

Core Network Transformation for 6G

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Agenda

IMT-2030/6G Services

6G Architecture Design

- System
- AI-native
- Modular
- Optimizations
- Exposure
- Sustainability
- Resiliency
- Security

IMT-2030/6G Service Requirements/KPIs

Immersive Communication

- > ≥ 100 Gbps
- > ≥ 1 Gbps
- > ≤ 1 ms
- > < 100 μ s



Hyper-Reliable & Low-Latency

- > 0.1–1 ms
- > 99.99999%
- > ≤ 10 μ s
- > 99.99999%



Massive Communication

- > $\geq 10^7$ devices/km²
- > 10+ years battery life
- > 10x Efficiency



Ubiquitous Connectivity

- > Global Coverage
- > Up to 1000 km/h



Integrated Sensing & Communication

- > 1–10 cm
- > Cm/s Accuracy
- > Multi-Static Sensing



AI-Native Communication

- > < 10 ms
- > Gbps Uplink
- > AI & Network Intelligence



Cross-Domain 6G Targets

- > 1–10 cm Accuracy
- > < 100 ns Sync
- > > 10 x Efficiency
- > Sustainability



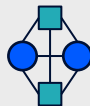
From connectivity to intelligence

● Humans ■ Machines/IoTs ◆ AI agents/tokens

The (r)evolution of AI and LLM is redefining network needs

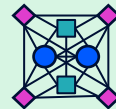
Today's networks

- Excel at connecting people and devices reliably and efficiently, optimizing speed, coverage and capacity
- They are still predominantly data transport systems



Tomorrow's networks

- Evolve from connecting data to understanding and processing intelligence
- They will provide perception, coordination, and governed autonomy.



2G & 3G

Built mainly for human communications

4G & 5G

Expanded to support machine and IoT connectivity

6G

Extend further to connect AI agents and intelligence

6G Architecture design

Simplified, resilient, modularized and service optimized



Single standalone
architecture



AI/ML native
architecture and full
automation



Unified exposure
framework



Sustainable by
design



Modularized design
for different devices



Optimized for new
service
requirements



End-to-end
resiliency



Security
by design



Enable orthogonality and modularity in the system

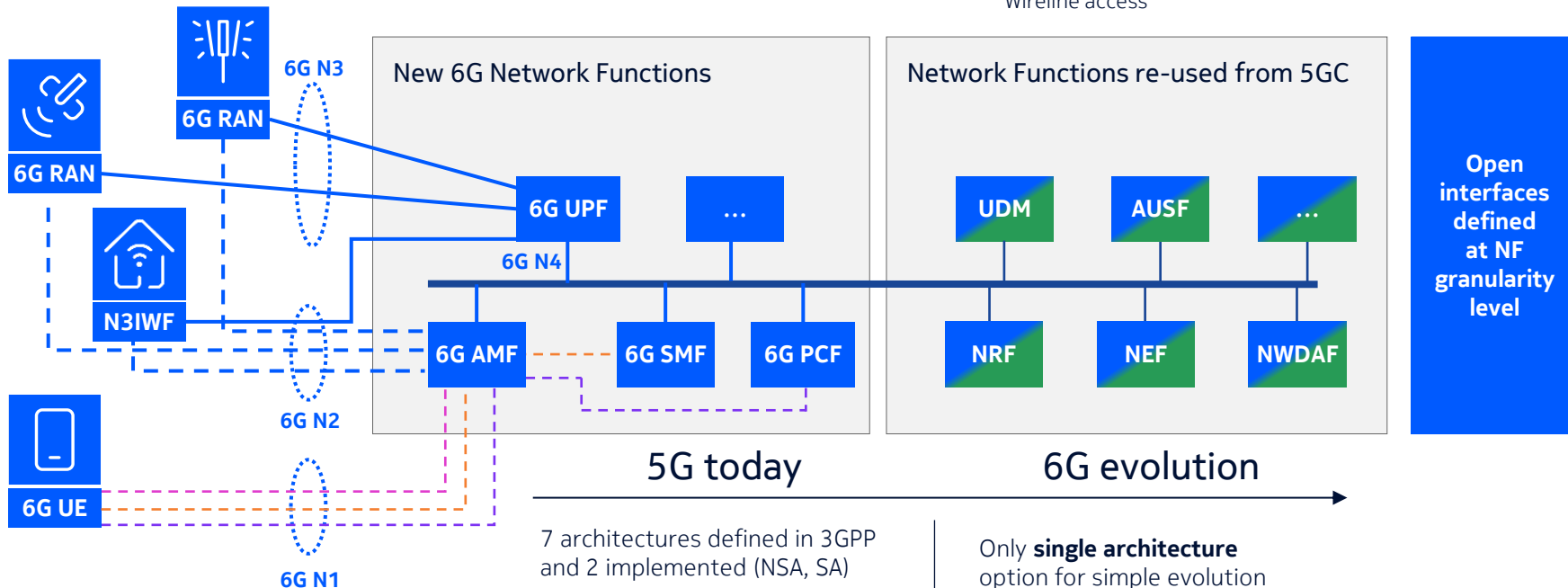
6G System supports the following accesses on Day-1:

6G Radio for Terrestrial & Non-Terrestrial Networks

Wi-fi access via N3IWF

6G System supports in the following subsequent releases:

Wireline access



7 architectures defined in 3GPP
and 2 implemented (NSA, SA)

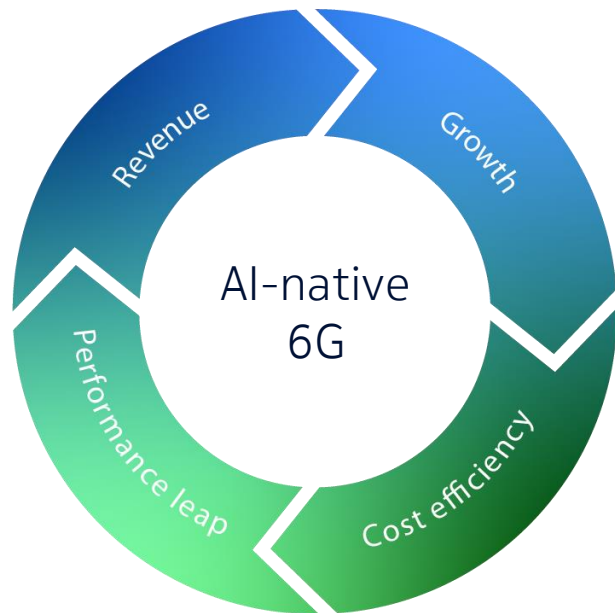
5G core is a major upgrade on top of 4G core

Only **single architecture**
option for simple evolution

6G core is a smooth migration from 5G core



The value-creation potential of AI-powered solutions



Data

High-quality and curated data products for AI/ML solutions



AI as a service

Hosting/inferencing, training/fine-tuning services for AI workloads



Agentic AI systems

AI agents for end customers and network operations



Customer experience enhancement

Superior optimization of service quality based on data and AI



Security and trust

AI services for threat detection and mitigation



Sustainability and energy efficiency

AI-based optimizations for sustainable network operations



Data: The foundation and fuel of AI

CSP/MNO

Management data, radio measurements, KPIs, etc.



010110
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Device/chipset vendor

UE-level radio measurements, proprietary data, etc.



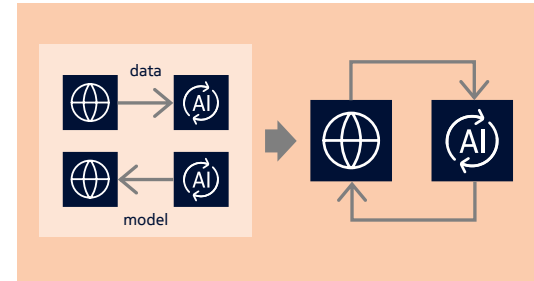
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Infra vendors

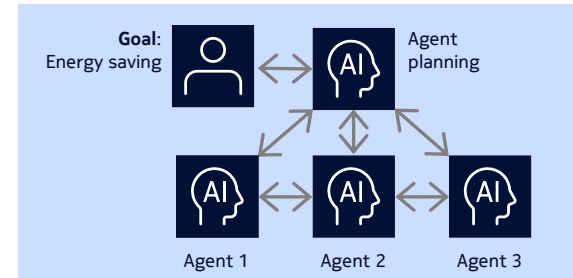
Cell-level radio measurements, KPIs, proprietary data, etc.



Data collection for continual learning



New data, e.g., for agentic AI

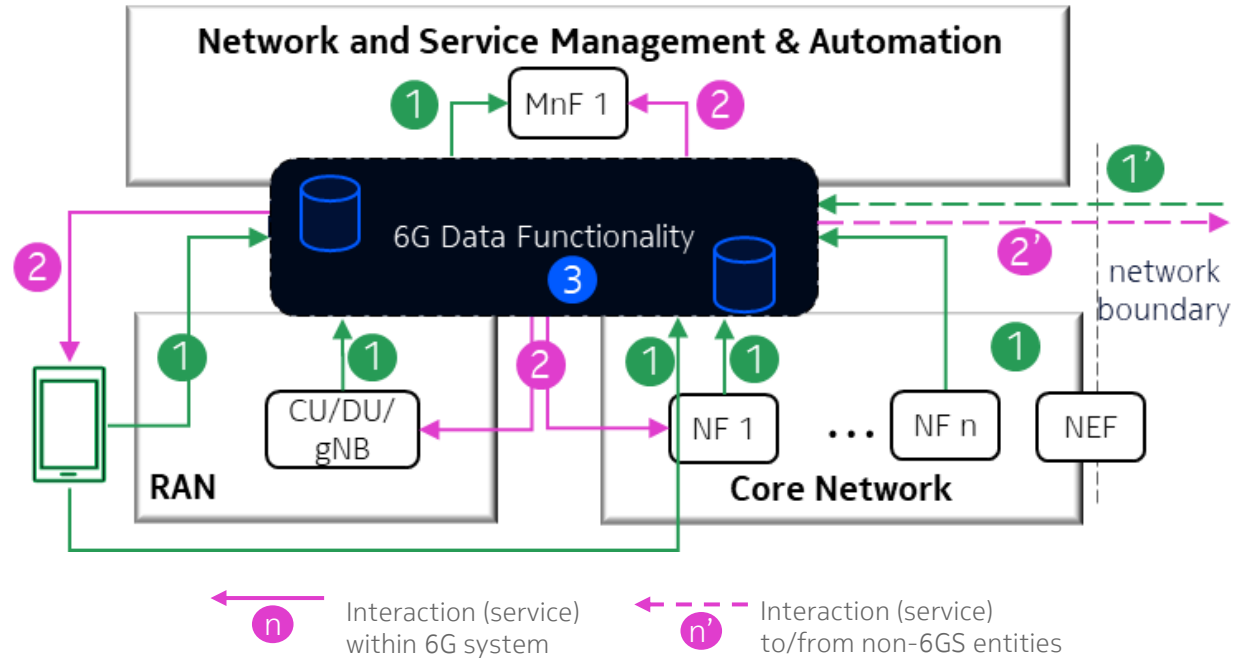


Data collection requires standardization



6G Data Management Framework

- 1) Collecting data** from UEs, 3GPP network Functions & from non-3GPP entities
- 2) Providing access to & exposing data** to any network functions & to non-3GPP entities
- 3) Supporting data processing** capability - output via data access & exposure services



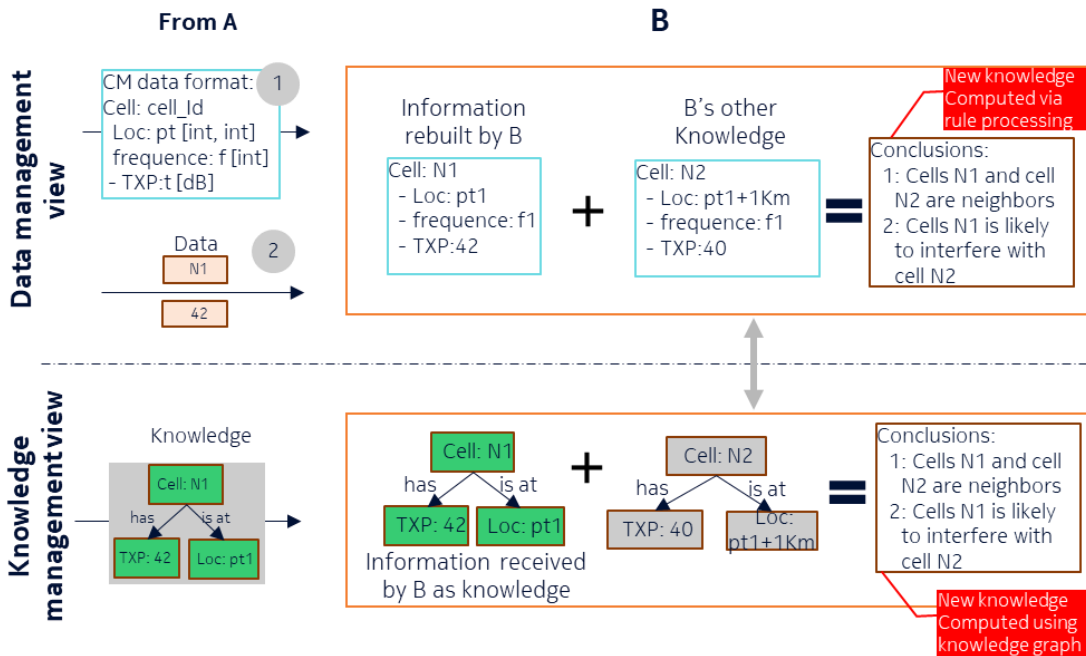
6G Data Framework across RAN, Core and Management Domains

Data and knowledge management

Defining data services enabling monetization of UE & NW data

Knowledge: A set of related data Items -> Set of data points and relations among them

Information: A set of related data Items from an external source



Knowledge to be structured & exchanged; Process KG to create new Knowledge



AI as a Service

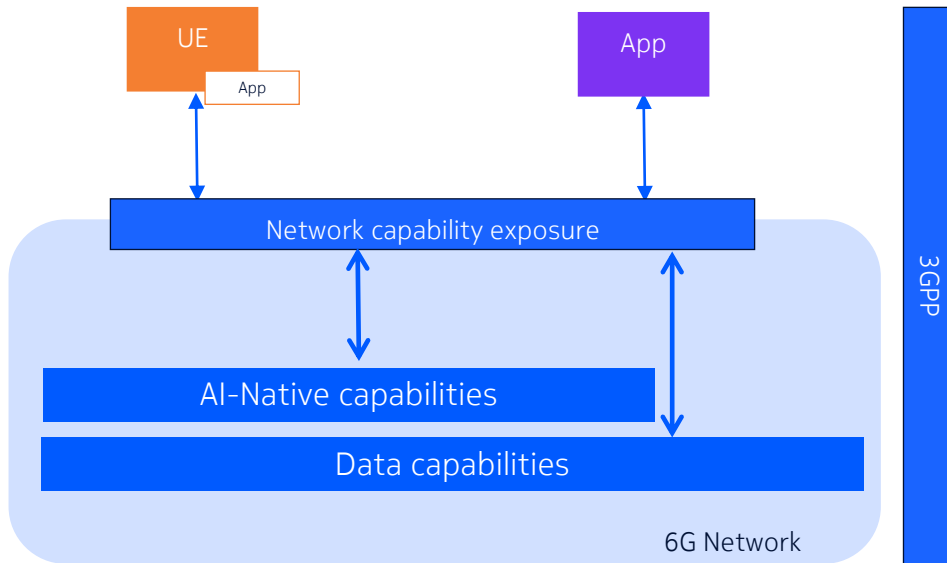
Providing on-demand customizable AI services

Data Services

Providing curated real and synthetic data, collected or generated specifically for the required use case.

AI Services

Network hosted MLOps (Training, Inference, testing, etc.) support for UE and 3rd party applications.



Data and AI services with interoperable mechanisms to consume them



Agentic AI systems

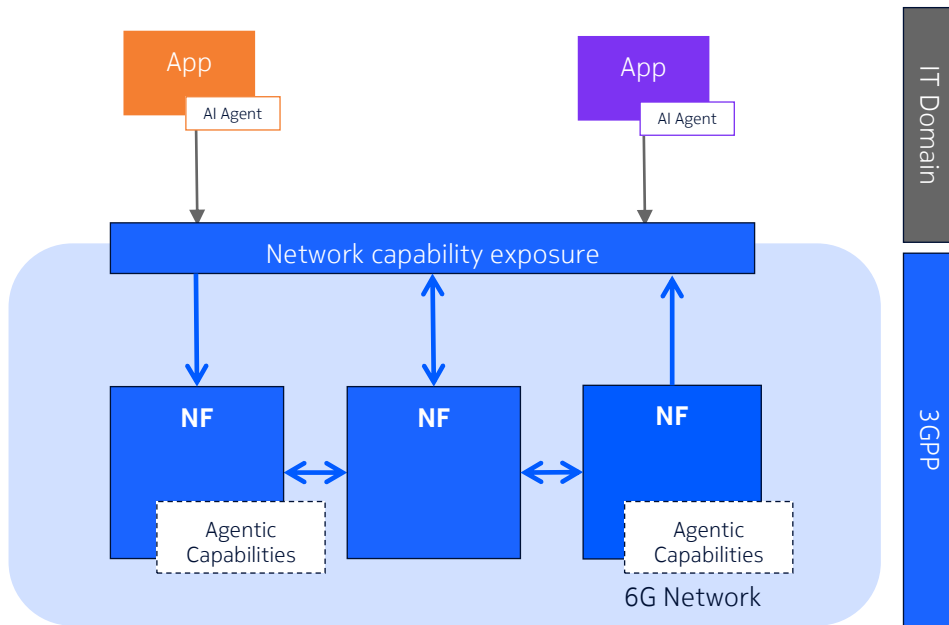
Enabling agentic intelligence in the Telco ecosystem

Agentic applications

leveraging network capabilities for consumer and enterprise solutions, providing new business opportunities for MNOs

Agentic capabilities

Integrated in the network, can provide new network services, improve network performance, analysis and decision making



Enable interoperability in an Agentic-AI-rich 6G telco ecosystem



The bridge between technology generations

5G

Making AI work

- UE/device capabilities to support emerging and future use cases
- Data collection and management
- Harmonized cross-domain functional AI framework, aligned across Standards Development Organizational (SDOs)

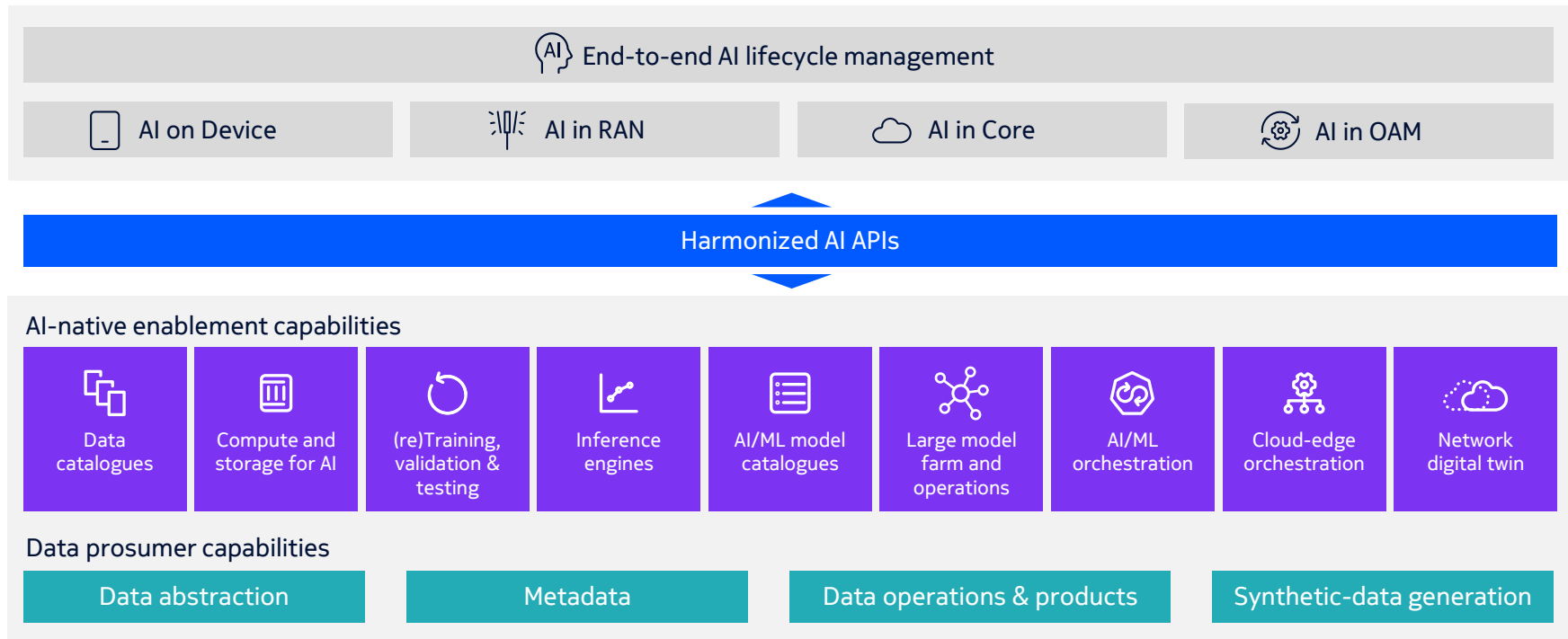
6G

Making AI trusted

- Network control over UE/device AI and data collection
- Trustworthy principles are embedded in the design
- Testing requirements and framework



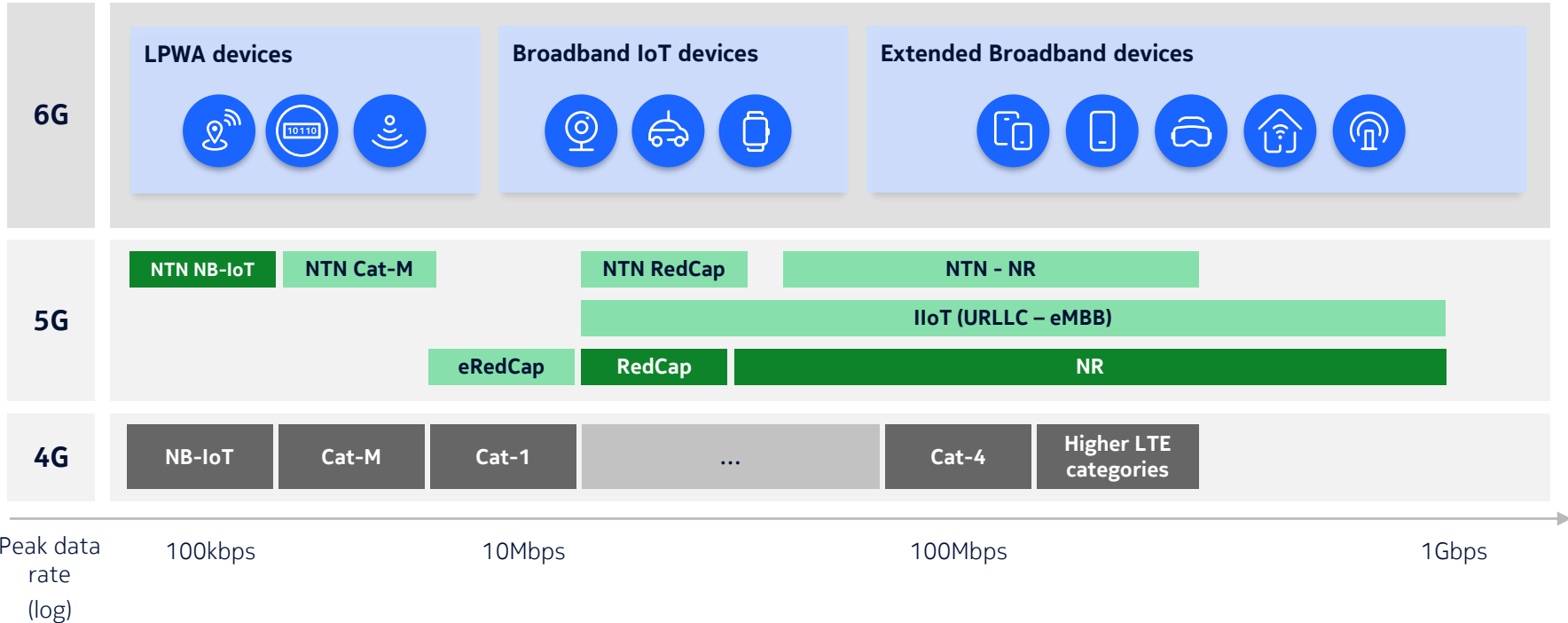
AI-native 6G requires a holistic E2E framework





Native support of different 6G device types

Terrestrial and non-terrestrial connectivity for all devices

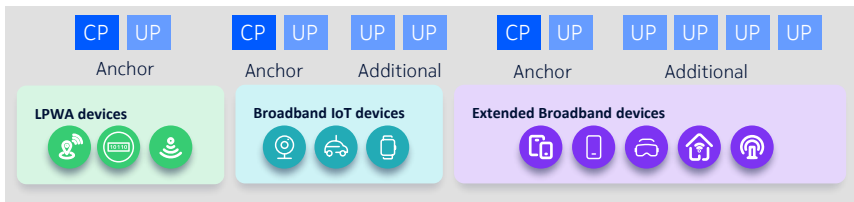


Modular protocol design

Anchor baseline protocol for the lowest capability devices

Additional processing and implementation-friendly protocol components for higher capability devices.

Modular Radio Protocol



2G-5G:

A one-size-fits-all design



6G:

Modular design support diverse use cases

Modular NAS Protocol

High-end UE

Base module

MM

Additional modules

SM

LOC

PC

XY

Mainstream UE

Base module

MM

Additional modules

SM

LOC

XY

Low-cost UE

Base module

MM

MM= Mobility Management
SM = Session Management
PC = Policy Control
LOC = Location

Modular protocol designed for scalable and efficient implementation

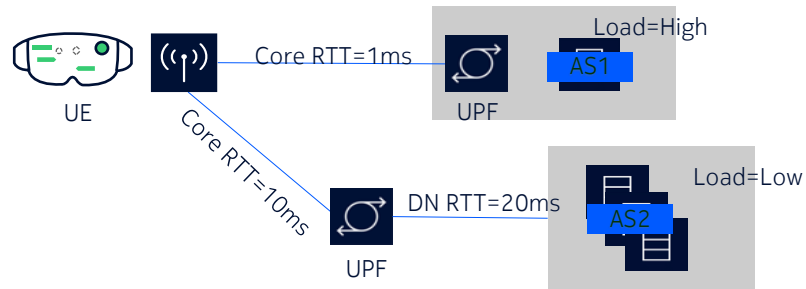


Integration of Network and Compute

Enable technology to support latency critical and/or compute heavy services

Key Use Cases

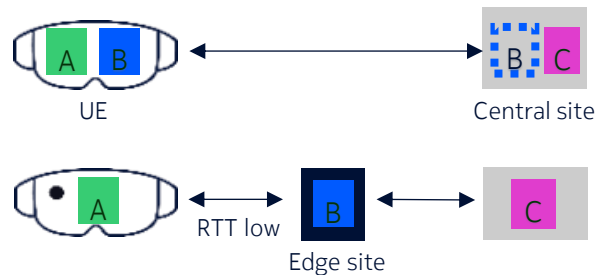
1. Application server selection among pre-deployed instances
2. Application server site selection and dynamic server instance deployment
3. Compute offload site selection and application software module offload from client (UE)



Use case #1 & #2: Dynamic application server selection/deployment

Requirements:

1. Optimize the utilization of both network and especially compute resources in different locations
2. Enable compute offload services for low latency or compute intensive applications such as XR or AI



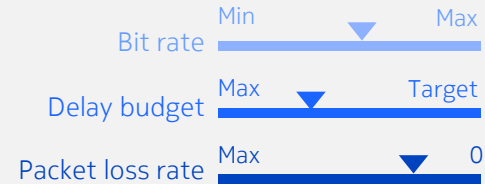
Use case #3: Dynamic offload of application module



Introducing an additional resource type in 6G

- Introduction of a new resource type called “adaptive” defining a QoS flow with a soft upper bound and certain target values
- Enables RAN to autonomously upgrade and downgrade QoS within the given range without signaling (i.e., no need for alternative QoS, notification control)
- Allows flexible and faster adaptation
- Enables improved Quality of Experience (QoE) and capacity utilization

Adaptive resource type with soft ranges to handle adaptive high bandwidth applications



Comparison of key QoS attributes for existing resource types and the new adaptive resource type proposed for 6G

Parameter	Non-GBR	GBR	DC-GBR	Adaptive
(Target) PDB	✓	✓	✓	✓
max PDB				(✓)
Maximum packet loss rate	✓	✓	✓	✓
Min FBR		✓	✓	✓
Target FBR				(✓)
Max FBR		✓	✓	(✓)
Notification control		(✓)	(✓)	

✓ denotes a mandatory parameter (✓) denotes an optional parameter

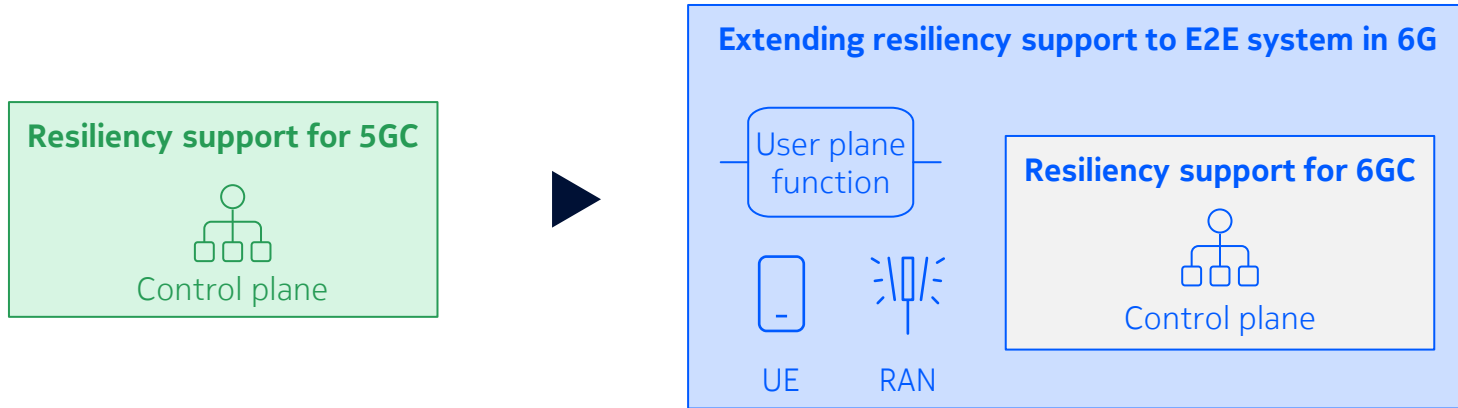
PDB: packet delay budget
FBR: Flow Bit rate
GBR: Guaranteed Bit rate
DC-GBR: Delay critical Guaranteed Bit rate

New adaptive resource type for efficient support of interactive services



End-to-end resiliency in 6G

- 5GC control plane NFs support resiliency
- Re-use same mechanisms also for 6GC NFs
- For a fully resilient system, adding resiliency support in RAN and UPF

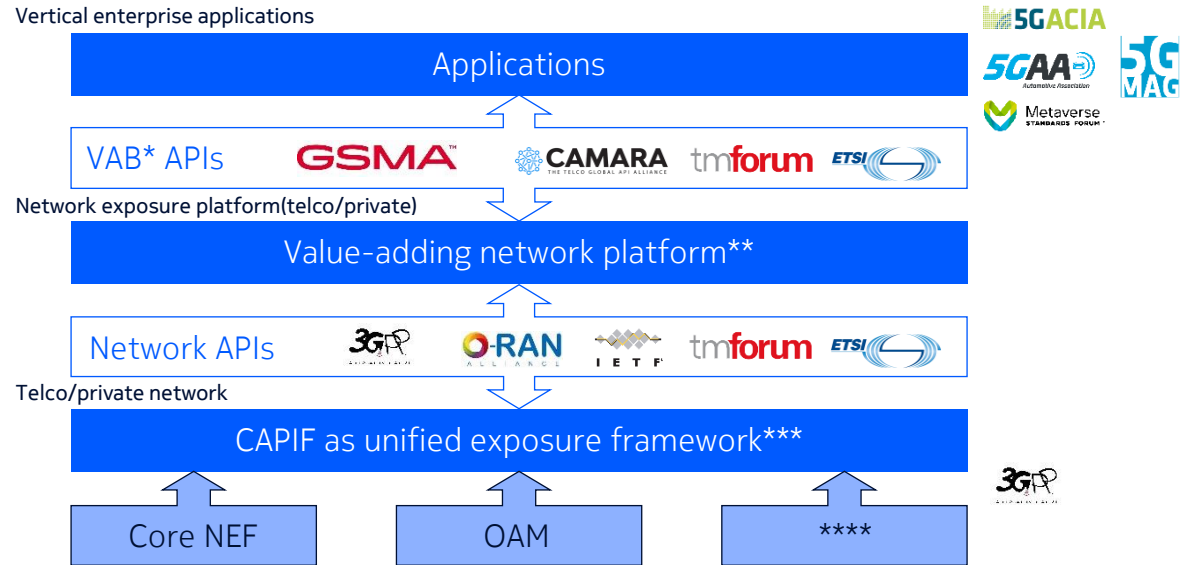


Fully Resilient System to enable zero downtime



Unified northbound exposure for 6G

- CAPIF is the unified framework for exposure from Core and OAM
- CAPIF enables seamless integration between Value-added platforms exposing APIs to 3rd parties and the underlying network domains
- CAPIF can evolve as needed



(*) Vertical Application Bound

(**) Consumes and transforms network APIs, exposes VAB APIs

(***) CAPIF may be centralized or distributed

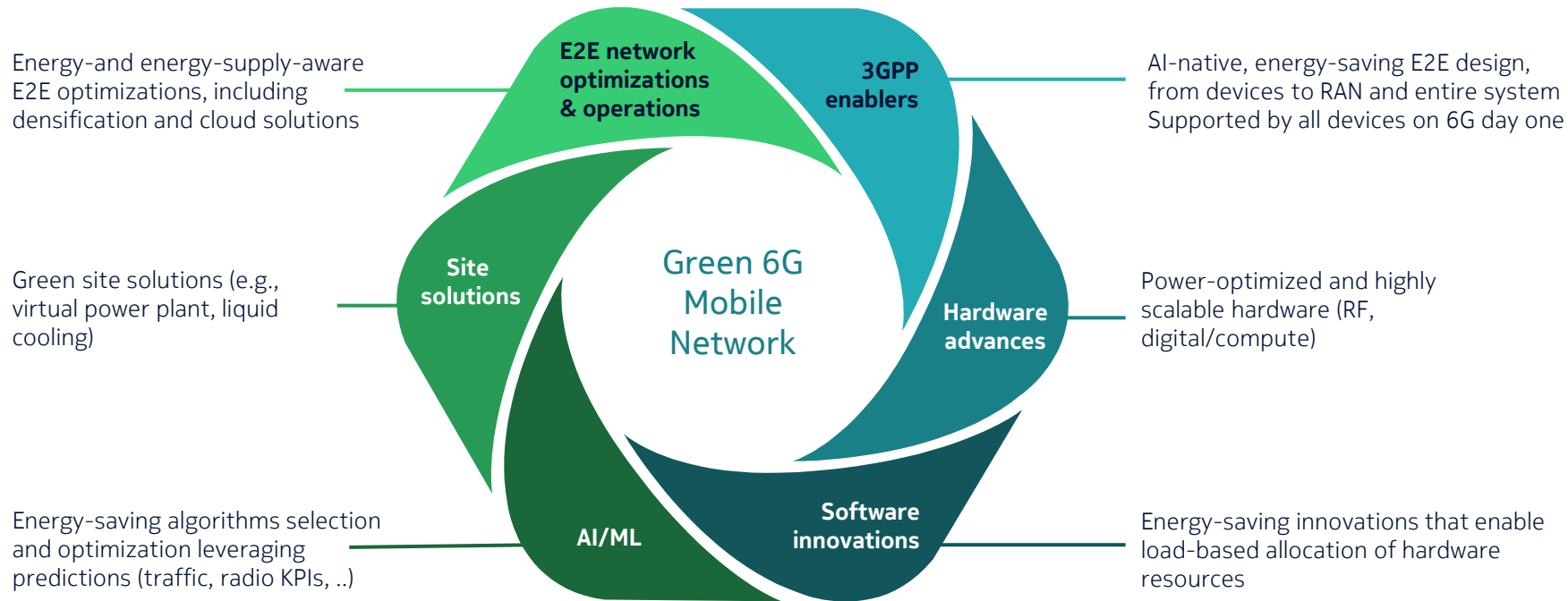
(****) Exposure for other domains like O-RAN, Transport, Cloud, etc. are not in scope of this presentation but should also be considered

CAPIF as the unified framework for exposure



Key components for a green 6G network

An end-to-end view



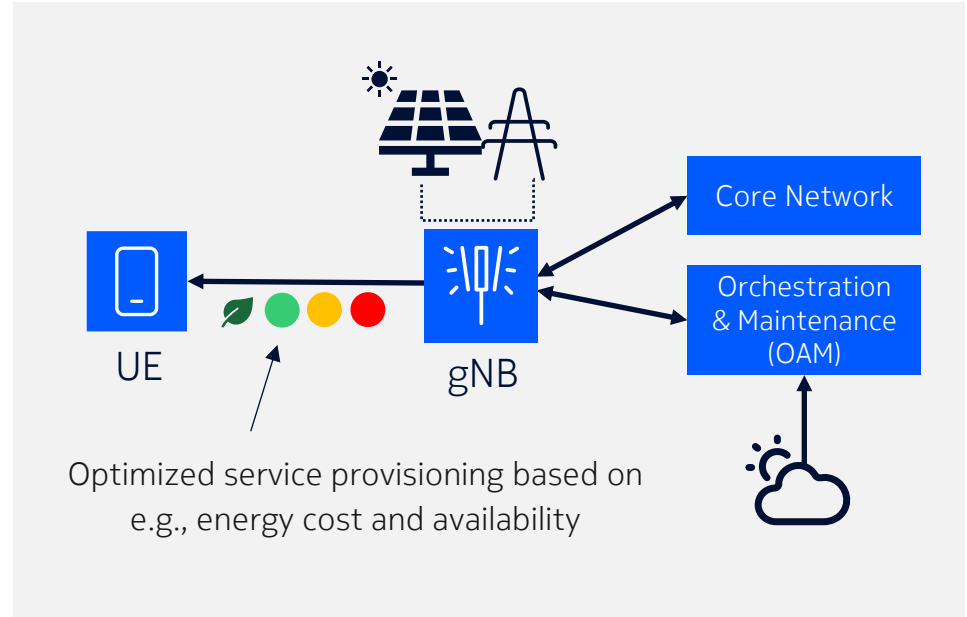


Key 3GPP enablers: a closer look

Energy efficiency by design

3GPP enablers for optimized E2E 6G service delivery:

- **Energy savings:** Minimize energy consumption E2E through intelligent design and optimizations including QoS adaptations
- **Smart energy management:** Take into consideration carbon intensity to favor renewables, energy cost and availability (e.g., disaster and off-grid scenarios)
- **Data-driven decisions:** Leverage energy and carbon exposure information for informed actions





Ensure a robust 6G security posture from the start

Threat vectors for 6G - fueled by emerging technologies



Quantum computing

threatens current cryptography



Offensive use of **AI** crafts adversarial inputs

AI will amplify current cyberattacks



SW-defined radios

can spoof signals and jam

We need to prepare today for tomorrow

Post-quantum cryptography

AI security

Radio lower-layer protection

Security for sensing

AEAD support

Authentication enhancement

Security for new NAS

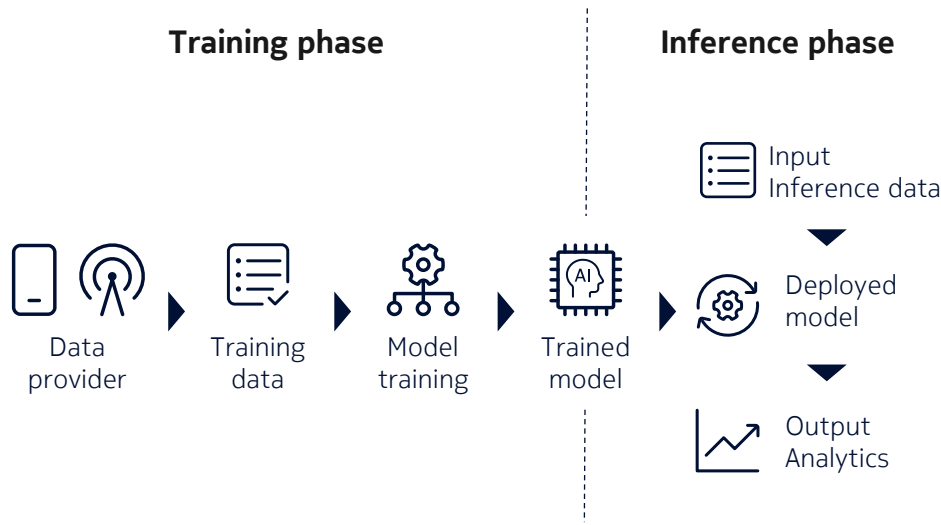
Data security

Security monitoring

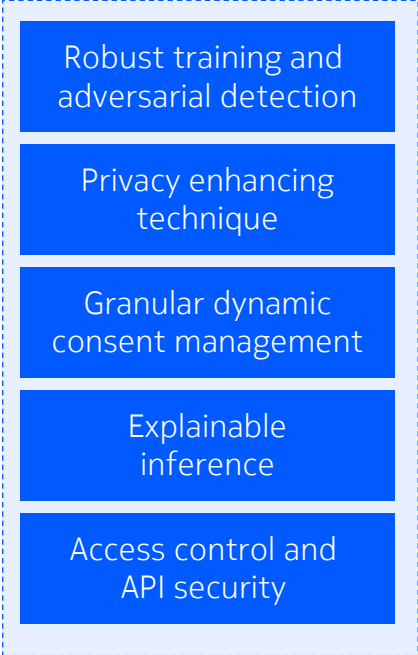


Holistic AI security and trust framework

Threats



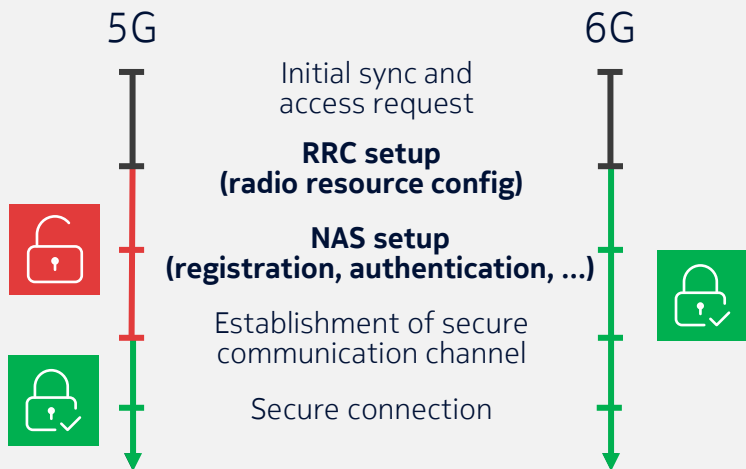
Solutions



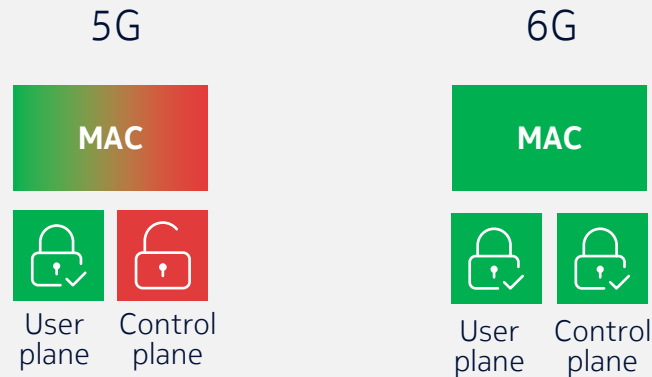


Improvements in 6G to protect the lower layer

6G will protect
the UE initial messages towards the gNodeB



6G will protect
L2/MAC Control elements



Summary

Value to society and business

Reuse

- 5G SBI framework
- 5G user plane architecture with wide range of topology options
- IMS for voice and multimedia services

Redesign

- Modular NAS protocol enabling scalable and implementation friendly design, non-backward compatible 6G UE
- New 6G NFs when justified: 6G AMF, 6G SMF, 6G UPF, 6G PCF

Reinforce

- Fully resilient system towards zero downtime
- Efficient support of interactive services via adaptive QoS
- Use of CAPIF as the unified framework for exposure

AI & Data

- Data as 1st class function
- AI powered network for better efficiency and performance
- AI based and intent based automation for TCO reduction

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