



Smart Transportation Alliance

Vehicular Cooperative Communications

*Approach on CV2X and legacy C-ITS Architecture
Integration Challenges*

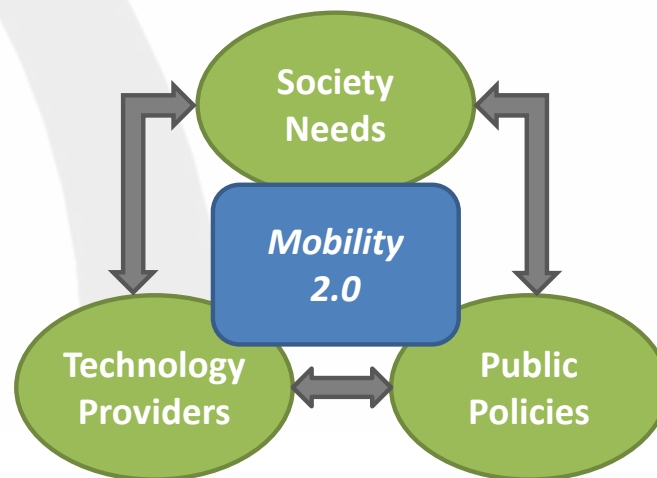
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Connected Mobility Introduction

- Urban and interurban mobility environment has been evolving more and more rapidly in recent decades.
- Challenges in transport focus on the **areas of mobility efficiency, road safety, security and environmental and economic sustainability.**
- Relevant trends:
 - **Electric mobility**
 - **Mobility mode shifts**
 - **Connected / Automated Mobility**

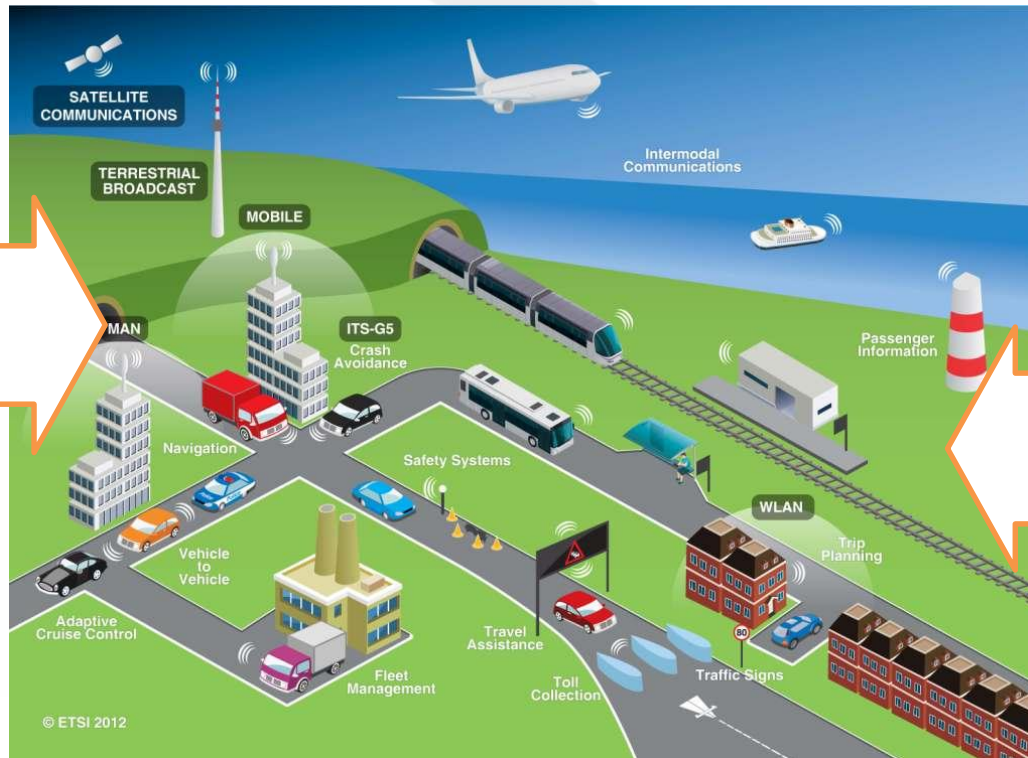


- Increasing needs of data exchanges at physical level, at network level, at service level.

Cooperative ITS

Natural evolution of increasingly complex ITS solutions.

The key for the deployment is the interoperability of solutions.



New Generation Networks

Technical evolution of an all-purpose platform, which can at some point be used for mobility solutions.

Connected Mobility

Use Cases / Services

| | |
|--|--|
| Safety | Providing enhanced safety for vehicle and driver, as well as driver assistance solutions |
| Vehicle operations management | Providing operational and management value to the vehicle manufacturer |
| Convenience | Providing value and convenience to the driver and passengers |
| Autonomous Driving | Specific SAE level 4 or level 5 solutions |
| Platooning | |
| Traffic efficiency and Environmental friendliness | Providing enhanced value to the infrastructure or city service providers |
| Society and Community | Providing value and interest to society and public |

Connected Mobility Technical requirements


- Relevant KPIs for Cooperative ITS applications have been given for Day 1 / Day 1.5 Safety Critical services.
 - *Ex1. OR007A The total latency time [for event detection and message transmission] shall be less than 220 ms in 95% of the cases.*
 - *Ex2. OR010A: The End To End Latency time increase caused by some network problems will be minimized as much as possible [and considering a default 'máximum message age' of 300 ms].*
- Relevant KPIs for NGN based applications have been specified for a number of different use cases and vary in orders of magnitude amongst them.
 - *Range* *Min. In the order of several m.*
 - *Service level latency* *Min. In the order of 10s of ms.*
 - *Service level reliability* *Min. 90%*
 - *Data Rates* *[Varied from use case]*

** Note: These KPIs and other considered relevant are actually being consolidated in initiatives such as the H2020 project 5G-MOBIX.*



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Connected Mobility Deployment & Issues

- New Generation Networks, embodied by the CV2X and the 5G initiatives, have been progressing very quickly in the last few years, advancing in the aspects of:
 - NR – New Radio
 - NFV/SDN – Network Function Virtualization and Software Defined Networks
 - Network Slicing
 - Edge Computing / Fog Computing / Cloud Computing
- 
- To ensure the capability of the network to provide **Guaranteed QoS for critical requirements' services.**



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Connected Mobility Deployment & Issues

- A number of demonstrators in the last few months have confirmed the performance level of 5G / CV2X deployments to provide similar and superior capabilities to those G5 / 802.11(p) based efforts
 - Continental & Nokia for Cooperative Driving
 - Ford & Vodafone Germany for Road Hazard Signaling
 - BMW & Qualcomm for intersection guiding
 - Daimler & Huawei for Remote Driving
- Radio tests have shown latencies well within requirements for a reliability of 99,9999% in many of the tested use cases.
- The 5GAA association will organise the first C-V2X Plugtests event with ETSI in Málaga at the beginning of December 2019.
- So, is 5G ready for overtaking mobility and critical mobility implementations?



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Connected Mobility Challenges

- Performance compliance alone is not an enough incentive to widely deploy the required NGN infrastructure.
- Different deployment scenarios:
 - Cellular (5G) when (economically) viable. Big urban areas, specially sensitive locations, ...
 - C-ITS (G5) when already deployed. European corridors, selected highways, maybe extending current covered locations.
 - Cellular (5G) + C-ITS (G5) when possible. Provides the best guarantee of QoS compliance.
 - Cellular (4G) when neither 5G or G5 would be available. This would restrict the sort of advanced mobility services that could be offered.

Connected Mobility Challenges

- Integrating selected functions at service and network control/management level between CV2X/5G and Cooperative ITS implementations should be the solution.
- Some relevant aspects to explore
 - **Integrated performance and resources control from the required performance level.** -> Can we control C-ITS network resources from a 5G-based service implementation?
 - **Security.** C-ITS architecture integrates security at different levels by design. 5G approach, with a distributed management and control of resources makes this more difficult.
 - **Interoperability and 'backward' compatibility.** -> The need to guarantee an adequate minimum level of performance for differently equipped vehicles and infrastructures -> Equality for all the users.



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**THANK YOU
FOR YOUR
ATTENTION**

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