ENI PoC #19: Space-Ground Cooperative Network Slicing Progress Update

Rapporteur: NDSC

China Telecom, Asiainfo, Huawei, CAICT, CNIT, CNR ISTI

ENI PoC project #19: Space-Ground Cooperative Network Slicing Progress Update

PoC Goals and PoC member task

Host/Team Leader: NDSC, 中国电信 CHINA TELECOM

Team members: cnit consorzio nazionale interuniversitario per le telecomunicazioni, HUAWEI, AsiaInfo 亚信科技, Consiglio Nazionale delle Ricerche, CAICT 中国信通院

- ✓ **PoC Project Goal #1: Network Slice Data Plane Adaptation Mapping. Demonstrate how to support identity resolution such as VLAN and IP address on the data plane, support precise identification and control for user services, and realize the slicing adaptation between mobile communication network and satellite network.**
- ✓ **PoC Project Goal #2: : Space-Ground Network Slice Cooperative Control. Demonstrate how to exchange the slicing control information with the control plane of ground mobile communication network and satellite network (5GC and SNOCC), optimize the global service quality of network slicing, and ensure the consistency and continuity of slicing service in space-ground cooperative network environment.**

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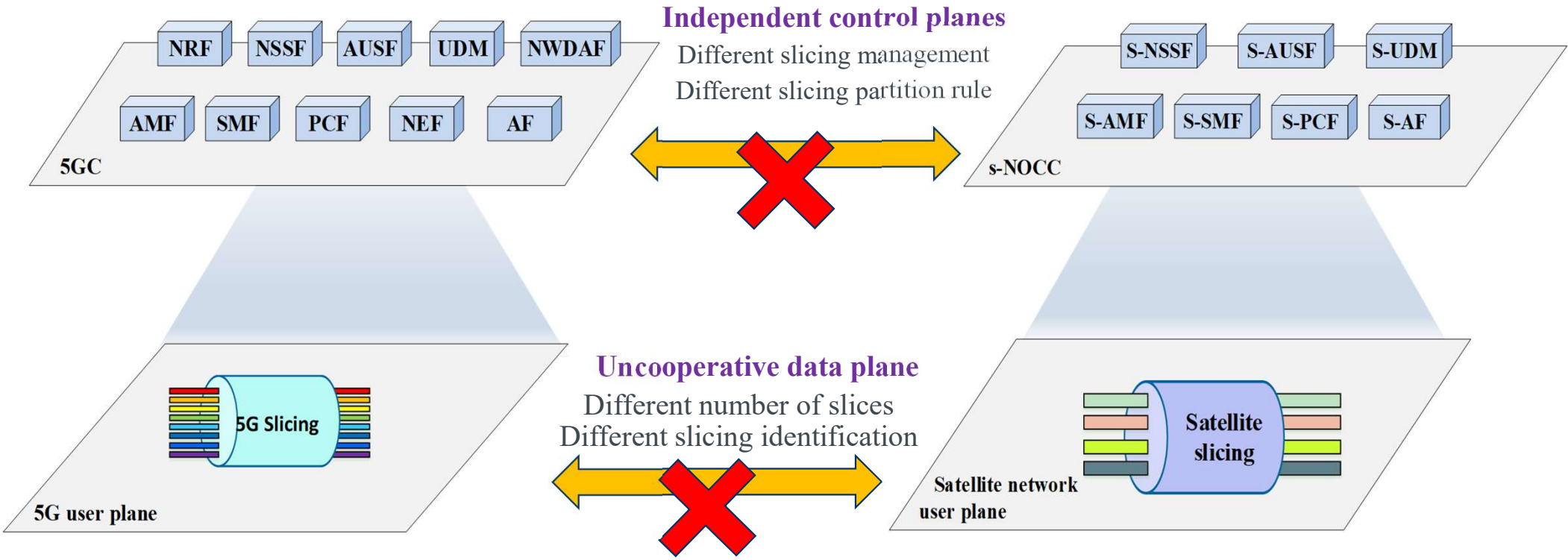
Core problem ：Difficulty to interconnect 5G network and satellite network slices



Core problem : Ground mobile communication network and space satellite network are different on service classification of network slicing, number of slices and slicing construction. As a result, the slices of the two networks cannot be directly interconnected.

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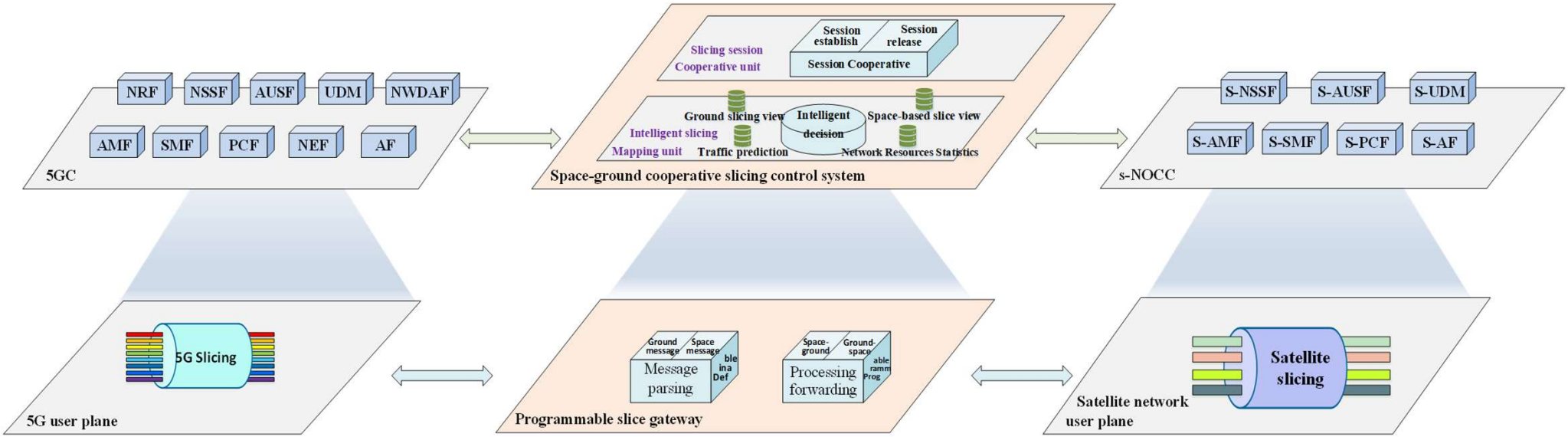
Innovation 1: Architecture of Space-Ground Cooperative Network Slicing



A programmable slicing gateway and a space-ground cooperative slicing control system can be deployed between the ground mobile communication network and the satellite network. On the data plane, it uses definable message parsing and forwarding capabilities to accurately identify and control slicing services, and realize heterogeneous network slicing adaptation. On the control plane, it collaboratively opens the slicing session channel in space-ground cooperative network, and intelligently generates the slicing mapping strategy, to improve the end-to-end slicing service quality of space-ground cooperative network.

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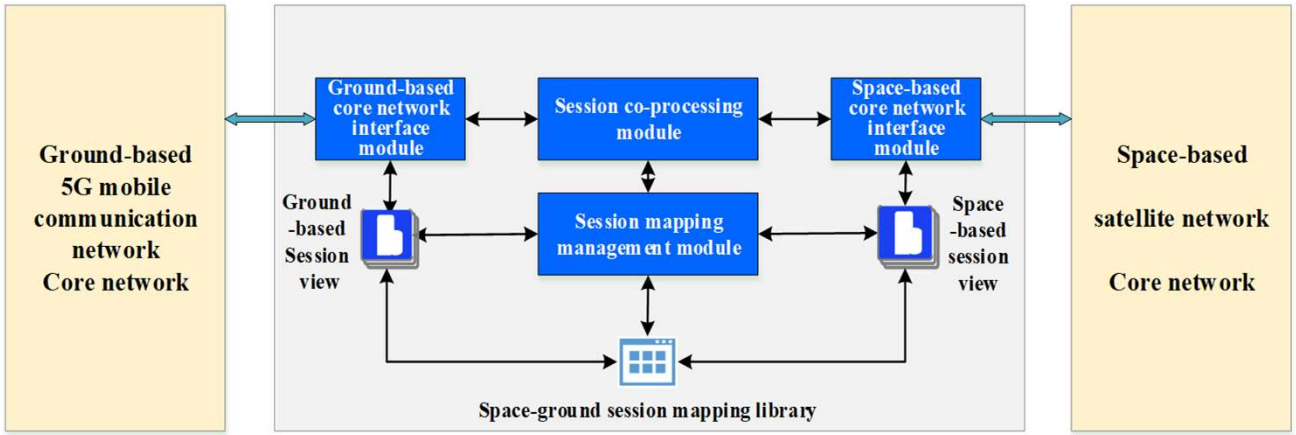
Innovation 2: Space-ground slicing session collaboration (Module introduction)



- **Slice mapping management module** is responsible for maintaining the mapping relationship between ground-based and space-based PDU sessions.
- **Session cooperative processing module** can cooperate with the process of establishing, modifying and releasing sessions of ground-based and space-based networks
- **Ground-based core network interface module** is responsible for the interface with the ground-based mobile communication core network.
- **Space-based core network interface module** is responsible for the interface with the space-based satellite network core network.

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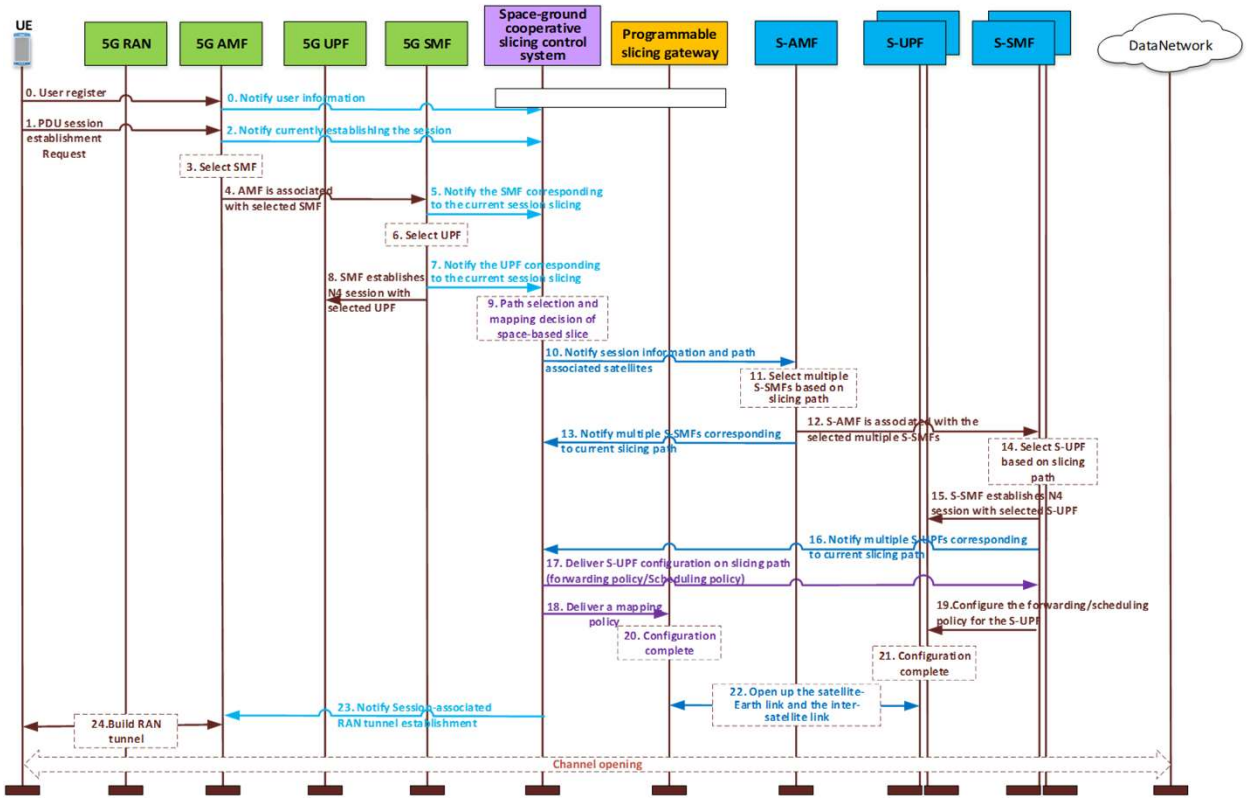
Innovation 2: Space-ground slicing session collaboration (PDU session establishing)



The space-ground cooperative slicing control system interacts with the space and ground network slicing control planes respectively to maintain the mapping relationship between ground-based PDU sessions and space-based PDU sessions. The establishing, modifying and releasing sessions of ground-based network and space-based network can be cooperated with each other. The programmable slicing gateway receives configuration policies and establishes PDU session channels from UE to ground-based 5G mobile communication network, space-based satellite network and up to Data Network.

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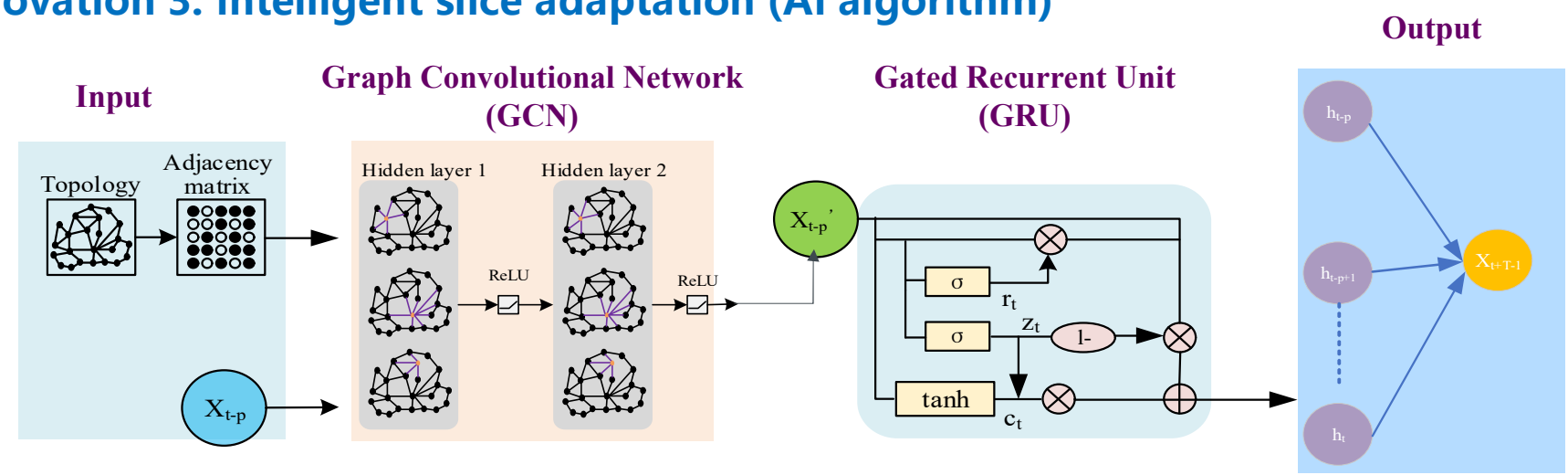
Innovation 3: Intelligent slice adaptation (AI algorithm)



To construct differentiated network slices involving different service characteristics, and realize multi-service integration, an intelligent slice mapping mechanism based on spatial-temporal correlation is proposed based on Graph Convolutional Network (GCN) and Gated Recurrent Unit (GRU).

- The network topological features are captured by GCN to obtain the spatial dependence.
- The dynamic changes of node attributes are captured by GRU to obtain the local time trend of traffic load.

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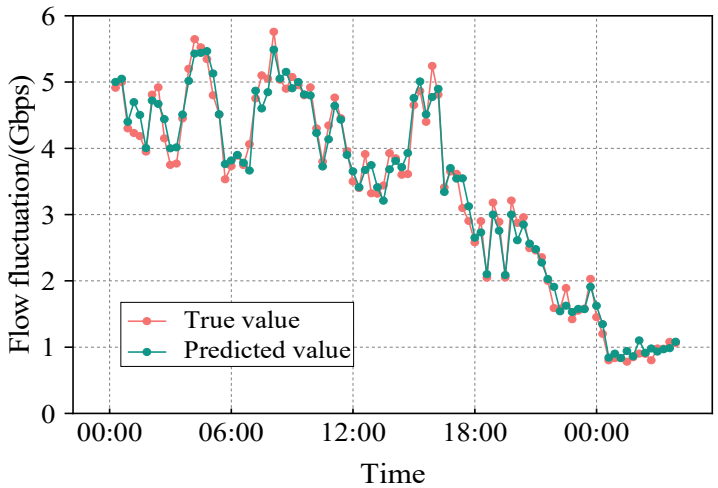
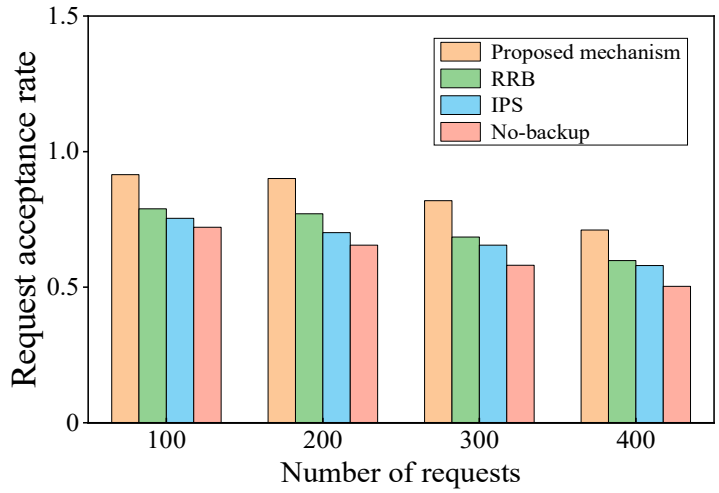
Innovation 3: Intelligent slice adaptation (Simulation results)





Simulation results indicate that, the proposed mechanism can effectively predict the business traffic, improving the service request acceptance rate of the slice adaptation strategy. Thus, the slices of network resources can be matched as needed with the wildly fluctuating traffic in the space-ground cooperative network.

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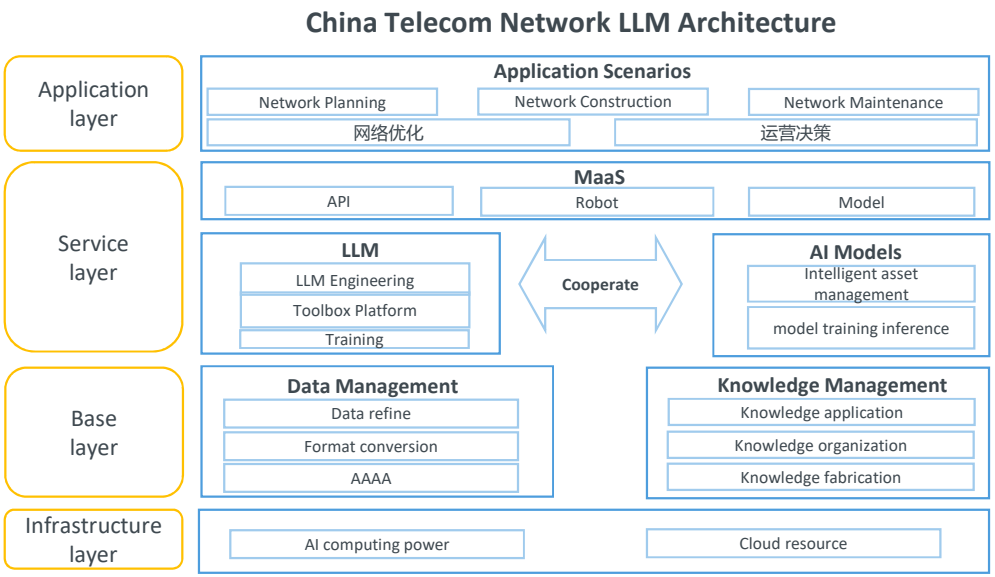
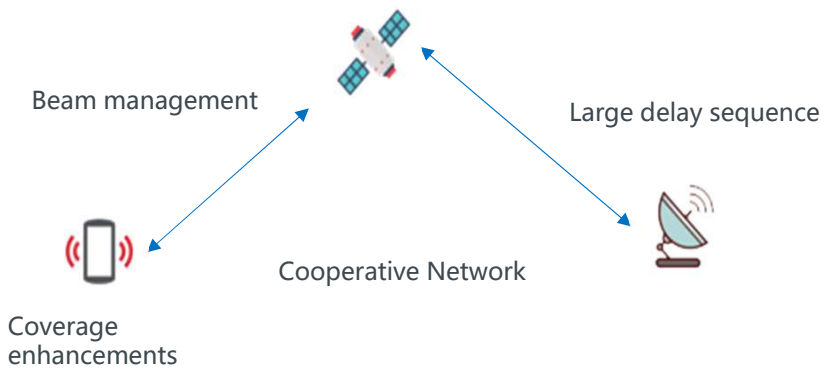
Innovation 4: Network Intelligence powered by telecom LLM architecture





- ✓ parallelization and signaling improve voice call latency
- ✓ link enhancement and network coding coordination improve voice quality
- ✓ user access and resource retention to improve voice capacity
- ✓ ultra-large-scale beam management with wide coverage
- ✓ dynamic networking with high-speed satellite movement

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PoC Milestones and Current Progress

Current

Target

PoC Milestone	Stages/Milestone description	Target Date	Additional Info
P.S	PoC project submission	09/2023	Presentation during #ENI 27
P.TP.1	PoC Test Plan 1	12/2023	Initial testbed up and running
P.D1	PoC Demo 1	12/2023	Webinar demo at the ENI#28 plenary meeting
P.D2	PoC Demo 2	06/2024	Demo at shanghai MWC2024
P.D3	PoC Demo 3	TBD	Demo at Intel AI summit
P.C1	PoC Expected Contribution 1	05/2024	Contributions to ENI use case
P.C2	PoC Expected Contribution 2	07/2024	Contributions to ENI requirement
P.C3	PoC Expected Contribution 4	07/2024	Contributions to ENI terminology
P.R	PoC Report	09/2024	PoC-Project-End Feedback
P.E	PoC Project End	12/2024	Presented to ISG ENI for information