

Technologies for

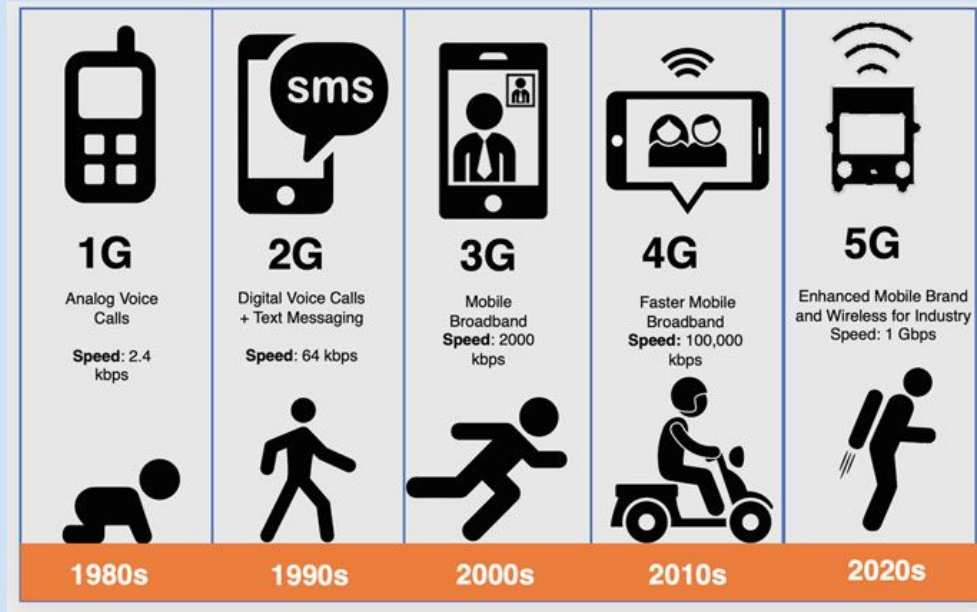


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Introduction to 6G

Evolution of Mobile Networks : From 1G to 5G



Introduction to 6G

What is 6G ?

- Next-generation wireless technology
- Expected around 2030
- Interconnect machines, environments, and smart systems



Introduction to 6G

Key Goals of 6G

Ultra-high Speeds

100 times faster than 5G

Minimal Latency

Near-zero delay to enable real-time
interactions

Enhanced Network Reliability

Reliable enough for critical
applications

6G Applications & Opportunities

New possibilities with 6G



Extended Reality (XR)



Holographic Communication



Immersive Experiences

6G Applications & Opportunities

Advanced Applications Across Industries



Autonomous Vehicles



Smart Manufacturing
(Industry 4.0)

6G Applications & Opportunities

Expanding Connectivity to Remote and Challenging Environment

6G aims

High-speed, reliable internet
in hard-to-reach areas



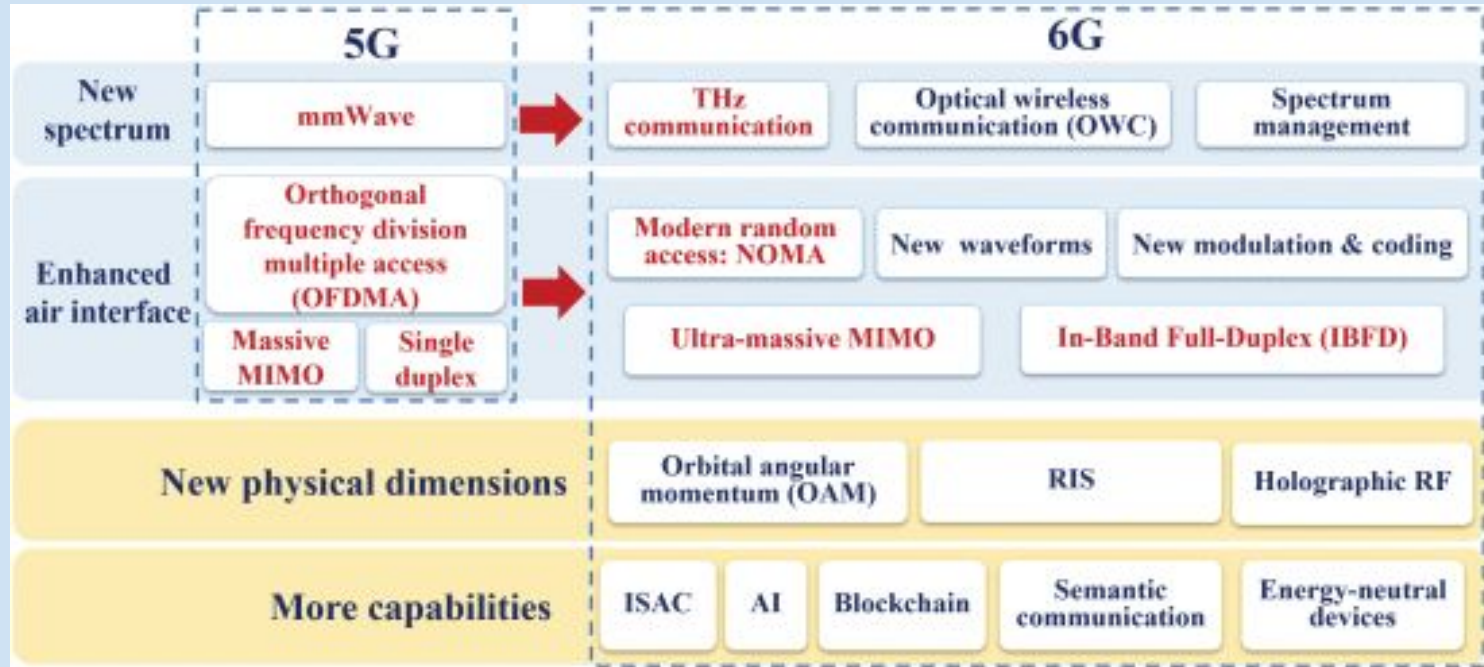
Rural regions
Mountains
Underwater

Expanding access and supporting
applications in remote healthcare,
environmental monitoring



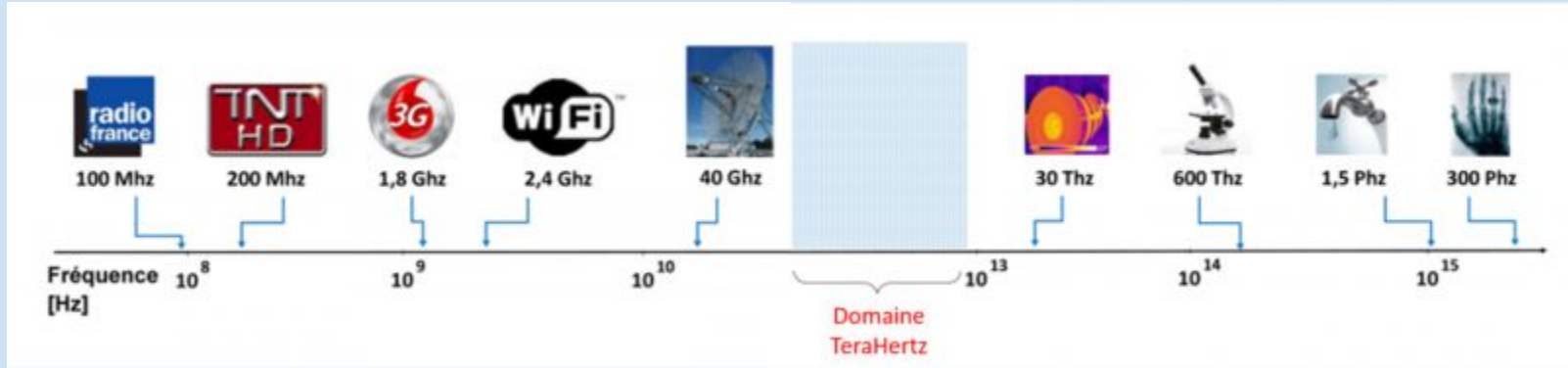
Core 6G Technologies

Technologies Overview



Core 6G Technologies

Terahertz (THz) Communication



Goals: Ultra-high data rates and low latency in wireless communication.

Applications: Virtual Reality (VR), Augmented Reality (AR), autonomous vehicles.

Challenges: Requires advanced noise management and interference reduction technologies.

Core 6G Technologies

AI and Machine Learning for 6G



Role: Optimizing network performance and managing data congestion.

Applications: Smart routing, predictive data demand.

Challenges: High computational needs, secure and adaptive algorithms.

Core 6G Technologies

Quantum Communication and Advanced Security



Goal: Enhanced security with quantum-based communication.

Mechanism: Quantum cryptography to protect data.

Impact: Secure communication resistant to cyber-attacks.

Core 6G Technologies

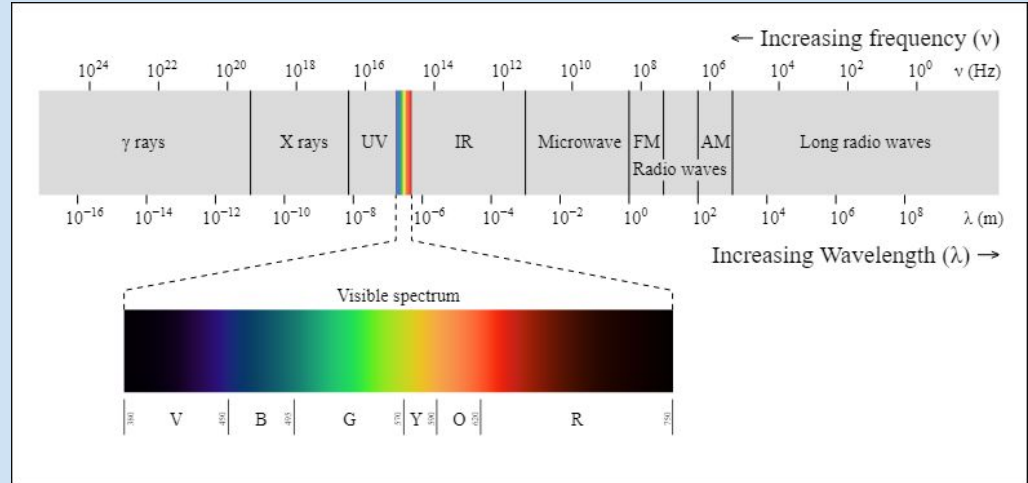
Visible Light Communication (VLC)



Principle: Utilizes the visible light spectrum (400-800 THz) to transmit data.

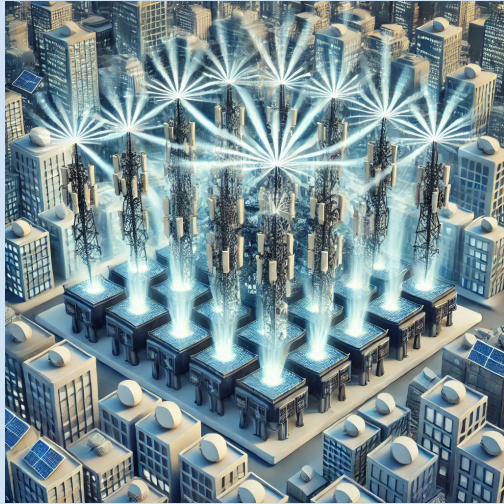
Applications: Underwater communication, indoor navigation, RF-restricted areas.

Challenges: Requires direct line-of-sight, susceptible to interference from other light sources.

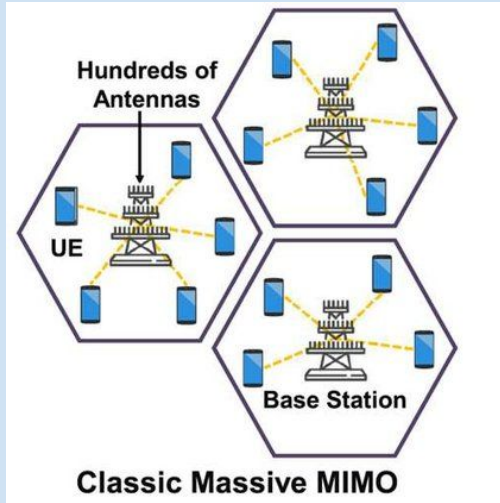


Core 6G Technologies

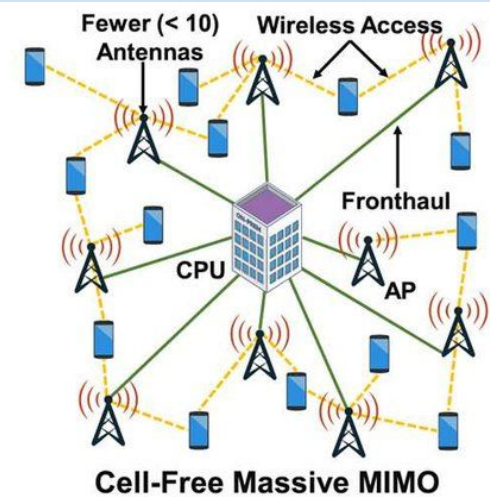
Ultra-massive MIMO (Multiple Input, Multiple Output)



Definition: Uses large antenna arrays to boost network capacity.



Applications: High-density urban areas, support for THz frequencies.



Challenges: Hardware complexity, high energy consumption.

Core 6G Technologies

Intelligent Reflecting Surfaces (IRS)

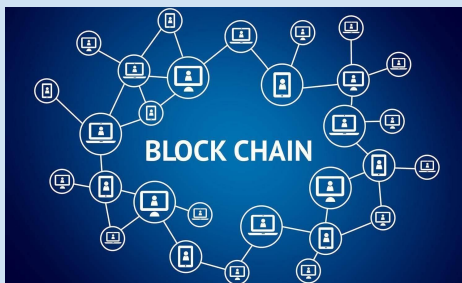


Definition: IRS is a surface that reflects signals to optimize network performance.

Applications: It improves signal coverage, reduces power usage, and boosts capacity.

Challenges: The main challenges are design complexity, deployment, and real-time optimization.

Block Chain



Definition: Blockchain is a decentralized ledger that records transactions.

Applications: It enables secure data sharing in healthcare, finance, and government.

Challenges: Scalability, computational demands, and system interoperability remain obstacles.

Other Promising Technologies

- Orbital Angular Momentum (OAM)
- Holographic Beamforming
- Edge Computing
- In-Band Full-Duplex
- Dynamic Network Slicing
- New Waveforms
- Satellite-terrestrial integrated networks

Challenges developing 6G

Technical Obstacles



Power Consumption

Signal Propagation

Hardware Limitations

Challenges developing 6G

Security and Privacy Concerns

Connect a vast number of devices and systems..

Cybersecurity ?

Increased data sharing and hyperconnectivity..

User privacy ?

Challenges developing 6G

Regulatory Challenges

Spectrum Allocation

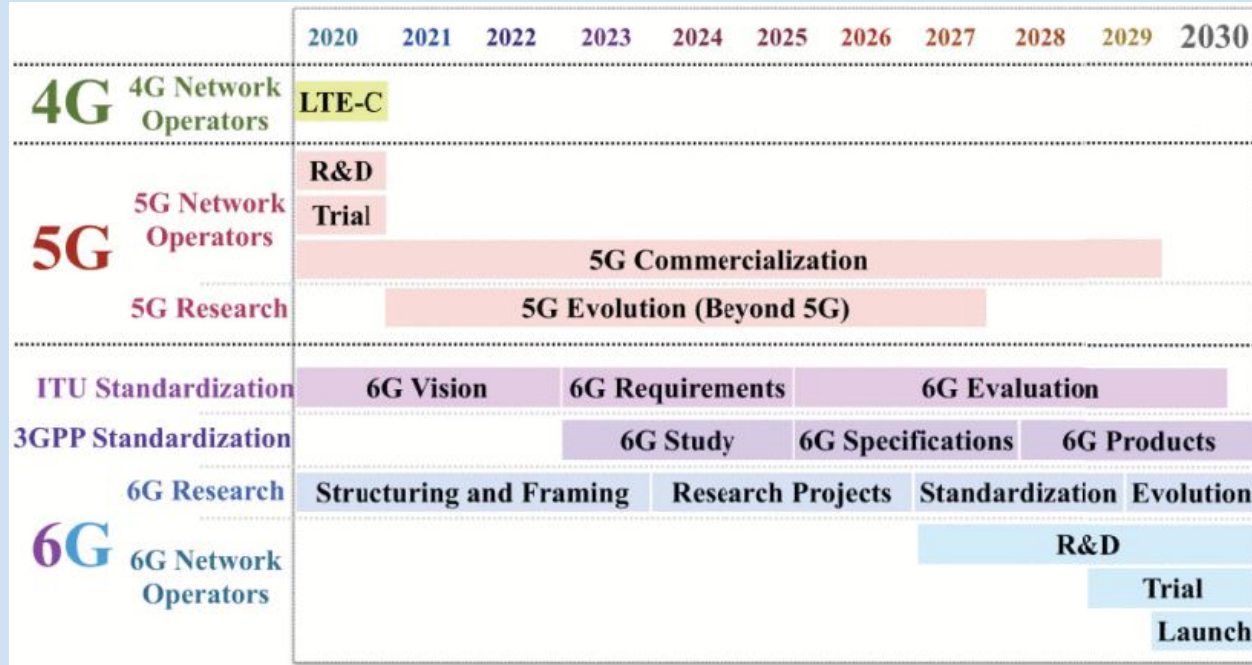
The THz spectrum needed for 6G is largely unallocated, requiring coordinated global efforts to manage these frequencies.

Global Coordination

To avoid interference and ensure compatibility across borders, regulatory bodies worldwide will need to work together, making international cooperation essential.

Development Timeline and Global Efforts

Roadmap to 6G Deployment by 2030



Development Timeline and Global Efforts

International Research Initiatives and Collaborations

Finlande - 6G Flagship/6G Bridge

165M€

World leader in 5G and 6G innovation

- + Sectors such as healthcare, energy and automotive
- + Human-centered applications

Netherlands - Future Network Service

203M€

Leading position in certain parts of 6G

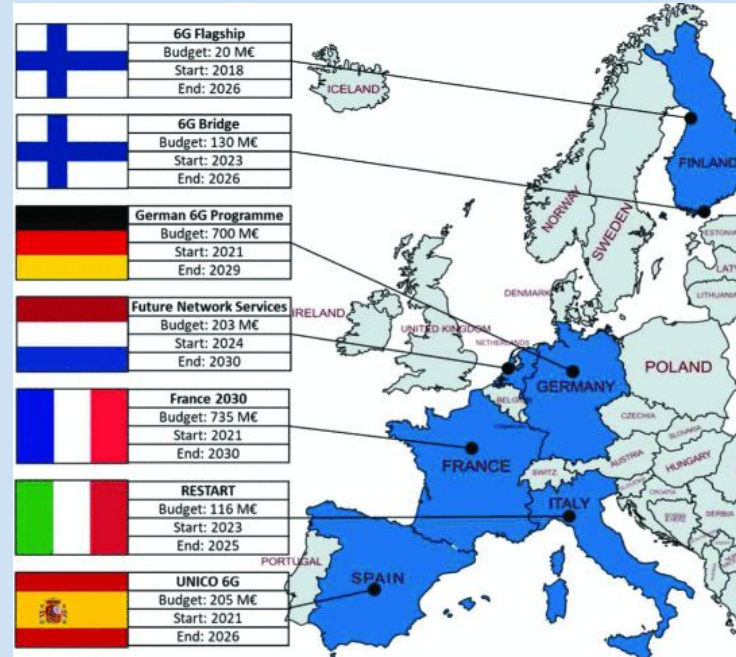
- + Economics and innovation in advanced network technologies

Italy - RESTART

116M€

Key player in research and innovation

- + Future telecommunications systems and networks ⇒ start-ups and intelligent network infrastructures.



Germany - German 6G Programme

700M€

World leader in 6G technologies

- + Specific applications ⇒ campus networks, mobility, and global coverage

France - France 2030

735M€

Leader in future network technologies

- + 5G and 6G applications and to support R&D

Spain - UNICO 6G

205M€

5G and 6G R&D center of excellence

- + Digital and technological future networks.

Development Timeline and Global Efforts

International Research Initiatives and Collaborations

China 6G R&D Program

Huawei, ZTE



K-ICT 6G Research Program

NTT, NEC Corporation



Next G Alliance

AT&T, Qualcomm



6G Vision 2030

Samsung, LG



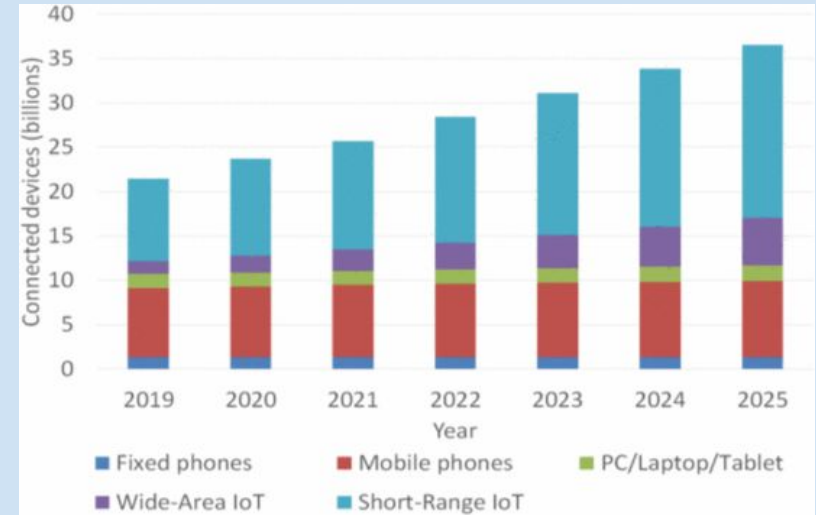
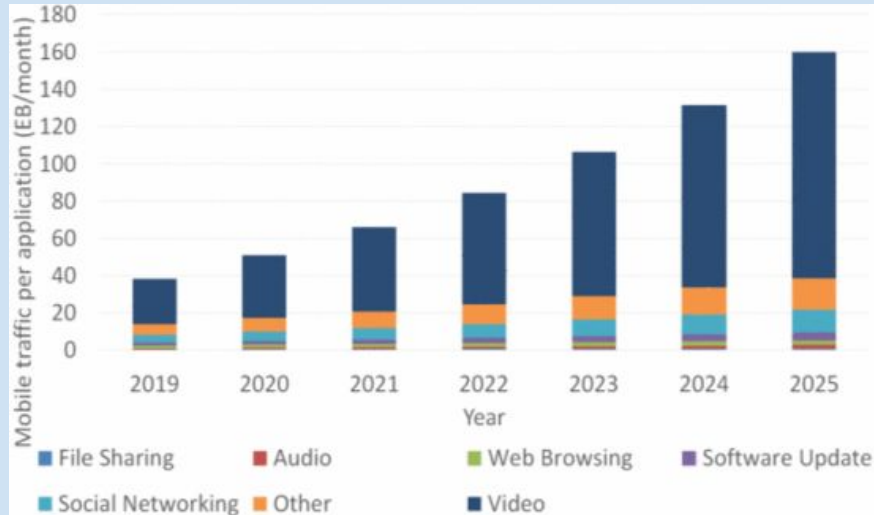
Development Timeline and Global Efforts

Roles of Governments, Industry, and Academia



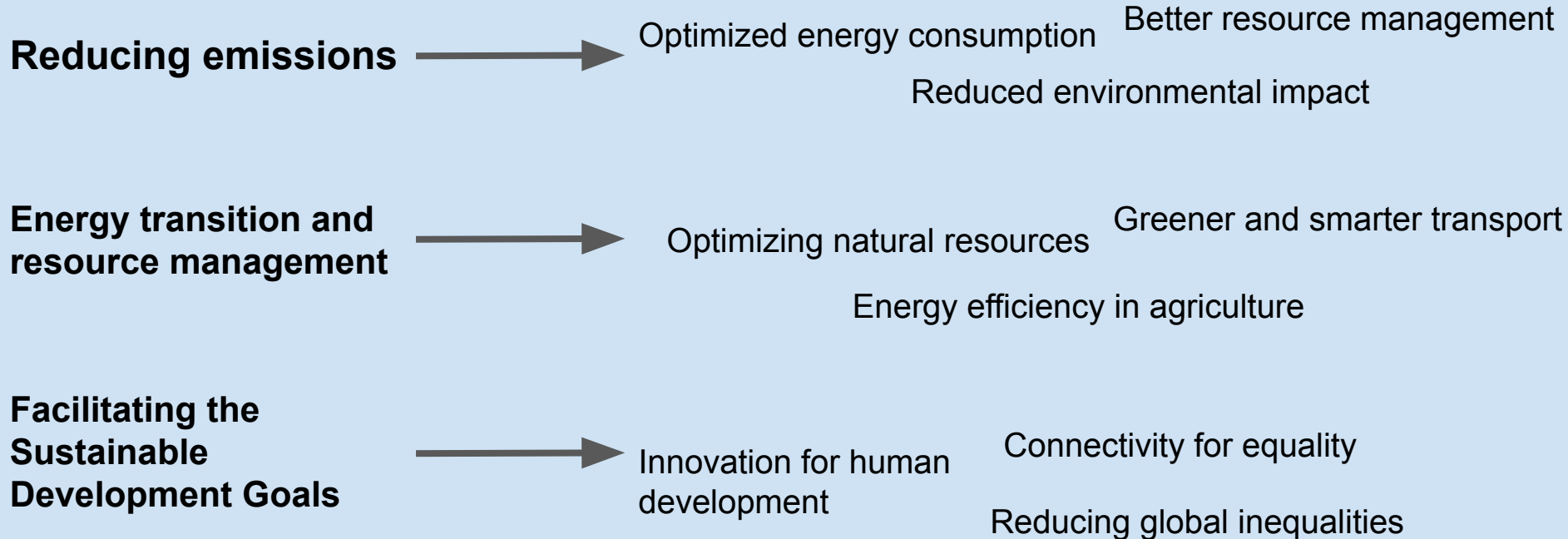
6G's Impact on Society

Ubiquitous Connectivity and New Applications



6G's Impact on Society

Carbon Footprint Reduction and Sustainability



6G's Impact on Society

Network Security and Reliability Issues

Personal Data Security

- Protection of Sensitive Information
- Transaction Confidentiality
- Cyber Attack Prevention

Threat Resilient Networks

- Attack Detection and Neutralization
- Continuity of Critical Services
- Securing Critical Infrastructures

Critical Applications and Crisis Management

- Reliable Emergency Communication
- Security for Automated Systems
- Real-Time Environmental Monitoring