

IEEE Future Networks Tutorial 5G/6G 2023

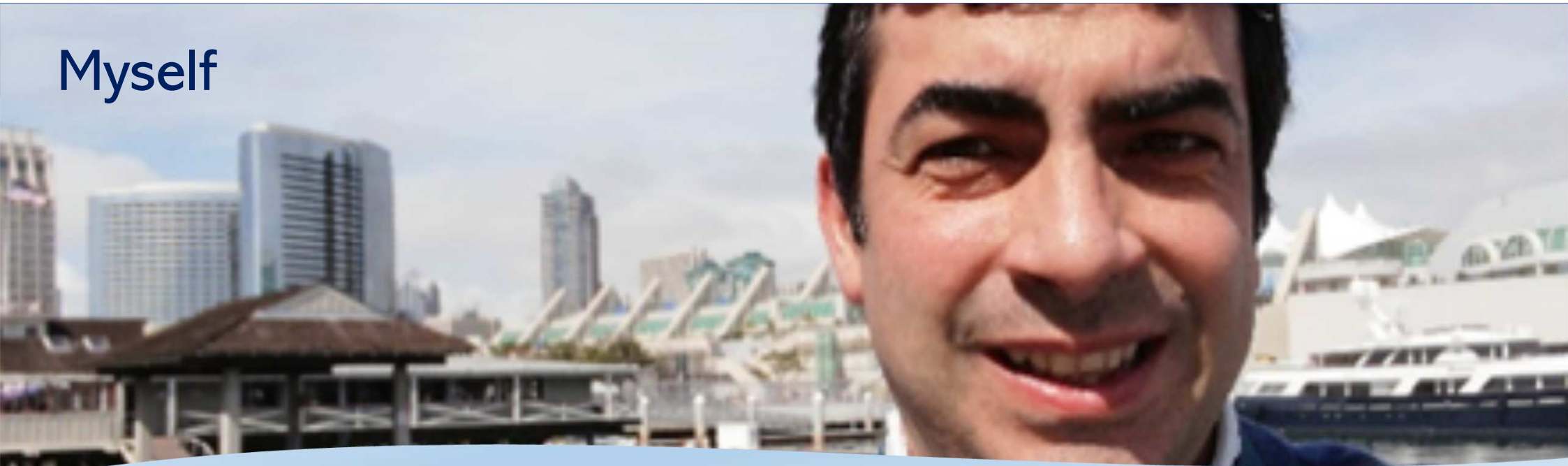
5G and beyond for eHealth

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TrialsNet project has received funding from the European Union's Horizon-JU-SNS-2022 Research and Innovation Programme under Grant Agreement No. 101095871

Myself



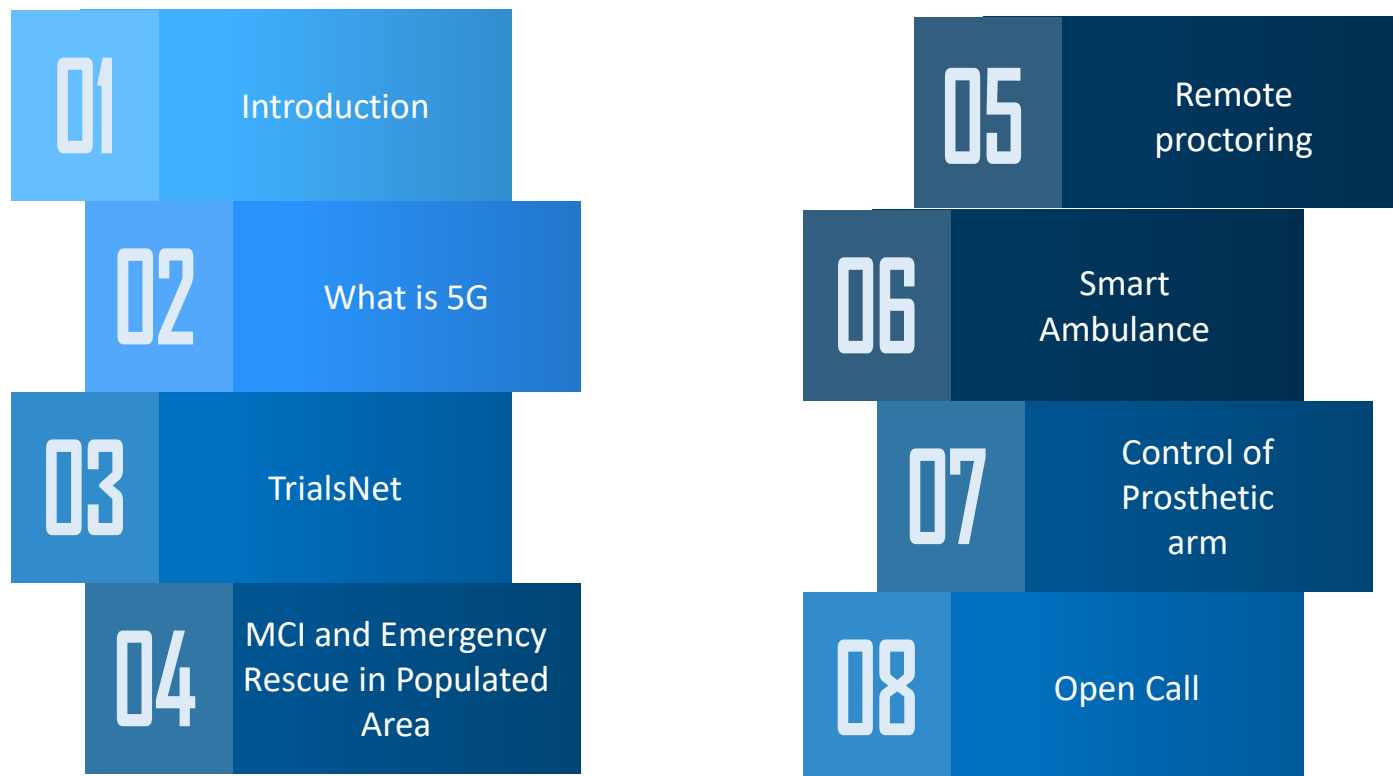
I received a Dr. Eng. degree in Electronic Engineering from the University of Pisa (Italy) and Scuola S. Anna. I joined Telecom Italia Lab, research, experimentation, and qualification in ICT and Telecommunications. I am interested in Internet Security, Storage Area Networks and Optical Networks Architecture. I have been involved in several EU Project: IST Nobel as WP leader, ICT STRONGEST and H2020 5G-SOLUTIONS (flagship project for European Commission research for the Verticals' usage of 5G Connectivity) as project coordinator. I published dozens of papers, including books, conference papers and workshops. I am currently responsible for eHealth in SNS JU TrialsNet project.



Horizon-JU-SNS-2022
Grant Agreement No. 101095871



Agenda

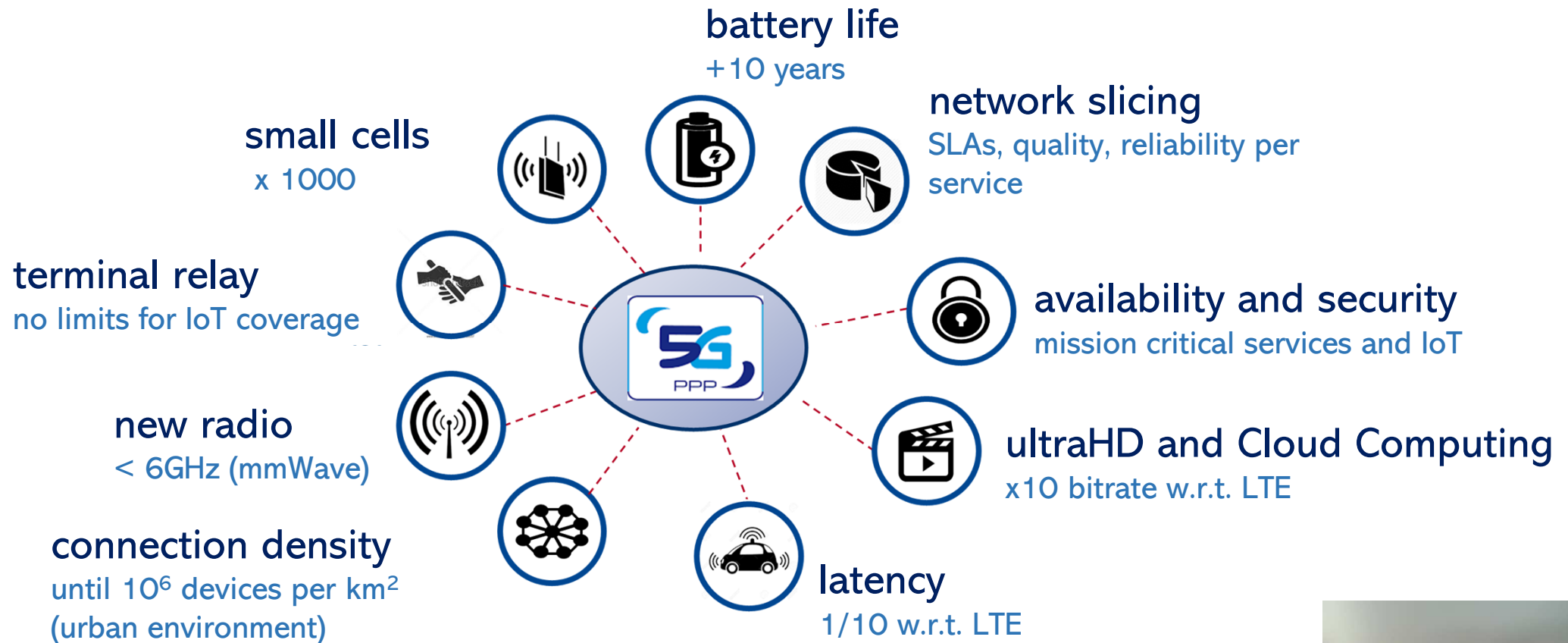


Before 5G

- 1G was analog cellular. (80-90)
- 2G (CDMA, GSM, and TDMA): first generation of digital cellular technologies.
- 3G technologies (EVDO, HSPA, and UMTS): speeds from 200kbps to a few megabits per second.
- 4G technologies (WiMAX and LTE) were the next incompatible leap forward, and they are now scaling up to hundreds of megabits and even gigabit-level speeds.
- 5G brings three new aspects to the table: bigger channels (to speed up data), lower latency (to be more responsive), and the ability to connect a lot more devices at once (for sensors and smart devices).



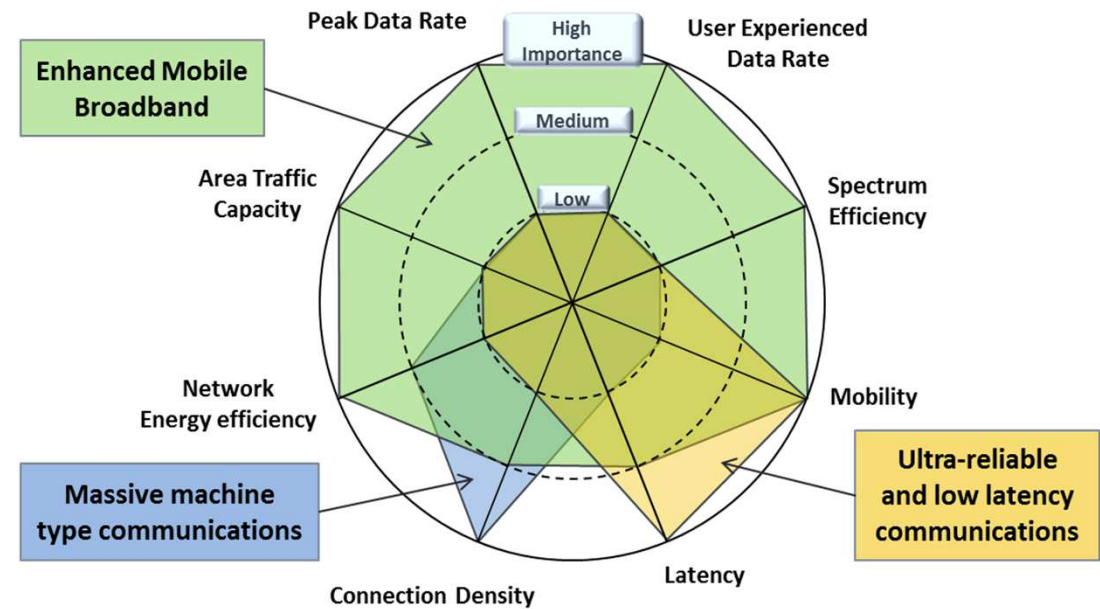
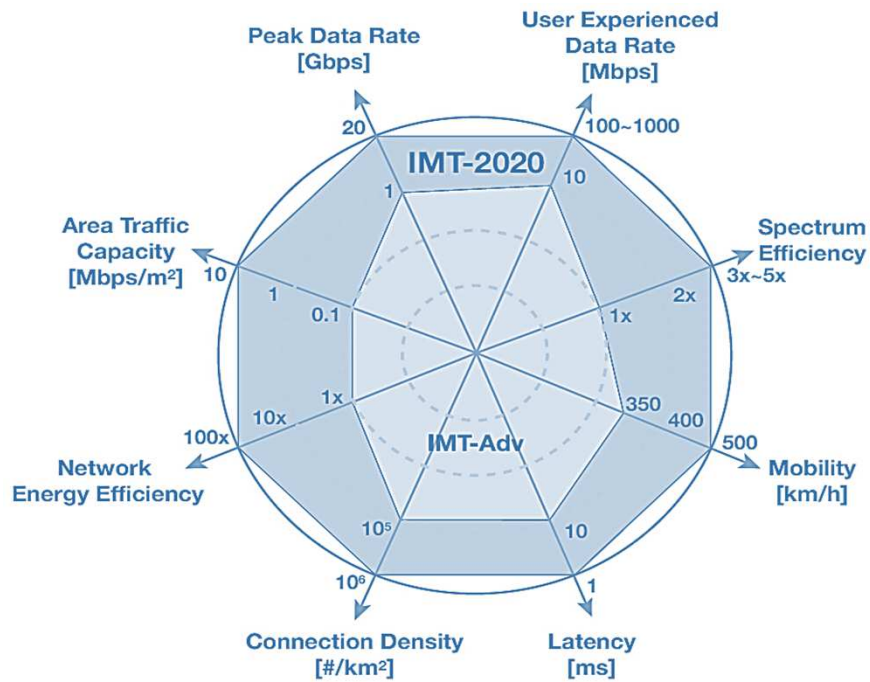
5G in a nutshell



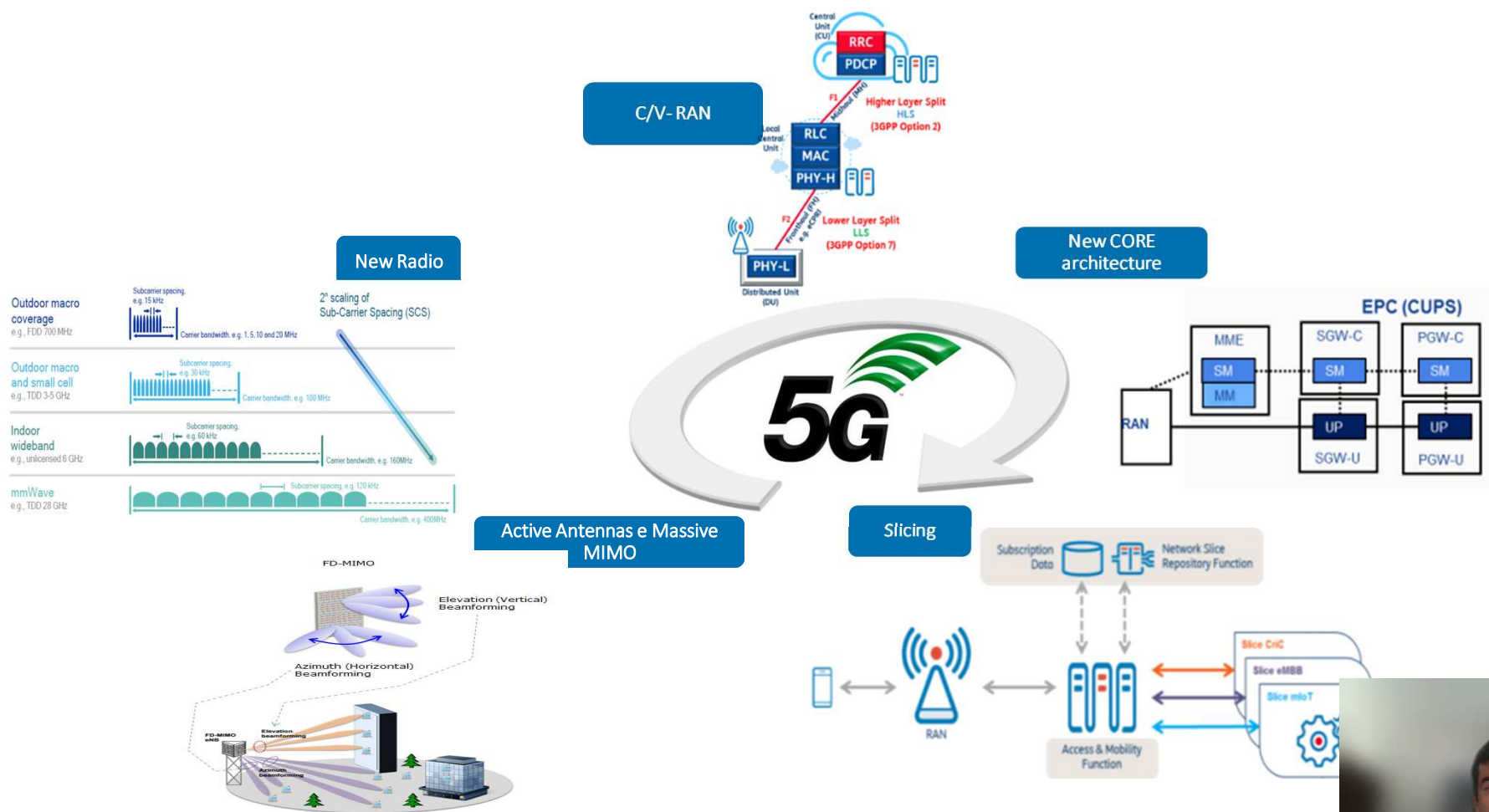
Not only better performance, but a brand new technology



Performances



Innovations



Slicing

Network Slicing

Support of services with similar requirements (eMBB, IoT, ULLR) on the same infrastructure

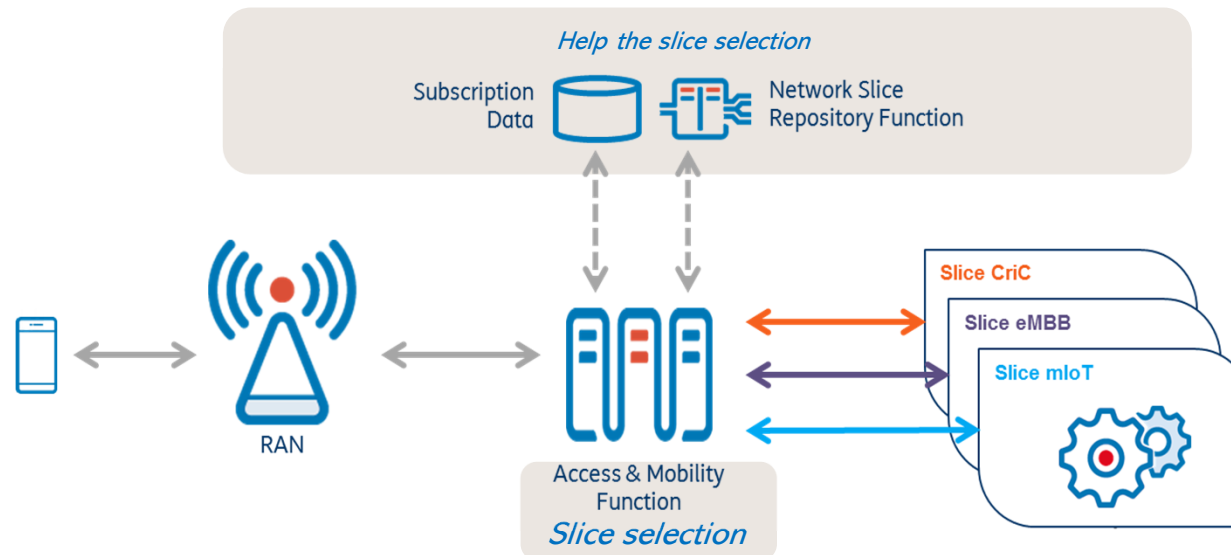
Cross-cutting e2e concept that includes access and CN functionality

Deployment of slices as an aggregate of network functions

Dynamic slice selection guaranteed for each traffic component

Simultaneous access to multiple slices

Orchestration required to manage a sliced network



Key takeaways



1

5G is the fifth generation of cellular networks. Up to 100 times faster than 4G, ultra-low latency, 5G is creating never-before-seen opportunities for people and businesses, transforming industries and dramatically enhancing day-to-day experiences.

2

With 5G technology, we can help create a smarter, safer and more sustainable future.

3

The main progresses (IMO) in terms of performance are latency and coverage, enabling IoT (...machine-to-machine, human-to-machine)

4

The main technological topics are slicing and edge/core architecture



TrialsNet

TrialsNet is deploying full large-scale trials to implement a set of innovative 6G applications based on various technologies such as Cobots, Metaverse, massive twinning, Internet of Senses, and others, covering three relevant domains of the urban ecosystems in Europe identified as

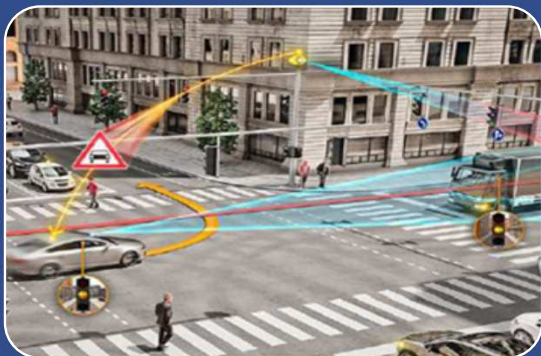
- Infrastructure, Transportation, Security & Safety
- eHealth & Emergency
- Culture, Tourism & Entertainment



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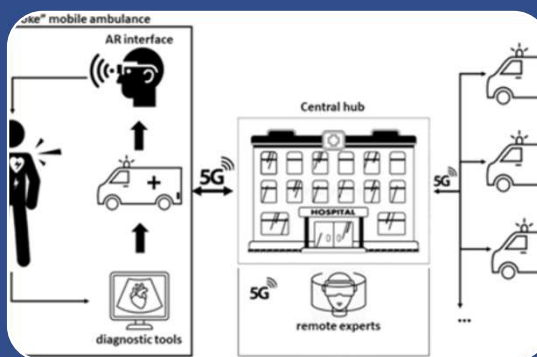


TrialsNet Use Cases



Infrastructure, Transportation,
Security & Safety

- UC1:** Smart Crowd Monitoring
- UC2:** Proactive Public Infrastructure Assets Management
- UC3:** Autonomous APRON
- UC4:** Smart Traffic Management
- UC5:** Control Room in Metaverse



eHealth & Emergency

- UC6:** MCI and Emergency Rescue in Populated Area
- UC7:** Remote Proctoring
- UC8:** Smart Ambulance
- UC9:** Adaptive Control of Hannes Prosthetic Device



Culture, Tourism & Entertainment

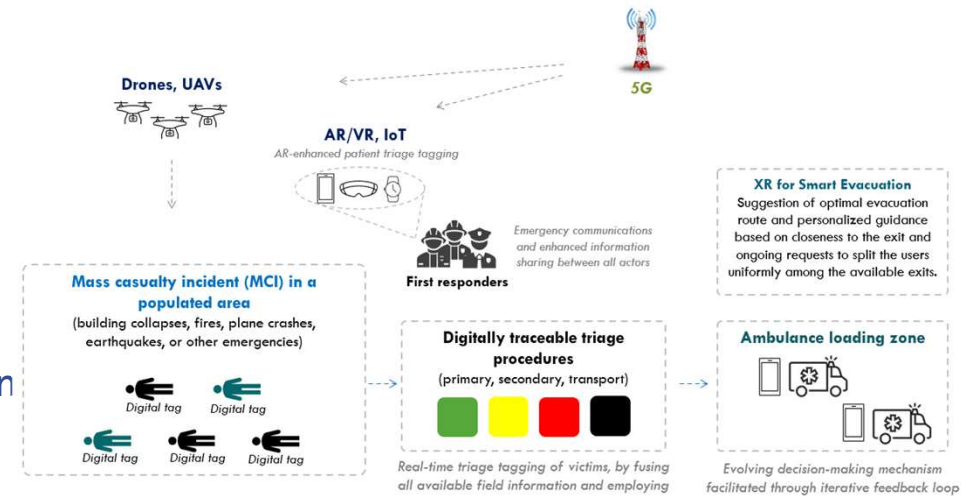
- UC10:** Immersive Fan Engagement
- UC11:** Service Robots for Enhanced Passengers' Experience
- UC12:** City Parks in Metaverse
- UC13:** Extended Reality Experience



eHealth in Trialsnet

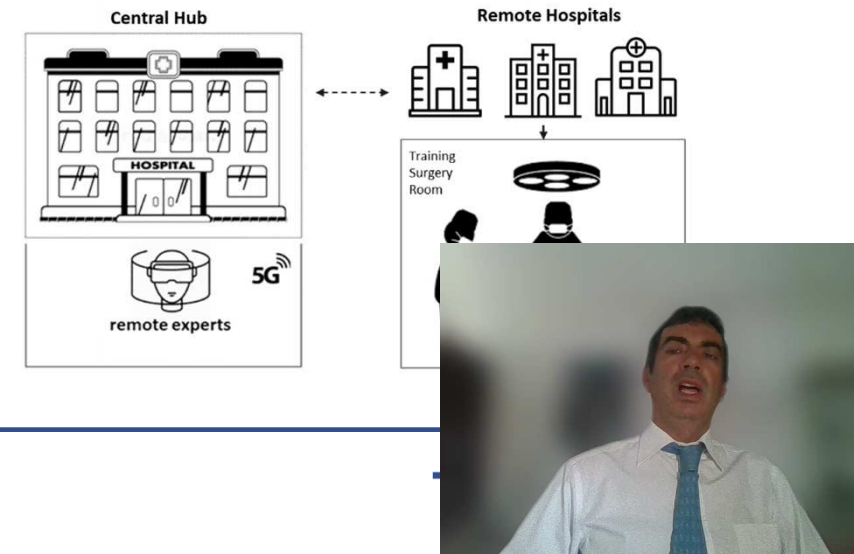
MCI and Emergency Rescue in Populated Area

- **Innovations:** AI mechanisms, crowdsensing techniques, orchestration mechanisms for network resources reconfiguration
- **KVIs:** More efficient communication between responders, faster triage and pre-hospital treatment, optimal evacuation
- **KPIs:** Latency, throughput, reliability, availability, localization accuracy



Remote Proctoring

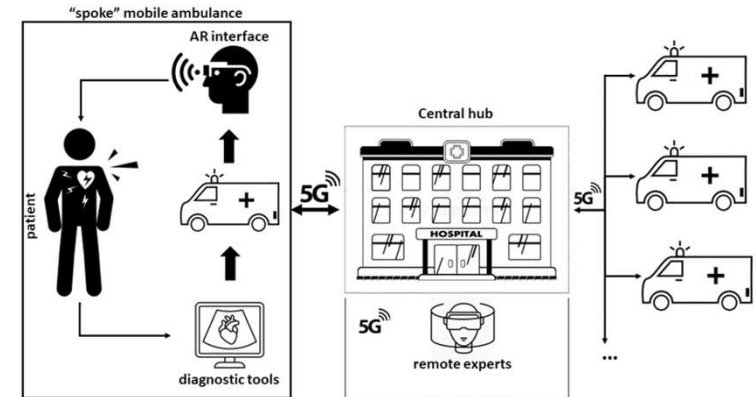
- **Innovations:** E2E network slicing, network orchestrator with efficient usage of shared network resources (minimizing the level of overprovisioning)
- **KVIs:** Real-time proctoring from a remote location
- **KPIs:** Latency, jitter, throughput, reliability



eHealth in Trialsnet

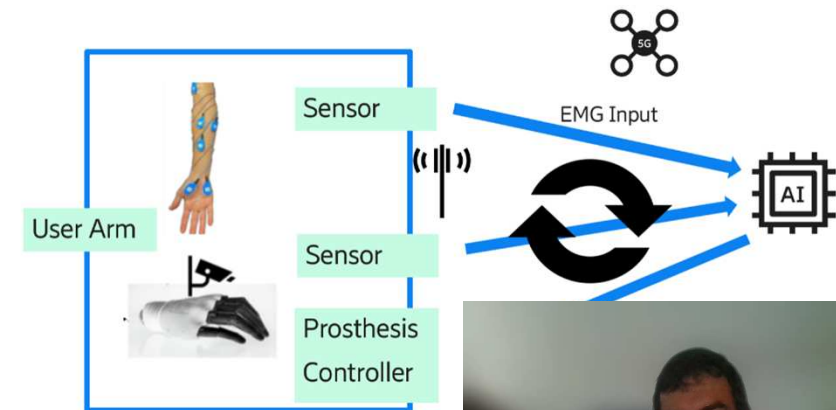
Smart Ambulance

- **Innovations:** High-quality/quantity information sent in mobility, E2E orchestration to ensure QoS in time and space
- **KVIs:** Enhanced data transmission between the ambulance and the hospital
- **KPIs:** Low latency, reliability, throughput, coverage



Adaptive Control of Hannes Prosthetic Device

- **Innovations:** AI-based efficient control system on the Hannes prosthetic device with heavy computation de-localized at the edge of the Network
- **KVIs:** reducing the need for explicit control by the user and thus their cognitive load for driving it
- **KPIs:** Latency, reliability, throughput



People contributing

 <p>Consiglio Nazionale delle Ricerche</p>	<p>Marco Laurino Chiara Benvenuti</p>		<p>Gianna Karanasiou Vera Stavroulaki</p>
 <p>ISTITUTO ITALIANO DI TECNOLOGIA</p>	<p>Elisa Maietti Nicolò Boccardo Lorenzo Natale</p>		<p>Paola Iovanna Giulio Bottari Giancarlo Sacco Mara Piccinino</p>
 <p>Universidad Carlos III de Madrid</p>	<p>Aruna Prem Bianzino Marco Gramaglia</p>		<p>Matina Loukea Spiliotis Aristotelis</p>
 <p>Fondazione Monasterio la ricerca che cura</p>	<p>Sergio Berti Simona Celi</p>		<p>Alessandro Trogolo Mauro Agus</p>
 <p>ATHENS INTERNATIONAL AIRPORT ELEFTHERIOS VENIZELOS</p>	<p>Dimitra Tsakanika Ilia Christantoni</p>		<p>Franco</p>



Key takeaways



1

A lot of research topics are addressing the use of 5G for different verticals. TrialsNet is an important project funded by EU aiming at implementing full large scale trials

2

5G has the potential to improve eHealth as it is not only quicker and more stable than previous generations but also gives the possibility of using network capacities more extensively.

3

MCI and Emergency Rescue in Populated Area is another important field of application, related to eHealth

4

Remote proctoring for surgery, smart ambulance and adaptive control of prosthetic device represent the edge of technology applying 5G technologies to eHealth

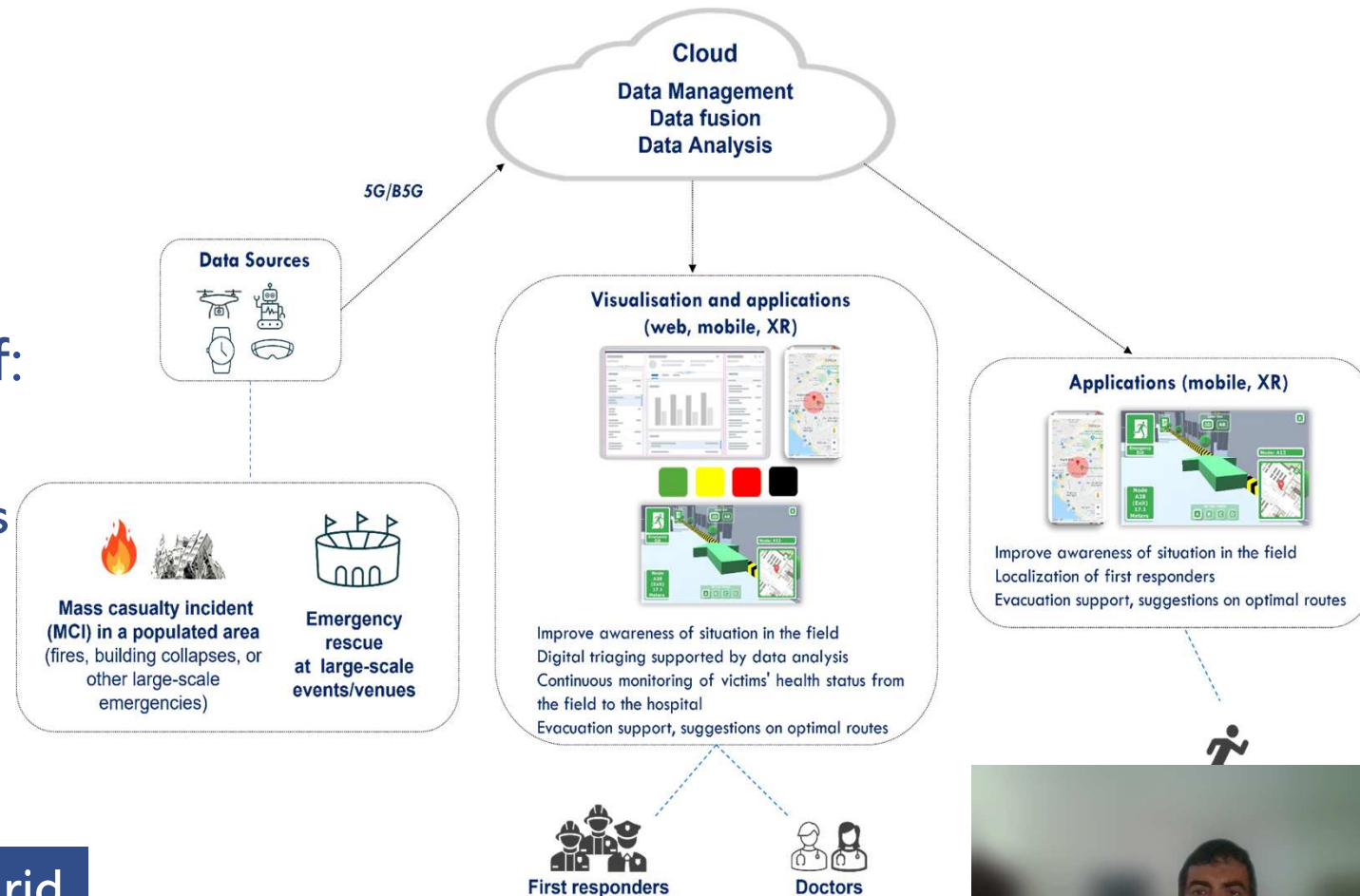


MCI and Emergency Rescue in Populated Area

Aims to offer cutting-edge technological solutions for the most effective coordination for first-case responders in the context of:

- triage and coordination of resources at the scene of mass casualty incidents and
- emergency evacuation in the context of a crowded sporting or cultural event

To be tested in Athens and Madrid



Network infrastructure

- In the Greek cluster a public 5G network will be used, for leveraging its high-speed connectivity, low latency, and wide coverage.
- In addition, a WINGS owned, private network infrastructure will be utilised, to conduct testing activities, validation and demonstration, prior to the deployment in the field.

