(Press Release)

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Nippon Telegraph and Telephone Corporation
NEC Corporation
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Mitsubishi Electric Corporation

"NTT, NEC, Furukawa Electric, and Mitsubishi Electric succeeds in the interworking the next-generation photonic network control protocol of GMPLS and the advanced IP network control protocol of MPLS for the first time in the world"

Nippon Telegraph and Telephone Corporation (NTT; Head Office: Chiyoda-ku, Tokyo; President: Norio Wada), NEC Corporation (Office: Minato-ku Tokyo; President: Akinobu Kanasugi), The Furukawa Electric Co., Ltd. (Office: Chiyoda-ku; President: Hiroshi Ishihara), and Mitsubishi Electric Corporation (President & CEO: Tamotsu Nomakuchi) will conduct the world's first successful demonstration of interworking between legacy MPLS (Multi Protocol Label switching) for IP network control and GMPLS (Generalized MPLS) for next-generation photonic network control. This interworking will produce a broadband and economical IP network environment. This interworking technology will realize the smooth introduction of the next generation high-speed and flexible backbone network without demanding that changes be made to existing IP and MPLS network configurations. Moreover, the novel high-speed and flexible network services offered by GMPLS technology can now be provided in addition to existing IP and MPLS services. This demonstration was performed in the Photonic Internet Lab (abbreviation: PIL.) (*1) where these four companies are taking part in the planning.

This interworking experiment will be demonstrated from October 26 and to 28, 2003 at the international conference MPLS2003 exhibition booth, in Washington D.C. USA. In MPLS2003, world telecommunication carriers and venders will debate the novel de-facto MPLS technology, which is an advanced IP network control technology used to provide IP VPN services.

1.Background

Due to the explosive increase in the number of Internet users and various new services, traffic volume is doubling every year. This trend will continue since novel network applications like VoIP and Video on Demand are emerging. These types of services are difficult to realize on the existing best effort type IP network. Accordingly, enterprise users, which employ various network applications, utilize more dedicated network services like IP-VPN (*2) and Ethernet as well as the leased-line service. This suggests the need for an adaptive network control mechanism that offers various transmission speeds and levels of communication quality to support user demands and new applications in the next generation network.
MPLS(*3) and GMPLS(*4) are the key technologies to achieve this adaptive network control mechanism (refer to Fig. 1).

(1) MPLS
MPLS realizes traffic control in the IP network. Using the circuit switching concept

seen in the telephone network, it establishes and handles traffic flows that satisfy different service quality demands. At present, MPLS technology is being used to realize traffic management in Internet service providers and to realize IP-VPN services.

(2) GMPLS
GMPLS is a new control technology designed for the next-generation photonic network. GMPLS is an extension of the MPLS concept to the circuit switching network and the optical fiber network. GMPLS enables unified control management of the network layers (packet / TDM(*5) / wavelength / optical fiber). The use of GMPLS unifies network operations which will yield significant network operation cost reductions. Moreover, GMPLS offers the novel network service of optical wavelength leased-line service in which users can freely change destination and quality.

Although it was able to cooperate and MPLS and GMPLS were not able to be operated until now, our proposed technology of MPLS and GMPLS interworking leads into introducing the next-generation network smoothly without alteration of the existing IP network equipment.

2.Technical points
PIL has succeeded in seamlessly connecting an MPLS network and a GMPLS network by using GMPLS routing and signaling technology. The trial network setup is shown in Figure 2.

(1) The implementation of each company
The GMPLS domain consists of a photonic MPLS router (*6) (IP/wavelength) of NTT, a digital cross connect (TDM/wavelength) of NEC, a GMPLS supported MPLS router (IP/TDM/wavelength) of Furukawa Electric, and optical cross connect (wavelength/fiber) of Mitsubishi Electric. Only the control parts of these components were examined. Control software that can handle at least two layers was developed and implemented by each company. The above expressions within the brackets represent the function and the layer handled by each company's equipment. All equipment can run a GMPLS-compliant routing protocol (GMPLS OSPF-TE). Each active component advertises the function and the layer that it handles. This allows all GMPLS equipment to recognize the layers handled by other equipment.

(2) The past reaching point
Since a wide variety of network equipment (e.g. IP router and a cross connect) will coexist in a GMPLS network, it is essential to verify the interoperability between multi-vendor network equipment. The four companies have already established a multi-layer GMPLS signaling technology using the GMPLS signaling protocol (GMPLS RSVP-TE). This trial verified cooperation between GMPLS routing and signaling technologies. Using this multi-vendor GMPLS network environment, we successfully demonstrated that equipment information could be exchanged, and that a GMPLS communication path could be set up.

(3) The result of this trial
In this trial, we also examined the interworking between MPLS and GMPLS networks using a newly developed routing interworking function. Fig. 3 shows a schematic of the interworking mechanism between the MPLS and GMPLS networks. This interworking mechanism has been proposed by NTT as an IETF internet-draft. In the GMPLS network, the GMPLS link information of each node is advertised by the GMPLS routing protocol. Unfortunately, conventional IP and MPLS routers can not

correctly recognize this GMPLS link information. To overcome this problem, the GMPLS edge routers that are directly connected to conventional MPLS routers (G1, G3, G5, and G7), translate and advertise the GMPLS information to the MPLS routers. This means that the MPLS domain side recognizes nodes G1, G3, G5, G6, and G7 as MPLS routers and the link states in the IP layer are advertised among the MPLS nodes. This approach allows the MPLS side to recognize not only the GMPLS nodes directly connected to the MPLS domain, but all nodes inside the GMPLS domain. GMPLS domain resources can be efficiently managed from the MPLS domain, such as shortest path setup and traffic control. In our trial, only NTT and Furukawa nodes can handle the IP layer across the GMPLS domain (see Fig. 2). This technology provides easy extension of the GMPLS network into the legacy MPLS network. The precise routing information of the MPLS network can be transmitted across the multi vender environment GMPLS network, which confirms the practicality of this technology.

3.Future plan

PIL is planning to conduct interoperability tests with a number of global companies, although this trial was performed only by control software of PIL member companies.

<Glossary>

*1) Photonic Internet Lab
abbreviation: PIL See http://www.pilab.org
PIL, which founded in September 2002, is promoting research into and development of next-generation photonic network technologies. PIL encourages the submission of proposals from its members to global standardization bodies, like ITU-T, IETF, and OIF. PIL also tests the photonic network control programs developed by PIL member companies. This experiment directly supports these goals. At present, PIL consists of seven companies; Fujitsu Ltd., Oki Electric Industry Co., Ltd. and Hitachi, Ltd. joined after the four above-mentioned companies. PIL activities are supported by the R&D support scheme of the MPHPT (Ministry of Public Management, Home Affairs, Posts and Telecommunications) for funding selected IT activities.

*2) MPLS
The abbreviation of Multi-protocol Label Switching. MPLS is a packet transmission control technology for the IP network.

*3) GMPLS(Generalized Multi-Protocol Label Switching)
GMPLS is a protocol that establishes generalized MPLS in all layers of the IP network: layer 2, TDM (Time Division Multiplexing), wavelength (WDM), and the fiber. The basic MPLS is a control mechanism that attaches fixed length labels to IP packets. GMPLS is attracting attention for controlling the next-generation photonic network. Standardization of GMPLS is being advanced mainly by IETF (The Internet Engineering Task Force). The basic function of GMPLS was released as a Proposed Standard in February 2003, with registration number RFC 3471-3473. In order to make it a complete and truly practical protocol, world-wide efforts are needed elaborate the remaining details and develop protocol code that can be directly installed in network equipment.

*4) IP-VPN
The abbreviation of Internet Protocol based Virtual Private Network. It offers a virtual private network (VPN) on the IP network.

*5) TDM
Transmitting technology using time division multiplexing. SDH/SONET is used widely in many networks.

*6) Photonic MPLS
In the legacy MPLS, an additional header to IP packet, or the path discernment / channel discernment of ATM (Asynchronous Transfer Mode) is used as a MPLS label. As a concept, Photonic MPLS subsumes the MPLS technology of using wavelength as a label and the future optical IP technology of adding label headers based on optical signaling to optical IP packets.

- Fig .1 Schematic of next-generation network and services over various paths
- Fig. 2 Setup for PIL interoperability test
- Fig .3 IP+MPLS and GMPLS interworking

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