Exploring the Future: 6G Internet of Things (IoT)
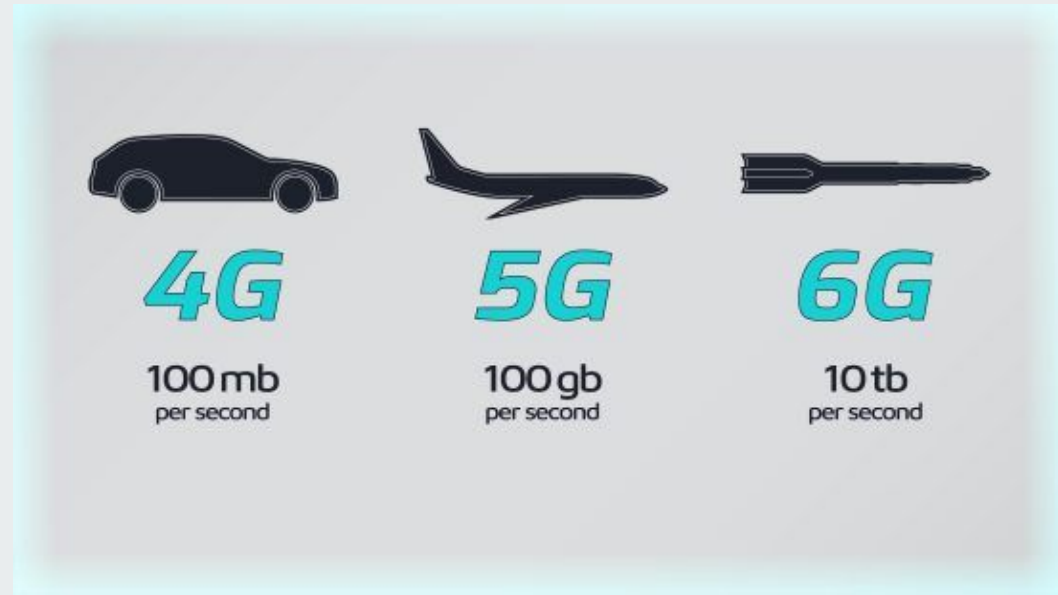
Presented By: Inemesit Michael & Onajite Ego

Course: Sensor Networks 700.460 S24

4G 100 mb per second

5G 100 gb per second

6G 10 tb per second

Introduction to 6G Internet Of Things

- **What is 6G?**
- **How will it Impact the Internet Of Things?**
- **Industrial Impacts: Healthcare, Smart Cities, Manufacturing & Logistics, Autonomous Vehicles**

What is Possible with 6G IOT?

Analog mobile phone

Sending emails on mobile phones

Smartphone

Watching video

1G   2G   3G   4G

Real-time live distribution with 4K and 8K images
Responding to the increase in communication traffic such as the development of IoT

With even larger capacity, higher speed, lower delay, and higher reliability, it may be possible to have conversations using real-time 3D images and remote treatment using robots.

IoT

4K/8K

5G   6G

Source: https://orbray.com/magazine_en/archives/385
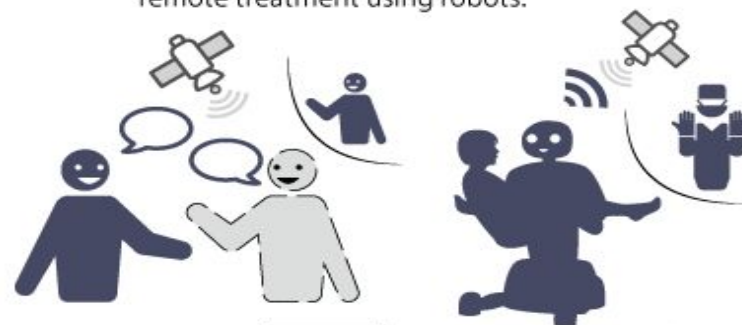
5G vs 6G Key Differences

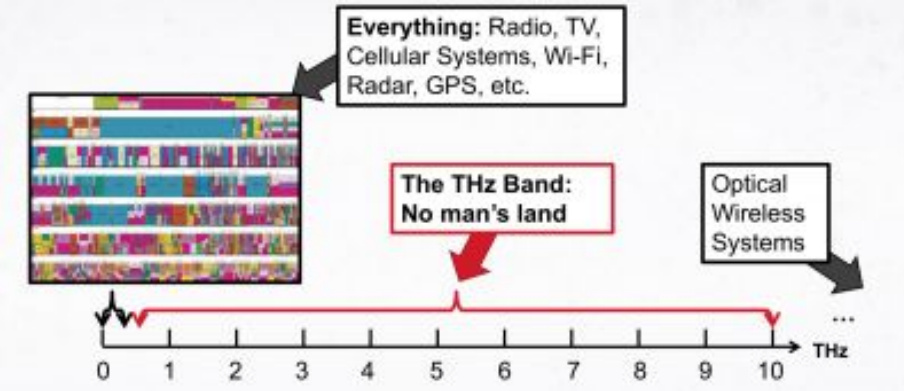|	5G	6G
Speed (Peak)	10 Gbps	100 Gbps
Latency	10 Milliseconds	1 Millisecond or less
Capacity	1 million devices per square meter	10 million devices per square meter
Spectrum Utilization	LB, MB, HB (0 - 40 Ghz)	terahertz (THz) (100 Ghz - 10,000 Ghz)

Expected Enhancements
- Advanced AI Integration
- Enhanced Security: advanced encryption methods, blockchain technologies, and AI-based threat detection
- Edge Computing
- Holographic Communication
- Internet of Everything and Advanced Internet of Things

Technology Enablers

How will 6G IOT be achieved ?
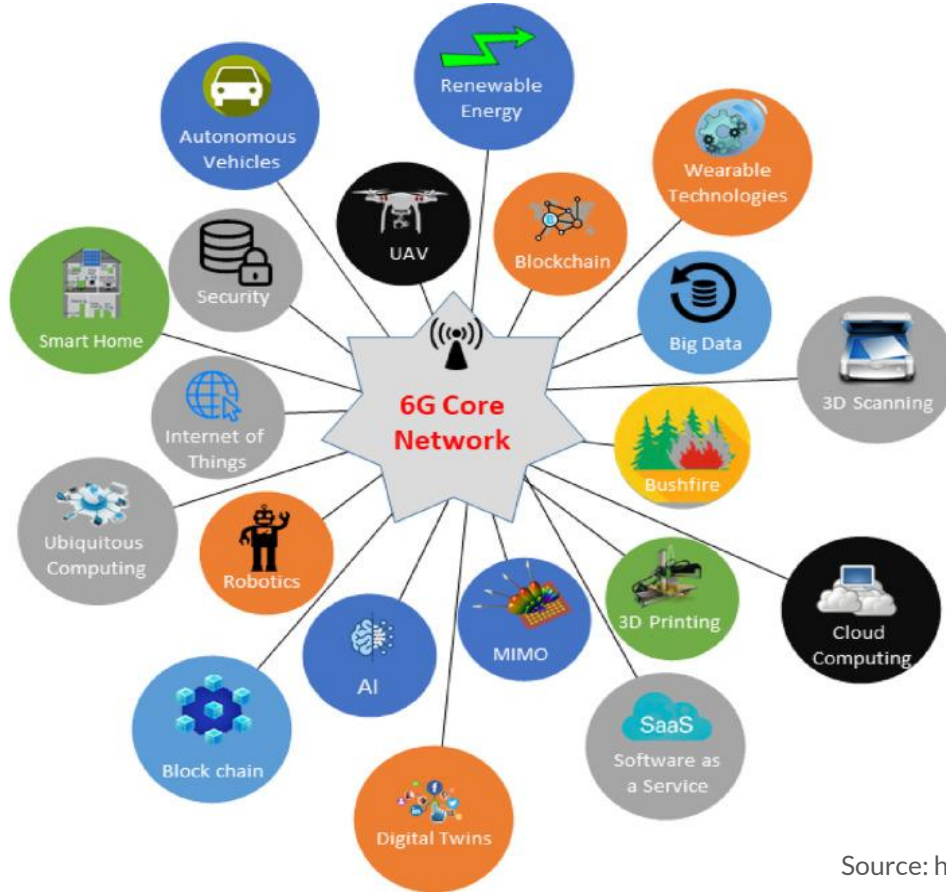
- **Terahertz Communication**
- **Advanced AI and Machine Learning**
- **Quantum Computing**
- **Edge Computing**
- **Blockchain Technology**
- **Advanced Antenna Technologies**
- **Energy Harvesting**
- **5G Evolution**

Source: https://www.sciencedirect.com/science/article/pii/S2405959522000959

(Proposed) 6G IOT Enablers: Terahertz Communication

Everything: Radio, TV, Cellular Systems, Wi-Fi, Radar, GPS, etc.

The THz Band: No man's land

Optical Wireless Systems

0 1 2 3 4 5 6 7 8 9 10 THz

Terahertz (THz) communication refers to the use of electromagnetic waves in the frequency range of 0.1 to 10 terahertz for data transmission.

INDUSTRY

OFFICE

HOME

VIRTUAL REALITY

SMALL BUSINESS

INFORMATION

THZ

Source: https://teraview.com/6g/

Terahertz Communication: Consideration Areas for Deployment and Integration

- **Infrastructure Requirements:** *New Hardware, THz Capable devices, Compact devices*
- **Network Architecture:** *Small cells and Dense network, Hybrid Networks*
- **Advanced Antenna Technologies:** *Massive MIMO, Beamforming*
- **Edge Computing and AI**
- **Deployment Strategies**

Proposed Benefits of Terahertz Communication in 6G IoT

- **Ultra High Data Rates:** *terabits per second (Tbps)*
- **Low latency;** *instantaneous feedback*
- **Enhanced Security:** *Advanced protocols, less interference*

Challenges

- **Range**
- **Hardware**
- **Regulatory Issues**

(Proposed) 6G IOT Enablers: Advanced AI & Machine Learning

Applications:

- **Network Optimization**
- **Resource Management**
- **Enhanced Security**
- **Autonomous Network Management**
- **Data Analytics and Insights**
- **Enabling new applications**

Concerns:

- **Data Privacy/security**
- **Integration and Interoperability**
- **Ethical and Social implementations**

Source: https://www.cisco.com/c/en/us/solutions/artificial-intelligence/artificial-intelligence-machine-learning-in-networking.html

- **Smart Cities:** *Security Surveillance, Intelligent Transport System*
- **Health Care:** *Telemedicine, Remote Surgery, Health Monitoring*
- **Industrial Automation:** *Predictive Maintenance, Remote Monitoring*

Source: https://www.diewimo.at/2022/11/mission-2030-jugendliche-machen-klagenfurt-zur-smart-city/

6G IOT Challenges and Future Outlook

Challenges:

- **Technical Challenges**
- **Regulatory Issues**
- **Ethical Issues**

Future Outlook

6G IoT holds the promise of transforming industries, enhancing everyday experiences, and advancing technological frontiers with its speed, intelligence, and connectivity. It represents a pivotal leap towards a more connected, intelligent, and sustainable future.

[1] Embracing the future: 6G connections with the power of AI. (n.d.). Telecoming. Retrieved June 4, 2024, from https://www.telecoming.com/blog/embracing-the-future-6g-connections-with-the-power-of-ai/

[2] RS Open Journal on Innovative Communication Technologies. (n.d.). Special Issue on Terahertz Communications. Retrieved June 3, 2024, https://rs-ojict.pubpub.org/special-issue-on-terahertz-communication

[3] Sanmark Solutions. (n.d.). The Race to 6G: What It Means for Consumers and the Future of Connectivity. Medium. Retrieved June 2, 2024, https://medium.com/@SanmarkSolutions/the-race-to-6g-what-it-means-for-consumers-and-the-future-of-connectivity-cda2a89be5c9

[4] ScienceDirect. (2024). Towards 6G Internet of Things: Recent Advances, Use Cases, and Open Challenges. Retrieved June 8, 2024, https://www.sciencedirect.com/science/article/pii/S2405959522000959

[5] IEEE Internet of Things. (2022). January 2022 Newsletter. Retrieved May 20, 2024, https://iot.ieee.org/articles-publications/newsletter/january-2022