

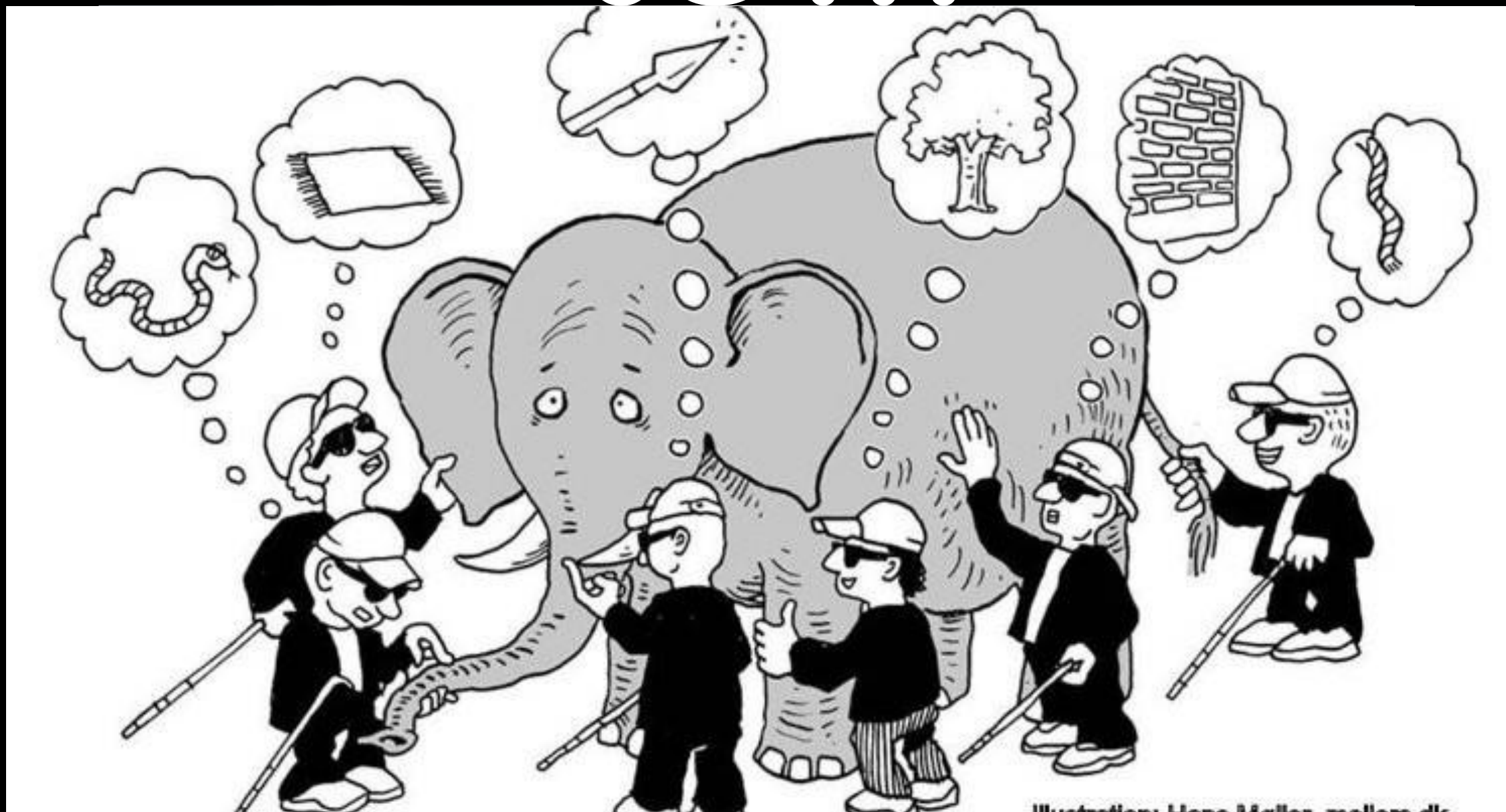


6G Flagship Programme – 6Genesis

Prof. Ari Pouttu
Centre for Wireless
Communications



6G ???

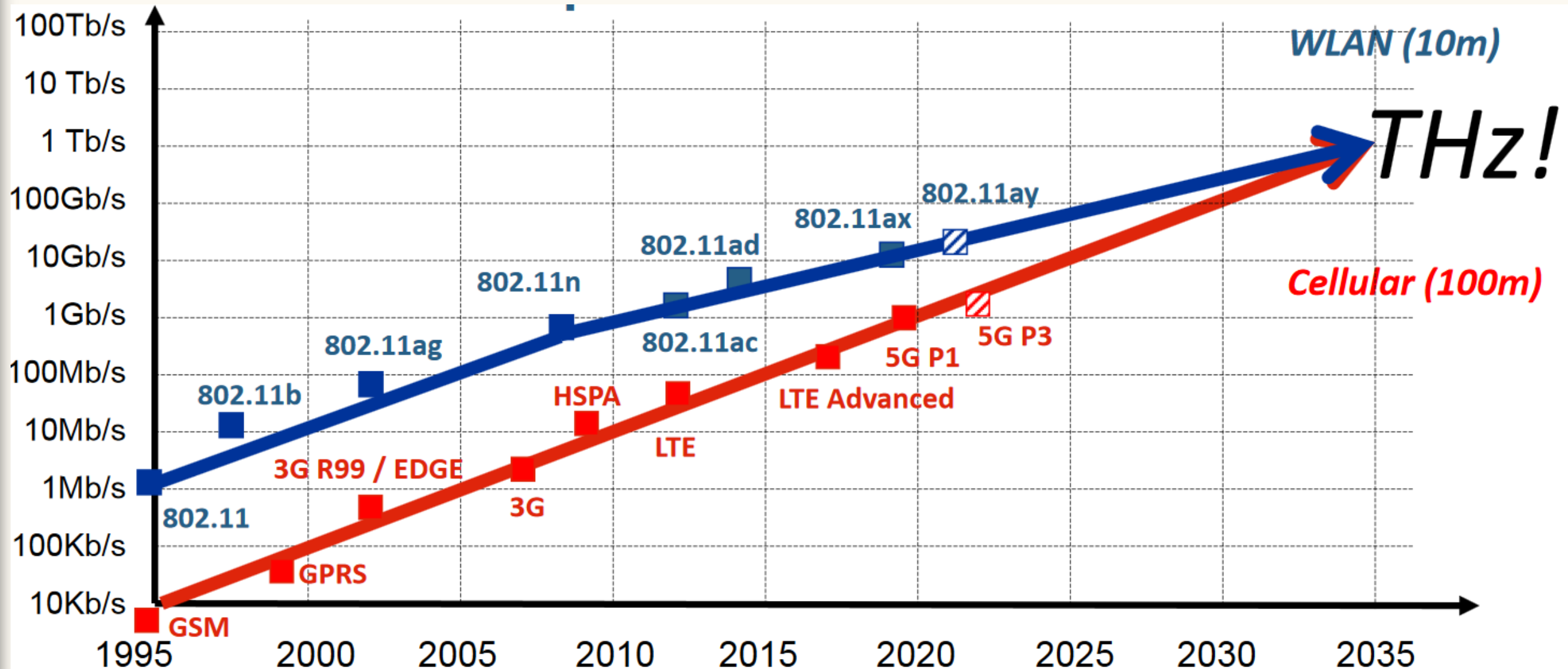


Some notions on Wireless Technologies at Dawn of 5G

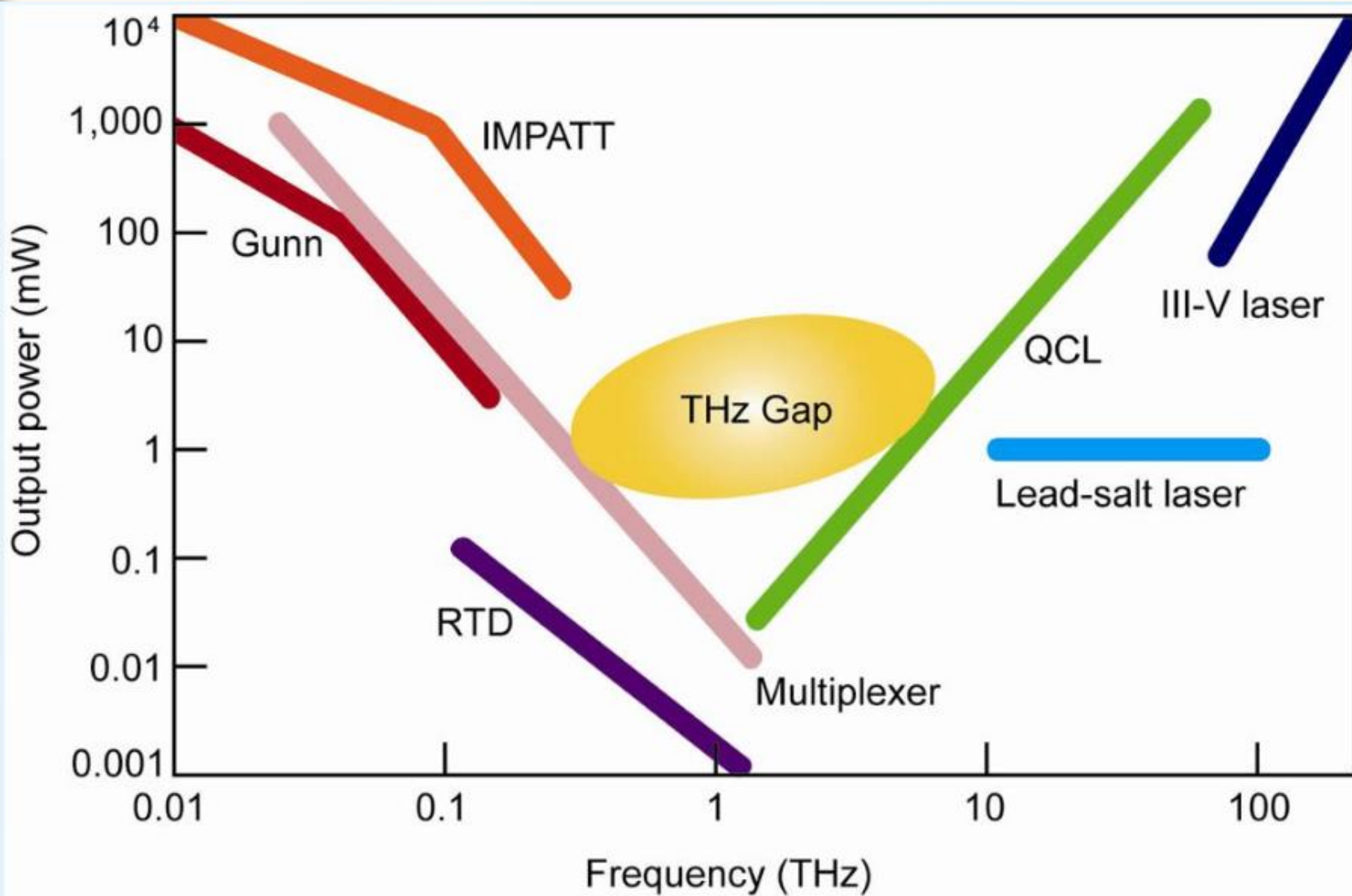
- Do you remember/have heard these discussions/controversies?
 - Why do we need 4G as we have 3G?
 - Why do we need 5G as we have 4G?
 - Why do we need 6G as
 - Why do we need a caterpillar as we have the spade?
- What happens in 5G?
 - It is the largest technology shift in ICT since 2G → 3G (e.g. 5G Core, Softwarization, Beamforming, Network Slicing, RAN virtualisation).
 - 5G is for verticals, happening rather slowly
- US vs. East vs. Europe

The Wireless Roadmap >2020 Outlook

THz allows to combine data transmission with sensing information and imaging



THz solid state sources – the “THz gap”



**Solving the THz Gap
not only provides
ubiquitous communications
but also new forms of
intertwined sensing and
imaging with 6G radio**

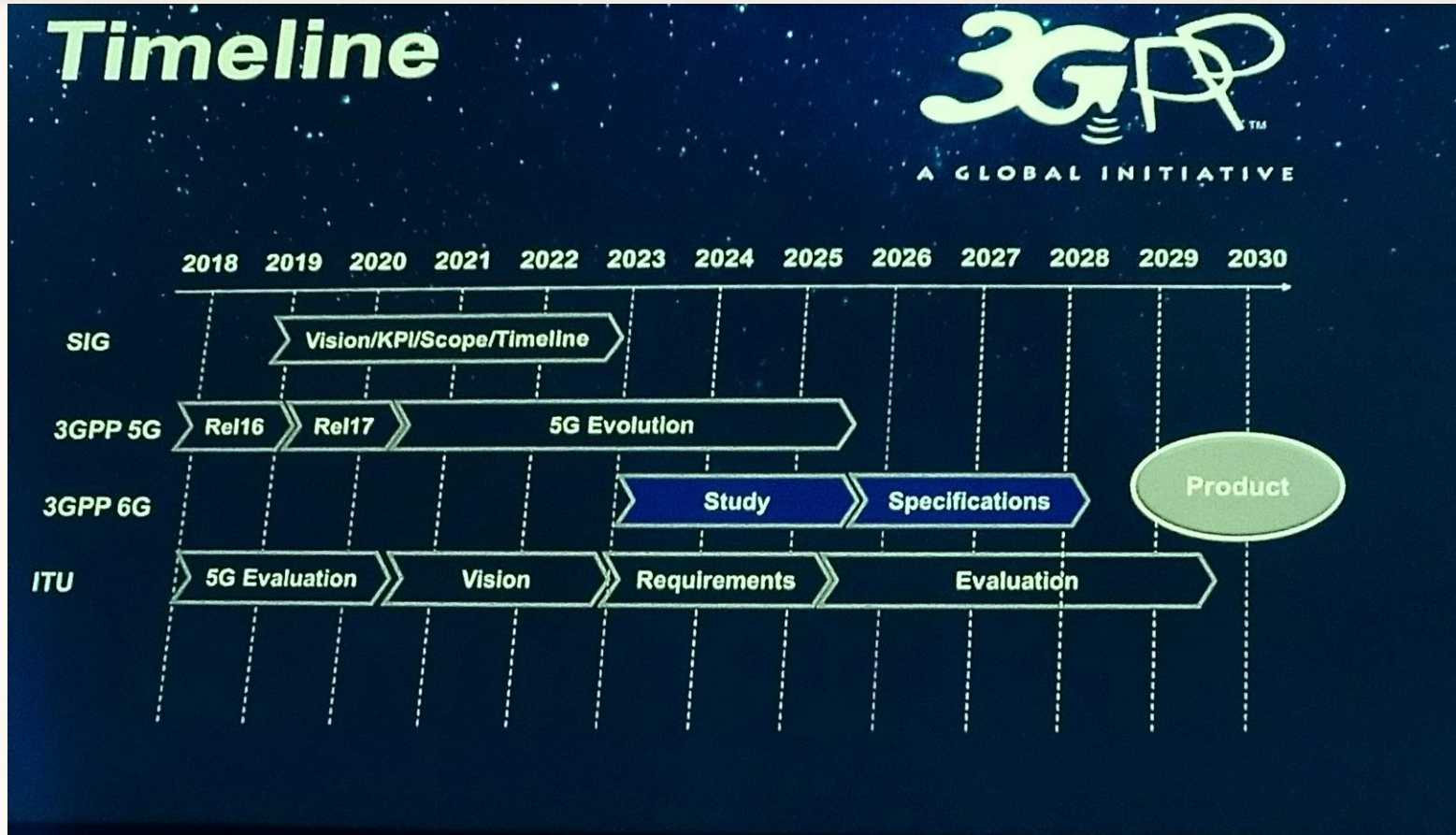
3+4 Open Challenges for 6G



- massive – Data rate beyond 10Gb/s (the end of OFDM)
- massive – Reliability using 50+year old framework
- massive – Low latency at 1ms and below
- massive – WPN deployment with Resilience against jamming & more
- massive – Scalability solution mapping
- massive – Rural coverage
- massive – Security & Privacy architecture

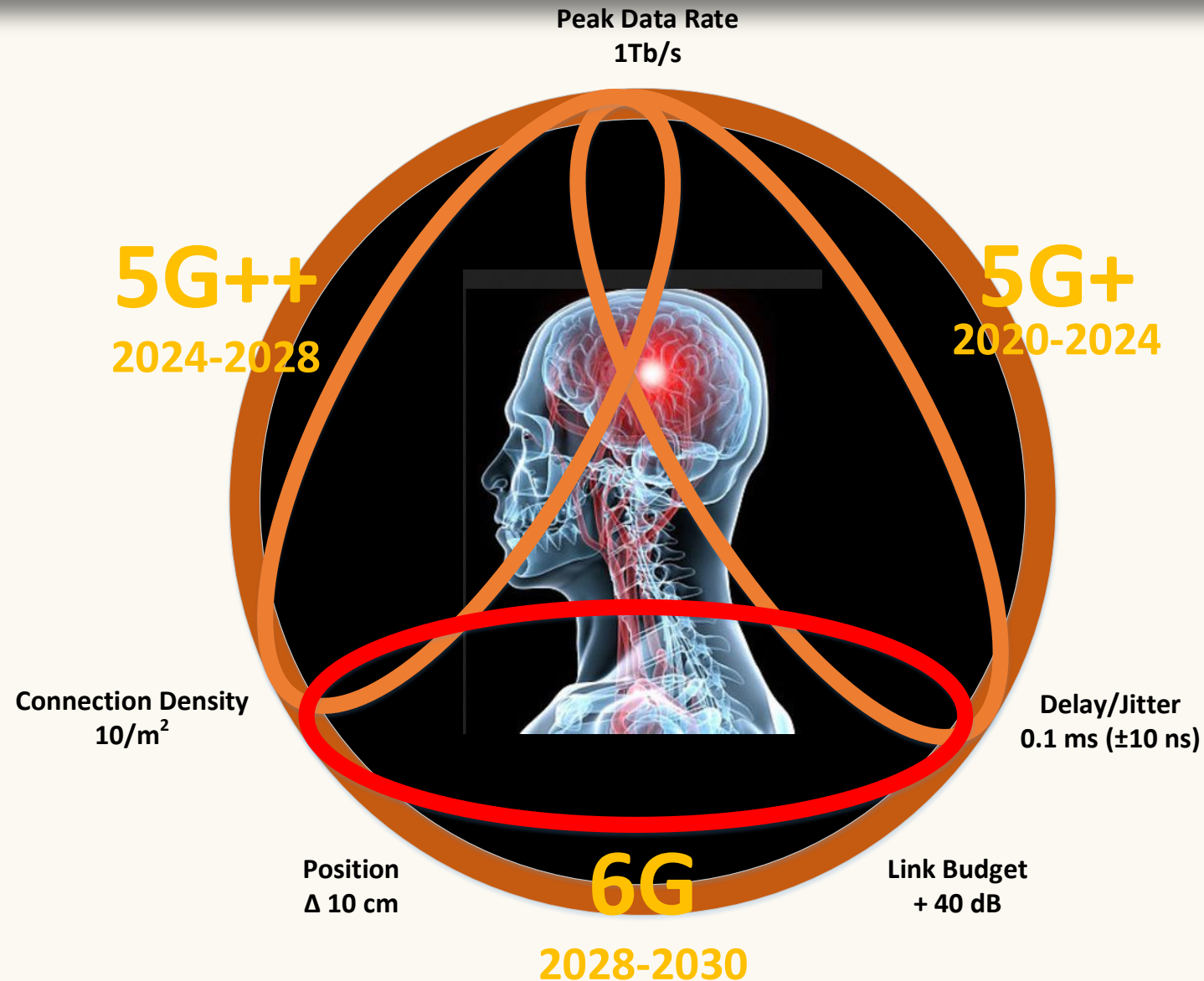
First use cases/requirements were discussed and some of these are summarised in this slide.

Globecom 12/2018 – “First” conference to touch 6G



First timelines
were offered and
these are
summarised.

Globecom 12/2018 – “First” conference to touch 6G



**First technical requirements
were discussed and
some of these are
summarised**

- Transmit only devices ? Sustainable Devices
- Beyond OFDM waveforms
- Vertical Specific Service Operators
- New software architectures to support dynamic virtualisation
- Zero jitter, low latency transport
- Fully distributed AI or Fog AI
- Global network slicing

**Further Notions on
Requirements/Use cases
for 6G**



First conference to discuss 6G

6G WIRELESS SUMMIT
24-26 MARCH 2019
LEVI, FINLAND

www.6Gsummit.com

6G

Radio City
OULU

Genesis

Vision for 2030

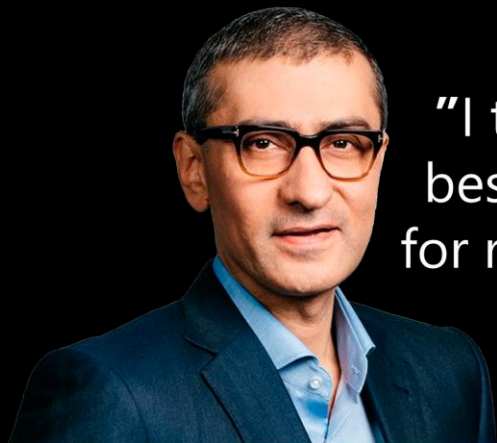
Our society is data-driven,
enabled by near-instant,
unlimited wireless connectivity.

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.

2030



Background: Oulu, Finland - Pioneering wireless



Rajeev Suri, CEO, NOKIA

"I think Oulu is the world's best place, second to none, for radio access engineering"

6 Oulu ICT facts

1. **2.6B** users for wireless technologies developed in Oulu.
2. **3-4B€** exports per year from wireless industry in Oulu.
3. **200** new startups from ICT since 2014.
4. **150** researchers makes CWC one of the leading radio group.
5. **Core technology** contributions from 3G to 5G
6. **1000+** ICT companies is directly reached in 6Genesis.



^{*)} In 10 key flagship research areas
(#1 in four areas) with FWCI 1.86.

National Flagship on **wireless communications**

6G Enabled Wireless Smart Society & Ecosystem

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



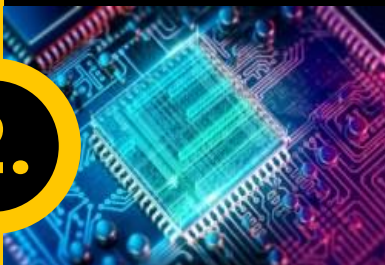
6Genesis was elected as
**Finlands high-tech
Flagship**, by Finnish
Government through
Academy of Finland

1.

Wireless Connectivity

Ultra-reliable low-latency communications and 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 accross verticals

Enabling **Disruptive Value Networks**

Basic pillars enabling future smart society

Flagship focuses on 5G & 6G

- **Now:** Utilize benefits of 5G
- **Next:** Develop 6G enablers

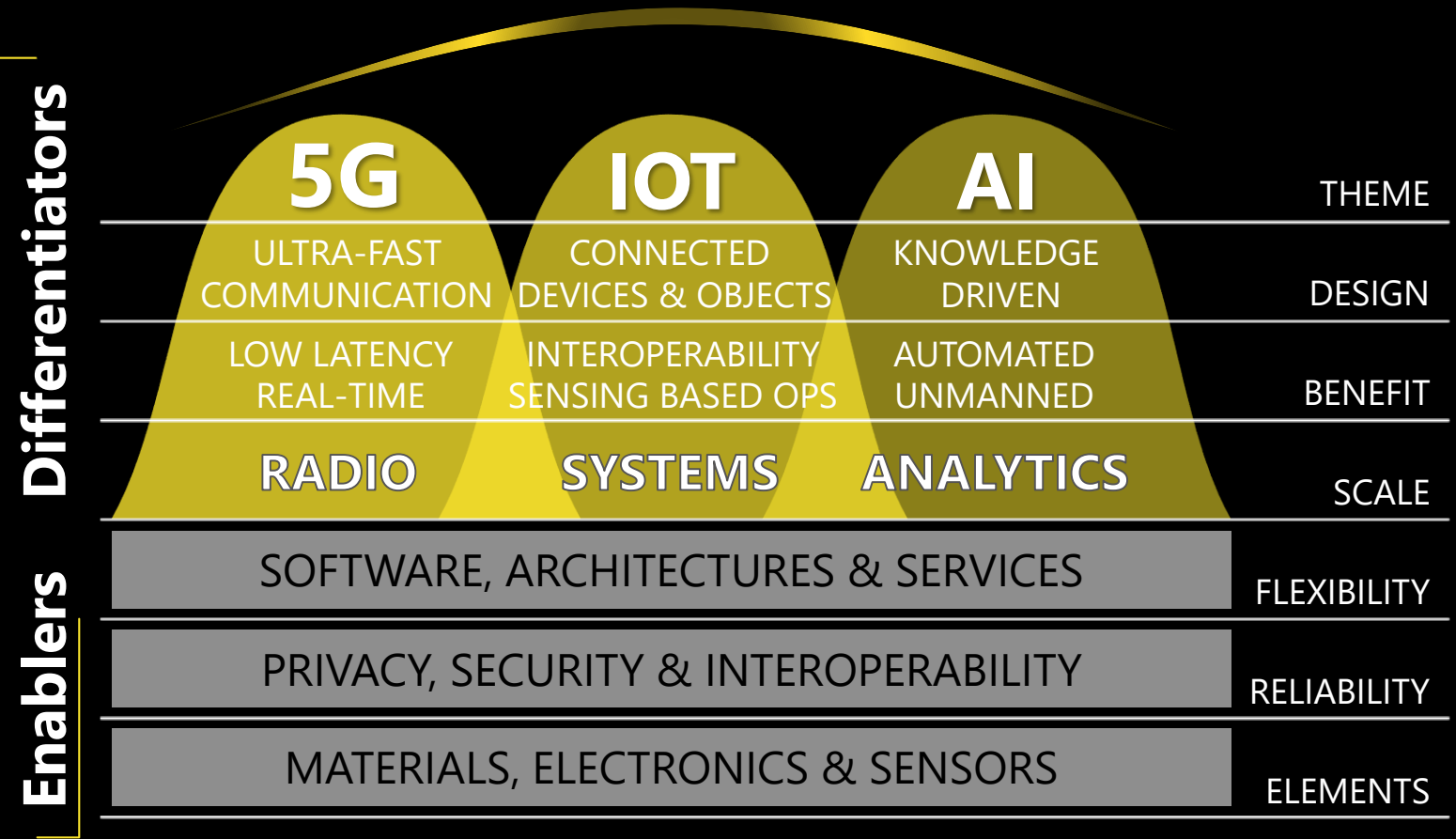
Wireless intelligent edge

- Technology convergence
- Enablers for speed, experience, performance & security

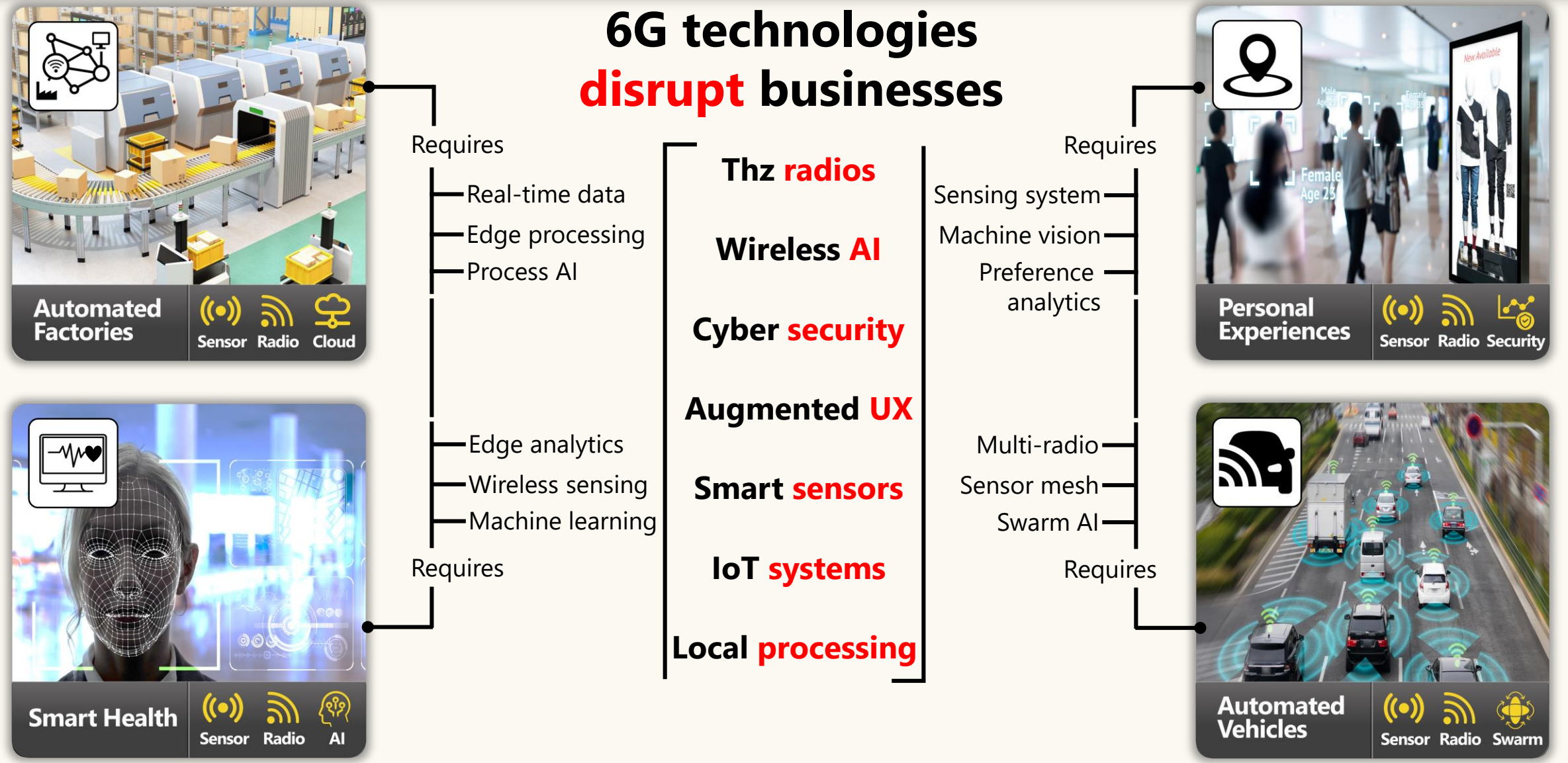
Next gen requirements

- Real-time
- Sensing-based
- Distributed intelligence
- ..list goes on!

WIRELESS INTELLIGENT EDGE

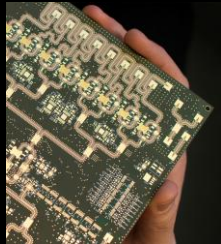


Enabling next generation **business cases**



5G Test Network

- Open test network for co-creation (<https://services.5gtn.fi/>).
- Main parts located in Oulu & Helsinki regions.
- Was used in EU-Korea demos at 2018 Winter Olympic Games.
- Operator grade live network with plugged in 5G prototype radios.
- Awarded Academy of Finland FIRI status Dec/2018
- Near future targets: become the first operational local micro-operator at University of Oulu Digital Campus.
- Long Term Target: World's First 6G Test Network



800 MHz @26/28 GHz
10 Gbps
Hybrid beamformer



5G PoC/5GNR



IoT sensors
LoRa, NB-IoT, UWB,, ZigBee, BLE



LTE Macros
with NB IoT

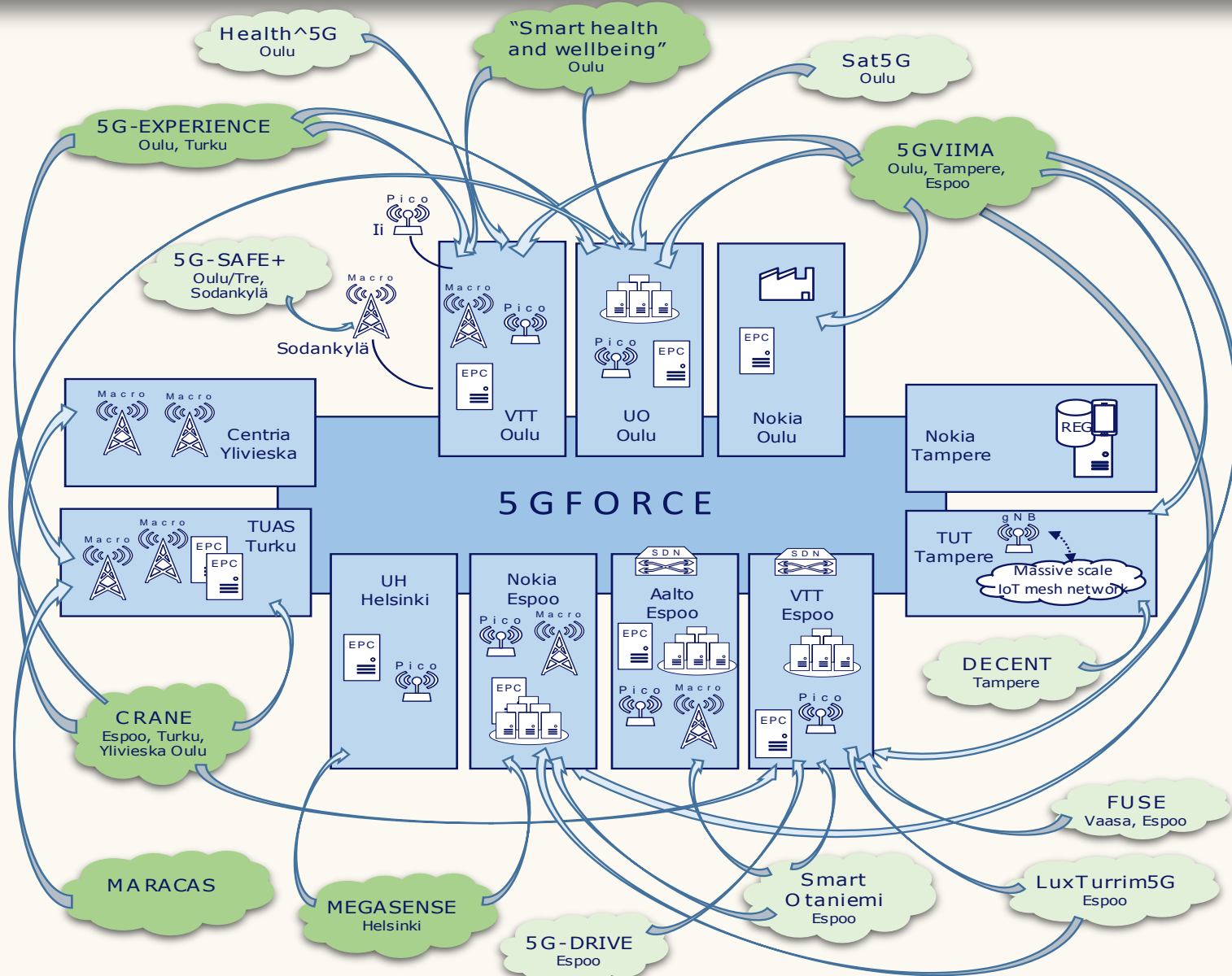


LTE small cell
@3.5GHz



5G SIM

Business Finland – 5th Gear and connected verticals ecosystem



5G FORCE Partners and Budget (under negotiation)

Academy	K€	
AALTO, VTT, UH, TUT, UOULU, Centria, TUAS	8450	35%
Own project: Nokia, Ericsson, Coriant,, Wirepas, Tieto, Fsecure, Indalگو	15330	
No project (in-kind contributions) : Elisa (infra), MediaTek (UEs)		
Total	23780	



6Genesis Flagship Summary

- Elected Academy Flagship
 - 8 year, 251M€ program
 - Hosted by Univ. of Oulu
 - Science & business ecosystem
-
- Work in themes and waves
 - Products: Take 5G to use
 - Science: Enablers for 6G
 - Mutual ROI is prioritized

Join us at www.6genesis.com