

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

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5G in the Era of Connected Cars

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Automated and Connected Vehicles

The role of 5G-CARMEN



Vehicles will merge in the digital world

From a device for moving from A to B to a smart hub that is **always connected and has different levels of automation**



5G-CARMEN

To provide a CCAM platform leveraging the most recent 5G advances and supporting the automotive sector in delivering **safer, greener, and intelligent transportation**



The 5G-CARMEN Challenges

Improving Road Safety

25K

Fatal car accidents on motorways in Europe

Motorway security is an important issue for humans and car safety but still 25.300 people lost their lives on EU roads in 2017 (EC, Press Release, 2018)

7M

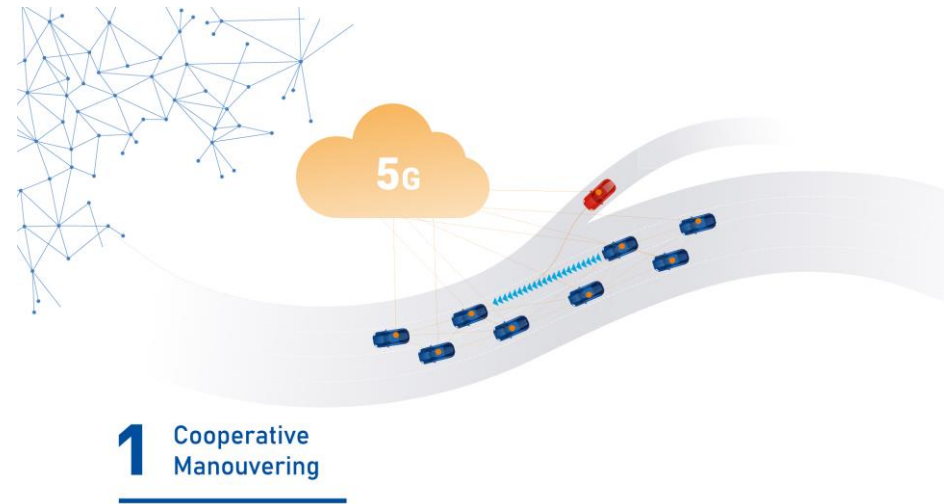
The U.S. traffic collisions in 2016

We could improve this number only if we had the chance to get better report about crashes (crashstats.nhtsa.dot.gov)



Improving road safety

UC1: Cooperative Maneuvering

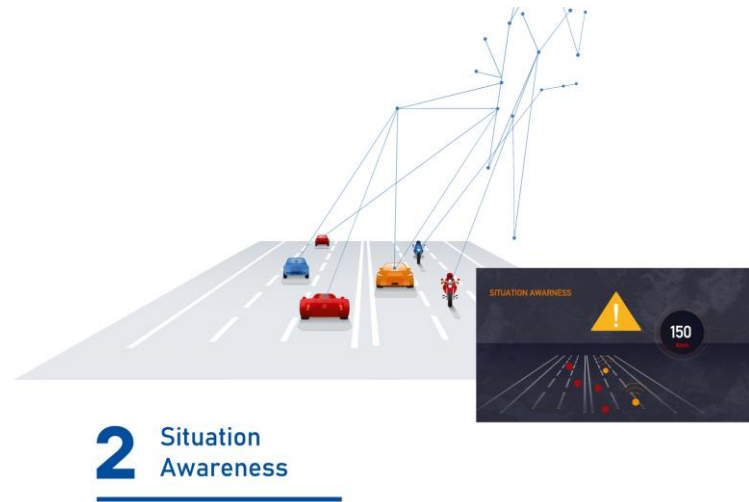


5G-CARMEN will provide a platform through which vehicles will be able to exchange speed, position, intended trajectories and manoeuvres

5G-CARMEN will explore distributed and centralized approaches for cooperative lane merging

Improving road safety

UC2: Situation Awareness



Automated vehicles and human drivers are limited in their ability to ensure safe and efficient travel by their perception of the environment

5G-CARMEN will promote extended situation awareness by enabling vehicles and infrastructure to share their perception of the road

The 5G-CARMEN Challenges

Providing an added value platform for OTTs

2020

\$35.2 billion in
infotainment

The largest market is in Europe, while the Asia-Pacific market is the fastest-growing market. The global market is growing because of developments in high-definition in-dash displays, voice recognition, and other new technologies.
(strategyr.com)

2025

Prevalence of
Internet-Connected
Cars

As of 2015, 35 percent of new cars were connected to the internet. By 2020, it's projected that 98 percent of new cars sold will be connected to the internet. All new cars are predicted to be internet connected by 2025. These are exciting statistics for people working in the in-vehicle infotainment industry.
(statista.com)

future is
promising



Providing an added value platform for OTTs

UC3: Video Streaming



5G-CARMEN will explore different network architectures and configurations with the goal of delivering high-quality video

5G-CARMEN will guarantee not only the data rate requirements but also the need for coverage at all the times

The 5G-CARMEN Challenges

Promoting Green Driving Styles



Connectivity

It is an essential matter to **reduce fuel consumption** and **pollutant emissions**, by controlling vehicles behaviour

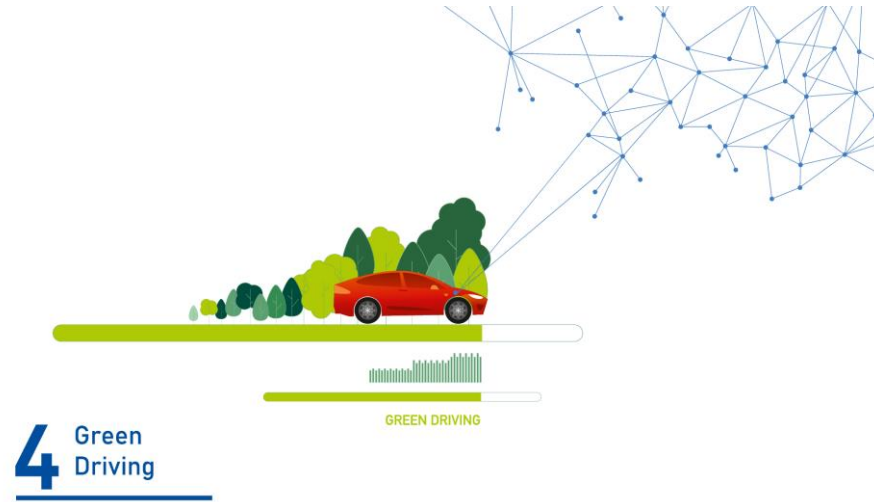


Rewards

It is fundamental to provide solutions geared towards the promotion of greener driving styles

Promoting green driving styles

UC4: Green Driving



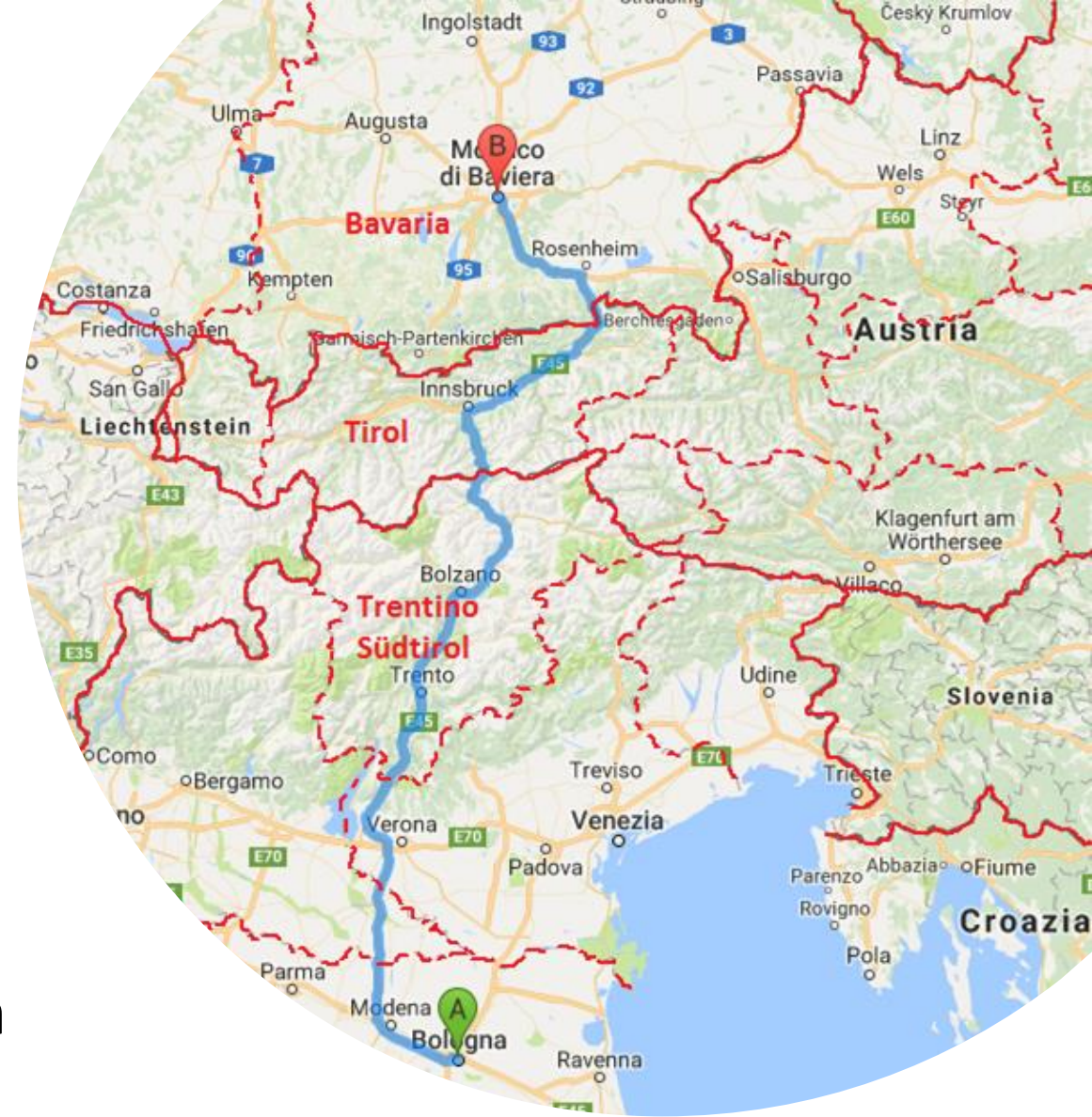
The 5G-CARMEN platform will merge information coming from vehicles and from other data sources

5G-CARMEN will help road operators and traffic authorities in determining courses of action aimed at improving air quality

The Bologna-Munich Corridor

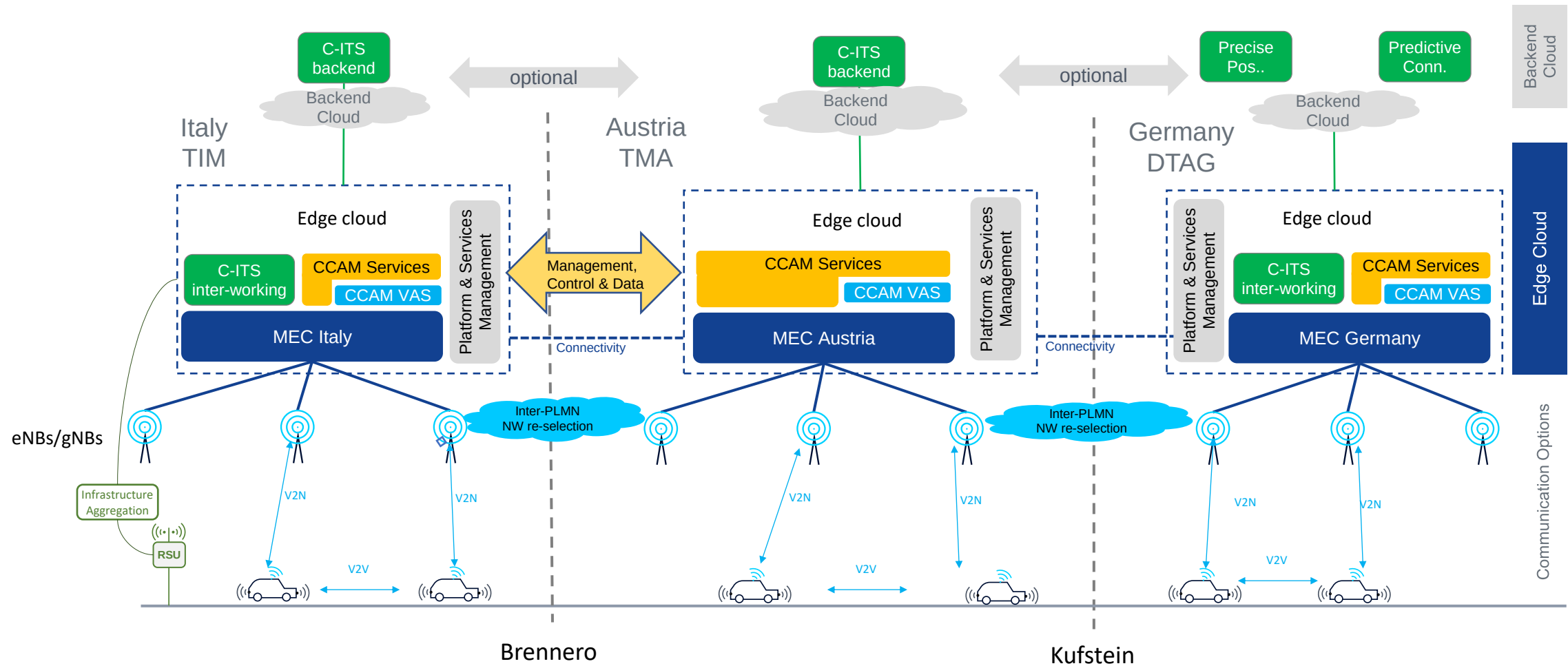
Key Figures

- Total length: ~600 Km
- Interconnecting two-major industrial poles
- Three countries covered
 - Italy
 - Austria
 - Germany
- 2 cross-country trials
- Single-country trials for pre-integration
- Explicit support from EUREGIO regions



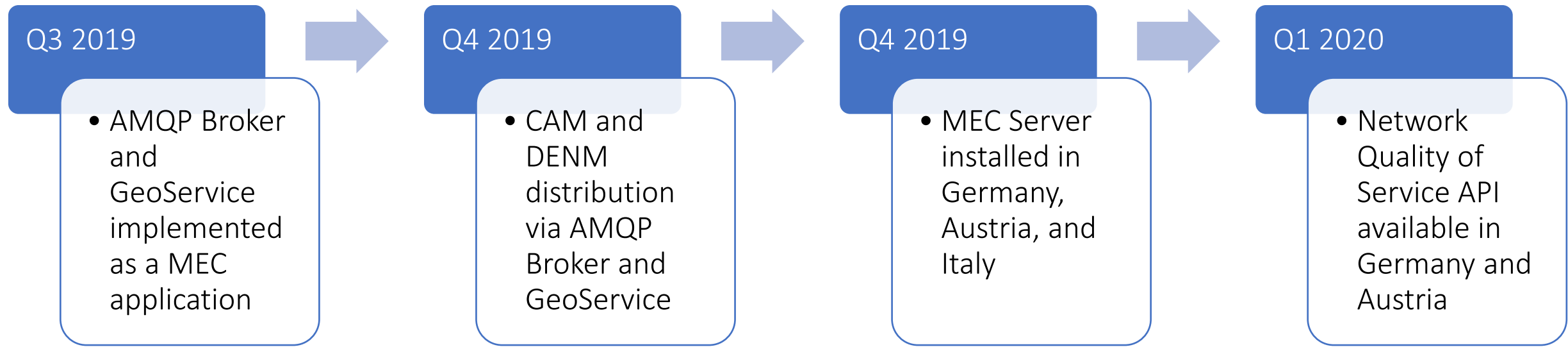
The Bologna-Munich Corridor

Enabling Technologies



The Bologna-Munich Corridor

Roadmap (Draft)



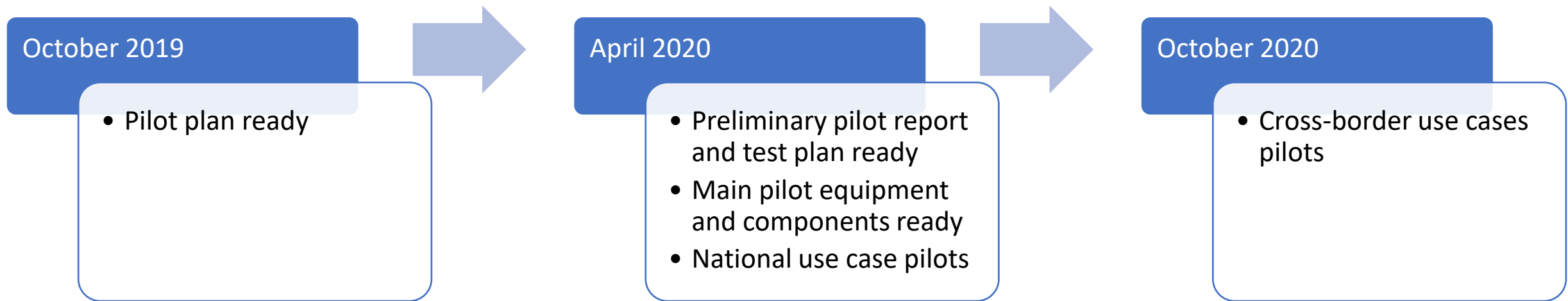
Cross-border and Site Trials

Current Status

- ASFINAG involved thanks to the partnership with FCA/Swarco in ICT4CART
- Qualcomm components about to be delivered to FCA and FBK
- A22 will send over the 5G-CARMEN platform the dynamic speed limits computed by EU Life project BrenneLEC (currently on variable message signs)
- Legacy cars and RSUs will deliver the ITS-G5 day 1 services over the 5G-CARMEN platform through A22 C-ITS service (e.g. car breakdown)
- A22 will provide over the 5G-CARMEN platform weather warning information (e.g., fog sensors) for situation awareness use case
- Swarco speed limit/day-1/weather services available in Austria (Kufstein border)

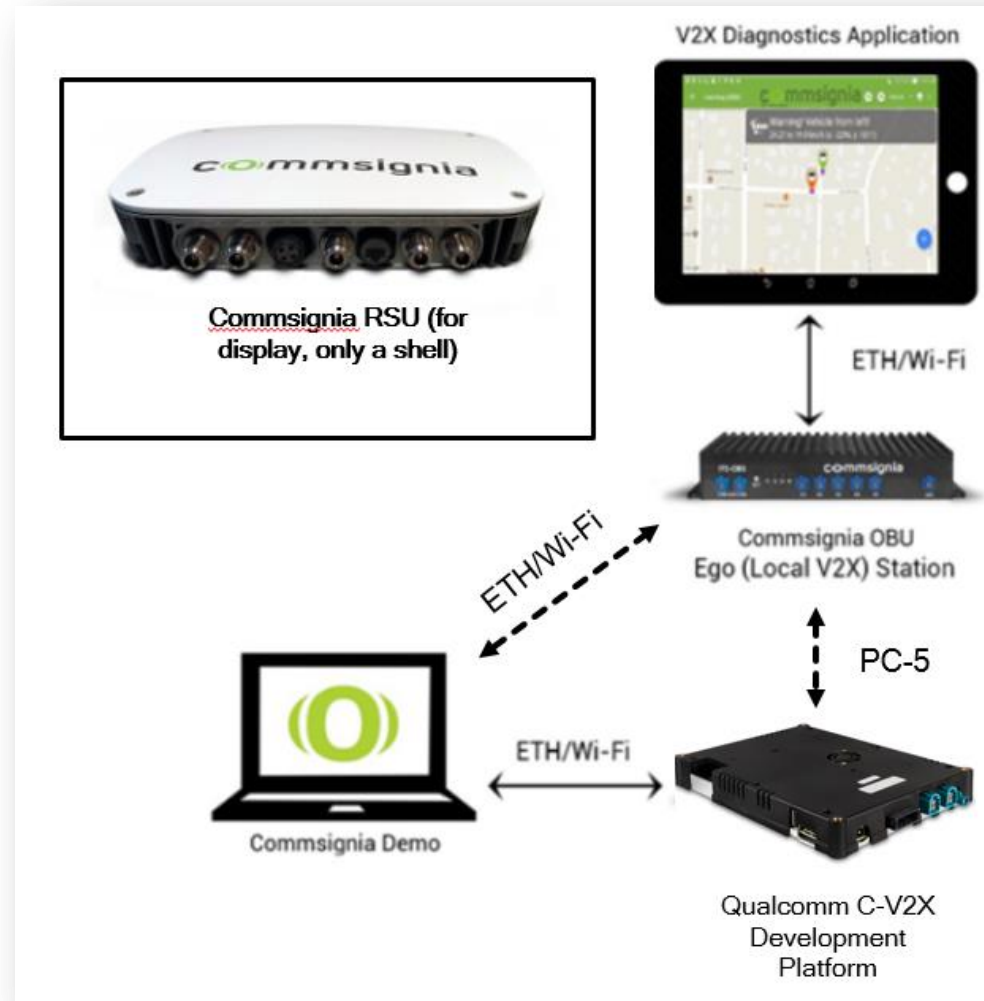
Cross-border and site Trials

Roadmap (Draft)



5G-CARMEN Booth

Live C-V2X Demonstration over PC5



¡Gracias! ¿Preguntas?

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Cross-board Trials and Test Sites

Test sites

- Common
 - One MEC Server available in each country
 - Improved positioning and time synchronization
 - Commercial-grade 5G New Radio Connectivity Available (through overlay network)
- Italy-Austria
 - Interworking with legacy technologies
 - Use Cases: Green Driving and Infotainment
- Austria-Germany
 - Predictive Quality of service
 - Use Cases: Green Driving and Infotainment
- Italy (Trento)
 - Secure, cross-border, and multi-domain service orchestration
 - Use Cases: Green Driving, Situation Awareness, Cooperative Maneuvering
- Italy (Modena)
 - Urban test site limited highway coverage

The 5G-CARMEN CCAM Platform

Technology enablers

- ✓ Hybrid radio access network (LTE, NR)
- ✓ Network-based interworking between C-V2X and ITS-G5
- ✓ Distributed and multi-layer network-embedded cloud
- ✓ Improved positioning and time synchronization
- ✓ Service-oriented predictive QoS
- ✓ Secure, cross-border and multi-domain service orchestration

A collective intelligence ecosystem

The 5G-CARMEN Approach



A hybrid network

Combining direct short range V2V and V2I communications with long-range V2N communications



5G Enabling Technologies

The 5G-CARMEN platform employs different enabling technologies, such as 5G New Radio, C-V2X, and secure, multi-domain, and cross-border service orchestration



The Bologna-Munich Corridor

Current Status

- Survey of existing inter-operator cross-border solutions in Italy, Austria and Germany is ongoing (including MNO's 5G roadmap)
- The use of Nokia's Geoservice and TIM's AQMP server are being discussed across several use cases
- Cloud Services as well as the inter-MEC connectivity requirements are under evaluation against the use case requirements
- Fundamental improvements to the network implementations and configurations are being evaluated (in cooperation with 5GAA)
- Enable seamless connectivity when entering the border area and switching from one PLMN to another
- Deployment locations for 5G gNBs at the Italian/Austrian Border already defined by TIM and TMA