The role of the Mobile Operator in automated driving

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Outline

- MNO: evolution of business scenario & key drivers
- C-ITS Platform Recommendations
- Use Cases and Requirements
- Sector Views
- Regulation & Spectrum
- Standards & Timeplan
- Service Requirements
MNO business – An evolving scenario

(GSM) - 2G system
• end-to-end services delivered to (human) end-users, CS voice and message services.
• Stakeholders: MNOs and mobile phone makers
• No specific ITS related use case

(GSM) – 2.5G system
• PS technology (GPRS, EDGE) and IP access through mobile network as enabler for OTT services and applications
• Stakeholders: MNOs, nomadic device makers, Service Providers
• First ITS applications: fleet management, proprietary emergency services, eCall, map & routing, insurance services

(3GPP) – 3G, 4G and 5G system
• Higher bandwidth, lower latency, full support of M2M data communication (distributed sensors, capillary, big data ..etc.)
• Additional domain-specific stakeholders; in the ITS domain: Telematic Service Providers, Road Administrations, Smart Cities, Mobility Managers, Vehicle Makers, ..etc.
• ITS applications: support of V2X communication paradigm, efficiency-related and business applications, environment, information, service billing & clearing, identity management, safety, support of autonomous driving, connected vehicle cloud, ..etc.
MNO industrial approach – Main drivers

• **Network deployment and operation** (wireless ...and fixed access)
  • Supporting modular/phased deployment/de-commissioning
  • Focused on mass market business

• **Network as Service/Application-independent Enabler**

• **Technology evolution** (in 2-3 years cycles)
  • R&D and Innovation
  • End-user expectations → new/improved requirements
  • Market analysis → new/improved features
  • Standard based (3GPP Releases) → interoperability

• **Backward compatibility**

• **Licensed bandwidth** (mainly)

• **Strong identity management/authentication security & privacy** mechanisms originally conceived for human end user and gradually being expanded to fulfil machine-to-machine communications requirements
C-ITS Platform recommendations on mobile network use

• **Hybrid Communication** approach including multiple technologies (including future new developments) and radios is the only way to support continued deployment of ITS services and applications today and in the future (e.g. multi-link – multi-RAT)

• Exploiting the advantages of **all communication technologies** proposed for C-ITS services (services to be communication-layer agnostic).

• Benefiting from the complementarity of current and future technologies, by including adequate **migration strategies**

• **Address the issues** (i.e. lifetime, traffic congestions, roaming) related to the use of cellular communications for C-ITS services to benefit from the wide coverage offered by existing infrastructure, leading to faster uptake of C-ITS services.

• Strengthened **cooperation** between **transport and telecommunications** stakeholders to further progress the hybrid mode and associated communication technologies (e.g. 3GPP, since they are developing standards that could serve the business case of C-ITS).

[Ref: C-ITS Final Report – January 2016]
ITS use cases and scenarios for 5G

Automated driving:
- Automated overtake
- Cooperation Collision Avoidance
- High density Platooning

Road safety and traffic efficiency services:
- See through (sharing video/image between 2 vehicles)
- Vulnerable Road User (VRU) Discovery
- Bird’s Eye View (supervision of trajectories in intersection)

Digitalization of transport and logistics:
- Remote sensing and control
- Remote processing for vehicles

Intelligent navigation

Information society on the road

Nomadic nodes
Technical requirements and KPI for V2X use cases

**End to end latency:** 1-5 ms for mission critical V2V/V2I communications

**Security and privacy:** user authentication, authenticity, data integrity, confidentiality, user privacy

**Vehicle density:** some thousands of vehicles per Km²

**Maximum speed:** 250 Km/h

**Reliability:** 99,999%

**Data rate:** 50 Mbps

**Range:** < 1000m

**Position accuracy:** 10cm

[Ref: 5G-PPP White Paper on Automotive]
Mobile & Automotive Drivers

**Mobile Industry**: 5G in the roadmap of MNO and telco industry as the backbone of the future digital economy, creating more and better jobs and contributing to a sustainable economic growth worldwide.

**ITS Industry**: the level of maturity has increased and some deployment policies have been identified

- in US a rulemaking process is currently ongoing with the clear target to make direct V2V communication based on IEEE 802.11p mandatory (US National Highway Traffic Safety Administration (NHTSA))
- In UE ministries of transportation of the Netherlands, Germany and Austria have started a deployment project (Cooperative ITS Corridor, 2015) for the equipment of roadwork protection systems on highways, with a plan to finalize the rollout by the end of 2018

**ITS & Mobile** sectors are joining forces (e.g. 5G-PPP, GSMA A-SIG)

- New business models have already started to emerge with the integration of connectivity in cars and roadside infrastructure
- Cooperation between Original Equipment Manufacturers (OEMs) and telecom operators to reduce cost of infrastructure deployment and at the same time lower barriers for other sources of data to enter the ecosystem
Views from the sector

- Major vehicle manufacturers believe that **5G mobile networks** could be vital in providing the mission-critical reliability to allow autonomous driving.
  - **Support of highly automated driving** - Need for ultra-reliable networks, low-latency and scalability (they must work everywhere)
  - **Service Continuity** - Technology working even when the network coverage is not present → so 5G with device-to-device communication could be a solution.
  - **ITS in Smart Cities** – It is important that vehicles can communicate with each other and with other participants in the city, such as pedestrians or cyclists. → You have bring all of this together to have a smart city where cars can autonomously drive.

- **Realistic Roadmap** - Some of the most futuristic features envisioned in networked cars will depend on 5G mobile technology that probably won't be available in full until 2020.
Regulation & Spectrum Recommendations from 5G PPP

- Enable **new** frontiers in mobile **connectivity** (Machine Type Communications, Device-to-Device, Broadcast, Automotive, Small cells) in the **period 2015-2020**
- Implement **radio spectrum management policies** that enable sustainable consumer benefits and increased competition
- Make **additional spectrum** available on shared license and unlicensed bases within higher bands (i.e., above 6 GHz)
- Cooperate internationally to timely harmonize and make available **radio spectrum for 5G**. In particular, the 700 MHz band and its availability currently in many EU member states already represents the potential to lay the stepping stone for the future spectrum policy that will benefit 5G.
- Regulators need to address **security, integrity, data protection, and privacy** in the data economy in a holistic manner from a user’s point of view, by setting rules that apply to all providers offering equivalent services
5G Standardization Approach and ITS

**Coordination** among European Standards Organizations (ESOs) and other Standards Developing Organizations (SDOs), to harmonize existing standardization efforts related to ITS

- ITS is not just V2X communications
- Different transport modes
- Integration with M2M, Internet of Things, Smart Environments
- Standards by other service domains (e.g. One M2M, ETSI M2M, etc.)

- **ETSI TC ITS (+ISO+CEN)** – Next releases of the standards to integrate the new 5G connectivity framework into ETSI ITS reference architecture

- **3GPP** – Current 3GPP activities include a “Study on LTE Support for V2X Services” for the purpose of efficient V2V communications, enabling short-range communications and multi-link traffic flows, delay-optimized protocols and 5G coexistence and augmentation with other access technologies (e.g., ITS-G5 for vehicular communications).

- **IEEE** – While 3GPP standardization is the central pillar of future 5G technology, the use of IEEE standards as extensions of LTE and LTE-A is considered fundamental as interworking networks in a multi-link / multi-RAT approach
LTE / 5G for ITS

Extremely flexible and highly programmable e2e system, including evolution of LTE access and providing complementary solutions to LTE use cases

• Serve at best high **diversity types of communications** (Human & Machine) with different performance attributes
• Support **on demand composition of network functions** and capabilities, enforcing flexible assignment of capability/capacity “where and when needed”, with NFV implemented in 5G network slicing
• Profitably supports new business opportunities and provides sustainability thanks to **cost saving**, solutions for services low deployment cost, synergies with LTE evolution
• **Future-proof** and ready to serve even not yet identified use case and radio technologies
5G features useful to ITS

**Telco Services**

- Ubiquitous LTE coverage availability (2020)
- Required: Voice/Video/Messaging, Public Safety applications, SMS (over 5G control plane)
- Not required: CS voice service continuity and/or fallback to GSM or UMTS (i.e. seamless handover)
Mobile Enhanced BB
(user experience)

- Indoor (e.g. videoconf from office): up to 1 Gbps (in some cases also bidirectional e.g. for virtual presence), very low latency
- Dense Urban: up to 1 Gbps @ pedestrian mobility
- Wide area coverage (same radio sites grid): 50-100 Mbps
- High speed mobility: **up to 500 Km/s** (LTE limit is now 300 Km/s)
Ultra-reliable & low latency communications (uMTC):

- Remote control (robot, drones, surgery),
- Automated driving
- Cloud-driven virtual reality,
- Industrial control (e.g. plant monitoring): < 1ms latency one-way,
- High reliability
Massive MTC (mMTC)

- Wide area sensor monitoring
- Event driven alarms.
- Long (>10Y) battery life,
- 1 million connections/Km² efficient data transmission,
- coverage enhancement
## 5G roadmap

### 2014 - 2024 Timeline

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<th>Year</th>
<th>5G in 3GPP</th>
<th>4G in 3GPP</th>
<th>ITU</th>
<th>EC FP7</th>
<th>EC 5G PPP</th>
<th>SDN/NFV</th>
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### Key Events
- **WRC'15**
- **WRC'19**
- **IMT-2020 specifications**
- **V2X project**
- **5G PPP set-up**
- **5G PPP Phase 1**
- **5G PPP Phase 2**
- **5G PPP Phase 3**
- **ONF, Open Daylight, OPNFV, Open Stack...**
- **Radio experiments**
- **Trials**
- **5G Deployment and commercialisation**

### Note:
- Winter Olympics in South Korea
- FIFA World Cup in Russia
- Summer Olympics in Japan

### Other Region events under elaboration

### 2 YEARS:
- **Exploratory phase and specification**
- **Detailed research and optimization**
- **Experimentation and trials**
V2X Deployment Scenarios

[Source 3GPP TR 22.885 v2.0.0 (2015-12)]

Infrastructure-less V2X operation

- UEs can communicate with each other directly using the V2X spectrum.
- UEs are configured with the same parameters for the V2X communication.
- Mechanisms defined for the ProSe out of coverage communication parameter provisioning can be reused. (UE obtains new parameters for V2X communication as soon as it returns into coverage)

Multi-MNOs shared V2X services scenario

- Multiple MNOs offer V2X services to their subscribers.
- Each UE is under the control of one MNO and the UEs are controlled by their MNOs for the access to the V2X spectrum and services.
- The different MNOs ensure that the UEs can transmit to and receive from UEs of other MNOs. (e.g. broadcast UE configurations via system information announcements, or via dedicated signaling for the individual UE)

Single MNO managed V2X scenario

- In this scenario, a single mobile operator is granted the ownership/lease of the V2X spectrum and thus manages the V2X services.
- This scenario requires all V2X UE to have a valid subscription to the MNO that manages the V2X spectrum. Alternatively, the MNO that manages the V2X spectrum would need to allow other subscription to other MNOs to be used in V2X authorization.
Conclusions

• ITS and mobile networks have **different business dynamics** and **timeframes** but synergy exists

• National **policies** are being defined and ITS **deployment is taking off**

• ITS and Mobile Networks sectors are **sharing views** and **expectations**

• **Hybrid communications** to make ITS future-proof, pervasive and mass market

• **3GPP** stakeholders recognized the growth potential of ITS market and preliminary **standardization** activity has already started in order to ensure support to many **ITS use cases**

• Mobile Networks (4G and 5G) will likely play a **major role in ITS**
References & Credits

• Special thanks to Bernadette Villeforceix (Orange Labs Networks) for her contribution and views

• Some further readings:
  • NGMN 5G White Paper
  • 5G PPP Vision Paper
  • 5G Automotive vision
Thanks