Wireless and Fixed Networks Fusion in the 6G era:

Building ultra-reliable networks for mission critical applications

FITCE Workshop

Friday May 16th 2025

PROTEUS 6G

www.proteus-6g.eu

FLEX-SCALE

www.6g-flexscale.eu

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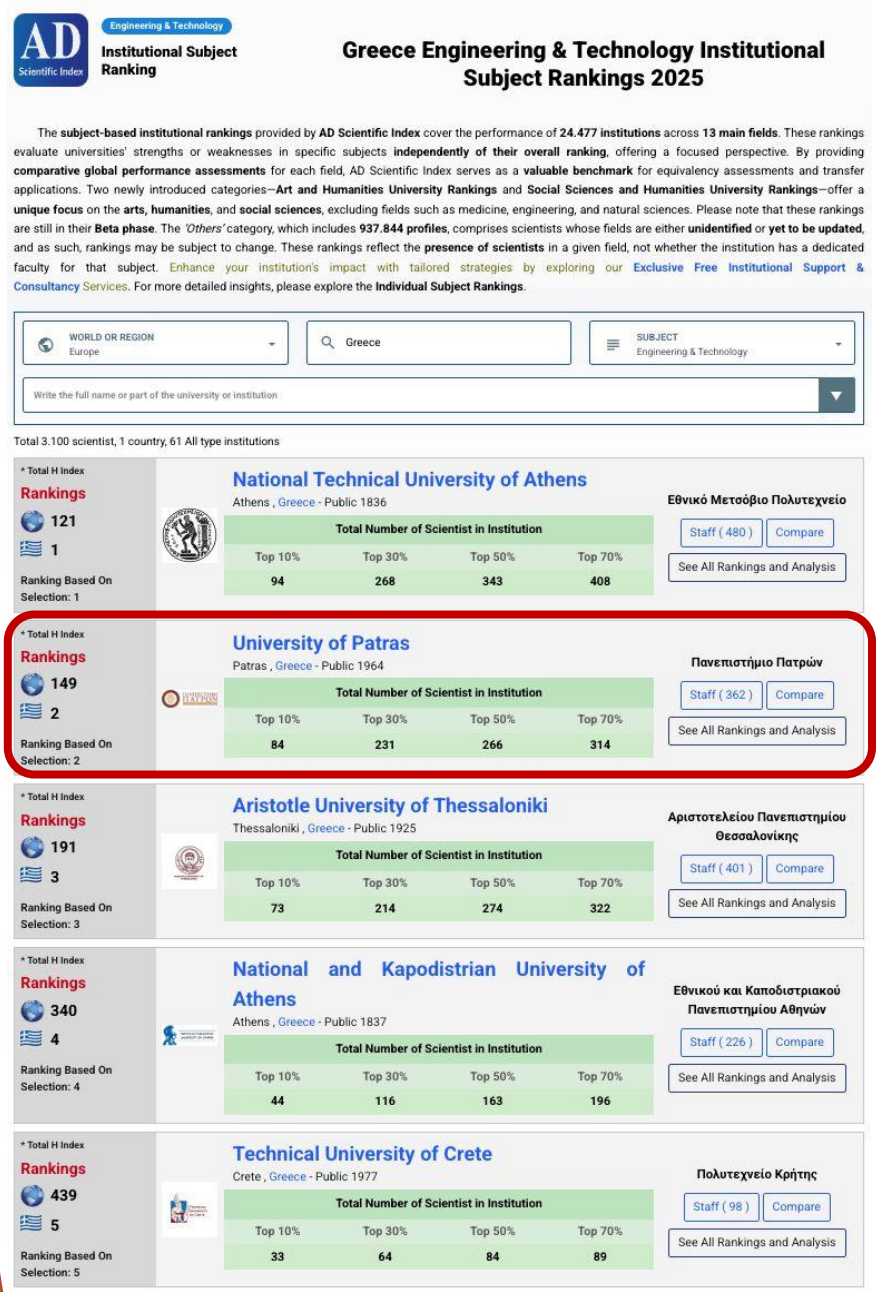
University of Patras

UPatras Rankings - Engineering



Engineering & Technology

Institutional Subject Ranking

Greece Engineering & Technology Institutional Subject Rankings 2025

The **subject-based institutional rankings** provided by **AD Scientific Index** cover the performance of **24.477 institutions** across **13 main fields**. These rankings evaluate universities' strengths or weaknesses in specific subjects **independently of their overall ranking**, offering a focused perspective. By providing **comparative global performance assessments** for each field, AD Scientific Index serves as a **valuable benchmark** for equivalency assessments and transfer applications. Two newly introduced categories—**Art and Humanities University Rankings** and **Social Sciences and Humanities University Rankings**—offer a **unique focus** on the **arts, humanities**, and **social sciences**, excluding fields such as medicine, engineering, and natural sciences. Please note that these rankings are still in their **Beta phase**. The *'Others'* category, which includes **937.844 profiles**, comprises scientists whose fields are either **unidentified** or **yet to be updated**, and as such, rankings may be subject to change. These rankings reflect the **presence of scientists** in a given field, not whether the institution has a dedicated faculty for that subject. Enhance your institution's impact with tailored strategies by exploring our **Exclusive Free Institutional Support & Consultancy** Services. For more detailed insights, please explore the **Individual Subject Rankings**.

WORLD OR REGION: Europe | Greece | SUBJECT: Engineering & Technology

Write the full name or part of the university or institution

Total 3.100 scientist, 1 country, 61 All type institutions

National Technical University of Athens
Athens , Greece - Public 1836
Εθνικό Μετσόβιο Πολυτεχνείο
Total Number of Scientist in Institution

Top 10%	Top 30%	Top 50%	Top 70%
94	268	343	408

Staff (480) | Compare | See All Rankings and Analysis

* Total H Index
Rankings: 121 | 1
Ranking Based On Selection: 1

University of Patras
Patras , Greece - Public 1964
Πανεπιστήμιο Πατρών
Total Number of Scientist in Institution

Top 10%	Top 30%	Top 50%	Top 70%
84	231	266	314

Staff (362) | Compare | See All Rankings and Analysis

* Total H Index
Rankings: 149 | 2
Ranking Based On Selection: 2

Aristotle University of Thessaloniki
Thessaloniki , Greece - Public 1925
Αριστοτελείου Πανεπιστημίου Θεσσαλονίκης
Total Number of Scientist in Institution

Top 10%	Top 30%	Top 50%	Top 70%
73	214	274	322

Staff (401) | Compare | See All Rankings and Analysis

* Total H Index
Rankings: 191 | 3
Ranking Based On Selection: 3

National and Kapodistrian University of Athens
Athens , Greece - Public 1837
Εθνικού και Καποδιστριακού Πανεπιστημίου Αθηνών
Total Number of Scientist in Institution

Top 10%	Top 30%	Top 50%	Top 70%
44	116	163	196

Staff (226) | Compare | See All Rankings and Analysis

* Total H Index
Rankings: 340 | 4
Ranking Based On Selection: 4

Technical University of Crete
Crete , Greece - Public 1977
Πολυτεχνείο Κρήτης
Total Number of Scientist in Institution

Top 10%	Top 30%	Top 50%	Top 70%
33	64	84	89

Staff (98) | Compare | See All Rankings and Analysis

* Total H Index
Rankings: 439 | 5
Ranking Based On Selection: 5

Technische Universität München
Munich , Germany - Public 1868
Total Number of Scientist in Institution

Top 10%	Top 30%	Top 50%	Top 70%
91	250	412	534

* Total H Index
Rankings: 143 | 2
Ranking Based On Selection: 29

Wageningen University & Research Centre
Wageningen , Netherlands - Public 1918
Total Number of Scientist in Institution

Top 10%	Top 30%	Top 50%	Top 70%
88	172	222	261

* Total H Index
Rankings: 148 | 3
Ranking Based On Selection: 30

Ghent University
Ghent , Belgium - Public 1817
Total Number of Scientist in Institution

Top 10%	Top 30%	Top 50%	Top 70%
87	226	308	373

* Total H Index
Rankings: 153 | 2
Ranking Based On Selection: 31

University of Patras
Patras , Greece - Public 1964
Total Number of Scientist in Institution

Top 10%	Top 30%	Top 50%	Top 70%
87	233	276	320

* Total H Index
Rankings: 154 | 2
Ranking Based On Selection: 32

University of Bristol
Bristol , United Kingdom - Public 1876
Total Number of Scientist in Institution

Top 10%	Top 30%	Top 50%	Top 70%
87	222	306	359

* Total H Index
Rankings: 155 | 9
Ranking Based On Selection: 33

University of Twente
Enschede , Netherlands - Public 1961
Total Number of Scientist in Institution

Top 10%	Top 30%	Top 50%	Top 70%
86	210	272	316

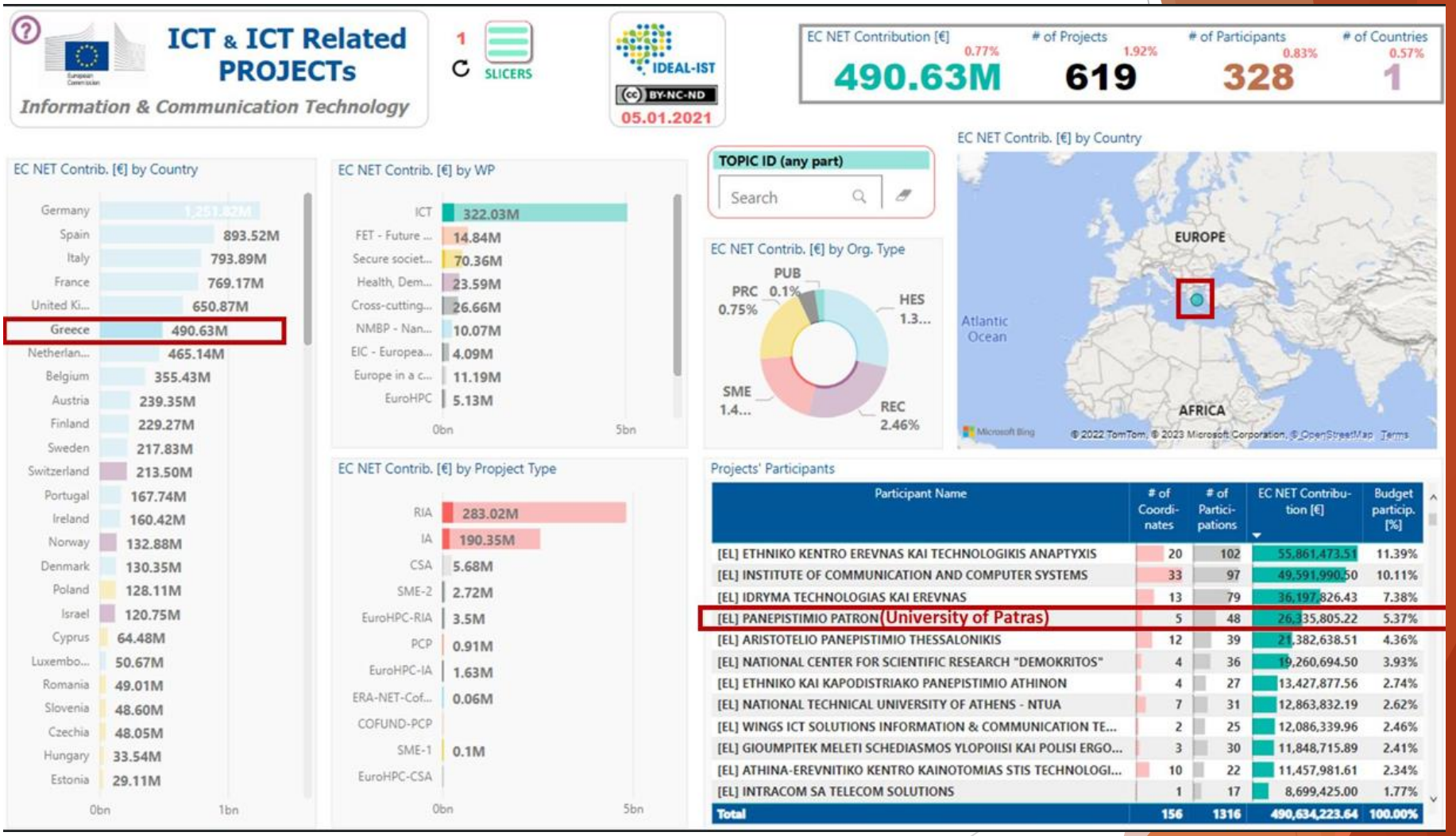
* Total H Index
Rankings: 159 | 4
Ranking Based On Selection: 34

Aalborg University
Aalborg , Denmark - Public 1974
Total Number of Scientist in Institution

Top 10%	Top 30%	Top 50%	Top 70%

* Total H Index
Rankings: 162 | 3

EC R&D Funding Ranking of Greece & UPatras



Participant Name	# of Coordi-nates	# of Partici-pations	EC NET Contribu-tion [€]	Budget particip. [%]
[EL] ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS	20	102	55,861,473.51	11.39%
[EL] INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS	33	97	49,591,990.50	10.11%
[EL] IDRYMA TECHNOLOGIAS KAI EREVNAS	13	79	36,197,826.43	7.38%
[EL] PANEPISTIMIO PATRON (University of Patras)	5	48	26,335,805.22	5.37%
[EL] ARISTOTELIO PANEPISTIMIO THESSALONIKIS	12	39	21,382,638.51	4.36%
[EL] NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRITOS"	4	36	19,260,694.50	3.93%
[EL] ETHNIKO KAI KAPODISTRIAKO PANEPISTIMIO ATHINON	4	27	13,427,877.56	2.74%
[EL] NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA	7	31	12,863,832.19	2.62%
[EL] WINGS ICT SOLUTIONS INFORMATION & COMMUNICATION TE...	2	25	12,086,339.96	2.46%
[EL] GIOUMPITEK MELETI SCHEDIASMOS YLOPOIISI KAI POLISI ERGO...	3	30	11,848,715.89	2.41%
[EL] ATHINA-EREVNITIKO KENTRO KAINOTOMIAS STIS TECHNOLOGI...	10	22	11,457,981.61	2.34%
[EL] INTRACOM SA TELECOM SOLUTIONS	1	17	8,699,425.00	1.77%
Total	156	1316	490,634,223.64	100.00%

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Optical Communications Systems & Networks Research Group (OCSN)

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OPTICAL COMMUNICATIONS SYSTEMS & NETWORKS (OCSN) LAB/GROUP

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Home > Research > Running Projects

Running Projects

6G-XCEL
2024-01 to 2026-12 | Contract
European Commission (Brussels, Brussels, BE)
Project Website
Project Description
Grant Agreement No.: 101139194

SENSEI
2024-11 to 2027-12 | Contract
European Commission (Brussels, Brussels, BE)
Project Website
Project Description
Grant Agreement No.: 101189545

PROTEUS-6G
2023-01 to 2025-12 | Contract
European Commission (Brussels, Brussels, BE)
Project Website
Project Description
Grant Agreement No.: 101139134

FLEX-SCALE
2022-01 to 2024-12 | Contract
European Commission (Brussels, Brussels, BE)
Project Website
Project Description
Grant Agreement No.: 101096909

Home > Research > Former Projects

Former Projects

5G INDUCE
2021-01 to 2023-01 | Contract
European Commission (Brussels, Brussels, BE)
Project Description
Grant Agreement No.: 101016941

Building on the Use of Spatial Multiplexing 5G Networks Infrastructures and Showcasing Advanced technologies and Networking Capabilties
2017-06-01 to 2020-05-31 | Grant
European Commission (Brussels, BE)
Project Description
Grant Agreement No.: 762055

Directly Modulated Lasers on Silicon
2016-02-01 to 2020-01-31 | Grant
European Commission (Brussels, BE)
Project Description
Grant Agreement No.: 688003

Application Centric IP/Optical Network Orchestration
2015-02-01 to 2018-01-31 | Grant
European Commission (Brussels, BE)
Project Description
Grant Agreement No.: 645127

Optical Communications Systems & Networks (OCSN) Lab/Group

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Lab Director

Prof. Ioannis Tomkos
Professor, Fellow IEEE, Fellow OPTICA, Fellow IET

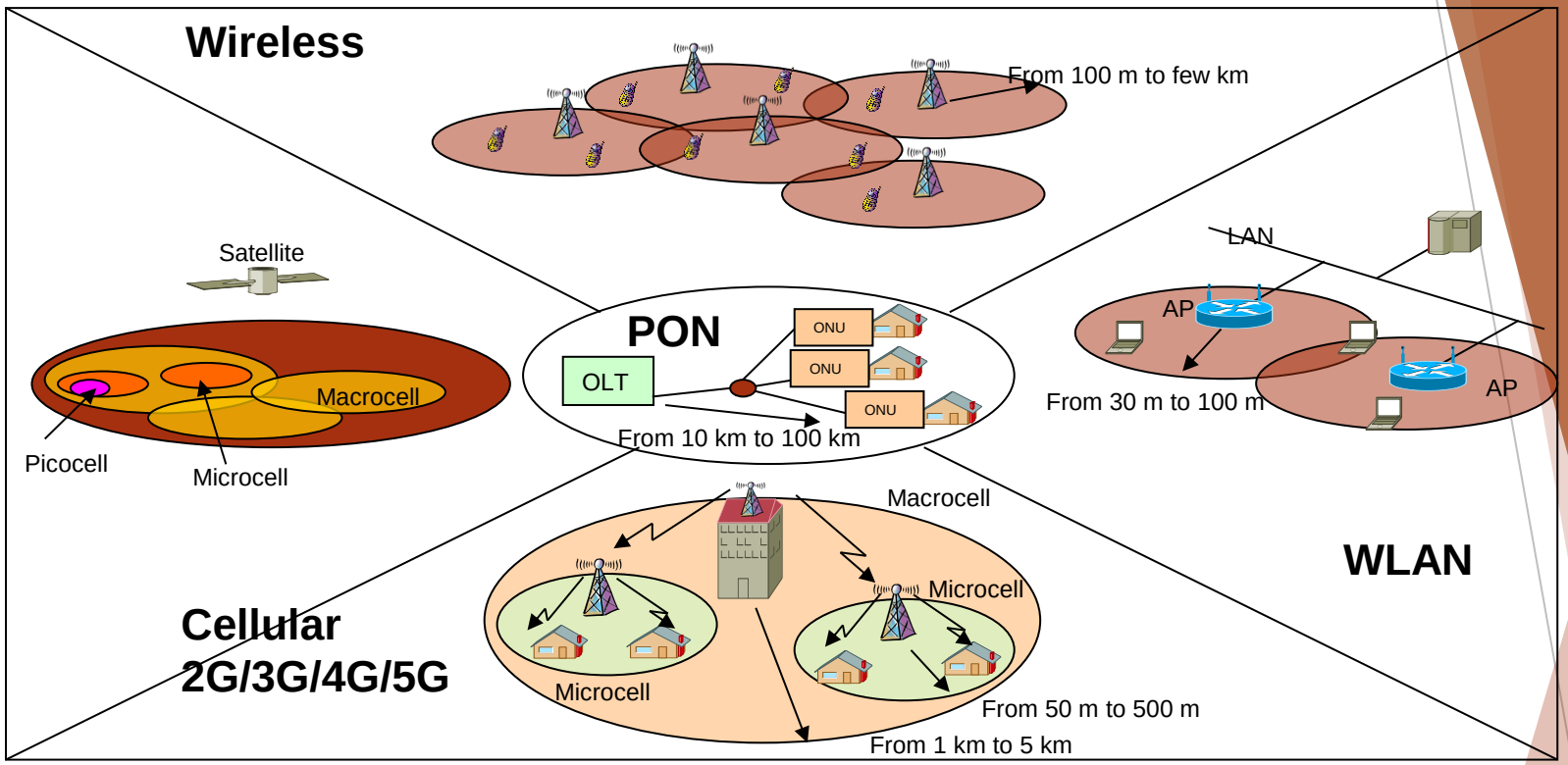
Team
OCSN Team

Publications
Journal & Magazine Publications
Conference Proceedings & Workshop Contributions
Guest Editorials in high impact IEEE Journals
Presentations at Workshops

Overview

- The fusion of Wireless and Fixed Networks alongside Cloud, Artificial Intelligence and Sensing technologies will set the foundations of 6G Smart Networks and Services.
  - Evolving convergence of Wireless and Fixed Networks
  - Network augmentation with Computing/Intelligence
  - Envisioned 6G Use Cases families
  - Targeted 6G Capabilities
  - Emergence of the Internet of Senses
  - Emergence of the Network as a Sensor
  - End-to-end 6G Networks
- 6G Network Capabilities support mission critical applications
  - Medical applications of 6G networks
  - Features of a Smart Hospital
  - 6G based smart hospital will enable the use of advanced Robotics
  - Smart 6G Networks enabling the Smart Hospital of the future
  - Deployment of a private 6G network within a smart hospital
  - Non-Radio based 6G network for hospitals (and schools)
- Summary & Conclusions

“Competitors” for Broadband Access

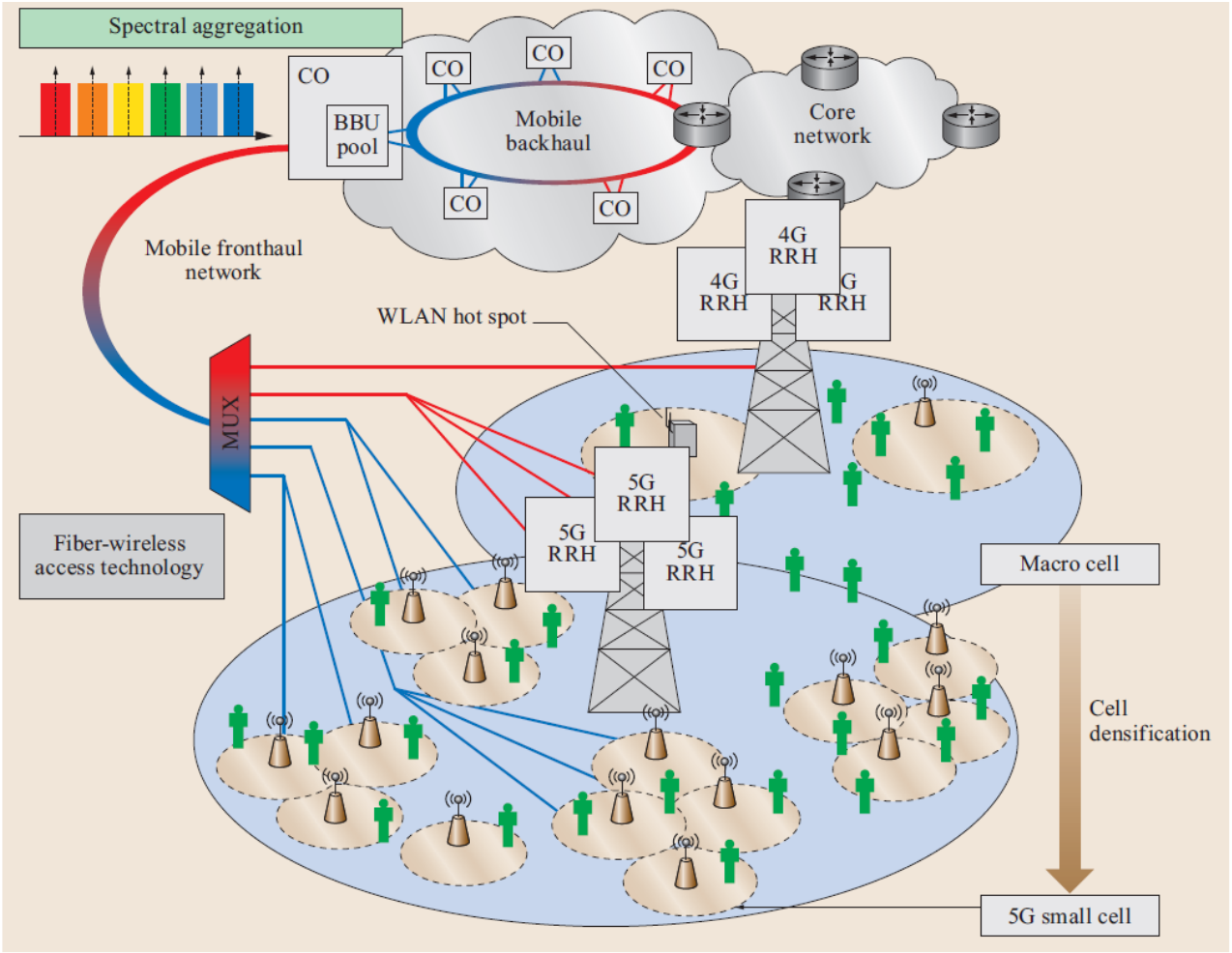


- Six main access solutions:
  - Cellular Mobile Wireless (evolving in Generations: 1G, 2G, 3G, 4G, 5G, 6G)
  - Satellite Mobile Wireless,
  - Fixed Wireless,
  - Fixed Wireline (Fiber),
  - Fixed Wireline (Copper),
  - Fixed Wireline (Cable)

Convergence among these networks is becoming more pronounced over time

“Competitors” become “Allies”!

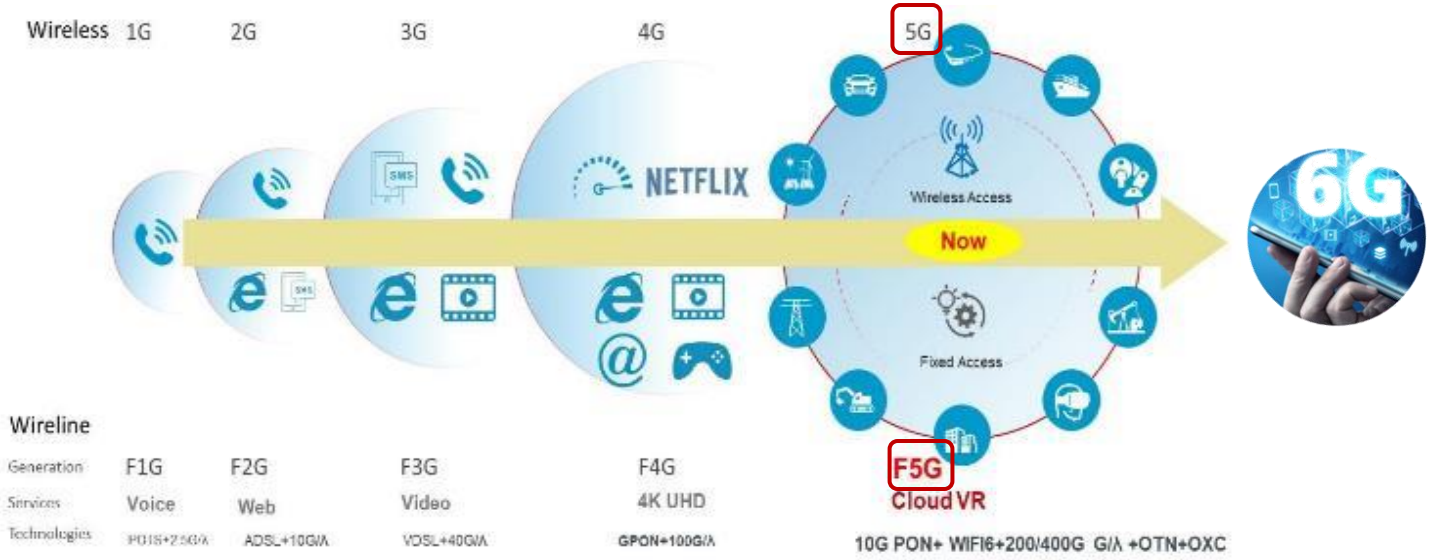
Fixed & Wireless Networks Convergence/Complementarity



"a wireless network is only as good as the fixed network it runs on")

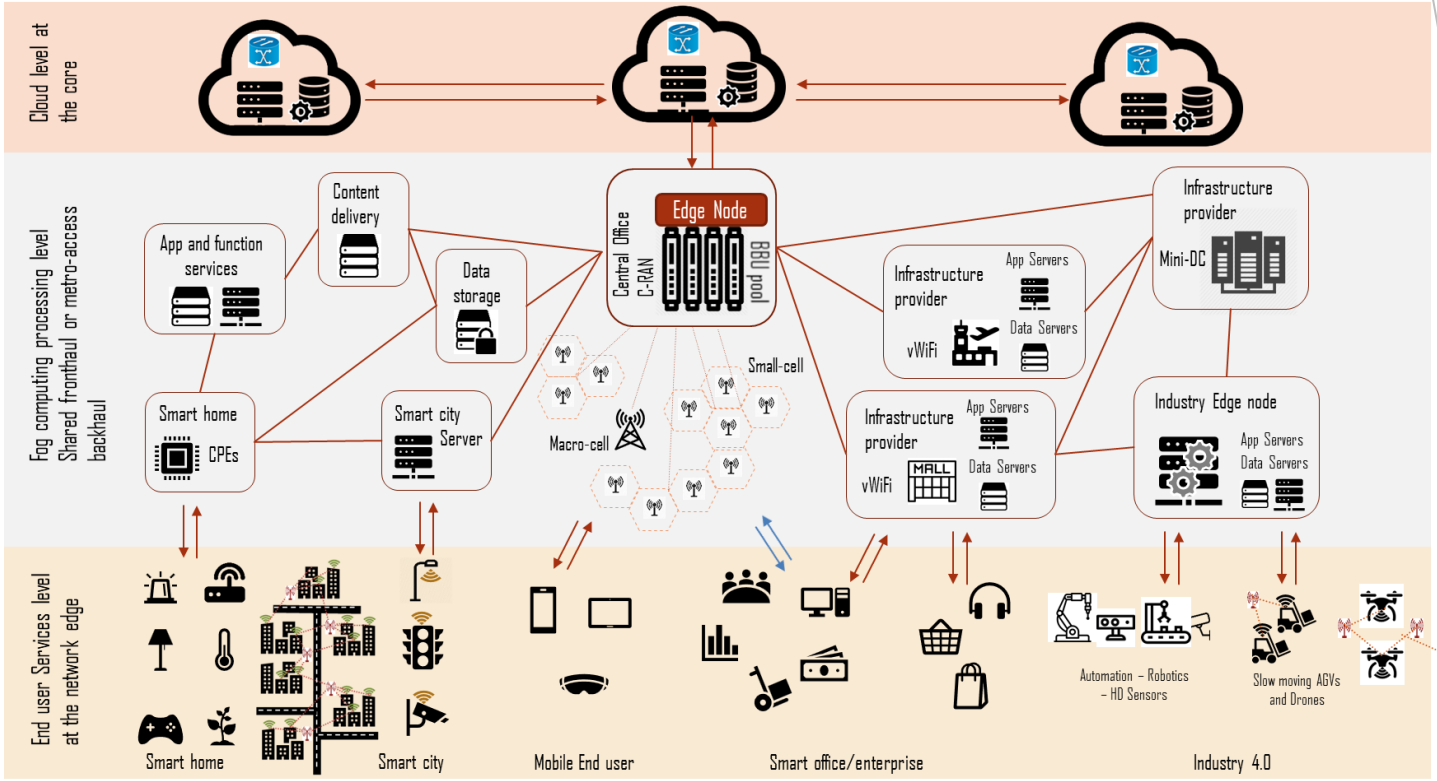
https://www.verizon.com/business/en-nl/resources/articles/5g-architecture/

Wireless & Fixed Networks are converging alongside computing and sensing infrastructures towards 6G



- The development of the wireless and wireline telecom generations followed a different path up to the 5th generation *when the two started being closer interrelated*
  - The term "5G" refers to the fifth generation of wireless networks
  - The term "F5G" refers to the fifth generation of wireline networks
    - Working Group set by ETSI to define F5G
- This evolving convergence of fixed/wireless infrastructures, alongside with computing, storage and sensing infrastructures will give rise to "6G" networks

Flashback to 2019: Intro of 6G Network Concept relying on Interconnected Data Centers (Edge-Fog-Core Clouds)



Journals & Magazines > IT Professional > Volume: 22 Issue: 1

Toward the 6G Network Era: Opportunities and Challenges

Publisher: IEEE | Cite This | PDF | Jan 2020, doi: 10.1109/MITP.2019.2963491

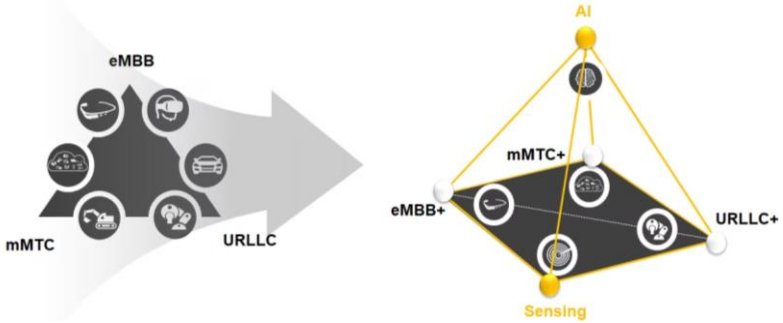
Ioannis Tomkos ; Dimitrios Klonidis ; Evangelos Pikasis ; Sergios Theodoridis All Authors

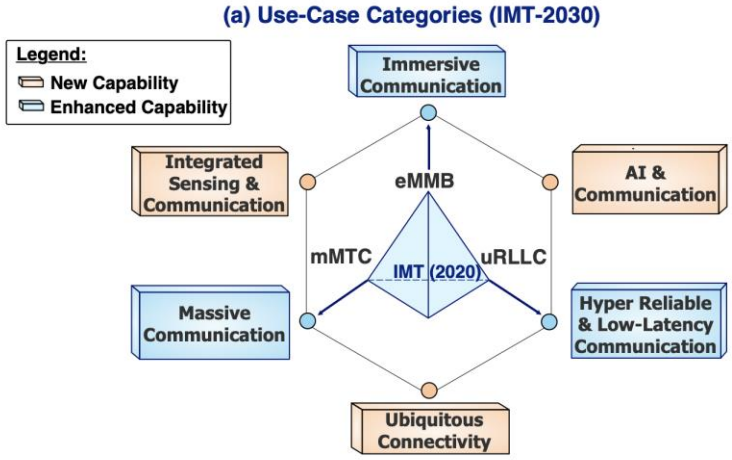
176 Cites in Papers

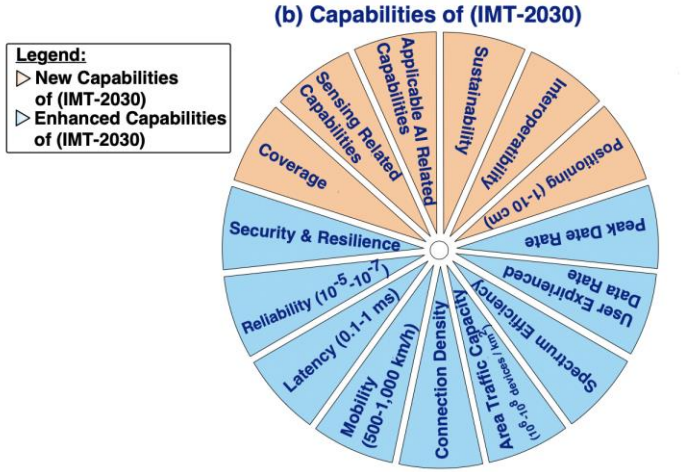
12650 Full Text Views

One of the most popular/cited articles on 6G that appears at IEEE Xplore

6G use-cases families & capabilities







- The vision for the upcoming 6G networks, as outlined by ITU-R standards body, defines the overall objectives, capabilities and expected applications of the "IMT-2030" ("International Mobile Telecommunications for 2030")
- IMT-2030 advances the capabilities specified by IMT-2020 and introduces new capabilities related e.g. with **AI & sensing**
- IMT-2030 encompasses the development of three new categories of use cases (Ubiquitous Connectivity, AI and Communication, Integrated Sensing and Communications), together with three evolved categories from IMT-2020 (eMBB → Immersive Communication, mMTC → Massive Communication, uRLLC → Hyper Reliable & Low-Latency Communication)

6G will enable the “Internet of Senses” going beyond the “Internet of Things”

10 Hot Consumer Trends 2030

Welcome to the internet of the senses.

01. Your brain is the user interface

Fifty-nine percent of consumers believe that we will be able to see map routes on VR glasses by simply thinking of a destination.

02. Sounds like me

Using a microphone, 67 percent believe they will be able to take on anyone's voice realistically enough to fool even family members.

03. Any flavor you want

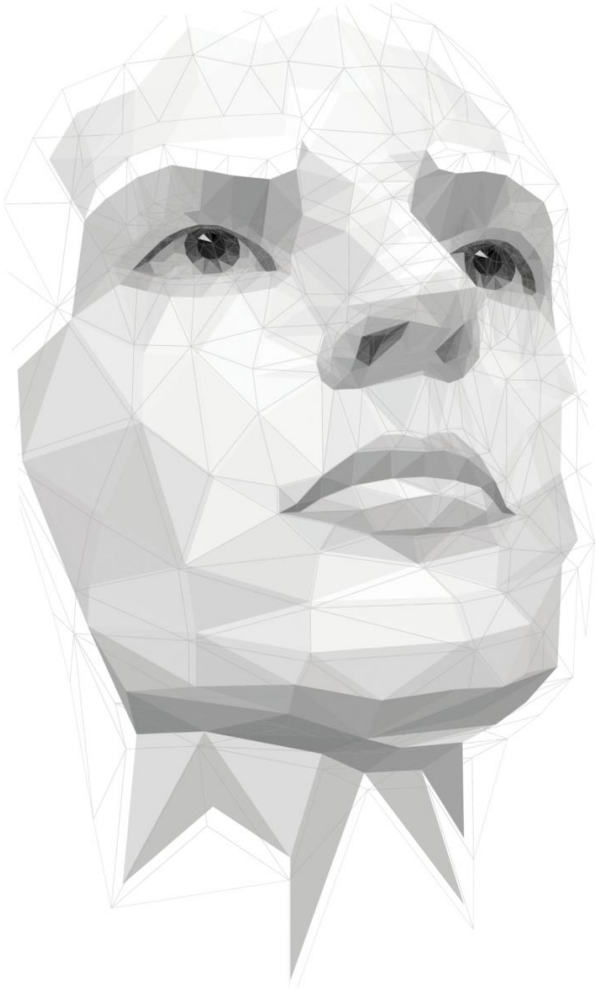
Forty-five percent predict a device for your mouth that digitally enhances anything you eat, so that any food can taste like your favorite treat.

04. Digital aroma

Around 6 in 10 expect to be able to digitally visit forests or the countryside, including experiencing all the natural smells of those places.

05. Total touch

More than 6 in 10 expect smartphones with screens that convey the shape and texture of the digital icons and buttons they're pressing.



06. Merged reality

VR game worlds are predicted by 7 in 10 to be indistinguishable from physical reality by 2030.

07. Verified as real

"Fake news" could be finished – half of respondents say news reporting services that feature extensive fact checks will be popular by 2030.

08. Post-privacy consumers

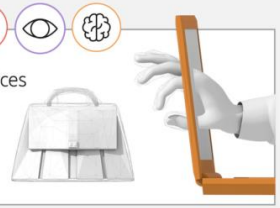
Half of respondents are "post-privacy consumers" – they expect privacy issues to be fully resolved so they can safely reap the benefits of a data-driven world.

09. Connected sustainability

Internet of senses-based services will make society more environmentally sustainable, according to 6 in 10.

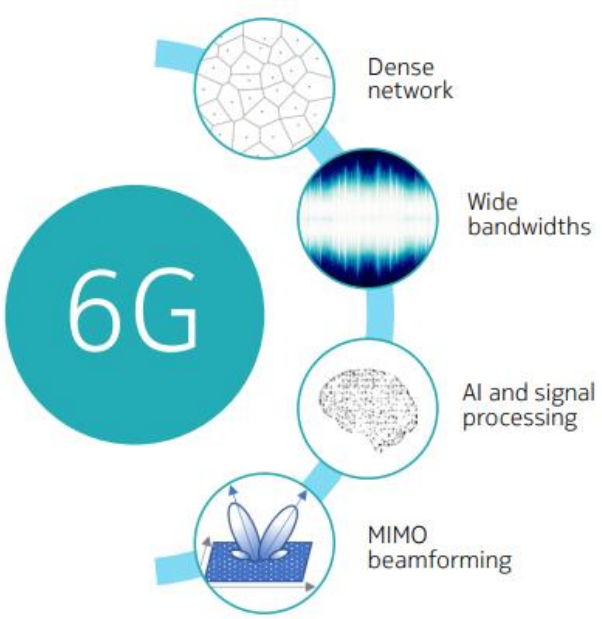
10. Sensational services

Forty-five percent of consumers anticipate digital malls allowing them to use all five senses when shopping.



Source: Ericsson

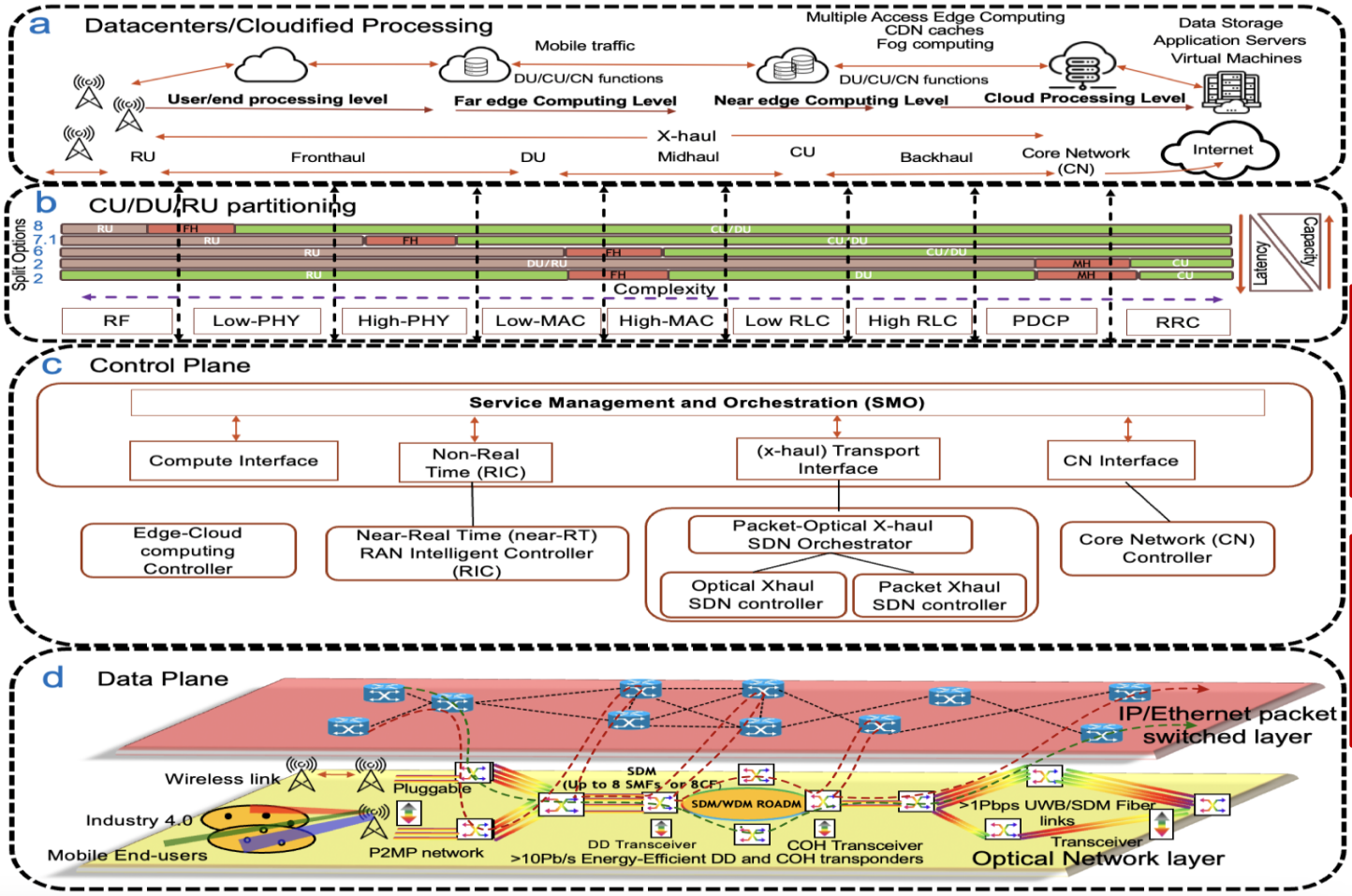
6G Network as a Sensor



- Avoid traffic accidents by sensing unseen cars driving around a corner. Support autonomous driving.
- Interact directly with machines and robots remotely, seeing what they see, hearing what they hear, while directing their actions through simple hand gestures captured by the network.
- Network sensing could be used to provide security in places where cameras aren't available or allowed, and it could be used to augment camera networks in foggy or dark conditions.
- Network sensing could replace complicated input sensors used for Virtual Reality applications.
- The network could detect if a vulnerable person has fallen and even "hear" their heartbeat, alerting emergency responders about possible trauma.

Sensing type	Range resolution	Maximum speed
Traffic monitoring	1 m	40 m/s
Pedestrian detection	tens of cm	3 m/s
Parked vehicle detection	50 cm	N/A
Drone detection	1 m	30 m/s
Around the corner	1 m	15 m/s
Motion sensing	< 10 cm	1 m/s

End-to-End 6G Mobile Networks relying on OWRAN/x-haul



REF: The "X-Factor" of 6G Networks: Optical Transport Empowering 6G Innovations Ioannis Tomkos, et.al., IEEE IT Professional Mag. Mar 2024

REF: The role of optical networking in the 6G era, I.Tomkos et.al., Invited Talk Optical Fiber Communication Conference (OFC), Mar 2024

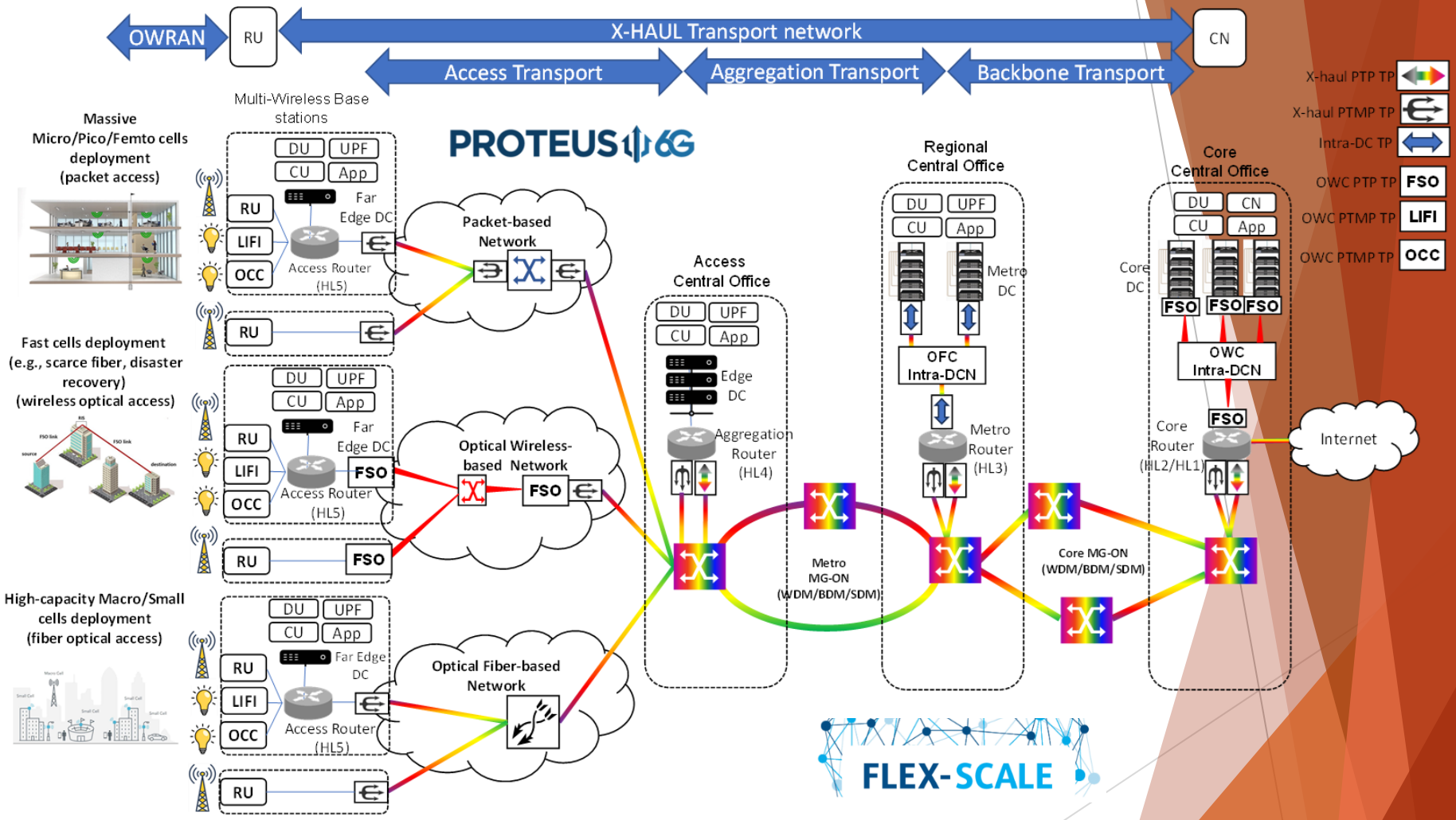
(a) The partition of the RU/DU/CU (implementing the RAN functions) defines the fronthaul, midhaul, and backhaul

(b) The CU/DU/RU partition addresses the transport capacity and associated latency requirements of 6G networks

(c) The SMO incorporates the O-RAN components (Non-Real Time & Near RT-RIC and links to the Packet/Optical Transport (x-haul) and Core Network (CN) Interfaces connected to Packet/Optical/CN controllers.

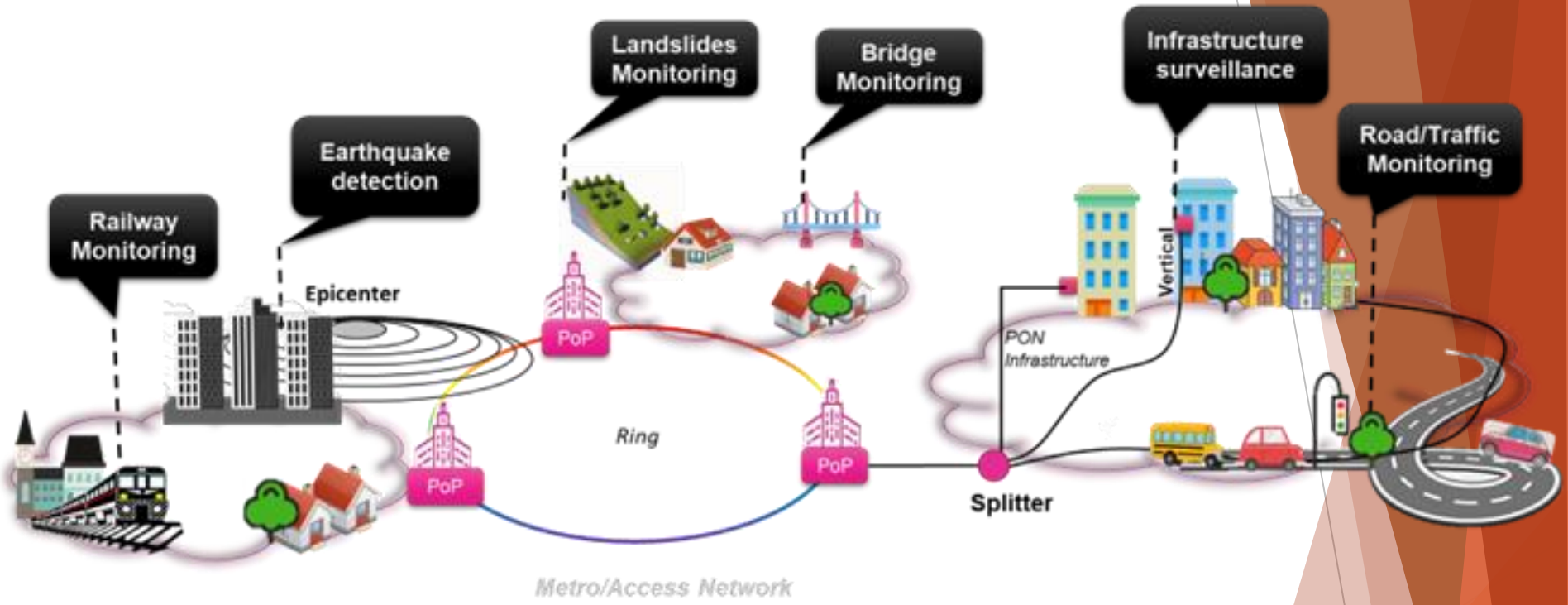
(d) The data plane is composed by the OWRAN wireless access and fixed x-haul segments

E2E 6G Mobile Networks relying on Fixed/Wireless Optical Fiber/Wireless Communications (OFC & OWC)



- The Optical Wireless & Radio Access Network (OWRAN) segment at the edge of 6G mobile networks is supported by the IP/Optical Fiber Communications (OFC) x-haul Fixed Network segment which should efficiently aggregate/distribute the (huge) traffic that is generated at the OWRAN segment by the end-users.

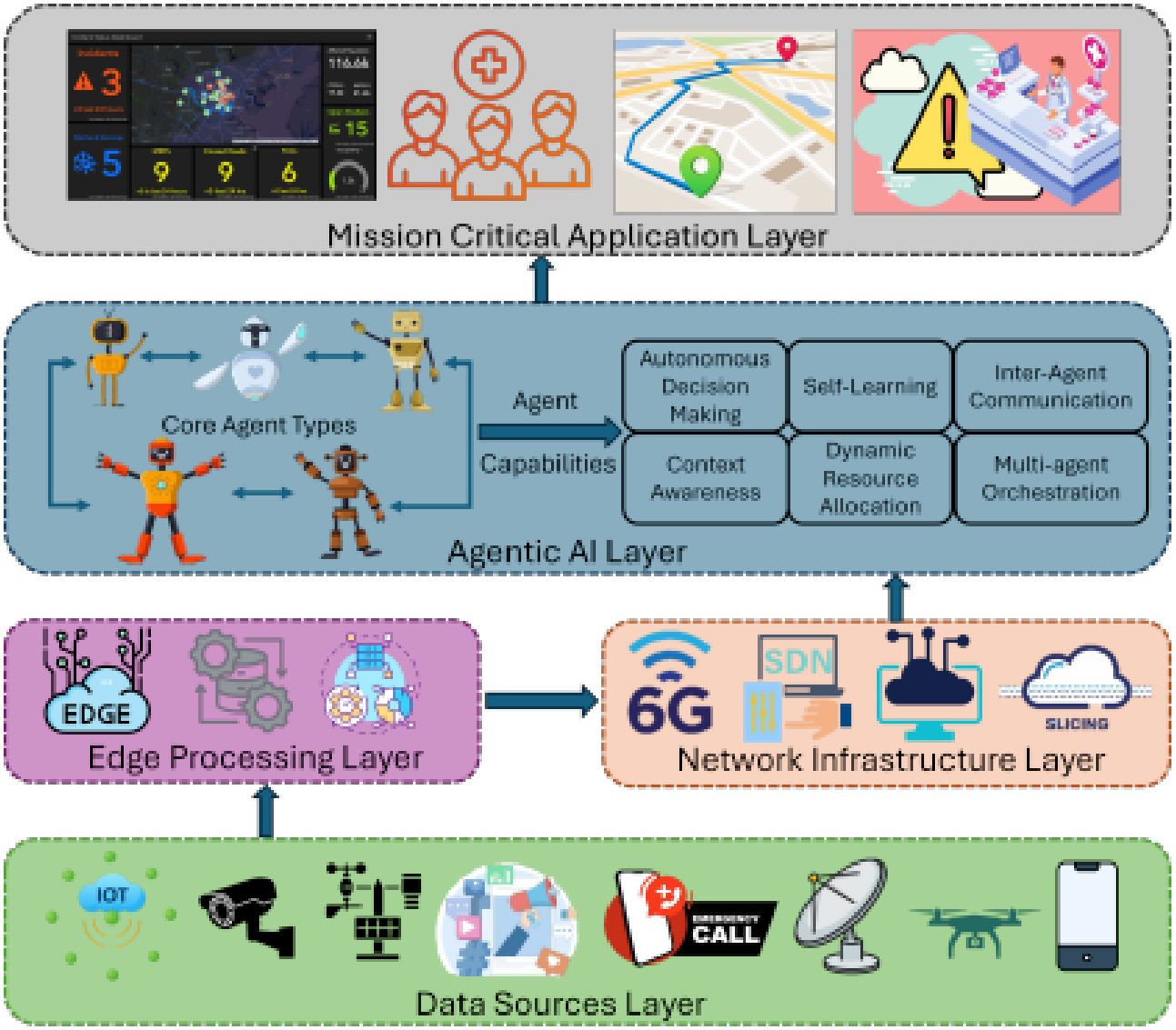
6G (Fixed) Network as a Sensor
What are some possible use cases?



- By analysing data collected during the optical fiber network operation, we can identify patterns that precede equipment failures or environmental threats, such as vibrations indicating seismic activity or, tsunamis or landslides or structural problems.
- In addition, if fluctuations in signal quality at a specific location is detected, network operators could be alerted about a potential fault before it leads to service disruption.

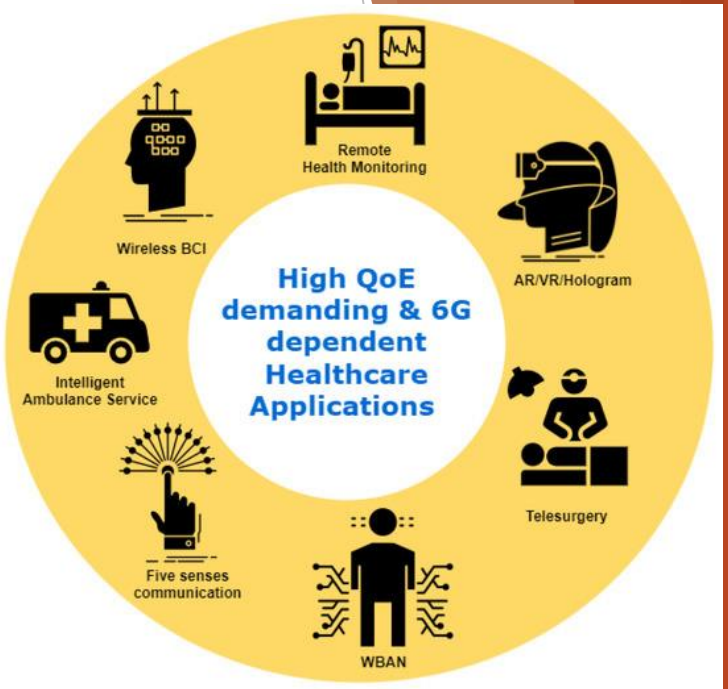
SENSEI

6G Network Capabilities support mission critical applications

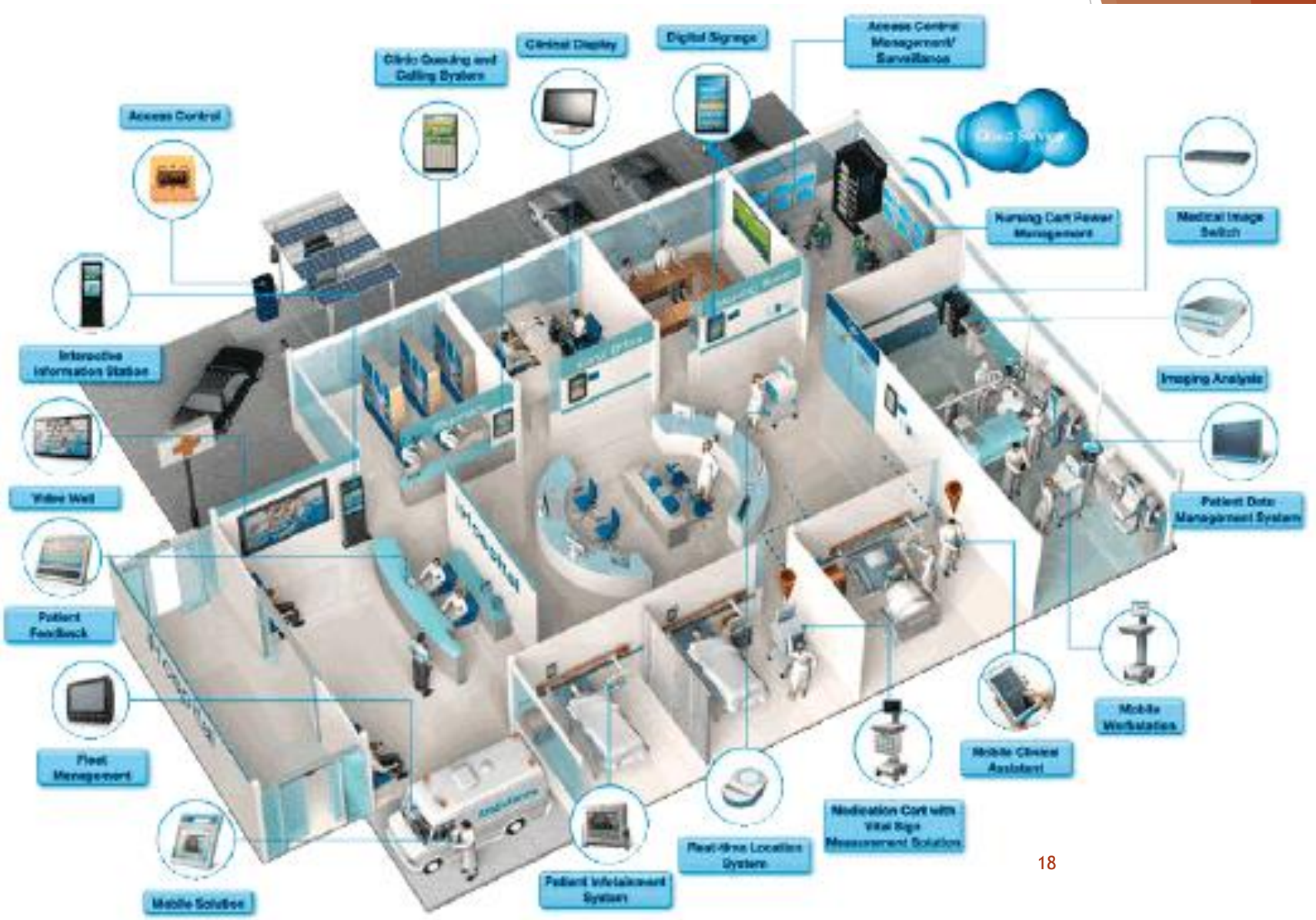


Medical applications of 6G networks

- From a clinical perspective, initial focus is on 3 use cases:
  - **Patient monitoring:** Biosignals collected directly from patients, such as blood pressure, body temperature, respiratory rate and other vital signs, are tracked remotely in real time. For this purpose, innovative, non-invasive sensor technology will be combined here with advanced 6G mediated network intelligence.
  - **Collaborative teamwork in medical care:** Doctors and nurses will be able to work together better in the future using enhanced network functionalities. Using AR/VR (augmented/virtual reality) or telemedical functionalities, doctors can, for example, view three-dimensional representations of organs and tissues for preparation before operations or consult other specialists.
  - **Smart Hospital:** 6G networks can connect medical devices to enable new types of processes so that treatment and logistics processes can be made more efficient and safer. The potential of 6G networks in medicine and medical technology is huge and very promising due to their technical characteristics.



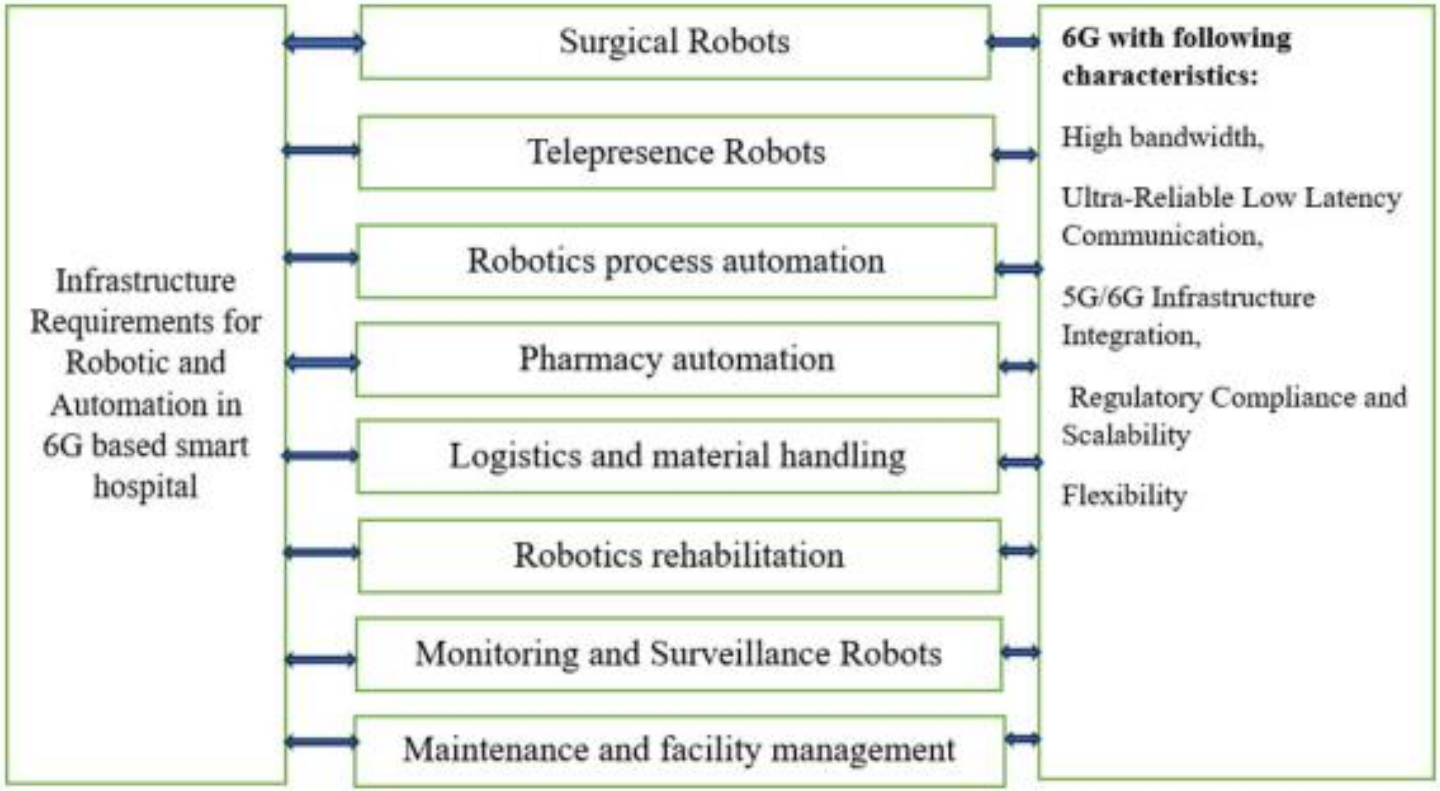
6G connectivity as an enabler for the Smart Hospital of the future



Features of a Smart Hospital

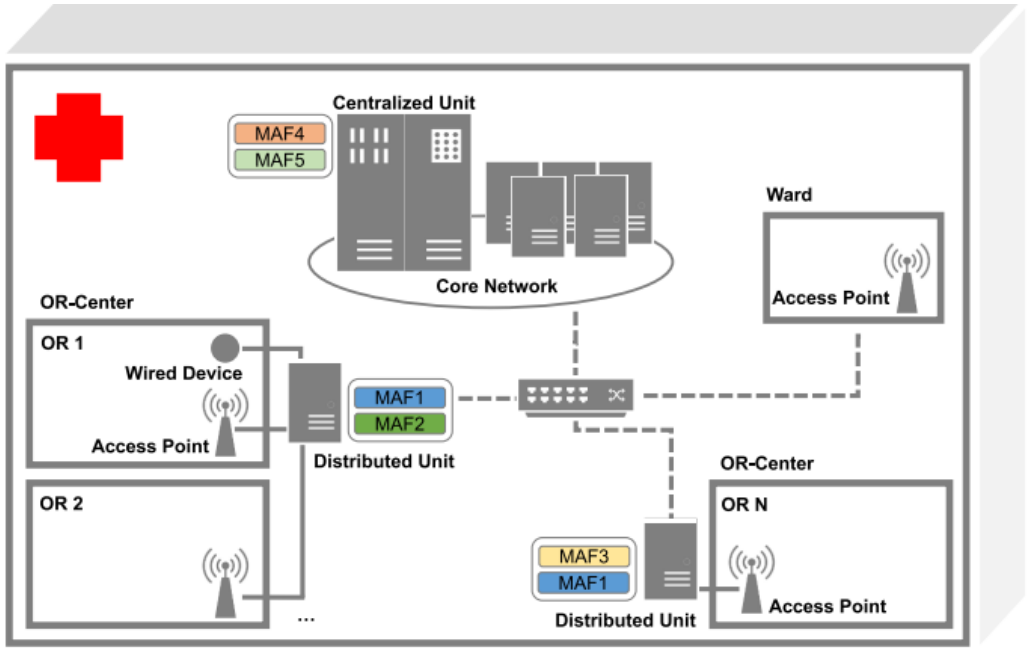
- **Connected Infrastructure:** Relies on a robust technology infrastructure and reliable communication networks that allow information to be exchanged in real-time among devices, IT systems, and healthcare professionals.
- **Artificial Intelligence and Data Analytics:** Employs AI algorithms and advanced analytics techniques, such as machine learning and natural language processing (NLP), to extract valuable insights that optimize healthcare.
- **Automation and Robotics:** Incorporates robots and automated systems for tasks such as medication dispensing and internal logistics, freeing healthcare professionals from routine tasks and improving safety.
- **Emerging technologies:** Integrates technologies such as augmented/virtual reality (AR/VR), wearables, and assistive robots, improving the patient experience and optimizing the tasks of healthcare professionals.
- **Telemedicine and remote care:** facilitate remote care through telemedicine platforms, enabling effective interactions between healthcare professionals and patients without the need for face-to-face visits.
- **Cybersecurity and privacy:** Given the high volume of sensitive data it handles; it implements robust cybersecurity measures to protect patient information and ensure the integrity of its systems. Patient-Centered Mobile Environment: Uses technology to improve the patient's experience through mobile apps that manage appointments and access medical information, as well as physical environments tailored to patient needs.

A 6G based smart hospital will enable the use of advanced Robotics



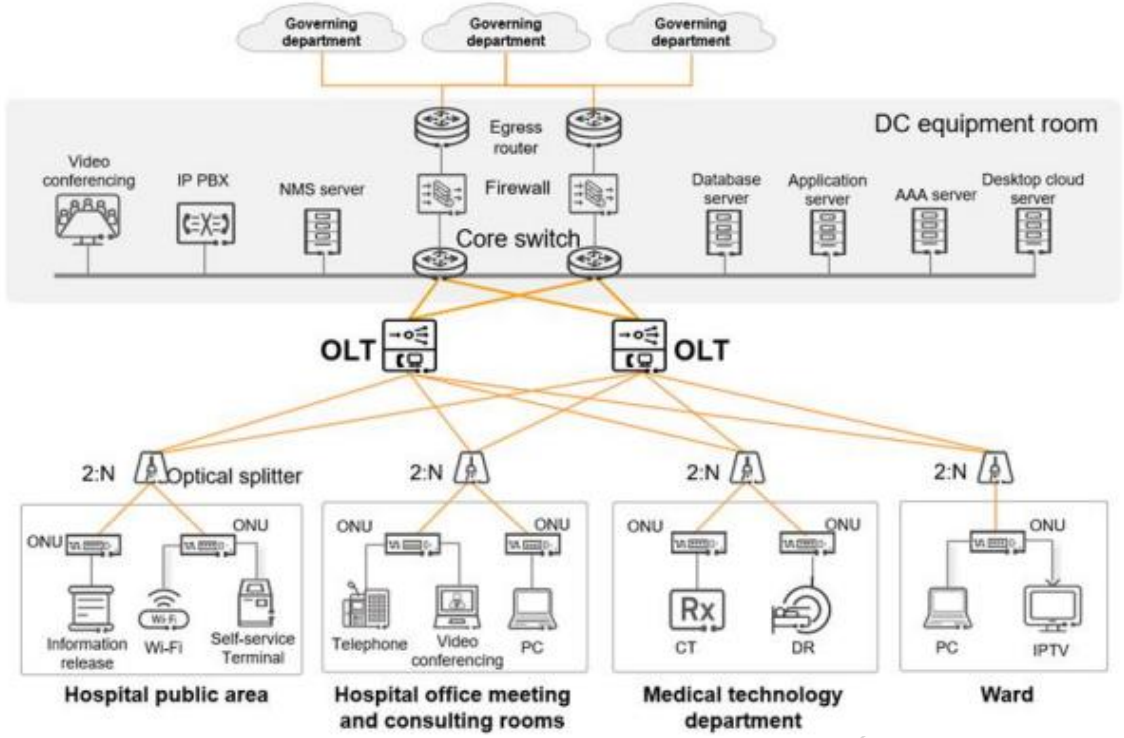
Visualization of a private 6G network within a smart hospital

- A **smart hospital** is a healthcare facility that integrates advanced technologies and connectivity, both between devices and information systems, to transform patient care and improve operational healthcare efficiency
- This type of hospital is based on the convergence of digital systems, medical devices, and data management platforms, creating a collaborative, patient-centered environment.
- The smart hospital harnesses the potential of 5G/6G networks, as well as emerging technologies such as Artificial Intelligence (AI) and Augmented/Virtual Reality (AR/VR), to help improve, innovate and optimize healthcare processes.

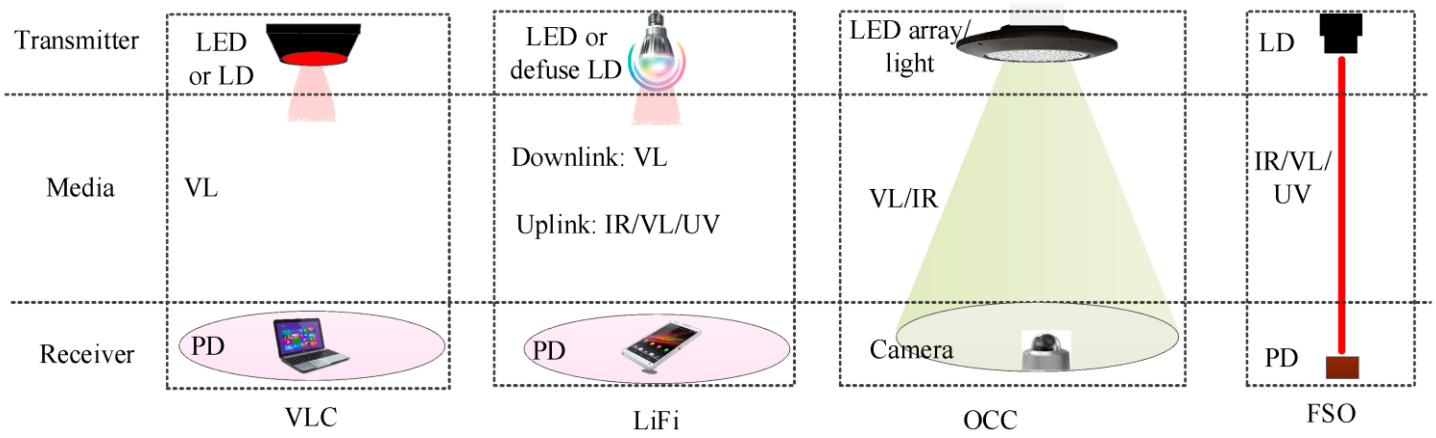


Optical Connectivity Replacing Copper & Radio Connectivity in Hospitals

- In smart hospitals, everything is interconnected, including the data center, outpatient area, nursing area, operating room, clinical laboratory center, and medical imaging center, leading to an exponential increase in connections. A Fixed Passive Optical Network, augmented wit Optical Wireless Networks can serve all corners of a hospital, including wards, consulting rooms, office desks, and medical equipment, and lays the foundation for the interconnection of devices, people, processes and data over the Internet, without exposing patients to radio waves.



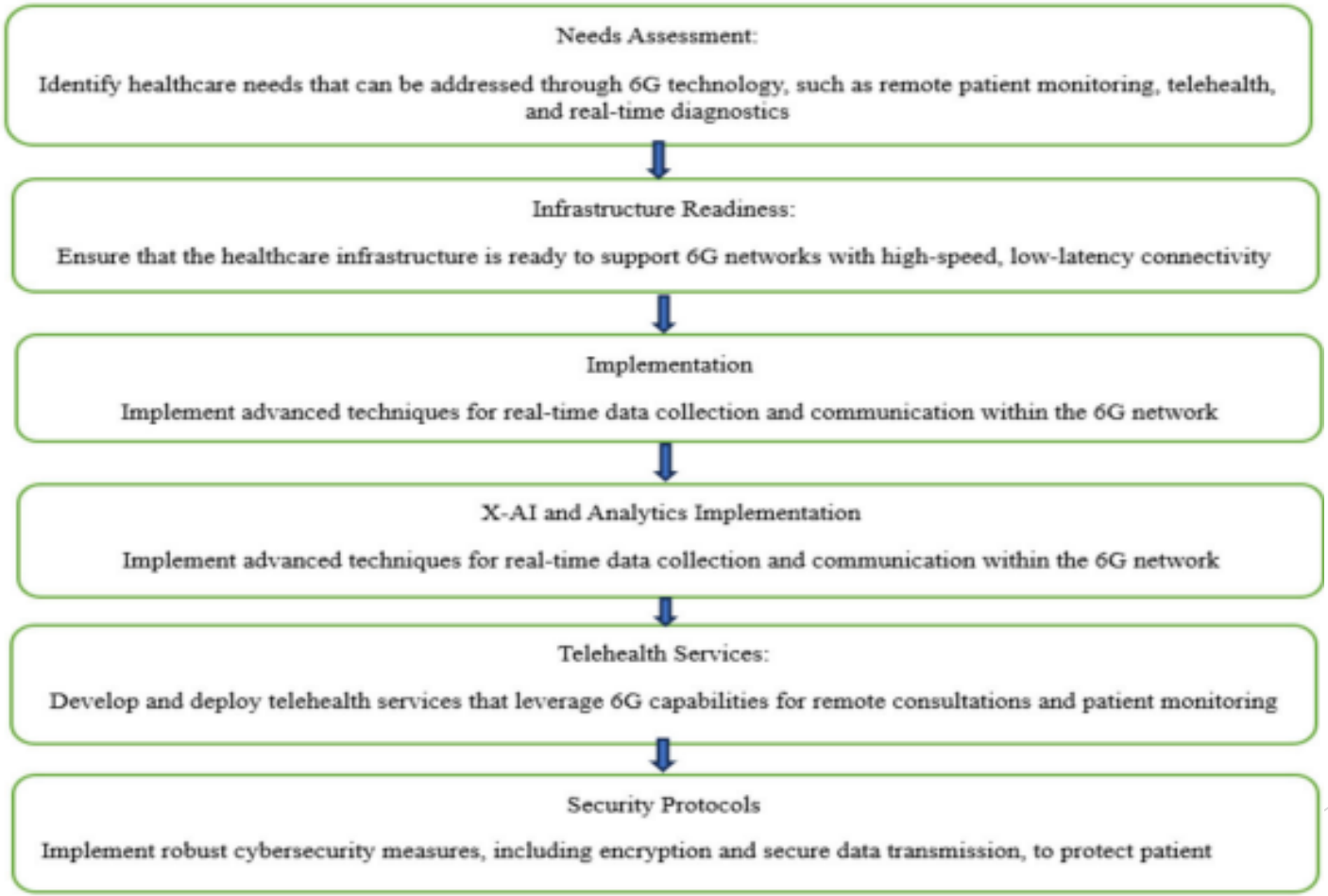
Optical Wireless Solutions for Smart Hospitals: a step beyond Wi-Fi



- These Optical Wireless Communication Networks can operate also at the Visible part of the electromagnetic spectrum (i.e. VLC) and support ultra-high-rate data connectivity

	RF	VLC
Pros.	Wide coverage	High security
	LOS not needed	Decreased co-existence problem
	Multiple standards	Very high data throughput support
	High dependability for connection	No SAR exposure
	Several available commercial technologies	Better energy and cost-efficiency
	Relatively low cost	Lower PHY layer latency
		Availability of huge unregulated bandwidth
		Integrated with lighting infrastructure
		Compatible with smart lighting
Cons.	Decreased security	Small coverage/each room needs an access point
	Decreased privacy	Need LOS for operation for best performance
	Increased SAR exposure	Mainly indoor limited
	Increased co-existence problem	Mainly short-range limited
	Lower data rate	Commercializating slowly
	Higher PHY layer latency	

Planning to Implement a Smart Connected Hospital



Summary & Conclusions

- Discussed how the fusion of Wireless and Fixed Networks alongside Cloud, Artificial Intelligence and Sensing technologies will set the foundations of 6G Smart Networks

- Discussed how 6G Network Capabilities support mission critical applications

- The deployment of a private 6G network can support the formation of a smart hospital to improve operational efficiencies and assist in the offering of advanced healthcare services

Thank you for your attention!

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