

47th ASECAP STUDY & INFORMATION DAYS

Tomorrow's Mobility...Is here Today

May 29-31, 2019



INTRACOM

T E L E C O M

Technology Shaping the Future

5G: An outlook on future enhancements of C-ITS services

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Link



Watch



 - 19 countries with local presence —  - 1,722 employees worldwide

67%
International
activities

A global telecommunication systems and solutions vendor with extensive know-how and a proven track record.

 40
years of
experience

 - 70 countries we export to —  - 3 R&D centers

Core Offerings

 **Wireless Access & Transmission**

Intracom Telecom products employ the most advanced field-proven technologies achieving and exceeding the level of performance required by the modern applications for wireless access and backhaul.

 **Telco Software Solutions**

Intracom Telecom has been building and enriching a wide portfolio of advanced telco software solutions, enabling Operators to generate new revenues and boost their Customers' Experience.

 **ICT Services & Smart City Solutions**

Intracom Telecom strategically focuses on the delivery and operation of top-notch services for converged networking and cloud computing solutions. The company also offers a range of Smart City solutions.

 **Energy Solutions**

Intracom Telecom designs, installs and commissions energy-related systems, providing Smart Grids and Energy Management solutions.



Performance

Customization

Sharing

5G Key Performance Indicators (KPIs)

1000 TIMES



INCREASING WIRELESS CAPACITY

90%



SAVING ENERGY

0 LATENCY



LOW LATENCY

7 TRILLION



CONNECTING THINGS

99.999%

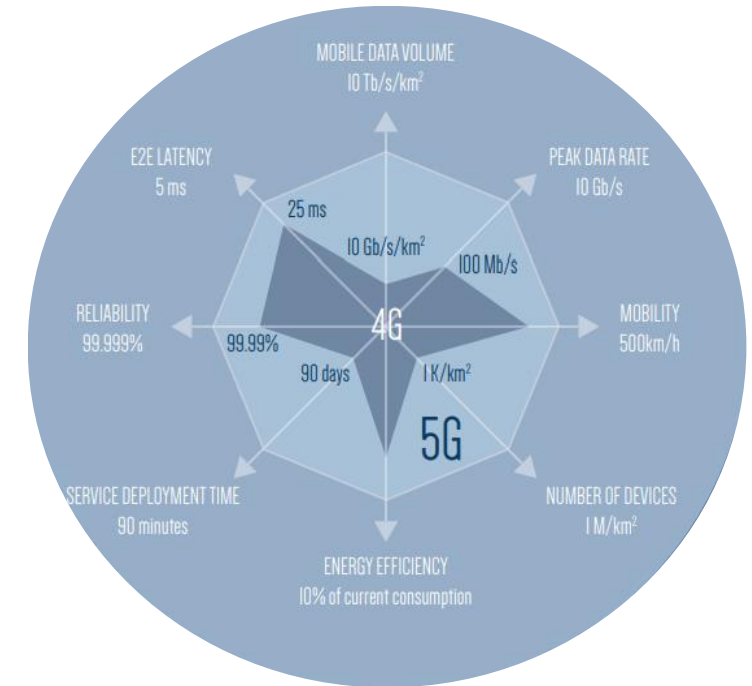


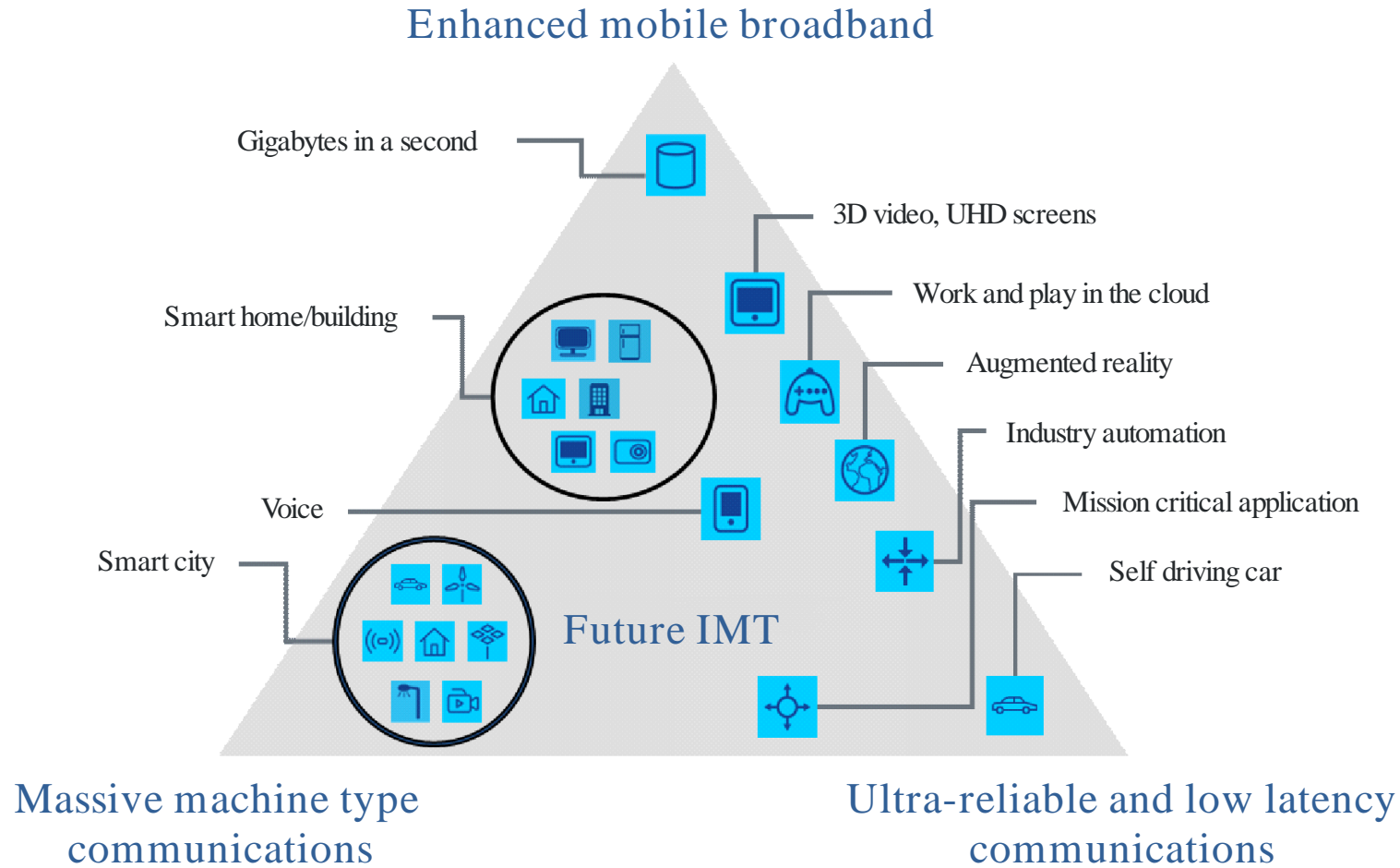
RELIABILITY

20 BILLION HUMAN-ORIENTED TERMINAL



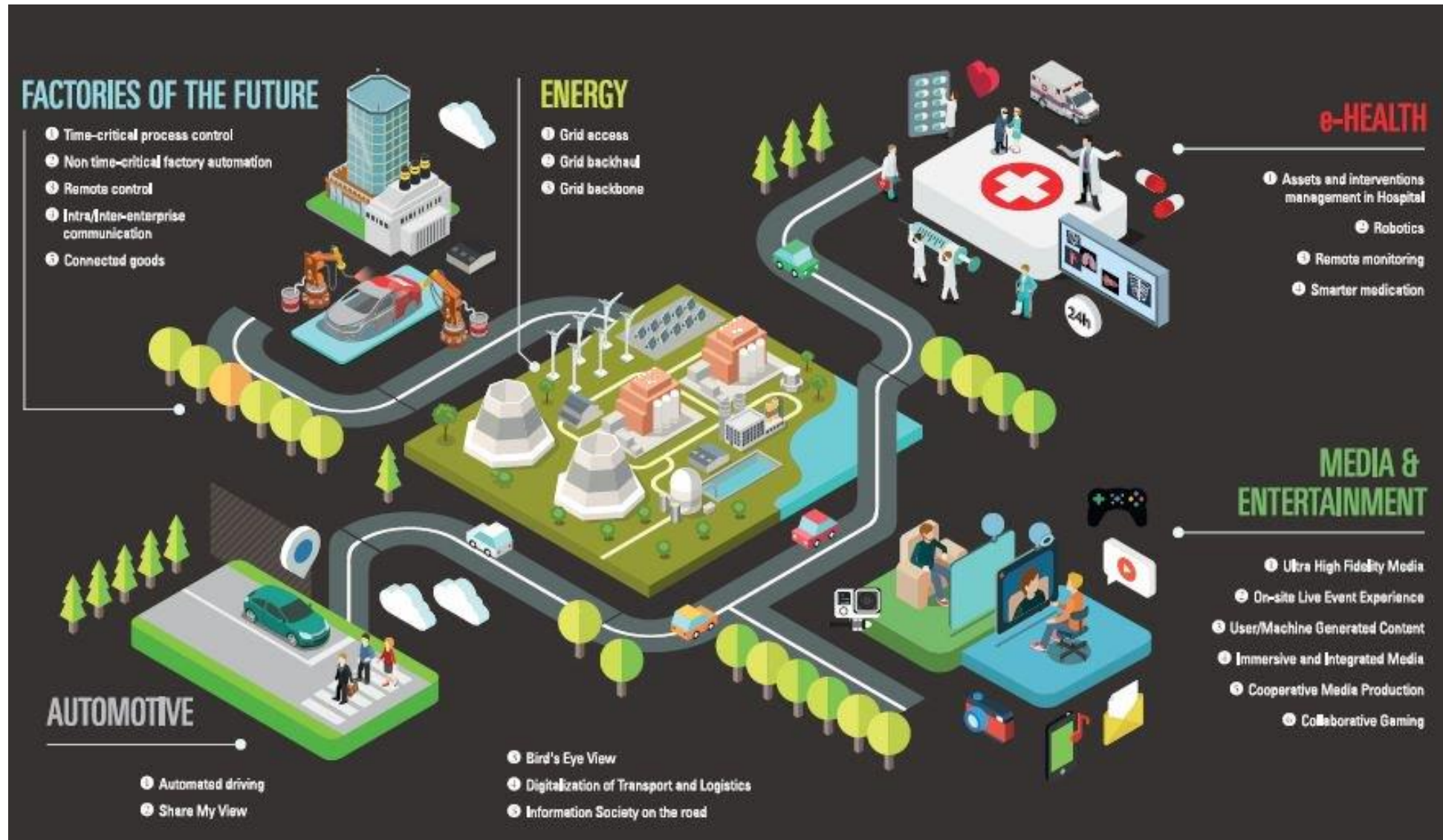
CONNECTING ALL PEOPLE





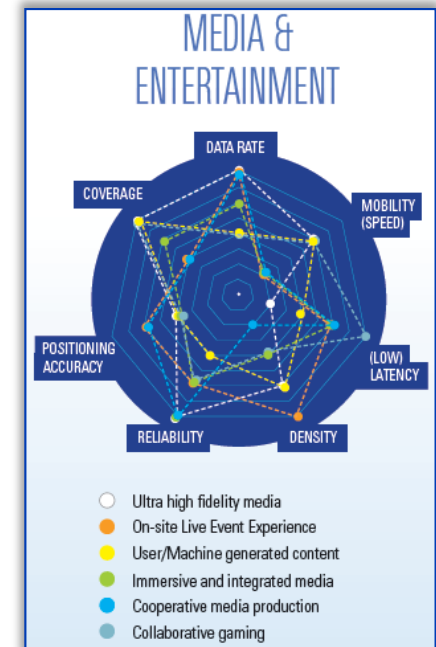
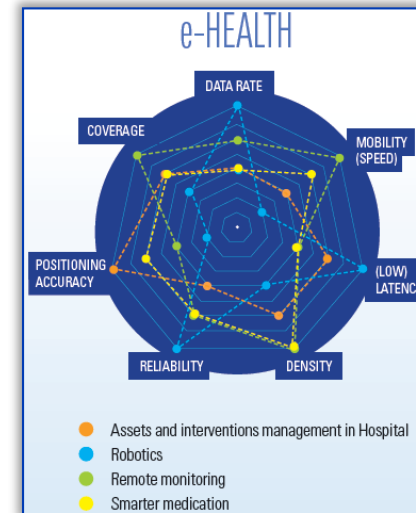
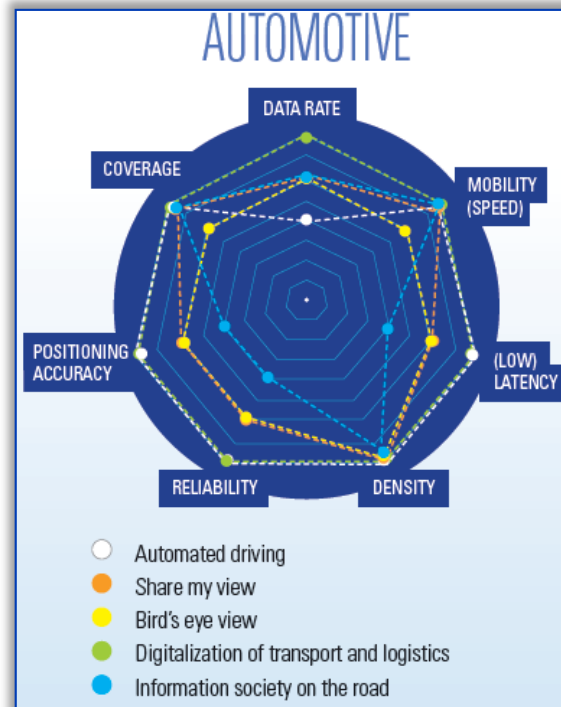
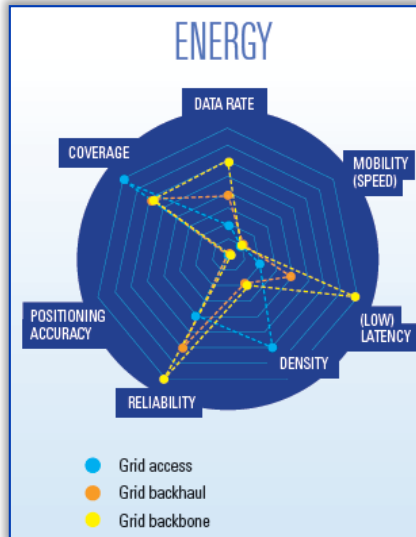
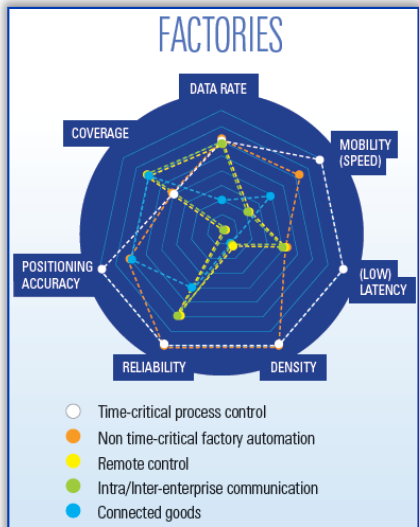
Source: ITU-R IMT 2020

M.2083-02



Source: 5G-PPP

5G Vertical KPIs



▶ 5G-New Radio (NR) & 5G Core

- 3GPP

▶ Network Function Virtualization (NFV)

- ETSI NFV

▶ Software Defined Networking (SDN)

- Open Networking Foundation

▶ Management and Orchestration (MANO)

- ETSI NFV MANO / ZTM / OSM

▶ Multi-access Edge Computing (MEC)

- ETSI MEC, LF Edge, etc.



5G-New Radio

- ▶ Non-Standalone mode: 4G control plane
- ▶ Standalone mode: 5G control plane

Frequency range designation	Corresponding frequency range
FR1	410 MHz – 7125 MHz
FR2	24250 MHz – 52600 MHz

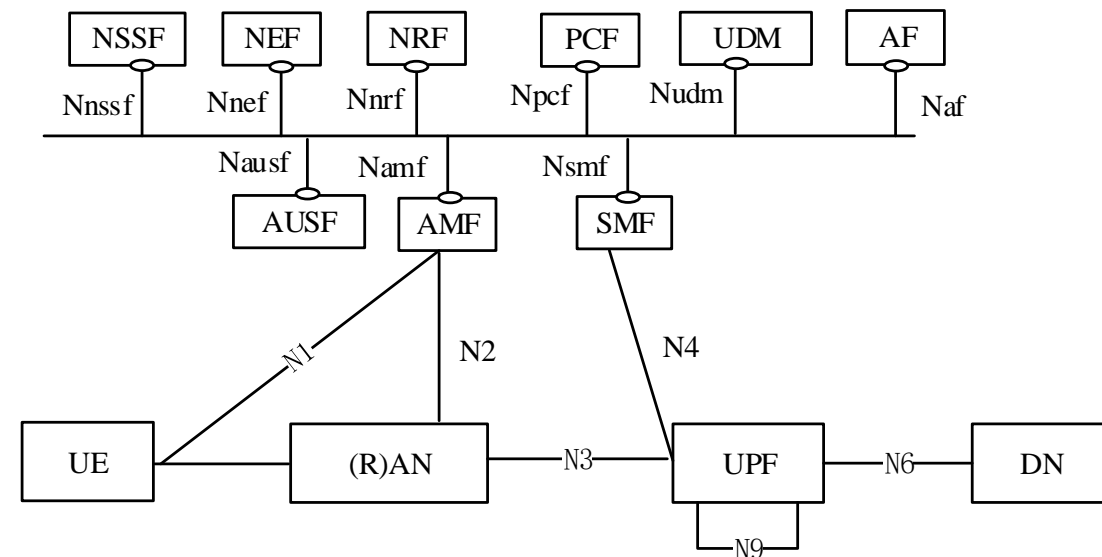
3GPP 38 Specification Series
 [Available at: <https://www.3gpp.org/DynaReport/38-series.htm>]

5G-Core

- ▶ Service-based architecture
- ▶ Control and Use Plane Separation (CUPS)
- ▶ Modular function design
- ▶ Enabling use of NFV/SDN

3GPP TS 23.501, TS 23.502, TS 23.503, TS 23.507
 [Available at: <https://www.3gpp.org/DynaReport/23-series.htm>]

Source: 3GPP TS 23.501 V15.2.0 (2018-06)



5G System architecture (5G Core)

Network Functions Virtualization (NFV)

Motivation

Large and increasing variety of **proprietary hardware**

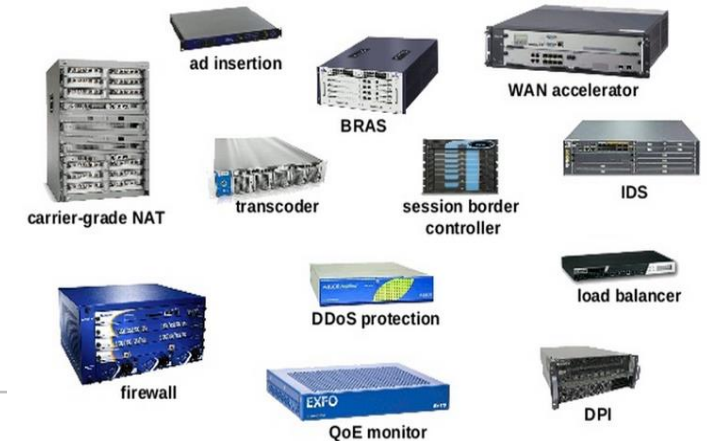
- ❌ High OPEX/ CAPEX
- ❌ Increased Time to Market for new services

Concept

- ▶ Leverage standard IT **virtualization** technology on top of **COTS hardware**
- ▶ Consolidate functionality in (micro-)Data Centers throughout the network (or even user premises)

Benefits

- ✔ Lower OPEX/CAPEX
 - ✔ Infrastructure sharing
 - ✔ Elasticity
- ✔ Openness & Rapid innovation
- ✔ Network Service Orchestration



Mobile/Multi-access Edge Computing

Concept

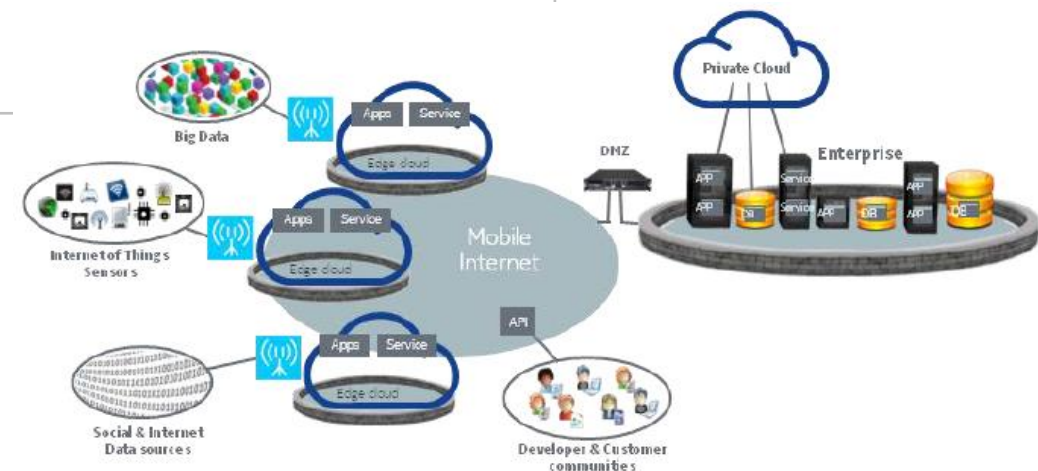
- ▶ Enable **cloud computing** capabilities **at the edge** of the (cellular) network
- ▶ Service/application oriented (as opposed to NFV...)
- ▶ Close integration with Radio Access Network (RAN)

Benefits

- ✔ Service optimization
 - ✔ Adaptation to (wireless) network conditions, location, *etc.*
- ✔ Reduced latency

Example application domains

- ▶ **C-ITS**
- ▶ **IoT**
- ▶ **Augmented Reality**
- ▶ **Content distribution**
- ▶ **Video Analytics**
- ▶ ...



5G Enabling Technologies

▶ 5G-New Radio (NR) & 5G Core

- 3GPP

▶ Network Function Virtualization (NFV)

- ETSI NFV

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▶ Multi-access Edge Computing (MEC)

- ETSI MEC, LF Edge, etc.

Performance



Customization & Sharing (*)

(*) Through *Network Slicing*...

To support all C-ITS services on the vehicle side, the **full hybrid communication mix** needs to be onboard. On the infrastructure side the choice of communication technology will depend on the location, the type of service and cost efficiency. **C-ITS messages should be unaware** of, and thus flexible about the communication technology used, **easing the inclusion of future technologies (e.g. 5G and satellite communication)** into the hybrid communication mix.

Currently, the most promising hybrid communication mix is **a combination of ETSI ITS-G5 and existing cellular networks.**



EUROPEAN COMMISSION

Brussels,
30.11.2016

COM(2016) 766
final

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT,
THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND
THE COMMITTEE OF THE REGIONS

A European strategy on Cooperative Intelligent Transport Systems, a milestone towards
cooperative, connected and automated mobility

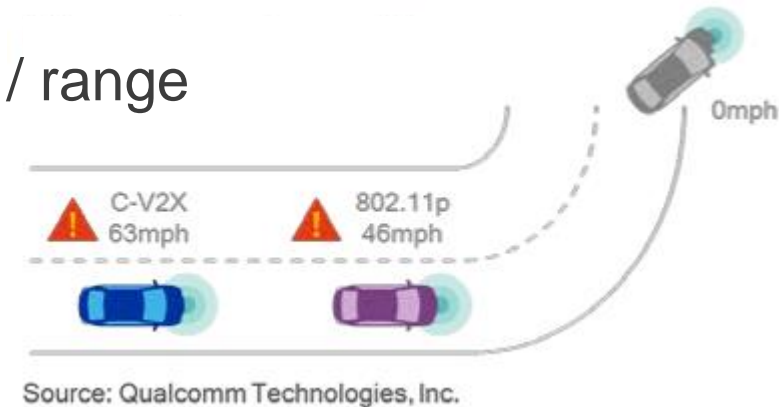
1. Introduction

Profound change lies ahead for the transport sector; both in Europe and in other parts of the world. A wave of technological innovation and disruptive business models has led to a growing demand for

KEY ELEMENTS	DSRC/ IEEE 802.11	Rel 14 C-V2X	5G C-V2X (Rel 15,16) (expected)
Out-of-network operation	✓	✓	✓
Support for V2V	✓	✓	✓
Support for safety-critical uses	✓	✓	x*
Support for V2P	✓	✓	✓
Support for V2I	limited	✓	✓
Support for multimedia services	x	✓	✓
Network coverage support	limited	✓	✓
Global economies of scale	x	✓	✓
Regulatory/testing efforts	✓	limited	x
Very high throughput	x	x	✓
Very high reliability	x	x	✓
Wideband ranging and positioning	x	x	✓
Very low latency	x	x	✓

Source: 5G Americas White Paper: Cellular V2X Communications Towards 5G , March 2018

- ▶ Current technology adequate for basic safety applications
- ▶ 5G expected to enable advanced, demanding applications (see next)
 - ✓ Performance
 - ✓ Coverage / range



(*) Rel-15 is LTE-based and supports basic safety messaging (as Rel-14 V2X). Rel-16 will include Rel-14 and 15 capabilities adding support for more advanced use cases via 5G NR-based V2X.

- ▶ eV2X support for vehicle platooning
- ▶ Information exchange within platoon
- ▶ **Automotive: sensor and state map sharing**
- ▶ eV2X support for remote driving
- ▶ Automated cooperative driving for short distance grouping
- ▶ **Collective perception of environment**
- ▶ Communication between vehicles of different 3GPP RATs
- ▶ Multi-PLMN environment
- ▶ Cooperative collision avoidance (CoCA) of connected automated vehicles
- ▶ Information sharing for partial/ conditional automated driving
- ▶ Information sharing for high/full automated driving
- ▶ Information sharing for partial/ conditional automated platooning
- ▶ Information sharing for high/full automated platooning
- ▶ Dynamic ride sharing
- ▶ Use case on multi-RAT
- ▶ **Video data sharing for assisted and improved automated driving (VaD)**
- ▶ Changing driving-mode
- ▶ Tethering via Vehicle
- ▶ Use case out of 5G coverage
- ▶ Emergency trajectory alignment
- ▶ Teleoperated support (TeSo)
- ▶ **Intersection safety information provisioning for urban driving**
- ▶ Cooperative lane change (CLC) of automated vehicles
- ▶ Proposal for secure software update for electronic control unit
- ▶ 3D video composition for V2X scenario

3GPP, TR 22.886 V16.2.0 (2018-12), 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Study on enhancement of 3GPP Support for 5G V2X Services (Release 16)

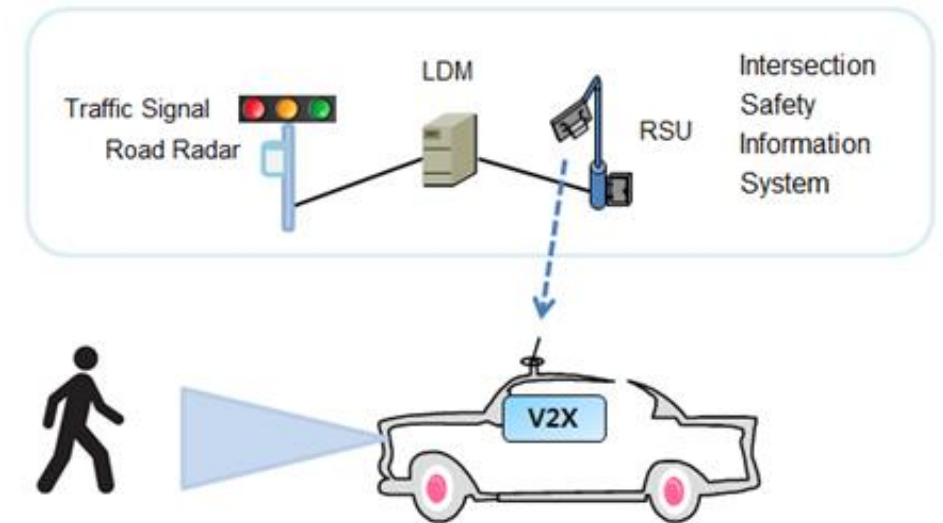
▶ Enhancing **Local Dynamic Maps** with:

- Higher **spatio-temporal fidelity**
- Higher **reliability**

▶ **MEC** support for:

- Localized, low-latency processing
- Network traffic savings
- Dynamic group communications

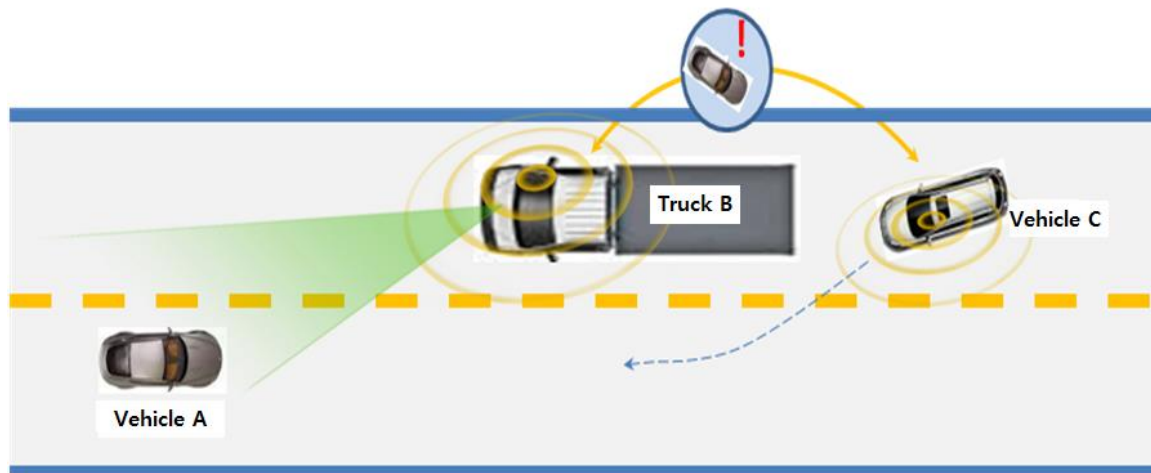
▶ **Applications:** platooning, intersection safety, etc.



Intersection safety information provisioning for urban driving

High-bandwidth	25-50Mbps/UE
Low latency	10 ms
Message reliability	90%-99.99%
Connection density	3-4K cars per Km ²

- ▶ Real-time exchange of vehicle sensor information
 - **Extend perception beyond local sensor range**
e.g., behind crests, curves or objects behind the corner of houses
 - Raw data: liability in case of accidents, distributed verification of sensor data, etc.
- ▶ **Applications:** automated forward collision avoidance, overtaking and lane changing



Assisted overtaking

High-bandwidth	1 Gbps/UE (peak)
Low latency	3-10 ms
Message reliability	99.999%
Connection density	3-4K cars per Km ²

▶ High resolution video streaming

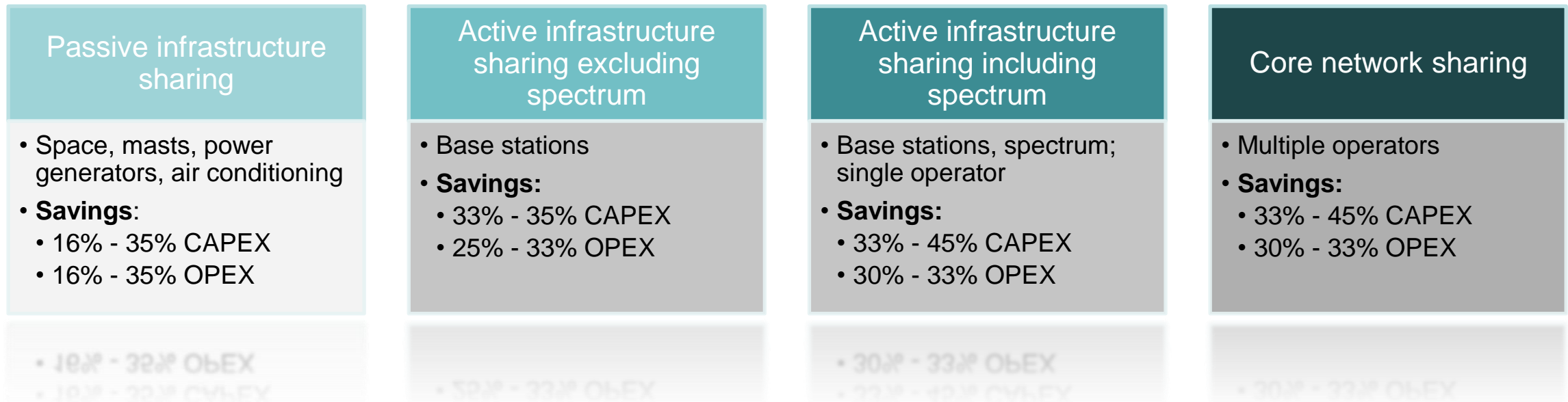
- Beyond local pre-processing for automated object detection
 - Assisted driving
- Dynamically established (group) communication
- MEC enables low-latency mediation of network-residing components

▶ Applications: assisted overtaking, etc.



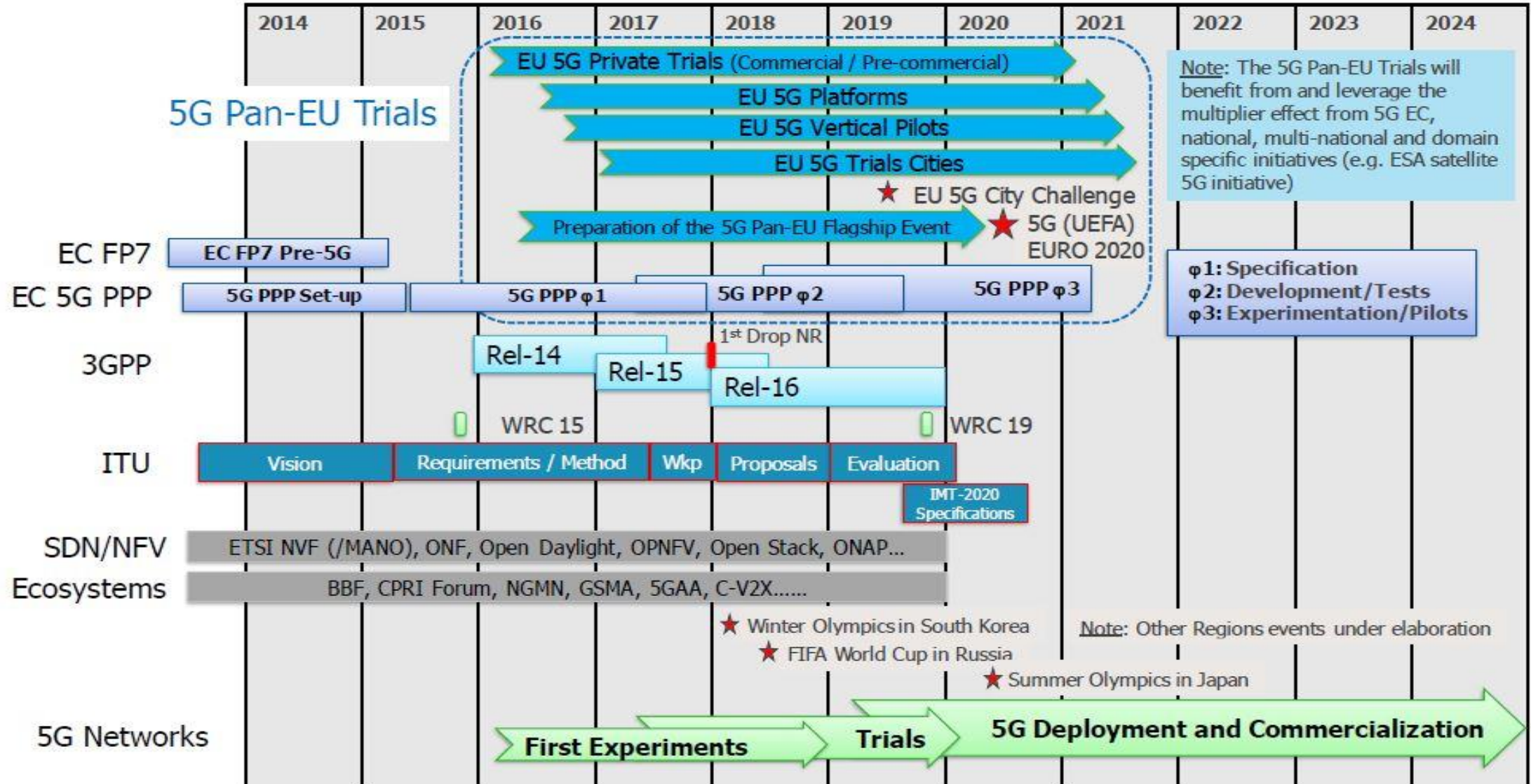
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▶ Infrastructure costs → Sharing models



(*) BEREC: BEREC Report on Infrastructure Sharing, June 2018 bereg.europa.eu/eng/document_register/subject_matter/bereg/reports/8164-berecreport-on-infrastructure-sharing

5G PPP Roadmap



Related European R&D Projects

ICT-7-2016: 5G PPP Research and Validation of critical technologies and systems
Start Date: 1/6/2017
Duration: 24 Months



5GCAR: Fifth Generation Communication Automotive Research and innovation

ICT-22-2018: EU-China 5G collaboration
Start Date: 1/9/2018
Duration: 30 Months



5G Harmonised Research and Trials for service Evolution between EU and China

ICT-18-2018: 5G for cooperative, connected and automated mobility
Start Date: 1/11/2018
Duration: 36 Months



5GCroCo: 5G Cross-Border Control



5G for Connected and Automated Road Mobility in the European union



5G for cooperative & connected automated MOBility on X-border corridors

Network & Service Management

- MEC orchestration
- Optimized cross-slice communication
- IoT Slicing
- Cross-domain Slicing & KPI monitoring
- Softwarization of WindPark Networks

Standardization



Technologies / Frameworks



H2020 / 5G PPP Projects



Phase 1



Phase 2 / B5G



Phase 3, Part I

5G-VICTORI



Phase 3, Part II (*)

(*) Starting: June 2019

Service Orchestration

- Edge & Beyond-the-Edge Computing
- Edge SaaS/PaaS/BaaS/FaaS
 - IoT, Analytics, vCDN, *etc.*

Enhanced Video Streaming Services / vCDN - eMBB

- Multi-party communication / streaming support
- User Generated Content / Personalization / Social networking
- High resolution and/or VR/360 video streaming
- AR and Video Analytics application support: streaming / MEC infrastructure

Multiple Vertical domains

- **Media & Entertainment:** large event coverage (sports, festivals, *etc.*)
- **PPDR/Security:** enhanced situational awareness
video surveillance, crowd-management, *etc.*
- **Smart X-culture:** agriculture/fish farming, field monitoring
- **eHealth:** expert guidance
- **Automotive:** see-through overtaking, infotainment, *etc.*

thank
you



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TELECOM



Backup Slides