6G Mobile Network：Evolves from CommaaS to XaaS

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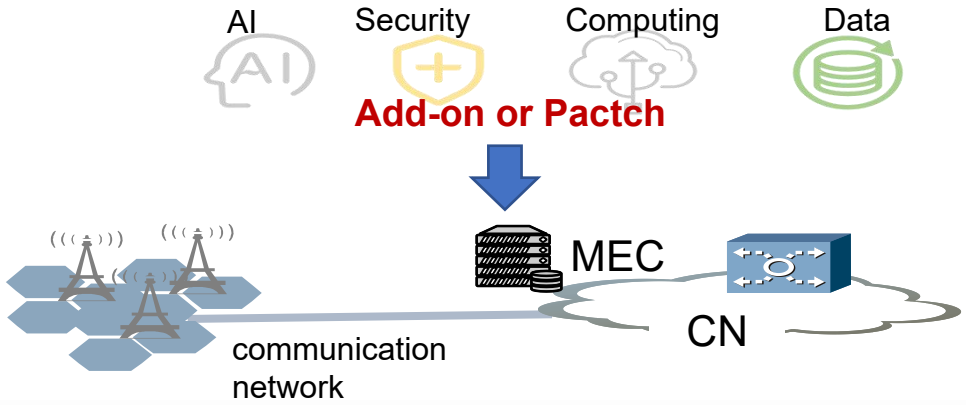
Driver 1: Learning from 5G

To Explore the differentiated scenarios and use cases, 5G has tried to expand network capabilities, e.g. AI, cloud computing, etc., but it doesn’ t work well in current network architecture

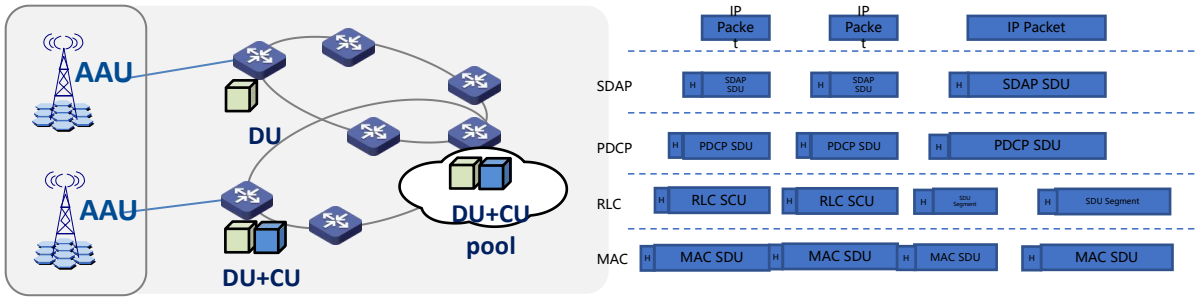
Poor business adaptability

- 2B applications require **more than connectivity, such as computing, AI, positioning, etc.**
- For 2B, the existing 5G network is not flexible and cost friendly: **Long development duration, high cost, difficult to fulfil the customized and personalized demand**
- Simply overlays of new capbility leads to **low resource and cost efficiency**



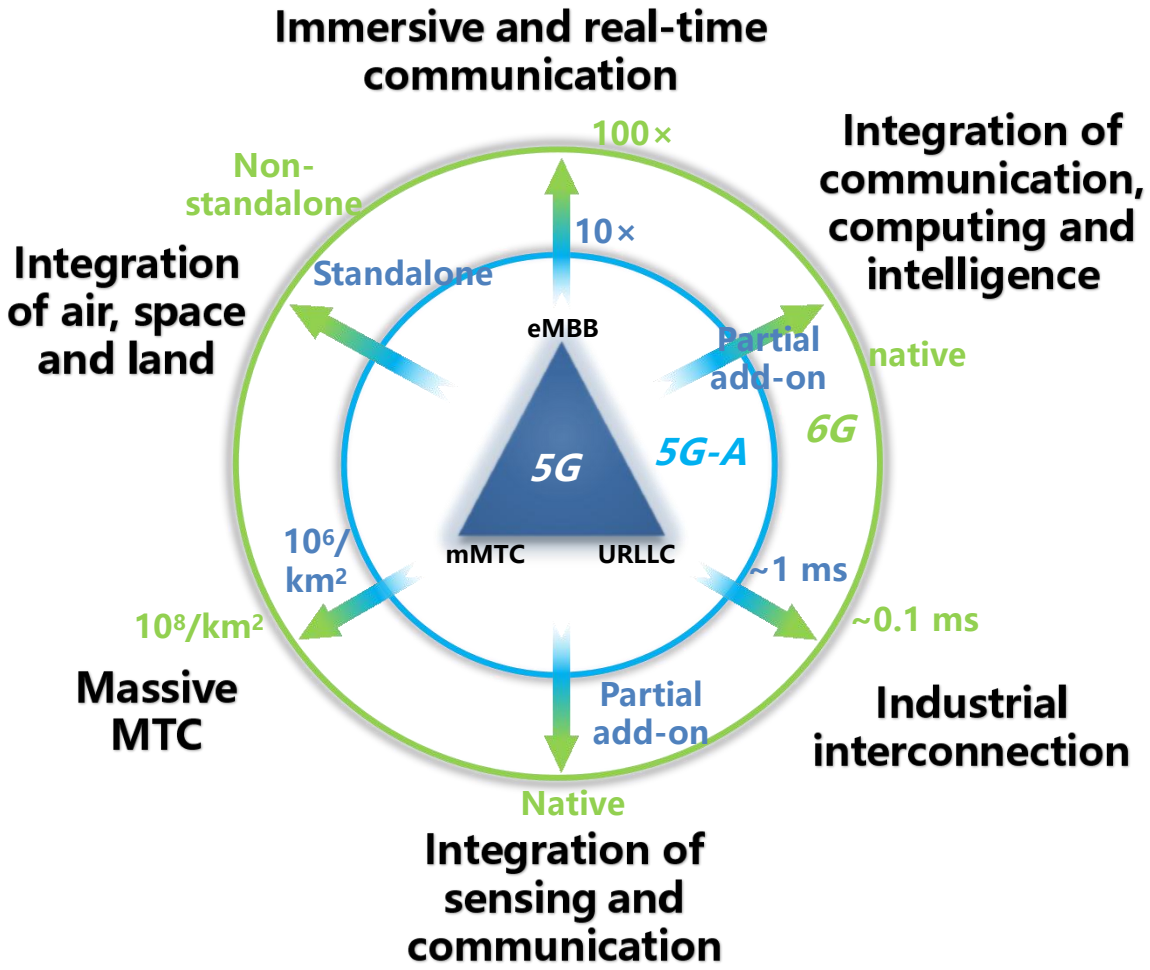
Network architecture and protocol are not flexible

- A single network architecture leads to simple stacking of network deployments. This leads to **high network deployment costs, high power consumption, long cycles for the introduction of new versions and features, and complex O&M management**
- The fixed protocol becomes the bottleneck of the agile adaptation of the network to the new business



Driver 2: Requirements for New Services/Apps and Scenarios

6G Typical Application Scenarios



Scenario-driven 6G KPIs:

- **Communication KPIs improvements:**
  - Experienced data rate
  - Spectrum and power efficiency
  - Latency
  - Connection density
  - …
- **Multi-dimension capabilities:**
  - For 5G-A, add new capabilities on the existing rigid system;
  - For 6G, native integration of communication, sensing, computing and intelligence, native integration of TN and NTN

Driver 3: Technology Trends

Due to the convergence of DOICT in 6G era, it becomes feasible to natively integrate the communication, sensing, computing, big data, AI, and security technologies

Cloud computing

Trends

- Computing and storage resources extend from the center to the edge
- Applications are evolving to function as a service

Impact on the network

- Network devices have native computing capabilities, and forwarding and computing capabilities are deeply integrated.
- Native network resource awareness and network management and control capabilities

AI

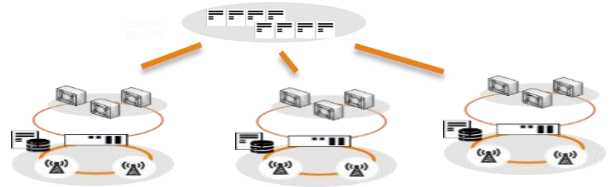
- Architecture Trends: Sinking to the edge, distributed deployment
- Technology trends: cognitive AI, computing and storage integration

- Distributed AI is deployed at the edge of the network to support real-time AI applications
- Build new native AI capabilities for operators to avoid OTT winner-take-all

Big data

- It extends from data storage and computing technology to data governance, data analysis and application, and data security circulation technology

- Data security and compliance need to be further improved
- Mining the value of data: network O&M and user services
- Explore the convergence of data from multiple industries



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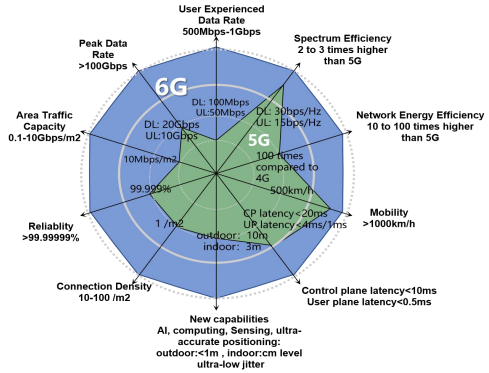
Design goals for 6G network

6G will evolve from a mobile network to a mobile information network, and play important role in each steps of information services providing, e.g. collection, storage, transmission, processing and application

Global Coverage

- 3D coverage of air, space, ground and sea
- The all-in-one architecture supports multi-RAT

Immersive Performance



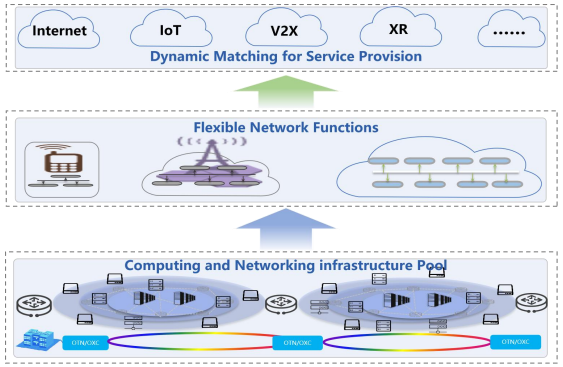
- The network should be able to sense the performance requirements of the service
- Customized for extreme performance

Integrated Capabilities

Communication, sensing, computing, AI and other capabilities

- Communication
- sensing
- computing
- AI
- Security
- Big data

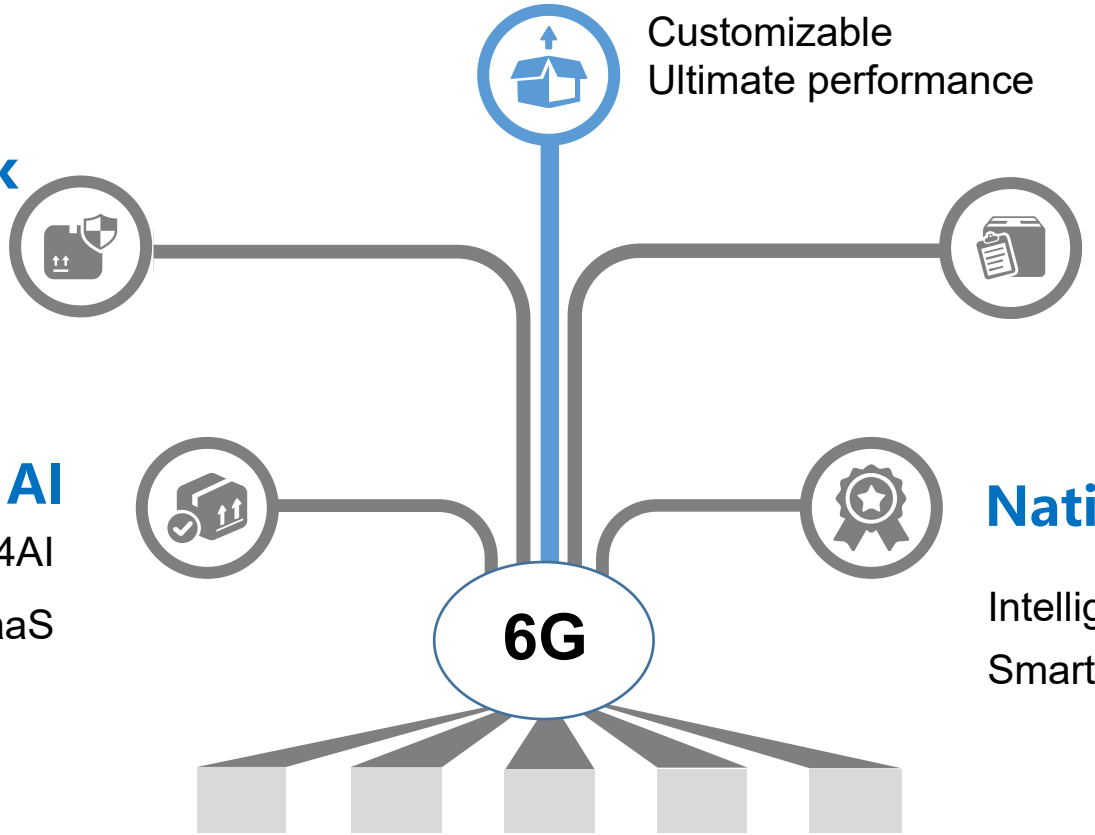
Platformized Network



- Integration of different capabilities
- On-demand, plug-and-play
- Open to all customers

6G Network Design Principles

On-demand Fulfillment Network



Customizable
Ultimate performance

Lite Network

Plug-and-play

Easy to deploy

Soft Network

ICDT convergence

Fully software-defined

Capability exposure

Native AI

AI4NET and NET4AI

AIaaS

Native Security

Intelligent consensus on information

Smart defense

Digital Twin

“Zero touch” maintenance

Auto-generation

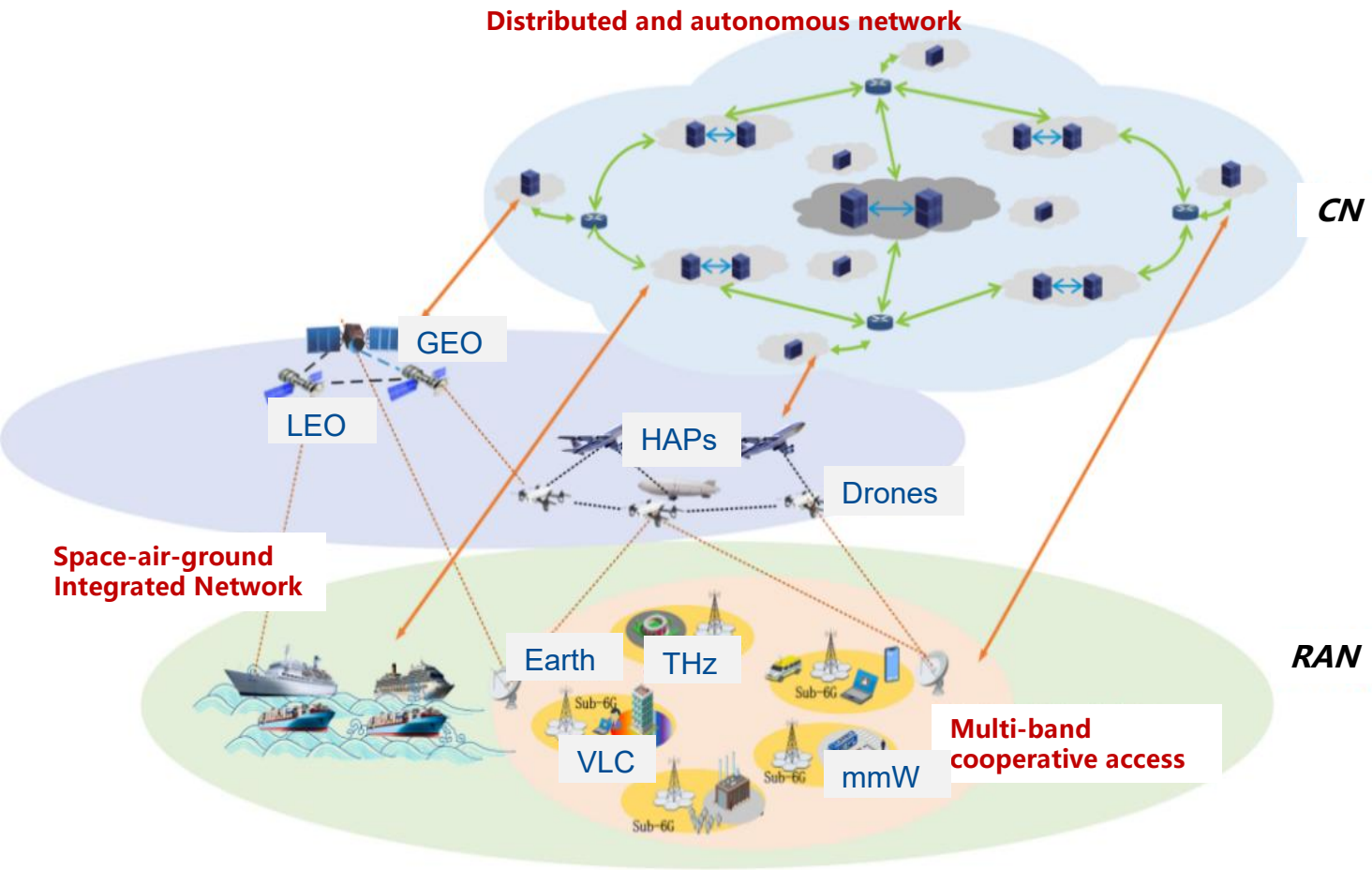
Self-evolving

Contents

- Driving Forces of 6G Mobile Network
- Design Principles and Goals for 6G network
- 6G Mobile Network Architecture
- China Mobile’s Trial Platform

6G Deployment Architecture

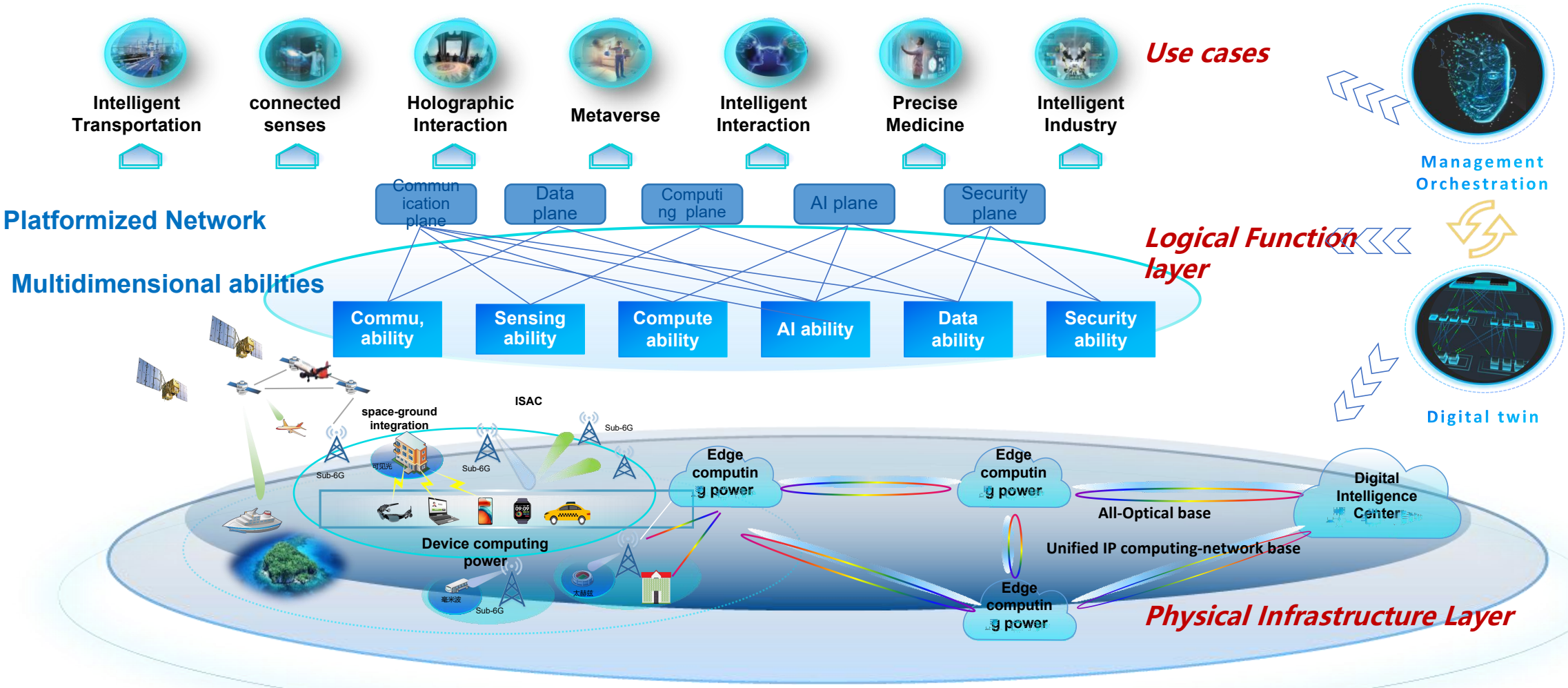
Through deep integration of space, air and ground, a 3D network will be built to achieve global, low-cost and ubiquitous coverage.



- Satellite network as an important **supplement and extension of terrestrial network**
- Seamless user experience between satellite and terrestrial networks
- Flexible network deployment, expand the scope of terrestrial communication services and reduce service costs
- Reliable network regardless of terrain constraints and disasters.

6G Logical Architecture

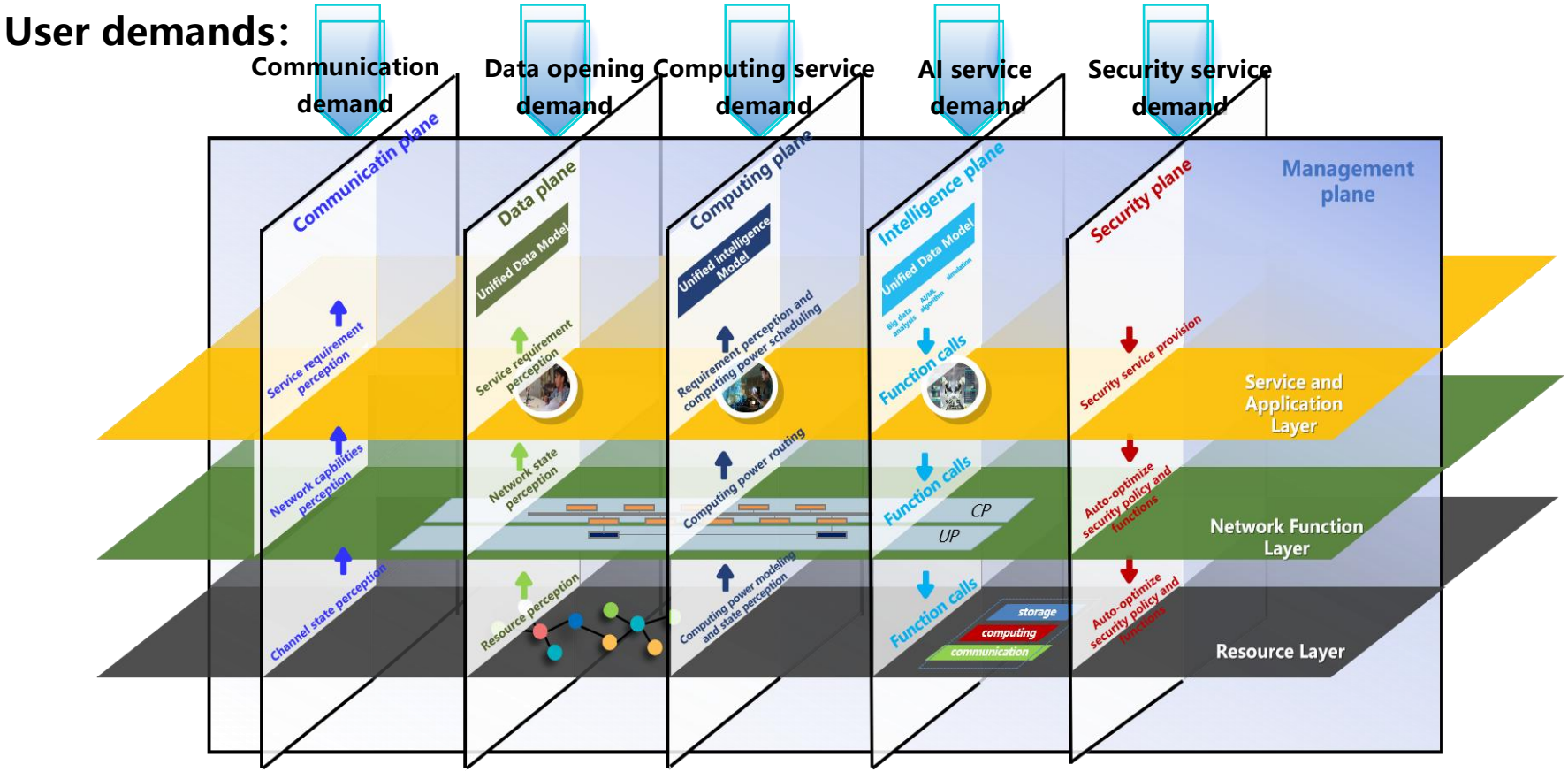
6G deeply integrates commu., sensing, computing, and intelligence, providing all-area seamless coverage across space-air-ground.



6G Logical Function Architecture: XaaS

6G will introduce multiple logical function planes, providing multi-dimensional network capabilities in a native way, e.g. communication, sensing, computing, AI, big data, and security, as well as a platform for all services

On the basis of 5G communication plane, 6G network will define new data plane, intelligence plane, computing plane, security plane



Data Plane: Manage network data and provide data services

Computing Plane: endogenous computing design, management of computing and computing services

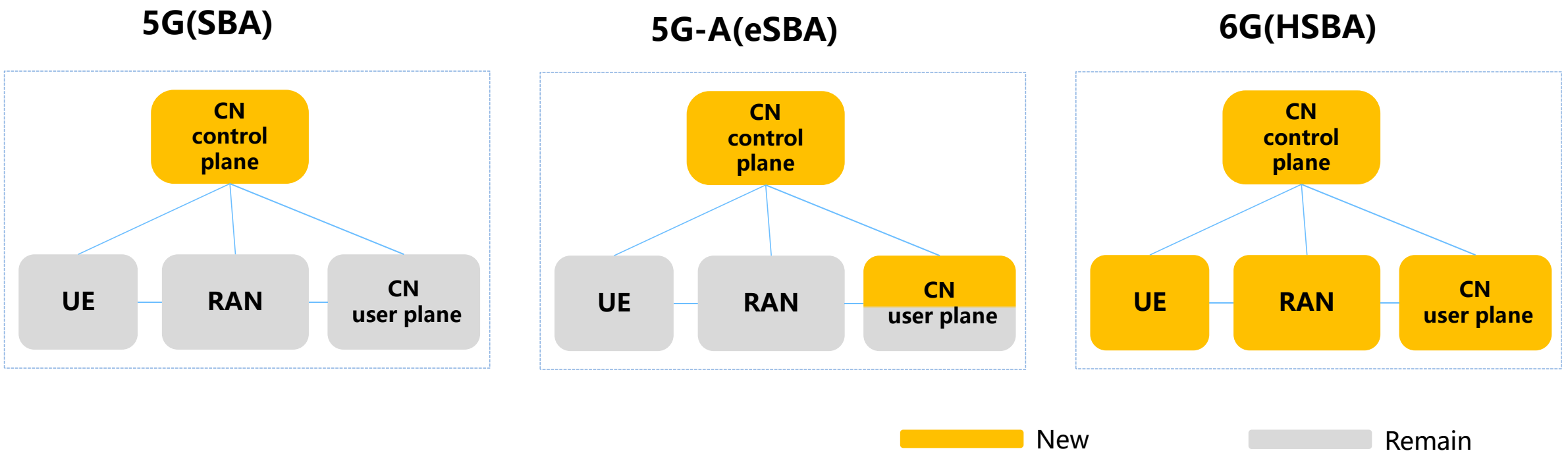
Intelligence Plane: The design of endogenous AI provides a full-life AI service operating environment

Security Plane: endogenous security design, provide security as a service

Communication Plane Design

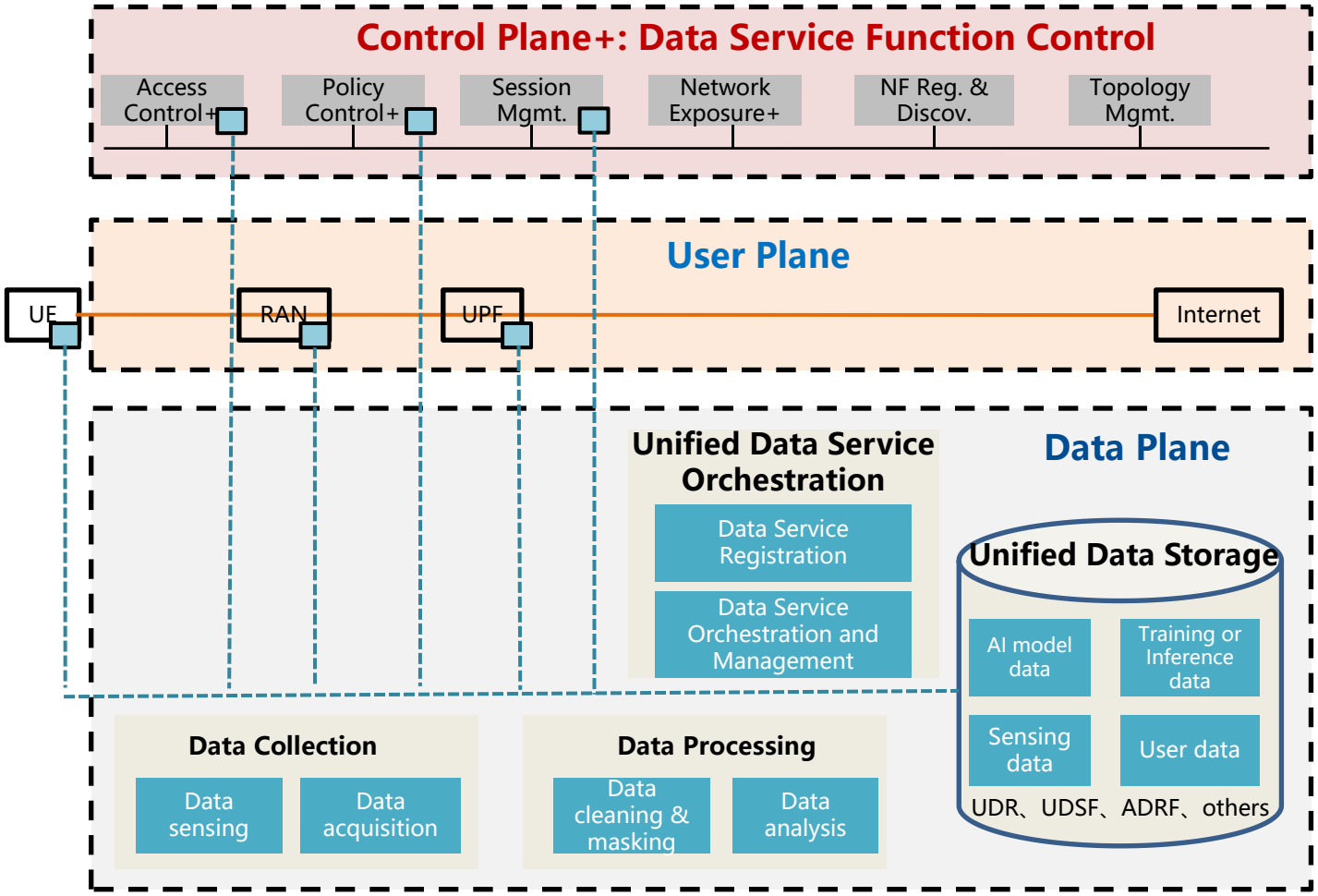
SBA brings profound changes to 5G network architecture. 6G will inherit the core concept of SBA and realize Holistic SBA

The service-based architecture continues to evolve and deepen SBA->eSBA->HSBA



Data Plane Design

Data Plane is designed based on the efficient and reliable storage of data, combined with the control of data service orchestration. The traditional CP is enhanced to support overall collaborative control of data service for the whole process of data collection, storage,transmission, processing and application.



Control Plane Enhanced Functions

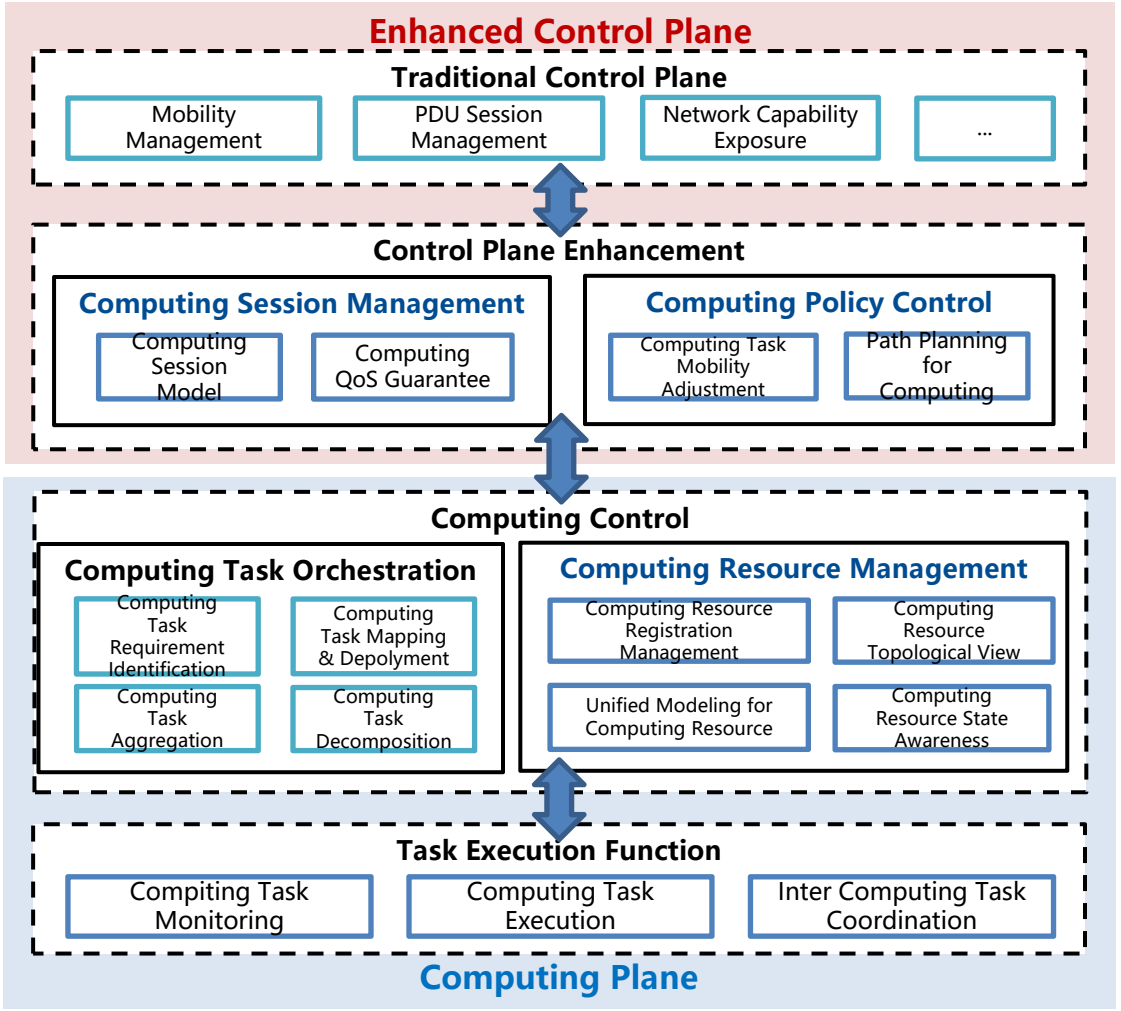
- Support control functions for data plane services, e.g. access control, policy generation, mobility management, network exposure, etc.

Data Plane Functions

- **Data storage management**
  - Support multiple data storage by levels and categories
  - Support storage, indexing and reuse in form of data object for efficient data storage, reading and writing
- **Data collection**
  - Construct real-time and efficient collection mechanism for multi-source heterogeneous data, to support fine-grained data acquisition based on the collection requirements
- **Data processing and analysis**
  - Construct an integrated processing mode for multi-dimentional and multi-modal data, to support data processing while transmitting
- **Data plane service orchestration**
  - For data service tasks, orchestrate the whole process service chain to support data collection, processing, storage, transmission, etc.

Computing Plane Design

Computing plane focusing on high-performance computing and combination of computing task orchestration and computing resource management. Enhancement on traditional control plane to support coordinated control on computing service and mobility management, achieving high-efficiency supply of computing serivces.



Control Plane Enhanced Functions

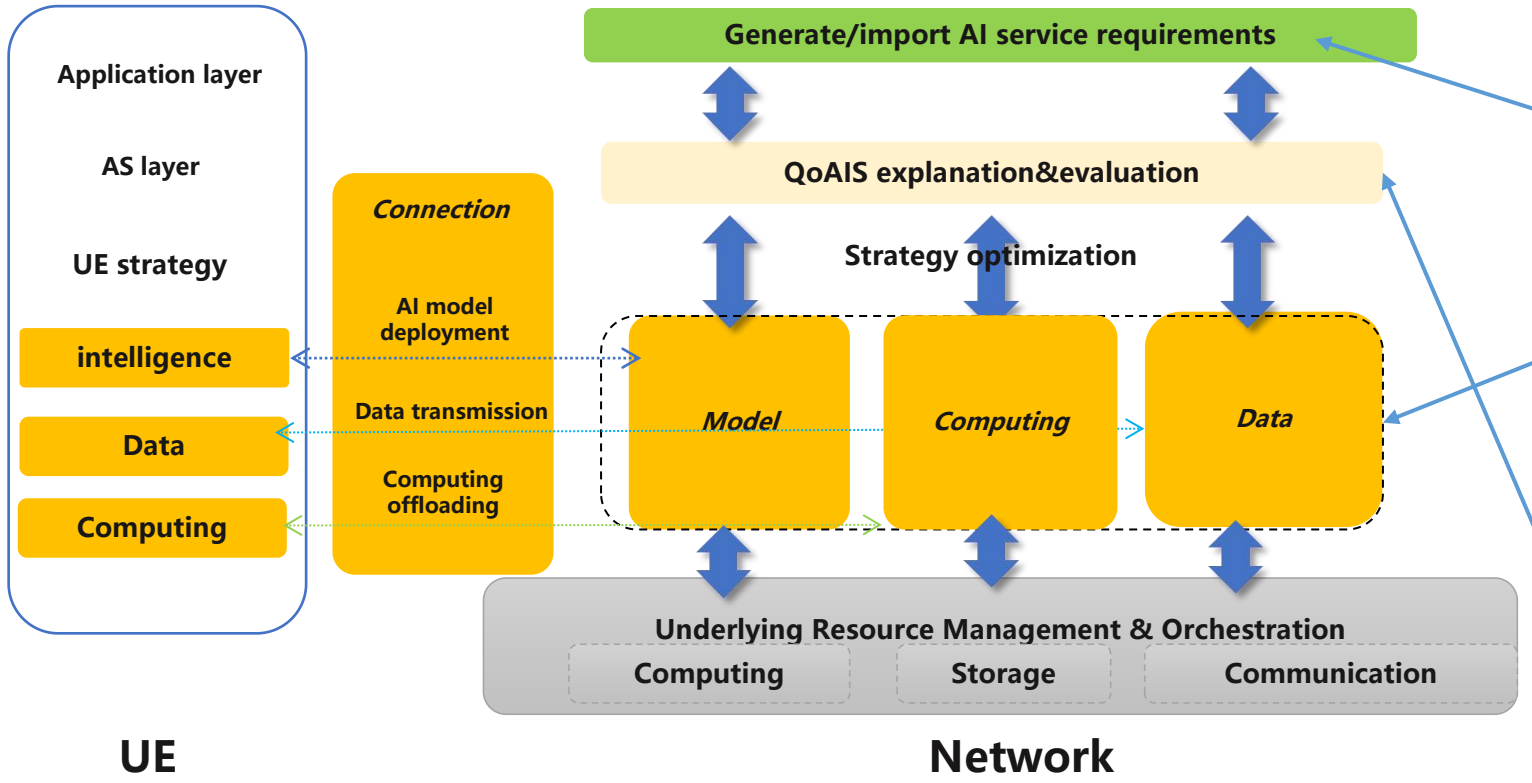
- **Computing Session Management**
  - Enhancement on QoS control and session continuity control for computing sessions.
- **Computing Policy Control**
  - Computing plane instance selection and computing & network convergence policy generation, according to computing service requirement, user location and network condition.

Computing Plane Functions

- **Computing Task Execution**
  - High-performance execution and real-time monitoring of computing task. Inter computing task coordination.
- **Computing Task Orchestration**
  - Identification of computing task requirement and on-demand computing task decomposition&aggregation.
  - Dynamic application deployment based on deployment requirement and computing-network resource condition.
- **Computing Resource Management**
  - Computing resource modeling, registration, sensing, etc.

AI Plane Design

Native AI is supported to provide real-time and efficient AI services and capabilities. Native AI includes AI use case self-generation, QoAIS guarantee mechanism, entire life cycle AI workflow management and on-demand scheduling of multi-dimensional resources.



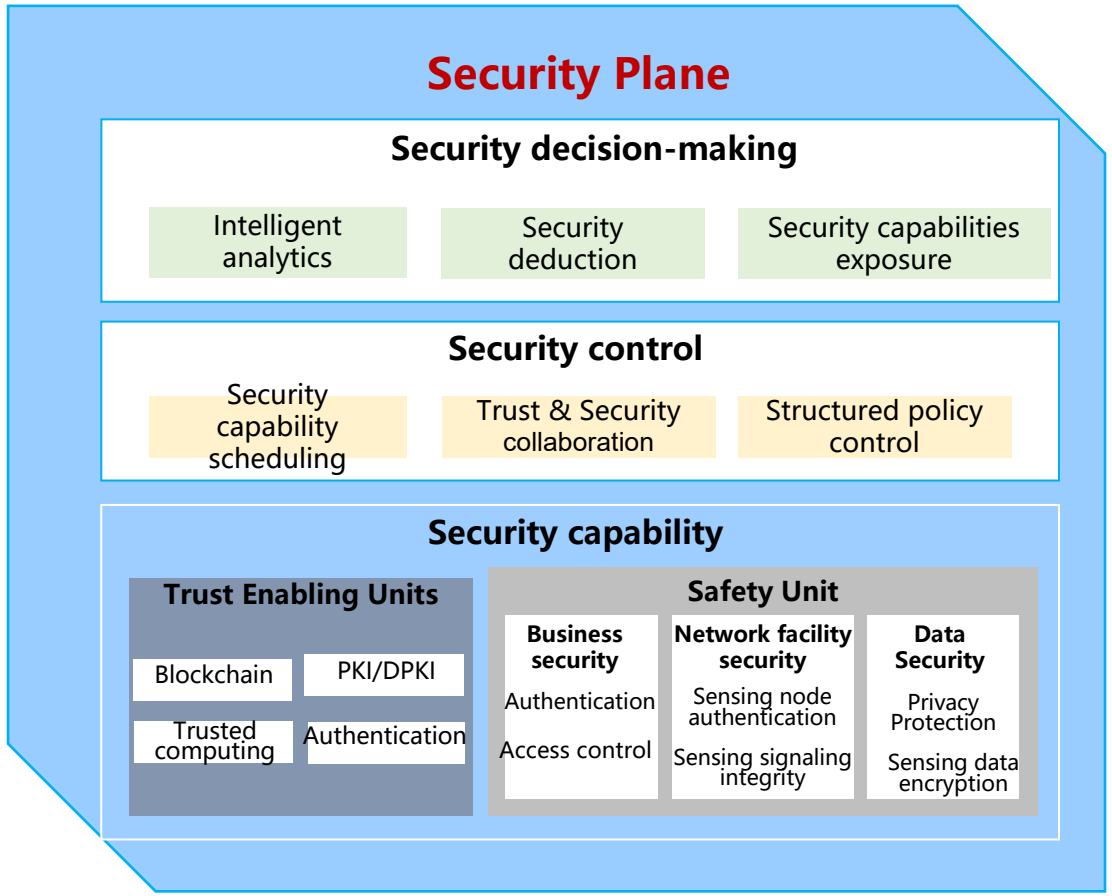
1. One **Unified Network AI Framework** for Ubiquitous Intelligence

2. Shift from external to **native and integrated**

3. Shift from best-effort to **on-demand**

Security Plane Design

With trust + security as the core concept, the 6G security plane is designed from the three dimensions of capability, control, and decision-making, and four transformations are realized to build an endogenous, active, dynamic, and collaborative trusted security system



1. Plug-in to endogenous to improve network self-immunity

- Security is integrated into the entire life cycle of 6G networks
- Wireless physical layer security enables the convergence of security and communication

2. Passive to active to improve network risk perception

- Intelligent analysis to prevent unknown risks
- Safety deduction, from qualitative to quantitative, improve certainty

3. Static to dynamic, improve the refinement of network protection

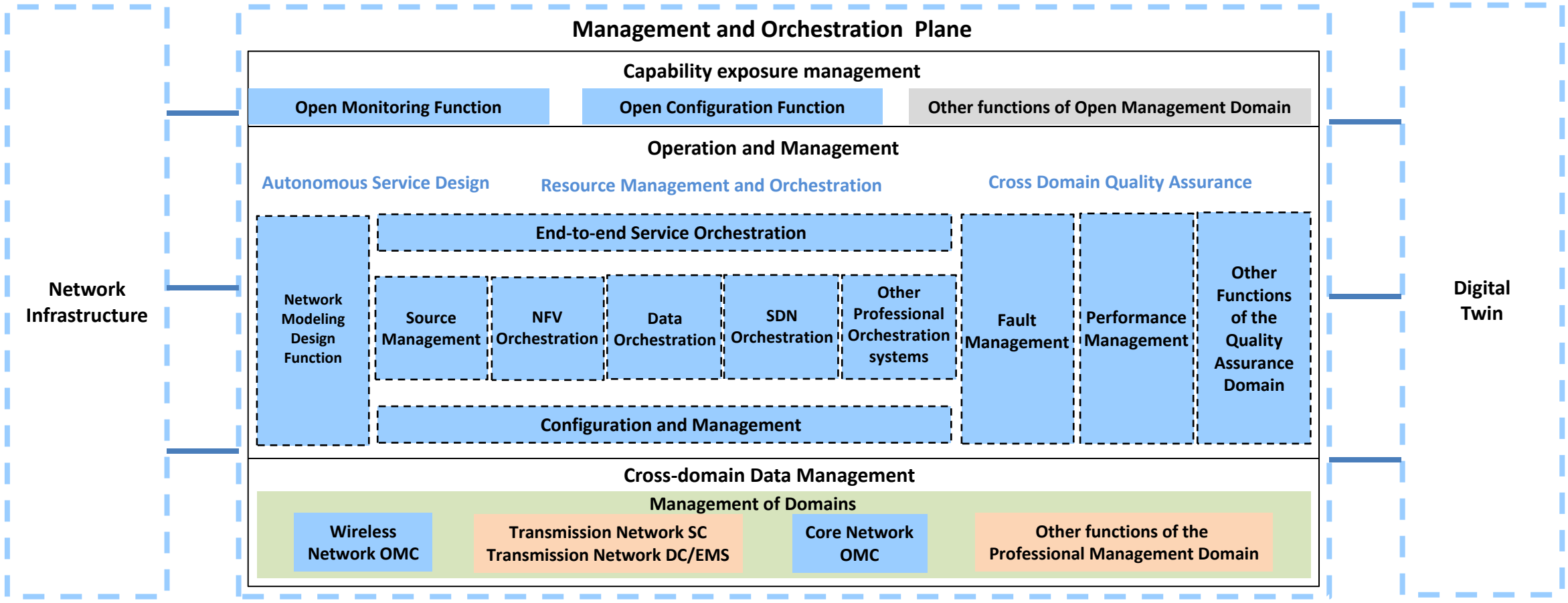
- Security capabilities are exposed to provide precise security services
- Scheduling of security capabilities, dynamic combination, and optimal efficiency

4. Isolation to collaboration to improve network security intelligence

- Trust & Security collaboration
- Collaboration between security capabilities and network capabilities

Management and Orchestration Plane Design

The management and orchestration plane is designed to intelligently orchestrate network resource and capability, and achieve network full life-cycle management.



- **Capability exposure management:** Orchestrating the connectivity, computing, intelligence and security capabilities of cross-domain network into service that can be provided internally and externally.
- **Operation and maintenance management:** Coordinating and fine managing network resources such as spectrum, storage and computing power. Network closed-loop management and operation are realized through autonomous service design, resource intelligent scheduling and cross-domain quality assurance.
- **Cross-domain data management:** E2E network data management capabilities, including data reporting, data monitoring, and parameters configuration.

Contents

6G EXPLORE
- EXperimental PLatform for Original REsearch of Comm-Sens-Comput-AI Integration

中国移动 China Mobile

Based on the unified computing network base, it gathers capabilities such as communication, sensing, computing, intelligence, and security, and integrates multi-node, multi-band, air-space-ground integration, and high-speed ubiquitous access, which is the basic foundation for incubating original innovations

System

中信科移动 CICT Mobile · YOFC · HUAWEI · FiberHome · ERICSSON · IPLOOK · ZTE · NOKIA

Devices/Chip

mi · oppo · Lenovo · MEDIATEK · 紫光展锐 · vivo

Software

Alibaba Group · Asiainfo 亚信 · Tencent 腾讯

8 Research labs


Network structure


Optical transmission


Space-air-ground integration

Integrated innovation

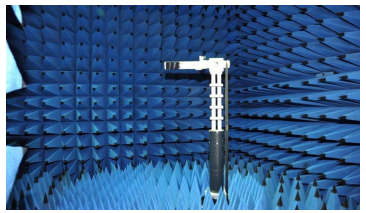

RF Tech.


Baseband tech.


6G Cloud network

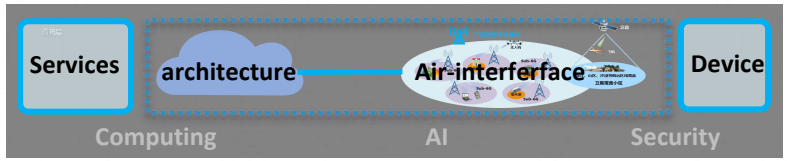

Solution integration

2 Infrastructure environments


Microwave anechoic chamber、shielding

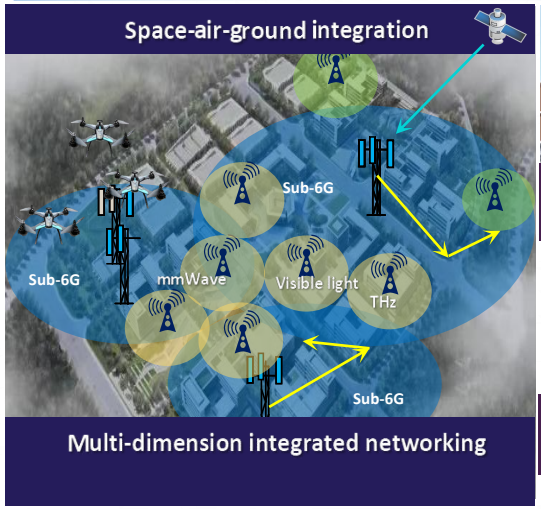

Simulation evaluation environment

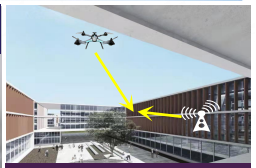
1 E2E 6G testing system

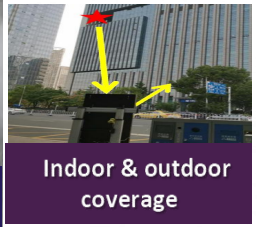


1 6G trial network

largest serving area, 3D covering, various scenarios multi-band




High coverage at low-altitude


Indoor & outdoor coverage

Meters

ROHDE&SCHWARZ · Ceyear 思仪 · KEYSIGHT TECHNOLOGIES · 创远仪器

Research institutions

X-NET

Applications

当虹科技集团 · FTEL

中国移动 China Mobile

6G EXPLORE-EXperimental PLatform for Original REsearch of Comm-Sens-Comput-AI Integration

Sub-7GHz Extreme MIMO Test

6G Integrated Communication and Sensing Test

High-Speed Visible Light Communication Test

System Parameters

No. of Antennas	No, of Channels	Transmit Power	Angle Resolution	Center Frequency	Bandwidth
512	4	58 dBm	5 °	26 GHz	400 MHz

Testdata

Communication Performance

Data Rate

888 Mbps

Throughput @Mbps

Sensing Performance

Range Accuracy

0.075 m

Range Estimation @m

Velocity Accuracy

0.15 km/h

Velocity Estimation @km/h

Trial Network Layout

Live Camera

Robot 360° Camera

Thanks!