UDON: User Defined and Organized Network

Katsuhiro Horiba
Graduate School of Media and
Governance KEIO University
qoo@sfc.wide.ad.jp

Seiichi Yamamoto
Computer Center Institute of
Industrial Science The
University of Tokyo
yama@wide.ad.jp

Yuji Sekiya
Information Technology Center
Network Research Division
The University of Tokyo
sekiya@wide.ad.jp

ABSTRACT

Virtual testbed network environment is major research topic, and well deployed on high speed nationwide Research and Development network in many countries. Testbed users can create their virtual experimental network based on their requirement on virtual testbed network. However, current virtual testbed network doesn't provide dynamic network resource control method, statistics for analysis of their experiments, and software descriptive network topology and test scenario. We propose UDON(User Defined and Organized Network) architecture that provides API to control virtual testbed network resource. This architecture allows testbed users to define virtual experimental network topology, modify property of its resource and write test scenario script using API by themselves. This paper describes the system architecture and introduces the preliminary implementation GINEW(General Integrated Network Engineering Workbox) as proof of concept.

1. BACKGROUND

Network virtualization technologies accelerated not only unifying network equipment for the individual purpose and its management, but also developing virtual testbed systems[1]. These projects provided dedicated network resource regardless virtual or physical network such as virtual node and link. testbed users can create own virtual experiment network based on their needs.

Testbed users also need dynamic network resource control method, statistics for analysis of their experiments, and software descriptive network topology and test scenario. For example, high bandwidth streaming tester wants to know where lost packets in end-to-end level are dropped. Routing protocol tester wants to describe network failure as well as simulation scripts.

However, these requirements aren't provided, because most of lending network resource are defined on network core, configuration of network equipment and their requirements are tightly-coupled, that means it has possibilities of destroying network. Therefore, NOC(Network Operation Center) member have been working hard behind user requests, they hear and consult user needs, sometimes configure network equipment by their hand and maintain network on a daily basis.

We propose UDON(User Defined and Organized Network) architecture that provides API to control virtual network resource on nationwide academic network. UDON architecture allows testbed users to control network topology and property of virtual network resouce based on their script using UDON API by themselves. This architecture will be helpful for testbed users, they can define own test scenario like simulation script as upon virtual machine technologies. This article describes the system architecture and introduces the preliminary implementation GINEW(General Integrated Network Engineering Workbox) as proof of concept.

2. UDON ARCHITECTURE

Our goal is network API to control virtual testbed network resource, testbed users define and modify their virtual experimental network by themselves when they need. The requirements of the goal are 1) API definition, 2) abstraction layer to map with API and individual method to control equipment, 3) Access Control of API per testbed user, 4) safety of virtual testbed network and 5) Consistency in current configuration (state) of equipment and management system. We propose UDON(User Defined and Organized Network) architecture on virtual testbed network.

UDON architecture is defined overlay network on top of layer-3 network to avoid that testbed user's request destroys underlaying network or the other user's virtual experimental network. Basically, overlay network doesn't guarantee the network quality such as bandwidth, packet forwarding rate and round trip time, because most of overlay network is laying over the Internet. However, we focus on the virtual testbed network on nationwide Research and Development network, all of the network equipment is under control, therefore, most of testbed user's needs can be satisfied by managing its resource as long as dedicated circuit is needed.

Figure 1 illustrates overview of UDON Architecture. UDON architecture defines virtual link and virtual node for testbed users as the entities of their virtual experimental network. Testbed users can ensure virtual nodes where virtual testbed network prepared, then they can define virtual links to con-
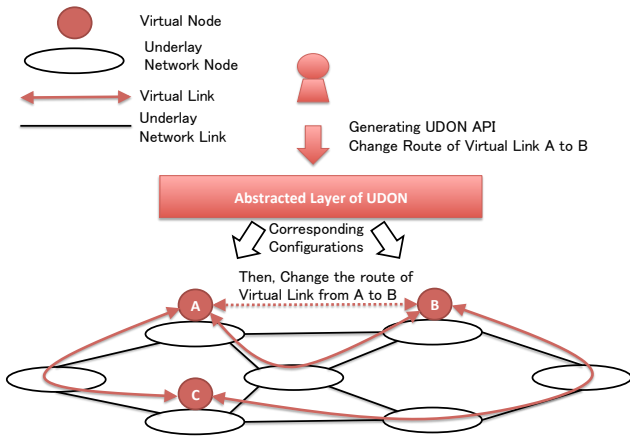
Figure 1: Overview of UDON Architecture

Figure 2: GINEW: Implementation of UDON Architecture on JGN-X and its Operation Procedure

nect virtual nodes. They can also define property of virtual link such as its route or limitation of bandwidth. By doing above, testbed users create their own virtual experimental network.

The entities of virtual experimental network resource and their property are ensured by UDON API. The abstracted layer of UDON translates API to individual operation module based on actual configuration or method for corresponding equipment like libvirtd[2]. For example, if testbed user calls an API to establish virtual link between virtual node A to B, the abstracted layer of UDON expands it to actual configuration or API to establish the Path between virtual node A to B.

3. AN IMPLEMENTATION OF UDON

We are implementing GINEW(General Integrated Network Engineering Workbox) as a prototype of UDON architecture on JGN-X. Currently, GINEW provides 3 API, user defined end-to-end virtual link, explicit route of virtual link and bandwidth limitation of virtual link. In GINEW on JGN-X, overlay network on top of layer-3 network of UDON architecture is MPLS, and virtual link is identified as VLAN and organized by LSP(Label Switched Path) in MPLS. RSVP-TE that is control plane signaling protocol of MPLS has Explicit-Route and Bandwidth Limitation of LSP.

Figure 2 shows system design of GINEW and its entire operation procedure on JGN-X. At first, testbed user submits an application with abstracted virtual experimental network topology via Web Application Form. If NOC member accept that application, they register it to the database and create their virtual experimental network. Then, testbed user can access their virtual experimental network and control All of operations of both testbed user and NOC member are executed via GINEW Interface that is an abstracted layer of UDON architecture. That expands individual configuration corresponding executing equipment's environment.

4. CONCLUSION

GINEW architecture abstracts individual underlaying network characteristics so that virtual testbed network provides
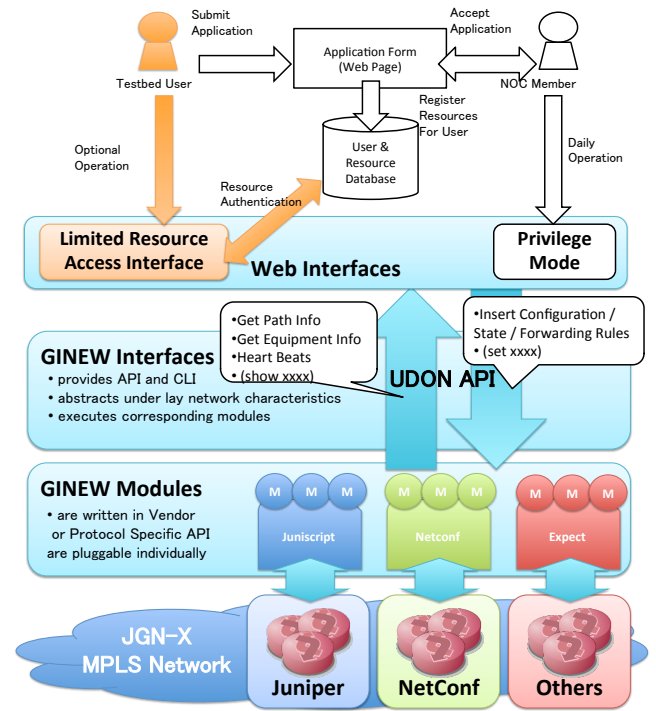
API to control its resource. That allows testbed users to define their virtual experimental network topology and control its attribute. GINEW architecture establishes virtual experimental network as an overlay network on top of layer-3, basically it doesn't destroy underlaying network and makes it easier to inter-connect among networks that are managed different manner (operation policy or protocol).

We implemented a prototype system of GINEW architecture for VPLS network with multi-vendor on JGN-X. We plan to improve and deploy it on JGN-X backbone as first proof of concept and we embed it actual NOC operation. Testbed users on JGN-X will define their testbed network topology and control the route of virtual links. We also aim to collaborate the other virtual testbed network to expand our architecture.

5. REFERENCES

[1] T. Anderson and M. K. Reiter. Geni: Global environment for network innovations distributed services working group, 2006.
[2] M. Bolte, M. Sievers, G. Birkenheuer, O. Niehörster, and A. Brinkmann. Non-intrusive virtualization management using libvirt. In *Proceedings of the Conference on Design, Automation and Test in Europe*, pages 574–579, 2010.

Acknowledgment