

6G Network Architecture

Core concepts & open questions

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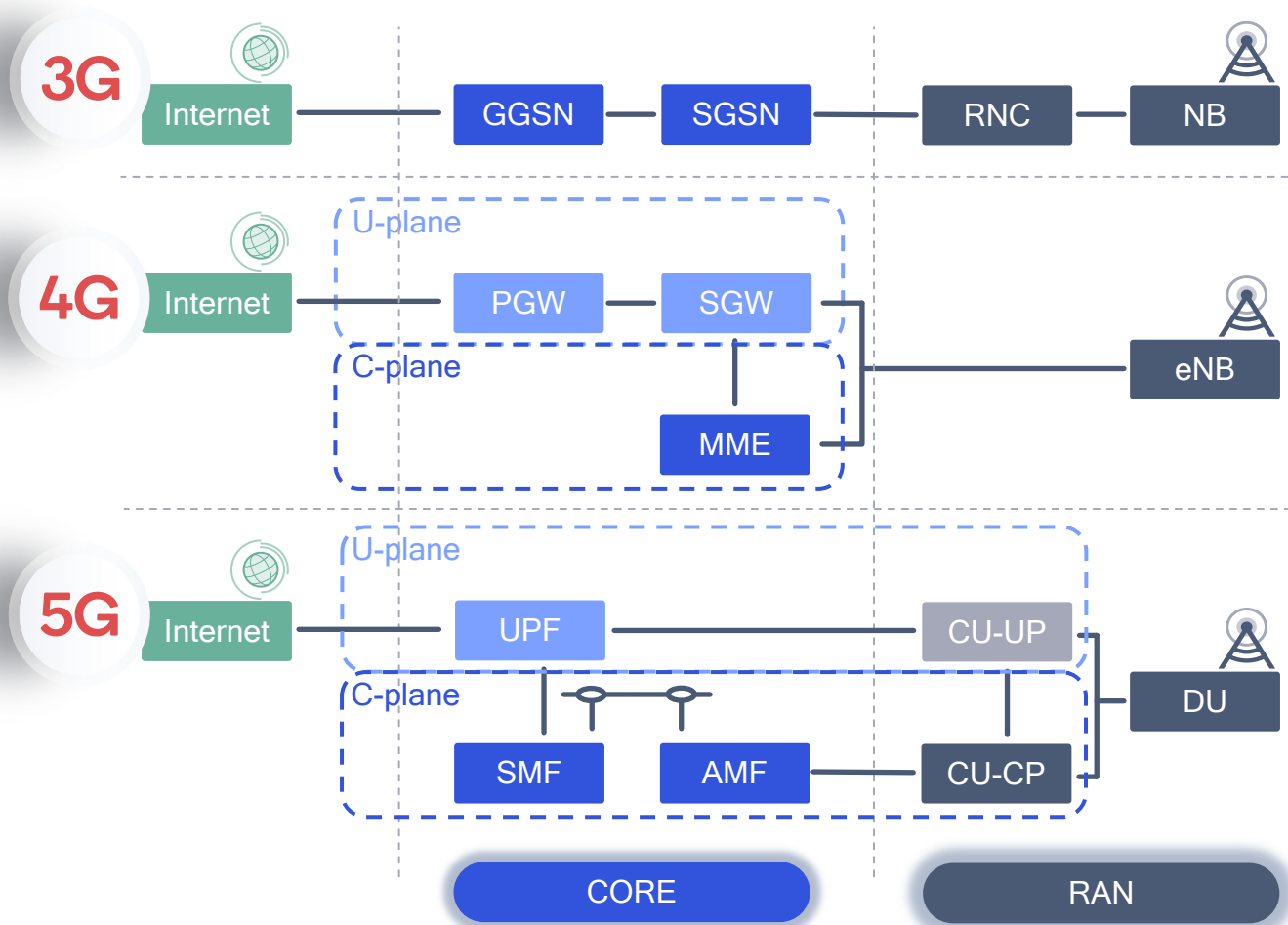
System architecture

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Network architecture evolution across Gs

What happened to the network architecture from 3G to 5G?



3G → 4G architecture trends

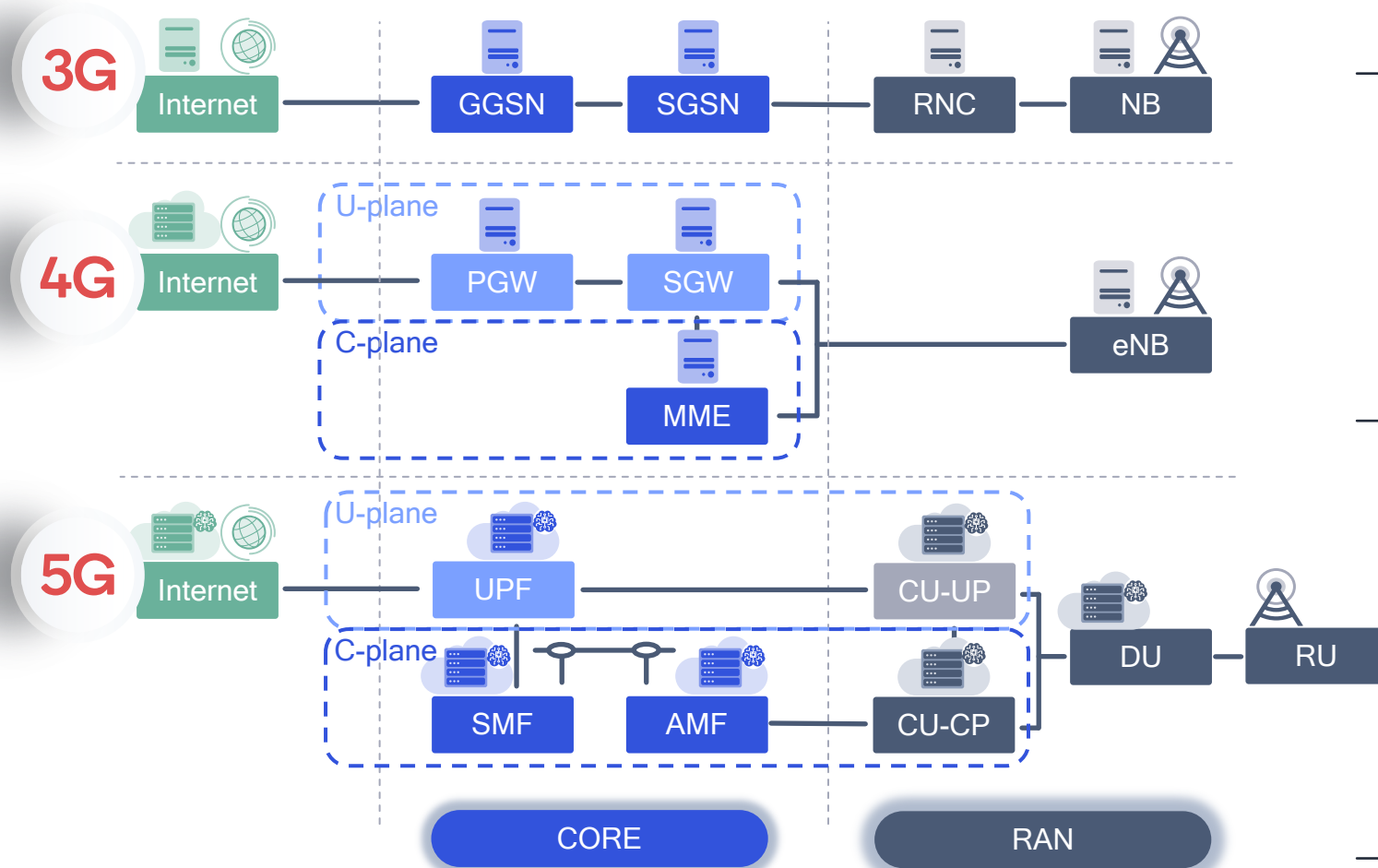
- Control and user plane split at the CORE
- Flat RAN architecture
- Separate security between RAN and CORE on control plane

4G → 5G architecture trends

- Control and user plane split extended to the RAN
 - Includes flexible location of CORE functions
- Distributed RAN architecture
 - To leverage a cloud platform implementation
- Service-based architecture in the core
 - To enable a more cloud friendly implementation

Platform evolution across Gs

How designing for cloud and virtualization influenced the 5G design?



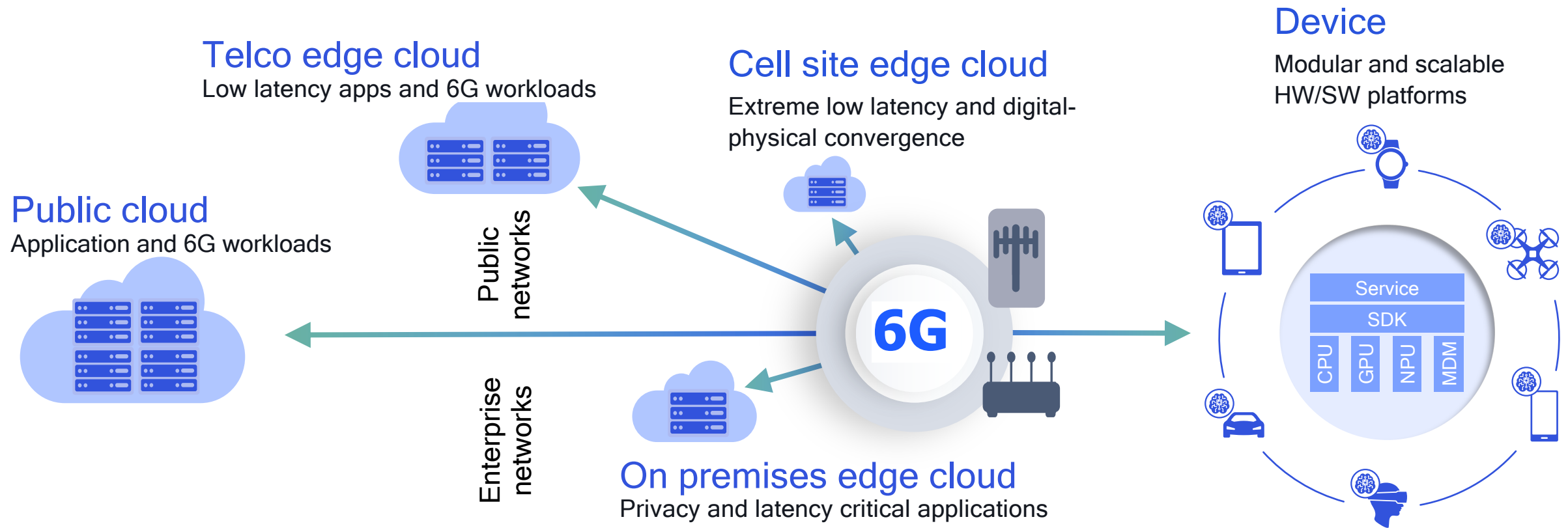
5G Core platform

- Separate control plane functions connecting via a service-based architecture, including Edge Computing

RAN platform (3GPP + ORAN)

- Disaggregated RAN
 - Horizontal separation of control & user plane
 - Vertical split of protocol stack functions across CU/DU/RU
- Virtualized RAN functions

Cloud transformation becoming a theme of the 5G-6G era



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What can it mean to make 6G more “cloud native”?

6G design principles: Modularization and Verticalization

5G

6G Design Drivers - Some Ideas

Inter-dependency of Functions

All Core network functions depend on AMF
AMF and CU-CP intertwined

Modularization into self-contained Services

Rethink the functional split in the network
Specialized “One expertise” Services

Monolithic control plane protocols

A single control plane protocol at the Core (NAS) and RAN (RRC) servicing all the functions

Modular protocols over lean Service Based Architecture

No single NAS or RRC for everything
Modular protocols specialized per service and individually upgradeable

“Repeated” Functionality in RAN and CN

Hard RAN / CN split creates need for repeated functionality in RAN and CN, e.g., connection/context management, mobility, paging

Convergence of RAN and CN functions

Minimize need for repeated functionality to serve one UE at different layers, i.e., RAN and CN

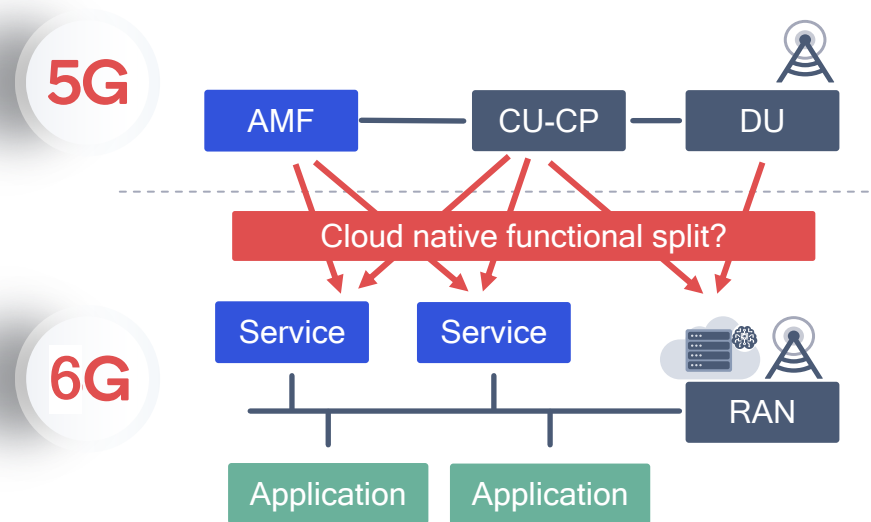
Makes some optimizations difficult

Control plane over baseline RRC/NAS limits optimization to new use cases e.g., passive IoT, massive sensors

Stronger verticalization

Vertical services interacting directly with eDU and UE

6G design principles: Modularization and Verticalization (cont.)



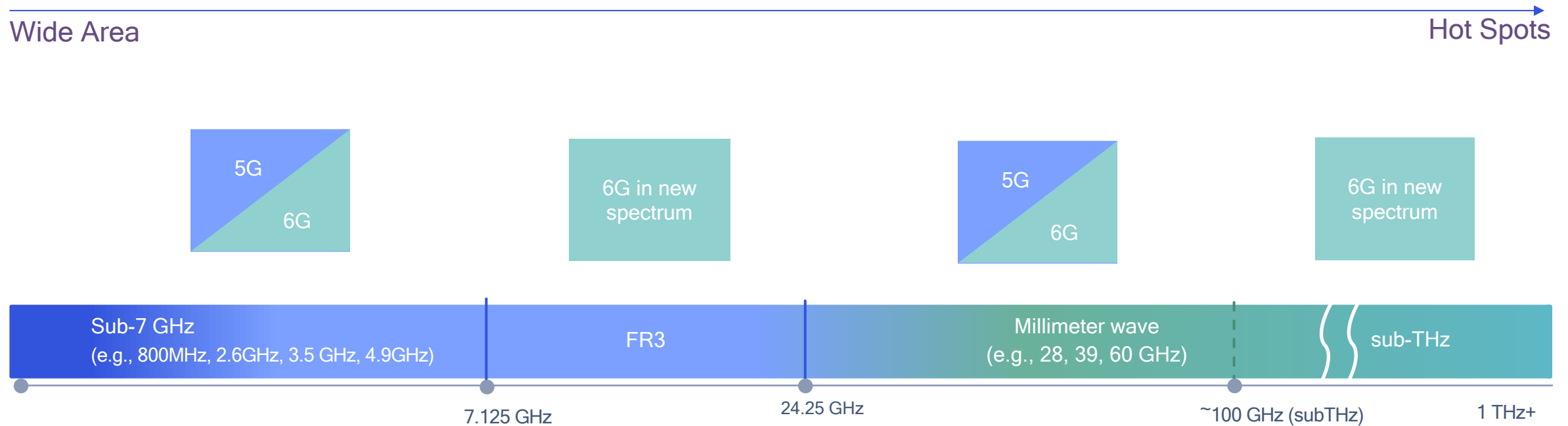
- Extend benefits of service-based architecture to RAN
- Re-factor functional split for Core and RAN
- Incorporate concepts developed in O-RAN Alliance
- Converge and expand the AI/ML functions across Core and RAN for network automation and near-real time control
- Move all real-time link management to the RAN edge

Radio access architecture

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Importance of smooth spectrum migration for a new G



Efficient 5G/6G Spectrum Sharing

Some design directions

- The forward compatible framework of 5G design was visionary enough that will enable efficient coexistence and multiplexing of 5G and 6G in existing 5G bands
- Coexistence and multiplexing of 5G and 6G in existing 5G bands, i.e., **multi-RAT spectrum sharing (MRSS)**, is expected to be easier, in general, than 4G/5G DSS
- However, MRSS design should take the market needs for 5G verticals with long lifespan into account
- To do so, more advanced cross-RAT spectrum sharing techniques could be possible

Motivation for Multi-RAT Connectivity from UE Perspective

Migration can take place **at the core first** or **at the RAN/spectrum level first**

- **RAN migration happens before Core**

- Similar to EN-DC, 6G NSA multi-RAT connectivity can be used as a fast rollout mechanism with an anchor on 5G core

- **Core migration happens before RAN**

- Multi-RAT connectivity may aggregate 6G and 5G carriers from a UE perspective to enrich UE features, aggregating throughput

- **Multi-RAT connectivity and multi-RAT spectrum sharing are complementary features**

- Multi-RAT spectrum sharing enables the best use of spectrum resources from the network perspective
- Multi-RAT connectivity allows the end users to benefit from available spectrum, infrastructure and offered services during the transition

- **How to design multi-RAT / multi-radio connectivity in the 6G area?**

- **“MR-DC” type of approach is maybe the default but other options may exist**

- Even the nomenclature “DC” may be obsolete as it implies “Dual” (2)

Conclusions & summary

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Conclusion & summary

System




- 6G offers the opportunity to revisit system architecture concepts to make cellular systems more **cloud-friendly**
- Extend benefits of **service-based** architecture to RAN
- Reconsider **functional split** for Core and RAN & incorporate concepts developed in **O-RAN Alliance**

RAN

- **Multi-RAT spectrum sharing** is essential for smooth transition to a new G & it needs to consider the longer lifespan of 5G verticals
- **Multi-RAT connectivity** helps facilitating smooth transition to a new G under different core/RAN/spectrum migration assumptions & it should become a foundational feature also in the 6G era



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