Quality of Service using Traffic Engineering over MPLS: An Analysis

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These slides, ID, and a paper are available online at
http://www.cis.ohio-state.edu/~jain/ietf/

Traffic Engineering: Trunks, LSPs, Links

Simulation Model

Results for 4 different scenarios

Conclusions

Traffic Engineering

Optimize the utilization of network resources

Using MPLS

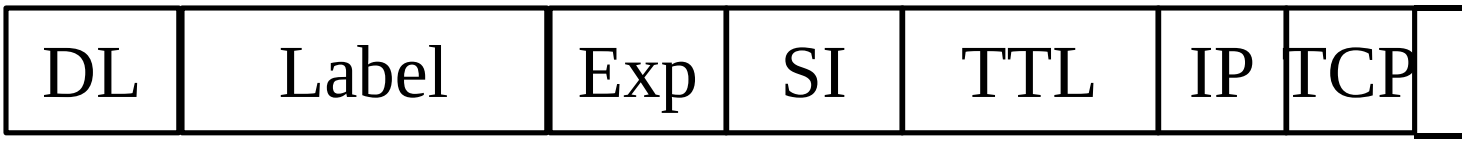
- Explicit Routing
- Policy Routing
- Traffic aggregation and disaggregation
- Constraint Based Routing

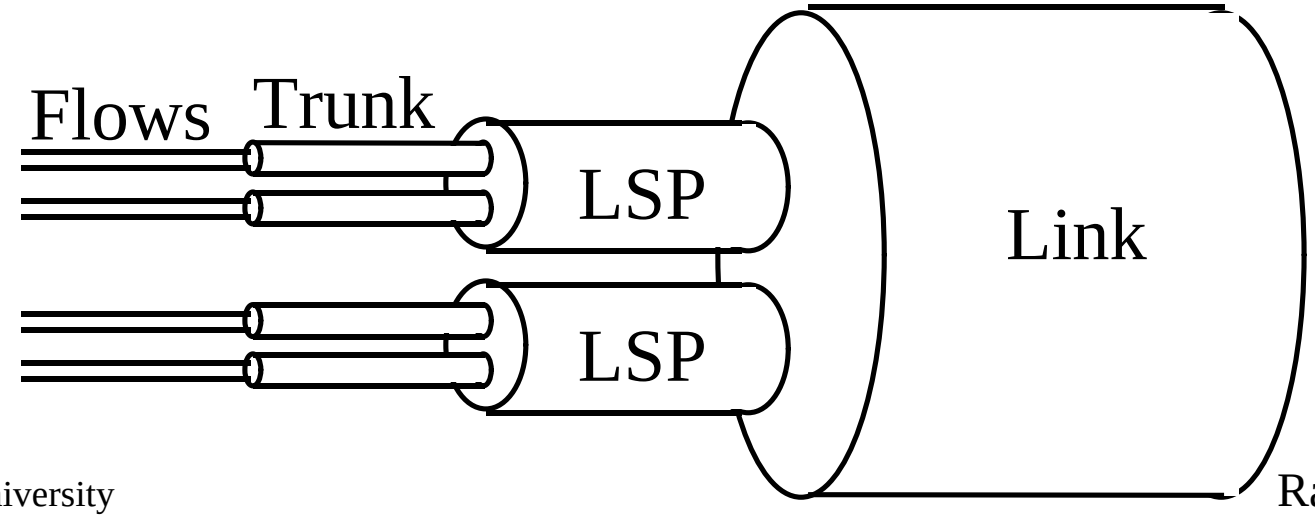
lows, Trunks, LSPs, and Links

Label Switched Path (LSP):
All packets with the same label

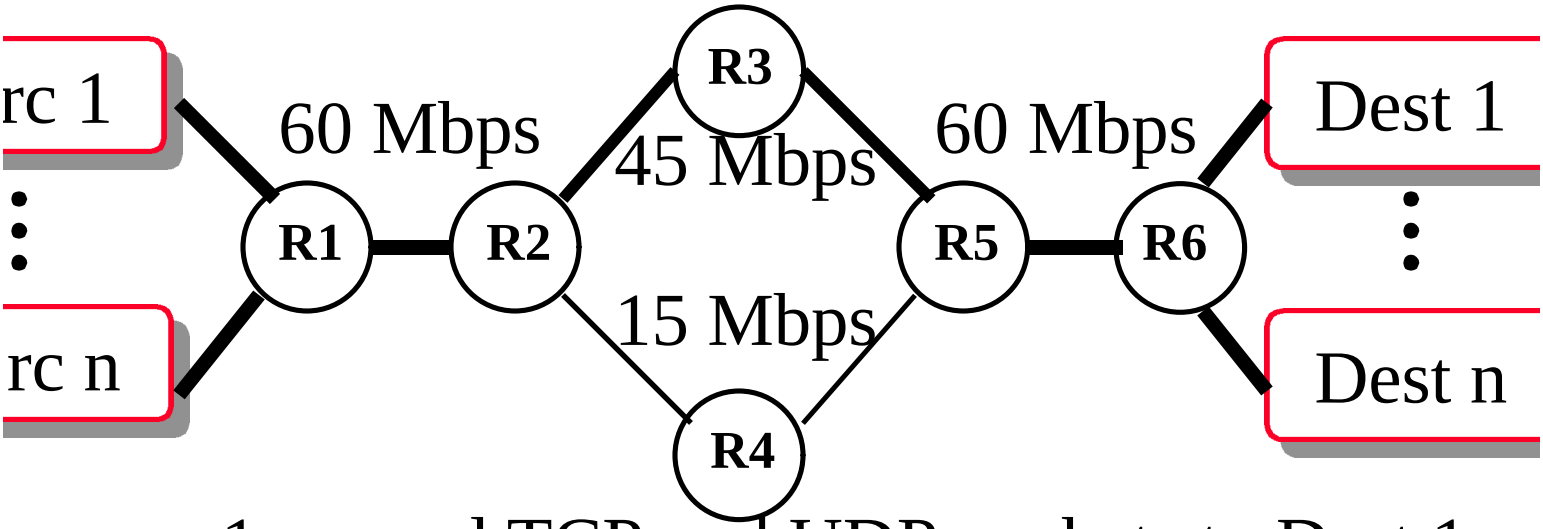
Trunk: Same Label+Exp

Flow: Same MPLS+IP+TCP headers





Simulation Model



ources 1..n send TCP and UDP packets to Dest 1..n

2-R3-R5 is a high bandwidth (45 Mpbs) path.

2-R4-R5 is a low bandwidth (15 Mbps) path.

ll links have 5ms delay

CP1 MSS = 512 B, TCP2 MSS = 1024 B,

DP MSS = 210B

Simulation Scenarios

Normal IP with Best Effort routing

Two trunks using Label Switched Paths

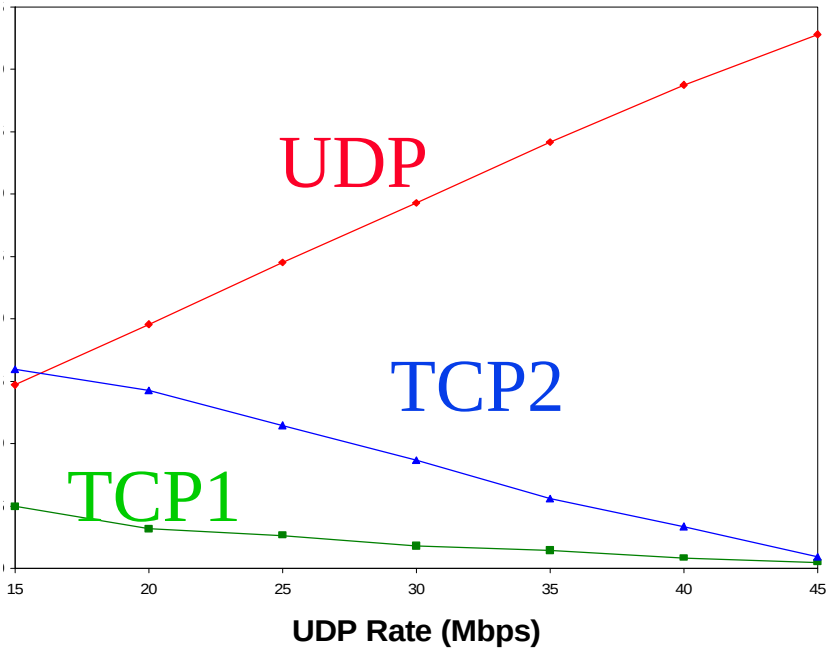
- Trunk 1: R1-R2-R3-R5-R6
  - TCP and UDP sources are multiplexed over this trunk
- Trunk 2: R1-R2-R4-R5-R6
  - Only TCP sources over this trunk

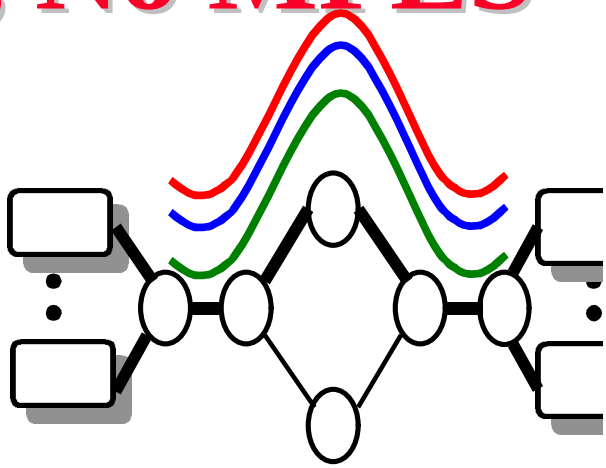
Three trunks using Label Switched Paths

- All three flows are isolated.

Non End-to-end trunks.

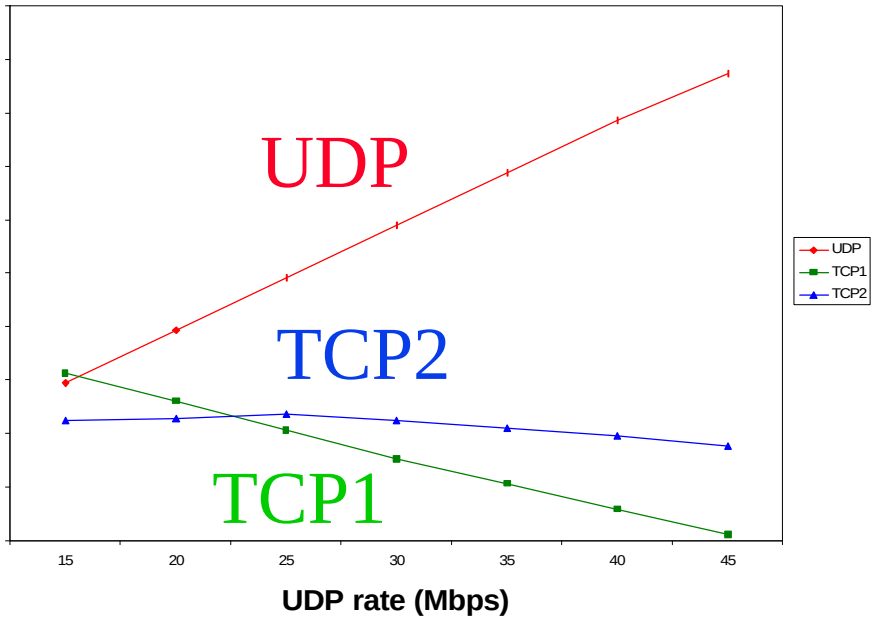
Case 1: No Trunks, No MPLS

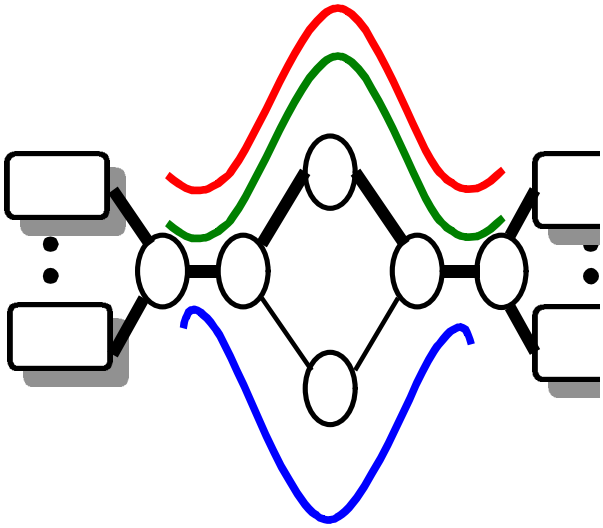




- 15 Mbps path not used at all
- TCP suffers as UDP increases its rate
- Unfairness among TCP flows

wo trunks w UDP + TCP Mixed



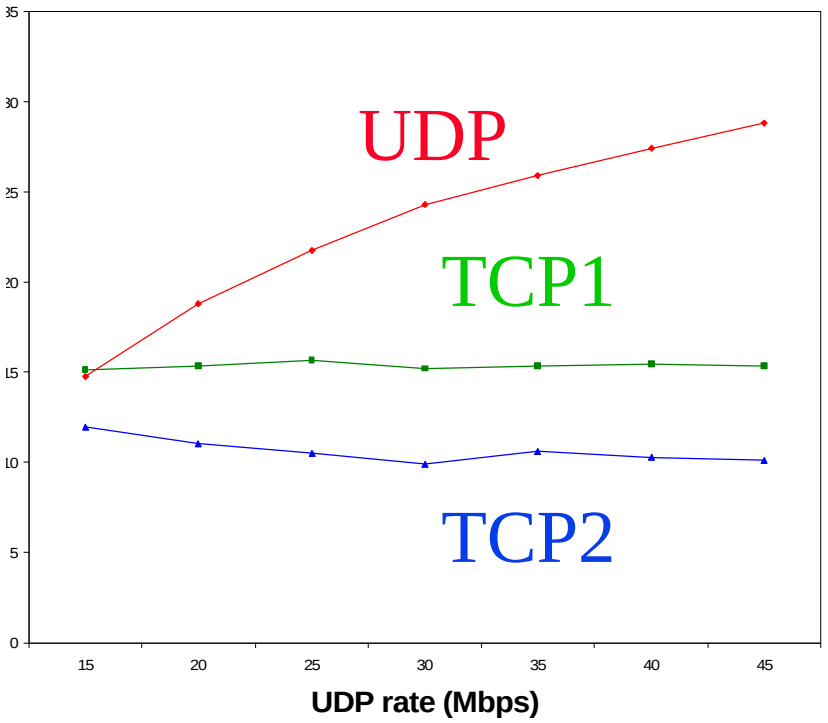


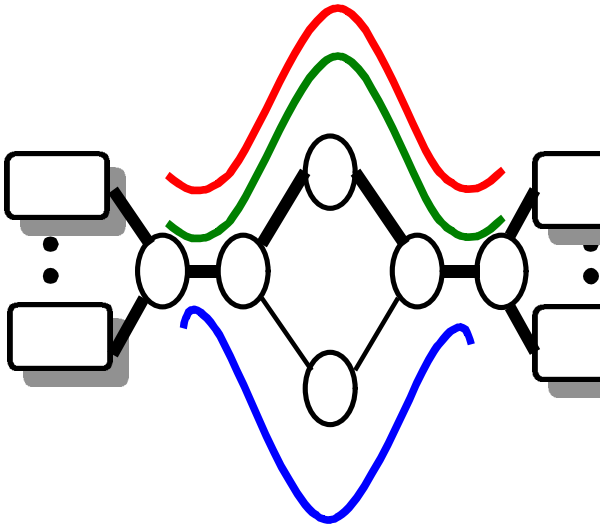
Total throughput > 45 Mbps (both paths used)

TCP flows sharing the trunk with UDP suffer

TCP flow not sharing with UDP do not suffer

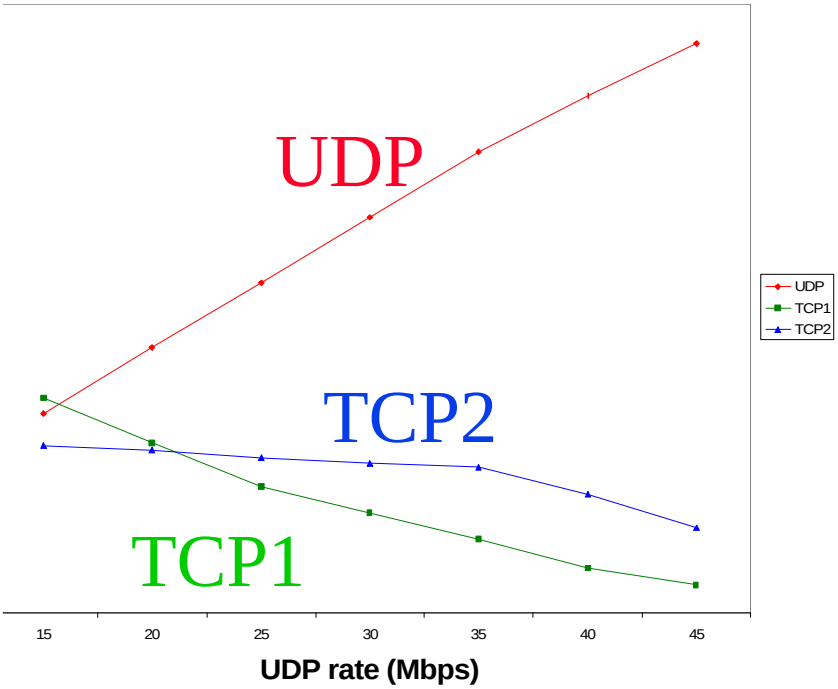
3 Trunks w Isolated TCP, UDP

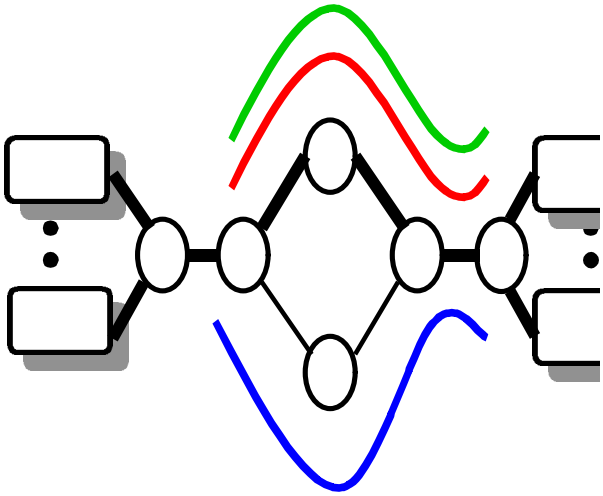




TCP flows are not affected by UDP and achieve a fairly constant throughput

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