Quality of Service using Traffic Engineering over MPLS: An Analysis

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Thes ine at

Overview

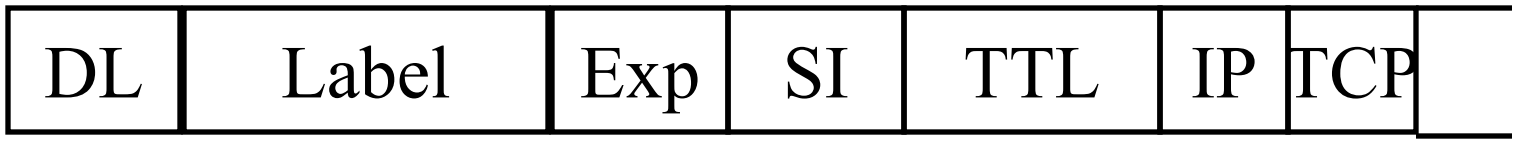
- Traffic Engineering: Trunks, LSPs, Links
- Simulation Model
- Results for 4 different scenarios
- Conclusions

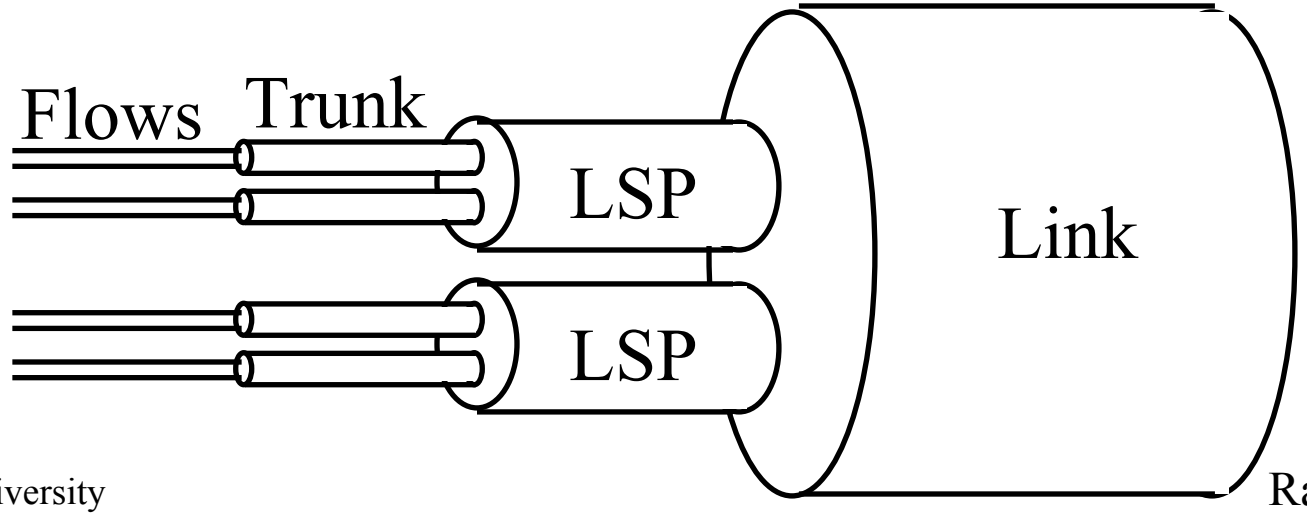
Traffic Engineering

- Optimize the utilization of network resources
- Using MPLS
  - Explicit Routing
  - Policy Routing
  - Traffic aggregation and disaggregation
  - Constraint Based Routing

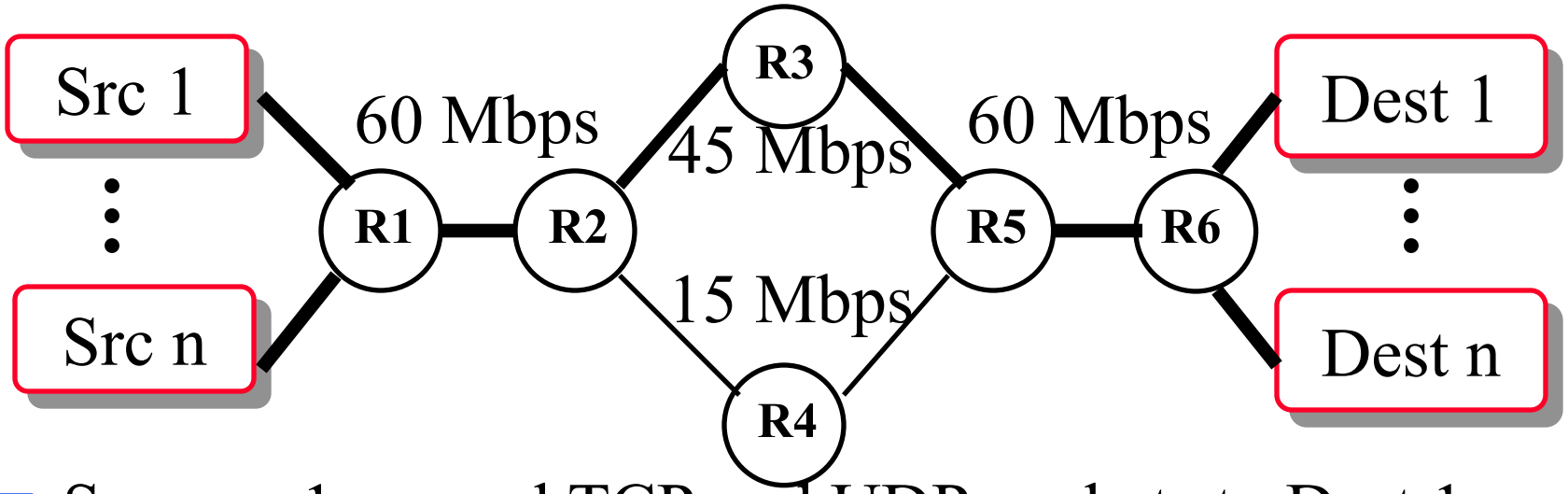
Flows, Trunks, LSPs, and Links

- Label Switched Path (LSP):
  All packets with the same label
- Trunk: Same Label+Exp
- Flow: Same MPLS+IP+TCP headers





Simulation Model

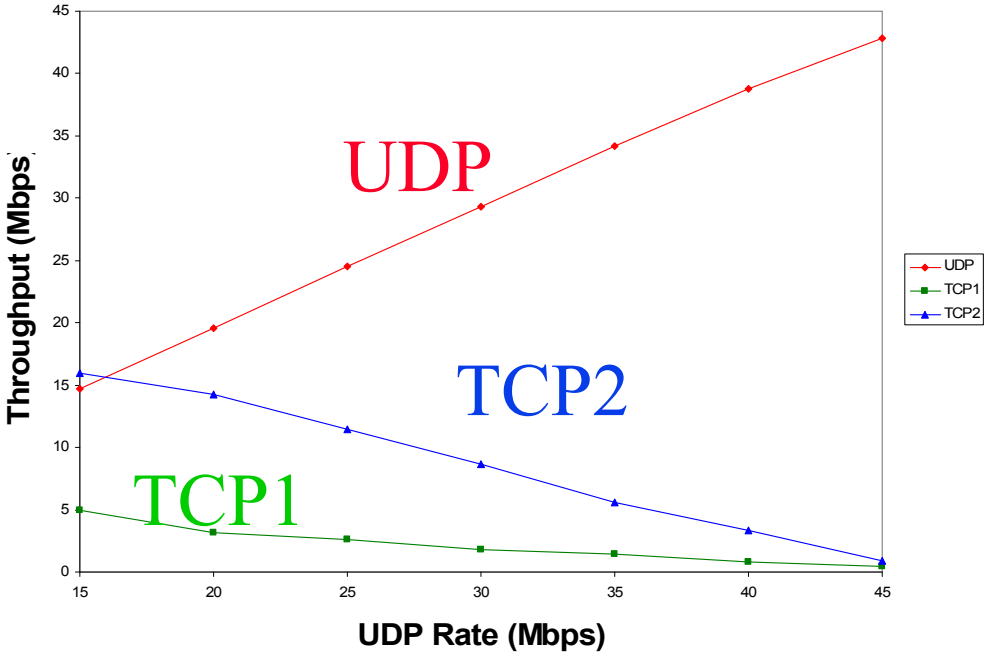


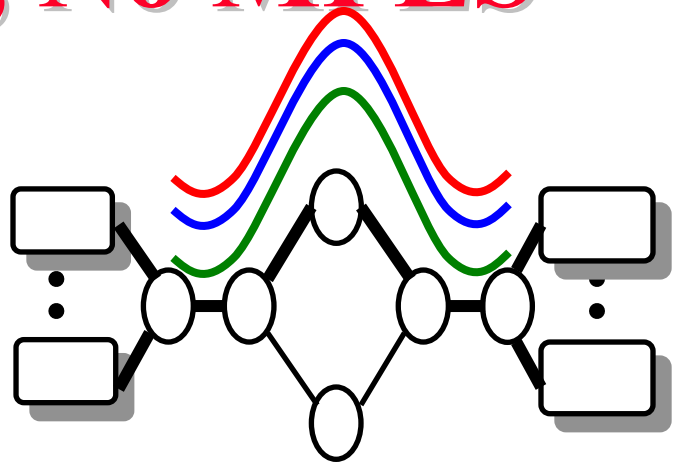
- Sources 1..n send TCP and UDP packets to Dest 1..n
- R2-R3-R5 is a high bandwidth (45 Mpbs) path.
- R2-R4-R5 is a low bandwidth (15 Mbps) path.
- All links have 5ms delay
- TCP1 MSS = 512 B, TCP2 MSS = 1024 B, UDP MSS = 210B

Simulation Scenarios

1. Normal IP with Best Effort routing
2. Two trunks using Label Switched Paths
   - Trunk 1: R1-R2-R3-R5-R6
     - TCP and UDP sources are multiplexed over this trunk
   - Trunk 2: R1-R2-R4-R5-R6
     - Only TCP sources over this trunk
3. Three trunks using Label Switched Paths
   - All three flows are isolated.
4. Non End-to-end trunks.

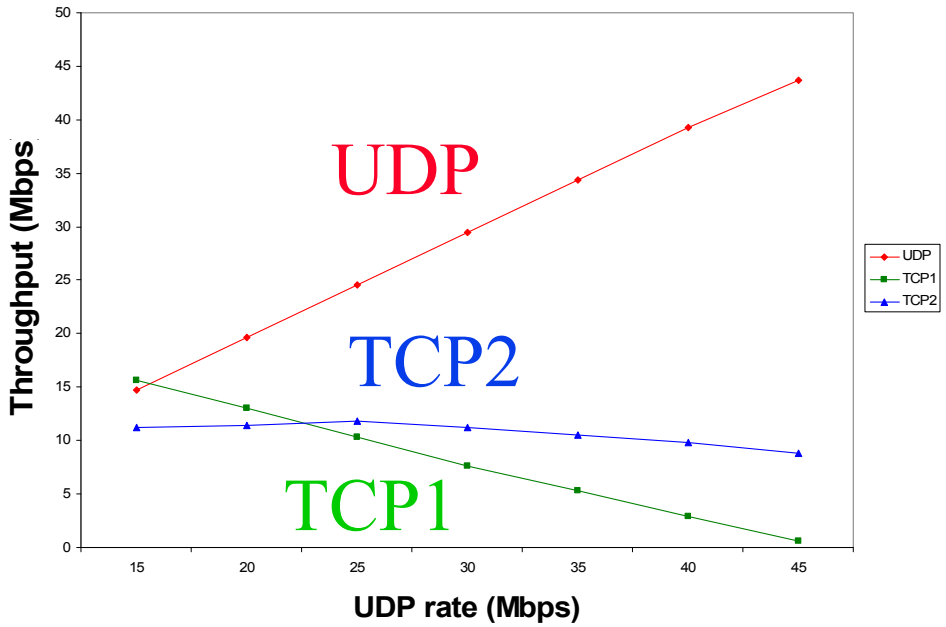
Case 1: No Trunks, No MPLS

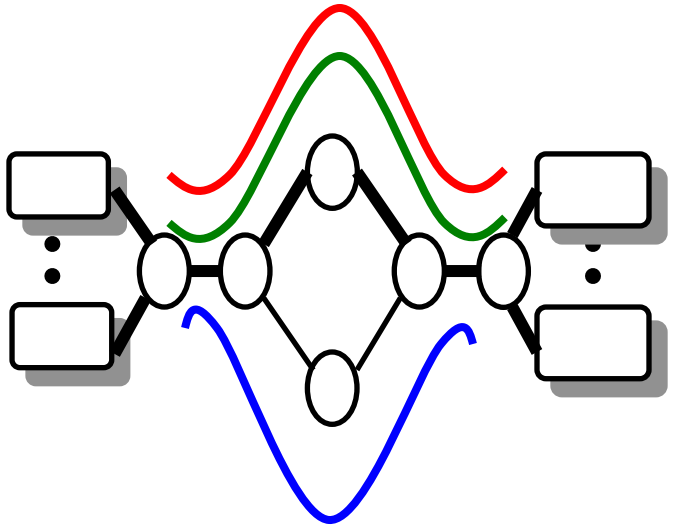




- 15 Mbps path not used at all
- TCP suffers as UDP increases its rate
- Unfairness among TCP flows

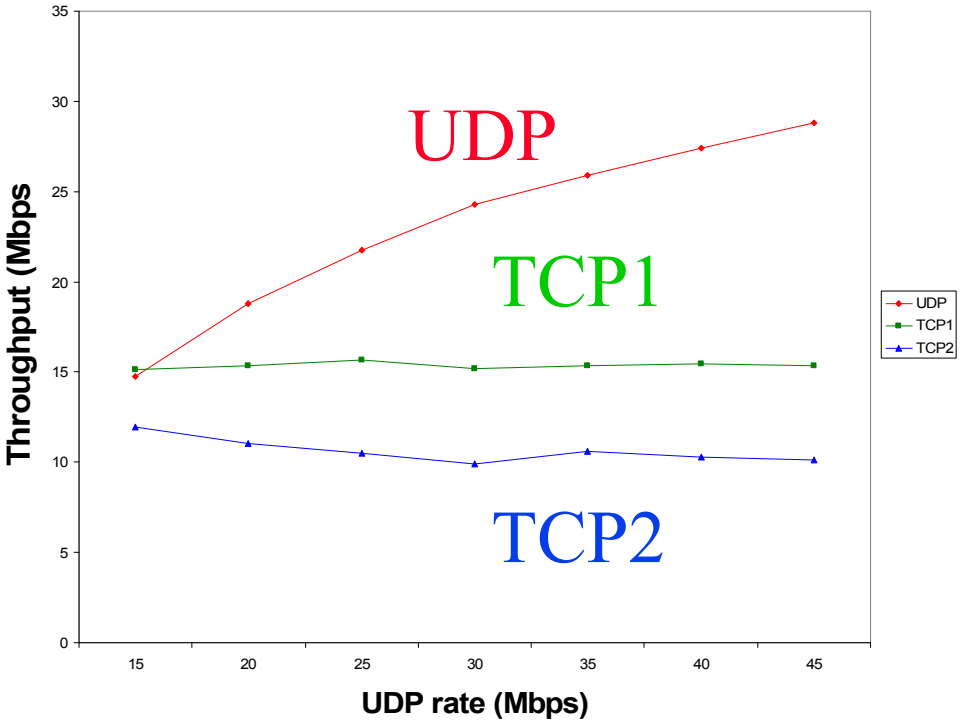
Two trunks w UDP + TCP Mixed

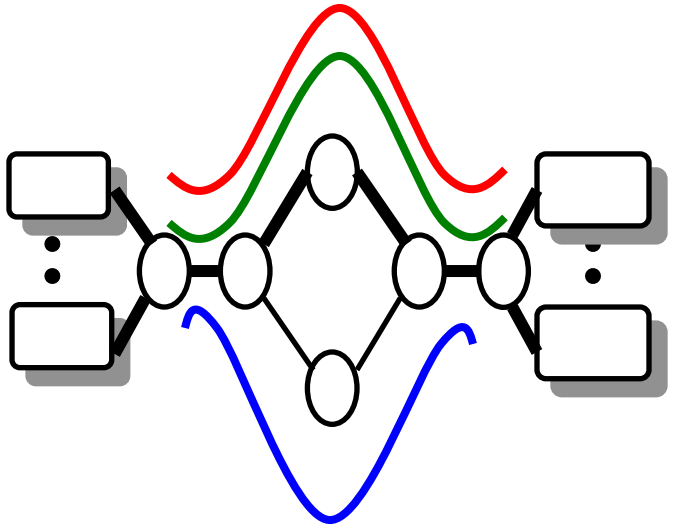




- Total throughput > 45 Mbps (both paths used)
- TCP flows sharing the trunk with UDP suffer
- TCP flow not sharing with UDP do not suffer

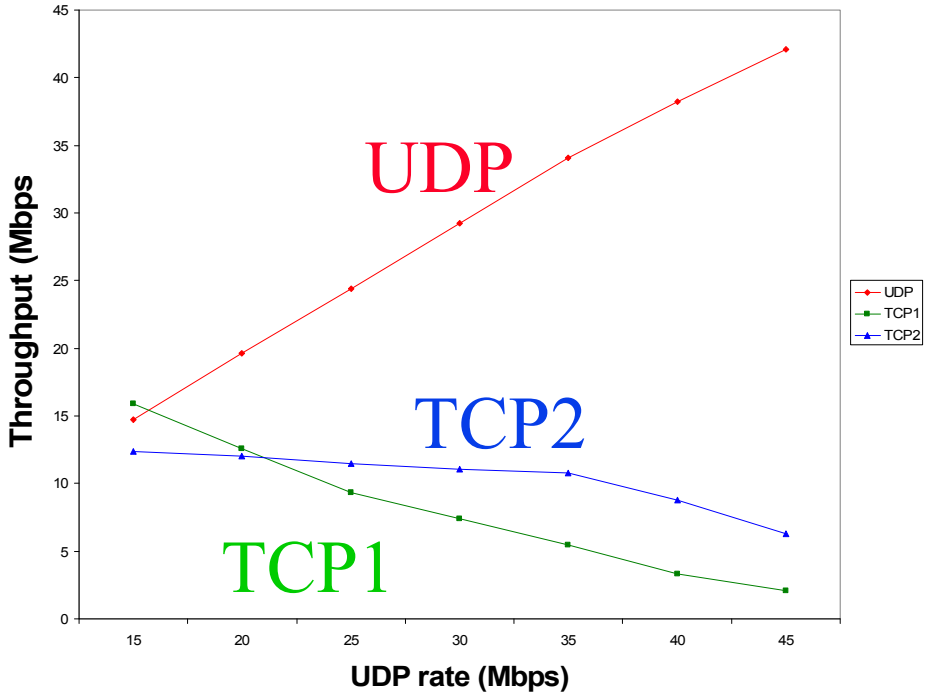
3 Trunks w Isolated TCP, UDP

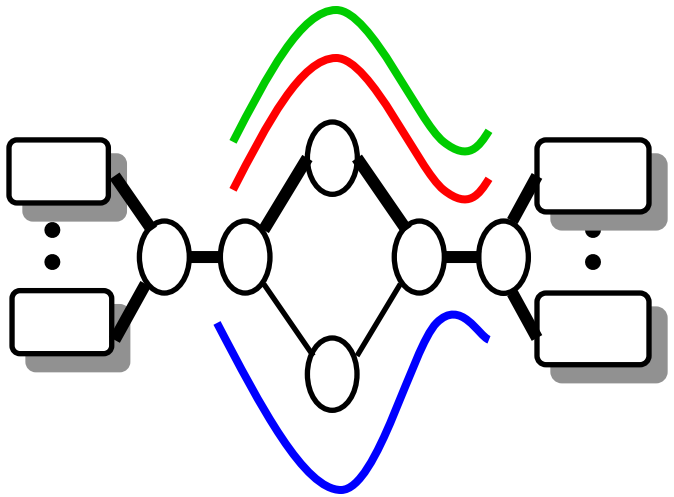




- TCP flows are not affected by UDP and achieve a fairly constant throughput

Non End-to-End Trunks

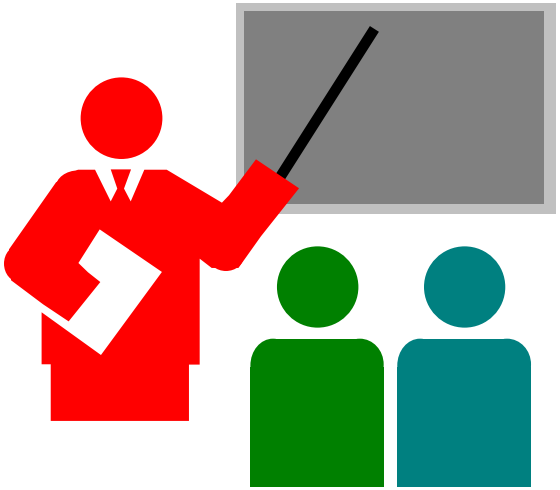




- TCP flows are affected by UDP in the shared path

Other Factors

- Queue Service Policies: WFQ, WF2Q, WF2Q+
- Packet drop policies: RED, Tail drop
- Round Trip Time
- TCP parameters:MSS, window size, etc.



Summary

- Total network throughput improves significantly with proper traffic engineering
- Congestion-unresponsive flows affect congestion-responsive flows
  - Separate trunks for different types of flows
- Trunks should be end-to-end
  - Trunk + No Trunk = No Trunk