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5G Varnost

5G PPDR from the telco perspective

Peter Zidar, Telekom Slovenije

5G Safety Workshop, Bled, 14.12.2018

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Naložbo financira Republika Slovenija in Evropska unija iz Evropskega sklada za regionalni razvoj.

REPUBLIKA SLOVENIJA MINISTRSTVO ZA IZOBRAŽEVANJE, ZNANOST IN ŠPORT

EVROPSKA UNIJA EVROPSKI SKLAD ZA REGIONALNI RAZVOJ NALOŽBA V VAŠO PRIHODNOST

Topics

1. Telekom Slovenije
2. Development of 5G mobile networks
3. EU project NEXES
4. Prioritization and pre-emption functions of mobile network

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Presence in the Region

The Telekom Slovenije Group is among the most comprehensive communication service providers in South- Eastern Europe. In addition to being the national telecommunications operator in Slovenia, it also operates through its subsidiaries on the markets of SEE, including Kosovo, Bosnia and Herzegovina, Croatia, Serbia, Montenegro and Macedonia.

We are not classic telco company focused only on fixed-mobile mass market – we are more and more also system integrator, provider of ICT and IoT solutions for business critical communications (MLAN, MPLS, Infranet, ECS, Cybersec) as well as PPDR type of communications. We have always (also through research projects) enabled advanced emergency services (eCall,eHeero). We are managing over 12.000 SLA.

We have ISO27001 and ISO22301 for Information security management.

We successfully handled sleet (freezing rain) natural disaster.

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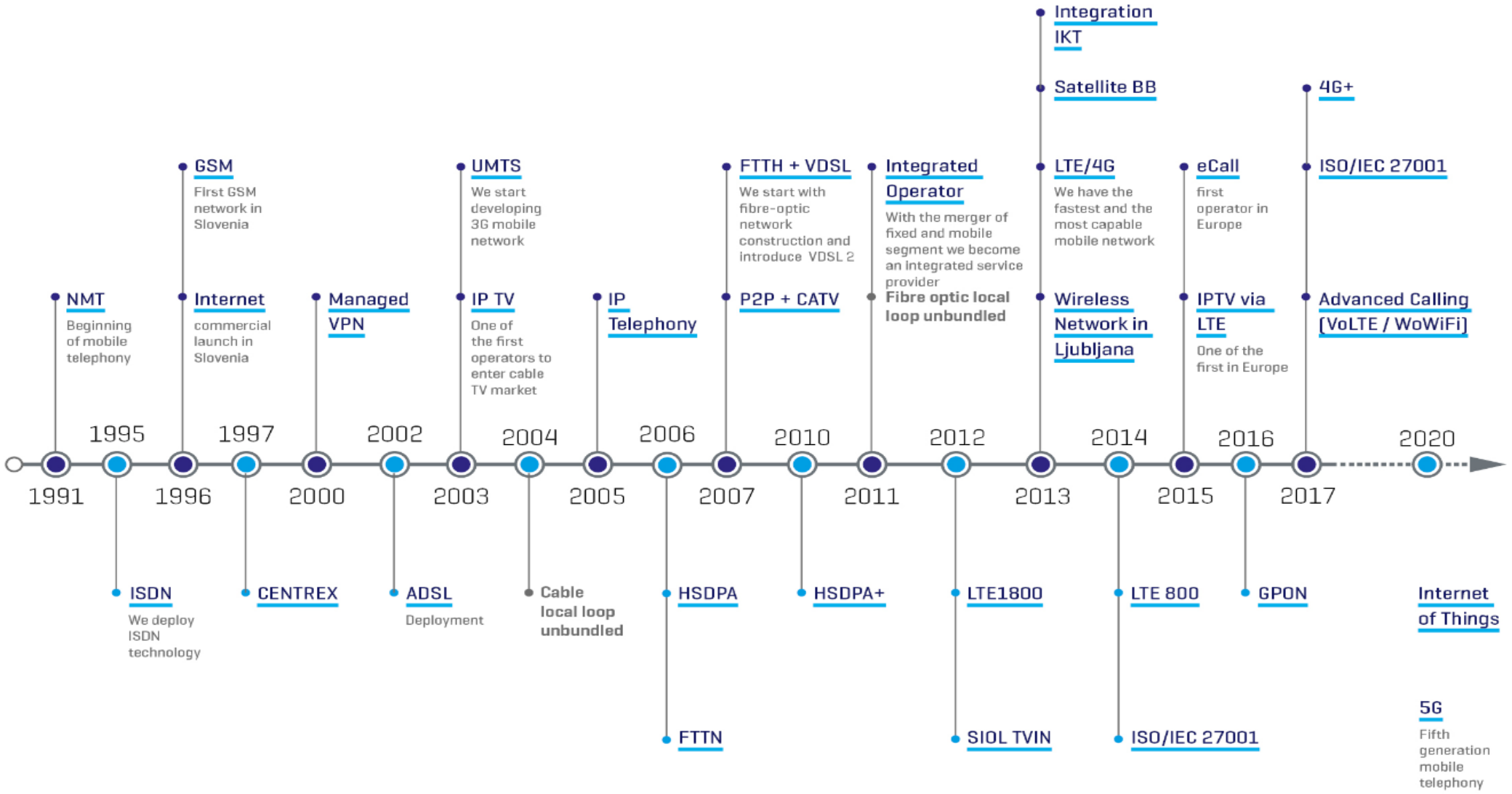
Deployment of Telekom Slovenije Network & Services



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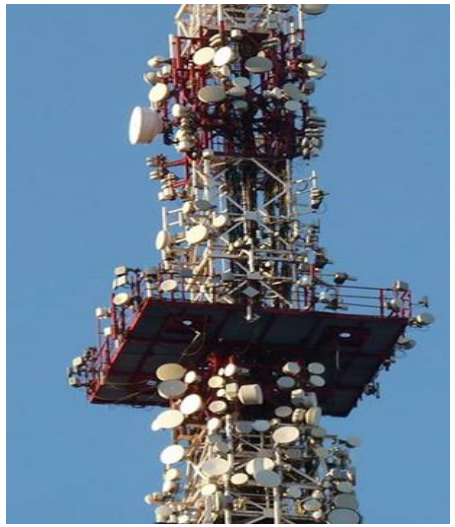
Development of 5G mobile networks

TelekomSlovenije

LTE-Advanced (4G+)

- Data transfer speed 1 Gbps and beyond (1.2 Gbps - LTE CAT18 Huawei P20)
- Backward compatible with LTE
- Up to 8X8 MIMO and 128 QAM
- Coordinated multipoint (CoMP) transmission and reception
- Improved performance at cell edge
- Multicarrier (up to 100 MHz of spectrum)
- Latency above 1ms



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Mobile data traffic is increasing

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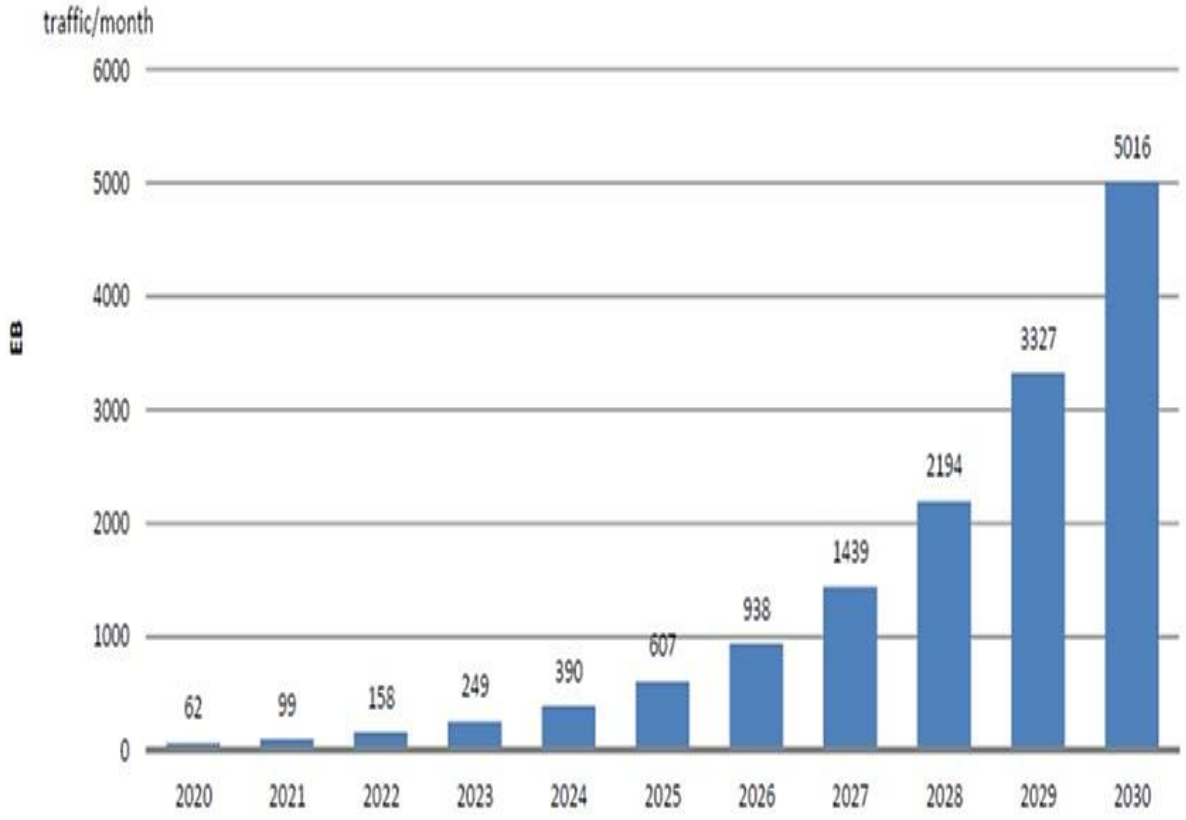
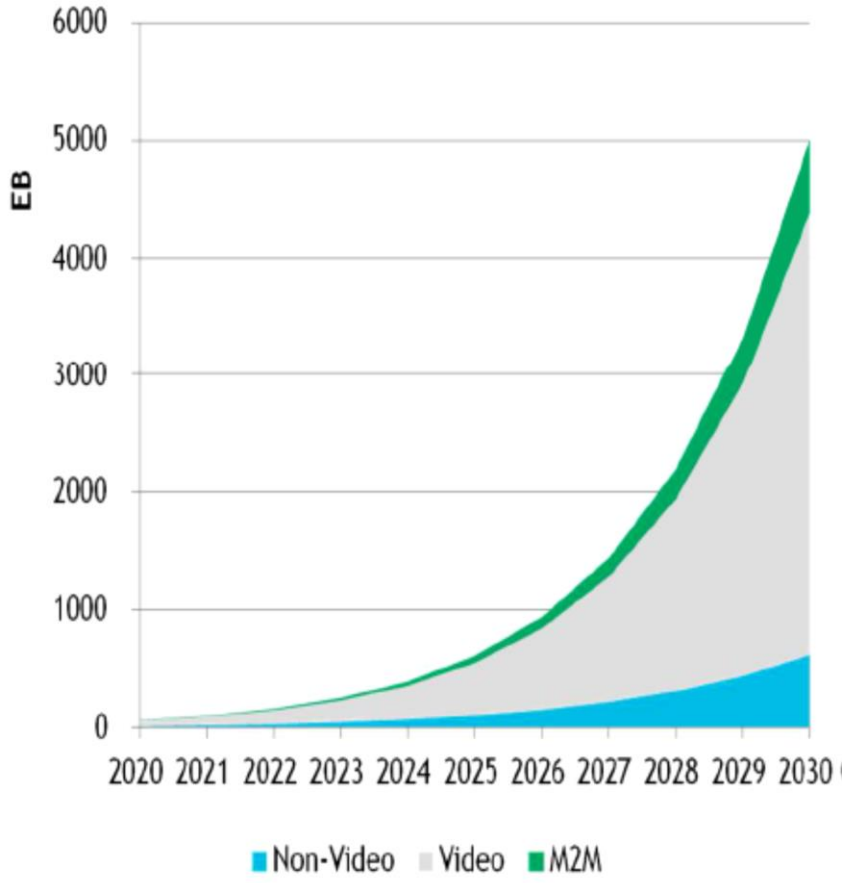
Global Growth of Data Traffic in Mobile Networks





Source: ITU, Alcatel-Lucent

In 2023, 20 percent of mobile data traffic will be carried by 5G networks (Ericsson)

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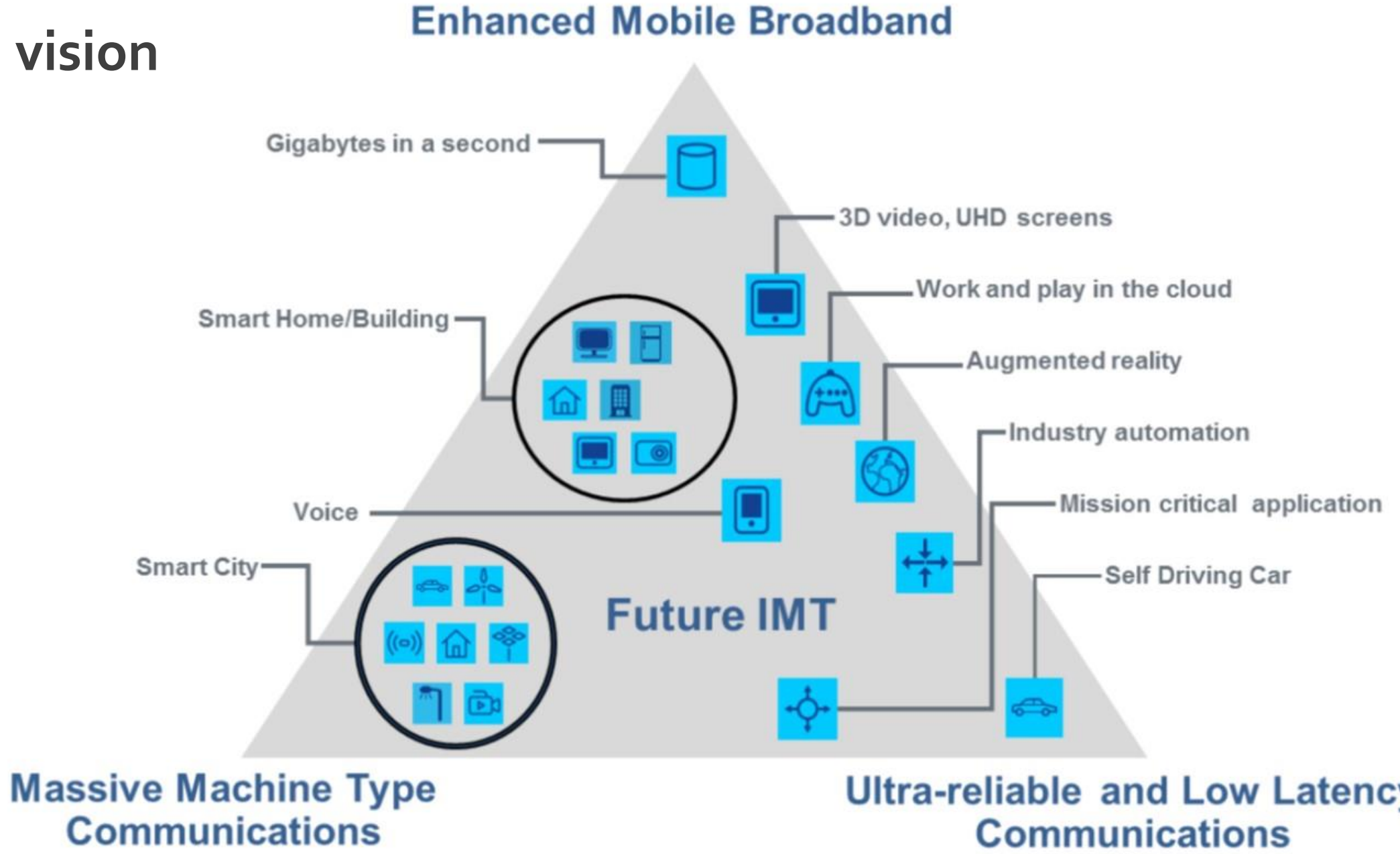
5G vision



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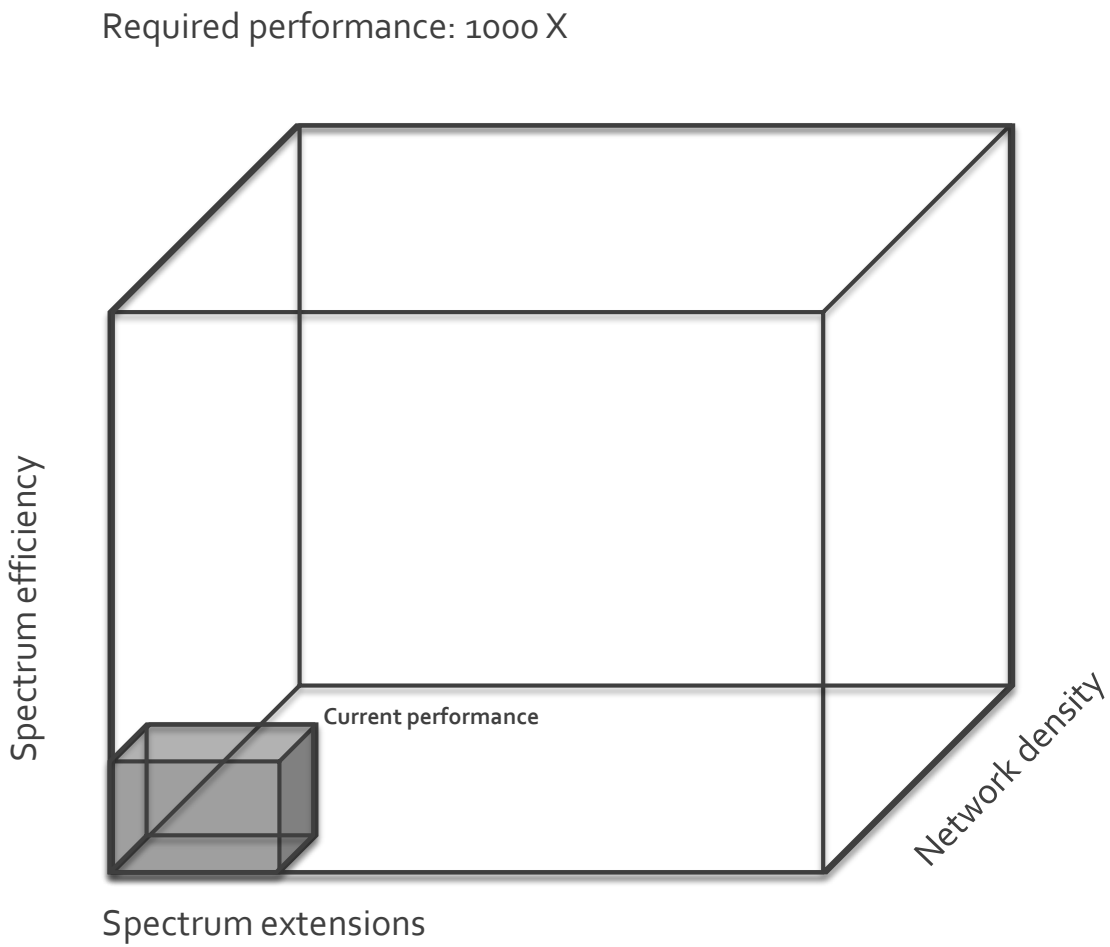
Performance Improvements by 5G

- Spectrum efficiency (6 X)
  - Massive MIMO…
- Spectrum extensions (3 - 10 X)
  - 700 MHz, 3.4-3.8 GHz, 24.25 – 27.5 GHz, 60 GHz
- Network density (16 - 56 X)
  - Small cells



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5G

Improvements:

- Massive MIMO
- High frequency bands (e.g. 6 - 100 GHz)
- Ultra dense small cells networks
- 3D MIMO
- Cloud RAN
- Cognitive radio
- NFV
- All-IP networks

Expected results:

- Reaching beyond 10 Gbps
- Latency less than 1 ms
- Energy-per-bit should be reduced by factor 1000
- Billions of connected devices

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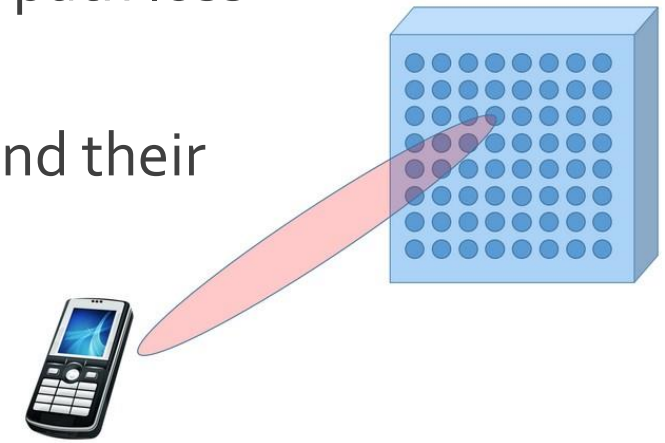
Massive MIMO - Technology for Higher Frequency Bands

- Can have more than 100 antenna elements
- Very narrow beam-forming (single user) – compensate for path loss at a higher frequency
- Higher frequency antenna elements can be miniaturized and their number can be increased
- Less need for additional small cell sites
- Less power needed – reducing OPEX
- Useful at frequency bands above 10 GHz
- At 40 GHz an antenna array consisting of 512 elements could be packed into a roughly 10X10-cm area



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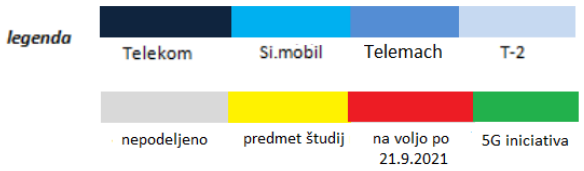
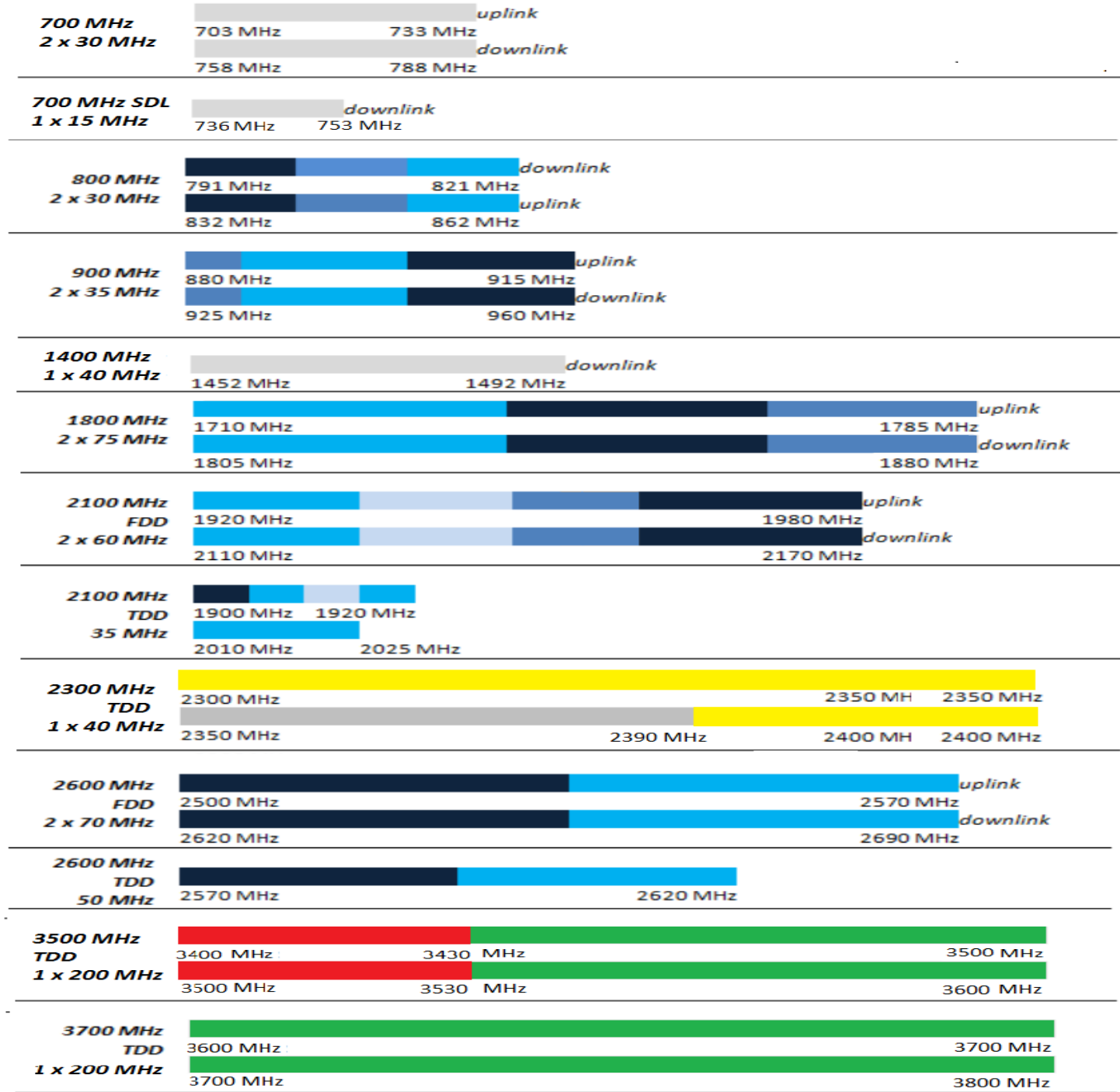
Mobile spectrum

Band
700 MHz (694- 790 MHz)
800 MHz (790-862 MHz)
900 MHz (880-915 MHZ /925-960 MHz)
1452-1492 MHz
1.8 GHz (1710-1785 MHz/1805-1880 MHz)
2 GHz (1920-1980MHz/210-2170 MHz)
2.3-2.4 GHz
2.6 GHz (2500-2690 MHz)
3.4-3.8 GHz





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New frequency space

Current focus is in the frequency bands 24.25-27.5 GHz, 31.8-33.4 GHz and 40.5-43.5 GHz

Agenda item (1.13)
24.25-27.5 GHz
31.8-33.4 GHz
37-40.5 GHz
40.5-42.5 GHz
42.5-43.5 GHz
45.5-47 GHz
47-47.2 GHz
47.2-50.2 GHz
50.4-52.6 GHz
66-76 GHz
81-86 GHz

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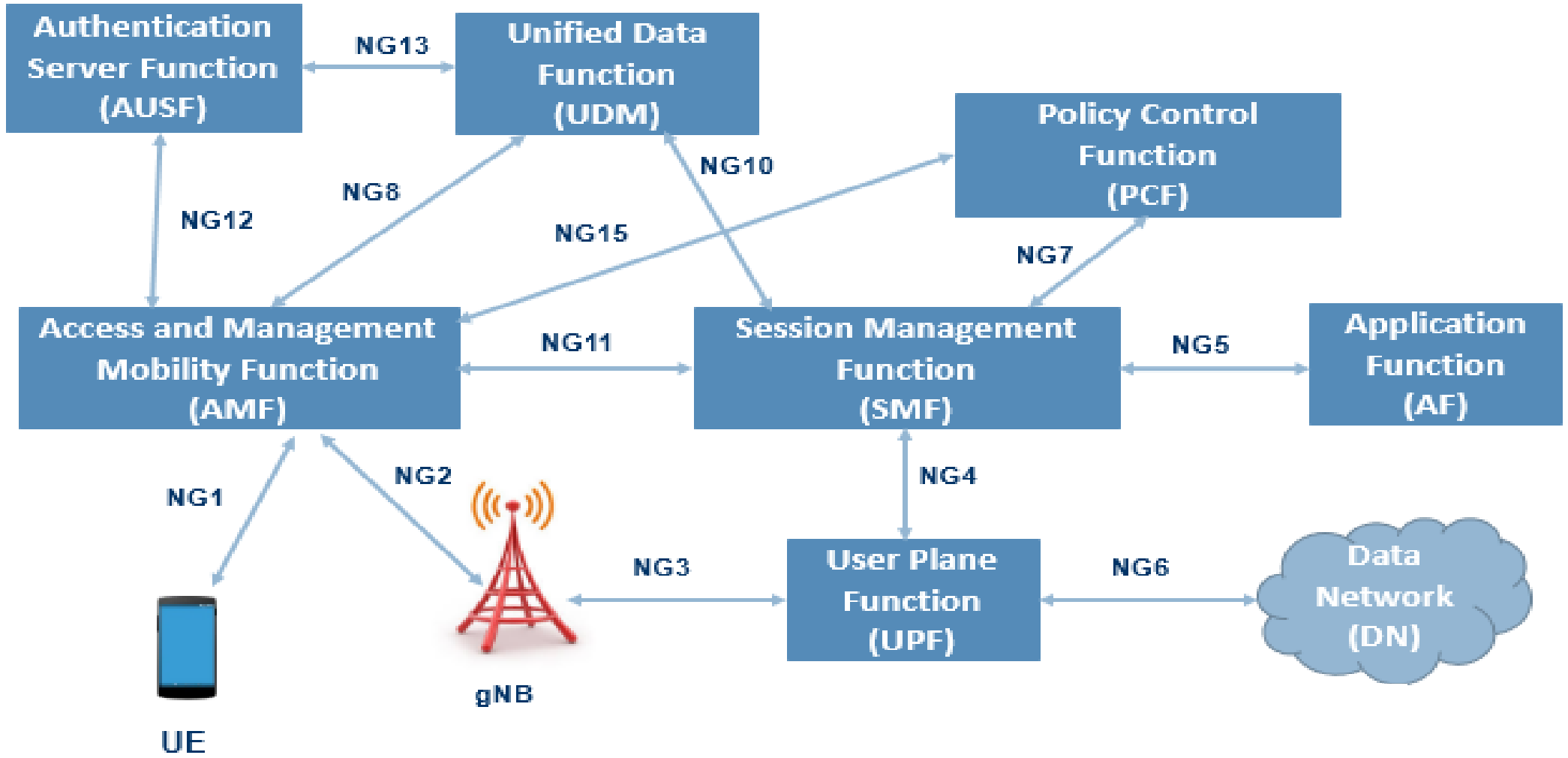
5G Reference Network Architecture according to 3GPP



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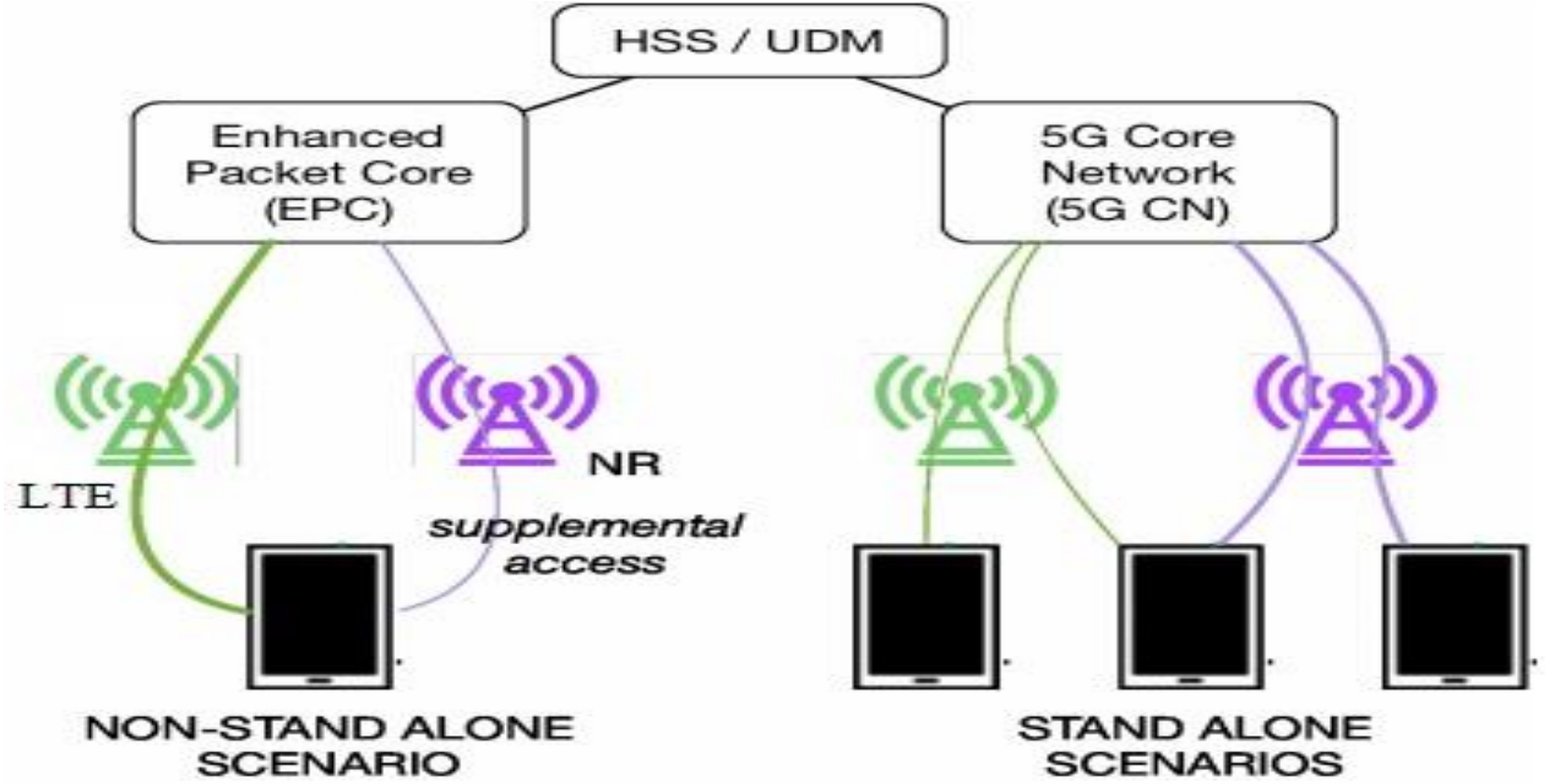
5G: Non-Standalone vs. Standalone



Freeze of 5G Non-Standalone (NSA) specifications in March 2018
Freeze of 5G Standalone (SA) specifications in September 2018

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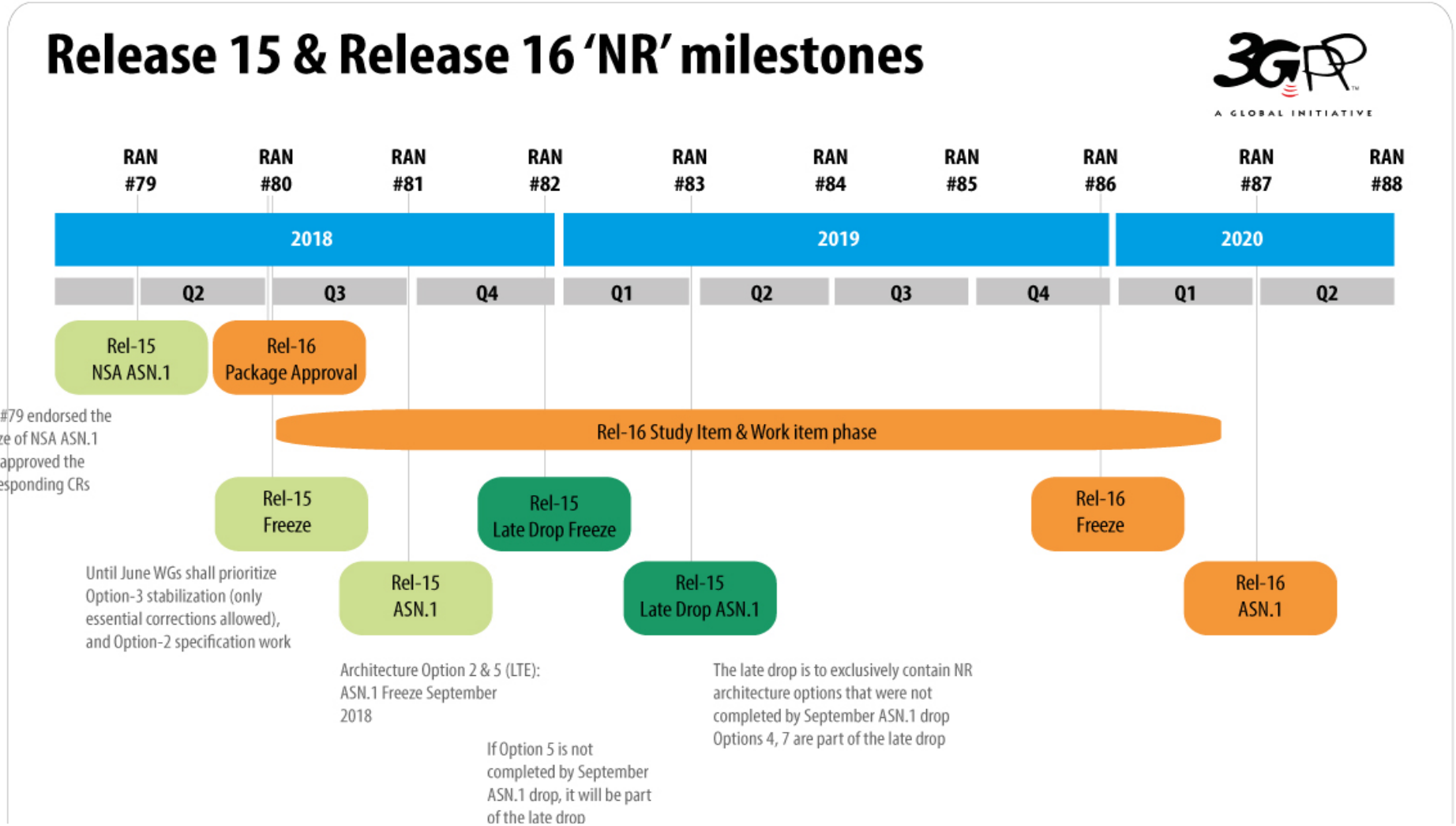
Standardization status - Release 15 and 16



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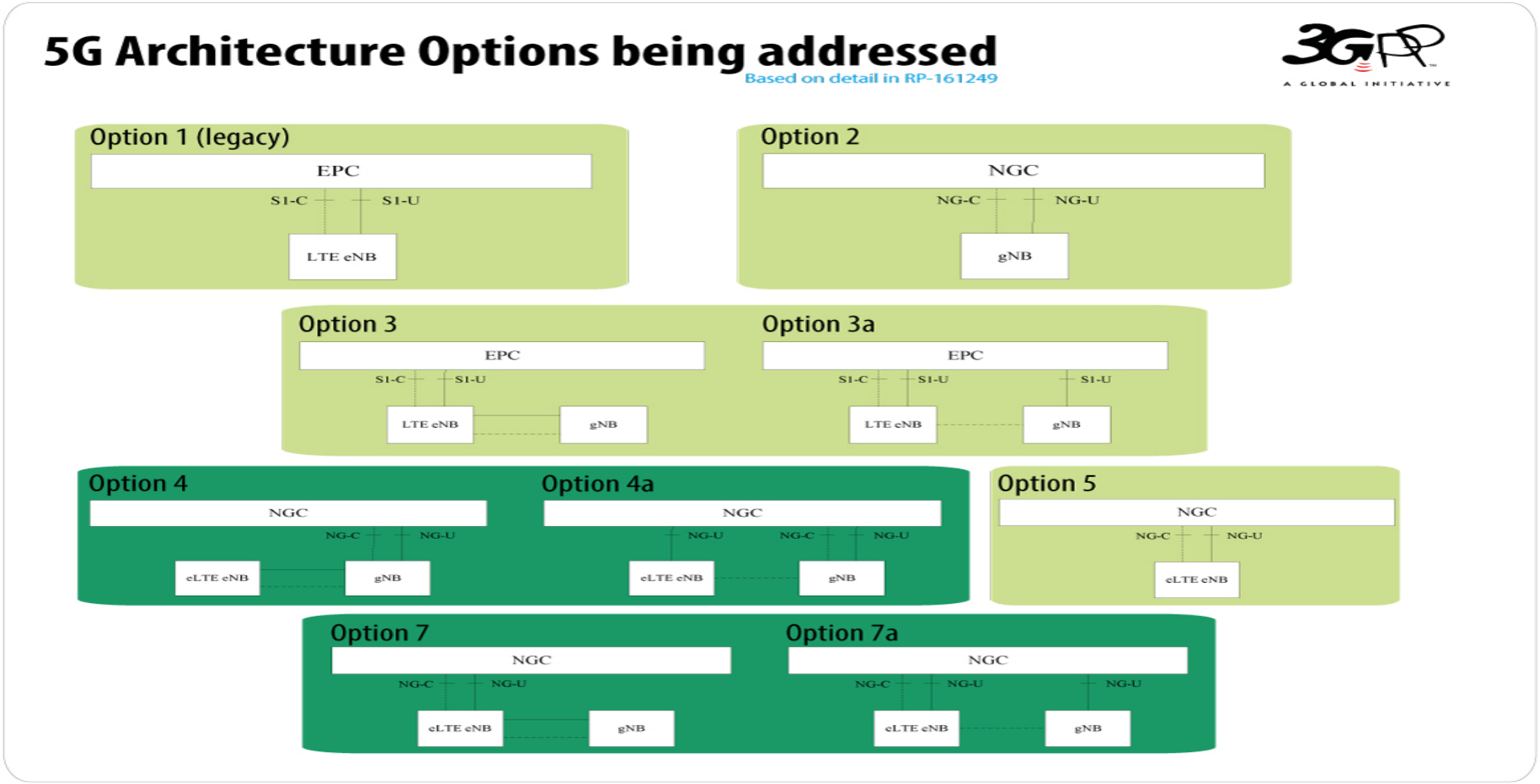
5G Options



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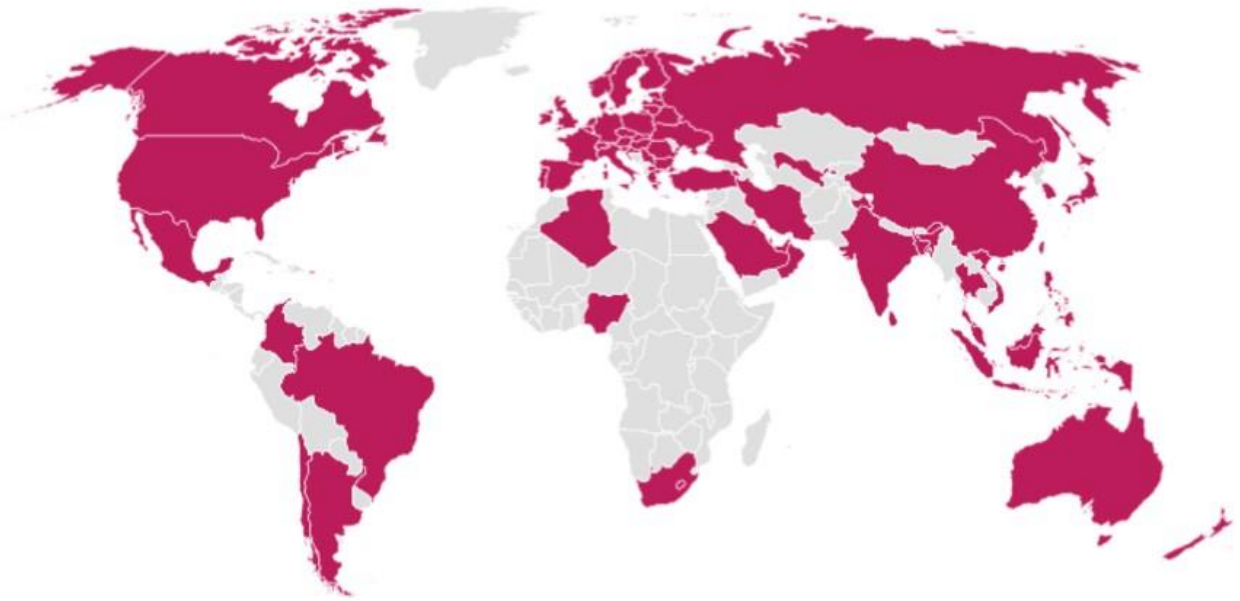
5G progress worldwide

- 524 separate 5G demonstrations
- Key 5G technologies being explored:
  - new radio (NR) interfaces operating in spectrur bands not previously used for mobile telecoms services
  - network slicing to support delivery of services tailored to specific types of customer
  - technologies such as massive MIMO
  - complex beam-forming that are needed to achieve very high speeds
  - backhaul, cloud- and edge-computing arrangements to support very low latencies.



Countries investing in 5G (source GSA)
192 operators in 81 countries

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5G launch

- December 1st commercial 5G services in Korea - Mobile router. LG Uplus deployed more than 4,000 base stations to support services in the greater Seoul area. 5G smartphones "after March" 2019.

Other worldwide operators claiming to be first in 5G:

- Verizon is using non-standard 5G for fixed-wireless access services
- Etisalat, STC and Ooredoo stated they had launched 5G in their respective home markets of UAE, Saudi Arabia and Qatar
- Elisa in Finland/Estonia claim it has the first commercial 5G terminal devices.
- 5G was introduced during World Cup in Russia

Confusion on marketplace what 5G really is and what it can deliver

Lack of devices for paying customers

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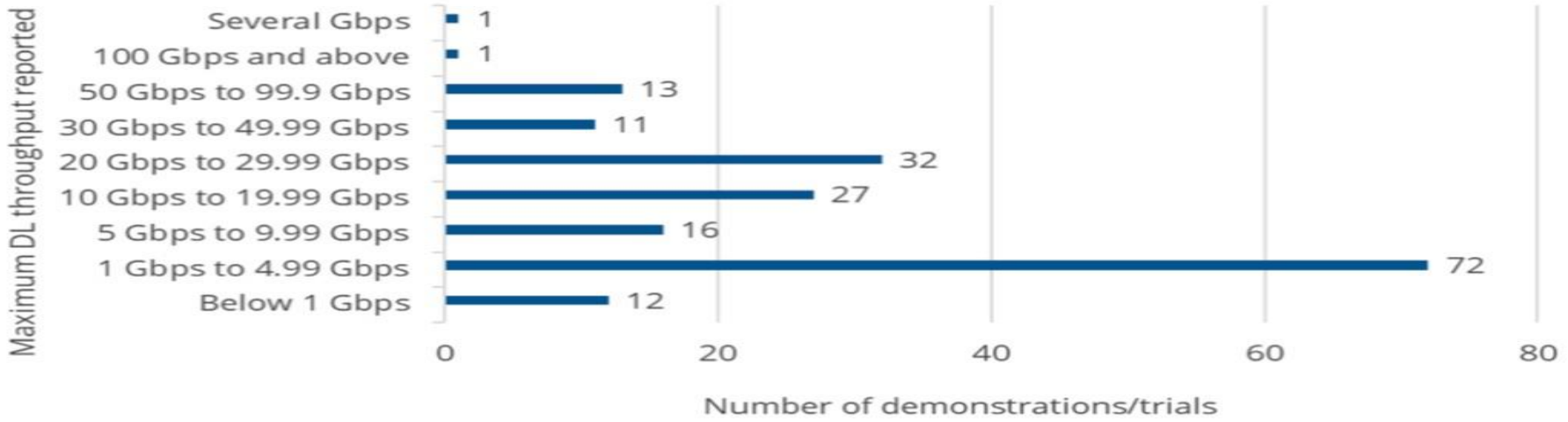
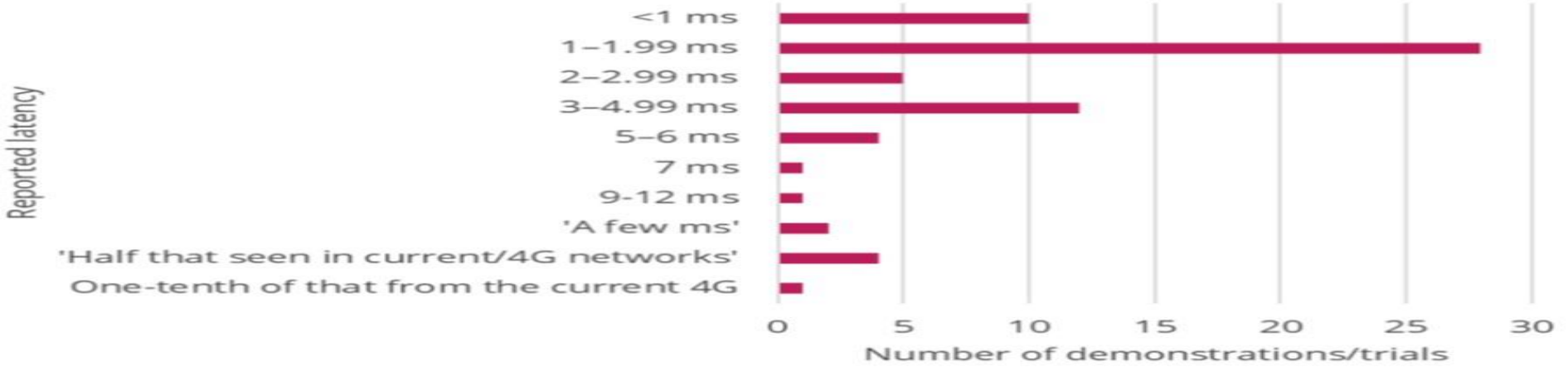
5G performance so far





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IoT in 5G: Smart Cities

- **Smart Transportation**: 5G will enable real-time collection of massive amounts of data from vehicles, drivers, pedestrians, road sensors and cameras to help streamline traffic flow.
- **Smart Buildings**: 5G-connected sensors/actuators can help optimize building temperature, humidity and lighting based on current activities inside them. They will also enable buildings to detect when hidden pipes and cables need repair, when unauthorized access takes place, when office supplies are running low and even when garbage bins are full.
- **Smart Home**: Examples include the transmission of home security alarms and home surveillance video data to commercial monitoring stations.

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IoT in 5G: Automotive

- **Vehicular Internet/Infotainment**: Typical infotainment options include video, audio, Internet access and upcoming applications such as augmented reality and heads-up displays.
- **Pre-Crash Sensing and Mitigation**: Pre-crash sensing enables vehicles to sense imminent collisions and exchange relevant data among vehicles involved, allowing vehicles and drivers to take counter-measures to mitigate the impact of the collision.
- **Cooperative Vehicles**: Cooperative vehicles use Vehicle-to-Vehicle and Vehicle-to-Infrastructure communications to safely operate vehicles as a self-driving car train on a highway in order to improve highway capacity, reduce occurrence of driver error and achieve better fuel economy.
- **Inter-Vehicle Information Exchange**: Peer-to-peer inter-vehicular communication using D2D cellular technology under the guidance of the operator policies can allow vehicles to communicate information related to road safety and traffic congestion directly in a mesh fashion, thus offloading data from the traditional RAN infrastructure.

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IoT in 5G: Improved Public Safety

- Telekom Slovenije participated in 6inACTION (GEN6) project - mobile control centre connected by LTE and Satellite, and also took part in the NEXES (H2020) project.
- Quick exchange of information necessary for response plan;
- Wireless head-mounted display, camera and computer;
- Officers can see same images, video and maps simultaneously;

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IoT in 5G: Improved Public Safety

- M-Health and Telemedicine;
- IoT sensor networks;
- Drones – comunicating over large distance through 5G network, sending multimedia data, offering assistance, sharing elevated viewpoint

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EU project NEXES

The NEXES RIA

Action full title	NEXt generation Emergency Services
Action acronym	NEXES
Type of Action	Research and Innovation Action
Work Programme	DRS 19-2014: Communication technologies and interoperability
Topic	Topic 2: Next generation emergency services
Grant Agreement No.	653337
Start Date – End Date	May 1 2015 – April 30 2018

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The NEXES Consortium

17 Partners / 11 Countries:

- 7 End-users
- 4 SMEs
- 4 Industries
- 2 Universities

Partners Expertise:

- Emergency Services
- Training Organisation
- Civil Society Organisation
- Telecommunications Network Operators
- Technology/Software Developers
- Academia

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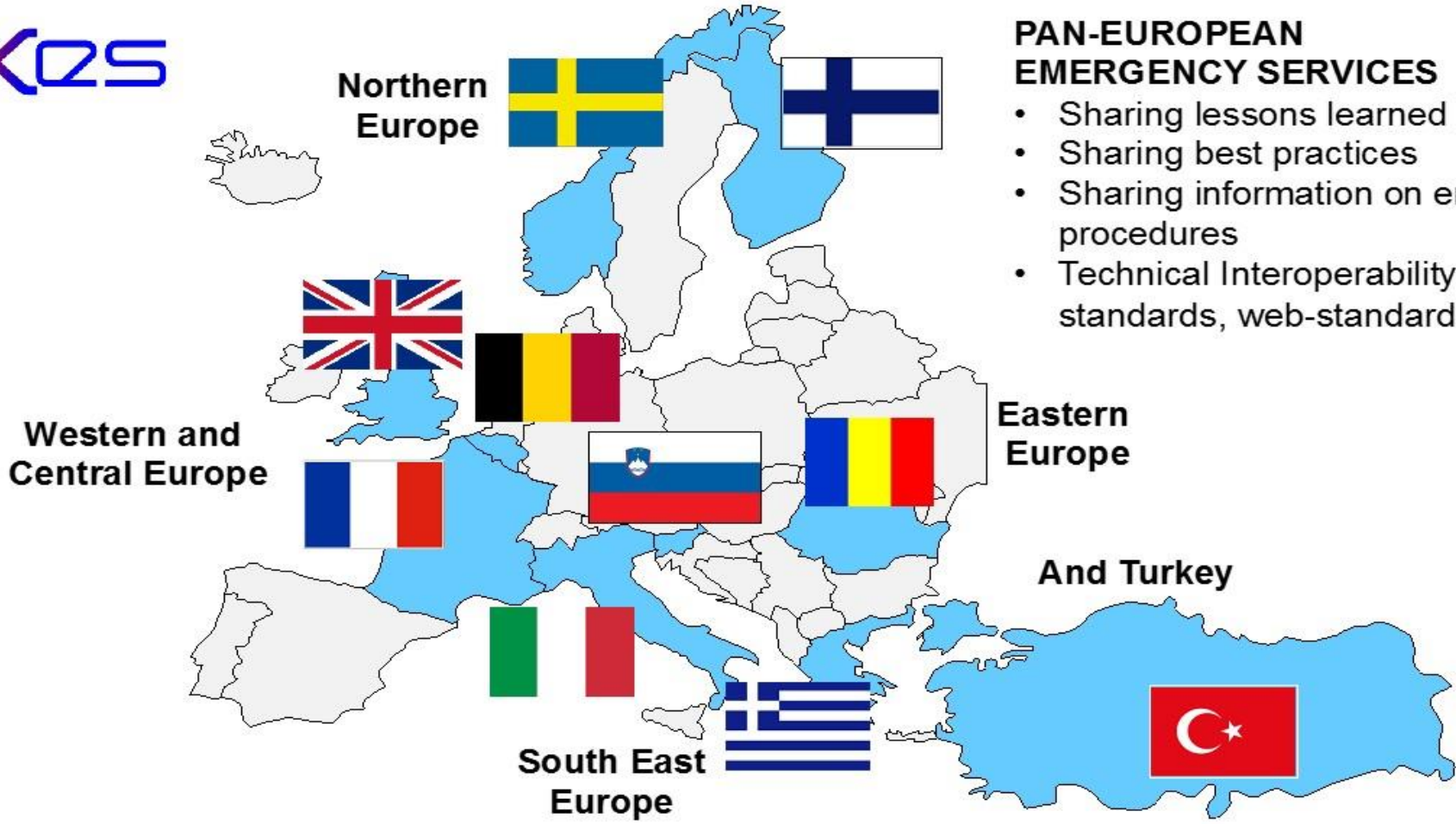
The NEXES Consortium



PAN-EUROPEAN EMERGENCY SERVICES

- Sharing lessons learned
- Sharing best practices
- Sharing information on emergency procedures
- Technical Interoperability: Internet standards, web-standards, CAP, …)

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The NEXES Context

Identified emergency services' problems to solve:

- Reliance on voice calls
- Poor accessibility to deaf/hard-of-hearing citizens
- Poor accessibility to non-nationals (no multi-language support to tourists or early migrants)
- Difficulty on accurate location (namely in remote areas)
- Impossibility to send additional relevant data (such as health or medical information)
- Impossibility to answer to automated emergency calls (eCall, smart sensors)

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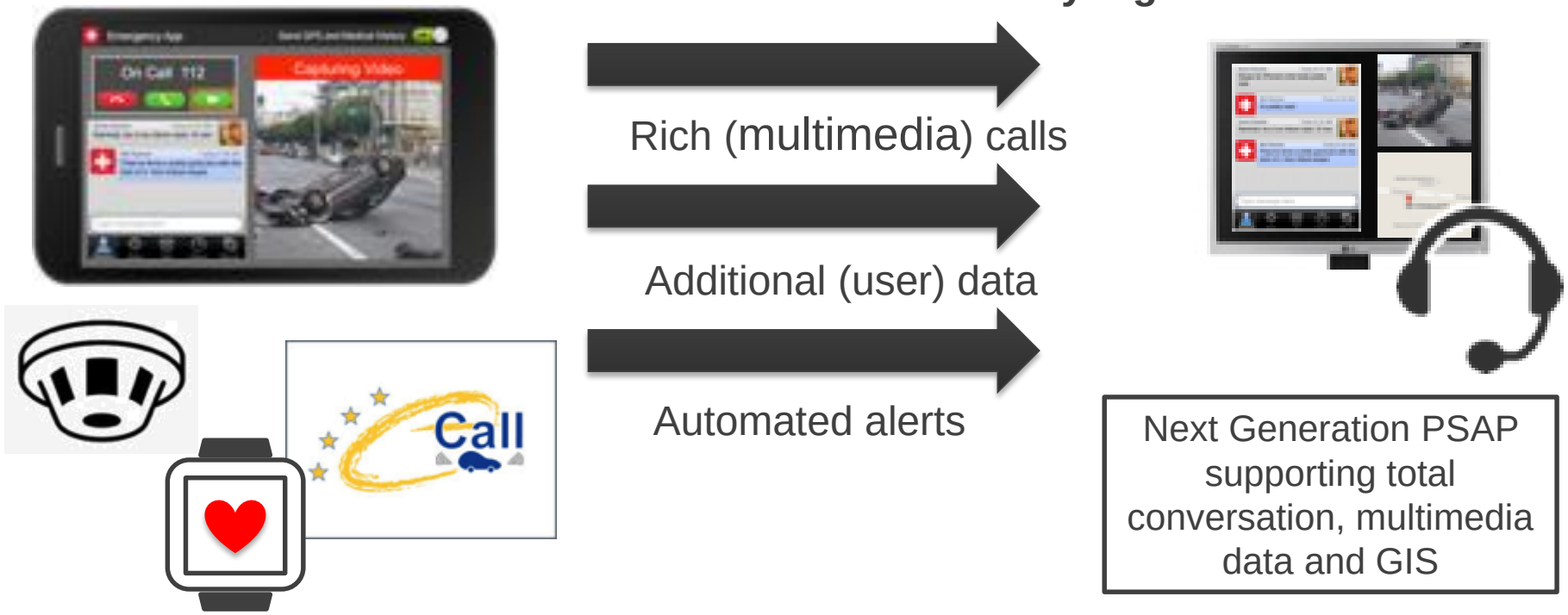
The NEXES Solution

NEXES proposes to
exploit Internet-enabled technologies to assist emergency services and citizens



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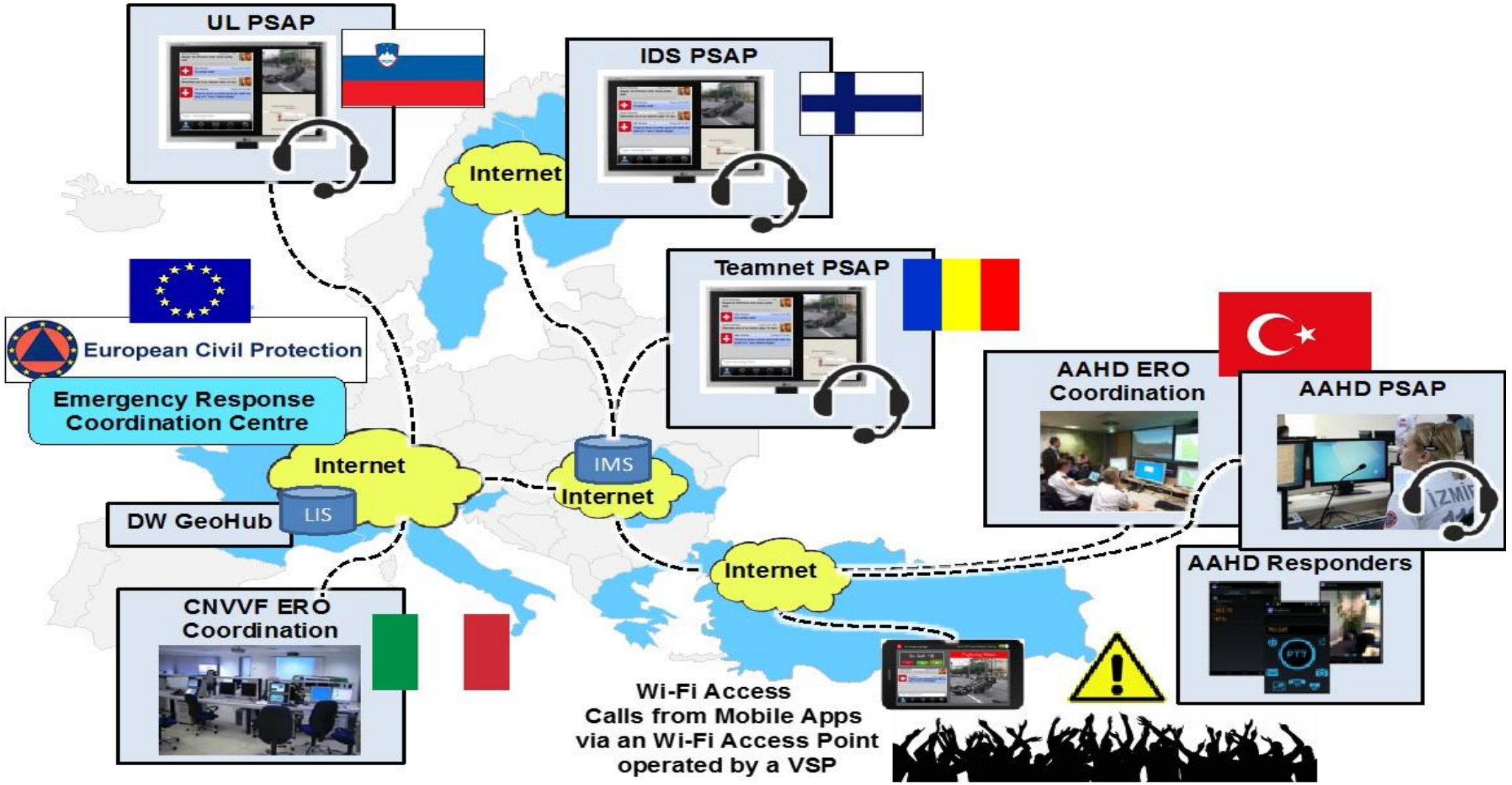
NEXES Pilots



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Prioritization and pre-emption functions of mobile network

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Prioritization and pre-emption functions

- Prioritization
  - to guarantee minimal service experience (SLA)
  - giving priority to certain type of traffic or certain user(s)
- Pre-emption
  - empty resources for prioritized users in fully loaded network
- Challenges
  - network design (costs)
  - network capacities planning (costs)
  - defining priority levels
    - makes no sense if everyone is prioritized with the highest priority

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Prioritization and pre-emption functions

- Scope: data traffic oriented prioritization and pre-emption
  - part of 3GPP standardization (3GPP TS 22.281, Rel. 14)
  - also earlier standards for voice prioritization
- Usage
  - IP TV over LTE (current usage)
  - PPDR services (target)
  - overall not widely deployed in production environment yet

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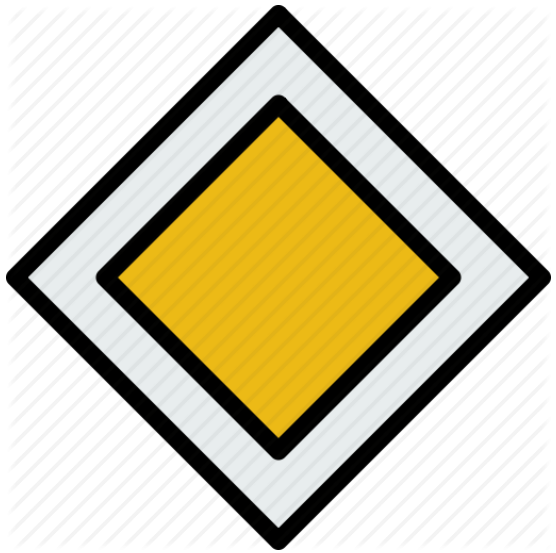
Demo



- LTE network under Release 14
  - virtualized environment (vEPC)
  - one base station (gNB)
- Network conditions
  - two priority levels
    - basic level – best effort: QCI = 7
    - prioritized: QCI = 6
  - max. number of user terminals allowed to be connected to single gNB: 3
  - total bandwidth limitation on single gNB: 2.3-times B_{video}
    - B_{video}: bandwidth of single video stream used in demonstration

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Demo

- User terminals
  - 2 terminals prioritized
    - iPhone 6S Plus(IOS 11.0.2 jailbreak)
    - QCI = 6
  - 2 terminals non prioritized
    - iPhone 6S (IOS 11.0.2 jailbreak)
    - QCI = 7
- Test data – video stream
  - Telekom Slovenije commercial video (.mpeg)
  - streaming server located in TS' internal network
    - Apache web server (HTML 5)
    - CentOS 7

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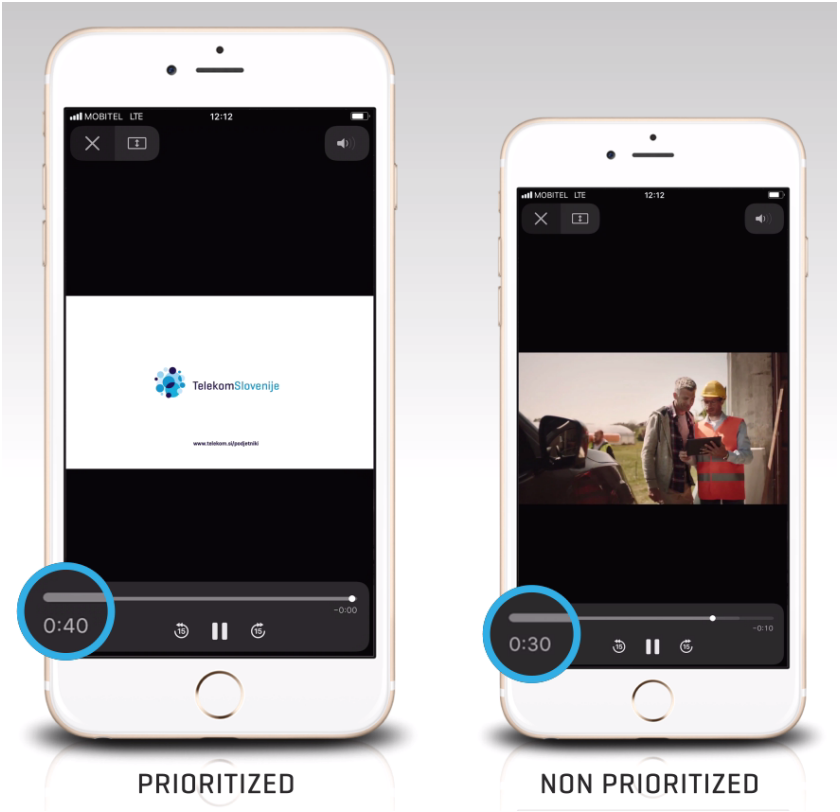
Demo scenario and observations

- (1) One prioritized terminal and one non-prioritized terminal are streaming a video. Both video streams are playing smoothly due to sufficient network recsources.
- (2) Another non-prioritized terminal starts streaming the video. Since there is not enough bandwidth for all three videos to be played simultaneously through the same LTE cell, prioritized terminal stream continue to play smoothly, while non-prioritized terminals streams now suffer from interruptions. Situation is due to network prioritization settings, ie. prioritized terminal gets bandwidth it requires, while remaining bandwidth is divided between non-prioritized terminals. Since the quantity of remaining bandwidth is less than required for streaming two separate videos, interruptions occur.



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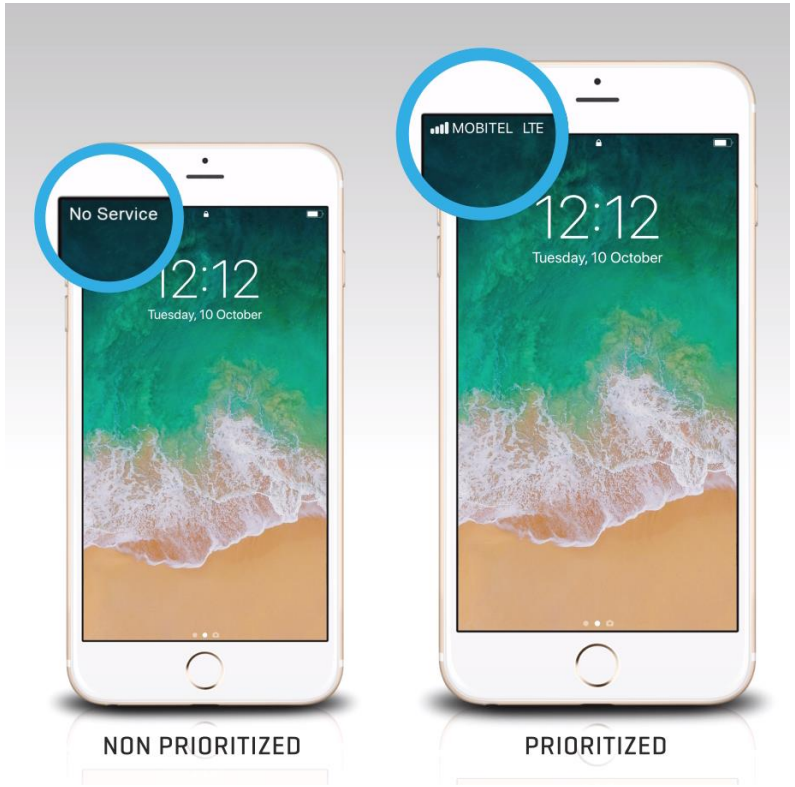
Demo scenario and observations

- (3) When the second prioritized terminal shows up, it should be immediately provided with required network resources, even the latter are already fully consumed. Preemption function of laboratory test network allows releasing resources of attached terminal only if the terminal is not active, ie. it does not send or receive any data. Therefore, video streaming on one of non-prioritized terminals was stopped which further triggered dropping the connection and providing resources for the second prioritized terminal.
- (4) With two prioritized terminals and one non-prioritized terminal in network, video streaming on both prioritized terminals are playing smoothly, while video on non-prioritized terminal nearly stopped.

– Note html browser caching which compensates for reduced bandwidth to certain extent, but will not help in real-time applications.



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Conclusion

Key messages are:

- 5G mobile networks are coming very soon
- PPDR services can benefit from 5G
- EU projects have shown some success enhancing PPDR
- Telekom Slovenije is competent to deploy and manage PPDR MVNO and be compliant with all safety requirements as NaaS. MVNO can have dedicated or multitenant virtual core as part of its 4G/5G core network.

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https://5gvarnost.iskratel.com/

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