Mhz| 5G SA Mode)

Private 5G Testing | Speed

Industrial 5G GW

gNb (n78 | TDD | BW 50 Mhz| 5G SA Mode)

DL 300 Mbps

UL 50 Mbps

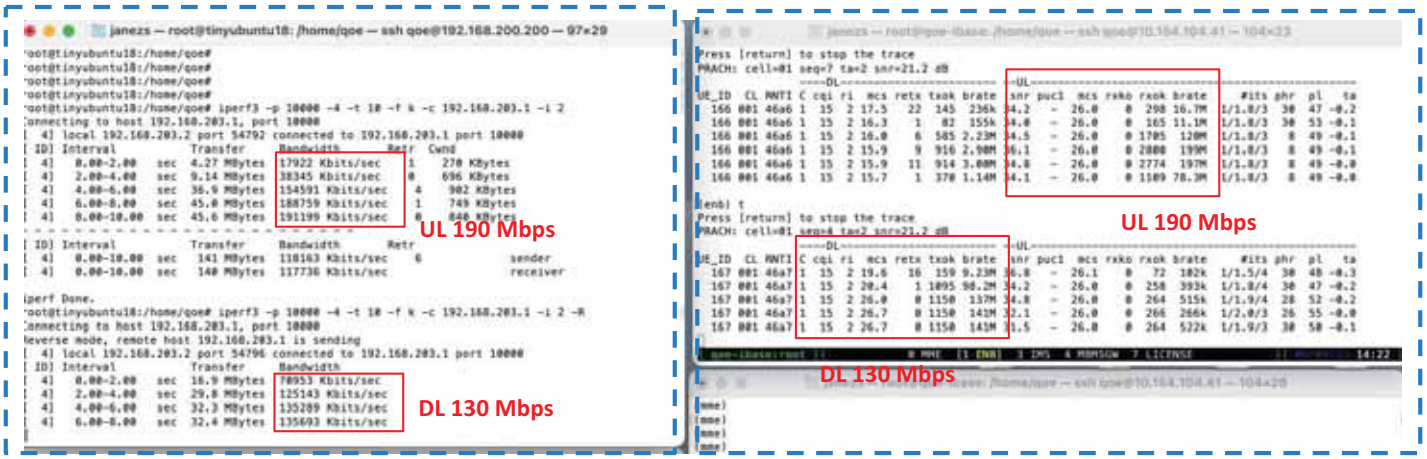
DL 300 Mbps

UL 50 Mbps

Private 5G Testing | TDD BW Profile Change

Industrial 5G GW

gNb (n78 | TDD | BW 50 Mhz| 5G SA Mode)

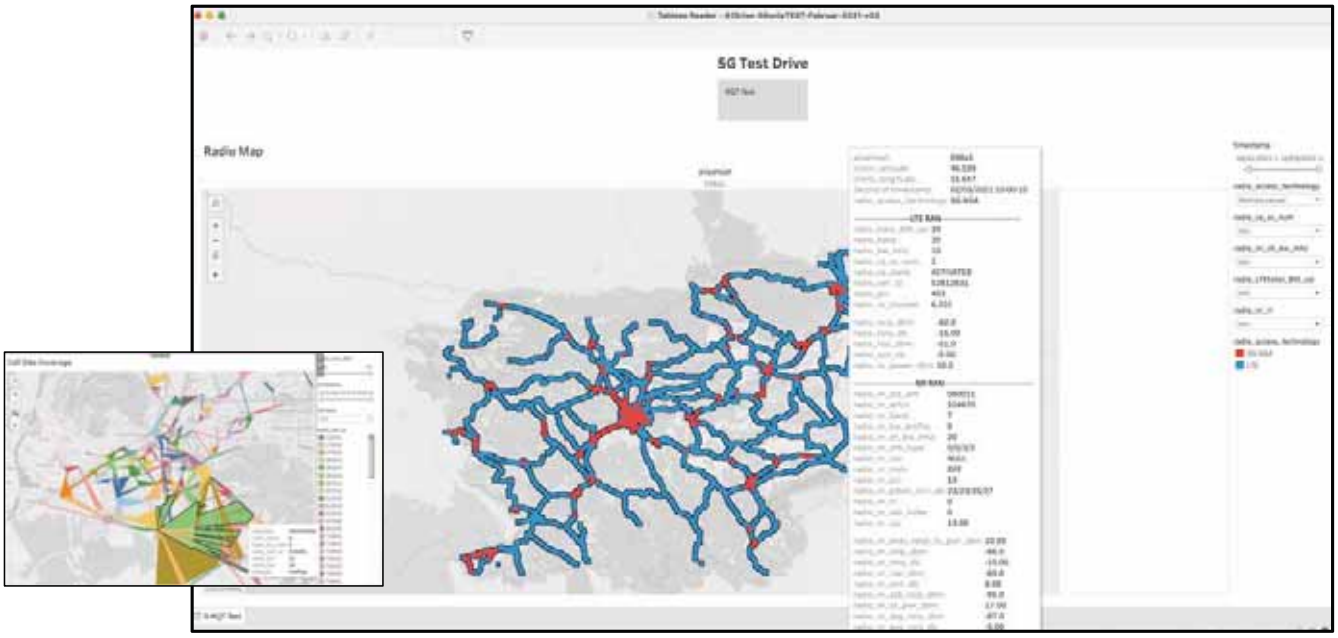


5G&AI Assisted Logistic Process

5G&AI Assisted Security Surevilance

Commercial 5G (NSA) Network | Drive test

qMON www.qmon.eu



5G Portfolio

tableau Grafana kibana elastic influxdb

qMON
www.qmon.eu

Telco grade system to deliver the next generation of quality assurance in mobile and cloud environments

rMON

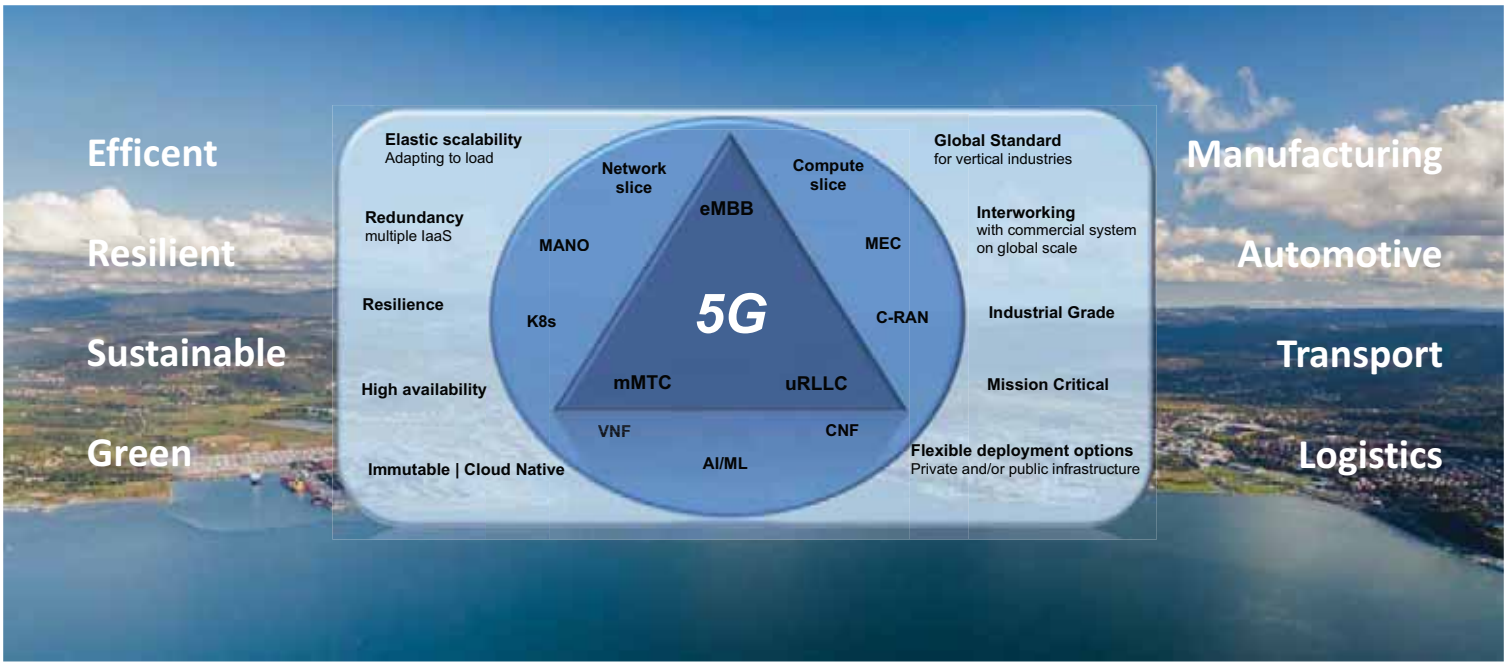
5G IoT System for industrial and outdoor environments

PPDRONE

Cloud-based private 4G/5G for Industrial and outdoor environments

internet INSTITUTE

5G – Connecting European Vertical Industries in Creating New Value Chaines



Industrijska digitalna revolucija

Industry digital revolution

Andrej Kranjčević
TELEKOM SLOVENIJE

POVZETEK

Digitalna transformacija je v ospredju poslovnih načrtov v številnih industrijah. Vizija Industrije 4.0 poziva panoge, naj zbirajo in uporabljajo podatke, da bi lahko izkoristile nove tokove prihodkov in optimizirala stroške. Praktično vsi industrijski sektorji zasledujejo izboljšane modele delovanja, ki izboljšujejo varnost in produktivnost z analitiko in avtomatizacijo.

SUMMARY

Digital transformation has long remained at the top of many business agendas and has spread across multiple industries. The Industry 4.0 vision calls on industries to collect and utilize data in order to tap into new IoT revenue streams and cost savings. Practically all industry sectors are pursuing enhanced operating models that improve security and productivity through analytics and automation.

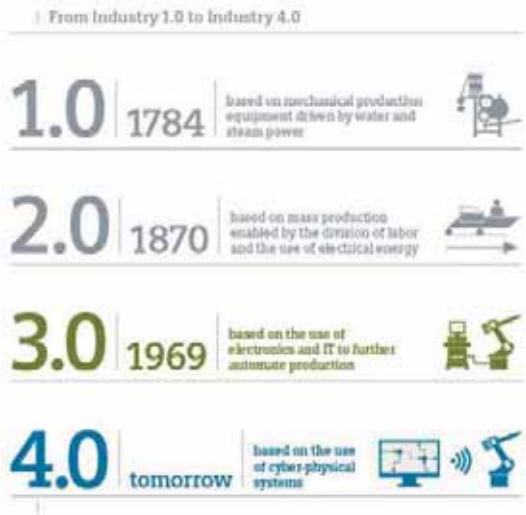
O AVTORJU

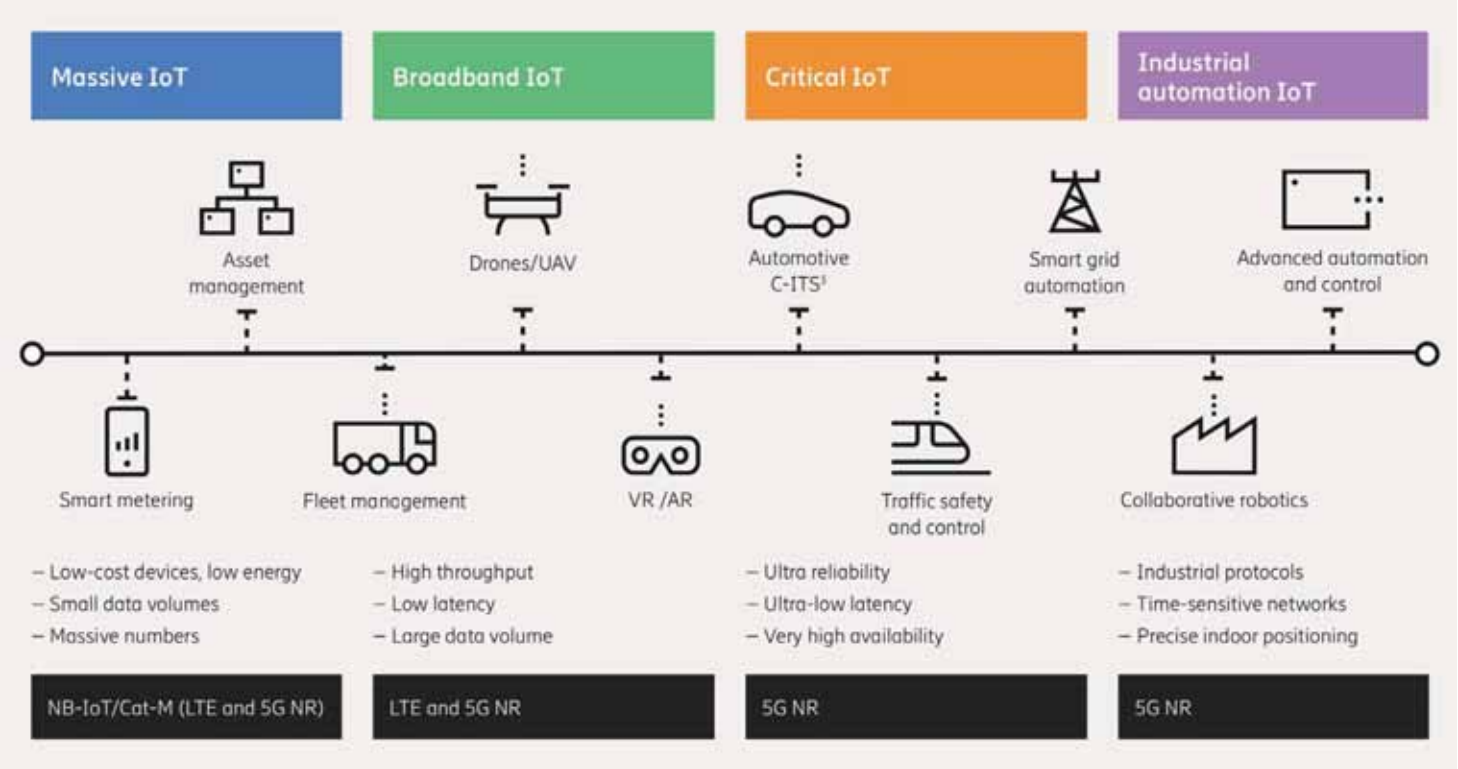
Andrej Kranjčević je diplomiral na Fakulteti za elektrotehniko v Ljubljani. Leta 2009 se je zaposlil v družbi Mobitel d. d., danes pa je na Telekomu Slovenije d. d. vodja raziskovalnih in razvojnih projektov v razvoju tehnologije.

ABOUT THE AUTHOR

Andrej Kranjčević graduated from the Faculty of Electrical Engineering in Ljubljana. In 2009 he joined mobile network operator Mobitel d. d. Today he is head of research and development projects in technology development at Telekom Slovenije d. d.

Industrijska digitalna revolucija





3 Industrijska digitalna revolucija

TelekomSlovenije

5G je bil ustvarjen za izpolnjevanje zahtev industrijskega IoT (IIoT)

- Združevanje povezljivosti, namenska omrežja, prilagojene storitve
- Visoka zanesljivost z nizko zakasnitvijo v zahtevnih RF okoljih
- Nadomestitev ožičenih ethernet povezav za prilagodnjivo proizvodnjo
- Spekter za zasebna omrežja

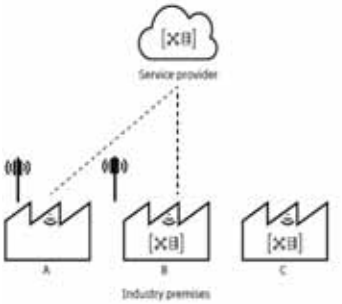
Zasebna 5G omrežja za vse storitve

Visokozanesljiva komunikacija z nizko zakasnitvijo (URLLC)

Enotno časovno občutljivo omrežje (TSN)

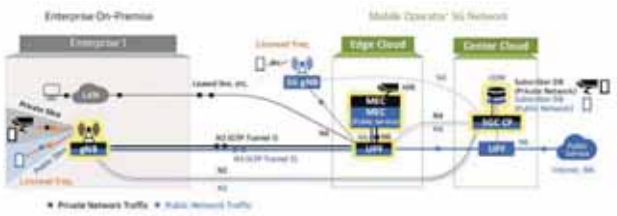
Licenčen spekter

Zasebna omrežja

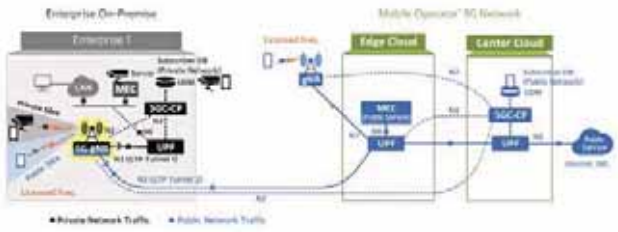


A. Local radio as an extension of service provider infrastructure with network slicing
B. Model A plus additional service provider infrastructure deployed locally, e.g. local core and cloud
C. Standalone local deployment with dedicated spectrum

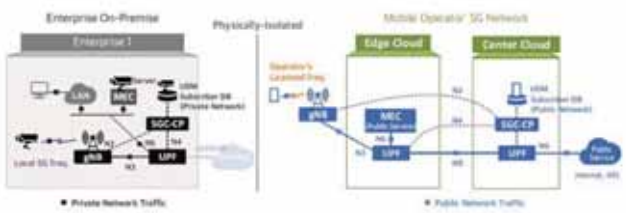
A



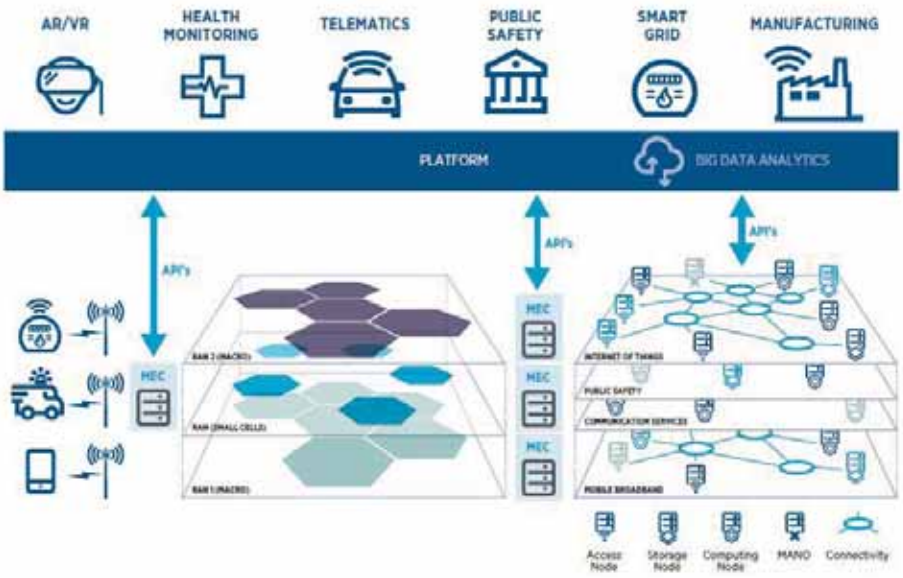
B



C



Omrežje 5G kot platforma



TelekomSlovenije

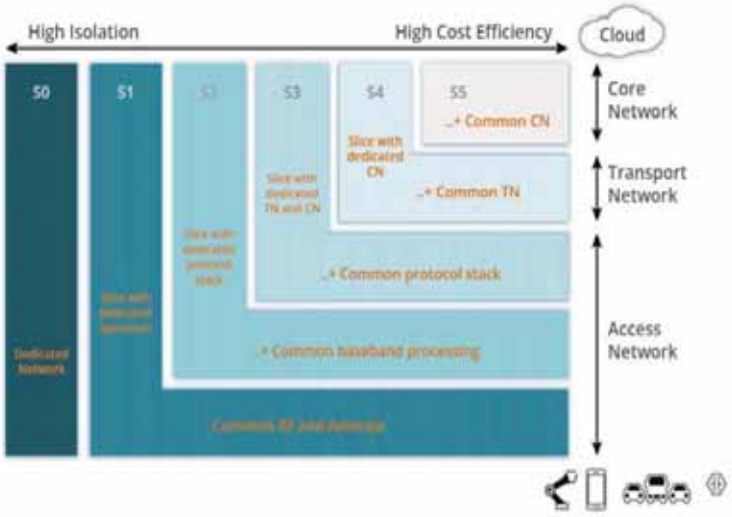
5G Network Slicing

Izolacija rezin
- Fizična
- Logična

RAN
- Izolacija spektra
- Izolacija procesnih zmogljivosti bazne postaje

Prenosno omrežje
- Rezina mapirana na VLAN

Jedro
- Izolacija med rezinami (sprememba ene rezine ne vpliva na drugo)
- Fizična izolacija (dodelitev celotnega fizičnega vira eni rezini)
- Uporabnik (tenant) lahko upravlja samo z lastno rezino



TelekomSlovenije

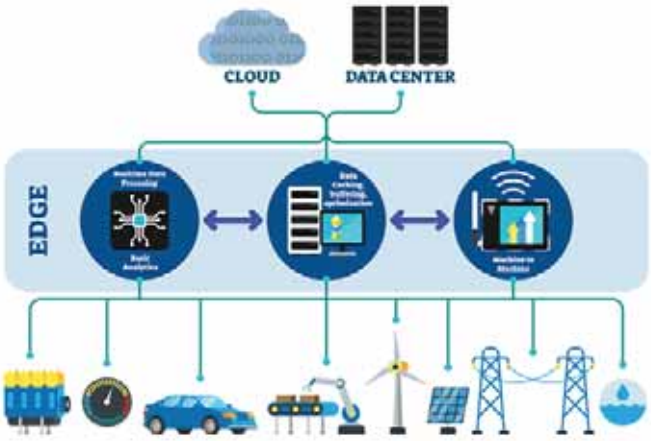
MEC

Multi-access Edge Computing (MEC)

Procesne zmogljivosti bližje pri uporabniku (v dostopovnem omrežju)

Za procesno zahtevne aplikacije, ki zahtevajo majhne zakasnitve

MEC in NFV imata skupno ali ločeni virtualizacijski infrastrukturi



TelekomSlovenije

INDUSTY 4.0 “USE CASES”

Obetavni primeri uporabe zasebnih omrežij v industriji, ki izkoriščajo večjo modularnost in prilagodljivost 5G povezljivosti:

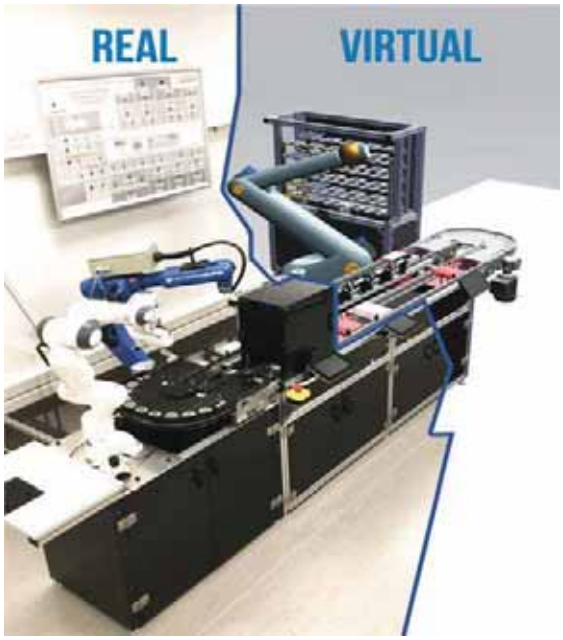
- **AGV/Autonomus robots** (samodejno vodeni vozički in avtomni industrijski roboti)
- **Machine vision/Artificial Inteligence** (strojni vid in umetna inteligenca)
- **AR/VR/AI** (obogatena resničnost/navidezna resničnost)
- **Condition-based monitoring (s**premljanje povezane opreme)
- **Asset tracking** (sledenje)
- **Digital Twin** (digitalni dvojček)

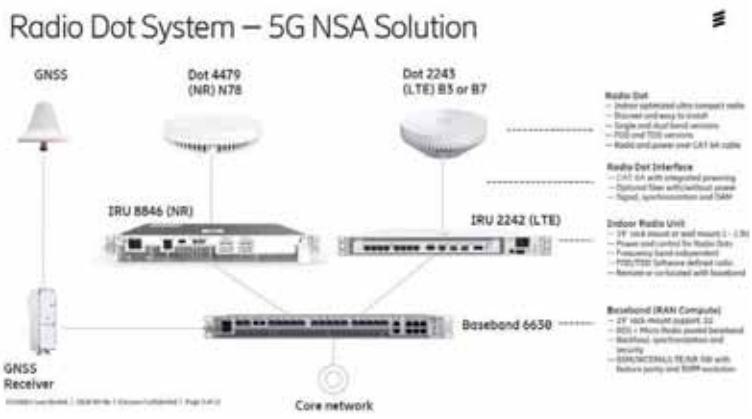
TelekomSlovenije

Pilotni projekti

ULFS
Digitalizacija proizvodnih strojev
Zasebno industrijsko kampus omrežje
5G LOGINNOV

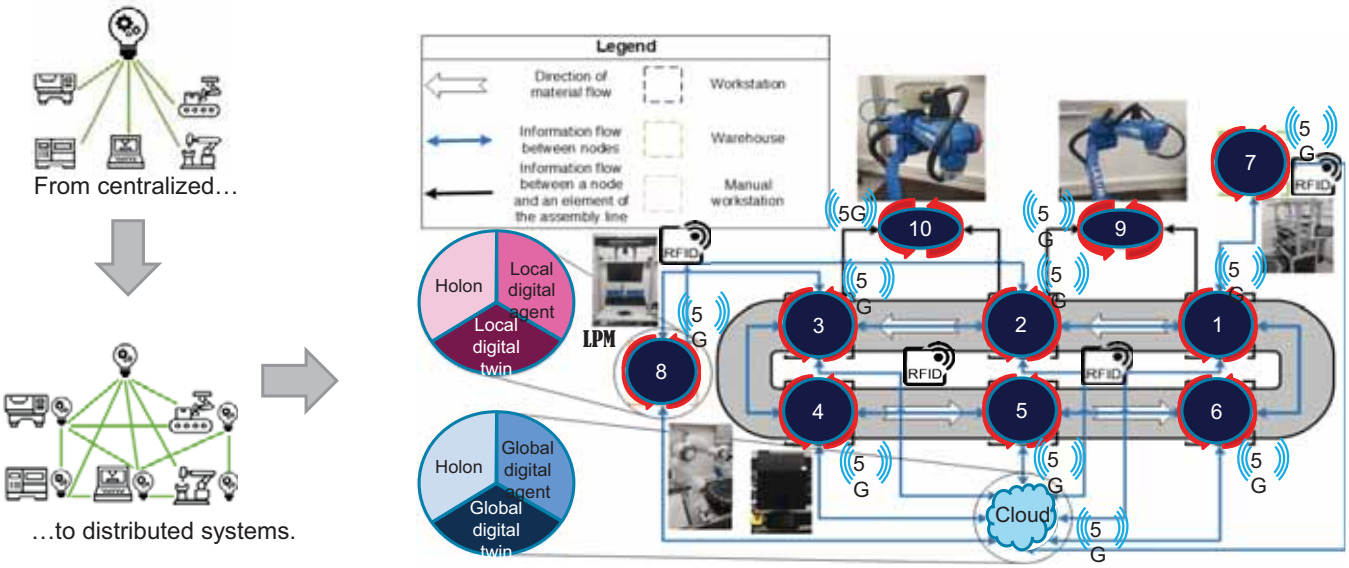
Univerza v Ljubljani – Fakulteta za strojništvo



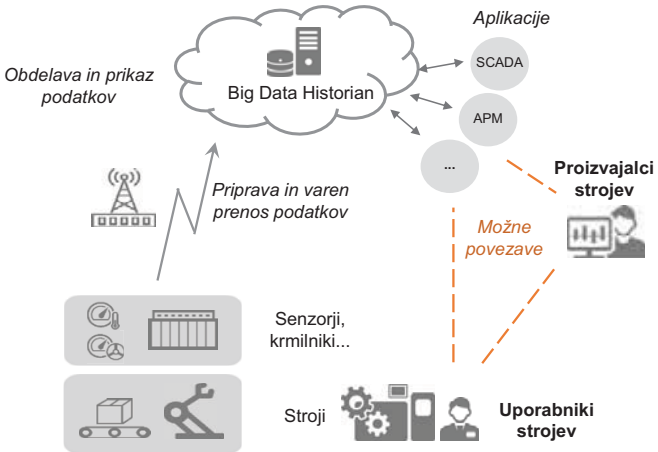


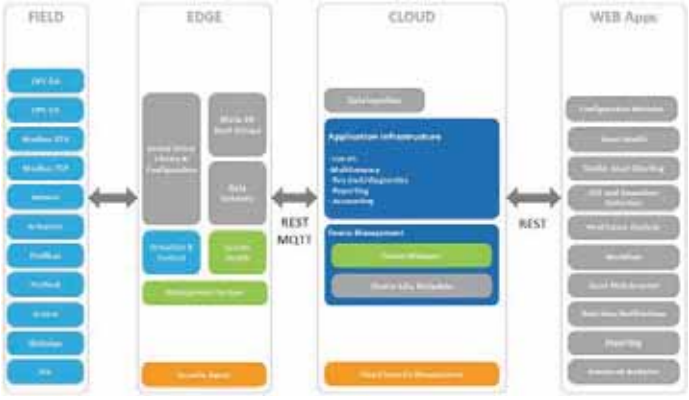
Univerza v Ljubljani – Fakulteta za strojništvo

Koncept LASIM demo centra pametne tovarne (računanje na robu in uporaba 5G)

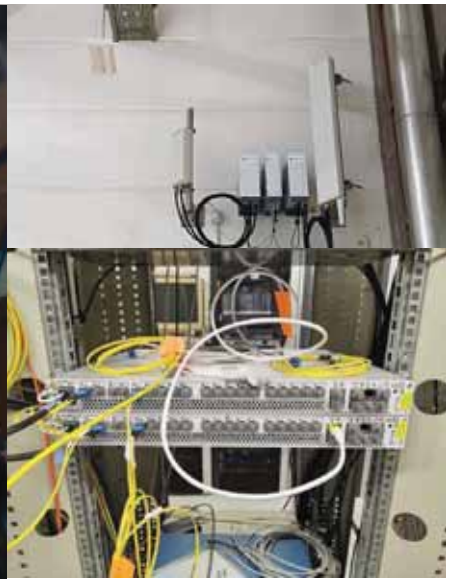


Digitalizacija proizvodnih strojev





Zasebno industrijsko kampus omrežje



15 Industrijska digitalna revolucija

TelekomSlovenije

5G za podporo delovanja sodobnih pristanišč

5G to support the operation of modern ports

Jurij Mirnik
LUKA KOPER

POVZETEK

Prispevek je razdeljen na dva dela, splošni del in posebni del. V splošnem delu je na kratko predstavljena družba Luka Koper (področje dela, institucionalni okvir, EU projekti,..), Luka Koper v kontekstu logističnih verig (gravitacijsko območje pristanišča, trgi, ladijske in kopenske povezave) in razvojni načrti širitev pristaniščna, nove obale, privezi, pridobitve). V posebnem delu sledi kratek pregled IKT okolja Luke Koper, predstavitev projekta 5G-LOGINNOV (H2020) (namen, cilji, pričakovanja,…), predstavitev uporabniških primerov v sklopu projekta 5G-LOGINNOV in možnosti in priložnosti za 5G v pristaniščih.

ABOUT THE AUTHOR

Mr Jurij Mirnik, B.Sc., is an expert at the Strategic Development Department at Luka Koper. He is responsible for management of development projects while his main area of work concerns EU projects, project management, planning, coordination, etc. He has obtained a degree in Transport logistics at the University of Ljubljana, Faculty of Maritime studies and transport. He has meaningful experiences in project management in the fields of port systems, maritime and port operations, and on topics related to port development, logistics, environment, ICT and security.

About the Company

established in **1957**	• public limited company listed on the Ljubljana stock exchange • terminal operator of all 12 specialized terminals in the port • 1,700 employees (Luka Koper Group)
280 ha of port area	• concession granted for the management of the port area until 2043 • invests in infrastructure and suprastructure in the port area • National spatial plan for the development of the port adopted in 2011
maritime throughput in 2020 **19,5** million tons	• 1st container terminal in the Adriatic • largest car terminal in the Mediterranean
modal split **59 % : 41 %**	• 59 % of all cargo handled in the port is transported by rail

LUKA KOPER Port of Koper

Multi-purpose port

12 SPECIALIZED TERMINALS

- Critical infrastructure
- Own security service and control center
- Own fire brigade

LUKA KOPER Port of Koper

Strategic position

PORT OF KOPER:

TEN-T Core Maritime Port

On 2 TEN-T Core Network Corridors:
- Baltic-Adriatic
- Mediterranean

On 3 Rail Freight Corridors:
- RFC 5 (Baltic-Adriatic)
- RFC 6 (Mediterranean)
- RFC 11 (Amber)

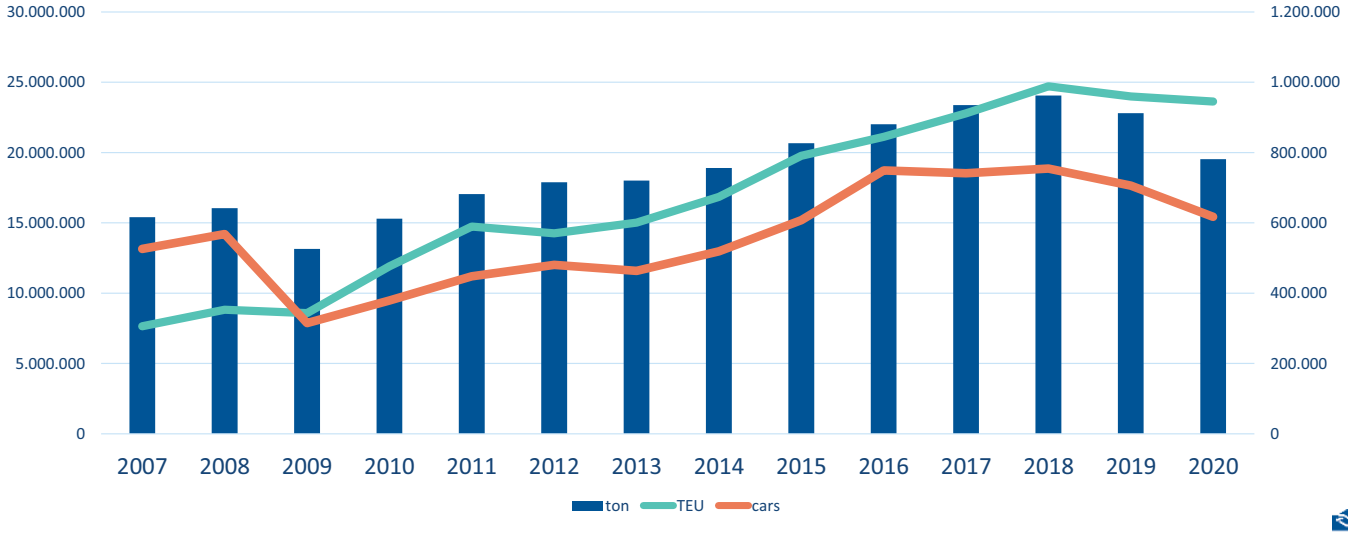
LUKA KOPER Port of Koper

Maritime throughput history

ton
total maritime throughput

TOTAL THROUGHPUT 2020:
- **Containers: 945.051 TEU**
- **Cars: 617.157 units**

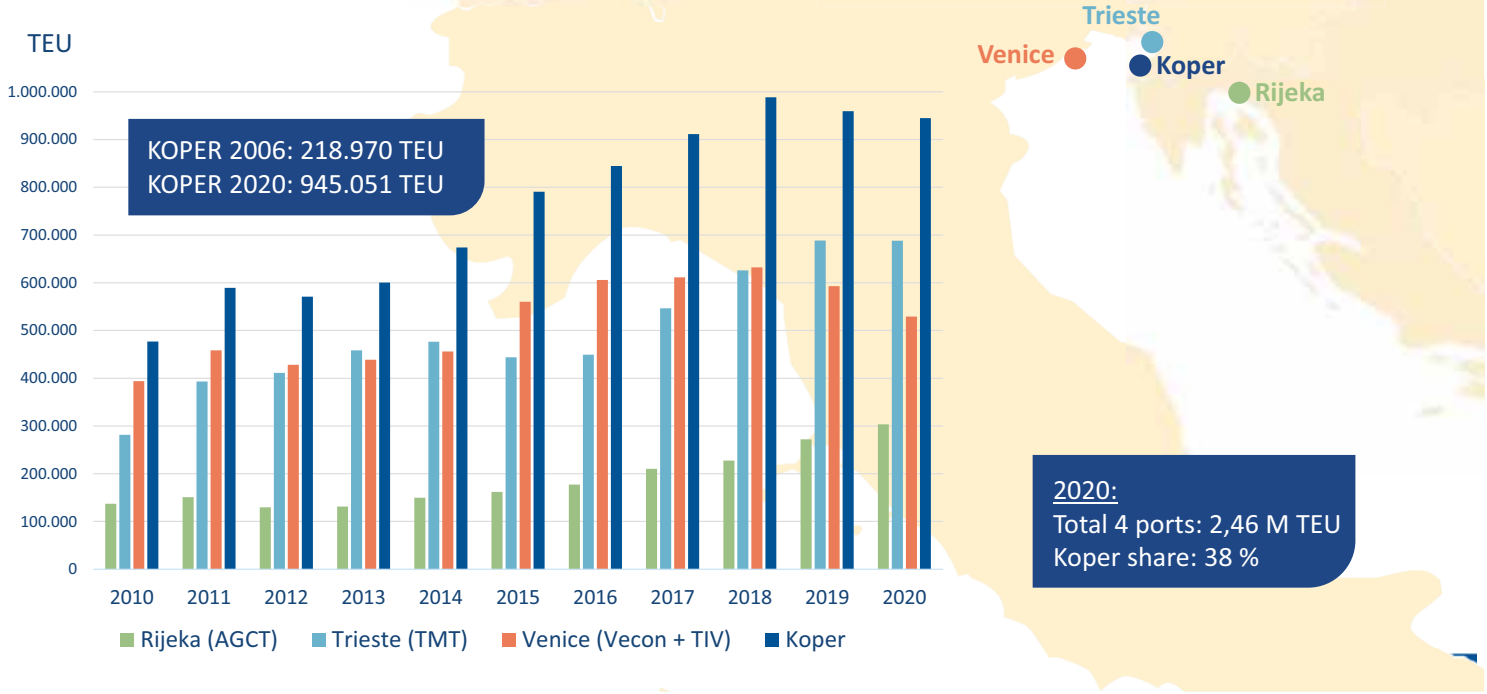
containers (TEU)
cars (units)



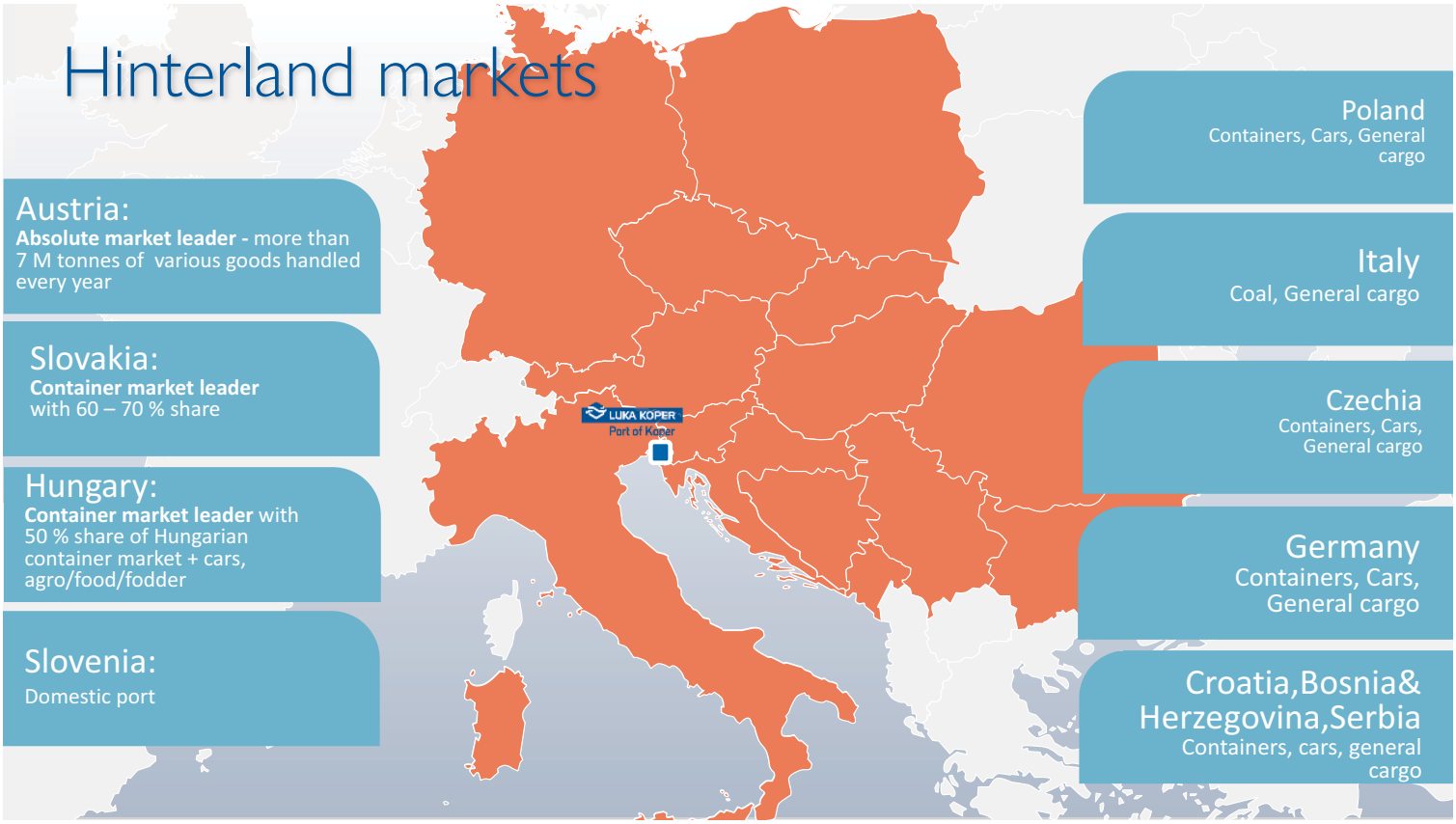
LUKA KOPER Port of Koper

Efficient combination of cost, time and energy savings

Leading container terminal in North Adriatic



Hinterland markets



Austria:
Absolute market leader - more than 7 M tonnes of various goods handled every year

Slovakia:
Container market leader with 60 – 70 % share

Hungary:
Container market leader with 50 % share of Hungarian container market + cars, agro/food/fodder

Slovenia:
Domestic port

Poland
Containers, Cars, General cargo

Italy
Coal, General cargo

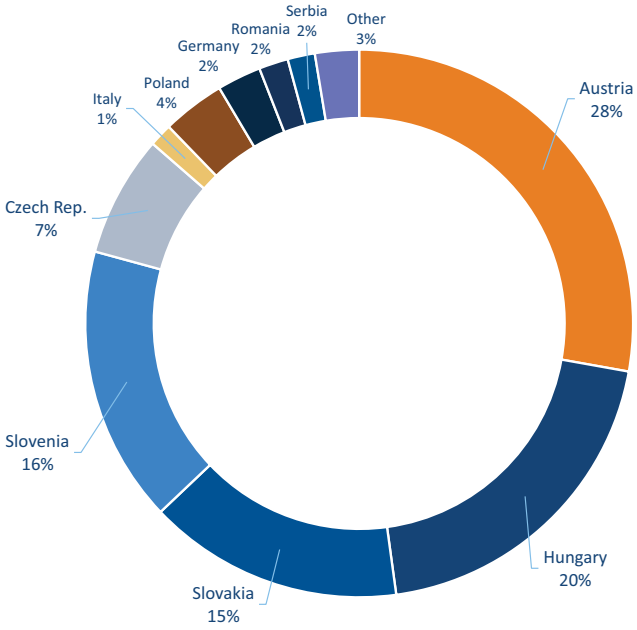
Czechia
Containers, Cars, General cargo

Germany
Containers, Cars, General cargo

Croatia,Bosnia& Herzegovina,Serbia
Containers, cars, general cargo

Hinterland container markets

Year 2020 (estimated percentage of full/stuf+strip containers throughput)



LUKA KOPER Port of Koper

Container terminal - Yard Equipment Count

Quayside: 596 m
Max. allowed draft: 14.5 m
Berths: 4
Railway tracks: 5 x 700 m, 2 x 270 m, 2 x 300 m
Storage capacity - marine terminal: 19,130 TEU
Storage capacity - depo for empties: 9,547 TEU
Reefer electrical outlets: 432 plug
Total terminal area: 270,000 m^2
Stacking area: 180,000 m^2

Equipment / Lift capacity (ton)

- **3x STS panamax cranes: 40 t (40') / 45 t (2x 20') under spreader**
- **4x STS post-panamax cranes: 51 t (40') / 65 t (2x 20') under spreader**
- **2x STS Super post-panamax cranes: 51 t (40 feet) / 65 t (2x 20') under spreader**
- **22x Rubber-Tyred G/C (storage area): 40 t**
- **4x Rail Mounted Gantries (Rail Yard): 40 t**
- **12x Reach Stackers: 42-45 t**
- **8x ECH - empty container handler: 7-9 t**
- **61x Yard Trucks**
- **61x Trailers**

Operating hours:
- Vessel ops: 24/7
- Rail ops: 24/7
- Customs ops (vessel & rail): 24/7

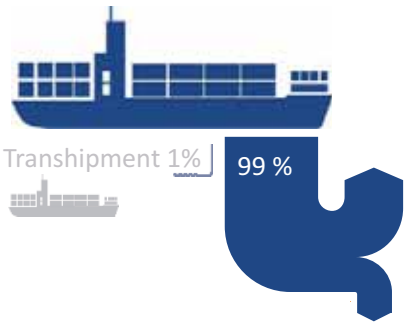
LUKA KOPER Port of Koper

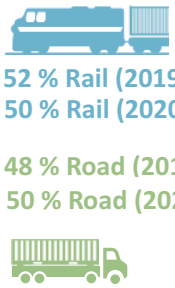
Container railway services

Handling operations:

- **22-24 container trains/day** (average 2020)
- **30 ontainer trains/day** (actual capacity of rail ops on CT)

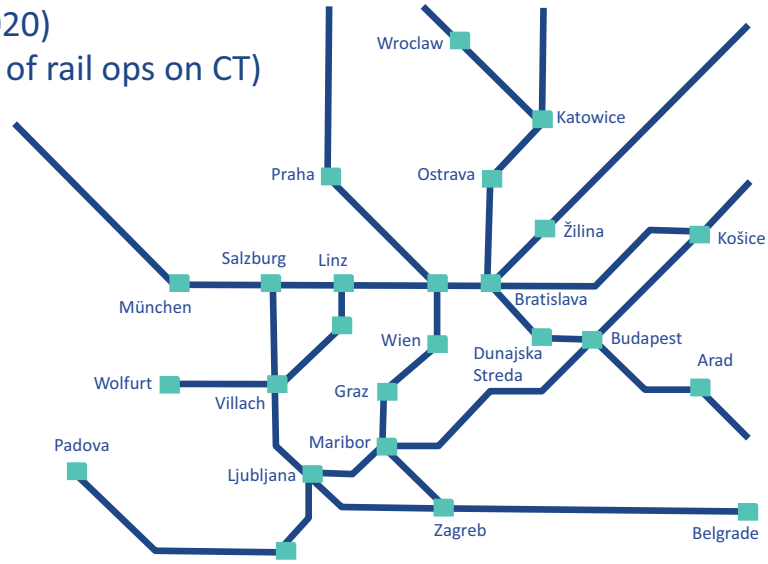
Container terminal modal split





52 % Rail (2019)
50 % Rail (2020)

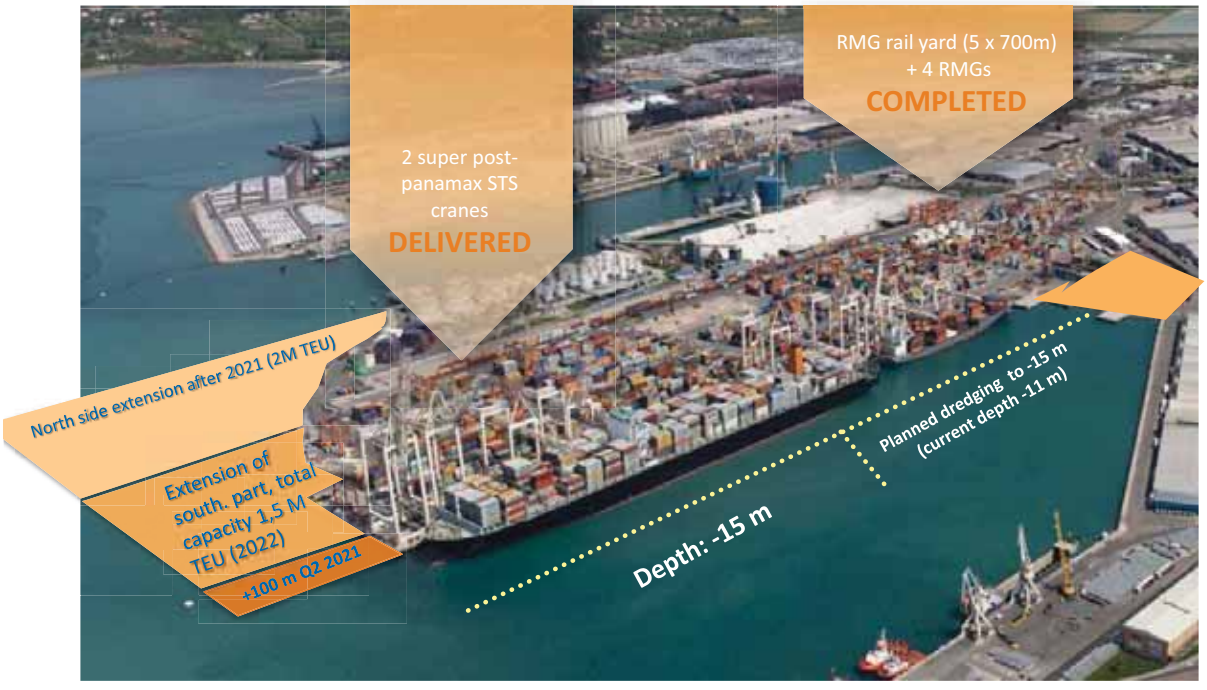
48 % Road (2019)
50 % Road (2020)



KOPER CONTAINER TERMINAL

LUKA KOPER Port of Koper

Container terminal development (2015 - 2021)



LUKA KOPER Port of Koper

Infrastructure / equipment investments

Ongoing extension of container quay

20.10.2020

30.12.2020

27.01.2021

30.03.2021

5G – LOGINNOV project

5G – LOGINNOV project

LUKA KOPER
Port of Koper

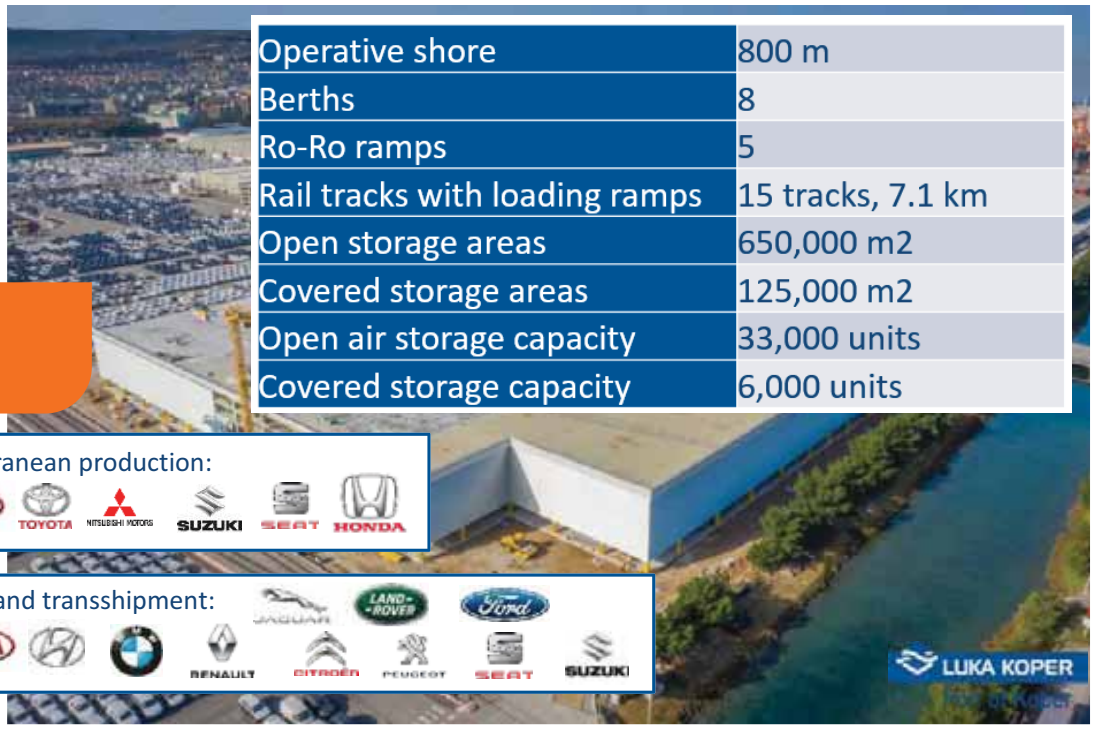
Container terminal – rail capacity

LUKA KOPER
Port of Koper

Examples of project & OOG cargo in Port of Koper

- Windmill blades: 45 m + 38 tons
- Bio-gas plant parts: 50 m + 70 tons
- Power generators
- Passenger railcars

Car & RO-RO terminal in numbers



Operative shore	800 m
Berths	8
Ro-Ro ramps	5
Rail tracks with loading ramps	15 tracks, 7.1 km
Open storage areas	650,000 m2
Covered storage areas	125,000 m2
Open air storage capacity	33,000 units
Covered storage capacity	6,000 units

Gateway for global car producers

Import – Far East and Mediterranean production:

Export – European production and transshipment:

Car & RO-RO terminal areas

STORAGE AREA

RO-RO berths/ ramps

RAILWAY TRACKS 15 X

FUTURE DEVELOPMENT AREAS

Ongoing investments on Car & RO-RO terminal

New 6.000 parking lots – operational in May 2021

Construction permit for additional 7.000 parking lots!

LUKA KOPER Port of Koper

Completed investments on Car & RO-RO terminal

New dedicated RO-RO berth – operational from June 2020

New railway access 4 x 700 m track – operational from May 2020

Co-financed by the EU - CARESMATIC Action (CEF CarEsmatic

LUKA KOPER Port of Koper

Rail access to Port of Koper

1. Koper Container terminal – Rail Yard
2. Koper Cargo Train Station / Marshalling Yard
3. **Multi-link Rail Access to Port of Koper**

} Distance = 2 km

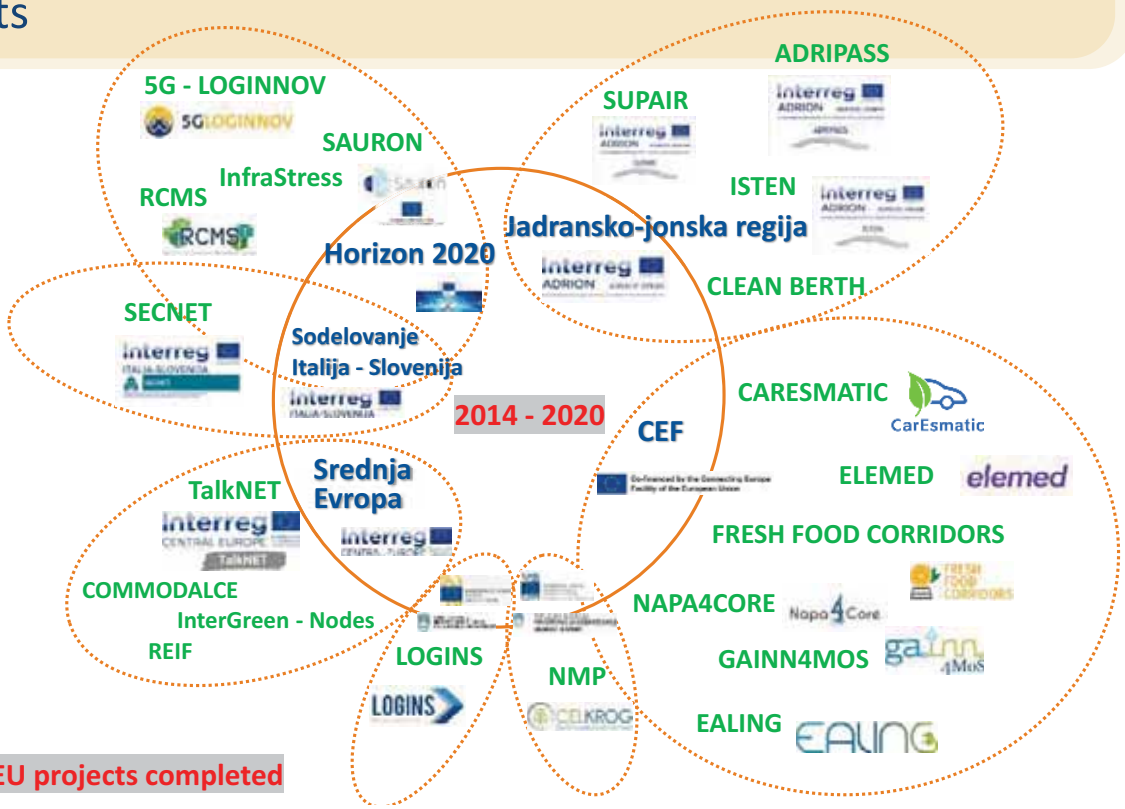
Average 2020: **55** cargo trains to/from the port per day passing rail access (all cargo groups included)

LUKA KOPER Port of Koper

Truck gates - entry procedure improvements

- Vehicle Booking System (VBS),
- Holders of annual pre-paid entry permits enter with simplified entry procedure,
- Easier arrival planning, better internal port logistic, less traffic in Koper city

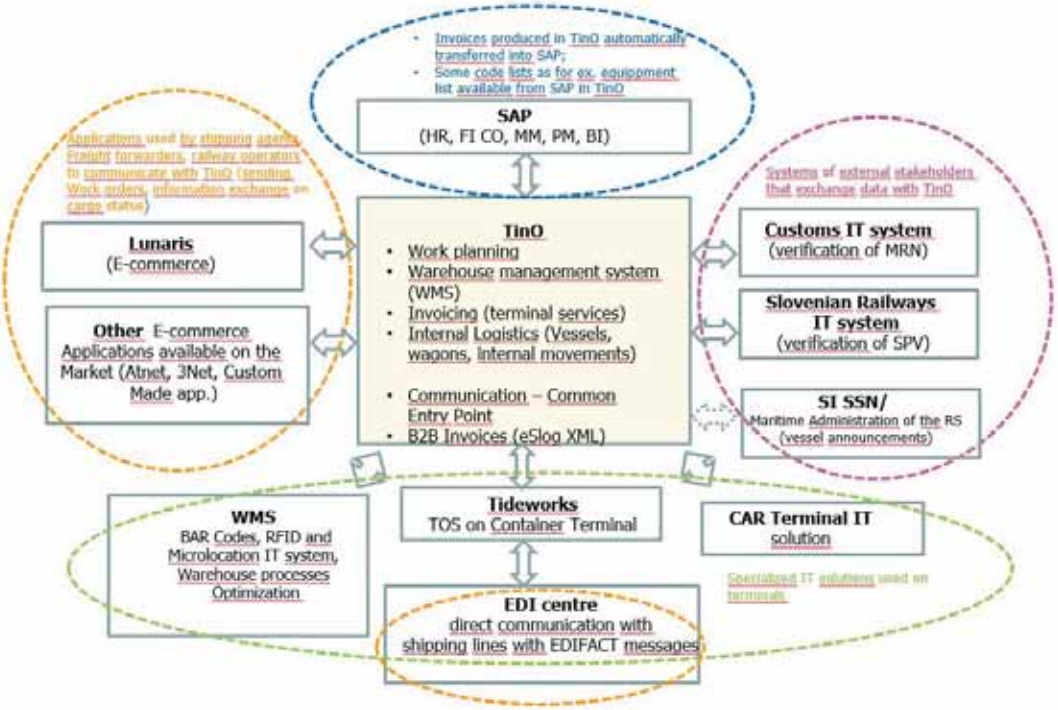
EU projects



2007-2013 → 34 EU projects completed

LUKA KOPER Port of Koper

Luka Koper IT systems



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On the way to the next IT platform

- **ALREADY 17 YEARS ON THE PRIVATE CLOUD WITH THE LOCAL IT PROVIDER**
  - **Mainly outsourcing model / Know-how on processes in the company**
  - **Flexibility, Best-of-breed solutions (→ implementing smaller-scale/agile solutions)**
  - **Orientation towards Adaptive sourcing (→ shift from "built to last" to "build to adapt")**

BUSINESS CLOUD SOLUTIONS IMPLEMENTED

- **HR (SAP Success Factors)**
- **Security**
- **2017: Office 365**

MOBILE SOLUTIONS IMPLEMENTED:

2014 Mobile app of Port of Koper
2015 Security mobile app
2015 Reefer measurments
2016 Container damages repair
2018 Capsule workspace app for employees
2021 Road haulers app

LUKA KOPER Port of Koper

IoT for better productivity and process automation

- D-GPS (location, speed)
- Equipment metrics (fuel consumption, engine status)
- RTG – TOS integration
- OCR (rail, gate, sea)
- RFID for truckers used with Vehicle Booking System
- Energy consumption management
- Process automation (Container terminal)

LUKA KOPER Port of Koper

Where we go? – next steps

- Process automation including IoT and Mobile solutions to gain better results & higher productivity
- „Single window“ approach in B2G segment (Maritime administration, Customs, Veterinary administration, Police, etc.)
- Changes on the EDI segment (EDIFACT for Container terminal)
- Use of predictive analytics within the operational planning process

5G – LOGINNOV project

- Horizon 2020 action
- 8 EU countries
- 15 partners
- Lead partner: ERTICO ITS Europe (Belgium)
- Budget: 8 million €
- 3-year project
- https://5g-loginnov.eu/

3 Living Labs (Koper, Athens, Hamburg)

11 Use Cases

3 Use Cases in Port of Koper

5G – LOGINNOV - Koper LL partners:

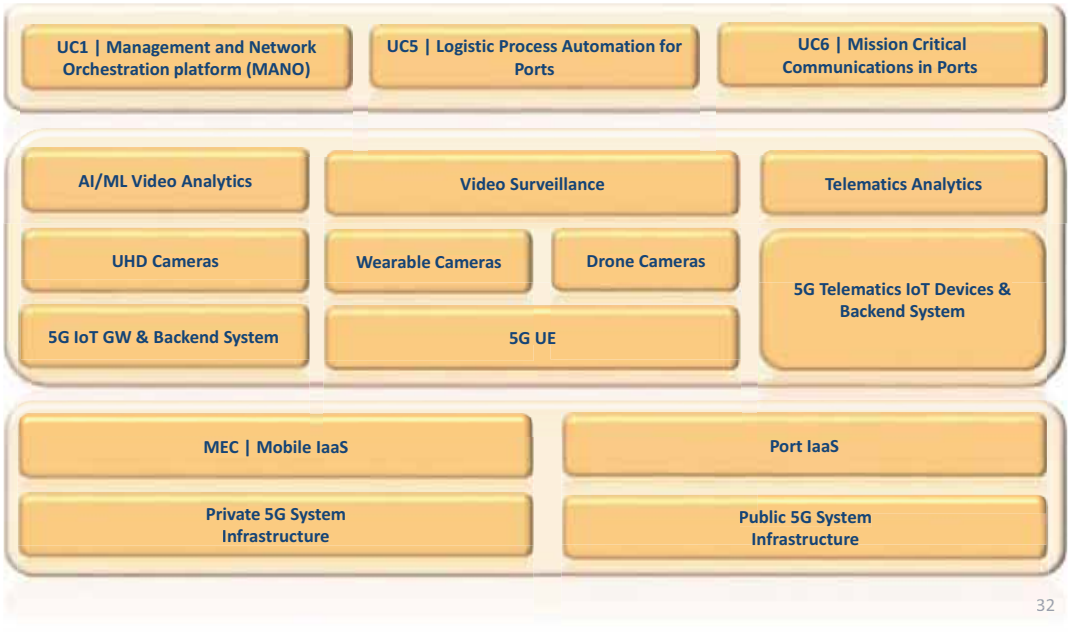
SLO:

- **Luka Koper / Port of Koper**
  - Port Operator | Living lab facility
- **Telekom Slovenije**
  - National mobile operator | Public 5G infrastructure
- **INTERNET INSTITUTE**
  - SME | Private 5G infrastructure & Industrial IoT

EU:

- **Vicomtech**
  - Research centre | AI/ML-based video analytics
- **Continental**
  - Industry | Telematics & IoT

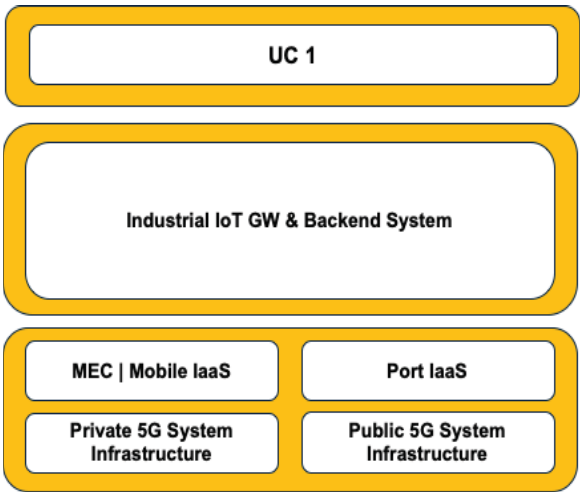
Koper LL Infrastructure and Use Cases



UC1: 5G-LOGINNOV Management and Network Orchestration platform (MANO)

- **Target 1:** automated deployment and life cycle management (MANO-based) of network and services VNF (Virtual Network Functions) and CNF (Cloud Native Functions) components tailored for the port operation

- **Target 2:** deployment of 5G SA System *(Private Core Network | Private Cloud RAN | 3.5Ghz/n78)* and 5G IoT System *(Industrial 5G IoT GW | Management | Collector | Reporter)*



UC1 components - Koper Living Lab

LUKA KOPER Port of Koper

UC1

5G network for remote control

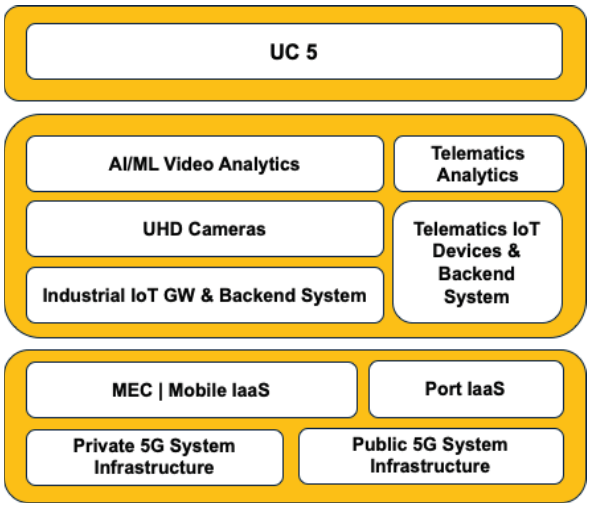
- Testing 5G SA (stand-alone) network capabilities for operating port machinery

Source: Konecranes

LUKA KOPER Port of Koper

UC5: The 5G-LOGINNOV automation for ports: port control, logistics and remote automation

- **Target 1:** Port control, logistics and remote automation *(port machinery equipped with industrial cameras for transferring images to CNS system | identification of container markers | detection of structured damage)*
- **Target 2:** Port infrastructure monitoring and remote metering with 5G IoT *(operating machine monitoring* by means of capturing and transfer of the key information | positions, usage and other telematics metrics from operating terminal vehicles)
- **Target 3:** resilient 5G based network services *(*alternative 5G connectivity capabilities to the established operational WLAN network, supporting data transfer redundancy between the operational port infrastructure and the operations centre*)*



UC5 components - Koper Living Lab

35

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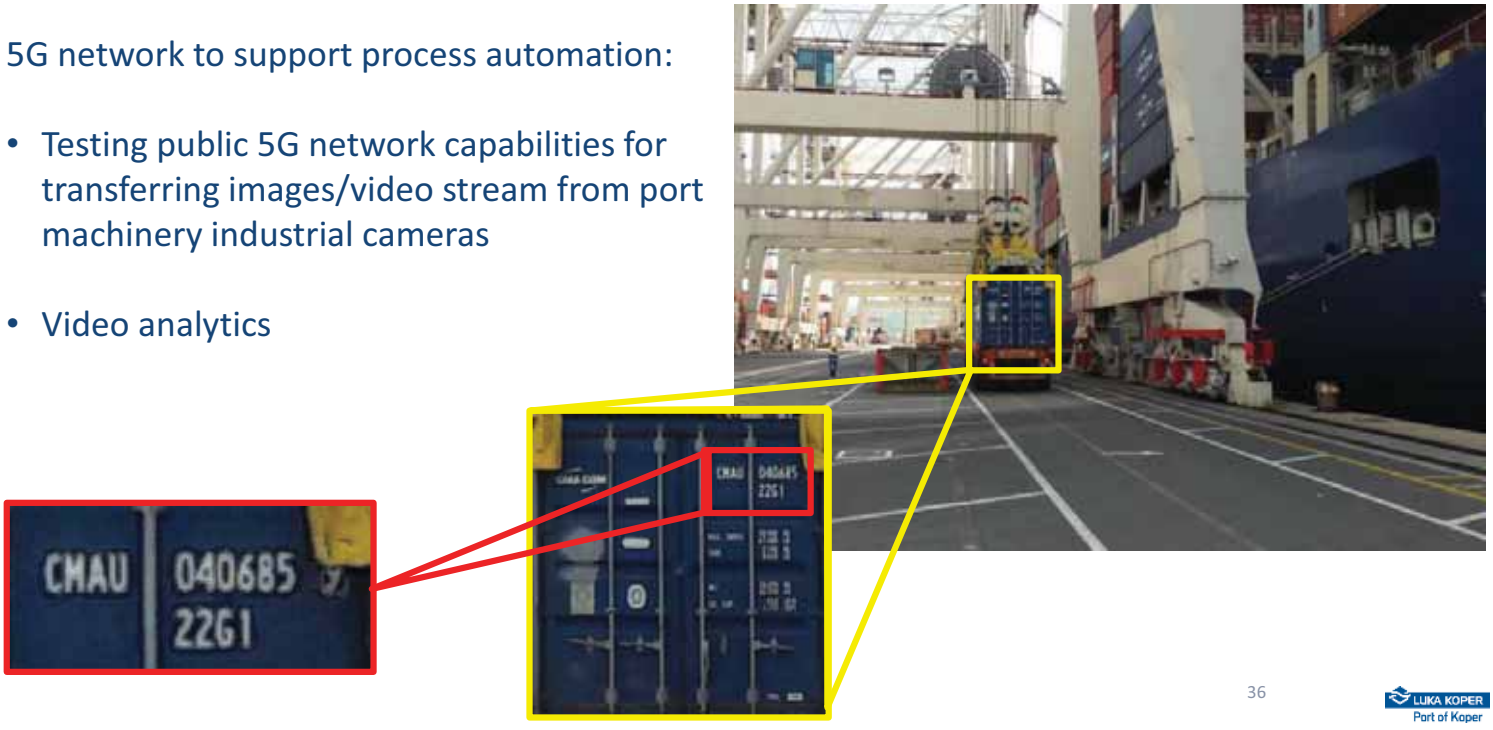
UC5

5G network to support process automation:

- Testing public 5G network capabilities for transferring images/video stream from port machinery industrial cameras
- Video analytics



36

LUKA KOPER Port of Koper

UC5

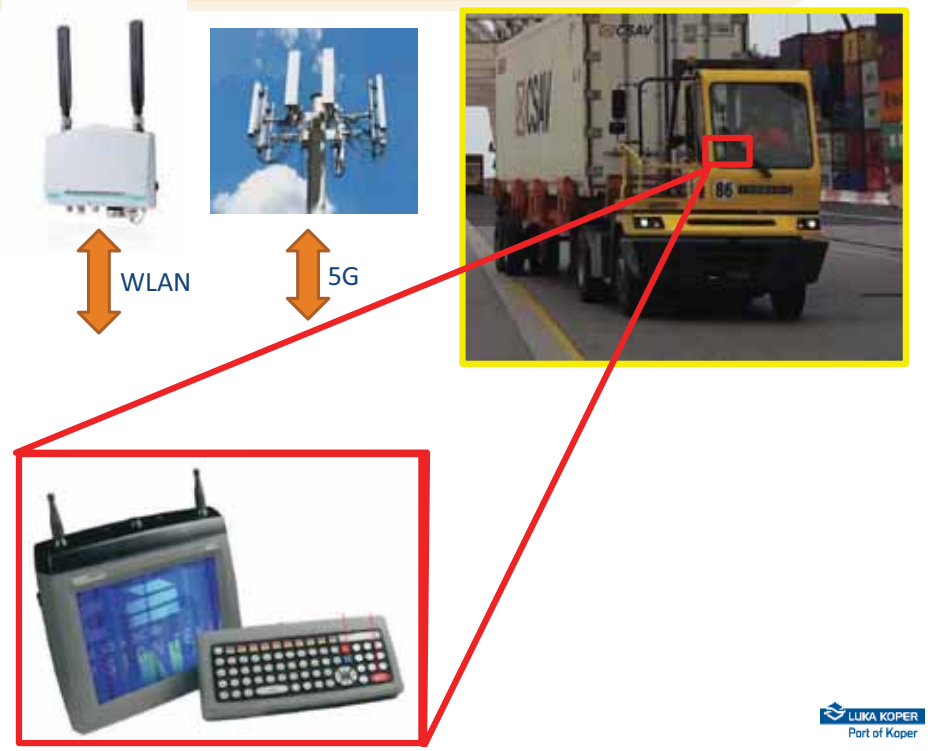
5G network to support monitoring and remote metering:

- Testing public 5G network capabilities for transferring data from port machinery
- Using IoT to monitor, track and control status of port equipment (e.g. Consumption, Battery Level, Fuel Level, Temperature, Working hours, Power status, Positioning & Tracking, Lights, etc.)

UC5

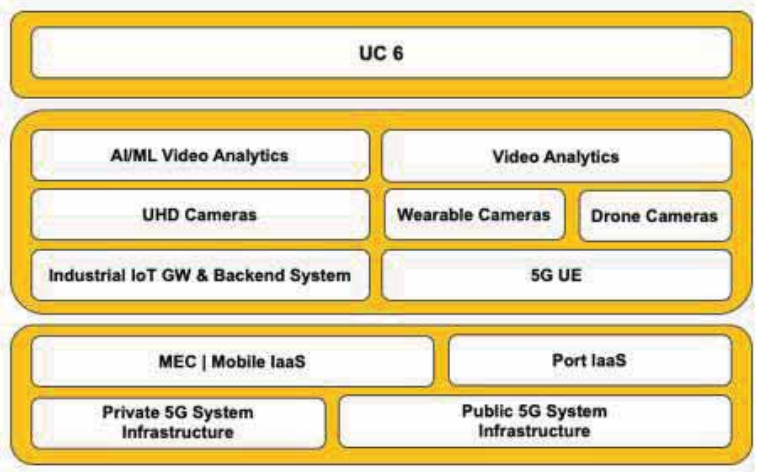
5G network to support port operations :

- Testing public / private 5G network capabilities as data transfer redundancy to the existing industrial WLAN network (in the future possible alternative to WLAN)



UC6: The 5G-LOGINNOV 5G mission critical communications in ports

- **Target 1:** A real-time video surveillance use case *(body-worn cameras | portable video surveillance cameras | drone-based surveillance)*
- **Target 2:** private security operations management and support *(personnel/team status monitoring | positioning and triage operations support with dedicated mobile applications)*
- **Target 3**: network reliability and resilience using public and private 5G infrastructure



UC6 components - Koper Living Lab

39

UC6

5G network to support security operations :

- Testing public 5G network capabilities for:
  - real-time port area video surveillance
  - drone-based activities
  - security personnel support

40


Thank you for your attention.
Hvala za vašo pozornost.
LUKA KOPER
Port of Koper
www.luka-kp.si
www.zivetispristaniscem.si
jurij.mirnik@luka-kp.si


Vsi sodelujoči vabljeni, da nas kontaktirajte, da skupaj iščemo priložnosti na novih EU sofinanciranih projektih. Aktualnih vsebin je veliko, domačega znanja v SLO tudi.
LUKA KOPER

5G za povezano in avtomatizirano mobilnost (CAM)

5G for Connected and Automated Mobility (CAM)

Božidar Volk

DARS

POVZETEK

Tehnologija 5G lahko ima v prihodnosti velike učinke na povezano in avtomatizirano mobilnost (CAM). Še posebno na komunikacijo med vozilom in okoljem (V2X), ki je postala priljubljen koncept mobilne tehnologije, ki pridobiva na vse večji uporabi. Komunikacija vozila do okolja (V2X) zahteva visoko pasovno širino, nizko zakasnitev in visoko zanesljivo komunikacijo med širokim spektrom transporta in prometnih senzorjev. Iz tega vidika so lahko mobilna omrežja 5G ključna za zagotavljanje povezljivosti vozila z vozilom (V2V) in komunikacije med vozilom in infrastrukturo (V2I).

SUMMARY

5G as a technology has the potential to have wide-ranging effects on the Connected and Automated Mobility (CAM) in the future. Especially on vehicle-to-everything communication (V2X) which has become a popular concept that is expected to see increased deployment in the near term. Vehicle to everything (V2X) is a term that refers to high-bandwidth, low latency and highly reliable communication between a broad range of transport and traffic-related sensors and because of this 5G mobile networks could be key to providing connectivity for vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) communications.

O AVTORJU

Božidar Volk je zaposlen v podjetju DARS, d. d., kot Vodja službe za upravljanje cestne infrastrukture in cestnih naprav, v sklopu katere je odgovoren tudi za področje telekomunikacij. Od leta 2008 se ukvarja z razvojem in implementacijo inteligentnih transportnih sistemov na področju avtocest. Sodeluje v večih mednarodnih razvojnih projektih na temo digitalizacije prometa in je vodja projekta C-Roads na področju implementacije pilotnih projektov C-ITS in tehnologij V2X.

ABOUT THE AUTHOR

Božidar Volk is employed at DARS as head of Department for road infrastructure and road equipment management, within which he is also responsible for the field of telecommunications. He has been involved in the development and implementation of intelligent transport systems in the field of motorways since 2008. He participates in several international development projects on the topic of traffic digitalization and has led the C-Roads project in the field of implementing C-ITS pilot projects and V2X technology.

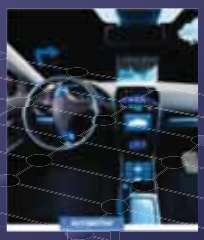
5G za povezano in avtomatizirano mobilnost

Božidar Volk

VITEL 2021, 17. in 18. maja 2021

36. DELAVNICA O TELEKOMUNIKACIJAH VITEL 2020

Glavna razvojna področja mobilnosti



- Avtomatska in avtonomna vožnja
  - Vodilno razvojno področje v avtoindustriji
- Cestne in prometne informacijske storitve
  - Z implementacijo C-ITS tehnologij
- Digitalizacija prometa in logistike
  - Povezava vozil in z ostalimi dejavniki v prometu (V2X)
- Socialna informiranost na poti
  - Kakovosten in dobro izkoriščen čas za potnike na poti

Povezljivost in IoT bosta bistveni sestavini inovacij na področju mobilnosti in zlasti avtomatizirane vožnje

2

Cilji razvoja

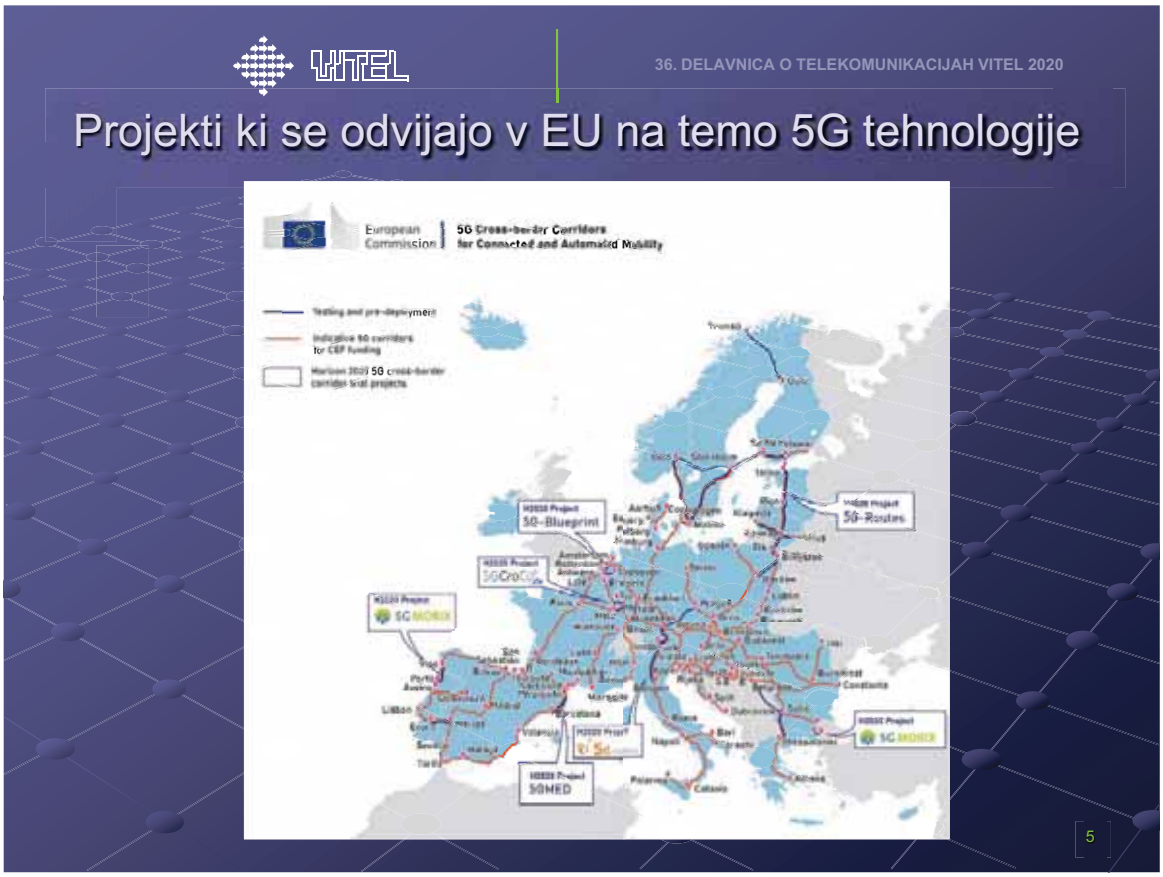
- Večja varnost v cestnem prometu (vizija nič smrtnih žrtev)
- Večja pretočnost (manj zastojev na cestah in krajši potovalni časi)
- Manjše emisije v okolje (prispevek k razogljičenju)
- Večja udobnost potnikov (zagotavljanje novih storitev mobilnosti za potnike in blago, s čimer bo spodbudil koristi za uporabnike in sistem mobilnosti kot celote)

3

Za mobilnost pomembne lastnosti 5G tehnologije

- Visoka hitrost prenosa podatkov (do 10Gb/s – omogoča prenose HD map, pretočni video,…)
- Zanesljivost prenosa (99,9% - primerna za kritične aplikacije kot je avtonomna vožnja)
- Nizka latenca (<10 ms - ključna za realno časovne aplikacije)
- Visoka kapaciteta (omogoča povezavo velikega števila naprav)
- Varnost (varovani in zanesljivi podatki)

4


VITEL
36. DELAVNICA O TELEKOMUNIKACIJAH VITEL 2020
Projekti ki se odvijajo v EU na temo 5G tehnologije
European Commission
5G Cross-border Corridors for Connected and Automated Mobility
5G-Blueprint
5G-Routes
5GMED
5


VITEL
36. DELAVNICA O TELEKOMUNIKACIJAH VITEL 2020
Primeri uporabe 5G tehnologije
Platooninng
Kooperativno manevriranje,
Video prenos
Daljinsko upravljanje vozil
Avtomobili brez voznikov
Eko vožnja
6

Vloga 5G za DARS kot cestnega operaterja

- Detekcija (zbiranje in pošiljanje podatkov iz cestnih senzorjev, VN, CVP…)
- Prometne informacije (pošiljanje prometnih informacij v realnem času in lokacijsko orientirane)
- Povezava z avtonomnimi vozili V2I (izmenjava senzorskih podatkov za upravljanje in koordiniranje avtonomne vožnje)

V prihodnosti bo raslo tako število povezanih naprav kot tudi količina podatkov, ki se bo prenašajo (avtonomni avtomobili 5 stopnje bodo vsako uro v oblak poslali 25GB podatkov)

7

36. DELAVNICA O TELEKOMUNIKACIJAH VITEL 2020

C-Roads Slovenija

	Projekt 1 kratkovalovna komunikacija (G5 - DSRC)	Projekt 2 Mobilna komunikacija (3g/4g/LTE)
Naprava v avtu	sprejemna naprava (OBU) tablični računalnik	Mobilni telefon (app DarsPromet+)
Naprava ob cesti	namestitev na obstoječe naprave	obstoječi oddajniki operaterjev
V centru	Aplikacija za sprejemanje in oddajanje informacij	Aplikacija za sprejemanje in oddajanje informacij

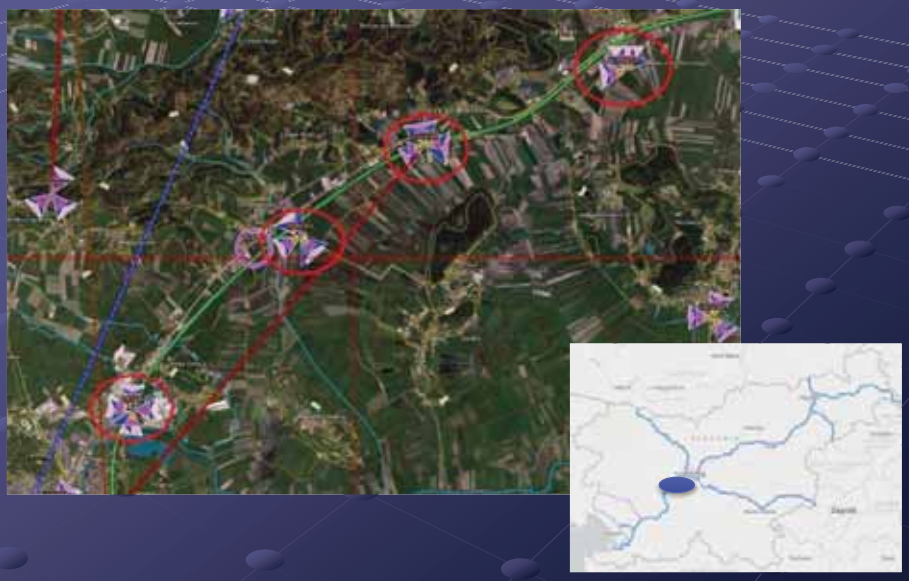
8


VITEL
36. DELAVNICA O TELEKOMUNIKACIJAH VITEL 2020
C-Roads Slovenija
80
Traffic congestion
Start in 750 meters
Kam?
Sporoči dogodek
zastoj
9


VITEL
36. DELAVNICA O TELEKOMUNIKACIJAH VITEL 2020
Pilot 5G DARS - Telekom Slovenija
5G pri razvoju celovitih rešitev za povezljivost za prihodnje storitve mobilnosti in prevoza zahteva sodelovanje med prometnim in telekomunikacijskim področjem
PROMET
Informacijsko prometne aplikacije, cestne naprave in infrastruktura
TELEKOMUNIKACIJE
Povezljivi in mrežni sistemi, naprave in tehnologije
10

36. DELAVNICA O TELEKOMUNIKACIJAH VITEL 2020

Pilot 5G DARS - Telekom Slovenija



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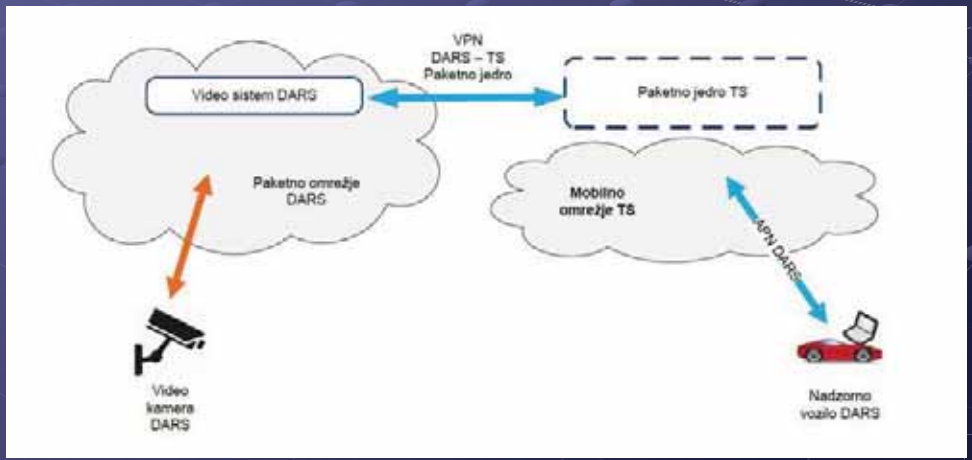
36. DELAVNICA O TELEKOMUNIKACIJAH VITEL 2020

Pilot 5G DARS - Telekom Slovenija

Namen testa je bil preveriti zmogljivost trenutno postavljenega omrežja. To smo preizkusili z video prenosom z nadzornih kamer avtoceste DARS na odjemalca, nameščenega v nadzorno vozilo DARS, ki je bilo povezano v mobilno omrežje 5G. Med testiranjem smo preverili kakovost video prenosa z več videonadzornih kamer.



12


VITEL
36. DELAVNICA O TELEKOMUNIKACIJAH VITEL 2020
Iz vidika prometne mobilnosti učinkovitost 5G ne zahteva le ustrezne 5G tehnologije, temveč tudi sposobnost oblikovanja njene uporabnosti, kajti prednosti niso v tehnologiji, temveč v njeni uspešni uporabi.
Hvala za pozornost
13

Transformacija mobilnosti z novimi tehnologijami

Transformation of mobility with new technologies

Daniel Avdagič
AV LIVING LAB

SUMMARY

5G Proof of Concepts CityLab with focus on real life scenarios, cross industry, applications during massive events.

ABOUT THE AUTHOR

As a founder and the CEO of AV Living Lab, Daniel Avdagic is focused on bringing the future cognitive autonomous mobility (CAV & UAM) to make life easier and more productive with new free time while on the move for billions of people around the world. Daniel previously served as External Digital Transformation Leader at Deutsche Telekom and Telekom Slovenije, as well as Account Manager at Cisco. He began his career in 1998 at cable company. Daniel was a project coordinator of Smart City consortium consisted of 16 entities from 6 EU countries in 2015, private cloud project (data collection) for EU agency and EU call for multi-modal smart logistics platform in 2016. Daniel with his team won 2nd place at Future Digital Insurance Hackathon in 2017.

Transformacija mobilnosti z novimi tehnologijami

Daniel Avdagic
AV Living Lab
CEO

AV Living Lab: The European largest CityLab

City of Ljubljana

AV Living Lab
in BTC City Ljubljana, one of the biggest business, shopping, and entertainment centers in Europe.

475.000 m^2 of surface area on private ground
11 km of roads
21 million visitors per year
600 shops and services

The Slovenian Autonomous Driving Ecosystem

AV Living Lab is the leading partner of **the Slovenian autonomous driving ecosystem**.

The Cross-Border Autonomous Driving Corridors

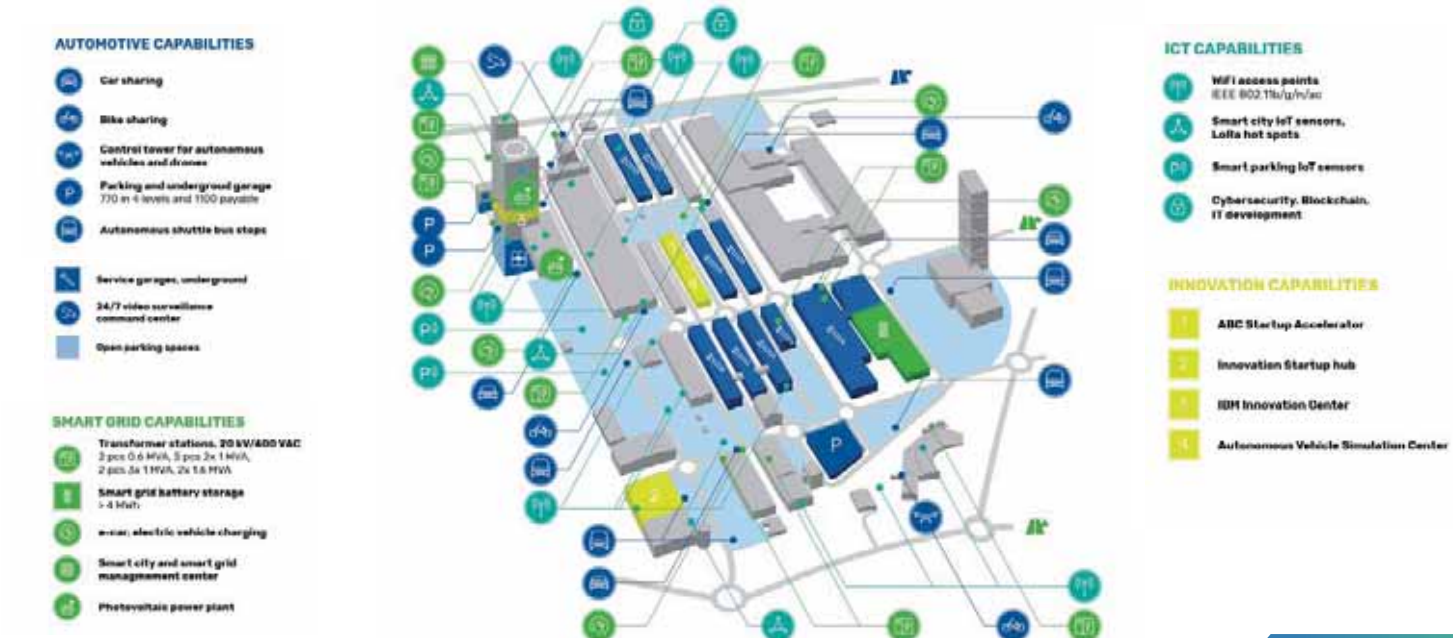
AVLL is a partner of Austria-Hungary-Slovenia trilateral **Cross-border testing ecosystem.**

	Lab	Motorways	Proving ground	Urban environment	5G test network
DARS Slovenian Motorways Company		600+ km			●
AMZS Automobile association of Slovenia	●		2,5 km		●
AV Living Lab	●			11 km	●

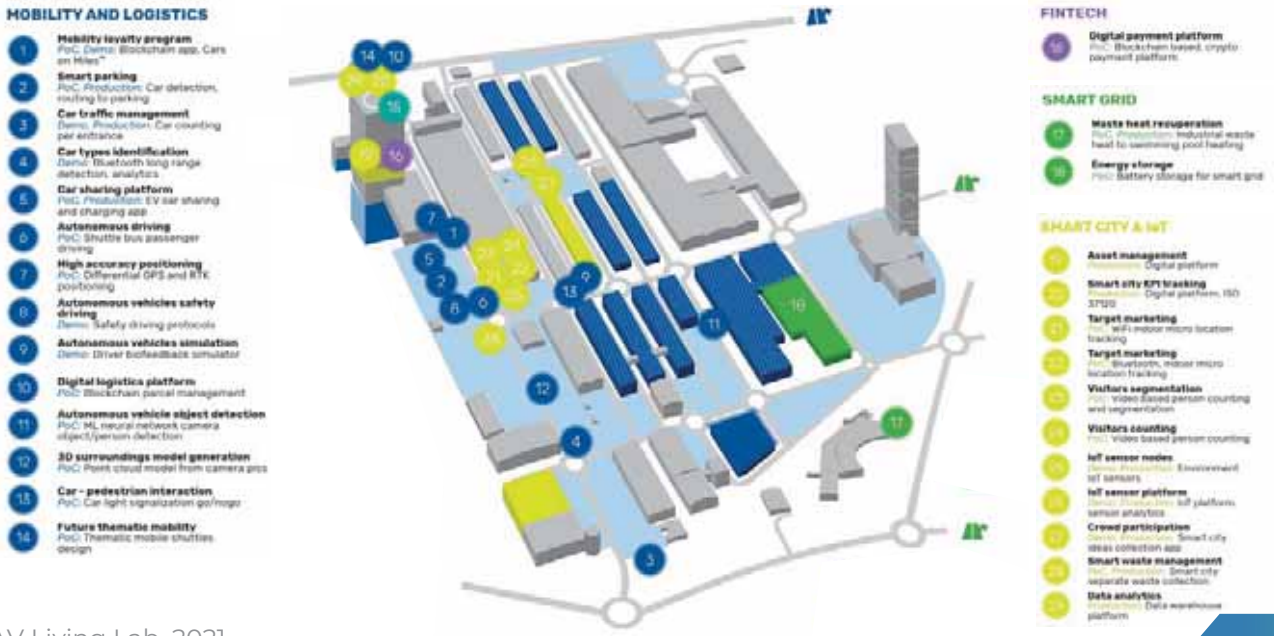
The Role of „City as a Lab“ for working on Public Acceptance

	Infrastructure	Technology	Real human interaction	Cross-industry ecosystem
Testbed	High	Low	Low	Low
Proving Ground	High	Medium	Low	Low
Living Lab	High	Medium	Medium	Low
City as A Lab	High	High	High	Medium - High

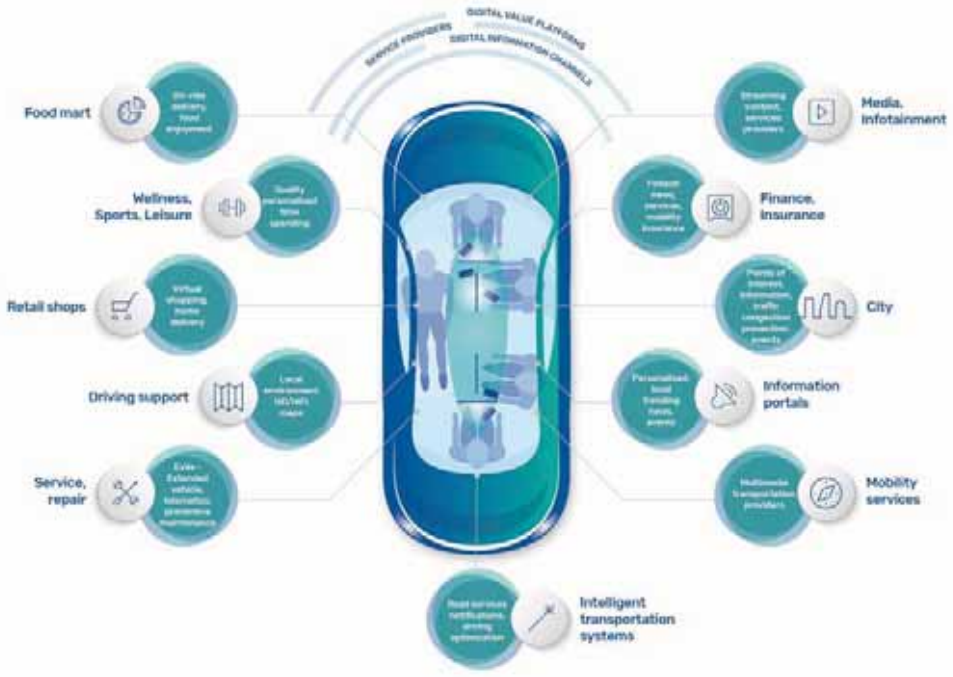
Cross-Industry and Smart CityLab



Proof-of-Concepts sandbox (2019-2021)



Validation of Autonomous-related Applications



Why City as a Lab

The Role of European Urban CityLab

- Working with EU citizens (human-centric) on Public/Social acceptance and embracement
- Working with EU Governmental bodies (GovLab) on complience with EU regulations, privacy, data protection, etc.
- Working with cross-industry applications for a better society

EU complience, validation and harmonization of digital products and services

Our Mobility PoC references and clients

Digital platforms

City car congestion relieve/mitigation through personal mobility behaviour influence with non-monetary incentives with possible application to on demand road reverse charging.

Autonomous public transport

Value added services ecosystem as a key enabler of corner-2-corner on demand, shuttle based autonomous public transportation.

Digital apps

Beyond mobility as a new concept of added value time consumption based on loyalty scheme partners' ecosystem and personalised points of interest.

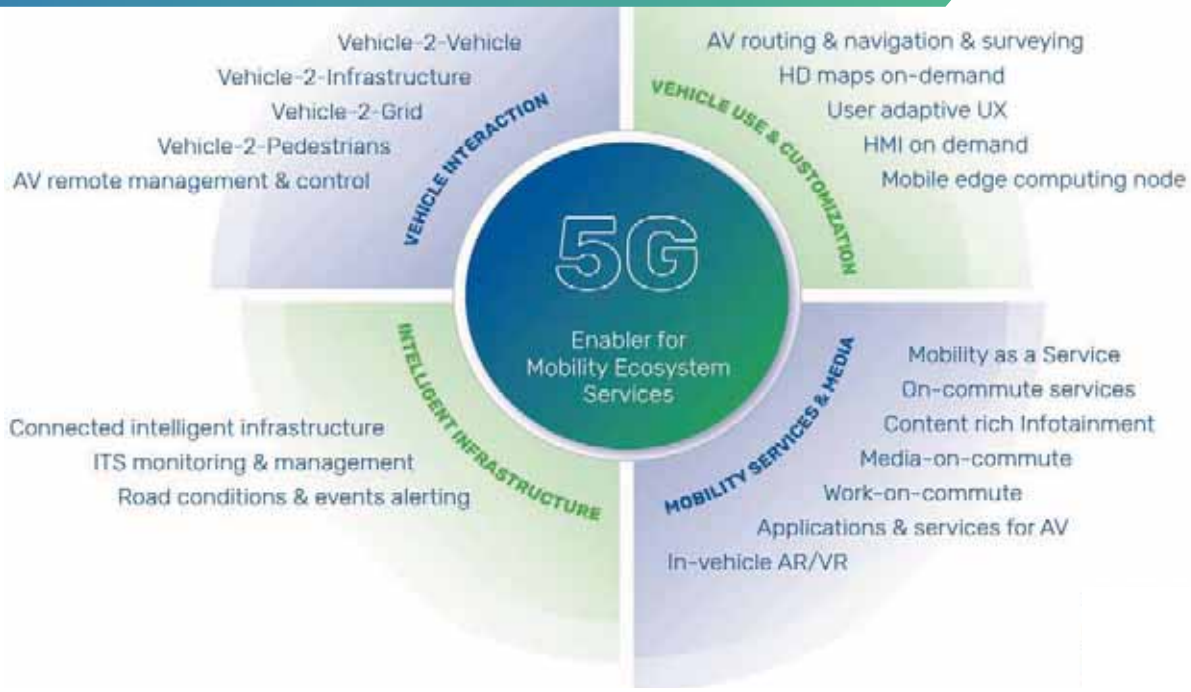
Car/ride sharing

Multi role 24/7 business district based car sharing based on a common car pool for personal business mobility, zero Capex and significantly lower Opex.

5G Proof-of-Concepts CityLab

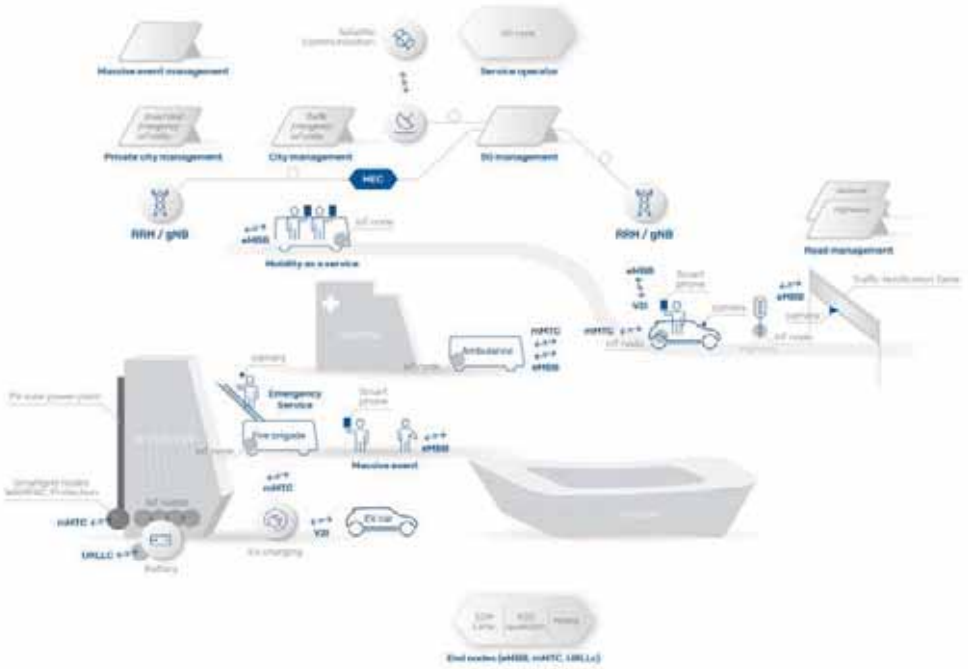
(with focus on real-life scenarios, cross-industry applications during massive events)

Sandbox for ITS & data: 5G for mobility

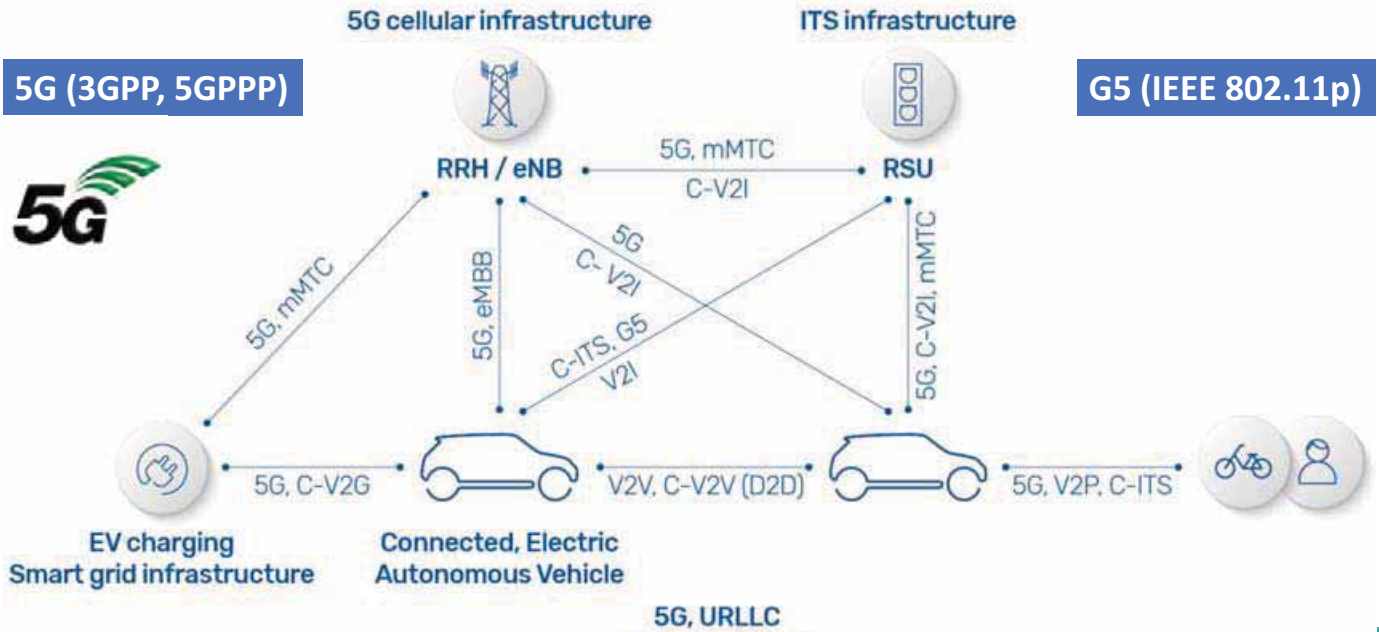


Our 5G cross-industry CityLab

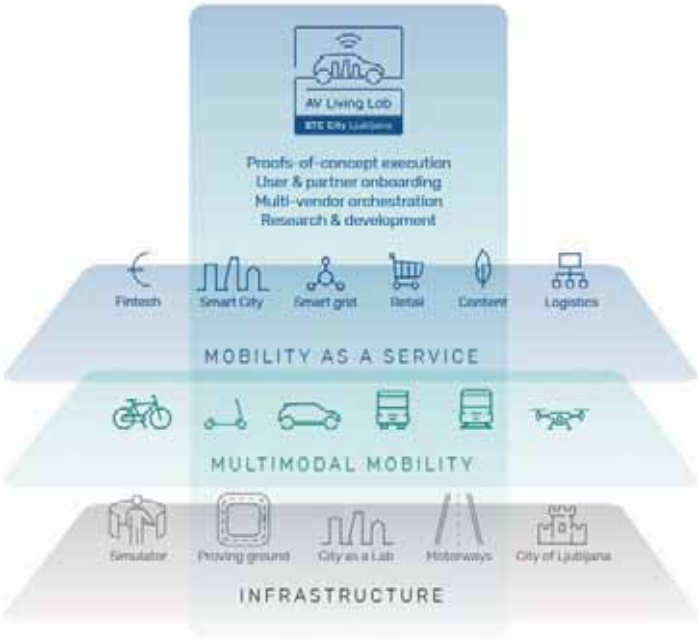
- Cross industries
- Multiple sites
- Private 5G for retail/indoor
- Underground locations
- Massive events



Our ITS & C-V2X use case



Our Approach:
Integrated and Multimodal Mobility Living lab



AV Living Lab
BTC City Ljubljana

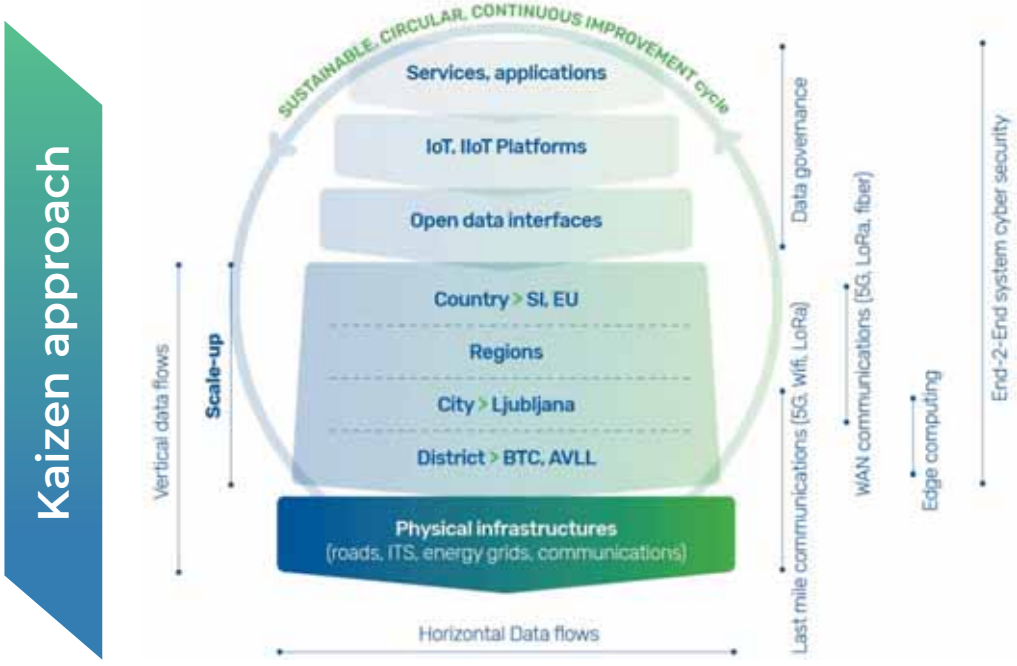
THANK YOU

Let‘s transform the Urban Future. Together.

daniel.avdagic@avlivinglab.com
AVLivingLab.com

BACK UP SLIDES

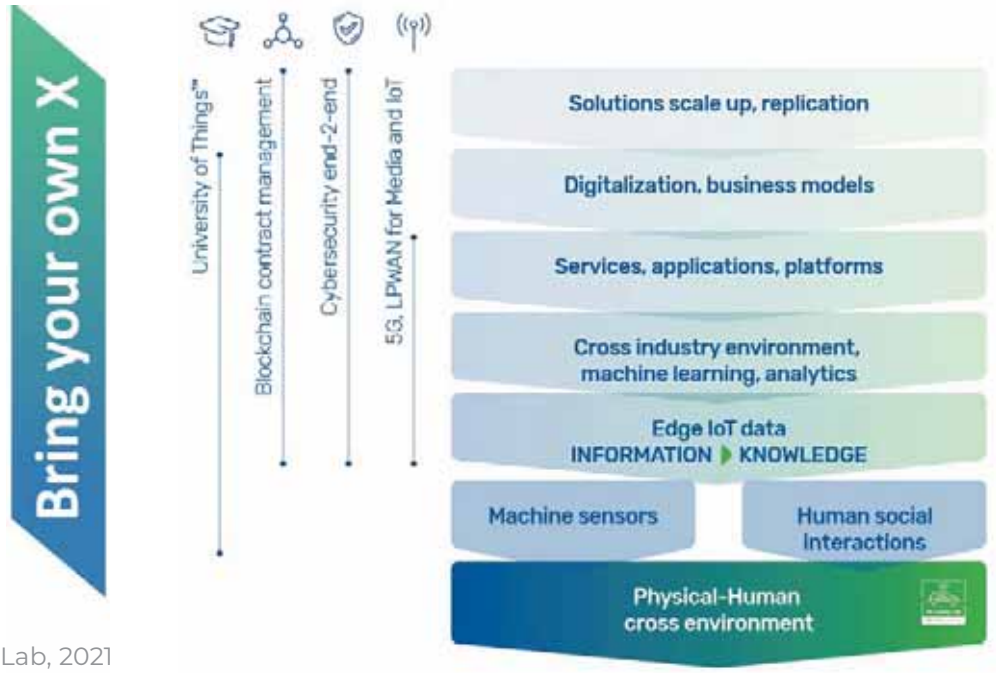
Our Business Development approach



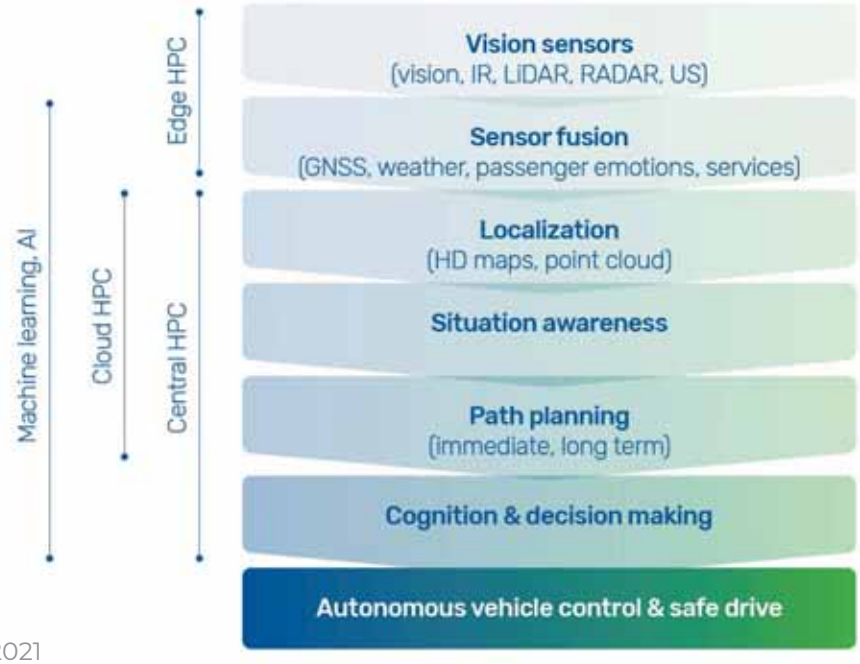
Our SmartCity approach

Our Competences and Capabilities

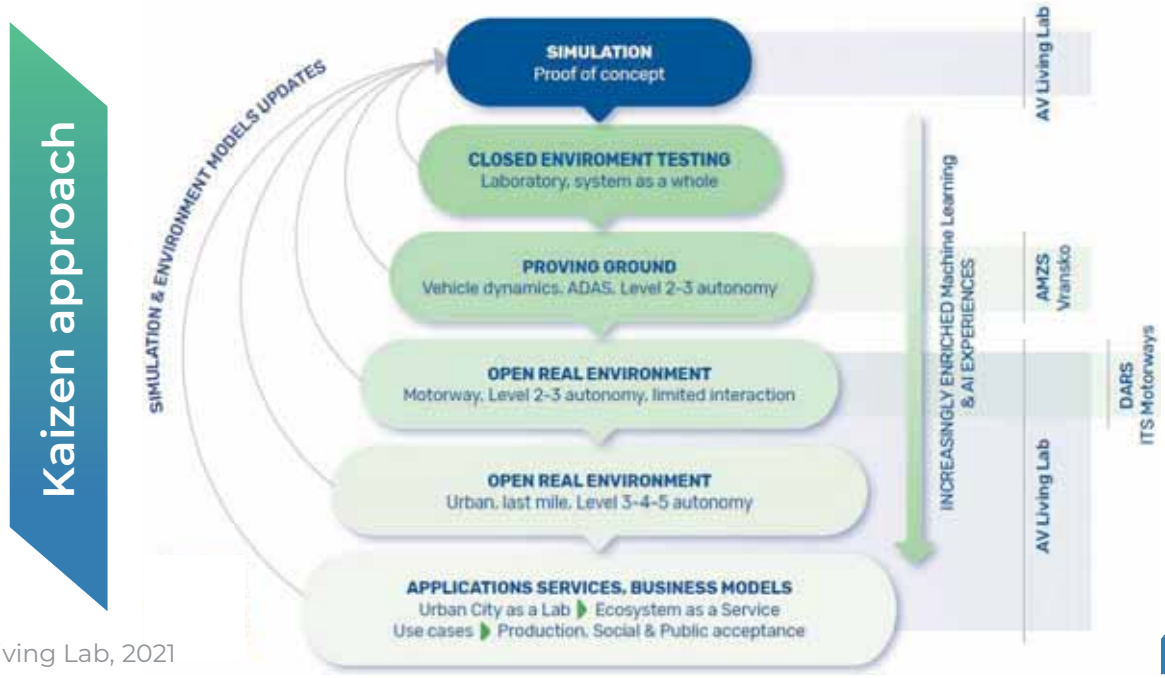
Sandbox of Physical world to Human interaction

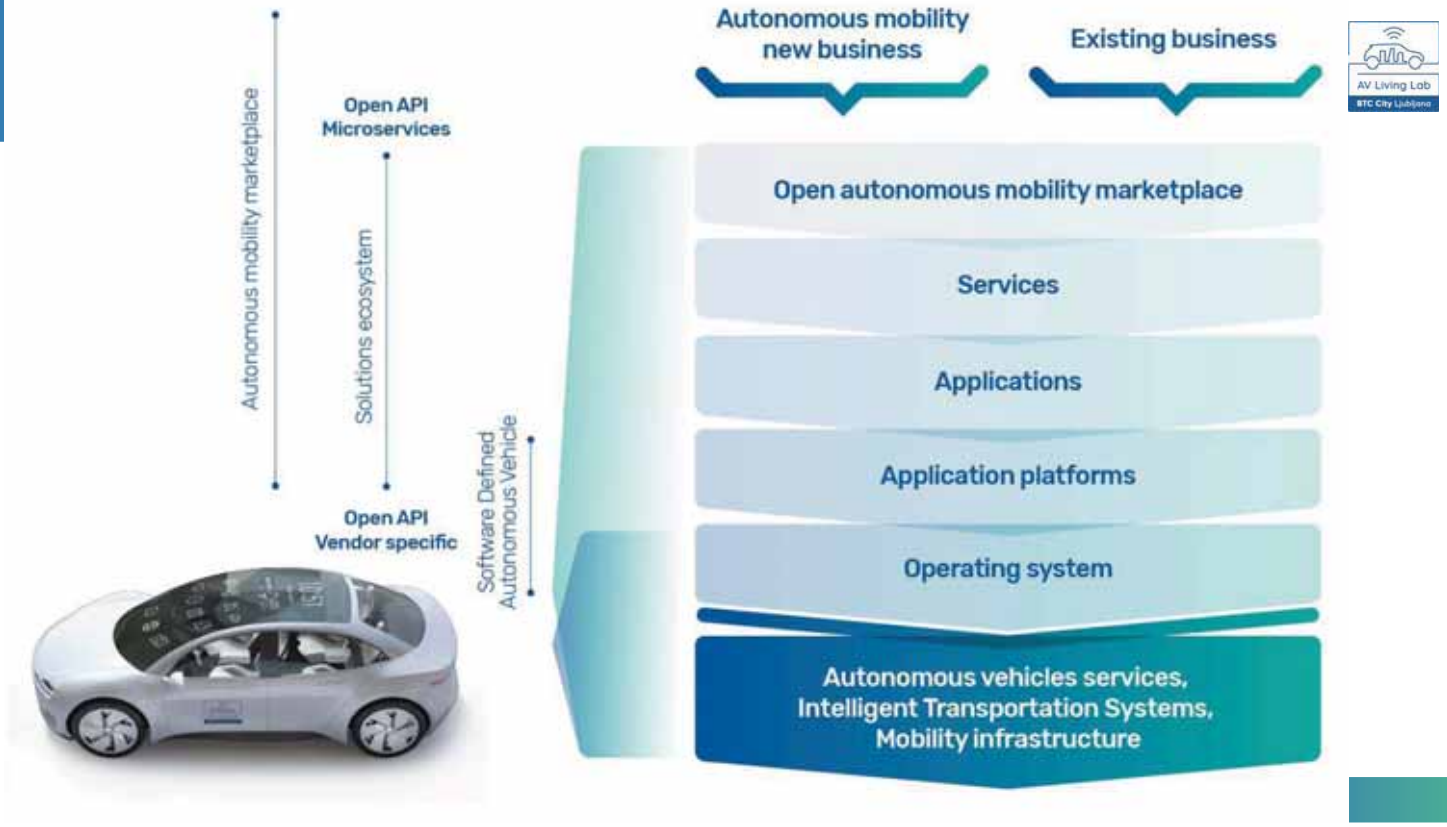


Autonomy & Cognition: Future Mobility CityLab

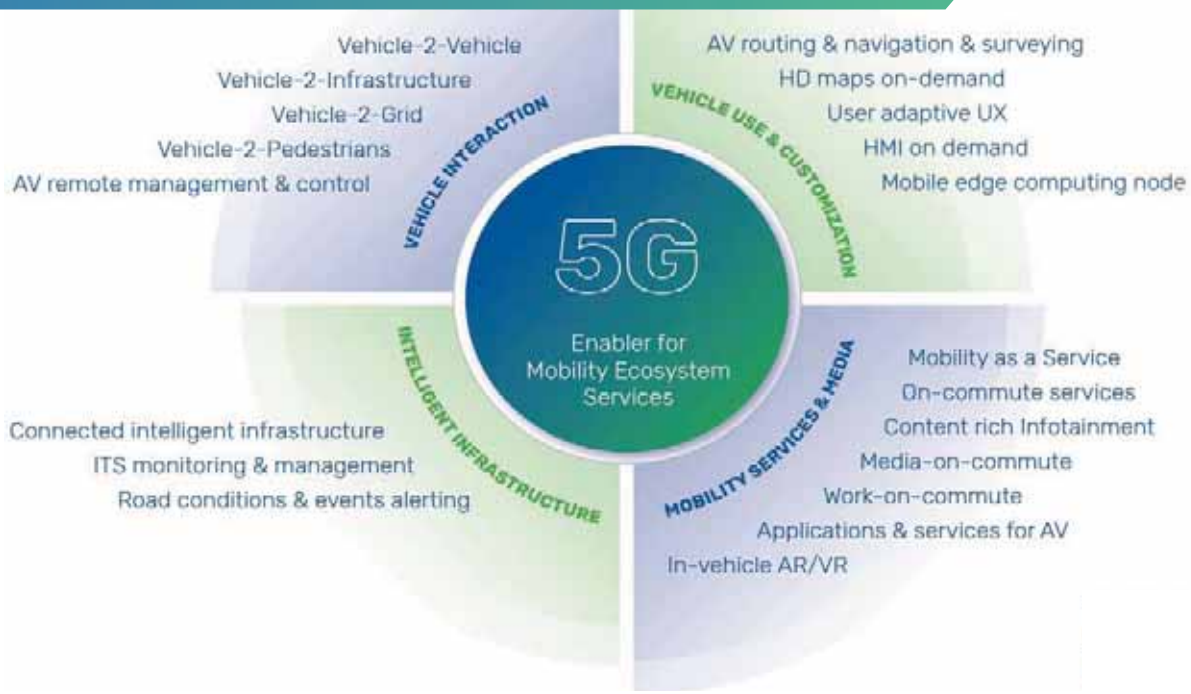


From Simulation to Real-Life Urban Mobility



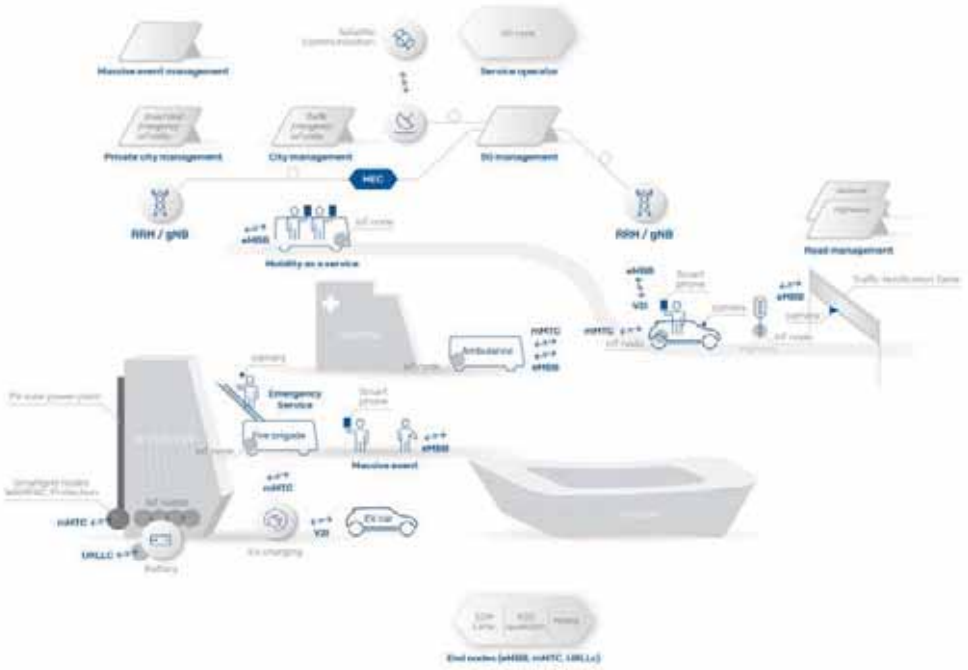


Sandbox for ITS & data: 5G for mobility

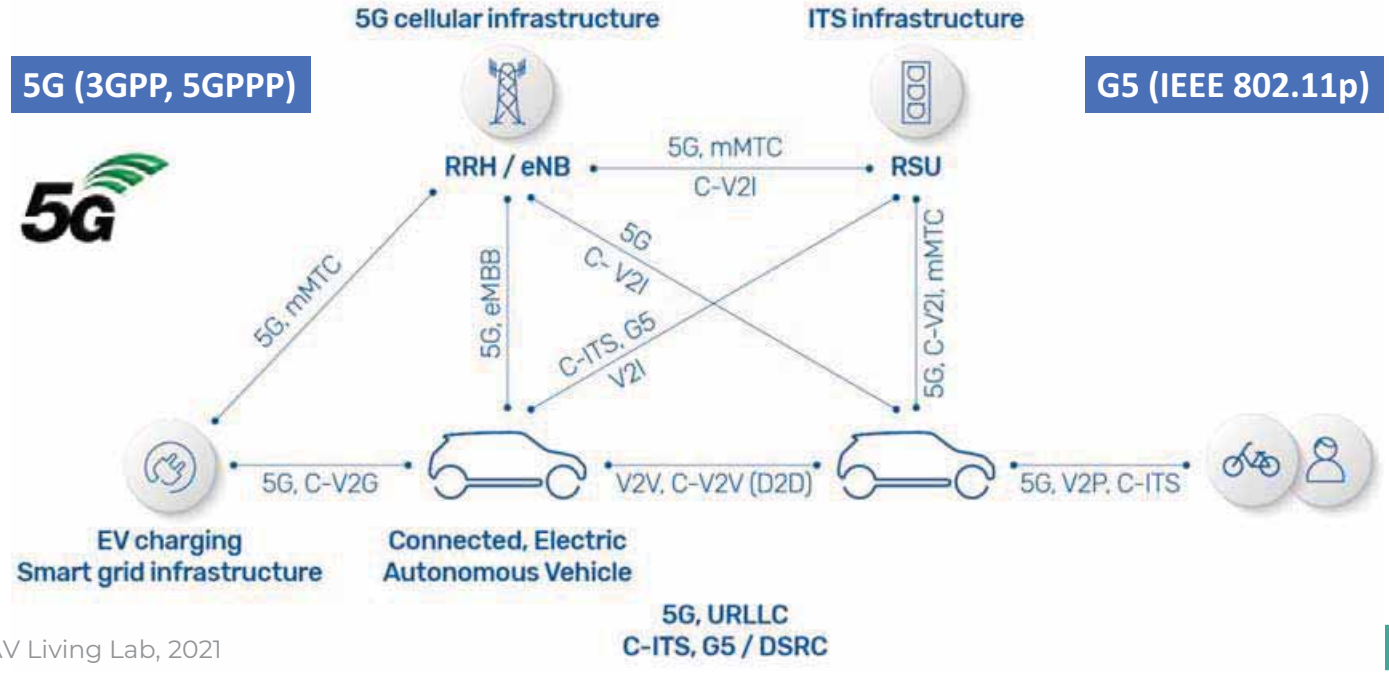


Our 5G cross-industry CityLab

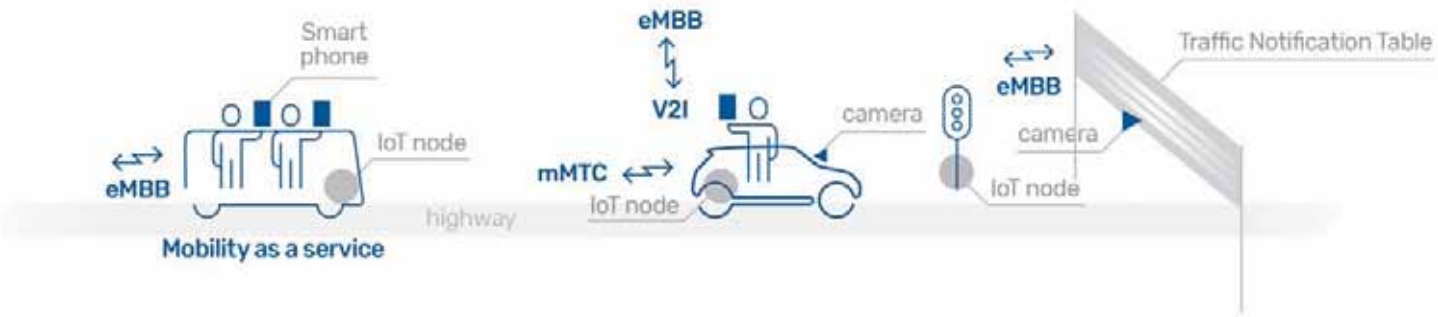
- Cross industries
- Multiple sites
- Private 5G for retail/indoor
- Underground locations
- Massive events



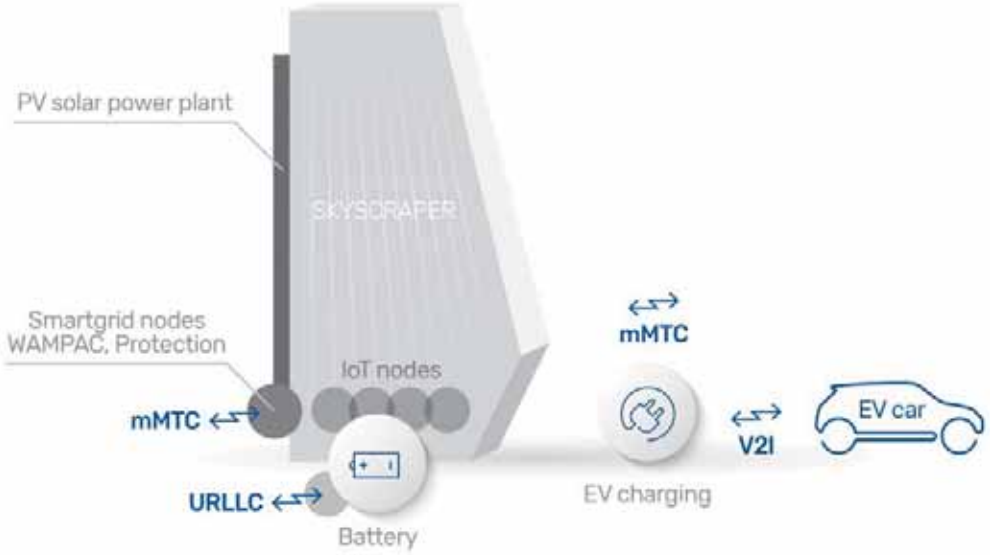
Our ITS & C-V2X use case



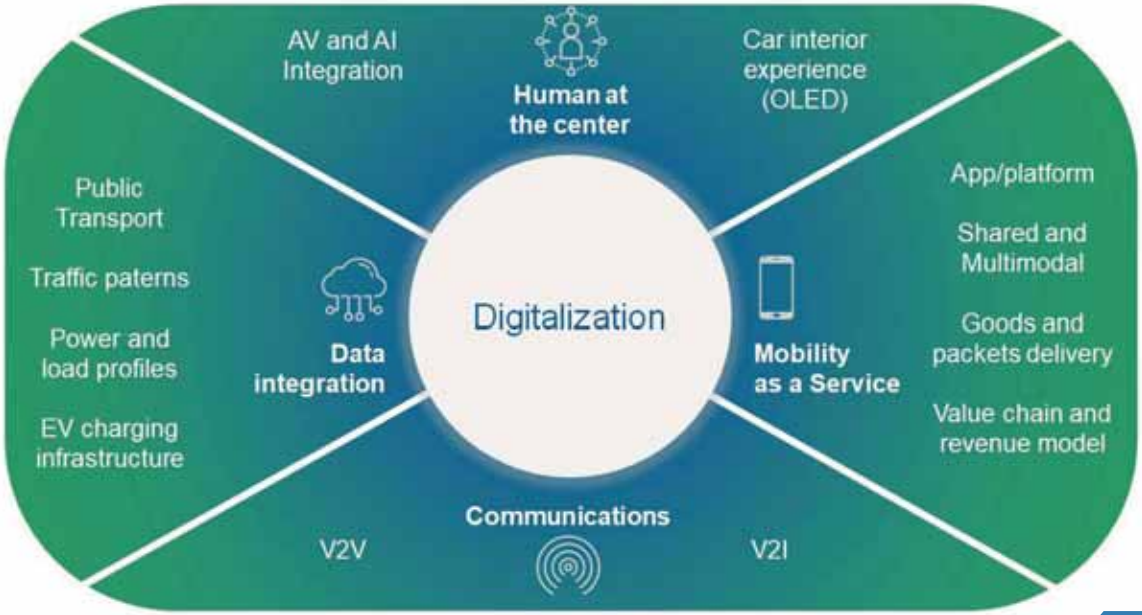
Mobility in motion: 5G use cases



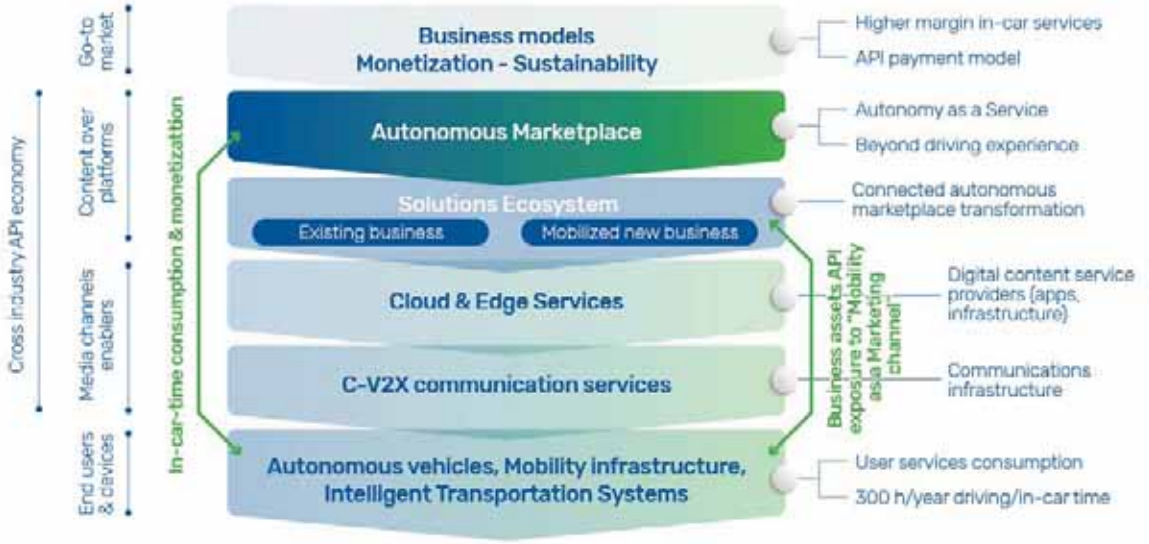
V2X cross-industry use cases: Smart grid, V2G, IoT



Strategic Initiative 1: Society and city digitalization



Strategic Initiative 2: Co-Creation of Autonomous marketplace



Tehnološka nevtralnost naslednje generacije klica v sili na številki 112

Technological neutrality of the next generation emergency call on 112

Boštjan Tavčar

Ministrstvo za obrambo, Uprava Republike Slovenije za zaščito in reševanje

POVZETEK

Številka za klic v sili, ki je bila sprva namenjena zgolj govornim klicem je z leti pridobivala številne nove storitve. Te so prej kot dejanskim potrebam sledile razvoju tehnologij. Mnoge od njih zato nikoli niso zares zaživele. Njihov uspeh je bil odvisen od ljudi, ki so jih ali pač ne sprejeli. Bolj uspešne so bile storitve, neodvisne od uporabnikov. Cilj vseh storitev klica v sili je pridobiti čim več relevantnih podatkov v čim krajšem času. Za dosego tega cilja morajo biti storitve tehnološko neodvisne. Tehnologija ne sme biti tista, ki diktira njihov razvoj, mora ga samo podpirati. Kakšno vlogo bo v tem primeru odigrala tehnologija 5G, bomo videli v prihodnje.

SUMMARY

The emergency number, which was originally intended for voice calls only, has been gaining with many new services over the years. The 112 services followed more the development of technologies rather than actual needs. Many of them, therefore, never really came to life. Their success depended on people who either did not accept them. User-independent services were more successful. The goal of all emergency call services is to obtain as much relevant information as possible in the shortest possible time. To achieve this goal, services must be technologically independent. Technology, should not be the one to dictate their development, it should only support it. We will see in the future what role will play 5G technology in this case.

O AVTORJU

Boštjan Tavčar je diplomiral na Fakulteti za elektrotehniko v Ljubljani na smeri telekomunikacije. Od leta 1994 je zaposlen na Ministrstvu za obrambo, Upravi Republike Slovenije za zaščito in reševanje. V zadnjih letih je bil vodja Centra za obveščanje Republike Slovenije. Od oktobra 2019 pa vodi Službo za informatiko in komunikacije. Zadolžen je za razvoj in delovanje informacijskih in komunikacijskih sistemov in storitev, številke za klic v sili in centrov za obveščanje na področju varstva pred naravnimi in drugimi nesrečami. Je tudi avtor aplikacije za klic v sili za gluhe in naglušne, WAP112, ki je bila predhodnica oziroma prva aplikacija naslednje generacije klicev v sili NG112. Aplikacija je leta 2009 prejela nagrado, ki jo podeljuje evropsko združenje EENA. Je pobudnik uvedbe sistema eCall v Sloveniji, pri razvoju slovenske rešitve je tudi aktivno sodeloval. Udeležen je bil pri številnih evropskih projektih, med katerimi so U2010, MONET, ABSOLUTE, I_HeERO, NEXES in drugi. Je član Evropskega kluba 112.

ABOUT THE AUTHOR

Boštjan Tavčar received his B.Sc. (univ.dipl.ing.el) from the Faculty of Electrical Engineering in the field of telecommunications. Since 1994 he has been with the Ministry of Defense, Administration for Civil protection and Disaster Relief. In recent years, he has held the position of the Head of the Notification Centre of the Republic of Slovenia. Since October 2019, he is the Head of Information and Telecommunication Department. He is in charge of development and adoption of information and communications systems and the unified European emergency numbers 112. He is also the author of the emergency application for hard of hearing WAP112, the predecessor of the next generation 112 call service, which received an international EENA award in 2009. He is the initiator of the implementation of eCall in Slovenia and has been actively involved in numerous European projects, including U2010, MONET, ABSOLUTE, I_HeERO, NEXES and others. He is a member of European Club 112.

Boštjan Tavčar
Uprava RS za zaščito in reševanje

Tehnološka nevtralnost naslednje generacije storitev klica v sili na številki 112

VITEL 2021, 17. in 18. maja 2021

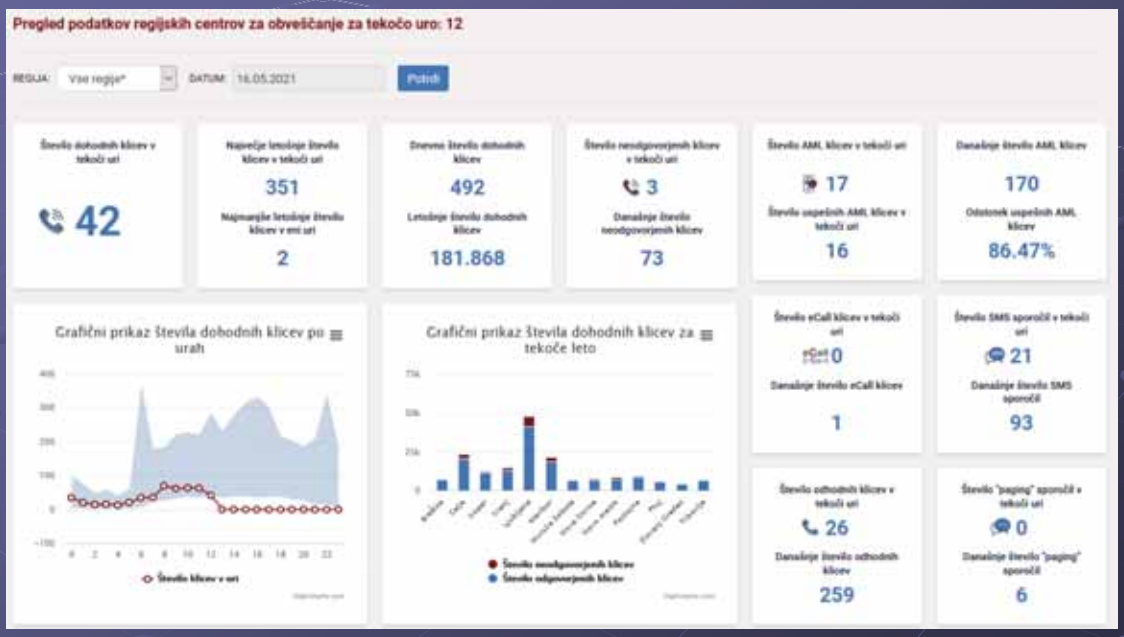
Razvoj storitev klica v sili - 112





2

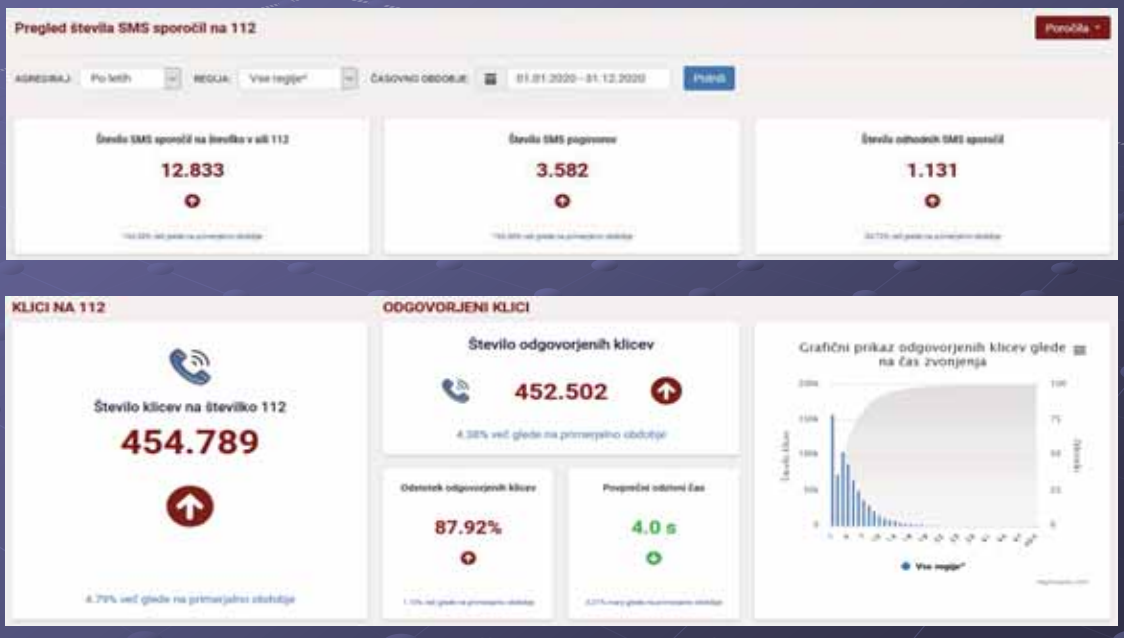
Dejanska uporaba storitev



https://statklic.sos112.si/

3

Dejanska uporaba storitev



https://statklic.sos112.si/

4

Tehnologije pogosto ne zdovoljujejo dejanskih potreb

https://siol.net/avtomoto/novice/nora-cesta-prometni-pas-se-menja-kar-med-voznjo-video-485957

5

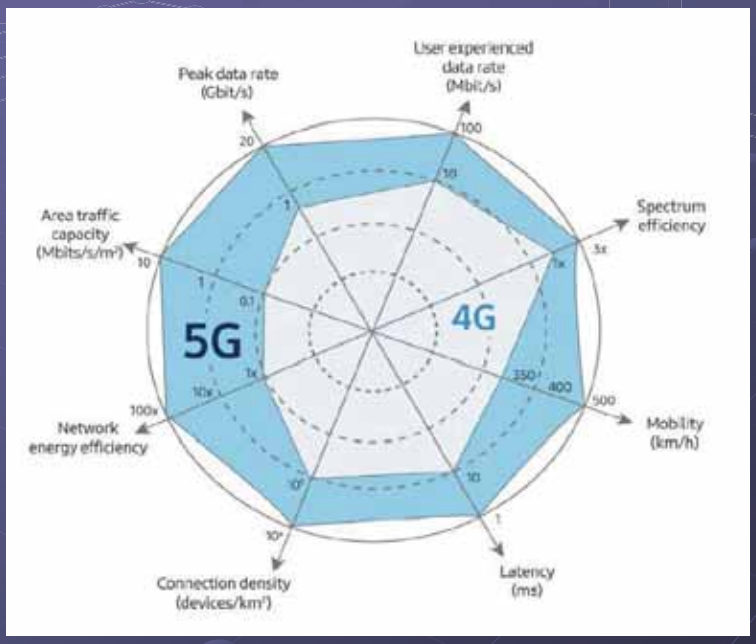
Marsikatere tehnološke rešitve v praksi niso zaživele

3G

ISDN

6

Storitve klica v sili morajo biti prilagojene potrebam, ne tehnologijam



7

Razprava

8

Slovenska mreža TeleKap – nova paradigma zdravljenja možganske kapi

Slovenian network TeleStroke – a new paradigm for the treatment of stroke

Bojana Žvan

Univerzitetni Klinični center Ljubljana, Center za TeleKap

POVZETEK

Strokovno znanje o možganski kapi je ključnega pomena za pravočasno in ustrezno zdravljenje z intravensko trombolizo (IVT) in vpliva na uporabo IVT. V Sloveniji se IVT izvaja v splošnih bolnišnicah, kjer pogosto niso imeli nevrološkega strokovnega znanja. Za premagovanje te ovire smo vzpostavili nacionalno omrežje za zdravljenje možganske kapi na daljavo s pomočjo telemedicine - TeleKap. Mreža je sestavljena iz svetovalnega centra za možgansko kap in 12 mrežnih bolnišnic, razvrščenih glede na razpoložljivost nevrološkega strokovnega znanja na kraju samem. Cilj je bil, da TeleKap poveča uporabo revaskularizacijskega zdravljenja v državi (IVT in Mehansko revaskularizacijo), da zmanjša smrtnost in zmanjša zdravstvene stroške. Rezultati retrospektivne opazovalne študije, ki je primerjala število bolnikov z akutni ishemično možgansko kapjo (AIMK) in uporabo IVT v prvih 3 zaporednih letih delovanja mreže TeleKap, smo ugotovili, da je TeleKap je izboljšala uporabo IVT ne glede na nevrološko strokovno znanje na kraju samem. Zaključimo lahko, da se je nacionalna mreža TeleKap izkazala za učinkovito. Lahko bi predstavljala model oskrbe s telemedicino za druge podobne države.

SUMMARY

Stroke expertise is critical for timely and appropriate intravenous thrombolysis (IVT) and affects IVT use. In Slovenia, IVT is administered in general hospitals, which often lack on-site neurologic expertise. To overcome this obstacle, a national telestroke network, TeleKap, has been implemented. TeleKap is a decentralized hub-and-spoke telestroke model covering the entire nation, consists of one comprehensive stroke center and 12 spokes classified according to the availability of on-site neurologic expertise. The aim of the network was to enhanced use of revascularization treatments (IVT, mechanical revascularization), to reduce mortality rate and medical costs. The results of retrospective observational study comparing the number of acute ischemic stroke (AIS) patients and the use of IVT during the first 3 consecutive years of network operation have shown that TeleKap enhanced IVT use regardless of on-site neurologic expertise. TeleKap proved to be efficient. It could serve as a model of telestroke care for other similar countries.

O AVTORJU

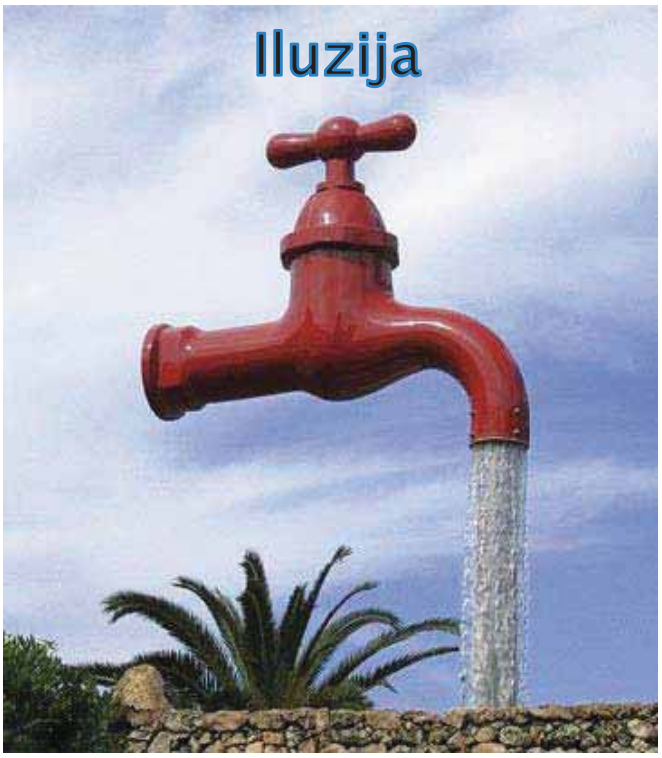
Prof. dr. Bojana Žvan, dr. medicine, primarius, višja svetnica, FESO, nevrologinja, redna profesorica na Medicinski fakulteti Univerze v Ljubljani, Slovenija, soustvarjalka vaskularne nevrologije v Sloveniji in avtorica mreže TeleKap. Je predsednica Nacionalnega društva za možgansko kap in podpredsednica Nacionalnega društva za glavobol. Je vodja Slovenske nevrosonološke šole, strokovna vodja Društva za preprečevanje možganskih in žilnih bolezni, predstavnica Slovenije v Evropski organizaciji za telekap, redna članica Evropske organizacije za možgansko kap (ESO) in sodelavka v organizaciji Kontroverznosti v nevrologiji (CONy).

ABOUT THE AUTHOR

Professor Bojana Zvan, M.D., Ph.D., "primarius", senior advisor, FESO, neurologist, full-time professor at the Medical Faculty University of Ljubljana, Slovenia, Co-creator of the vascular neurology in Slovenia and the author of telestroke network – TeleKap. She is the president of the National Stroke Society and the vice president of the National Headache Society. She is the head of the Slovenian Neurosonology School and the professional head of the Society for the Prevention of Cerebral and Vascular Disorders. She is also the cofounder of the Migraine Association, a regular member of the European Committee for Telestroke, a fellow of the European Stroke Organization (ESO) and a fellow of the organization Controversies in Neurology (CONy).

TeleKap nova paradigma zdravljenja možganske kapi

prim. prof. dr. Bojana Žvan, dr. med. višja svetnica
Univerzitetni klinični center Ljubljana



Telezdravje – Teleoskrba – Telemedicina

E-Zdravje (TeleHealth) – zdravstvene informacijske storitve, zdravstveno izobraževanje, zdravstvene storitve v širšem pomenu, ... Temelji na Telekomunikacijah.

TeleOskrba (TeleCare) – tehnologije, ki omogočajo ohranjanje zdravstvene neodvisnosti in varnosti bolnikom na domu: mobilne nadzorne naprave, medicinski sistemi opozarjanja, uporaba telekomunikacijske tehnologije → računalniki in telefoni.

TeleMedicina (TeleMedicine) – izobraževanje na daljavo, zagotavljanje zdravstvenih storitev z uporabo telekomunikacijske tehnologije = uporaba informacijskih tehnologij in elektronskih komunikacij za zagotavljanje oddaljenih kliničnih storitev pacientom: digitalni prenos medicinskih slik, oddaljena medicinska diagnoza, video-posvetovanja s strokovnjaki.

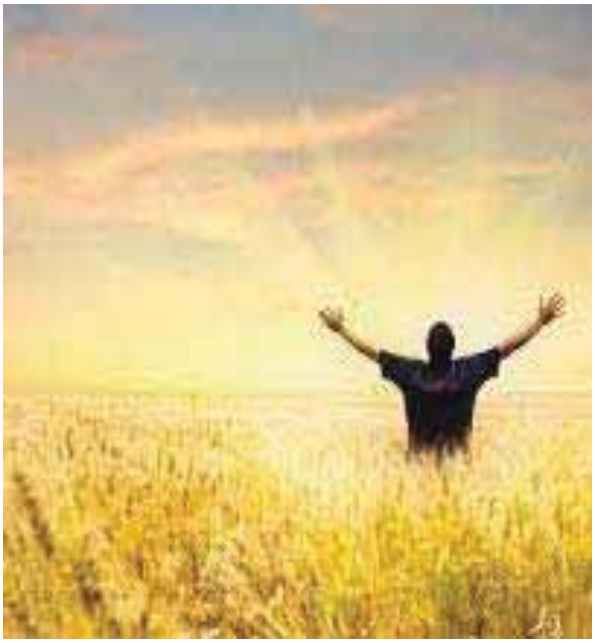
Telemedicina

Pomanjkanje specialistov in napredek tehnologije = razvoj telemedicine za zagotavljanje zdravstvenega varstva

Prenos medicinskih informacij po elektronski komunikaciji iz ene lokacije na drugo

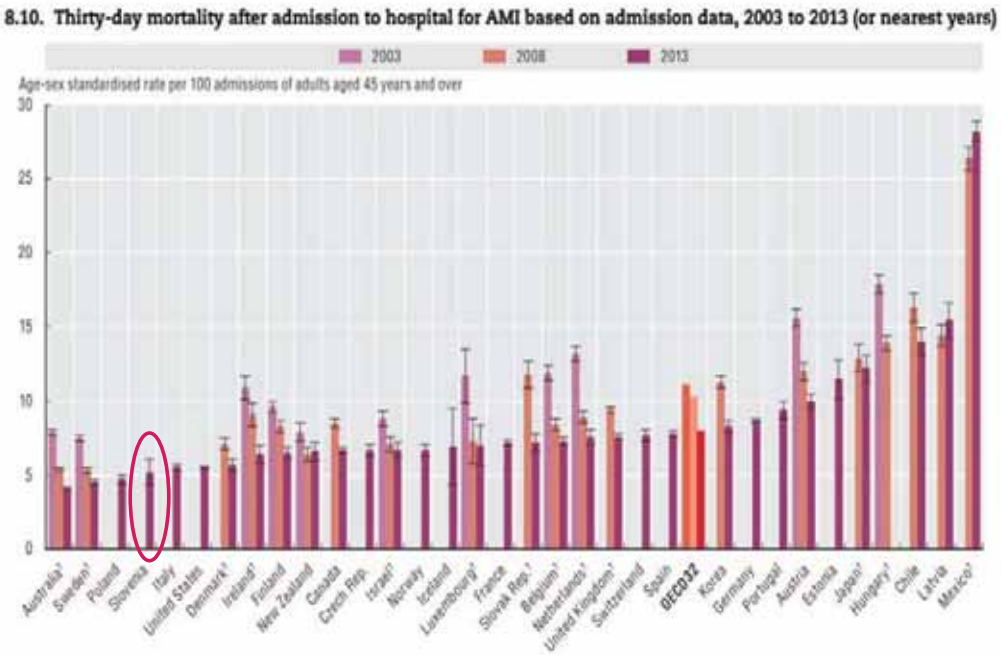
Dostop do zdravnikov na območja pomanjkanja → z diagnostičnim pregledom prek spletnih kamer omogoča takojšnje zdravljenje

Znižuje stroške zdravstvene obravnave



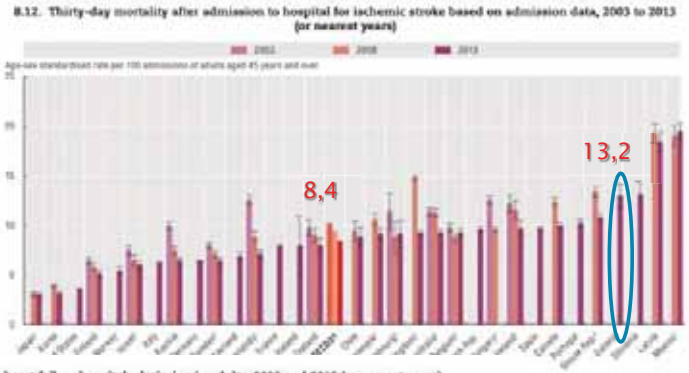
»Ljudje so se do mene obnašali brutalno neprijazno,«

AMI – statistika za Slovenijo 2013



https://podcrto.si/zakaj-imate-vec-moznosti-za-prezivetje-mozganske-kapi-v-avstriji-in-srcne-v-sloveniji/

MK in srčno popuščanje – statistika Slo 2013



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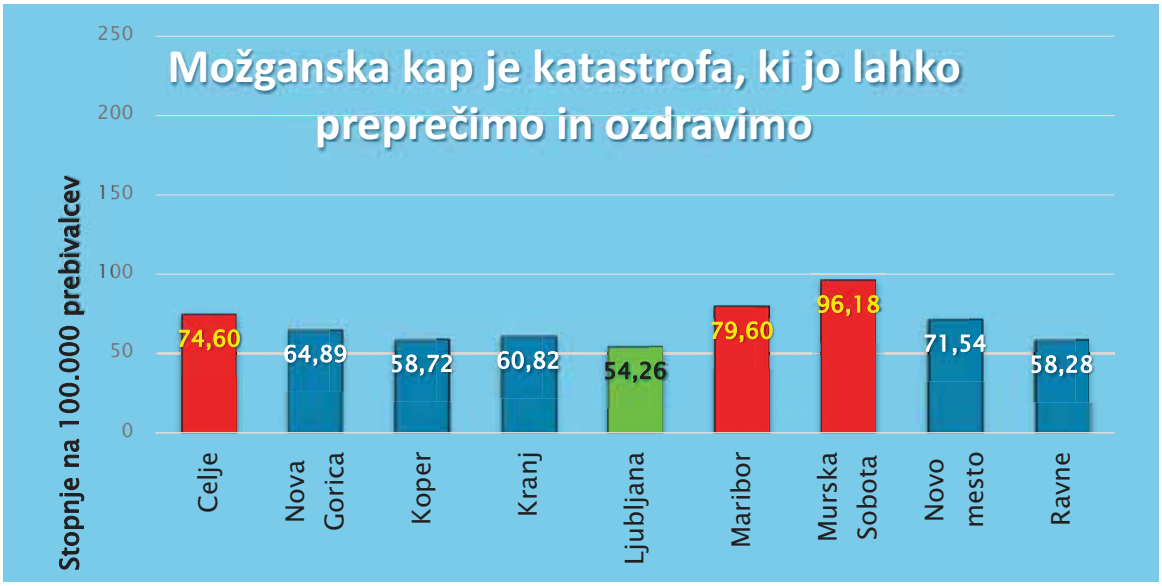


Podatki za obdobje 2007–2011 ⇨ stopnja umrljivosti v Sloveniji zaradi MK bi lahko zmanjšali kar za **35%**, če bi jo lahko v vseh slovenskih regijah zmanjšali na raven umrljivosti ljubljanske regije.

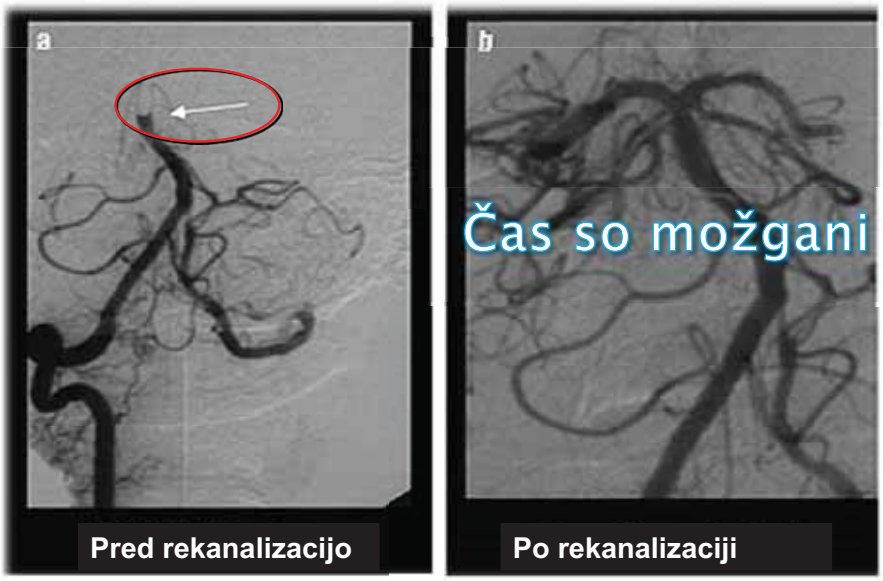
Čas so možgani!

Bolnišnice v Sloveniji do leta 2014

V Sloveniji do 2014 – organizirana nevrološka služba 7/24 le v 4 bolnišnicah:

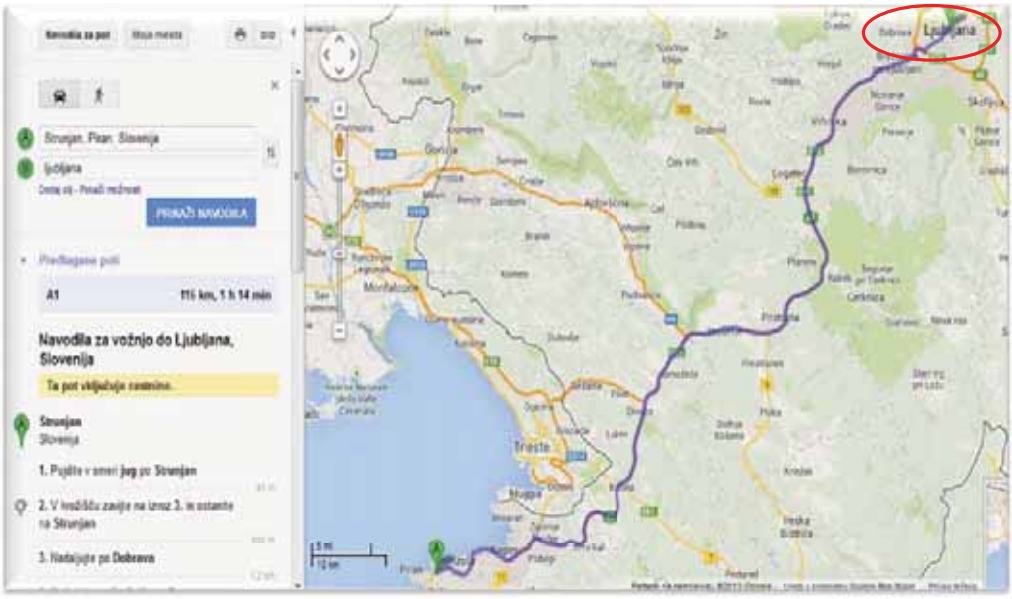
- **UKCL** – bolniki s Primorske, Goriške, Notranjske, Gorenjske, del Dolenjske, del Štajerske, Koroške, Prekmurja
- **SB Celje** – del Štajerske in Koroške
- **UKCM** – Prekmurje, del Štajerske in Koroške
- **SB Novo mesto** – Dolenjska

Zapora bazilarne arterije



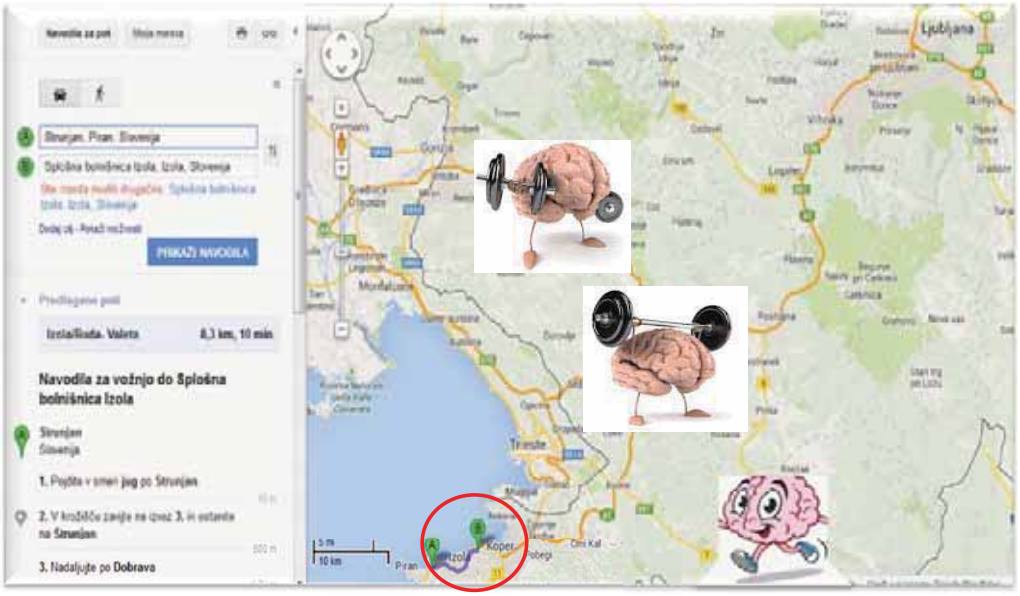
Zdravljenje MK je borba s časom

Vsako uro, ko so možgani brez kisika umre 2 mio živčnih clic



Krajša razdalja, boljši izid bolezni

Prihranimo 1 uro ⇨ 2 mio x 60 min = preživi 120 mio nevronov



Koncept TeleKap

Žvan B.

Slovenska mreža TeleKap

Razvrstitev bolnišnic glede na razpoložjivost nevrologov

- UKCL, UKCM, SB NM, SB CE – nevrolog neprekinjeno 24/7
- 6 mrežnih bolnišnicah – nevrolog 8/5 (telemedicina izven rednega dela)
- 2 mrežni bolnišnici – nevrolog 0/0 (telemedicina)
- UKCL – glavna terciarna bolnišnica; pokriva celotno državo s 24-urno celostno oskrbo, endovaskularno zdravljenje, večina nevrokirurške oskrbe
- EMK – UKCL, UKCM, SB CE

Slovenska mreža TeleKap

Center TeleKap

- @ Telemedicina
- @ „Hotline“ 051 617 330
- @ Dosegljivost 24/7/365
- @ ~ 10 vaskularnih nevrologov

Oddaljeni Center TeleKap – delo od doma

Mobilni telemedicinski voziček v mrežnih bolnišnicah

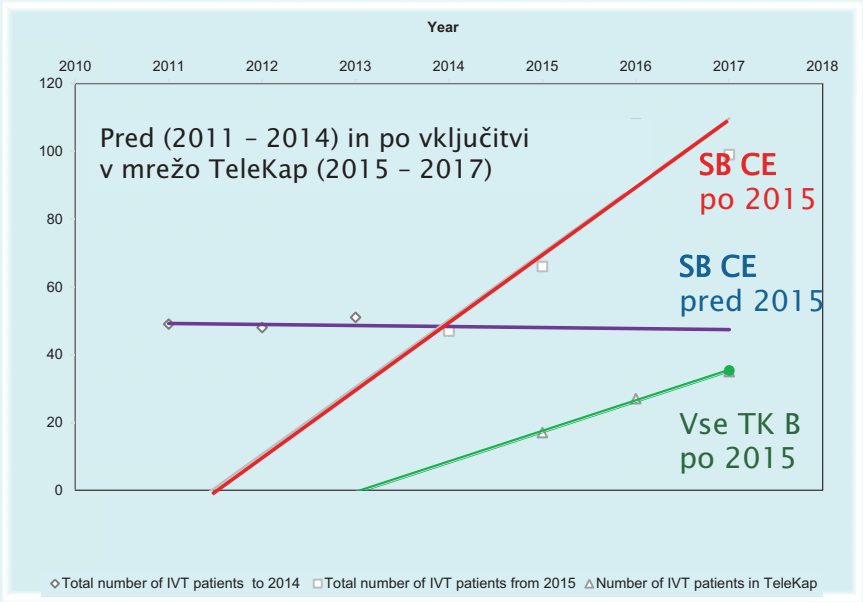
HD videokamera visoke ločljivosti

Potek dela v mreži TeleKap

Deluje po principu 24/7/365

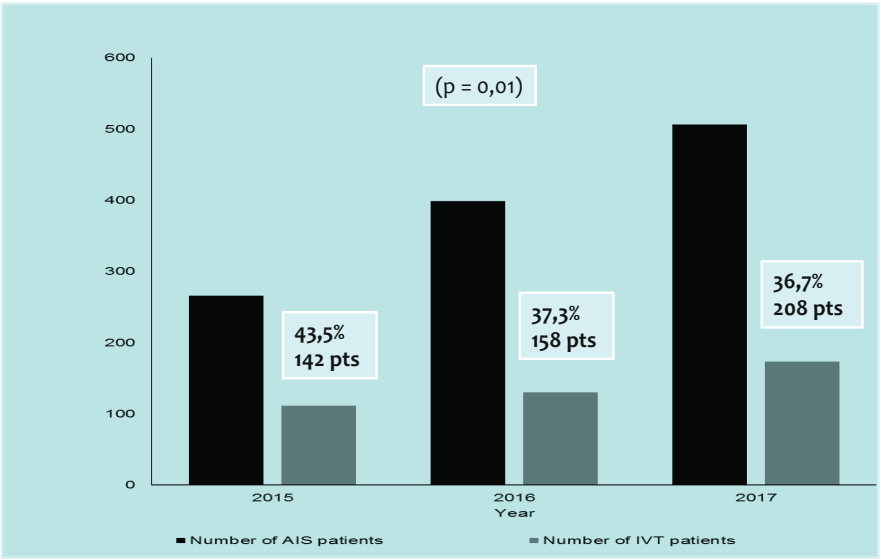
- Telefonski stik
- Zdravnik v mrežni bolnišnici (ni obvezno) zaprosi za telekonzultacijo
- Klinična preiskava preko videokonference v realnem času
- Prenos digitalnih radioloških slik
- Vsaka mrežna bolnišnica zagotavlja hiperakutno oskrbo bolnikov z IMK: telemedicinski kontakt, CT / CTA / (CTP) in izvede IVT, zdravstvena oskrba
- Spremljanje bolnikov preko TeleKapi

Trend IVT v 24/7 MB Celje



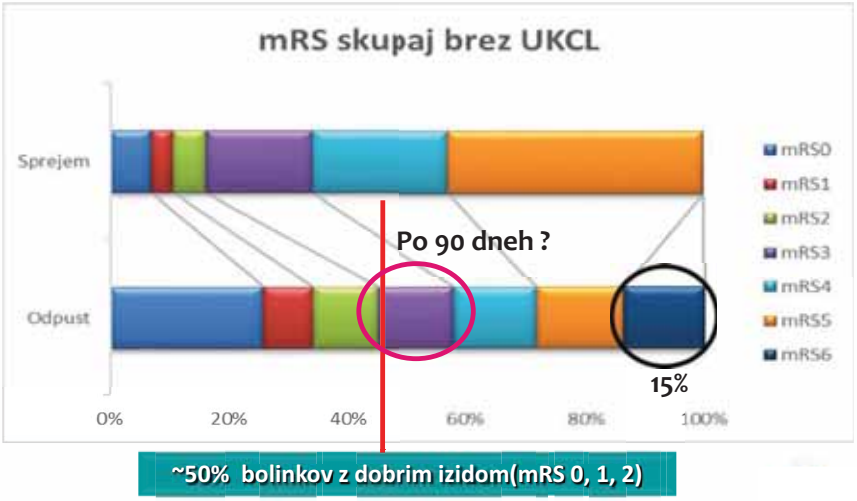
Absolutno št. IVT se je povečalo

Linearna regresija: statistično značilni pozitivni trendi v absolutnem št. IVT bolnikov in absolutnem št. bolnikov z akutno IMK (p = 0,010)



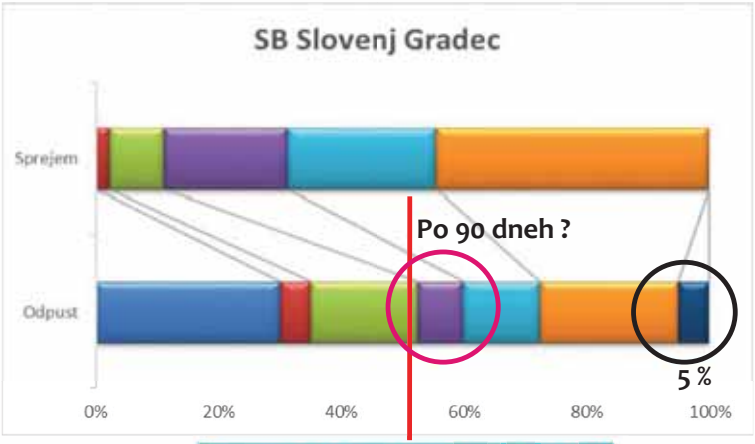
Izidi po IVT v mreži TeleKap

Analiza funkcionalnega stanja bolnikov po lestvici mRS ob odpustu iz mrežnih bolnišnic (mRS 0, 1 in 2 = dober izid)



~50% bolinkov z dobrim izidom(mRS 0, 1, 2)

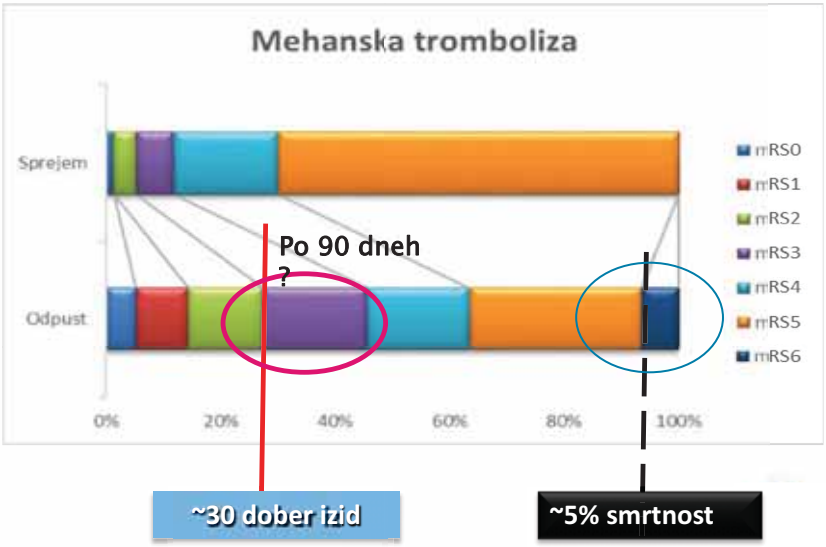
Izidi po IVT v mreži TeleKap – MB SG



>50% z dobrim izidom (mRS 0, 1, 2)

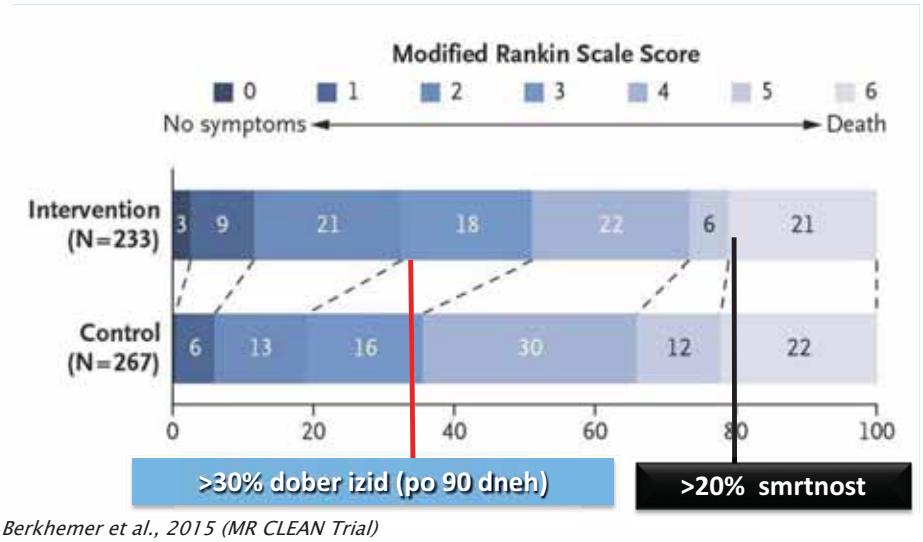
Izidi po MeR v mreži TeleKap

Funkcionalni izid mehanske revaskularizacije
(mRS 0, 1 ,2 – dober izid)



Kje smo z MeR v mreži TeleKap (Mr. Clean)

TeleKap: dobri izidi (mRS 0–2) in >30% po odpustu
(po 90. dneh ?)



Berkhemer et al., 2015 (MR CLEAN Trial)

Razprava

Glavna ugotovitev

- Stalno, postopno povečevanje absolutnega št. B zdravljenih z IVT v mreži TeleKap
- Značilno postopno povečevanje absolutnega št. B z akutno IMK
- Značilna povezava s tele-obravnavo in zdravljenjem z IVT
- Dobri izidi zdravljenja

Ali smo opravičili TeleKap ?

Stroški storitev TeleKap
Prihranki od 2015-2020

»TeleKap“ omrežja = Cilj povečanje št. bolnikov z AIMK zdravljenih z IVT = < invalidnosti, < dolgoročne oskrbe za hospitalizacije, oskrbo na domu ali v negovalni inštituciji
Ocenjeni stroški rehabilitacije 1 bolnika z IMK, ki ne dobi IVT so 60.000 € (svetovno povprečje)
2015–2020 – v omrežju »TeleKap« **1196 bolnikov z IVT**
Rezultati zgodnjega zdravljenja (mRS ob odpustu iz bolnišnice):

- 50 % bolnikov ni potrebovalo dolgotrajne hospitalizacije v akutnih in negovalnih bolnišnicah, rehabilitacijskih ustanovah, nege doma oz. v DSO.
- Umrlo 15 % bolnikov,
- 20 % zmerno prizadetih,
- **15%** huje onesposobljenih – doživljenjska oskrba.

Do konca oktobra 2020 »TeleKap« privarčevala **57.420.000 evrov zaradi zdravljenja z IVT**

57.420.000 evrov

Stroški storitev TeleKap

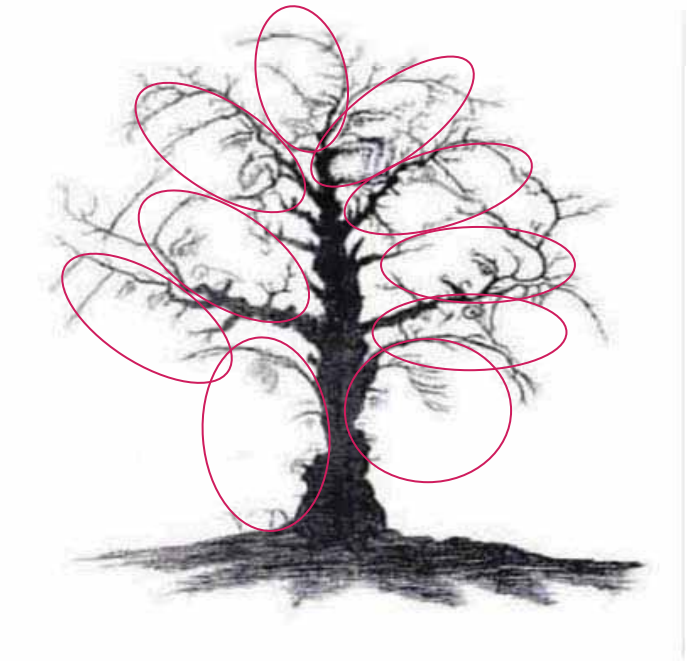
Dodatni finančni prihranki – < št. prevozov bolnikov z AIMK iz regionalnih bolnišnic (ocena povprečnega stroška prevoza 1.500 EUR (svetovno povprečje). Vsaj 80%/5411 bolnikov v mreži TeleKap prevoz v centralno bolnišnico ni bil potreben – prihranek za prevoze bolnikov: 1.500 EUR x 4029 =.

Od začetka leta 2015 do konca oktobra 2020 delovanja mreže TeleKap = prihranek 57.420.000 evrov + 6.043.500 EUR = **63.463.500 EUR**.

Neprestano povečevanje trenda obravnav v mreži TeleKap pomeni, da prihranki zaradi vzpostavitve mreže TeleKap eksponentno naraščajo

63.463.500 EUR

ILUZIJA? REALNOST !!!



Evolucija E-zdravja v 5G

Evolution of eHealth towards 5G

Pavel Kralj
TELEKOM SLOVENIJE

POVZETEK

Vzpostavljamo vertikalo eZdravja ter storitve in tehnologije v smeri infrastrukture 5G. Kako bo 5G vertikalo spremenil ter kaj lahko 5G ponudi industriji in posledično poveča zahteve glede zanesljivosti, SLA in kibernetske varnosti.

SUMMARY

Building the eHealth vertical and services and technology towards the 5G infrastructure. How a 5G is going to modify the vertical and what 5G could offer to the industry and subsequently increase the reliability, SLA and cyber security requirements.

O AVTORJU

Pavel Kralj se je leta 2008 pridružil družbi Mobitel, prvemu slovenskemu mobilenmu operaterju. Oddelku za storitve z dodano vrednostjo se je pridružil kot analitik in arhitekt. Bil je vključen v načrtovanje in razvoj portalske platforme za izdelavo portalov za mobilne terminale. Leta 2013 se je kot analitik in arhitekt pridružil oddelku za načrtovanje jedrnih sistemov. Danes je v Telekomu Slovenije vključen v strateško planiranje ter raziskave in razvoj.

ABOUT THE AUTHOR

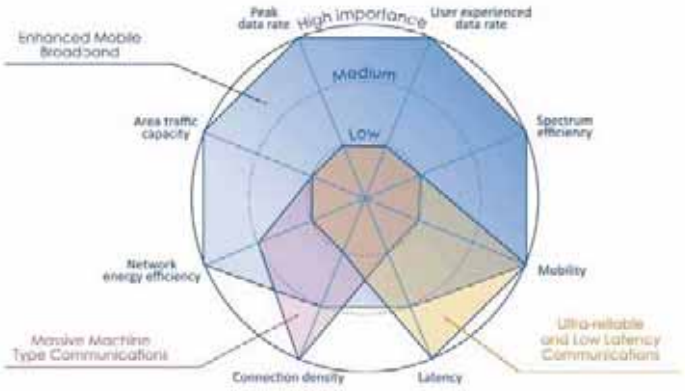
Pavel Kralj joined Mobitel, the first Slovenian mobile operator, in 2008. He joined the Value-Added Services Department as an analyst and architect. He was involved in the design and development of a portal platform for the creation of portals for mobile terminals. In 2013, he joined the Core Network Department as an analyst and architect. Today, he is involved in strategic planning and research and development at Telekom Slovenije.

Evolucija E-zdravja v 5G

TelekomSlovenije

5G

- Enhanced mobile broad band - eMBB
- Massive machine type communication - mMTC
- Ultra reliable low latency - URLLC



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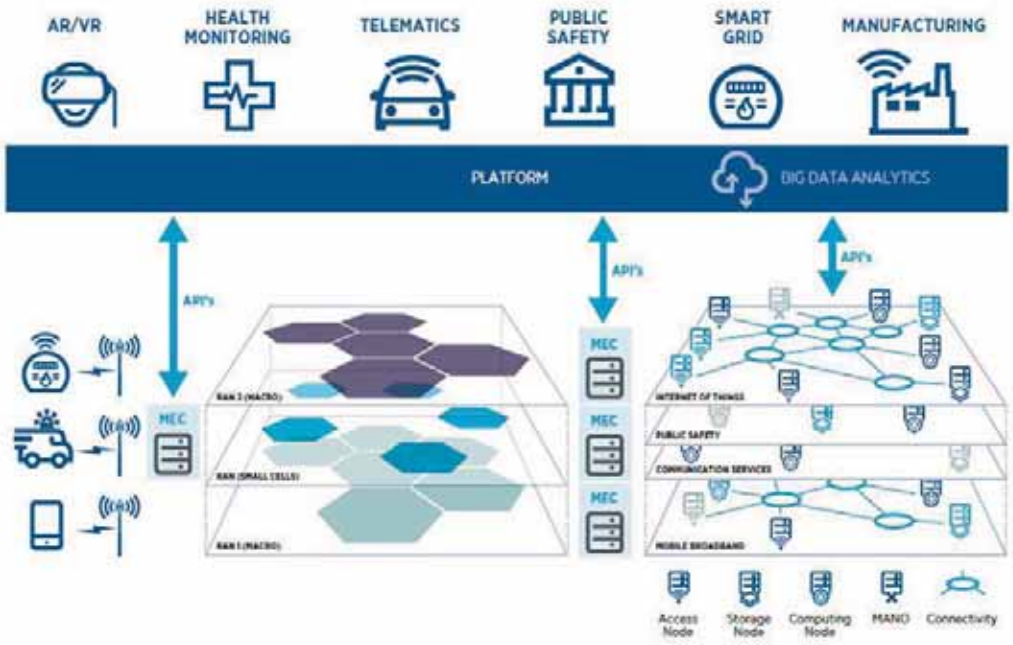
5G – platforma za vertikale



3 Evolucija E-zdravja v 5G

TelekomSlovenije

E-zdravje

E-oskrba

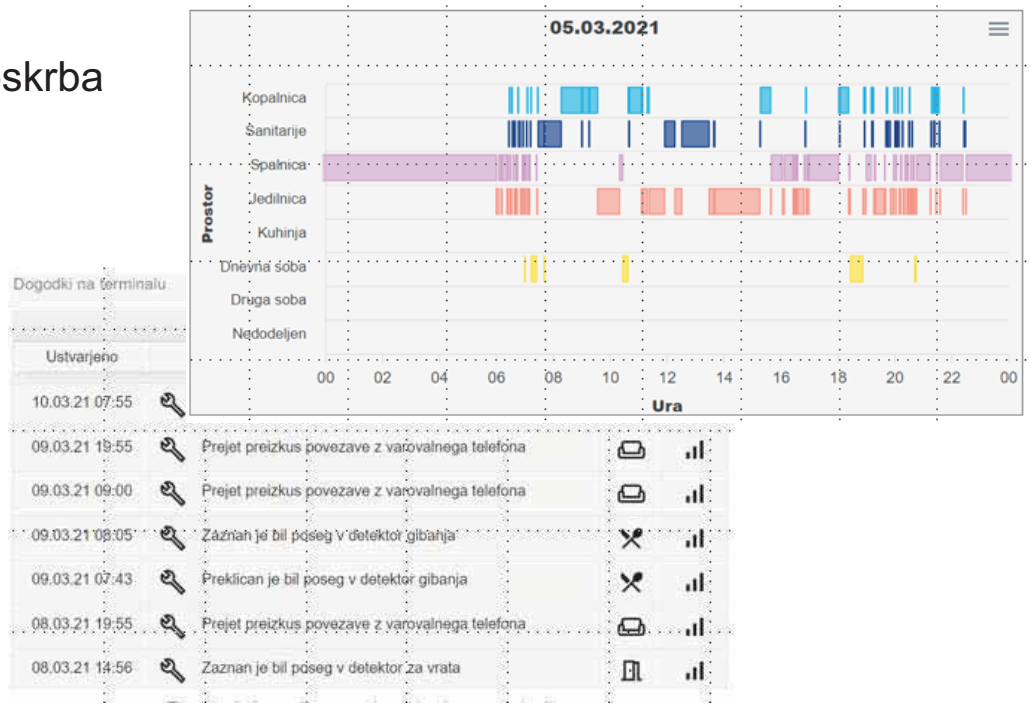
- 24-urna prisotnost pomoči za oskrbovance – asistenčni center
- Spremljanje alarmov, zaznava padca,
- Spremljanje aktivnosti oskrbovancev, graf aktivnosti
- Tehnični alarmi in odprava napak

4 Evolucija E-zdravja v 5G

TelekomSlovenije

E-zdravje

E-oskrba



TelekomSlovenije

E-zdravje

Vitalne funkcije

- Vitalne funkcije omogočajo stalno spremljanje in merjenje vitalnih funkcij ter drugih zdravstvenih parametrov na daljavo.
- Razbremenitev zdravstvenega osebja
- Ažurno in učinkovito spremljanje bolnikov
- Zmanjšanje števila obiskov bolnikov

TelekomSlovenije

E-zdravje

Varnost

- Dostopnost naprav in tudi sistema, sistemov

Zanesljivost

- Prioretizacija glede na ostale storitve na javni infrastrukturi

Masovnost

- Veliko število naprav, ki komunicirajo proti omrežju

TelekomSlovenije

E-zdravje danes

Varnost

- Skupna javna infrastruktura
- Privatno omrežje na nivoju APN-ja

Zanesljivost

- Skupna javna infrastruktura
  - Jedrno omrežje
  - Radijsko omrežje

Masovnost

- Namenjeno „malemu“ številu naprav
- Promet v smeri proti uporabniku

TelekomSlovenije

E-zdravje v 5G

Varnost

- Varno zasebno omrežje na javni infrastrukturi.
- Kontrolirana povezljivost terminalnih naprav
- Znani in predvidljivi podatkovni tokovi, enostavnost detekcije odstopanj

Zanesljivost

- Prioretizacija na nivoju virtualne infrastrukture - prometa in sredstev
- Licenčni frekvenčni prostor, operatersko načrtovanje kapacitet

Masovnost

- Pričakovano veliko število naprav, ki komunicirajo proti omrežju
- Povezljivost perifernih enot z omrežjem direktno - aplikacija
- Enotno upravljanje končnih naprav.

TelekomSlovenije

E-zdravje v 5G

- 5G je zelo dobra platforma za vertikalo E-zdravje, horizonala, ki omogogoča učinkovito upravljanje zanesljivosti in cyber varnosti.

TelekomSlovenije

Podporniki

Sponzors

ZLATI / GOLDEN

ISKRATEL

S&T Group

SREBRNI / SILVER

HUAWEI

TelekomSlovenije

BRONASTI / BRONZE

ERICSSON

ZNANSTVENI / SCIENTIFIC

Univerza v Ljubljani
Fakulteta za elektrotehniko

Univerza v Mariboru
Fakulteta za elektrotehniko, računalništvo in informatiko

FUTURE NOW

Digitalizacija industrije z močjo zasebnih omrežij 5G

Z uvajanjem najsodobnejših tehnologij in izvajanjem nizko tveganih migracij, Iskratel že vrsto let pomaga svojim strankam v telekomunikacijskem in industrijskem sektorju preiti na naslednji nivo poslovne preobrazbe

Telco Industry

Railroads and Transport Industry

Electricity Distribution and Energy

PPDR, 5G Safety and smart cities

Smart Manufacturing

www.iskratel.com

ISKRATEL
S&T Group

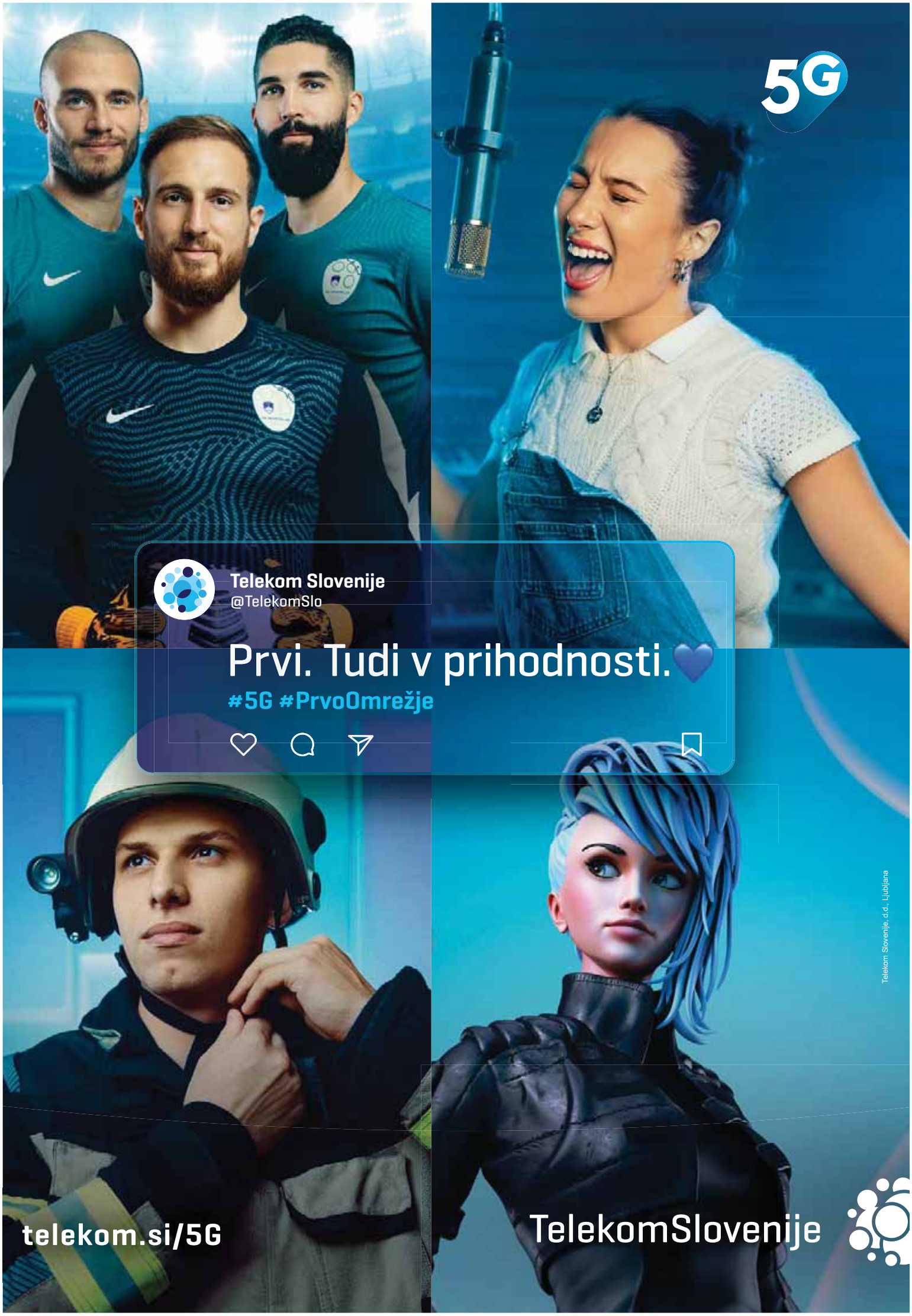
Ustvarjamo popolnoma povezan, pametni svet

HUAWEI IdeaHub

Nov stil Pametna pisarna

3 v 1 Tabla | Projektor | Spletni sestanek

HUAWEI


5G
Telekom Slovenije
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Prvi. Tudi v prihodnosti.
#5G #PrvoOmrežje
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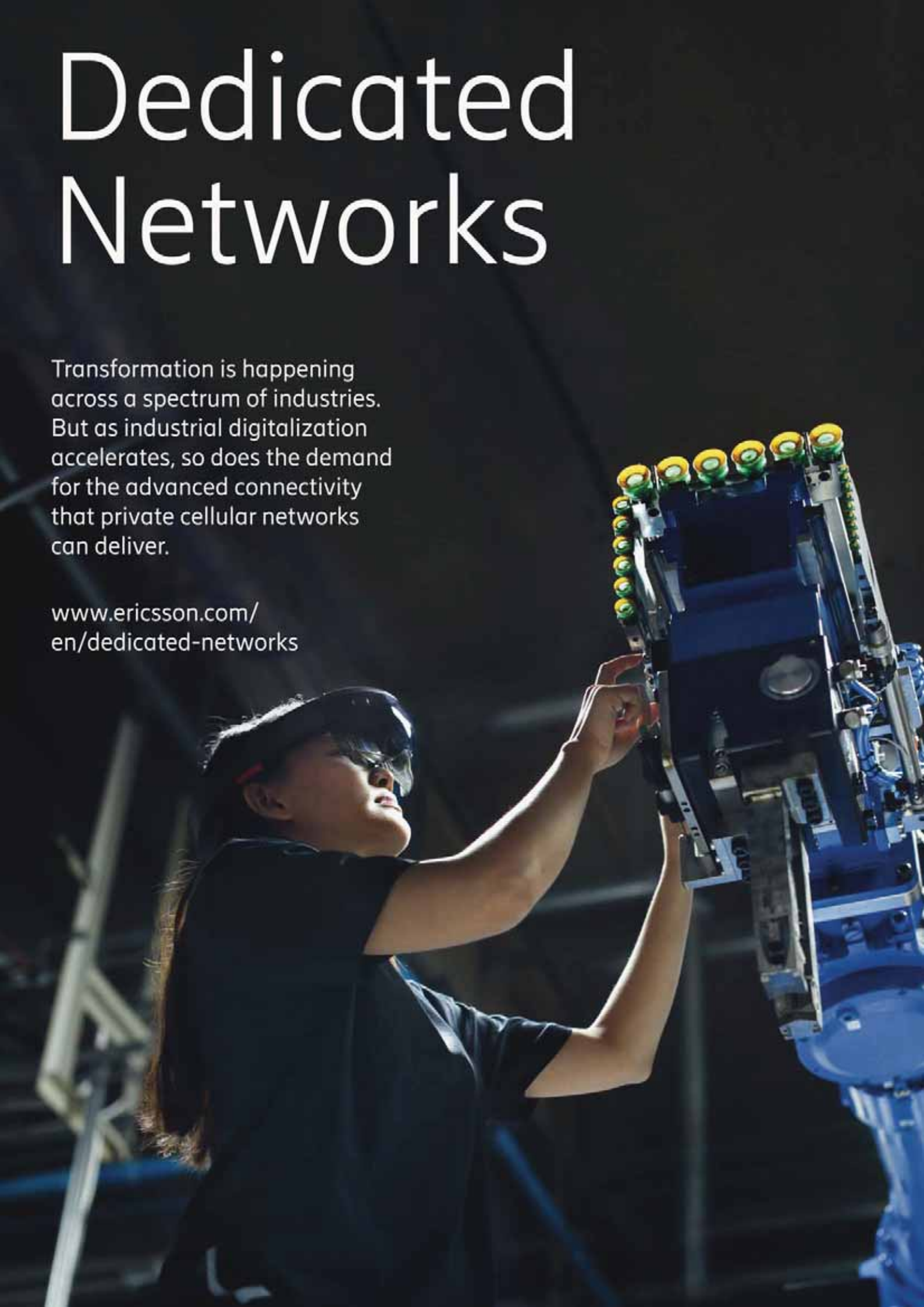
Telekom Slovenije, d.d., Ljubljana

Dedicated Networks

Transformation is happening across a spectrum of industries. But as industrial digitalization accelerates, so does the demand for the advanced connectivity that private cellular networks can deliver.

www.ericsson.com/en/dedicated-networks



Slovensko društvo za elektronske komunikacije
Elektrotehniška zveza Slovenije