SDN: Driving ICT System Evolution and the Changing IT & Network Market

In the Mid-term Management Plan 2015, NEC declared its commitment to the "Social Solutions Business" that will provide ICT-driven advanced social infrastructure. As social infrastructure becomes more sophisticated, ICT systems that encompass entire systems while appropriately responding to the dynamically changing environment are demanded.
This article discusses ICT system issues that will arise in support of future advances in the social infrastructure, and explains the SDN concept for responding to such issues. In addition, while presenting use cases and examples of SDN applications, it examines the value created for society by the ICT system enhancements and the evolution of the IT and network markets.

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1. Introduction

In step with the virtualization of servers and storage in recent years, ICT systems are expected to have a total operation and intensive control over the entire system while responding to dynamically changing requirements. One of the technologies that is said to support the realization of this concept is Software-Defined Networking (SDN).

The following paragraphs will explain the technological trends that have given birth to SDN, what SDN is and what SDN can make possible.

2. Creation of a Social Value Creation Platform Using ICT

The social infrastructure is advancing. From submarine optical cables and seafloor seismometers to the expanded utilization of space engineering through space satellites, a broad diversity of technologies are finding practical application. In the realization of these advances, ICT systems make a significant contribution.

In addition to the previously described social infrastructure, various infrastructure that is indispensable to our daily lives are supported by ICT systems. Such systems include traffic management, fire and disaster prevention, electronic "karte" (medical patient diagnostic records) management, water management, etc.

Within such practical application of ICT, the area of the use and application of information will significantly grow in importance in the future. The capability to collect information, perform analyses using highly sophisticated algorithms, and then forecast the future will important keys to the development of solutions that will solve issues facing society.

NEC possesses numerous ICT assets that are rich in originality and provide a competitive edge as shown in **Fig. 1**: advanced sensor technology to collect information, human interface technology to the high-performance, high reliability IT platform technology for the analysis of the collected data, and the advances in SDN that make possible next-generation network platform technology to support the distribution of huge quantities of data. By exploiting all these assets, NEC is paving the way for solutions to a variety of social issues and aggressively tackling the creation of new value. Among these assets, SDN is seen as a critical technology in the overall advance of ICT systems, and is accordingly the focus of much effort.

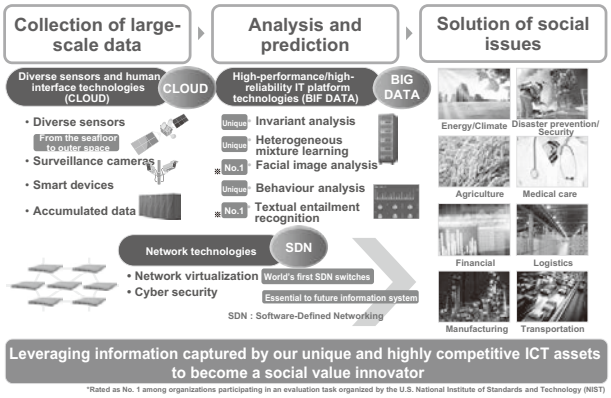

Fig. 1 Social value creation using NEC ICT assets.

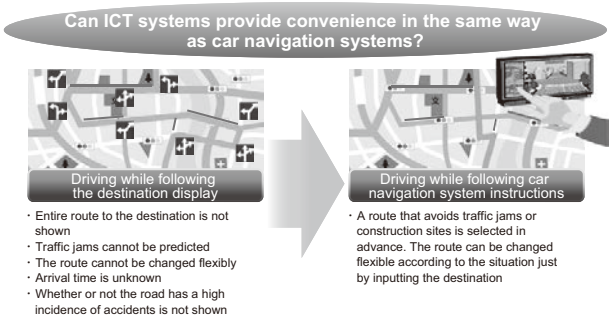

Fig. 2 Example of an ICT system that can be realized by SDN.

3. Issues Confronting Current ICT Systems

As Internet usage has become a normal part of life over the past 20 years, the development of network architecture and devices has been optimized to meet the demands of the Internet. At the same time, e-business and SNS have had a revolutionary impact on information communications and business around the world.

The emergence of such services has made it possible to easily connect with networks and communicate with various countries around the world. In step with this evolution, low-cost mass-produced devices that are compatible with Internet technology become available.

On the other hand, we are already beginning to see cases where conventional network devices and technology are unable to respond to the demands placed on them in order to realize the advanced social systems and the ICT systems that will become complex more and more. Attention is increasingly focusing on SDN as one of the solutions to these issues.

Let's take a look at current ICT systems, taking as an example car navigation as shown in **Fig. 2**. Non-navigation system drivers usually check road signs at each intersection. As they near an intersection, they looked at the signs to confirm their route, turning where appropriate. Even if multiple routes to a destination exist, the driver may not have selected the route that offers the shortest distance or a route that avoids congestion.

Now let's see what happens in actual traffic systems today. With the introduction of the car navigation system, users are first given the option of indicating their preference for a route that uses or avoids toll roads. Then the system collects a variety of information including traffic congestion and road construction sites in real time, enabling a bird's-eye view of the overall route and efficient guidance to the destination.

In the same way as navigation systems, the ICT system will be expected to have comprehensive grasp of the overall system configuration, real time usage information and to have optimized control that incorporates the distinctive requirements of each user. SDN is considered one of the key technologies that will make this level of advanced control possible.

4. Definition of SDN

While there are various definitions and interpretations of SDN, NEC considers this term to mean the dynamic control of the network with software. It also encompasses the methodology and architecture to realize this concept.

While collecting information from the entire ICT system, performing analyses and obtaining a grasp of the situation, this architecture enables the control of networks using software executed on servers.

Fig. 3 shows how conventional networks and SDN differ, and the unique capabilities that can be achieved by SDN. Conventionally network control and data transfer processing are integrated and performed by dedicated network devices. Based on preset static transfer settings and operating autonomously, these devices determine the transfer destination of information packets that arrive at the device. This is how networks have been built up to now.

In this type of resilient and scalable network architecture, it is relatively simple to construct a large-scale network, but it faces some issues: the difficulty in grasping the overall network situation and inflexibility to meet individual communication demands.

SDN is an architecture concept that separates the network control plane from the data transfer processing plane, and also enables dynamic control of the network control component by programmable software. This approach not only separates control and transfer, but also enables the freedom for anyone to design networks using software and to operate them on a general-purpose server.

Advantages of having the capability to dynamically control networks with software are as follows.

Non-network IT devices have evolved technologically in various directions such as virtualization, making advances in dynamic control and optimization to a point that many are now

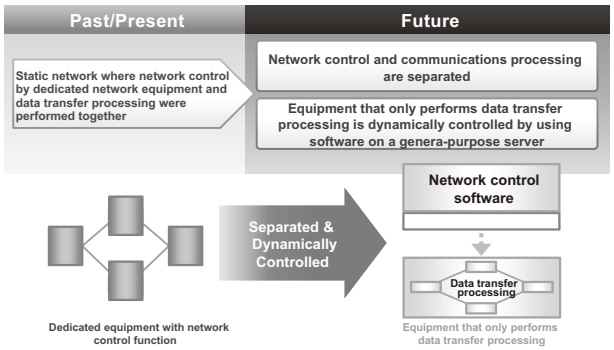

Fig. 3 Definition of SDN.

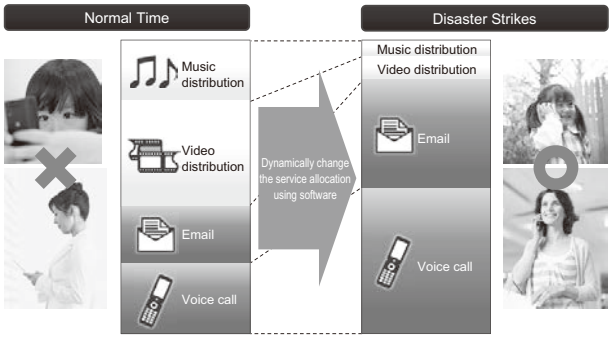

Fig. 4 Prioritized control of services during a disaster.

software controllable. On the other hand, the inability to dynamically control networks with software has been a barrier to the realization of the overall advance of various ICT systems.

From eliminating control obstacles and augmenting the efficiency of infrastructure equipment to system "visualization," improved security and optimization of ICT resources, SDN has made the solution of these issue possible and paved the way for the concrete advances in ICT system that are necessary for the fulfillment of the social infrastructure.

5. Application of SDN to the Social Infrastructure

This section shows some examples of the benefits that SDN will bring.

First is a case of how SDN can help realize social infrastructure that is more resistant to disaster. For example, in the wake of a large-scale earthquake or other major disaster, information collection-related communication needs temporarily become highly localized. As a consequence, mobile phone communication is flooded with demands - it becomes extremely difficult to deliver vital information on a timely basis due to delays or failure to connect calls and deliver e-mail. A conventional network is unable to simply switch the allocation of network bandwidth between voice communication, email and music content streaming services. Accordingly, it cannot instantly respond to such congested situations.

By using SDN to dynamically control with software the network bandwidth allocation between communication services and information streaming services, user access to voice communication, email and disaster management portal sites at times of disaster can be prioritized as shown in **Fig. 4**. This flexible control can restrict bandwidth usage for video streaming, music streaming and other low-priority services. Through this control capability, the social infrastructure can be made far more resilient when disaster strikes.

The next example shows how SDN applies to e-commerce websites such as an online service selling tickets to high-demand concerts or sports event, and an online retailer featuring

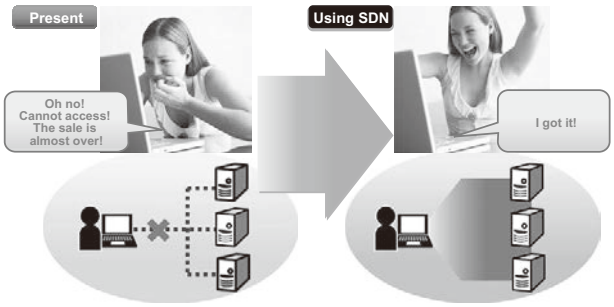

Fig. 5 System allocation shifting with SDN to respond to spikes in access.

hit apparel. In the case of an EC ticket site handling the sales of tickets to a large-scale and very popular event, the single website will be temporarily and intensively flooded by inquiring users, making the site difficult to access and slowing screen loading to a crawl.

In fact, the delay may be caused by a bottleneck in the network or perhaps an inability to process requests because of an insufficient number of servers.

As shown in **Fig. 5**, SDN grasps the total situation, and automatically makes route changes and assigns different degrees of priority to not only the servers but also network systems. Such performances are also conducted for individual service menus. By dynamically rerouting and securing communications to prevent the occurrence of bottlenecks, SDN optimizes the utilization of resources as a total service or system, and easily responds to access spikes. Through optimization by SDN, the frustration of a down server and messages that say "the website cannot be accessed at this time" due to an intensive traffic load can be avoided.

6. Emergence of IT & Network Market Fusion

SDN is predicted to bring dramatic changes to the future IT and network market environment. The market trends that have occurred in the IT market over the past 20 years were the

movement toward open protocols and horizontal (international) specialization as well as commoditization and price deflation driven by the widespread adoption of open source software. The same market trends are expected to simultaneously and intensively affect the network market at an accelerated rate.

On the other hand, as the network market evolves, its fusion with IT and the pace of the race to innovate will accelerate, leading to the formation of a new market. It will be a market that gives new value creation in the form of solutions that combine various IT, networks, software and hardware in diverse ways.

It is the understanding of NEC that SDN will drive the formation of this new market and the creation of these solutions. NEC believes that the incorporation of this value is the key point in the advance of ICT systems.

7. Conclusion

This article has touched on the value created by the SDN-driven evolution of ICT systems and on the changes coming to the IT and network markets.

NEC believes that SDN is transforming the existing relationship between IT and networks, revolutionizing ICT systems and contributing to the creation of innovative value. In the future, NEC will continue to expand our development of SDN technologies and the provision of solutions with the aim of providing customers with systems that flexibly support their ever-evolving business.

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NEC SDN Solutions
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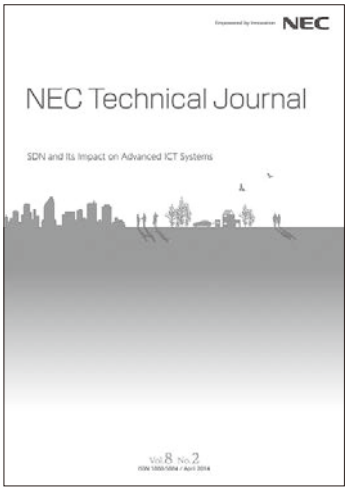

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