WWRF 46

European 6G Flagship Project Hexa-X

hexa-x.eu

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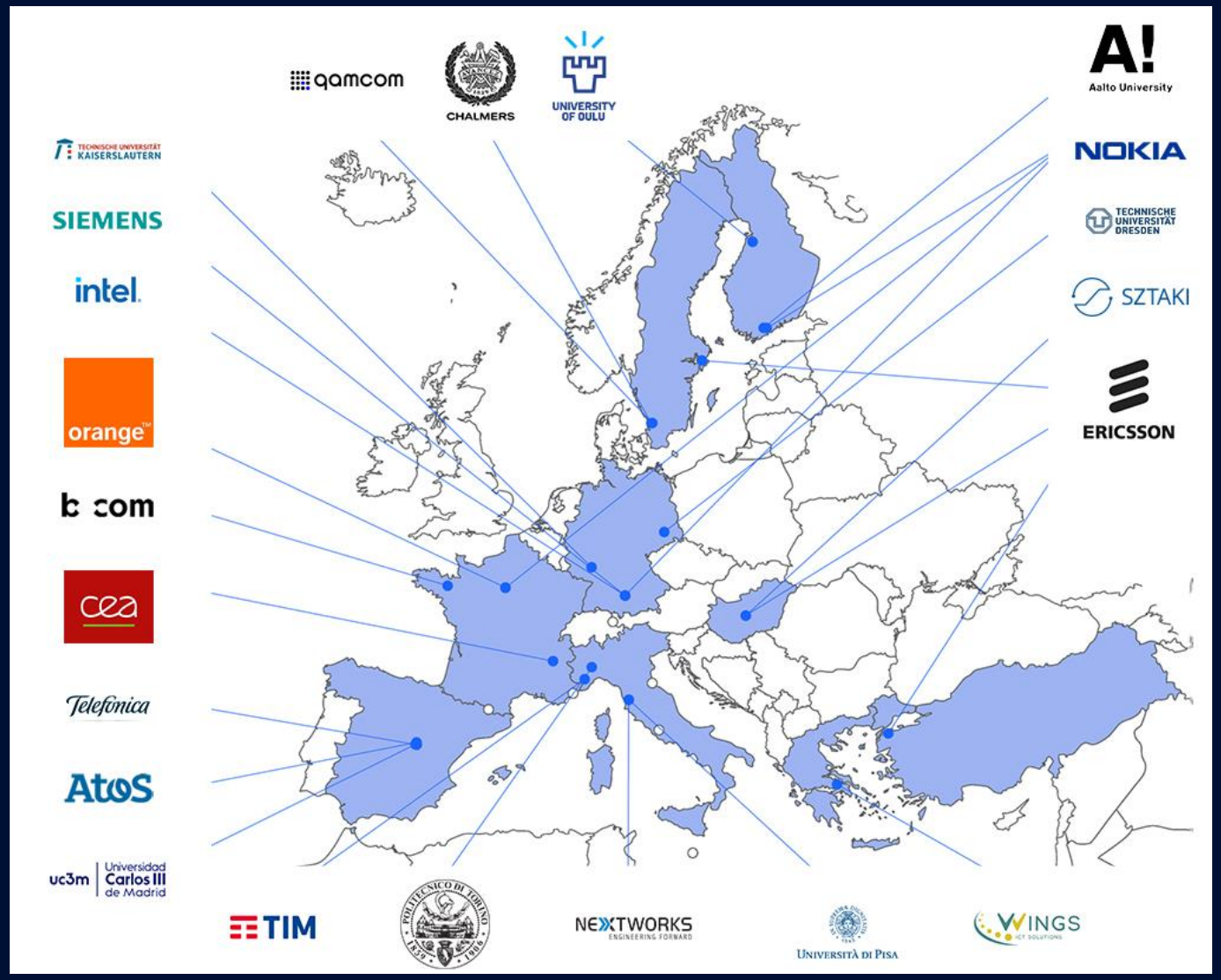
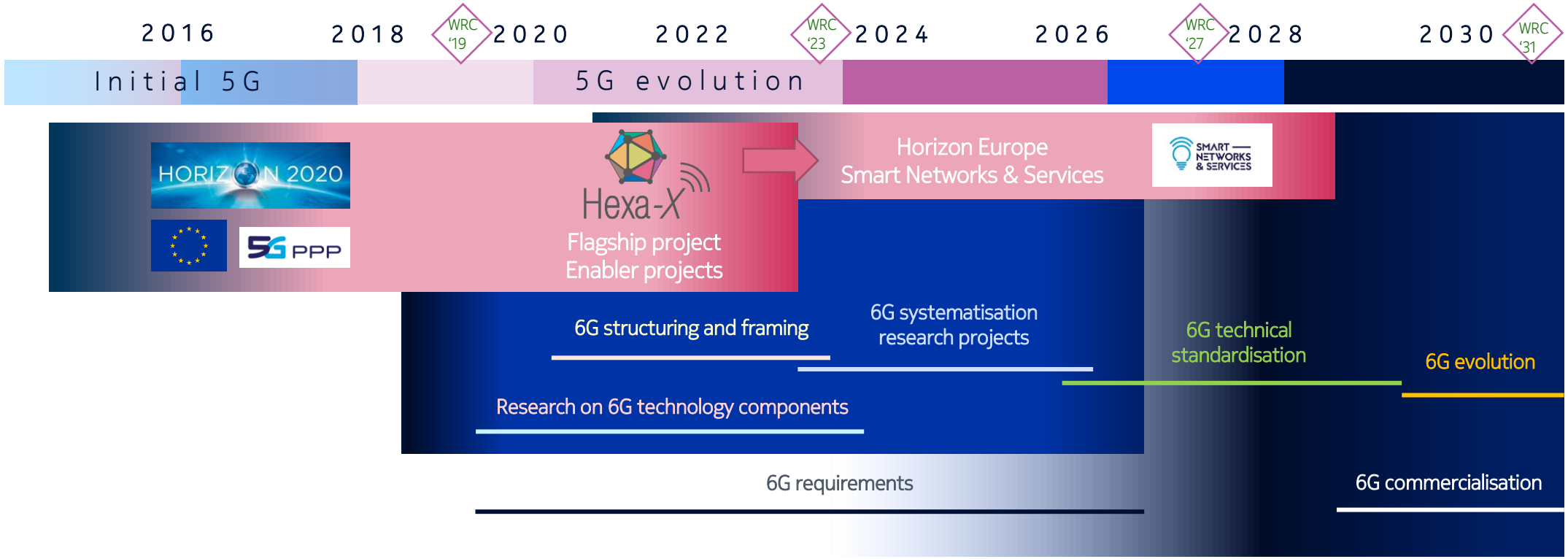
Hexa-X overview

- 2.5 y project started Jan 2021
- Funded through EU H2020 ICT-52
- 25 partners
  - NW vendors
  - Operators
  - Industry
  - Academia
  - SMEs
- Nokia is overall leader
- Ericsson is technical manager



Timeline


2016
2018
WRC '19
2020
2022
WRC '23
2024
2026
WRC '27
2028
2030
WRC '31
Initial 5G
5G evolution
HORIZON 2020
5G PPP
Hexa-X
Flagship project
Enabler projects
Horizon Europe
Smart Networks & Services
SMART NETWORKS & SERVICES
6G structuring and framing
6G systematisation research projects
6G technical standardisation
6G evolution
Research on 6G technology components
6G requirements
6G commercialisation

6G Ecosystem

Hexa-X

North America

NEXT G ALLIANCE

NSF RINGS

Europe

EU

Hexa-X

SMART NETWORKS & SERVICES

FI

6Genesis

DE

BMBF

6G Hubs

Asia

CN

MIIT

中华人民共和国科学技术部

未来移动通信论坛 FUTURE MOBILE COMMUNICATION FORUM

KR

Ministry of Science and ICT

5G Forum

JP

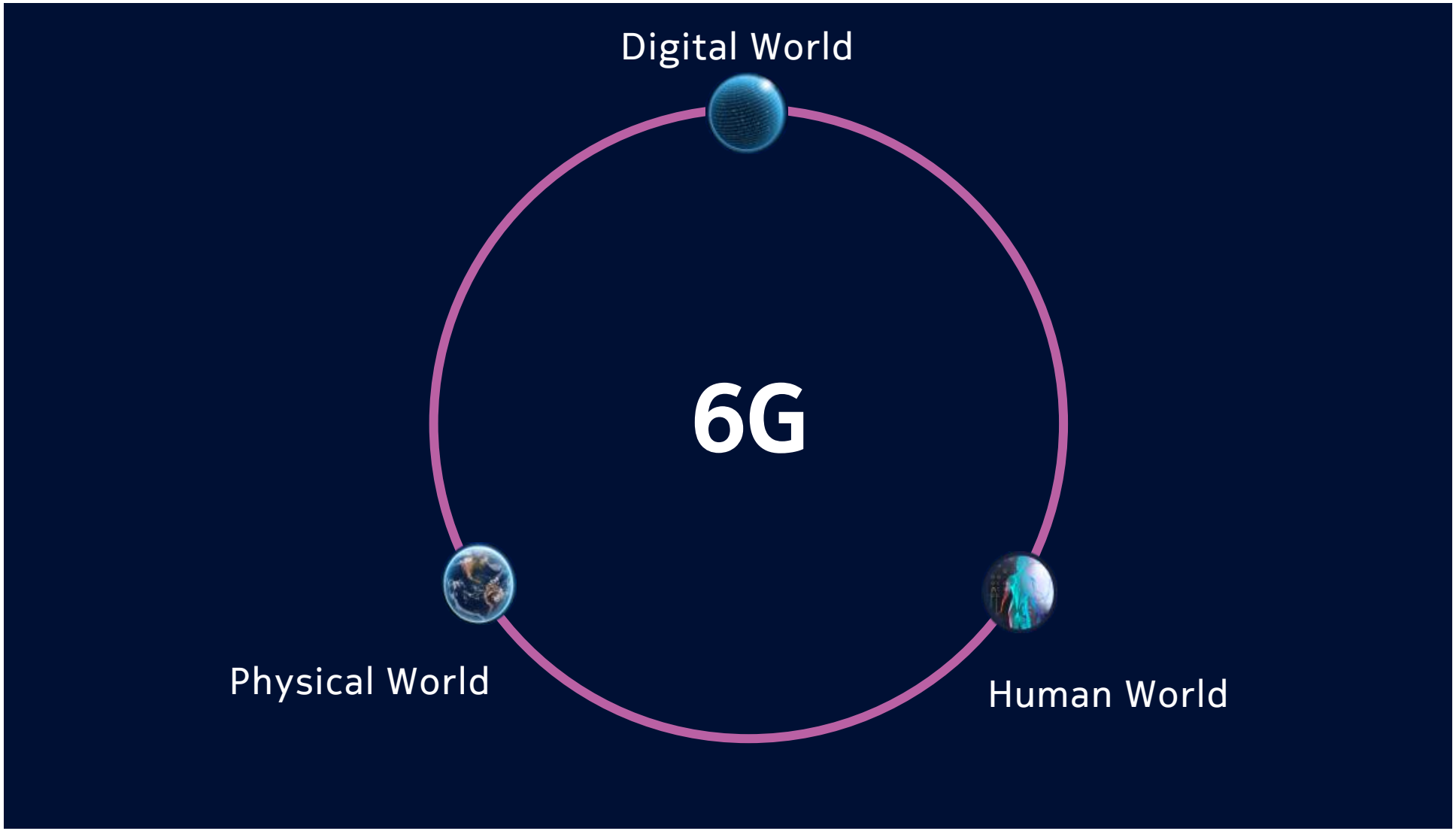
MIC Ministry of Internal Affairs and Communications

IOWN GLOBAL FORUM

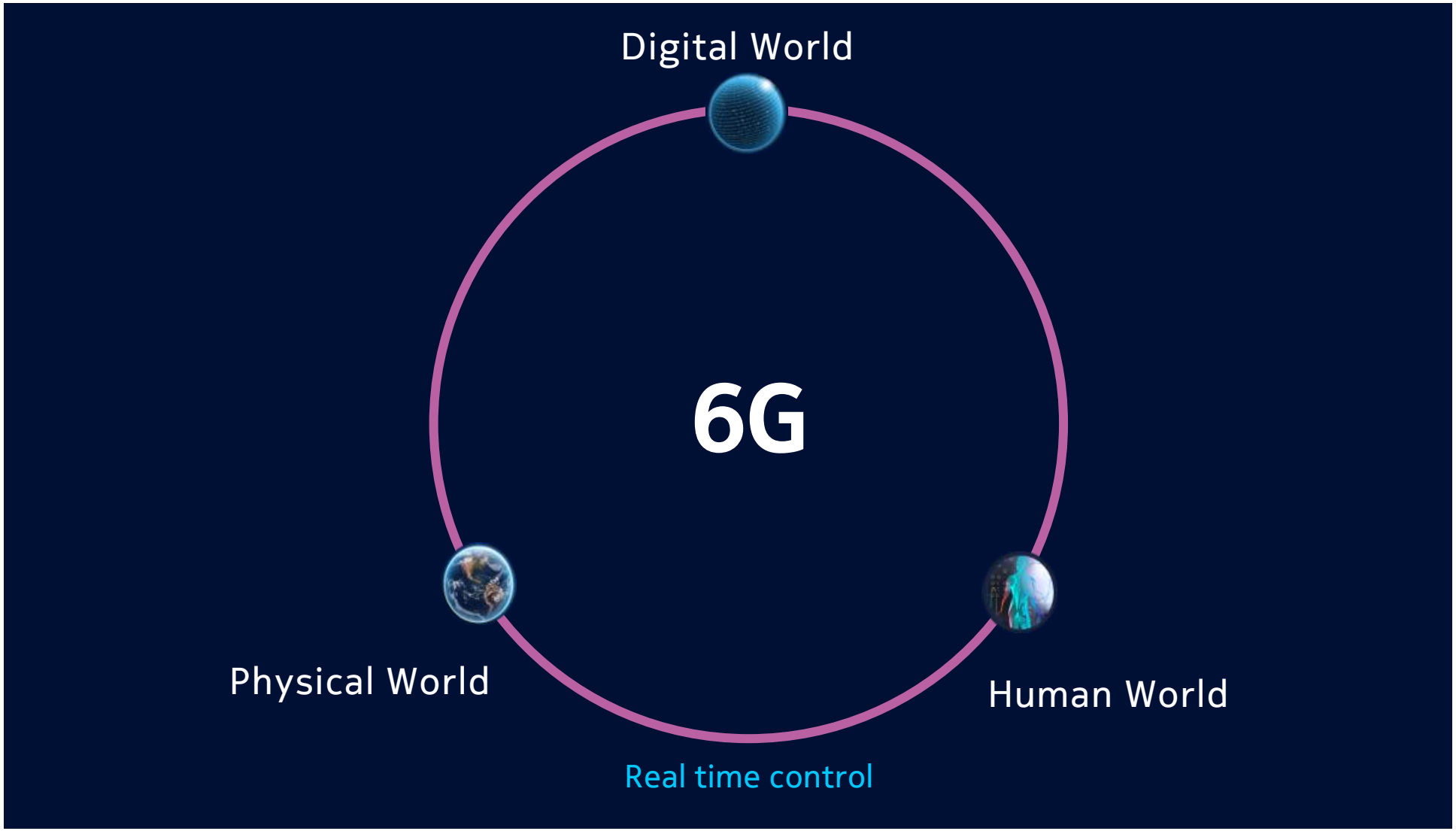
IN

tsdsi

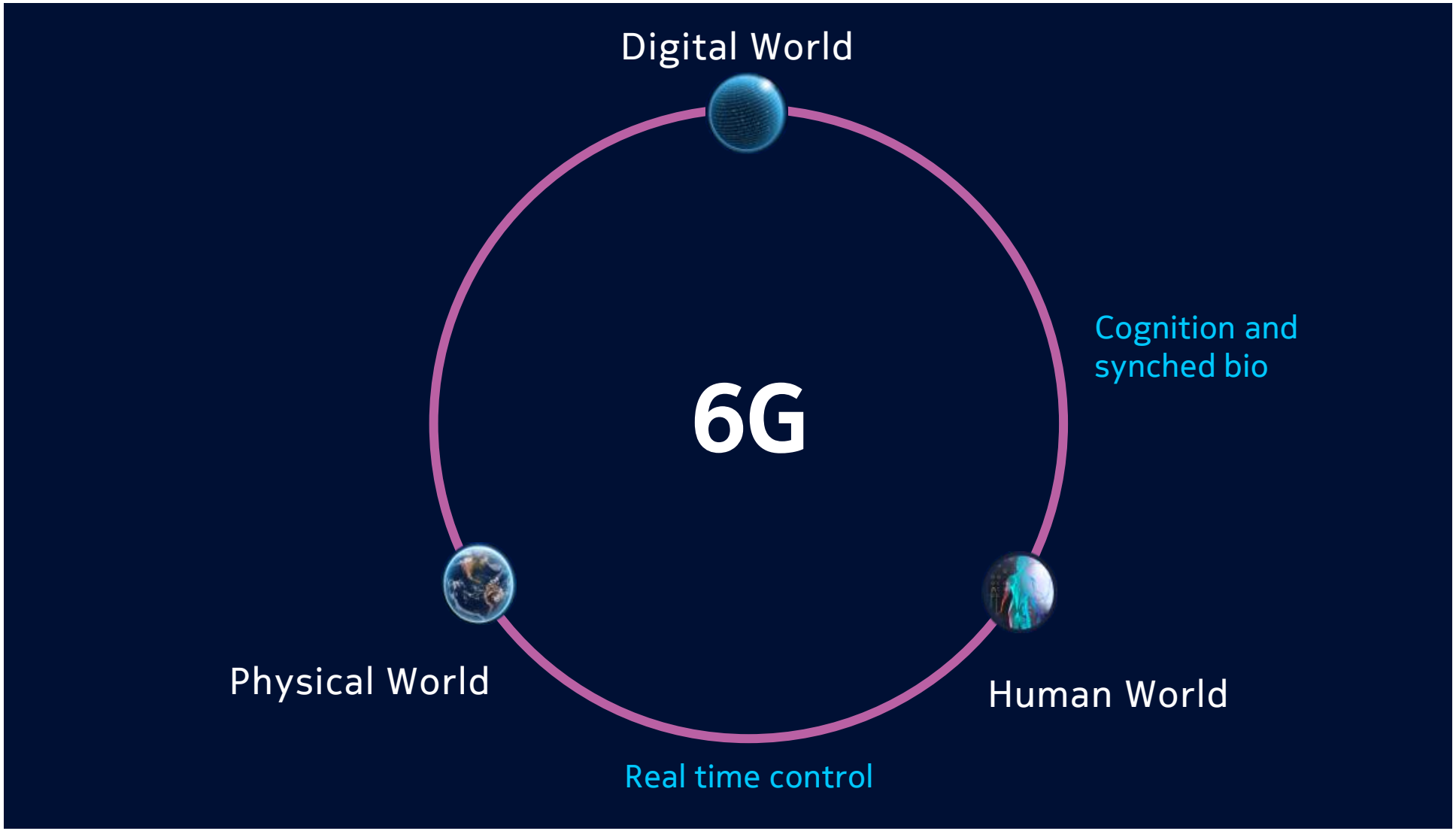
Hexa-X Vision



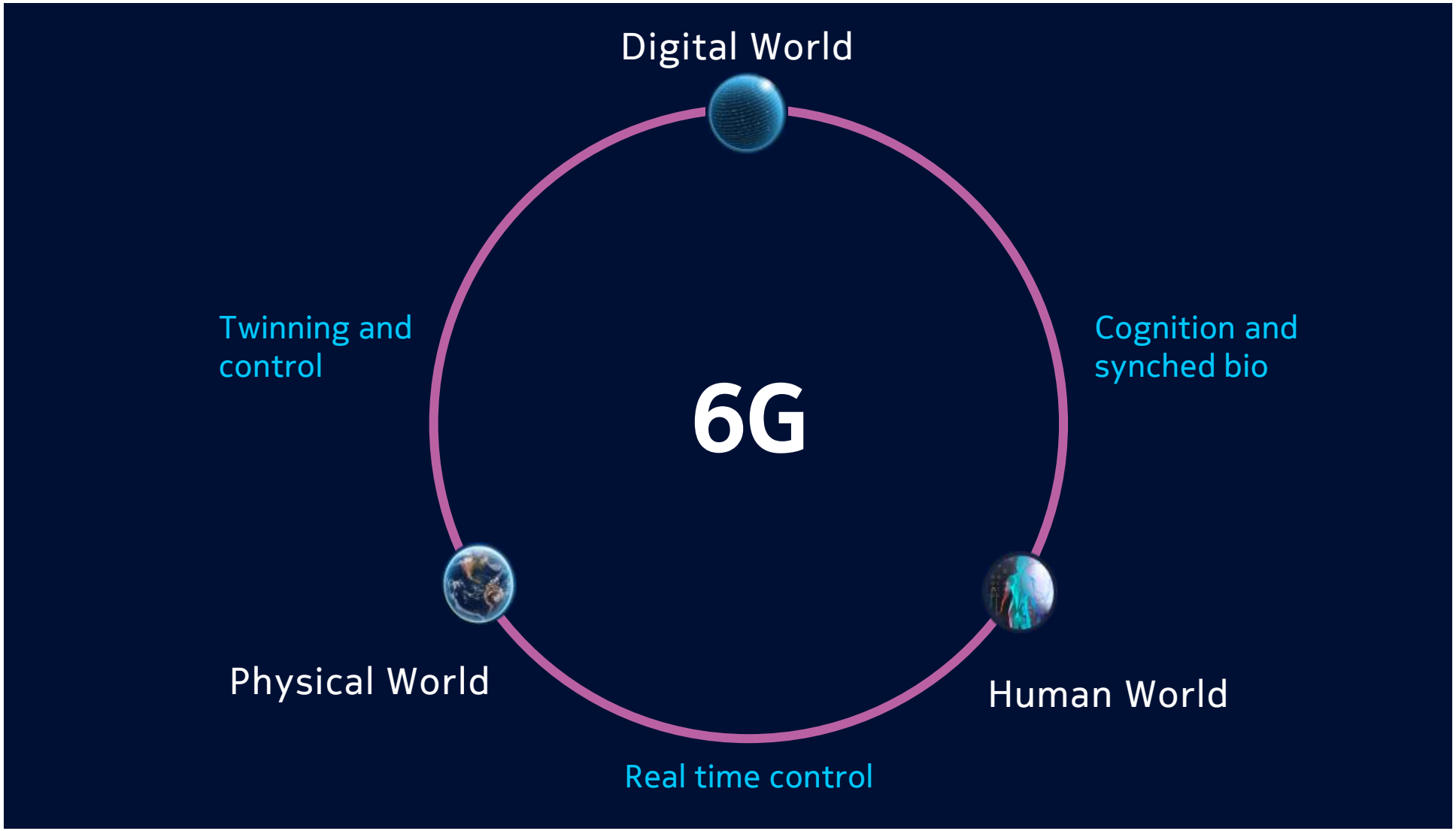
Hexa-X Vision



Hexa-X Vision

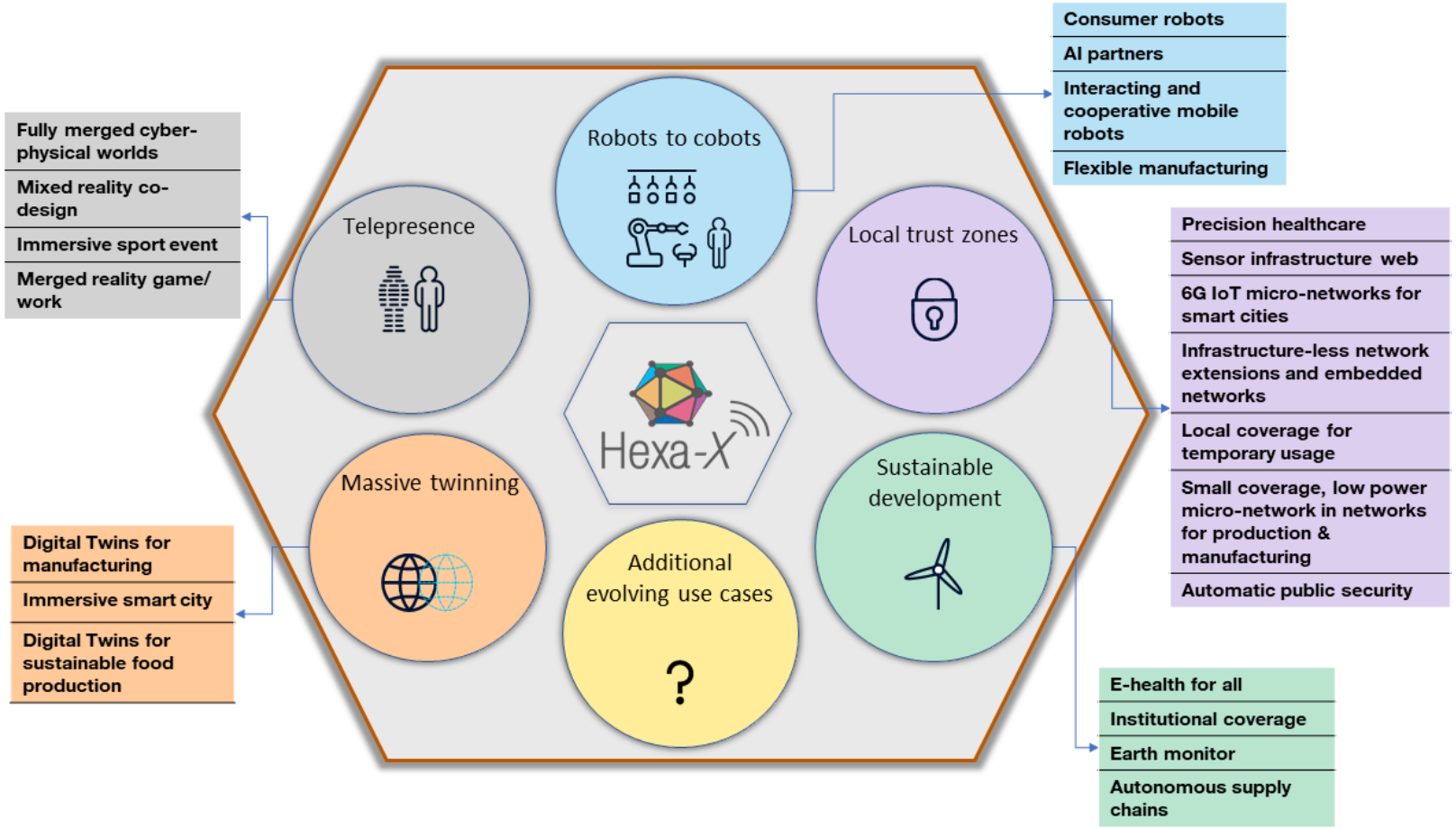


Hexa-X Vision



Use Cases & Services

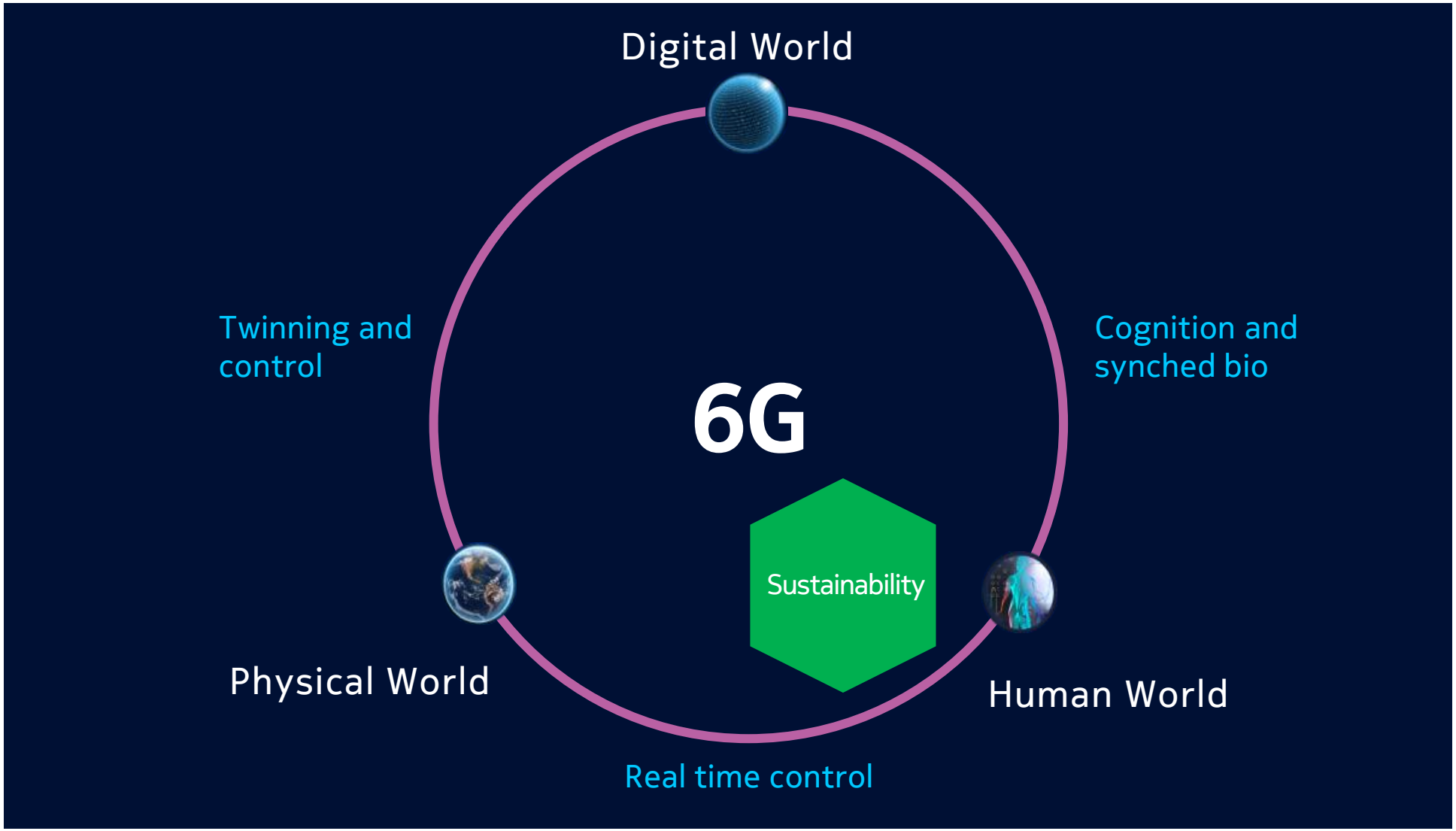
23 use cases, clustered in to 5 families



In addition to the use cases, 7 enabling services harnessing new capabilities have been identified:

- Compute-as-a-Service (CaaS) for resource-constrained devices
- AI-as-a-Service (AIaaS)
- AI-assisted Vehicle-to-Everything (V2X)
- Flexible device type change
- Energy-optimised services
- Internet-of-Tags
- Security as a service for other networks

Hexa-X Vision



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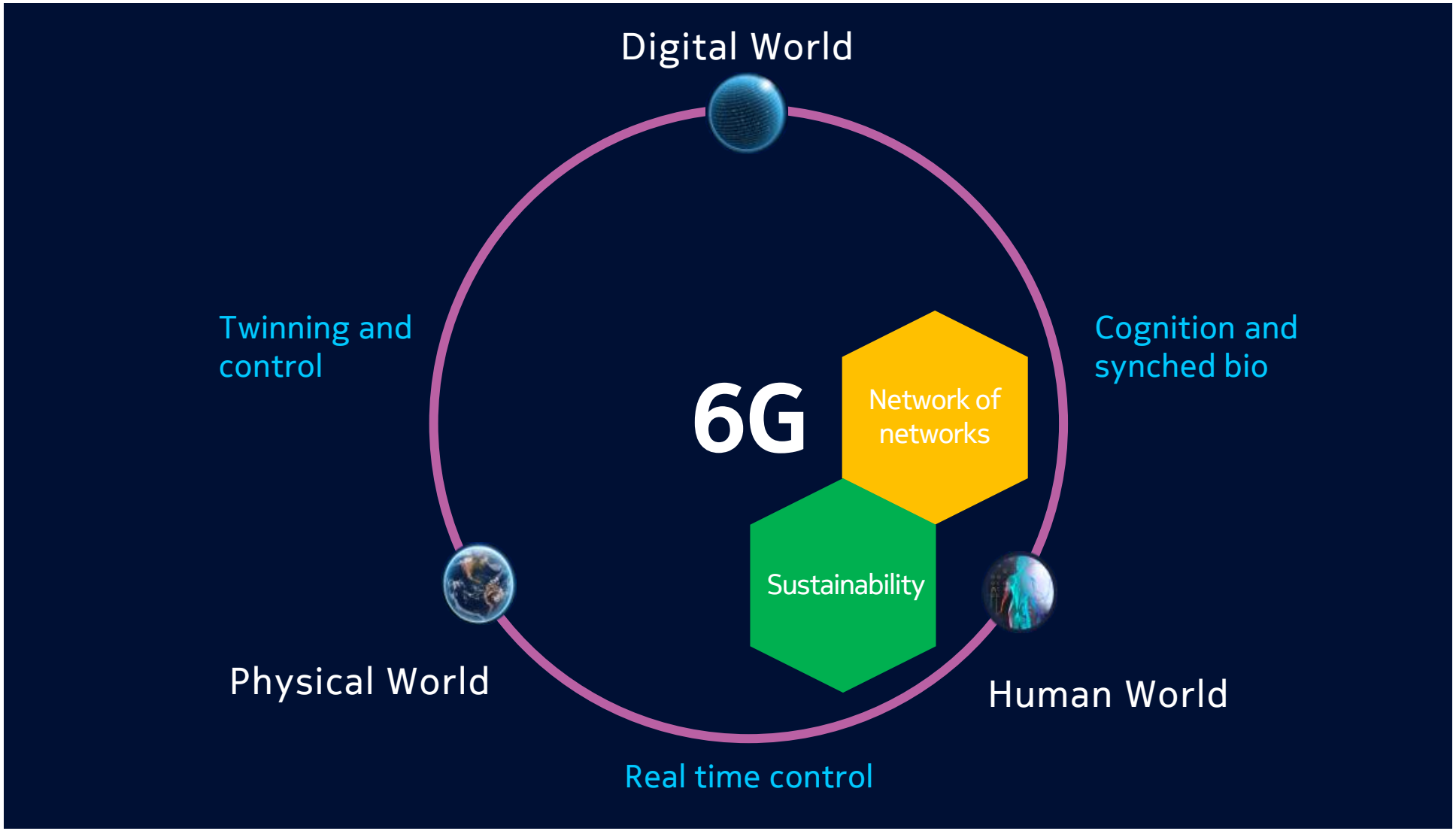

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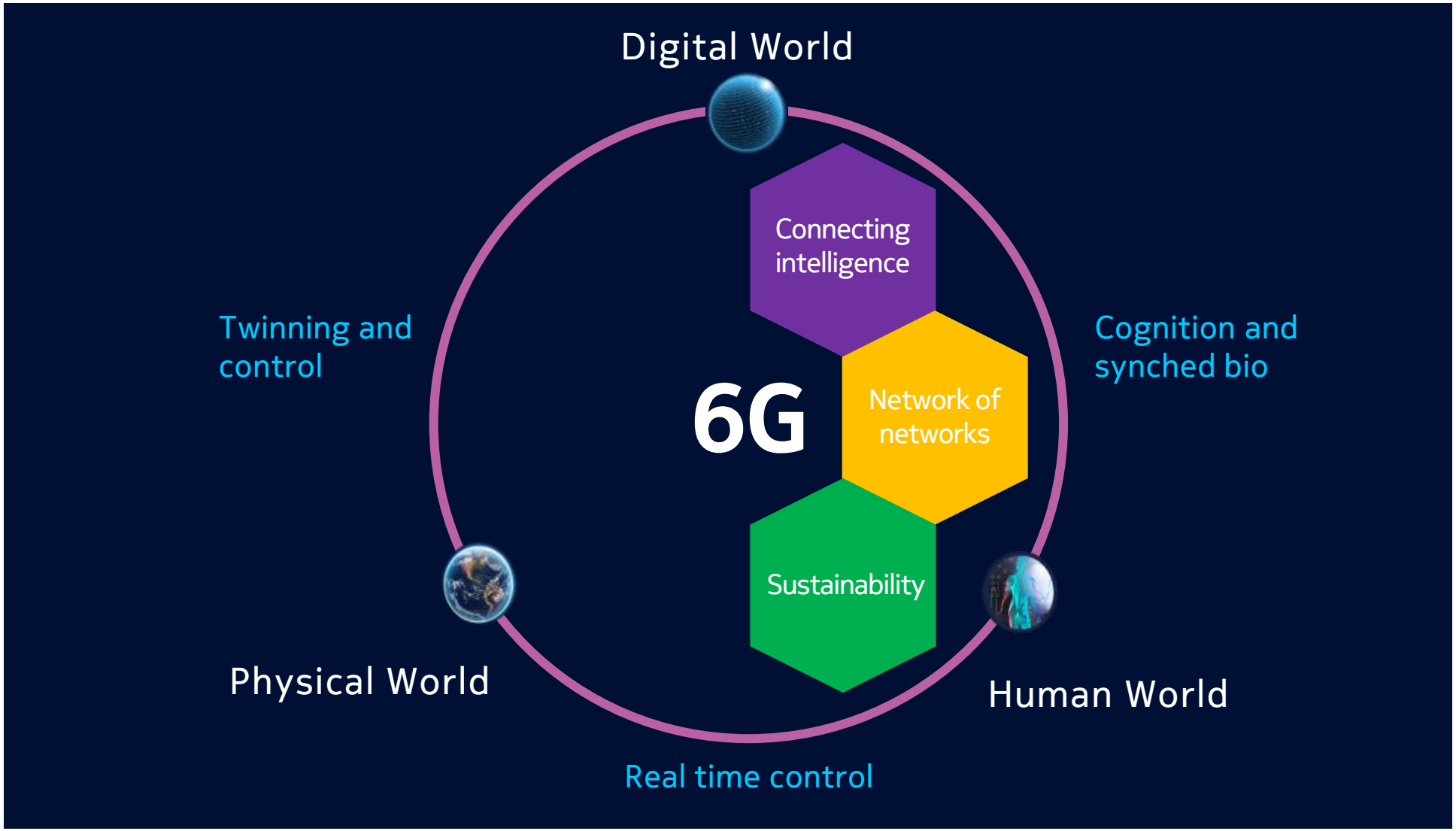

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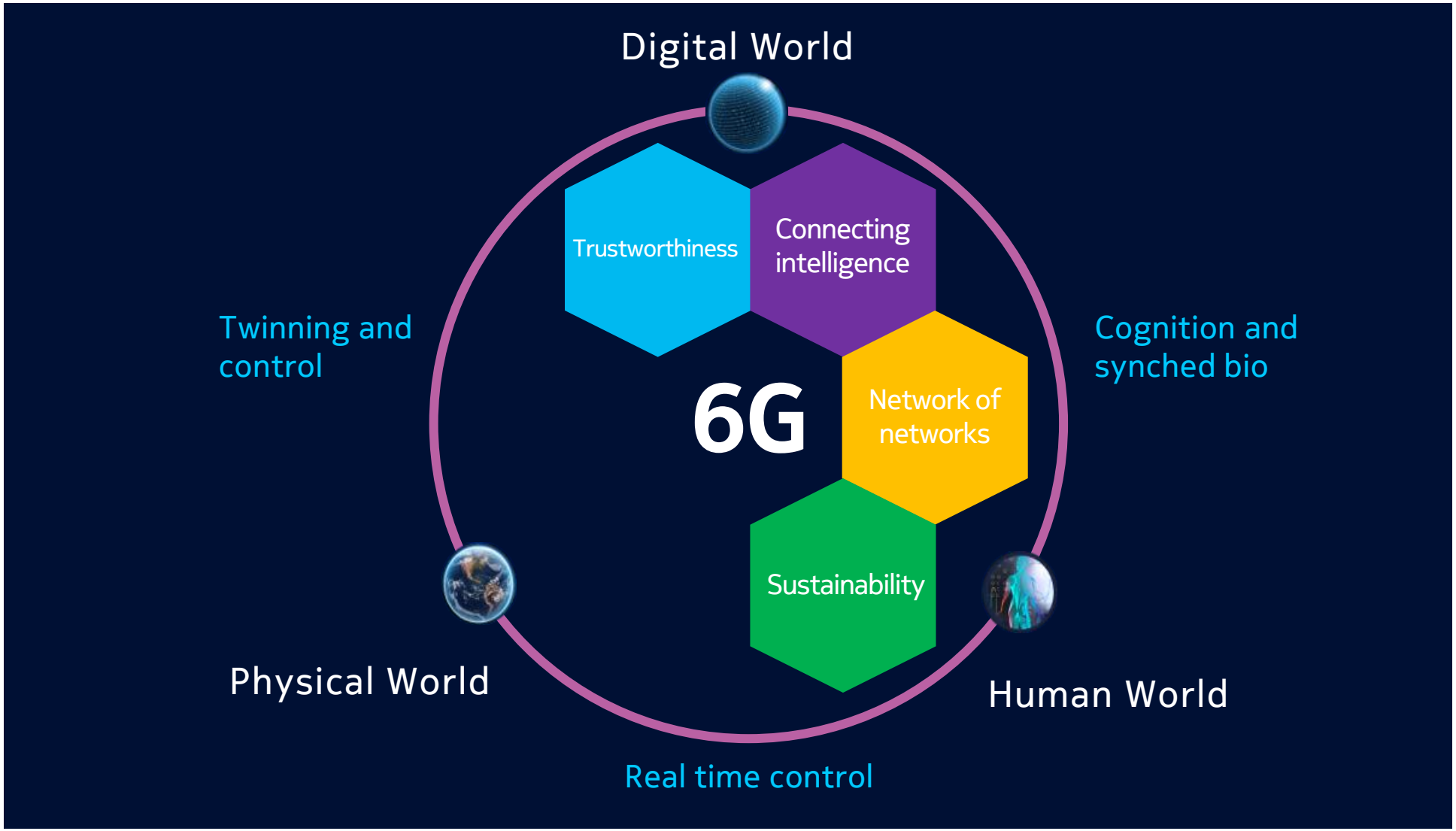

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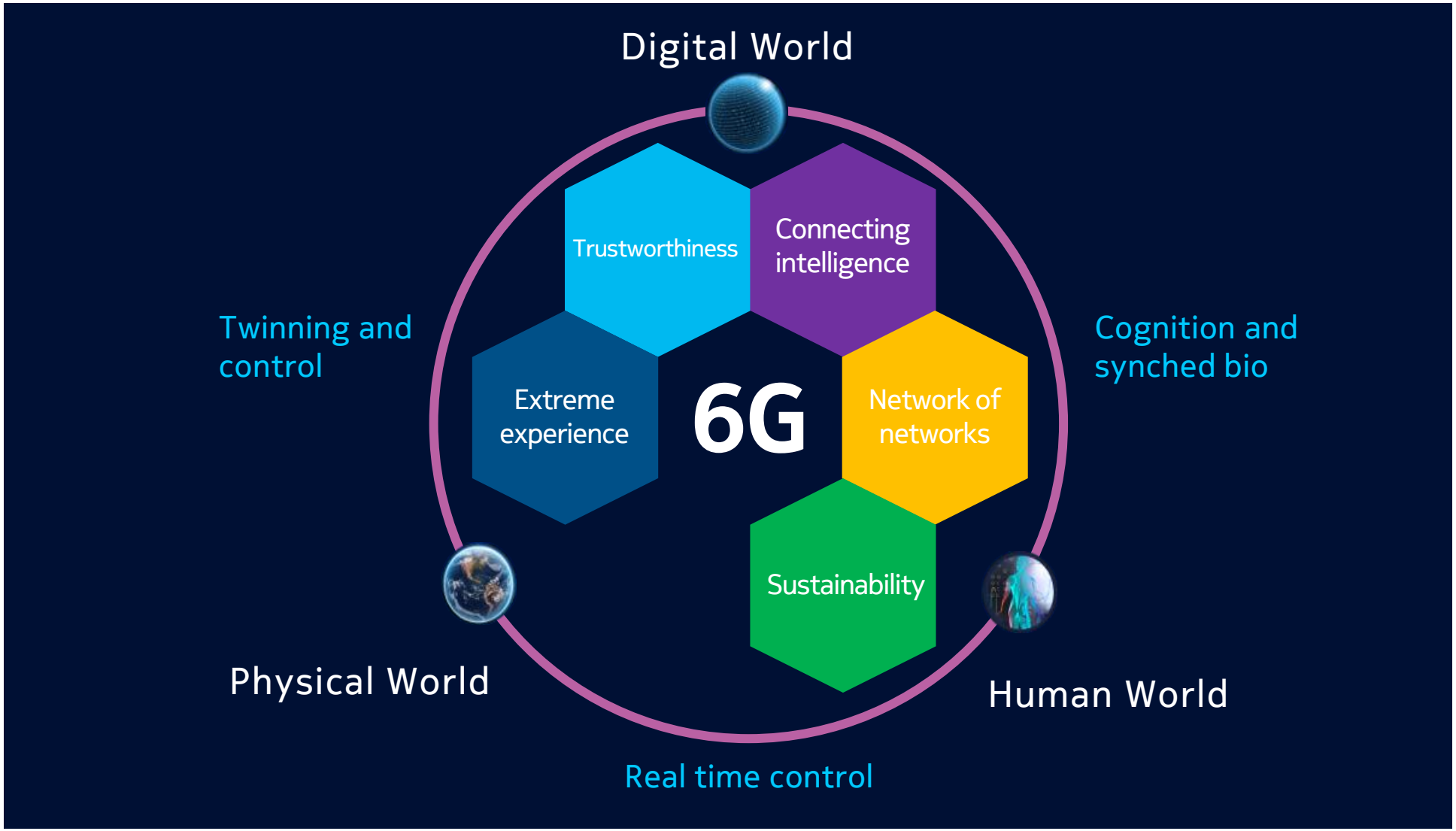
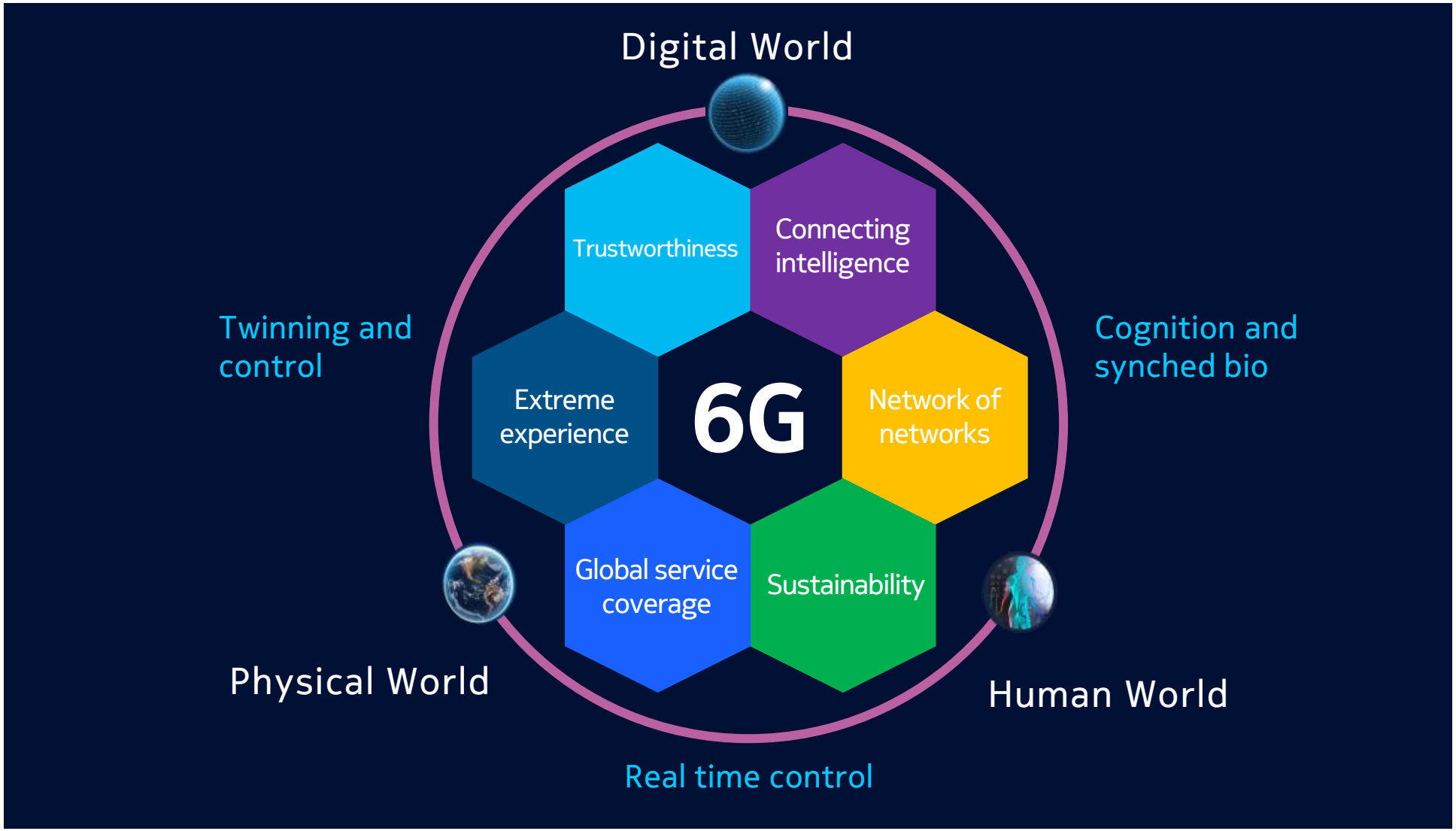
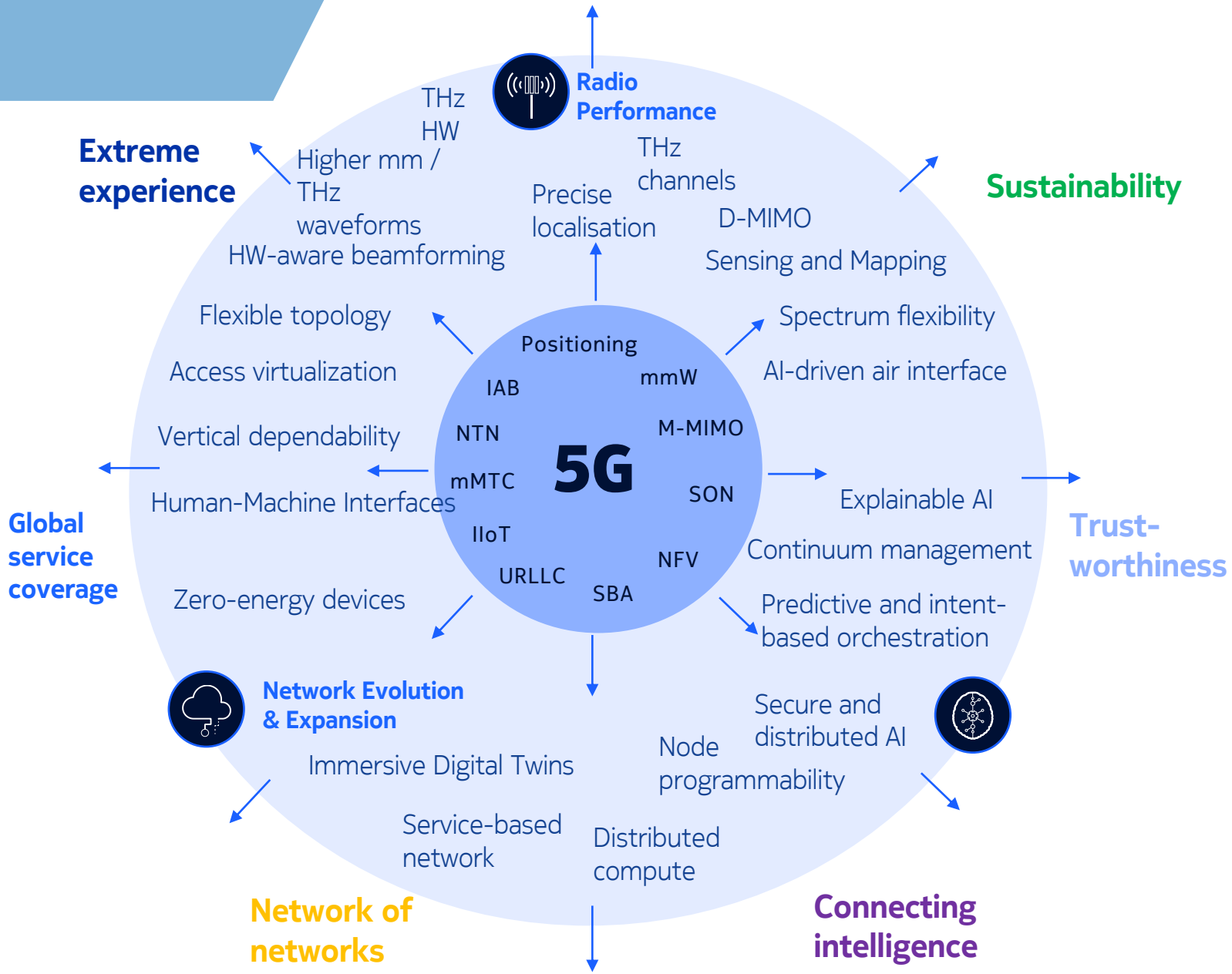


Hexa-X Vision

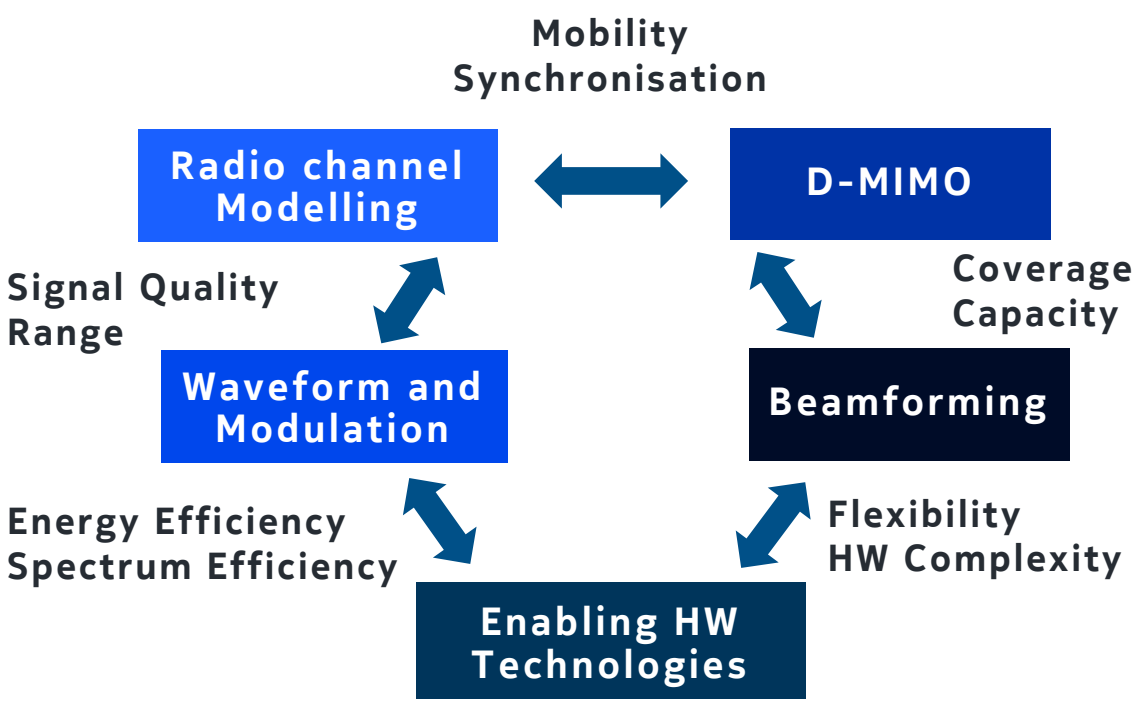


Ambitions

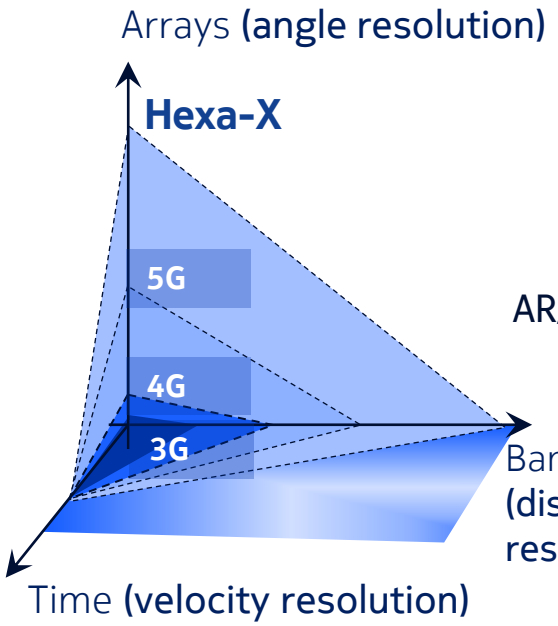

Radio Performance
THz channels
D-MIMO
Sensing and Mapping
Precise localisation
Sustainability
Spectrum flexibility
AI-driven air interface
Trust-worthiness
Explainable AI
Continuum management
Predictive and intent-based orchestration
Secure and distributed AI
Connecting intelligence
Node programmability
Distributed compute
Service-based network
Network of networks
Immersive Digital Twins
Network Evolution & Expansion
Zero-energy devices
Global service coverage
Human-Machine Interfaces
Vertical dependability
Access virtualization
Flexible topology
Extreme experience
Higher mm / THz waveforms
THz HW
HW-aware beamforming
5G
Positioning
mmW
M-MIMO
SON
NFV
SBA
URLLC
IIoT
mMTC
NTN
IAB

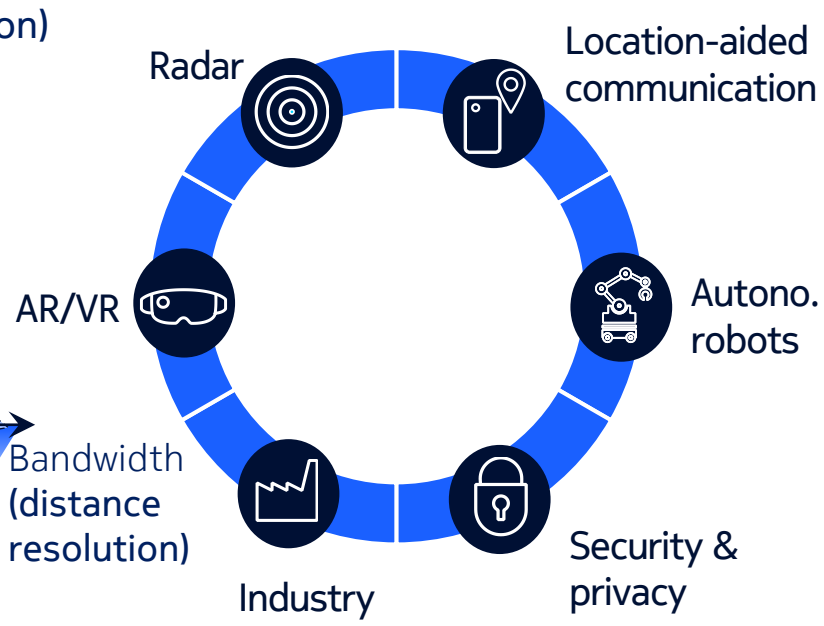
Radio performance towards 6G

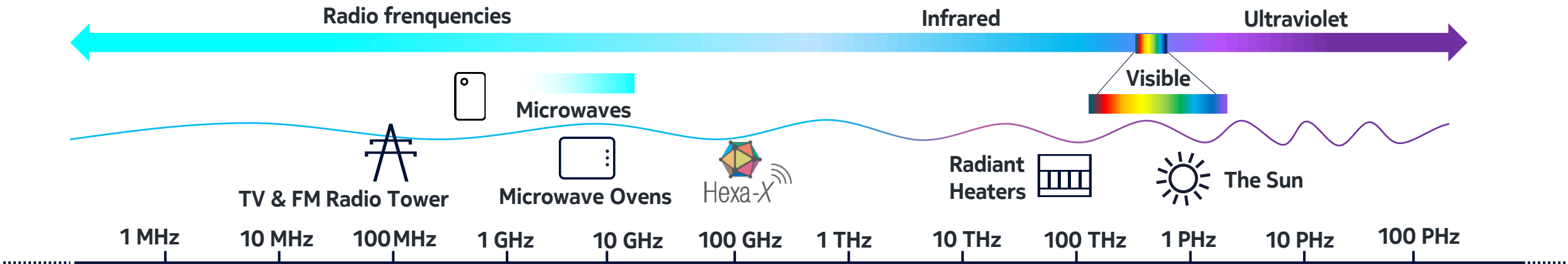
Towards Seemly Infinite Capacity and Data Rate



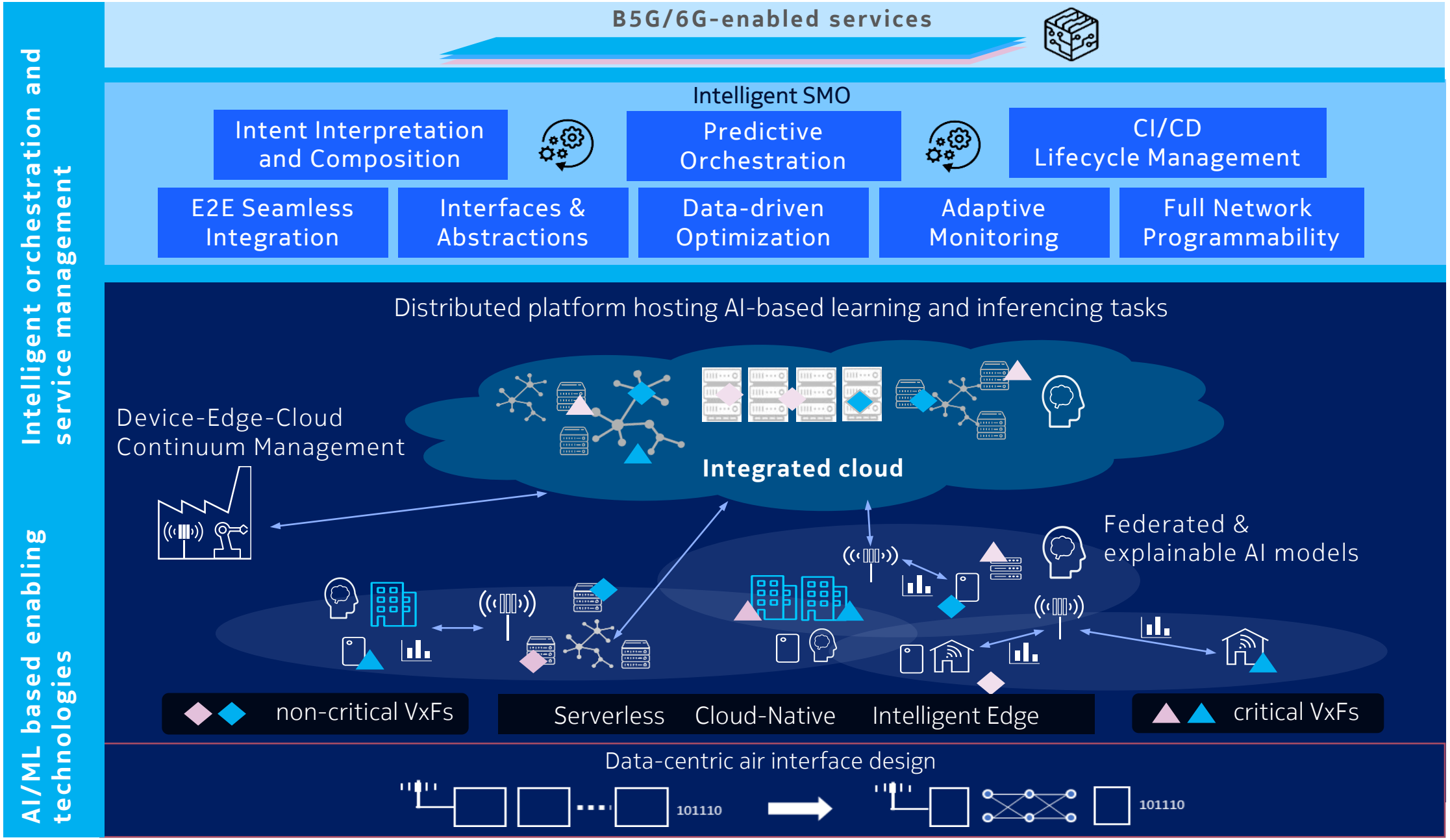
6D high-resolution localization and sensing



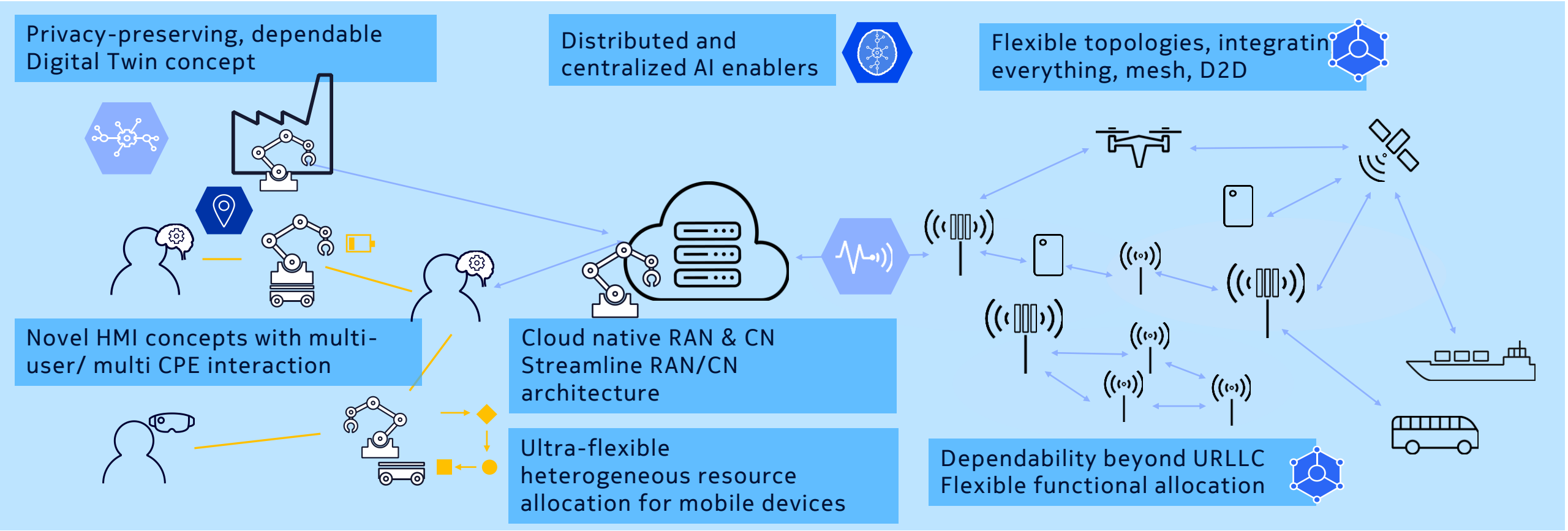




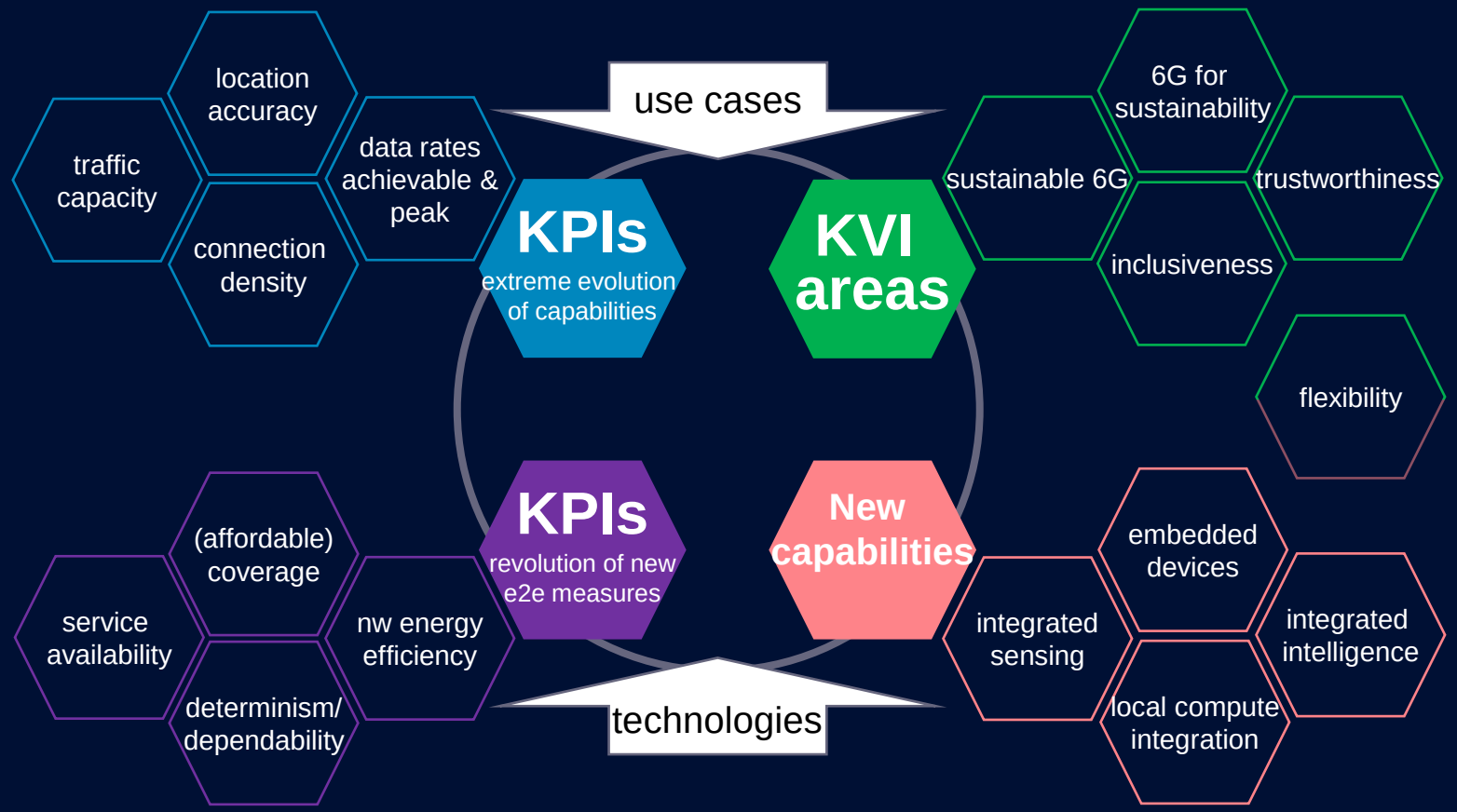
Connecting intelligence towards 6G



Network evolution and expansion towards 6G



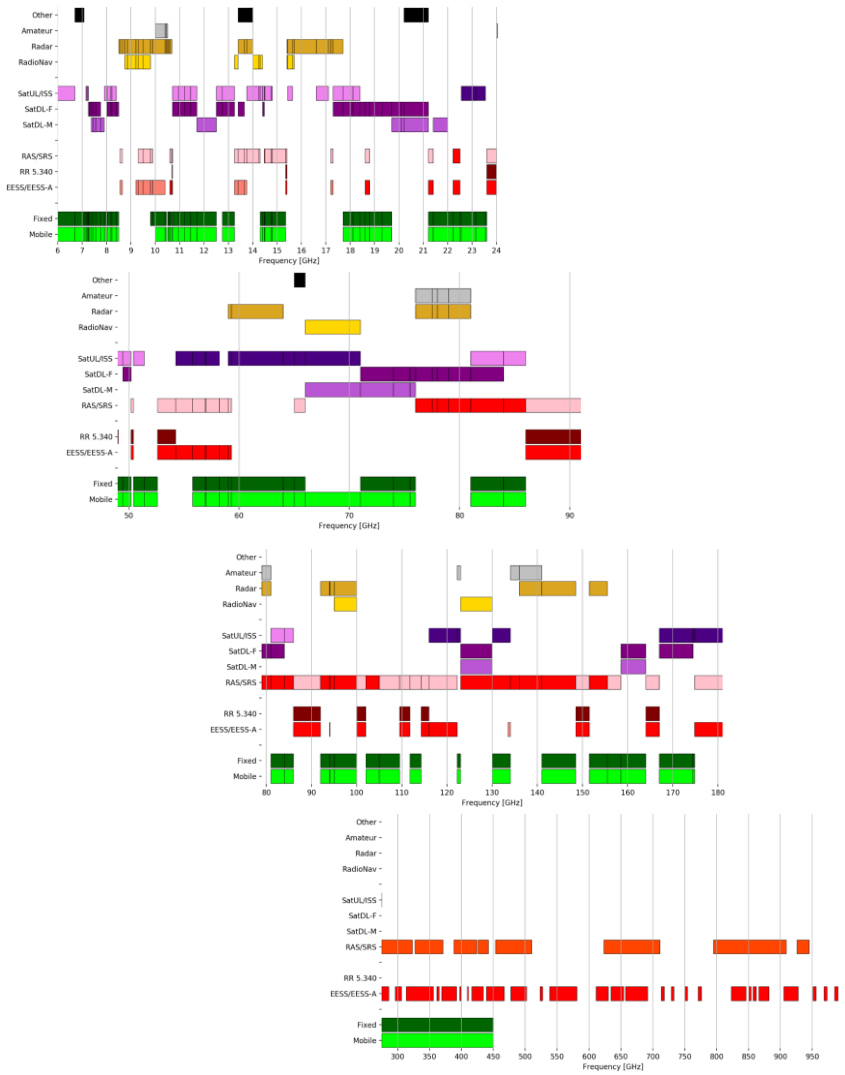
Needed capabilities



Spectrum evolution aspects

Improve spectrum utilization & extend current spectrum boundaries

- THz spectrum will be utilized with combinations of bands: low, mid, and mmw ranges to optimize wireless link characteristics and cooperatively provide the full set of service requirements
- Spectrum under 6 GHz pivotal for wide radio coverages
- Possible usage of spectrum in 6-24 GHz range; currently not available for mobile communications to be exploited by proper design of sharing methods with current users
- Improved intelligent spectrum access systems, in particular in newly available spectrum resources in higher bands, to dynamically assign frequency resources to authorised subsystems on both time and geographical basis while preventing interference issues
- Studies on intelligent spectrum usage and interference management schemes will include scenarios for, e.g.,
    - nomadic, mobile, or temporary spectrum usage
    - spectrum access for local low power networking
    - exploitation of predictable properties of radio transmissions for AI-based interference avoidance
- New regulation and licensing strategies aspects in support of both dynamic spectrum sharing and access to new spectrum will be comprehensively addressed



An overview of spectrum allocations in several ranges between 6 GHz and 1,000 GHz

Sustainability

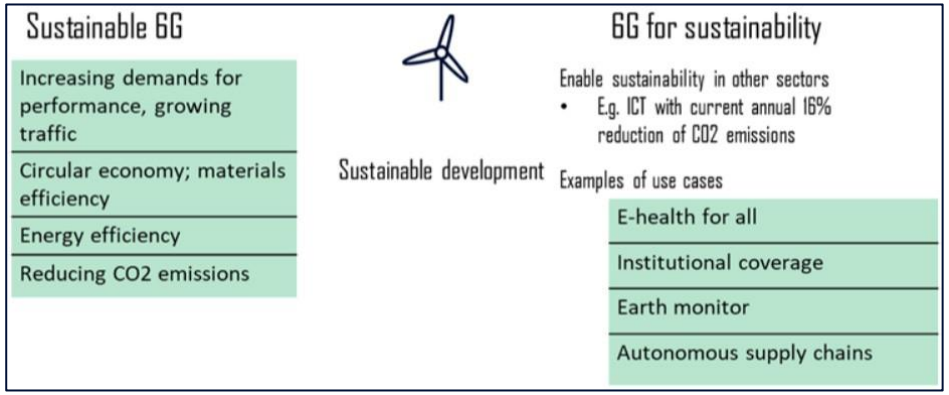
Ambition

ICT is linked to all 17 UN SDGs and interacts with all of them. For instance:
•#9 (Industry, innovation and infrastructure): 6G will contribute to bridging the digital divide to provide equal access to information and foster entrepreneurship, for billions.
•#11 (Sustainable cities and communities): ICT enables innovative approaches to city management (smart water and waste management, intelligent transportation).
•#13 (Climate action): 6G will help monitor climate change and strengthen resilience, and will enable other sectors to reduce their own emissions. At the same time, 6G will have its own carbon footprint which should be minimized

UN Action plan:
17 goals
165 targets
231 indicators

How

- Embedded energy monitoring systems everywhere.
- Adaptive telecommunication protocols, to avoid the need for 'always-on' infrastructure; push toward Zero watt @ zero load for all products.
- Systematic assessment of environmental impact of materials and design choices, including virtualization and softwarization (e.g. balance between latency and energy).
- Equipment and consumer products eco-design: modularity, upgradeability, reparability.
- Limiting obsolescence: circularity, refurbishment, effective management of end-of-life.
- New energy efficient material (e.g. GaN for sub 3 GHz products).
- Continue the development of energy efficiency features and compact and efficient renewable energy supply solutions.
- Big potential using AI for green networks (overdimensioning...)
- EMF-aware networks.



New results available at hexa-x.eu/deliverables/

- D1.2 Expanded 6G vision, use cases and societal values – including aspects of sustainability, security and spectrum
- D2.1 Towards Tbps Communications in 6G: Use cases and Gap Analysis
- D6.1 Gaps, features and enablers for B5G/6G service management and orchestration
- D7.1 Gap analysis and technical work plan for special-purpose functionality
- D4.1 AI-driven communication & computation co-design: Gap analysis and blueprint

- Note also e.g. M. A. Uusitalo, P. Rugeland et al, “6G Vision, Value, Use Cases and Technologies from European 6G Flagship Project Hexa-X”, IEEE Access, Nov 2021

Thank you!

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