Case Study

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NEC

Software-Defined Networking (SDN) Solution

West Nippon Expressway Company Limited (NEXCO-West)

NEXCO WEST

Challenges

- NEXCO-West has to ensure a transportation system that can deliver the personnel and materials required for rescue, restoration and reconstruction to the appropriate places in the event of any disaster.
- NEXCO-West needs to upgrade cumbersome traffic control systems with backup functions to manage traffic faster and more flexibly.

Solution

- NEC has supplied 4 OpenFlow controllers and 136 OpenFlow switches from NEC's UNIVERGE PF Series to build an SDN network linking multiple routes between 45 traffic control centers and expressway offices within a 4,000km-wide area.

Results

- Introducing centrally-controlled, software-driven SDN networks has greatly enhanced the stability of its expressway traffic control.
- It monitors traffic more closely and responds faster, provides more timely and appropriate information to expressway users, and ensures road services suffer minimum disruption in times of disaster.
- Enabled shorter lead times on network construction by virtue of visualization of the connection links for each service on a simple graphic user interface screen.

The West Nippon Expressway Company Limited, or NEXCO-West, operates a myriad of expressways in a 3,400km-wide area of Western Japan which spans the four -regions of Kansai, Chugoku, Shikoku and Kyushu. NEXCO-West is not only responsible for the construction and operational management of expressways, but also the broad and ever-expanding range of attractive services for expressway users, such as expansive rest stops, restaurants and gas stations. Driven by its founding motto for "100% safety and reliability," NEXCO-West is dedicated to ensuring maximum road and traffic safety, and optimum customer satisfaction. The company is also committed to boosting development within Western Japan and cooperation among the region's various traffic-related institutions.

Challenges

A strong disaster recovery capability is key to road and traffic safety, and NEXCO-West has been seeking to boost the speed and flexibility of its traffic management networks in times of emergency or disaster.

"We are likely to experience huge earthquakes in Western Japan, so we have to ensure a transportation system that can deliver the personnel and materials required for rescue, restoration and reconstruction to the appropriate places in the event of any disaster," insists Katsunori Takemoto, director for Disaster Management at NEXCO-West. NEXCO-West has always kept its earthquake-resistant roads in top condition, and worked proactively to improve cooperation with local governments and other regional organizations on disaster-preparedness drills. NEXCO-West has made consistent improvements to its traffic control centers. But they knew it needed to upgrade cumbersome traffic control systems with backup functions to manage traffic faster and more flexibly, particularly in emergency situations. NEXCO-West's four regional traffic control centers are the "control towers" of its expressway network. The traffic control centers observe local traffic volumes and weather patterns based on ample information from traffic measurement facilities and weather forecast equipment located at regular intervals on the highway network. The centers use this information to control and regulate traffic around the clock. They swiftly inform expressway users of accidents through the signage system, and communicate closely with . expressway offices, traffic patrol units and the Traffic Police Force located within their region.

NEXCO-West had improved the reliability of its traffic control system through redundant configuration and linking traffic control centers via networks. However, the networks are not the same in every region. System operators had to physically adjust settings on countless different network functions in order to change the final destination for mainline data, making it extremely difficult to share information or establish control functions between traffic control centers in each region.

"If a disaster in Kyushu renders the Kyushu traffic control center inoperable, we

need to be able to reroute the information from our expressway equipment in Kyushu to the neighboring Chugoku traffic control center to ensure safe, consistent traffic control," explains Takemoto.

Solution

In its quest to boost disaster preparedness, NEXCO-West proactively searched for a solution which would allow them to use centrally-controlled software to define and direct inter-linked networks flexibility and swiftly. Following extensive market research, NEXCO-West decided that software-defined networking (SDN), and more specifically OpenFlow, would be the best option for them. NEC's SDN solution was selected in a subsequent competitive tender as the system which best suited the company's needs. By introducing SDN, NEXCO-West has created new agile network units for backup lines which use centrally-controlled software to facilitate rapid network reconfigurations in addition to existing area- and system-specific networks. In the event of a disaster, the company can instantly transfer control functions from traffic control centers in affected areas to neighboring centers. By managing multiple switches and actions as one unit, the OpenFlow controller can also adjust network operations to suit transmission conditions.

"The OpenFlow system is simple and easy to operate, and while the concept is still fairly new, we believe efforts to standardize the technology will make it easier to refine and develop over time," states Atsushi Edahiro, from NEXCO-West's Facilities Maintenance Engineering Division. "NEXCO-WEST adopted NEC's SDN system based on comprehensive evaluations of technology and cost," states Kazuto Yamamoto, manager of the Facilities Maintenance Engineering Division.

NEXCO-West has introduced four OpenFlow controllers and 136 OpenFlow switches from NEC's UNIVERGE PF Series to build an SDN network linking multiple routes between 45 traffic control centers and expressway offices within a 4,000km-wide area.

Now, information from thousands of signboards updating drivers on the latest traffic conditions, and traffic and weather observation equipment lining the expressways is transmitted via local expressway offices to the .nearest traffic control center. If the nearest traffic control center is unable to operate properly in times of disaster, the OpenFlow controller can redirect information to any of the remaining three traffic control centers to ensure uninterrupted traffic control.

"We were reassured by NEC's rich track record in the SDN field, its long experience

building previous NEXCO-West systems, and broad experience constructing and operating social infrastructure for many different companies," said Edahiro.

NEXCO-West now enjoys a secure, reliable operating system for its traffic control centers, with new SDN backup traffic control networks making it much easier to reroute or redirect vital traffic information.

Results

NEXCO-West's forward-looking decision to introduce centrally-controlled, software-driven SDN networks has greatly enhanced the stability of its expressway traffic control. It can monitor traffic more closely and respond faster, provide more timely and appropriate information to expressway users, and ensure road services suffer minimum disruption in times of disaster.

"Our new ability to swiftly reconfigure networks gives us better overall control because we can easily transfer information from expressway monitoring equipment to neighboring traffic control centers in times of emergency," says Yamamoto.

Thoroughly convinced of the benefits of SDN for swift disaster recovery, NEXCO-West is now exploring SDN's usefulness for other applications as well. One of the most attractive features of the UNIVERGE PF Series is that it enables you to build secure, individual "Virtual Tenant Networks"(VTN) which can all be operated independently within one OpenFlow framework. This means IT resources can be employed more efficiently, combining individual networks supplying anything from business administration LAN to networks for each individual expressway service on the same overall SDN infrastructure.

Another advantage of the SDN framework is its clear network display which helps operators to visualize the connection links for each service on a simple graphic user interface (GUI) screen. Users can then use the screen to reroute traffic to suit transmission volumes, or divert routes to avoid transmission stoppages during maintenance.

"Previously it would take expert technicians six months to introduce a new system and make the necessary expansion or changes to our networks. Now, we enjoy much shorter lead times on network construction. We just visualize the two points we want to link on the screen and do it ourselves," explains Edahiro. "Services no longer need to be interrupted for maintenance. Maintenance is more efficient, and we can resume regular transmissions more swiftly."

Introducing a pioneering SDN system will always present some challenges, but, as Edahiro strongly highlights, NEXCO-West was able to overcome the hurdles easily with NEC's support.

"NEC patiently explained all the special technical features, and the operating manuals and documents were very clear and helpful."

NEXCO-West is now considering using SDN in other projects, including the company's various ongoing efforts to boost expressway user comfort. Yamamoto considers future options: "We would be able to introduce multiple new measures and services quicker using virtualized SDN networks. The possibilities are endless."

West Nippon Expressway Company Limited has deployed NEC's SDN to strengthen the disaster-preparedness of its expressways which arguably form part of Japan's most important social infrastructure. It has helped fuel a revolution in the fundamental systems which underpin this key social infrastructure and, in maximizing the system's strengths and benefits, the company will contribute to development in Western Japan.
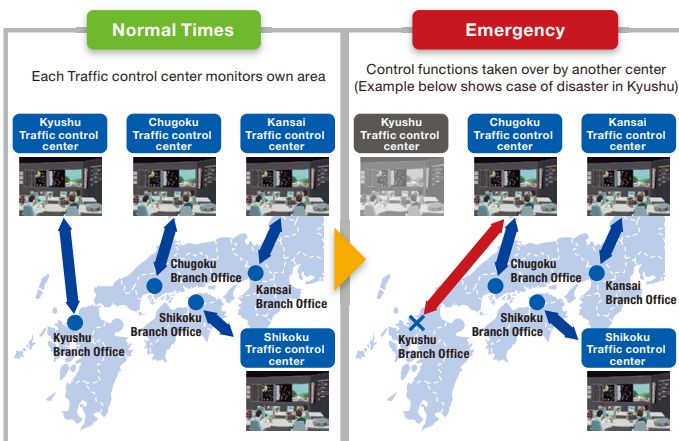
Example of an SDN backup traffic control-framework for traffic control centers

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