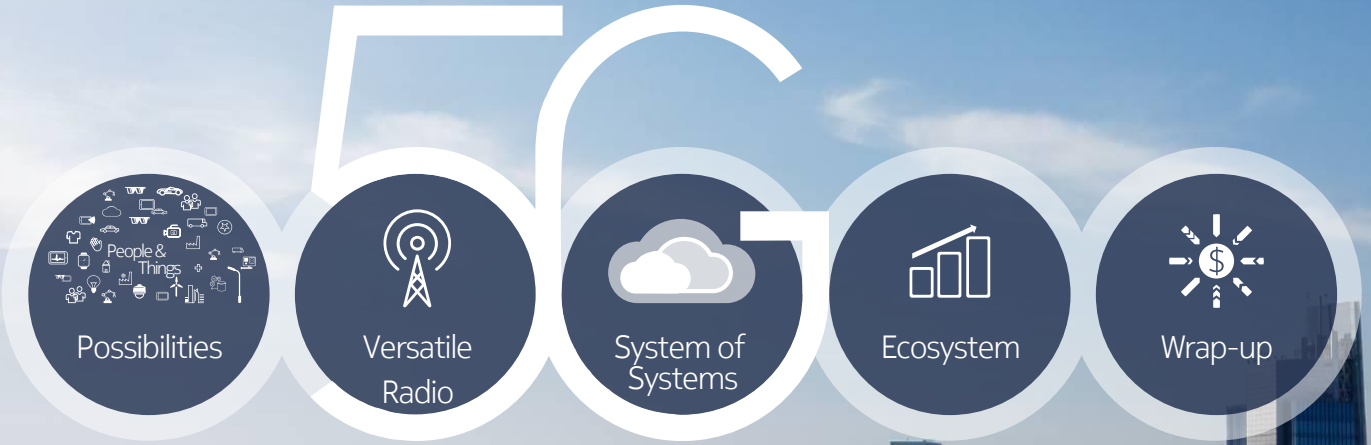
5G Technology Aspects



GSMA/GSA Session : Forward Thinking for Spectrum
Getting Ready for 5G
16.11.2017, Bangkok

Dr. Ulrich Dropmann
Head of Standardization
BellLabs/CTO – Nokia

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Possibilities

Versatile radio

System of systems

Transition

Wrap-up

5G

Making 5G a reality

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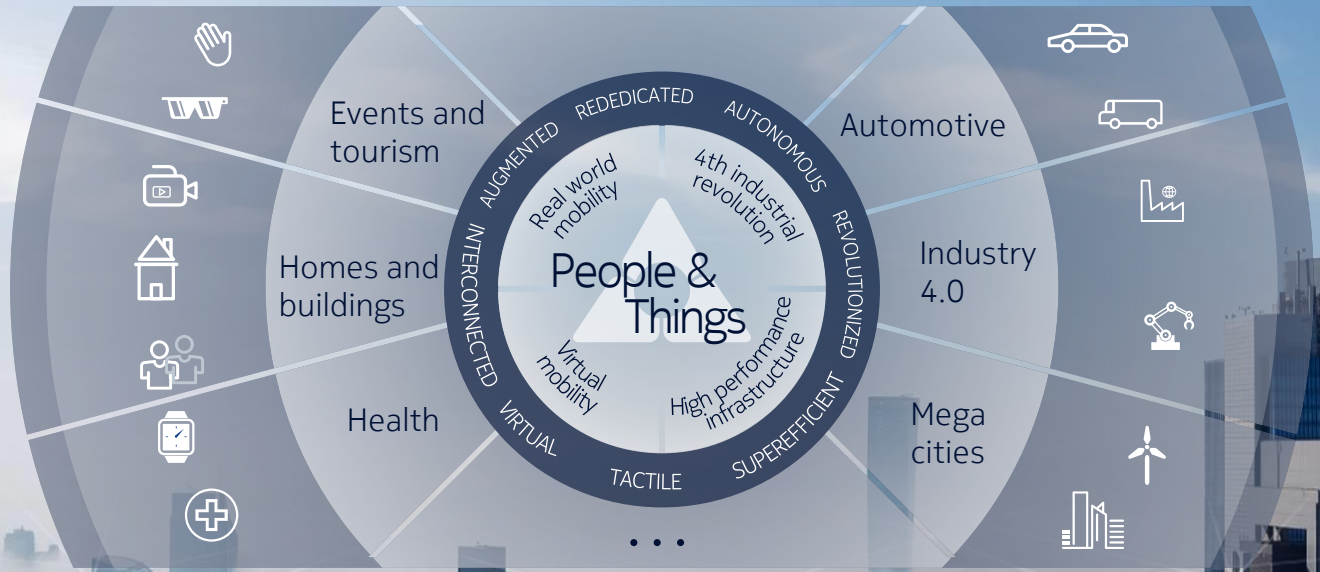
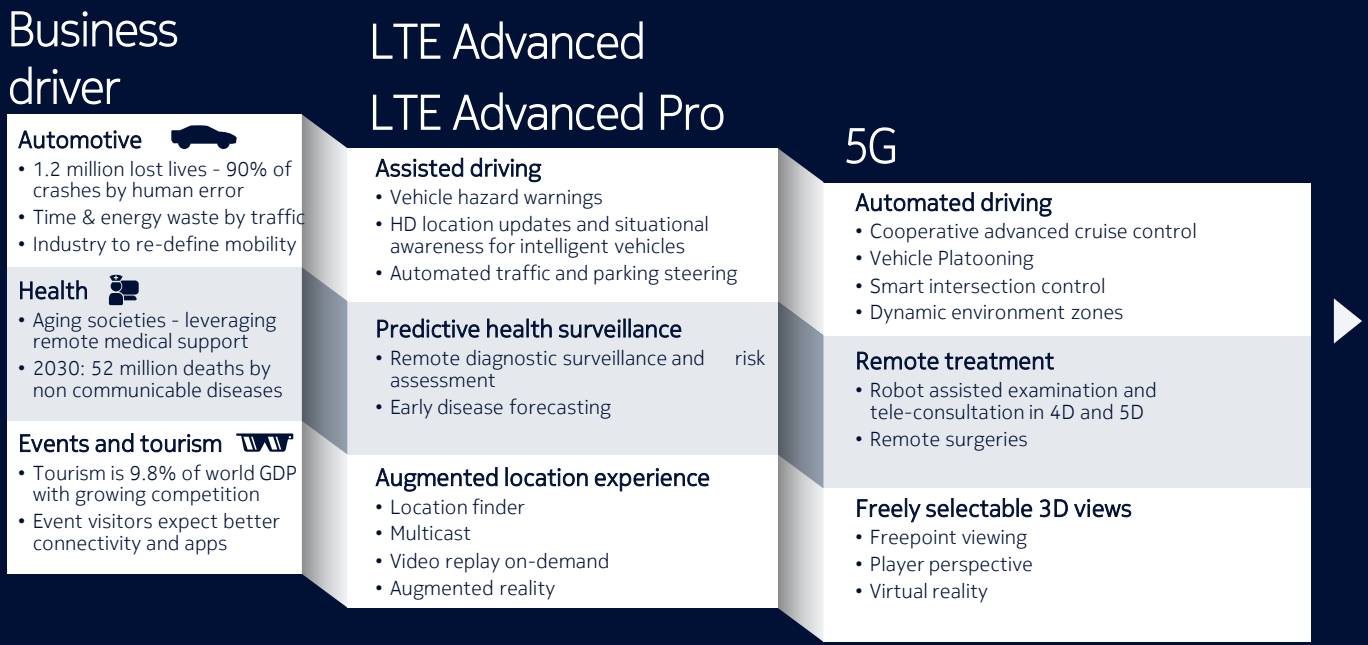
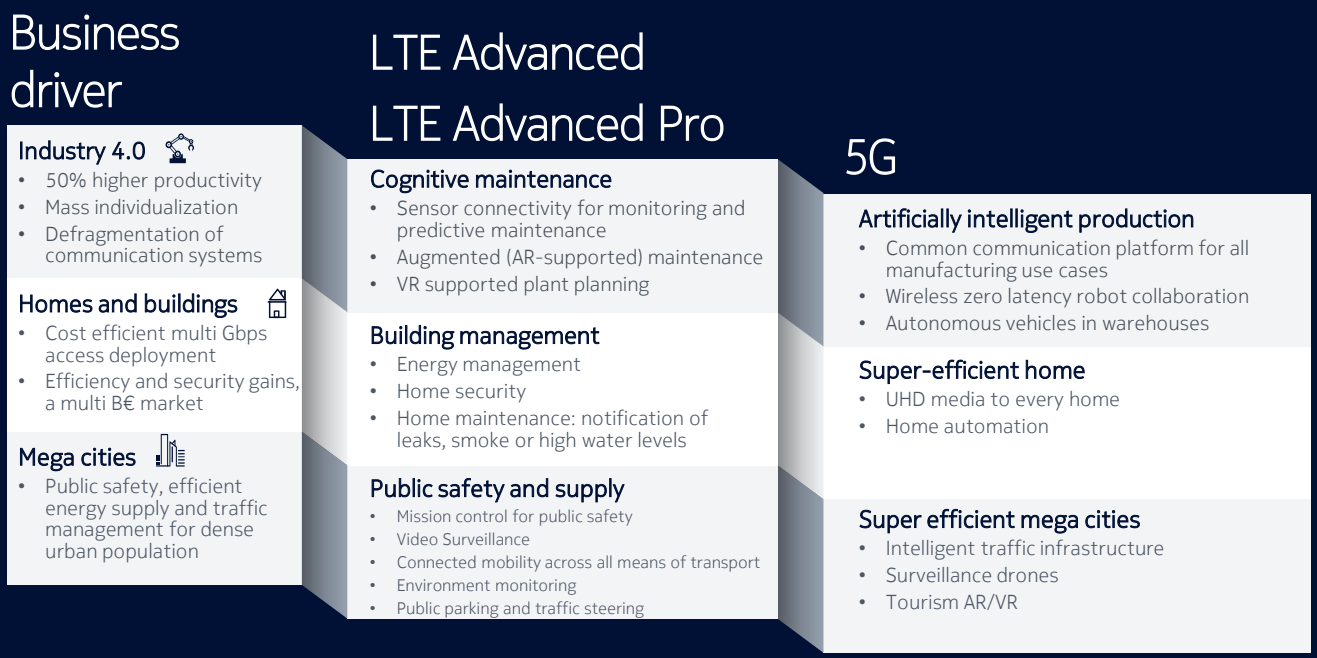
5G is all about enabling revolutionary use cases



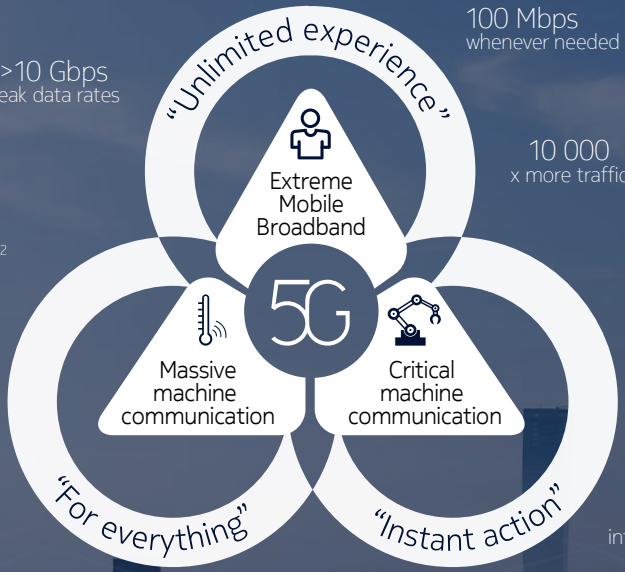
Use case evolution – 5G business starts now



Use case evolution – 5G business starts now



Revolutionary use cases demand widest system capabilities



Capacity

>10 Gbps
peak data rates

100 Mbps
whenever needed

10 000
x more traffic

1,000,000
devices per km^2

Latency

<1 ms
radio latency

Ultra low cost
for massive machine coms.

Ultra reliability
< 10^{-5} E2E outage

Connectivity

10 years
on battery

Zero
mobility interruption

Reliability

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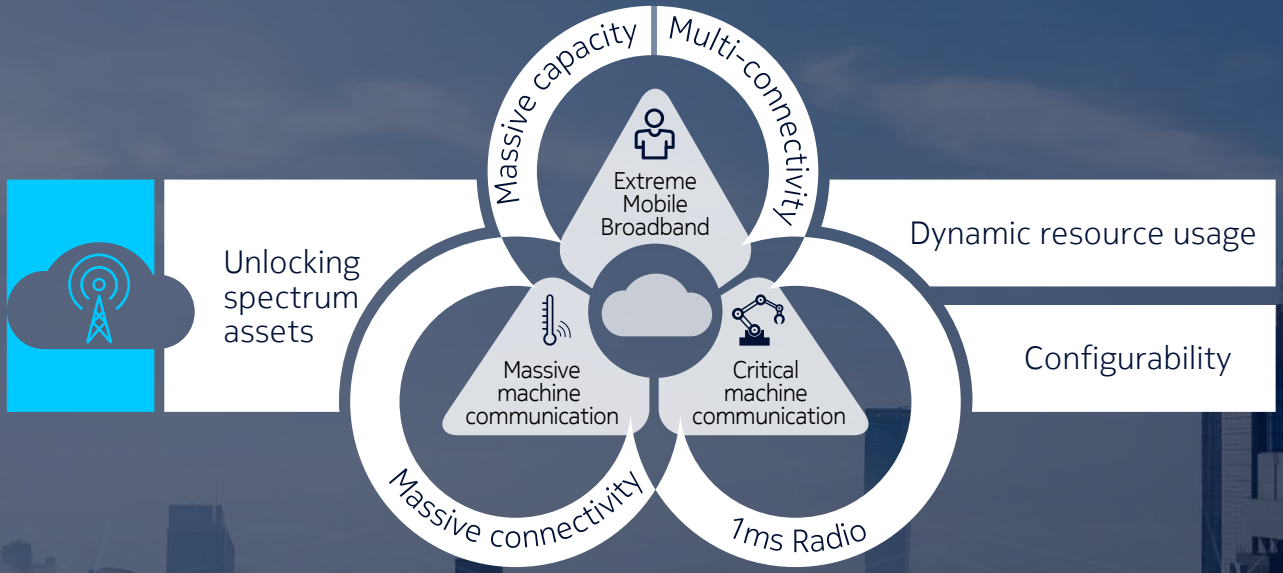
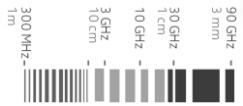
Versatile radio– Scalability, performance and efficiency

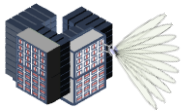


Main 5G Radio Technology Components

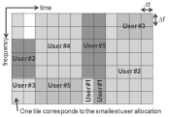
All kind of **spectrum** and bandwidth



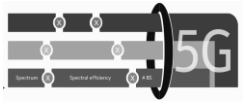
Scalable Massive **MIMO**, 3D MIMO, beamforming and beamsteering



Flexible frame **design**, dynamic optimization, large bandwidth

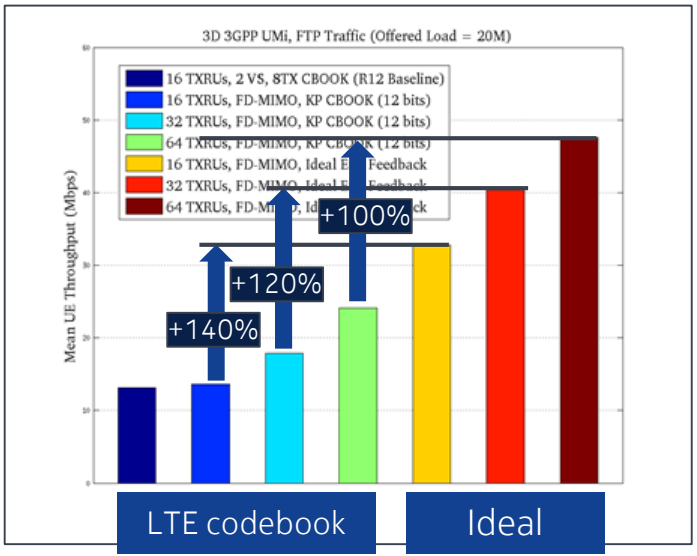


Multi-connectivity and aggregation

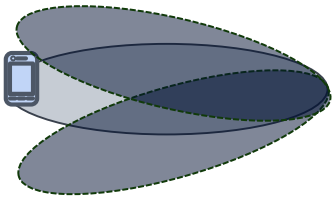


Cloud RAN for massive scalability & openness

Beamforming Gain Potential with MU-MIMO

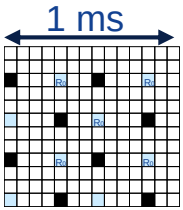


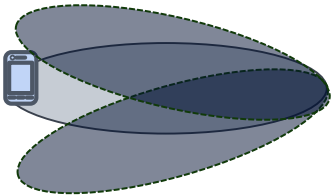
- There is a major difference in MU-MIMO gains with ideal feedback and with LTE codebook.
- The ideal results are +100..+140% higher. Room for improvement in 5G.



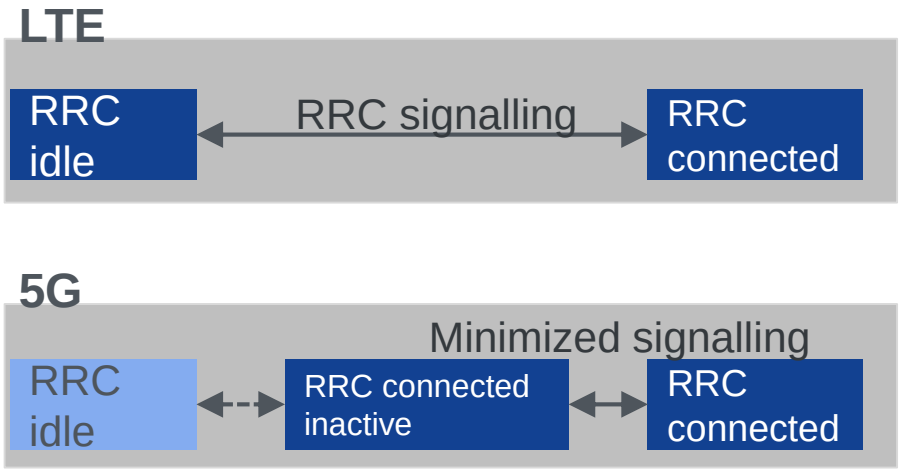
Flexible Design : 5G Lean Carrier

Lower power consumption	Zero users – zero power consumption
Less interference from reference signals	Minimized intercell interference improves capacity
More efficient beamforming	Dedicated user specific reference signals for massive MIMO





5G True Always-On



- Maintain RRC connection
- Minimize signalling and power consumption

RRC = Radio Resource Control

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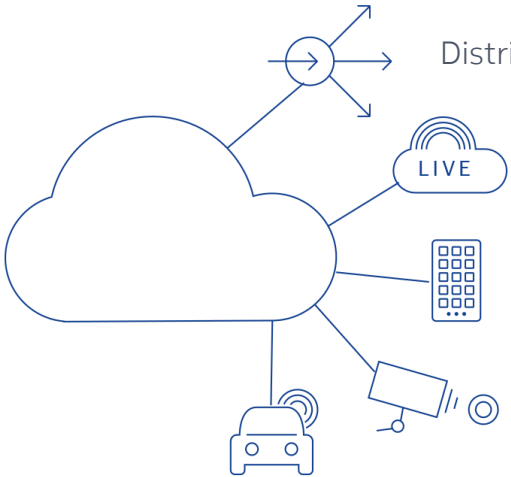
Multi-Access Edge Computing (MEC) in 5G



Distributed computing for **intense, local tasks**

Real-time delivery of live and on-demand content

Apps with **unmatched interactivity**

IoT **analytics** at the point of capture

Robust low latency for **critical communication**

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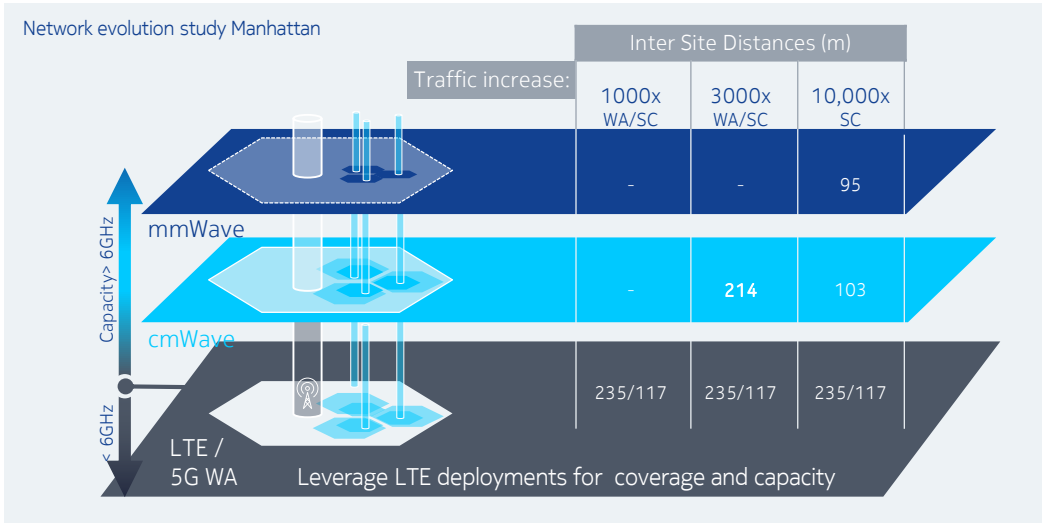
All Spectrum needed to adress traffic explosion



Economically feasible capacity for 10,000x traffic

Grow with traffic demand while building on existing investments

Extensive deployment studies in NYC, Tokyo and Chicago

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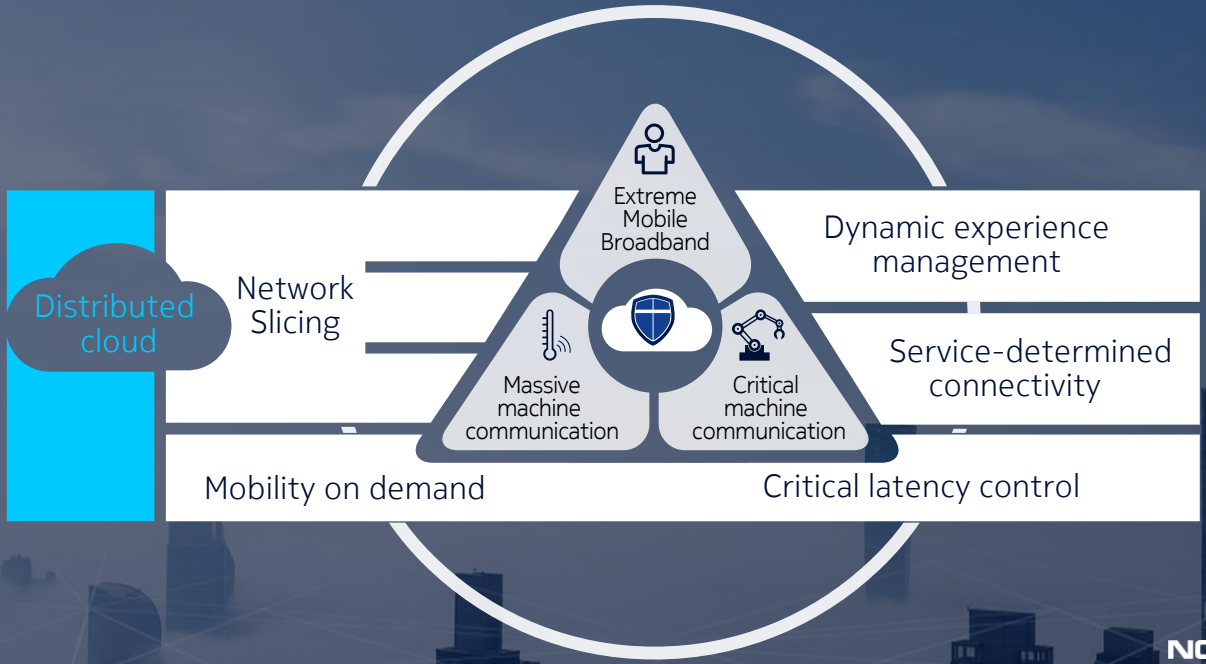
System of systems – capabilities for 5G



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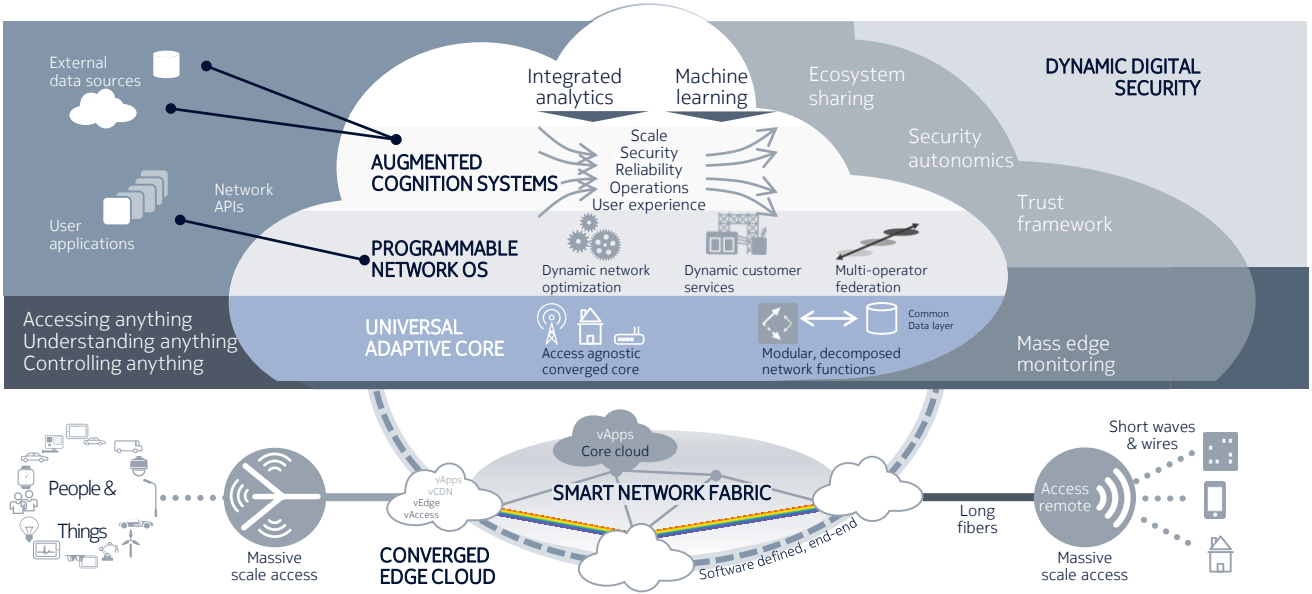
Future-X : The architecture vision for the 5G era



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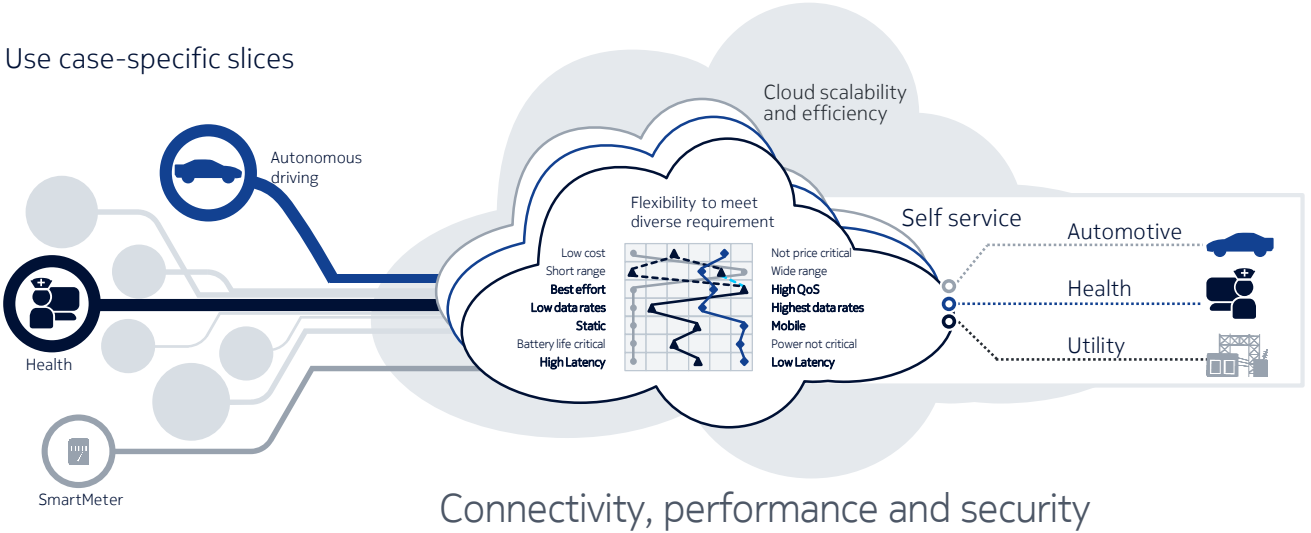
E2E Network slicing

Enable tailored Network as Service for diverse use cases and Verticals



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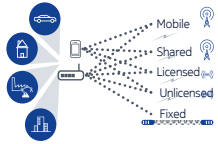
5G New Core : A cloud-native architecture

Configurability

Separation of control and user (data) plane

- Control plane
- User plane

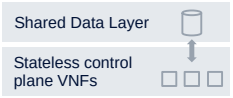
Multi-access



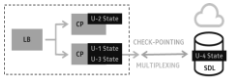
Deployment flexibility

Scalability

Cloud data store such as Shared Data Layer



State-efficient VNF processing



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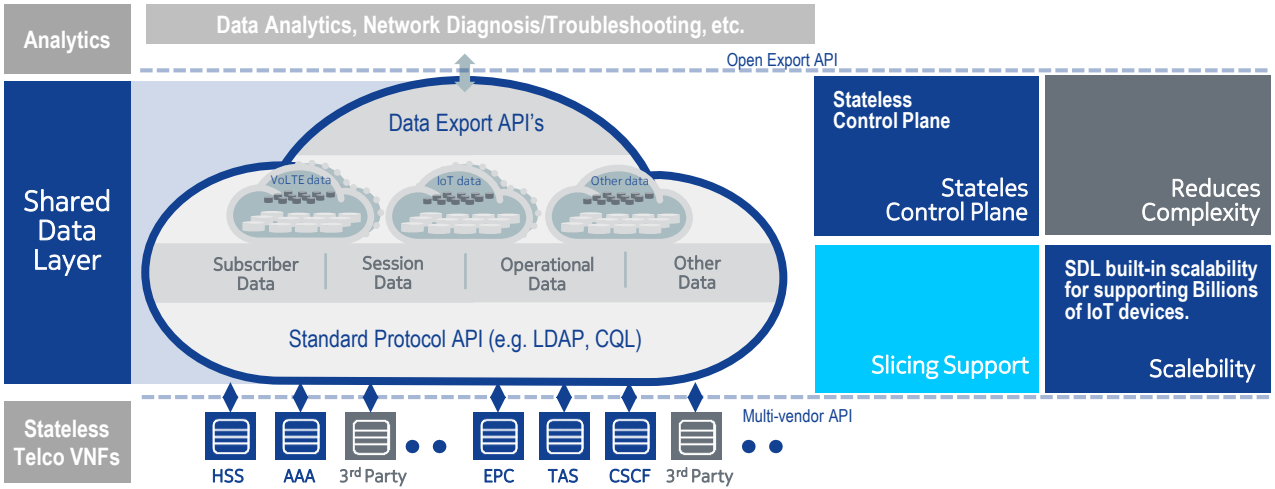
Shared Data Layer (SDL) concept

A key component of data-center optimized 5G architecture



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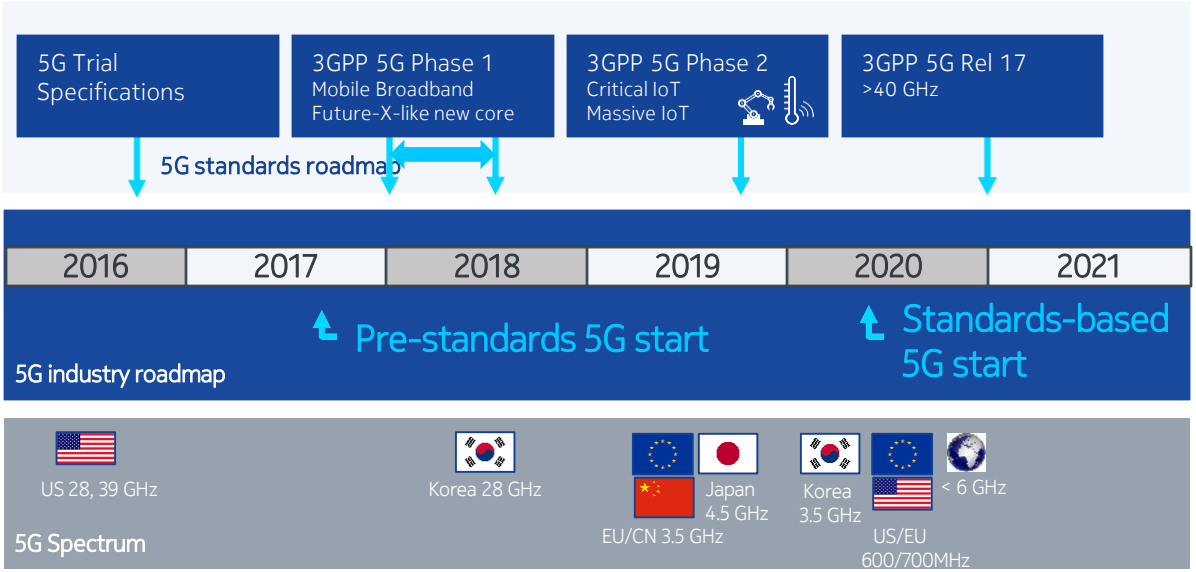
5G Industry Roadmap



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Potential 5G Bands in (Early) 5G Deployments

600 MHz	LTE/5G	North America
700 MHz	LTE/5G	APAC, EMEA, LatAm
3.3-3.4 GHz	LTE/5G	APAC, Africa, LatAm
3.4-3.6	LTE/5G	Global
3.55-4.2	LTE/5G	US
3.6-3.8	5G	Europe
4.5	5G	Japan China
28	5G	US, Korea Japan
39	5G	US
24.25-27.5	5G	WRC-19 band, Europe
31.8-33.4	5G	WRC-19 band (Fra, UK)
~40,~50,~70	5G	WRC-19 bands

Full coverage with <1 GHz

Dense urban high data rates at 3.5 – 4.5 GHz

Hotspot 10 Gbps at 28/39 GHz

Future mmwave options

Driving the global 5G end-to-end ecosystem

Business partners and verticals

BOSCH

QUALCOMM

5GAA

intel

Cities

Automotive

Utilities

Health

Safety

Engagements with 30+ world technology leading customer

Standardization & Research

Euro 5G

5G NORMA

CWC

ngmn

ARIB

FANTASTIC-5G

METIS II

NYU

3GPP

TECHNISCHE UNIVERSITÄT DRESDEN

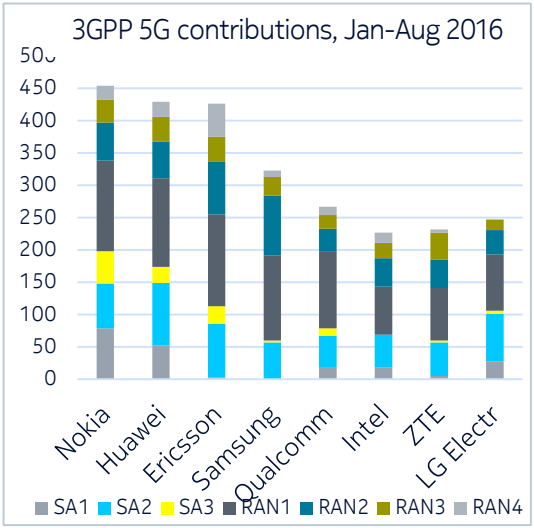
ITU

LTE

5G Forum

Xhaul

mmMAGIC



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5G Automotive Association

Automotive Industry

Vehicle Platform, Hardware and Software Solutions

Telecommunications

Connectivity and Networking Systems, Devices and Technologies

Automotive and Telecom Industries to Develop and Accelerate Availability of Communications Solutions for Connected Mobility, Road Safety, Autonomous Driving and Intelligent Transportation

5GAA Launched on 27 September, 2016 in Munich

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5GAA Members

Global association open to companies and organizations engaged in the automotive and ICT industries and the broader eco-system and value chain for vehicle and road transportation systems

Founding Members

Several LOI received. >55 companies expressed interest in 5GAA

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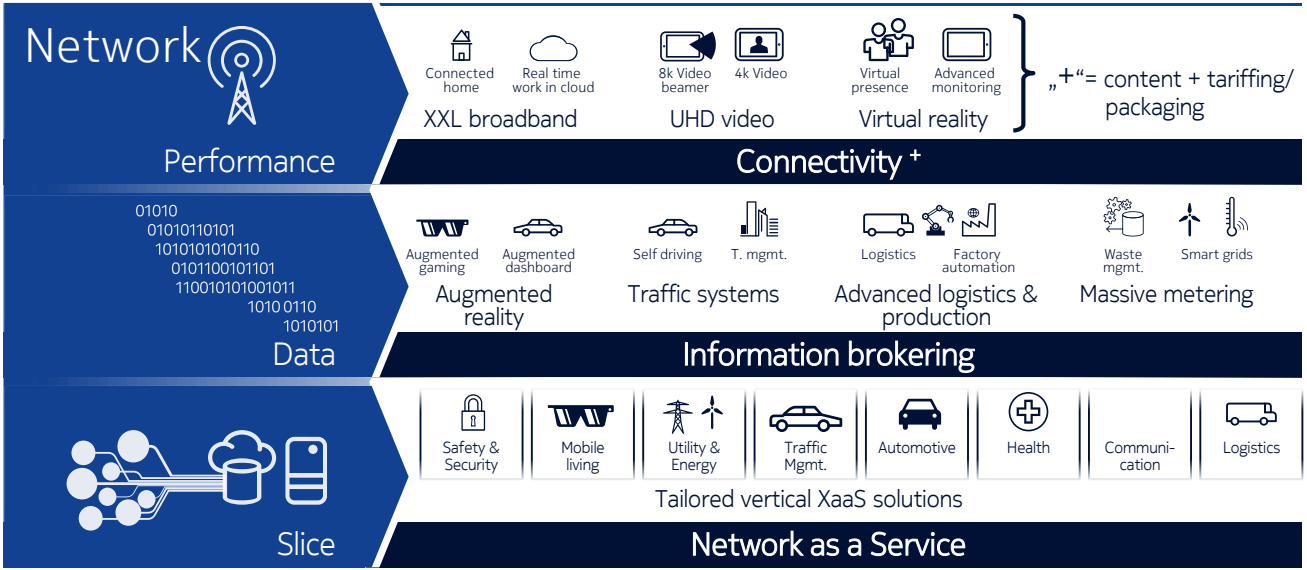
5G key technology component enable new revenue



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Making 5G a reality

Enable Novel Use Case

Cloud-optimized System of Systems

Versatile 5G Radio

Global Ecosystem moves agressively

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