5G for people and things

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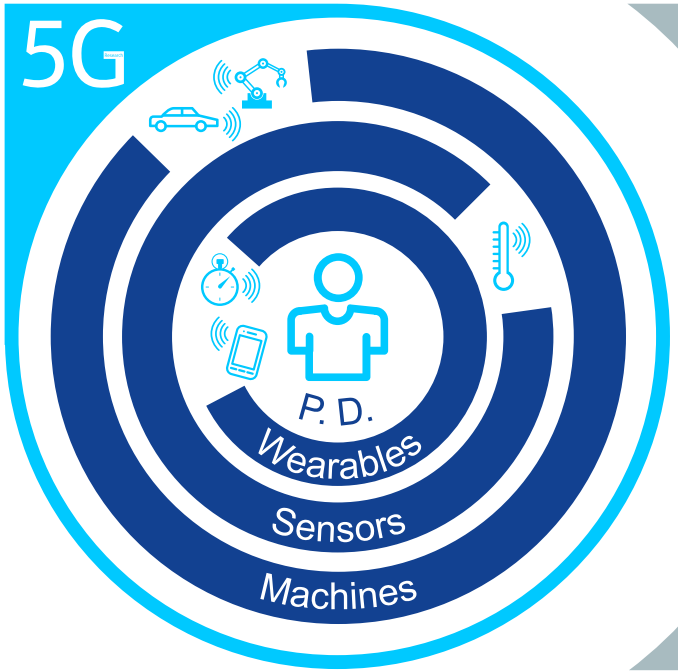
Jun.11, 2015

IEEE ICC London

Expanding the human possibilities of technology

5G for people and things

Expanding the human possibilities of cellular technology



Give back 2hrs/day… never be in a rush

Everyone is an innovator – easier and faster to innovate

Towards **zero road fatalities**

Zero loss water distribution

Healthier people with connected wearables, remote medics

Less transport costs and fuel consumption

Never lost - always find an address – always on time

Higher industry productivity through connected cyber physical systems

Safer in connected homes

Individual | Society | Economy

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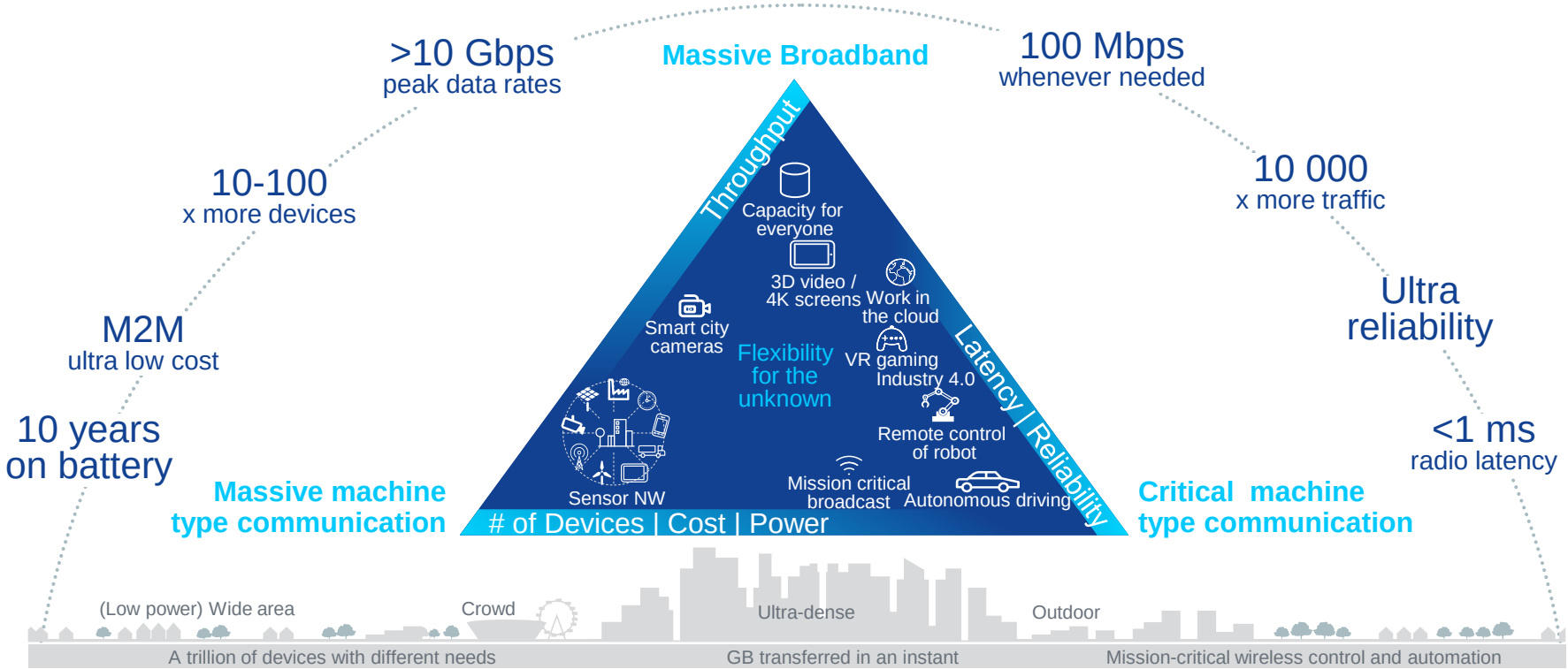
5G will enable very diverse use cases with extreme range of requirements



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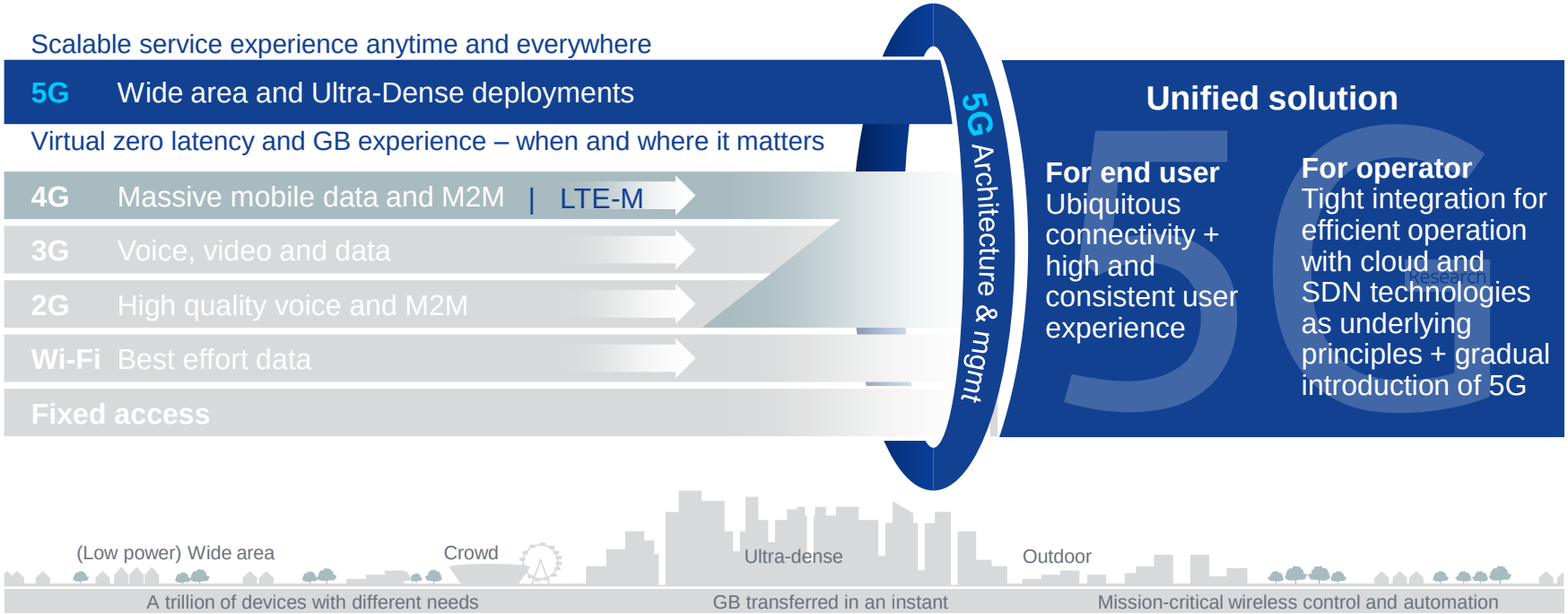
A symbiotic integration of novel and existing access technologies

Nokia 5G system vision



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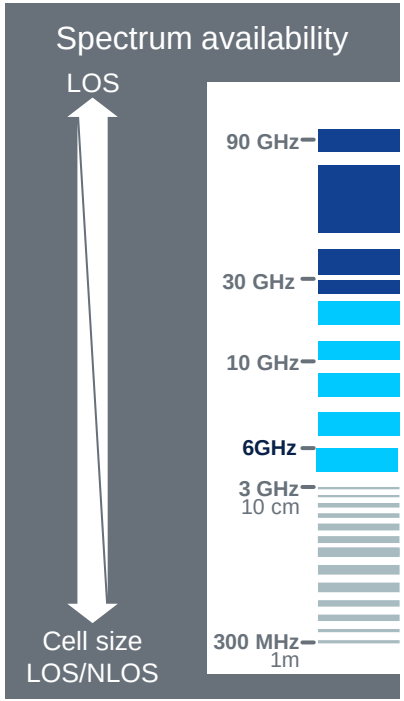
Spectrum is Key



- The exclusive licensing regime should remain the preferred solution for access to core mobile broadband spectrum(CA for fragmented band, exploration of >6G Hz band)
- Spectrum sharing between operators(e.g. Co-Primary sharing) and other industries(e.g. LSA/ASA) should be considered as a complementary solution for additional spectrum
- Nation-wide spectrum that is globally harmonized to enable guaranteed QoS, global scale and global roaming

The range of diverse use cases results in various requirements for the architecture

Enabling benefits for the operators

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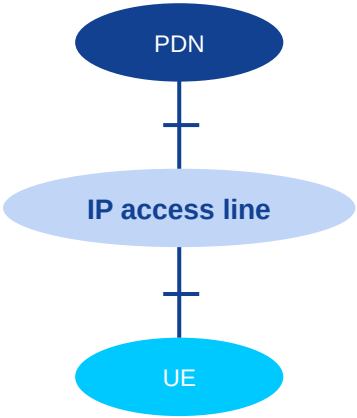
5G needs an enhanced connectivity model

To enable new use cases

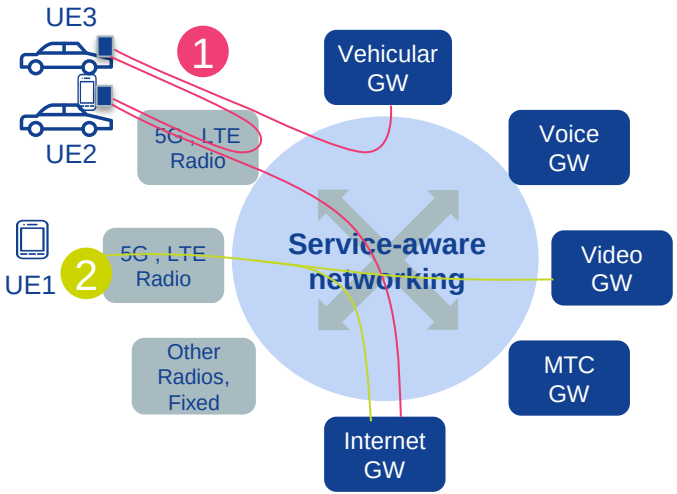
Connectivity in LTE

- Transparent pt-pt IP access line
- U-plane and c-plane are designed for pt-pt model



Enhanced 5G any to any connectivity

- Service-aware u-plane packet forwarding with full support for mobility, charging, lawful intercept
- New c-plane optimized for highly distributed service-aware networking functions



Some use cases require enhanced connectivity options for e.g.

1. local switching (for 5G low latency) and simultaneous access to Internet or other services
2. simultaneous connection to multiple GWs (e.g. for internet and optimized video delivery (MEC))

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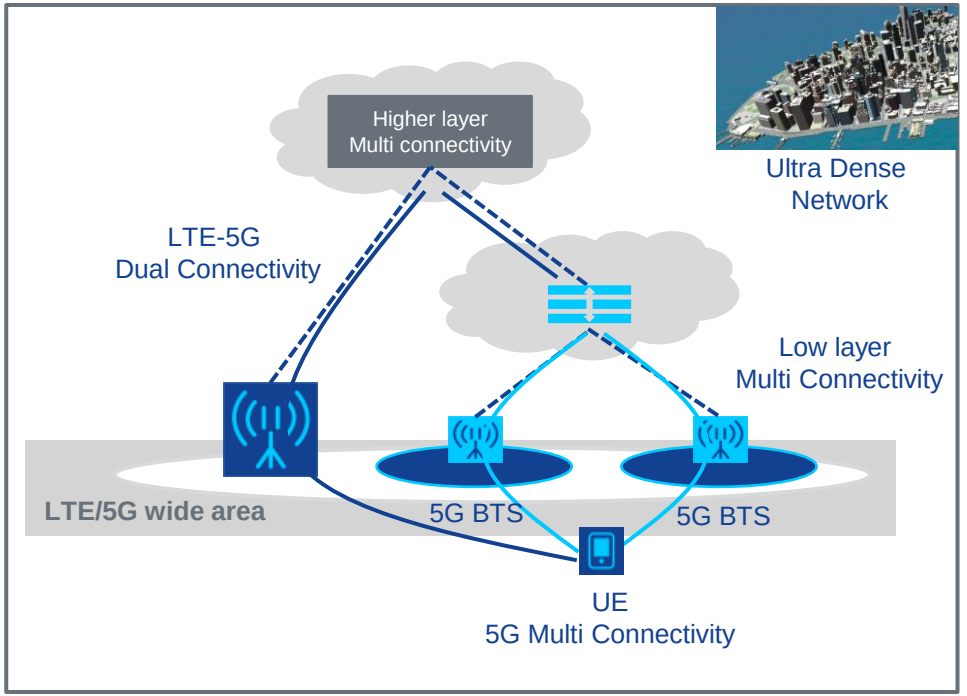
Reliability

Simultaneous and native Het Net & multi-connectivity

- LTE⇔5G dual connectivity ensures smooth introduction of 5G
- 5G multi-connectivity improves robustness and data throughput
- Multi or Single connectivity selected depending on the type of service

Benefits:

- Highest data throughput and consistent end user experience
- Enabler for the growing market of mission-critical services, e.g. health and safety, industry automation



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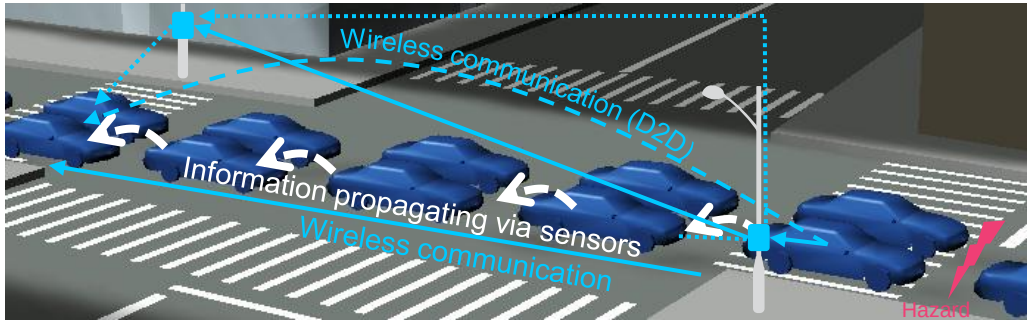
Low Latency

Example: autonomous vehicles transforming urban space

Dynamic geo-networking of vehicles:

- In a certain geographic location or area (e.g. an intersection, a road hazard)
- Forming a moving platoon of cars in close proximity with full mobility support



Related connectivity requirements:

- Lowest latency packet forwarding among UEs forming a virtual network
- Full mobility of UEs and virtual networks
- Seamless connectivity to additional services (e.g. Internet, traffic control)

Advances in automotive sensors

Advances in wireless comms.

t

Communications-assisted driving

Car drivers receiving information about hazards ahead

Autonomous driving

Sensors used to avoid collisions or drive in “road trains”

Communications-enhanced auto-nomous driving

Sensors + wireless communications used to react to hazards

lowest latency / highest reliability

In combination with mobility!

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Mobility on demand

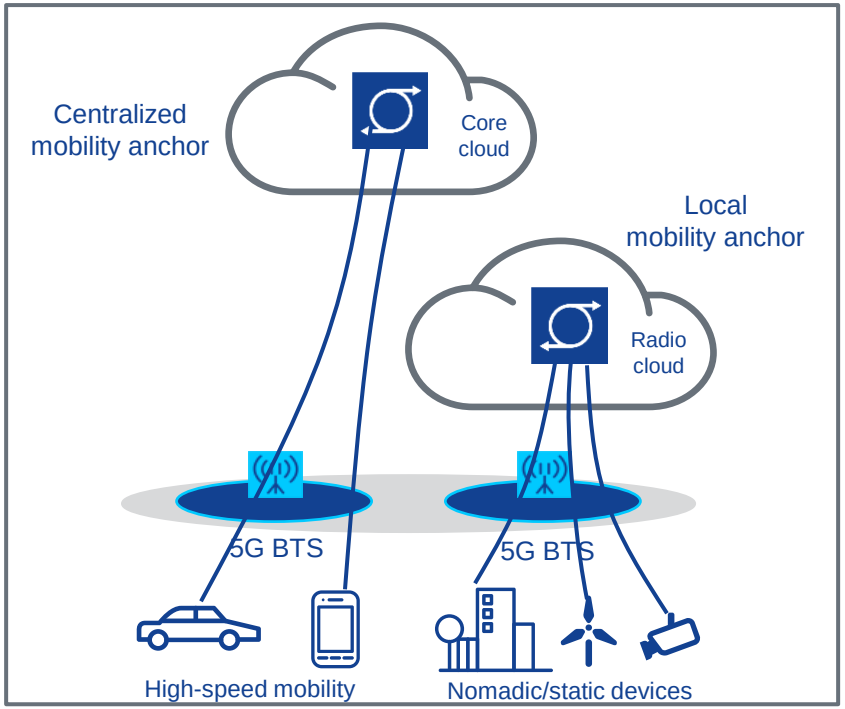
Mobility and service continuity offered on demand

Wide range of mobility options

- No mobility (stationary meters, CPE) to high-speed trains running at 500km/h
- Various levels of service continuity: seamless mobility, nomadic mobility, sporadic senders
- Some MNOs observed that only 30% of subscribers are actually mobile

Benefits

- Optimize traffic flows and network resources
- TCO optimization:
  - Not all devices need full mobility support
  - Reduce core network resources and avoid traffic backhauling to centralized cloud



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Quality and user experience
5G QoE architecture

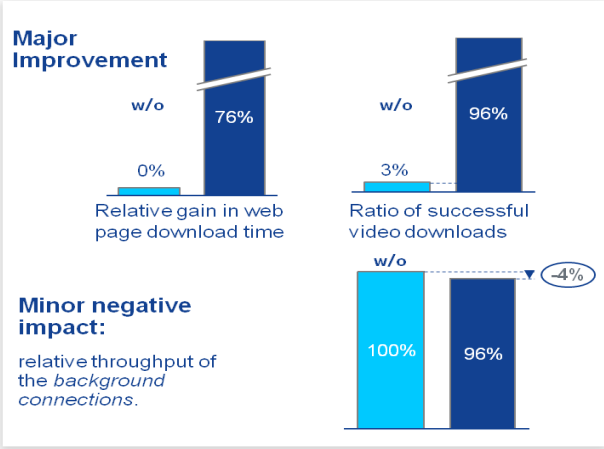
Drivers for a new QoE architecture

- Network enforces Quality of Experience rather than QoS
- Dynamic application-based QoS for known and future OTT applications
- Not achievable with LTE where same QoS is applied for all traffic in a bearer

Benefits

- Monetize quality of experience (B2B , B2C)
- Efficiently serve different business models, verticals (IoT and mission critical) as well as consumers
- Ensure superior user experience (web pages loading 76% faster, 96% of videos stream successfully)
- Good QoE in nearly 100% of the cases even in congested networks

Dynamic app-based QoE during congestion periods



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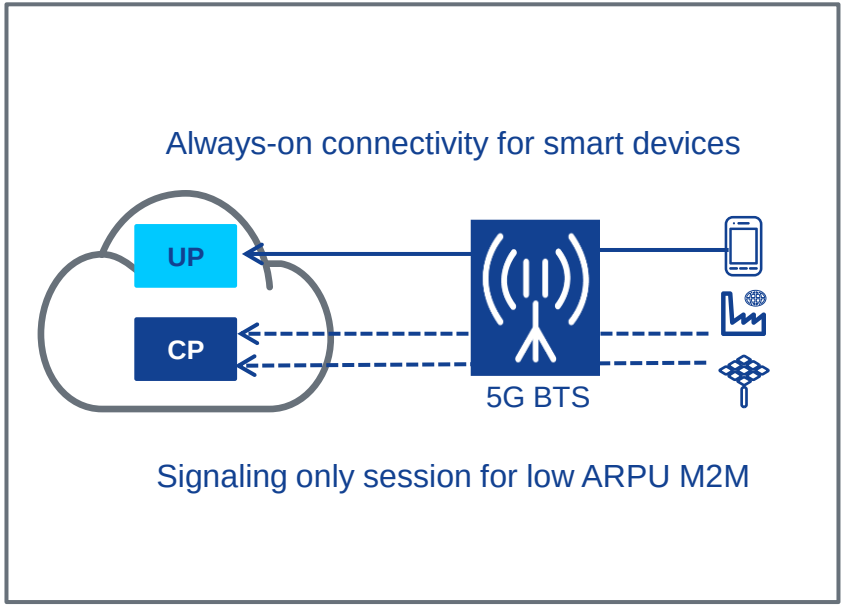
Session on demand

For improved network resource efficiency

- Resource efficiency for sporadic data transmission of low-cost and low ARPU devices can be significantly improved
- Session on demand eliminates signalling overhead for user-plane management
  → signalling only session

Benefits

- Efficient use of network resources
- Extended UE battery life



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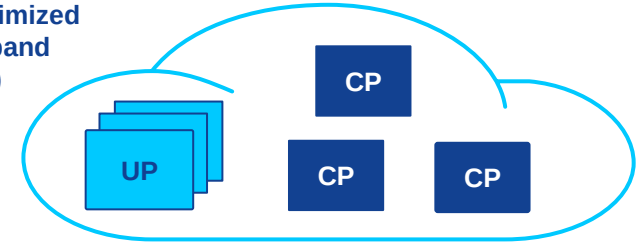
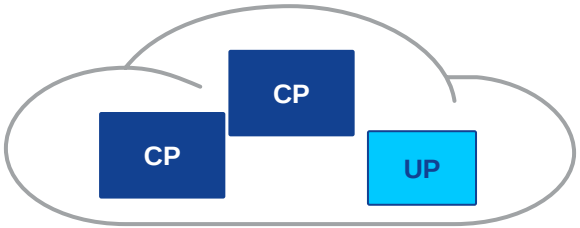
Network as a Service enables flexibility and Scalability

RAN selects the proper network slice based on UE type, class of service

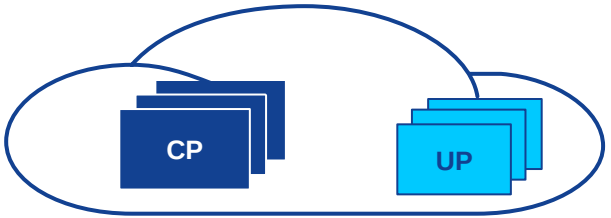
Network instance optimized for massive broadband (smart devices)



Network instance optimized for Massive MTC



Network instance optimized to offer low latency, high reliability (critical MTC)



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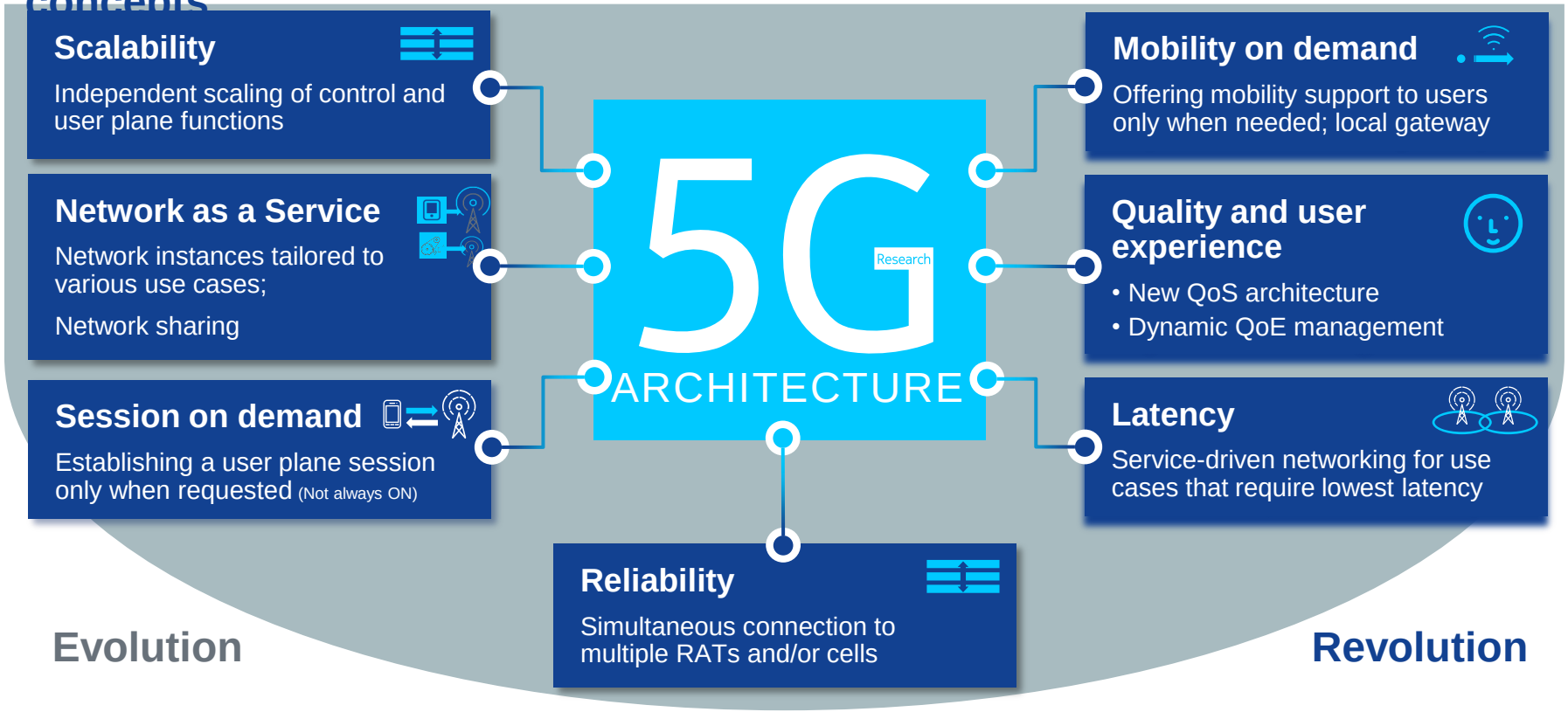
Translate into the need of a healthy balance of evolutionary & revolutionary concepts



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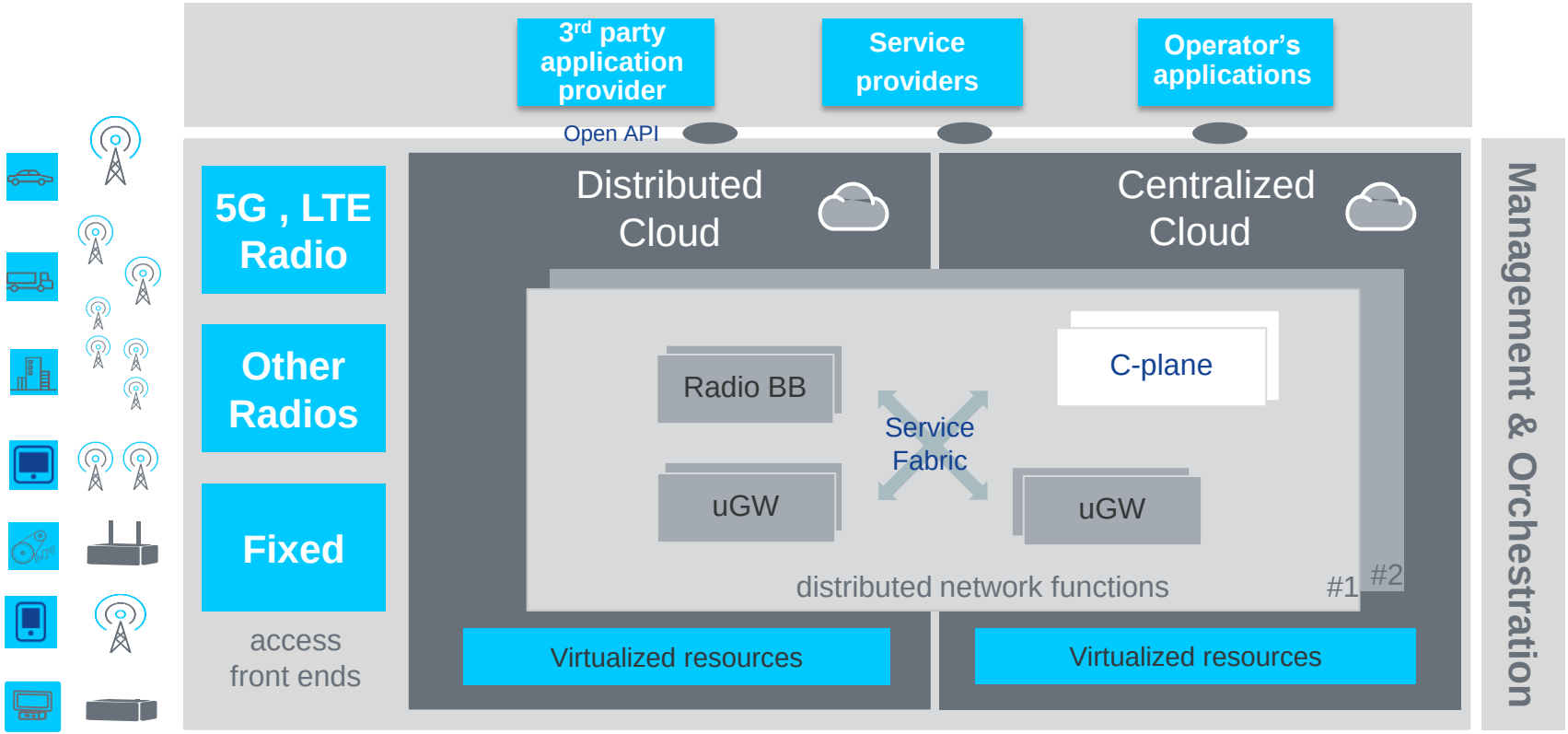
End to end 5G network architecture



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Nokia active on 5G

COLLABORATION

Leading HetNet

Chairing association

Leading WP2

Focused customer collaborations

Requirements contribution

REGULATORY & STANDARDS

ITU-R

Evolution

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RESEARCH

Holistic systems research, prototyping & development

University collaborations

Conference, Journal & Workshops

POLICY

Supporting right technology related policies

ALIGNMEN

Bringing together industry, academia & regulators

→ find regular updates under www.networks.nokia.com/innovation/5G

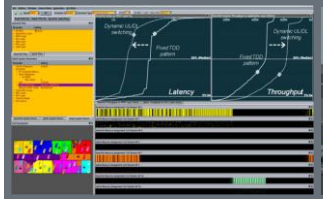
- Deep technological competencies
- Unparalleled innovation capabilities
- Trusted collaboration partner
- Strong intellectual property
- Holistic system approach

http://networks.nokia.com/innovation/5G

5G

Nokia is geared to lead

Meeting you at our 5G DEMO booth:

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