Proactnes Series for Efficient IP Network Operation Management

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The carriers of the world are now developing the Next-Generation Network (NGN) to provide IP phone service, IP broadcasting, bidirectional interactive communications, broadband Internet access service, and other diversified services. Proactnes is a system that supports network service operation management in an environment of such diversified services. The operation systems require integrated network operation management, scalability to manage a large quantity of network equipment in the access networks, a resource management function to realize end-to-end QoS, and performance monitoring and quality management functions to guarantee voice and video services. Proactnes is an operation management system designed to provide solutions for these needs. This paper introduces the operation systems for the NGN, the Proactnes technology used to realize the NGN, and Fujitsu's road map for future network operation management.

1. Introduction

Carriers worldwide are now developing Next-Generation Network (NGN) to provide IP telephony services, IP broadcasting, bidirectional visual communications, broadband Internet access, and other services. In an environment of such diversified services, integrated network operation and the management of various services will become essential.

NGNs provide IP-based services, but end users are demanding the same level of quality as that already provided by existing services. In other words, users are demanding the same level of quality provided by fixed telephone and Digital Terrestrial Television Services. NGN services must therefore guarantee end-to-end quality of service.

Up until very recently, there was demand for the network operation management of such dedicated line services as IP-VPN services and Wide Area Ethernet designed for corporate use. NGNs, however, must provide services not only for companies but also for general subscribers, thus entailing a network management system that can manage and monitor a huge number of IP network devices. To cope with these changes, scalability will therefore be required to manage the large number of IP network devices. Moreover, as the vendors of devices and models that comprise the networks become more diversified, multi-vendor compatibility will also be required.

At Fujitsu, we are continuing development of the Proactnes series for providing solutions for NGN requirements. The Proactnes system has been already deployed in many carrier networks as a network operation management system.

This paper outlines the integrated network management, scalability, multi-vendor compatibility, resource management, and monitoring of quality of service provided by the Proactnes series technology used to realize the network operation management functions that carriers are incorporating into NGNs. It then describes Fujitsu's road map for further development of the Proactnes series.

2. Integrated network operation management

Integrated network operation management of diverse services is required of NGNs, and carriers seek centralized network operation management where multiple services are overlaid. Actual carrier network operation management varies among the carriers, but generally one division handles management of the entire network, while other divisions provide management in service, regional, or customer units.

The Proactnes system provides a function called the service overlay function that is designed to realize the network management of such services as Internet services, IP telephony services, and IP television services provided on the same network. The Proactnes system has a mechanism for managing network configuration information using screens called topology maps that show the devices and link connection configurations. The service overlay function enables separate operation for the topology map used to manage the connection configuration for the entire network, and for the topology maps used to manage the connection configuration of each service. Carrier operators can use this function not only to manage the physical network connection configuration as required by the division handling management of the entire network as well as by those divisions responsible for managing specialized services, but also to obtain a grasp of the services and end users affected should a malfunction occur in the network (**Figure 1**).

In addition, a section overlay function de-

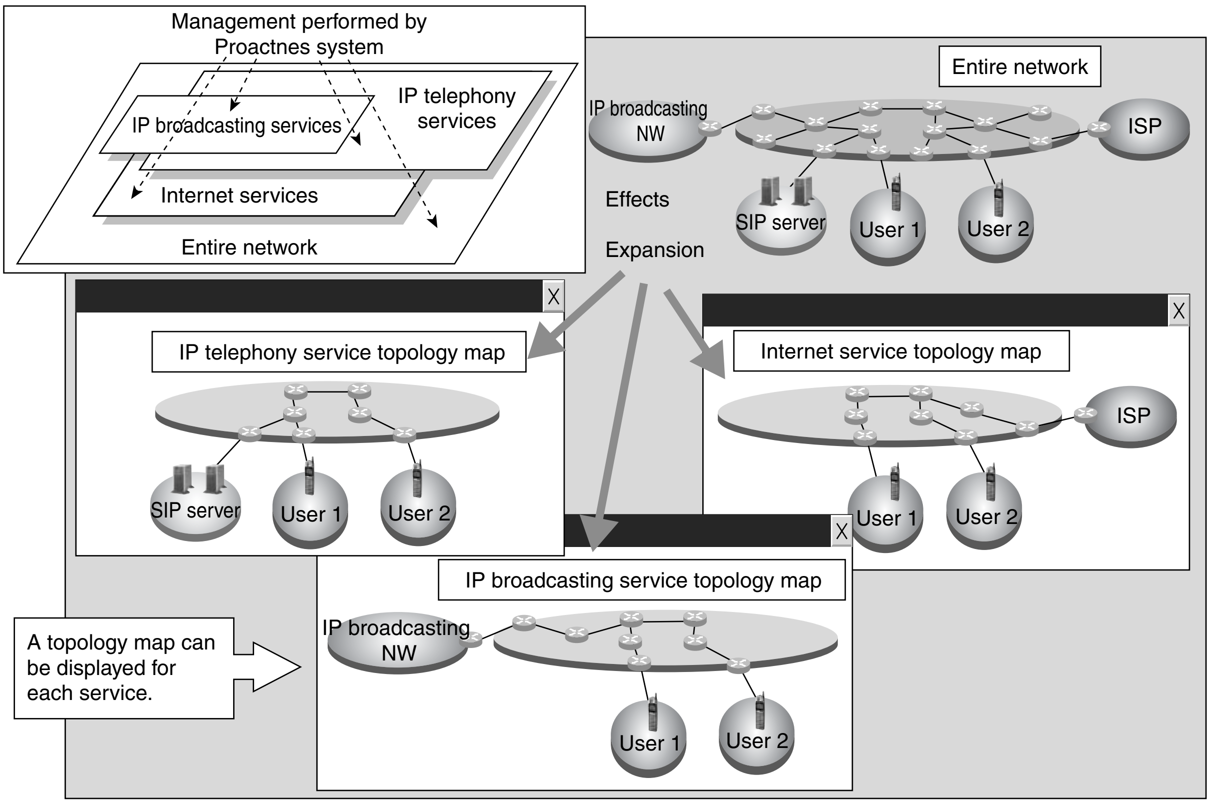

Figure 1
Service overlay management provided by Proactnes system.

signed to realize regional network management is also provided. The section overlay function is used for management by cropping sections from the topology map used to manage the physical network connection configuration of the entire network, and sections from the topology maps and views used to manage the physical network connection configurations of divisional units (such as regions, administrative divisions of Japan, and offices), and then overlaying these sections. Moreover, layer management is also possible for more detailed requirements, such as for cities within the administrative divisions of Japan or the buildings in a particular city. The use of this function enables a grasp to be obtained of the area(s) affected in case a network malfunction occurs. Furthermore, operation rights with regard to the items designated for management (such as devices, regions, administrative areas of Japan, and offices) can be specified so that each operator can only view those items for which operation rights have been granted. For example, an operator in eastern Japan will not be able to view network data for any regions outside eastern Japan. Carrier operators can therefore use these functions to perform secure, layered network operation management in divisional units.

3. Scalability

End-to-end network operation management is also required of NGNs, and therefore the scalability necessary to manage a huge number of network devices in the access network is essential. The Proactnes system software divides the program components according to function in the distributed object architecture, and enables the distribution of functions by using server partitions.

Moreover, since both equipment access and traffic capture loads increase roughly in proportion to network scale, the server can be partitioned according to network scale to distribute the load. This kind of load distribution enables scalability for large-scale networks.

In addition, the Proactnes system adopts a hierarchical configuration to facilitate network operation management. An even higher level of scalability is thus achieved by employing a hierarchical configuration in which a lower-level Proactnes system monitors and controls each regional and core network in conjunction with a higher-level Proactnes system that performs integrated management of the network configuration information and malfunction information received from the lower-level Proactnes system.

By employing this type of technology, the Proactnes system enables flexible expansion of a large-scale network, as well as achieving end-to-end network operation management designed for NGNs.

4. Multi-vendor compatibility

Looking forward, we can expect more new vendors and vendors offering new models as advances are made in network functions designed for NGNs. The management of a diversity of vendors in the areas of network operation management and service management will therefore become necessary. Devices provided by different vendors each have their own interfaces, and the information exchanged via these interfaces also differs. Firmware and other modifications have resulted in different levels of interface modifications, and disparities occur even with the same models. The need for managing a diverse range of devices while bearing in mind the characteristics of each particular interface places a great load on the operator. A system that combines all the diverse elements into a manageable configuration and provides unified screens coupled with improved operability is therefore required.

The Proactnes system uses the wrapping function provided by the Element Access Module (EAM) to ensure interoperability regardless of any differences in vendor devices.

However, since the EAM wrapping function used to realize multi-vendor compatibility had to be developed separately for each vendor and each model, the cost and time frame associated with EAM development for each model became an issue for consideration. We therefore developed a new type of EAM for the Proactnes system: the Data Definition-type EAM (DDE). The DDE employs device-monitoring logic in the form of a data definition file, and by using this file externally, the device monitoring of multiple models from multiple vendors is possible using a single EAM. The use of the DDE also allows for the addition of a data definition only when an EAM is added for a new model, and thus helps reduce the EAM development time and cost for new models (**Figure 2**).

5. Resource management

Along with providing diversified IP-based services, the objectives of NGNs are to realize the IP-network provision of existing general telephone and broadcasting services. The technology used to maintain the same level of quality as provided by existing services for an integrated IP network, however, has become an issue. Thus, there is an urgent need for a mechanism that ensures end-to-end quality of service by employing such measures as reducing interference to maintain inter-service quality and emergency call-out support.

With regard to standardization, the ETSI-TISPAN RACS (Resource and Admission Control Subsystem) is being considered. RACS is a subsystem responsible for the reservation of TISPAN NGN architecture network resources and service admission controls. RACS provides a mechanism whereby upon receiving a request for service from an end user, it asks the network whether it is possible to reserve the required resource, and then determines whether the request can be accepted or denied. With TISPAN, the access system is considered the center. However, to expand this mechanism to core networks as well and ensure end-to-end quality of service, the system must be able to manage such information as available resources for each QoS class corresponding to the IP network paths used by the services, recognize the path on which the applicable flow passes when a service request is

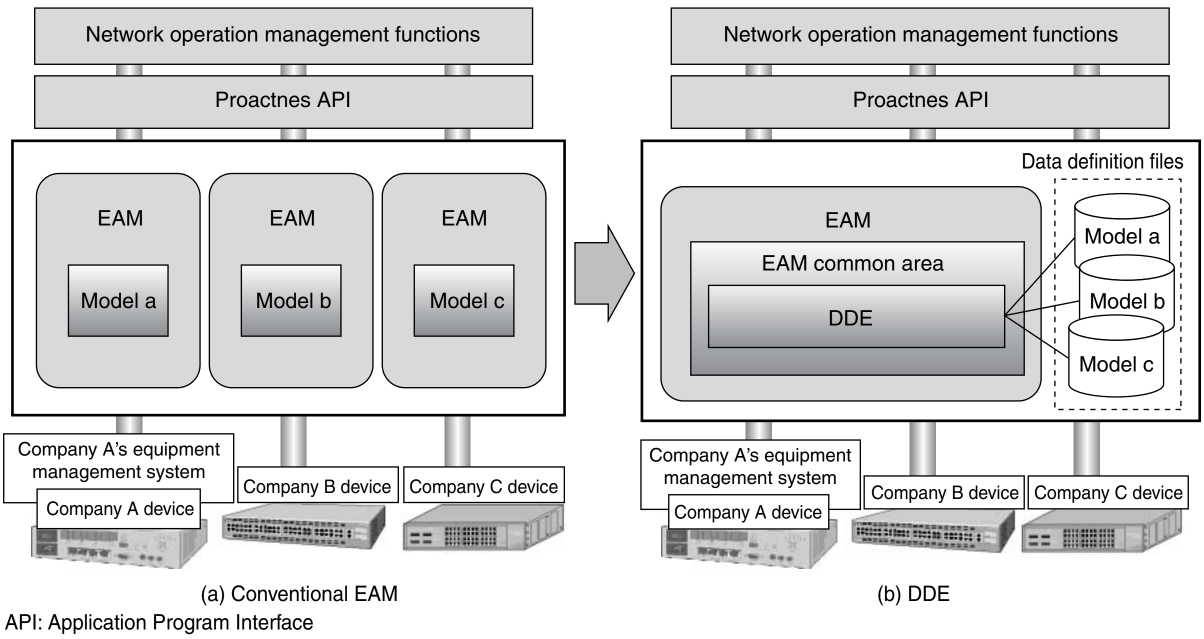

Figure 2
Data Definition-type EAM (DDE).

made, and sequentially check which resources are available.

To realize these functions, the following points must be considered:

As static functions:

- Management of the physical and logical network configurations
- Maximum bandwidth management for each equipment port

As functions for each dynamic flow:

- Management of the bandwidth used and bandwidth calculation for each flow
- Resource check function for when services are requested

The Proactnes system manages the facilities configuration information for the entire network, while maintaining the relationships between the actual network configuration and the services or subscribers. For example, when using the MPLS-VPN to provide dedicated line services, the VPN and users that are affected by a physical port malfunction can be identified. Moreover, the Proactnes system features QoS functions to determine the priority setting for each MPLS-TE path, reserve resources, and make resource settings, and thus may be considered to possess the static functions required for maintaining end-to-end quality of service. By using these functions as a base and providing integration with dynamic control and expandability, the Proactnes system permits adaptability with regard to maintaining end-to-end quality of service.

6. Service quality Monitoring

The demand by end users for the same level of quality as that provided by existing services is not the only quality issue. For example, when a carrier wants to provide IP telephony service, Japanese law[1] requires that the value R (indicating the suitable voice transmission quality standard of IP phones as stipulated by ITU-T recommendation G.107) be assessed and approved using a measurement method compliant with a specified technology standard (i.e., TTC standard JJ201.01 or higher). Moreover, there are many considerations for the carrier in terms of measuring the quality of service, such as guaranteeing regular service and service along the boundaries of responsibility with other carriers, and measuring quality for troubleshooting purposes. Therefore, there are growing expectations regarding the monitoring of quality of service.

By measuring, analyzing, and monitoring voice service quality, the Proactnes system enables a grasp of the quality of voice service provided by carriers. As measurement methods, the Proactnes system provides both active measurement that is suitable for guaranteeing regular service and service along the boundaries of responsibility, and passive measurement suitable for measuring quality for troubleshooting purposes. For active measurement, measurement connections are laid out for ground-to-ground measurement, and quality is measured in the flow of voice packets for measurement use (RTP, RTCP). The main advantage of this method is that measurement is possible even when no data flows through the network. Conversely, passive measurement captures and analyzes actual communication voice packets flowing past the measurement points. The actual operating network conditions (mainly jitter, packet loss, and voice flow) can thus be ascertained. However, such bidirectional measurement methods have disadvantages as well. For active measurement, there are cases of scattered measurement results due to the effects of traffic patterns flowing through the network. On the other hand, passive measurement requires expensive dedicated equipment. Fujitsu Laboratories are currently developing a product called the VoIP Planner (VoIP Network Analyzing & Planning Tool)[2] to overcome these disadvantages. The VoIP Planner employs active measurement, and by analyzing the sending patterns of voice packets for measurement based on a statistical method, it can effectively measure the quality of all VoIP sessions occurring at the same time and on the same path across extensive

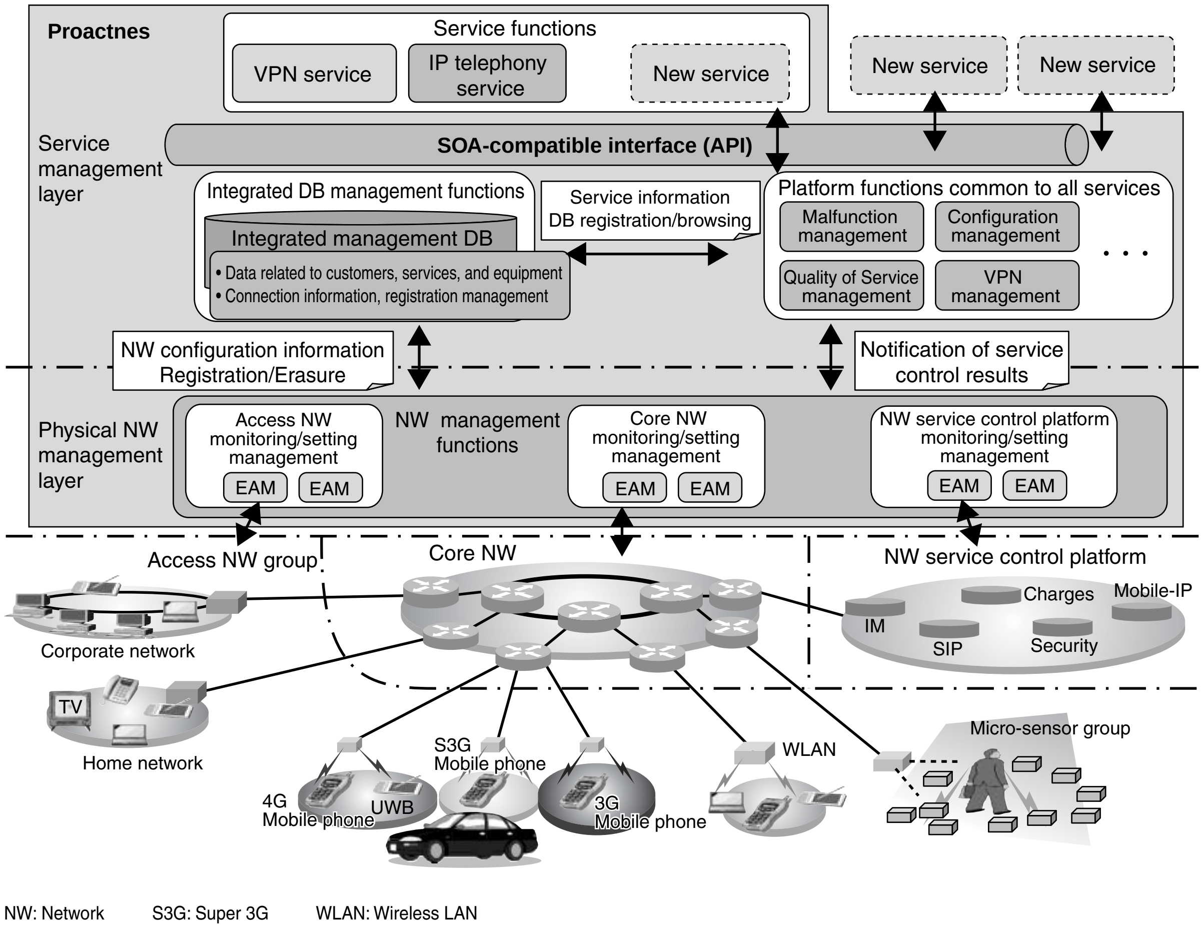

Figure 3
Basic concept of end-to-end operation.

load variations.

In the near future, the monitoring of quality for not only IP telephony services, but also various other services such as visual services will also be possible.

7. Future Developments

The Proactnes system makes it easy to add network operation management functions by using a software configuration that integrates an integrated DB management function at the nucleus of platform functions that are common to all services with network management functions.

From now on, carriers and service providers can be expected to use the NGN as a base for developing diverse new services, coupled with a growing demand for the timely provision of new services even for network operation management. The deployment of an intra-layer interface (API) in the Proactnes system to meet Service-Oriented Architecture (SOA) requirements has realized an open environment that facilitates the addition of new services and functions in upper-level systems that employ the Proactnes system, and provides an expandable software architecture that will enable a fast and flexible response to new services (**Figure 3**).

8. Conclusion

This paper introduced the operation management systems required by NGNs and the Proactnes system technology that was developed to meet these needs, as well as Fujitsu's road map for future network operation management products. Carriers throughout the world are making steady progress with the development of

NGNs, with services becoming increasingly more diverse. Accordingly, demands with respect to network operation systems are also becoming diversified. Within this context, Fujitsu will continue its ongoing development of network operation management technology for the Proactnes series so we can develop operation systems that support the creation of new businesses and provide faster deployment to meet customer needs.

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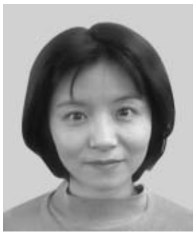

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