Implementation and evaluation of fast lightpath setup method in wavelength-routed WDM networks

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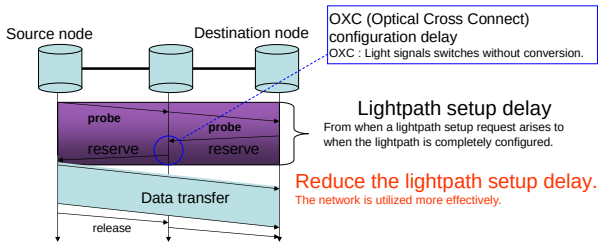
Background

- ✓ WDM (Wavelength Division Multiplexing)
  - The wavelength channel (lightpath) is configured on demand basis
  - Control plane : routing and wavelength assignment, resource management
  - Data plane : the data is transferred
  - Lightpath setup trial continues until it is succeed



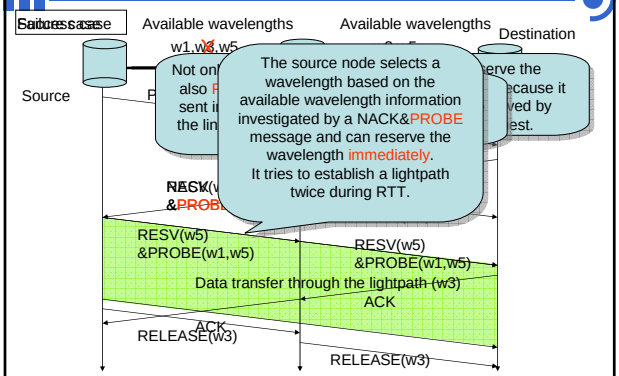
Research Purpose

- ✓ Hybrid lightpath setup method [5]
  - Integration of existing forward and backward methods
  - We have evaluated by computer simulation
  - The method has not been evaluated by experiments
    - ✓ The effect of the transmission, processing and OXC configuration delay of control packets is unknown

•Implementation of the hybrid lightpath setup method
• Evaluation by experiments

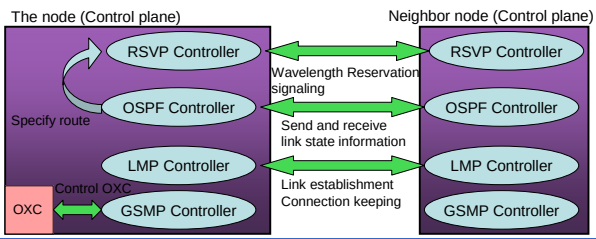
[5] Y. Kanitani, S. Arakawa, M. Murata and K. Kitayama " Distributed wavelength reservation method for fast light-path setup in WDM networks," in Proceedings of Optical Network and Technologies Conference, pp. 121-128, Oct. 2004

Hybrid reservation method



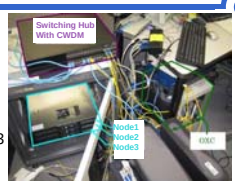
Implementation of hybrid lightpath setup method

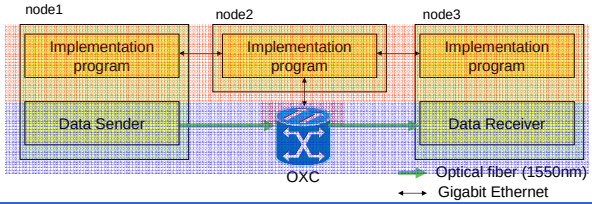
- ✓ The implementation program is based on standard GMPLS
  - Resource reservation module (RSVP Controller)
    - ✓ Extend the header and change the management of message
  - Routing module (OSPF Controller)
  - Link management module (LMP Controller)
  - OXC control module (GSMP Controller)



Experimental environment

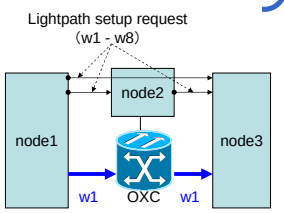
- ✓ **Control plane**
  - The implementation program runs on each of three nodes
  - Only node 2 has a OXC
- ✓ **Data plane**
  - IP packets are sent (node1 to node 3)
  - We observe the packet arrivals on node 3
    - ✓ Lightpath setup delay is calculated by the interval





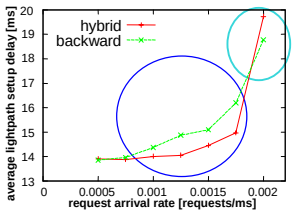
Lightpath setup request arrival model

- ✓ The lightpath setup requests
  - The arrival rate of λ (Poisson process)
  - The requests are one direction
- ✓ The lightpath holding time follows an exponential distributed (1 sec)
- ✓ 8 wavelengths (w1～w8) are available
  - Only one wavelength (w1 & node 1 to node 3) is actually switched by the OXC



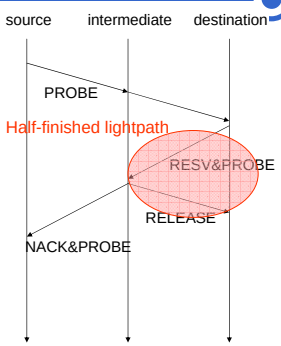
Compare with backward reservation method

- ✓ The average lightpath setup delay of the requests (W1 & node 1 to node 3)
  - OXC configuration delay: 9ms
  - Packet processing delay: 5ms
- ✓ hybrid method takes smaller lightpath setup delay
  - Under heavy-load
    - ✓ The setup delay of hybrid method is greater



Consideration for the result

- ✓ The reason why hybrid method is inferior under heavy load
  - Half-finished lightpath is obstructive
    - ✓ It appears when it fails wavelength reservation
  - Hybrid method is more likely to make half-finished lightpath
    - ✓ Hybrid method attempts lightpath establishment twice during RTT.
- ✓ This is an exception
  - Networks are not operating actually such heavy-load

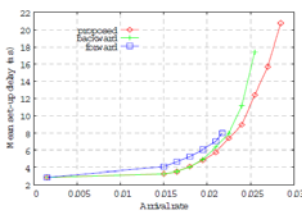


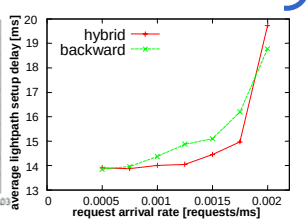
Conclusion and future work

- ✓ **Conclusion**
  - We have proposed the hybrid lightpath setup method to reduce lightpath setup delay
  - We implemented the hybrid method
  - We evaluated hybrid lightpath setup method through experiments
    - ✓ Hybrid method takes smaller lightpath setup delay than the backward method in realistic use
- ✓ **Future work**
  - Examine various routing methods
  - Evaluate the lightpath setup delay.

✓ Thank you

Compare with simulation result





- ✓ The larger the RTT is, the more effective our hybrid method works.
  - Our hybrid method works more effectively in experimental result because the OXC configuration delay works as it add to RTT.

Yosuke Kanitani, Shin'ichi Arakawa, Masayuki Murata, "A Proposal of Fast Wavelength Reservation Method with Retrial for Distributed Lightpath Establishment in WDM Networks," Technical report of IEICE(PN2003-10), pp. 27-32, October 2003