Huawei iMaster NCE Data Sheet

5G Network Challenges in the Cloud Era

With the advent of the 5G and cloud era, numerous innovative services are emerging, such as VR/AR, live streaming, and autonomous driving, which in turn bring further vitality to the booming ICT industry. Network traffic is also experiencing explosive growth. According to Huawei Global Industry Vision (GIV), there will be 180 ZB more data by 2025. What's more, the dynamic complexity of services makes networks even more complex. Gartner pointed out in a recent report that the biggest challenge for carriers is reducing OPEX, improving user experience, and improving agility. With this in mind, how should telecom carriers respond to the opportunities and challenges in the 5G and cloud era?

Such challenges can only be overcome by constructing automated and intelligent network systems centered on user experience. Current networks are becoming increasingly complex, which aggravates existing network issues. These issues cannot be effectively dealt with using a traditional device-centric manual network. Instead, automation is needed to achieve dynamic network resource scheduling. Also, 5G networks need to support high-speed and high-mobility enhanced broadband services such as Internet streaming media and live streaming, as well as ultra-reliable and low-delay machine-to-machine communications. 5G networks will be widely used in scenarios such as Internet of Vehicles (IOV), smart healthcare, and autonomous driving. In such scenarios, traditional O&M, which is passive and relies on user complaints and device alarms, will be insufficient, failing to effectively ensure service experience. As cloud services become more widespread, carriers and enterprises are shifting their focus to a broader vertical market. Their business model is also changing — from B2C to B2B or B2B2X. Enterprise and industry customers now demand open and easy-to-integrate networks, so that they can flexibly integrate their digital IT systems with networks.

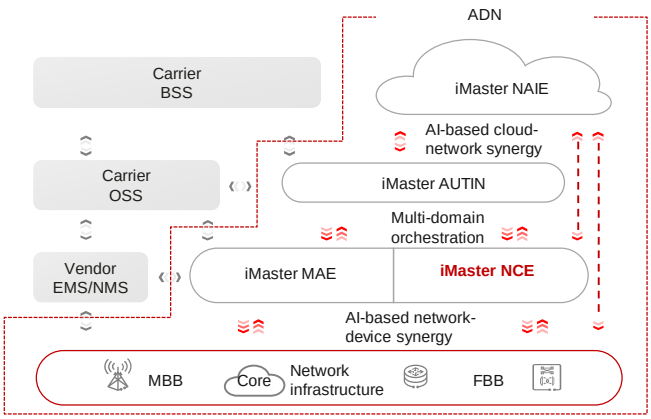
Huawei's ADN Solution

The information society is developing at a speed beyond our imagination. After the fourth industrial revolution driven by artificial intelligence (AI), substantial breakthroughs will be made in productivity, bringing dramatic changes to the mode of production.

In this era in which everything is intelligent, autonomous driving is becoming a reality, gaining momentum in the automobile, aircraft, and manufacturing industries, among others.
At the core of the information society is the ICT industry. As the scale of networks increases, so does OPEX, and the industry structural challenge is increasingly prominent. Against this backdrop, autonomous driving networks (ADNs) are urgently needed.

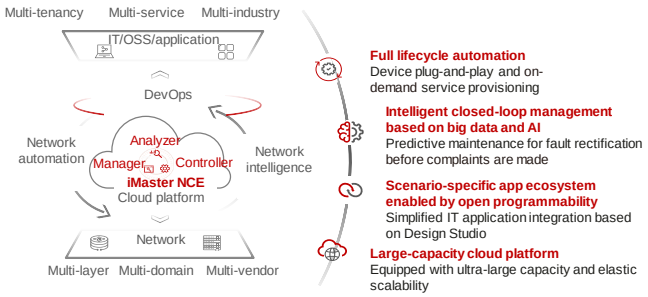
As an important player in the telecom industry, Huawei has been actively exploring ADNs with carriers and industry customers. ADNs go far beyond the innovation of a single product. Instead, they are more about innovating system architecture and business models. Huawei calls for all industry players to work together to clearly define standards and guide technological innovation and rollouts. Based on service experience and operating efficiency, Huawei has outlined five levels of ADNs for the telecom industry. Huawei is also actively exploring the application of ADNs in wireless, broadband access, IP, optical, and data center network fields. With these efforts, Huawei aims to comprehensively improve network O&M efficiency and achieve network autonomy and self-healing by building simplified networks centered on user experience.

There is still a long way to go to fully realizing autonomous driving networks. And to make the dream a reality, the industry must forge ahead together. By taking on complex issues itself while creating simplicity for customers, Huawei will further promote deep integration between AI and telecom networks to accelerate ADN development and embrace a fully connected, intelligent world.



Huawei iMaster NCE

iMaster NCE effectively associates physical networks with business intents. In the southbound direction, it implements centralized management, control, and analytics of global networks, as well as enabling cloud-based resource management, full-lifecycle automation, and intelligent closed-loop management driven by data analytics based on business and service intents; In the northbound direction, it provides open network APIs for quick integration with IT systems. It is mainly used in 5G transport, IP metro, IP backbone, premium optical private line, premium broadband, data center, and enterprise campus scenarios. iMaster NCE makes networks simpler, smarter, more open, and more secure, and accelerates the service transformation and innovation of enterprises and carriers.



iMaster NCE is the industry's first network automation and intelligence platform that integrates management, control, analysis, and AI functions. It provides the following key capabilities: full-lifecycle automation, intelligent closed-loop management based on big data and AI, open programmability-enabled scenario-based app ecosystem, and large-capacity cloud platform.

Full-lifecycle automation: iMaster NCE provides full-lifecycle automation across multiple network technologies and domains based on unified resource modeling and data sharing, enabling device plug-and-play, immediate network availability after migration, on-demand service provisioning, fault self-healing, and risk warning.

Intelligent closed-loop management based on big data and AI: iMaster NCE constructs a complete intelligent closed-loop system based on its intent engine, automation engine, analytics engine, and intelligence engine. It also uses telemetry to collect and aggregate massive volumes of network data. This allows it to determine the network status in real time. iMaster NCE provides big data-based global network analysis and insights through unified data modeling, and is equipped with Huawei's sophisticated AI algorithms accumulated during its 30 years in the telecom industry. It provides automated closed-loop analysis, forecast, and decision-making based on customers' intents, and resolves issues before complaints are made. This helps minimize service interruptions, improve user experience, and continuously enhance network intelligence.

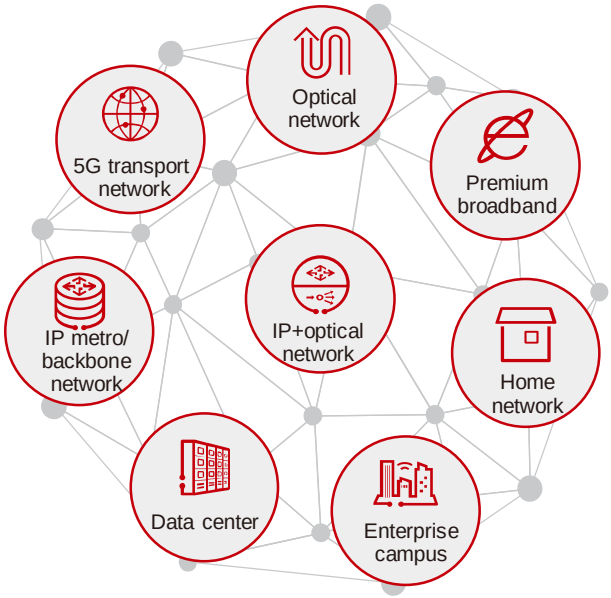
Open programmability-enabled scenario-based application ecosystem: In the southbound direction, iMaster NCE provides a programmable integrated development environment — Design Studio — and a developer community for integration with third-party network controllers and devices; in the northbound direction, it provides cloud-based AI training platforms and IT applications. iMaster NCE allows customers to purchase Huawei native apps on demand, develop their own apps, and turn to third-party system integrators for app development.

Large-capacity cloud platform: iMaster NCE, with cloud architecture, supports both on-premises deployment and cloud-based deployment. With elastic scalability, it can provide the world's largest system capacity to allow a large number of access users. With online data sharing and process streamlining, it avoids scattered data distribution and multi-level O&M in offline mode.

iMaster NCE Application Scenarios and Use Cases

iMaster NCE provides a wide range of solutions for different application scenarios, such as 5G transport, optical network, IP metro, IP backbone, IP+optical, premium broadband, home network, data center, and enterprise campus

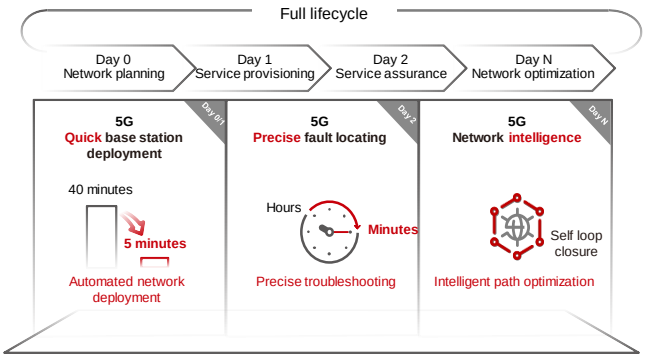
scenarios. Also, Huawei and leading global operators jointly launched the NetCity project to develop more innovative use cases.



5G Transport Network

International Telecommunication Union - Radiocommunication Sector (ITU-R) proposed three major types of 5G services: Enhanced Mobile Broadband (eMBB), Ultra-Reliable and Low-Latency Communications (URLLC), and Massive Machine Type Communications (mMTC). To meet the requirements of 5G networks in the three application scenarios, the transport network requires a vast number of base stations and must provide capabilities such as network slicing, L3 to the edge, co-management of 4G and 5G services, and intelligent O&M.

With its unified management and control platform, iMaster NCE provides a full-lifecycle automated and intelligent solution for 5G transport scenarios, covering network planning, service provisioning, service assurance, and network optimization.



Simplified Network Deployment

5G networks require more base stations than 4G, increasing maintenance and configuration workload. Traditionally, tunnels and VPNs are manually configured at each layer. In the 5G era, however, manual configuration involves a heavy workload, requires high skills, and is error-prone. iMaster NCE overcomes such challenges by providing a zero touch deployment (ZTP) app, eliminating the need for manual configuration. In a PTN 5G scenario, this app delivers basic configurations, including SR domain, IGP, BGP, and PCEP configurations, to devices after they go online. In addition, SR configurations, IGP IDs, LSR IDs, and link IP addresses are planned in advance through resource pool planning. During PTN 5G deployment, this app directly obtains resources from resource pools to effectively improve deployment efficiency.

Mobile Transport Automation

To help access devices quickly go online in IP RAN 5G and PTN 5G scenarios, this app allows users to plan key content such as configuration templates and resource pools. After devices are powered on, iMaster NCE automatically delivers configurations to them, reducing the attendance duration of NOC personnel.

5G Smart Clock

To support clock synchronization between NEs in the PTN 5G scenario, this app allows users to plan and deliver SyncE and PTP clock configurations to online NEs. It covers all the phases involved with a clock network, including planning, deployment, and O&M. The app enables smart management of clock features, effectively reduces labor costs, and minimizes the issues caused by manual operations.

Mobile Transport Service Assurance

For IP RAN 5G and PTN 5G scenarios, this app provides path restoration and quality visualization functions for E2E monitoring of base station services. It presents SLA analysis results to help users quickly locate and rectify faults.

Premium Optical Private Line

In the cloud era, millions of enterprises are moving to the cloud, raising requirements on private line service provisioning, experience, and self-service capabilities. For example, some customers require fast private line provisioning, some require ultra-low private line delay, and some require real-time adjustment of private line bandwidth

to deal with traffic changes caused by bursty services and key events. Therefore, it is imperative to have a full-lifecycle, automated, and intelligent system that supports the evolution of optical networks towards ultra broadband, ultra simplicity, and intelligence, as well as providing premium optical private line services. This system is expected to cover planning and design, resource deployment, service provisioning, service assurance, and analysis and optimization.

iMaster NCE integrates network management, control, and analysis in the optical domain and provides features such as optical network resource assurance, delay map, service SLA analysis, key service assurance, and optical network health assurance and forecast.

Optical Network Resource Assurance

With optical network resource assurance, iMaster NCE manages and analyzes live network resource data, as well as planning and design data, in a unified manner, enabling unified visualization, analysis and forecast, and online capacity expansion planning of network resources. This feature visually displays resource usage in real time, identifies network resource bottlenecks, and accurately expands network capacity, ensuring resource availability for rapid service provisioning.

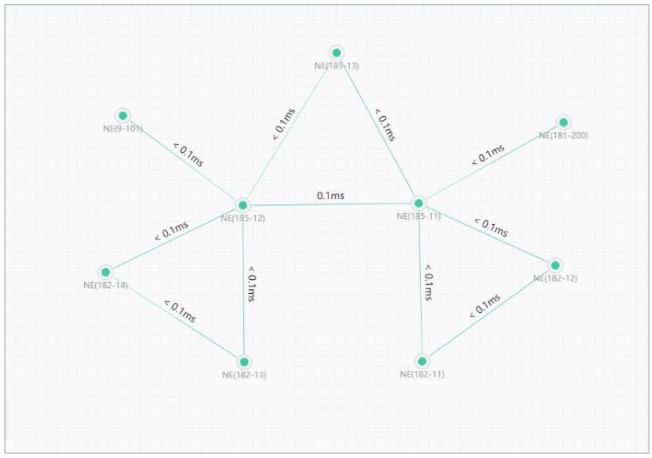
Unified and visualized resources: Live network data and planning data are intelligently combined and displayed in a unified manner, and resources can be quickly checked within minutes.

Resource forecast: The ARIMA model algorithm is used to forecast the resource requirements of the next one to three months to an accuracy of 90% for the entire network, ensuring resource availability at any time while avoiding wasted investment due to overstocking.

Online capacity expansion: The online planning capability, specially designed for capacity expansion, enables batch application and automated configuration of planning data, achieving service provisioning within minutes.

Delay Map

Customers from industries such as finance are willing to pay more for private lines with less delay. However, the sales personnel of carriers have to repeatedly confirm with the network construction and design department about such requirements, and the O&M personnel lack effective methods for monitoring and guaranteeing delay. In addition, carriers lack effective methods for learning the specific delay of private lines and the impact of increased delay on services. iMaster NCE is able to overcome such issues by providing E2E visualization, selection, and monitoring of service delay. Sales personnel can quickly obtain the delay and bandwidth information between sites or source and sink nodes based on the delay map and estimated capabilities. What's more, O&M personnel can leverage the delay-based path computation capability to provision private lines with guaranteed delay, as well as monitor private line delay and threshold-crossing alarms in real time.



Private Line SLA Analysis

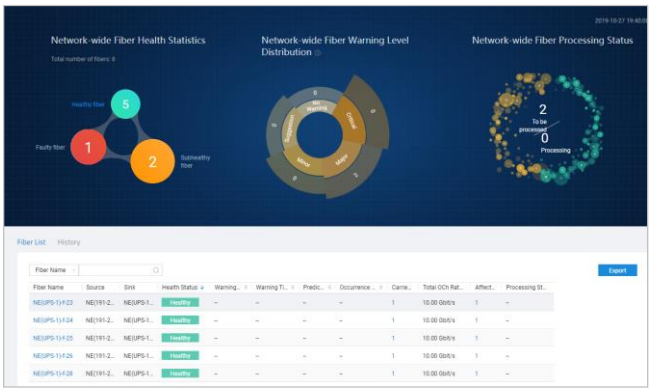
High-value customers have high requirements on the quality of private lines, expecting high availability, high security, low delay, and fast provisioning. Government customers, on the other hand, are mostly concerned about cyber security, while financial customers are concerned more about low network delay and high security. Large enterprises, in contrast, focus more on highly elastic bandwidth. The private line SLA includes KPIs such as bandwidth usage, private line availability, delay, and packet loss rate, which are important KPIs of telecom networks and for private line users. For private lines, these KPIs are monitored and analyzed by iMaster NCE using the optical private line SLA analysis, enabling proactive monitoring and assurance of private line service indicators.

Key Service Assurance

To improve the satisfaction and experience of private line users, iMaster NCE provides Key Event Assurance (KEA) to help carriers identify and diagnose faults on key services at the earliest time possible. It can centrally monitor the status of key services to identify service risks, replay faults by time, create and manage one-time, periodic, and permanent monitoring tasks, and manage service connectivity status and key alarm indicators.

Optical Network Health Assurance

During the O&M of WDM networks, fiber degradation is difficult to identify in the early stage and may cause a large number of service faults. Scattered fault data and lack of effective correlation analysis result in inefficient fault locating. Generally, faults are discovered and handled only after users complain about service interruptions. In addition, O&M engineers need to spend a long time in demarcating and locating faults onsite, resulting in lengthy service interruptions and greatly affecting user experience.
Optical network health assurance enables iMaster NCE to provide OTS/OCh health monitoring, sub-health forecast, and automatic optimization based on use cases such as visualized optical network health, optical network health forecast, and intelligent optical network commissioning.
Optical network health forecast analyzes the health status of each fiber and channel through machine learning, big data, and AI forecast algorithms. It also forecasts the risk of faults, and identifies faulty points in advance to mitigate network risks and provide rectification suggestions, implementing proactive O&M, reducing service interruption, and avoiding penalties caused by SLA violation.



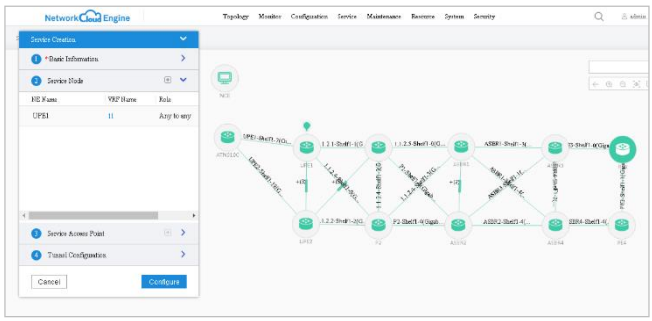
IP Metro/Backbone Network

With the numerous new services and demands that emerge in the cloud era, metro and backbone networks play a pivotal role in bridging Internet services. Carriers require networks with more flexibility, lower cost and delay, and higher bandwidth and reliability.

With its unified cloud platform, iMaster NCE provides real-time network resource visualization, adjustment, automation, and open capabilities. It can determine the network performance within seconds and optimize a network within minutes through network optimization algorithms.

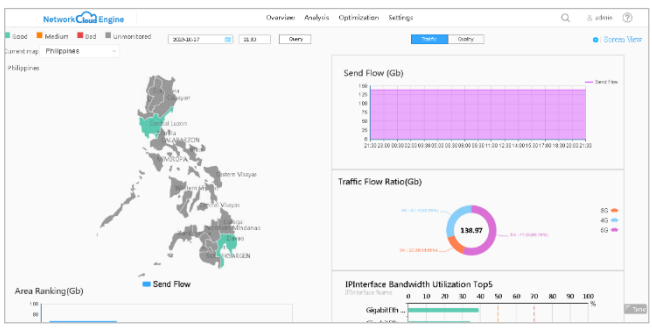
Automated Service Provisioning

iMaster NCE automates service provisioning on IP networks through service abstraction and model-driven development. For mainstream services such as EVPN, L3VPN, and PWE3, iMaster NCE provides various configuration templates, greatly simplifying service configuration. Parameters can be bulk-delivered and verified, and tunnels can be automatically created, greatly shortening time to market (TTM) and improving service provisioning efficiency.
iMaster NCE simplifies service provisioning parameters through model-driven service automation. It supports service-driven automated tunnel creation and SLA constraint-based centralized tunnel path computation, as well as providing simplified service provisioning process and SLA assurance.



Multi-Dimensional Network Visualization

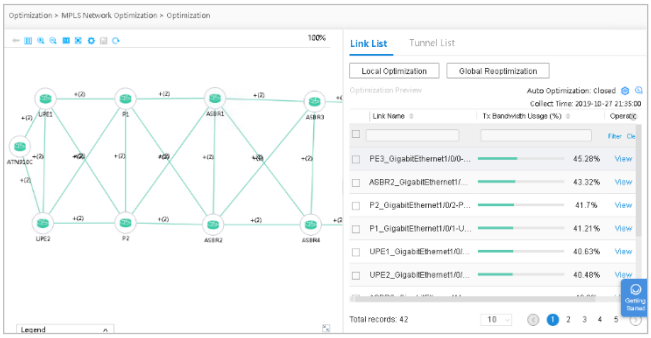
iMaster NCE uses protocols such as SNMP and telemetry to collect network-wide traffic quality data, intelligently performs big data analytics, and displays device and network status from multiple dimensions, such as dashboards, topologies, maps, and reports. By visualizing network traffic information, regional network performance, ring network performance, and network capacity, this feature helps O&M personnel quickly detect and handle device and network exceptions, ensuring the normal running of devices and networks.



Network Path Management

iMaster NCE uses the Routing Optimization Algorithm based on Matrix (ROAM) for real-time analysis, centralized path computation, and unified scheduling on MPLS TE networks. It computes optimal E2E paths for MPLS TE tunnels, balances global network traffic, and manages differentiated services to guarantee user experience with high-priority services.

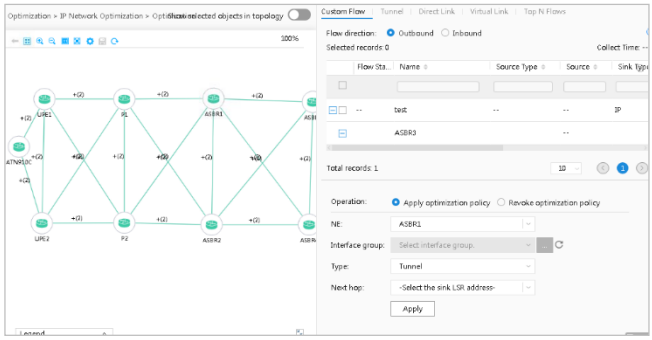
- Computes optimal paths for MPLS TE tunnels (including RSVP-TE and SR-TE tunnels).
- Centrally computes paths based on the overall network topology and tunnel information and implements global optimization using the formula Min. ∑(Tunnel bandwidth x Cost).
- Locally optimizes congested tunnels and links with trivial impact on the entire network.
- Centrally configures and manages TE network topology information and tunnel constraints to simplify network O&M.



IP Network Optimization

iMaster NCE collects link bandwidth and directions on IP networks in real time. Based on network-wide topology, traffic, and link quality, it can perform one-hop optimization for inbound and outbound inter-AS traffic on native IP networks in DC egress and public network interconnection scenarios. It supports bandwidth on demand (BOD) for VIP customers, localizes traffic in the same city, balances egress link loads, provides the optimal DC egress traffic optimization solution, and ensures SLA performance for VIP customers. In addition, iMaster NCE supports one-hop and multi-hop optimization for intra-AS traffic, which improves backbone resource utilization and operational efficiency.

- Optimizes outbound traffic on the DC egress to balance egress link loads and localize traffic, thereby preventing network congestion and alleviating pressure on the backbone network.
- Balances inbound traffic among IGWs to resolve local congestion of return traffic on the metro network.
- Directs intra-AS IP traffic to designated tunnels to ensure VIP service quality and provide differentiated SLAs.



Premium Broadband

As FTTH broadband services grow rapidly, troubleshooting of optical paths has become a major pain point for carriers on live networks due to ODNs lacking visibility and manageability. Carriers are unable to locate faults remotely and therefore require maintenance engineers to troubleshoot faults onsite, which is inefficient.

iMaster NCE analyzes and locates E2E broadband service faults and forecasts the optical paths of faulty broadband services. It enables carriers to not only detect the experience of home users proactively, but also troubleshoot faults proactively, remotely, and intelligently in addition to forecasting and repairing faults proactively. This improves troubleshooting efficiency and reduces maintenance costs.

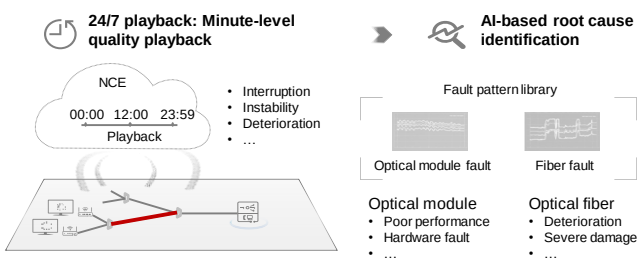
Automatic PON Fault Identification and Root Cause Analysis

PON faults account for 25% of all faults. Due to long and complex optical lines, engineers need to troubleshoot faults onsite, which is inefficient and affects user satisfaction.

iMaster NCE collects the running status and KPIs of OLTs and ONTs, and performs big data computing and analytics to determine the locations and types of PON faults.

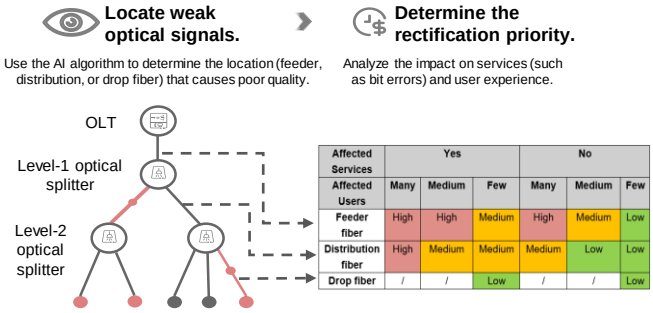
It uses machine learning and big data analytics to learn the passive ODN topology, enabling it to perform ODN topology restoration.

If the quality of a PON optical line deteriorates, iMaster NCE can identify the root cause based on the fault pattern library (for example, a bent or dirty fiber) and determine the location (feeder, distribution, or drop fiber) of the issue.



Cause Analysis and Priority-based Rectification of Weak Optical Signals on a PON

iMaster NCE periodically collects data about optical line performance and uses AI algorithms to analyze and restore the optical line topology. It also identifies the causes and locations of weak optical signals and associates user experience with weak optical signals. In addition, iMaster NCE improves the rectification efficiency by enabling targeted and batch rectification of weak optical signals. It locates the root causes of weak optical signals on drop, feeder, and distribution fibers, and allows rectification priority-based sequencing and batch export of weak signal data.

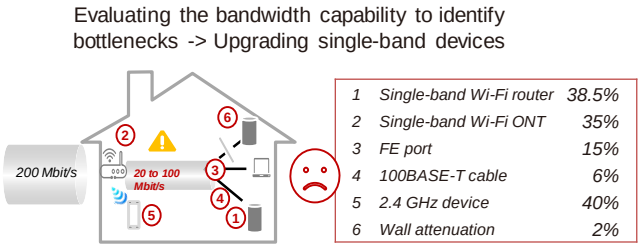


Home Network

Wi-Fi networks have become essential in homes along with 100 and even 1000 Mbit/s home broadband services gaining popularity. However, users often complain about the quality of home networks — poor quality hinders the improvement of broadband user experience. Based on network connection quality and carriers' business requirements, iMaster NCE performs big data collection and intelligent analysis of home Wi-Fi networks to not only promote the development of carriers' home network services in terms of marketing, deployment, and maintenance, but also continuously improve user experience.

Accurate Identification of Potential Home Network Users

In China, the penetration rate of 200 Mbit/s broadband services is close to 70%. However, most broadband users experience only 20% to 50% of the subscribed bandwidth through Wi-Fi. Bottlenecks inside the home network cause large amounts of bandwidth to be unavailable.
Through big data collection and intelligent algorithms, iMaster NCE identifies these bottlenecks and offers effective support for carriers to deploy home network services, improve the user conversion rate, and unleash the full network potential.

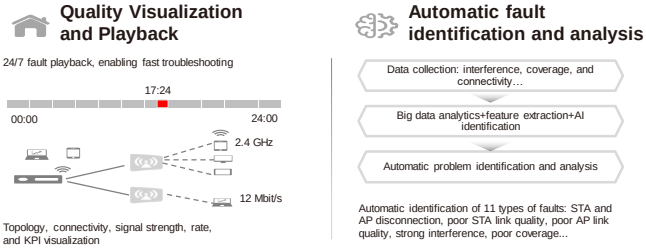


Fast Service Deployment on Home Networks

Currently, carriers do not have a quantitative evaluation method for network service deployment, resulting in repeated onsite commissioning. iMaster NCE provides an app to help installation and maintenance personnel quickly deploy high-quality services on the live network.

Improved Retention of Home Network Users

Approximately 50% of reported home broadband faults are related to Wi-Fi. Because troubleshooting a home network depends on device restart, onsite fault diagnosis, and device replacement, the troubleshooting process in inefficient, resulting in high labor and material costs. With data collection and analysis capabilities, iMaster NCE visualizes home networks for proactive fault identification and rectification, helping prevent complaints and improve user satisfaction.



Data Center

The increasing popularity of mobile Internet has brought challenges to telecom carriers' traditional services, such as audio services and SMS. Carriers must therefore change their R&D, operating, and service models to overcome these challenges. Digital transformation and data center reconstruction are essential undertakings for carriers to improve resource utilization, management, and O&M efficiency.

Carriers must quickly build, expand, and upgrade network infrastructure, implement automated E2E service provisioning and adjustment, and realize intelligent O&M. iMaster NCE provides industry-leading automated and intelligent data center network solutions for carriers' EDC and IDC scenarios, redefining data center network service provisioning and O&M.

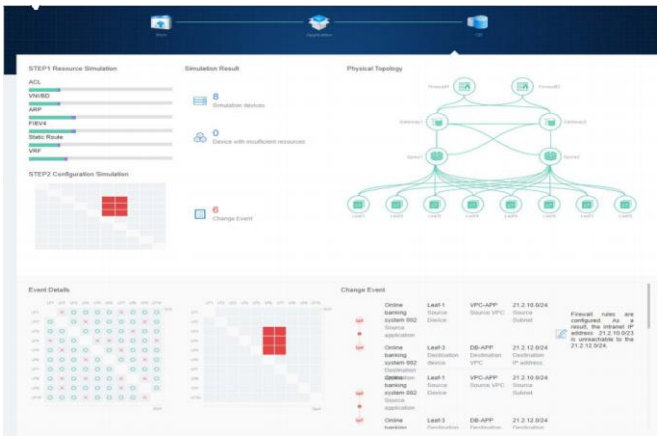
Automated E2E Network Deployment

iMaster NCE supports two modes for deploying the underlay network: zero touch provisioning (ZTP) and flexible planning. This not only meets the requirements of automated network deployment, but also enables quick construction, upgrade, and expansion of network infrastructure. In addition, iMaster NCE allows the logical overlay network to be designed in a drag-and-drop manner and automatically deployed. Network deployment with iMaster NCE is three times more efficient than the industry average, enabling services to be provisioned within minutes.

Change Risk Evaluation

Nearly 40% of faults on the network are caused by human error, such as logical vulnerabilities in network design, deviation from administrator intents, and misoperations. Risk evaluation of network changes and policy adjustment involves a heavy workload.

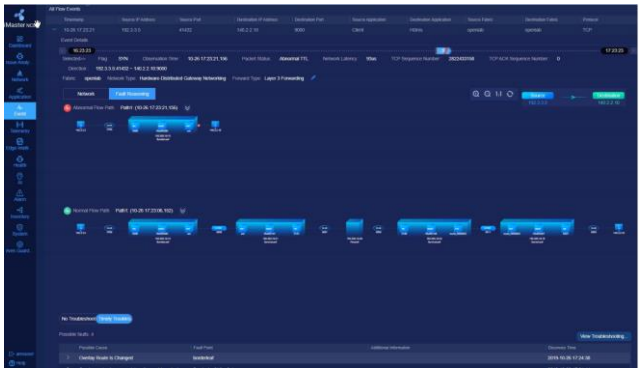
iMaster NCE provides the simulation verification module. With live network configuration, topology, and resource information, iMaster NCE analyzes whether network resources are sufficient. It displays detailed connection relationships and analyzes the impact of changing configurations on the corresponding services through network modeling and formal verification algorithms. This enables network engineers to evaluate change risks in advance and eliminate human error, ensuring zero network configuration errors.



Intelligent Recovery of Typical Faults

Data centers are central to supporting services and therefore have zero tolerance for network interruption. However, network O&M relies heavily on manual work. Service continuity may be severely affected if a network fault occurs, due to difficulty in locating the fault.

iMaster NCE uses telemetry to collect traffic on the management, forwarding, and data planes of the entire network and comprehensively evaluates network health based on service experience. It proactively forecasts faults and detects existing faults within 1 minute. With Huawei's unique AI algorithm, iMaster NCE performs in-depth feature mining and learning to locate the root causes of 75 types of typical faults (grouped into 7 categories) within 3 minutes. In addition, an intelligent decision-making system enables iMaster NCE to analyze the fault impact and recommend preferred troubleshooting methods for quick rectification of typical faults within 5 minutes.

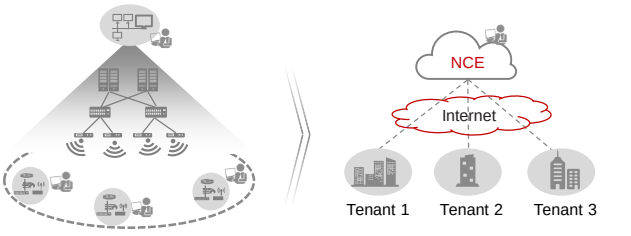


Enterprise Campus

As the demographic advantages of the telecom industry continue to erode along with the impact of mobile Internet, carriers face tremendous pressure to increase revenue from their traditional services. However, their government and enterprise services are rapidly developing at an annual growth rate of more than 50%. For carriers, traditional network construction requires specialized personnel to deploy and maintain the network onsite. This is both time consuming and labor intensive, and cannot adapt to large-scale expansion of government and enterprise services.

Cloud-based Multi-Tenant Management

With mature cloud computing technologies, iMaster NCE provides rights- and domain-based multi-tenant management to implement centralized management on scattered campus networks while ensuring E2E tenant data security and isolation, effectively reducing network OPEX.

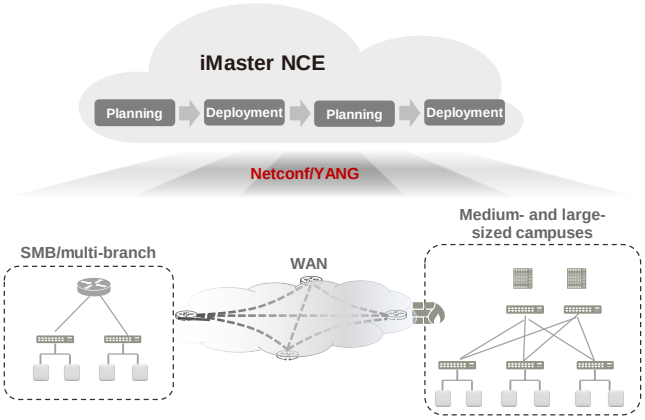


Traditional NMS

Cloud-based multi-tenant management

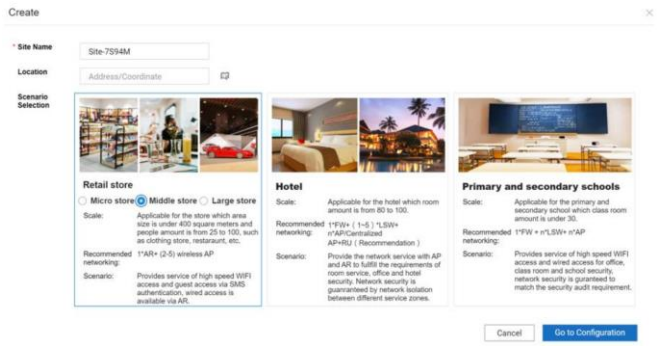
One-Stop Full Lifecycle Management

iMaster NCE provides automated management capabilities throughout the entire network lifecycle, covering network planning, design, deployment, maintenance, and optimization. It integrates LAN, WAN, and security network configurations to implement one-stop unified management, reducing network OPEX.



Automated Network Service Deployment

iMaster NCE provides a wizard to guide network configuration based on service intents and intelligently recommends the optimal networking solution. It supports ZTP for device plug-and-play and automates network planning and deployment in five steps, simplifying the planning and deployment of networks and reducing deployment costs.



Proactive Identification of Potential Network Issues

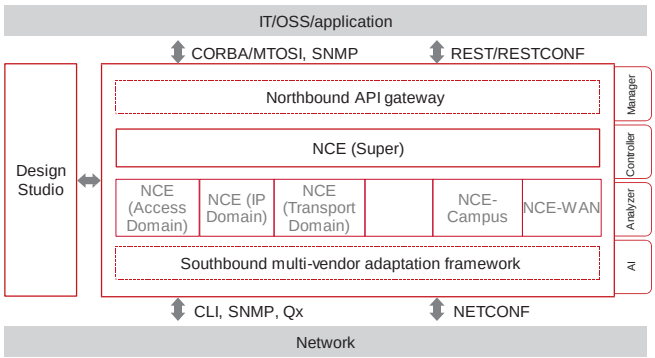
iMaster NCE uses telemetry to dynamically collect network data in seconds. It proactively identifies connectivity, air interface performance, roaming, and device issues through an expert experience library and AI algorithms, improving the identification rate of potential issues by 85%. This allows administrators to quickly demarcate faults and eliminate risks to ensure optimal service experience.

Product Architecture

With the open northbound API gateway, iMaster NCE provides different standard northbound interfaces for differentiated northbound applications. The standard northbound interfaces include both traditional interfaces (such as CORBA/MTOSI and SNMP) and new interfaces (such as RESTCONF), facilitating the future development of solutions and technologies.

With the southbound multi-vendor adaptation framework, iMaster NCE can interconnect with different southbound network devices. iMaster NCE supports both traditional interfaces (such as CLI, SNMP, and Qx) and new interfaces (such as NETCONF), facilitating long-term evolution.

iMaster NCE is based on the unified cloud platform and flexibly integrates feature modules based on application scenarios, enabling customers to purchase modules as required. The offerings available include NCE (Super), NCE (IP Domain), NCE (Transport Domain), NCE (Access Domain), NCE-Fabric, NCE-Campus, and NCE-WAN. Customers can evolve single-domain iMaster NCE towards the multi-domain iMaster NCE architecture. In addition, customers can deploy the Manager, Controller, and Analyzer modules of iMaster NCE independently.



Note: NCE-Fabric, NCE-Campus, and NCE-WAN are planned to go to market in Q1 2020.

Installation and Deployment

Based on the underlying software and hardware environments, iMaster NCE can be deployed either on premises or on clouds.

- On-premises deployment refers to software and hardware integration. Huawei provides and completes the E2E configuration of the required hardware and software. In on-premises deployment, iMaster NCE can be deployed on physical servers or VMs. Huawei generally completes factory installation for iMaster NCE before delivery.
- Private cloud-based deployment means that customers prepare the underlying deployment environment based on the iMaster NCE configuration requirements. This includes the virtualization platform, VMs, and OS. Huawei installs iMaster NCE in the prepared environment.

Depending on customers' system protection requirements, iMaster NCE can be deployed either at a single site or in disaster recovery mode.

- In single-site deployment, a complete set of iMaster NCE is deployed at a single site, and only intra-system protection is provided.
- In disaster recovery deployment, two identical sets of iMaster NCE are deployed in two locations to form a disaster recovery system. In addition to the intra-system protection at each site, the two sets of iMaster NCE protect each other.

Summary

Huawei's NetCity joint innovation projects with leading carriers has enabled the key functions of iMaster NCE to be fully integrated into business scenarios jointly innovated with customers. This helps accelerate automation and intelligence innovation in various network scenarios. So far, Huawei carried out xx NetCity innovation projects worldwide.

Network automation and intelligence are long-term evolution processes. Together with upstream and downstream partners, Huawei aims to build an open industry ecosystem. Huawei has already completed integration certification or test certification with more than 40 industry partners and organizations, covering orchestrators, public clouds, cloud platforms, and value-added network services. iMaster NCE opens network capabilities, builds the developer enablement platform DevZone, and provides comprehensive learning, development, and verification environments for partners, developers, and customers. By the end of 2018, iMaster NCE provided more than 400 APIs. Huawei collaborates extensively with third-party certification organizations such as EANTC, IOL, and SDNCTC to verify interoperability with the controllers and forwarders of other vendors, facilitating ecosystem development.

Huawei is committed to building an autonomous driving network that "leaves complexity to itself and brings simplicity to customers". iMaster NCE is accelerating this process and enabling the network industry to rapidly evolve from the IDN era to the autonomous driving network era.

Acronyms and Abbreviations

AR	Augmented Reality
AVR	Aggregated Virtual Router
BC	Bandwidth Calendaring
BOD	Bandwidth on Demand
DVR	Distributed Virtual Router
EDC	Enterprise Data Center
eMBB	Enhanced Mobile Broadband
GR	Graceful Restart
IDC	Internet Data Center
IDN	Intent-Driven Network
mMTC	Massive Machine-Type Communications
NFV	Network Functions Virtualization
NFVI	Network Functions Virtualization Infrastructure
OPEX	Operating Expense
OLT	Optical Line Terminal
ONT	Optical Network Terminal
PON	Passive Optical Network
SDN	Software-Defined Networking
SLA	Service Level Agreement
URLLC	Ultra-Reliable and Low-Latency Communications
VNF	Virtualized Network Function
VR	Virtual Reality
ZTP	Zero Touch Provisioning