Beyond 5G to 6G

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Evolving 5G, monetizing 5G to its full potential

First few years of 5G

1.6B[1]
5G sub's
<19% of total

~40%[1]
pop coverage
~60% to go

Enhancing the 5G networks

- 5G stand alone
- 5G slicing
- Carrier aggregation
- Network exposure
- RedCap
- All frequency bands

Monetizing 5G

5G still early in the cycle, continued network evolution needed

[1]Dec. 2023

Differentiating traffic in high-performance networks

QoS/speed/latency

Dynamic control
Resource intense

TCO/simple operations

Wireless
as-a-service

Reliability

Flexible manufacturing
Broadcasting

**Positioning &
advanced capabilities**

3D mapping
Location check

Coverage
(in/outdoor, 3D)

Automated
guided vehicles

**Security, ID &
authentication**

Identification
2-factor authentication
Secure access service edge

Use 5G to its full potential

Demanding 5G use cases already today

Prioritized communication

First Responder support

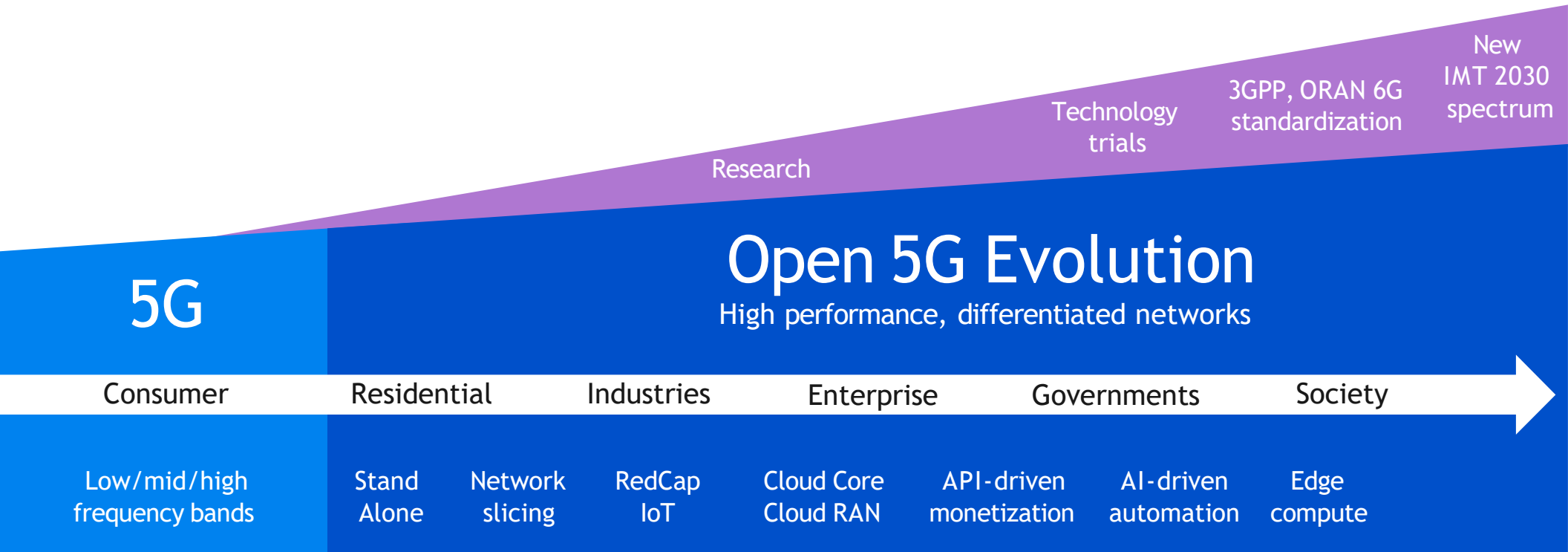## Optimized manufacturing

Car assembly plants

Real-time surgery
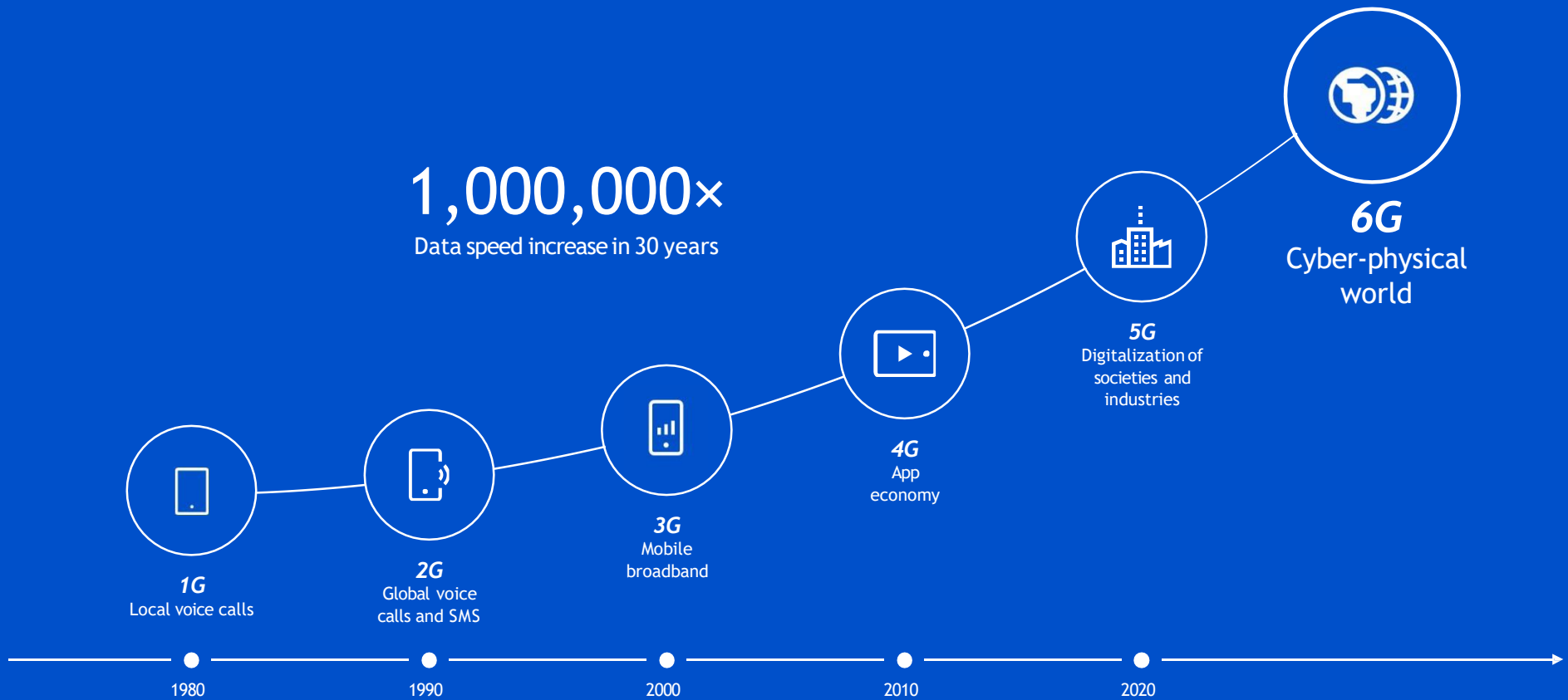
Holo-medicine with real-time XR

Long-term network evolution – for new needs
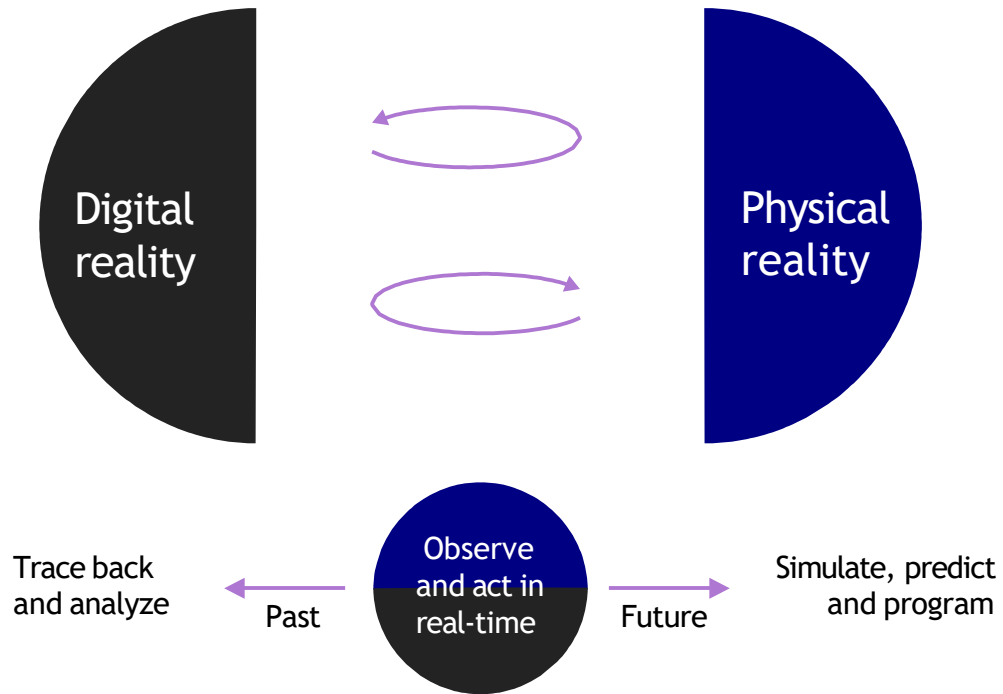Continuous mobile innovation in hardware, software and automation

New IMT 2030 spectrum

3GPP, ORAN 6G standardization

Technology trials

Research

5G

Open 5G Evolution
High performance, differentiated networks

Consumer	Residential	Industries	Enterprise	Governments	Society
Low/mid/high frequency bands	Stand Alone	Network slicing	RedCap IoT	Cloud Core Cloud RAN	API-driven monetization	AI-driven automation	Edge compute

Networks will evolve with software capabilities for future services long into next decade

Driving mobile networks for new waves of innovation

1,000,000×

Data speed increase in 30 years

6G
Cyber-physical world

5G
Digitalization of societies and industries

4G
App economy

3G
Mobile broadband

2G
Global voice calls and SMS

1G
Local voice calls

1980   1990   2000   2010   2020

Connecting a cyber-physical world
Wireless metaverses, twinning and more

What's in the cyber-physical world?

Massive merged reality

Massive twinning
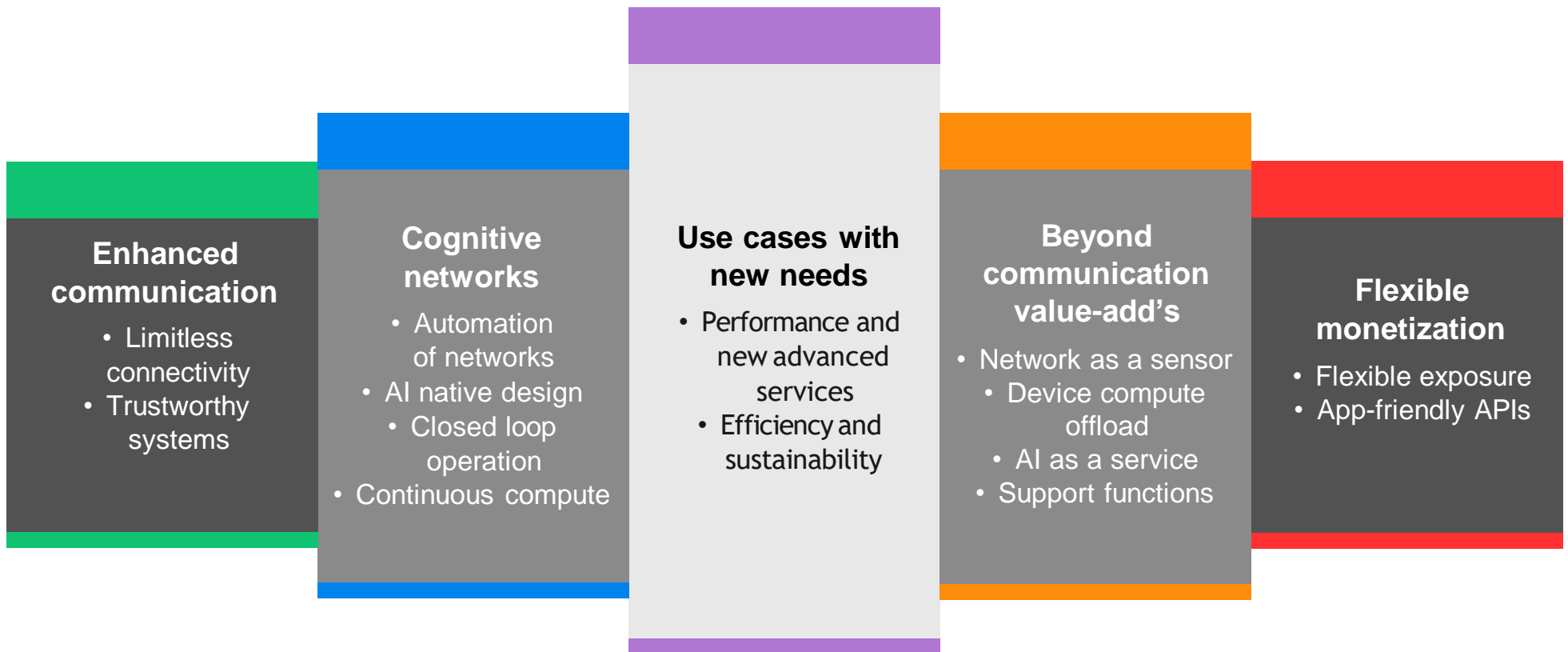

Situational awareness

Sustainable food production
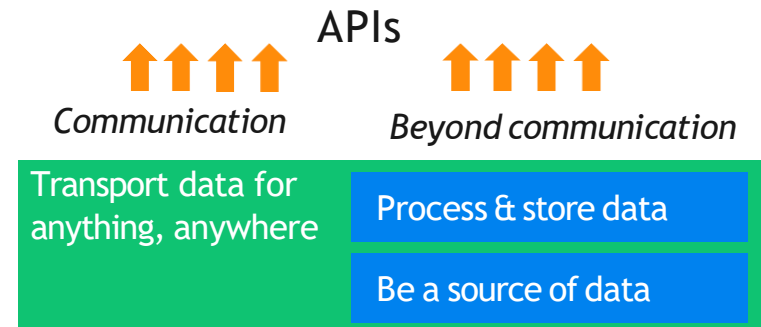

Efficient data

E-health for all

6G building blocks

Enhanced communication

- Limitless connectivity
- Trustworthy systems

Cognitive networks

- Automation of networks
- AI native design
- Closed loop operation
- Continuous compute

Use cases with new needs

- Performance and new advanced services
- Efficiency and sustainability

Beyond communication value-add's

- Network as a sensor
- Device compute offload
- AI as a service
- Support functions

Flexible monetization

- Flexible exposure
- App-friendly APIs
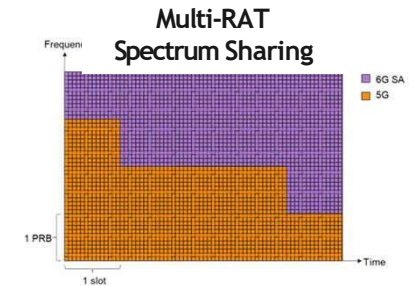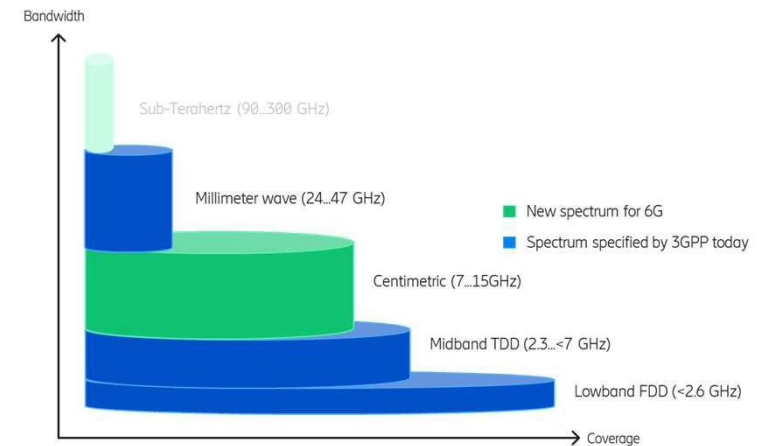
Networks-driven versatile monetization

- Future networks should be designed to better interact directly with the app ecosystem
  - Tailored communication service APIs

- Future networks can also take a bigger role in the combined ecosystem
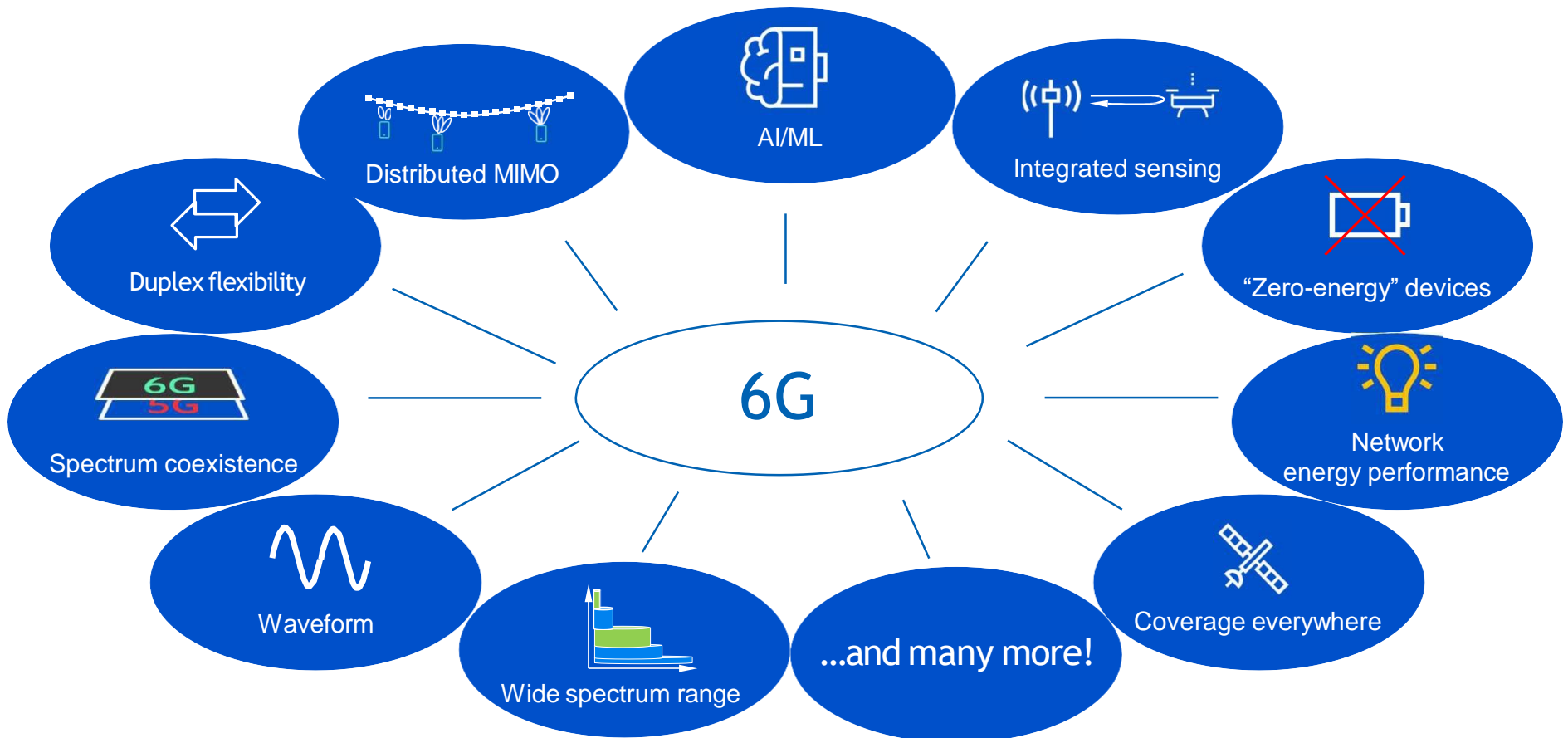 - Data and information service APIs

APIs

Communication   Beyond communication

Transport data for anything, anywhere

Process & store data

Be a source of data

Key 6G principles
Minimize complexity, Maximize performance

- 6G RAN shall have a standalone architecture

- 6G RAN shall interface to an Evolved 5G Core

- The standardized 6G architecture should include key open interfaces

- 6G shall operate in all existing 3GPP bands and in new cmWave bands

- 6G Spectrum Sharing shall be supported between 5G and 6G

- 6G shall support new and evolved use cases, efficiently & sustainably

Multi-RAT Spectrum Sharing

6G technology components

Distributed MIMO · AI/ML · Integrated sensing · "Zero-energy" devices · Network energy performance · Coverage everywhere · ...and many more! · Wide spectrum range · Waveform · Spectrum coexistence · Duplex flexibility · 6G
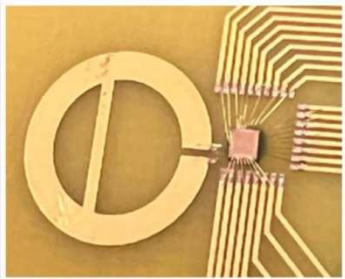
6G zero-energy devices
Massive IoT and Zero energy devices, shown at MWC23

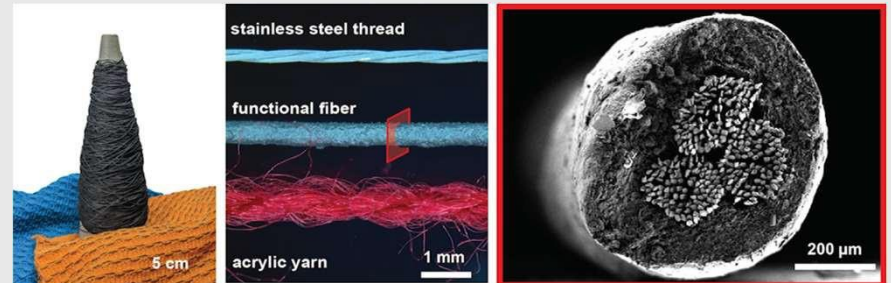### Zero-energy IoT devices

[2]

First prototype:

- Designed to fit with fabric

- No need for batteries

Potential future IoT device for 6G

Tactile textiles with piezoresistive fibers

stainless steel thread

functional fiber

acrylic yarn

5 cm   1 mm   200 µm

[1]

Application potential:

- Feel body pressure and movements to monitor patient

Need low-energy connection to the mobile network

Long-term use case vision to study future network needs

Beyond 5G technology qualification

- Lab and field trials are needed to assess key technology steps
- WRC23 identified study items in

  - 7–8 and 14–15 GHz bands

- Potential new radio units need to

  - manage scattered spectrum in a wide bandwidth

  - coexistence with incumbents (e.g. satellite service)

- Prototype equipment under study

  - Two wide-band power amplifiers

6G industry timeline

7	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	203

Basic research

Regional initiatives
Japan Beyond5G   EU Hexa-X-II
USA ATIS NGA   China MIIT & MOST
India Bharat 6G   S. Korea 6G Forum

6G requirements

6G technical standardization

ITU process

Applied research

Basic technology trials

System test beds and trials

Commercial

7	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	203

Pushing the boundaries with Beyond 5G / 6G

- Continued deployment and evolution of 5G necessary to support demanding services

- 5G experience will provide vital input to 6G definition

- Early 6G studies well on way in regional efforts

- Important to shape study inputs for standardization activities

- Technology trials will provide essential feedback