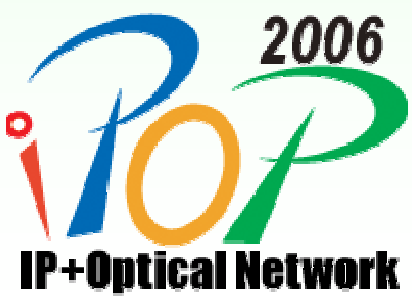
A novel nodal and network architecture to realize GMPLS based Multi Layer Service Network

Zafar Ali (Cisco)
Ichiro Inoue (NTT)
Hisashi Kojima (NTT)
Shigeo Urushidani (NII)



Outline

- GMPLS advantage for future carrier's network
- Requirement for deploying GMPLS technologies
- Multi-Layer Service Network Architecture
  - Architectural Model
  - Nodal Model
- Conclusion

GMPLS advantage for future carriers' backbone networks

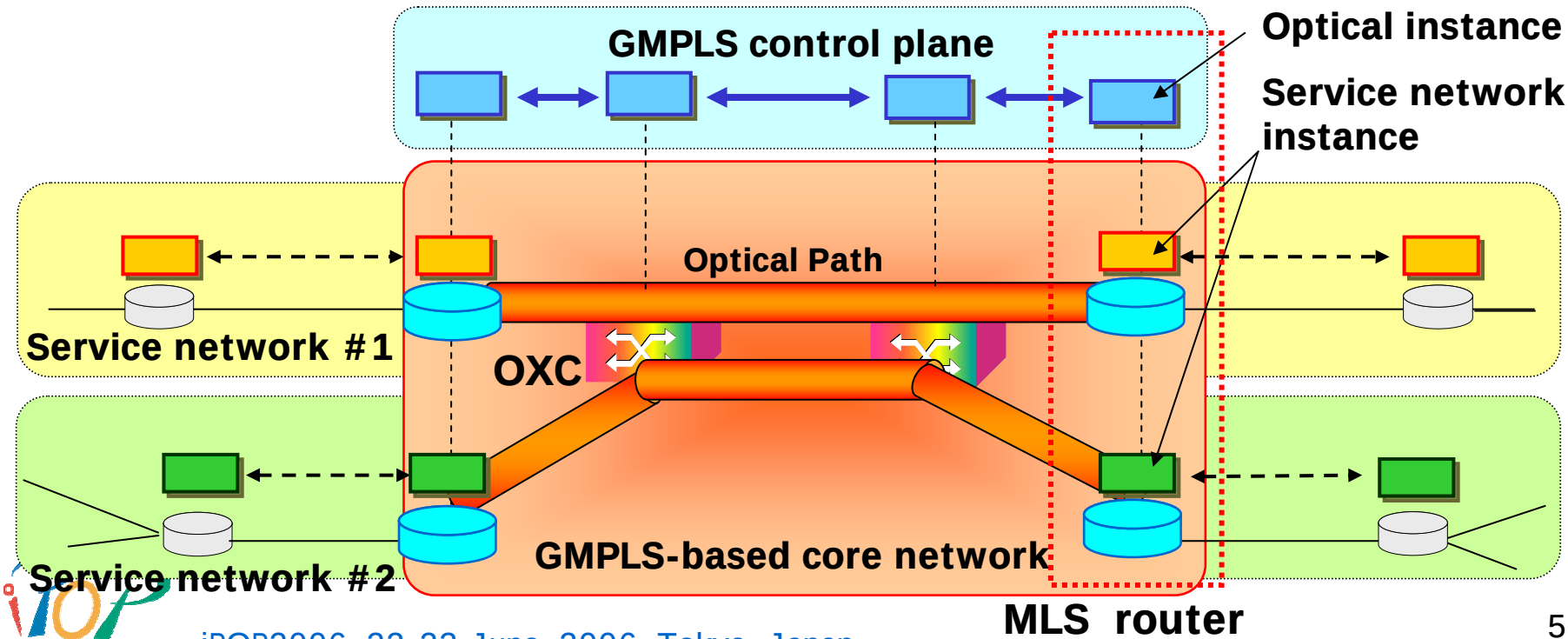
- **High capacity (rapid traffic growth)**
- **Flexibility**
  - Uncertain demand
  - Rapid new service provision
  - Multi-layer TE
- **Advanced Protection and Restoration**
  - Mesh Protection

Requirements for deploying GMPLS technologies

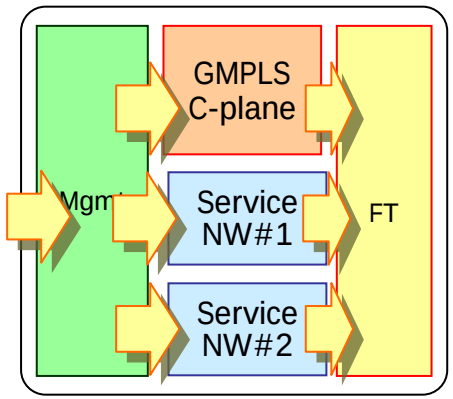
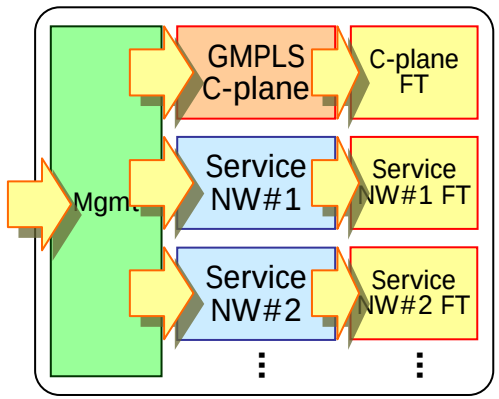
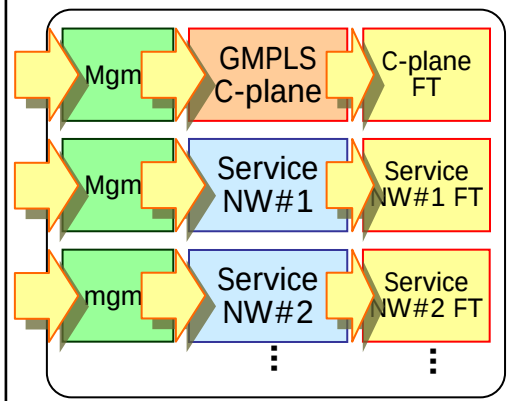
- **Multiple service network accommodation**
  - Share a single optical infrastructure with multiple service networks
  - Each service network...
    - Should have its own C-plane and F-plane separated with other service networks
    - May be administrated by different entity
- **Easy migration from existing networks**
  - Little or no impact on services
  - All the existing nodes can not always support GMPLS protocols.

Multi-layer Service Network Architecture Overview

- Composed of GMPLS-based core network and MLS routers
- MLS routers with an optical and multiple service network instances can accommodate multiple service networks.
  - ➢Each service network is separated in terms of C/F-plane.
  - ➢Service network nodes do not need to support GMPLS.



Multi-layer Service Network Architecture
Architectural model comparison

Architecture	C-Plane separation	C- and F-plane separation	C-, F- and M-plane separation
			
Routing design independency	**Yes**	**Yes**	**Yes**
Network design independency	**Limited** Address space overlapping should be avoided.	**Yes**	**Yes**
Management independency	**Limited**	**Limited**	**Yes**
Deployment scenario for carriers	-	**Multi service backbone administrated by single entity**	**Multi service backbone administrated by different entity**

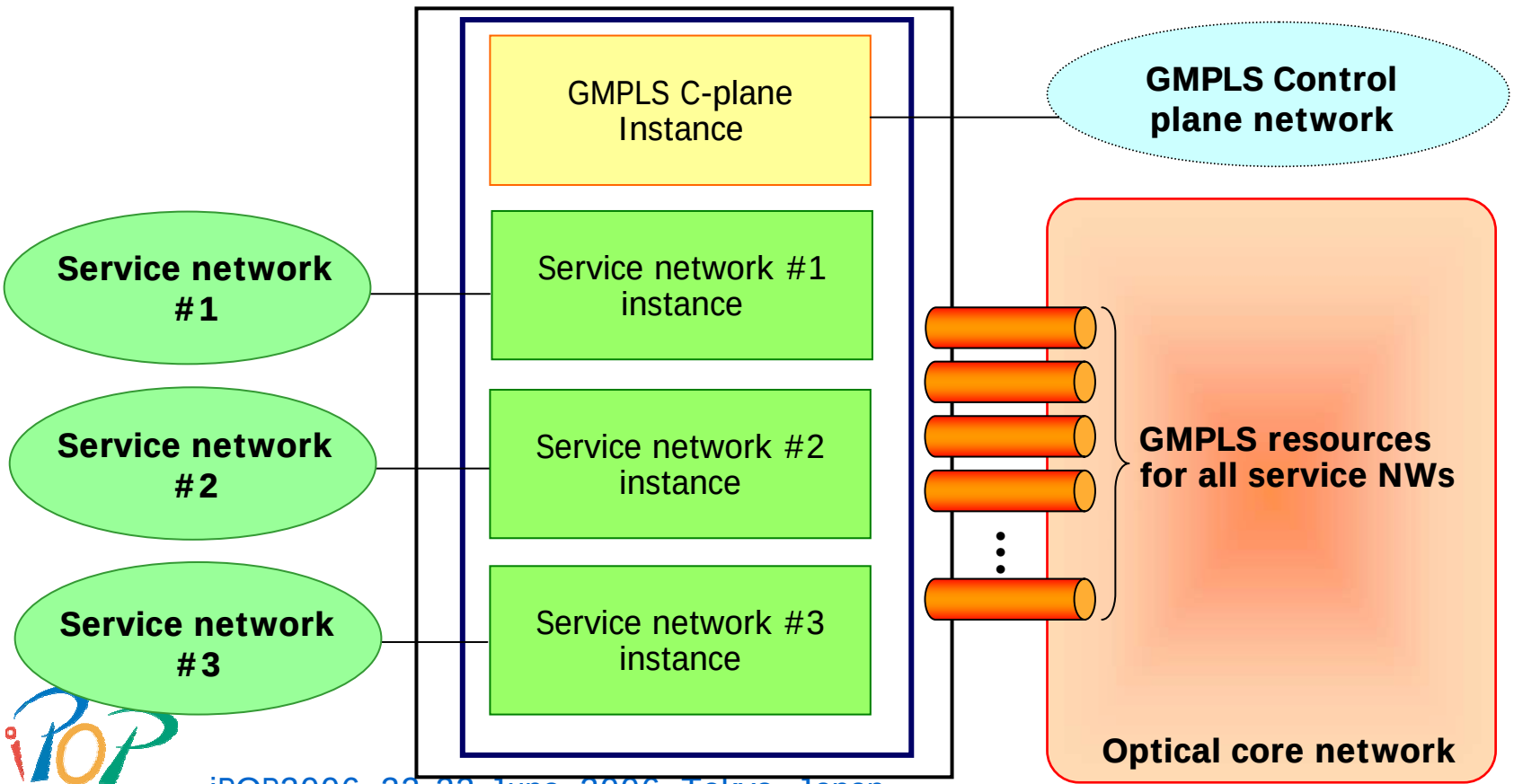
Multi-layer Service Network Architecture Architectural model comparison

- **C- and U-plane separation model and C-, F-, and M-plane separation model are applicable for future carrier's backbone network.**
  - Each service network is designed independently, so C-plane and F-plane separation is required at the least.

- **Necessity of M-plane separation depends on how and who to administrate each service network.**
  - M-plane separation is required if each service network is administrated by different organization or different company.

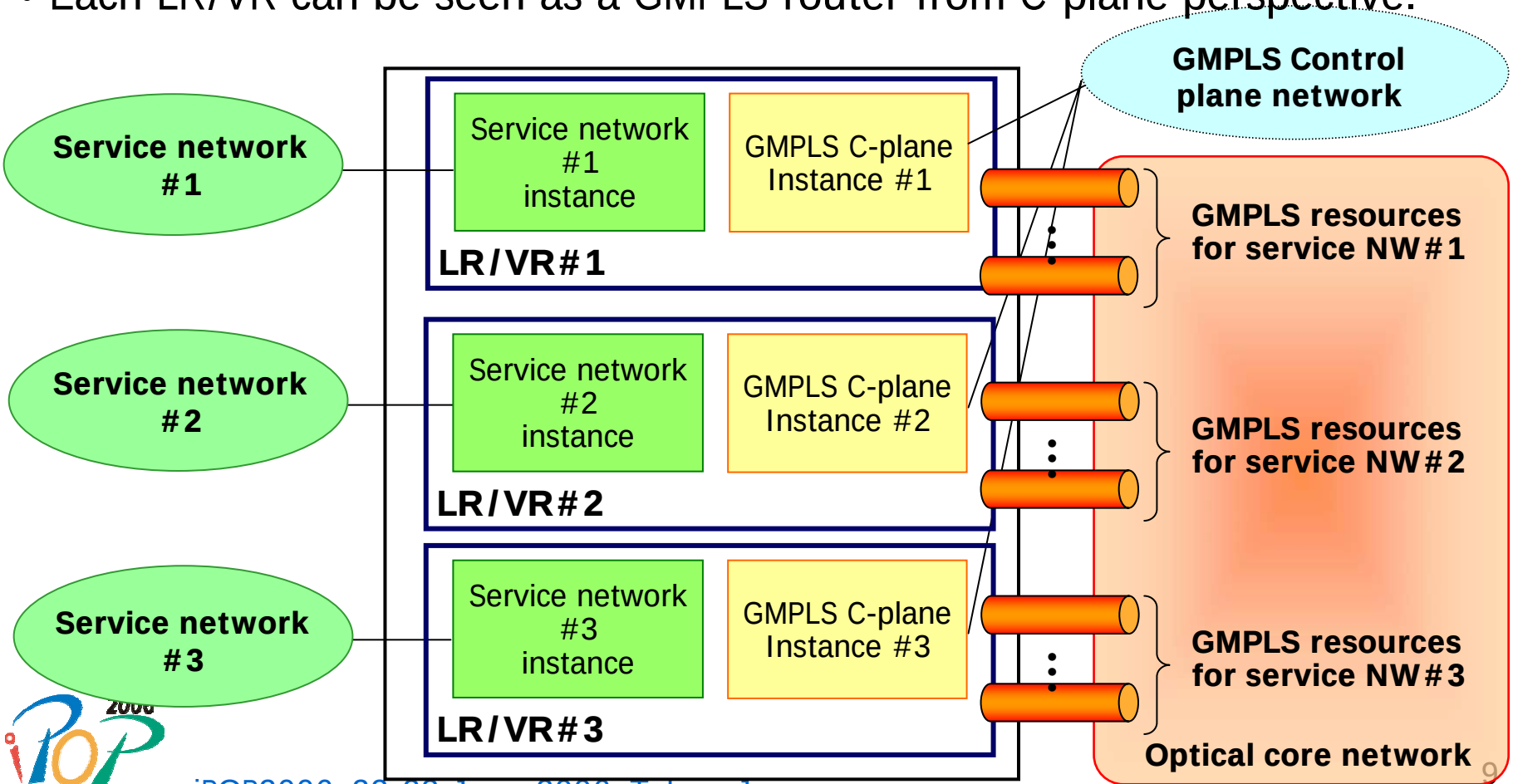
Multi-layer Service Network Architecture
Nodal model 1: BM with process distribution

- Each service network instance has an independent routing process and routing/forwarding table.
- GMPLS resources can be shared with all service networks.



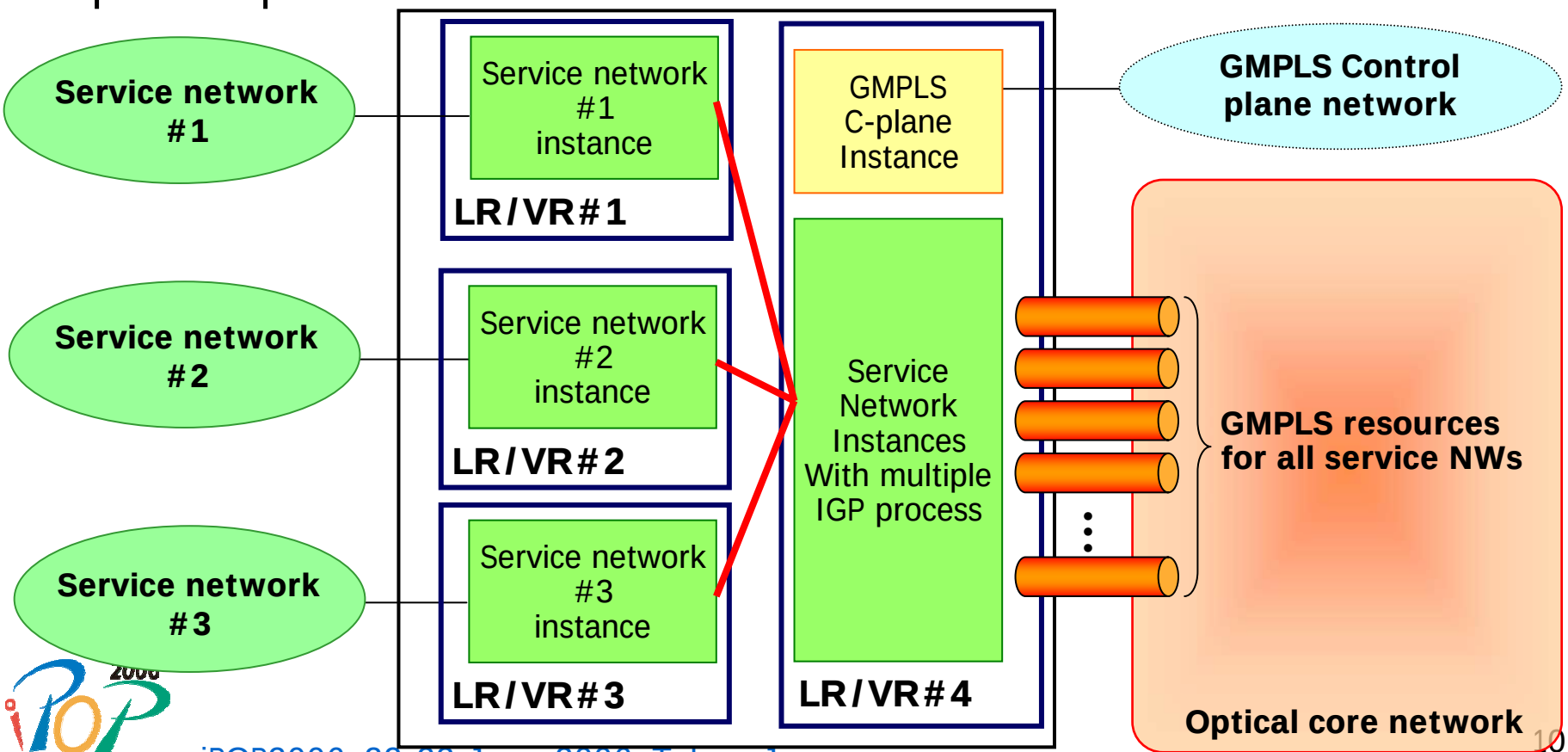
Multi-layer Service Network Architecture
Nodal model 2: BM within LR/VR

- Each LR/VR has a service network instance and a GMPLS C-plane instance.
- GMPLS resources are dedicated for each service network.
- Each LR/VR can be seen as a GMPLS router from C-plane perspective.



Multi-layer Service Network Architecture
Nodal model 3: BM using LR/VR

- In addition to LRs/VRs dedicated for service network, GMPLS core network side LR/VR is configured on the border router.
- GMPLS resources can be shared with service networks.
- F-plane separation can not be realized.



Multi-layer Service Network Architecture
Nodal model comparison

- Each model has its own pros and corns, especially for F/M-plane independency, sharing of local router and optical network resources.
- Actual selection of a given realization depends on the requirements.

Nodal model		BM with process distribution	BM within LR/VR	BM using LR/VR
Corresponding architecture		C- and F-plane separation	C-, F- and M-plane separation	
Separation among service networks				
	C-plane	Yes	Yes	Yes
	F-plane	Yes	Yes	Limited
	M-plane	Limited	Yes	Yes
Sharing of local router resources		High	Moderate	Moderate
Sharing of optical network resources		Yes	No	Yes
Need for inter-LR/VR connectivity		No	No	Yes

Conclusion

- **Multi-layer Service Network Architecture**
  - Multiple service network accommodation
  - Easy migration

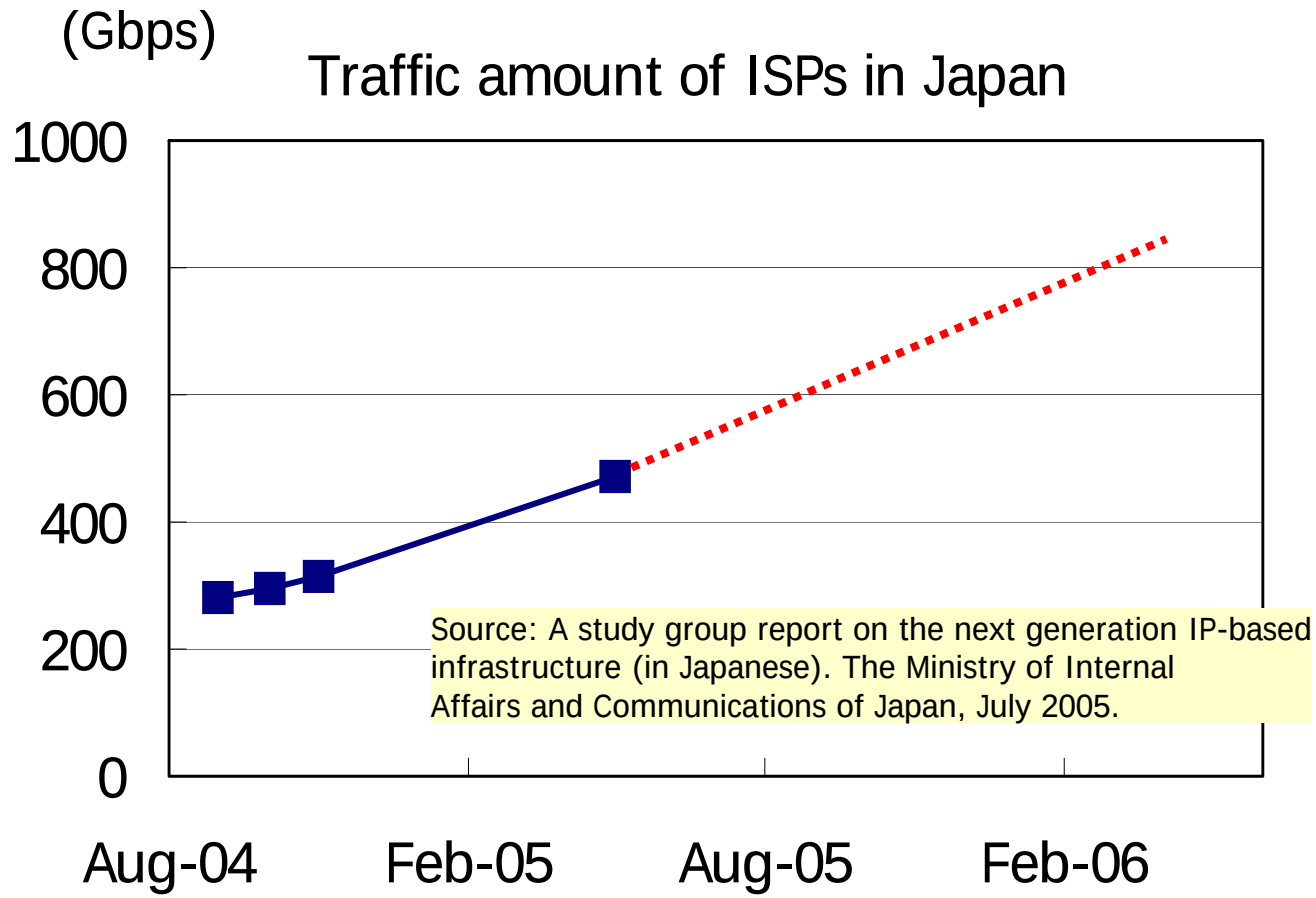
- **Architectural model and Nodal model**
  - C-plane and F-plane separation are required, and M-plane separation is required if each service network is administrated by different entity.
  - Nodal models have been proposed using border model architecture and router separation implementation such as LR/VR.

Thanks !

Backup Slides

High capacity network

- **The amount of traffic is rapidly growing.**
- **Optical-based network is a solution.**



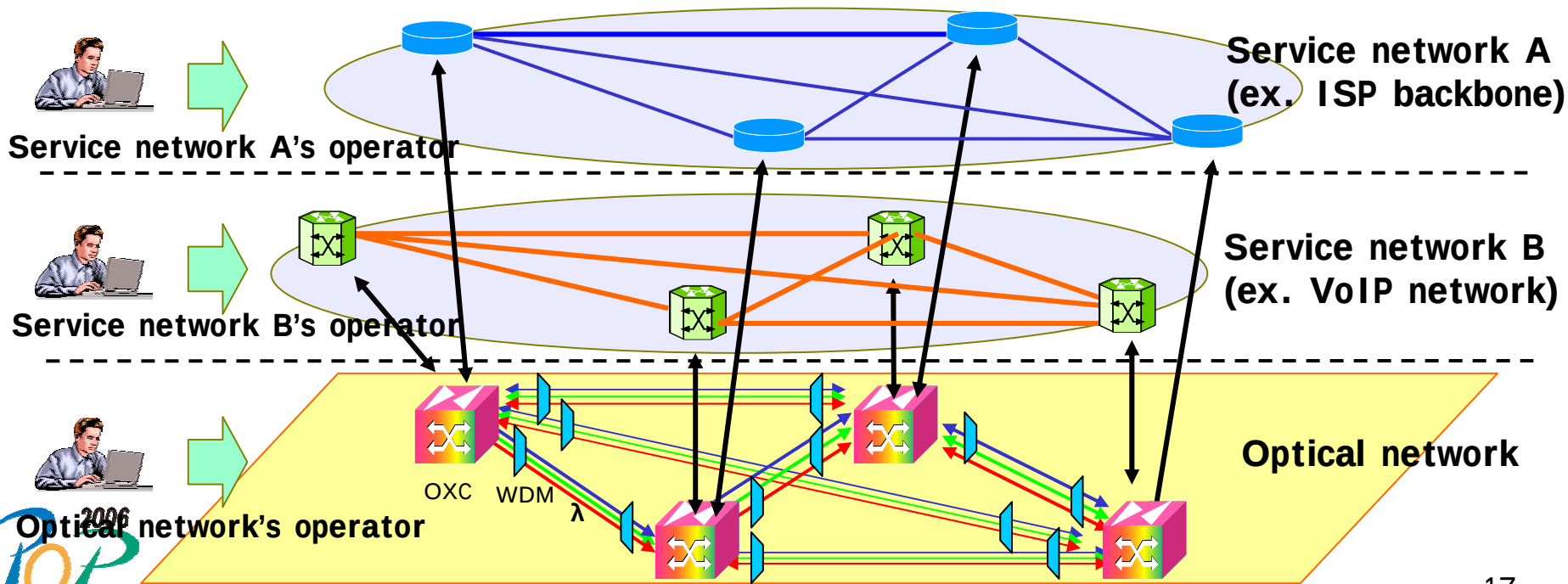
Flexibility

- **Flexibility is a critical issue for future carriers' backbone networks:**
  - **Traffic demand forecast of IP-based services tends to be difficult.**
  - **Carriers need a new provisioning tool to build and expand a service network rapidly.**

- **GMPLS and Multi-layer TE are solutions.**
  - **GMPLS will be a useful tool for provisioning optical layer paths.**
  - **Multi-layer TE enables more advanced provisioning by considering both of optical network and IP/MPLS service networks.**

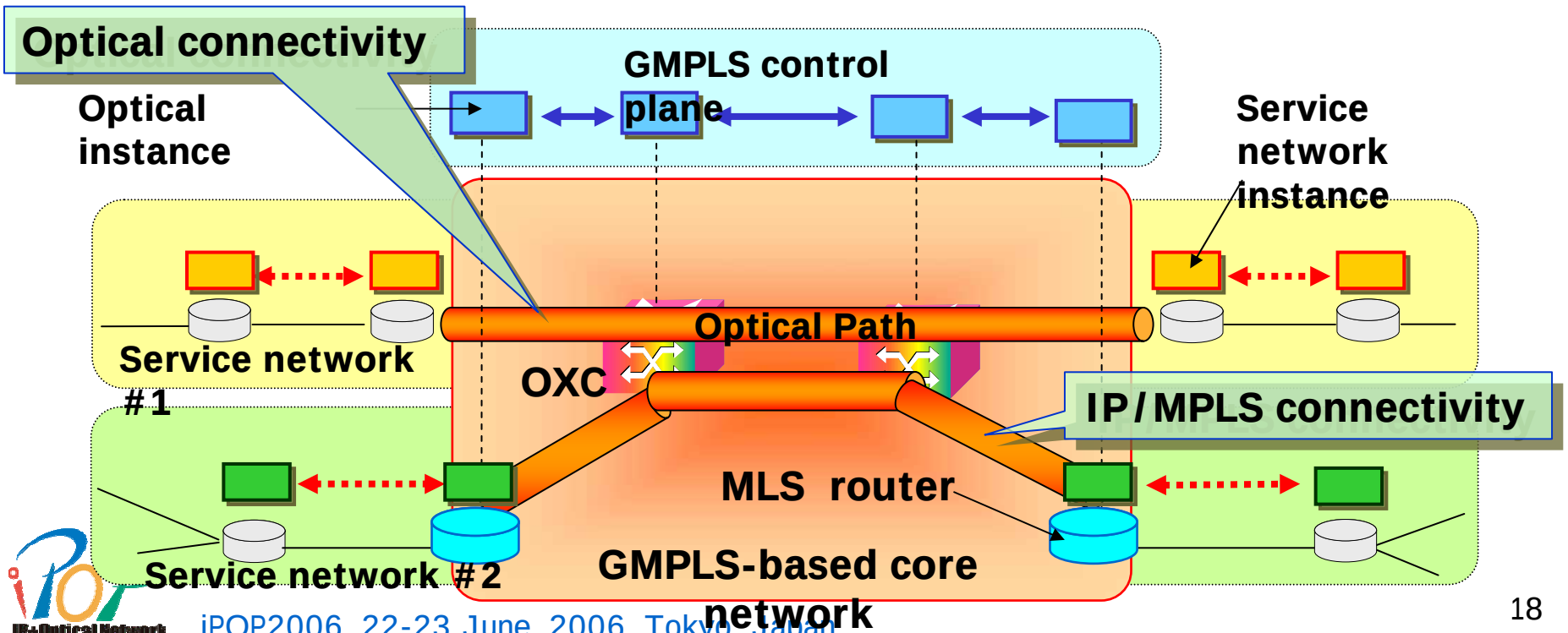
Multiple service network accommodation

- **Today, multiple service networks are managed independently along with its own policy.**
- **An optical infrastructure is to be shared.**
- **Need migrating without impact on;**
  - **IP address conflict, routing instability, …**



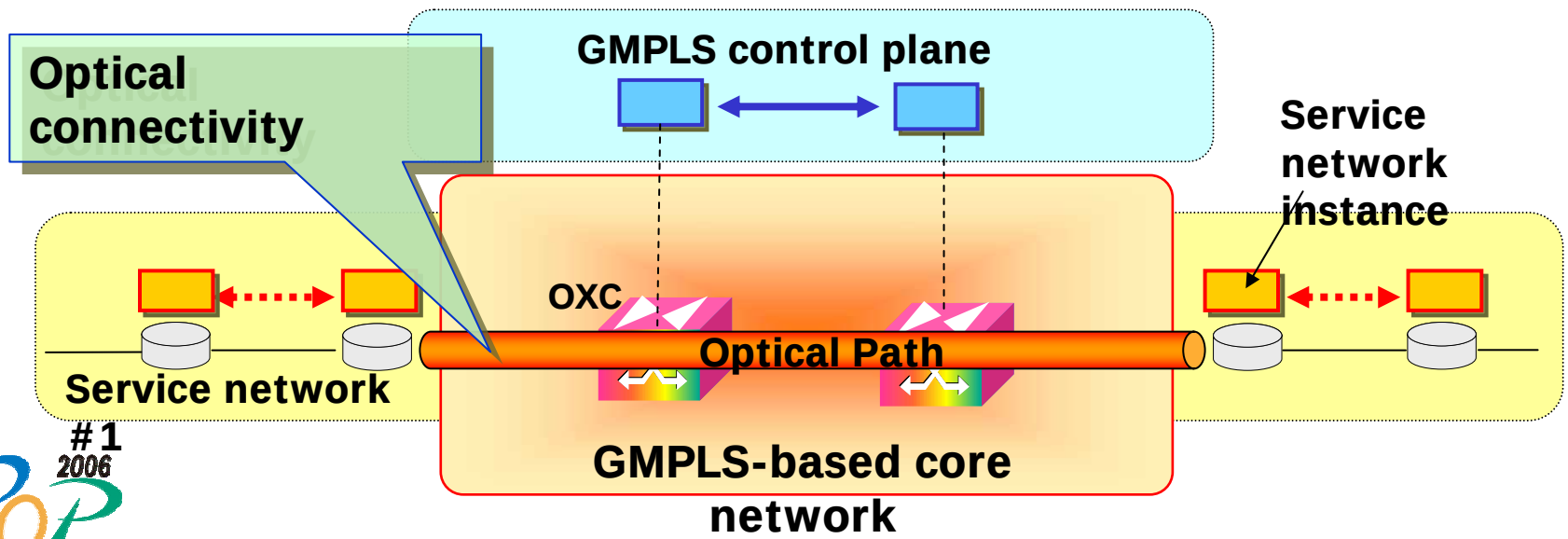
Multi-Layer Service (MLS) Network Architecture

- **An optical-based network architecture which provides optical connectivity and IP/MPLS connectivity to service networks to meet the needs of service specifications.**
  - **Bandwidth, QoS, Reliability, Management-independency, etc.**



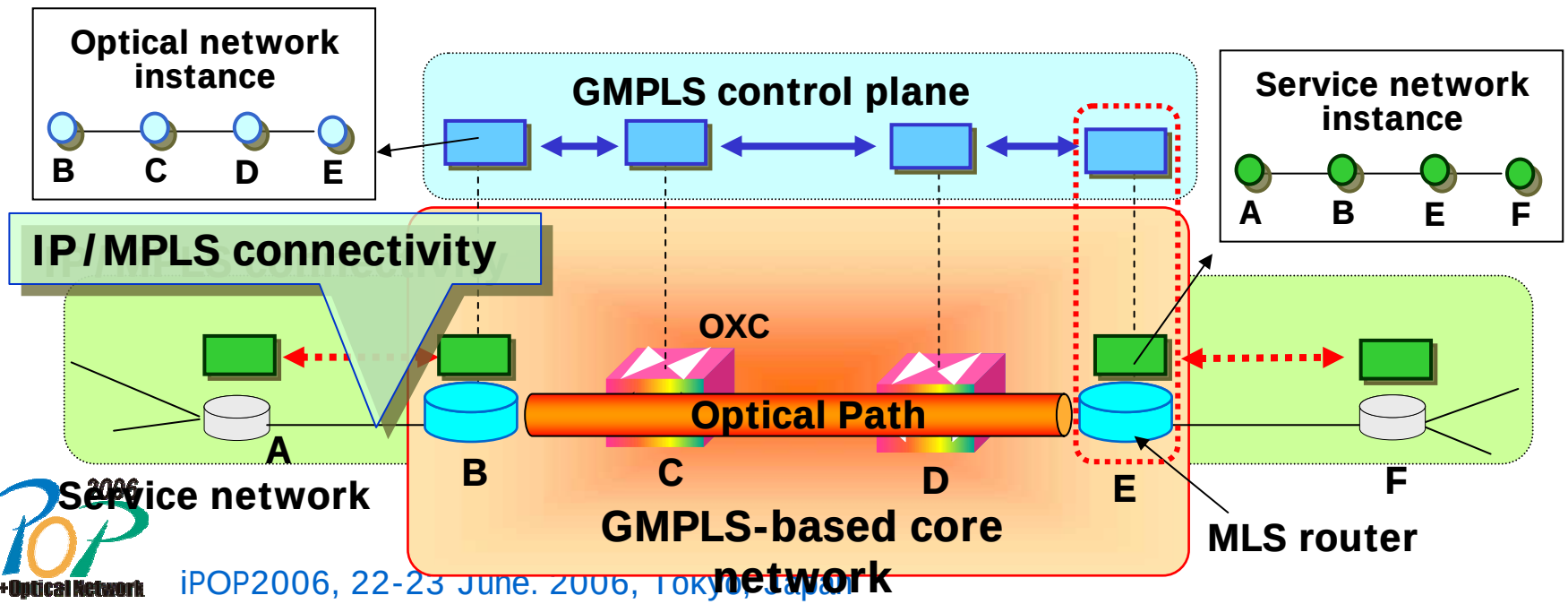
Multi-Layer Service Network Architecture
Optical connectivity service

- **Service networks are separated using layer 1 path. (wavelength, optical fiber and TDM channel)**
  - ➢ **High independence among service networks**
- **GMPLS provides optical connectivity, P&R, TE etc. to service networks.**



Multi-Layer Service Network Architecture
IP/MPLS connectivity service

- MLS routers have one (1) optical and one-or-more service network control instances.
  - Visibility of both layers for multi-layer TE
  - No need for pure “peer” GMPLS
- GMPLS provides IP/MPLS connectivity to service networks.



Comparison with existing network models

	Multi-layer Service Network	Peer model	Overlay model
Architecture			
Routing instance	Separate	Share	Separate
Existing Protocol	GMPLS can be used as it is.	GMPLS	GMPLS UNI OIF UNI
Evaluation			
Multiple service network support	Good	Poor	Good
Multi-layer TE	Good	Good	Poor
Ease of migration	Good	Poor	Good