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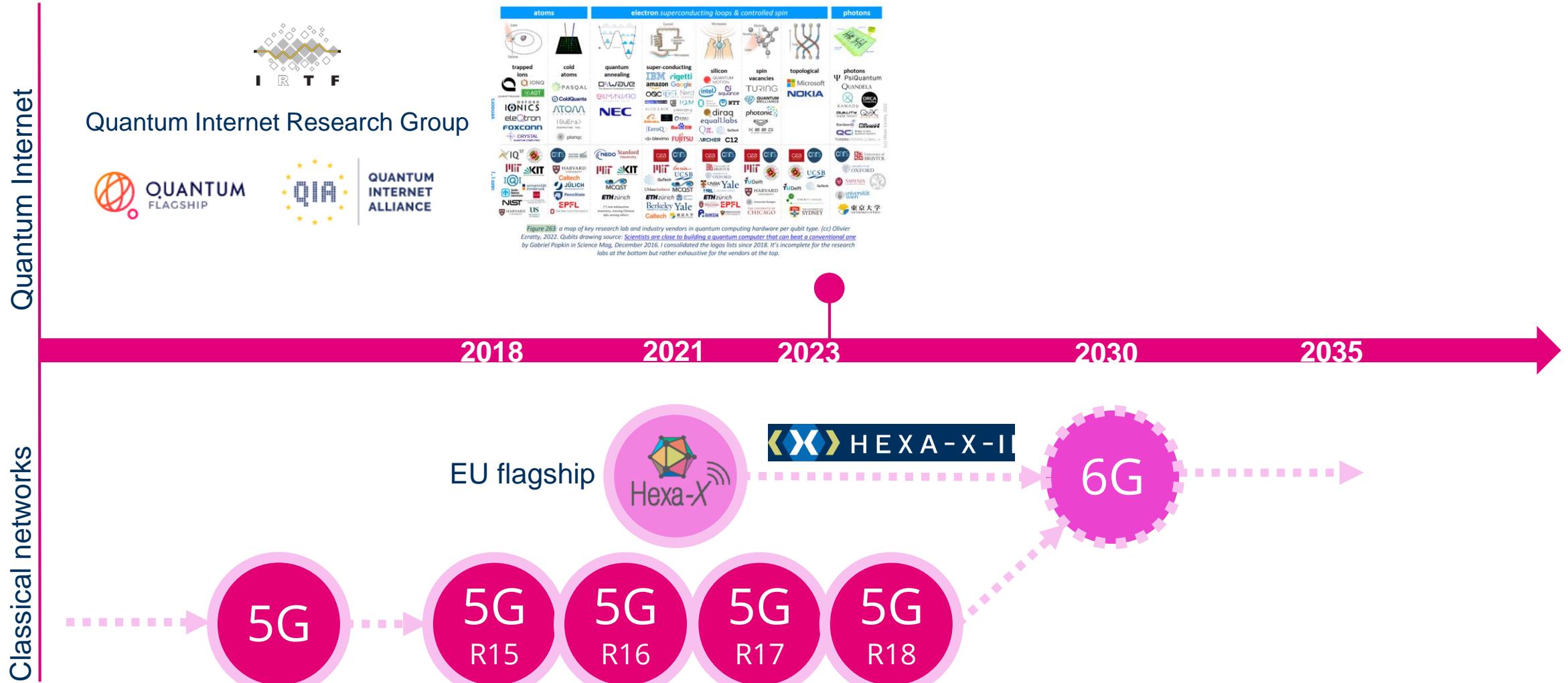


Towards the Integration of 6G and the Quantum Internet

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Roadmap of 5G, 6G, and the Quantum Internet



R. Bassoli, H. Boche, C. Deppe, R. Ferrara, F. H. P. Fitzek, G. Janssen, S. Saeedinaeen, "Quantum Communication Networks", 1st Ed., Springer, 2021, ISBN: 978-3-030-62938-0.
O. Ezratty, "Understanding Quantum Technologies", 5th Ed., 2022, Online Available: <https://www.oezratty.net/wordpress/2022/understanding-quantum-technologies-2022/>

UN Sustainable Development Goals – Developing Future Networks Towards 2030

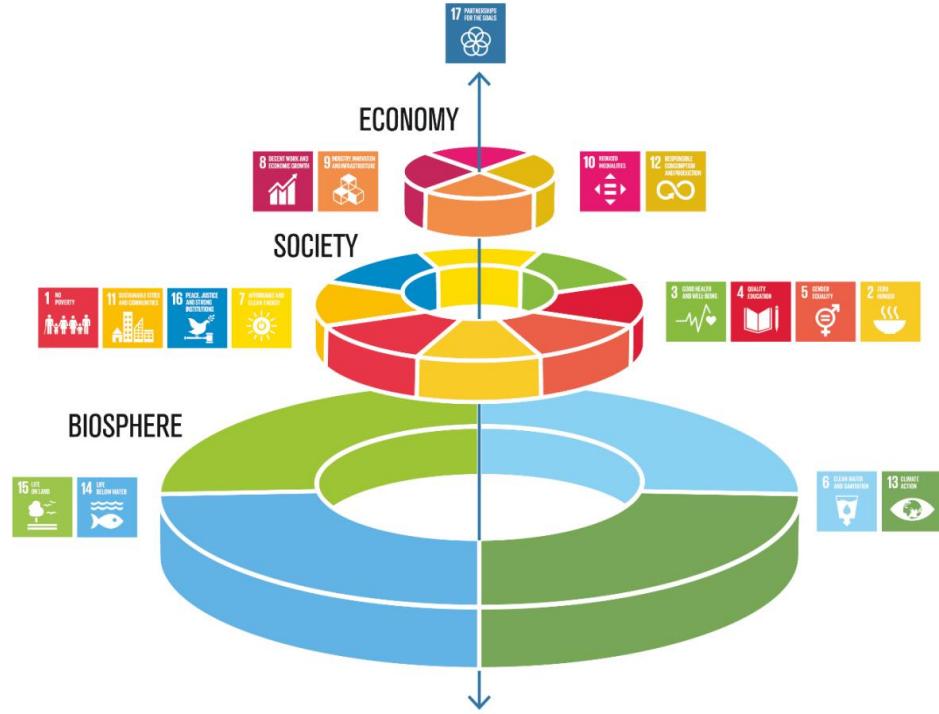


Figure 2-1: United Nation's sustainable development goals

Hexa-X, "D1.4 – Hexa-X architecture for B5G/6G networks – final release", Jun. 2023. [Online]. Available: <https://hexa-x.eu/wp-content/uploads/2023/07/Hexa-X-D1.4-Final.pdf>
Hexa-X II, "D2.1 – Draft foundation for 6G system design", Jun. 2023. [Online]. Available: https://hexa-x-ii.eu/wp-content/uploads/2023/07/Hexa-X-II_D2.1_web.pdf

6G Macro Use-Cases and Objectives

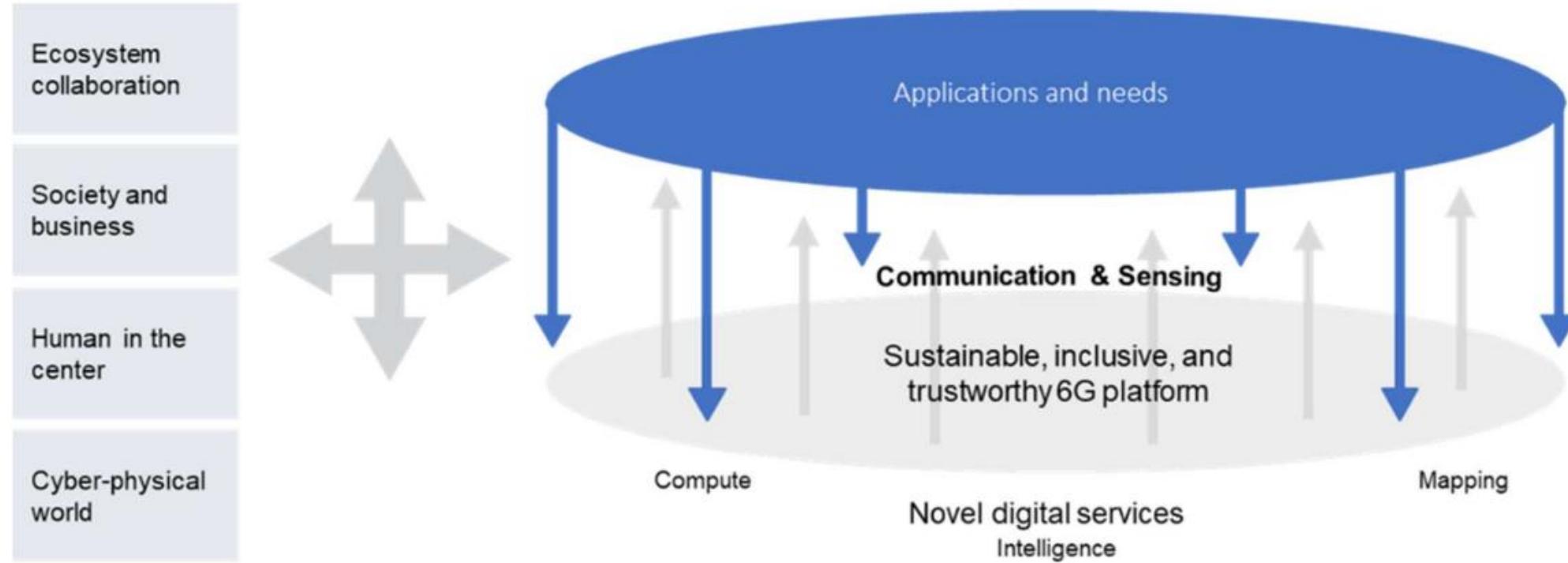
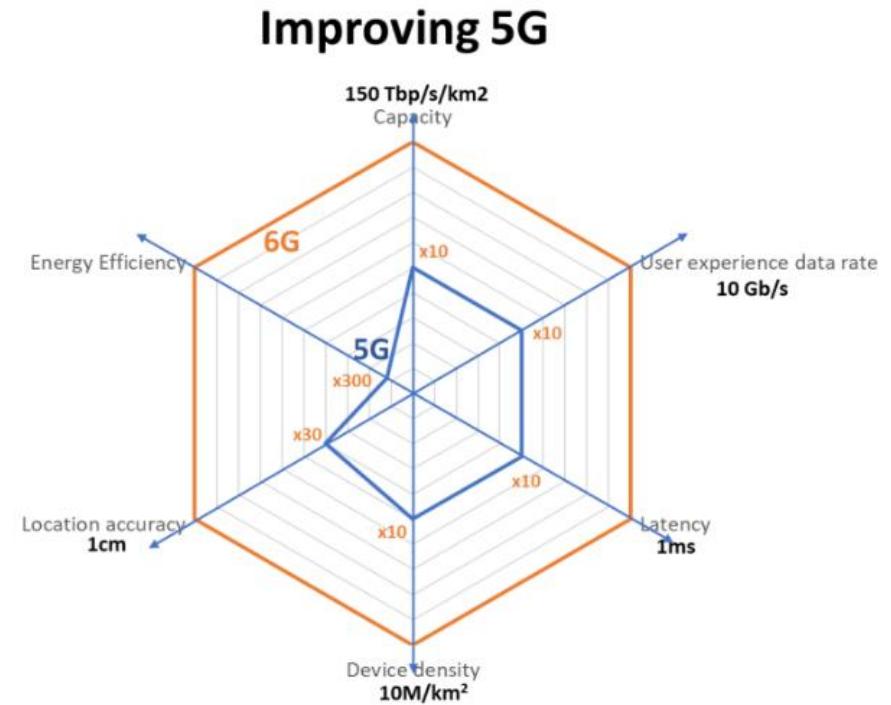
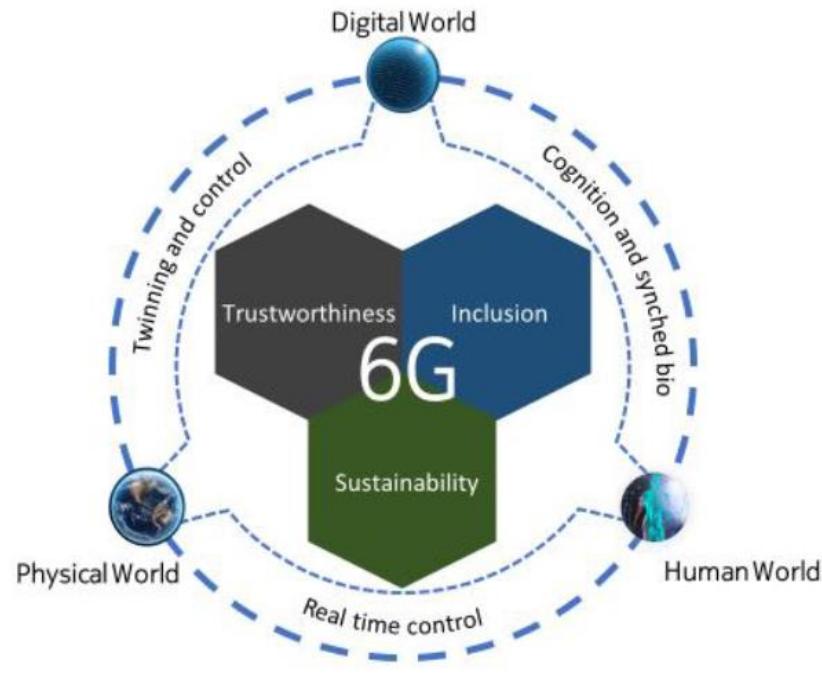


Figure 3-1: 6G platform vision in Hexa-X-II and what it can enable.

Hexa-X II, "D2.1 – Draft foundation for 6G system design", Jun. 2023. [Online]. Available: https://hexa-x-ii.eu/wp-content/uploads/2023/07/Hexa-X-II_D2.1_web.pdf

Unification of the Physical, Digital and Human Worlds



Hexa-X, "D1.4 – Hexa-X architecture for B5G/6G networks – final release", Jun. 2023. [Online]. Available: <https://hexa-x.eu/wp-content/uploads/2023/07/Hexa-X-D1.4-Final.pdf>

The 5G Infrastructure Association (5G IA), "European Vision for the 6G Network Ecosystem", Jun. 2021. [Online]. Available: <https://5g-ppp.eu/wp-content/uploads/2021/06/WhitePaper-6G-Europe.pdf>

R. Bassoli, F. H.P. Fitzek, and E. Calvanese Strinati, "Why Do We Need 6G?", ITU Journal on Future and Evolving Technologies, vol. 2 no. 6, Sep. 2021.

6G Architectural Principles and Design Goals

Table 3-1: Mapping of architectural principles on the 6G E2E system design.

Architectural principle	E2E design impact	Related Hexa-X-II design goals
1: Support and exposure of 6G services and capabilities	Generic and dynamic exposure functionality; Integration of beyond-communication network functions and HW; Pervasive AI; Compute infrastructure	Sustainability, Trustworthiness, Inclusiveness
2: Full automation and optimization	Pervasive data and analysis framework; Pervasive AI framework; Pervasive service management and orchestration	Sustainability, Trustworthiness
3: Flexibility to different topologies	Pervasive service management and orchestration; Exposure of infrastructure towards network layer to make accesses transparent; Gateway UEs; Programmable transport	Sustainability, Inclusiveness
4: Network Scalability	Pervasive service management and orchestration; Network-centric exposure layer; Transport network functions	Sustainability, Trustworthiness
5: Resilience and availability	Pervasive service management and orchestration; Pervasive data and analysis framework; Pervasive AI; RAN functions; Transport network functions; core network functions (CNFs); Subnetworks	Trustworthiness

Hexa-X II, "D2.1 – Draft foundation for 6G system design", Jun. 2023. [Online]. Available: https://hexa-x-ii.eu/wp-content/uploads/2023/07/Hexa-X-II_D2.1_web.pdf

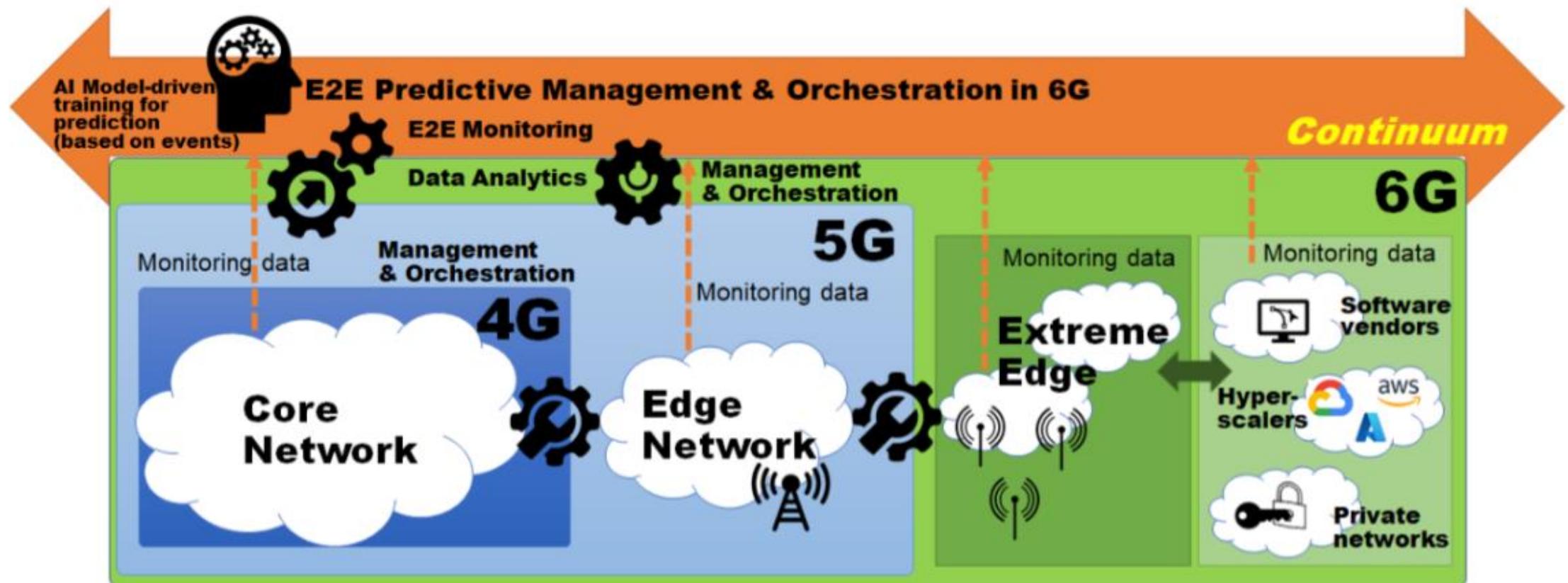
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Table 3-1: Mapping of architectural principles on the 6G E2E system design.

Architectural principle	E2E design impact	Related Hexa-X-II design goals
6: Persistent security and privacy	Pervasive security and privacy framework	Trustworthiness
7: Internal interfaces are cloud optimized	Cloud-native virtual network functions; Exposure interfaces between layers	Sustainability, Trustworthiness
8: Separation of concerns of network functions	Optimized functionality in CN and RAN; Self-sustained NFs	Trustworthiness
9: Network simplification in comparison to previous generations	Avoid many standardized deployment options / protocol splits; 5GC evolution to support 6G RAN; Simplified protocol and reduced UE-NW signalling	Sustainability, Inclusiveness
10: Minimize environmental footprint and enabling sustainable networks	E2E orchestration for energy-lean and cost-aware operation; Pervasive data and analysis framework; Modularization of network functions; Energy and cost-efficient infrastructure	Sustainability

Hexa-X II, "D2.1 – Draft foundation for 6G system design", Jun. 2023. [Online]. Available: https://hexa-x-ii.eu/wp-content/uploads/2023/07/Hexa-X-II_D2.1_web.pdf

6G Continuous Orchestration



Hexa-X, "D5.1 – Initial 6G Architectural Components and Enablers", Dec. 2021. [Online]. Available: https://hexa-x.eu/wp-content/uploads/2022/03/Hexa-X_D5.1_full_version_v1.1.pdf

6G-Quantum Communication Network in Germany

