

Multilayer coordination architecture  
based on multilayer service network  
for advanced service provision and  
operation in future IP optical  
networks

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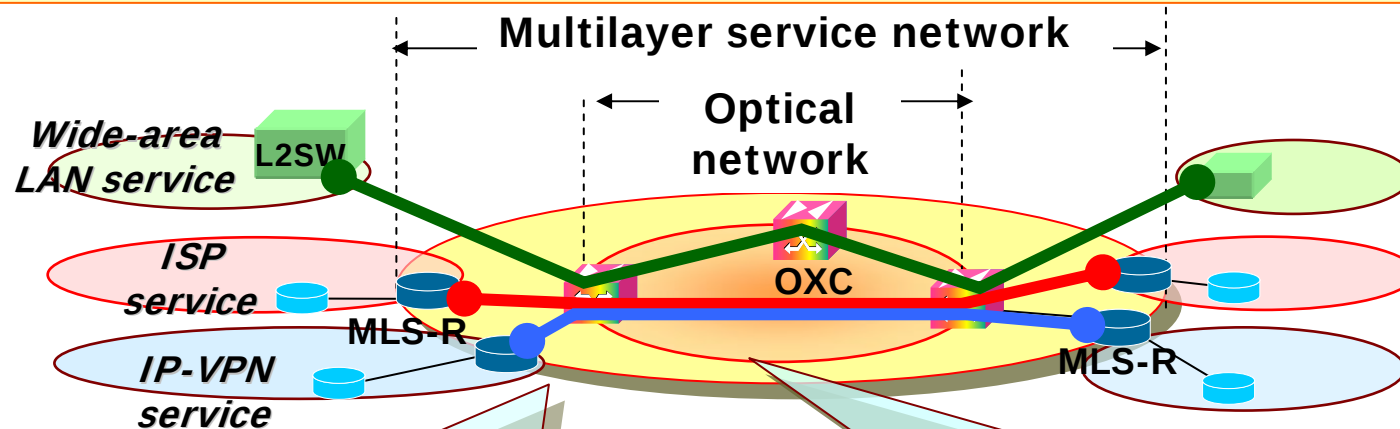
# Presentation Outline

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- Multilayer service network architecture
- Dynamic optical path provision and restoration
  - Automatic dynamic provision operation
- Multilayer coordination
  - Multilayer coordination function
  - Interface for multilayer coordination function
  - Option of multilayer coordination function deployment
  - Multiple operation policy
- Proposed failure recovery mechanism
  - Proposed recovery mechanism
  - Cost evaluation

# 1. Multilayer service network

- Common network for various layer, various service network
- Path control mechanism from service network
- Dynamic optical path provision

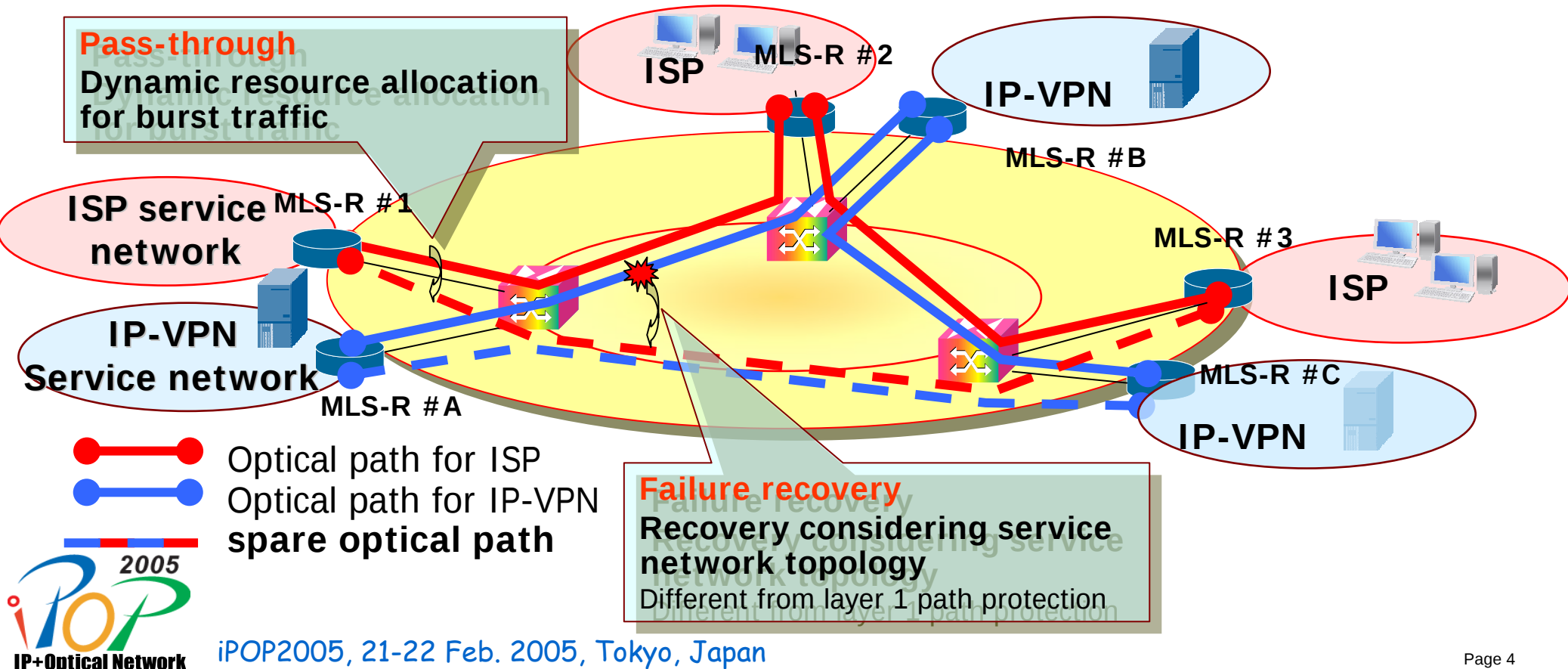


Path control mechanism,  
Dynamic optical path provisioning  
• Highly reliable and highly efficient

Common optical backbone  
OXC to Reduce IP forwarding  
high performance, low cost and low power

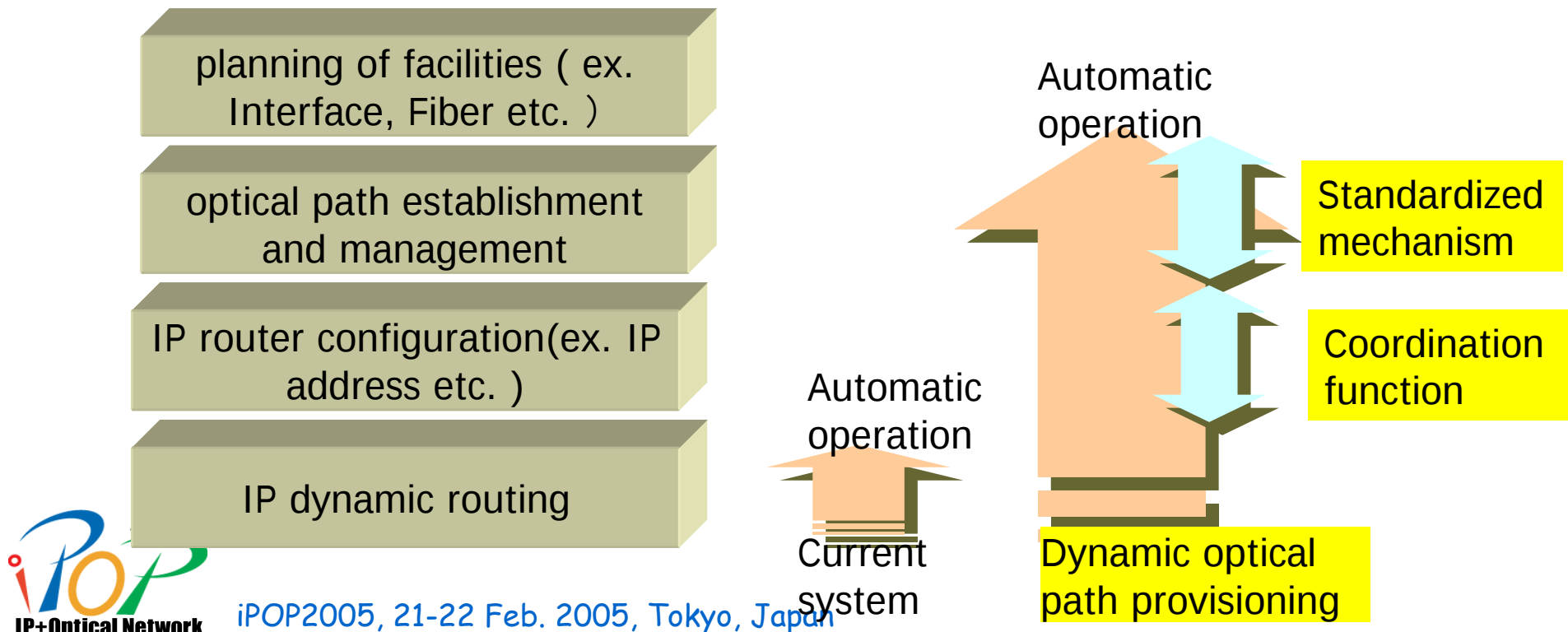
# 2.1 Dynamic optical path provision & restoration

- Dynamic optical path provision and restoration triggered by the change of network state



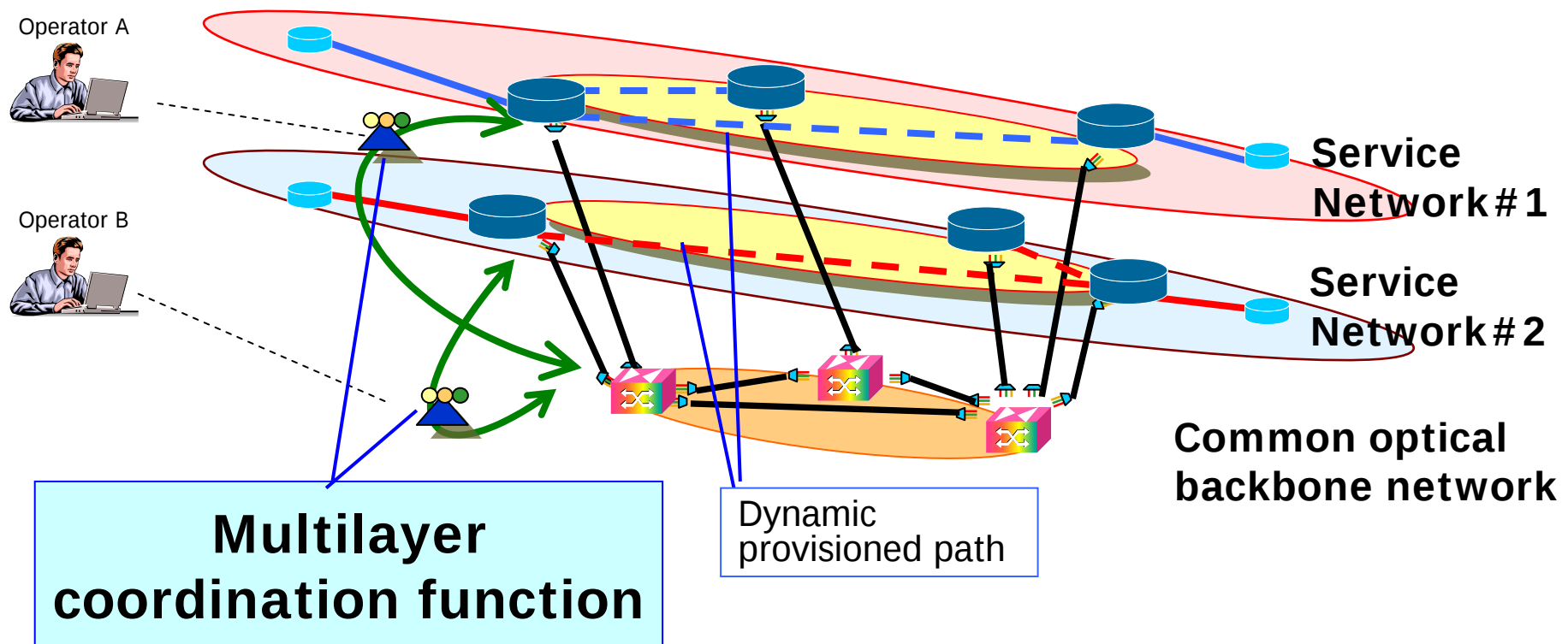
# 2.2 Automatic dynamic optical path provisioning

- Standardized mechanism is required to optical path establishment, management
- Router configuration is coordinated with optical path establishment/deletion



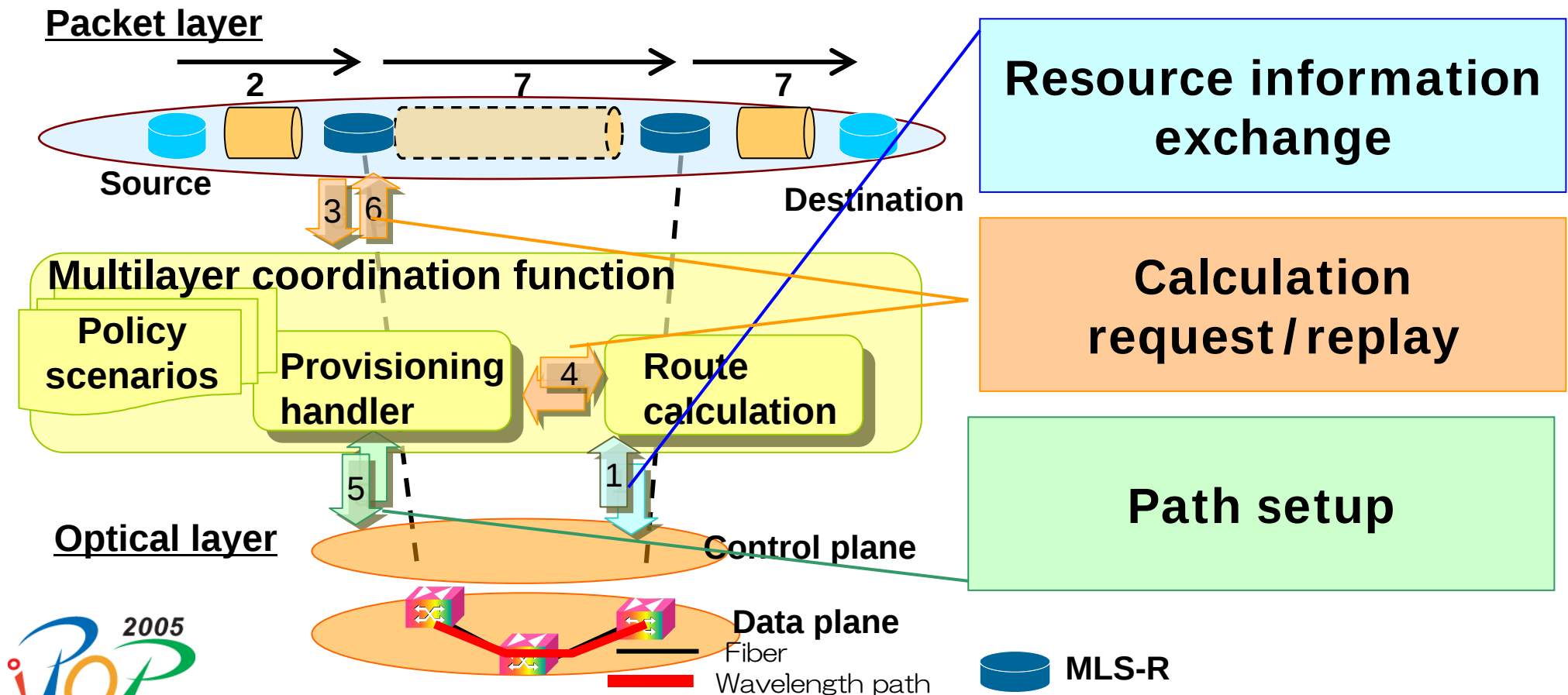
# 3.1 Multilayer coordination function

- Automatic dynamic provision by multilayer coordination function taking account into each service network policy



# 3.2 logical functions and interfaces of multilayer coordination function

- Logical Functions may be deployed at router( distributed) or server (centralized )



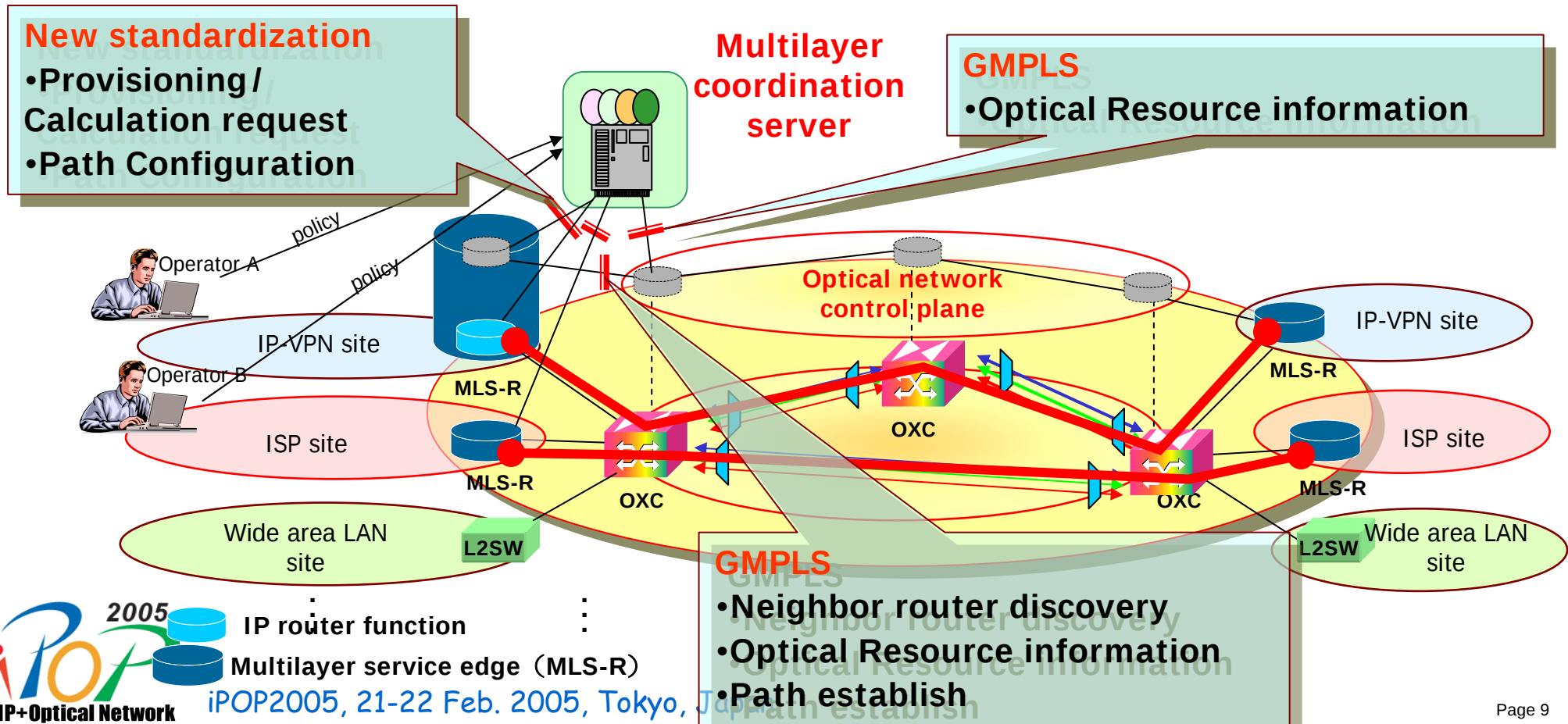
# 3.3 Option in coordination function deployment

- Type-A is rigorous path management and flexible policy management
- Type-C is Scalable dynamic path management

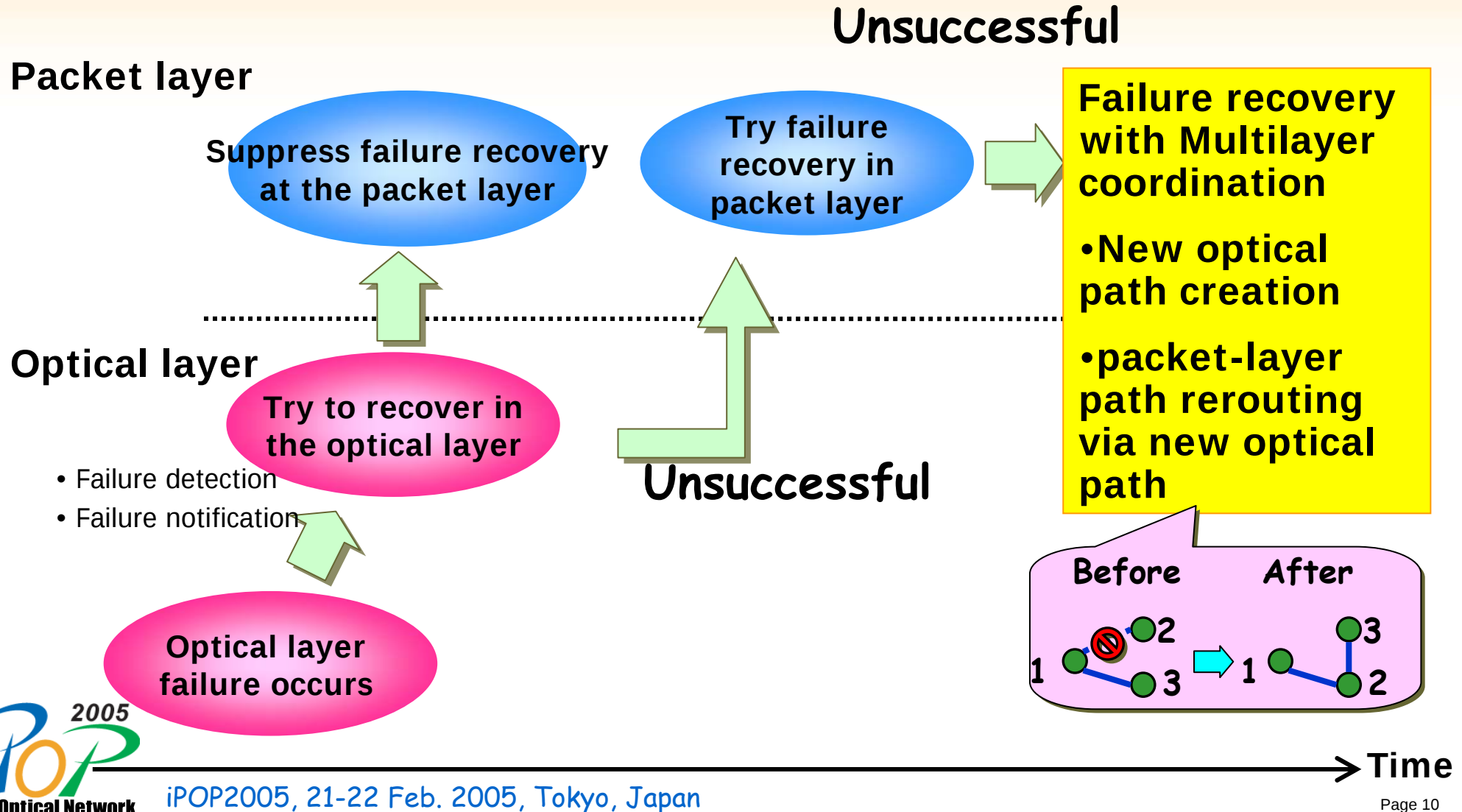
| Management Feature | Type A                       | Type B                          | Type C                   | Description                             |
|--------------------|------------------------------|---------------------------------|--------------------------|-----------------------------------------|
|                    | Rigorous and flexible policy | Combined management             | Scalable path management |                                         |
| Provision handling | Centralized manner           | Centralized /Distributed manner | Distributed manner       | Centralized; rigorous path management   |
|                    |                              |                                 |                          | Distributed; high scalability           |
| Route calculation  | Centralized manner           | Centralized manner              | Distributed manner       | Centralized; flexible policy management |
|                    |                              |                                 |                          | Distributed; high Scalability           |

# 3.4 Multilayer coordination server for multiple service policy

- Multilayer coordination server manage multiple policy
- Triggered by multilayer coordination function deployed at MLS-R

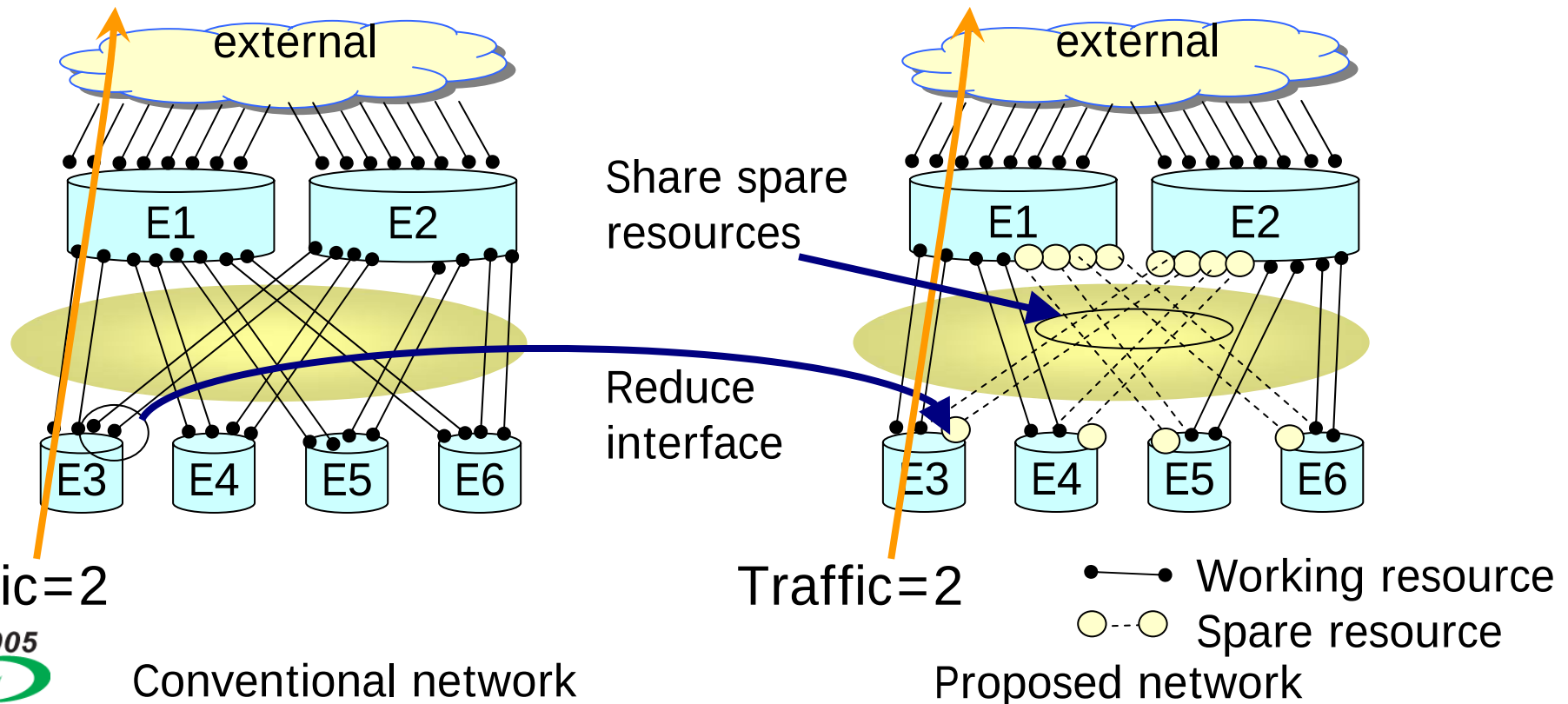


# 4.1 failure recovery with multilayer coordination function



# 4.4 Comparison between conventional and proposal

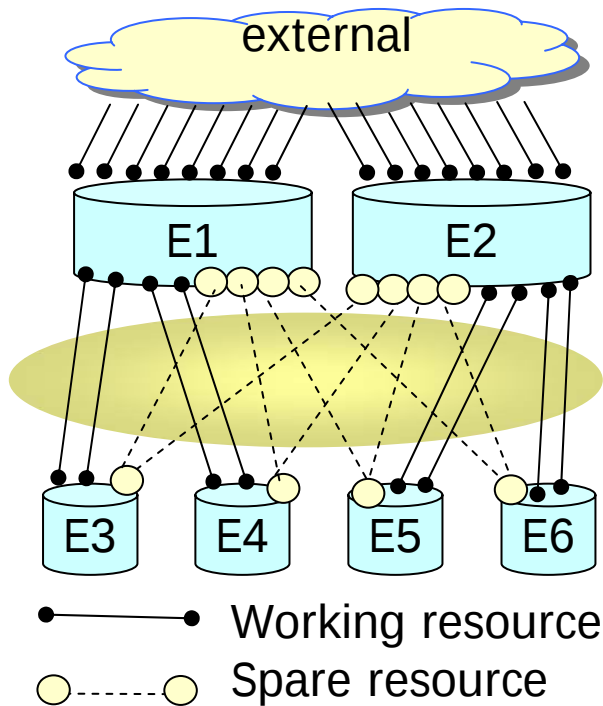
- Conventional network depends on IP re-routing
- Proposed network depends on optical path dynamic provisioning
- Save optical resource by sharing spare for different failure points



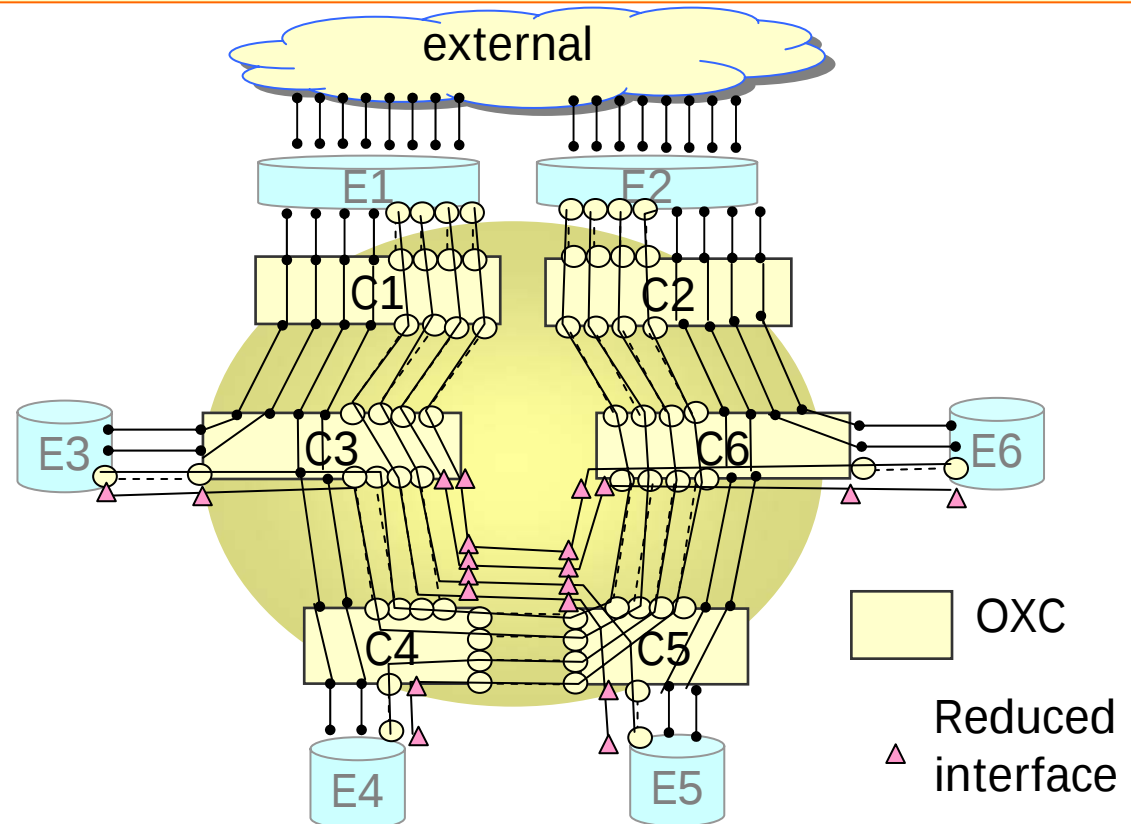
# 4.5 Network Provisioning with proposed failure recovery

- Example provisioning

- IP network: star topology consists of edge and transit router
- Layer 1 network : ring topology



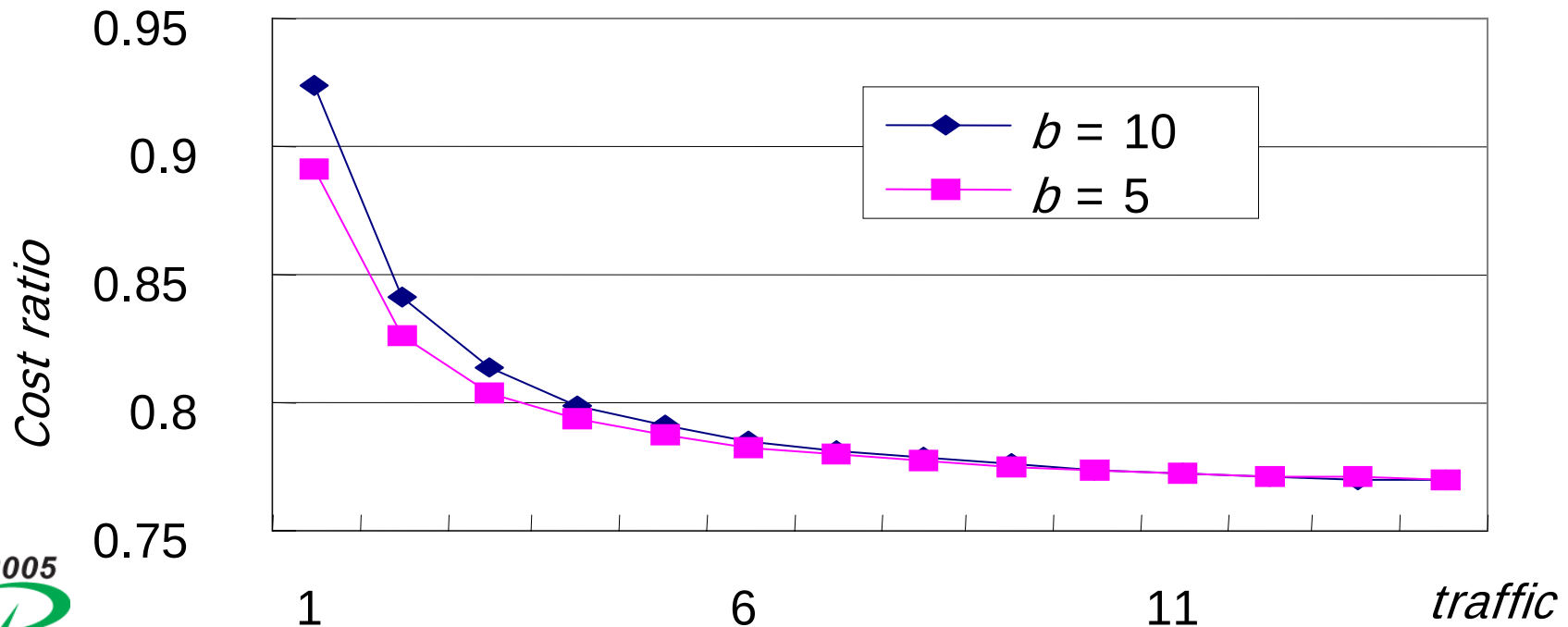
(a) IP network topology



(b) Layer 1 network topology

# 4.6 Cost comparison

- Proposal can reduce network cost with the increase in traffic
  - Cost ratio: proposed network cost/conventional network cost
  - Traffic: amount of edge to transit normalized by one fiber
  - network cost: router interface number  $\times b$  + layer 1 switch interface
  - Interface cost ratio  $b$ : router interface cost/layer 1 switch interface cost



# Summary

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- Dynamic optical path provision and restoration in multilayer service network is described
- Multilayer coordination function is proposed and these functions achieve multiple operation policy
- Multilayer failure recovery using multilayer coordination function is proposed
  - Proposed restoration mechanism reduces the network cost about 10-20%