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NTT Develops Logical-topology Reconfigurable WDM Network System

Enables network managers to change network topologies dynamically

Nippon Telegraph and Telephone Corp. (NTT; Head Office: Chiyoda-ku, Tokyo; President: Norio Wada) has developed a logical-topology reconfigurable Wavelength Division Multiplexing (WDM) ([*1](#)) network system with a star-shaped topology. The system enables network managers to change the topology of a network very quickly. This feature makes it possible to cope with the rapid increase in traffic during disasters, traffic changes that occur when re-structuring departments in a company, and load balancing for Internet services.

The network developed by NTT Photonics Laboratories uses the wavelength-path selecting technology based on the AWG-STAR ([*2](#)) network. This has been established for logical-topology reconfiguration and functions by adjusting the wavelengths of optical signals.

It offers flexibility in network design and allows us to optimize network topologies for data communications. This feature has excellent potential for application to metro area regional distributed Internet exchange (IX) ([*3](#)) and Internet data center (iDC) ([*4](#)) networks.

Features of network

- 1) The network is an optical network with a star-shaped topology.
- 2) The network is applicable to any networks with logical mesh, ring, or star, structure and mixtures of these topologies.
- 3) The path and signal destination can be configured dynamically by selecting the optical signal wavelength.
- 4) Network nodes can be added, moved or replaced in several seconds.

Background to development

Data traffic originating in metropolitan and local areas is growing rapidly, and networks are required that are flexible, large capacity, and transparent. Non-stop management and operation is one of the most important requirements for a metropolitan/local area network system. Local government systems, including private e-government networks, and education, and information sharing networks for city residents, require a secure multi-service provision that does not disturb other private networks.

For such systems, logical-topology reconfiguration technology provides rapid network service provisioning and network restoration.

Key related technologies

NTT Photonics Laboratories have already developed the AWG-STAR network, which offers logical full-mesh connections with a star-shaped topology by using an Arrayed-Waveguide Grating (AWG) router. (*5) Since optical signals from any source node are optically routed to the destination nodes through the AWG router, multiple private networks with a different format or multiple bit rate signals can be co-implemented with low latency in an AWG-STAR network. This feature provides flexibility as regards network design, enables low-cost deployments and meets the requirements for network applications.

In the AWG-STAR network, the destination node of a wavelength path can be reconfigured to another destination node by changing the wavelength of the optical signal. The dynamic wavelength path in each node enables the creation of a reconfigurable AWG-STAR network with a logical topology. Multiple logical topologies, including mesh, star and ring, can be established on one AWG-STAR network by selecting a suitable wavelength.

A mesh topology network can be dynamically reconfigured to a ring network or vice versa by selecting wavelength paths. For a ring topology network, a healing path can be constructed when a node fails. By an appropriate choice of wavelength by the node previous to the failed one, the failed node can be skipped, while maintaining the optical link for the ring network. Thus, this network system has inherently survivability features in logical ring topology with a fault isolation system without redundant physical network topology.

These features make the reconfigurable network with a logical topology a strong candidate for distributed IX or iDC networks in metropolitan areas.

Future Developments

NTT will continue its research and development activities with regard to commercial systems.

Glossary

(*1) WDM (Wavelength Division Multiplexing)

A data transmission system where multiple signal channels from different end-users can be multiplexed on the same fiber.

(*2) AWG-STAR network

The AWG-STAR network system consists of an N -channel AWG-router and surrounding N -WDM nodes. The nodes are connected with single-mode fibers and the network has a simple star topology. The AWG-router provides $N \times N$ full-mesh interconnection between the nodes wholly on the optical layer.

(*3) IX (Internet exchange)

A place where Internet Service Providers can interconnect independent networks and exchange Internet traffic with each other.

(*4) iDC (Internet Data Center)

A place where there are infrastructures for housing customer's server in a secure, high-speed and reliable environment, ensuring high Quality of Service (QoS).

(*5) AWG (Arrayed-Waveguide Grating) router

An optical device that routes incoming WDM optical signals by their wavelength.

For further information, contact:
Minako Sawaki, Hirofumi Motai
Planning Division
NTT Science and Core Technology Laboratory Group
Tel: 046-240-5152
E-mail: st-josen@tamail.rdc.ntt.co.jp

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