From Next Generation Network virtualization to Computing Power Network

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Q2 TOR introduction and NFV related work item overview

- **Q2/13 focus on Next-generation network (NGN) evolution by adoption of emerging network technologies in a phased network evolution approach, technologies including, but not limited to SDN, NFV, distributed ledger technologies and computing power network related technologies**

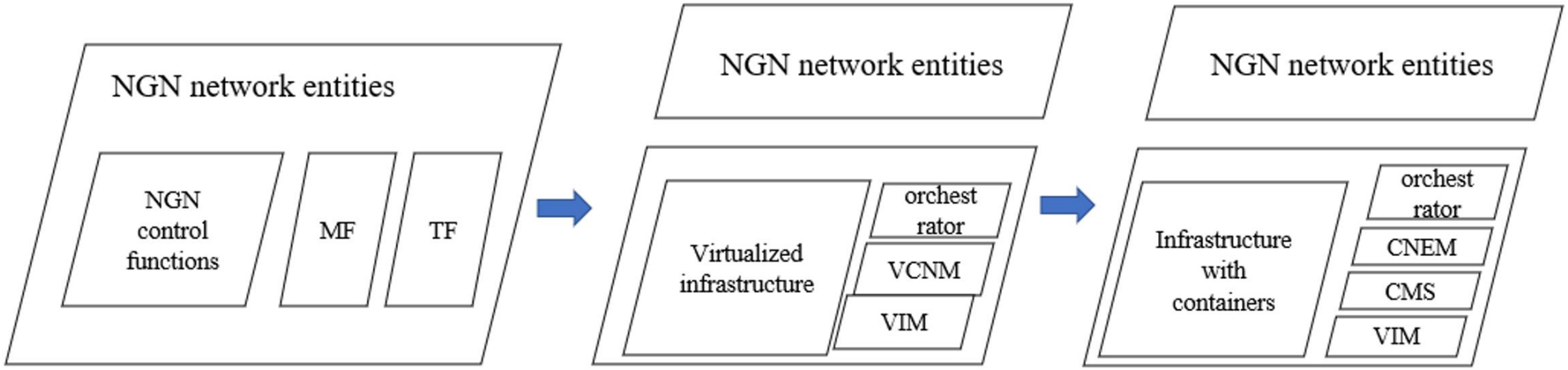


Figure : next generation network evolution with NFV

1. NGN evolution with virtualization technologies

- Y.2320: Requirements for virtualization of control network entities;
- Y.2321: Functional architecture for supporting virtualization of control network entities;
- Y.2322: Functional architecture of virtualized control network entities management and orchestration

2. NGN evolution with cloud native technologies

- Y.2350: Requirements to support container-based network entities;
- Y.NGN-CNE-arch: architecture for supporting container-based network entities;
- Y.vtne-fram: framework enhancement in NICE

Y.2320(2015): Introduction of virtualization technology to control plane network entities

- **This Recommendation provides requirements for virtualization of control network entities (VCN) in NGN evolution, which enables a virtualized running environment (for control network entities) in NGN evolution.**

Scenarios concerning virtualization of control network entities in NGN evolution

- Auto-deployment of control network entity;
- Scaling in/out;
- Self-healing
- Hardware change without interrupting the service
- Change of VCN system
- Virtualized resource provision

The VCN system enables the VCN in NGN evolution

- The virtual infrastructure: the hardware resources (computing, storage, and network resources) and the virtualization layer on top of them;
- virtualized control network entity (VCNE);
- VCN management system: performs the management of the virtual infrastructure and the management of the virtualized control network entities

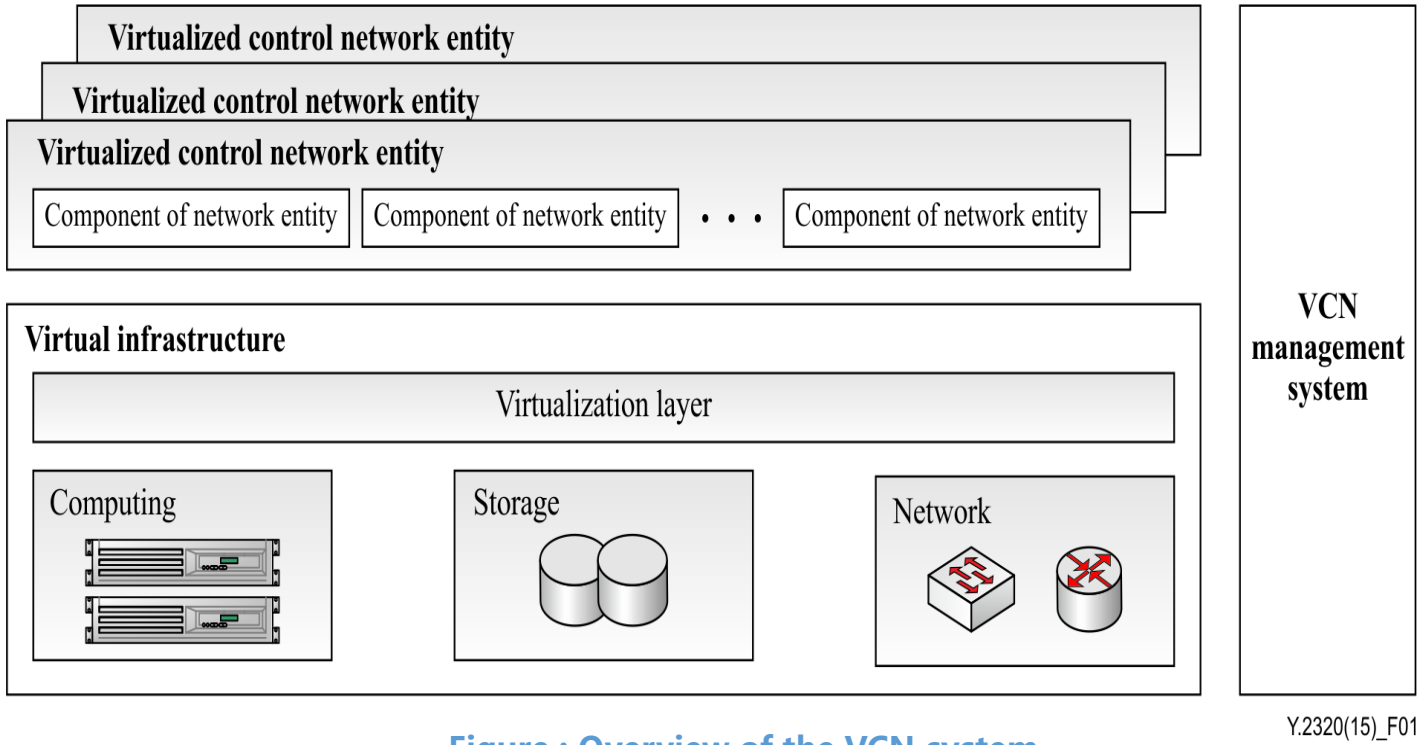


Figure : Overview of the VCN system

Y.2321(2016): Functional architecture for supporting virtual control plane network entities

- **This Recommendation describes the functional architecture, functional entities (FEs), reference points and information flow to support virtualization of the control network entities (VCN) for NGN evolution. The architecture design fulfils the requirements proposed in Recommendation ITU-T Y.2320.**

The functional architecture of the VCN identifies the following functions

- Virtualized infrastructure (VI)
- Virtualized infrastructure manager (VIM)
- VCN manager (VCNM)
- Virtualized Control Network Entity (VCNE)
- Orchestrator
- Management functions (MFs).

Reference points

- V(or-vc): reference point between orchestrator the VCNM
- V(vc-vim): reference point between VCNM and VIM
- V(vc-vcn): reference point between VCNM and VCNE
- V(vim-vi): reference point between VIM and VI
- V(or-vim): reference point between Orchestrator and VIM
- V(mf-or): reference point between Orchestrator and MF

Information flows

- VCNE package management
- Scaling of VCNE
- Network service management

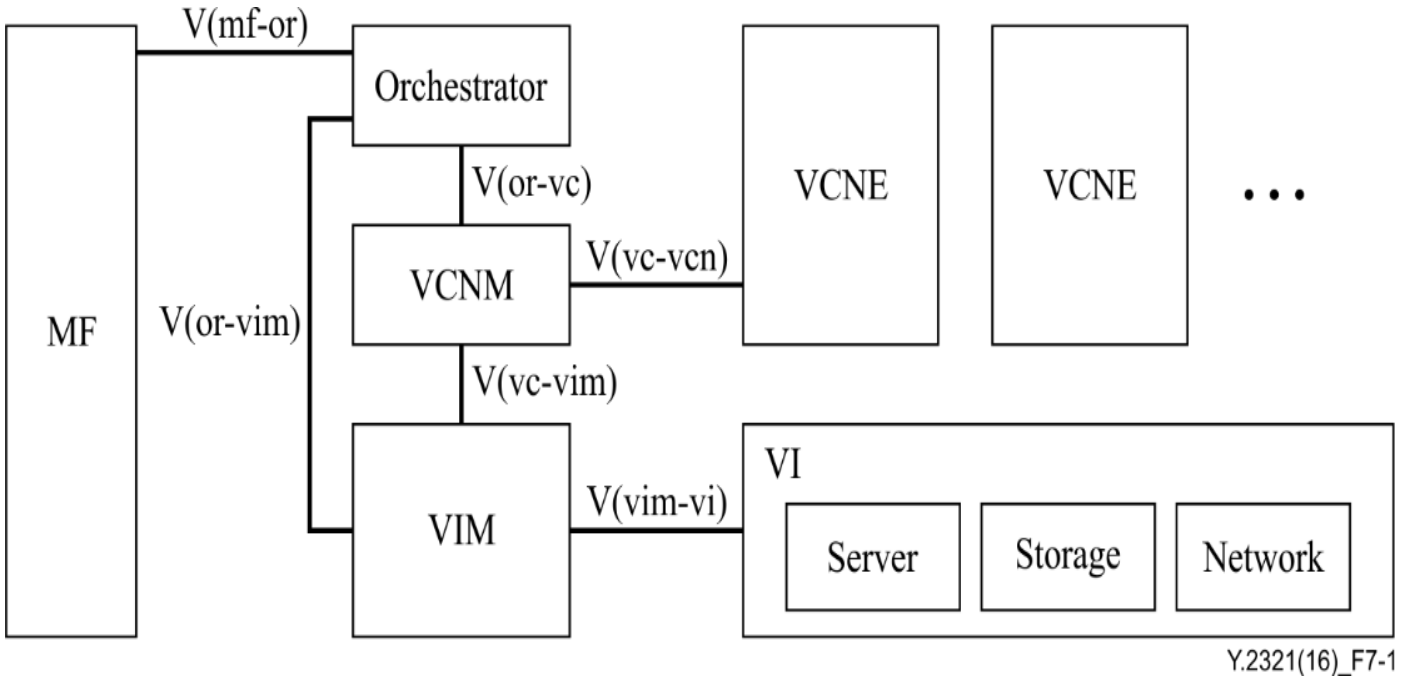


Figure : Functional architecture for supporting VCN

Y.2322(2018): Functional architecture of VCNE management and orchestrator

- **Based on Y.2320 and Y.2321, this Recommendation defines the functional architecture of virtualized control network entities management and orchestrator (VCNMO) and specifies the related reference points of VCNMO and its subcomponents.**

Functional architecture of VCNMO

- Orchestrator functions: split into service orchestrator functions and resource orchestrator functions.
- VCNM functions: two architecture options of VCNM functions, the generic VCNM functions architecture and the other is the dedicated VCNM functions architecture.
- VIM functions :virtual resource management and virtual infrastructure status monitoring.

Reference point of VCNMO

- External reference point: The reference point between VCNMO and VCNE, NGN management functionof VCNMO.
- Internal reference point of VCNMO.
  - V(ro-so): reference point between the resource orchestrator functions and service orchestrator functions
  - V(or-vc-so): reference point between the service orchestrator functions and VCNM
  - V(or-vc-ro): reference point between the resource orchestrator functions and VCNM
  - V(or-vim): reference point between the VIM and resource orchestrator function
  - V(vc-vim): reference point between the VCNM and VIM

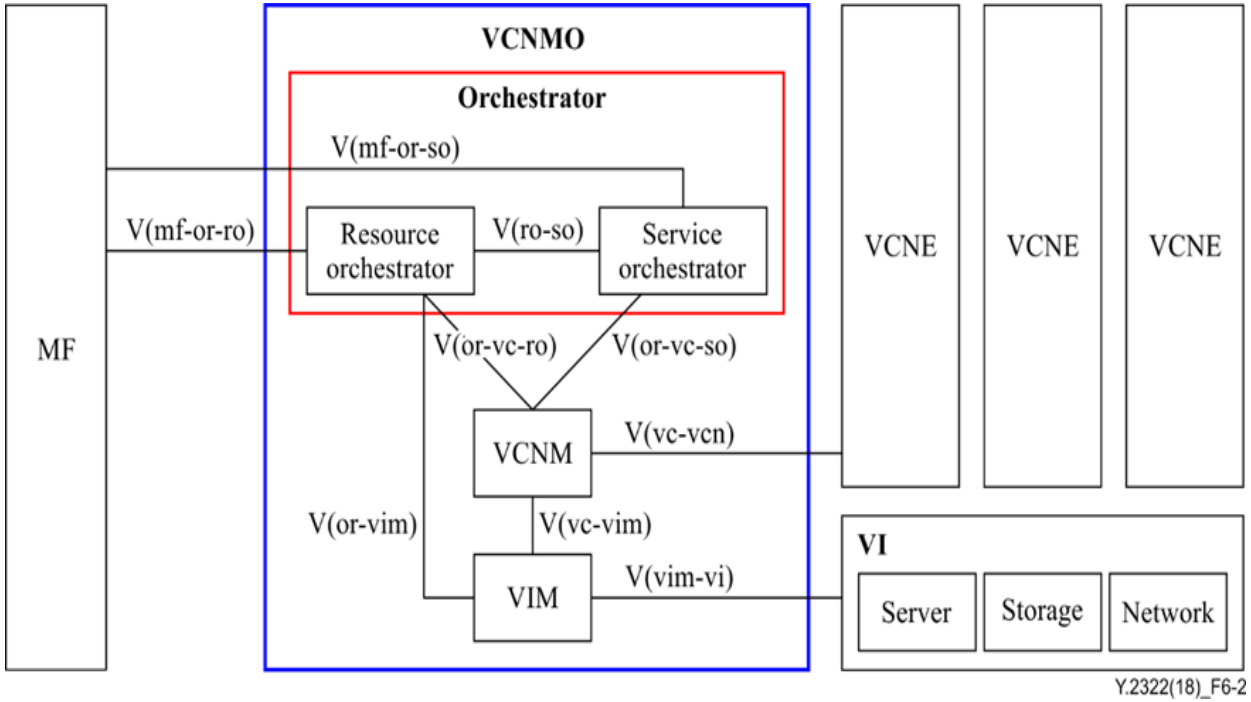


Figure : The functional architecture of VCNMO

Y.2350(2024):Introducing cloud-native concepts represented by container technology into NGN

- **The container-based network entity, realizing the rapid construction, operation and elastic expansion of telecommunication networks, can evolve the next generation network (NGN) furthermore.**
- **This Recommendation addresses special requirements for supporting the telecommunication network evolution based on Y.3535.**

Scenarios of container-based network entities in NGN evolution

- Auto-deployment of container-based network entity;
- Scaling in/out;
- High-performance forwarding plane
- Container-based network entity service capability provision
- Network entity container live-migration
- Container-based network entity observability

The container-based network entities (CNE) system enables the container-based network entities in NGN evolution

- Infrastructure: a fusion of physical and virtual resources, offering isolation, resource management, and the portability of containers and container clusters.
- CNE: a construct of multiple network function microservices.
- CNE management system: serves as the orchestrator of the CNE ecosystem, and performs resource coordination and management across network entities and infrastructure.

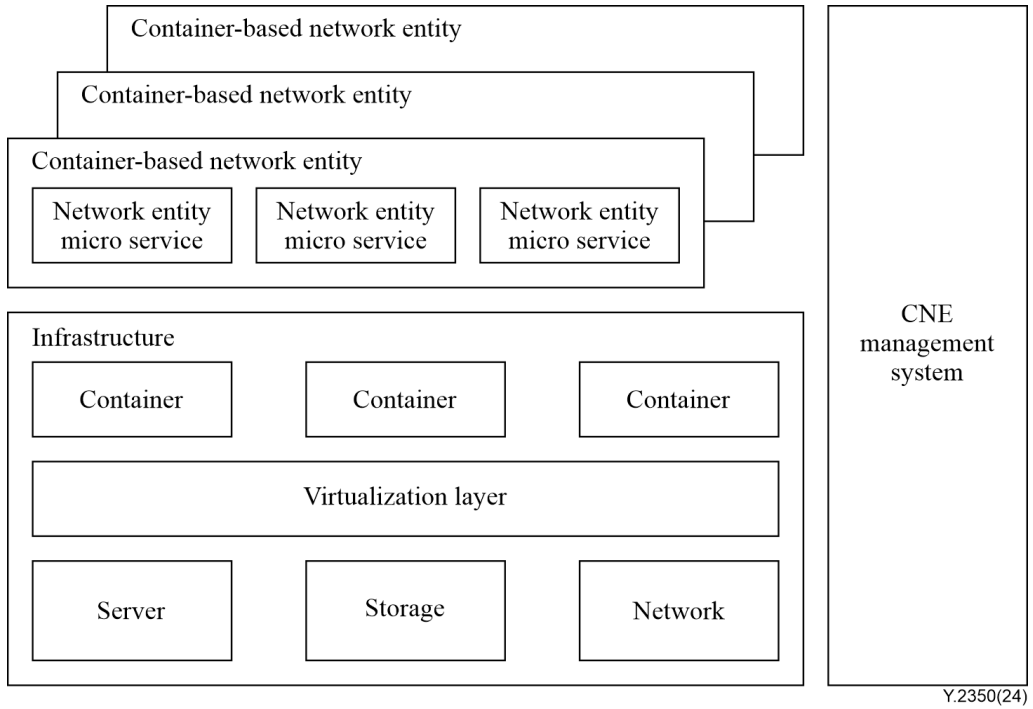
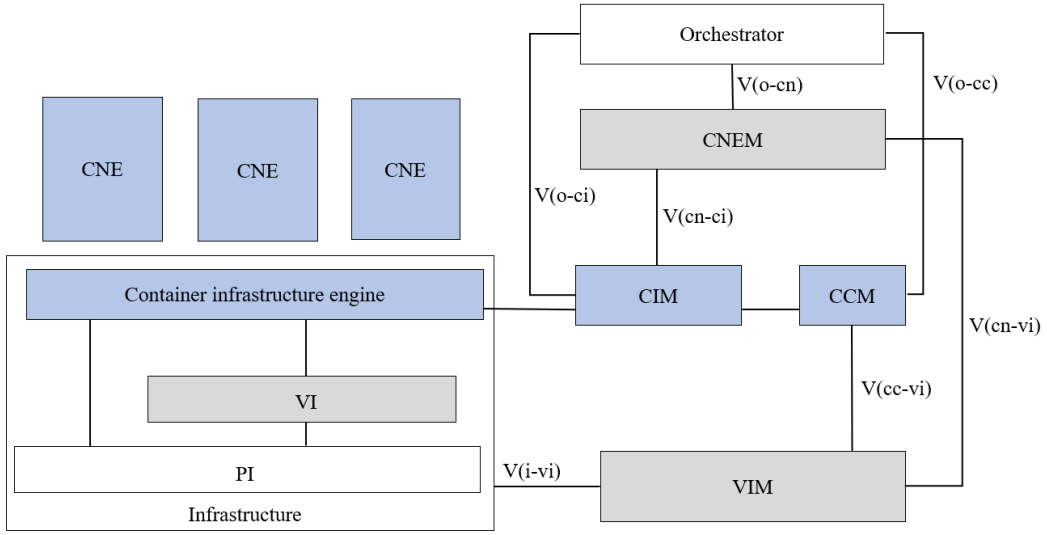


Figure : CNE system in NGNe

Other on going work items-Y.NGN-CNE-arch and Y.vtne-fram

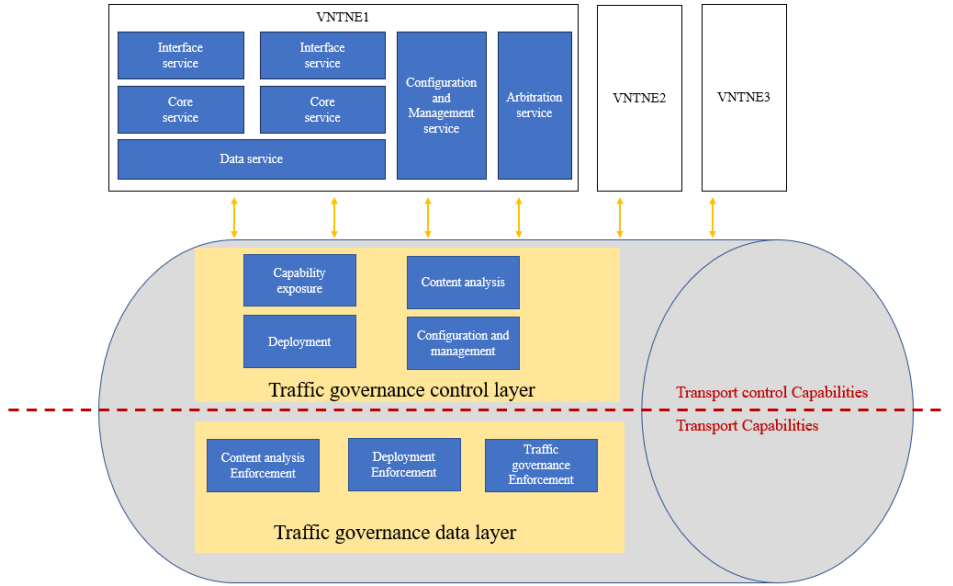
- **Builds on Y.2350, Y.NGN-CNE-arch provides the functional architecture of next generation network evolution (NGNe) to support container-based network entities. The functional architecture includes detailed functions, functional entities (FEs), reference points and procedures.**



functional architecture to support CNE

- Physical infrastructure (PI), Virtualized infrastructure (VI)
- Container infrastructure engine (CIE)
- Virtualized infrastructure manager (VIM)
- Container infrastructure manager (CIM)
- Container cluster manager (CCM)
- Container-based network entity manager (CNEM)
- Orchestrator (O).

- **Y.2320/Y.2321/Y.2322 cannot fully cover the requirements to support network element virtualization in the transport layer. Y.vtne-fram describes framework enhancement for supporting virtualized transfer network entities in NICE in order to ensure the stability and performance of the transport network.**



framework enhancement

- introducing traffic governance in the context of NICE-VTNE to manage, control, and optimize the flow of network traffic between network entity microservices
- includes network element microservice governance interface and parsing function, data layer deployment function, data layer configuration function and data layer management function

From Virtualization to CPN

- **With the rapid development of computing power demand, we put forward the concept of computing power network in Q2 based on SDN/NFV technologies.**

- **Definition**: A type of network that optimizes resource allocation by distributing computing, storage, network and service resource information to provide optimal scheduling of resources for enterprises.

- **Element**: Computing power network consumer, Computing power network provider, Computing power network transaction platform, Computing power network control plane and network operator

- **Goal**: Establish a computing-network resource base, enabling on-demand allocation of ubiquitous computing power resources and network resources according to user needs.

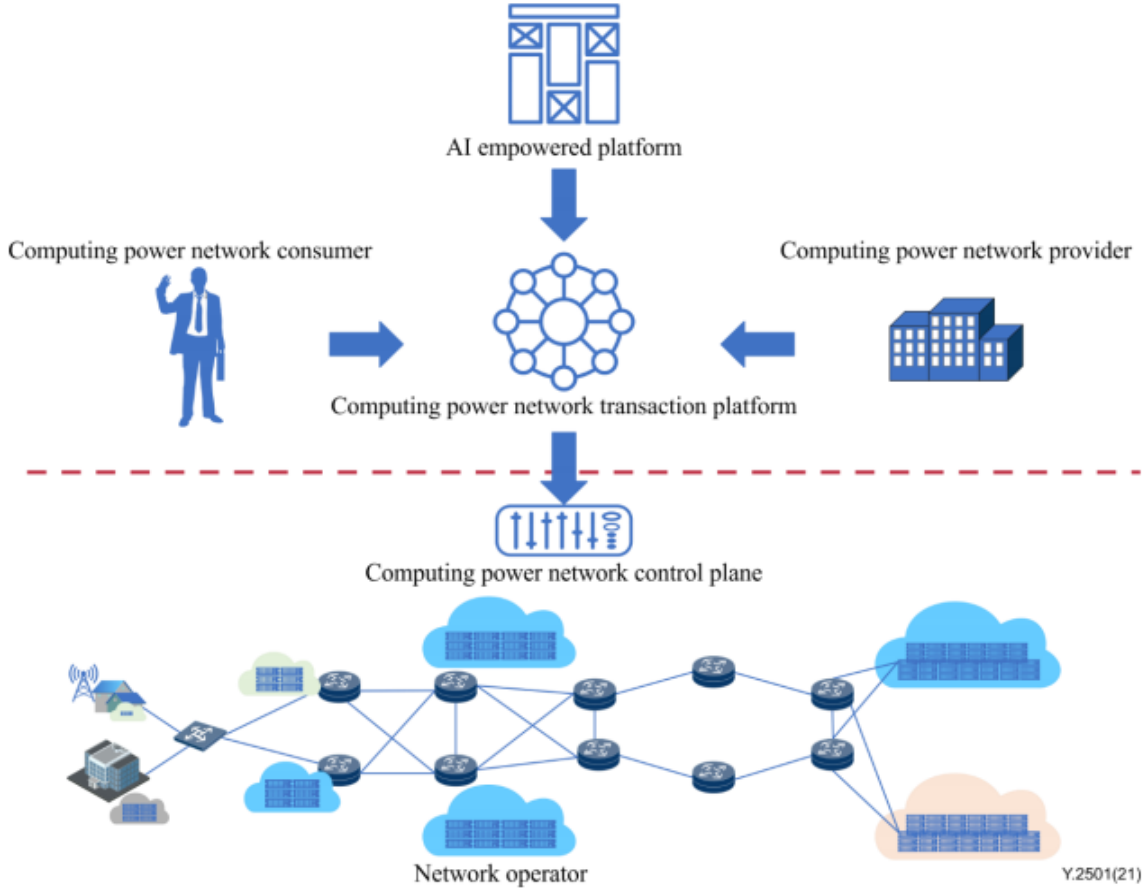


Figure 9-1 – Computing power network framework

CPN functional architecture

- **The functional architecture of the computing power network mainly consists of four layers: CPN resource layer, CPN control layer, CPN service layer and CPN orchestration and management layer.**

- **CPN resource layer**
  - resource report
- **CPN control layer**
  - Resource information collection function
  - Resource allocation function
  - Network connection scheduling function
- **CPN service layer**
  - Resource information processing
  - Billing
  - Transaction process execution
- **CPN orchestration and management layer**
  - CPN orchestrator
  - CPN security
  - Computing power modelling
  - Computing power OAM

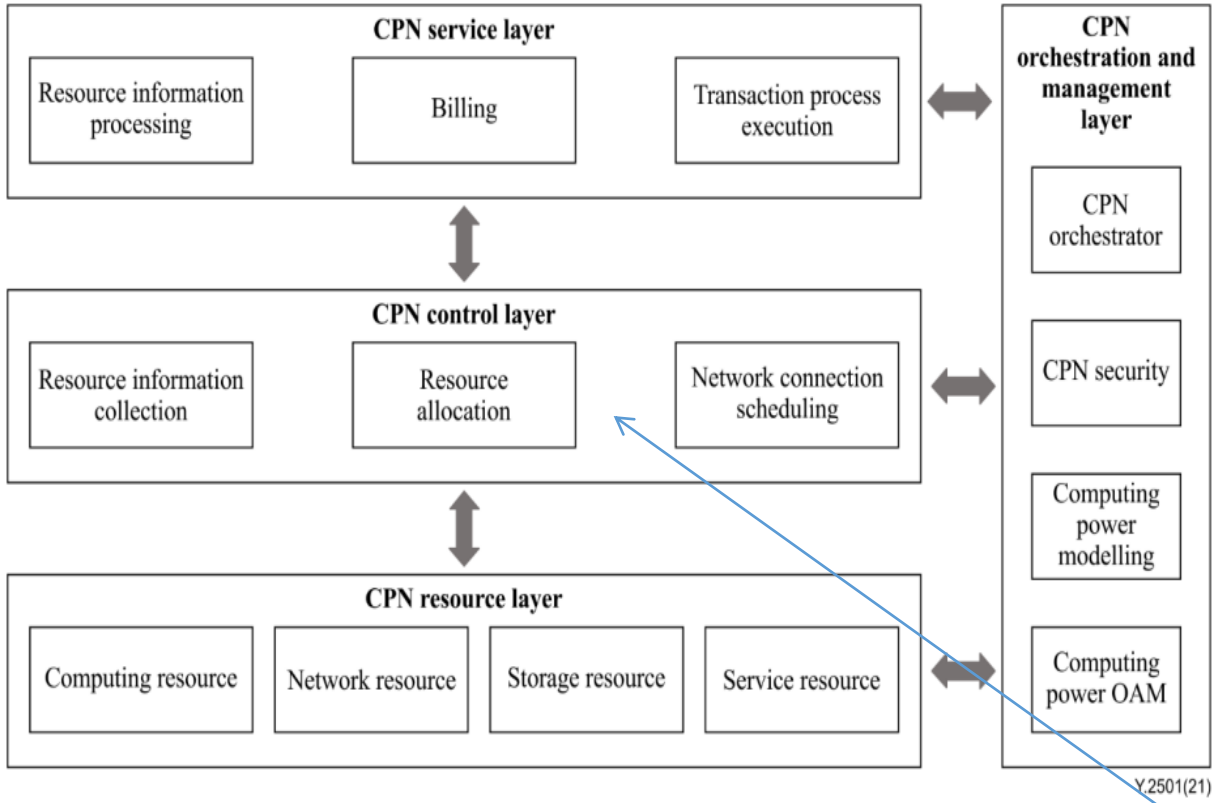


Figure 10-1 – Computing power network functional architectur

Network virtualization

Standardization progress of CPN

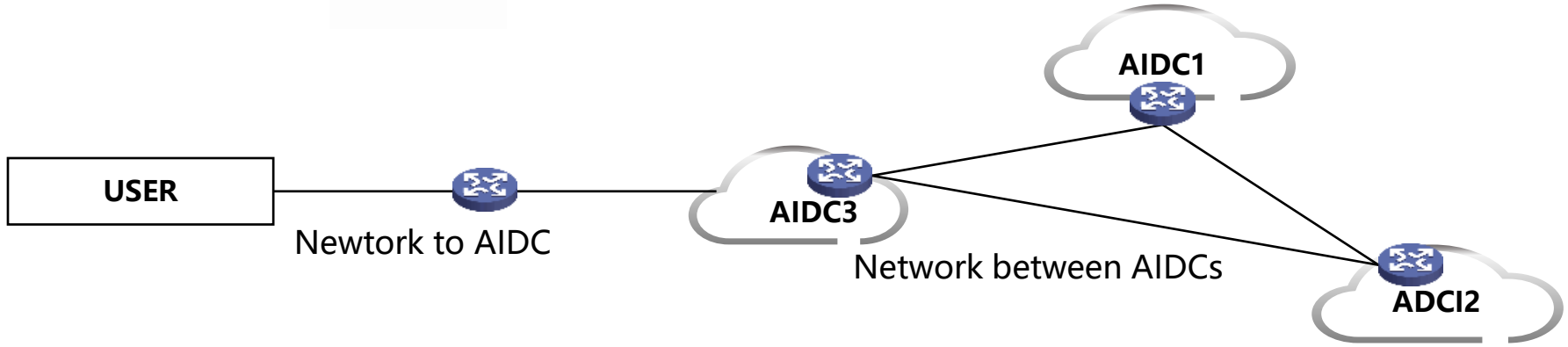
- **Standardization activities for CPN have been widely carried out in organizations such as ITU-T SG2, ITU-T SG11, ITU-T SG13, and ITU-T SG17, covering requirement, framework and architecture, test, monitoring, security etc.**

Computing power networks

framework & architecture	signalling requirement & architecture	test, monitoring & procedure	security	requirement	supplement
Y.2501 (SG13) Y.2502 (SG13) Y.CPN-CL-Arch (SG13) Y.CPN-TP-SA (SG13) Y.NGNe-O-CPN-reqts (SG13) Y.CPN-DF (SG13)	• Q.4140 (SG11) • Q.4141 (SG11) • Q.cpi (SG11) • Q.CSO (SG11) • Q.CPN-TP-SA (SG11) • Q.CPN-NC-SA (SG11) • Q.CPN-RM-SA (SG11) • Q.CPN-SA (SG11)	Q.CPN-GW-IBN (SG11) Q.CPNP (SG11) Q.CPN-BNG-iopt (SG11)	TR.cpn-col-sec (SG17) TR.sec-int-cpc (SG17)	M.rcpnm (SG2) Y.CPN-exp-reqts (SG13) BBF TR-466 (BBF) BBF WT-491 (BBF)	Y.Suppl.CPN-EF (SG13) Y.Suppl.CPN-UC (SG13) Y.Suppl.CPN-SR (SG13)

CPN used in AI

- **Computing power network provides flexible, elastic, lossless, ultra-low latency and ultra-large bandwidth connections by network virtualization, supporting the distributed collaborative training of large AI models and the accessing of massive amounts of data to AIDC.**



Newtork to AIDC	
Distributed Bandwidth Resource Management	Traffic prediction
Dynamic expansion of NFV resources	AI-based real-time network scheduling

Network between AIDCs	
Collaborative computing with multiple computing power nodes	Fast congestion mitigation and recovery strategy
Intelligent evolution of SDN controllers	Wide-area Lossless Network

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5G hello

Thank you !