6 G – connected intelligence

COST Action 2022
WG3 – Network Architectures and Protocols
HA3 – Training

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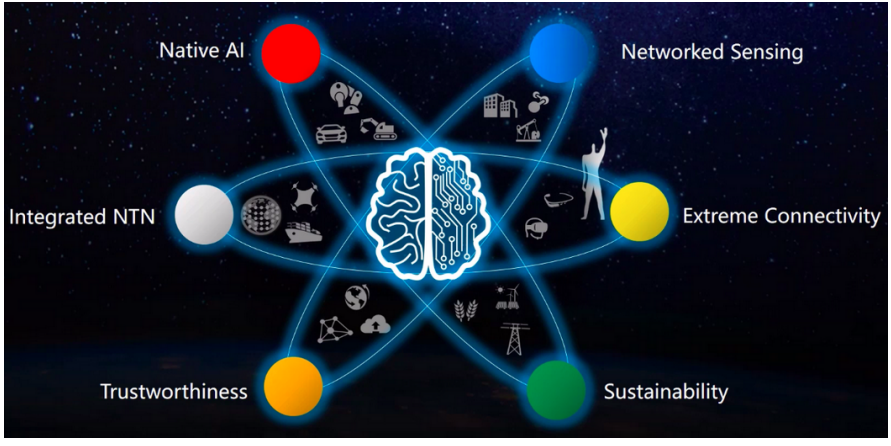
Full Members

Materials and figures adapted from the COST meeting, for internal use only.

6 G – Connected Intelligence

Huawei – white paper
https://www-file.huawei.com/-/media/corp2020/pdf/tech-insights/1/6g-white-paper-en.pdf?la=en



6 G – Connected Intelligence

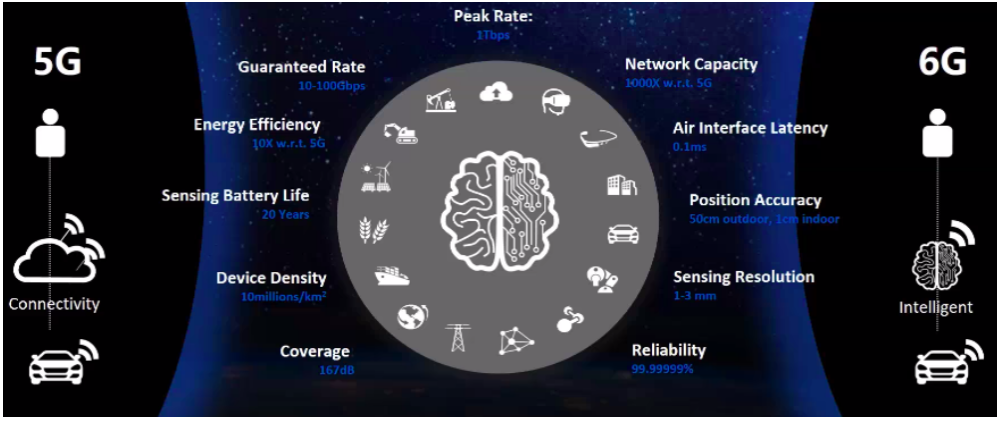
The 6 G Pillars

- **Pillar 1**: New Communication Paradigm – reliable, low latency, high efficient connectivity based on **machine learning**
- **Pillar 2**: Integrated Sensing and Communications – networks as sensors (NLOS[1] joint sensing with gNB[2] and UE)
- **Pillar 3**: Ultimate Connectivity Supremacy – peak data rate 1 Tbps, battery life 20 years, sensing resolution 1-3mm, latency 0.1 ms (new eMBB, mMTC, URLLC, new sensing, all being controlled by **Intelligence**)
- **Pillar 4**: NTN[3] integration – inter-satellite 600 km, satellite-to-terrestrial 300 km
- **Pillar 5**: Native Trustworthiness – Quantum resisted security, block-chain, QKD and quantum switching key distribution compatible
- **Pillar 6**: Sustainability and Humanity Good – need to establish and industry consensus on the methodology for the evaluation of sustainability

[1] Non-line of sight

[2] 3GPP 5G Next Generation base station

[3] NTN – Non-Terrestrial Networks

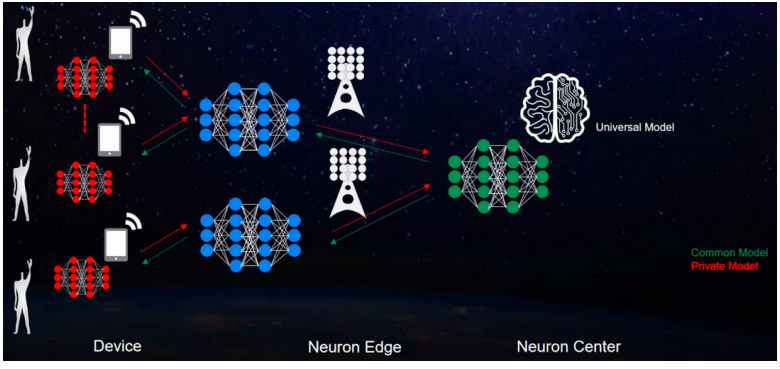

5G
Peak Rate:
1Tbps
Guaranteed Rate
10-100Gbps
Network Capacity
1000X w.r.t. 5G
Energy Efficiency
10X w.r.t. 5G
Air Interface Latency
0.1ms
Sensing Battery Life
20 Years
Position Accuracy
50cm outdoor, 1cm indoor
Device Density
10millions/km²
Sensing Resolution
1-3 mm
Coverage
167dB
Reliability
99.99999%
Connectivity
6G
Intelligent

New Communication Model

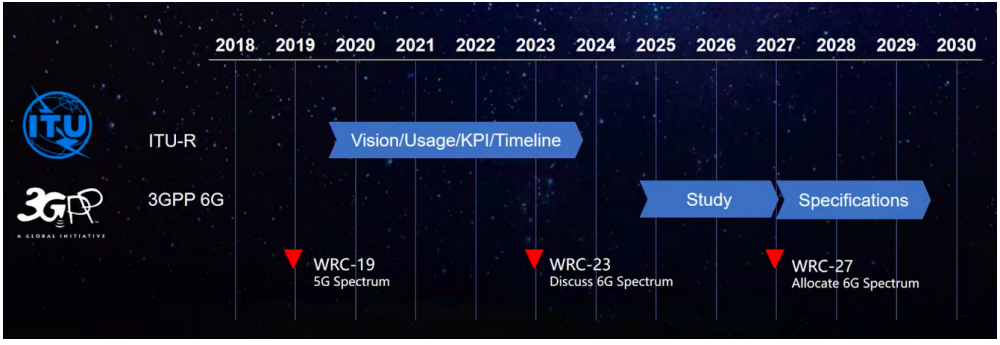
DNN Model as a Communication Object – as Compressor, Data Operator, Data Memory, Data ID

For 6 G ISP – **the AI model more important than data**, the model can be exchanged over networks while data can be kept at local

Distributed Learning Model for 6 G – federated learning, distilled learning



6 G and Timeline



Current research overview – examples

CNIT / WiLab

- AI-Enabled Massive URLLC[4] for Inter-Machine IIoT[5] Applications – distributed machine learning
- Non-orthogonal Resource Allocation Techniques for Sidelink Cellular – Vehicle to Everything (V2X)
- Radio signal analysis – to gain information about target objects or environment
-

Ottawa Wireless Advanced System Competency Center

- 3D Networks – UAVs flying over cities acting as BSs

JLab

- Proactive link selection in high frequencies IoVs[6] network – sensor sharing

And many more – over 100 papers published and available as TDs

[4] Ultra-Reliable Low-Latency Communication

[5] Industrial Internet of Things

[6] Internet of Vehicles

The trends in networking and ML

- NETWORK ARCHITECTURES
- **NETWORK PLANNING AND ORCHESTRATION**
- ML approaches for planning and orchestration
- NETWORKING FOR ML

In cooperation with Connected Experience Lab (ConExLab) – Institute of Information Systems (IIG), University of Applied Sciences of Western Switzerland – HES SO Valais

The personal inside view of possible research

WG3 – Network Architectures and Protocols

- Protocols enabling cooperation of 6 G IIoT and cloud systems for high adaptability, low latency employing Machine Learning
- Network Architectures for 6 G enabled transit core network
- …

A tip:
https://www.comsoc.org/publications/magazines/ieee-network/cfp/federated-optimizations-and-networked-edge-intelligence

Leaflet

https://bit.ly/3DQgzHb

Leaflet - Colour version *Leaflet - Print version B/W*

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