Technology Reports | Operation System | Dedicated Management Software for Commercial Products | Network Monitoring

Improving Maintenance Efficiency through Resource Assurance System Implementation

DOCOMO Technology, Inc. Solution Service Division Keiji Nomura †1
Masanori Furutani †2 Toshihiro Matsushita
Network Service Operation Department Koji Yamamoto †3

In recent years, many inexpensive commercial products have come to be used as components on the NTT DOCOMO network. Monitoring of these products has been generally performed with product-dedicated management software. For this reason, it has been necessary to use a management screen with a different UI for each product, which has led to the issues of maintenance personnel requiring sophisticated skills and long working times.

To address these issues, and ensure quality of monitoring work, we developed the resource assurance system to integrate the UIs of various management software applications and abstract monitoring work. This enables efficient network monitoring without the need for sophisticated skills, even on large-scale networks.

1. Introduction

The OPS (OPeration System)*1 is used for centralized monitoring of the operating status and alarm occurrence status of the devices that make up the network, and for setting those devices, and is a critical system for stable mobile network operations.

With the increasing importance of mobile networks as social platforms supporting various industries and social lifestyles, efficient operation of

†1 Currently DOCOMO CS Chugoku, Inc.
†2 Currently Network Service Operation Department, NTT DOCOMO, INC.
†3 Currently Core Network Engineering Department

*1 OPS: A general name for systems used for maintaining and operating communications networks.

each service, which has a different Service Level Agreement (SLA)*2, must be achieved on networks as they inevitably expand and become more complex.

By adopting the Smart OPS concept [1], NTT DOCOMO has been making major advancements to the efficiency and sophistication of OPS.

However, due to the increased opportunities to use inexpensive commercial products on NTT DOCOMO networks in recent years, the network maintenance challenges of maintenance personnel requiring advanced skills and long working times have become more prominent. As the "smart OPS" concept aiming to solve these maintenance issues and achieve advanced OPS, we introduced a resource assurance system to make interfaces such as Artificial Intelligence (AI) and End to End Orchestrator (E2EO)*3 commonly available for OPS to give maintenance workers a unified sense of operations by abstracting the differences of various devices. This has achieved improvements in accuracy and work efficiency of monitoring operations, more efficient operations, and significant reductions in OPS development time and cost.

This article describes an overview of the resource assurance system.

2. Issues and Circumstances Surrounding OPS

2.1 Automation of Network Operations

As networks evolve from 3G and 4G to 5G, they will become more complex and the limitations of manual maintenance will be reached.

On March 25, 2020, with the commencement of full-scale 5G services in Japan with their high-speed, high-capacity, low latency communications and simultaneous connection between multiple terminals, network slice*4 was defined as an essential function for the generation of new businesses using 5G. Although users will be able to enjoy many advantages such as high-speed, high-capacity communications and simultaneous multi-terminal connections, telecommunications carriers will have even more network operational issues to overcome such as operational performance limitations due to network complexification and management layering, difficulties in managing memory and data, and speeding up analysis of fault causes and their rectification.

To solve these issues, there are ongoing discussions in a range of groups such as European Telecommunications Standards Institute Zero Touch Network and Service Management (ETSI ZSM)*5, Open Network Automation Platform (ONAP)*6 and Open Radio Access Network (O-RAN) Alliance*7 to achieve Zero Touch Operation, an initiative to automate network operations.

2.2 Expansion of the Use of Commercially Available Products by Telecommunications Carriers

Traditionally, telecommunications carriers have built networks using specialized equipment, but as the conversion of communications to IP has progressed, the opportunities for telecommunications carriers to use commercial products have increased. Monitoring of networks made up of these products is generally performed with product-dedicated management software. In large-scale telecommunications

*2 SLA: A guarantee of the quality of a provided service.
*3 E2EO: Life cycle management of slices based on service orders. A concept of achieving service orchestration over a wide range by linking each Fulfillment-OSS in each OPS network such as the access, core, and link network.
*4 Network slice: A system for achieving next-generation networks in the 5G era, that entails logically dividing a network into service units for use cases and business models, etc.

carriers, various types of network equipment are often used, and hence the types of management software used tend to increase proportionally.

2.3 Issues with Operations

Even at NTT DOCOMO, the trend of using commercial products is the same. NTT DOCOMO centrally monitors and controls the equipment that makes up its network using dedicated OPS. However, with the trend in recent years of using commercial products as equipment used to connect between data centers called transmission equipment, each piece of equipment is monitored and controlled individually using product-dedicated management software. An increase in management software applications leads to requirements for diversified network construction and maintenance skills, which increases operational costs. Also, since management software applications are commercial products, they often do not meet the required level of quality for industry. The following describes specific transport system maintenance issues at NTT DOCOMO (**Figure 1**).

1) Multiple Management of Configuration Information and UI Handling of Each Management Software Application

Information such as network configuration, equipment configuration and warning information for commercial products is handled by individual management software applications, so that when a fault occurs, information about the fault and connection information for device (network configuration information) must be obtained. Determining the location of faults takes time because the acquired

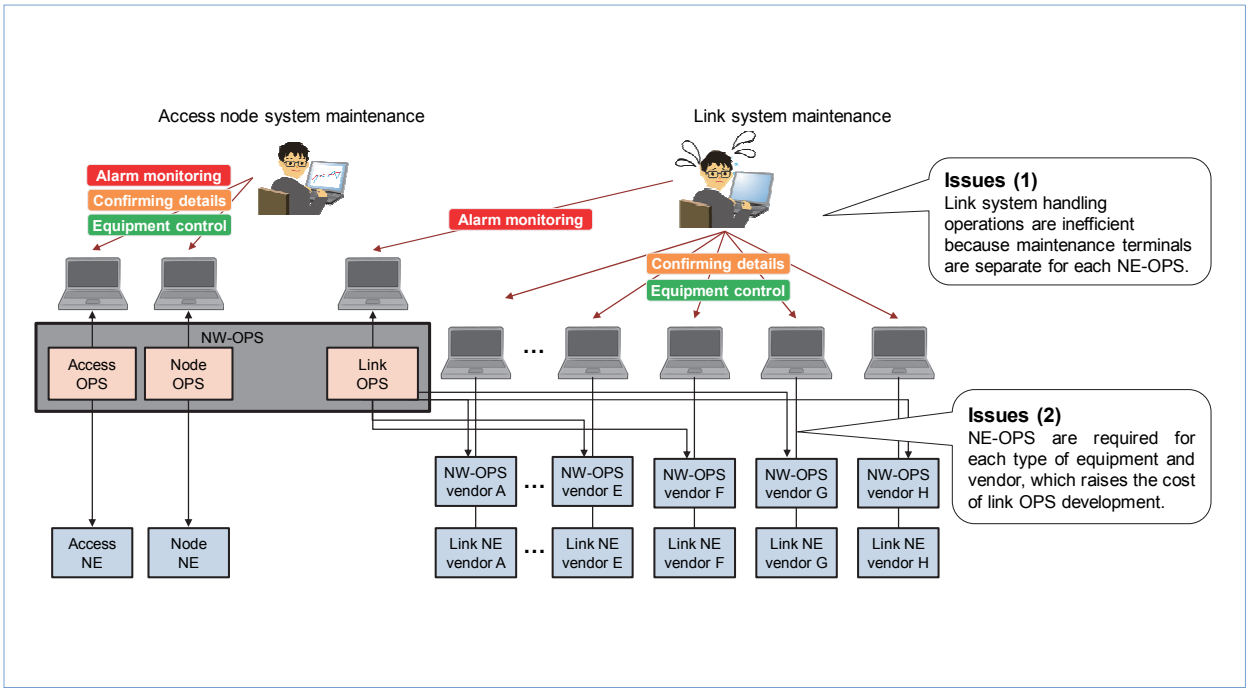

Figure 1 Issues when using management software

*5 ETSI ZSM: ETSI is a European standardization body engaged in the standardization of telecommunications technologies. Headquartered in Sophia Antipolis, France. The purpose of ETSI ZSM is to work on requirements, architecture, and management interface specifications to change management methods of networks and services to realize the autonomous networks required for end-to-end automation, and network slice technology and cross-domain service orchestration automation from use cases.

*6 ONAP: An open source network project. A platform development initiative for full lifecycle management by orchestrating and automating physical or virtual network elements.

*7 O-RAN Alliance: A group of telecommunications carriers and telecommunications equipment suppliers aiming to make the next generation radio access networks more scalable, open and intelligent.

information must be combined, and the entire network configuration understood. Also, determining fault locations requires simultaneous operation of several types of management software to acquire information, which means maintenance personnel must have diverse skills because of the different displays and operating methods of each type of management software.

2) Increased Costs and Time When Implementing New Equipment

In recent years, microservices[*8] have become the mainstream OSS products, and there is a trend of building a single system by combining multiple products. Although it is possible to some extent to freely implement functions by combining products, it is necessary to prepare a device UI for each OSS product when implementing new equipment, which entails concerns about high development costs and extended development time.

3) Responding to Faster Provisioning through the Use of Commercial Products

As mentioned, opportunities to use commercial products as equipment to be monitored are increasing and tend to shorten the time it takes to implement new equipment on a network. In network operations, implementation speeds between DOCOMO-only OPS and those of commercial products diverge, which means OPS also have to keep up with the speed of implementation of products.

3. Overview of the Resource Assurance System

The resource assurance system absorbs the differences in monitoring UIs of product-dedicated management software to provide integrated monitoring screens and control functions that are easy to use, and is currently used as a transmission equipment maintenance system (**Figure 2**). The introduction

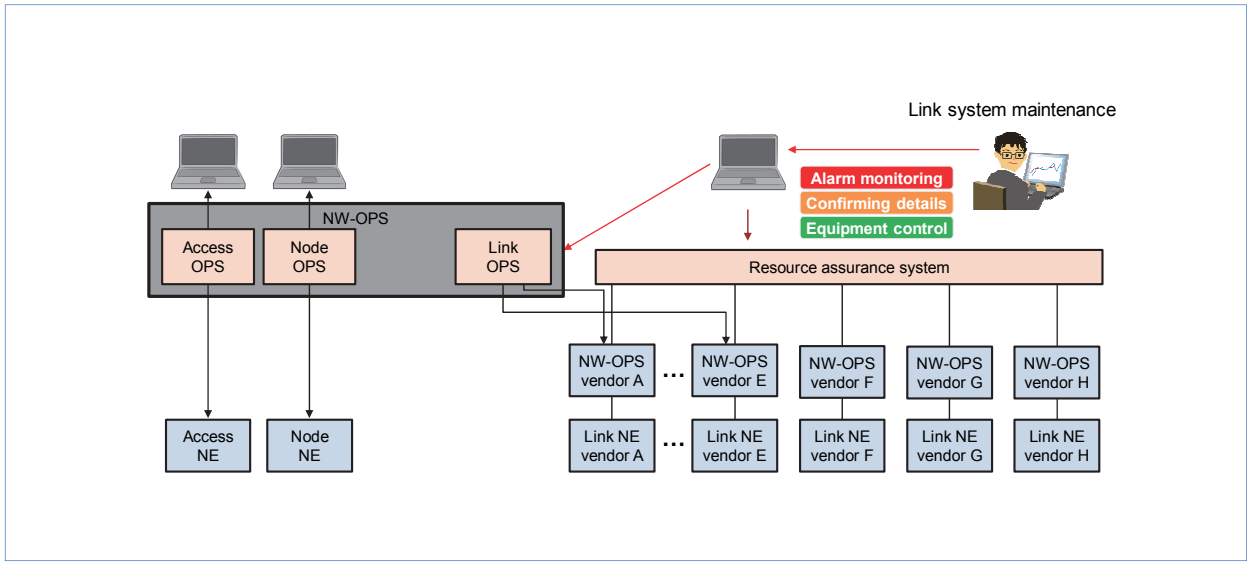

Figure 2 Configuration after resource assurance system implementation

*8 Microservice: A software development technique in which applications are composed of a collection of smaller services aligned with functions, and that communicate with each other using lightweight protocols.

of this system has enabled many advantages, as described below.

3.1 Improving to Monitoring Accuracy and Work Efficiency

Transmission equipment monitoring accuracy and work efficiency have been improved by uniformly displaying monitoring and control screens for the management software of each device, regardless of whether equipment information is physical or logical.

This system's centralized management of connection information of devices managed by multiple management software applications enables quick understanding of the configuration of entire networks made up of different equipment, and converting information such as alarm information indicating equipment status so that it is portrayed with unified expression eliminates the need for maintenance personnel to have a wide range of skills.

3.2 Making Operations More Efficient

Realizing an interface conversion function has made it possible to abstract equipment information, and easy linking with OPS such as already-implemented AI and E2EO under consideration for future implementation, etc., has enabled improved operational efficiency.

Because the display of equipment information such as housing position information (positions such as port[*9] number, etc. in the equipment) and alarm information is different for each management software application, the interface for each device must be converted for each system in the OPS. As shown in **Figure 3**, the "mediation section" implemented in this system adopts an abstraction model to convert interfaces so that they have uniform expression. Thus, external systems can use the uniform device information provided by this system after conversion, which does away with the need to convert interfaces for each management software application.

3.3 Dramatically Reducing Development Time and Costs

This system greatly reduces development time and costs to enable monitoring of newly implemented equipment through functions to support and customize a wide variety of standard equipment UIs such as Simple Network Management Protocol (SNMP)[*10] and REpresentational State Transfer (REST)[*11] that are generally adopted by IP equipment.

As the product library[*12], the system's mediation section has UI conversion logic (smart plugins) for devices generally used around the world, and it can be modified as necessary to enable monitoring of newly implemented equipment.

In addition, applications do not need to be modified for future operational changes, as the system has a user customization mechanism that can follow such work.

For example, the system can make it relatively easy to follow regular changes such as the addition or editing of equipment alarm information, and achieve future operation improvements/automation such as automatic recovery processing triggered by alarm information reception and single operation of device control through calling of external shells[*13]

*9 Port: An interface for exchanging data with other equipment.
*10 SNMP: A protocol for defining methods of communicating information for monitoring and controlling network devices on the IP network. v1 has five command groups, to which the two v2c and v3 commands were added for a total of seven command groups. Uses MIB as parameters.
*11 REST: An API that sends requests with GET, POST, PUT, DELETE for each resource (URL) and receives responses in XML or json formats, etc. (the response format is not specified).
*12 Library: A collection of highly versatile programs in reusable forms.
*13 Shell: A type of software that makes up an operating system (OS), that starts programs, terminates running programs, and changes the operating mode by specifying startup parameters, etc. in response to user operations.

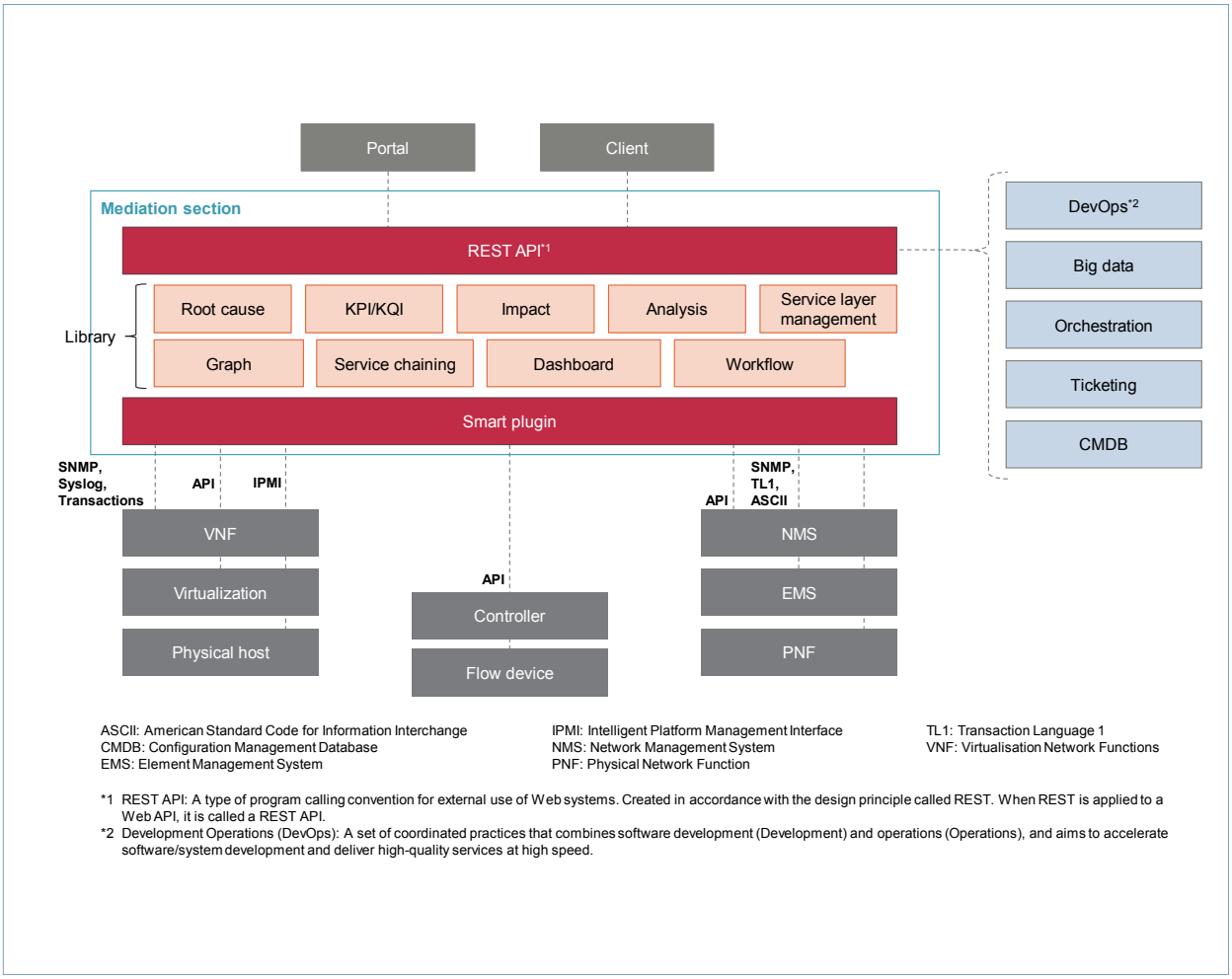

Figure 3 Interface provisioning with smart plugins

or URL access, etc. through the customization functions in the system.

Compared to conventional OPS, these functions greatly shorten development time and reduce development costs.

4. Future Outlook

4.1 Handling Network Slicing

Currently, maintenance work for individual parts that comprise networks such as the radio access network*14 or core network*15 is performed separately. However, with the introduction of network slicing, monitoring will be possible from the perspective of the services (slices) provided to users because the resource assurance system enables end-to-end display of individual slices.

4.2 Handling Zero Touch Operation

Currently, this is only applied to transmission

*14 Radio access network: The network consisting of radio base stations and radio-circuit control equipment situated between the core network and mobile terminals.

*15 Core network: A network comprising switching equipment and subscriber information management equipment, etc. Mobile terminals communicate with the core network via a radio access network.

equipment, but the scope of application will be expanded in the future. To advance OPS, various systems that constitute OPS will be able to acquire necessary information such as the linkage with AI, etc., without the need for awareness of equipment differences, by common UI support through the interface functions provided by the resource assurance system. This will enable efficient automation of work.

5. Conclusion

This article has described the resource assurance system.

Going forward, we aim to further handle network slicing, expand the scope of application to network areas other than transmission equipment, link with the networks of other companies, achieve automated network operations through further advancements, reduce downtime by speeding up response to network faults, and speed up the implementation of new equipment to improve the speed of service provision.

REFERENCE

[1] S. Shibata et al: "Overview of Smart OPS," NTT DOCOMO Technical Journal, Vol.21, No.1, pp.18-20, Jul. 2019.