GMPLS技術を用いた
光IP統合ネットワーク

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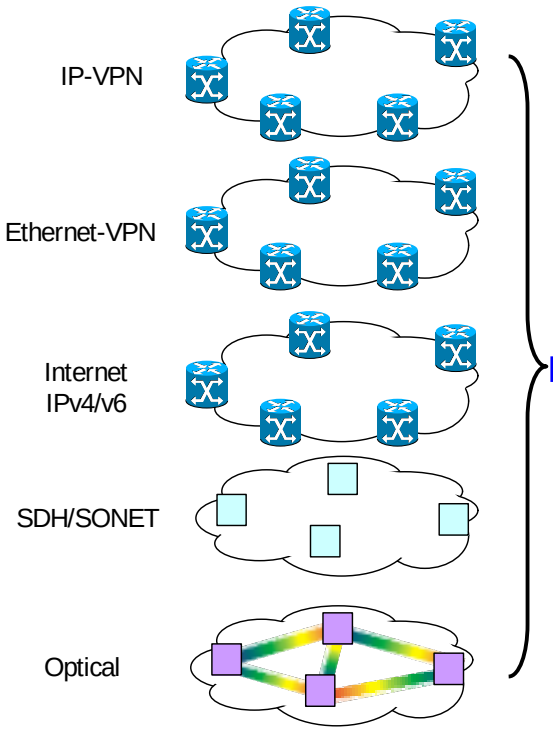
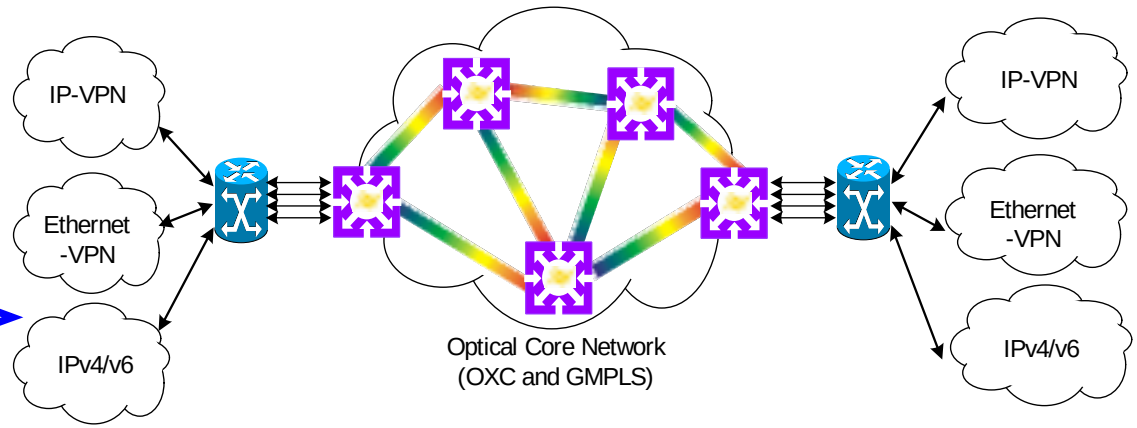
Overview of this presentation

- Background
  - Integrating IP/optical networks
- GMPLS early field trial
  - Interoperability between PXCs and GMPLS routers
  - Advantages of GMPLS networks
- Service transport over GMPLS networks
  - MPLS/GMPLS
  - BGP-4/GMPLS
- Conclusions

Background



MPLS/
GMPLS



- A network per a service and per an operational division
  - Service specific functions
  - Equipment specific skills
  - Merger of companies

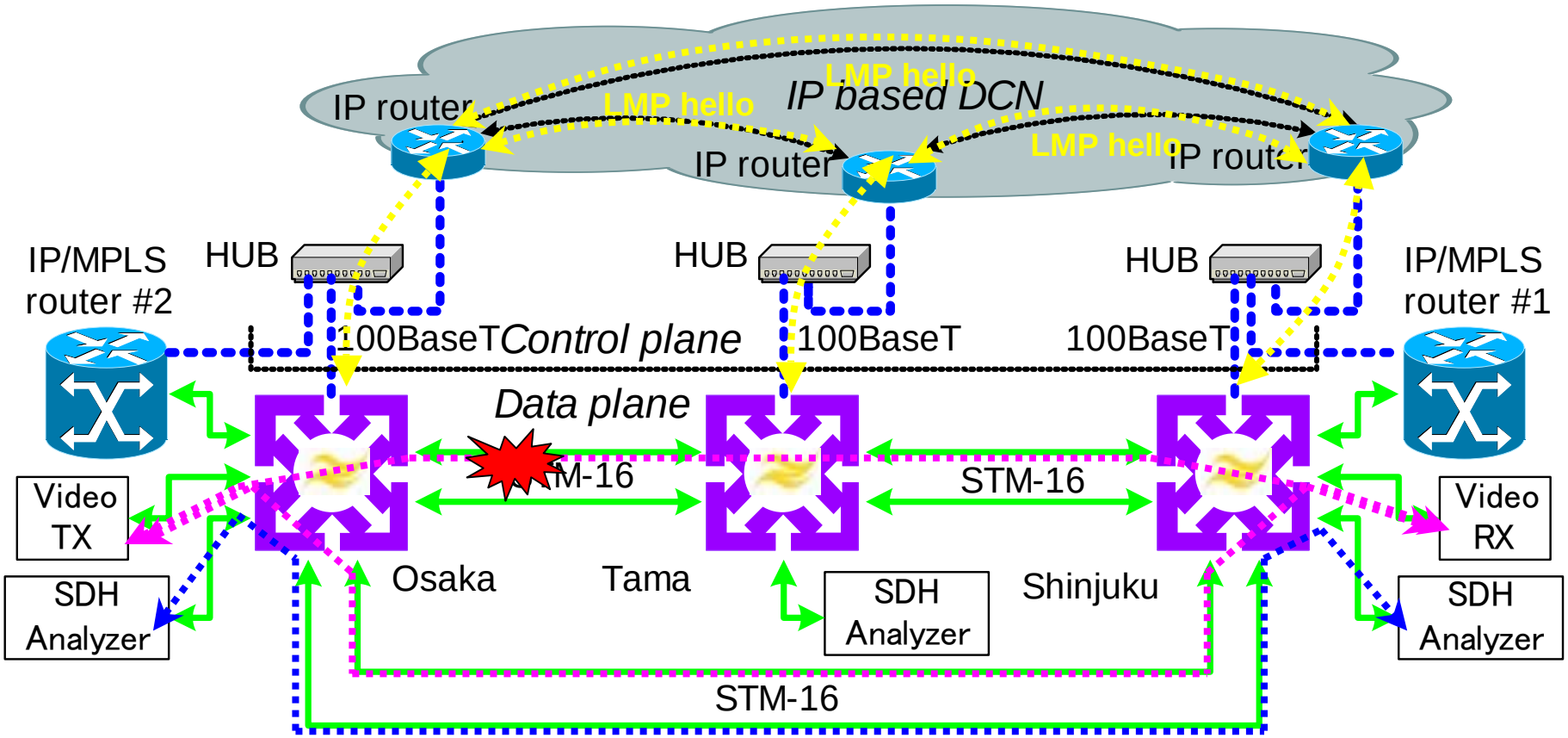
- Network integration of multi services and multi layers is expected to improve
  - Operational efficiency
  - Resource utilization of backbone bandwidth
  - Network resiliency

GMPLS field trial

- GMPLS (Generalized multi-protocol label switching)
  - can control and manage core nodes (OXC, PXC) as well as client nodes (IP/MPLS router, MSPP) by an unified control plane.
  - provide flexible and reliable end-to-end services as well as achieve flat network management over optical infrastructure.
- GMPLS-controlled photonics cross-connect (PXC) and IP/MPLS routers
  - Evaluation from the viewpoint of operation and maintenance
    - All-optical SW with bit rate and format transparency
    - Simple, cost effective solution with low power consumption
  - Evaluation of interoperability with GMPLS controlled IP/MPLS routers
    - Signaling level
    - Routing level
  - Separation of data and control planes in a GMPLS-controlled network
    - Investigation of reusing an IP-based DCN for a control plane

Objective: **Evaluation of GMPLS-controlled equipment in the actual operational environment, in order to introduce a very simple and effective next generation lambda based optical network.**

Field trial configuration



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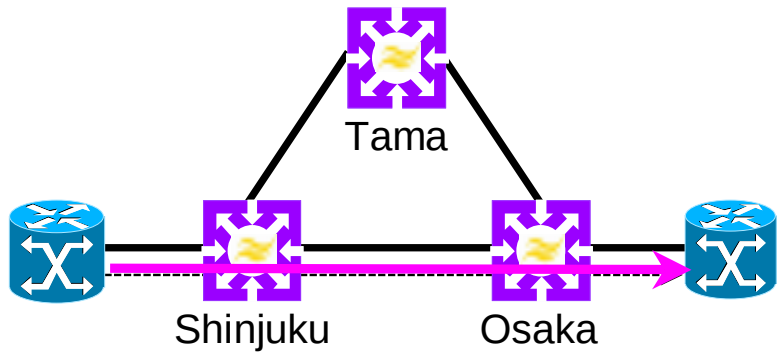
GMPLS interoperability results (1)

- Evaluation of GMPLS interoperability between PXCs and IP/MPLS router on both signaling and routing levels

(i) Automatic path provisioning

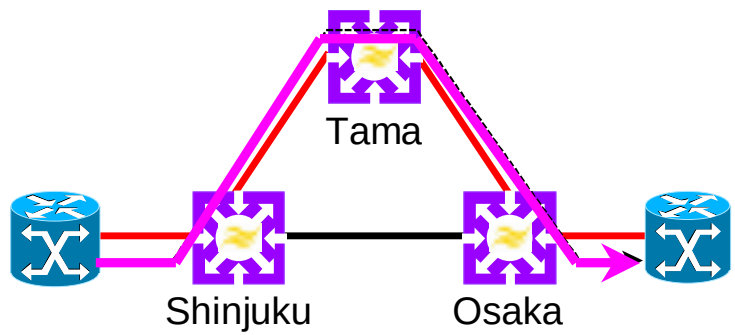
- Automatically calculate the explicit route (Source routing)
- Selected the shortest path



(a) A shortest path exists

(ii) Explicit path provisioning

- Specifying an IP address (Node ID) of interfaces
- Signaling the specified route



(b) Explicit routing（selected red links）

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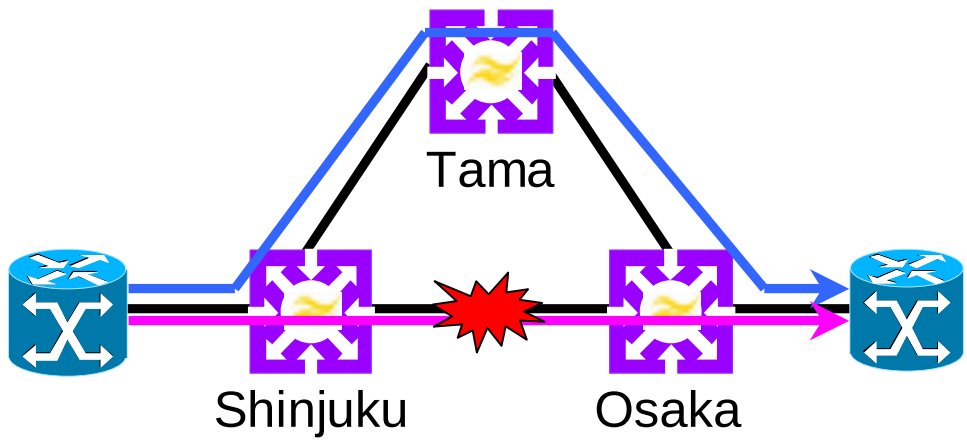
GMPLS interoperability results (2)

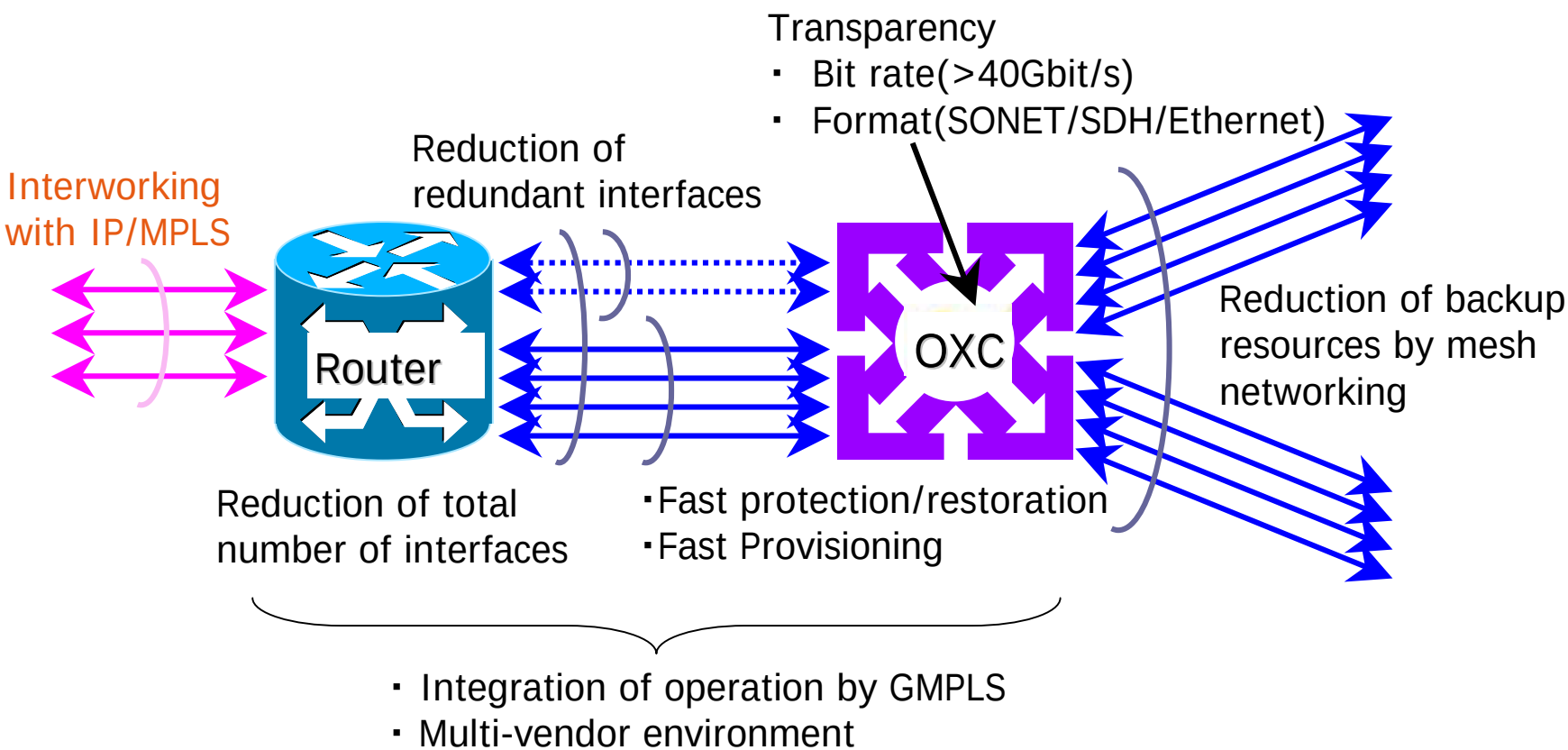
- End-to-end restoration of a Lambda LSP between routers
  - Disruption time measured by traffic generators
  - Detecting Fiber failure and fault isolation by LMP
  - RSVP-TE re-signaling
  - Restoration time : 700ms (now)



GMPLS technology not only improves the network resource utilization, but also provides network resiliency to a client equipment.

Advantages of GMPLS interworking

- Introduction of an integrated IP/optical network



Service Scenario over GMPLS

GMPLS controlled PXCs and IP/MPLS routers was evaluated in a carrier's actual environment.

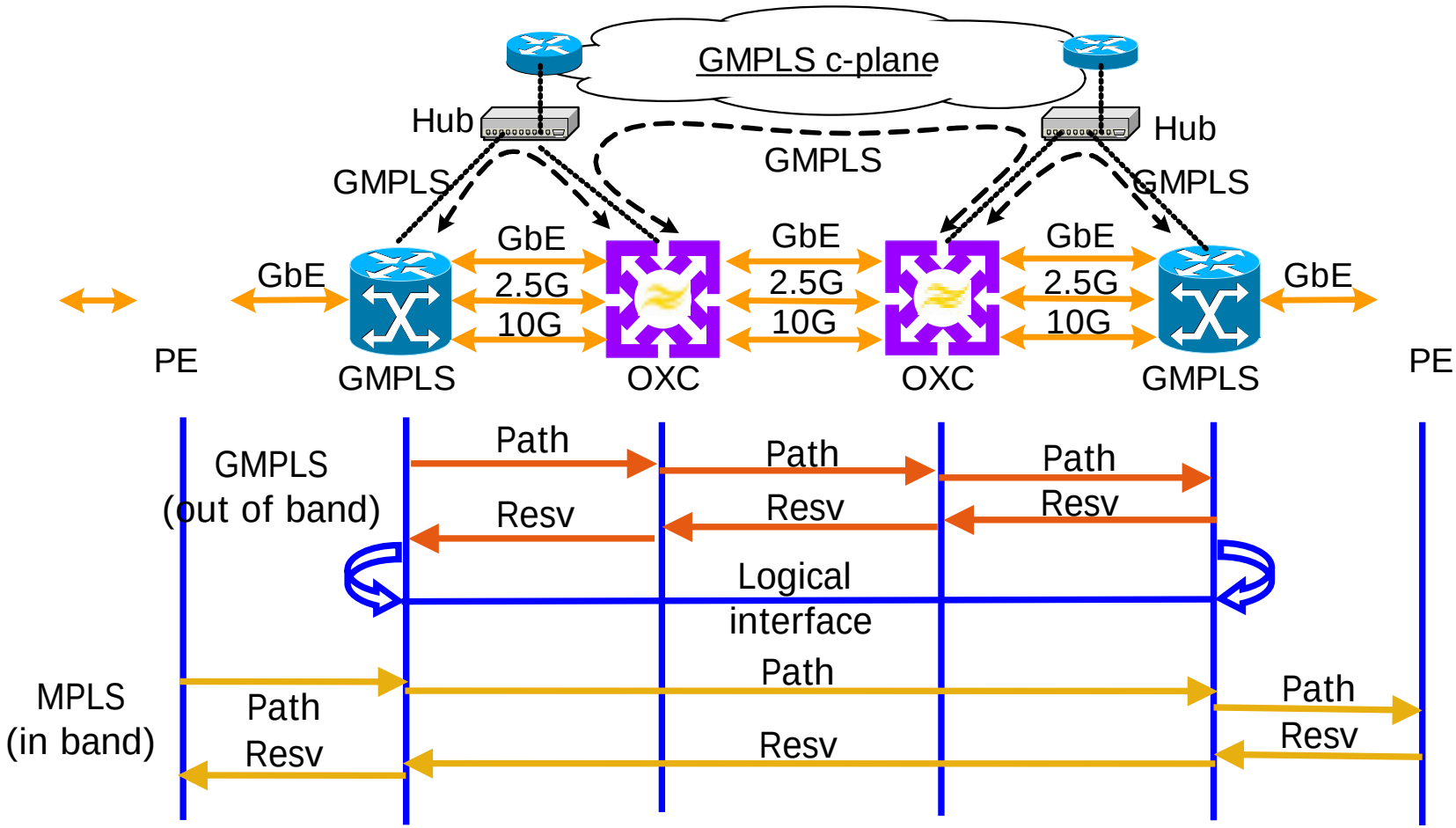
- Interworking operation between PXCs and IP/MPLS routers on both signaling & routing levels
- Interworking operation for restoration (protection in the future)
- Reuse of the IP-based DCN as IP Control Channels

Service scenario ?

- Service migration from GMPLS point of view
  - MPLS interworking with GMPLS
    - Major services (IP-VPN, Ethernet-VPN) are based on MPLS
    - Legacy services (ATM/FR) can be transported using MPLS
  - IP interworking with GMPLS
    - IPv4 as well as IPv6 is to be supported.
    - BGP-4 is to be transported over GMPLS

Next target

MPLS over GMPLS (1)

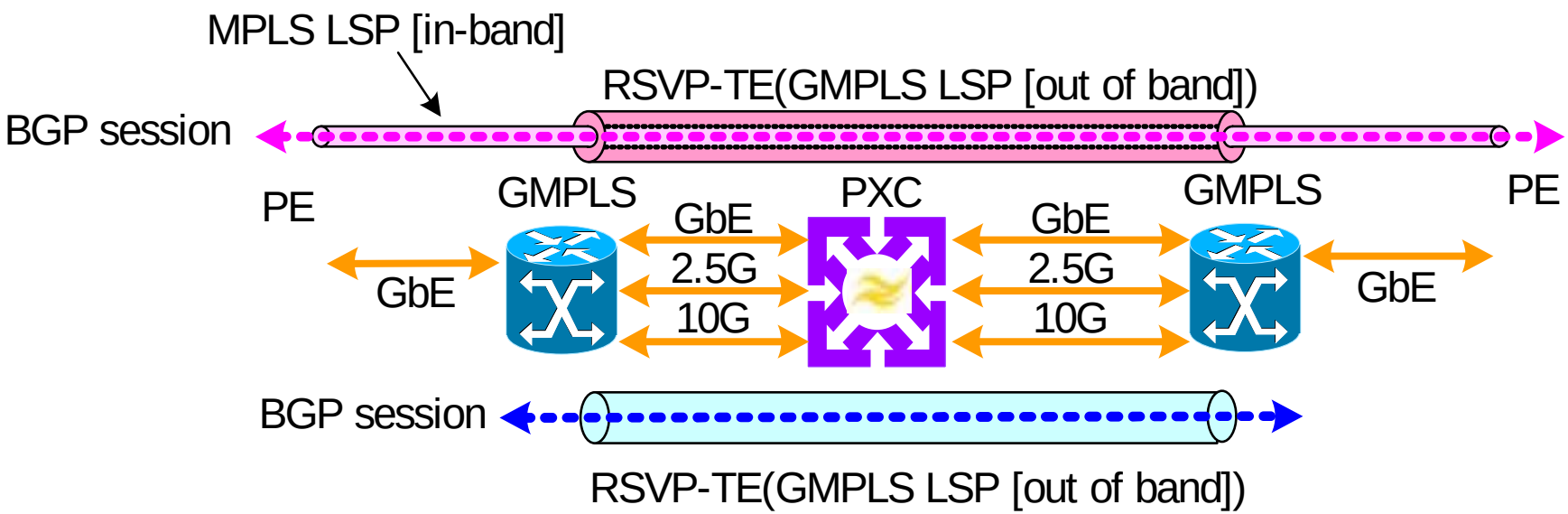


MPLS over GMPLS (2)

- MPLS LSP creation over a GMPLS LSP
  - A (bidirectional) GMPLS LSP is created between GMPLS routers.
    - LSPs can be created with GbE, 2.5G and 10G bandwidth
    - The tunnel is logically numbered as IPv4 addresses.
  - A MPLS LSP is created between PE routers.
    - LSPs can be created specifying logically created interfaces.
- IP traffic restoration by GMPLS
  - IP traffic can be restored within GMPLS restoration time (700ms)
    - The MPLS signaling storm can be avoided by GMPLS restoration (and protection).
    - Fast protection of GMPLS is also required and to be evaluated.

BGP over GMPLS

- BGP-4 over GMPLS
  - GMPLS LPS creation between GMPLS routers (w/o OSPF-TE)
  - BGP-4 session establishment over a GMPLS LSP
    - Different ASes are connected over a GMPLS core
  - BGP-4 session establishment over a MPLS LSP as well (w/o OSPF)



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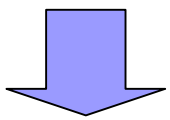
Future investigation and challenge

- Actually operational migration
  - Consideration of addressing, AS number and so forth.
- Control of multi layers
  - Dynamic interaction between (IP/)MPLS/GMPLS
- High resiliency of GMPLS networks
  - Data plane recovery as well as control plane recovery
- GMPLS multi-domain
  - GMPLS Inter AS/area
    - draft-otani-ccamp-interas-GMPLS-TE-00.txt
- Interoperability
  - To assure multi-vendor environment

Conclusion

The field trial using GMPLS controlled PXCs, IP/MPLS routers and existing DWDM systems was successfully demonstrated.

- Fast provisioning/restoration of PXCs as well as IP/MPLS routers
- Interworking operation between PXCs and IP/MPLS routers on both signaling & routing levels
- Reuse of the IP-based DCN as a GMPLS control plane



In addition….

- Demonstration of MPLS/IPv6 transport over GMPLS networks
  - MPLS/GMPLS
  - BGP-4/GMPLS

A GMPLS controlled network will be deployed in a carrier's actual environment and is expected to improve carriers network operation and service management.