6G-ANNA

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Sustainable and Secure Architecture & System Design - an update

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The 6G series workshop by Hexa-X-II

February 11th, 2025

6G-Access, **N**etwork of **N**etworks, **A**utomation & Simplification (6G-ANNA)

6G ANNA – a recap

6G-Access, **N**etwork of **N**etworks, **A**utomation & Simplification

- Lighthouse research project in the German 6G Platform for Future Communication Technologies and 6G (6g-platform.com)
- Develop blueprint for a functional 6G end-to-end system designed for energy efficiency, security and resiliency, aiming to improve the interaction between human, technology, and environment
- Work areas:
  - 6G Architecture & System Design
  - 6G Access
  - Network of Networks
  - Automation & Simplification
- Use cases (selected): Vehicular Mobility, Public Safety, Mobile XR, Digital Twins, Collaborating cyber physical systems
- Drive global pre-standardization activities from a DE / EU perspective

Consortium

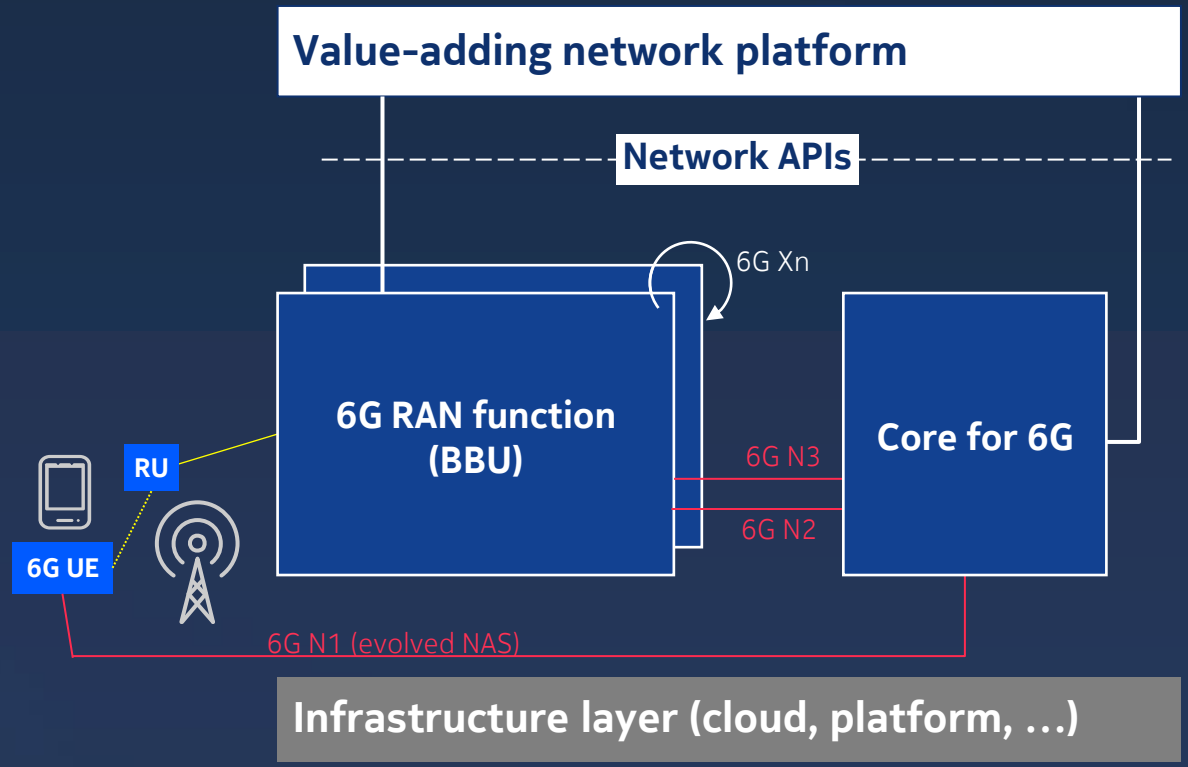
7 industry partners
8 Small Medium Enterprises
3 research institutes
16 universities
3 associated industry partners

https://6g-anna.de/

6G architecture

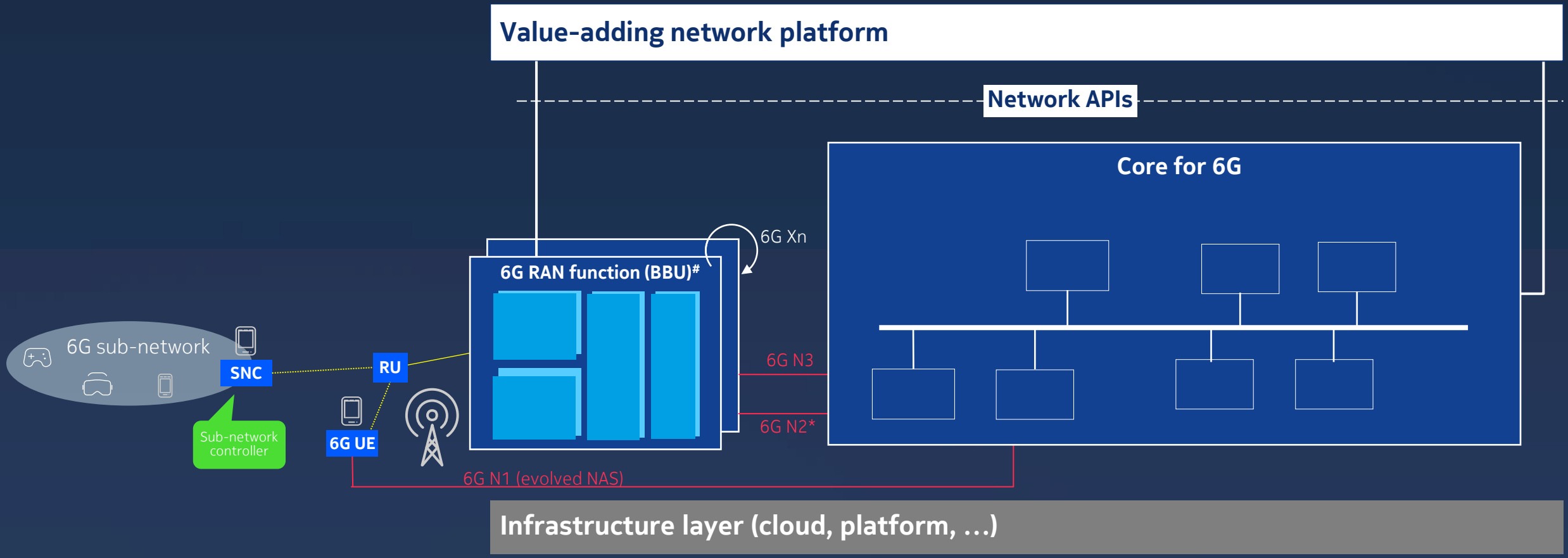
Key design principles & recommendations

- Single stand-alone architecture
  - Avoiding complexity of standardizing multiple deployment options
  - Support distributed RAN and cloud RAN
  - AI-native, cloud-native, API-native
- Evolve 5G System
  - With critical enhancements for new 6G services
- Clear domain / layer separation
  - E.g. abstract any potential implementation options due to cloud/IT infrastructure
- Focus on key standardized interfaces
  - Where multi-vendor choice outweighs required complexity & effort
- Increased sustainability
  - Aim for maximizing energy efficiency at all layers/domains



6G functional architecture

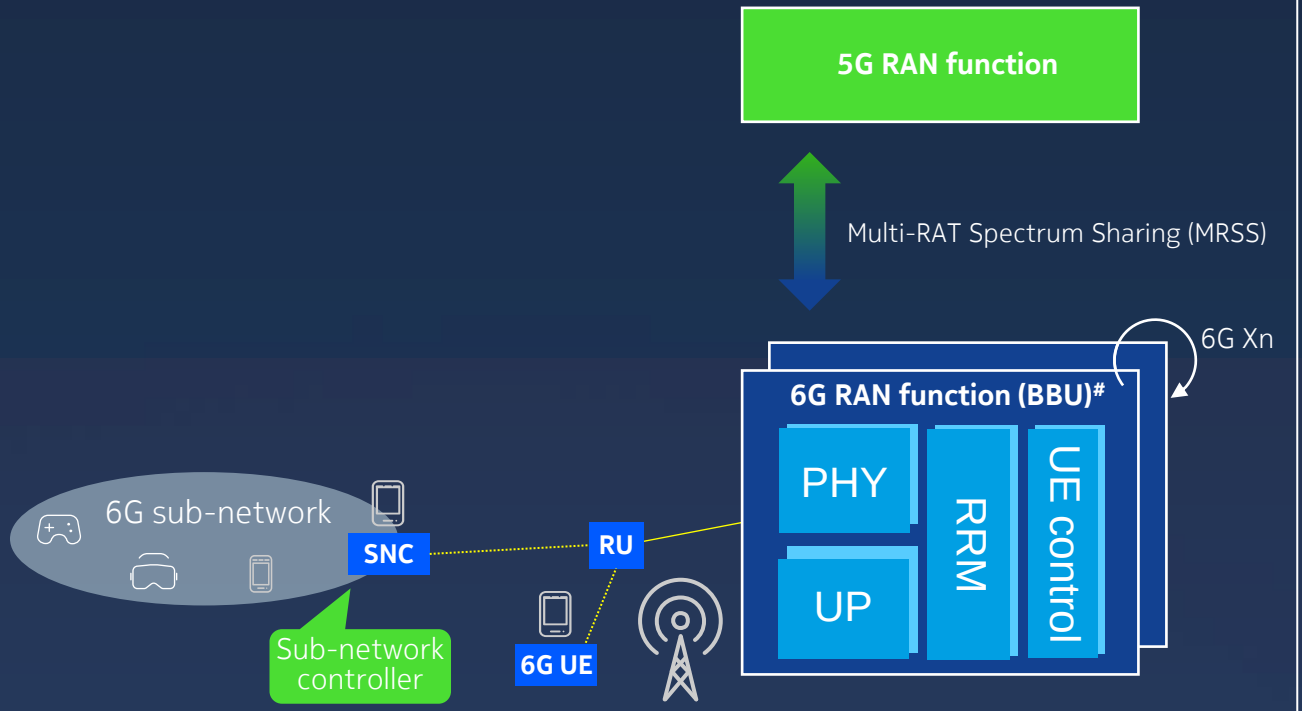
3GPP centric view focusing on 6G system architecture (exemplary figure)



Note:
*) 6G RAN-Core may be realized as Point-to-Point (like 5G N2) or as a hybrid option.

6G functional architecture

3GPP centric view focusing on 6G RAN function



6G RAN

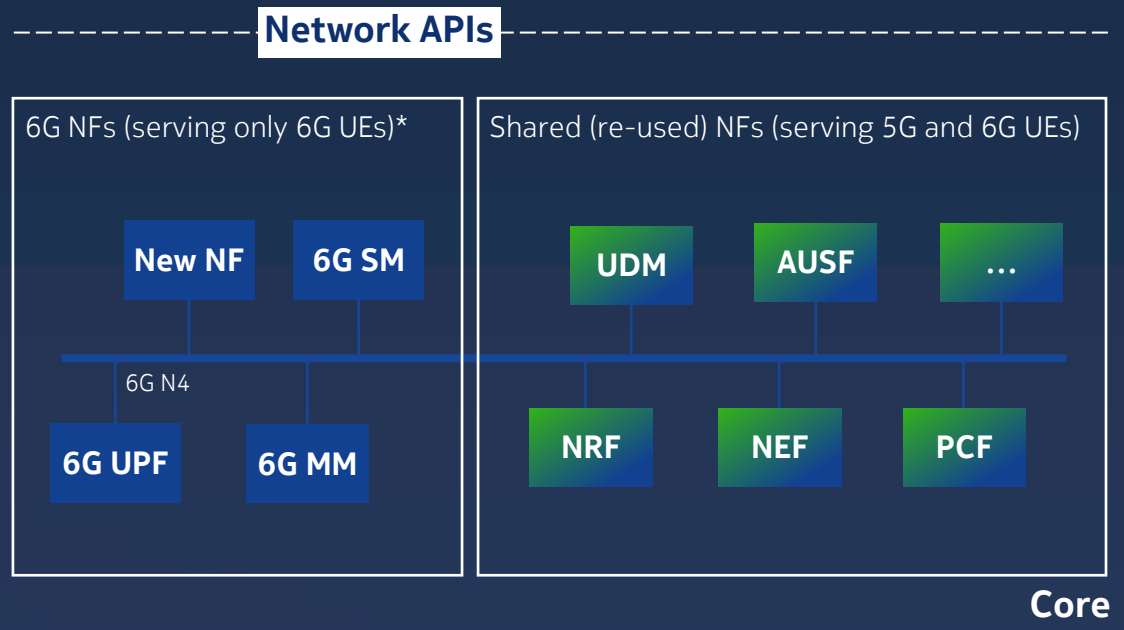
- Functional architecture
  - abstracting from implementations and deployments
  - Freedom to apply also to subnetwork, e.g. SNC
- Focus on selected open interfaces
  - Uu from UE to RAN
  - LLS from RU to BBU, stateless
  - Xn between BBUs for mobility only
  - No higher layer split
- Multi-connectivity realized by carrier aggregation (CA), not by dual connectivity (DC): UE connects to only one RAN at a time.
- Lean protocol stack to enable savings in memory, processing, latency and energy consumption
- Enh. radio resource management (RRM), contention-based UL, AI-based, enrichment information, energy efficiency features
- Evolved PHY layer, flexible OFDM & more massive MIMO
  - Multi-RAT spectrum sharing with 5G

6G functional architecture

3GPP centric view focusing on Core for 6G (exemplary figure)

Core for 6G

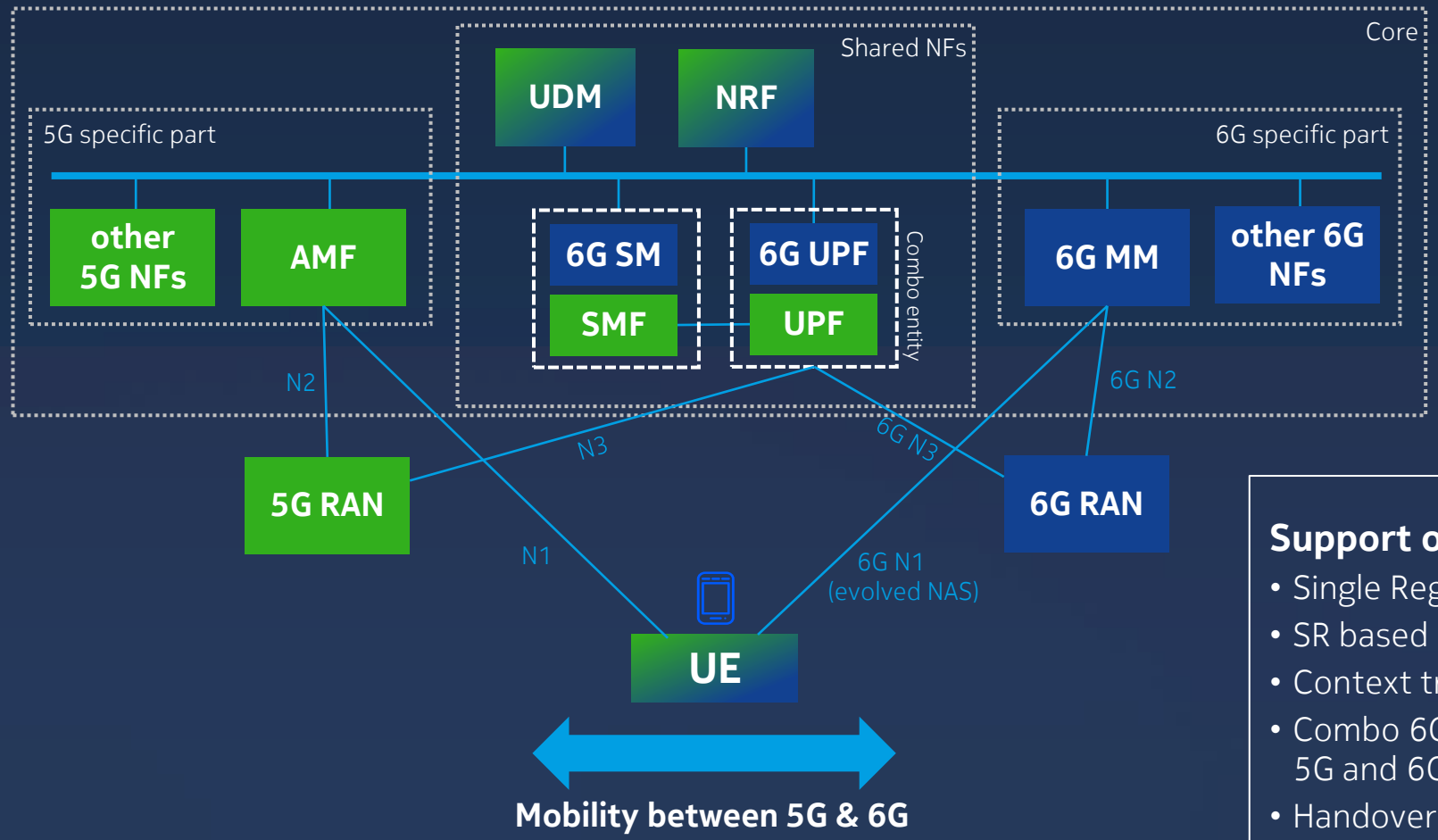
- **Shared NFs:** majority of 5G NFs are continued to be used to serve 6G UEs. They follow regular evolution, i.e. they may evolve from current Rel-19 specs.
- **6G NFs:**
  - 5G services adopted/forked to the 6G System (baseline are related 5G services), e.g. to optimize system design & performance
  - New 6G services (e.g. to support Sensing)



6G MM: 6G Mobility Management
6G SM: 6G Session Management
*) Studies are ongoing whether other NF types need to be realized as a 6G NFs.

6G functional architecture

3GPP centric view focusing on Support of 5G-6G interworking (exemplary figure)



Support of 5G-6G interworking (IWK)

- Single Registration (SR) based interworking between 5G-6G
- SR based IWK mandated for all UE(s)
- Context transfer between AMF and 6G MM
- Combo 6G-SM+SMF and common UPF IP anchor needed for 5G and 6G network to ensure seamless service continuity
- Handover support needed between 5G radio and 6G radio to enable SR based IWK

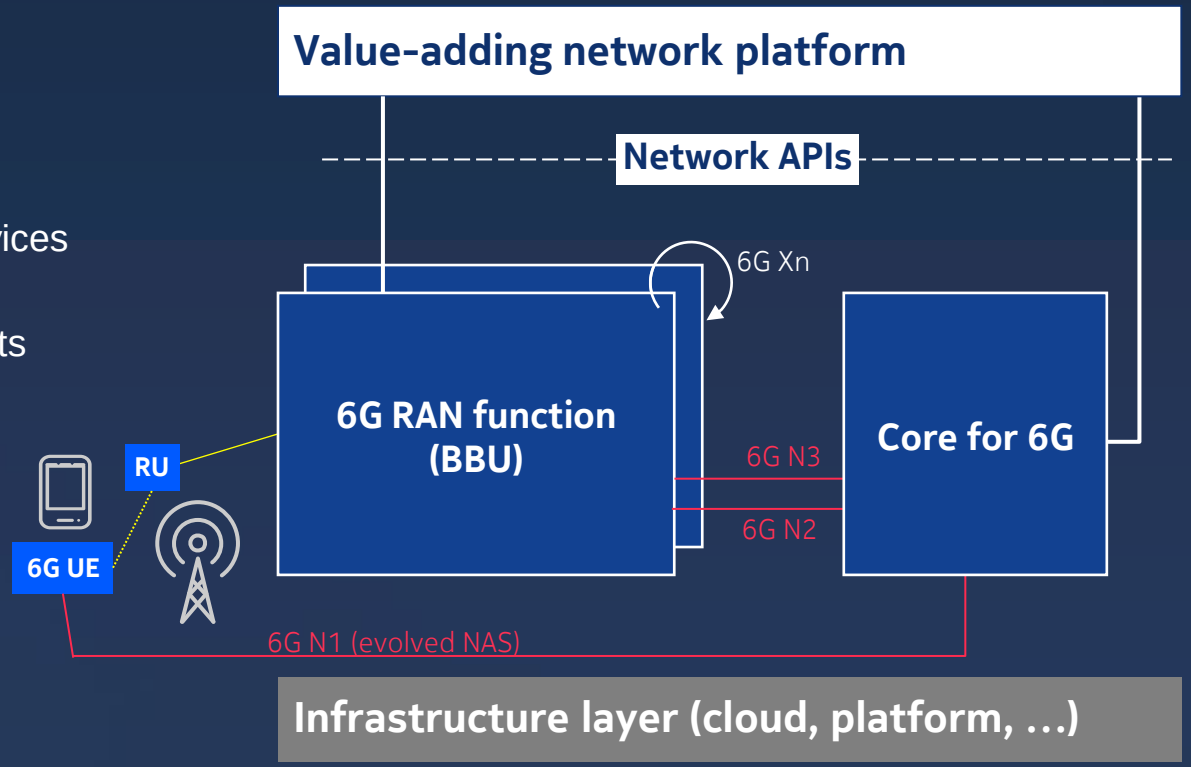
6G architecture

Summary & recap

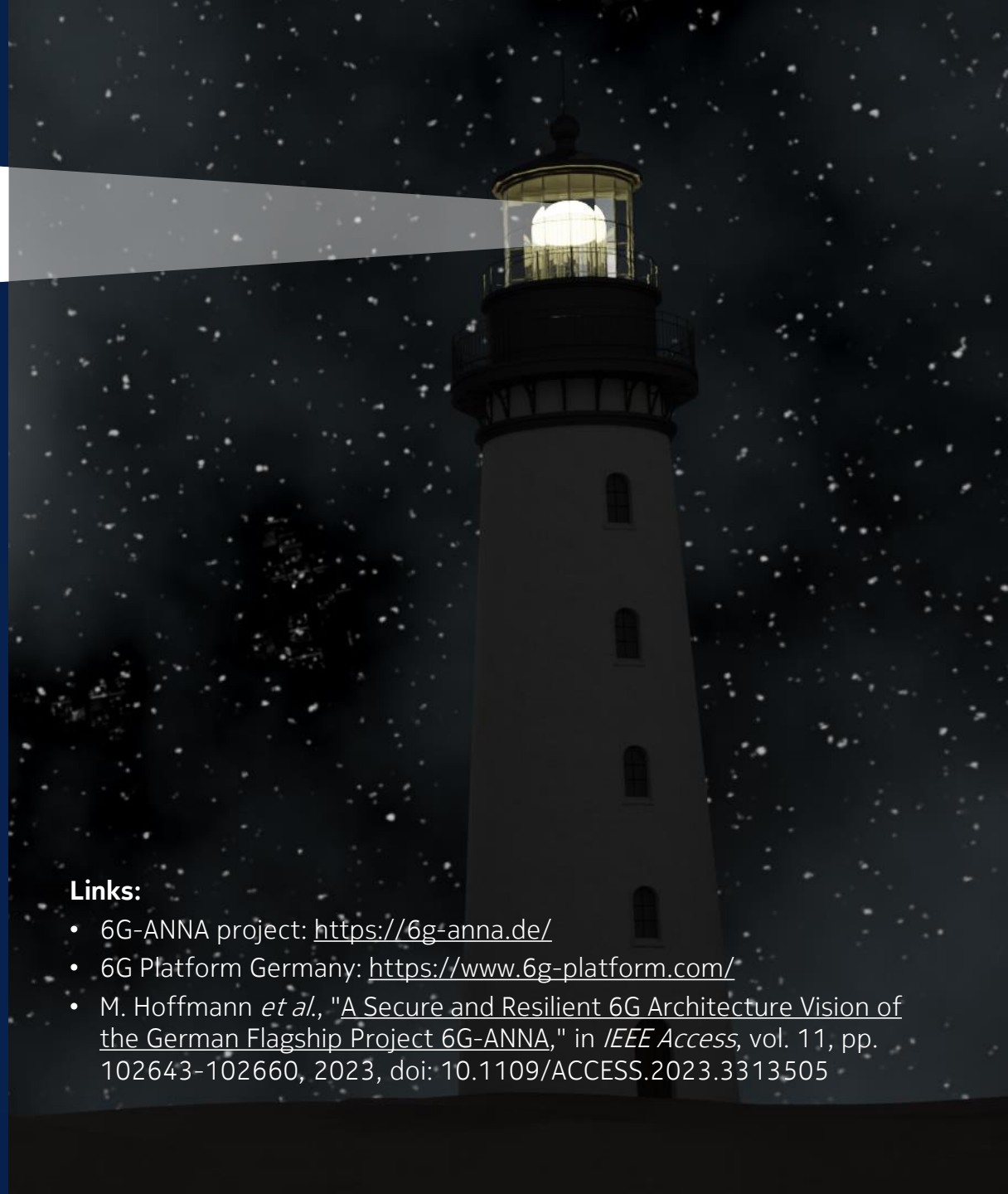
- 6G will push boundaries on key performance indicators, while prominently addressing new major factors, including sustainability, security, privacy, and digital inclusion

- Key design principles of 6G system architecture
  - Single, lean and future-proof stand-alone architecture
  - Based on 5G System, with critical enhancements for new 6G services
  - Clear domain / layer separation
  - Focus on key standardized interfaces for multi-vendor deployments
  - Increased environmental sustainability at all layers/domains

- 6G presents opportunities to make the network programmable and monetizable
  - At scale and with global reach
  - Holistic support for value-generating use cases



Thank You!



6G-ANNA WP1 “Architecture” lead
6G Platform WG7 “Architecture” lead

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Links:

- 6G-ANNA project: https://6g-anna.de/
- 6G Platform Germany: https://www.6g-platform.com/
- M. Hoffmann *et al.*, "A Secure and Resilient 6G Architecture Vision of the German Flagship Project 6G-ANNA," in *IEEE Access*, vol. 11, pp. 102643-102660, 2023, doi: 10.1109/ACCESS.2023.3313505