5G-CARMEN NEWSLETTER #6

Dear readers,

The 5G-CARMEN project aims at producing valuable know-how and tangible results for all the involved partners, the scientific community, the industrial world and ultimately - the general public that will be affected by the deployment of effective and secure Cooperative, Connected and Automated Mobility (CCAM) services.

The long-term success of a research project like 5G-CARMEN relies on a fruitful activity on standardisation and dissemination in scientific and industrial for a, and by exploiting synergies with other 5G-PPP initiatives and projects, so as to make the most of the community consensus.

This very complex period in which humanity is embarking has undoubtedly affected the way in which this dissemination has been carried out in a conventional way to date.

The experience gained by the first trials during the last year made with our wireless solutions and the insights gained in the adopted technologies through these trials, represent a central exploitation opportunity in the project in which the partners are starting to figure out how the research done can be transformed in business opportunities.

In terms of standardization, the project has monitored the main standard bodies and industrial organizations that should be monitored, and where the highest impact can be achieved. Contributions to the IETF and ETSI standards were submitted, and several partners are strongly active in both 3GPP and the 5GAA initiative.

Within the 5G-PPP framework, the most relevant 5G-PPP working groups for 5G-CARMEN have been followed, with intense participation in the preparation of the 5GPPP Verticals Whitepaper, and with the leading role of 5G-CARMEN in the Strategic Deployment Agenda study that the European Commission is promoting for the allocation of funds in the CEF plan 2021 to 2027.

Technical achievements

During the last period 5G-CARMEN partners have refined the last details on their proposed system architecture, including additional functional blocks and interfaces, which enable a seamless, low-latency 5G cross-border communication and support our two flagship use cases:

Cooperative and automated lane-change manoeuvres
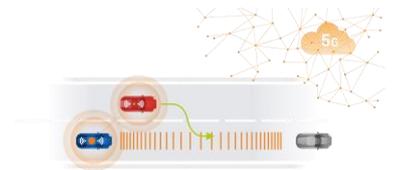
And

Cooperative and automated in-lane manoeuvres
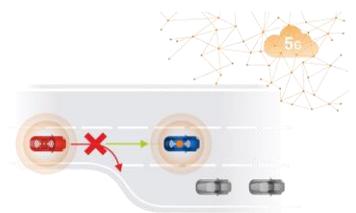
These 5G-CARMEN pilots started the testing of the above 5G-enabled use cases along the corridor in Germany, Austria and Italy.

Preliminary results are available for the deployed cross-border network features, for MEC services, in-vehicle 5G New Radio, on-board applications.

BMW vehicles demonstrate the cooperative lane change managed by Mobile Edge Computing services.

CRF-Stellantis vehicles demonstrate an extended perception, enabling SAE L4 automation, thanks to high frequency sensor sharing. In addition, a back situation awareness service notifying an emergency vehicle approach across countries, is a mean to

evaluate the Orchestrated platform for CCAM.

At present, partners are optimizing the cross-border seamless handover and will soon reach the final pilot configuration, to measure the KPI of 5G for automated driving.

The 5G-CARMEN system architecture extends the 5G cellular network with an orchestrated edge solution, which controls the deployment of CCAM services in each mobile operator's edge cloud and coordinates between different mobile operators' edge cloud the provisioning and continuity of services when vehicles cross country borders and attach to a new mobile operator network.

In the view of security enablers, the project's solution for mutual authentication between vehicles and orchestrated edge services has been defined as an integral part of the service continuity enablers and is currently being evaluated in a lab environment, together with the adopted mechanism to protect edge services from intrusion attacks.

In the current period of the project, the orchestrated edge components have been fully integrated with the edge cloud of all three participating mobile operators, which serve the highway region in the proximity of the pilot's country borders.

While onboarding and deployment of CCAM services in different edge clouds is under control of each operator's

Service Orchestrator, the project and its trials make use of local orchestration and control of CCAM services in each operator's edge cloud for fast re-configuration of edge services and data plane traffic steering in support of smooth transition of service connectivity while the vehicles handover to a new mobile operator, which results also in a change of the edge cloud that hosts the service to which the vehicle re-connects.

When the vehicle attaches to a new mobile operator during a cross-border move, the different orchestrated edges of these operators leverage a direct interface at edge orchestration and data plane level to reduce the service interruption and packet loss during the relocation of the edge clouds to which the vehicle is connected.

These enablers of the orchestrated edges have been tested and validated with dedicated test applications and make use of the developed and collaborating features of smart edge applications, which leverage data analytics, coordinated orchestration between different operators' edge clouds, and of a programmable edge data plane.

The tested enablers for service continuity include the preparation and enforcement of a vehicle's connection to the handover target operator's edge service before the actual handover happens.

Firsts local and cross-border tests with connected vehicles on

the highway and the edge services for Cooperative Lane Change (CLC), Server- Local Dynamic Map (S-LDM) emergency vehicle Back Situation Awareness (BSA) have been performed with instances of these edge applications running on different operators' orchestrated edge platform.

The project completed a detailed analysis of 5G measurements performed on corridor, a documentation of results including 5G signal strength, dependability, and latency charts and also an additional description of 5G frequency bands available in the three countries.

KEY FACTORS

Don't miss next upcoming webinar!

5G-CARMEN webinar on business & technoeconomic analysis

Friday 11/03 11am-12am

Business model finetuning based on the trials

Aiming at improving/validating the business models proposed by the project to support CCAM provision in a cross-border environment, a template with several questions has been prepared to capture the challenges faced during the on-site trials done in November 2021. By knowing exactly what the encountered problems are, the involved actors, how it was solved, is it a work around or a future-proof solution and what are the suggestions made to support such a solution, the business models identified before can be improved or/and new ones can be added.

Dissemination activities

Several dissemination activities were organized to leverage the awareness that has already been created around the 5G-PPP programme.

In order to compensate for the lack of physical events, caused by the lockdown, the project has pushed its online presence, preparing content that could be shared online.

Regular webinars are organized by 5G-CARMEN to communicate recent project achievements.

We have the summaries and recordings of past webinars on our website so they are available for you to browse anytime!

5G-CARMEN webinar on "Advanced prototype for secure, cross-border, and multi-domain service orchestration"

Video recording: [Linkedin](#) | [Facebook](#) | [YouTube](#)
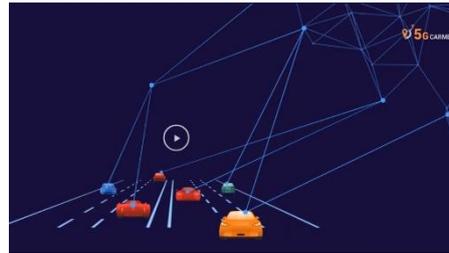
5G-CARMEN webinar on "5G Enabling Technologies for Cooperative, Connected and Automated Mobility"

Video recording: [Linkedin](#) | [Facebook](#) | [YouTube](#)

5G-CARMEN webinar on "System Architecture and Interfaces"

Video recording: [Linkedin](#) | [Facebook](#) | [YouTube](#)

5G-CARMEN webinar on business & technoeconomic analysis

Next project webinar is scheduled 11th March at 11 a.m. Stay tuned, we will provide all connection details as soon as they become available!

ITS WORLD CONGRESS

Despite the pandemic, 5G-CARMEN was present during last ITS World Congress (Hamburg, 11-15 October 2021) 5G-CARMEN with an info corner at ERTICO's stand.

The project also organized a presentation with the other 2 corridor projects 5G MOBIX and 5G CroCo on the subject of: "5G for Cooperative, Connected and Automated Mobility (CCAM) in cross-border corridors: Challenges, Results and Prospects"
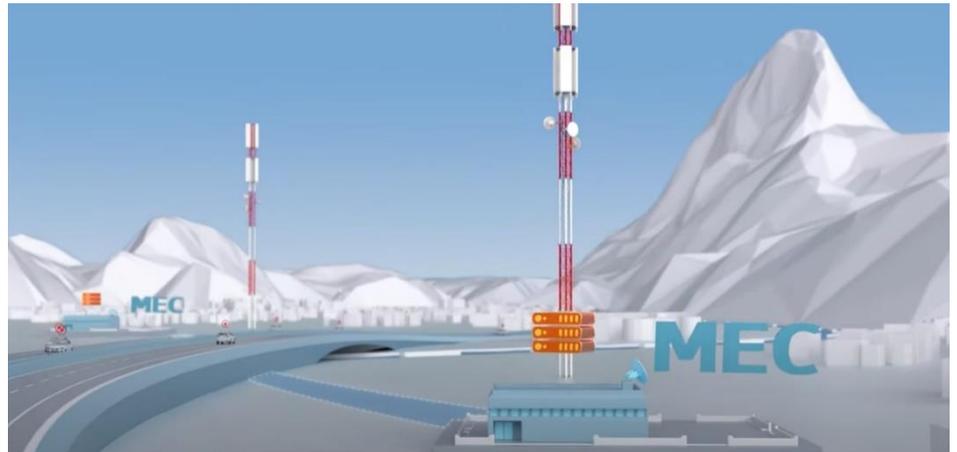
5G CARMEN PROMOTIONAL VIDEO

A promotional video was also recently released and is available [here](#).

It provides key facts and figures about the project, the main use cases that are being tested in the Bologna-Munich corridor and the different enabling technologies employed on the platform such as 5G New Radio, C-V2X (Cellular vehicle to everything), and secure, multi-domain, and cross-border service orchestration system to provide end-to-end 5G enabled automated mobility services.

Some additional videos are also available on our YouTube channel. You can see them all [here](#).