

6G

FLAGSHIP
UNIVERSITY
OF OULU

Key drivers and research challenges for 6G

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6G Flagship



World's First 6G Research Program

6G Enabled Wireless Smart Society & Ecosystem

- National Flagship for **2018-2026**
- Volume **251 M€**
- Operated by **University of Oulu**
- Collaboration with **Nokia, VTT, Aalto University, BusinessOulu, OUAS.**



6G Flagship was elected as **Finland's high-tech Flagship**, by Finnish **Government** through **Academy of Finland**

1.

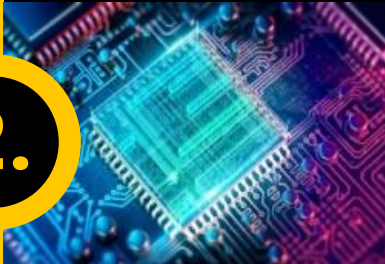


Wireless Connectivity

Ultra-reliable low-latency communications vs. 1 Tbps

Enabling **Unmanned Processes**

2.



Devices & Circuits

THz communications materials & circuits

Enabling **Unlimited Connectivity**

3.



Distributed Computing

Mobile edge intelligence

Enabling **Time Critical & Trusted Apps**

4.

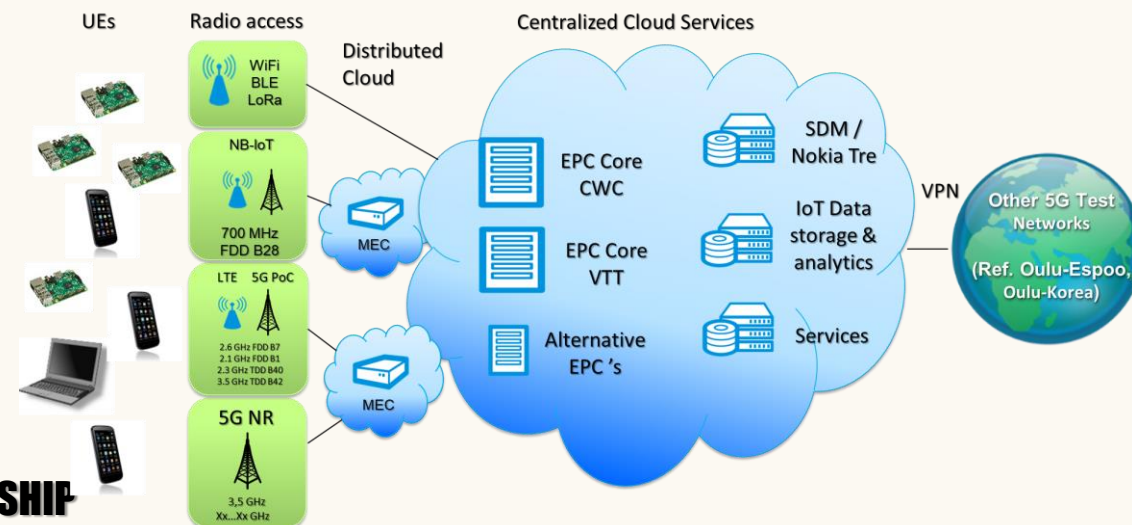


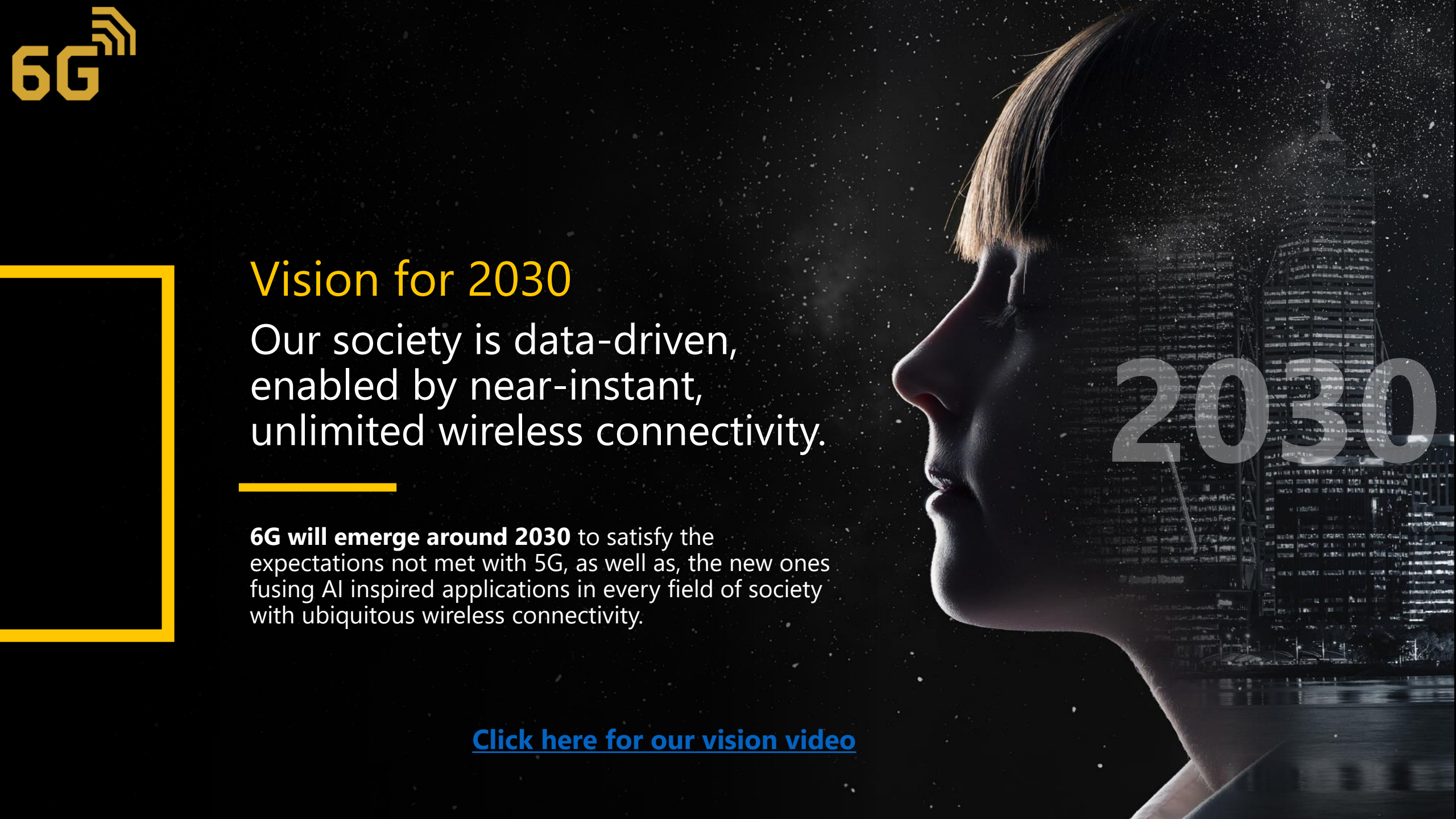
Services & Applications

Multidisciplinary research across verticals

Enabling **Disruptive Value Networks**

- To support companies in **finalisation of the 5G** standard by carrying out technology and system pilots.
- To develop/co-create the **fundamental technology components to enable 6G** systems.
- To speed up **dependable, robust and secure digitalisation of society** via 5G and 6G.





Vision for 2030

Our society is data-driven,
enabled by near-instant,
unlimited wireless connectivity.

6G will emerge around 2030 to satisfy the expectations not met with 5G, as well as, the new ones fusing AI inspired applications in every field of society with ubiquitous wireless connectivity.

[Click here for our vision video](#)



ACADEMY OF FINLAND



FLAGSHIP PROGRAMME



6G

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WORLD'S FIRST 6G WHITE PAPER

The 6G research vision is based on three cornerstones:

1

6G technologies will bring to life the data-driven and hyper-connected future society.

2

Major drivers for 6G include sustainability goals and societal challenges on top of productivity targets and technology enablers.

3

Numerous business and societal players together create the new 6G infrastructure, products and services.

<http://jultika.oulu.fi/files/isbn9789526223544.pdf>



6G Flagship aims to integrate intelligence with mobile communication technologies.

- World's first 6G Wireless Summit gathered all major telecom players to throw ideas around 6G including speeches from Nokia, Ericsson, Orange, Telia, NTT DoCoMo, Samsung, MediaTek, and China Telecom, among others, in Levi, Finland in March 2019.
- The Summit launched 6G White Paper development with 70 experts from around the world representing different stakeholders.
- New version of 6G White Paper will be prepared annually.

<https://www.6gsummit.com/>

<http://jultika.oulu.fi/files/isbn9789526223544.pdf>



6G

Key drivers for 6G research

1. Societal Challenges



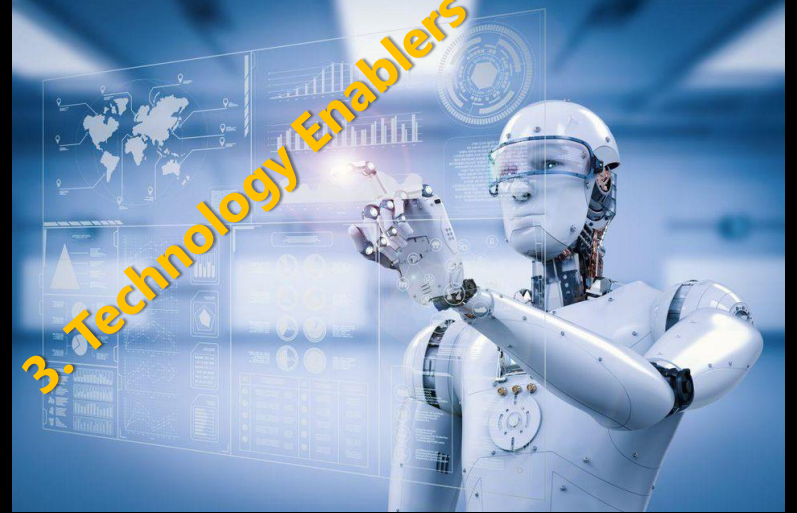
2. UN SDGs



Soft and hard values meet at 6G



3. Technology Enablers



4. Verticals' Productivity





6G Research drivers

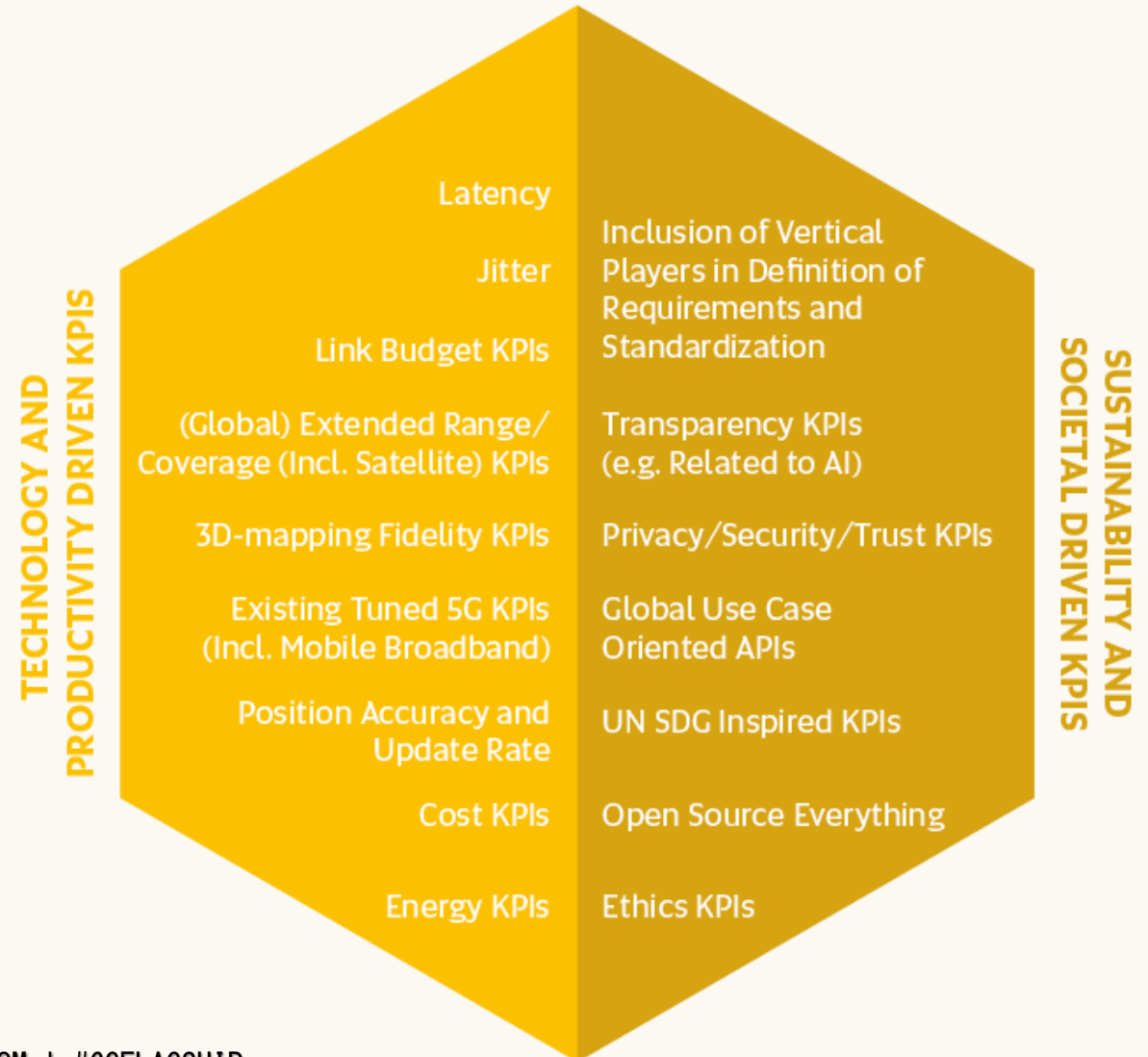
Is it naïve to say:
From 5G Engineering
to 6G Humanity – or
is it imperative?





Initial 6G Key Performance Indicators (KPIs)

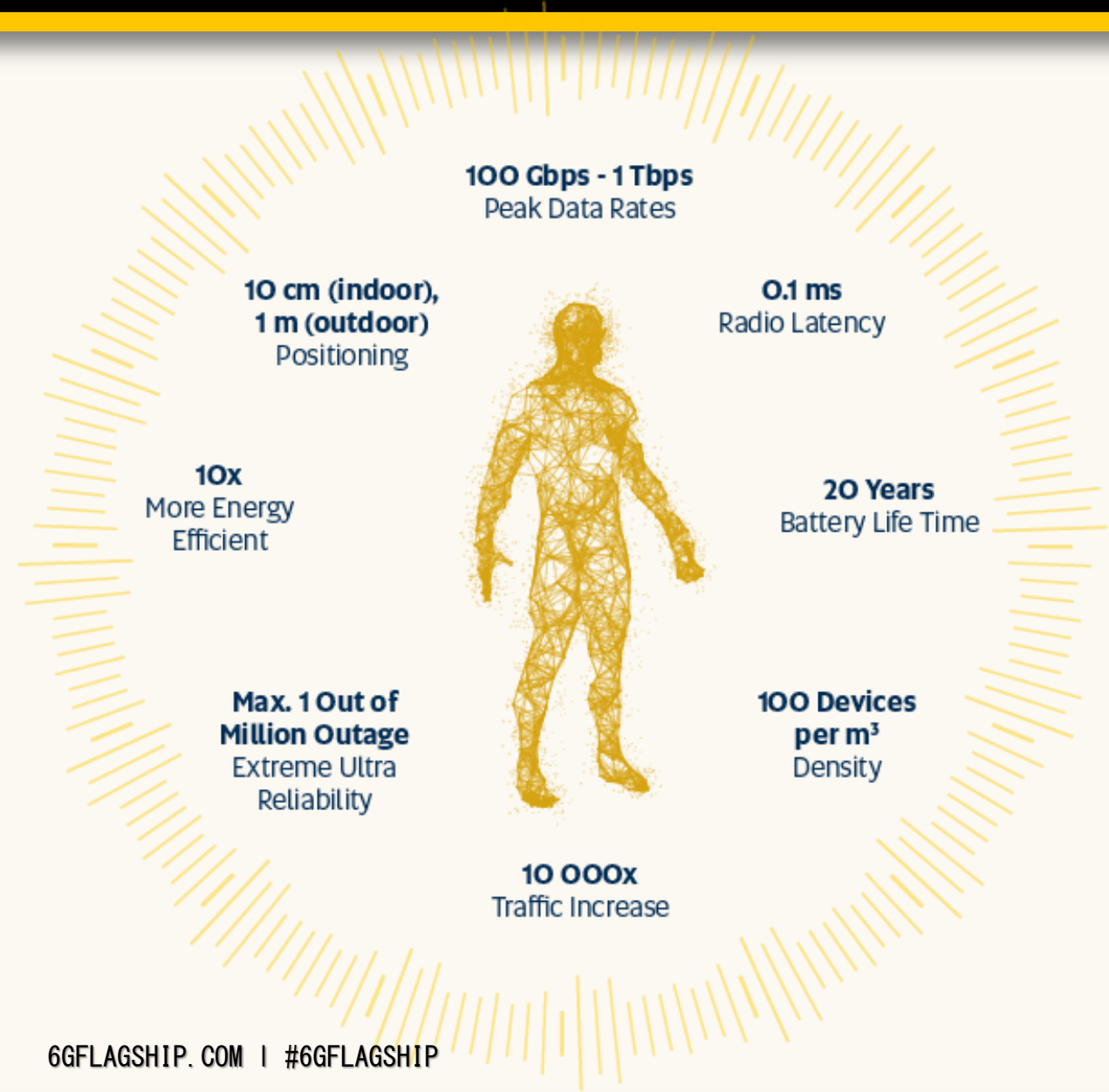
Many of the KPIs used for 5G are valid also for 6G. However, the KPIs must be critically reviewed and new KPIs must be seriously considered.





Initial 6G Key Performance Indicators (KPIs)

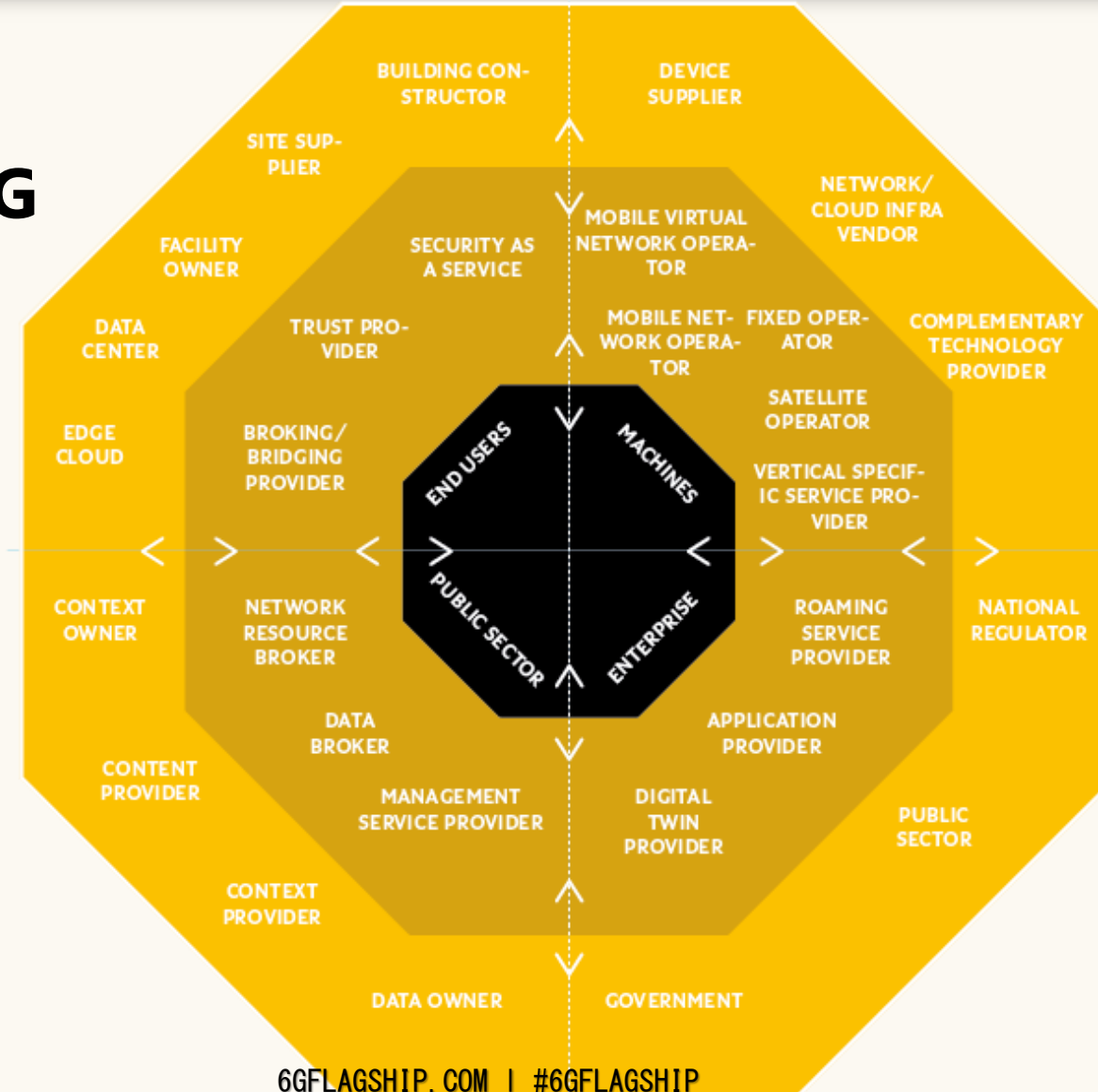
**Generic 6G targets
presented by academia
and industry in different
fora.**





Future 6G business ecosystem

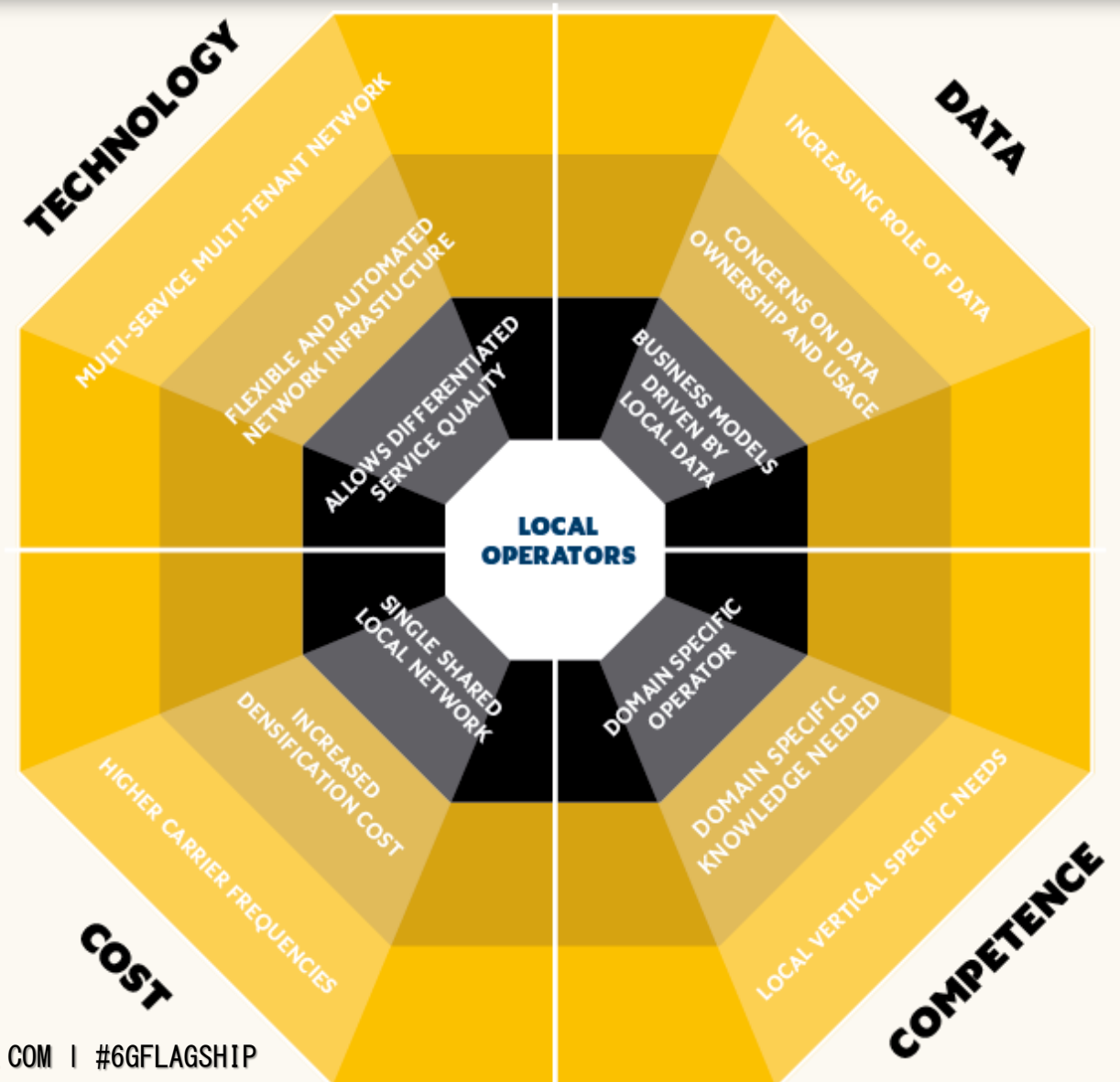
Stakeholder roles in 6G will change compared to the current mobile business ecosystem and new roles will emerge.





Towards Local Operator Paradigm

Transition to higher frequencies and increasing role of indoor networks will boost network sharing in cities and indoor spaces, and drive the “local operator” paradigm.



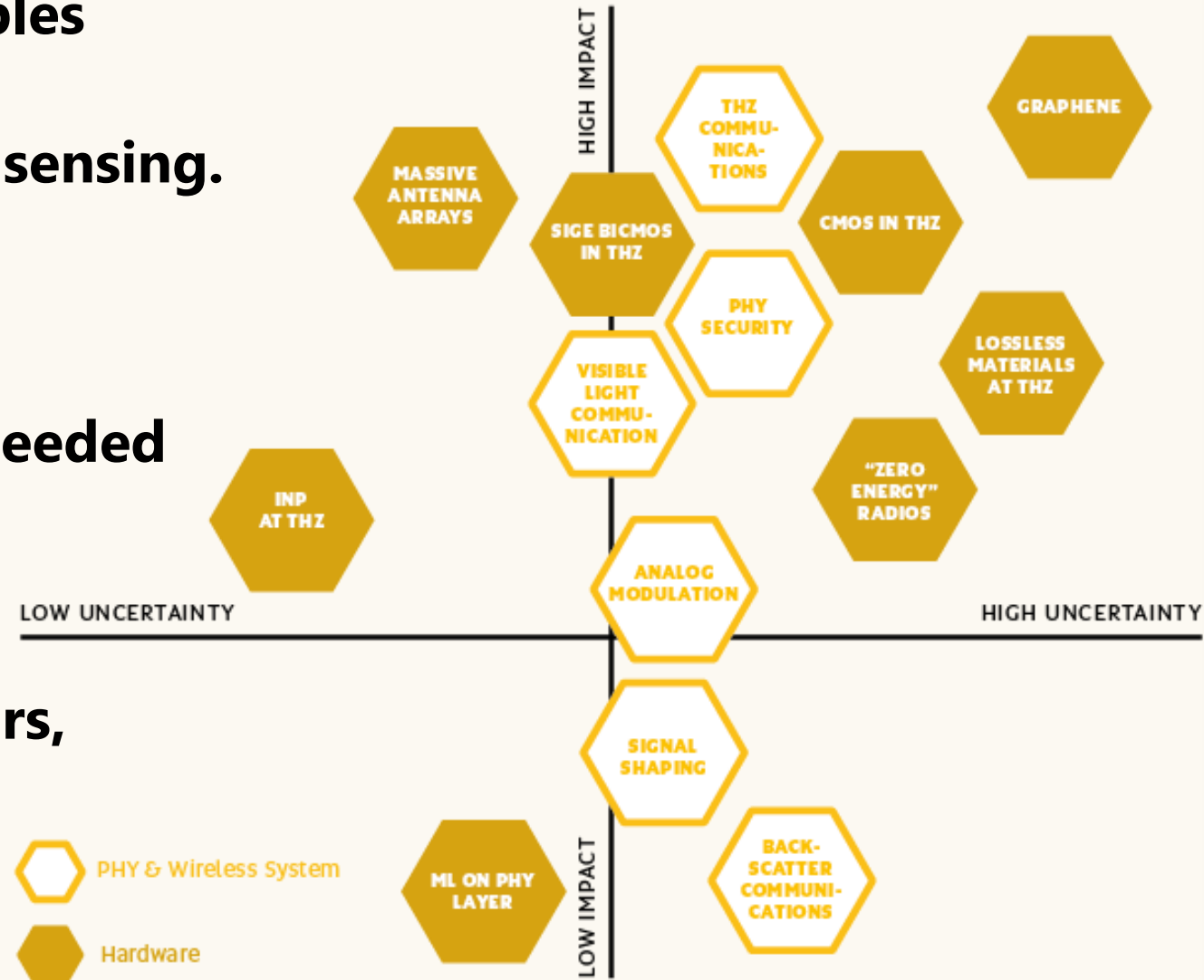


Radio HW Progress and Challenges

Extended spectrum towards THz enables merging communications and new applications, such as 3D imaging and sensing.

New paradigms for transceiver architecture and computing will be needed to achieve 1 Tbps.

New opportunities for semiconductors, optics and new materials in THz applications.



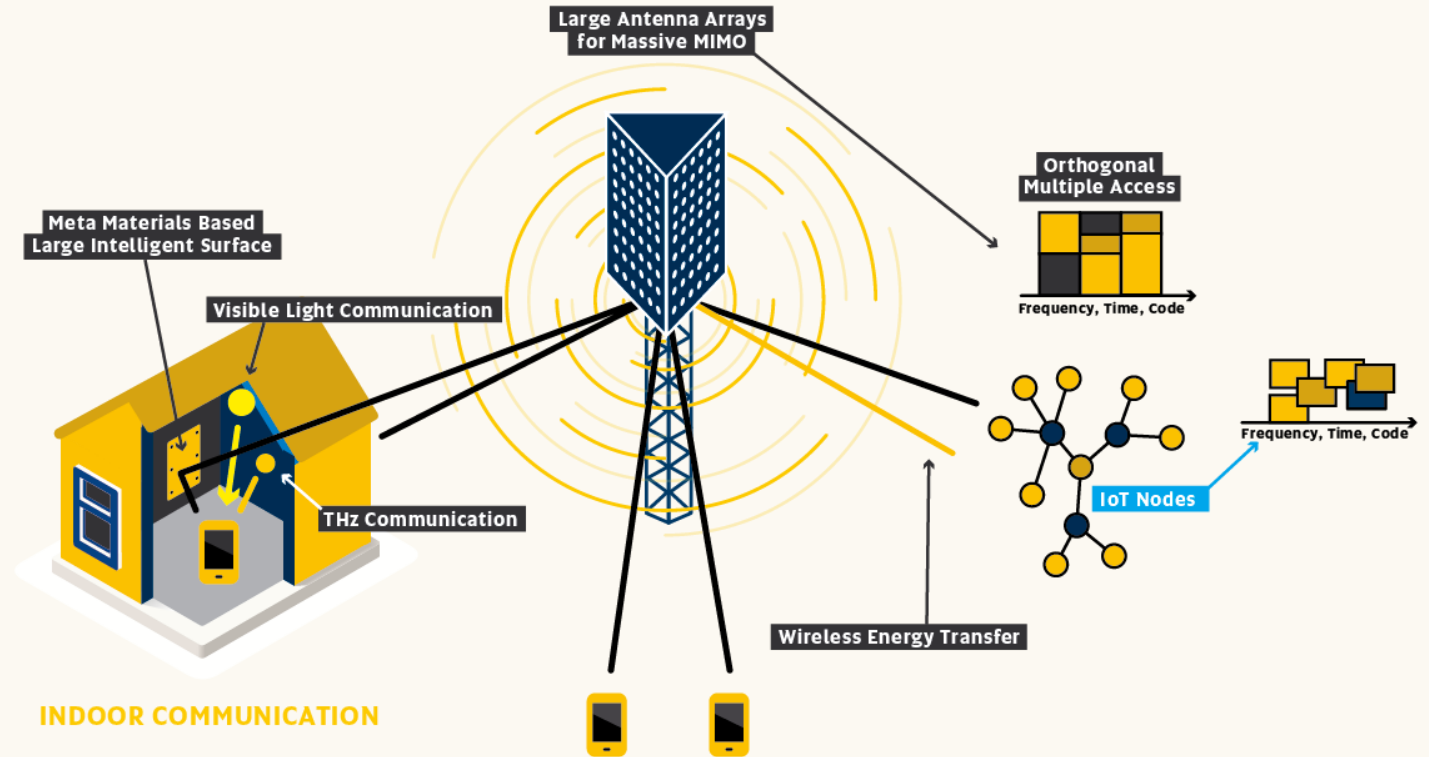


Physical Layer and Wireless System

AI/ML will play a major role both in link and system level optimisation of 6G wireless networks.

New grant-free access methods are critical for truly massive machine-type communication.

Signal shaping is a way to achieve record-high spectral efficiency.



Analog modulation schemes in 6G?

The strongest security protection may be achieved at the physical layer.

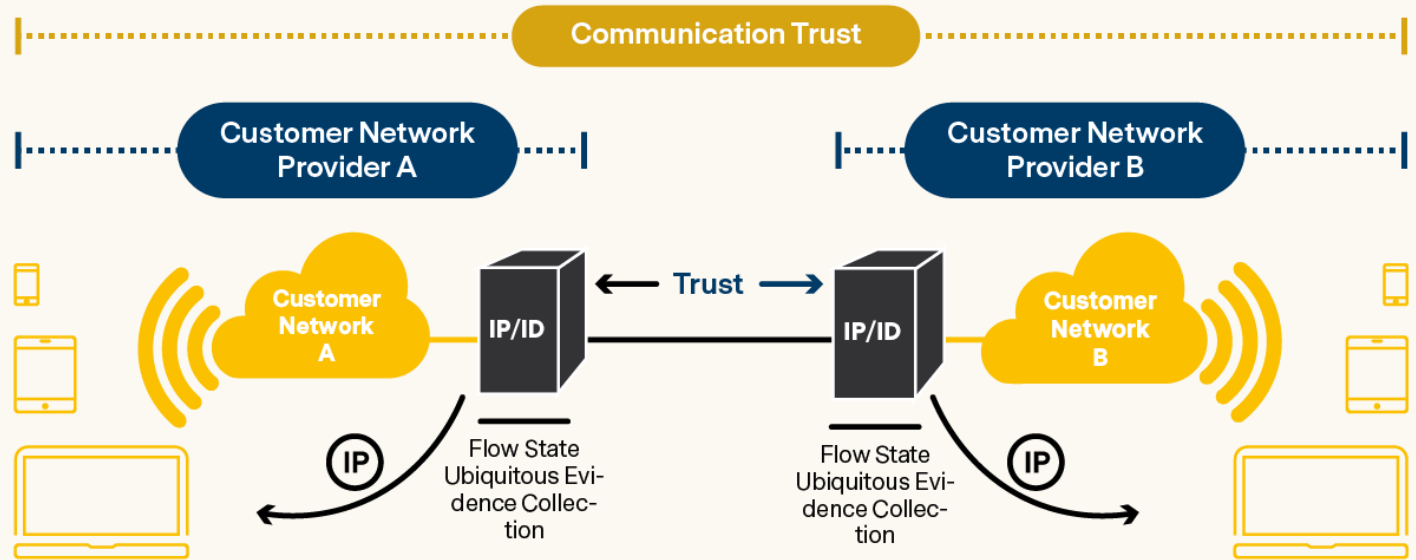


6G Networking

6G needs a network with embedded trust.

6G will create data markets – privacy protection will be a key enabler.

6G needs an upgraded networking paradigm – from best effort to dependability.



Artificial intelligence and block chain may play a major role in 6G networks.



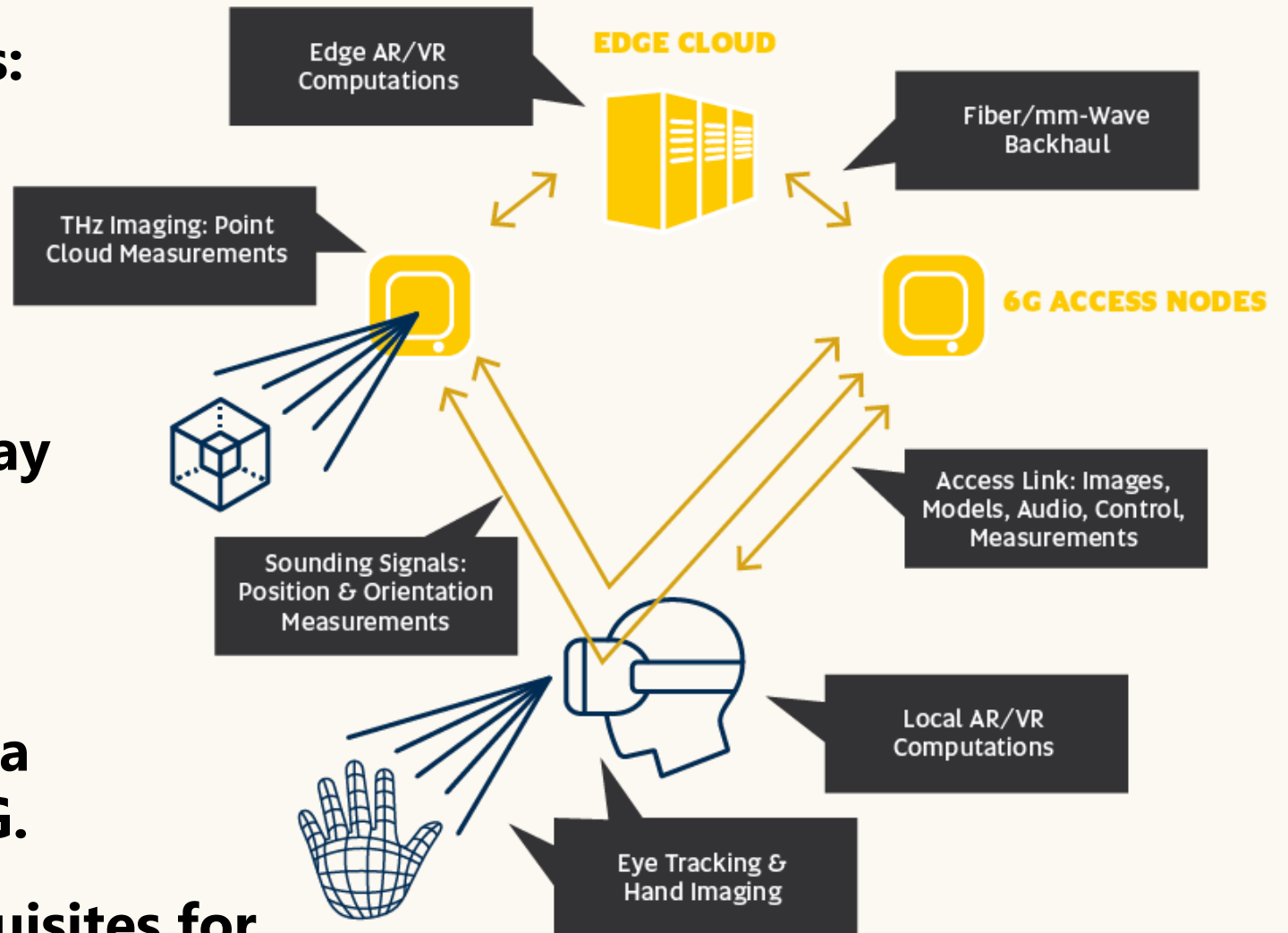
6G Merges Communications with New Applications

6G is not only about moving bits: it will become a framework of services, including communication service.

In 6G, all user specific computation and intelligence may move to edge cloud.

Integration of sensing, imaging and highly accurate positioning capabilities with mobility opens a myriad of new applications in 6G.

Trust and privacy are key prerequisites for successful 6G service platform.





6G WIRELESS SUMMIT
17-20 MARCH 2020
LEVI, FINLAND

www.6Gsummit.com