A New Dynamic Distributed Bandwidth Reservation Mechanism to Improve Resource Utilization

Sukrit Dasgupta  
Department of ECE  
Drexel University  
Philadelphia, PA, USA

Jaudelice C. de Oliveira  
Department of ECE  
Drexel University  
Philadelphia, PA, USA

Jean-Philippe Vasseur  
Cisco Systems  
Boxborough, MA, USA

Presented at IEEE-INFOCOM, Barcelona, Spain  
27th April 2006
Motivation

› Traffic Engineering
  › Already generated a lot of interest and work

› Resource Allocation
  › Very researched topic
  › Dynamic and static

› We propose
  › “Dynamic TE”
  › Calculate the reservation needed, find the best path
Static Reservations keep peak demand in mind
Why Dynamic TE?

- More TE-LSPs on IGP shortest paths
- Leads to smaller total path costs
- No apriori knowledge of traffic matrix required
- Allows more traffic in the network
- Use traffic + time characteristics
Outline

- Dynamic TE
- Constraint Shortest Path First
- Performance Metrics
- Simulation Setup
- Results
- Summary
Dynamic TE

- Decentralized, all routers behave individually
- Take online measurements
- Change reservation size according to load
- Find better path for new reservation
- Signal new reservation on new path
- Forward traffic on the new path
- Tear down old reservation
Dynamic TE

1. Resizing Timer Expired?
   - Yes: Calculate the New_Size
   - No: Take Sample
2. Sampling Timer Expired?
   - Yes: Sampling Timer Expired
   - No: Wait
3. Yes: Find a new route using CSPF for New_Size
4. No: Calculate the New_Size
5. Yes: Resize TE_LSP
6. No: Restart Timers

Traffic Profile Plot - Data+Voice

Bandwidth (Kbps)

Time (Minutes)
Constraint Shortest Path First

- Prune links to find subgraph

- Run Dijkstra’s Shortest Path First Algorithm
Performance Metrics

› Maximum reservation on a link
  › ‘Indicator’ of utilization in the network

› Number of TE-LSPs not on the shortest path
  › Less is good.

› Worst case load on a router
  › CPU stress on a router

› Maximum setup requests on a router
  › Signaling in the network
  › CPU stress on a router
Simulation Setup

- Realistic traffic profile
  - Internet data traffic
  - 6-8 hour peak period
  - Full mesh ~ 6800 TE-LSPs

- Realistic topology
  - Backbone from ‘Rocketfuel’
  - 83 nodes, 167 links

- Failure events
  - Random link failure
    - Inter failure time ~U(0,60) min
  - Traffic is rerouted
  - Failed link is restored
    - Inter restore time ~U(0,15) min
Reserved Bandwidth

Maximum

Average

- STAT reserves more bandwidth than required
- DYN fits more traffic by creating room
Affect of Scaling

- Scaling traffic matrix increases reserved bandwidth per link
- Links experience a higher “maximum reservation”
- Static TE causes traffic to “spread” - longer paths
- Dynamic TE “compresses” - more traffic on shorter paths
Affect of Scaling

- Scaling causes more reservation: less space to fit TE-LSPs
- TE-LSPs spread across the network: longer paths
- Static TE + Failure cause TE-LSP setup failures
Worst Case Load on a Router

- Static TE leads to routers having fewer traversing TE-LSPs
- Dynamic TE causes routers to handle more TE-LSPs
Affect of Scaling

- Scaling spreads traffic - Less TE-LSPs per router
- Failure causes TE-LSP setup failure - Less TE-LSPs per router
Static TE does not involve periodic resizing
Dynamic TE has periodic setup requests: RSVP signaling. No affect of scaling
Topological View

Average Reserved Bandwidth > 50%

DYN-TE
+ Failures

17 links

STAT-TE
+ Failures

33 links
Summary and Future work

- Proposed a dynamic resizing mechanism for TE-LSPs
- Identified and study metrics that effectively capture the network state
- Presented a detailed analysis of the metrics
- Provided groundwork to better understand and analyze future dynamic resizing mechanisms

Future Work

- Consider mixed traffic. eg Voice, VoD, Gaming, etc.
- Affect of timezone
- Node Failures
- SRLG failures
- Signaling issues (LSAs/LSPs)
Acknowledgments
Questions ?
Backup!
Traffic Profiles