NEWS RELEASE

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Virtual network architecture over IP-optical network successfully proven on testbed network

Nippon Telegraph and Telephone Corporation (NTT, Chiyoda Ward, Tokyo, President and CEO: Satoshi Miura) has developed a technology to create multiple virtual networks upon a common physical network infrastructure, leveraged by the integrated control of optical and IP networks. The concept was proven through experiments in which we succeeded to operate multiple virtual networks simultaneously upon a wide-area testbed.
Our virtual network architecture enables to launch services quickly and to operate them independently upon a common network infrastructure in spite of their diverse requirements. We plan to demonstrate these results at the upcoming SC10*1 held in New Orleans, Louisiana (USA), November 13-19, 2010, by international connection between the test network and the exhibition booth.

Background
Recent trends in telecommunication have focused on converging services such as IP telephony, Internet access and IPTV in a shared IP network. However, in the future, IP networks may face expectations to support much innovative applications with wide range of diversity. Uncompressed transmission of ultra-high-density video consumes huge bandwidth of several gigabits per second, while communications of sensor nodes and RFID tags emit very small amount of traffic but they require the network to accommodate an enormous number of terminals.
NTT laboratories had been working on technologies to make much efficient use of the IP and optical networks, on the belief that future services are so diverse that they cannot be easily converged in a common IP network.

Achievements
We have established a novel concept of dynamic construction of virtual networks (Figure1). In our architecture, the physical network infrastructure which we call it an IP-optical network is consisted of IP routers, OXCs (optical cross connects) and optical fibers. Such resources are virtually sliced and allocated to service operators. Using the allocated resources, service operators are allowed to setup optical paths between the router pairs in order to form IP links. Set of these IP links provides the IP topology to deliver the service, and we call this a virtual network (Figure 2).
Resource isolation in the physical layer ensures to avoid traffic conflicts between virtual networks. This also enables virtual networks to be operated with high degree of freedom compared to current IP networks that are managed only in the IP layer. They can also control the lower layer, the optical paths, for further optimization.
Furthermore, the integrated control of IP-optical networks enables quick setup of virtual networks.
In the experiment, we have implemented multiple virtual networks over a wide-area network constructed upon the national testbed network, JGN2plus*2. We have

succeeded in individual operation of such virtual network that transmit ultra-high density video streaming whose data rate is up to about 6 Gbps, and virtual network that reconfigures its topology dynamically by setting up and tearing down the optical paths.

Technical Features

(1)Integrated control of IP-optical networks

We have developed a physical network manager that triggers the setup of optical path between a router pair, and configures it as an active IP link. For the given source-destination pair of the IP link, path computation for the optical path is done considering the available resources. As soon as the optical path is set up, physical network manager configures the IP routers so that the optical path can be used as an IP link. Such integrated control of IP and optical paths enables to provide virtual networks in a very short term.

(2)Resource management and access control

Topology and resource information of the IP-optical network is automatically collected at the physical network manager. Administrator of the physical network will apply permission for virtual networks to obtain each unit of resources. This enables amount control and it avoids conflicts between virtual networks. In addition, balance of the amount of resources allocated to each virtual network can be modified flexibly, in accordance to the change in traffic demands.

(3)Standardized network control

We use GMPLS*3, the standardized protocol for the network management and control. It means that our virtual network architecture can be implemented using ordinary products that support GMPLS available now in the market.

Future Plans

We will be working on further research issues for much advanced control of IP and optical networks. Functional enhancements and trials on testbeds will be done expecting that this technology will enable prompt, economical, and flexible operation of the practical network in the near future.

Footnotes

*1 SC10
SC is the international conference for high performance computing, networking, storage and analysis. SC10 will be held in New Orleans, Louisiana (USA), November 13-19, 2010.
http://sc10.supercomputing.org/

*2 JGN2plus
JGN2plus is an advanced testbed network for R&D provided by NICT (National Institute of Information and Communications Technology).
http://www.jgn.nict.go.jp/

*3 GMPLS (Generalized Multi-Protocol Label Switching)
As an extension of Multi-Protocol Label Switching (MPLS) technology used to configure a logical packet-switched network on an IP network, GMPLS is a communications technology that enables standardized network control by configuring a switched network using wavelengths as labels in addition to conventional MPLS labels. GMPLS is standardized at the Internet Engineering Task Force (IETF).

- Figure 1: Dynamic construction of virtual networks
- Figure 2: Resource management and access control

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