ZTE

5G & NFV
Operation and Maintenance
White Paper

contents

Overview

At the time of the 5G era, multiple technologies are widely used, like artificial intelligence, Internet of Things, cloud computing, big data, network slicing, and edge computing. Such technologies are integrated into 5G network that creating a extremely capable one by comparing than a traditional network. 5G has been highly anticipated not only by the industry but also by the whole society, in which the features of 5G network, eMBB, URLLC and mMTC, produce multiple of applications and services that its precedent 4G cannot offer. The evolution for the use from 4G MBB to 5G eMBB like Cloud AR/VR, Cloud Gaming and Personal Video Streaming resulting in much lower unit cost per bit. With the introduction of uRLLC and mMTC, 5G shall bring industrial transformation of Internet of Things (IoT), including autonomous driving based on the Internet of Vehicles (IoV), intelligent manufacturing based on drone and robot, telemedicine based on low latency connection, as well as those of smart city, smart agriculture and other industrial applications.

Since the introduction of virtualization technology into core network, the core network architecture has undergone several phases of evolution, from the initial virtualization to cloudification and then to cloud native, the architecture has been gradually decoupled and opened up. In order to provide economic and agile 5G services with the capabilities of scalable, flexible and high performance, operators need a brand-new core network architecture based on cloud native and 5G service, including an independent user plane and control plane. For rapidly deploying rich of services, operators need to redesign the software architecture and core functions by using cloud native design principles and IT learning development methods. Such new architecture also helps to implement on-demand orchestration and upgrade through fine-grained microservices, so that operators can release new services quickly and shorten the time to market.
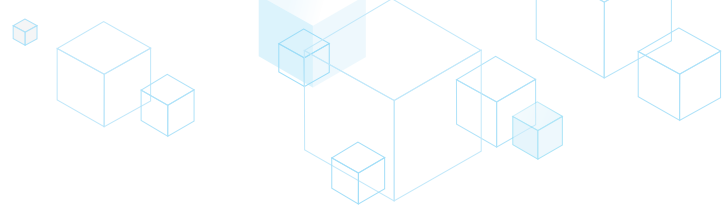
The Trend and Challenges for Telecom O&M Transformation in 5G and NFV Background

With the development of 5G standards and its gradual deployment around the world, more and more 5G networks are established in the mobile industry. The 5G features of eMBB, URLLC, mMTC and employment of cloud-native application, network slicing and edge computing shall produce drivers for digital transformation in the industry. Within a more complicated 5G environment and much more applicable services, customer experience shall be more personalized. To this end, relevant standard organizations and leading operators are actively engaged in research and practice for 5G full-lifecycle management, aiming to achieve automatic and intelligent digital O&M models, for instance;

ETSI established a ZSM group (ZSM ISG, Zero Touch Network and Service Management Industry Specification Group), dedicated to the management of 5G network and services. It aims to implement flexible and efficient management, services and operation automation system, and the automatic execution of all operation flows and tasks such as delivery, deployment, configuration, guarantee and optimization throughout the full lifecycle of 5G network, including end-to-end network slicing management and O&M.

The ONAP open source community has released its first automatic O&M open source version named Amsterdam in the end of 2017, and then has released its Beijing version and Casablanca version continuously. The ONAP community focuses on hybrid networking of 5G scenario, provides solution for intelligent analysis and network optimization as well as automatic deployment for future network.

The TMF aims at developing zero-touch orchestration, operation, and management, and to explore the applications of network function virtualization technologies by software-defined network. The TMF advocates to establish end-to-end orchestration system and end-to-end guarantee system for service analysis. For the 5G network services, it aims to achieve rapid deployment and automatic O&M with creating of new revenue for telecom operators.
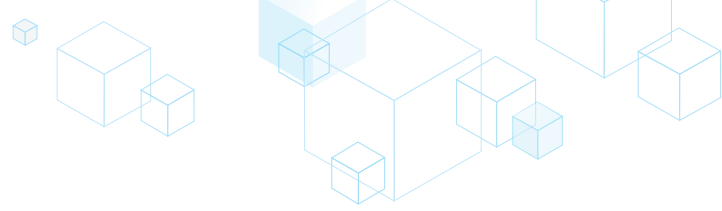
China Mobile is setting its step for 5G much quickly than its previous 4G way. The goal is to achieve pre-commercial use in 2019, and commercial applicable in 2020. China Mobile focuses on future-oriented and its related orchestration and management, and now is working with multiple parties to actively explore centralized, automatic, and intelligent O&M for 5G network.

NTT DoCoMo has planned to launch 5G service in Tokyo and other parts of Japan in 2020, and will gradually expand to major areas of Japan within three years with early focusing on eMBB. Based on its multi-vendor VNF launched in 2016, NTT DoCoMo is actively developing orchestration and O&M system that applied AI technology to virtualized network with the capabilities of automatic network configuration and intelligent O&M.

Deutsche Telekom aims to put 5G into commercial use in 2020. At the early stage, the services are focused on eMBB and uRLLC in which it shall target on individual mobile subscribers, fixed network subscribers and Internet of Vehicles subscribers. Deutsche Telekom believes that automatic deployment, O&M of network services and 5G slicing are the basis for service innovation. O&M related organization and personnel have to transform with innovative capabilities for service design and applications.

It has reached common understanding that it has to equip automatic and intelligent capabilities for 5G O&M. However, network operators are still facing challenges to realize such 5G O&M related automatic and intelligent, such as：

- 5G is a scenario-driven service environment in which it is necessary to quickly provide on-demand customization services, and deepen various applications. This is the critical successful factor for the successful digital transformation of network operator.

- Within the actual service scenario of 5G, it has to own intelligent capabilities for slice-oriented cloud resource scheduling, to implement 5G network slicing through properly allocating slice resources and optimizing network configuration.

- To meet the high quality of complicated 5G network slicing, it has to apply intelligent and accurate tools not only guarantee network slicing but also provide automatic way of operation and maintenance with less manual intervention and thus less operation cost.

- For meeting the demand of automatic and intelligent operation, the O&M organization and personnel skills also need to be rebuilt in association with new network architecture and technical characteristics.

Dual Challenges in the Early Stage of 5G and NFV O&M Transformation

In 2020, operators around the world are accelerating their deployment and commercial use of 5G and NFV networks. Facing elastic slicing networks, massive data, innovative business models and higher requirement of KPIs/SLA, the traditional O&M way is no longer applicable and effective. It is an urgent need to re-establish smart O&M way with automatic and intelligent tools and to reshape the skill and expertise for 5G O&M.

Driving force of elastic network and massive data reshaping O&M tooling platform

Within 5G cloud native environment, NEs apply service based as micro-service architecture with scalable resources, and also provides network functionalities and service through network slicing. In comparison with traditional 4G network, while 5G owns higher stability, security, and openness, it also confronts challenge to maintain the network:

- It has to quickly provide identification of alarms and faults, rapid analysis and helps for processing

- Proceed multi-dimensional check as preventive maintenance periodically, like inspect physical layer, virtual resource and etc., on daily, weekly or monthly basics

- It is complicated and time consuming for diagnosis to hierarchical, multi-vendor and heterogeneous scenarios in 5G network, in which it can take dozens of minutes or even days to identify root cause and to solve the relevant issue

- Better utilization of system resource needs capable tools for continuous system performance and capacity monitoring, accurate performance statistics, capability of performance forecast

- The always changes of network for network expansion as well as service going-online and offline shall cause frequent changes of configuration and its resource layer, this has to be under proper management

- It has to assure network security by proper IT set up and trace relevant security message through log monitoring, anti-hacker, anti-virus, and etc

- The cloud platform is updated and upgraded frequently, resulting in heavy workload

The traditional way cannot meet O&M requirement of 5G network, those previous expertise and experience cannot be fully adopted. Automatic and intelligent O&M tools have to be developed to fit for 5G demand and to guarantee smooth running of 5G network. As a result, the three key technologies of service-based architecture, DevOps and AI can be effectively as fundamental support for the establishment of O&M platform for digital operation.
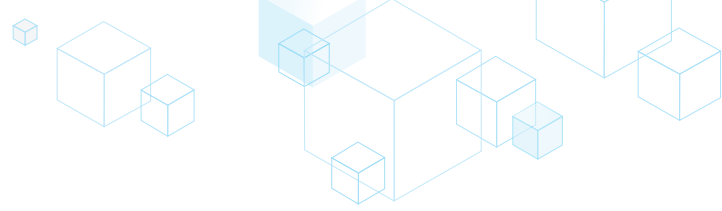
Agile and Open O&M Systems based on Service-Based Architecture

Building a cloud-based network architecture is the first step for operators in the digital transformation process. Within such cloud native environment, 5G deployment can be based on its flexible and agile service-based architecture. It is an industrial trend that network management system to be a service-based architecture (SBA).

The SBA owns the following advantages:

Fast release

Release service quickly, as each service can be changed independently and rapidly for facilitating its service function

Fault isolation among service units

The cluster technology not only can isolate the fault only within its related service but also guarantee whole system reliability

Open for Management

Service management can be adopted easily by multiple management systems.

Self-adaptation

The service cluster technology provides the scaling capability, in which the management processing can be performed according to the scale of managed objects

According to the management function described in 3GPP 28.533 standard, the management system can consist of multiple service management system, for example, management for alarm message and service performance. The management system provides standard external interfaces, allowing access services and service management system. The O&M system based on service-based architecture can flexibly adapt to various O&M scenarios by its flexible combinations of services under the management system. Such standardized service interfaces can further support the openness for ecosystem of O&M system.
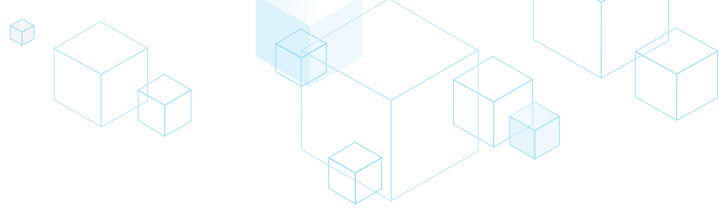
DevOps concept deeply inspired digital transformation of telecom O&M

The application of DevOps promotes the communication and collaboration between the software developers (DEV) and the IT operators (OPS). The objective of DevOps is to build a new environment and culture, so that the build up, test and software release can be more smooth and reliable in smart way. At present, DevOps has been widely used in Internet and IT industry, much shortening Time to Market (TTM) with improvement of service quality.

For the next-generation network, it has to establish an end-to-end closed loop including network services, network design and slicing, deployment verification, and O&M assurance so it can provide continuous improvement as a way of digital O&M transformation. the DevOps8 ring is used for end-to-end management of network service and slice lifecycle.

Dev closed loop
Network slicing developing environment

Ops closed loop
Network slicing O&M environment

DevOps closed loop
Real-time monitoring and analysis for Ops based on big data, changes of Dev slice, and its design parameters
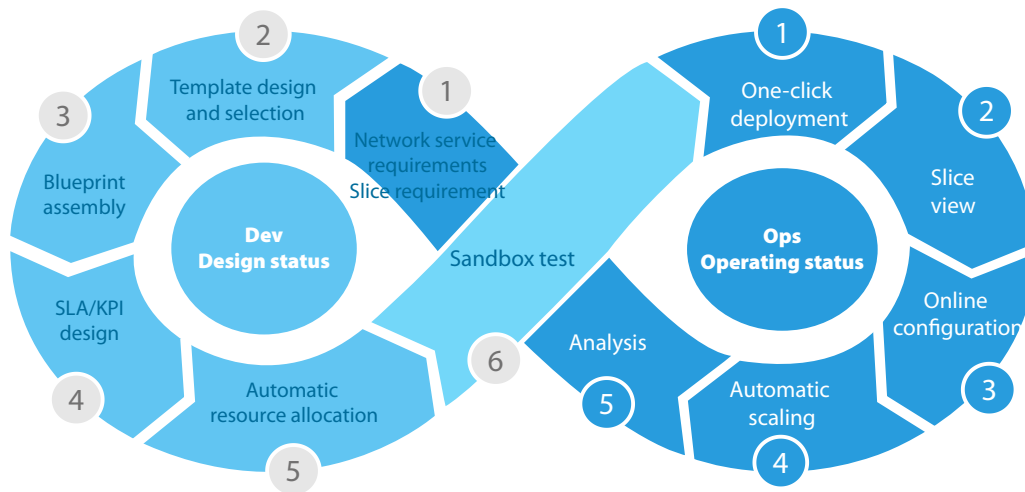
AI technology application is the key to intelligent O&M

As the function of 5G-oriented network shall be orchestrated as demand, so network functions can be deployed in more diversified way which introducing complicated for identification of network problem. Within 5G environment, massive traffic and high concurrency service scenarios can be re-routed as edge computing in which forwarding plane functions shall be moved to edge data center. To have fast and accurate scheduling of resources and dynamic network elasticity, an introduction of AI technology for 5G O&M shall effectively support intelligent troubleshooting, network prediction and optimization.
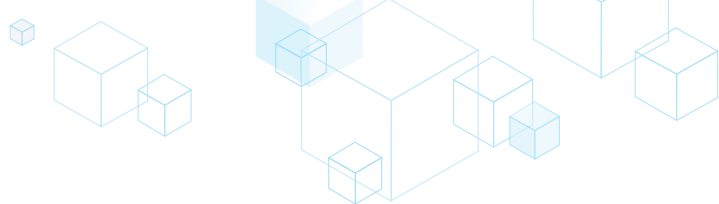
Innovative application and integrated ICT network reshaping skill and expertise O&M personnel

The cloud native 5G network integrates with more ICT facilities and applications of NFV, Cloud, Edge computing, containerization, microservice, as well as the implementation of artificial intelligence for network OM. That means the O&M personnel should be familiar with not only CT equipment but also the skills for IT infrastructure, and they also need skills and knowledge for intelligent tools.

As the O&M experience for traditional 4G network cannot fully meet skill requirements of the 5G network, especially in the aspects of cloud resource and its management platforms, inter-NE and their cross-layer data analysis.

Network Cloud Position Skill

- Master template development and agile development
- Master the automation of operation and maintenance
- Master virtualization, cloud, and big data technologies
- Master hardware and network data communication skills, and be familiar with hardware network planning, network construction, setting and maintenance, and network performance management of the resource pool
- To grasp the knowledge of component configuration of the SDN/VNF/cloud platform
- Be familiar with the telecom service (wireless/bearer/core network) process, and be capable of cross-domain service design, test, and verification

CN Position Skill

- Master CN planning and design knowledge
- Master basic communication knowledge, service flows, and signaling network protocols
- Master the optimization and analysis capabilities of at least two CN professions
- Master the performance and troubleshooting capabilities of each VNF NE
- Master the implementation of the planning and deployment of internal design-state and internal VM migration policies of the VNF
- Master the technologies of virtualization, cloud and Openstack, docker, KVM, OVS

Safety/Infra/Surveillance Position Skill

- Knowledge and skills in traditional network security, cloud computing security and 5G security, and anti-virus and anti-hacker capabilities
- Master the maintenance capabilities of the DC power supply system and AC power supply system in the data center of the traditional equipment room
- Master the maintenance capabilities of air conditioners in the equipment room, lightning protection grounding, and security systems
- Master the capability of front-line monitoring and scheduling of future networks such as network cloud/NFV/SDN, and have the capability of fault prediction and resolution
- Master the monitoring and scheduling management process for responsible area
- Be familiar with communications, network knowledge skills, IT hardware, software, storage, and other knowledge skills

ZTE Supports Operators' Transformation for 5G and NFV O&M

Applying an automatic OES based O&M platform, ZTE provides 5G and NFV O&M support with intelligent approach, service assurance, and expertise through ZTE global delivery capabilities. Supporting operator's digital O&M transformation for 5G and NFV O&M, ZTE offers credible, reliable and sustainable O&M support services not only with automatic and intelligent tooling solution but also with skill transformation and training services.

Service for 5G and NFV of Core network

On top of traditional management services, ZTE integrates cross-layer and cross-domain end-to-end approach into the service for 5G and NFV of Core Network. In accordance with operator's requirement, ZTE can freely adopt service modules from a series of options that even can be embedded into operator's existing O&M organization.

Full set of E2E O&M solution with options for selection

Service design	Policy design	Policy lifecycle mgmt	Service orchestration
APP status check	VNF lifecycle mgmt	Log analysis	Fault mgmt
Network monitoring	Alarm mgmt	Performance mgmt	Configuration mgmt
VM lifecycle mgmt	Release mgmt	Security mgmt	Resource status check
Capacity mgmt	Disaster recovery	Preventive& corrective maint.	Spare parts mgmt

OSS/BSS — Os-Ma — Orchestator
Service,VNF and Infrastructure Description — Se-Ma

EMS 1 | EMS 2 | EMS 3 — Ve-Vnfm — VNF Manager(s) — Or-Vi
VNF 1 | VNF 2 | VNF 3
Vn-Nf

NFV1
Virtual Computing | Virtual Storage | Virtual Network — Nf-Vi — Virtualized Infrastructure Manager(s)
VIRTULIZATION LAYER
Vi-Ha
Computing Hardware | Storage Hardware | Network Hardware

NFV Management &Orchestration

ZTE tooling solution for 5G and NFV Core Network consists of multiple tools for multiple layers of VNF, NVI and NM system. It owns automatic O&M functionality and can work independently, so the tools can be flexible for the requirements of different scenarios.

Service layer maintenance

OMC（EMS+、CTS）

RCA	Event monitoring	Alarm statistics
Real-time monitoring	Signaling resolution	Time sequence map
Signaling trace	Grayscale upgrade	NFS configuration

NFVO+

Alarm association	Tri-network perspective	Intelligent RCA
Slice design	Slice orchestration	Dashboard
Resource management	Security	Logs

UPF | MEP | APP | PIM VIM CISM
Edge NFVI

Access

UPF | MEP | CDN | PIM VIM CISM
Edge NFVI

Core

NFVO | VNFM | OMC | MEPM-V
Edge NFVI | PIM/VIM

Edge Access — Convergence — Core/regional equipment room

TECS

| Alarm monitoring | Performance monitoring | Intelligent RCA |

CCN Guard

| Parameter check | Preventive inspection | Capacity evaluation |
| Traffic evaluation | On-duty guarantee | Performance comparison |

Inspector/Netinsight

| Packet capture statistics | Network check | Network topology |

Cloud platform maintenance

Consulting service for O&M organizing and skill transformation

Traditional network O&M focused on network and service quality, more than that, cloud-based network O&M focuses on full lifecycle guarantee of services. For example, the traditional way of network planning was proceeded from a perspective of overall plan in which it provided a general level of traffic mode, capacity, and resources. In contrast, the planning for 5G-oriented architecture is dug into the granularities for each slice per each tenant for meeting the specific SLA requirement. In stead of traditional O&M method for network operation and troubleshooting, automatic and intelligent approach is in place for 5G, where service organization and personnel skills have to adapt for digital architecture.

ZTE provides consulting services and helps operator for end-to-end O&M transformation such as service design, service re-organizing, process set up and re-engineering, personnel skill improvement, and etc.

Organizational Structure Transformation

Organizational structure transformation consulting service
Evaluation Report for Customer Organization, High-Level Design of Organizational Structure, and Roadmap for Organizational Change & Implementation and Evolution Plan

Human Resources (HR) transformation consulting service
Performance Evaluation Report for Personnel in Key Positions, Skill Transformation and Design Scheme for Key Positions, Investigation Report for Talent Reserve in Key Positions, Human Resources Development Plan

Personnel Skill Transformation

On-site Training Service-Providing On
Site Skill Training for Customer Employees

Skill improvement teaching material
Training materials, remote or video teaching for customers

Personnel recruitment service
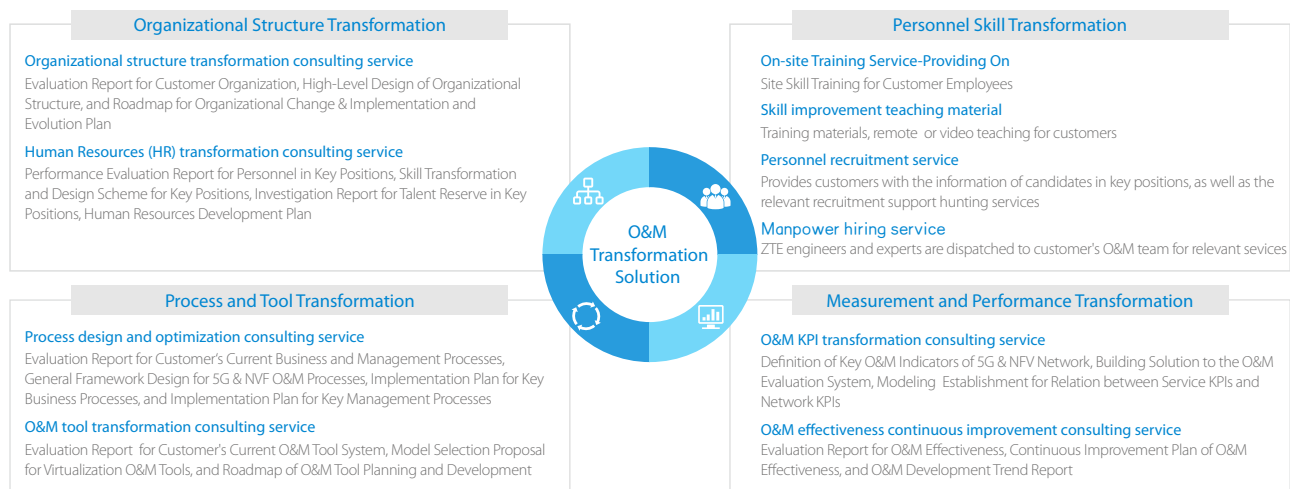Provides customers with the information of candidates in key positions, as well as the relevant recruitment support hunting services

Manpower hiring service
ZTE engineers and experts are dispatched to customer's O&M team for relevant sevices

O&M Transformation Solution

Process and Tool Transformation

Process design and optimization consulting service
Evaluation Report for Customer's Current Business and Management Processes, General Framework Design for 5G & NVF O&M Processes, Implementation Plan for Key Business Processes, and Implementation Plan for Key Management Processes

O&M tool transformation consulting service
Evaluation Report for Customer's Current O&M Tool System, Model Selection Proposal for Virtualization O&M Tools, and Roadmap of O&M Tool Planning and Development

Measurement and Performance Transformation

O&M KPI transformation consulting service
Definition of Key O&M Indicators of 5G & NFV Network, Building Solution to the O&M Evaluation System, Modeling Establishment for Relation between Service KPIs and Network KPIs

O&M effectiveness continuous improvement consulting service
Evaluation Report for O&M Effectiveness, Continuous Improvement Plan of O&M Effectiveness, and O&M Development Trend Report

Organizational transformation

The O&M organizational structure needs to match the characteristics from decoupled network, that is changing from traditional maintenance focused to a flat end-to-end service-centric O&M team. ZTE proposes to set up a service design team, a network O&M team and a telecom cloud O&M team, in which they shall work in DevOps way as an O&M entity supporting digital network O&M.
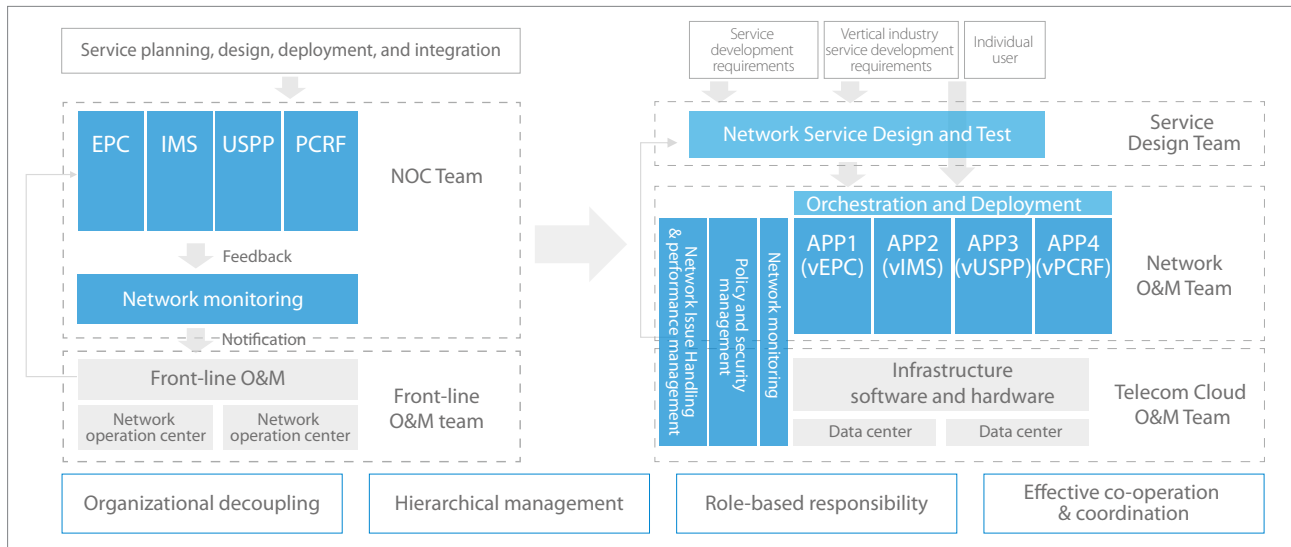
The service design team is responsible for investigating and analyzing user requirements, determining SLA requirements per user group, translating user requirements into network configuration, and delivering network requirement for specific service(s) to application management team for further process.

Network O&M team is responsible for network planning and service design based on requirement analysis, including network slices and sub-slices, and network service. The team shall proceed full lifecycle management through its O&M action of deployment, upgrade, test and maintenance.

Telecom cloud O&M team is responsible for cloud resource management, including planning, construction, allocation, maintenance, security assurance and etc, , and provides appropriate resource as needed in the application layer.

Service skill transformation

The CT skills of O&M team need to be integrated with IT knowledge for O&M activities. To have proper network plan and design as well as its application and cloud platform planning, the design engineer should be familiar with telecom network and services and should also equip capabilities for cross-domain related service design, network slicing, resource planning and security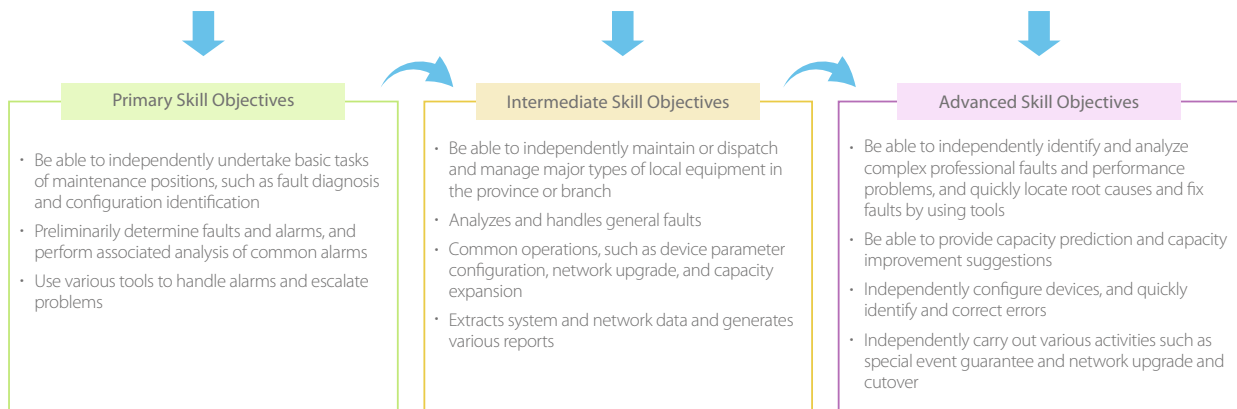 set up. The engineer for deployment and integration has to own skill not only for system integration but also for implementation of network slicing. Cloud engineer must be familiar with computing related configuration and maintenance, storage, and relevant network devices. Engineer for application maintenance and cloud platform maintenance not only need to handle problem issue in their respective areas but also require to own capability to design maintenance approach.

ZTE 5G & NFV O&M service, together with ZTE University, provides O&M skill training services for operators' O&M engineers. In accordance with the existing skill level, ZTE can customize the related training and improvement program to facilitate skill enhancement for 5G NFV digital O&M.

· The NFV O&M training courses are customized as role-based and responsibility related
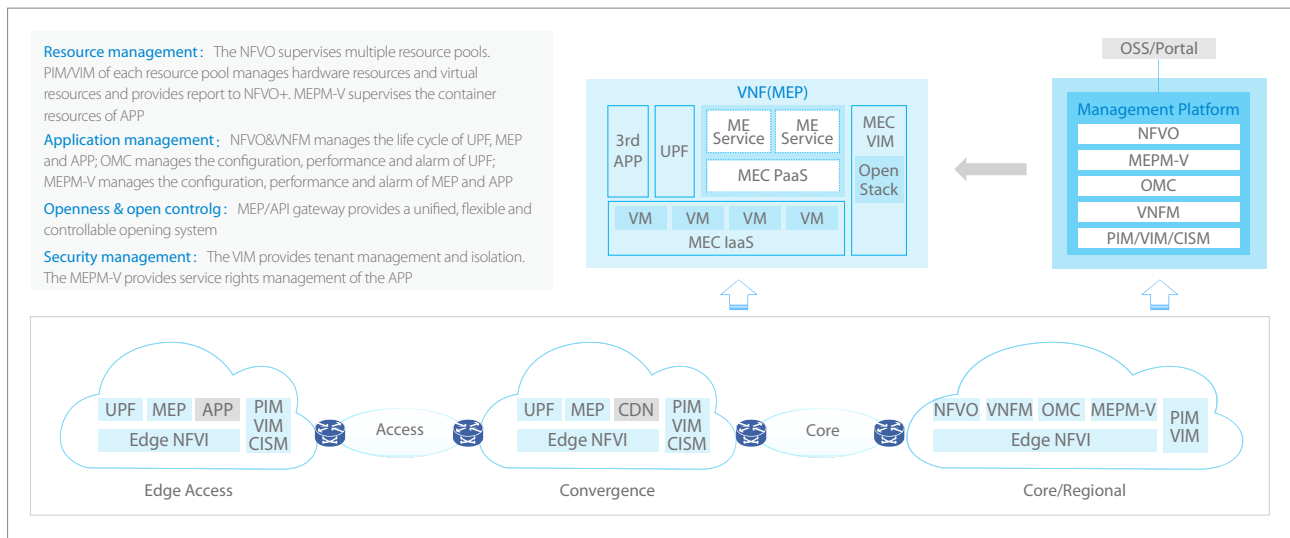· Through face-to-face and on-job training, the O&M skills of engineers are improved step by step

Primary NFV Training Course (Theoretical + practical operation, 27 hours)	
Key technologies and development trends of the IT industry	Database technology fundamentals
Server overview and key technologies	Cloud computing overview
Operating system principles	General virtualization technology
Storage technology fundamentals	Technical fundamentals and practices of the KVM
Raid technology and applications	Openstack operation

NFV Intermediate Training Course (Theoretical + practical operation, 27 hours)	
Key technologies and development trends of the IT industry	Database technology fundamentals
Server overview and key technologies	NFV platform O&M automation
Operating system principles	Emergency troubleshooting on the NFV platform
Storage technology fundamentals	NFV platform security maintenance
Raid technology and applications	Mano infrastructure

Advanced NFV Training Course (Explanation, 30 hours)	
Basic principles of IMS&VoLTE	5G Service scenarios and key technologies
Basic principles of IMS&VoLTE	Cloud computing overview
VoLTE signaling flow	AI helps network intelligence
EPC network planning training	Development and application of big data in the telecommunications industry

Primary Skill Objectives

· Be able to independently undertake basic tasks of maintenance positions, such as fault diagnosis and configuration identification
· Preliminarily determine faults and alarms, and perform associated analysis of common alarms
· Use various tools to handle alarms and escalate problems

Intermediate Skill Objectives

· Be able to independently maintain or dispatch and manage major types of local equipment in the province or branch
· Analyzes and handles general faults
· Common operations, such as device parameter configuration, network upgrade, and capacity expansion
· Extracts system and network data and generates various reports

Advanced Skill Objectives

· Be able to independently identify and analyze complex professional faults and performance problems, and quickly locate root causes and fix faults by using tools
· Be able to provide capacity prediction and capacity improvement suggestions
· Independently configure devices, and quickly identify and correct errors
· Independently carry out various activities such as special event guarantee and network upgrade and cutover
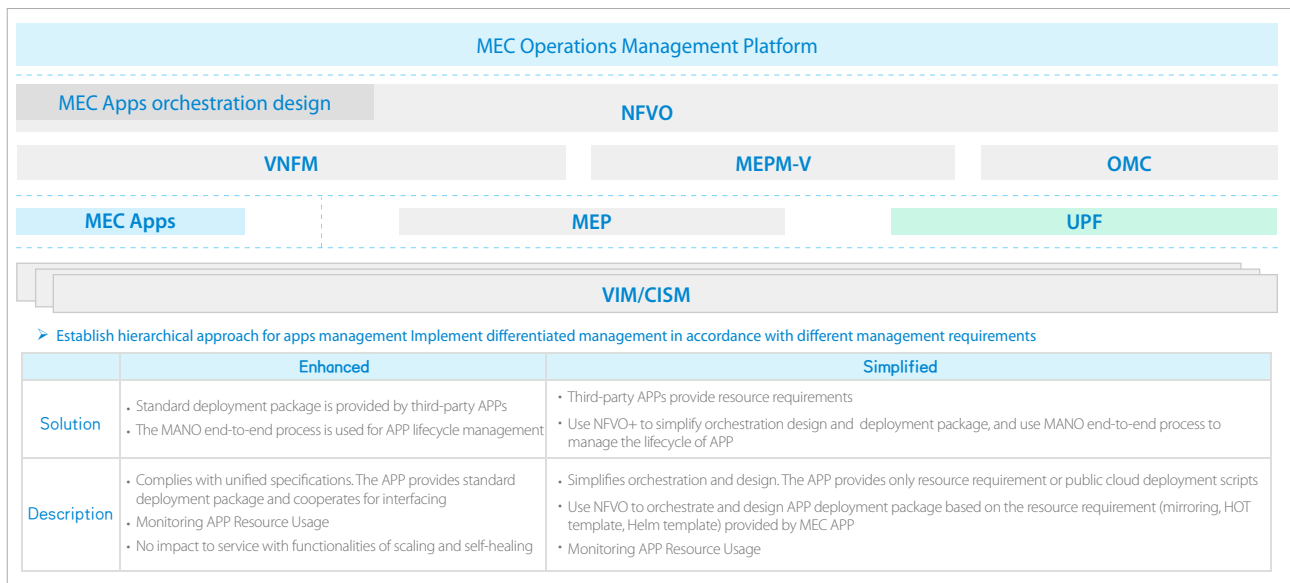
Assurance service for MEC

As an evolution of cloud computing, Multi-Access Edge Computing (MEC) moves application programs from a centralized data center to network edge that is closer to the data generated by consumers and applications. MEC provides IT and cloud computing capabilities close to the network edge of mobile users, and uses such MEC capability for higher bandwidth, low latency, and near-end deployment, resulting in generating of new services and revenue opportunities. MEC is widely deployed in which is ToB is a common choice in the industry.
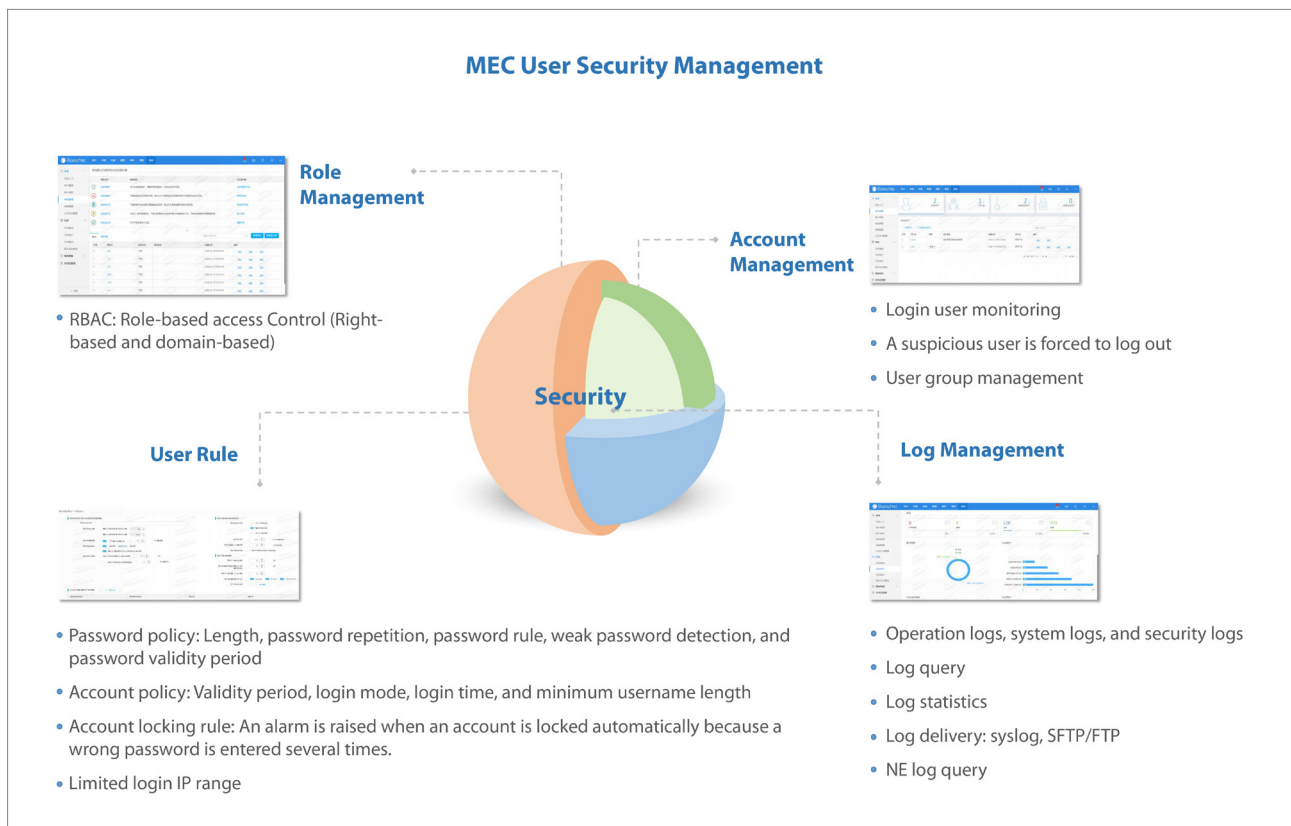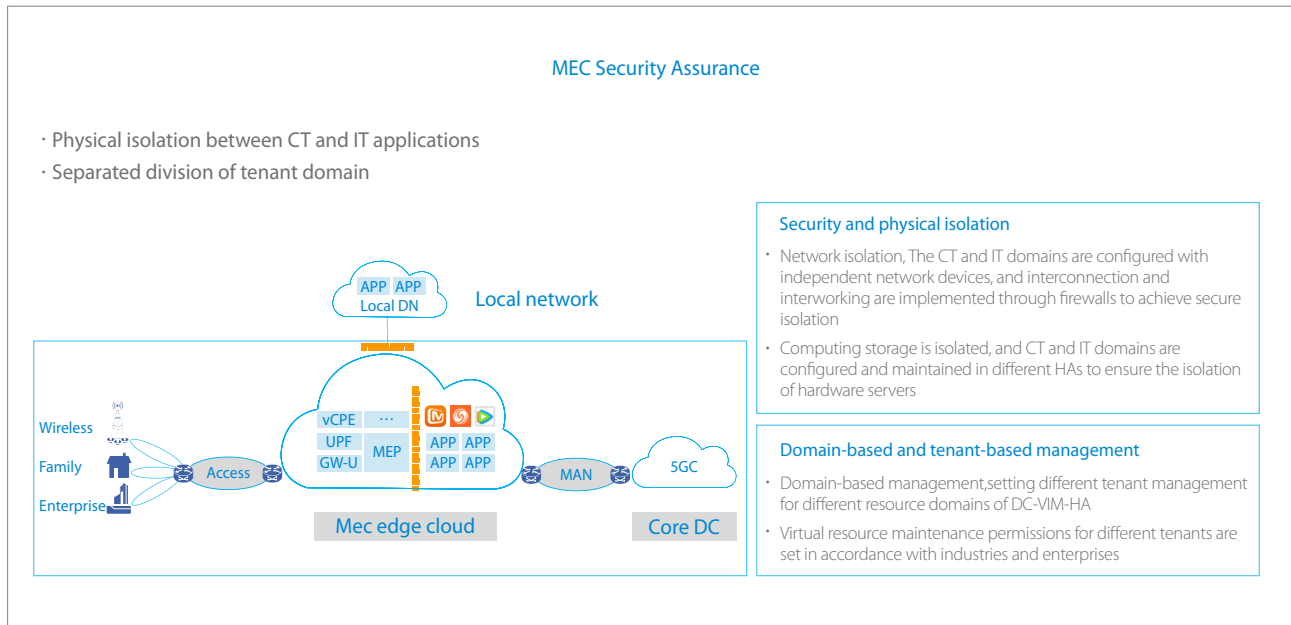
ZTE assurance service for MEC provides effective resource management for edge clouding, guarantee of security and applications through remote + local tool deployment, and also supports openness for third-party apps.

Resource management: The NFVO supervises multiple resource pools. PIM/VIM of each resource pool manages hardware resources and virtual resources and provides report to NFVO+. MEPM-V supervises the container resources of APP

Application management: NFVO&VNFM manages the life cycle of UPF, MEP and APP; OMC manages the configuration, performance and alarm of UPF; MEPM-V manages the configuration, performance and alarm of MEP and APP

Openness & open controlg: MEP/API gateway provides a unified, flexible and controllable opening system

Security management: The VIM provides tenant management and isolation. The MEPM-V provides service rights management of the APP

Effective management for third party application through hierarchical approach for application management

> Establish hierarchical approach for apps management Implement differentiated management in accordance with different management requirements

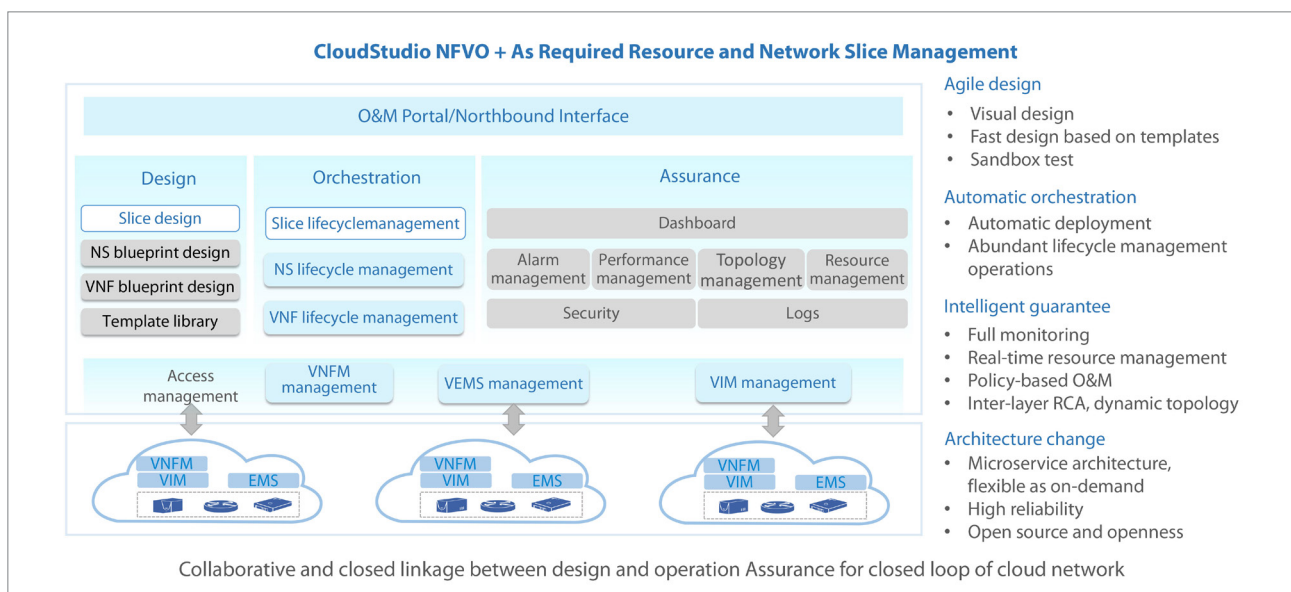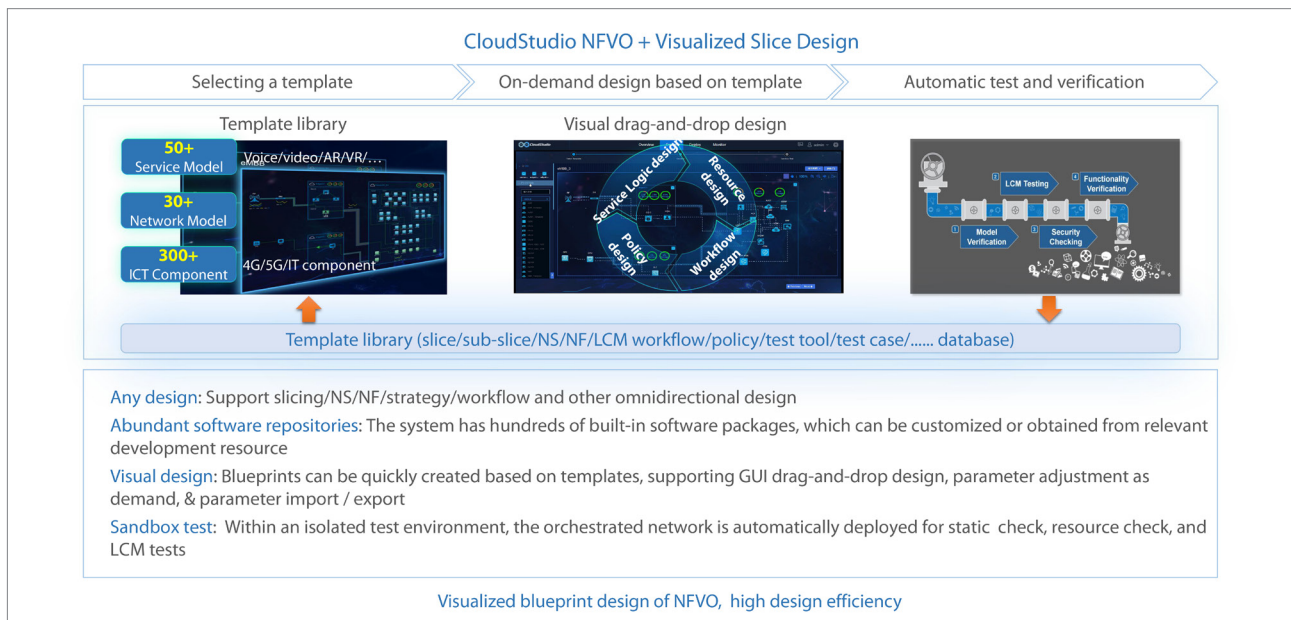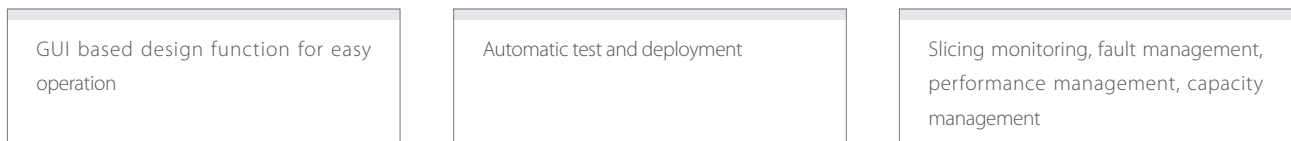|	Enhanced	Simplified
Solution	• Standard deployment package is provided by third-party APPs • The MANO end-to-end process is used for APP lifecycle management	• Third-party APPs provide resource requirements • Use NFVO+ to simplify orchestration design and deployment package, and use MANO end-to-end process to manage the lifecycle of APP
Description	• Complies with unified specifications. The APP provides standard deployment package and cooperates for interfacing • Monitoring APP Resource Usage • No impact to service with functionalities of scaling and self-healing	• Simplifies orchestration and design. The APP provides only resource requirement or public cloud deployment scripts • Use NFVO to orchestrate and design APP deployment package based on the resource requirement (mirroring, HOT template, Helm template) provided by MEC APP • Monitoring APP Resource Usage

Ensure security of edge clouding through physical isolation, separated division of tenant domain, and user security protection

MEC Security Assurance

· Physical isolation between CT and IT applications
· Separated division of tenant domain

APP APP
Local DN

Local network

vCPE …
UPF
GW-U MEP
APP APP
APP APP

Wireless
Family
Enterprise
Access

MAN

5GC

Mec edge cloud

Core DC

Security and physical isolation

· Network isolation, The CT and IT domains are configured with independent network devices, and interconnection and interworking are implemented through firewalls to achieve secure isolation
· Computing storage is isolated, and CT and IT domains are configured and maintained in different HAs to ensure the isolation of hardware servers

Domain-based and tenant-based management

· Domain-based management,setting different tenant management for different resource domains of DC-VIM-HA
· Virtual resource maintenance permissions for different tenants are set in accordance with industries and enterprises

MEC User Security Management

Role Management

Account Management

Security

User Rule

Log Management

• RBAC: Role-based access Control (Right-based and domain-based)

• Login user monitoring
• A suspicious user is forced to log out
• User group management

• Password policy: Length, password repetition, password rule, weak password detection, and password validity period
• Account policy: Validity period, login mode, login time, and minimum username length
• Account locking rule: An alarm is raised when an account is locked automatically because a wrong password is entered several times.
• Limited login IP range

• Operation logs, system logs, and security logs
• Log query
• Log statistics
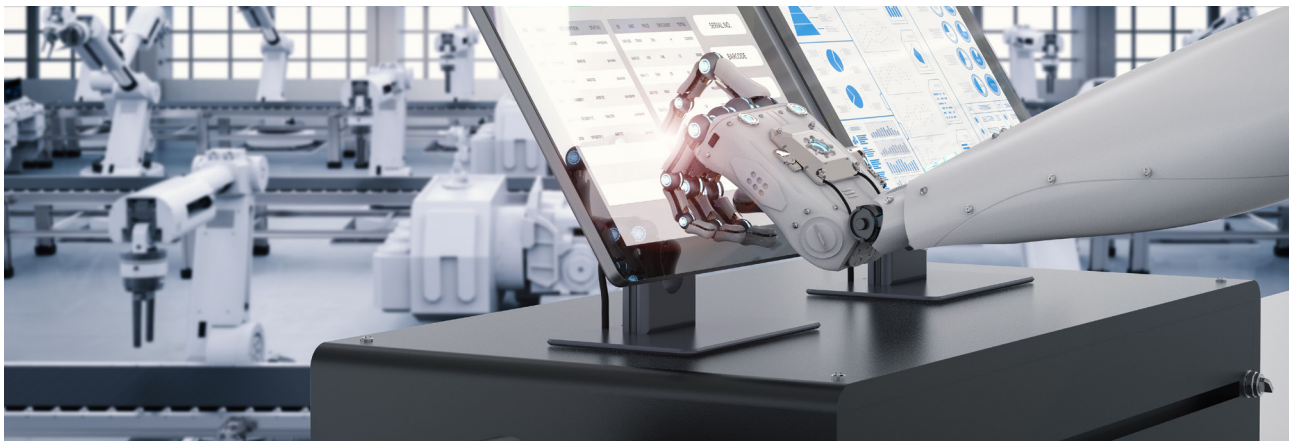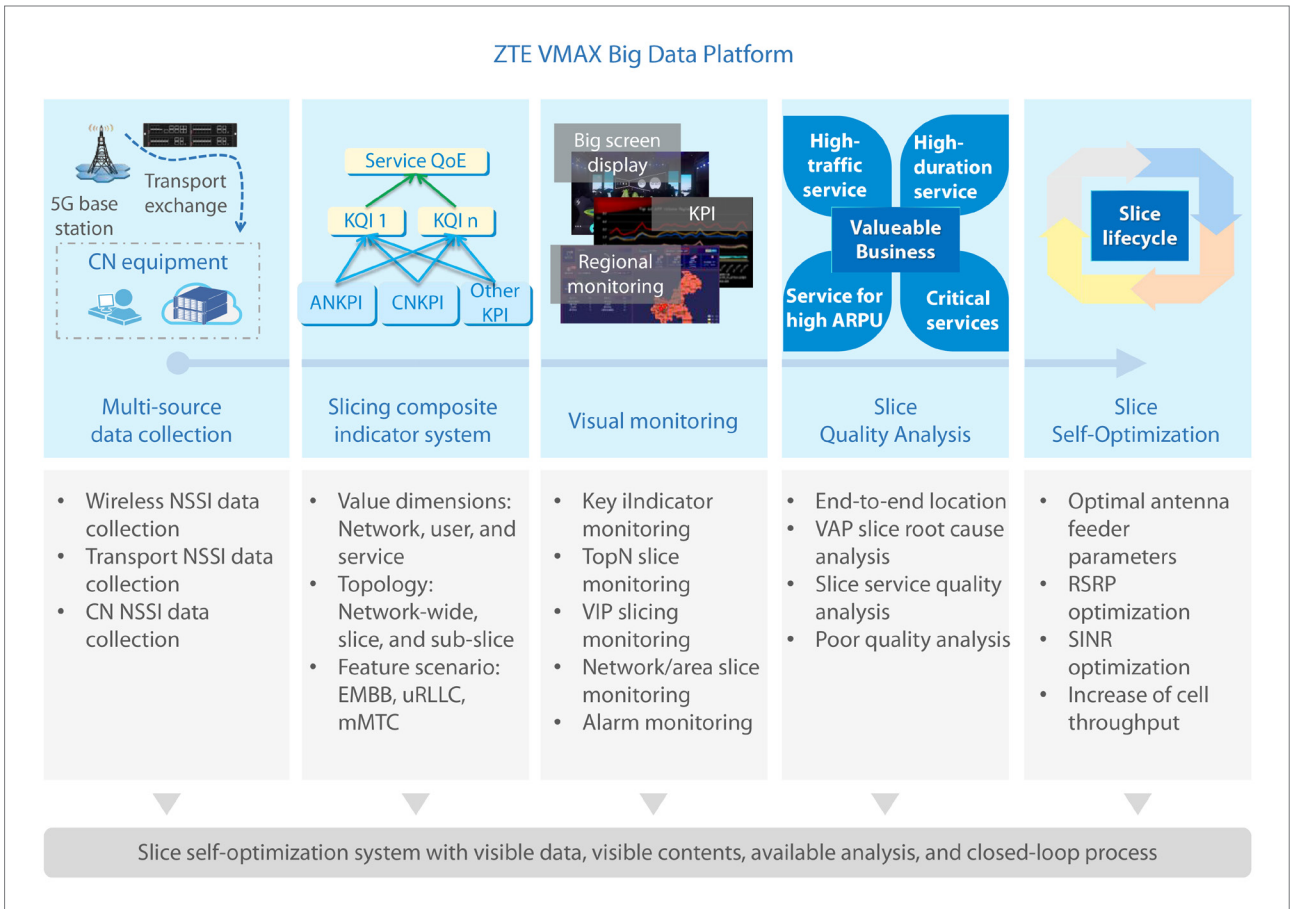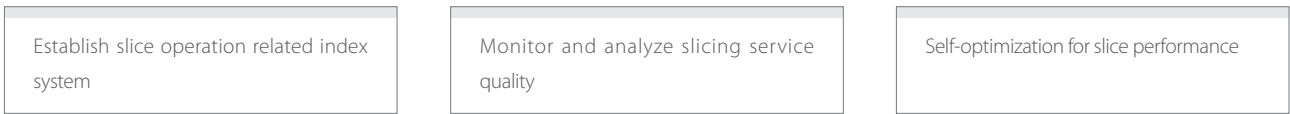• Log delivery: syslog, SFTP/FTP
• NE log query

Operational service for 5G network slicing

5G network slicing is one of innovative application in the industry in which operator can apply it for specific service to the market. Therefore, the capability for proper 5G network slicing is the basis for operators to achieve digital transformation in the 5G era. Meeting operators' requirement for transformation and development strategies, ZTE 5G NFV O&M launches a full-lifecycle solution for 5G network slicing that is based on ZTE Cloudstudio platform and provides network slice related end-to-end O&M services, including:
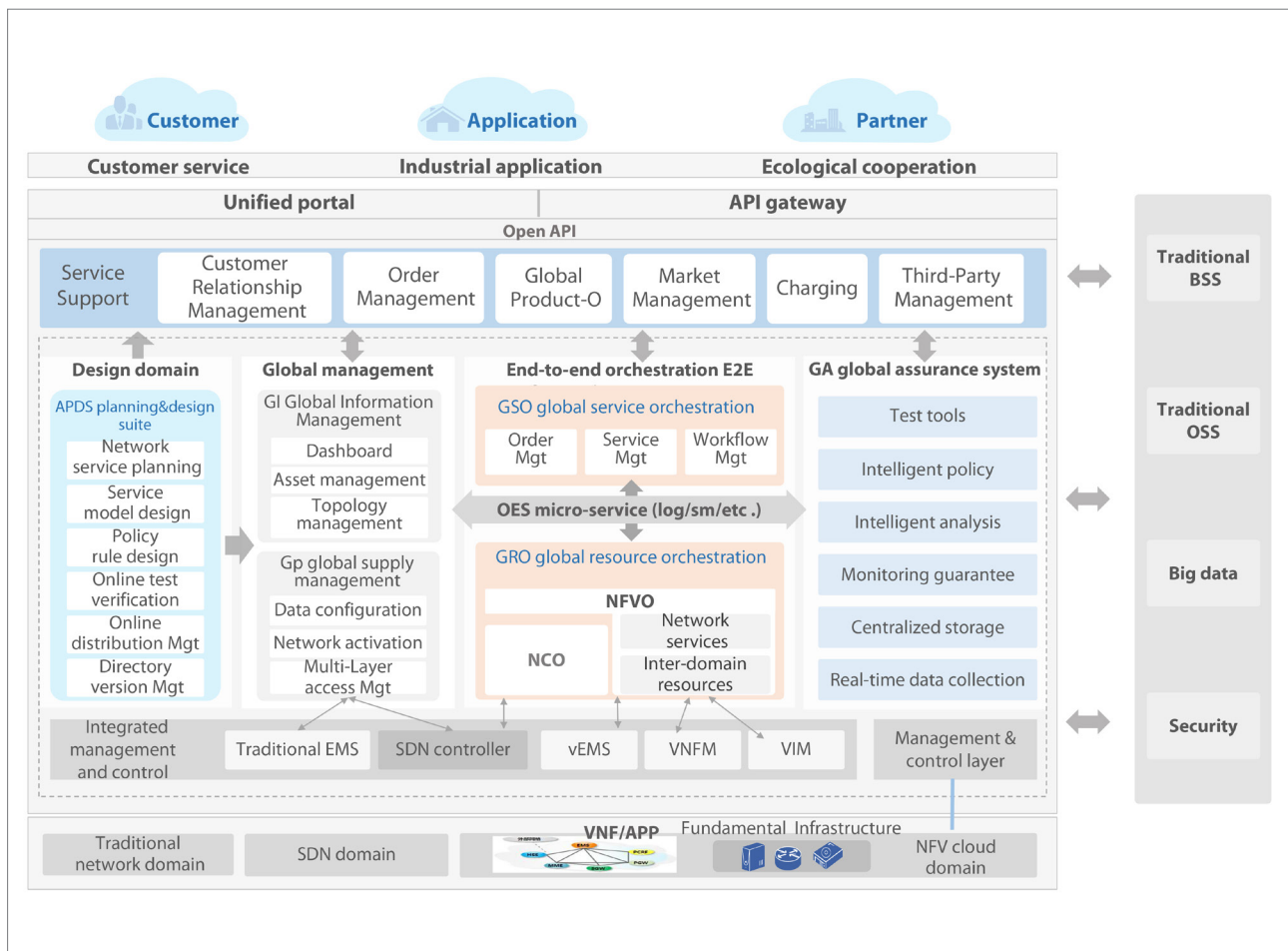
GUI based design function for easy operation	Automatic test and deployment	Slicing monitoring, fault management, performance management, capacity management

CloudStudio NFVO + Visualized Slice Design

Selecting a template ▷ On-demand design based on template ▷ Automatic test and verification

Template library · Visual drag-and-drop design

50+ Service Model · Voice/video/AR/VR/...
30+ Network Model
300+ ICT Component · 4G/5G/IT component

Service Logic design · Resource design · Policy design · Workflow design

LCM Testing · Functionality Verification · Model Verification · Security Checking

Template library (slice/sub-slice/NS/NF/LCM workflow/policy/test tool/test case/...... database)

Any design: Support slicing/NS/NF/strategy/workflow and other omnidirectional design

Abundant software repositories: The system has hundreds of built-in software packages, which can be customized or obtained from relevant development resource

Visual design: Blueprints can be quickly created based on templates, supporting GUI drag-and-drop design, parameter adjustment as demand, & parameter import / export

Sandbox test: Within an isolated test environment, the orchestrated network is automatically deployed for static check, resource check, and LCM tests

Visualized blueprint design of NFVO, high design efficiency

CloudStudio NFVO + As Required Resource and Network Slice Management

O&M Portal/Northbound Interface

Design
- Slice design
- NS blueprint design
- VNF blueprint design
- Template library

Orchestration
- Slice lifecyclemanagement
- NS lifecycle management
- VNF lifecycle management

Assurance

Dashboard

| Alarm management | Performance management | Topology management | Resource management |

| Security | | Logs |

Access management · VNFM management · VEMS management · VIM management

VNFM / VIM / EMS — VNFM / VIM / EMS — VNFM / VIM / EMS

Agile design
- Visual design
- Fast design based on templates
- Sandbox test

Automatic orchestration
- Automatic deployment
- Abundant lifecycle management operations

Intelligent guarantee
- Full monitoring
- Real-time resource management
- Policy-based O&M
- Inter-layer RCA, dynamic topology

Architecture change
- Microservice architecture, flexible as on-demand
- High reliability
- Open source and openness

Collaborative and closed linkage between design and operation Assurance for closed loop of cloud network

ZTE applies VMAX big data platform to support network slicing related service quality management and intelligent operation, in which:
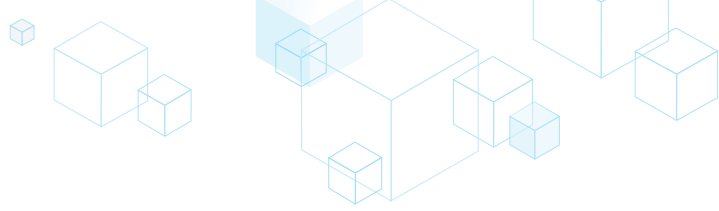
Establish slice operation related index system	Monitor and analyze slicing service quality	Self-optimization for slice performance

ZTE VMAX Big Data Platform

5G base station → Transport exchange
CN equipment

Service QoE
KQI 1 — KQI n
ANKPI — CNKPI — Other KPI

Big screen display
KPI
Regional monitoring

High-traffic service — High-duration service
Valueable Business
Service for high ARPU — Critical services

Slice lifecycle

Multi-source data collection	Slicing composite indicator system	Visual monitoring	Slice Quality Analysis	Slice Self-Optimization
• Wireless NSSI data collection • Transport NSSI data collection • CN NSSI data collection	• Value dimensions: Network, user, and service • Topology: Network-wide, slice, and sub-slice • Feature scenario: EMBB, uRLLC, mMTC	• Key iIndicator monitoring • TopN slice monitoring • VIP slicing monitoring • Network/area slice monitoring • Alarm monitoring	• End-to-end location • VAP slice root cause analysis • Slice service quality analysis • Poor quality analysis	• Optimal antenna feeder parameters • RSRP optimization • SINR optimization • Increase of cell throughput

Slice self-optimization system with visible data, visible contents, available analysis, and closed-loop process

ZTE's Key Capabilities to Support Transformation of 5G and NFV O&M

Owning more than thirty years of experience and deep understanding for industrial development, ZTE keeps looking at telecom operators' demand for digital O&M transformation. We apply advanced technologies and concepts such as service-based architecture, DevOps and AI to create our CloudStudio product family and to establish our O&M transformation service for 5G and NFV.

ZTE has built a 5G network-oriented service-based O&M management system for telecom operators:

The architecture of this system includes IaaS, PaaS and SaaS layers, where PaaS is further breakdown into two sub-layers of OTCP and cPaaS. OTCP is an OSS component including microservice application framework and microservice for public OSS application. On top of that, it consists of a series of microservice components for service design, commissioning and guarantee, and they are applicable for external connection and make use of such microservice. The Common PaaS platform (cPaaS), including K8S, application middleware, data service and DevOps, they can extract relevant application from middleware in its upper-layer and then proceed the tasks of data store, compute and share. The features of O&M system include:

Decoupled service architecture from the IT architecture	Decoupled service development unit from software development	Separated between design and operation
Model-driven automatic commissioning	Policy-driven automatic O&M	An integration consists of design, development, operation and maintenance, with capabilities for further development and operation

As described service-based architecture above, the ZTE CloudStudio product series is flexibly composed of various service components for meeting various scenarios for digital O&M transformation. For example, a requirement for 5G slicing orchestration and management, it can invoke its relevant components such as CSMF,NSMF, NSSMF, NFVO and etc., as a combination for full lifecycle management on such 5G slicing. Moreover, the CloudStudio series can also support operator's digital O&M transformation required agile design, automatic operation and intelligent O&M capability.

Agile design capability

In association with the complexity of telecommunication services as well as the great increase of digital requirements, the Network Element (NE) itself consists of more and more number of components with complicated parameters and specification, resulting in extremely high requirement for relevant design tasks. If such tasks rely on manual intervention of design orchestration and verification, not only it may cause high chance of error but also high cost and time consuming. Therefore, it is essential to have a professional platform for agile design and automatic verification, ZTE's APDS can meet operators' relevant requirement.

The Advanced Planning and Design Suite (APDS) consists of an UI integration of micro-service and unified management right, it can be online design through GUI, verification by sandbox test, proof of test result, and etc.

ZTE O&M Management System Architecture

- The APDS design suite consists of two modules: Blueprint Center and Software Repository
- "Blueprint Center" refers to the designed operating environment, which allows the design of VNF, NS, NSST and NST, design-package editing and one-click deployment
- The "Software Repository" is the status management environment for design package. It can register, activate, and disable the design package

As a design tool, APDS design suite (built-in sandbox) adopts graphic design interface and supports one-click deployment.

This APDS module has the following features:

Service lifecycle design
The service model runs through service provisioning domain and service guarantee domain. The goal is to define relevant service attributes and full lifecycle management process. For the service provisioning domain, designer can proceed modeling of design, service, workflow, and resource. For the service guarantee domain, designer can proceed modeling of data collection, service monitor, analysis and intelligent policy.

Perform service modeling
Facing the complex requirement of telecom network, It can proceed service planning as required, such as fundamental plan, resource planning, life cycle management and guarantee planning. For efficient and effective planning, its unified interface provides a series of planning template that can be selected for further manual modification. The design module proceeds relevant calculation for the service model with invoking relevant plug-in NE.
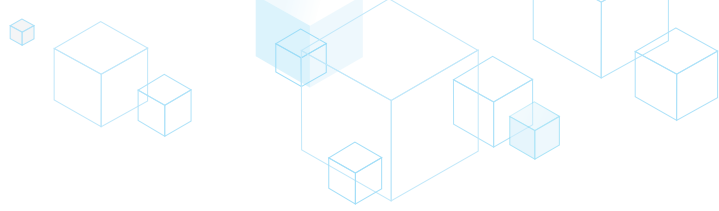
Online blueprint design

The APDS supports mainstream modeling of TOSCA, HOT and etc. By using its GUI application, designer can design online just easily as drag and drop, and the relevant result of design is observable. In addition, the templates have been issued with each release, making it easy to use.

Sandbox test

The APDS integrates with automatic test tool and customized end-to-end process for auto-execution of model verification, resource evaluation, security check and functional verification, and etc. This can let the verification for design model within a minute and shorten the design time to hours. As a result, it greatly helps rapid development of new services and much less time to be online.

APDS runs a closed loop of "design + verification + release" throughout the entire service lifecycle. Not only it can support rapid planning and design but also provide functionality of automatic deployment with CI/CD capable for continuous implementation.

Automatic operation capability

The traditional way for deployment and O&M are tedious and complicated with many tools intervention, moreover, the capabilities of such tools are different and also lack of orchestration. Therefore, a lot of manual operations have to be involved in O&M work and the O&M personnel have to equip lot of relevant knowledge / experience for such tasks. Obviously, it is far from the way of automatic O&M. In the 5G era, a lot of new services are emerging and their cycle time for revision is becoming shorter and shorter. Therefore, it is essential to equip O&M tooling solution, such as tasks for deployment, commissioning, testing, and upgrade, with high capabilities for automatic, efficient, and accurate operation.

The ZTE CloudStudio solutin can refine various O&M scenarios into the steps of operational process, and turn such workflow automatically through its visual platform of management and control.

Maintenance Pain Points

Many virtual-layer of IT software operations: lot of tasks, frequent changes and time-consuming environment patches, system upgrade, software upgrade, database backup, and preventive maintenance.m and etc Such tasks occupying 40% of time for O&M personnely day

Response Capability

Task scheduling: Through the scheduled task function, it can formulate a task execution policy, in stead of manual work, it can complete the relevant tasks automatically an quickly

Today 100 + O&M operation
Execute on the 1000 + node

Highlights

Task execution engine: Executes tasks in proxy or w/o proxy mode, and it supports sequence, parallel, and condition modes
Reduce repetition: Reduce workload of virtual layer 30%

Cloud Booster - operational automation   ⛾ Administration

Operations
- Overview
- Operation history
- Scheduled task
- O&M scenario

Configuration
- Orchestration management
- Operation management
- Resource management
- Authorization management
- System configuration

#	Periodic O&M operation	Execution time	Auto	Manual execution	Execution status
1	Checking the HHT connection	8:30	Auto	Manual execution	✅
2	nGen health check(App server)	8:30	Auto	Manual execution	✅
3	nGen health check by console	8:40	Auto	Manual execution	✅
4	Reboot Guider APP	9:00	Auto	Manual execution	✅
5	Prepare HPUX APP backup Tape	9:00	Auto	Manual execution	✅
6	Prepare HPUX System backup Tape	9:00	Auto	Manual execution	🔴
7	Prepare Linux_Full backup Tape	9:00	Auto	Manual execution	✅
.....	.....			.....	.....
100	YICCS01 Data Permanent Backup	0:00	Auto	Manual execution	🟡
101	Restart FIX APP	6:00	Auto	Manual execution	🟡
.....	.....			**Automatic one-click execution**	

Operation and maintenance operations can be managed and scheduled in a centralized manner, so that hundreds of operation and maintenance operations can be executed in parallel with thousands of entity resources. Such execution is fully visible.

The capability automated operation of ZTE CloudStudio product has the following features:

Customized operation flow for various O&M scenario

The O&M operation flow can be designed according to actual scenario, such as service deployment, configuration, test, upgrade and preventive maintenance. Its trigger factor / level for execution can also be customized and embedded with the operation flow. So, the O&M mode can focus on relevant operation definition and its monitoring, which shall make less and less manual operation in the process.

Automatic deployment and configuration with end-to-end orchestration

The CloudStudio owns one-click function for automatic deployment. By using its extensible / automatic deployment framework, CloudStudio can implement a series of end-to-end related orchestration like fast bootstrapping of various infrastructure, cloud platform software, data configuration and automatic software update. Moreover, CloudStudio can automatically interpret service model and then apply applicable systems to perform relevant deployment, this significantly helps service provisioning. During the process of service provisioning, it can automatically match with required configuration model in accordance with their service parameters, and automatically deliver instructions for automatic configuration, as a result, its one-click function not only brings automatic interpretation but also service activation.

An introduction of automatic test platform

By establishing a well-structured test flow, the CloudStudio seamlessly links a series of test processes and performs customized test that is flexible in accordance with test function. It supports the test by various tools and various scenarios, thus achieving automatic verification for multiple scenarios with end-to-end service test. This can greatly improve the efficiency of service deployment and its upgrade.

Support automatic batch upgrade

Applying its end-to-end upgrade flow, CloudStudio provides an unified upgrade flow through its integration consisted of sub-flow of APP system and NFVI system. Its upgrade process can be flexibly customized in accordance with upgrade scenarios and upgrade requirements which can lead to an automatic process of batch upgrade, resulting in zero-interruption, faster upgrade time, better upgrade efficiency, and accelerate the deployment of new service.

Visual operation flow

All operation flows can be controlled and visually through the unified portal. The execution progress for various types of operations can be seen clearly by the user, so the user can run or stop the process as required. Meanwhile, it can provide operation related reports and logs as evidence of performed tasks.
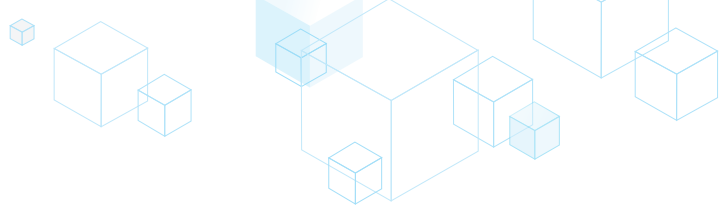
Capabilities for evolving intelligent guarantee

The values of cloud native network and 5G network are their diversities of services. The guarantee for service-oriented SLA requires intelligent action of fast response, active intervention, accurate location, and automatic troubleshooting. in the initial stage of capability building for intelligent guarantee, a global strategy center can be set as the intelligent brain of operation and maintenance system. In accordance with relevant experience and service characteristics, an automatic closed loop for O&M shall be set up with pre-defined strategy for intelligent operation. By further introducing AI technologies in the process, the capability for intelligent guarantee will be evolved to next high degree of intelligence. Through a series of automatic process by machine learning and AI algorithms, such as automatic analysis of fault characteristics, automatic ruling of troubleshooting, automatic policy generation for troubleshooting with relevant triggering level, the evolving to intelligent O&M guarantee can be achieved. With the development of AI technology, it is anticipated that future network shall own self-management capability for intelligent guarantee, And, it is way of doing by ZTE uSmartNet.
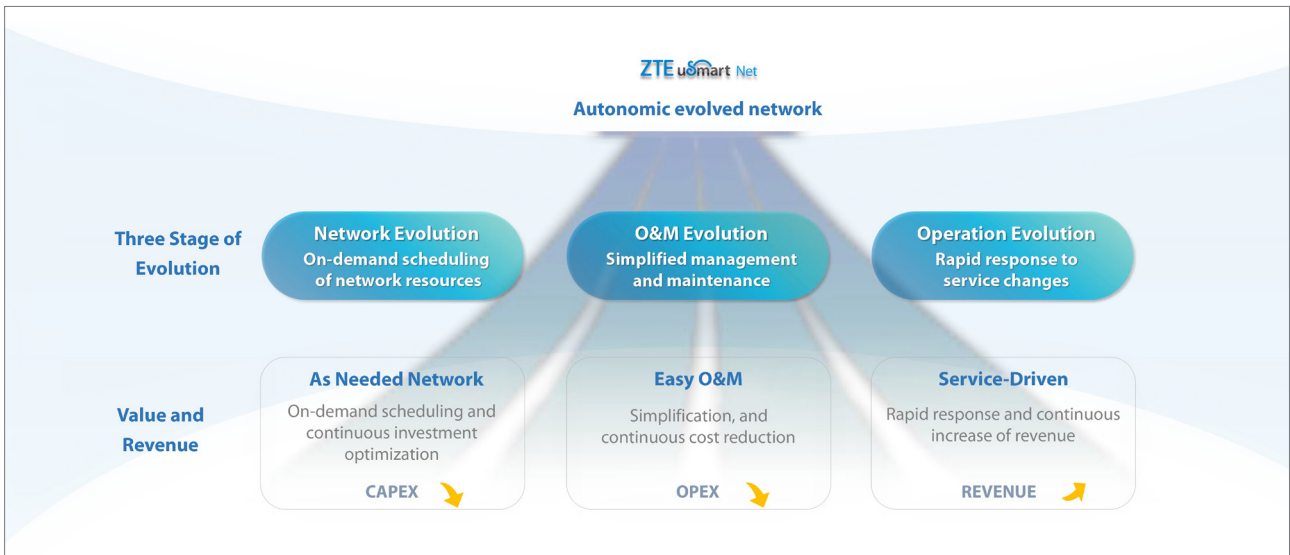
Policy-driven closed-loop for automatic O&M

Acting as a unified strategy management and control center, ZTE CloudStudio plays a key role for intelligent operation and maintenance with essential components for strategy implementation and operation management. different to the traditional way of doing, its policy-based O&M process has deprived manual process for fault handling and

analysis. It designs its O&M policy by real-time monitoring and applies such data to establish its automatic process flow for O&M. Whenever the system detects a network fault, a policy-driven action(s) in accordance with its predefined rule, an automatic O&M action is triggered to clear the identified issue. At the same time, the system is continuously

to proceed its network monitoring and data collection, so it can automatically adjust and optimize its policy based on machine learning and relevant ruling, thus forming a closed loop for automatic guarantee, and enhancing network robustness with reduction of pressure in the support domain.
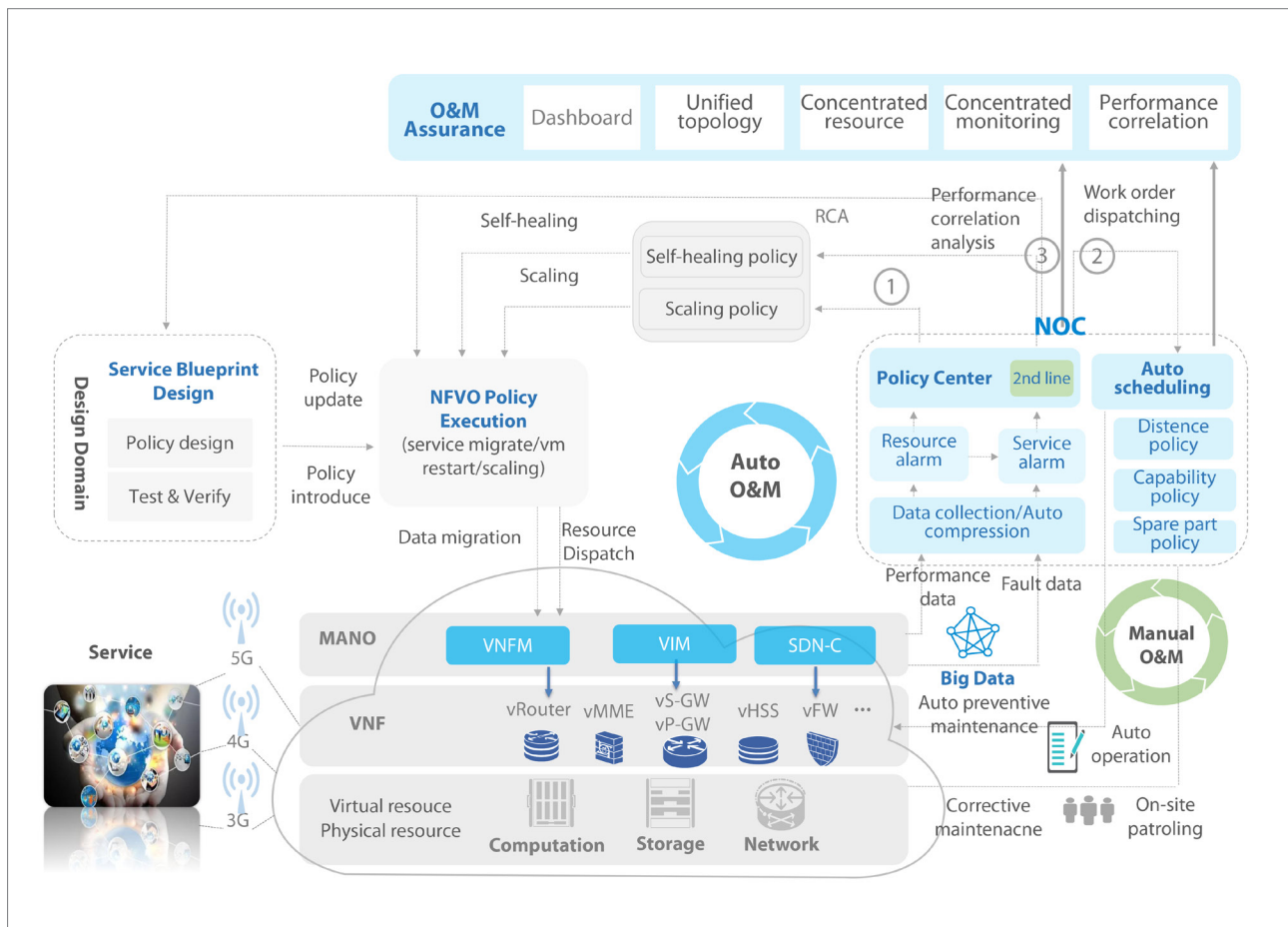
AI drive intelligent O&M

ZTE CloudStudio introduces AI technology and relevant algorithm into actual O&M scenario for alarm correlation, root cause analysis, and automatic fault location. These can significantly assist the O&M personnel to proceed troubleshooting quickly. In addition, it provides a fault prediction model that can act as a running program as intelligent action for preventive maintenance. Moreover, its algorithm for the function of self-optimized can help for network resource configuration which leading to better optimized network with better customer experience.

- Based on big data and AI technologies, instead of experience, O&M by policies
- Based on AI & RCA, quick fault localization, within close-loop maintenance
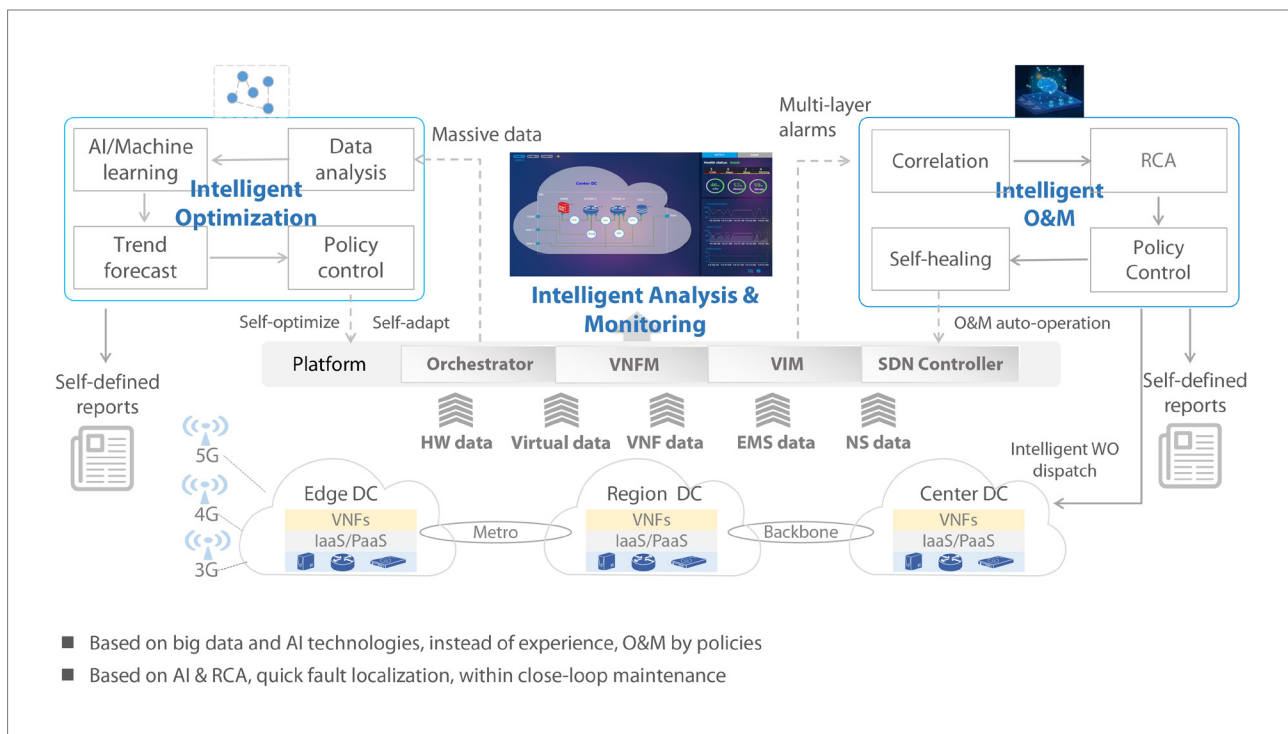
AI based alarm correlation, automatic location of problem issue and root cause analysis

From the perspective of network O&M, network stability is the fundamental basic. Rapid location of network fault is a preferred approach for realizing the value of network intelligence. ZTE CloudStudio provides intelligent functionality of fault identification and location which includes detection of abnormal network performance, root cause analysis, log investigation and etc. For quickly identify the root cause, the checking is carried out by going through multi-dimensional analysis, in which it not only examines the relevant correlation to the resource status but also proceed relevant action by ruling created by historical data. As a result, the efficiency of root cause analysis can increase 70% and such high efficient can also greatly improve the efficiency of fault location.

AI-based fault prediction and preventive O&M

ZTE CloudStudio is implanted with training model for correlation studies among network service, abnormal KPI, network faults and performance of network slicing, so it can create prediction for coming network performance. Such prediction can be applied for preventive action for coming network issue, like but not limited to the prediction to cell loading, network performance, base station healthiness, capacity of core network, traffic of transport network, and etc.
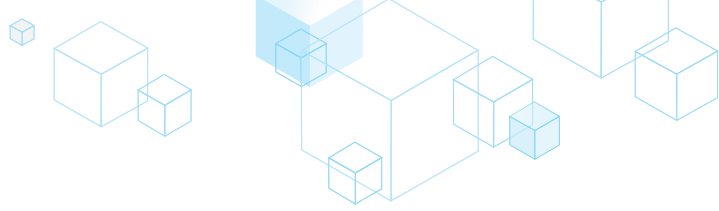
AI-based intelligent preventive maintenance

ZTE CloudStudio can provide comprehensive inspection to the healthiness of network by using its components of health checking suite. Based on the inspection, it can automatically generate reports of status observation, failure analysis, suggestion for troubleshooting, and etc., resulting in much less manual intervention. By using AI based model and relevant algorithm, such inspection and report are further analyzed in association with the historical data, the O&M personnel can predict what problem issue may occur and take preventive action for eliminating the possible issue.

AI-based network optimization and user experience improvement

User-centric is the characteristic of digital networks. Therefore, the O&M of digital networks also requires the use of digital technologies to continuously optimize network performance and improve user experience. ZTE CloudStudio applies AI algorithm to study relevant ruling for network slice and shared resource, and automatically implements network slice related adjustment and network optimization by using its NF reset function as well as SDN intelligent routing strategy. Referring to the end-to-end user experience indicator system, ZTE CloudStudio integrates AI and edge computing technologies to improve user experience in network slice related area.

The mission of Zero Touch for intelligent O&M shall be achieved in the future network by further network automation, mature AI technology, and comprehensive correlation among full lifecycle of service design, configuration, strategy and assurance, resulting in an innovative way of network assurance

Conclusion

Looking ahead to the future network, digital technologies, 5G network, and AI technologies have brought operators a broader space for business innovation. It is forecasted that telecommunications business and its operation and maintenance will continuously develop. Therefore, digital transformation for telecom O&M is a continuous evolution process.

In association with the rapid deployment of 5G network, it is a common concern among network operators for what and how to achieve effective network assurance and intelligent management way for innovative service.

With more than thirty years of experience in the industry and full insight into development trends, ZTE provides operators an all-round transformation support and consulting services. Applying CloudStudio product family that embedded with advanced service-based architecture, DevOps concept and AI technology, ZTE can support operators' O&M transformation with capabilities of agile, automatic and intelligent.

ZTE's 5G & NFV O&M service, which integrates comprehensive expertise and intelligent strategy, supports diversified application scenarios with high effective and efficient for network maintenance and management, ensures 5G network stability with agile service, and helps operators to grasp opportunity in the market.
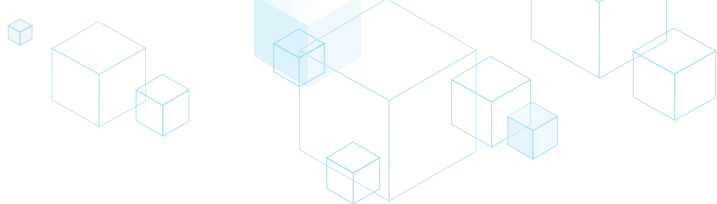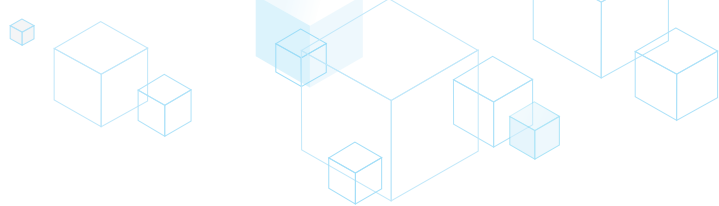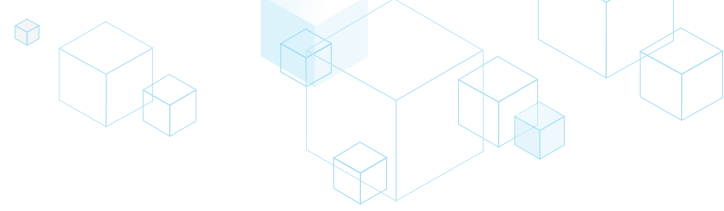
Acronyms

Acronyms	English
5G	Fifth Generation of Mobile Network
5GC	5G Core
5GNR	5G New RAN
APDS	Advanced Planning&Design Suits
API	Application Programming Interface
BSS	Business Support System
CI/CD	Continuous Integration/Continuous Deployment
CPaaS	Common PaaS
CSMF	Communication Service Management Function
CT	Communication Technology
DC	Data Center
eMBB	Enhanced Mobile Broadband
EMS	Element Management System
ETSI	European Telecommunication Standards Institute
GP	Global Provision
GUI	Graphical User Interface
G-VNFM	General VNFM

Acronyms	English
IaaS	Infrastructure as a Service
IBN	Intent Based Networking
IT	Information Technology
K8S	Kubernetes
KPI	Key Performance Indicator
LCM	Life Cycle Management
MANO	NFV Management and Orchestration
MEC	Mobile Edge Computing
mMTC	Massive Machine Type of Communication
MSB	Message Bus
NCO	Network Connection Orchestration
NF	Network Function
NFV	Network Functions Virtualization
NFVI	NFV Infrastructure
NFVO	NFV Orchestrator
NS	Network Service
NSD	NS Descriptor
NSMF	Network Slice Management Function

Acronyms	English
NSSMF	Network Sub-Slice Management Function
O&M	Operation and Maintenance
OPEX	Operating Expense
OSS	Operation Support System
OTCP	OSS Technical Components Platform
OTT	Over the Top
PaaS	Platform as a Service
PNF	Physical Network Function
SaaS	Software as a Service
SDN	Software Defined Network
SLA	Service Level Agreement
TOSCA	Topology and Orchestration Specification for Cloud Applications
TTM	Time to Market
uRLLC	Ultra Reliable & Low Latency Communication
VIM	Virtualized Infrastructure Manager
VNF	Virtualized Network Function
VNFD	VNF Descriptor
VNFM	VNF Manager
ZSM	Zero Touch Network and Service Management Industry Specification Group

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