5G-HEART Newsletter

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5G HEART
5G Health, Aquaculture and Transport Validation Trials

Project website: https://5gheart.org/

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1. 5G-HEART Final Event

The 5G-HEART project will organise a public Final Event in Oulu, Finland on 17 November 2022. During the past 42 months, the 5G-HEART project has developed and executed large-scale vertical trials on top of European 5G test facilities focusing on the specific needs of innovative digital services from the healthcare, transport and aquaculture vertical industries. The Final Event will present technical results and key findings from the 5G trials conducted during the project by demonstrating and introducing over 20 specific use case scenarios from targeted vertical domains.

The day will be divided into three special sessions, each focusing on one of the project's target verticals. The first half of each vertical specific session will be dedicated to an overview presentation that summarises the key trialling activities performed during the project and highlights selected vertical use cases with demonstrations on the main stage. The second half of each vertical specific session will be dedicated to more informal discussions and networking as the Final Event audience can visit the project's demo booths and discuss in more detail with the research groups that conducted the trials during the project.

This issue of the 5G-HEART Newsletter focuses on the transport vertical and some of its key use cases and trials to be presented in the Final Event.

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2. Transport vertical trials

Communication between vehicles, infrastructure, the cloud and other road users is crucial to increase the safety of future automated vehicles and their full integration in the overall transport system. 5G is expected to meet the requirements of various advanced use cases of the transport vertical through enhanced wireless connectivity and increased automation, which would pave the way to fully connected mobility and autonomous driving.

The transport vertical trials in the 5G-HEART project are structured under four high-level use case categories , i.e., “T1: Platooning”, T2: Automated/assisted driving”, “T3: Support for remote driving” and “T4: Vehicle data services”. The individual trial scenarios within these four categories are further divided into two main groups. The trials in the so called transport vertical core scenarios focus on the large-scale implementation and in-depth trialling of the key 5G functionalities and KPIs of the transport vertical use cases. The supplementary scenarios provide additional insight into the 5G performance by providing trial results for specific technology enablers.

The core scenarios in the transport vertical are “T2S1: Smart junctions and network assisted & cooperative collision avoidance (CoCa); Trial track”, “T2S4: Human tachograph”, “T3S1: Tele-operated support (TeSo)”, “T4S5: End-to-end (E2E) slicing” and “T4S6: Vehicle sourced high-definition (HD) mapping”. They provide a comprehensive view into the capabilities of the current 5G technologies to support the four high-level use case categories investigated in the project. All of the core scenarios have implemented the service components and network technology enablers required to deploy the tested service in the field. Using these live trial setups, the core scenarios have performed large-scale trials and extensive measurement campaigns to assess and validate the performance of state-of-the-art 5G networks as the connectivity platform for the tested services.

The supplementary scenarios in the transport vertical are “T1S1&T1S2: High bandwidth in-vehicle situational awareness and see-through for platooning”, “T2S2: Smart junctions and network assisted & cooperative collision avoidance (CoCa); Simulation track”, “T2S3: Quality of service (QoS) for advanced driving”, “T4S1: Vehicle prognostics”, “T4S2: Over-the-air (OTA) updates”, “T4S3: Smart traffic corridors”, “T4S4: Location based advertising” and “T4S7: Environmental services”. The supplementary scenarios have studied and trialled the suitability of varying 5G configurations in a smaller scale using different experimental methods ranging from field and lab -based trials to simulations and emulations. The results achieved in the supplementary scenarios complement the results gathered from the large-scale core scenario trials and complete the picture when it comes to commercial 5G networks serving the needs for the transport vertical.

The presented trials have been conducted by utilising mainly the 5GENESIS (Surrey, UK), 5Groningen (Groningen, Netherlands) and 5GTN (Oulu, Finland) trial facilities. Some trials results have also been collected by using a dedicated automated driving trial site in Chemnitz, Germany.

3. Transport trial videos

Several videos focusing on the 5G-HEART transport vertical use cases have been prepared to demonstrate the implementations of the final trials as well as to present key results from them. A short summary of the videos is presented in the subsections below. The videos can be found from the 5G-HEART website at https://5gheart.org/dissemination/videos/ and directly from the project's YouTube channel by following links provided for the different videos below.

Use case T2S1 – Smart junctions and network assisted & cooperative collision avoidance (CoCa)

A high percentage of all traffic accidents occur at intersections, where there is a high density of vehicles and vulnerable road users (e.g. cyclists and pedestrians). The smart junctions scenario provides network assisted safety information towards vehicles to prevent traffic accidents and assist cooperative automated driving functions when vehicles pass through an intersection.

The objective for this use case was to evaluate to what extend a 5G standalone network is able to deliver the network performance requirements as required by a time-critical safety service like a smart junction, when such a time-critical service is not the only service operating on said 5G standalone network. Hence, this work compared network performance of a 5G standalone setup with and without network slicing configured.

A video titled "5G standalone slicing for smart junction and paramedic support" (https://youtu.be/CLD9Kx1wsdM) presents the final trials and key findings from this use case.

Use case T2S4 – Human tachograph

The human tachograph service utilises wearable sensors to monitor the biosignals of professional drivers and provides guidance to prevent fatigue and improve wellbeing based on the live biosignals during driving as well as sleep and physical activity in long-term. The information from the human tachograph application can also be shared with other drivers and vehicles via a 5G-based traffic warning system, which triggers anonymised warning messages towards other road users and road traffic safety systems based on the human tachograph driver condition analysis.

The objective for this use case was to trial the transfer of the monitoring data to and warning messages from the network edge with different service and 5G network configurations. The key 5G connectivity challenges were related to the end-to-end latency and reliability with specific focus on the 5G uplink direction when transferring the raw sensor data to the network.

A video titled "Human tachograph" (https://youtu.be/FCWt-wKzmso) presents the final trials and key findings from this use case.

Use case T3S1 – Tele-operated support (TeSo)

Tele-operated support (TeSo) refers to the remote control of a vehicle using the available mobile network infrastructure. A human operator located remotely sends control commands to the vehicle over the network, while at the same time, information about the vehicle's state and its surroundings is properly transferred and visualised back to the operator.

The objective for this use case was the trialling of the TeSo service prototype in a real pilot over a 5G network. During the trials, a research vehicle properly equipped with sensors and actuators was actively controlled remotely from a distance of around 36 km. Several maneuvers, including driving straight, turning right, changing lane, and parking, are performed and the collected data was analysed to assess the 5G network infrastructure's effectiveness and efficiency in supporting TeSo.

A video titled "Tele-operated support for remote driving" (https://youtu.be/VSZSlE-00gY) presents the final trials and key findings from this use case.

Use case T4S4 – Location based advertising

With vehicle and passenger information readily available, location-based servers can be implemented to stream content (upon request, if required) as well as local advertising or traffic guidance to vehicles and road users. This becomes especially useful in car-sharing models where vehicles are not owned, and the origin and destination of each journey may vary depending on the passengers.

The objective for this use case was to implement and demonstrate high quality multimedia delivery to vehicles over 5G and measure the network metrics like throughput and latency.

A video titled "Location based advertising" (https://youtu.be/BIQJcOuJy3k) presents the final trials and key findings from this use case.

Use case T4S6 – Vehicle sourced high definition (HD) mapping

Autonomous vehicles do not only require on-board sensors to perceive the world around them, but also High Definition (HD) maps to aid their decision making. HD maps of roads and infrastructure will take years to capture and consolidate. There is the added issue of dynamic changes to these maps over time. An innovative means to collect and maintain up to date data would be to crowdsource this information through vehicle on-board sensors which would stream back to a central service, firstly to establish baseline maps and subsequently to manage change detection.

The objective for this use case was to implement and demonstrate capture of sensor data like LiDAR, upload this over 5G and measure the network metrics.

Videos titled “Vehicle sourced HD mapping” (https://youtu.be/DDLlUtGR4aY) and “Tele-operation support” (https://youtu.be/ZRHd7HXV--U) presents the final trials and key findings from this use case.

Use case T4S7 – Environmental services

Vehicles may provide a rich and real time source of weather and environmental information through existing on-board sensors such as light sensors for external light conditions such as cloud cover and fog, wiper data for intensity of rain, and suspension data for monitoring road conditions such as potholes. These can be consolidated to create hyper local weather maps aiding drivers and automated vehicles s in day-to-day driving but also to assist local authorities to improve road maintenance.

The objective for this use case was to implement and demonstrate capture of air quality data using IoT technologies and upload this over 5G and measure the network metrics.

A video titled “Environmental services” (https://youtu.be/pbJyEejHIPU) presents the final trials and key findings from this use case.

4. Summary

This issue of the 5G-HEART Newsletter focused on the upcoming 5G-HEART Final Event and provided an overview to the transport vertical trials that will be presented in more detail during the event on 17 November 2022. This issue of the newsletter also introduced a selection of use cases from the transport vertical with links to videos highlighting the implementations of their final trials and achieved key results.