Aiming for a flexible IX

PIX-IX is a new Internet eXchange (IX) using Software Defined Networking (SDN) technologies under development by researchers primarily at the Nara Institute of Science and Technology and The University of Tokyo. Currently, IX uses Layer 2/Layer 3 devices to provide the interconnection locations to carriers. To forward traffic to the appropriate address, carriers perform route exchange with other carriers using BGP. PIX-IE uses SDN technologies on top of the IX framework to realize functions not possible with conventional IX, such as route control, path exchange, and security provisions.

Structure of PIX-IE

As the SDN technology to implement each type of function, PIX-IE uses OpenFlow, which can precisely control traffic (Fig. 1). Additionally, switches can be controlled via the OpenFlow controller through an API, allowing the AS carriers to control traffic based on its status. However, IX connects AS, but because setting errors or rule conflicts can have a large impact on traffic, PIX-IE includes a conflict settings mechanism to circumvent such issues and to confirm the effects of rule changes before they occur. In the future, we plan to use existing and SDN technologies other than OpenFlow-based on the required function.

Preventing attacks through PIX-IE

Large-scale denial-of-service attacks (DDoS attacks) are becoming more prevalent, creating an urgent need for countermeasures against threats to the internet backbone. In the past, victims of attacks were responsible for their own attack prevention and mitigation measures. However, recent attacks are large-scale (several hundred gigabits/second) and distributed over a wide area, oppressing the carrier for the attacking channel and the IX network zone. Because attack prevention and mitigation on the network channel is essential as countermeasures for such large-scale attacks, as part of the NECOMA Project, we have introduced SDN technologies to IX, which is responsible for interconnecting networks, to heighten the preventative functions of IX itself and develop SDN IX technology. SDN IX can provide effective preventative functionalities to IX operators and internet service providers connected to IX.

SDN
Software Defined Networking or SDN for short is the general term used to describe technologies that control network devices via software by differentiating between control and data planes.

OpenFlow
OpenFlow is an SDN technology and various vendors provide switches that are compatible with OpenFlow. Controller functions equivalent to control planes are also being developed as open source projects. OpenFlow is standardized under the Open Networking Foundation (ONF).

PIX-IE
Programmable Internet eXchange in Edo
Application of SDN technologies in IX

Figure 1: PIX-IE structure
The NECOMA Project demoed an SDN IX prototype at the Interop Tokyo 2015, held at Makuhari Messe, Chiba City, Chiba Prefecture on June 10 - 12, 2015. Figure 2 summarizes the PIX-IE structure and attack prevention using the demo network ShowNet at the Interop conference with four OpenFlow switches and two distributed controllers. The red arrows indicate the attacking traffic from external connecting organizations A and B to the target network host. The inflow port of SDN IX filters this attacking traffic. First, the target network operator issues a filter request through the portal after detecting the attacking traffic. The portal sends the filter setting information to the controller and initiates the filter using the OpenFlow switch. The filter information is comprised of five-tuple (sender/destination IP address, sender/destination tcp/udp port number, protocol type).

Filtering invalidates the attacking traffic at the inflow port of PIX-IE, reducing the attacking traffic flow within IX and preventing strain on the zone between IX and the targeted network.

**Future developments**

The NECOMA Project continues to advance research and development on PIX-IE, focusing on security functions. Additionally, we plan to implement some test operations through live deployment of IX in cooperation with the WIDE Project. Research and development achievements for PIX-IE will be communicated at exhibitions, manuscripts, and operator’s groups (Janog, APIX, Euro-IX).

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