WAN Connection Optimization Solution for Offices and Data Centers to Improve the WAN Utilization and Management

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Abstract

A lot of companies built own corporate networks. WAN connects these corporate networks between offices and data centers. The corporate network consists of a backbone network, computer network, Internet connection and telephony systems. Network traffic patterns of these networks have different characteristics (different peak/off-peak times), which have redundant bandwidths constantly somewhere in the corporate network. The corporate executives who expect to improve the cost efficiency of networks, especially decreasing the connection fee of communication lines, and improving flexibility for the WAN usages. Moreover flexible WAN usage such as use of datacenter services, ensuring BC/DR (business continuity/disaster recovery) and use of public cloud services are required to support.
This paper discusses our solutions to optimize WANs between offices and datacenters that allow our customers to solve the issues.

Keywords

SDN, OpenFlow, WAN, line utilization rate, line cost, operation quality, operation cost

1. Introduction

Most corporate networks today are based on IP communications. WANs (Wide Area Networks) used for those corporate networks consist of a combination of communication lines such as wide-area Ethernet networks, IP-VPNs, and Internet VPNs. These line services guarantee network bandwidth that can keep a connection at the peak traffic. In order to ensure the communication reliability, enterprises sometimes prepare backup communication lines that are only used in emergencies in addition to the main line. This configuration which has backup line encourages the usage of datacenters and is installed to the network systems that achieve BC/DR, public clouds, private clouds, etc. Such trend has been increasing the network bandwidth of WAN.

This paper discusses our solutions to optimize offices and datacenters connection that improves the cost efficiency of communication networks, improve operational quality and decrease system installation cost to utilize the redundant bandwidth that are only used at peak time and the backup communication lines effectively that are used only in emergencies.

These solutions are achieved by SDN technologies (Software-Defined Networking).

2. Problems of Corporate Networks (WANs)

Current corporate networks (WANs) connect each corporate network (backbone system, enterprise system, Internet connection, and telephony systems, etc.) between shared system (business servers, Internet connection gateways, SIP servers, etc.) and offices. Their network traffic characteristics differ from system to system. For example, the characteristics of backbone system are that the most traffic are text data, the bandwidth size is only a few Mbps, large scale network traffic are occurred in the morning and evening while small scale traffic at night. Also, internet traffic characteristics are that large scale traffic is occurred due to the transmission of image and video files and the network traffics at lunch time tend to be increased.

In such optimizing solutions, each network with different traffic characteristics as mentioned above are multiplexed to one or multiple physical networks. Then the communications are carried out each other while considering the necessity of redundancy configuration based upon the reliability requirements. Required bandwidth is in most cases calculated by total network traffic size of each network at peak-time. Such network usage, nevertheless, is inefficient because the peak time

of each network is different so that it constantly has redundant bandwidth. Telecom carriers assure 99.99% of the availability of existing WAN services under the SLA (Service Level Agreement), so the backup communication lines are almost unused.

Moreover, some users always expect the same network response time at peak times as off–peak times, while other users tolerate the deterioration of response time to some degree. The communication line fee and the response time have been decided equally for all users. However, there must be some communications and users that should have been given priority in an emergency if any disaster occurs.

On the other hand, main tasks of network management was monitoring the communications availability/unavailability and taking a corrective action on communication deteriorations. However, tasks to improve the communication performance are recently increasing: deterioration in response time, the abnormal network traffic occurrence from specific business centers, etc. Such situation tends to prolong the trouble shooting time required to deal with those incidents. Moreover, the physical system configuration was complicated, if enterprises operate WAN internally, the technicians who deal with the system trouble have to acquire the technological skills of system designs and configuration of each ICT products. Furthermore, the current trend of active M&As and organizational reforms bring about an increase of opening, closing and merging offices. In consequence, network configuration changes between LANs and WANs are increasing.

3. Optimization Solutions for Office/Data Center Connections

An overview of the optimization solutions for office/data center connections is shown in **Fig. 1**.

Our solutions are aimed at effective use of WAN. The concept of SDN is applied to WAN in order to integrate physical networks and to enable the virtualization of corporate networks. Then, end user devices of each office are divided into two groups according to the usage priority of the business system. Next, the virtualized corporate network is built while being divided into two categories of priorities - high and regular. Finally the priority controls and bandwidth controls for each virtual network as well as the communication path control for each flow (the packet flow of each business application in the communications between terminals) are carried out. Such functions have achieved the effective usage of bandwidth and optimal efficiency of communication line fee.

Moreover, these solutions achieve network visualization through the centralized control of both physical and virtual networks in order to control traffics per flow-base. This makes it possible to deal with performance incidents much easier, such as deterioration in response time, etc. System maintenance can also be performed easily; thereby operators enable to modify the system without referring to configuration files. This means that operations may be conducted by an operator that has not yet gained advanced technical proficiency.

Therefore, our solutions are effective for high-cost communication line.

3.1 System configuration

A system configuration model of the optimization solution for office/data center connection is shown in **Fig. 2**.

The system is basically configured with two data centers - primary and secondary, on the assumption of the assurance of BC/DR, as well as of major offices such as HQs, sales office, production plant and logistics center.

The UNIVERGE PF6800 (controller) and UNIVERGE PF5000 Series (switch) that use OpenFlow technology are applied to achieve SDN. The UNIVERGE PF6800 is installed in

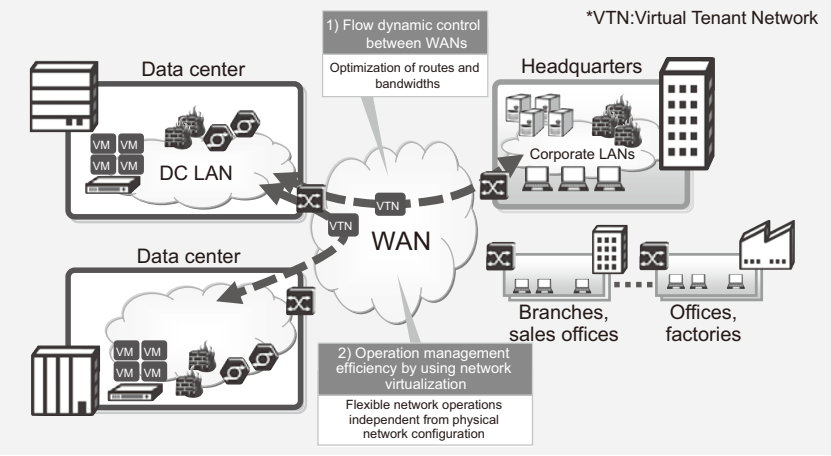

Fig. 1 Overview of an optimization solution for an office/data center connection.

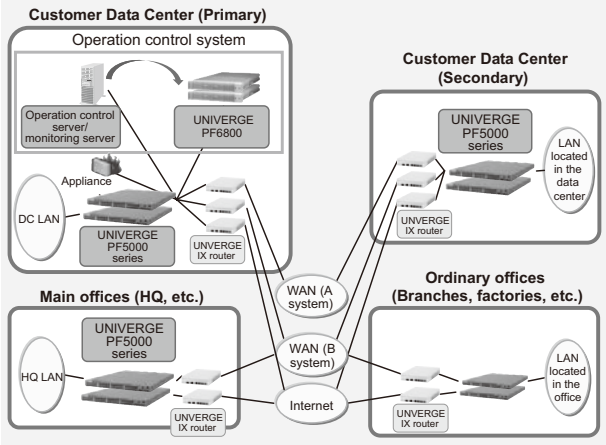

Fig. 2 System configuration model of the optimization solution for the office/ data center connections.

the data center (primary) while the UNIVERGE PF5000 Series is installed in the offices that are to be connected to the LANs of the data centers, HQs and offices respectively.

Multiple communication routes are provided for the lines that connect between offices and the data centers, and these are used in an active/active configuration and not in an active/ standby configuration. Essentially, three routes are provided between the data centers (primary and secondary) whereas two routes are provided between the data centers and the offices.

When OpenFlow is to be applied to a corporate WAN, a control system network that connects the UNIVERGE PF6800 and UNIVERGE PF5000 Series is required (not shown in Fig. 2 for the sake of convenience). However, in order to set this route between offices additional communication lines will be required and additional communication fee for installing new lines will be expected. In order to avoid such an additional cost, transmission is performed by multiplexing (inbound) the new route to the data system lines that connect between offices and data centers. Consequently, routers are installed to connect UNIVERGE PF5000 series switches located in different offices.

UNIVERGE PF6800 and the monitoring server use SNMP (Simple Network Management Protocol) for monitoring the physical network while the UNIVERGE PF6800 uses a control network for monitoring the virtual network. Additionally, the UNIVERGE PF6800 manages both physical and virtual network configuration. Automatic and scheduled operations are achieved by configuring the operation control system under the linkage operation between the monitoring system and the operational control server.

3.2 Solution Features

The main features of the "WAN connection optimization for offices and data centers" include the following two improvements: (1) Efficiency of WAN line usage and (2) Efficiency of WAN operation management by using network virtualization. The details are described below.

(1) Improvement in the efficiency of WAN line usage

As discussed above, physical networks are integrated, corporate networks are virtualized and applied a priority control in two-level with each virtual network. This makes it possible to use the connection line under the active/active configuration so that the efficient usage of line capacity can be achieved. Moreover, the operation control system enables the communication route control according to the time of day and communication line usage (for example; batch processing at night, ensuring enough bandwidth for business systems whose service time is fixed, prevention of deterioration in the response time by rerouting traffic when traffic volume is increased, etc.)

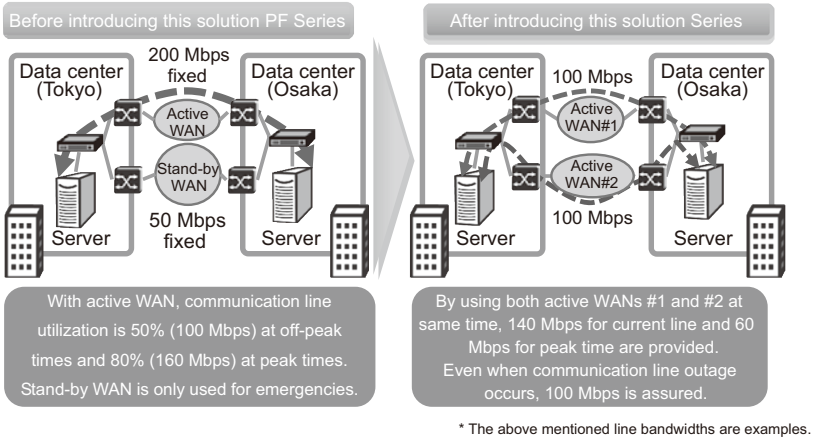

Fig. 3 Example of improved communication line utilization

Thus, improvement in the utilization of communication lines and bandwidths, improvement in line fee efficiency and the stable operation of network response time may be achieved.

Fig. 3 shows an example of improved utilization of WAN. This case uses WANs which guarantee 200/50-Mbps bandwidth in an active/standby configuration, with 100-Mbps (50% usage) traffic at off-peak times and 160-Mbps (80% usage) at peak times (note that these are common line usage). 100/100 Mbps communication can be achieved in an active/active configuration to be applied to SDN. While 200 Mbps can be ensured in off-peak times, traffic at peak time can also be dealt with. In spite of the one communication line outage, the other 100Mbps communication line can use for the communication equivalent to the off-peak times network traffic. If the network outage occurs at a peak time, the response time deteriorates (the priority control function puts priority on the specific terminal group), but the communication does not break.

(2) Improvement in the efficiency of WAN operation management

A conventional WAN system consists of multiple physical systems that are complicatedly connected each other, and the system monitoring function has been focused on live monitoring, trap monitoring and linkup condition monitoring. With regard to traffic monitoring, it is often not performed at all or is executed only by limited number of ports. As a result, it takes much time to solve the performance incident such as “response time deterioration”, “no response from a certain business application” or “LAN looping occurrence”, etc.

Applied to the SDN technology, centralized control of both physical and virtual networks is now possible, and both physical and virtual networks are now visualized. Therefore, the conditions of failures and rerouting of each business/division system can be confirmed with a simple operation. The system operator who does not have deep technology skills and knowledge can operate and manage this network system, so that even IT system operator can do it.

Moreover, it allows operator to control traffics per flow, so that the performance incident, which used to require much time to be solved, can now be dealt with smoothly. This solution enables reduction of both cause analysis time and the number of related processes.

Furthermore, as shown in **Fig. 4**, the operation control system that collaborates with a monitoring system (monitoring server and UNIVERGE PF6800) and an operation control server makes it possible to cope with events that happen during night time. This is because automatic operation is now possible by registering the operation definitions for detecting events (such as system outages or abnormalities) in advance to the operation control server.

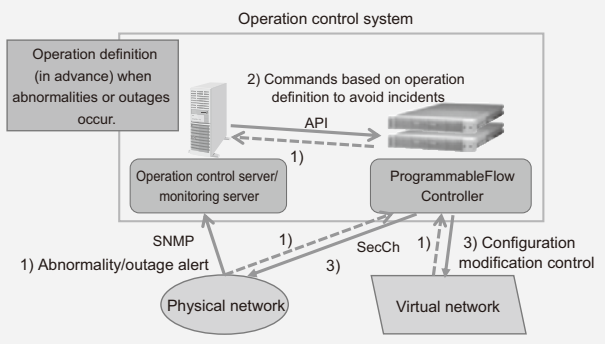

Fig. 4 The monitoring and control systems integrateion.

This solution can reduce the impact of the differences in the skill and know-how of the network operators.

4. Conclusion

These solutions will significantly change the way to use communication lines of telecom carriers in a corporate WAN, and improve the effective line resources usage, thereby achieve the communication line fee improvement. This solution will meet the social needs where there is a tendency toward increased traffic flows. We believe that this solution will contribute to the realization of a secure, safe, efficient and flourishing society.

* OpenFlow is a trademark or registered trademark of Open Networking Foundation.

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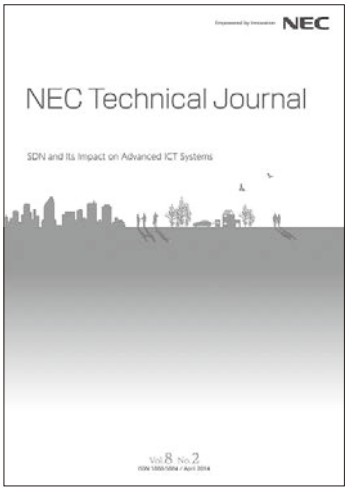

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