

Enabling Multi-grade LSPs in GMPLS Networks

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Outline

- ◆ Overview of current *MPLS/GMPLS* status
- ◆ P&R (protection and restoration) extensions
- ◆ Introduction of *extra-class* LSP
- ◆ Issue of *misconnections*
- ◆ Summary

What MPLS provides now

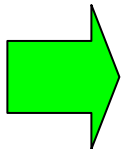
- **L3/L2 VPNs**
- **TE (Traffic Engineering)**
 - Load balancing
 - Traffic Monitoring
- **MPLS Diffserv**
- **Fast Reroute (resiliency, fast recovery)**
- **Multi-service, Multi-media on a single network**
 - **Distributed IX(Internet eXchange)**

Current status of GMPLS

- Based on MPLS, multiple *switching capabilities*
- Basic protocols are almost standardized
(RSVP-TE, OSPF-TE, IS-IS TE)
- New features
 - LMP
 - Fault Recovery (P&R)
 - Multi-layers (regions)

Multi-grade LSPs

- Enabling multi-grade service on one network allows...
 - Flexible service offerings
 - Efficient use of idle resources
 - Graded pricing to meet diverse customer requirements



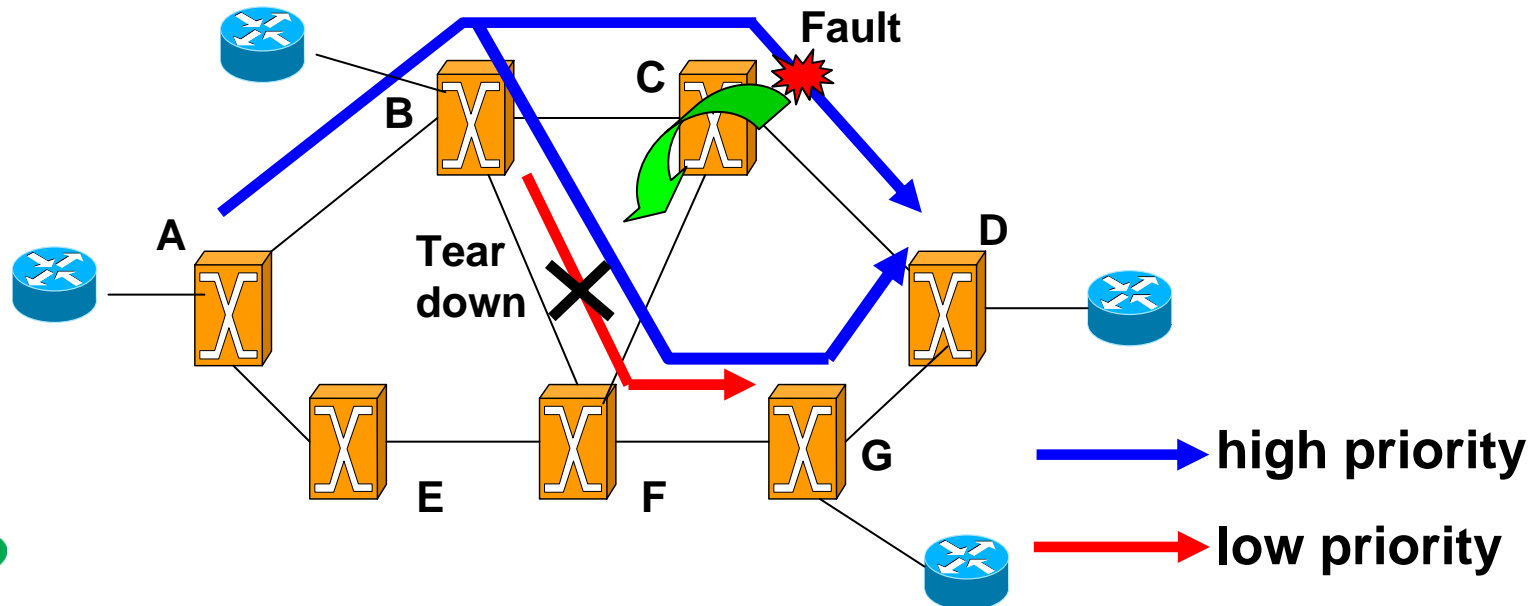
More revenue with less expenditure!

- Key ingredients

- Bandwidth
- Latency and jitter
- Resiliency
- Pricing

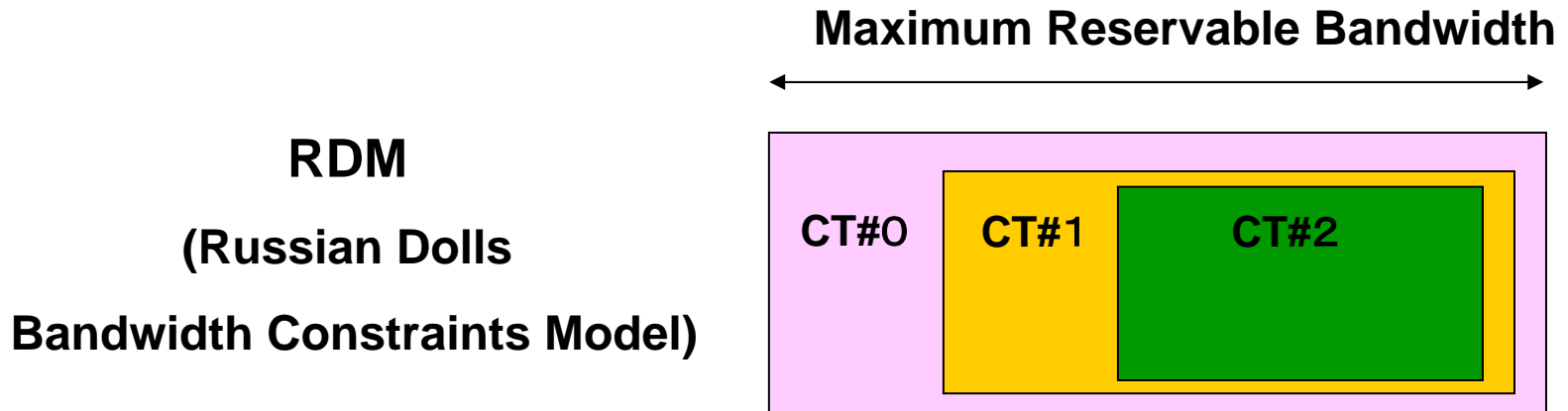
Priority Mechanism (MPLS)

- Higher priority LSP preempts lower priority LSP during network congestion/failure
- Required for maintaining QoS: bandwidth, latency
- Preempted (lower priority) LSP torn down or re-routed (shortly disrupted)



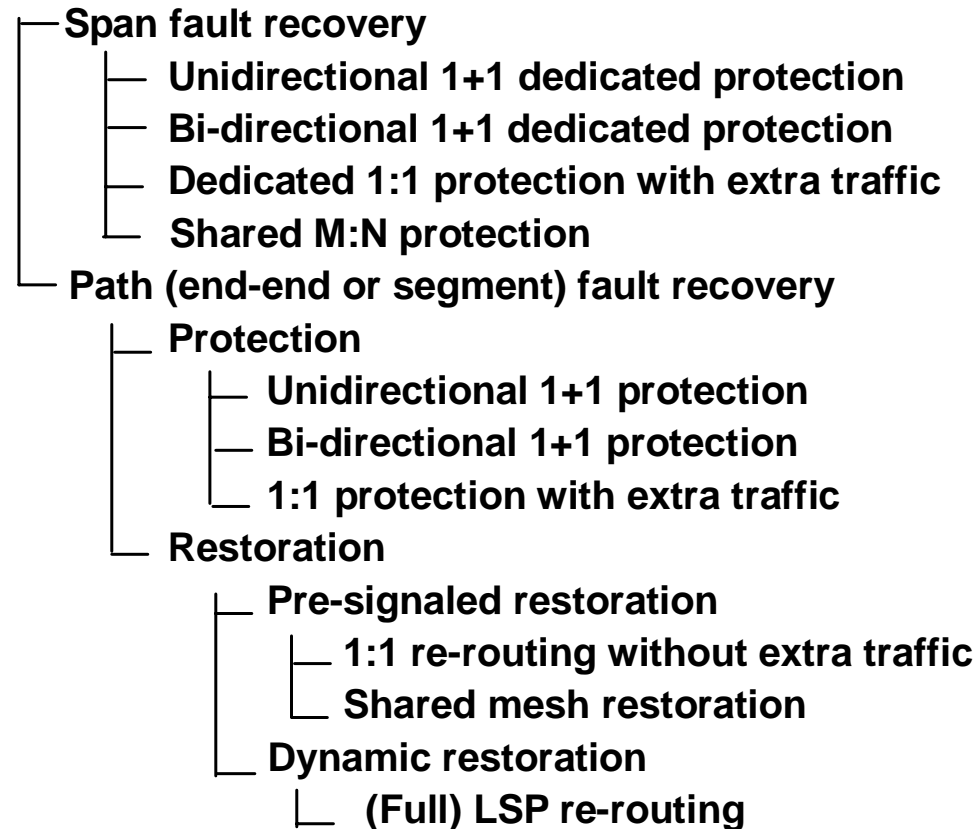
DSTE: Diffserv-aware TE (MPLS)

- Separate bandwidth accounting for each traffic type (*class type*)
e.g. VoIP traffic for one class type
- To guarantee end-end QoS (bandwidth, latency, jitter)



P&R (Protection and Restoration) Mechanisms

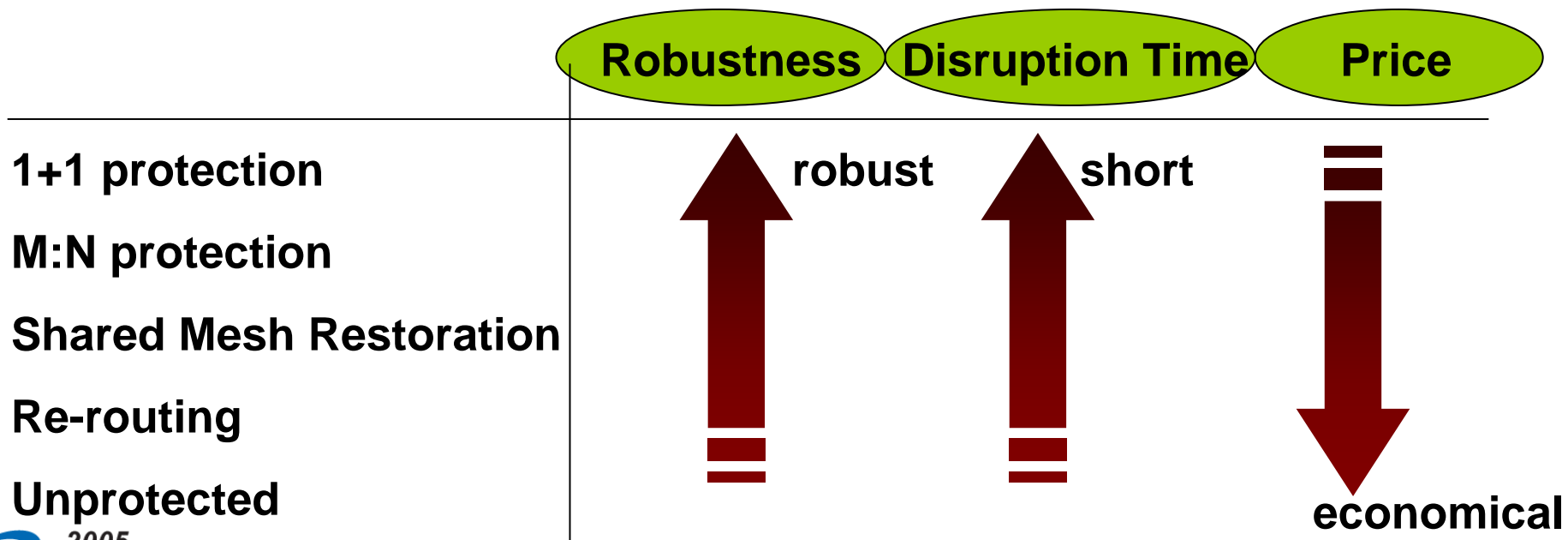
- GMPLS signaling extensions for *full LSP or LSP segment recovery*
- Various recovery mechanisms are provided



P&R provides Class of Resiliency

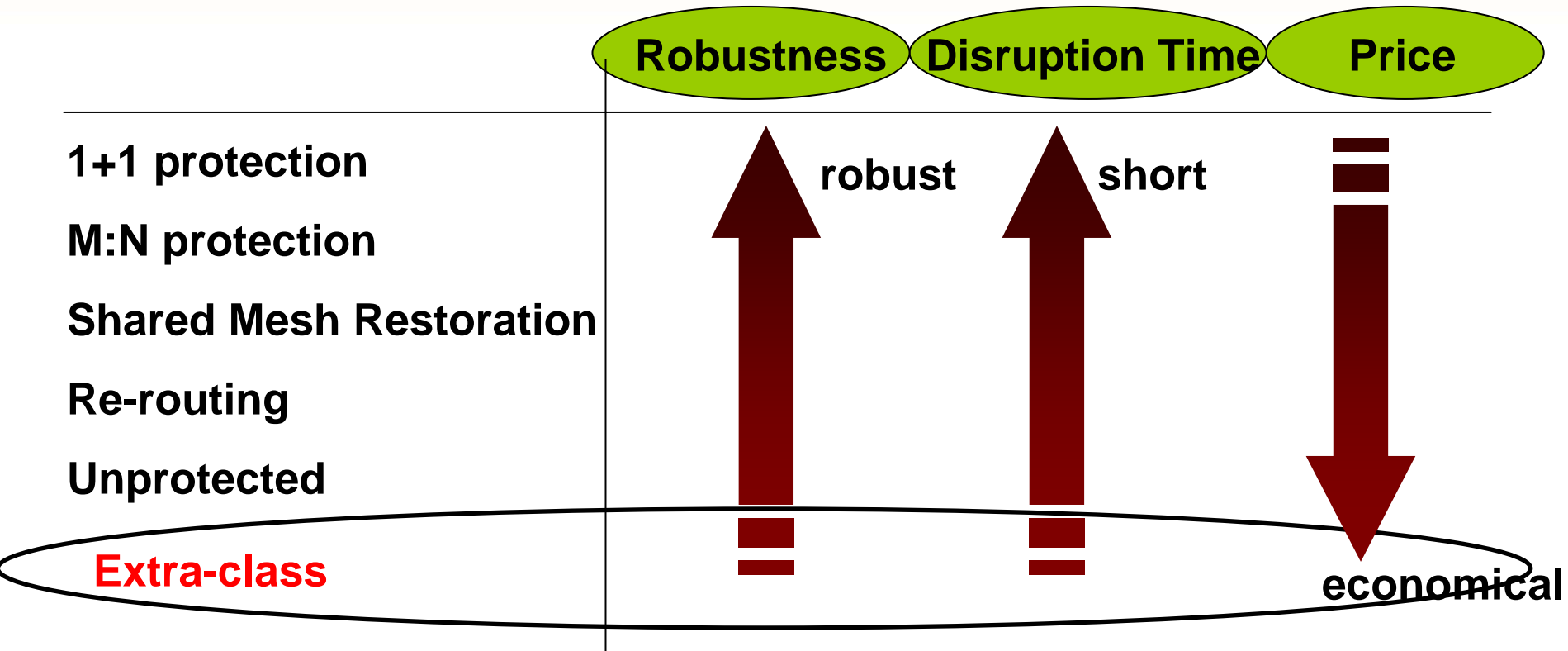
- Ingredients of class

- Availability (robustness)
- Time to recover (service disruption time)
- Resource efficiency (price)



A further possible "Class" of Resiliency

"Extra-class LSP" -- more stable than a mere lower priority LSP

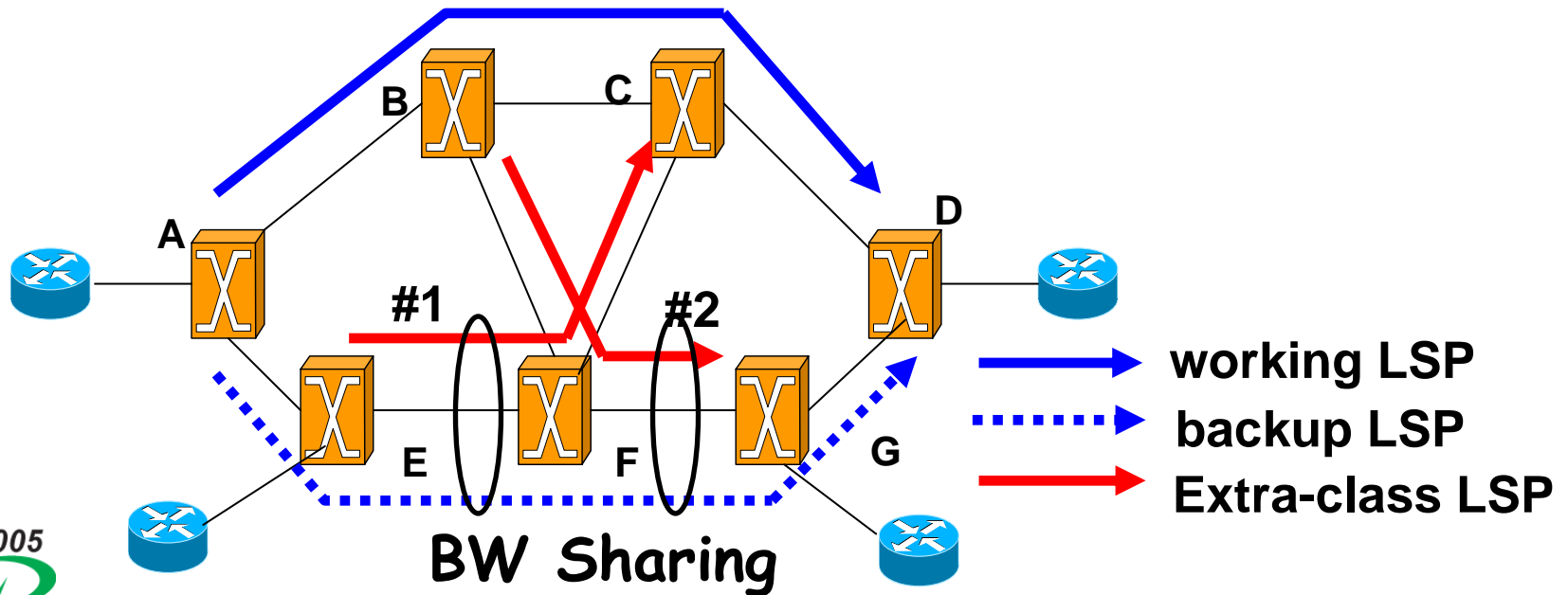


Defining Extra-class LSPs

- Utilizes backup resources in **shared mesh restoration**

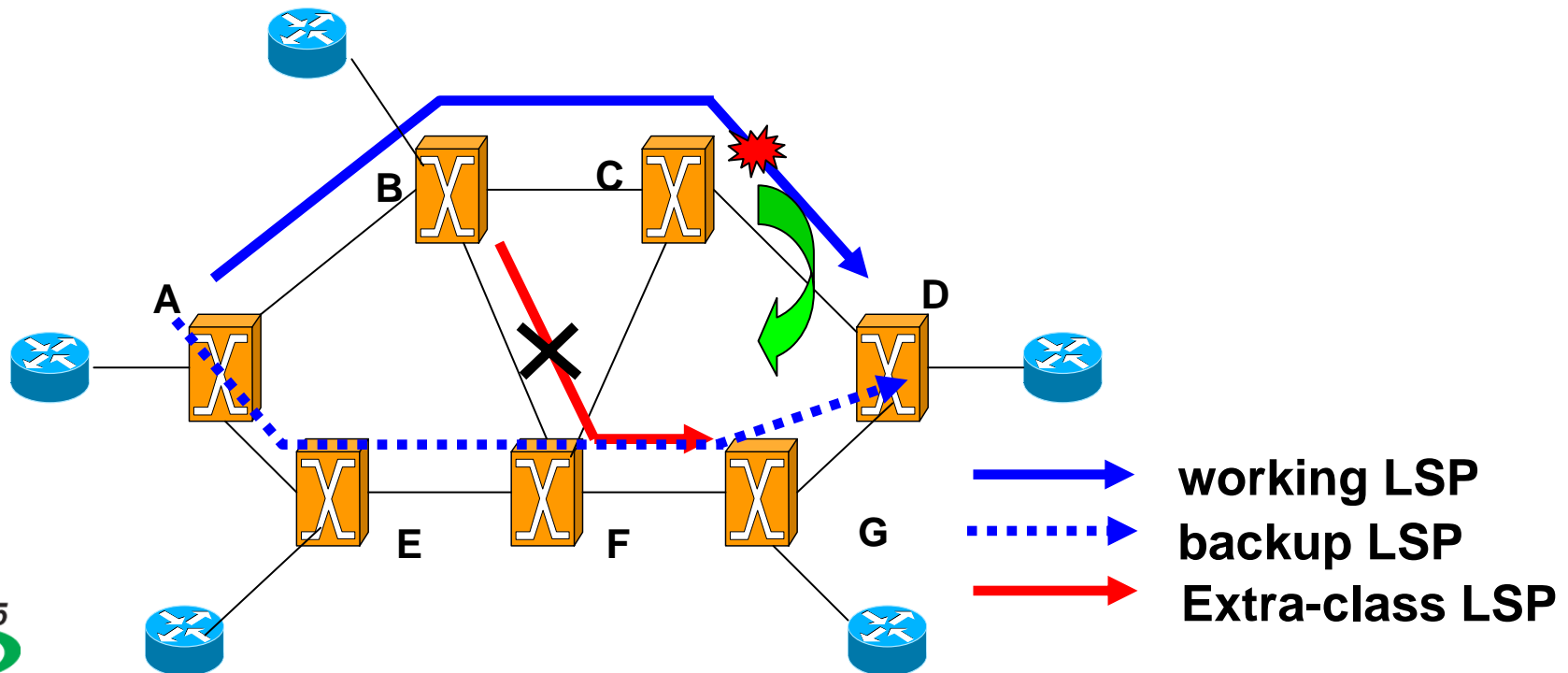
Up to 50% of bandwidth is reserved for backup LSP but not really used to carry traffic until a failure occurs!

⇒ Could use it for low-priority traffic like “extra traffic”



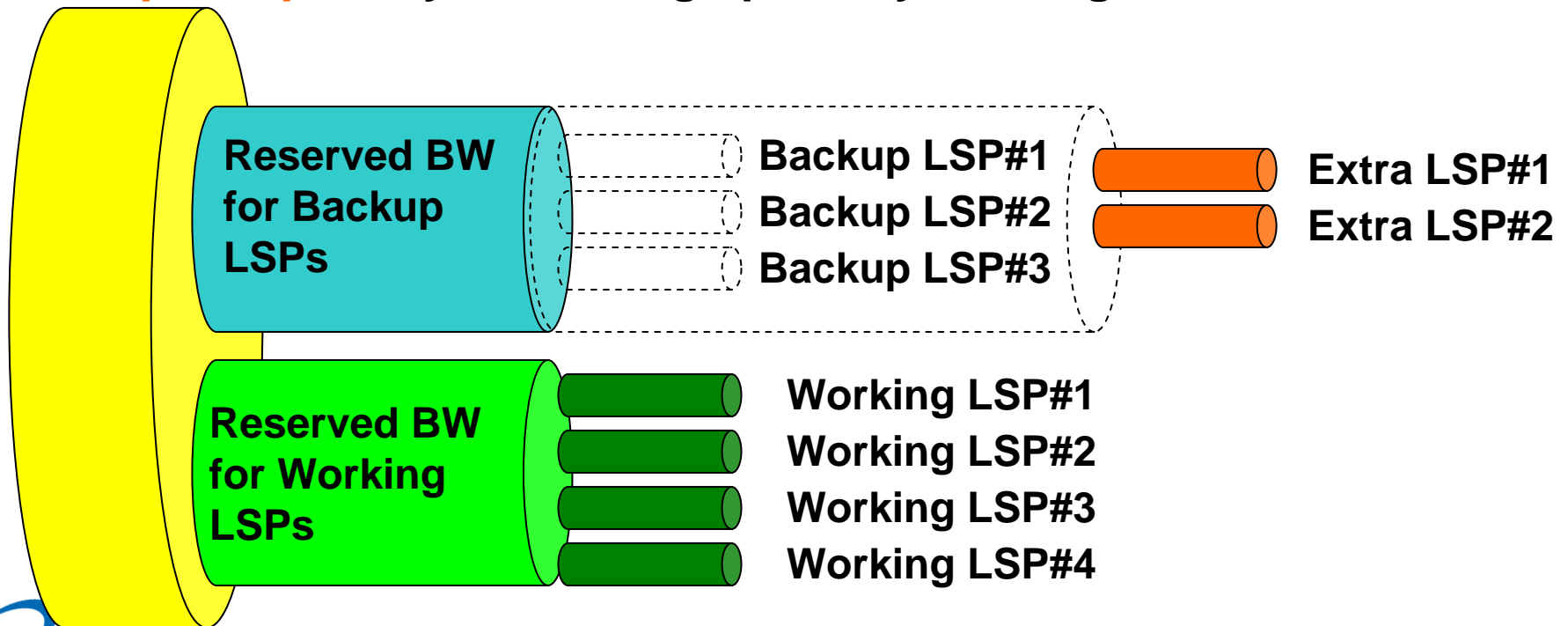
Defining Extra-class LSPs

- Established by GMPLS signaling as well as working/backup LSP
- Preempted **only** on failure of working LSPs whose backup LSPs share the resource



Extra-class LSP - Bandwidth model

- Uses (shares) bandwidth reserved for backup LSPs
- Preempted **only** when the backup LSPs are activated by switch-over (triggered by network failure)
- **Not preempted** by the setting up of any working LSP



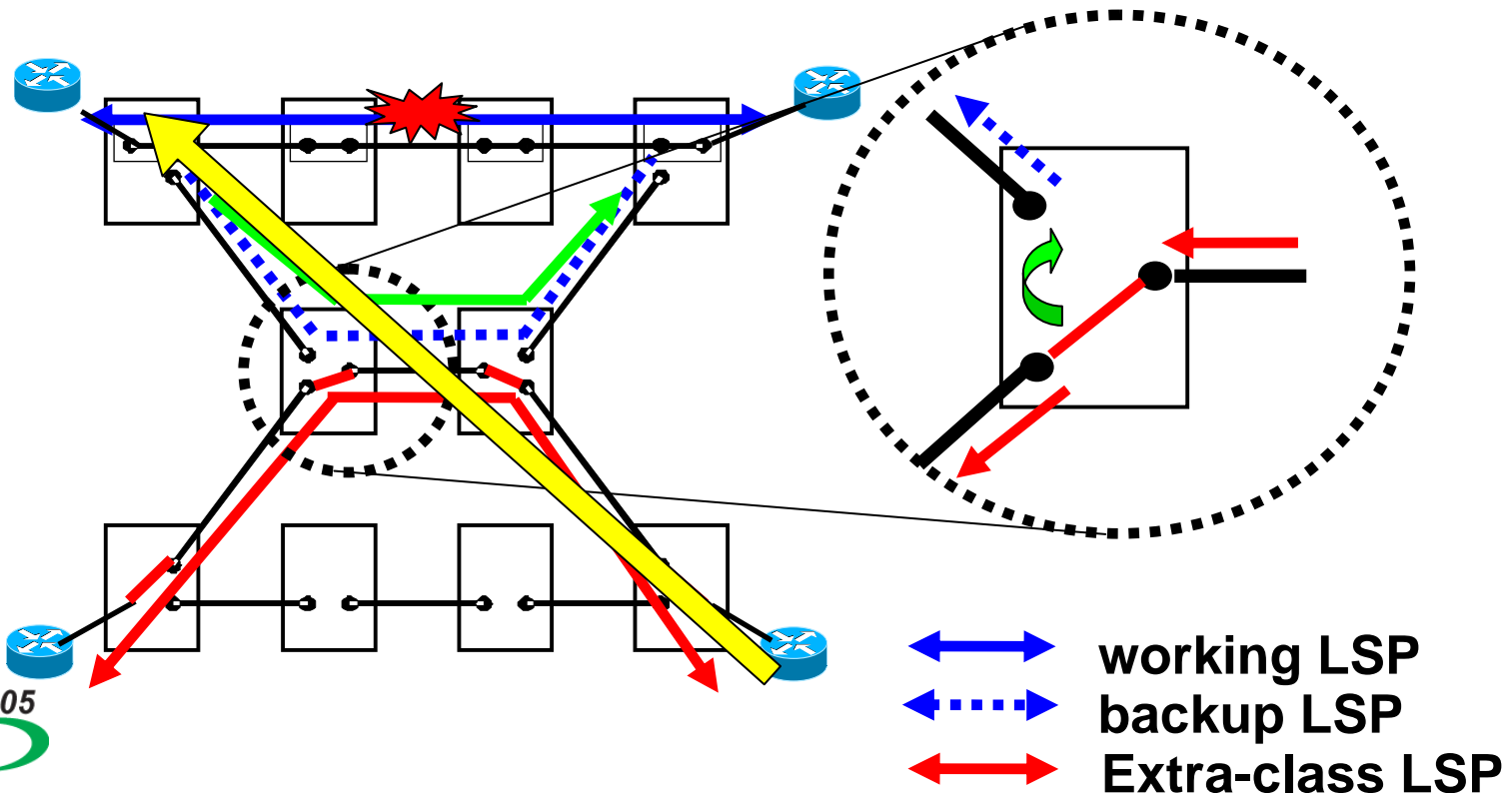
Extra-class LSP - GMPLS Extensions

- A bit (indicator) requesting Extra-class LSP in signaling
- Routing extension is required as well as for P&R (shared mesh restoration)
 - Available bandwidth for Extra-class LSP
- Resource efficiency must be accounted for in CSPF

Misconnection problem

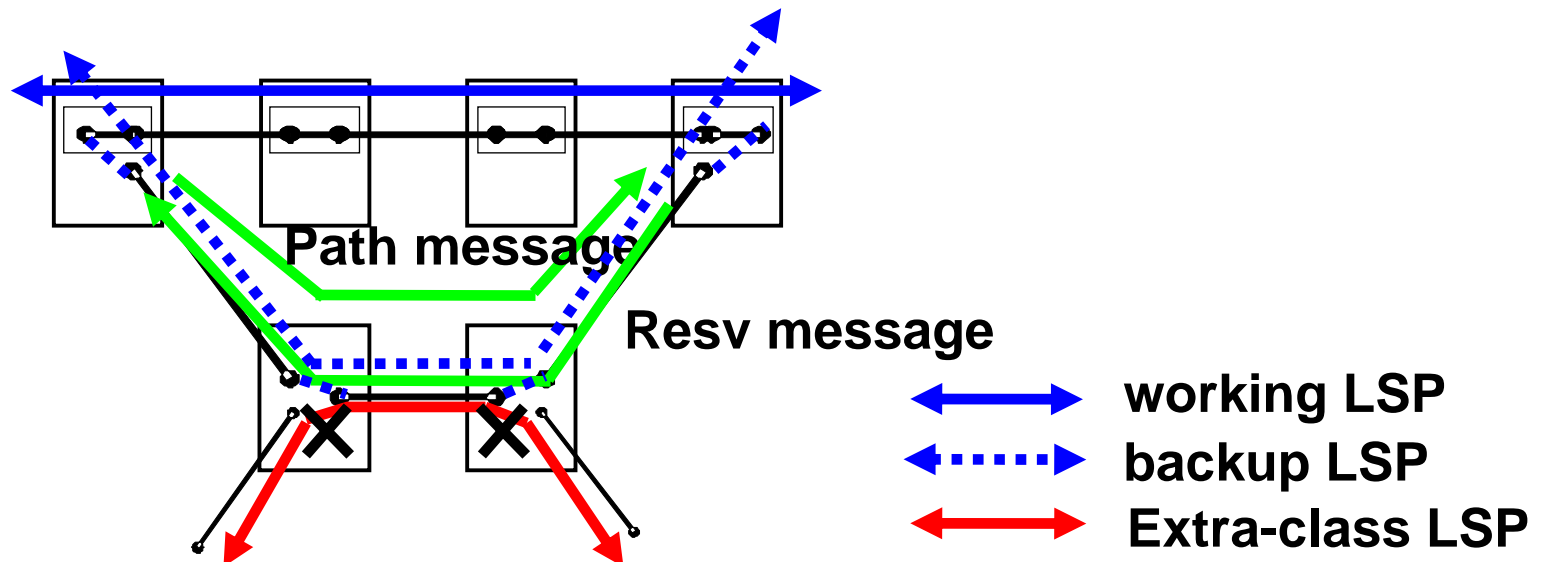
- Unintended connection during...

- Switch-over preemption in shared mesh restoration
- Setup preemption of higher priority LSP



Solutions

- Two-way activation scheme
 - Path message to disconnect Extra-class LSP
 - Resv message to connect backup LSP
- Distinguish activation Resv msg from Refresh msg
 - Use Protection Object in Resv message



Summary

- ◆ **MPLS enables multi-grade services on one network**
- ◆ **GMPLS P&R adds classes of resiliency**
- ◆ **Extra-class LSP allows additional class of resiliency**
- ◆ **Misconnections arise in multi-grade networks (multi-priority or extra-class LSPs)**
 - ◆ **Various solutions proposed**

Thank you for your attention

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