VLAN Tag Path Networking

April 8, 2004

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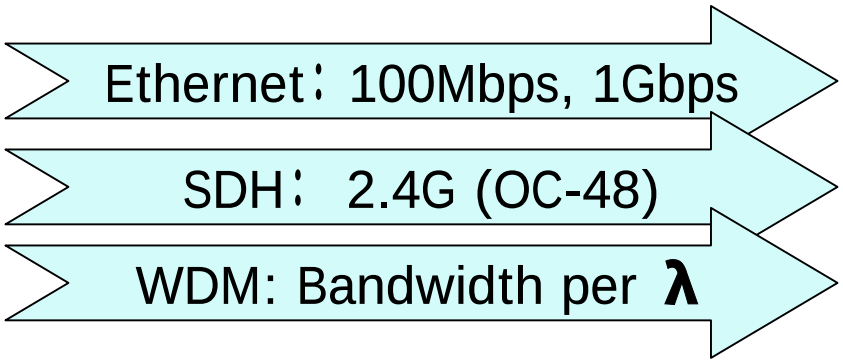
What's the Next in Ethernet WAN solution ?

- Ethernet has continued to be a Winner after fighting many other schemes (Token-Passing, FDDI, ATM) for long time and will continue.
- 10 Gigabit Ethernet has equipped the WAN oriented specifications.
- In Japan, Ethernet WAN and MAN have played a great role in VPN services.
  - Wide-area Transportation Scheme always reaches "Path Concept".
    - Ethernet does not yet.

	Transportation Scheme	Path Technology
Layer 3	MPLS	Label Path
Layer 2	Ethernet	
	ATM	VPI / VCI
	Frame Relay	DLCI
Layer 1	SDH	Path Section
	WDM	λ-Path

VLAN Tag Path

Technology Trends and VLAN Tag Path Concept



Higher Throughput with Lower Cost

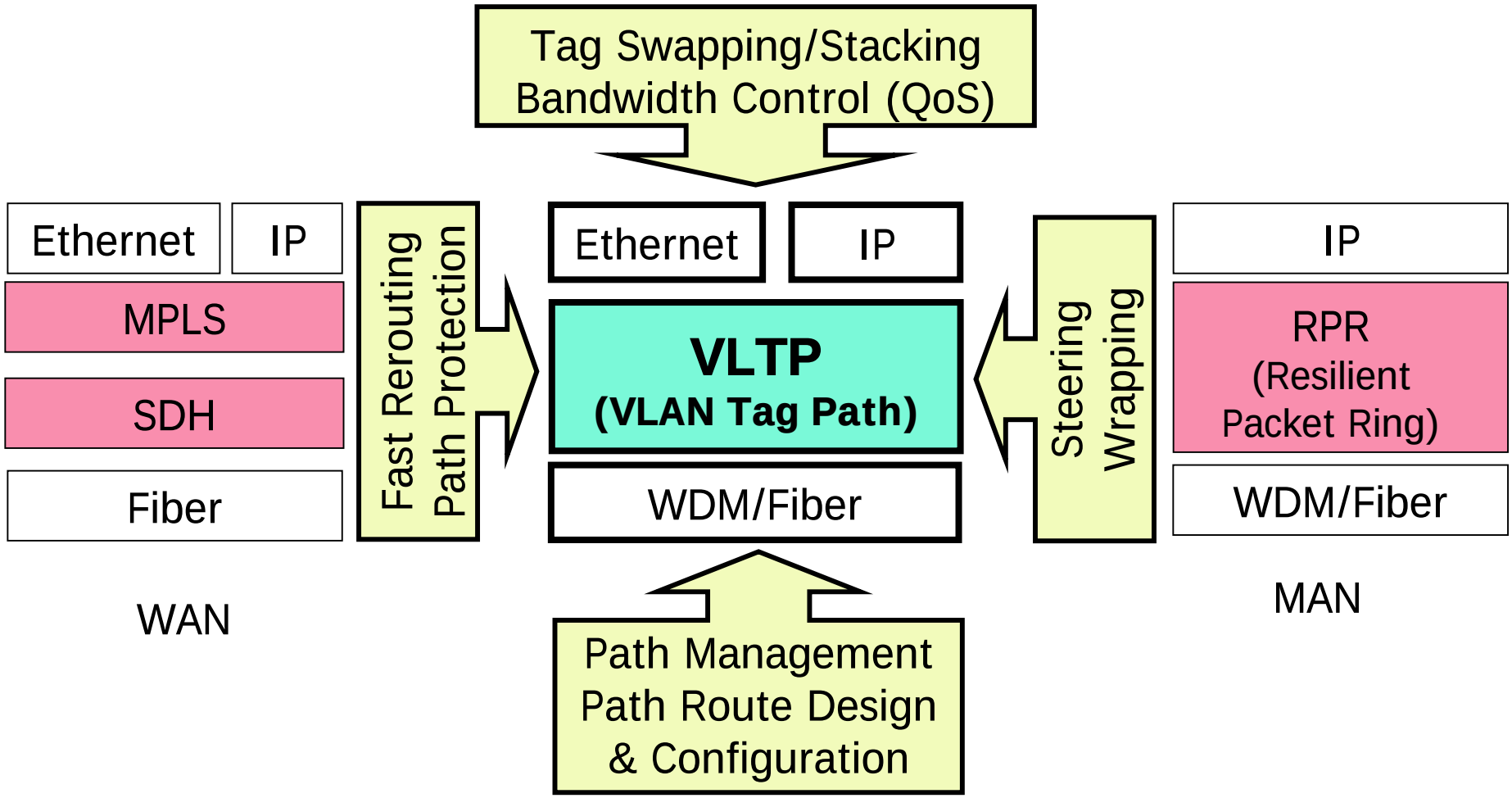
- Current Ethernet Technologies for WAN services
  - VLAN Tag Stacking & Swapping
  - QoS Control for VLAN tag flow
- Lack of Path Concept
  - Spanning Tree Protocol is not enough good for WAN services
- Issues to be considered for Path Concept
  - Fast Rerouting Control against link or node failure
  - Path Management
  - Path Route Design and Configuration

10 Gigabit Ethernet

IP (MPLS) / SDH will shift to Ethernet / WDM

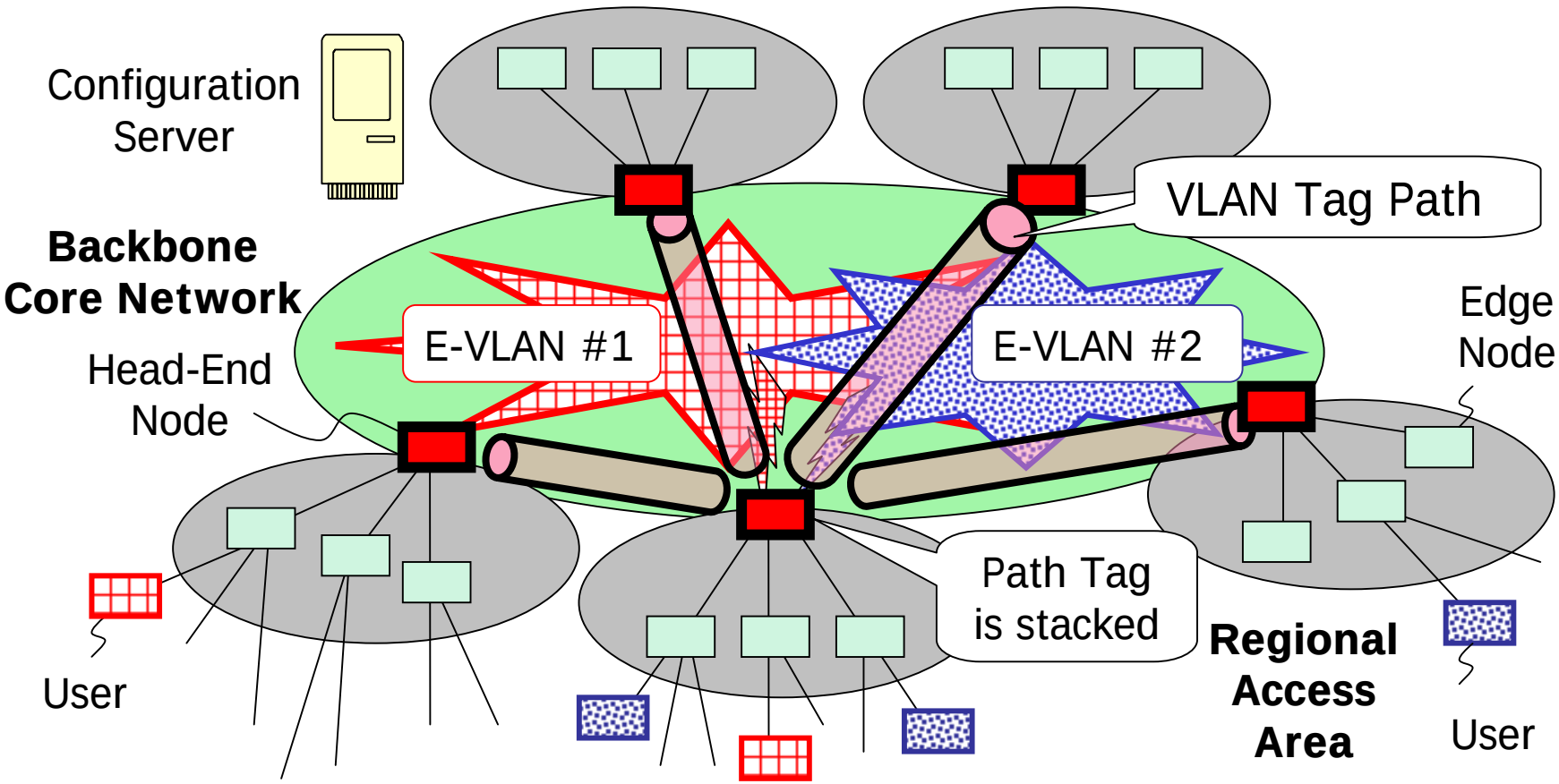
Path Concept is mandatory especially in Core Network.

VLAN Tag Path Networking

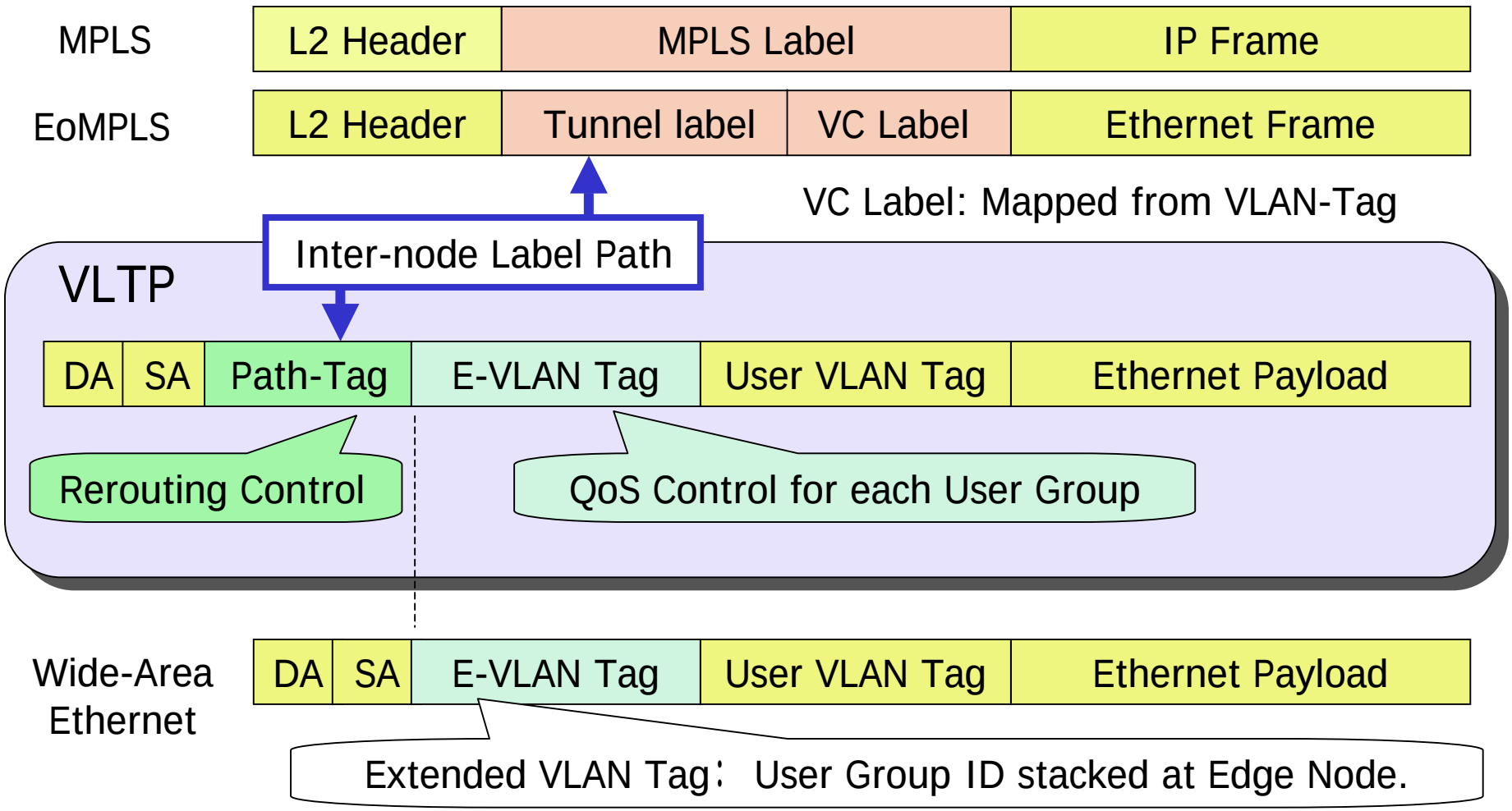


VLTP VPN Model

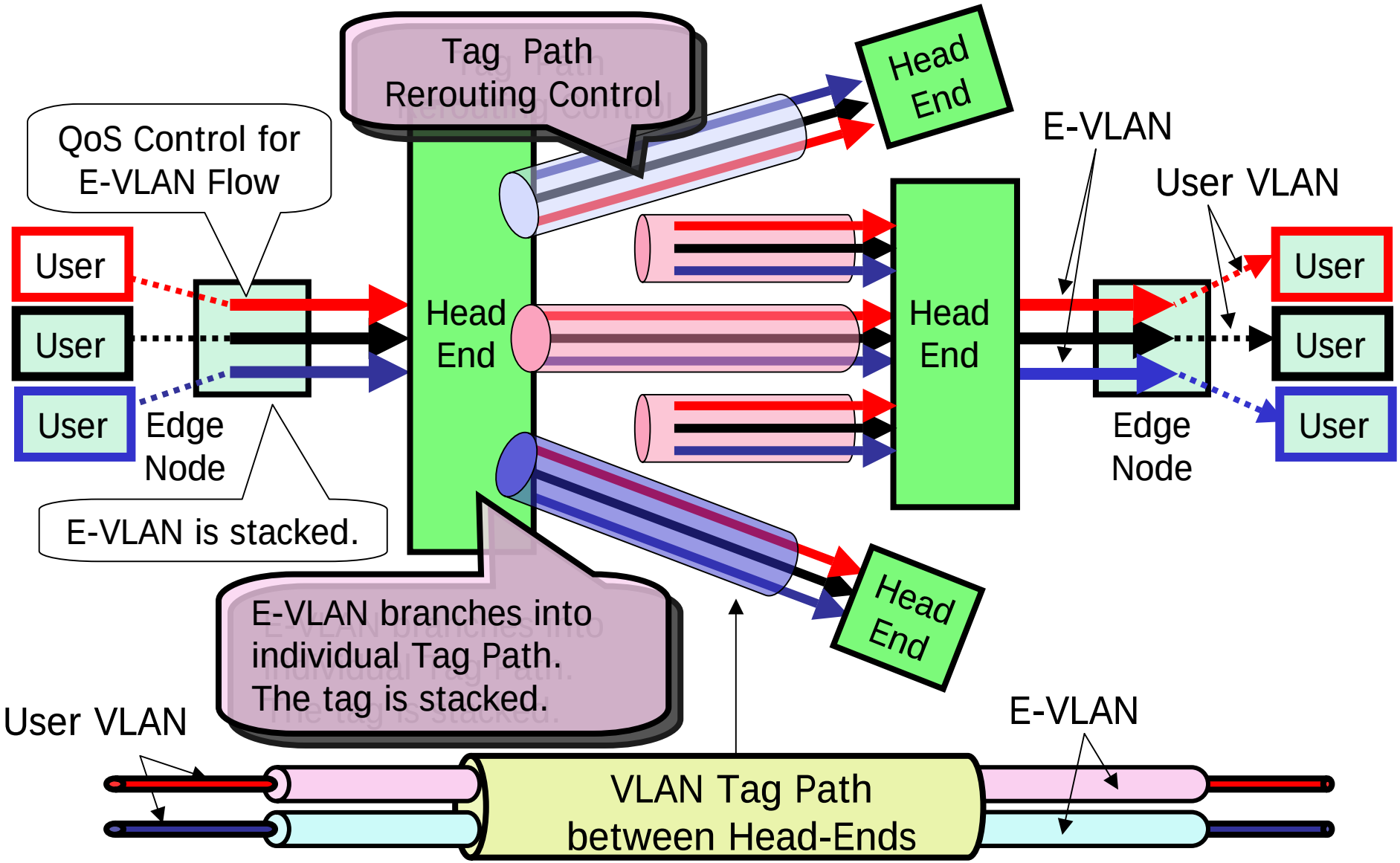
- Extended VLAN(E-VLAN): For each user group (corporate user), E-VLAN ID is assigned and stacked at Edge Node.
- VLAN Tag Path: For each destination, the path is defined between Head-End Nodes.



VLTP Frame Format



VLAN Tag Processing



Target Functionality of VLTP Rerouting Scheme

- Conventional Schemes
  - 1+1 Path Protection (SDH Network)
    - High-speed protection
  - Fast Rerouting (MPLS)
    - Local restoration scheme
  - Wrapping/Steering (Resilient Packet Ring)
    - High-speed loop back operation (Wrapping)
    - Short cut for space reuse (Steering)

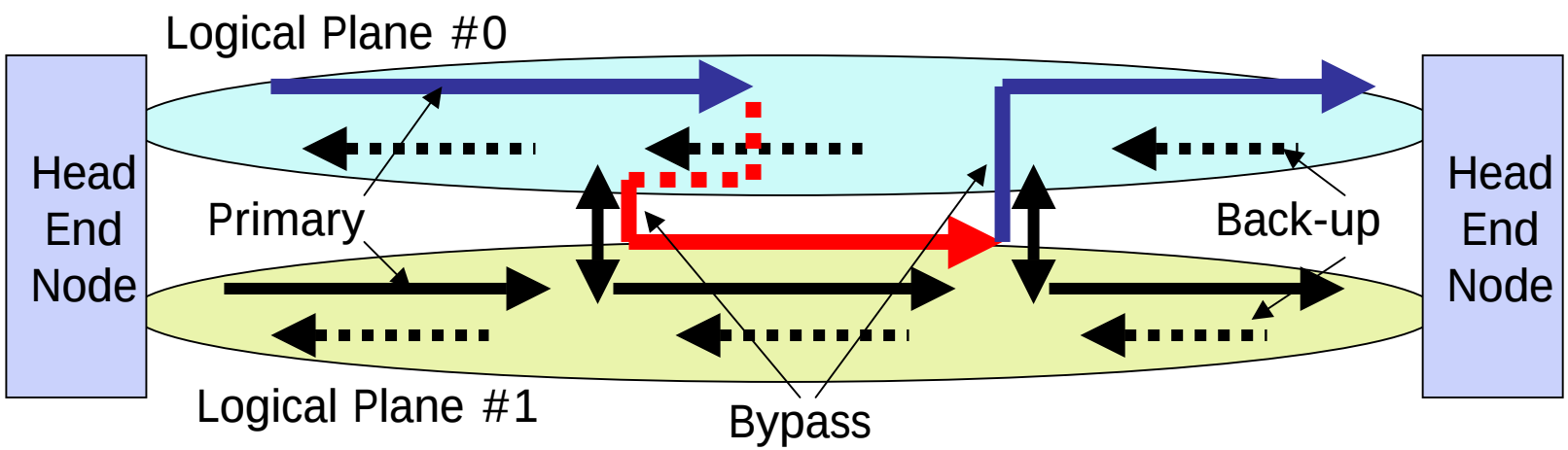
- Target Functionality of VLTP Rerouting Control
  - High-speed 1+1 protection
  - Rerouting with short-cut operation
  - These shall be integrated into single mechanism over Ethernet

Rerouting Control Policy

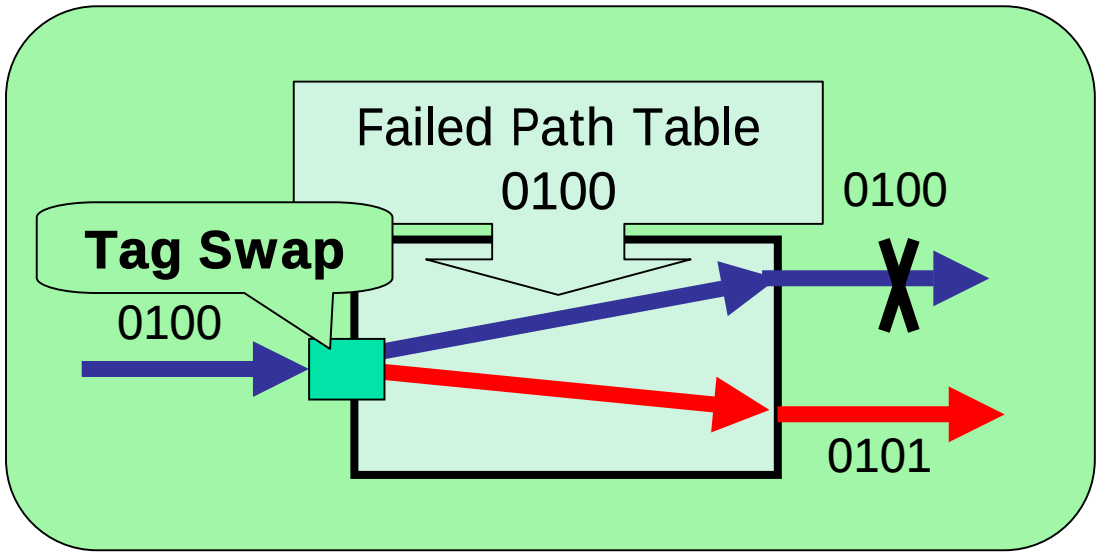
- Dual Paths shall be provided for Destination Node.
  1. One is Primary, Other is Back-up
  2. Load Sharing between two paths
     - Link Aggregation between Head-End Nodes
- High-Speed Local Rerouting over the Two Paths.
- Path/VLAN is designed and configured by Configuration Server.

Path Route Design Concept

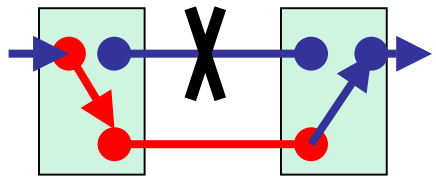
- Dual logical planes are defined
  - Primary path goes forward and back-up path goes backward.
  - Both planes can work in the primary and back-up mode.
  - At some points, both plane have bypass routes.
    - The back-up path in a plane goes forward in other plane after bypassing.
  - Path hunting rule at transit node:
    1st: Primary 2nd: Bypass 3rd: Back-up
- For the mission critical location, two parallel links are defined for 1+1 protection.



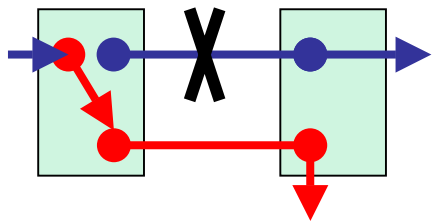
Tag Swapping Control in Ethernet Switch



1+1 Protection



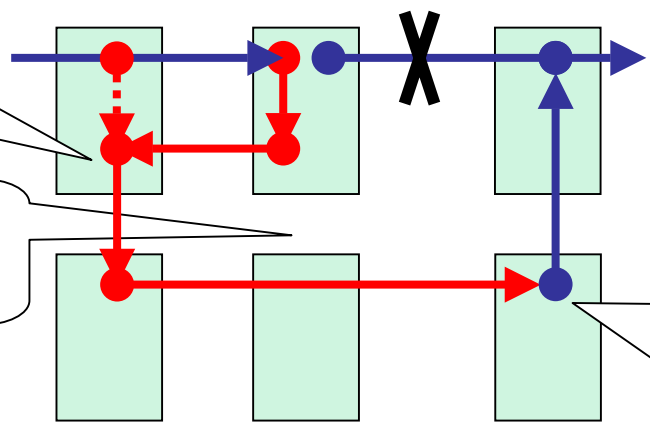
Rerouting



Short-cut **Route-back**

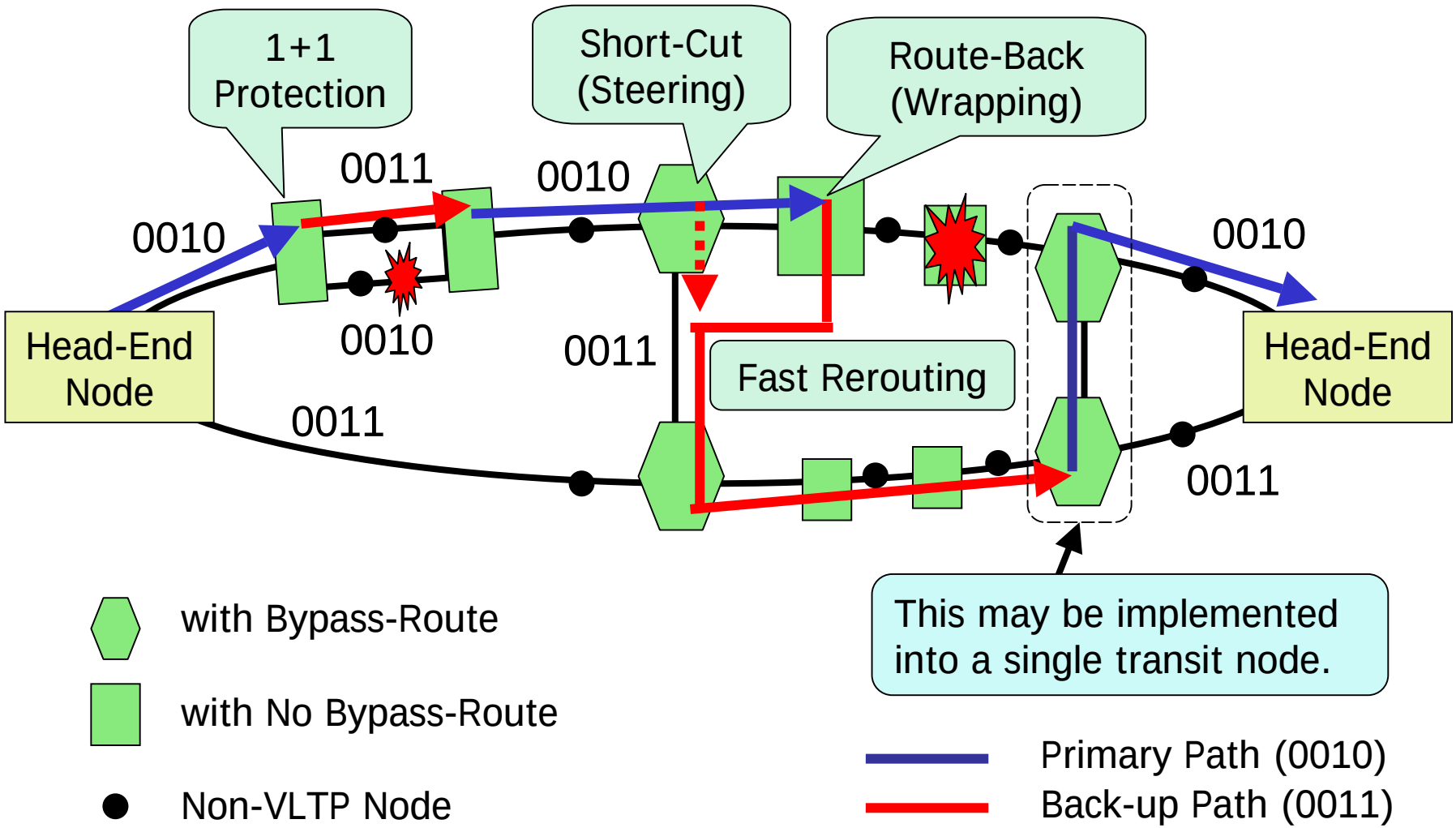
Arrival of 0101 means Failure of 0100

No Bypass Route



Since Primary Path is available, the tag is swapped to the primary.

VLTP Rerouting Control



VLAN Tag Path Management

- Rerouting Control at the node:
  - Mutual supervision with next-hop VLTP nodes
  - MAC frame/Line condition monitoring
  - Action report to Path Management Server

- End-End Path Management:
  - Management packet for all VTLP nodes in the VLAN path and the response from them to the source Head-end node.
  - Path status report to Path Management Server

Configuration Server

- VLAN configuration is mandatory for Ethernet.
- Variety of VLTP rerouting control operation depends not on access control but on path design including back-up path.
  - As well as configuration, path design is important.
- Primary path and back-up path are determined following to the operator policy.
- The server may integrate the lower layer path configuration such as WDM path.

VLTP-Ring Network
- Wrapping/Loop-back Operation -

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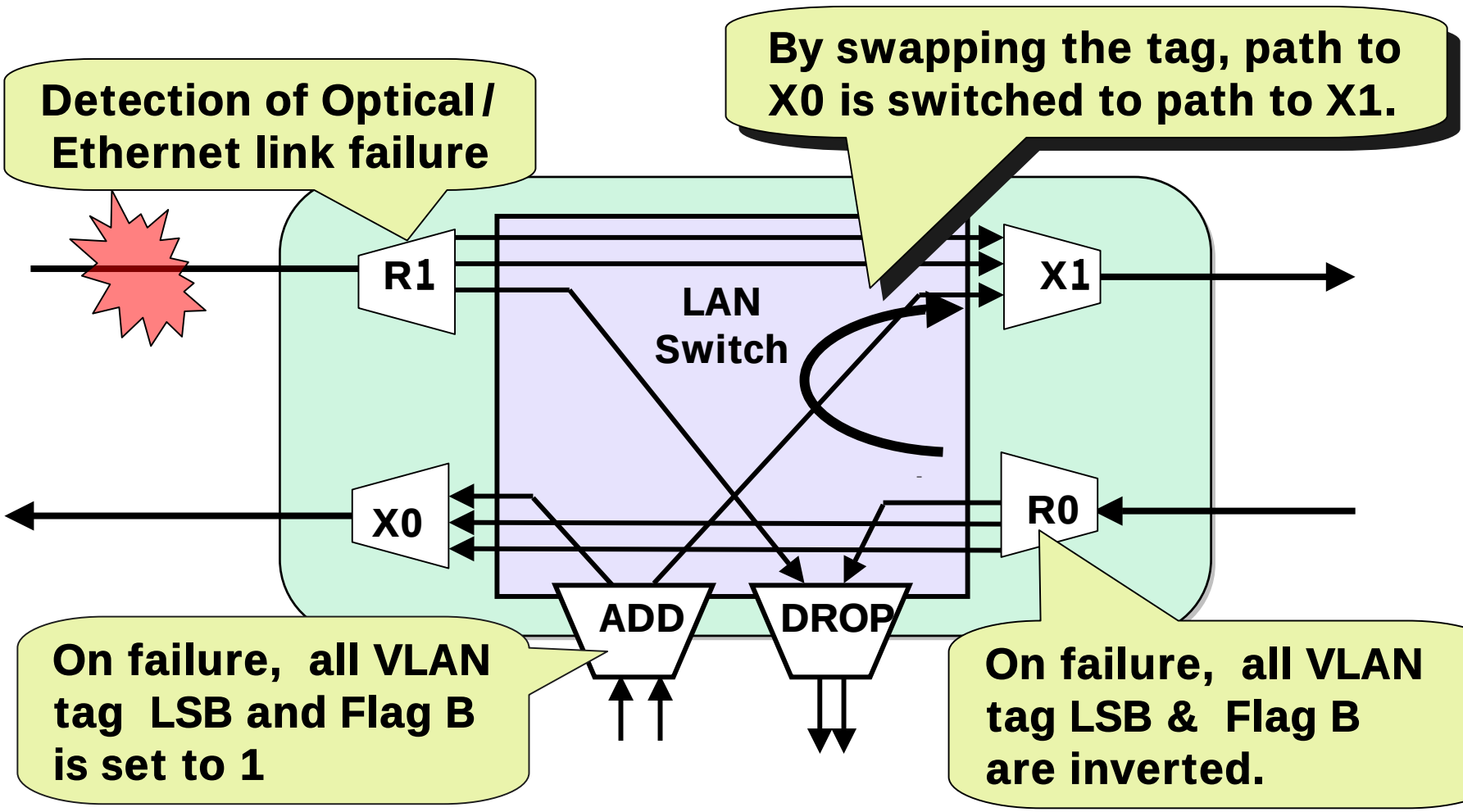
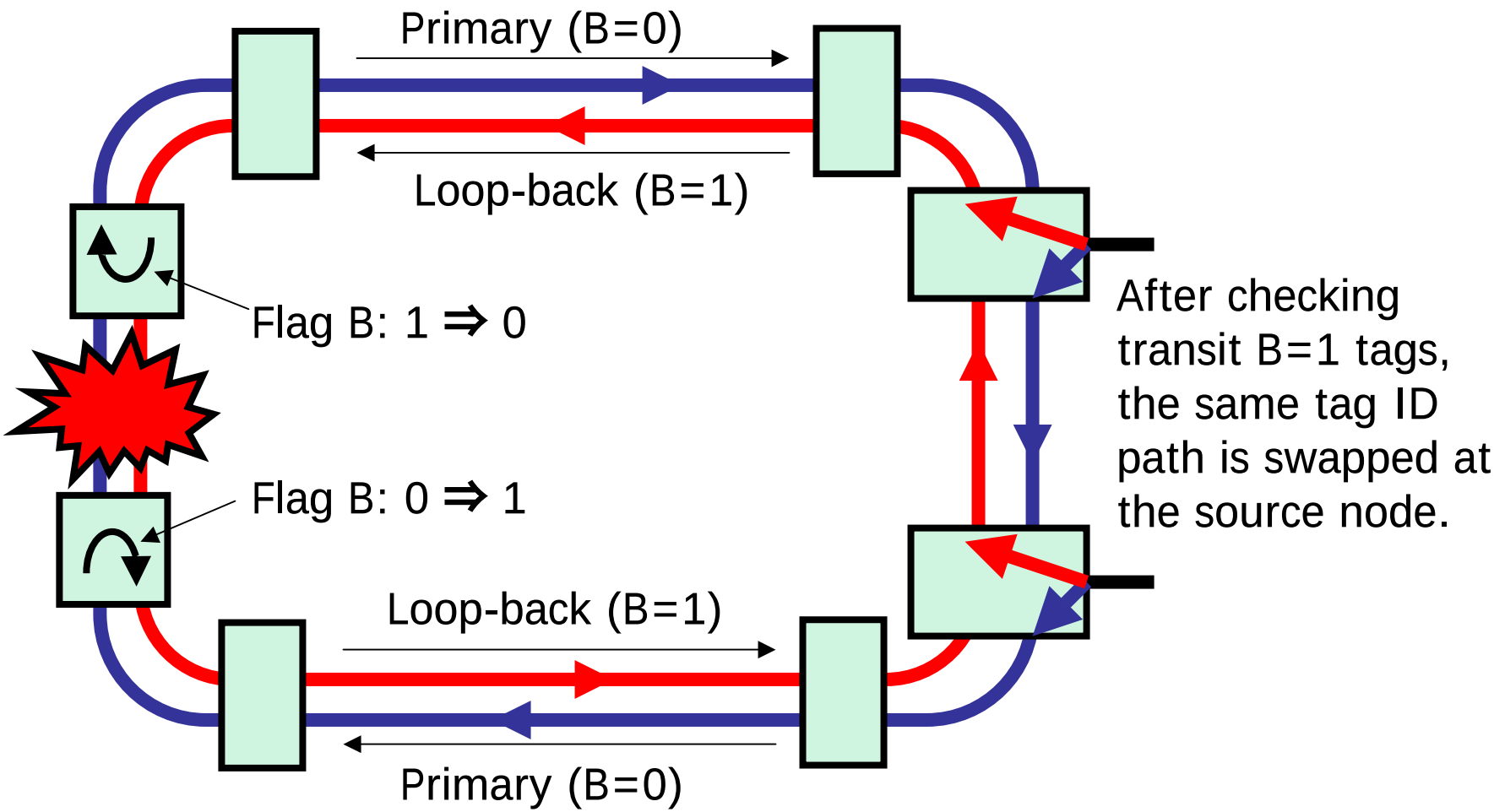
VLAN Tag | B | Node ID | 0/1

Node ID: Destination Node
Flag B: B=1 indicates Loop-back



VLTP-Ring Network
- Steering Operation -



Packet Removal from Ring: Unicast at destination node
Multicast at source node after ring circulation

Conclusion

- In order to expand the broadband services, Optical or WDM Networking is expected to be a main player.
- However, optical or λ path is “solid”, which has no statistical multiplexing functionality.
  There needs a partner with the functionality for the total solution.
- “VLAN Tag Path” will be the partner.
  - Policy base of primary and back-up paths design
    with tag swapping operation
  - Supporting 1+1 Protection, Route-Back, Short-cut operation,
    which covers the functionalities of MPLS/SDH path and RPR
  - High-speed operation
    - Simple algorithm and localized negotiation for rerouting
  - End-End Path management
  - Path route design and configuration by Configuration Server
    - The server may integrate for the optical or λ path.