



NATIONAL & KAPODISTRIAN UNIVERSITY OF ATHENS

5G-and-Beyond Communications for Smart Cities



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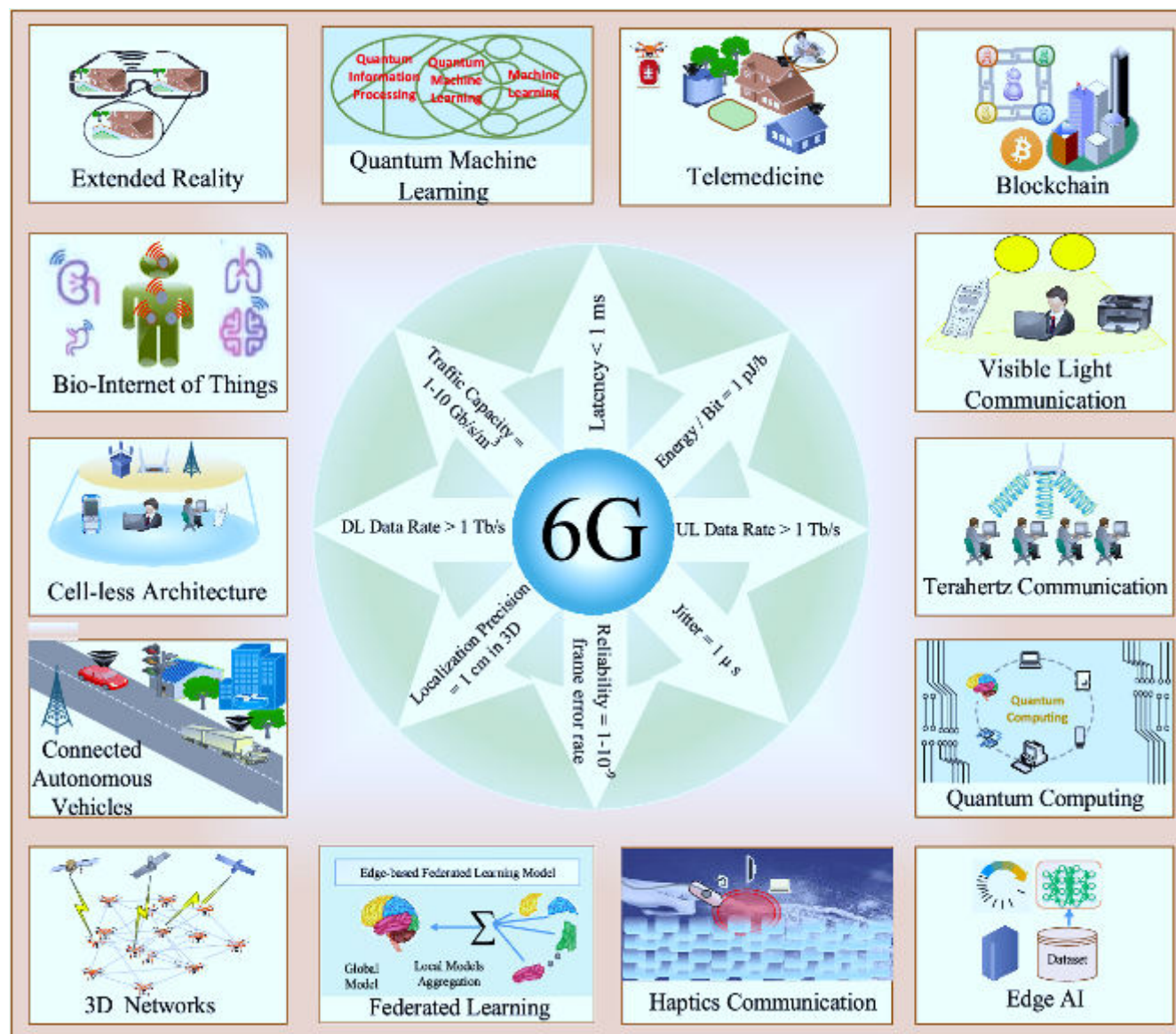
Beyond 5G → 6G

- Global 5G Stand-alone infrastructure market will exceed \$94B by 2025
- AI, IoT, 5G and 6G will be the most influential technologies for smart cities
- Public Safety, Smart transportation, Sustainability will be the top smart cities market application area through 2025
- Connected Digital twins, Teleoperations, telerobotics will be leading 6G-enabled solutions
- Identity management and authentication will be critically important for 6G mesh networking
- Ambient intelligence will take a major leap forward with embedded device AI in 6G networks
- Fastest growing professional services for global smart cities is infrastructure maintenance, reaching \$3.6B by 2025
- 5G, AI, and IoT investment in smart cities market represents 63%, 34%, and 52% for each technology area respectively by 2025
- What 6G may offer would have no comparison to 5G. The peak speed is expected to be 100 times that of 5G networks touching 1Tbps. It is also expected that the latency rate will drop to 0.1 ms, at least ten times less than that of the 5G network. The work on 6G has already begun, and the vision is to roll out 6G by 2030.

Key figures

- With 6G, it will be possible to connect 10 times more devices /m³ leading to a huge number of connected devices with ultra-high reliability and efficiency. The data is integrated in real-time to assess the situations and probabilities of an outcome using quantum computing.
- 6G wireless connectivity will come with speeds of 1 to 100 Gbps and will provide speeds in the tens of terabytes per second; which is 50-times the peak data rate of 5G
- The main user of 6G technology, will actually be machines. There will be 500 billion connected devices in the world by 2030 – 59-times larger than the expected world population by that time.
- Within three to five years, Gartner predicted, "billions of things will be represented by digital twins, a dynamic software model of a physical thing or system."

6G Ecosystem



Beyond 5G,... 6G and AI for SMART CONNECTED CITIES

- Digital Twins
- Robots for city operations, e.g., waste management
- Multimode transportation
- Digital assistants for citizens' municipal services
- Connected Cities – Cross City applications (e.g., Public Safety – Predictive critical risk management, impact mitigation)



Digital Twins – enabler for complex urban operations

LAYER 5
Uses data from Layer 4 for simulation

LAYER 4
Collects data from layers 0-3 (from sensors, IoT, connected devices, etc.) to manage and monitor systems and services

LAYER 3
Movements of people and goods in the city

LAYER 2
Basic physical and organizational structures and facilities

LAYER 1
Current buildings in the city (Building Information Modeling)

LAYER 0
Terrain and basic information about the city



LAYER 5
VIRTUAL
DIGITAL
TWIN

LAYER 4
VIRTUAL
SMART
CITY

LAYER 3
MOBILITY

LAYER 2
INFRASTRUCTURE

LAYER 1
BUILDINGS

LAYER 0
TERRAIN



Unified Physical and Digital Cities

Ubiquitous compute

Precision sensing & actuation

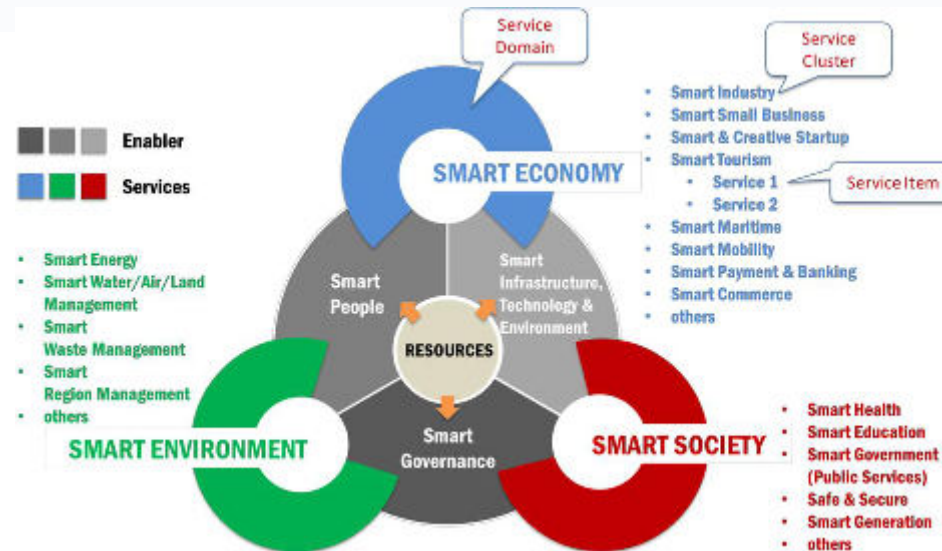


Knowledge systems

Human machine interface



6G will unify the experience across physical, digital and human worlds



Our Profile and Focus

General Profile

- National & Kapodistrian University of Athens (UoA, uoa.gr) – the oldest and first ranked among all Greek Universities
- We form a research and innovation unit in Department of Informatics & Telecommunications (Ranking 110 in EU, DIT, di.uoa.gr): Software Centric & Autonomic Networking Lab (SCAN, scan.di.uoa.gr)
 - 20 **researchers, engineers** and support personnel
 - **More than 20 EU Funded Projects**
 - SCAN-NKUA coordination (both PM and TM) in several of them
 - **More than 10 Industry Contracts**
 - Several **patents** filed in European Patent Office,
 - More than 500 **publications**,
 - More than 4000 **citations**,
 - Support of BSc/MSc/PhD dissertation thesis: ~15 per year.

Focus Areas

- Mobile/Wireless Communications (6G, 5G, LTE)
- MEC - Cloud
- Internet of Things – Smart Cities – Connected Cars
- Software-Defined Networks (SDN) - Network Function Virtualisation (NFV)
- Big Data (Data Analytics, Predictive Analytics, Data Economy)
- Future Internet



EU & Industry Projects

The image displays a collection of logos for various EU and industry projects, organized into four rows:

- Row 1:** HORIZON 2020 (The Framework Programme for Research and Innovation), PRIVACY FLAG, FED4FIRE (FEDERATION FOR FIRE PLUS), 5GINFIRE.
- Row 2:** SEVENTH FRAMEWORK PROGRAMME, EUROPEAN COMMISSION, METIS, fractals, Flspace (Business Collaboration), specifi, Smart Agri-Food, UNIVERSELF, CONSERN (COOPERATING AND SELF-GROWING ENERGYWARE NETWORK), LiveCity, PHYDYAS, E3, Self-NET.
- Row 3:** SIXTH FRAMEWORK PROGRAMME, European Commission, END-TO-END RECONFIGURABILITY (two instances), LIAISON, CASCADES, ANWIRE.
- Row 4:** HUAWEI, INTRACOM TELECOM, COSMOTE, CRI (Making your business happen), Net Technologies (Information & Communication Technology projects and services).

Thank you!

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