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On the path to 6G

Industry alignment and collaboration is key to bring it to life

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EuCNC & 6G Summit 2022

Services to evolve from 5G, to 5G Advanced and 6G

2022 5G	5G-Advanced	6G 2030
High quality video (4K-8K)	XR - fully immersive user experience	Holographic transmissions
Object driven digital twinning (e.g. an engine)	Large scale digital reconstruction (e.g. a vertical farm)	Broad based digital twins with RT synchronous updates (e.g. smart city)
Data communication and control	Provide precise location and timing services that complement GNSS	Network with a 6th sense

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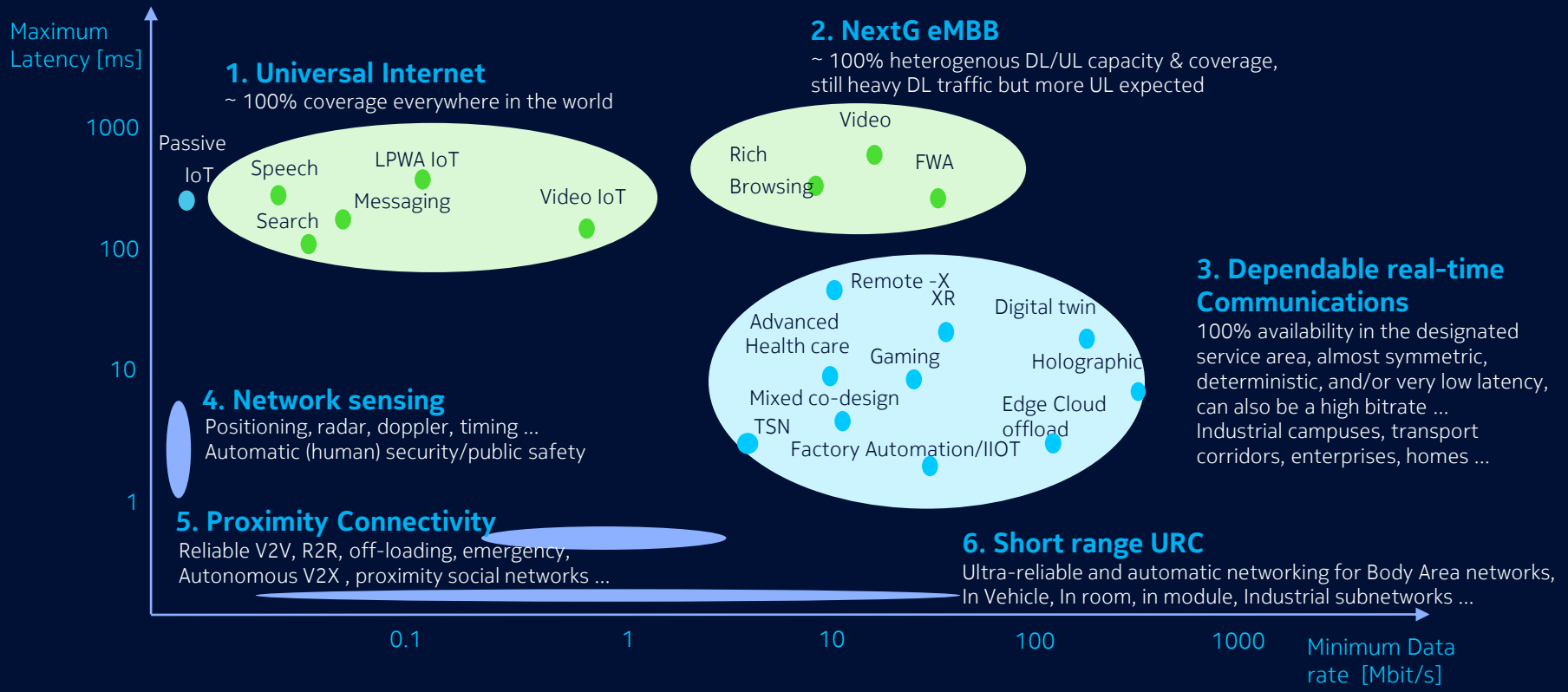
Key service categories driving the 6G development @ 2030



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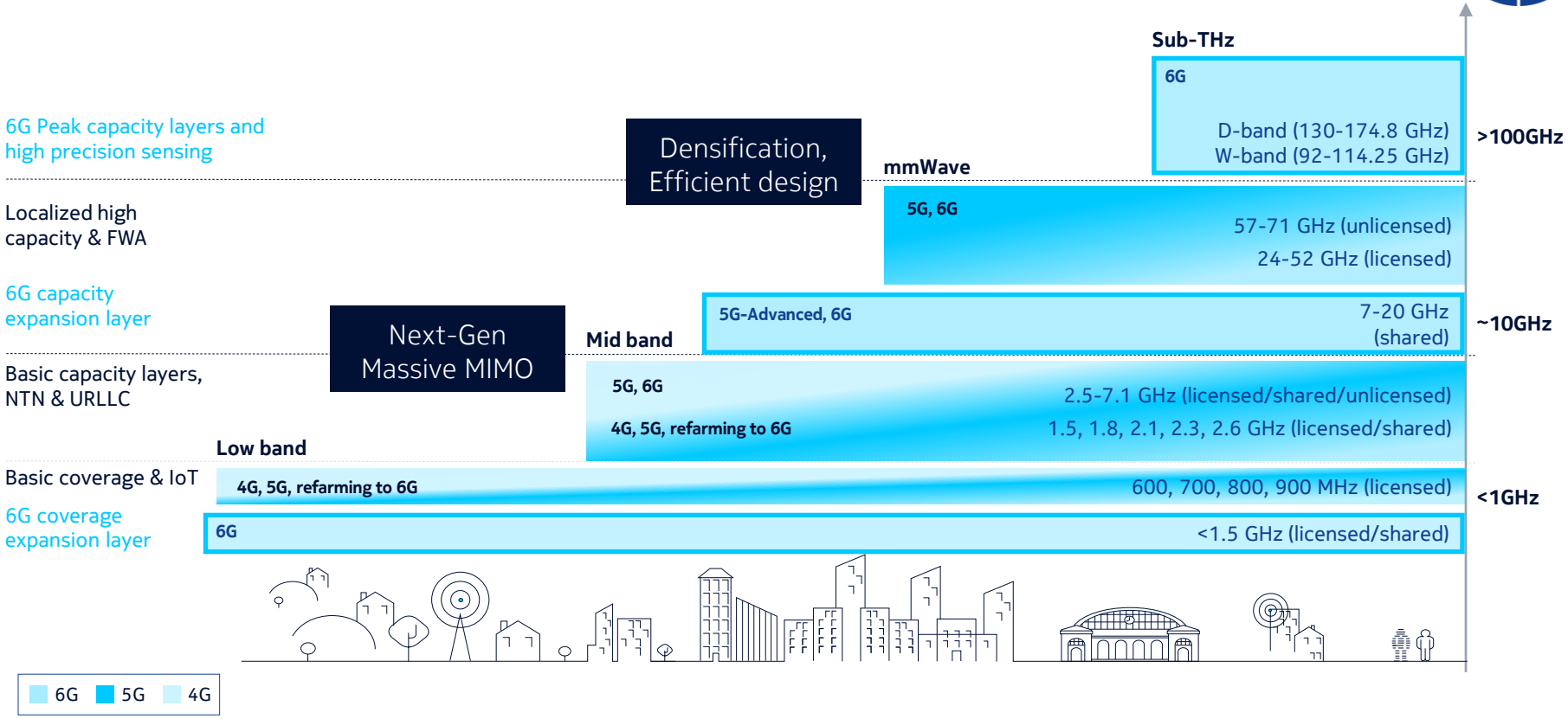
6G technologies landscape
Nokia perspective

5G-Advanced and 6G spectrum options



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Massive MIMO for higher site spectral efficiency

Low-cost/Low-power Radios/Arrays

Scale to very large arrays

Flexible Radios/Arrays

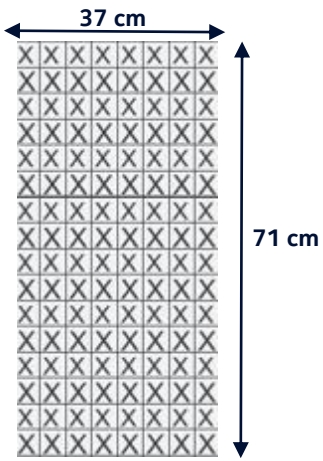
Multi-band, large bandwidth, waveform agnostic

Advanced Signal Processing Platforms & Algorithms

Increase spatial multiplexing efficiency

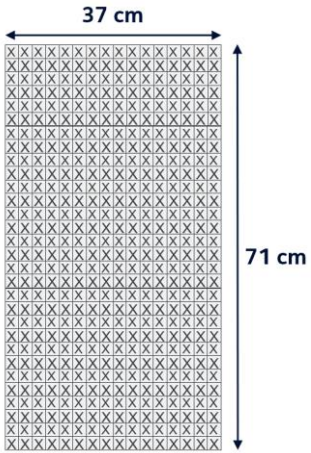
Coverage solutions

Beamforming and coupling to lower bands



256 radiator size @ 3.5 GHz

100 MHz, 160 MHz,…



1024 radiator size (7 GHz) is similar to the existing 3.5 GHz mMIMO antennas

100 MHz, 200, 400 MHz,…

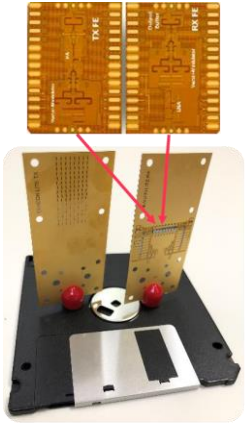
Sub-THz air interface for highest peak data rates

Efficiently providing ultra high bandwidth under challenging conditions

Ultra-high data rates

Future applications requiring up to and beyond **100 Gbit/s**

Advanced HW components



World's first D-Band Phased-Array-on-Glass

New PHY layer for sub-THz

- Low PAPR waveforms
- High gain antenna arrays
- Advanced beam forming for hybrid architectures

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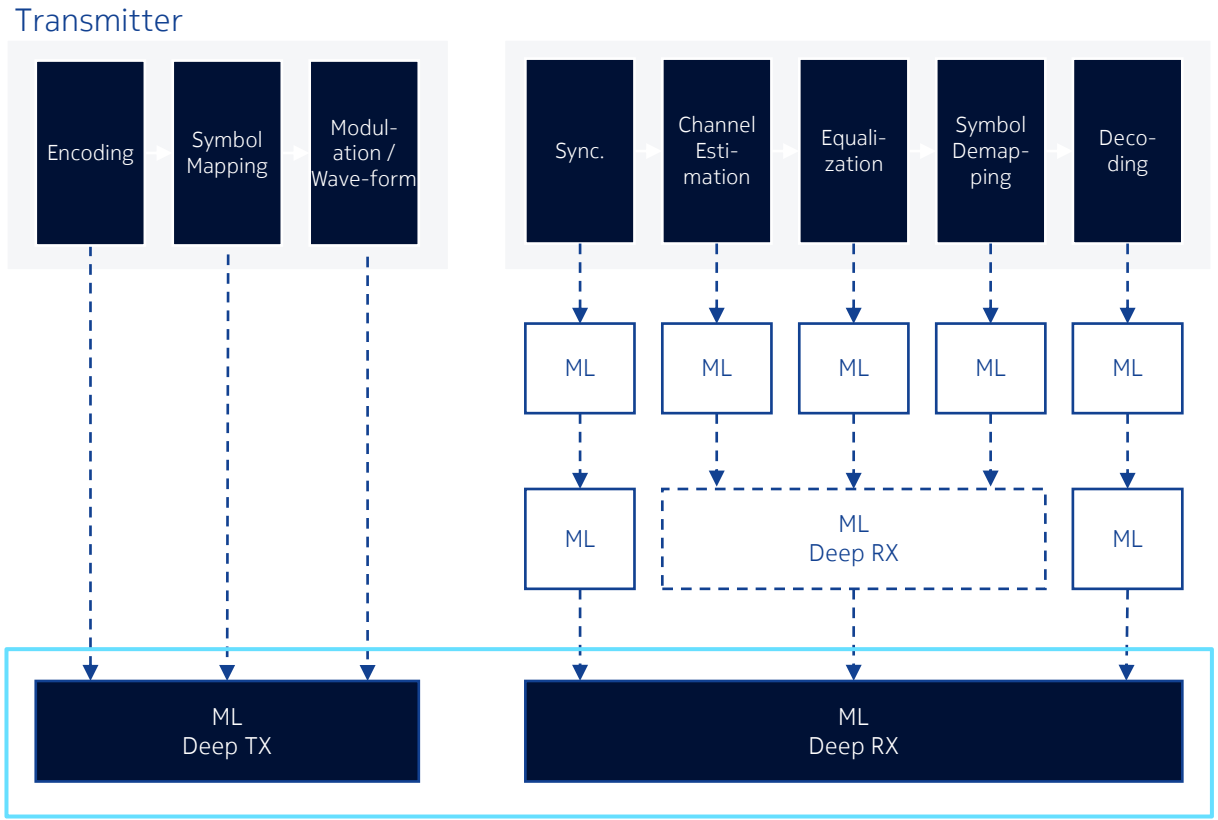
Roadmap to optimized 6G AI native air interface



5G

The classical architecture

5G-Advanced

ML replaces/enhances individual processing blocks

5G-Advanced

ML replaces multiple processing blocks

6G

ML designs part of the PHY itself

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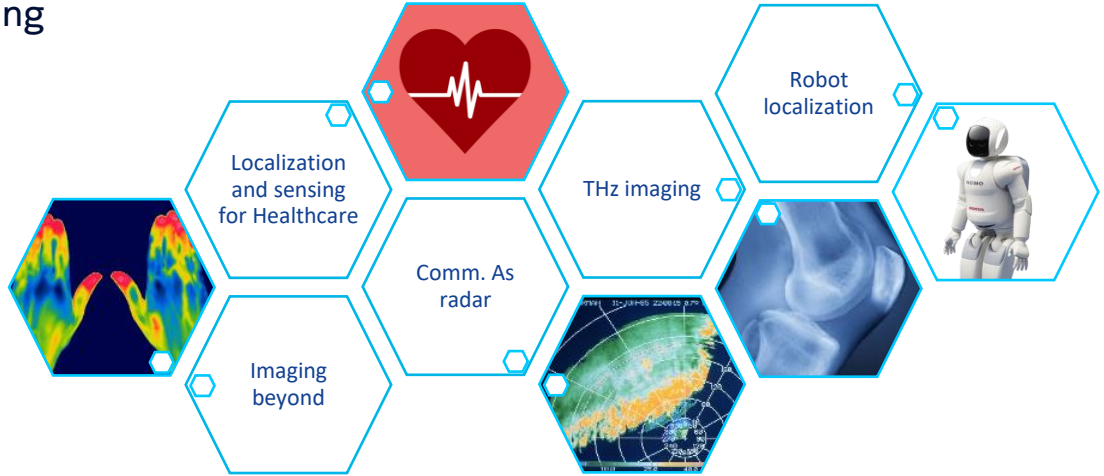
6G network (&device) with a 6th sense

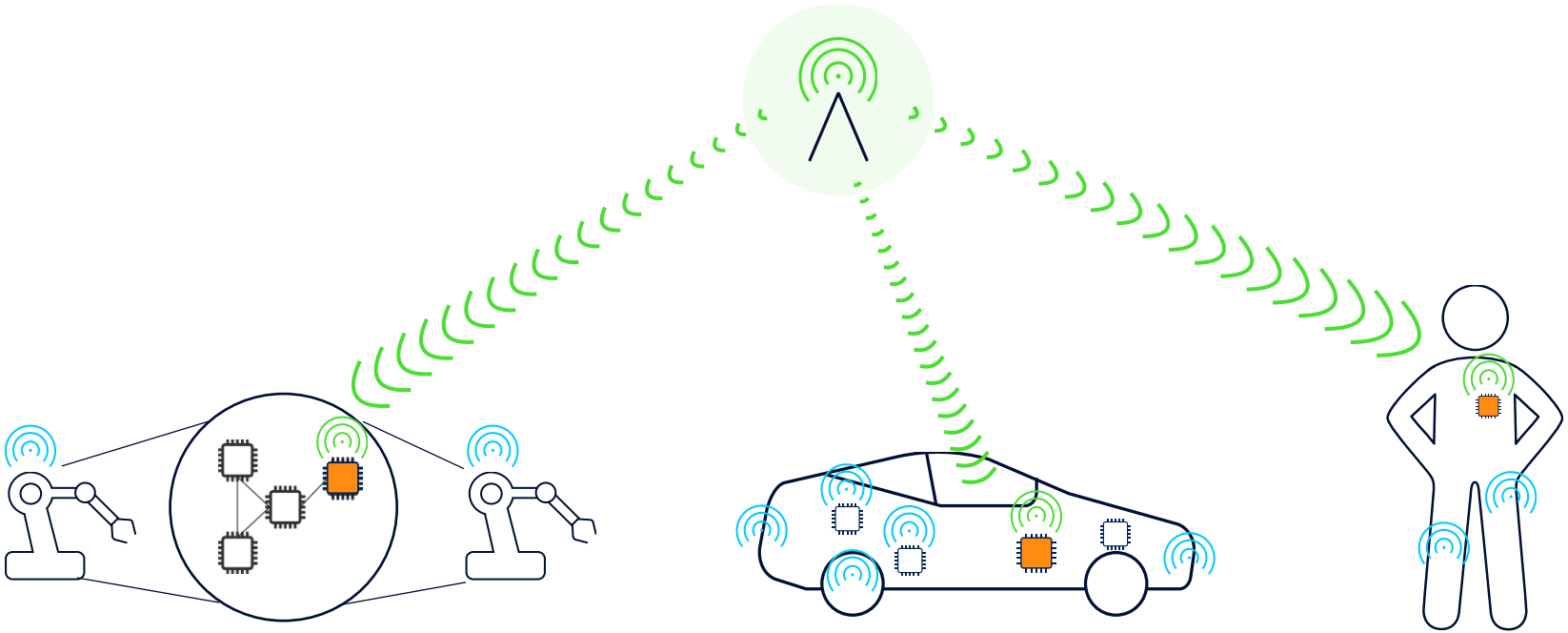
Simultaneous communication and sensing

- Waveform multiplexing
- Resource allocation
- Beam sweeping
- CSI based sensing
- High precision localization in NLOS



6G extreme connectivity

The end-point is a network for life-critical communication



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6G architecture themes

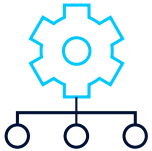
Het-Cloud

New RAN-Core functionality

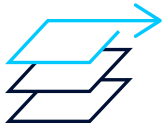
Cognitive Networking

Automated Management and Orchestration

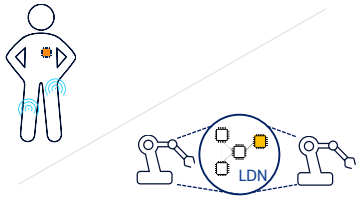
Data and Information Architecture



Deep Slicing



6G Subnetworks



Mesh / Cell-less

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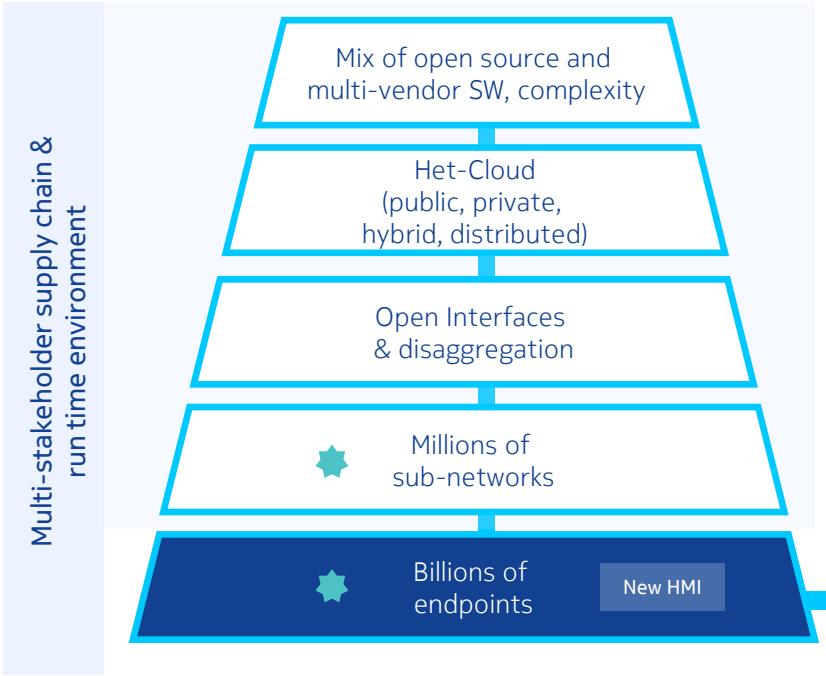
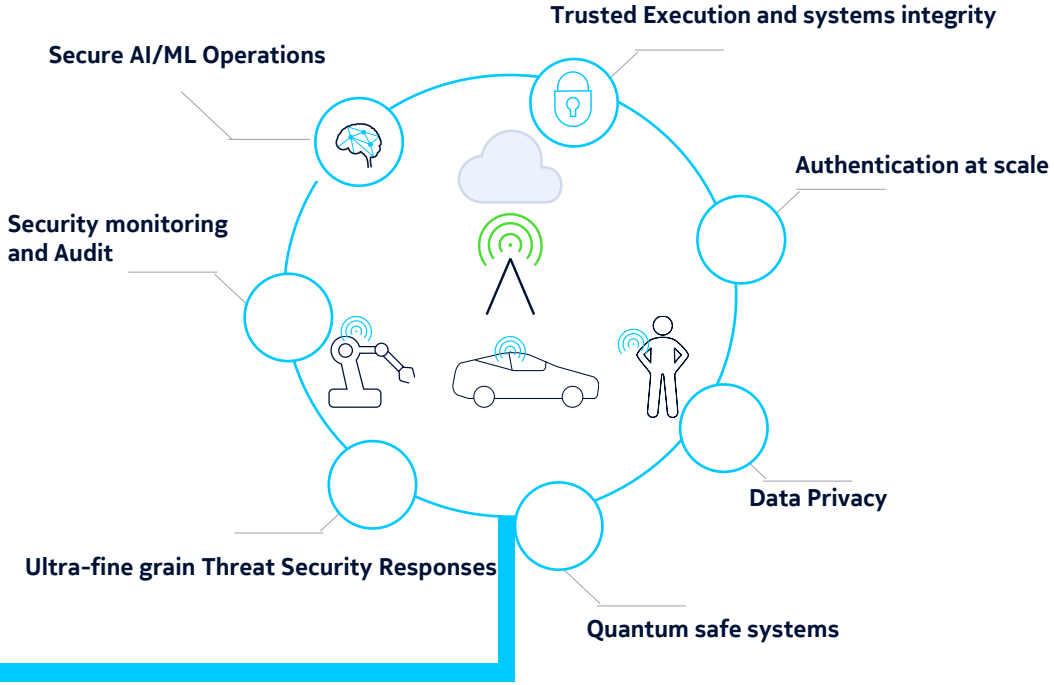
6G security and trust

Mitigate the exploding threat surface



Zero trust

Technology enablers



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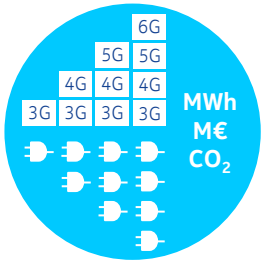
Energy efficient design and deployment is key for 6G

Data traffic boom continues



Double digit annual growth in energy costs and CO_2 emissions

Mobile Network Operators increasingly setting long term sustainability targets to reduce CO_2 emissions *

Financing sector prioritizes investments for businesses reducing CO_2 emissions **

* http://sciencebasedtargets.org/
** https://www.nordea.com

How to support x20 traffic increase @ ½ Energy ?

- **Technology**
- **Features**
- **Deployment**

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Let us create 6G together