

5G Era Architecture Vision

Evolution to a Cognitive and Cloud optimized Architecture

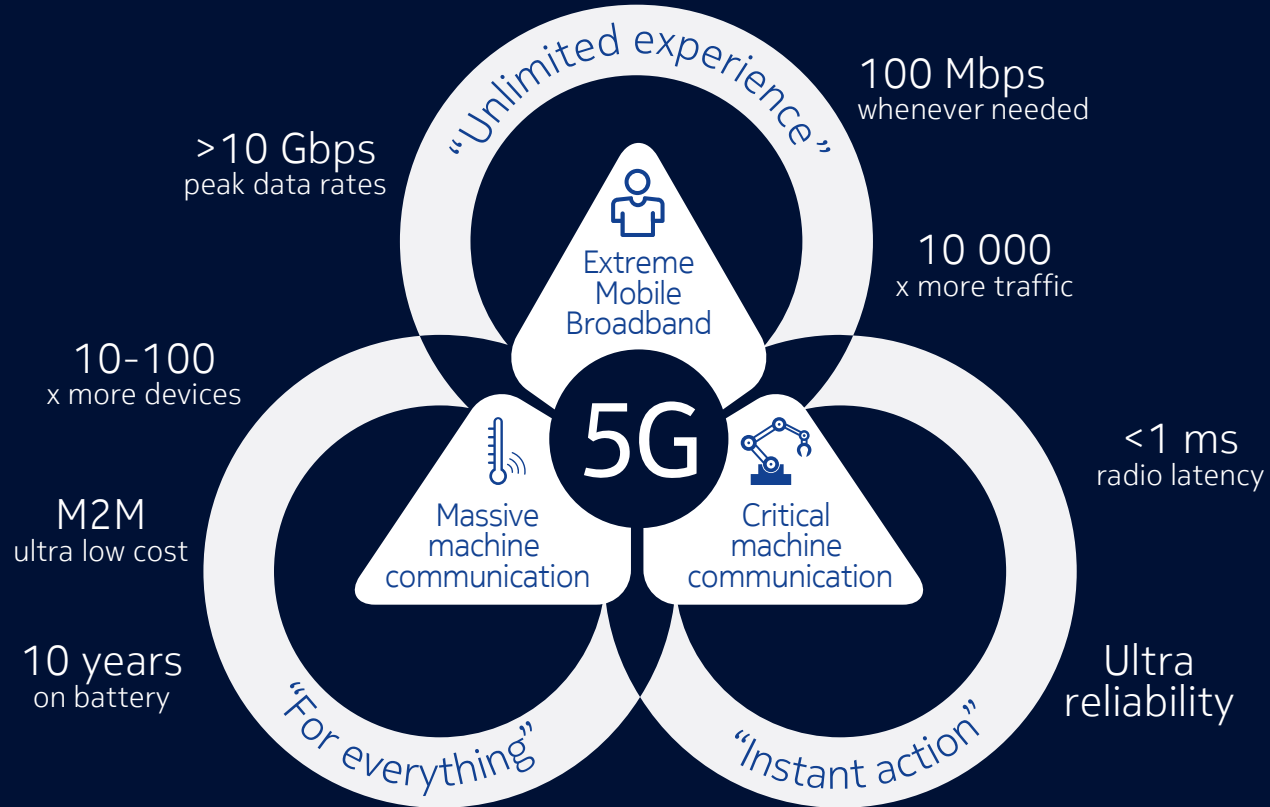
ICIN

March 3, 2016

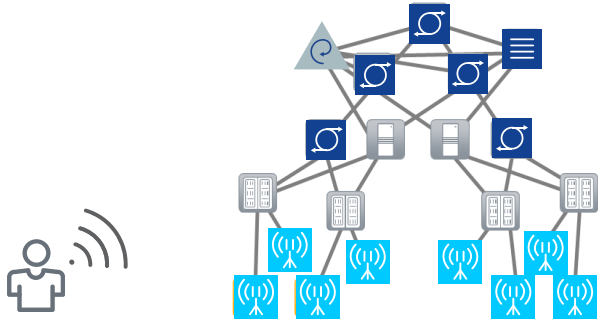
Volker Ziegler

Head of 5G Leadership, Chief Architect
Nokia Mobile Networks

5G will change the world...



...and translate into a network architecture for the 5G era to rewrite the paradigm



History

- Standardization driven
- Large integrated equipment providers
- Vertical architecture
- Value in Services and Devices
- Yearly Release Cycle

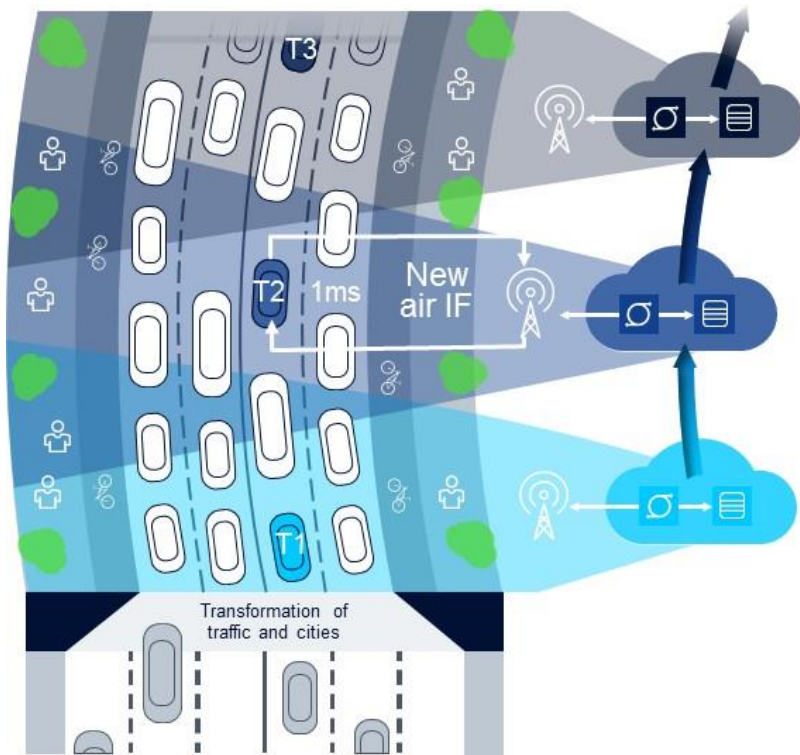


Future

- Open Source and industry compliance
- Greater collaboration with IT players
- Cloud Optimized architecture
- Value in Network and Application Personalization
- Continuous Integration and Development

5G autonomous driving - world's first

Connected mobility will become a reality



0

Close to zero fatalities;
1 million lives saved

1 hour
day

Personal time gain
due to traffic optimization

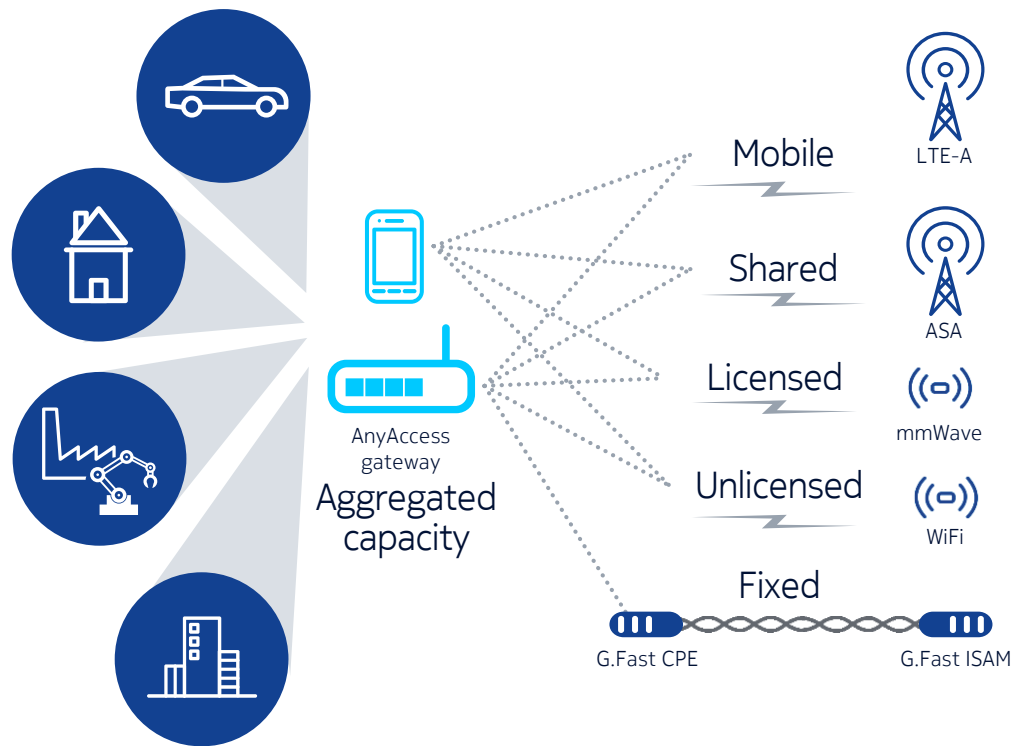


Up to 4 times more cars on
existing roads possible

- Autonomous cars, solely steered by 5G live network
- 1 ms latency and ultra reliability for fast moving vehicles
- 5G architecture for overall car traffic performance

5G Massive Capacity - world record

>30Gbps for the user, new business for operators



300x

faster than 100Mbit/s
commercial fiber services
today

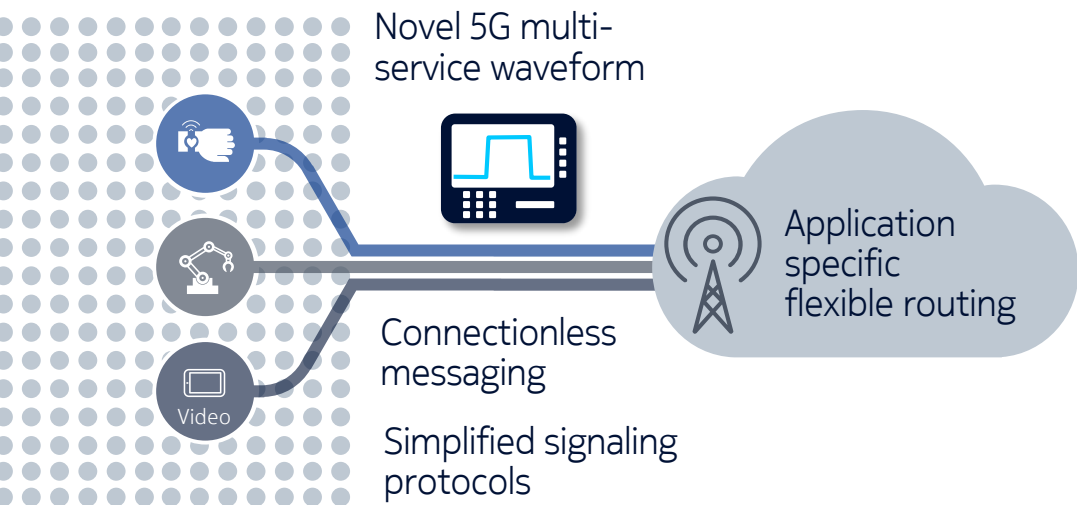
8K

Virtual Reality and UHD video
to the mass market

- Combining any kind of access
- For fixed, mobile, human and machine type devices
- For all traffic types

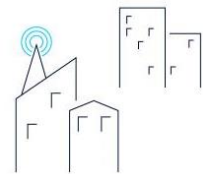
Massive Connectivity – world record

Over 1 million devices connected to a single cell site



150x

more devices than a 3 sector,
2 carrier LTE cell site



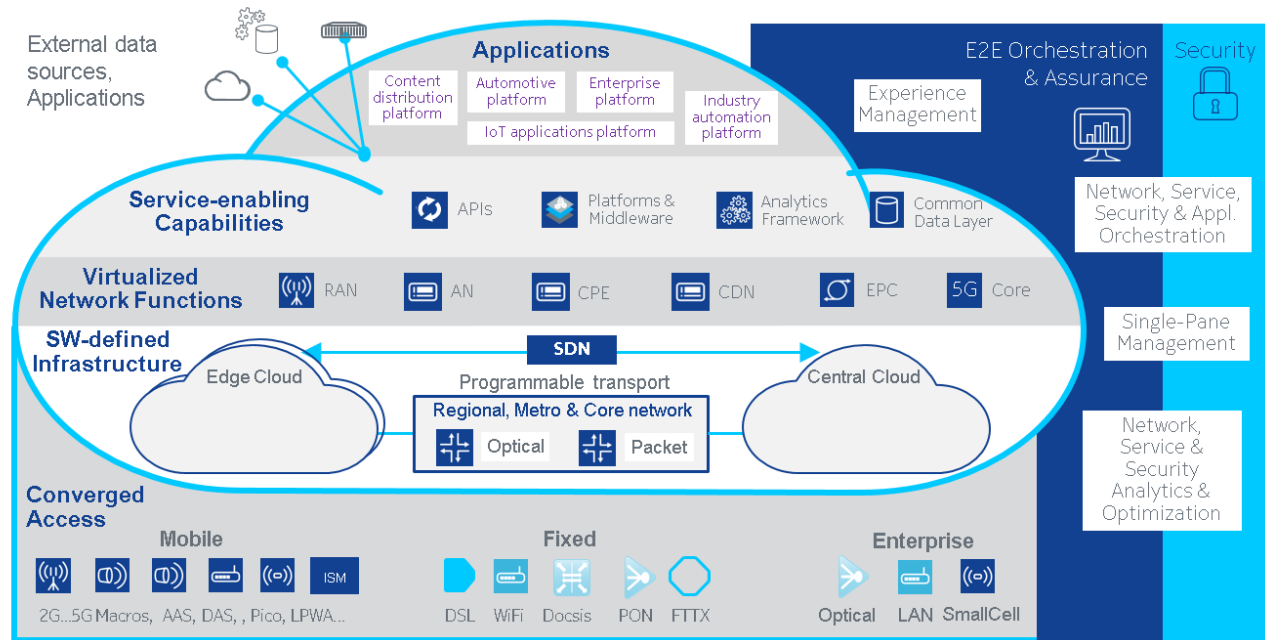
Superefficient connected cities
become real

- Connect billions of devices
- Support diverse applications in most efficient manner
- E2e QoE session control

Nokia's Architecture vision for the 5G era

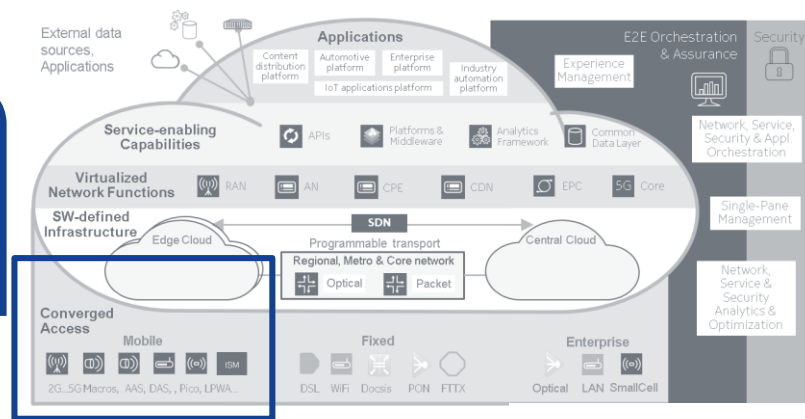
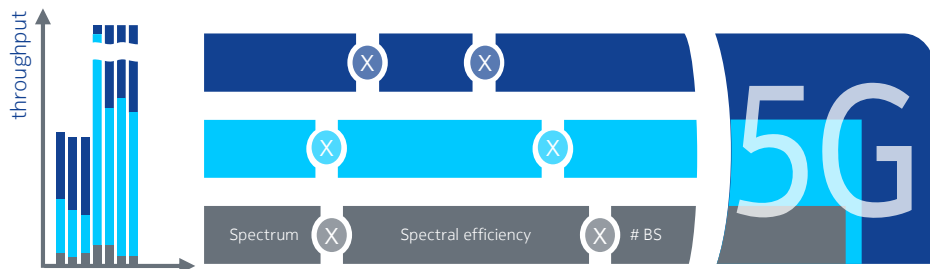
Cognitive and cloud optimized network architecture ("CONE")

- Cognitive networks and shared data, extreme automation
- Security embedded across all domains
- Distributed telco cloud and mobile edge; telco and IT domain data center convergence
- Software Defined Networking and Virtualization
- Heterogeneous backhaul
- Multiple radio technologies (licensed and unlicensed; full frequency range; ultra-dense; virtual zero latency)



5G Mobile access

Multiple radio technologies collaborating as one system *



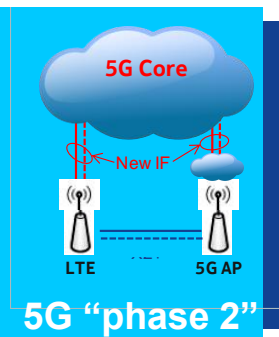
radio access

- Multiple technologies
- licensed and unlicensed
- full frequency range
- ultra-dense
- virtual zero latency
- automated

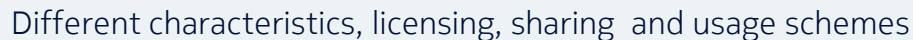
edge cloud

- cloud closer to user
- personalize service experience
- faster service delivery
- augmented reality
- cloud-based radio access

- Leverage frequencies also >6Ghz
- Support for all use cases
- Local anchoring, low latency switching
- Multi-connectivity intra-5G, inter-RAT
- Enhanced mobility framework.#
- e2e Network slicing including RAN aspects
- Support for evolved LTE with new architecture



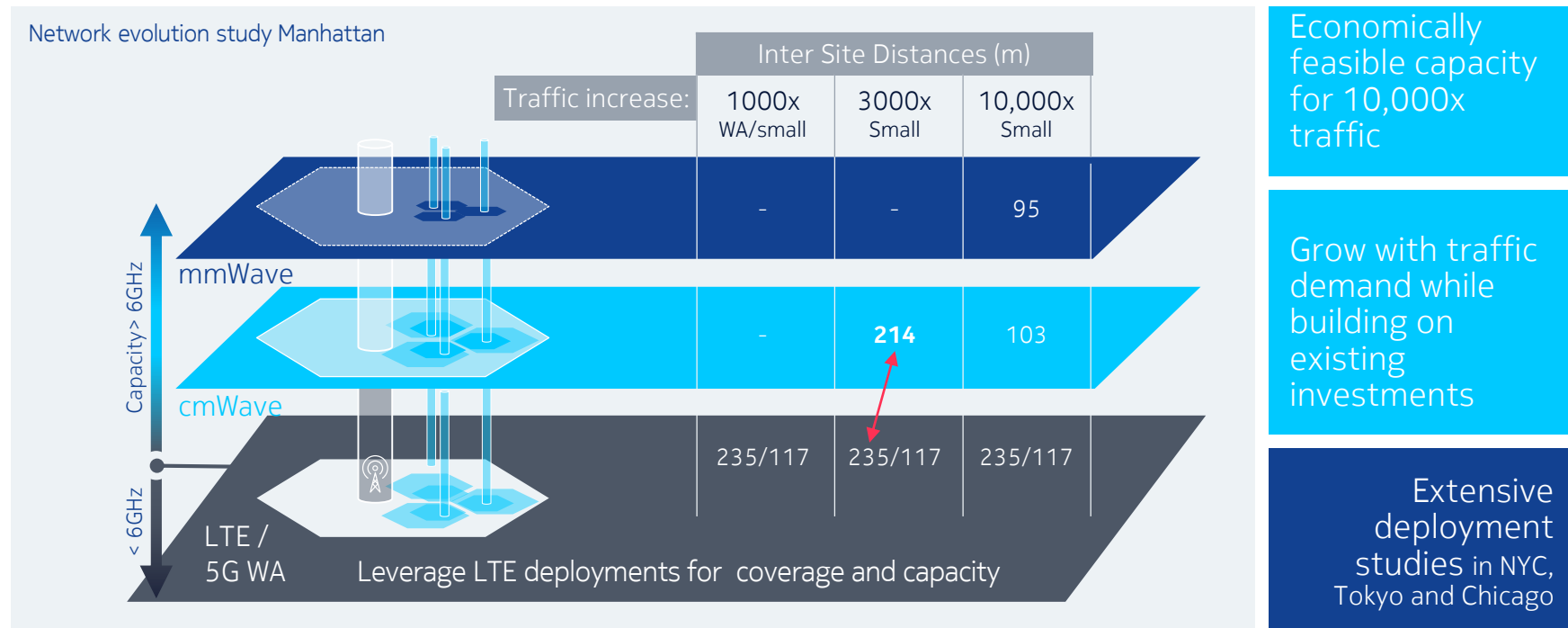
Leveraging all bands , ranging from ~400MHz - 100GHz



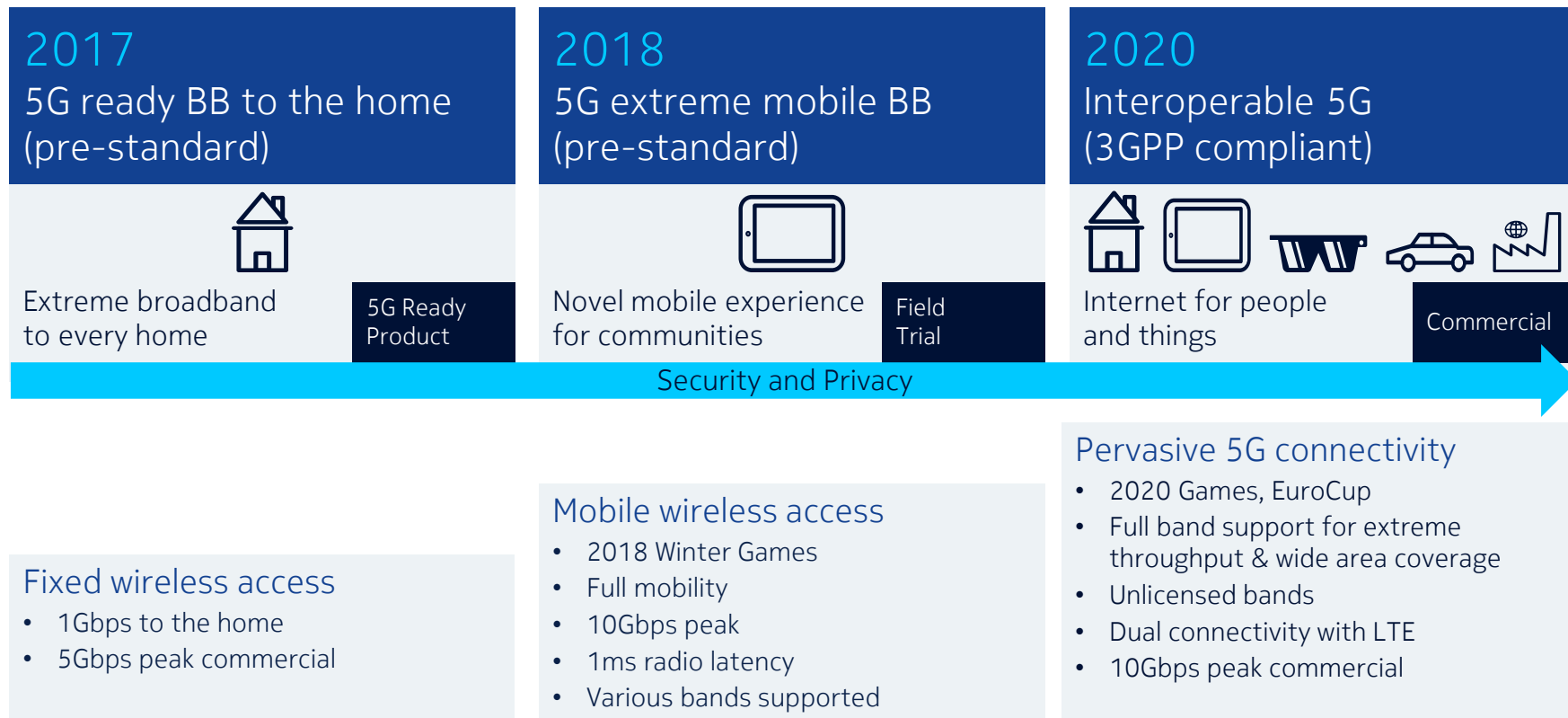
World's 1st trials on shared spectrum access

Generation interlock

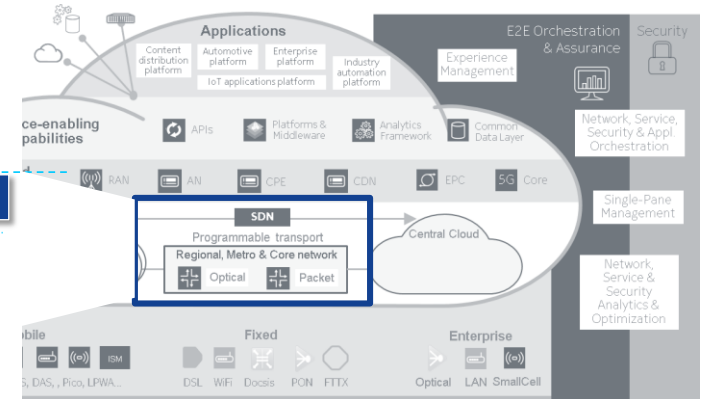
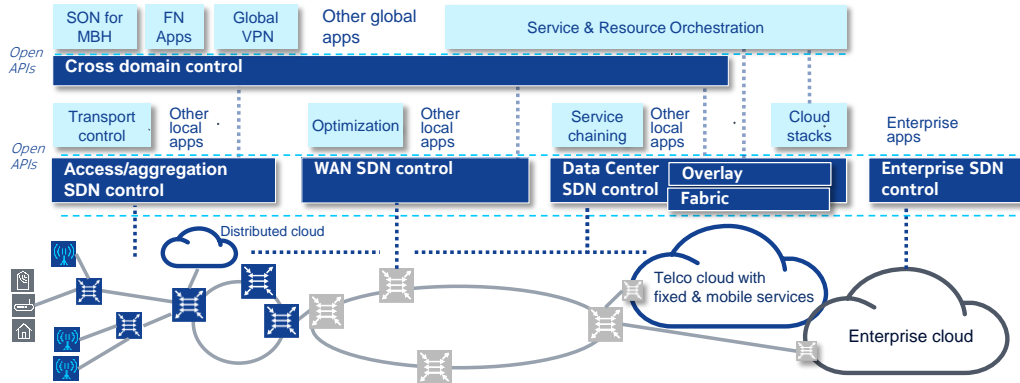
LTE coverage and capacity boosted with 5G



From pre-standard products and trials to fully standardized 5G solution



Software defined networking for 5G era



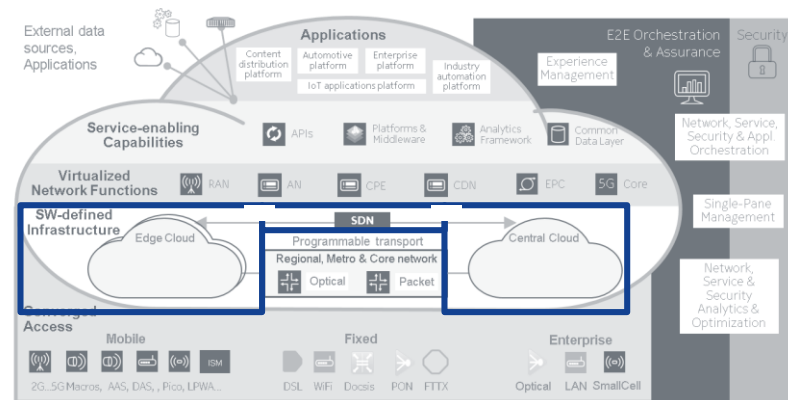
software defined networking

Enable transport network resources, including front-haul and backhaul, to become programmable

use cases

- SON for MBH; fixed networks apps; global VPN
- Service and resource orchestration
- Transport control
- Dynamic optimization
- Service chaining
- Cloud stacks

5G ready cloud technologies leverage data center resources

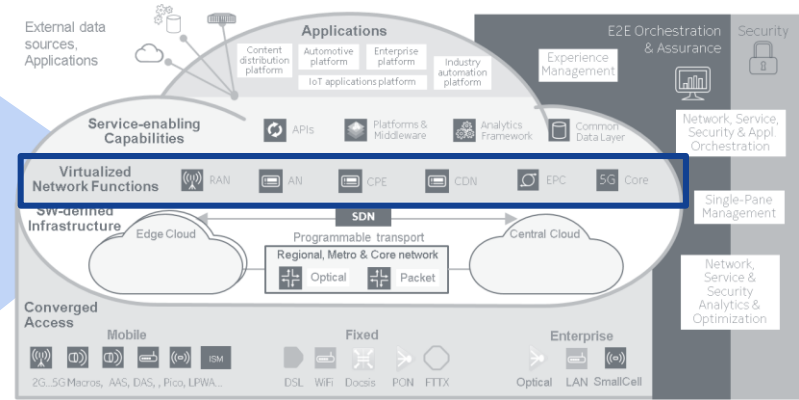
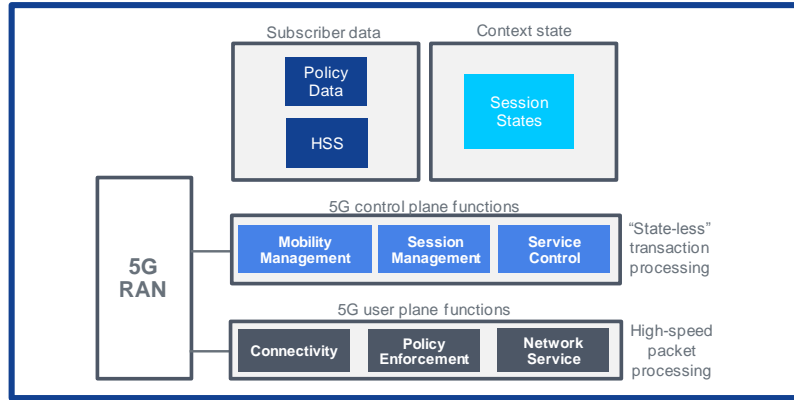


- telco and IT domain data center convergence
- fixed mobile convergence

network functions on
same abstracted
resources for computing,
storage, network

Virtualized network functions

VNF transformation into cloud-optimized layered architecture



C/U plane decomp

- Logical and physical separation, independent scalability
- flexibility: distributed and/or centralized user plane; programmable

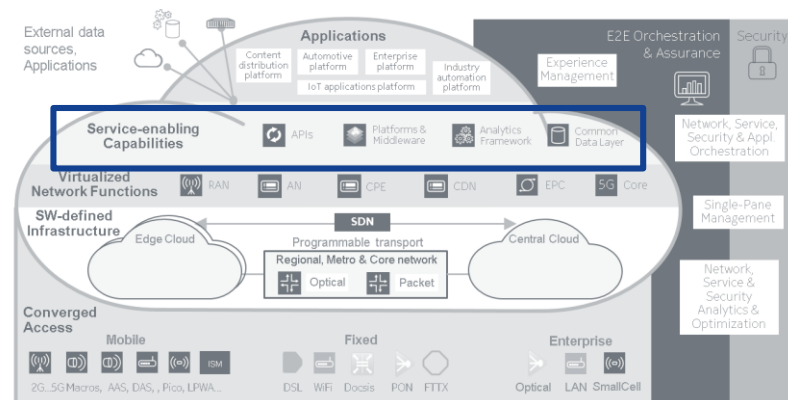
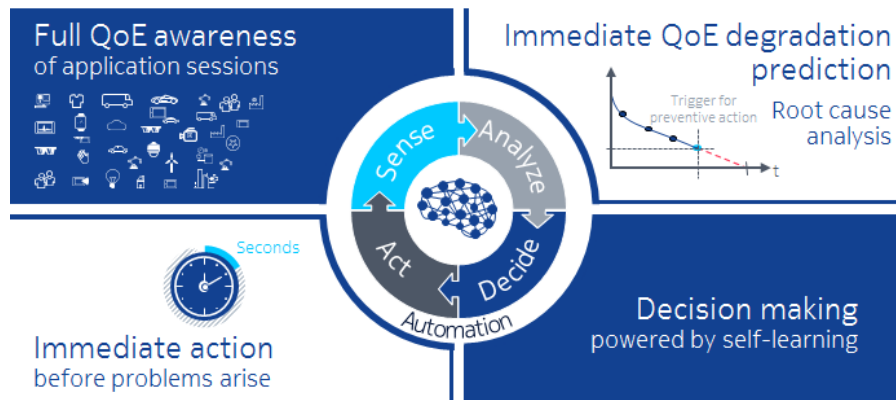
- Enabling seamless elasticity and failure recovery based on pool redundancy
- independent scaling of number of sessions

Stateless C Plane

consolidated session data

Enables sharing and synchronization of state between control plane functions, removing redundant local information

Cognitive Domain: SEC*, Shared Data and APIs



shared data

- big data analytics for cross-layer orchestration and real-time actuation
- self-aware, cognitive networks
- extensive automation predictive learning

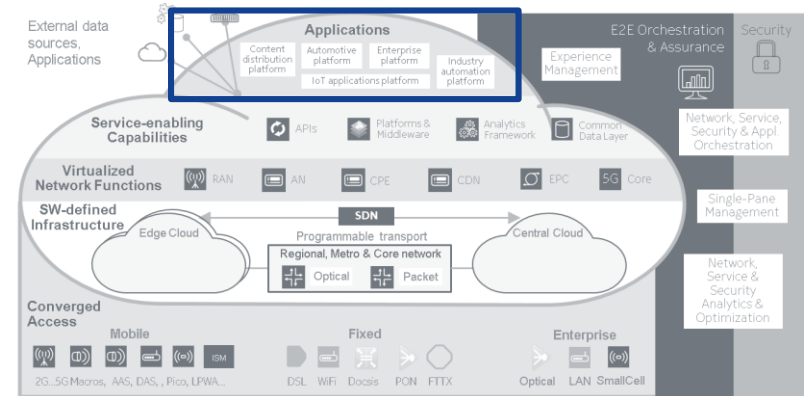
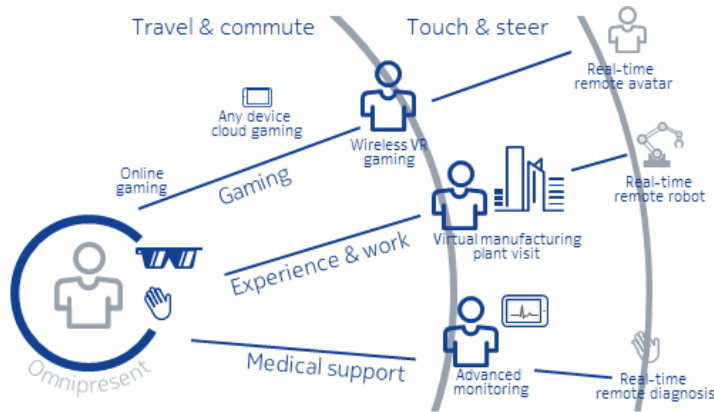
- enabling new service verticals to access network data and optimize connectivity.
- flexible service control, integration and optimization across different service verticals

Open API

PaaS

- Developer support
- Enterprise and IoT
- API incl. exposure to VNF; various mashups; runtime; messaging; streaming; shared data; ML**; reporting, visual

Application Layer



3rd party

- flexible, agile and rapid deployment
- leveraging the information exposed by the SEC
- myriad of new use cases
- distributed

personalized and service aware

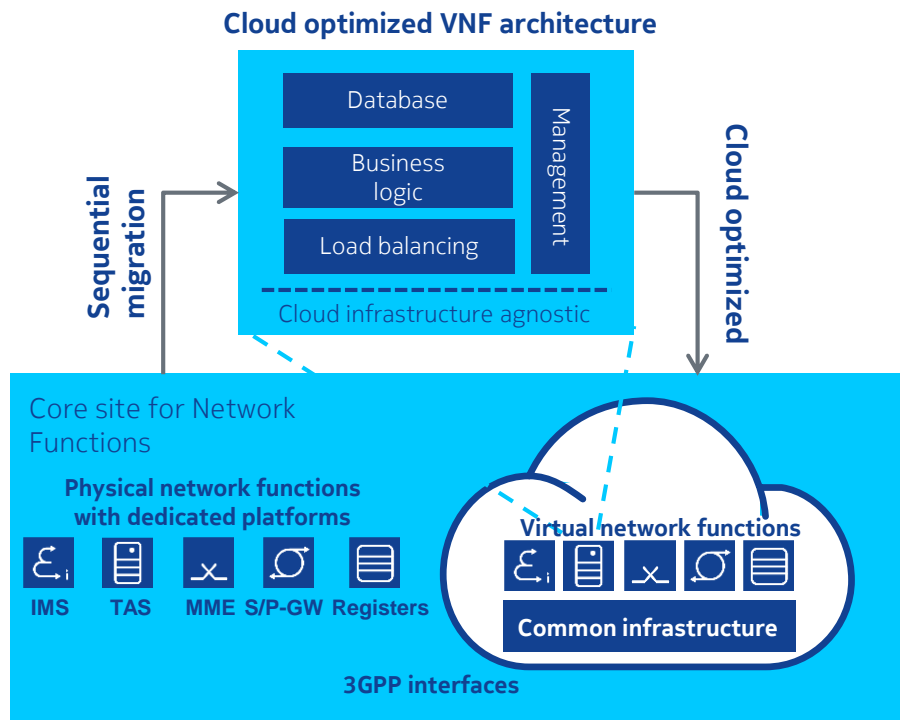
- knowledge of real-time radio
- information and location awareness
- with SEC for zone-specific services in high density locations

SaaS

- CID*; self-service, CRM, billing, analytics, machine learning, support of business model B2B2x, open APIs
- Enterprise and IoT: e.g., Health; Industry4.0

CONE Roadmap translation -- cloud and legacy co-existence

How to cost efficiently evolve the network?



Multi-tier architecture for resiliency, elasticity and cloud infrastructure agnosticism.

Cloud optimized

Reduced risk and return of investment improvement by up to 30%.

TCO

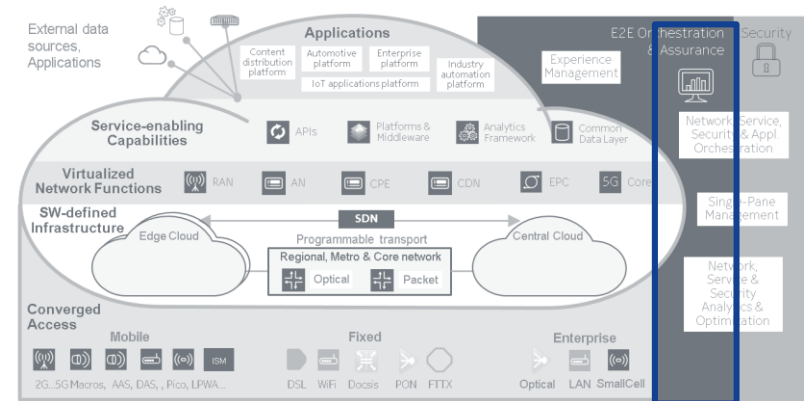
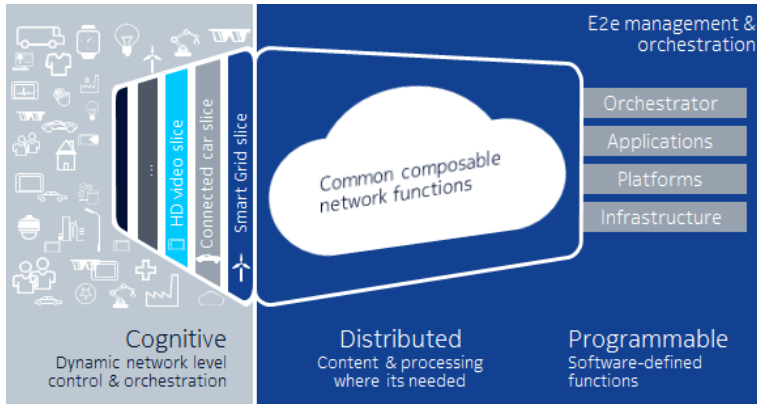
Step by step migration to cloud in operator specific order.

Controlled migration

Smooth evolution to cloud with simplified and optimized architecture

Nokia benefits

E2e management and orchestration



e2e MANO

across all domains

- Resource management
- Service management
- Network function orchestration
- Application orchestration

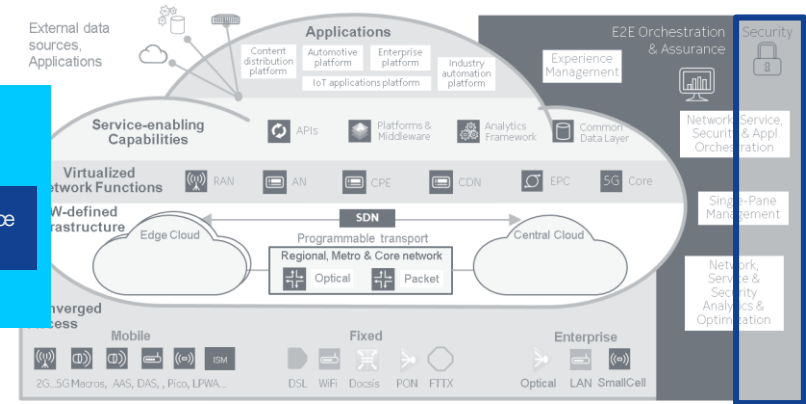
network slicing

- Optimized service delivery for heterogeneous use cases
- multi-tenant capability
- B2B2x business model

transformation

- Full automation and self-optimization
- All kinds of NaaS business models

Security



security

- embedded across all architectural domains
- near real-time automated action
- robustness against cyber attacks
- Aligned with carrier grade requirements

cognitive

- predictive security through efficient correlation, ML engines and analytics
- Integrated dashboard for all security related events in the converged network

security architecture

- comprehensive, holistic, designed-in
- security orchestration in conjunction with distributed cloud

Evolution to a Cognitive and Cloud optimized Architecture for the 5G era

Key benefits

