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6GSNS

IMAGINE-B5G

Advanced 5G Open Platform for Large Scale Trials and Pilots across Europe

IMAGINE-B5G Vertical Experiments

Version v1.0

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Imagine B-5G

1. Public Protection and Disaster Relief (PPDR)

PPDR sector focuses on the creation of a stable and secure environment for the citizens and protecting their lives in case of natural and provoked disasters. The activities considered in the PPDR sector are routine day-to-day activities (such as police, firefighting, medical attendance), planned events (fairs, sports, conferences) and unforeseen incidents (natural disasters, terrorists attacks). Due to the nature of these activities, there is an increasing need for ensuring the real-time collection and exchange of information, including control data, pictures, and video streams, along with voice to ensure the success of operations and the collaboration between groups of first responders. PPDR imposes several challenges to the network such as deploying wireless broadband coverage with the orchestration of different radio access technologies, portability, mobility, and specialized requirements for different services.

1.1 UC1: Firefighting and forest surveillance (French Facility)

1.1.1. UC Description

In the future, sensors, cameras, and other automatic devices will be a significant source of information for public safety and other professional users. Information from IoT will also become important for developing a full picture and thus providing better support – before and during incidents. Public safety organizations will have significantly more information on which to base decisions. This could help critical operations be more active, for example, moving from extinguishing fires to preventing fires in advance. The UC's goal is to improve event identification and characterization, operation, and disaster relief. To achieve this, the IMAGINE-B5 platform will leverage B5G features for reliable and efficient information collection (from UAVs and other sensors) and data processing to provide smooth real-time reporting, critical updates, and actionable intelligence, as timing and reliability can be the difference between life-or-death disasters. Furthermore, the platform relies on the computing continuum to overcome the complex decision-making process throughout the cycle.

1.1.2. UC Scenario

The scenario should focus on the role that flexible networking and computing infrastructure coupled with IoT may have for the detection, characterization, and operation of fire scenarios (deployed team status, fire progression, weather, and other multiple data). This will be done by deploying the project capabilities, enabling the collection, and monitoring of big amount of information from the field and in control centres. Organizations improve the quality and timeliness of their operational decisions and communications (e.g., field deployment decisions or updates). The project components will be challenged, addressing both the dynamic and mission critical nature of the scenarios.

Forest surveillance and firefighting involve various PPDR organizations (e.g., fire fighters, civil rescue, police, local organizations, private organizations), with field operation being coordinated both in local field commander positions and control centers, and by the remote headquarters. The goal is to validate the applicability, performance, and benefits of the project for supporting Mission Critical multimedia

communication in firefighting scenarios, and its interaction with data centric IoT technologies to improve event identification and characterization, operation, and disaster relief by PPDR organizations.
During firefighting scenarios, decisions and operations should be strongly aided by technologies such as communication networks, multi-source data and IoT analysis and assisted decision-making platforms, including UAVs / drones which are used both for realizing data collection (e.g., visible & thermal image, geo-references) and mission support (e.g., equipment delivery, signal repeating).
This UC is mainly based on:

- A 5G Core Network and a 5G RAN based on OAI and will run on a private edge based on Openshift
- A vertical PPDR application, so called Mission Critical Multimedia Communication and Collaboration, a E2E solution, that implements the MCX services standardized in 3GPP services (MCPTT, MCData , and MCVideo).

1.1.3. OC Desired Contribution

The desired contributions include (but not limited to):

- Experiments that utilize UAVs/drones both for data collection (e.g., visible & thermal image, geo-references) and mission support (e.g., equipment delivery, signal repeating),
- Experiments involving IoT devices to improve fire forest surveillance (carbon monoxide, gas spreading, heat, ...),
- Applications of AI-based image recognition algorithms for different abnormal detection (fire, smoke), multimodal analysis (audio/video), data processing collection, UAV placement optimization,
- Experiments that leverage Augmented and Mixed reality (VR, AR, MR) to help situation awareness.

1.2 UC2: Critical surveillance and inspection at a maritime port (Spanish Facility)

1.2.1 UC Description

Safety and protection are considered as major aspects that must be integrated into the port-logistic chain connected with daily activity of maritime ports and terminals. In this domain, surveillance and inspection activities are fundamental to minimize the risks that are intrinsic to the activities carried out at berthing areas, port accesses and terminal yards. In the last years, the use of Unmanned Aerial Vehicles (UAVs) in surveillance and infrastructure inspection activities has grown rapidly, since UAV enable safer, faster, and more accurate operation than traditional surveillance and inspection methods. Some potential applications of UAVs are maritime rescue support (e.g., man overboard situations), anchoring area inspection, oil spill detection, dangerous goods tracking, etc. This use case (UC) aims at enabling critical surveillance and inspection with UAVs in maritime ports and terminals thanks to the use of 5G Rel.16 capabilities, which will allow to meet the stringent URLLC requirements related to real-time inspection and surveillance activities. Additionally, optimal coverage will be achieved by exploiting a seamless combination of 5G private and public network services. These functionalities will be combined with traditional 5G Rel.15 broadband capabilities to transmit real-time video streams with high-definition resolutions from different inland and coastal locations.

1.2.2 UC Scenario

The port of Valencia offers its facilities, experience, and support to integrate the required components into the drone. The port is highly monitored with multiple cameras and sensors offering the possibility to test the UC in a real environment where multiple actors interact daily. Currently there is one 5G mmW node inside the port facilities and the centre of control which will monitor the operation of the UAVs. In addition, a 5G sub-6 GHz node (SA) is expected to be installed. Available 5G modems will we procured and equipped in the UAVs for enabling 5G communications. The port will be responsible of controlling the drones and asking for the licenses.

1.2.3 OC Desired Contribution

The desired contributions include (but not limited to) :

- Experiments that will leverage the UAV and the USV inside the port facilities for surveillance and inspection applications (anchoring area inspection, infrastructure inspection, oil spill inspection, etc.)
- Experiments involving novel AI-based image recognition algorithms for different surveillance and identification applications.
- Solutions that focus on the design of an intuitive user interface for the final user that allows obtaining updated information (e.g., the visualization of real-time UAV video streams) and making decisions more quickly.

*Note that the execution of such experiments will require the procurement of the UAVs as well as integration of cameras, surveillance hardware and/or other IoT devices .

1.3 UC3: Multi-functional remotely operated boat (Spanish Facility)

1.3.1 UC Description

Commercial ports have reliable contingency plans and actions in case of accidents. However, if an accident occurs in the port, advanced and ready-to-use technologies could boost these contingency actions and rescue plans. As for the preventive actions, advanced technologies could also be used for periodical and ad-hoc inspections of ports' waters. The use of Unmanned Surface Vehicle (USV) in surveillance and inspection enables safer and faster first-aid rescue actions and a continuous seafloor mapping inside the port facilities. This UC leverages 5G communications to enable the usage of a remote USV devoted to support critical operations at the port. More precisely, this USV will be a multifunctional boat for, but not limited to, first-aid rescue actions, first evaluation and signalization in case of accidents or under-water inspection to detect hazards. To support these operations, it is expected that exchanged data between the ground control station, located at the ports' Emergency Control Centre, and the vehicle will include among others: wind speed, weight, pitch, roll, current depth, geolocation, real-time, LIDAR images, video (dock's/boat's cameras), etc. This UC includes the development of an immersive cockpit on top of the GCS, sensorizing the USV, integrating the USV equipment within the 5G and implementation of AI image recognition for the operational designed tasks of the USV.

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1.3.2 UC Scenario

The port of Valencia offers its facilities, experience, and support to integrate the required components into the boat. The port is highly monitored with multiple cameras and sensors offering the possibility to test the UC in a real environment where multiple actors interact daily. Currently there is one 5G mmW node inside the port facilities and the center of control which will monitor the operation of the USV. In addition, a 5G sub-6 GHz node (SA) is expected to be installed. Available 5G modems will we procured and installed in the UAVs for enabling 5G communications. A USV will be procured by the port for demonstrating the UC.

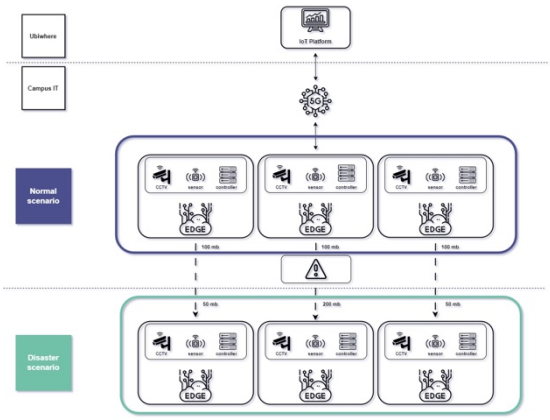
1.3.3 OC Desired Contribution

The desired contributions will be aligned with the UC2- Critical Surveillance and inspection at a maritime port to provide a holistic surveillance below and above sea level. This includes but not limited to:

- Experiments involving the remote control of the boat specifically designed to monitor the underwater surface.
- Experiments to detect potential hazards underwater and classify the accordingly.
- Experiments to provide real time updated information to the end-user making decisions more quickly.

1.4 UC4: IoT platform for crisis management (Portuguese Facility)

1.4.1 UC Description



IMAGINE-B5G will provide an IoT platform for the management of all emergency cycles. Focused on Emergency Management, this platform manages risks for communities, the environment and infrastructure. It is the core business of the Emergency Services, but every individual and organisation have a role to play. In addition, this platform uses IoT sensors and telecommunications infrastructure to increase the ability to collect data and make informed decisions. This solution helps companies to be better prepared, respond more quickly, and to send vital information to those who need it.

1.4.2 UC Scenario

The platform must be efficient in collecting and processing data to provide smooth real-time reporting, critical updates, and actionable intelligence, as seconds can be the difference between a life-or-death disaster. Furthermore, and since the emergency management cycle largely depends on latency and rapid decision making, edge/fog must be developed and implemented to adapt the network to the required real-time response. Thus, the platform focuses on the computing continuum to overcome the complex decision-making process throughout the cycle. Ubiwhere''s main contribution lies in concepts of interoperability, edge computing, and sensing. This platform must support:

- Information processing in the cloud, which will mainly serve to produce point-to-point data integration and large-scale data processing.
- Edge computing information processing, closer to users to reduce processing latencies and enhance faster decision-making scenarios.
- Automatic Device Discovery, part of the zero touch management capabilities
- Integration with 3rd party experimenter platforms/solutions through APIs
- CI/CD pipelines

1.4.3 OC Desired Contribution

The desired contributions include (but not limited to):

- Experiments from emergency responders such as civil protection, firefighters, police forces, with the goal of improving existing procedures and routines during disaster scenarios.
- Solutions based on biometric devices with live data and other sensors relevant to emergency scenarios.
- Solutions based on novel computer vision algorithms to detect dangerous situations (natural disasters, guns, knives, etc.).

2. Media

The media industry is dedicated to creating multimedia content for a wide variety of applications, such as entertainment, gaming, sports, marketing, meetings, etc. Traditionally, 2D video and stereo audio is used for these purposes, but with the introduction of new technologies such as stereoscopic video, 360 and volumetric capture, haptics, holograms, surrounding audio, immersive content is increasingly being demanded. However, this new kind of content asks for new functionalities and requirements from the networks that will carry the media, not only for the distribution of the content but also to produce it. Immersive technologies listed before are key for the future media ecosystem.

2.1 UC1: Robust and flexible remote production (Norwegian Facility)

2.1.1 UC Description

IMAGINE-B5G will develop and make trials for audio and video to be wirelessly transmitted from the capture setups to the production setup that will be finally broadcasted to the end nodes, where it is presented to the users, leveraging on B5G networks. This UC will cover the high-quality, studio or live content production and may also investigate the possibility of user generated content.

For the trials, the content will be captured wirelessly in one facility/field and the production will take place in the same facility/field or another facility/location remotely. The trials will be coordinated and conducted in coordination with NRK, a main UC stakeholder for immersive media production and distribution in Norway.

NRK is the Norway's public owned broadcaster offering online, TV, radio, and audio content [NRK]. Live and studio broadcasting is an important part of NRK's activity, e.g., covering sports and entertainment events.

2.1.2 UC Scenario

The UC will be deployed in the Norwegian facility. Media-specific functions and applications for content production and distribution can be hosted either on the central site at Fornebu, or on the edge site in Svalbard. Three RAN sites (Fornebu, Trondheim, Svalbard) will be available to support the experiments.

2.1.3 OC Desired Contribution

The desired contributions include (but not limited to) innovative (immersive) media production/distribution solutions and performance studies.

*The beneficiary is expected to have/procure any media hardware and software necessary for the scenario implementation and experiments.

2.2 UC2: Holographic communication (Spanish Facility)

2.2.1 UC Description

Immersive communication technologies, such as holography, are becoming increasingly popular as they provide 3D visual information without the need for a device. Holographic technology is considered a key element in the future 5G-Advanced and 6G ecosystem, which aims to create a more interconnected, immersive, tactile, holographic Internet, providing a seamless connection between the real and digital worlds. This UC primary objective is to explore the potential of holographic technologies in pre-recorded media or real-time scenarios, it will consist in performing multiple tests and trials for different verticals to understand the value and requirements of holographic technologies. To achieve this, the IMAGINE-B5G platform will leverage beyond-5G features for high data rates for transmitting holographic content in real time, also through the IMAGINE-B5G platform will be performed numerous tests and trials to understand the specific requirements and value of holographic technologies.

2.2.2 UC Scenario

The UC will be mainly deployed in the UPV immersive laboratory premises, and it also can be deployed in other remote location to test different scenarios. In this UC, the platform will examine the potential and requirements via relevant KPIs and KVIs of holographic technologies. By leveraging beyond-5G features, such as high data rates and low latency, the platform will enable the transmission of holographic content. This will allow for a more immersive and interactive experience for users, whether in remote teaching, training, marketing, showrooms, concerts, talks, events, webinars, etc. By enabling users to view and interact with virtual objects and environments, holographic technologies can bring a new level of realism and excitement to these industries.

2.2.3 OC Desired Contribution

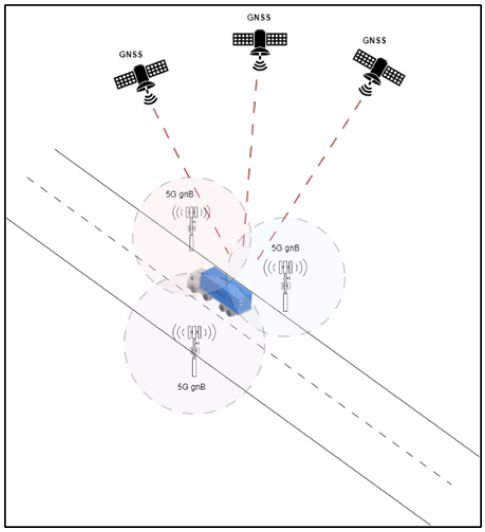
The desired contributions include (but not limited to) novel solutions for holographic communications and experiments exploring and optimizing the performance of holographic communications. Additionally, this OC is related but not limited to the project's PE4: but not limited to the project's PE4: Holographic equipment and SW.

3. Transportation and Logistics

This vertical is dedicated to the organization and implementation of transportation workflows. The associated UCs must be enabled by high performance networks, but still very flexible communication architecture empowered by B5G functionalities. For example, advanced location functionalities have the potential to improve industrial environment by enabling utilization scenarios that range from flexible asset tracking and route optimization to Automatic Guided Vehicles (AGVs). Moreover, transportation scenarios are not limited to logistics, instead they are heterogenous by nature and may involve critical and non-critical communications, which imposes stringent requirements to the subjective networking system. Eventually, requirements will reach a level where the communication-related resources are not enough, requiring the combination of different technologies, empowered at large by advanced edge computing resources. As such, transportation and logistics scenarios will play a fundamental role in the validation of the IMAGINE-B5G functionalities.

3.1 UC1: Improved localization mechanisms for transportation and logistics (Portuguese Facility)

3.1.1 UC Description



This UC depicts a scenario of autonomous driving that relies on a hybrid positioning system utilizing both GNSS and 5G terrestrial base stations to provide an improved position accuracy and FTTF. This system utilizes RTK corrections and 5G signal information to achieve better accuracy. The road vehicle moves around a transportation route where the algorithms will determine its most accurate position.

In principle, GNSS positioning can be accessed globally, anywhere on the Earth, without requiring any local or regional infrastructure and with great accuracy but have a not-so-great latency. On the other hand, 5G network-based positioning demonstrates good latency performance but requires indoors scenarios to achieve good accuracy in most of the cases. However, the latency of GNSS positioning can be improved with the assistance of 5G network-based positioning as a complementary trade-off between them, since on GNSS positioning we have a better accuracy while on 5G positioning we have a better latency, so joining them together we can have the better of both technologies.

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3.1.2 UC Scenario

First, we will have a standalone solution using only the GNSS positioning solution and using the new 5G network to calculate the position of UE (User equipment) like a vehicle. The position calculation in 5G appears in Release 16, and there are enhancements in Release 17.
To make this happen, it will be necessary to use dedicated algorithms that take the RAN information and can calculate the position of the receiver (UE). This is not enough, and the 5G core needs a new function to control the position side. That function will need to run the necessary algorithms to calculate the position. The Location Management Function (LMF) is responsible for tracking the position of the vehicle and other connected devices in the network. It is also responsible for selecting the methods that will be used to calculate the vehicle's position, such as AOA (Angle of Arrival) or others.

3.1.3 OC Desired Contribution

The desired contributions include (but not limited to) solutions that require localization information in the transport and logistics domain. Stakeholders such as logistics operator (e.g., cargo trucks), motorway/road/private operators that can deploy RSUs are encouraged to apply.

3.2 UC2: Telepresence-aided maintenance (Spanish Facility)

3.2.1 UC Description

The reparation or maintenance of machines in logistic environments is a highly expensive task, due to the necessity of sending experts to physically check the equipment. If the asset to repair is very specific, it may require experts from other countries to travel long distances, with the consequent carbon footprint. However, a minimally qualified engineer may also perform the task if he receives the proper assessment from a remote expert. By using immersive technologies such as telepresence and haptics, boosted by the capabilities of B5G networks, the remote expert would be able to provide the required instructions to the field engineer in real-time.

The field engineer will place a robot or an AGV equipped with a 360º/PTZ camera next to the damaged machine, allowing the remote expert to connect via 5G to visualize the video on a VR/AR HMD, controlling the viewing perspective via the HMD's IMUs. Moreover, the field engineer can be equipped with other VR/AR HMD to visualize instructions from the remote expert, who shows the action to perform using haptic gloves. The introduction of immersive communication into the workflow will be assessed and compared with traditional methods. Different slices will be available so that multi-user deployments can be enabled based on GBR (Guaranteed Bit Rate) profiles for ensuring the required minimum quality in terms of assigned bandwidth for every single UE taking place in the UC.

3.2.2 UC Scenario

The remote collaboration for maintenance or reparation of logistic machinery with audio-visual feedback will be performed either in the Valencia Port or in the Rural Site. A field engineer located there will be supported by a remote expert located in the UPV Immersive Lab.

Grant Agreement No.: 101096452
Call: HORIZON-JU-SNS-2022

UPV's Immersive lab is an experimental facility that supports telepresence, AR/XR, volumetric/360º capture, haptics, and holographic technologies. If needed, the lab's equipment will be available for the VE, including chromas, LEDWall, and VR/AR headsets; volumetric and 360° video capture; haptic gloves and suits; and immersive cockpits for remote driving.

3.2.3 OC Desired Contribution

The desired contributions include (but not limited to) immersive telepresence solutions for maintenance of machines in logistic environments.

*The beneficiary should have experience in robotics, haptics and/or VR, to integrate the necessary components that guarantee a full view and feedback of the machine to the remote expert, as well as a full view and feedback of the instructions to the field engineer.

4. Industry 4.0

The industry vertical is dedicated to the production of goods, with the help of equipment, machines, tools, etc. Industries of the future aim to be benefited by emerging technologies that can enhance the production processes. These processes will be increasingly smart, connected, and automated and will allow for a more efficient, cost effective, faster, and greener production industry. The transformation envisioned for this vertical is focused on the smart automation and optimization of the production processes. This will be thanks to the advanced mobile network technologies, IoT, big data analytics, ML, AI, and robotics.

4.1 UC1: Industrial infrastructure automation (Norwegian Facility)

4.1.1 UC Description

The aim of this UC is to empower industries with B5G technologies to facilitate the prediction of problems, increase production, flexibility, safety, mobility, scalability, reduce downtime, maintenance intervention and costs, thus improving manufacturing competitiveness. In this context, IMAGINE-B5G advanced features will be leveraged to explore novel UCs on the factory floor such as control-to-control communication, equipment tracking, close loop control for process automation, network-based AGV control, asset condition tracking for predictive maintenance, among others. Moreover, leveraging edge computing capabilities and the integration such technologies with factories' Manufacturing Execution System (MES) and production line will enable a low latency closed control loop targeting diverse production aspects including orders, machinery status and asset location. This UC will then leverage B5G technologies to provide very low latency and advanced edge based IoT solutions, while satisfying industry isolation requirements.

4.1.2 UC Scenario

The UC will be deployed in the Norwegian facility. Industrial-specific functions and applications can be hosted either on the central site at Fornebu, or on the edge site in Svalbard. Three RAN sites (Fornebu, Trondheim, Svalbard) will be available to support the experiments.

4.1.3 OC Desired Contribution

The desired contributions include (but not limited to) advanced edge based IoT solutions, infrastructure monitoring and process automation solutions, as well as performance studies.

*The beneficiary is expected to have/procure any industrial hardware and software necessary for the scenario implementation and experiments.

5. Education

The education vertical is dedicated to the transmission of knowledge. Education practices are evolving nowadays since information technologies are being introduced in this field. Rethinking education in the digital age should become a central matter for today's society: first, remote teaching should be allowed to facilitate the attendance of students who cannot be physically present in the classrooms and second, they should enhance improve the current means of knowledge transmission to enhance understanding and retention. During the COVID-19 pandemic, online classes and digital media resources became very common but were unable to replace physical presence for hands-on education, group work and social interactions. Seeing the benefits of online education, further steps forward must explore ways to exploit them. New technologies like immersive telepresence, holograms, XR and haptics are key to the evolution of education.

5.1 UC1: Immersive remote education (Spanish, Norwegian Facilities)

5.1.1 UC Description

As information technologies are being introduced in this field, education practices and opportunities are rapidly evolving worldwide. The primary challenge that this UC will aim to address is remote/distance teaching to facilitate the participation of both teachers and students who cannot be physically present in the classroom. On the other hand, certain skills such as lab work and hands-on experiences, require extra tactile stimulation to produce the same level of learning online as in real life and real-time. Learning such skills or visualizing abstract concepts in an interactive way can benefit from the integration of AR and VR into immersive classrooms. Further, haptic responses that are possible through tactile internet, and can reproduce the feeling, touch, or motion of interacting directly with a physical object, could introduce tactile forms of learning to a classroom through traditional video conferencing platforms, thus enriching the interactions. 5G/B5G can help in this direction as it will improve personalization by creating intelligent systems, using Artificial Intelligence, to understand the

unique needs of each student and create targeted learning pathways. To achieve a highly immersive and interactive experience between the two ends (e.g., by using VR Robotics, Figure 16), it will exploit B5G features and KPIS, mainly focusing on low latency and network reliability aspects, as well as advanced data analytics and AI algorithms to perform predictive analyses (e.g., latency) and enhance the end-to-end performance. In addition, it will explore solutions towards improving the current means of knowledge transmission from a learning retention perspective.

5.1.2 UC Scenario

This UC will be deployed in two different facilities: UiO's SIN-Lab is a playground for immersive networking research. SIN-Lab consists of state-of-the art cameras and LIDARs, such as tracking camera, Velodyne LIDAR, Intel RealSense LIDAR(L515), Azure Kinect, and several headsets for VR and AR. In addition, the lab is equipped with a Shadow Hand and a UR10e arm. For the haptics equipment, it has Gloves and Suit Full Body.

UPV's Immersive lab is an experimental facility that supports telepresence, AR/XR, volumetric/360º capture, haptics, and holographic technologies. To bring these capabilities, the lab provides multiple equipment for each type of communication: chromas suited with specific processing hardware and software from Brainstorm multimedia, Alfalite LEDWall, and several VR/AR headsets (e.g. Meta Quest Pro) for telepresence; Evercoast volumetric video capture, YBVR 360º video capture; several haptic gloves (e.g. bHaptics TactGlove) and suits (e.g. bHaptics TactSuit X40, OWO Vest) for haptic feedback and control of UR5e arm; and immersive cockpits for remote driving of AGVs/AMRs (e.g. Robotnik Summit XL) equipped with RoboSense LiDAR and 360º cameras.

5.1.3 OC Desired Contribution

The desired contributions include (but not limited to) novel solutions for VR/AR/XR educational environments, intelligent personal assistants, and experiments exploring and optimizing the performance limits of immersive remote education.

6. Smart Agriculture & Forestry

The agriculture vertical is focused on the cultivation of plants and livestock. The world of agriculture is changing towards an unprecedented digitalization and automation. The use of autonomous vehicles for preparation of the soil, sowing, harvesting, etc. is common, but much more enhancements can come into play with the introduction of new technologies such as advanced mobile networks, vehicles, imaging techniques, AI, ML, immersive communications, etc. These new technologies can be used for infestation detection, fertilization, fields performance analysis via imaging, teleoperation of machinery and vehicles, surveillance, weather prediction, etc.

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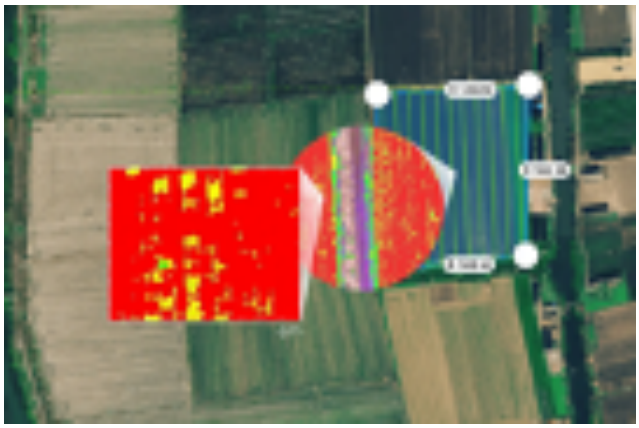
6.1 UC1: Smart agriculture in rural areas (Spanish, Norwegian Facilities)

6.1.1 UC Description



IMAGINE-B5G aims to precisely apply fertilizers and pesticides, helping to increase the performance of the cultivation and reducing the environmental impact of pesticides. The data gathered by the advanced IoT sensors will be processed in a computing continuum platform, which will optimize for the most energy efficient location for processing. The federated edge architecture will allow the coordination between the UPV campus and the agricultural warehouses, which enables the optimization of the logistics of the transportation of the goods, improving energy efficiency at transportation. IMAGINE-B5G counts with the support of ITACYL in the AB for agriculture expert support, their experts- with deep knowledge of innovative agricultural SMEs interested in participating in the trials. They will help to showcase a real world setting of the UC.

6.1.2 UC Scenario

The Matanza 5G Energy experimental site is ideal for the experimentation of efficient algorithms using 5G infrastructure for the automation of industrial or agricultural tasks. Currently the experimental site is logging data from sensors deployed in the coverage area of the 5G radio. The information of the sensors is updated in real time, including: electrical energy devices consumption, electrical energy generated by wind, electrical energy generated by sun, electrical energy consumed by servers and radio baseband. The site also counts with some AGVs that can execute some automation tasks like terrestrial video supervision missions which visual information is uploaded to the 5G servers for AI analytics.

6.1.3 OC Desired Contribution

The desired contributions include (but not limited to):

- Solutions based on advanced video processing automated tasks that help in the optimization of detection of some plant diseases or efficiency problems with the crops while being able to report in real time the use of energy for the automated task implementation.
- Solutions for AGV missions, the implementation of some AI algorithms for improving the treatment of plants, the implementation of programmed multispectral drone missions, the generation of detailed report on scalability of the proposed solutions and the cost of energy for each mission.

6.2 UC2: Forestry connectivity and monitoring (Norwegian Facility)

6.2.1 UC Description

Nowadays rangers perform different operations in the forest such as planning operations regarding biotope preservation, identifying trees for thinning process, or monitoring and inspecting the health of the forest. IMAGINE B5G will leverage high capacity, low latency, and massive machine-type communications to provide higher resolution and diversity of data for forest health monitoring, and the also the potential of remote management of forest machinery. Along with passive sensors, drones and UAVs can be used to monitor and survey the forest, saving significant time and increasing worker efficiency during harvesting. IMAGINE B5G will also explore the option of extending the coverage towards rural areas along with deploying portable 5G network solutions that could be utilized more effectively during the harvesting period or thinning process in a certain specific region. XR immersion can be used in an educational context to teach about natural forest habitats.

6.2.2 UC Scenario

The UC will be deployed in the Norwegian facility. Forestry-specific functions and applications can be hosted either on the central site at Fornebu, or on the edge site in Svalbard. Three RAN sites (Fornebu, Trondheim, Svalbard) will be available to support the experiments.

6.2.3 OC Desired Contribution

The desired contributions include (but not limited to) innovative forest monitoring solutions and performance studies.

*The beneficiary is expected to have/procure any forestry/monitoring hardware and software necessary for the scenario implementation and experiments.

7. eHealth

The healthcare vertical is dedicated to maintaining or restore physical, mental, or emotional well-being. The healthcare of the future can be greatly enhanced with the introduction of new technologies. The future healthcare systems will provide remote assistance to people in their own home by means of remote monitoring devices, immersive experiences for cognitive rehabilitation, or robots that can provide home care to people with special needs. Both action and feedback are essential and time-critical to perform a medical activity, safely and in a natural manner. Such scenarios require, in general, fine motion control and low latency. The combination of the eMBB for increased bandwidth and URLLC can prove difficult to achieve. Additionally, in medical applications, the interface between the doctor and the patient must be seamless for a correct treatment. This interface supposes a great challenge for development and integration.

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7.1 UC1: Enhanced care facilities (Portuguese Facility)

7.1.1 UC Description

World Health Organization (WHO) defined eHealth as "the cost-effective and secure use of Information and Communications Technologies (ICT) in support of health and health-related fields, including healthcare services, health surveillance, health literature, health education, knowledge and research" [UC5-IT-01]. So, the inclusion of ICT technologies can bring a revolution to the health system, increasing access, efficiency, and quality of care, while providing high control to the patient.

5G and beyond technologies are expected to support novel eHealth UCs, which will significantly improve the health system. This includes the usage of smart sensors to monitor the vital signs of patients while having the flexibility and mobility of wireless communications; improving hospital processes with logistics tracking; early connecting the patient to hospital personnel during emergencies; and helping in the processing of complex diagnoses. Imagine-B5G will aim at exploring eHealth UCs in the context of enhancing the operations of care facilities to provide improved health services. The goal is twofold: on the one hand better understanding the challenges in leveraging advanced 5G features; and on the other to increase the awareness of care facilities of the potential solutions to be achievable through the adoption of 5G technologies as part of their process of digitalization.
This UC focuses on enhancing care facilities by means of advanced 5G technologies to improve the overall quality of the health system and its delivery to patients. To this end, the UC considers three different stages of the health system: (i) the proactive/continuous care; (ii) the care in emergency situations; and (iii) improved health facility logistics.

7.1.2 UC Scenario

The Portuguese facility has available different kind of end-user devices including 5G CPEs, Mobile Phones and 5G Communication Modules. These devices could be used to access the services deployed at the edge of the network. By having different 5g Core and Radio solutions scenarios involving different domains and PNI-NPN could be realized in the facility.

7.1.3 OC Desired Contribution

The desired contributions include (but not limited to) experiments aiming to explore advanced 5G technologies to enhance care processes such as proactive/continuous care, the care in emergency situations; and improved health facility logistics. Stakeholders in the larger eHealth ecosystem (e.g., a care facility, an eHealth solution provider) are encouraged to apply.

*The beneficiary is expected to have/procure any medical hardware and software necessary for the scenario implementation and experiments.

7.2 UC2: Remote care with immersive media facilities (Norwegian Facility

7.2.1 UC Description

The demand for expert examination (such as ultrasound examination for congenital heart disease can practically come from anywhere. In some cases, such demands may come from remote locations with insufficient access to trained and experienced healthcare professionals both for performing the examination and producing correct diagnoses.

The aim of this UC is to develop and make real-world trials regarding remote care by providing immersive equipment (e.g., MR/AR/VR headsets, controllers, 3D cameras) for seamless interactions between a remote medical expert and the local doctor/technician or the patient that needs specialized treatment. On the patient's side, there must also be medical equipment that can be remotely controlled by the expert (e.g., medical robot). For this UC to work, future B5G technologies will be leveraged to provide high-quality immersive media with very low latency between the remote and local sites.

7.2.2 UC Scenario

The UC will be deployed in the Norwegian facility. eHealth-specific functions and applications can be hosted either on the central site at Fornebu, or on the edge site in Svalbard. Three RAN sites (Fornebu, Trondheim, Svalbard) will be available to support the experiments.

7.2.3 OC Desired Contribution

The desired contributions include (but not limited to) the implementation of innovative (immersive) remote care solutions and performance studies.

*The beneficiary is expected to have/procure any medical hardware and software necessary for the scenario implementation and experiments.