

Integrating LAN Systems and Portable Medical Examination Machines' Network

- OpenFlow Brings Groundbreaking Innovation to Hospital Networks

The network infrastructure created by Kanazawa University Hospital has been expanding under the pressure of the individual needs of each department and laboratory and has thereby become too complex to be managed effectively. Moreover, under the constraints of such a complex network system, it has been increasingly difficult to operate the new equipment that is frequently added to the network. This situation has resulted inevitably in too much time and effort being spent in changing the network settings accordingly. In consequence the Kanazawa University Hospital has decided to introduce NEC's OpenFlow compliant "UNIVERGE PF Series" network solution and has thus received various benefits including reductions for network management and operations load. The hospital is now planning to extend the employment of OpenFlow in their network. OpenFlow is expected to realize universal connectivity, by which the appropriate network policy of medical equipment such as portable diagnostic devices will be applied once it is connected, regardless of which LAN port is used for a connection.

Customer profile

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OpenFlow Reconstructs the Complex LAN

Kanazawa University Hospital is a core medical facility in the Hokuriku area of Japan. In 2012, NEC's "UNIVERGE PF series," which is a network solution based on OpenFlow technology, was deployed at the hospital in support of reconstruction of the network infrastructure.

Issues had been experienced over the entire network infrastructure due to the network optimizations and expansions that had been conducted by individual departments, such as by the clinical departments and research laboratories, etc. Such complex network conditions exposed the doctors and staffs to a

situation with which they could barely cope, even affecting the actual wiring and overall network configurations.

Technologies are evolving rapidly in the medical field. Therefore, doctors often tend to try out new equipment, including the current state-of-the-art devices. Various medical devices are being added to the networks on a daily basis. Besides the servers that support the network systems as well as the PCs connecting to these servers, much medical equipment such as electroencephalographs, ultra-sonic devices, and electrocardiograms, etc. are being connected to the LAN in order to exchange data. Each time new equipment is added to the network, changes in the settings, connection verifications, and sometimes even rewiring are required. Such conditions place a considerable strain on the hospital budget.

In order to resolve such issues, SDN (Software Defined Networking) has been introduced using the UNIVERGE PF series network solution to achieve flexible configurations and modifications as well as to enable the efficient management and operation of the networks. The UNIVERGE PF series has successfully halted the need to construct more LANs and has integrated networks that used to be constructed different networks for different departments.

Constructing a Flexible Individual Network System While Achieving Management Related Load Reductions and Operational Stability

As a start, two controllers and 16 switches were installed in

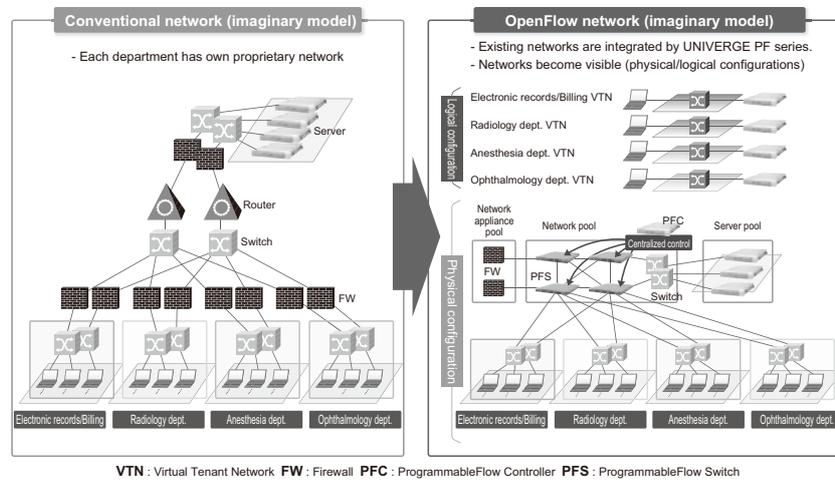


Fig. 1 OpenFlow network usage situation.

the newly built hospital's clinical research building in order to operate the four VTNs (virtual tenant networks). These are the "electronic medical records/billing system networks," "radiology department," "anesthesiology department" and "ophthalmology department" (Fig. 1). The UNIVERGE PF series achieves an overall flexible network architecture that supports individual department policies. It also gives visibility to both the network's physical and logical configurations as well as enabling a clear picture of all network statuses via GUI. This enables integrated management and reduces the operational load.

Moreover, safety advantages have been provided. These are issues that cannot be ignored in the medical domain.

The UNIVERGE PF series allows users to determine fault locations easily, such as the whereabouts of device malfunctions, wrong settings, etc. Moreover, when a fault occurs, an alternative route will be automatically set, so that the stability of the network operation will be significantly increased. Actually, it now takes only seconds to retrieve operation when replacing wirings of switching devices; a function that used to take more than a minute.

Development Policy that Focusses on Practical Advantages and High Quality Product Performance

The UNIVERGE PF series deployed in the newly built clinical research building has delivered desirable results and the hospital is examining the possibility of accelerating the introduction of OpenFlow technology. In January 2015 it is scheduled to replace the hospital information systems that are configured together with the electronic medical record systems, billing systems and medical examination data integration systems. It is also planned to use this opportunity to replace the present network system with OpenFlow technology.

Dr. Keisuke Nagase, Vice Director and Corporate Planning

Division Director/Professor of Kanazawa University Hospital said "The OpenFlow network system introduced in the newly built clinical research building is providing us with the expected results. When we try to solve issues involving the hospital network system, it is quite natural for us to choose the OpenFlow technology. It would be perfect if we could carry out replacement over the entire hospital system. However, we must also consider the implications of our budget. We are making our plans while examining the balance between our budget and the resulting benefits. For example, we would aim to start replacement where we could receive most advantages in dealing with hospital management issues. Some still feel rather doubtful about the reliability of the OpenFlow technological input because it is still a new technology. However, software bugs also occur in the technologies that are currently in use. Moreover, the fault rate of the hardware announced by NEC is rather low, and we cannot find any conflict with our present systems so far since introducing the OpenFlow system. I assume that the risk of malfunctions occurring will be the same or rather less compared to that of our previous equipment."

When considering the network replacement project options for 2015, the UNIVERGE PF series, which has been introduced to the clinical research building, appears to be the most attractive solution. The series is judged to be a product that offers a high quality performance.

Dr. Nagase continued "Recently, so many products are found that are compliant with OpenFlow. However, many of these products merely claim compatibility with OpenFlow and do not indicate their detailed specifications. Such a lack of information does encourage support for our choice of a product. However, the UNIVERGE PF series states that it mounts OpenFlow technology in achieving the most appropriate performance while focusing on practical usage. I cannot think of a more appealing choice at the moment."

NEC's approach focusing on practical usage is also employed for our other product lineups. The requirement of a network switch generally differs depending on usage characteristics and also on the installation location of the system such as core, distribution or edge. Especially when installation is on the ToR (top-of-rack) at a data center, the number of terminals to be accommodated is the most important requirement.

However, as Dr. Nagase mentioned, a product with no advantages other than compatibility with OpenFlow will sometimes pose disadvantages, such as having less flow table capacity when writing information and a limit to the number of terminals to be accommodated, etc.

In order to solve such issues, NEC has developed the "MAC Forwarding function" that improves the processing performance by using a MAC address table together with flow tables during data transmission. This function is implemented in the "UNIVERGE PF5459," which allows accommodation of more terminals, thereby being suitable for installation at the ToR of a data center.

By expanding the product lineup, customers will be able to employ products via the OpenFlow technology while selecting the most appropriate switch for their installation location or function. Dr. Nagase also stated that "NEC is expanding their product lineup while focusing on the user's needs in building networks. This is a praiseworthy policy."

Devices Connected Automatically to the Appropriate Network, Regardless of Which LAN Port is Used

Kanazawa University Hospital expects that the MAC Mapping function, which is added to the MAC Forwarding function, will deliver "universal connectivity" (Fig. 2).

Many portable types of medical diagnostic devices are used in hospitals. When a patient is examined for a biopsy test, he/she has to go from one room to another for the different tests, such as for electrocardiography, echography, electroencephalography, etc. If the relevant examination machines can be moved from room to room to where the patient stays, an ideal way to perform a medical examination for patients is then achieved (Photo 1).

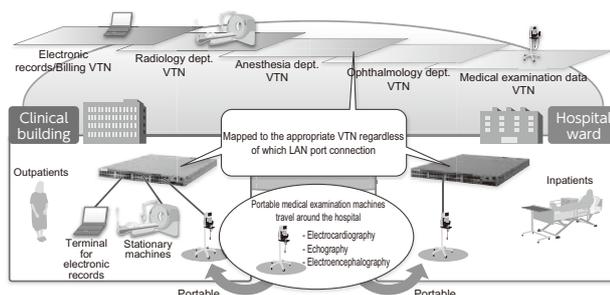


Fig. 2 Illustration of a universal connection.



Photo 1 Various medical examination machines set around the medical examination bed.

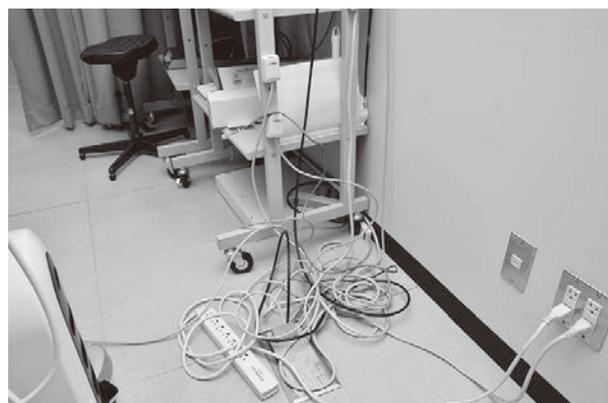


Photo 2 The various LAN ports installed in the medical examination room.

In order to realize this, the hospital installs several LAN ports in each of the examination rooms. Different colored cables are employed for different medical devices so that misconnections of machines to the LAN ports can be avoided. For example, the orange cable is for electrocardiography and the gray one is for echography. Such a countermeasure is provided in order to connect medical devices to appropriate network systems. However, such manual operations always involve a misconnection risk (Photo 2).

The MAC Mapping function allows users to preset the appropriate connections so that the MAC address of the machine is recognized and the appropriate VTN is decided automatically for whichever LAN port the machine is to be connected. This means that each machine will be automatically accessed to the appropriate network or system just by connecting a cable to a LAN port, wherever and whenever it may be.

Once this system is functioning, the results of the "delivered medical examination (a medical examination by bringing the examination devices to a patient's room)" may be confirmed in the room where the patient stays, and not in a medical exam-

ination room as previously.

At the moment, LAN ports have not been prepared for all medical examination machines in the hospital, so that some examination data has to be first stored in the medical examination machine and then uploaded to the system after connecting the machine to a LAN port installed in the medical examination room. When several patients are examined with the “delivery medical examination,” it takes quite a time to finish all of the examinations so that a time lag may occur between the examination finish timing and the data upload timing.

Universal connectivity will enable real-time data transmission just by connecting machines to a LAN port prepared in a patient’s room. A doctor finishing his/her medical examination can confirm the result data without any time lag, and an improvement in the medical services can be expected while decreasing the burden on the patients. Dr. Nagase stated “I keenly await the realization of universal connectivity and many of our staff in the hospital are also looking forward to its arrival.”

Contributing to the Standardization and Advancement of OpenFlow by Providing All Appropriate Technologies for Customers

As mentioned above, the OpenFlow technology brings various advantages to the network infrastructures of hospitals. However, Dr. Nagase said “The greatest advantage of the OpenFlow technology is that we will hold the network initiatives that are currently held by the system vendors”.

He continued “In the past, once the network of a certain vendor was introduced, it was difficult to select the products of another vendor. This is the so-called “customer retention system”, and still some vendors continue to adopt such a business style. However, a network that is compliant with OpenFlow has to be built with the cooperation of several vendors. When a mutual connection verification process becomes available we will be able to select products more freely and without being limited by the architectures or protocols specified by the vendors. I expect that equal competition will result and that this will bring us more advantages in products, as well as in the price performance”

Dr. Nagase well understands the meaning of the OpenFlow technology and positively evaluates the policy of NEC that contributes to progress in OpenFlow standardizations.

NEC has achieved a world first commercialization in OpenFlow technology, and its accumulated technologies and expertise have been passed to various consortia, such as for the ONF (Open Networking Foundation), etc. The first model of the UNIVERGE PF series has been released to the market by incorporating various NEC original technologies that are compliant with OpenFlow 1.0. For example, some of these technologies are adopted as a standard specification for OpenFlow 1.3.

“NEC is able to take advantage of these originally developed technologies and thereby strengthen its competing power

in the market. However, it has been decided to contribute these technologies to support the progress of the entire market, instead of contributing exclusively to its own profit. I respect this policy. NEC is not only trying to take advantage of the growing “Open Network” market but it is trying also to influence the market by firmly and speedily developing the appropriate technologies. I am looking forward to seeing NEC continuing as market leaders in the future.” Dr. Nagase said.

In order to meet such needs, NEC will continue to challenge by developing further technologies to support the UNIVERGE PF series and to contribute to the progress of OpenFlow technology while also actively seeking to satisfy customer requests.

* This article is presented based on the interview conducted in September, 2013.

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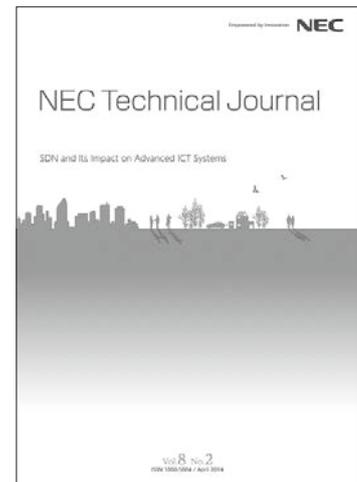
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