Towards 6G
2030 Scenarios

June 2022
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Needs in the 2030's

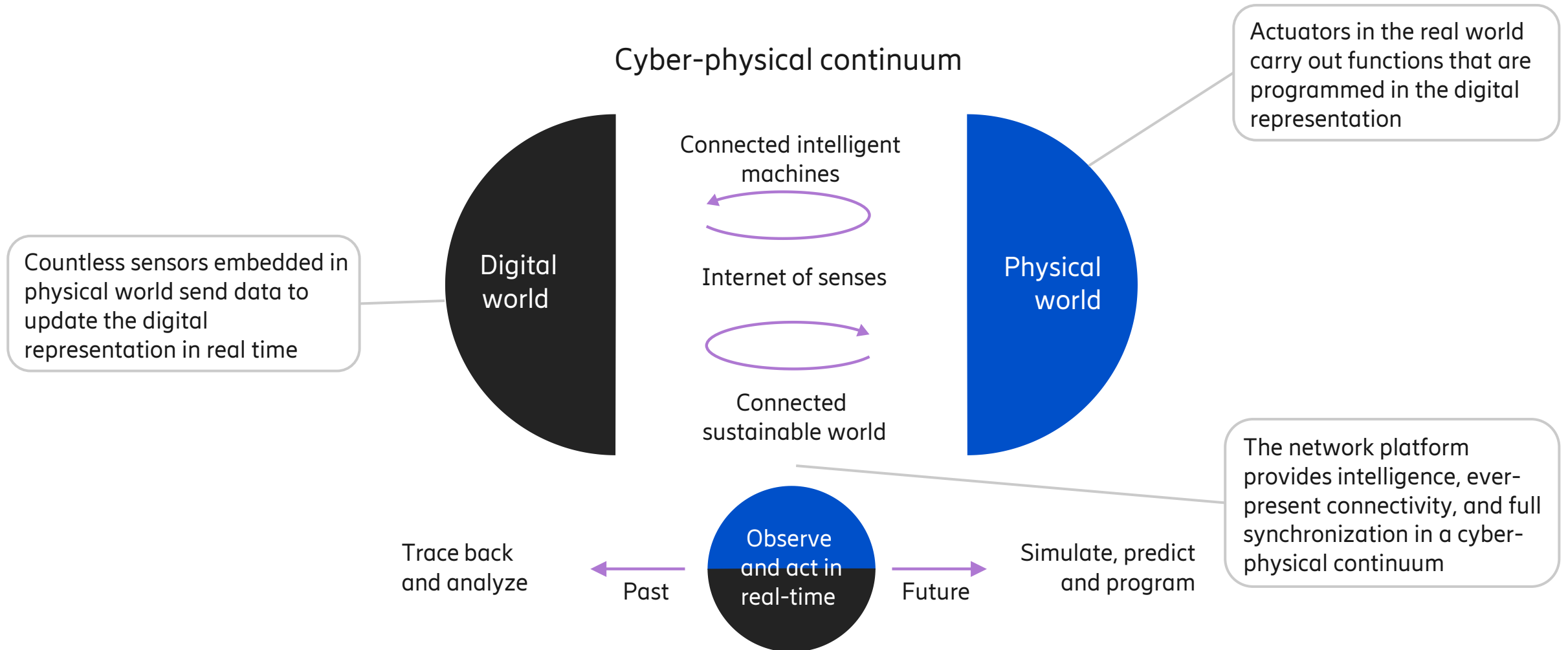|	
Trustworthiness	Trusted communication and computing for industry and society relying on critical information
Sustainable world	Communication and network as part of and enabler for sustainable development
Simplified life	Massive use of AI across systems for optimal assistance and efficiency
Application demands	Extended and new services requiring extreme connectivity performance

Connecting a cyber-physical world

Cyber-physical continuum

Actuators in the real world carry out functions that are programmed in the digital representation

Countless sensors embedded in physical world send data to update the digital representation in real time

Digital world

Connected intelligent machines

Internet of senses

Connected sustainable world

Physical world

The network platform provides intelligence, ever-present connectivity, and full synchronization in a cyber-physical continuum

Trace back and analyze

Past

Observe and act in real-time

Future

Simulate, predict and program

What's in the cyber-physical continuum?

Merged reality

- New ways of meeting and interacting with other people
- New possibilities to work from anywhere
- New ways to experience culture and scenes far away

Massive digital twins

- Connecting all equipment and tracking material
- Using the network as a platform for many ecosystems
- Allowing accurate predictions and detailed control
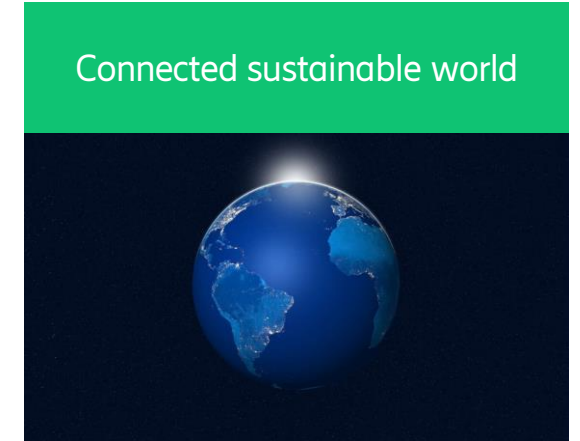
Situational awareness

- Sensing surroundings and locating objects
- Guiding robots and vehicles with digital maps
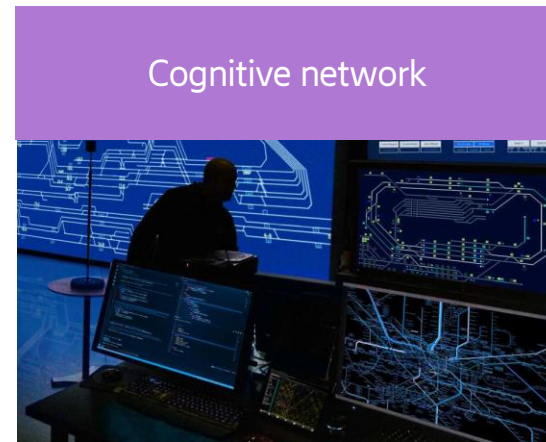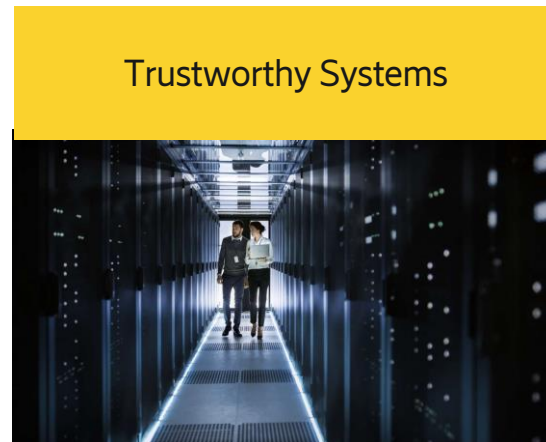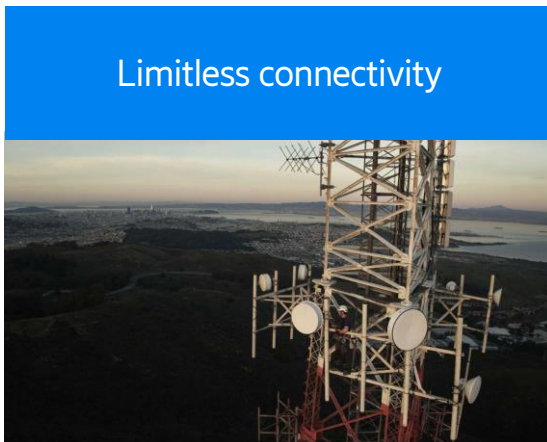- Interacting with collaborative robots

2030 Scenarios

Human and society use cases & needs

The Internet of Senses	Connected Intelligent Machines	Digitalized & programmable physical world	Connected sustainable world

Use case focus

Limitless connectivity	Trustworthy Systems	Cognitive network	Network compute fabric

Technology focus

Fundaments of a 6G network platform

Massive Multisensory Merged Reality

What is offered

- Realization of virtual presence and immersive interactive applications

- Merged reality experiences

- All-senses involvement

- Holographic presence

- The portal to a metaverse experience powered by XR

Network Requirements

— Very high rates

— Low latency

— High capacity for high density of users

— Edge compute

— Sensing to support spatial mapping

— Privacy preservation

Interacting Navigating Robots
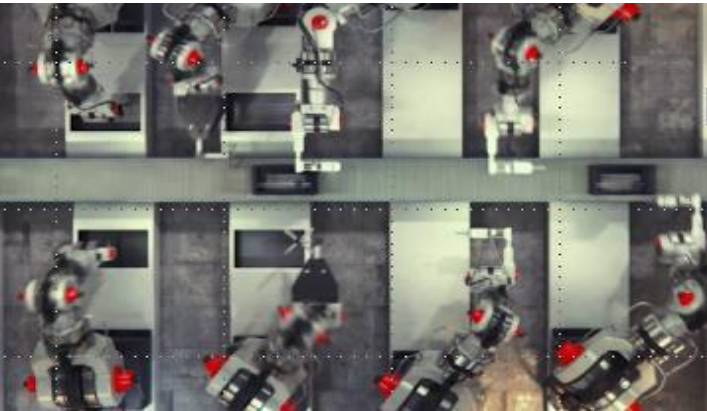
What is offered

- Platform for sharing sensor data for smart cities

- Enabling connected autonomous vehicles/ robots to use external sensors

- Creating a sensor network for safe transports

- Communication among collaborative robots to coordinate their tasks

Network Requirements

– Localization of devices

– High service area coverage

– Sensing of objects

– Digital mapping

– Very high service availability and reliability

Collaborative AI Partner

What is offered

- Autonomous systems and service robots interact, assist and collaborate with humans

- For industry, home and healthcare

- Cobots can coordinate activities between them, e.g. in factories, production

Network Requirements

- Localization of devices

- Service area coverage

- High Data rates

- Low E2E latency

- Sensing of objects

- Very high availability and reliability

Interactive 4D Map

What is offered

- Digital 4D representation and aggregation of sensors and actuators

- Accurate description of history

- Detailed real-time-control

- Tool for predictions of the future (trends, faults, KPIs, etc.)

Network Requirements

- Massive amounts of devices

- Real time and very low latency

- E2E data protection

- Support for zero-energy devices

- Compute offload

- Accurate positioning

- Availability and Reliability

Precision Healthcare

What is offered

- Connecting a body area network of in-body and on-body devices

- Reliable and secure health data handling

- Real-time monitoring and online analysis

- Predictive medicine

Network Requirements

- Service reliability

- Maintenance free low energy sensor devices

- Support short survival time

- Privacy preservation

- E2E data protection

2030 Scenarios

Human and society use cases & needs

| The Internet of Senses | Connected Intelligent Machines | Digitalized & programmable physical world | Connected sustainable world |

Use case focus

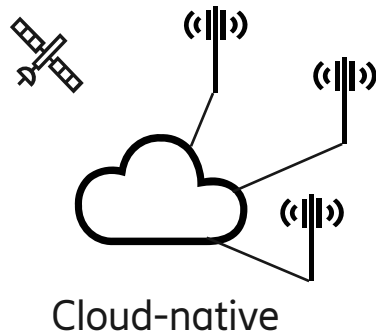| Limitless connectivity | Trustworthy Systems | Cognitive network | Network compute fabric |

Technology focus

Fundaments of a 6G network platform

Network Adaptability

Cloud-native

Network architecture optimized for cloud

- Based on a common cloud platform and IT
- Fully service-based architecture
- Enhanced functional separation
- Enabling optimization and simplification

Flexible and dynamic networks

- Integration of new types of access nodes
- Versatile programmable transport for cost effective densification
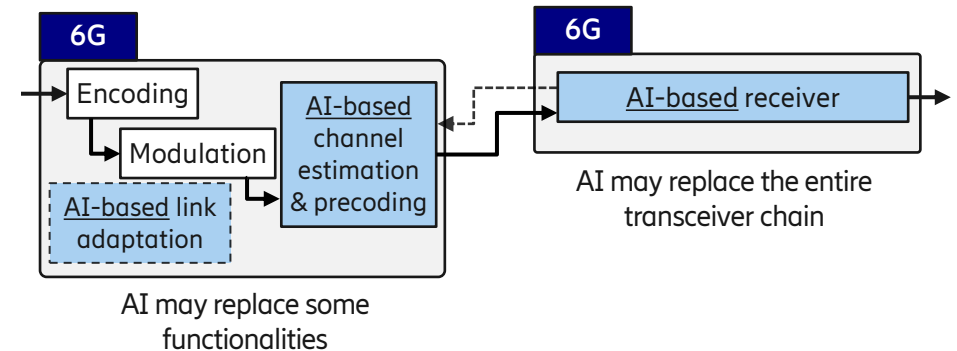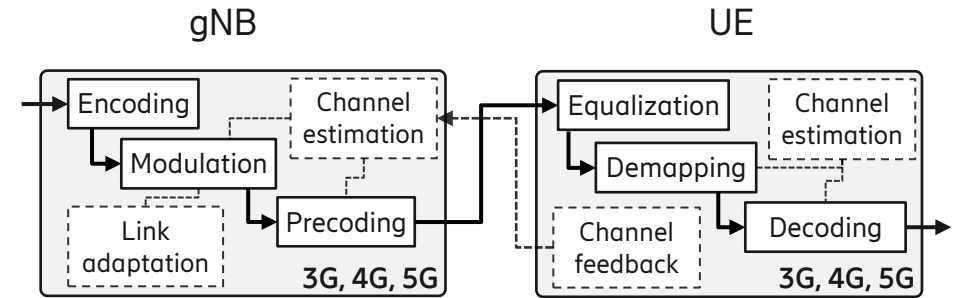- Addressing needs from enterprises and verticals

Programmable devices and network

- Adjust to new deployments and use cases
- Faster TTM for new services & features, DevOps
- Dynamically deployable AI/ML agents

AI for Air Interface

Wireless channel

gNB — Wireless channel — RX / UE

AI for PHY

gNB (3G, 4G, 5G)

Encoding → Modulation → Precoding
Channel estimation
Link adaptation

UE (3G, 4G, 5G)

Equalization → Demapping → Decoding
Channel estimation
Channel feedback

6G (gNB)

Encoding → Modulation → AI-based channel estimation & precoding
AI-based link adaptation

AI may replace some functionalities

6G (UE)
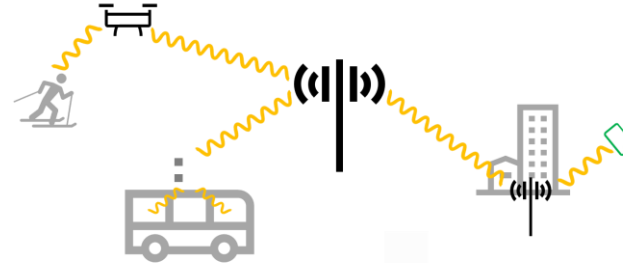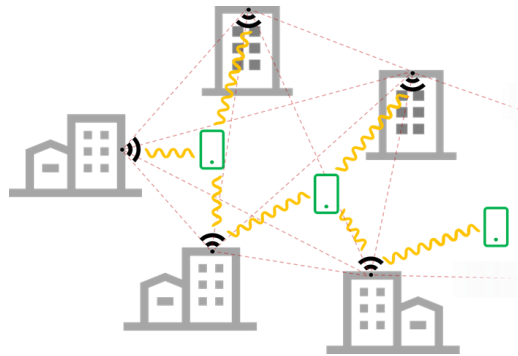
AI-based receiver

AI may replace the entire transceiver chain

Air interface

- Learn air interface functionality instead of using hand-crafted models

- Embrace non-linearities and limitations- and adapt dynamically

- Optimize parameters and automate configuration

New Network Topologies

NTN

Terrestrial Network
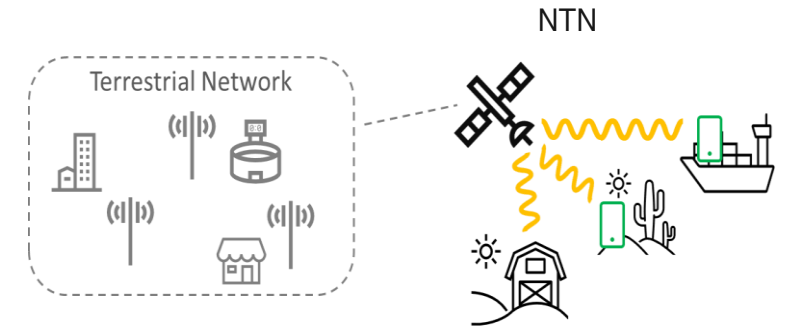
Multi-point connectivity

- Number of tightly coordinated NW nodes, D-MIMO
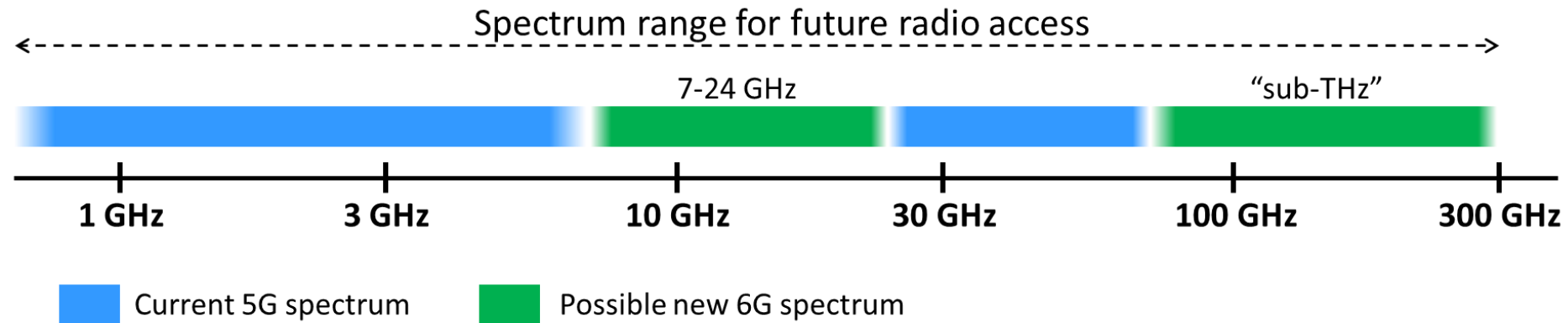
- Simultaneous connectivity to multiple nodes

Multi-hop connectivity

- Integrated Access and Backhaul like relaying, mobile relay nodes, air-borne nodes

- Lower-cost dense deployments, and temporary deployments

Satellite component

- Global coverage and enhanced availability

- Both cellular and satellite-specific bands

Radio Spectrum

Spectrum range for future radio access

7-24 GHz

"sub-THz"

1 GHz   3 GHz   10 GHz   30 GHz   100 GHz   300 GHz

■ Current 5G spectrum   ■ Possible new 6G spectrum
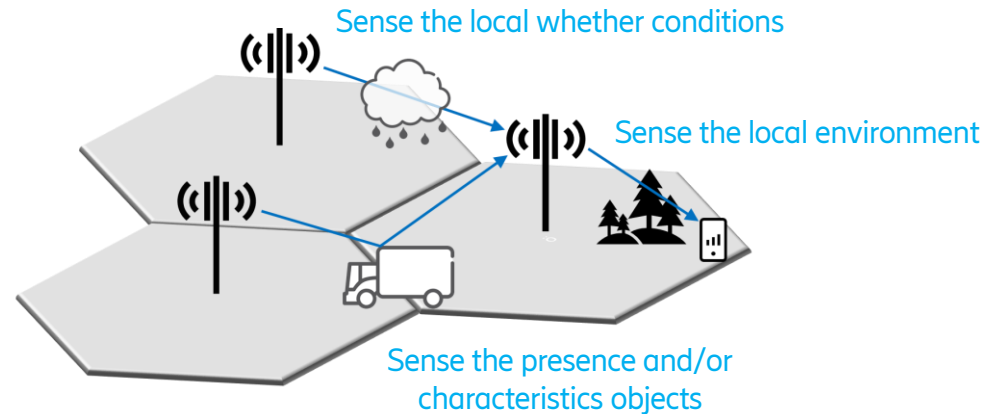
Future 6G radio access - from sub-GHz to beyond 100 GHz

- Capacity expansion in sweet spot 7-24 GHz
- Lower frequencies needed for wide-area coverage of future 6G services
- Very high frequencies for extreme data rates in specific scenarios
- Co-existence with legacy technology like 4G LTE, 5G NR for smooth migration to 6G

Network Sensing

Sense the local whether conditions

Sense the local environment

Sense the presence and/or characteristics objects
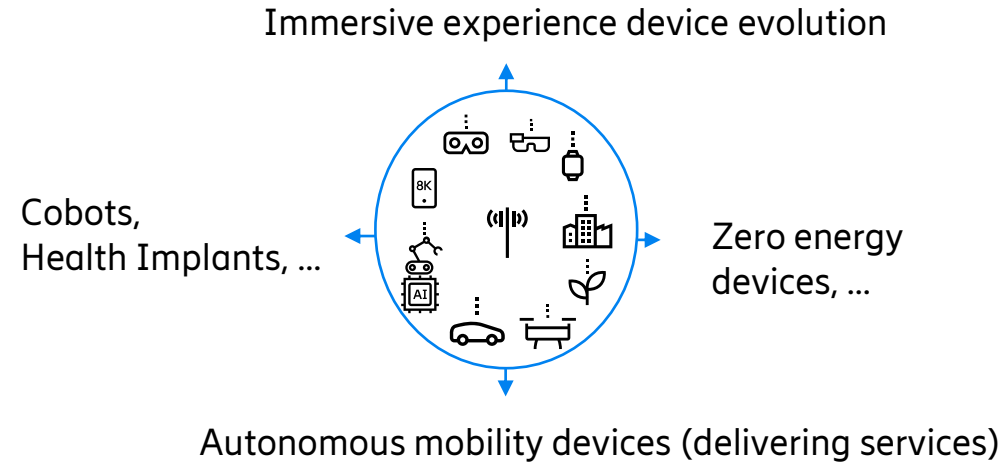
Sensing as part of the network

- Reuse the communication spectrum and infra-structure for sensing

- Low-cost introduction of sensing functionality

- Benefit from huge number of co-operative network nodes

Sensory information

- Externally to enable new and enhanced services

- Internally to enhance and protect the network

- Sensing functionality for immersive experience

Embedded devices everywhere

Immersive experience device evolution

Cobots,
Health Implants, …

Zero energy
devices, …

Autonomous mobility devices (delivering services)

Enabling connectivity everywhere

- Legacy devices (smartphone, NB-IoT sensors, …).
- Emerging devices (VR glasses, zero-energy devices, health implants, …).
- Offer rich sensory experiences by a cluster of collaborative devices with varied ownership.

Immersive interactive devices

- Enable natural and intuitive interaction with digital and mixed digital-physical world.
- Network provides authentication, resource management, edge compute etc. in addition to setting up the application aware device clusters.

"Zero-energy" devices

Devices harvesting ambient energy

- From solar, temperature, vibrations, RF, …

- "No need to change battery"

- Enabling sustainable asset trackers, sensors for mass deployment, …
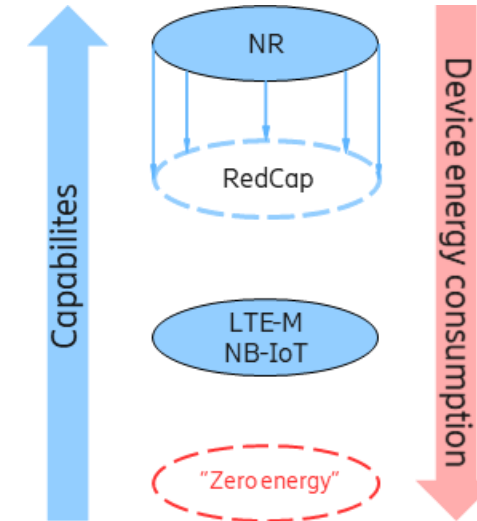
Design challenges

- Very small amounts of energy available, complete redesign of the air interface needed

- PHY: Waveform suitable for Rx/Tx device imperfections, crystal oscillators likely not feasible

- Mobility: Current mobility mechanisms cannot be afforded from an energy perspective

- Security: Power-efficient security mechanisms

Network compute fabric

Dependable compute & storage

- High availability & capacity

- Respond in real-time

- Defined levels of reliability, availability, and resiliency

- Run in an energy-efficient manner

Unified, fluid computing across the fabric

- Seamless & dynamic deployment of applications (on central cloud, edge, devices)

- Balance compute & energy use and performance & cost

- Let workloads follow mobile users

- Allow processing close to data sources and data consumers

Ubiquitous compute resources fully integrated with the network to complement connectivity

Enabling broad collaboration in federated ecosystems

Devices

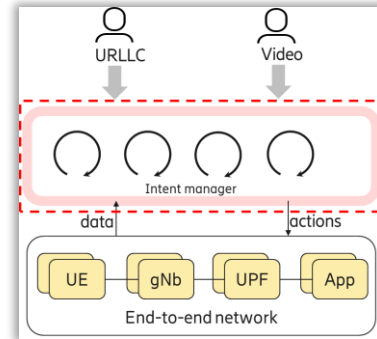Network Compute Fabric

Public Clouds
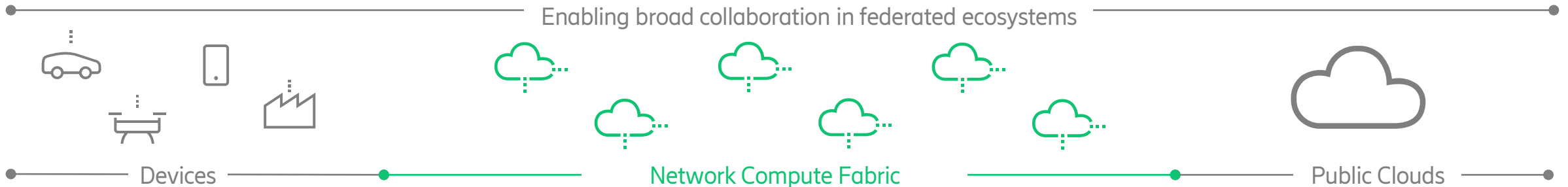
Cognitive Networks

Intent-based management

- Declarative intents to specify requirements and constraints

- Learning agents to execute network assurance & control.

## Distributed intelligence

- Smart algorithms guide all network operations

- Distributed & centralized AI to optimize performance.

Data-driven architecture

- Make data accessible for applications.

- Use data to optimize performance and automate operations.

Continuous learning

- Continuously monitor network performance
- Shift from reactive to predictive management

→ autonomous operations
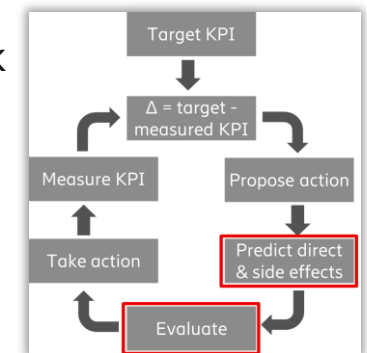
Trustworthy Systems

Security assurance

- Enhanced assurance for the whole product lifecycle

- ML/AI capabilities for threat detection and response

Secure identities & protocols

- Root of trust-based identities

- Privacy-preserving protocol stacks

- Confidential Computing for network slices

Service availability

- Efficient and robust resource provisioning for critical services

- Observability of network parameters exposure for E2E availability
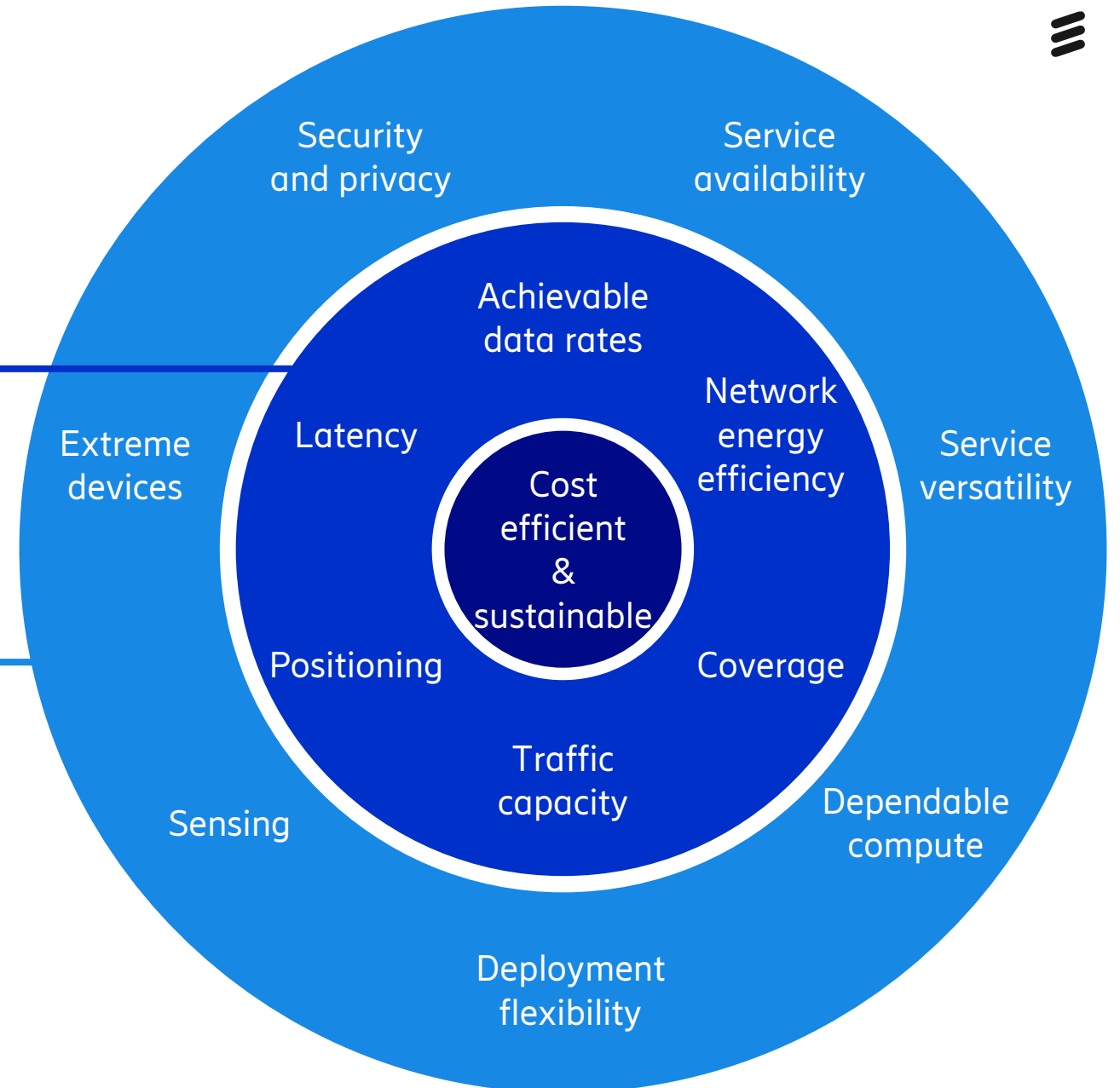
Capabilities

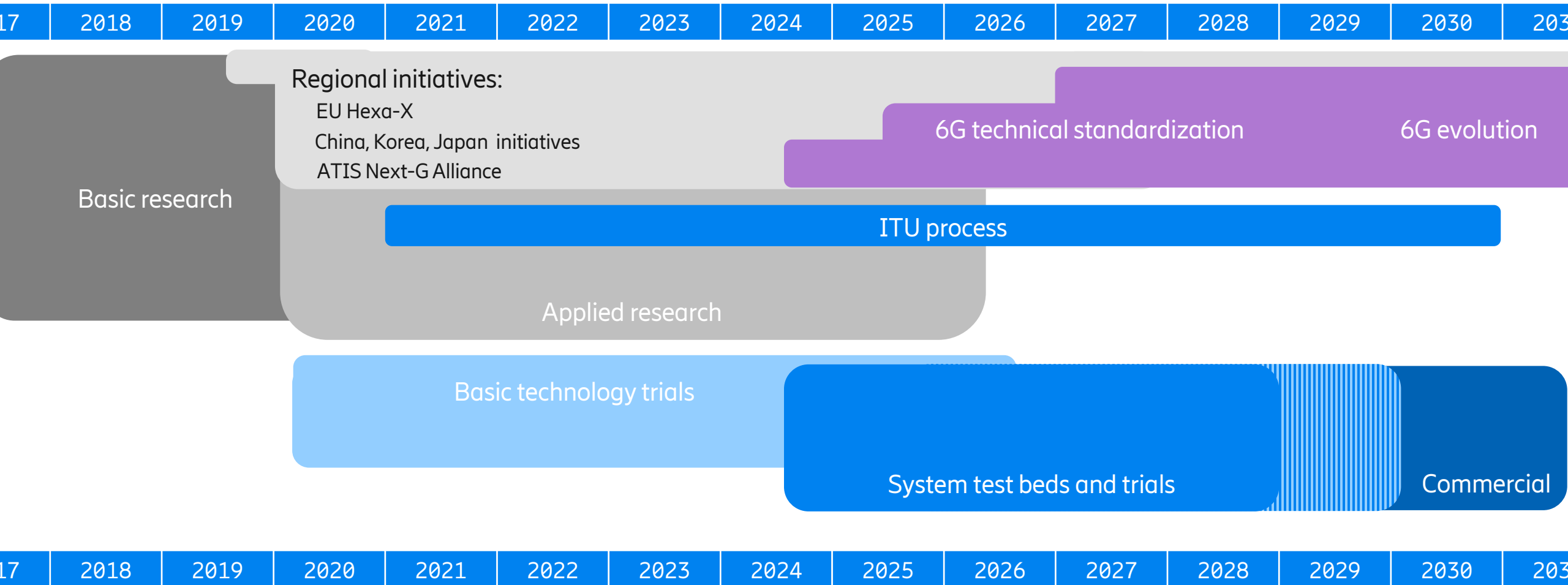"Classical" capabilities still important

New capabilities for emerging use cases

Cost efficient and sustainable

Security and privacy

Service availability

Achievable data rates

Network energy efficiency

Service versatility

Extreme devices

Latency

Cost efficient & sustainable

Positioning

Coverage

Traffic capacity

Sensing

Dependable compute

Deployment flexibility

6G industry timeline

17	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	203

Regional initiatives:
- EU Hexa-X
- China, Korea, Japan initiatives
- ATIS Next-G Alliance

Basic research

6G technical standardization

6G evolution

ITU process

Applied research

Basic technology trials

System test beds and trials

Commercial

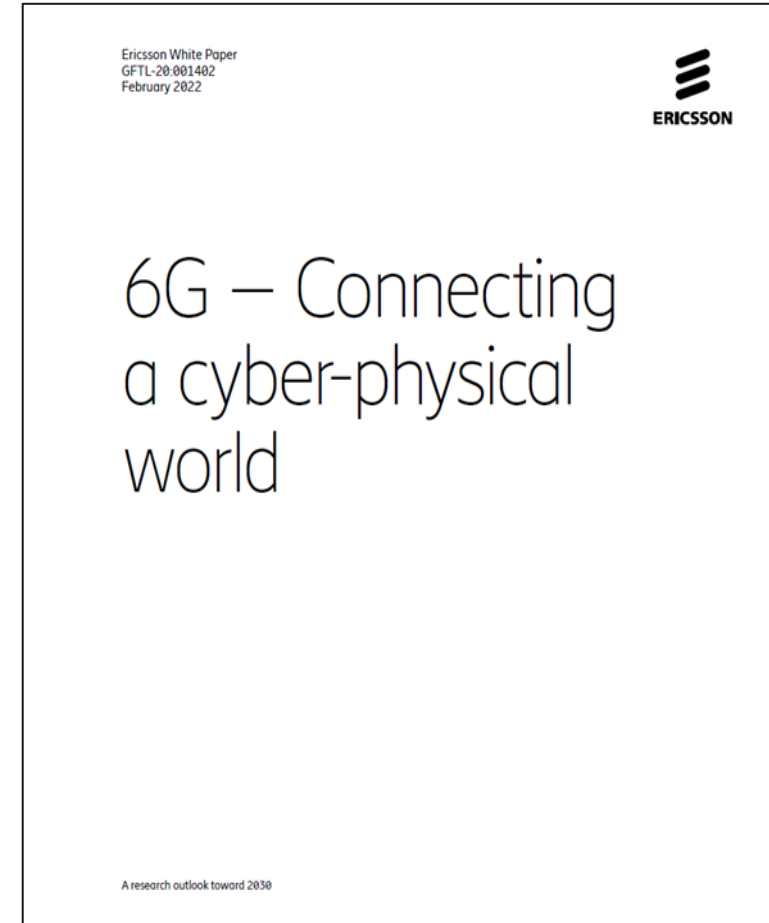| 17	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	203

Connecting a cyber-physical world

6G white paper

Released in February 2022

Presents Ericsson's 6G vision for 2030 - a broad view covering our ongoing explorative research
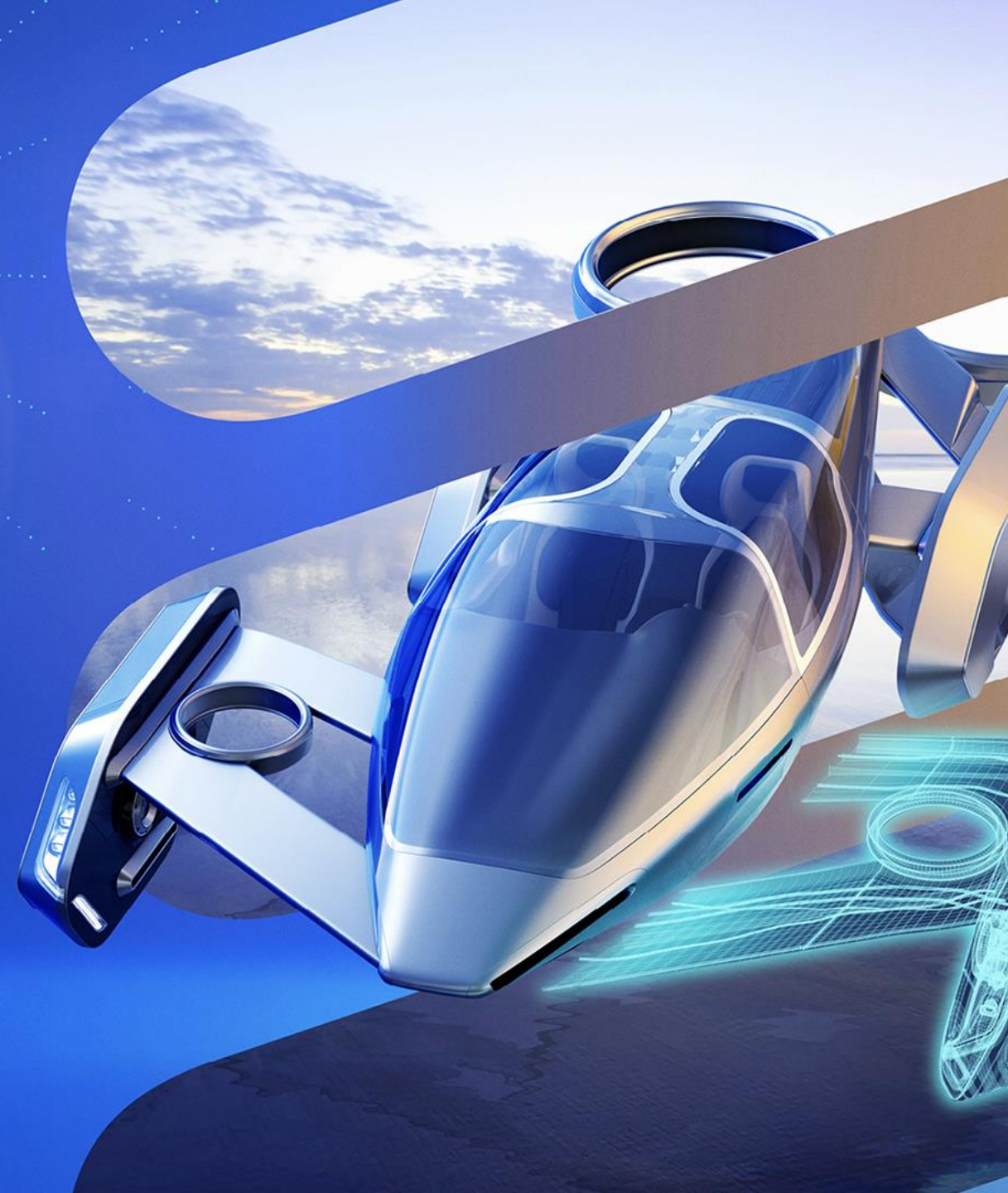
https://www.ericsson.com/en/reports-and-papers/white-papers/a-research-outlook-towards-6g

Ericsson White Paper
GFTL-20:001402
February 2022

ERICSSON

6G – Connecting
a cyber-physical
world

A research outlook toward 2030

6G Network Platform

A trusted platform delivering ever-present intelligent communication including connectivity, data, and compute.

Imagine Possible

https://www.ericsson.com/en/6g