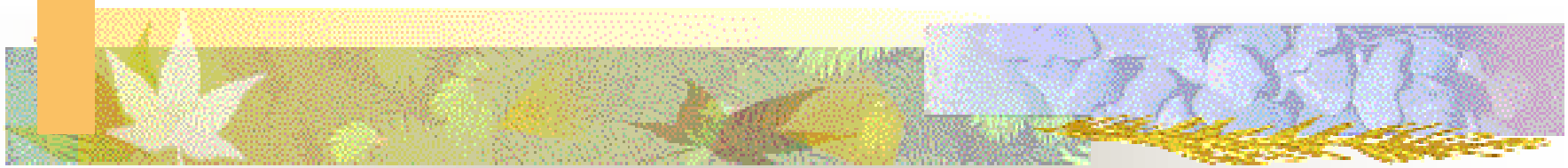
A Distributed LSP Mechanism to Reduce Spare Bandwidth in MPLS Networks



ICC’2002

報告人: 唐崇實,　9/13/2002

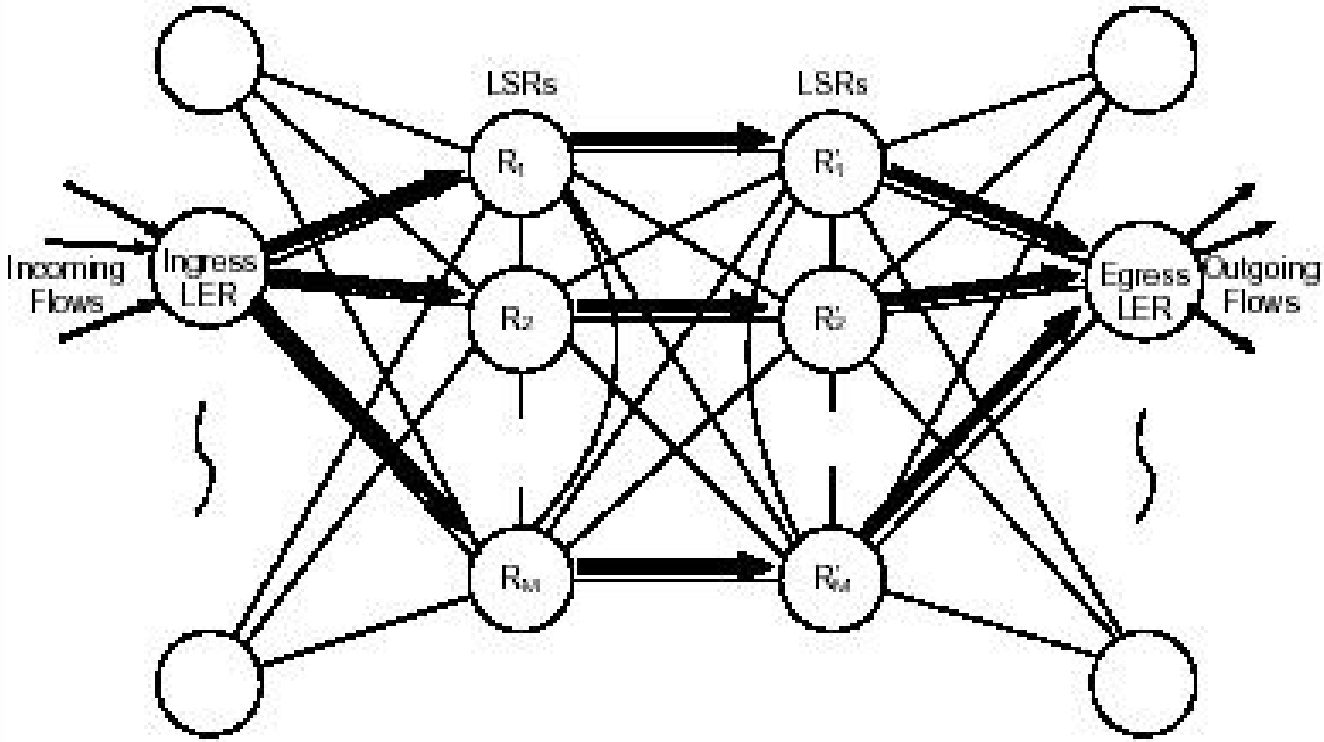
Outline

- Key Idea: Distributed LSP
- LSP Assigning Mechanism
- Spare Bandwidth Demand
- Effect of LSP Partitioning
- Conclusions

Key Idea

- Distributed LSP (D-LSP)
  - An LSP is partitioned into several sub-LSPs.
  - Each sub-LSP is distributed to a different node-disjoint route.
  - The incoming traffic is also partitioned and spread over the sub-LSPs at the ingress LSR.
  - The backup LSP for a D-LSP is established on another node-disjoint route.
  - The amount of spare bandwidth is equal to the bandwidth demanded by a sub-LSP

A D-LSP Example



LSP Assigning Mechanism (1/3)

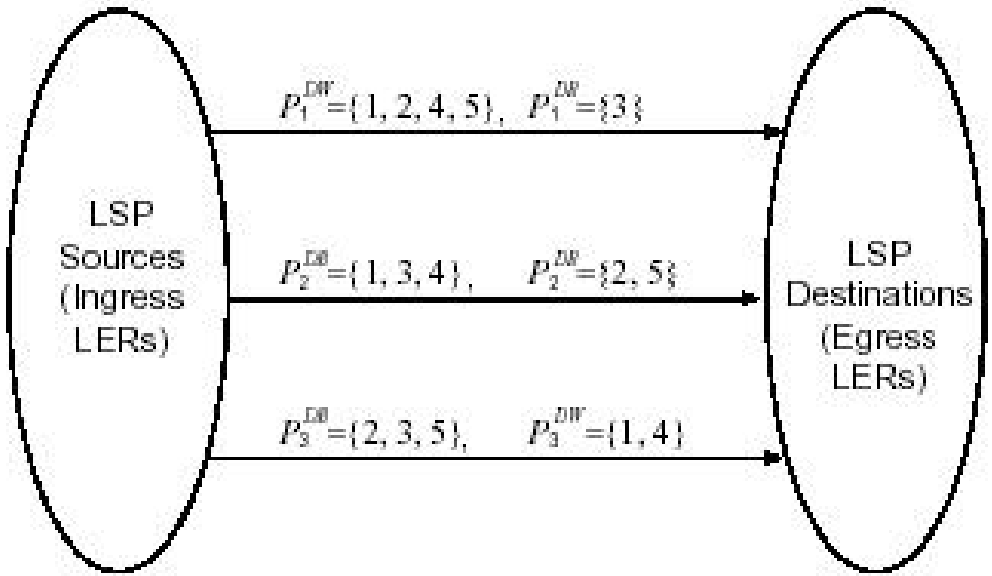
- For D-LSP, assume that
  - ***L*** D-LSPs originates from ingress LSRs to egress LSRs through the ***M*** parallel paths
  - P_m^{DW} : a set of "working D-LSPs" of which a sub-LSP is assigned to the node-disjoint route *m*
  - P_m^{DB} : a set of D-LSPs for which a backup LSP is assigned to the node-disjoint route *m*
  - Backup LSPs are distributed over node-disjoint routes uniformly

$$\left|P_m^{DB}\right| = \begin{cases} \lfloor L/M \rfloor, \text{on } M - R \text{ routes} \\ \lceil L/M \rceil, \text{on } R \text{ routes} \end{cases}$$

LSP Assigning Mechanism (2/3)

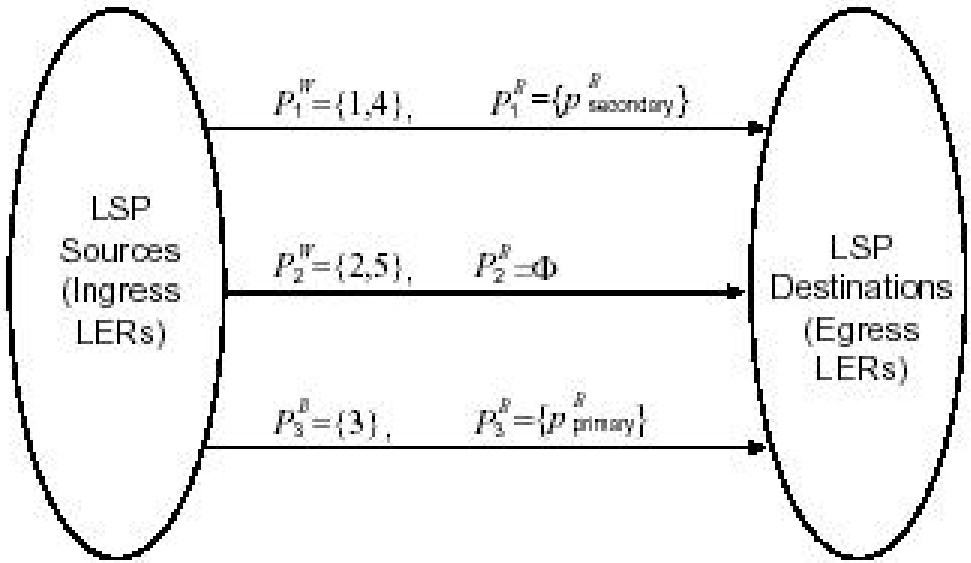
- For each D-LSP, there is only one backup LSP

$$\sum_{m=1}^{M} \left| P_m^{DB} \cap \{p\} \right| = 1, \quad \text{for } p = 1, \ldots, L$$



LSP Assigning Mechanism (3/3)

- For conventional LSP
  - At least two backup LSPs are required



Spare Bandwidth Demand

- For D-LSP, the total bandwidth demanded is

$$B_{total}^{D} = LMC'$$

- For conventional LSP, the total bandwidth is

$$B_{total}^{C} = (L + (2Q + \min(R,1)))C, \text{ where } L = QM + R$$

- LSP Partitioning Gain

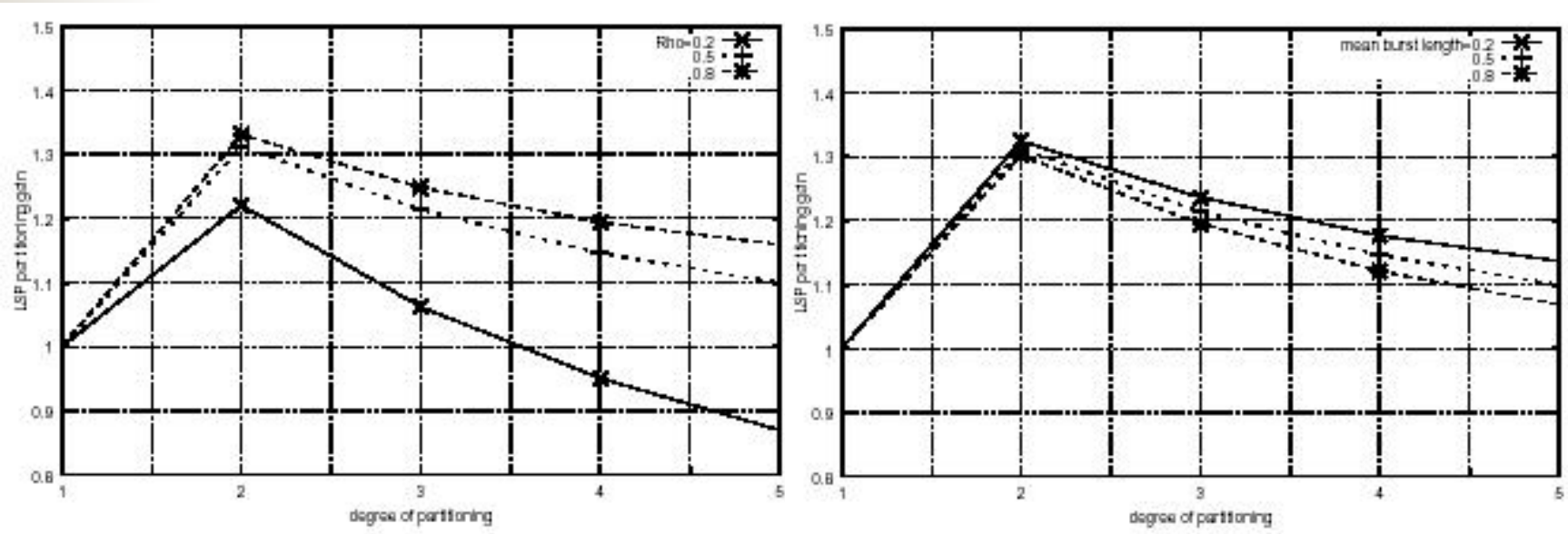
$$\gamma = \frac{\text{bandwidth demand of conventional LSP mechanism}}{\text{bandwidth demand of D-LSP mechanism}} = \frac{B_{total}^{C}}{B_{total}^{D}}$$

$$= (L + 2Q + \min(R,1))C / LMC'$$

Effect of LSP Partitioning

- Considering ON-OFF traffic model (r, b ,ρ)

  r: peak rate; b: mean burst length; ρ: flow source util.



Conclusions

- A very intuitive and effective mechanism for reducing the spare bandwidth demand is proposed.
- There is a trade-off between LSP partitioning and statistical multiplexing gain.
- One possible extension of this study can be investigating the D-LSP mechanism for multi-QoS leveled MPLS networks.