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5G-TOURS NEWSLETTER

The official 5G-TOURS project newsletter

5G-TOURS

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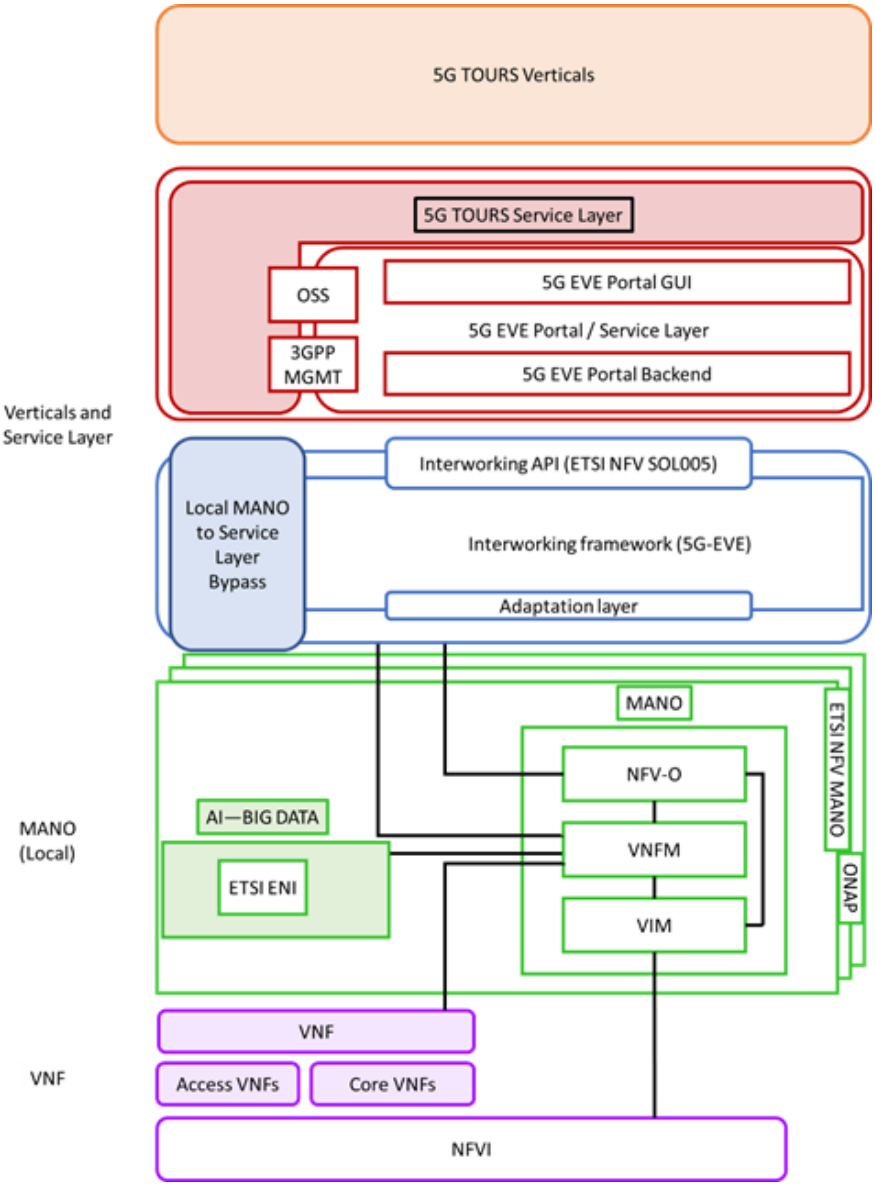
A welcome from the 5G-TOURS technical manager

Belkacem Mouhouche

Welcome to the second edition of the 5G-TOURS newsletter, in which recent milestones and trials will be discussed. Midway through the project, we are swiftly moving from the architecture definition to the implementation of the use cases with some very exciting early demonstrations.
Recently, we had our mid-term review where we presented the progress so far and shared the plan for the second half of the project.
The first half of the project focused on the definition of the use cases and their technical requirements, the overall architecture that incorporates many components such as 5G-EVE, legacy projects (5G-Monarch and 5G-Xcast) as well as 5G-TOURS specific innovations.
The second half of the project will focus on the finalisation of the infrastructure and verticals implementation and subsequently on the use cases validation where the original requirements will be compared with project outcomes.
We are also accelerating our dissemination activities by providing videos and webinars on specific use cases while we continue the organisation of workshops and contributions to standards such as 3GPP and specific verticals.
This second edition focuses on 8 innovative use cases.
Remember to visit our website and our YouTube channel for the latest videos!
Enjoy the reading!

WHAT'S INSIDE THIS ISSUE?

5G-TOURS Architecture



The 5G-TOURS overall architecture has been designed with the goal of fulfilling the requirement posed by the different use cases, while gathering input from all the ongoing standardisation activities happening at each domain of the network. We followed a layered approach that builds on the findings of the 5G EVE project architecture, enriching it with specific elements that support the 5G-TOURS view.

The overall 5G-TOURS architecture is depicted in Figure. It is composed by the following five main layers:

• The Verticals: The aim of 5G-TOURS is to provide a flexible infrastructure for the verticals, thus verticals provide the utmost feedback regarding the usability of the architecture and the network, as it must fulfil the requirements set for their use cases through the service layer in a user friendly way. Specific details about this part are reported within WP4, WP5 and WP6 deliverables;

• The Service Layer: The service layer is the “door” that is used by the vertical to access the 5G-TOURS network. It must provide advanced functionality for the service on-boarding, integrating AI and Big Data concepts, to support the automated operation of the network. The Service Layer has to consider its integration with the 5G EVE portal, which can provide a subset of the needed functionality;

• The Interworking Layer (Central MANO) and its bypass: The 5G EVE interworking layer glues together the different sites that provide infrastructure around Europe. It also allows for some functionality for network on-boarding and KPI monitoring, as well as the definition of the templates that are used by the underlying network infrastructure. However, as some of this functionality is not enough for the 5GTOURS system, we envisioned a bypass that directly interfaces with the local Management and Orchestration (MANO) of each site, to provide enhanced functionality that would have been too complex to provide when using the Interworking Layers included in 5G EVE. Still, 5G-TOURS will use the portal and other software assets provided by 5G EVE as much as possible;

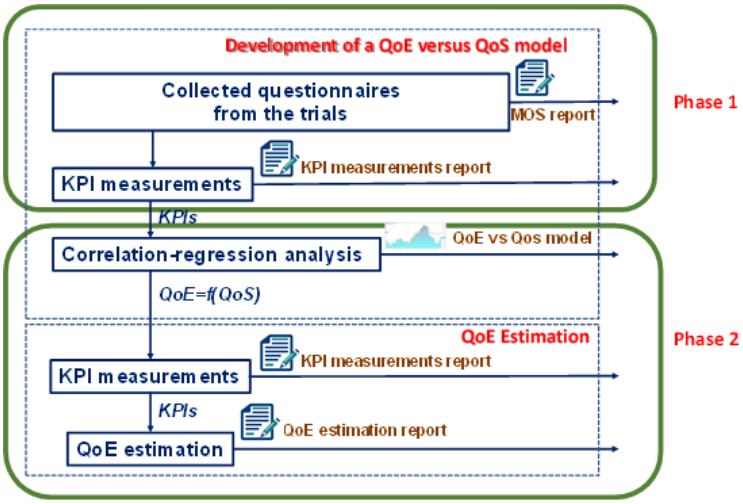
• The local MANO: As each site leverages on different infrastructure (both physical and for the available network function), so the MANO needs to be tailored to the different sites. Each of the MANO interfaces to the interworking layer (as part of 5G EVE) also offers specific APIs for the bypass to be used by the 5G-TOURS service layer. The MANO offers all the functionality exemplified by the ETSI NFV MANO reference architecture composed by the NFV Orchestrator (NFV-O) VNF Manager (VNFM), enhanced by some 5G-TOURS specific functionality such as the AI-based orchestration algorithms. This also includes specific architectural design such as the ones designed by the ETSI Experimental Network Intelligence (ENI) group, to which 5G-TOURS is contributing with a proof of concept;

• The VNF (infrastructure layer): which represents all the assets available in the sites.

More information you can find in Deliverable 3.2 "Technologies, architecture and deployment initial progress".

5G-TOURS QoE/QoS evaluation approach

In recent years, the technical community has shifted some attention from one related gauge, quality of service (QoS), to a more consumer-centric metric, quality of experience (QoE). Network operators and service providers from the very advent of telecommunications wanted to know, the level of service quality which is provided to the end users. This is because that knowledge can be extremely useful when trying to manage network topology, optimize its capacity and operating costs, introduce new services or plan investments and expansion of a network. This is particularly true in a scenarios such as 5G, where we have extreme requirements resulting from new applications and the QoS values required to provide a good experience to end-users are not known.
Thus, to demonstrate the benefits of 5G technology in the pre-commercial environment for real users, tourists, citizens and patients in terms of both QoE and QoS was developed the final 5G-TOURS evaluation methodology.



We discriminate between two phases. Phase 1 is realized during the trials execution and collects both the QoS metrics, automatically collected from the infrastructure, and the QoE metrics (and vertical satisfaction) collected using appropriate questionnaires. The user's definition of QoE does not consider measurability and so set of QoS parameters, which together provide a service and mostly influences the QoE, has to be defined. The most important parameters from this set can be measured and quantified. To define this set of parameters, Phase 2 is realized after the trials executions and by using correlation-regression analysis which aims to create a model for QoS-QoE correlation.

The 5G-TOURS project aims at deploying three full end-to-end trials involving real end-users (volunteers who consent to participate) and vertical operational services in three different European cities (Turin, Rennes, and Athens)

Virtual reality use cases

Samsung Research UK is tasked with developing two distinct use cases.
Samsung Research UK is tasked with developing two distinct use cases: use case 1.a (VR part) in Palazzo Madama and 1.b in GAM. The development of both use cases has started.

UC1.a VR - In the very heart of Turin

For the former case, a Virtual Reality application in which users will solve a puzzle with the works of art in the frames in a room is in the works.
During this time, planning for the experience, selection of the venue (Camara de la Guardia), and usability guidelines have been defined.
Samsung has a working prototype of a 3D space with scans of the selected chamber done by RAI.
You can join the virtual space in VR and interaction is being developed. It is being analysed now the optimization of the assets required, as well as the experience itself.

UC1.b - Gamification, let's play artist

For this use case, an interactive wall application is being created that allows users to create art that mimics the style of artist Nicola De Maria.
Samsung has developed a gesture recognizer to be used over a Bluetooth connection with a prototyping platform to use as input for the experience. The graphical interface of the interactive wall is under development.
Samsung has been actively participating in meetings, plenaries and other coordination efforts for these use cases.

Augmented tourism experience

With 5G technologies, mobile operators will offer new services allowing verticals to use AR/VR applications for their needs

The objective of this Use Case is to implement and validate an immersive and personalized virtual experience application, targeted both to the museum's visitors and to tourists/citizens inside and the surroundings of the Palazzo Madama museum in Turin.

The culture digitalization is one of the keys focuses that UC1.a is promoting, and especially in this situation of social distancing in which technology could contribute to approaching us in a digital way.

This virtual guide is delivered as an advanced mobile application and will be based on interactive technologies such as Augmented Reality (AR) and XR (Cross Reality) tecnology on top of a managed 5G infrastructure in order to enable users to interact with the artwork virtually, and it will also provide key information on the piece of art (how it was created and/or restored, information on other works from the same artist and details on the artistic movement).

Moreover, exploiting the indoor localization system, the application detects the proximity to a specific area and pre-downloads multimedia contents to augment user's visit to the museum before the user gets to the piece of art.

Finally, by scanning the work of art in each case with image identification, detection software, and Augmented Reality, the user can see additional information about the author, the year, the type of work, and other works of art or videos. This is heavy data that require the latest 5G technology to increase bandwidth and decrease latency.

Atos brings its expertise in Immersive & Interactive Media, which includes interactive technologies such as Augmented Reality (AR) and Virtual Reality (VR) to this project. On the other hand, the RAI Research Centre in Turin is providing new and refined 3D models of art on display at the museum, to improve the Fondazione Torino Musei multimedia database, which will be used to create the virtual application. Finally, TIM brings specific knowledge on smart city applications and artificial intelligence algorithms as well as the Internet of Things (IoT).

The video about this use case is available here:

Robot assisted museum guide

This use cases demonstrates the use of 5G technology in the implementation of autonomous robot behaviors. This uses cases employs R1, a humanoid robot developed by Istituto Italiano di Tecnologia (IIT), specifically designed to assist humans, monitor dangerous situations, entertain and perform service tasks in domestic or public environments.

In this use case, R1 will be tested for the first time in a museum environment. In particular, it will be deployed in the two museums of Palazzo Madama and Galleria d'Arte Moderna (GAM),Turin, which have been equipped with an indoor 5G network, provided by Ericsson and TIM.

At the main entrance, or in common areas inside the museum, R1 will be able to provide basic information about collection highlights and temporary exhibitions, as well as the location of notable points, such as vest rooms, toilets and security exits. During queuing time at ticket desk, R1 will assist visitors giving them real time information about the line and prospect waiting time. Inside the museum, instead, the robot will be able to physically guide visitors to the attractions, moving through the rooms and describing the artworks.

Thanks to the 5G connection, the computation required to perform the autonomous navigation will be moved from the robot to a powerful remote server located in the museum. This will allow to run more complex algorithms with negligible delay, boosting the robot capabilities. Additionally, a human operator will be able to control R1 during museum closing time, inspect the halls and perform remote surveillance.

Due to the COVID emergency, most of the work done in the first part of the year has been carried on developing 3D simulations of the museums, and testing R1 movements in IIT laboratories. In this phase, developers tested the ability of the robot of localize itself, navigate in the environment, and started to work on the robot dialogue system.

We are now entering a new phase of the project: in these days R1 has been upgraded with a 5G-capable hardware and has been moved to Ericsson labs in Genoa. Here, all the mobile network parameters will be tuned, in order to make the robot ready for the next phase, when the robot will be deployed in the real museum environment. According to the schedule, preliminary experiments with R1 in Turin have been planned for the end of the 2020, while a complete installation of indoor antennas in the museums is expected in 2021.

The video about this use case is available here:

The fifth generation of wireless technology will pave the way for a new generation of robots

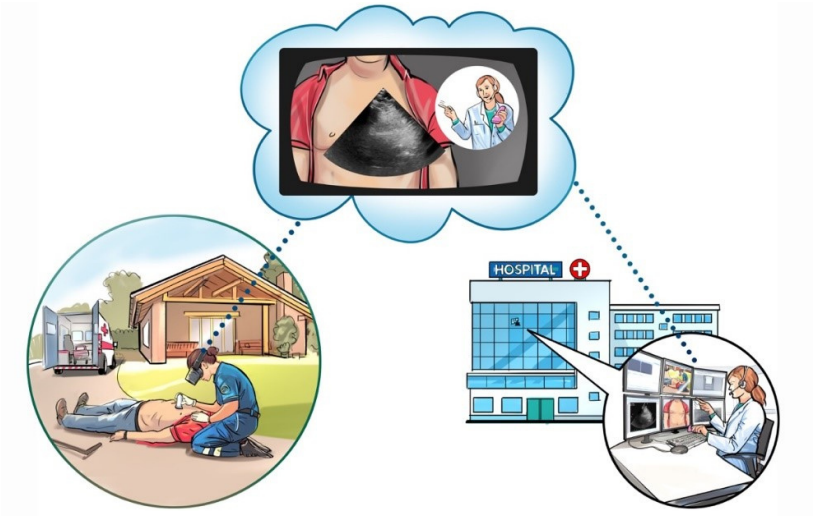
The Safe City aims to demonstrate how multiple vertical industries can simultaneously use the same 5G architecture and services to deliver advanced use cases to citizens

Teleguidance for diagnostics and intervention support

The goal of the use case is to develop profound understanding on how 5G can be used to improve emergency care. In particular, how it can improve the communication between care givers in the ambulance / near the patient, the medical regulator, remote experts and emergency department staff to save the life of more patients than before, improve the outcome for patients on the short and longer term as well as their wellbeing, reduce the workload and stress for all care providers and improve their effectiveness, and last but not least, reduce the overall cost of care on the short and longer term so that patients can participate fully in society again after a quick recovery.

Precise diagnosis of life threatening conditions is essential to give patients the necessary lifesaving treatment as quickly as possible, e.g. drain fluids from the pericardium in case of a cardiac tamponade, or directly start the treatment of critically ill patients to reduce irreversible health damage as much as possible, e.g. start anti-coagulant medication treatment ASAP to save heart muscle in case of a myocardial infarction.

Ultrasound is a highly versatile diagnostic tool in these cases, enabling rapid and quantitative examination of a variety of organs, including the heart, lungs, and abdomen. Major drawback is that correct placement of an ultrasound probe is difficult, for the acquisition of images of diagnostic quality and for the interpretation of these images. Ultrasound has therefore limited usefulness without an expert doing the probe handling and the image interpretation. However, if a less trained ambulance doctor could be guided by a remote expert, fast and accurate diagnosis and intervention support would still be possible.



Current network technologies do not provide sufficient coverage, are not reliable enough and do not provide sufficiently low latency communication for this application. Next, network performance KPIs should be guaranteed at all times in case of an emergency, even in crowded spaces with network overloading such as may happen in a football stadium.

It is expected however that 5G technology will provide the key differentiating network KPIs to enable remote collaboration scenarios between care providers, where an expert guides a remote doctor or paramedic in performing an ultrasound exam or an ultrasound guided intervention. A guaranteed Quality of Service level is of key importance in this case, which 5G network slicing technology can provide.

First experiments have already been performed at the Academic hospital (CHU) in Rennes (France) with the Philips Lumify-Reacts portable ultrasound solution and the XpertEye smart glass solution provided by AMA.

Webinar video about this use case is available here:

5G technology will provide the key differentiating network KPIs to enable remote collaboration scenarios between health care providers

Operating room powered by 5G

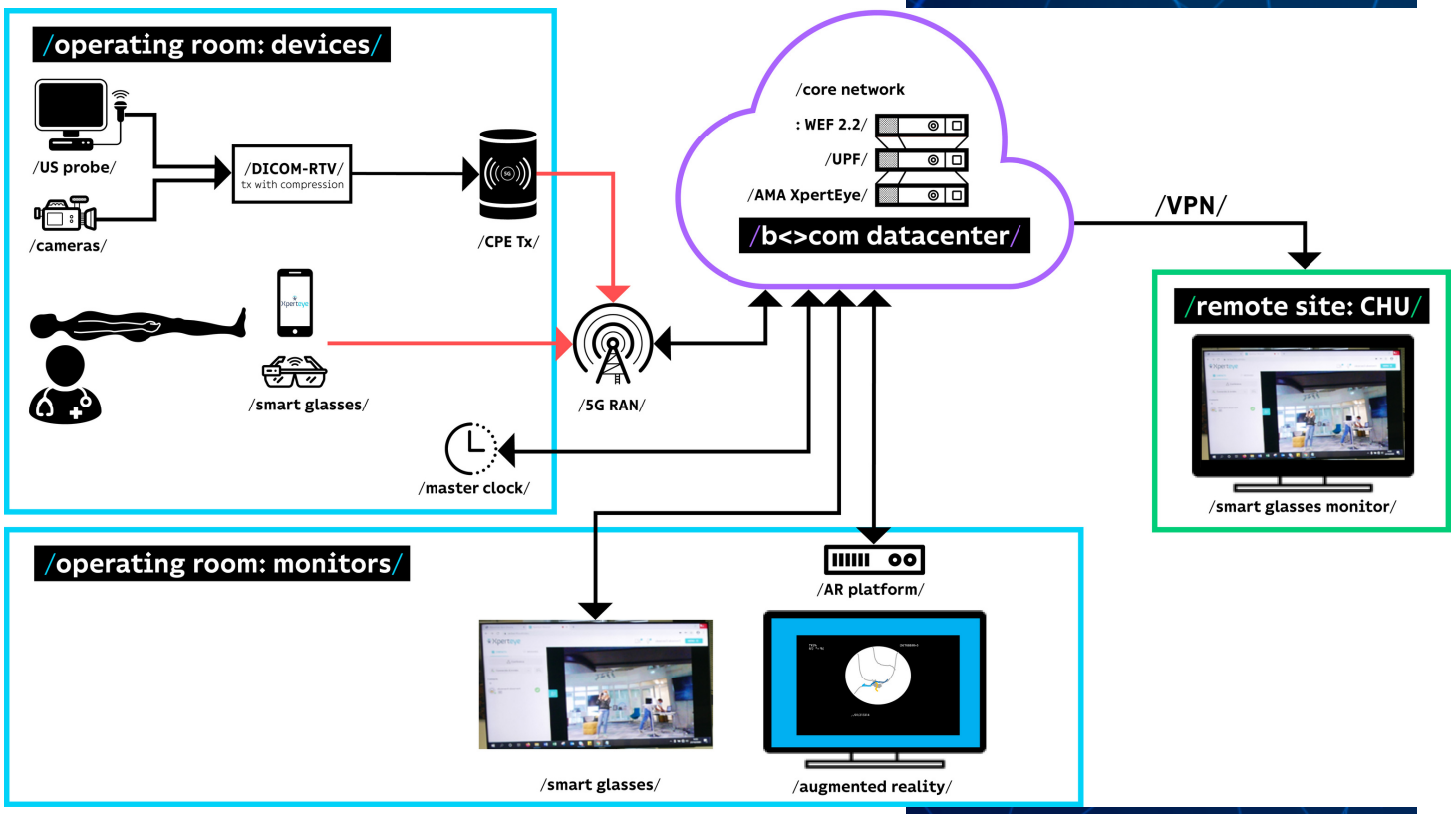
This UC addresses the challenge of the mobility of the devices inside the operating room thanks to 5G connectivity.
Medical interventions are more and more complex and involve multiple imaging devices. This leads to a high number of wires in the Operating Room, which can be a real source of nuisance. Wires may present a risk for the team, defocus from the patient. They also prevent to easily move the devices from one room the other. The use of 5G inside the OR offers great promises to remove unnecessary wires by transmitting the signals in a fast and secure way.
Our UC implements a scenario where a cardiologist is performing a complex intervention with the help of an Augmented Reality (AR) application. The AR display performs the fusion of two complimentary real-time imaging devices: ultrasound, showing the flow and the cardiac muscles, and X-Ray fluoroscopy, showing the surrounding anatomy and the catheter.

While the X-Ray device is wired connected to the AR platform, stream from the ultrasound probe is converted to DICOM-RTV standard and connected to a 5G device; this stream is transmitted through the 5G network to the same AR platform. Registration and fusion of the two video streams are performed to produce the AR images used by the cardiologist during the intervention. Those AR images are transmitted through 5G network and displayed in a monitor connected to another 5G device. During the intervention, this cardiologist is wearing AMA smart glasses to interact with a remote colleague. The video stream from the glasses is transmitted thanks to a 5G smartphone connected to the same network.

This Use case addresses the challenge of the mobility of the devices inside the operating room thanks to 5G connectivity

To check the technical feasibility of this setup, a first trial was implemented in b<>com facilities in February. Instead of the X-ray device, an external video camera was used. This video display was presented to the cardiologist, enhanced by the fused live ultrasound image thanks to the AR platform.
The 5G Network leverages on b<>com's core network solution deployed in b<>com's datacenter, 5G RAN is deployed by Nokia in the Operating Room, and Orange is managing the network orchestration through 5G-EVE platform. In order to reduce the end to end latency, the data-plane carrying the data from the imaging equipment to the AR application and for the AMA applications is instantiated in an Edge Cloud in the operating room.

5G opens the future of telesurgery



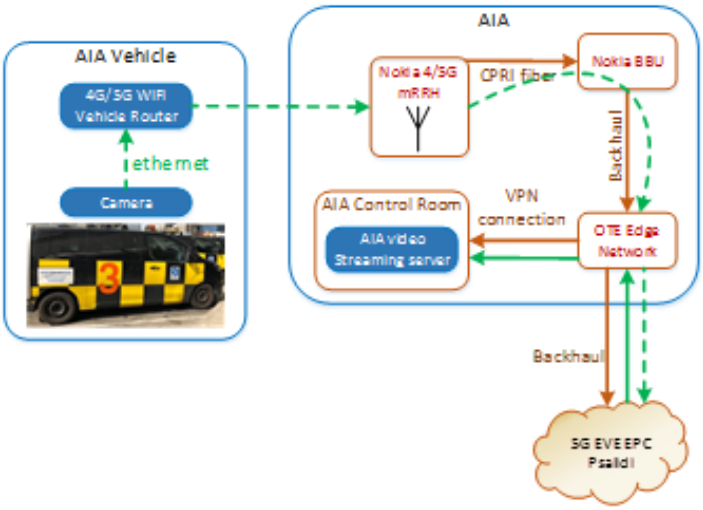
Webinar video about this use case is available here:

5G could usher in telesurgery and remote surgical procedures

This use case aims to demonstrate the potential of 5G technology for high bandwidth and fast network response in live streaming of camera feeds

Video-enhanced ground-based moving vehicles

This use case aims to demonstrate the potential of 5G technology for high bandwidth and fast network response in live streaming of camera feeds. This use case will be implemented via the installation of high definition cameras on the Athens International Airport (AIA) follow-me vehicles, which will feed live video feeds to the ASOC as well as to other concerned third parties and stakeholders. Enhancing the ground-based moving vehicles with technologies that provide real time notification on the Apron situation at any given time is of great value to the airport in sustaining an efficient and safe operation, for the customers (Airlines) for whom, safety and avoiding flight delays is vital, as well as other stakeholders (emergency resource personnel – Police, Ambulance Services, Fire Brigade) in efficiently responding to emergencies.



The innovation in this UC is that there will be Active Performance Measurement while the Service is running and the real time feed of KPI values will allow for better AI-based decision making.

Therefore, the end users (follow-me car driver and the control center personnel) will increase their situation awareness, have better and more interactive collaboration among themselves and pre-emptively address irregular or harmful conditions that might happen.

The UC is designed as follows: Live video feed captured by moving AIA vehicles will be forwarded via 5G Wi-Fi routers on the vehicles through Cosmote 5G Network (AIA's NOKIA RAN and 5G EVE EPC at OTE Psalidi area) to the video server installed in AIA's control room for real time inspection.

The goal of this UC is to demonstrate the impact of 5G on video that is transmitted from the UE (in this case AIA's ground based vehicle) to a Server located closer to the Core Network. The direction of the Video Transmission is Upstream (as opposed to the usual downstream direction from the Server to the Access and UE). It is more frequent to expect that the End-User will receive High-Definition Video but in this case the End-Use transmits High-Definition Video. Therefore, since also it is a Real-time service (the Video Feed is to be real-time and stored and forwarded on demand) the Upstream direction of the 5G Mobile Access Network is being stressed.

5G-TOURS partners involved with video enhanced ground based moving vehicles management UC are WINGS, AIA, OTE, NOKIA-GR and ACTA.

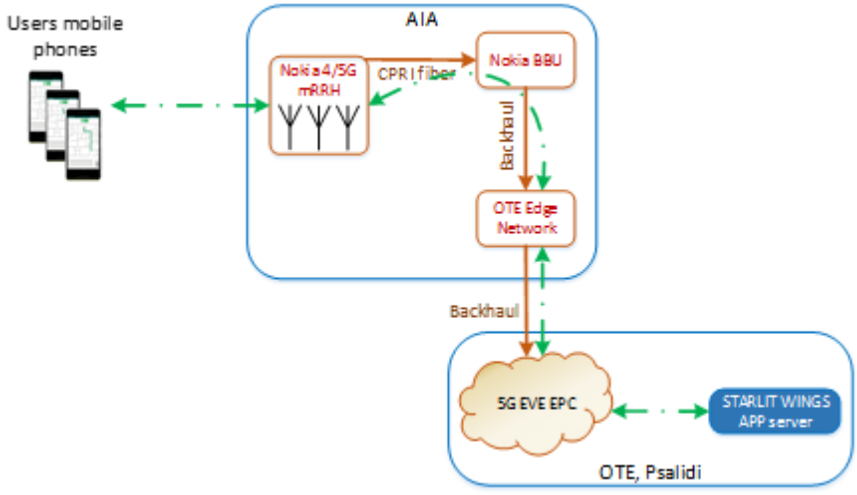
Emergency airport evacuation

This use case aims to prove that 5G technology enables low-latency and high-reliability communications to a big number of users concentrated to an indoor area. To achieve this, the use case demonstrates the quick and organized evacuation of people in large crowded indoor public spaces, reducing thus the possibility or magnitude of casualties with the aid of 5G enabled solutions.

The idea of this scenario is to support occupants to be safely guided to the nearest exit, after an unattended item is left at Gate A36 of the Satellite Terminal Building (STB) in Athens International Airport (AIA) and based on the current protocols an evacuation is deemed necessary.

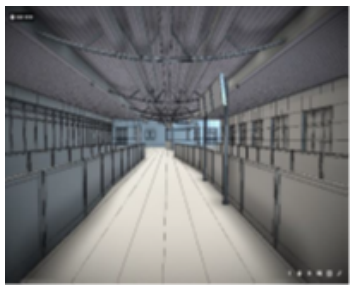
The end-user (evacuee) will be guided towards the nearest exit via an intuitive interface rather than a set of instructions that maybe confusing for the user under stress. Also the location accuracy that will be provided from the 5G network in conjunction with the 3 indoor cells will provide the users location precisely. Thus, the accuracy will be better than the one provided by current mobile networks.

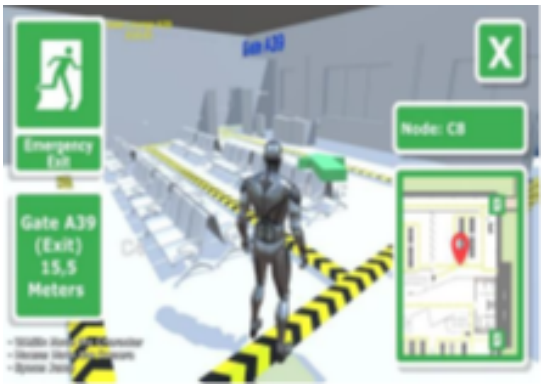
Indoor micro cells provided by NOKIA-GR and connected to Cosmote 5G Network will be installed in appropriate places in a selected Gate area in AIA, thus allowing WINGS application deployed on STARLIT server (located in OTE Lab in Psalidi together with 5G EVE EPC) to estimate accurately all users' position via triangulation. The result of this processing will return to WINGS mobile application that eventually draws the user a personalized and optimized evacuation path.



This use case aims to prove that 5G technology enables low-latency and high-reliability communications to a big number of users concentrated to an indoor area

The key aspects on this UC is the transmission of Location Information (and direction using the gyroscope) per UE with High-Accuracy and Low one-way Latency in the Upstream Direction and Transmission of guidance information from the Server towards the UE. Therefore Location Accuracy and Latencies (UEà Server and Server à UE) are important. Since there might be involvement of a large number of UEs the total Throughput (and not the Throughput per UE) is also important. Finally, since this UC deals with an Emergency Situation Availability and Reliability are the most important parameters.





For Latency, software probes provided by ACTA will be used on the end user mobile phones, probe at the NOKIA ePC, and next to the Starlit Platform. This distribution of the probes will provide latency data at segments of the network, as well as the end to end Latency. For Throughput, ACTA probes will be installed between the ePC and Cosmote POTP and also in other locations to measure throughput at specific points of the network i.e. at the end points.
The probes will gather locally network metrics data. This data will be collected centrally for analysis and reporting. If metrics values are worse than the expected 5G network values, feedback will be given to the network providers, to study and identify if issues can be resolved.
For the application part a digital 3-D model of the area, based on the airport's architectural plans, was developed as well as enhanced routing and indoor localization algorithm.
5G-TOURS partners involved with emergency airport evacuation UC are WINGS, AIA, OTE, NOKIA-GR and ACTA.

This use case aims to prove that 5G technology enables low-latency and high-reliability communication to a big number of users concentrated to an indoor area

The fast and reliable wireless connectivity offered by 5G and the smooth streaming of online content that it can enable will be utilized to generate top quality digital learning experiences both during the transportation to and from the destination, and during the visit of the exhibit

AR/VR services

The goal of this Use Case (UC) is to demonstrate the value offered by 5G in cases when groups of people travel, e.g. on a bus, in order to visit a site of interest. UC focuses particularly on the example of school students traveling to a destination of educational interest during a field trip or excursion. So, in the trials of the 5G-TOURS project, a group of 20-25 students from the school of Ellinogermaniki Agogi (EA) will travel on a school bus to Athens International Airport (AIA) to visit an exhibit that will be hosted in the public space of the Arrivals area of the airport.

The exhibit and the learning experiences linked to it will be related to the “Myrtis, face to face with the past” exhibition, which presents the results of renowned interdisciplinary research led by Professor Manolis Papagrigorakis of the University of Athens and his team. The focus is on the reconstructed face of “Myrtis”, an 11-year-old Athenian girl who was, along with Pericles, one of the tens of thousands of victims of typhoid fever in the year 430 BC. Cutting-edge VR and AR applications enabled through 5G will allow students as well as other airport visitors to find out more about this important research, about various aspects of everyday life and historical events in the ancient past of Athens, as well as about Myrtis’ very topical messages to modern-day people especially in the current context of the COVID-19 pandemic.

The fast and reliable wireless connectivity offered by 5G and the smooth streaming of online content that it can enable will be utilized to generate top quality digital learning experiences both during the transportation to and from the destination and during the visit of the exhibit. During the school bus ride transferring the students to the airport, students will be presented with rich informational and educational content preparing them for the visit of the exhibit in the airport, through the use of VR technologies on their 5G-enabled smartphones and headsets. Next, during the visit at the airport, the students will be able to interact with the exhibit using AR technologies on their 5G-enabled smartphones, to enhance the learning experience and overall enjoyment of the activity. Finally, during their bus ride back to school, students will interact with digital content relating to the visited exhibit through VR technologies on their 5G-enabled smartphones and headsets, as a wrap-up and follow-up to the learning experience of the visit.

Future 5G-TOURS events

EuCNC join workshop

The 2021 Joint EuCNC & 6G Summit, initiated this year, builds on putting together two successful conferences in the area of telecommunications: EuCNC, in its 30th edition of a series, supported by the European Commission; the 6G Summit, in its 3rd edition, originated from the 6G Flagship programme in Finland, one of the very first in its area.

EUCNC
6G Summit
Virtual Conference (Porto, Portugal)
8-11 June 2021

IEEE International Conference on Communications 2022

IEEE ICC is one of two IEEE Communications Society's flagship conferences (ICC and Globecom). Each year, close to 2,000 attendees from over 70 countries attend IEEE ICC to take advantage of a program which consists of exciting keynote session, robust technical paper sessions, innovative tutorials and workshops, and engaging industry sessions. This 5-day event is known for bringing together audiences from both industry and academia to learn about the latest research and innovations in communications and networking technology, share ideas and best practices, and collaborate on future projects.

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