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RAN slicing as enabler for low latency services

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ITG 5.2.4 Fachgruppentreffen

Dresden, June 10th, 2016

Outline

Low latency-services

- Which services are we talking of?
- Requirements

What is “RAN slicing” and why do we need it?

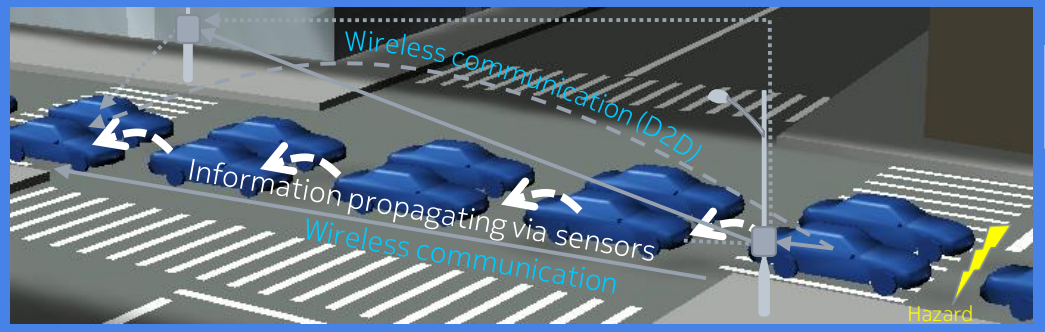
- Principles of RAN slicing
- Architecture enablers

Enabling low latency services in a common infrastructure

Outlook

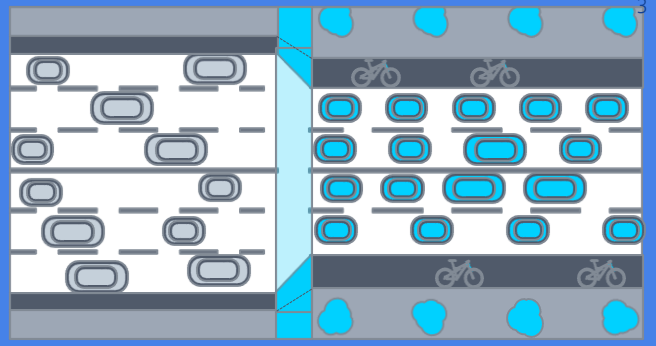
Low-latency use cases

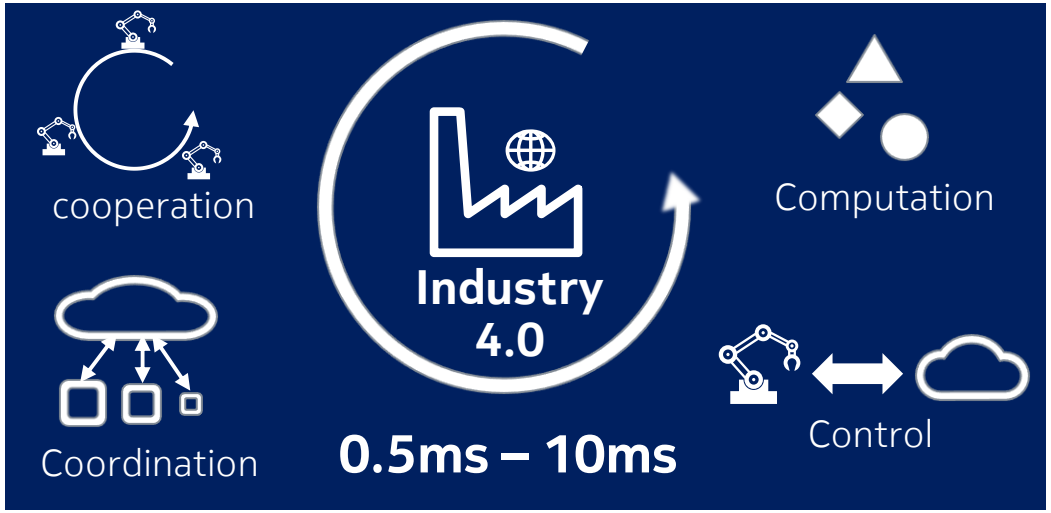
Automotive



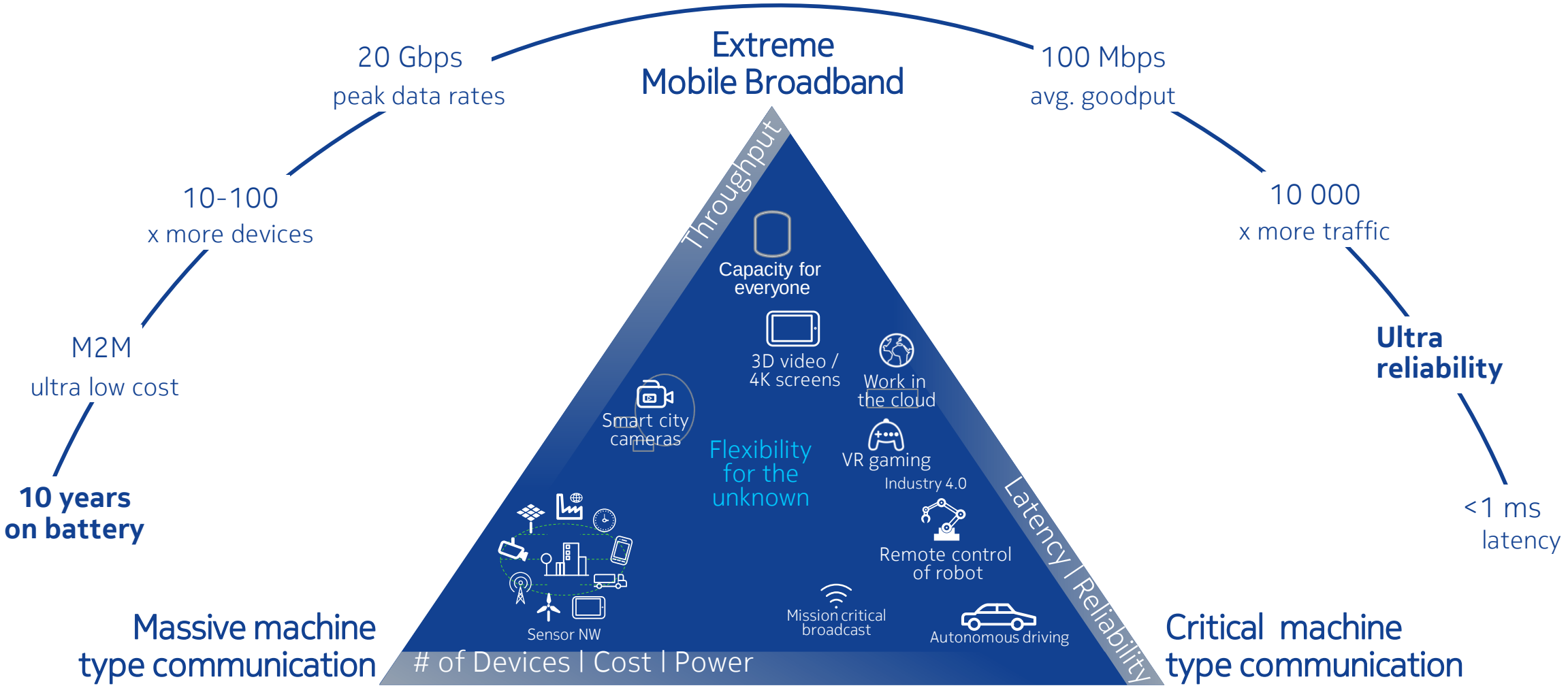
<3ms

4x more cars possible
Safer and faster individual transport



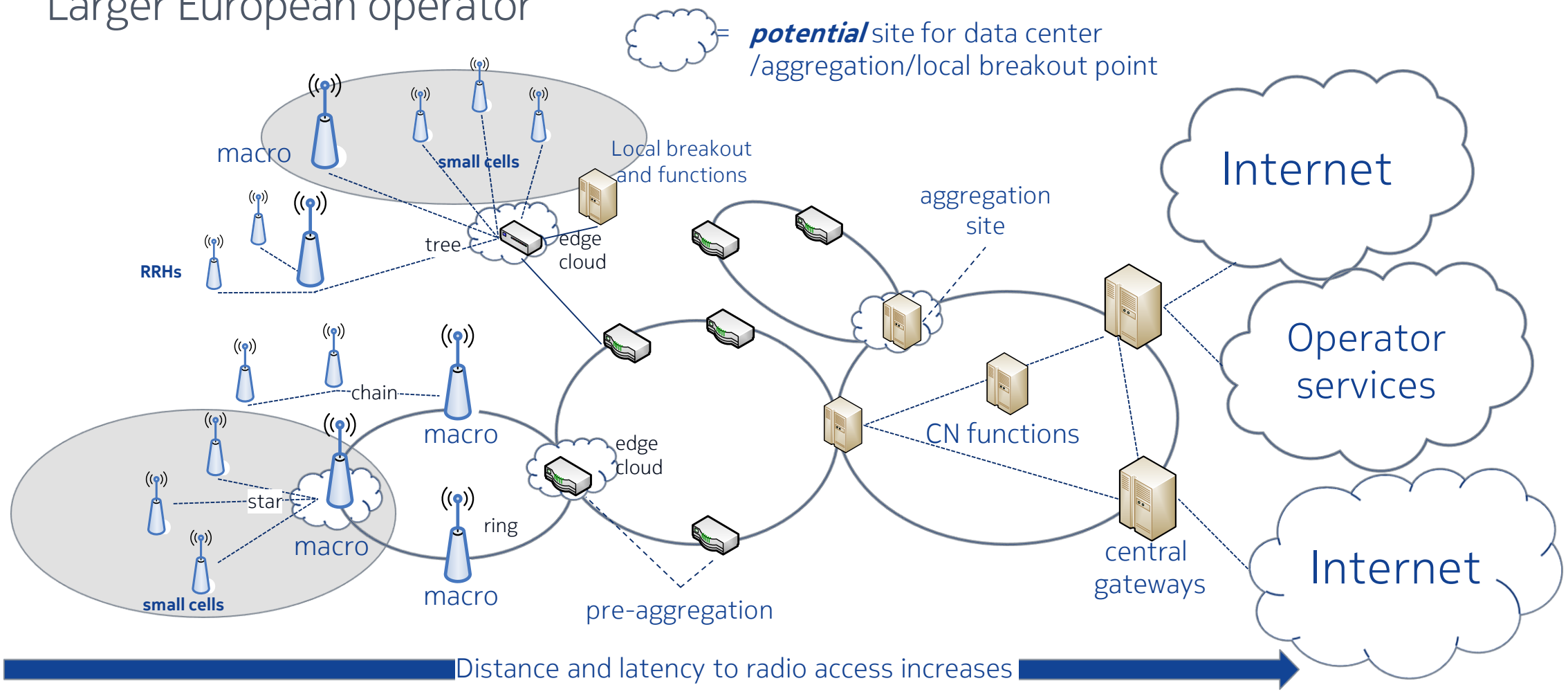


Diversity of use cases



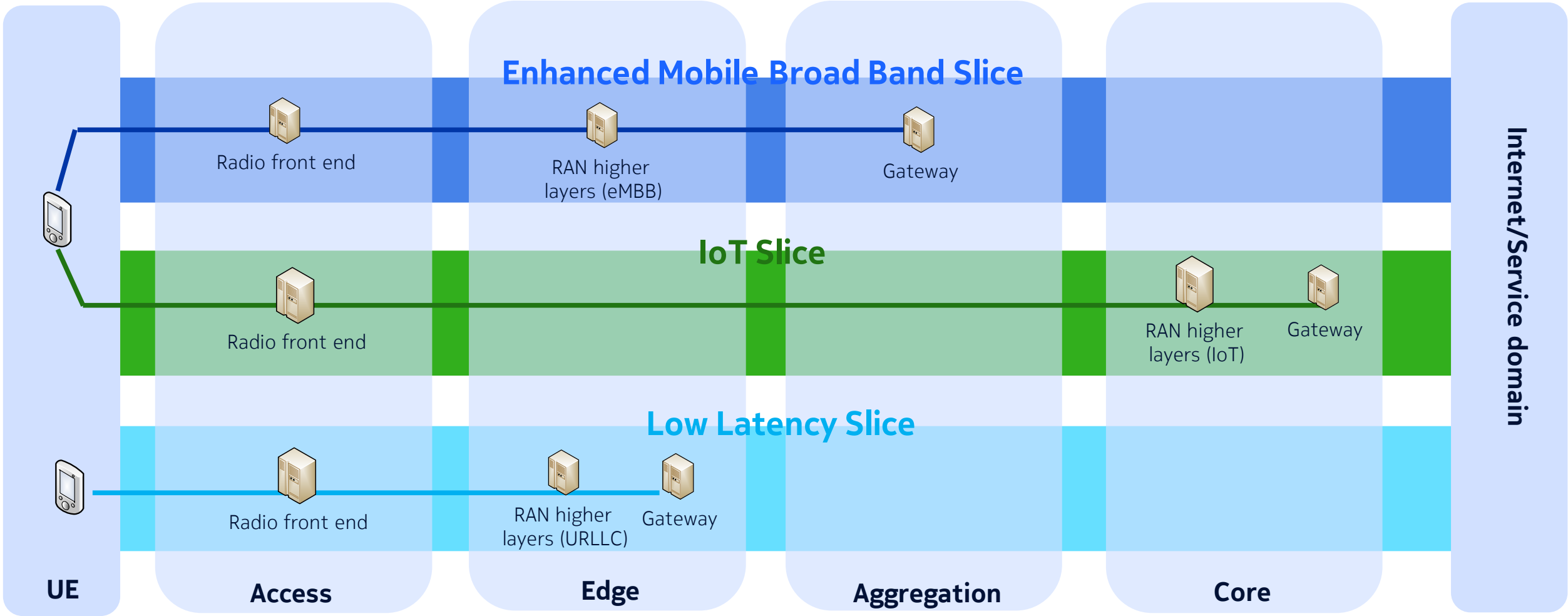
Mobile Network Topology
Larger European operator

➔Diverse x-haul, network topologies, aggregation scenarios



Network and RAN slicing

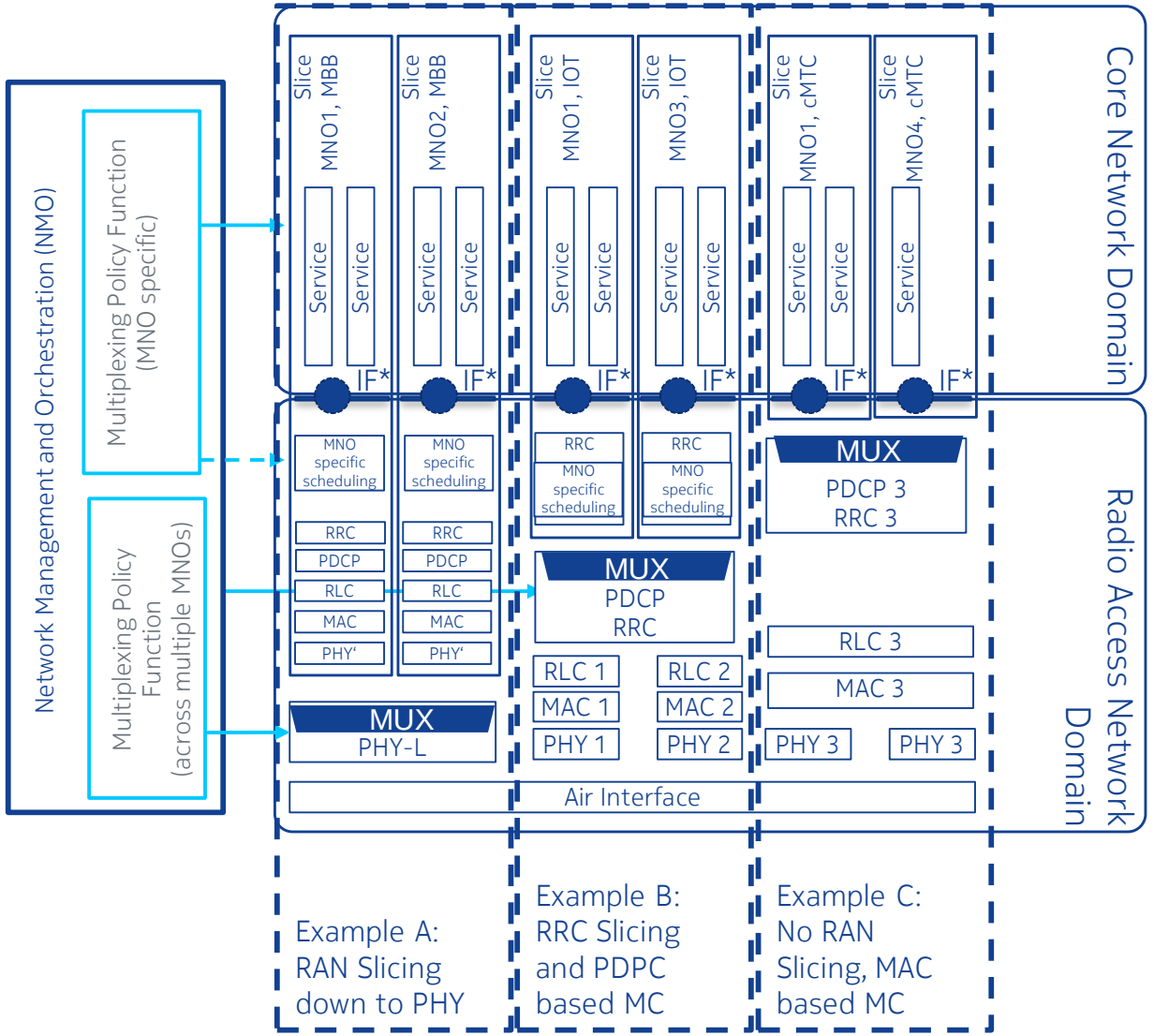
Flexibility to support different use cases in the same physical network



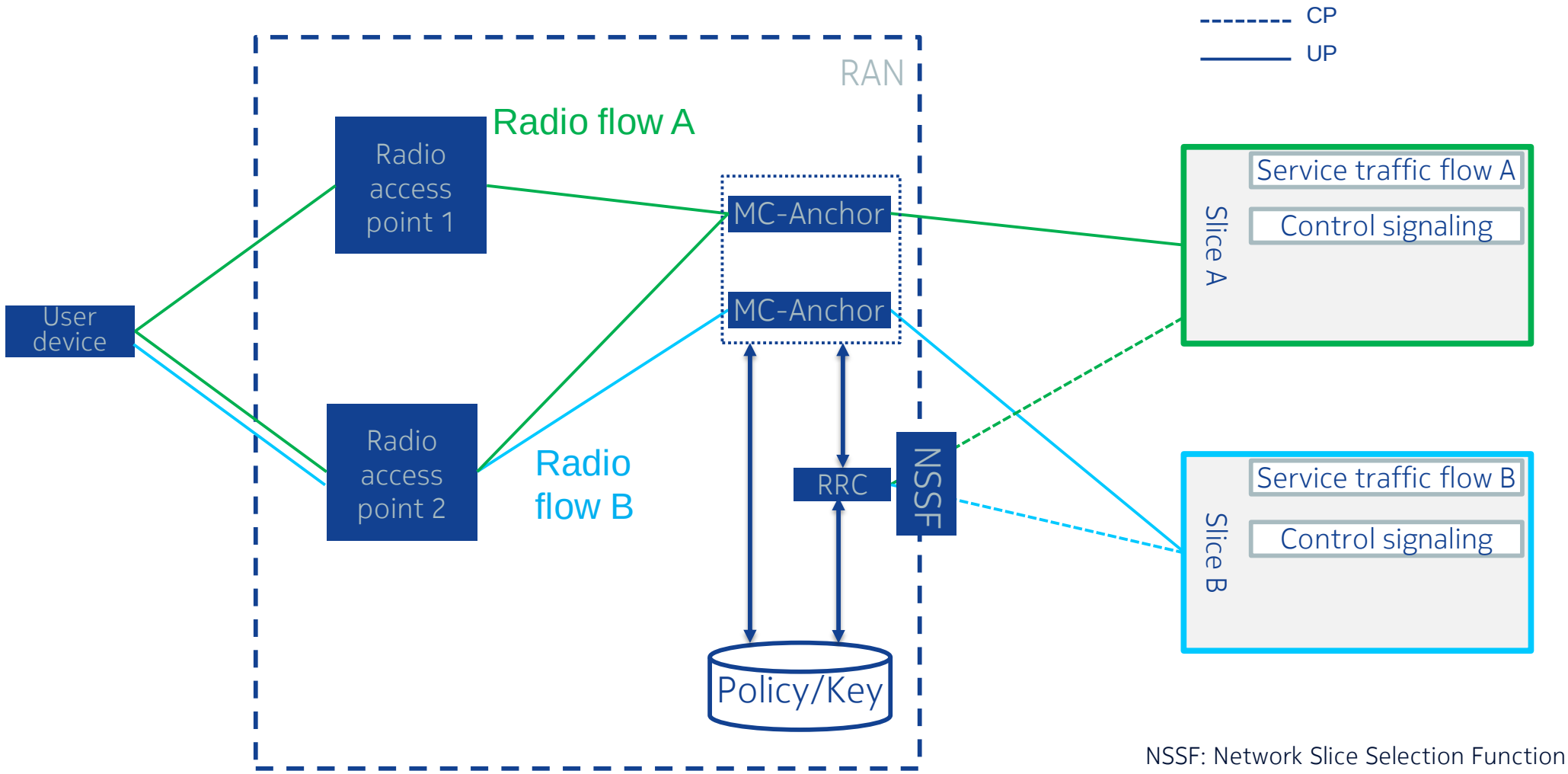
Isolation requirements

- Isolation of radio resources:
  - in order to fulfil slice-specific service level agreements (SLAs).
  - Function of the QoS framework and can be enforced by resource scheduling on MAC or on higher layers.
- Isolation of processing resources for network functions, e.g. if network functions are operating in a virtualized environment.
- Cryptographic isolation between slices, by providing cryptographic keys to the corresponding encryption function in RAN.

RAN slicing – basic concept

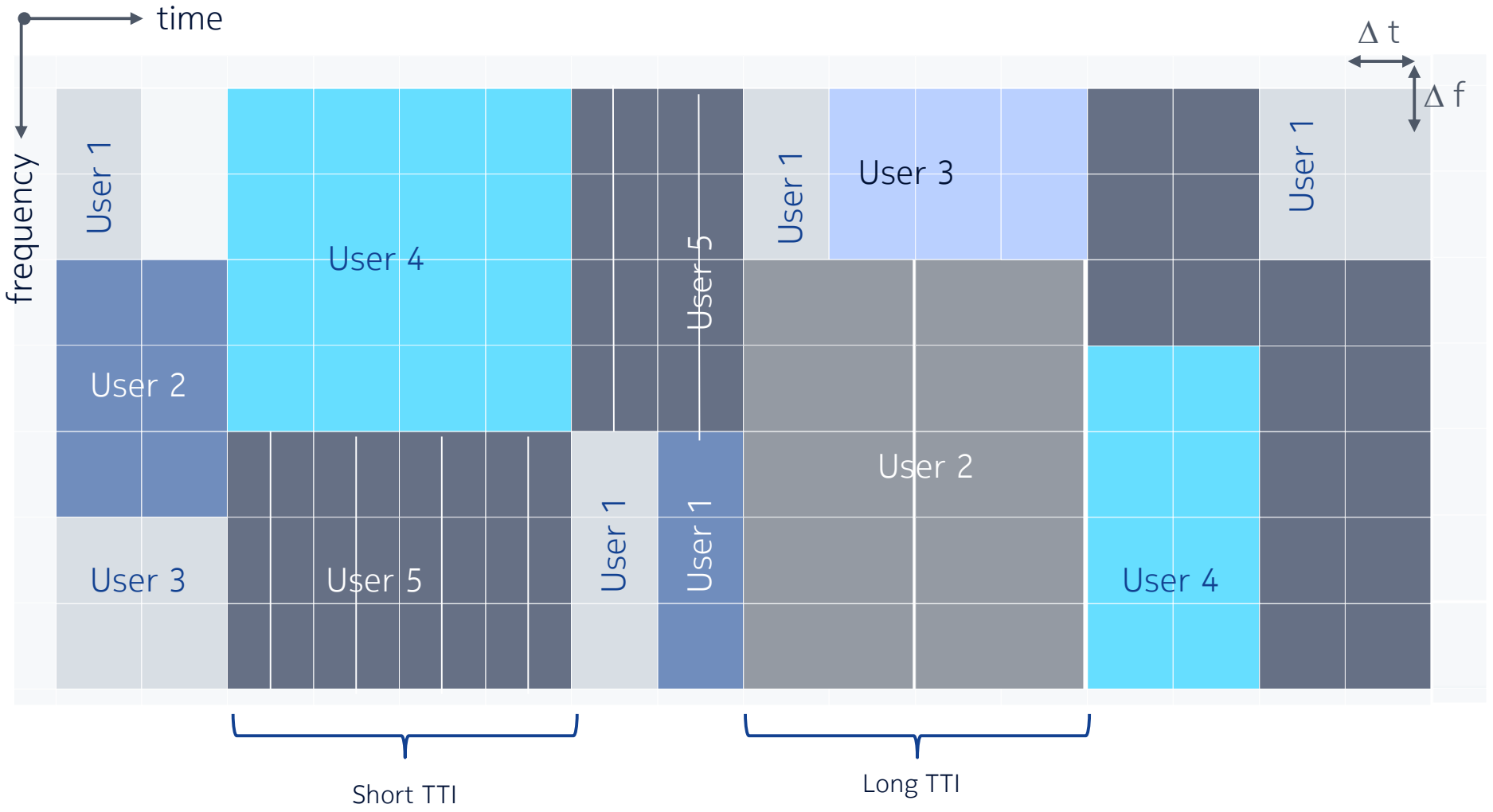


Basic architecture concept in 5G



NSSF: Network Slice Selection Function

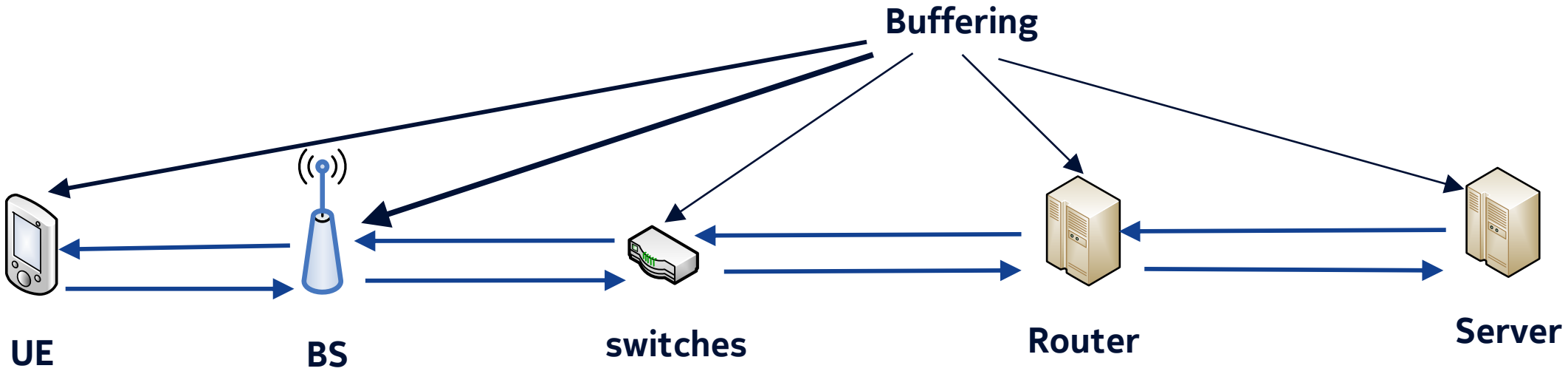
Mapping to lower layers
Exploiting air interface flexibility



Different TTI length per tile as enabler for slices with low-latency requirements

However, trade-off with cell capacity (multi-user diversity gains) need to be considered

Where does delay come from?



Air interface:
- Frame alignment/TTI
- Resource request (UL)
- RACH (UL)
- HARQ

On all nodes:
- Processing delay
- Packet buffering
- Multiplexing (e.g., TDM)

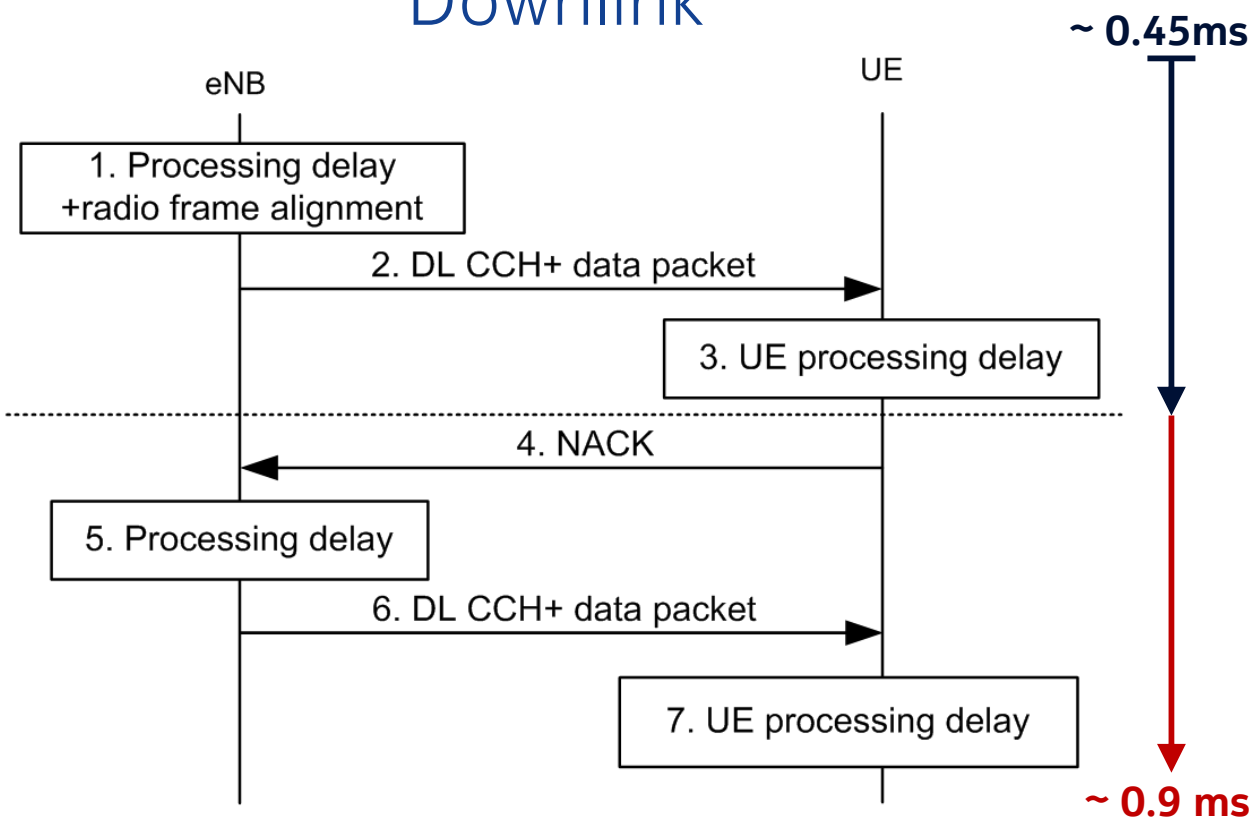
On all links:
- Transmission delay
- Duplex (e.g., TDD)

Air interface latency in 5G

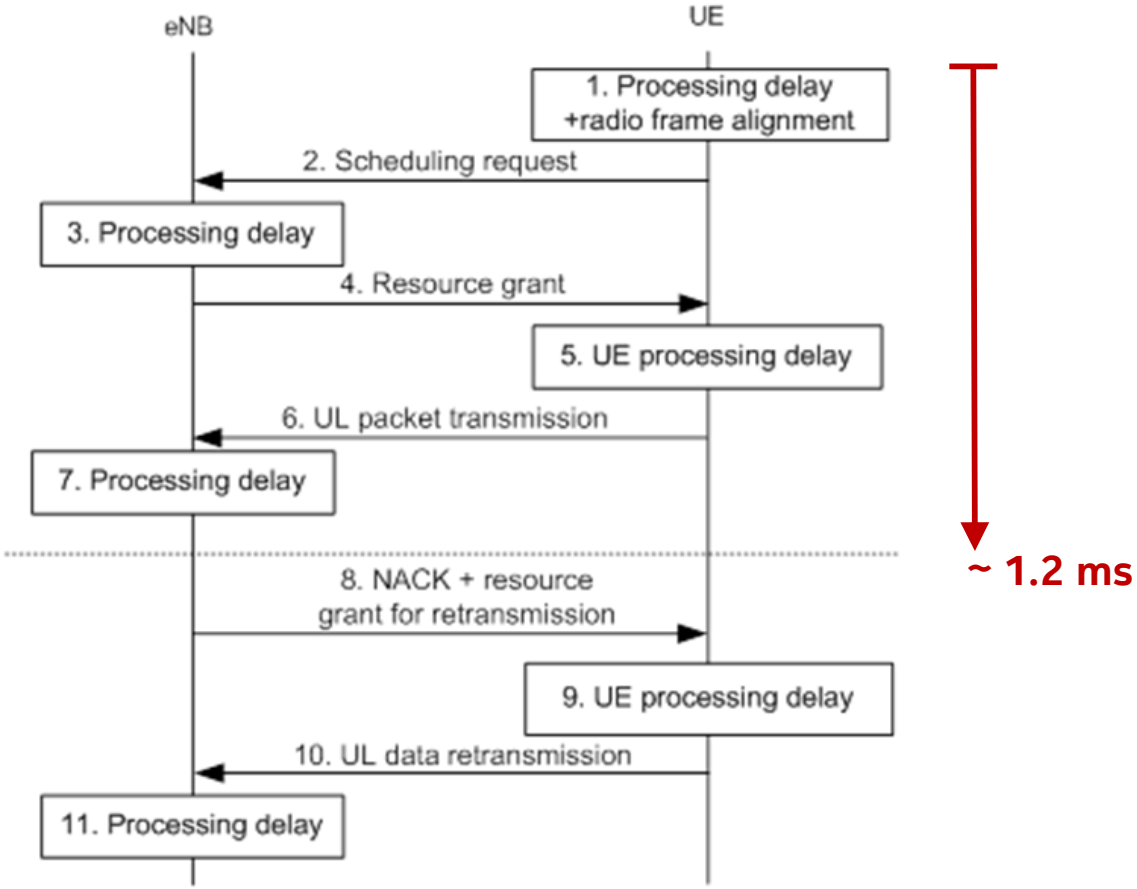
FDD, 0.125ms subframe length, 0.1ms processing in DL, 0.15ms in UL

Target: 0.5ms in UL and DL

Downlink



Uplink



Source: NOKIA Networks, “R1-165028; URLLC U-Plane Latency Analysis”

What to do in 5G?

Air interface:

- Shorter TTI/subframe (0.125 ms)
- Bi-directional subframes
- Shorter processing times (10x reduction)
- Robust coding/no or low #HARQ retransmissions
- Resource pre-allocation (e.g., semi-persistent scheduling – avoid resource request)
- Enhanced random access (e.g. 1 or 3 step instead of 5 step)
- Service-aware RRM
- Enhanced mobility mechanisms
- Device-to-device communication
- Multi-connectivity schemes

On all nodes:

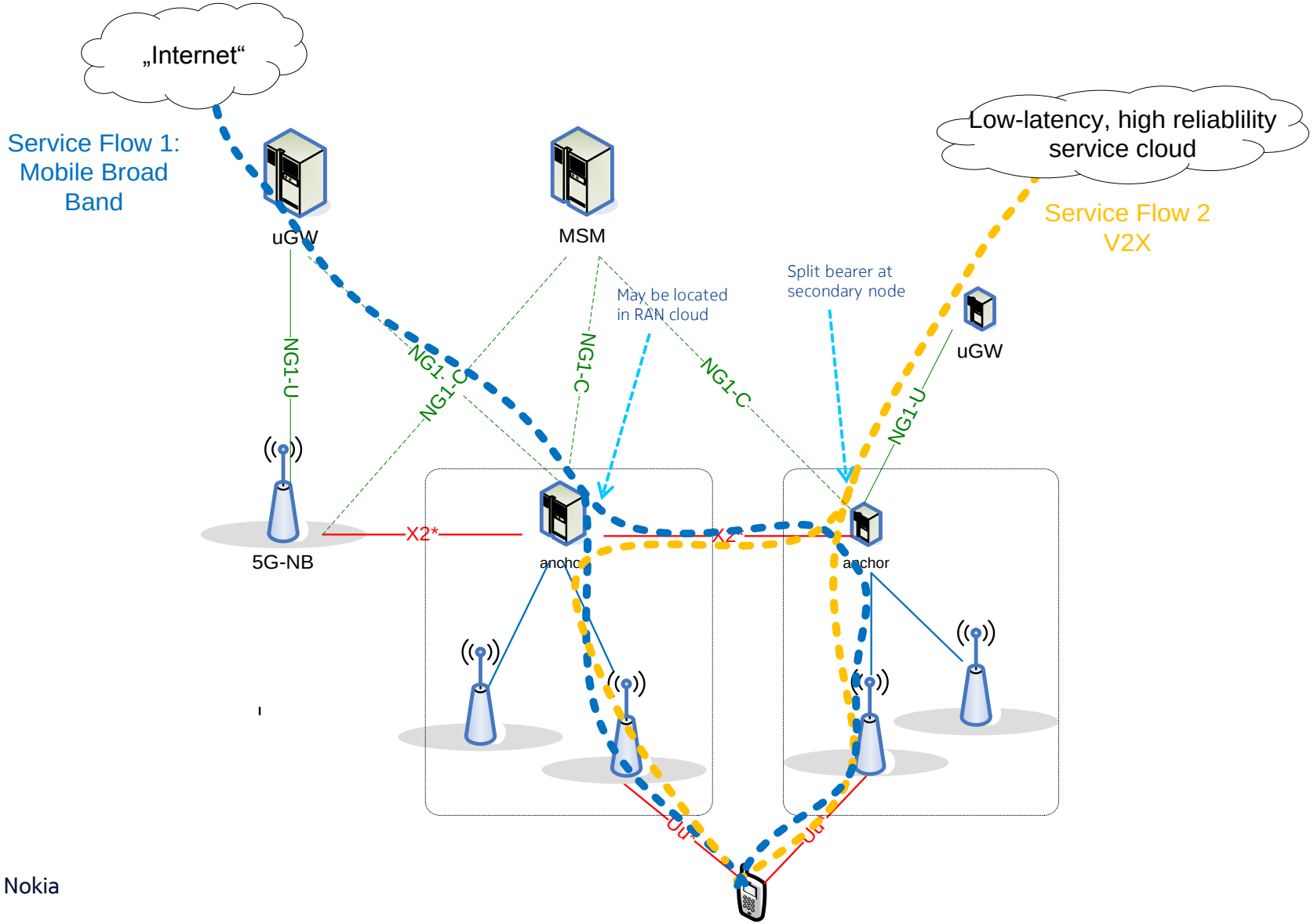
- Reduced processing delay (10x reduction)
- Priority queuing very small buffers
- Low number of hops to reduce instances of processing and buffering
- Path switching instead of packet switching

E2E architecture view

- Functions close at network edge
- Mobile edge computing optimized for low-latency
- Local area routing
- End-to-end QoS enforcement
- Resource isolation and/or dedicated infrastructure for low-latency
- Centralized resource coordination

Support for low-latency in unified architecture

Scenario: support of mobile broadband and ultra low latency



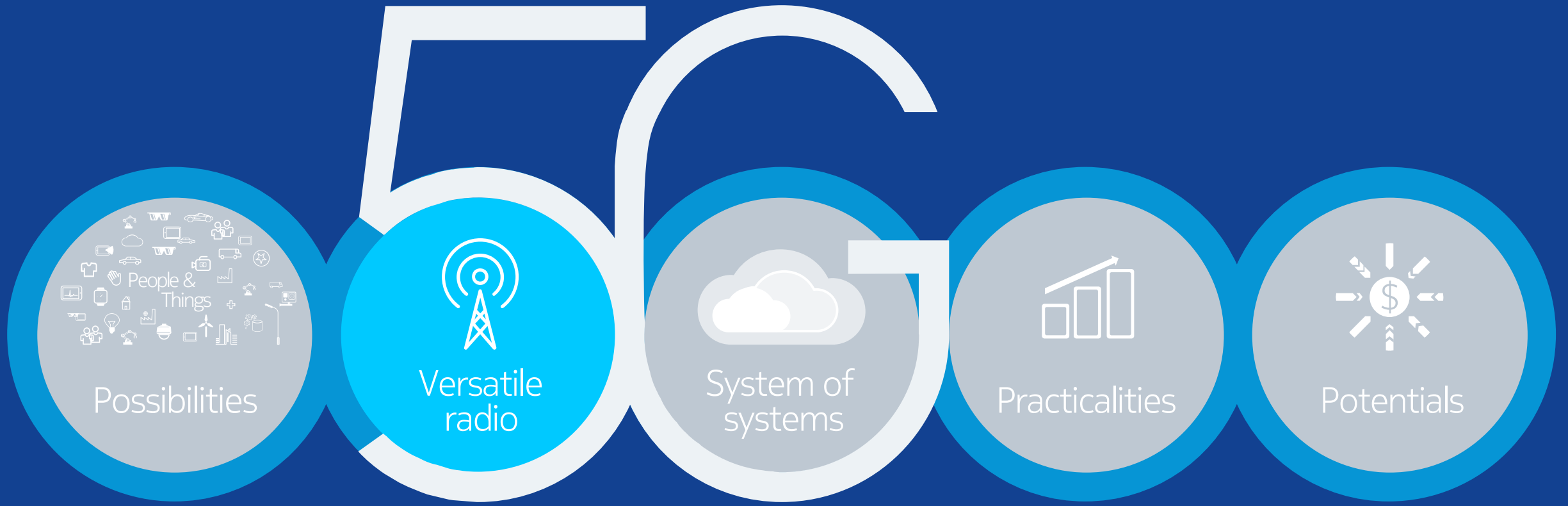
Summary and Outlook

Network and RAN slicing are key concepts for 5G

- Enables flexibility for different use cases in the same network
- Reduces management and maintenance efforts

Low latency services – enabled by function optimization and deployment flexibility

- Configuration and optimization across all RAN functions
- New resource management schemes needed
- Flexible architecture concepts to support different use cases



Key to the programmable world

RAN slicing as enabler for low latency service

NOKIA

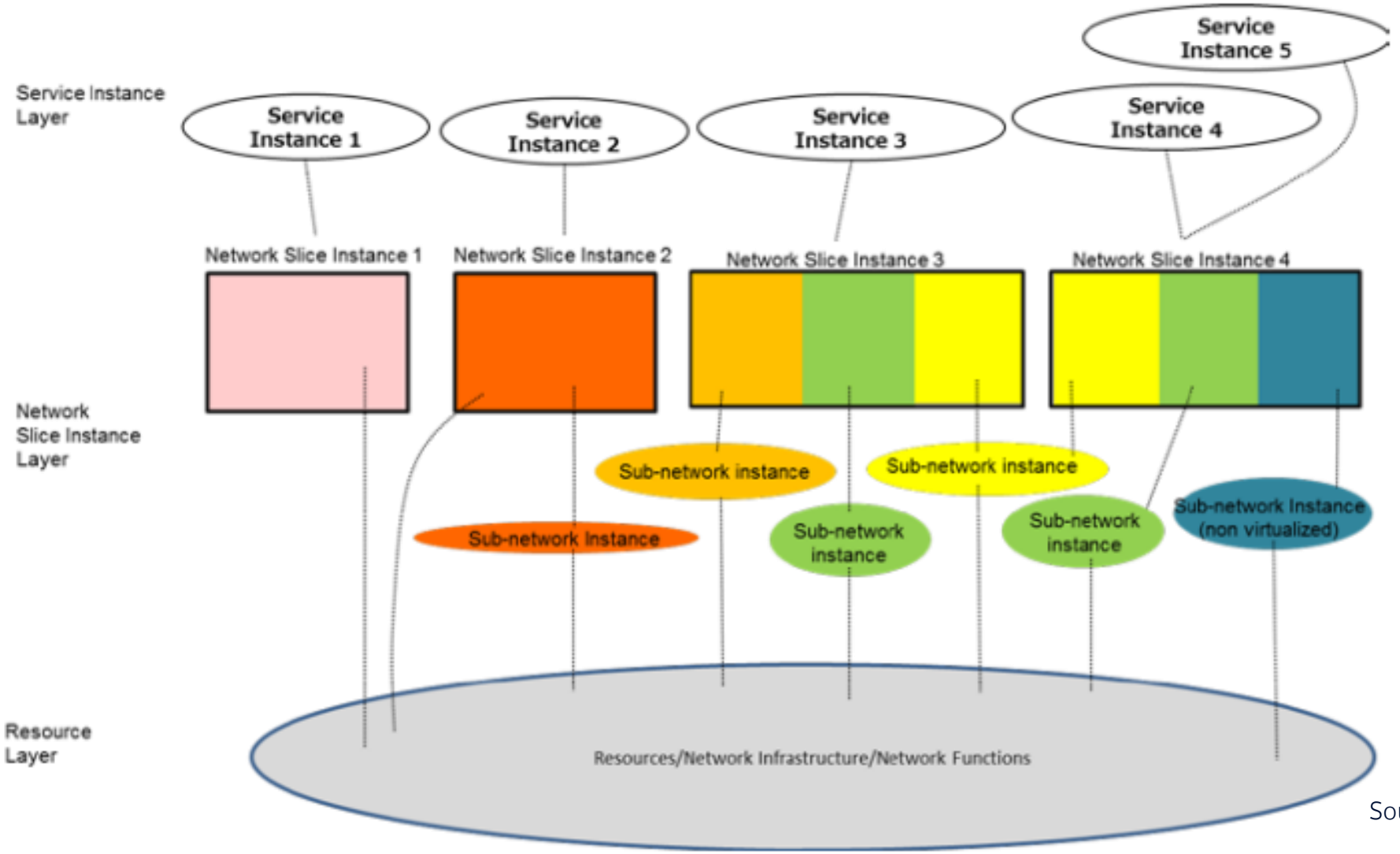
References

[1] NGMN Alliance, “Description of Network Slicing Concept”, January 2016

[2] NOKIA Networks, “R1-165028; URLLC U-Plane Latency Analysis”, 3GPP RAN1#85, May 2016

[3] 3GPP, “TR 38.913 V.0.3.0; Study on Scenarios and Requirements for Next Generation Access Technologies”, May 2016

Definitions



Source: NGMN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