MENTER: Dynamic Traffic Engineering for MPLS Networks

T. Guven, K-T Kuo, S. Phuvoravan, L. Sudarsan, H.S. Chang, S. Bhattacharjee, and M. Shayman

Project Overview

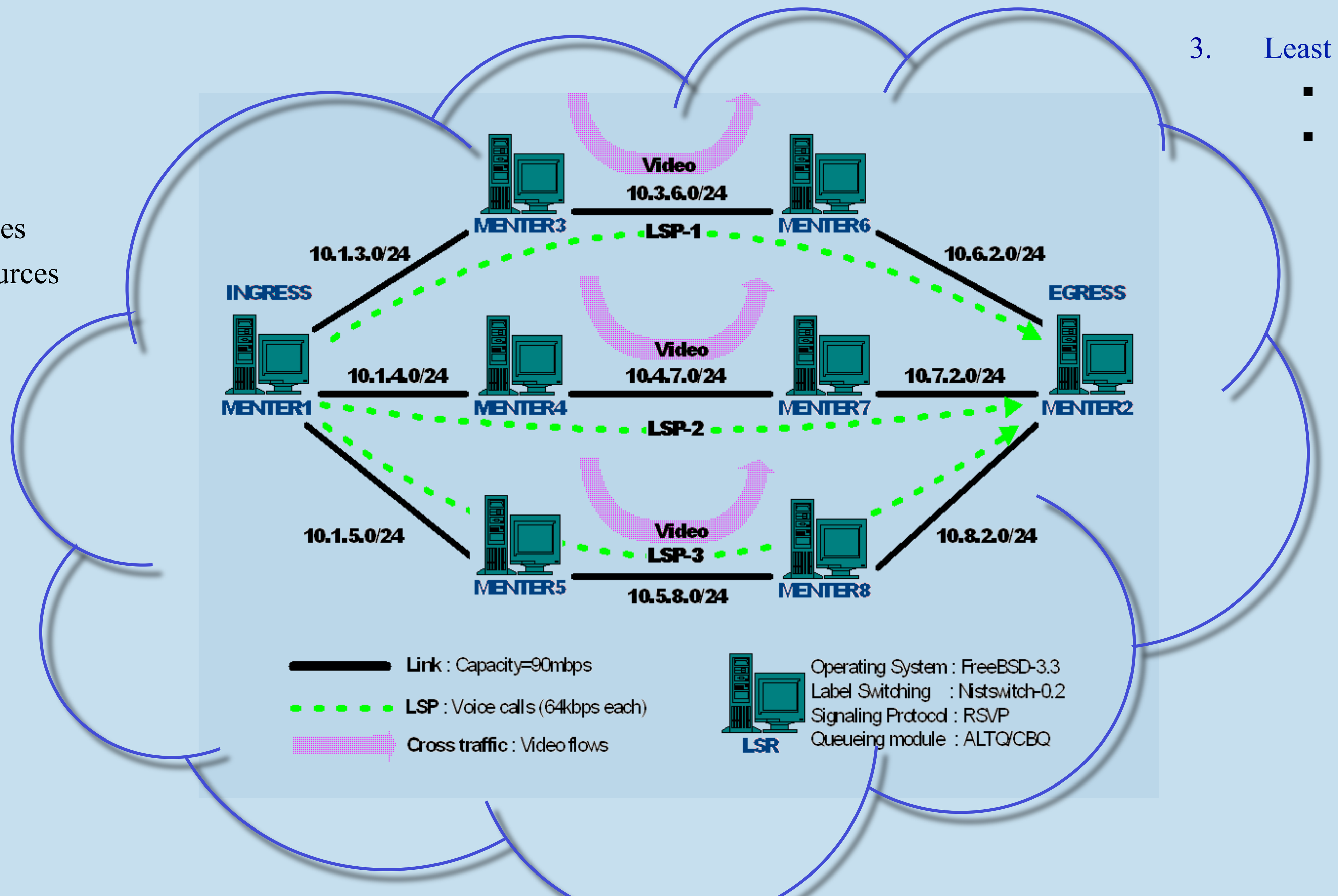
- MENTER overall goals:
  - Integrate traffic engineering and network management
  - Monitor and modify network-level properties at fine timescales
- MENTER reduces the feedback loop between monitoring and control
  - Traditional approaches: Minutes or hours
  - MENTER: seconds or milliseconds
- Use fine-grained monitoring and control to increase overall utilization without degrading quality of service

Simulation Traffic Models

- Voice traffic
  - 64 kbps CBR with Poisson call arrivals
  - Exponential call durations
- Video traffic
  - Aggregation of on-off sources, each with exponential on-off times
  - Burstiness varied by fixing b/w and varying the no. of on off sources

MPLS Overview

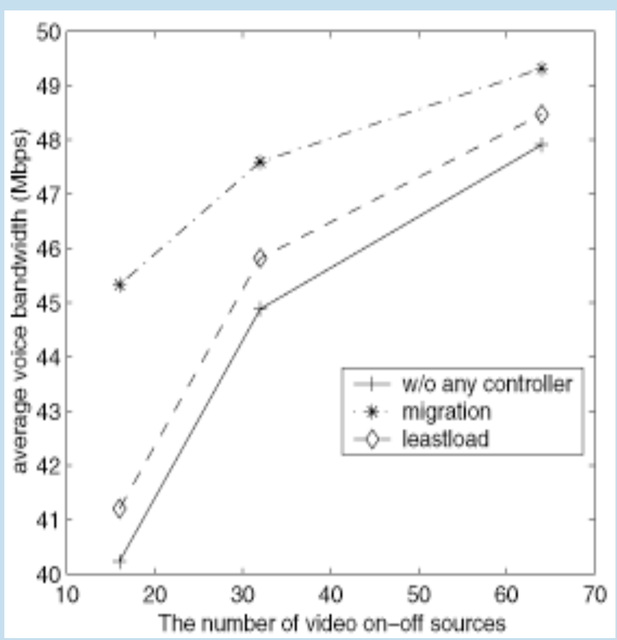
- Set of protocols for imposing virtual circuit-switched paradigm over IP on a flow-aggregate basis
  - Circuits are called Label Switched Paths (LSPs)
  - LSPs carry multiple flows
  - Analogous to virtual paths in ATM
- Incurs the traditional circuit-set up and admission control costs
  - Label Switching Routers (LSRs) keep per-LSP state
- End-to-end path for a flow through MPLS domain is *fixed*
  - Allows service provisioning
  - Enables real Quality of Service guarantees



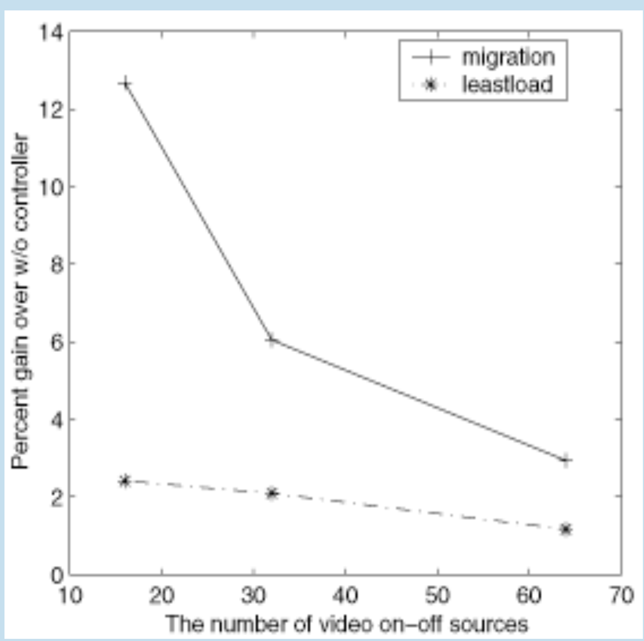
Controller Algorithms

1. No Controller/Offline Optimization Only
   - New voice calls assigned to LSPs using statistical splitting with probability 1/3.
2. Migration Controller
   - Use the offline optimization in (1).
   - Include an online centralized controller :
     - *In each controller time-slot, get the link l with maximum utilization that is over the threshold Γ%.*
     - *If l exists, then discover the set ζ of LSPs using it.*
     - *Find alternative LSPs for each $\rho \in \zeta$.*
     - *For each $\rho \in \zeta$, calculate*
       $S(\rho) = \Sigma$ *[available bw – safety factor (δ %)] of its alternative LSPs.*
     - *Choose $\mu \in \zeta$, that maximizes $S(\mu)$. The Ingress migrates from μ to its alternative LSPs proportional to their [available bw - δ%] values.*
3. Least Load Controller:
   - LSP utilization continuously monitored and used by the controller.
   - New voice calls assigned to least-loaded LSP.

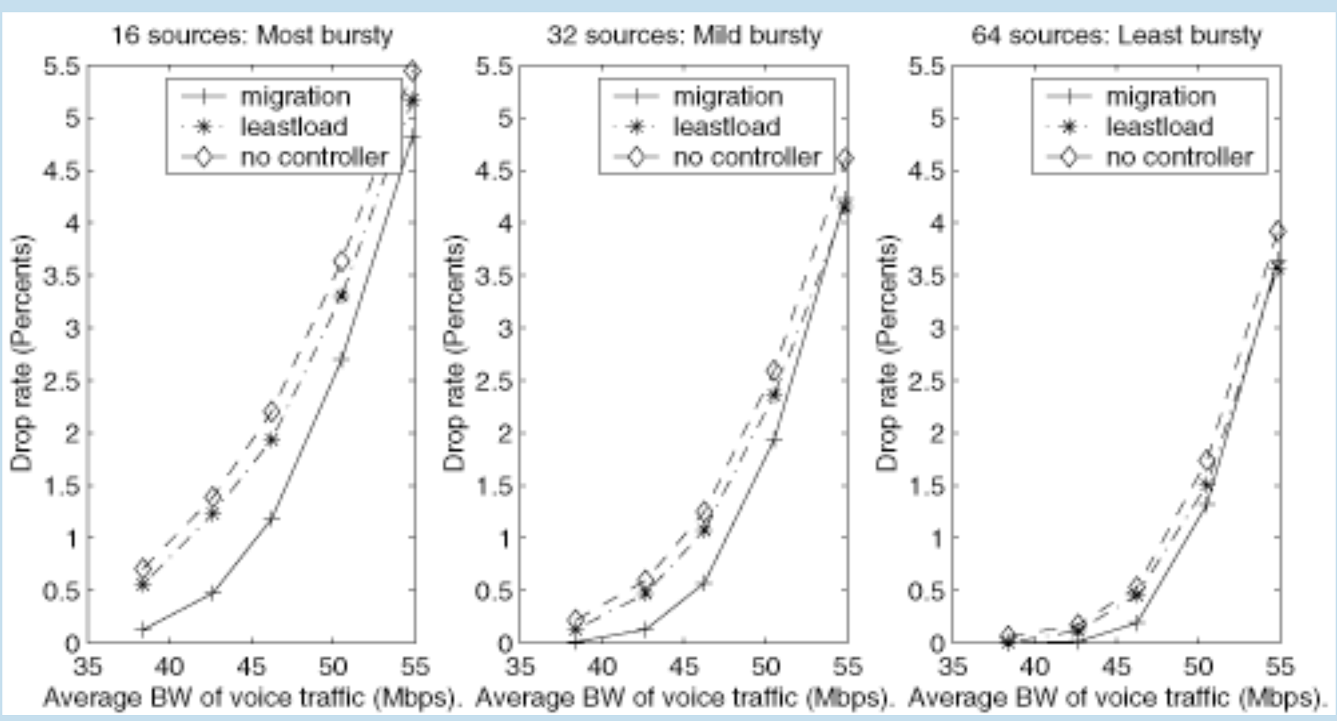
Simulation Results



Max voice BW to get 1% drop rate requirement



Relative bandwidth gain over no controller

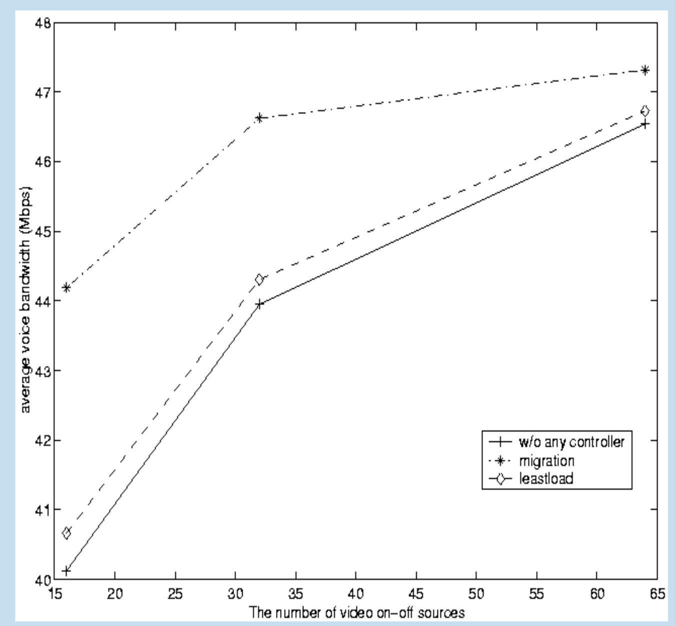


The drop rate at different voice load

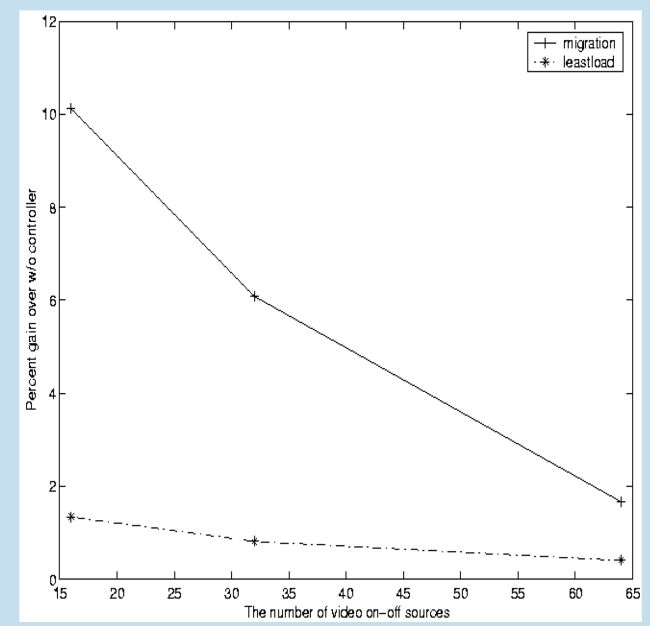
Conclusions

- Simulation : Up to 13% more voice traffic in the network with Migration, under 1% drop rate requirement.
- Test-bed: Up to 10.2% more voice traffic in the network with Migration, under 1.5% drop rate requirement .
- Performance of Migration controller is better than Leastload controller and no controller at every voice load.

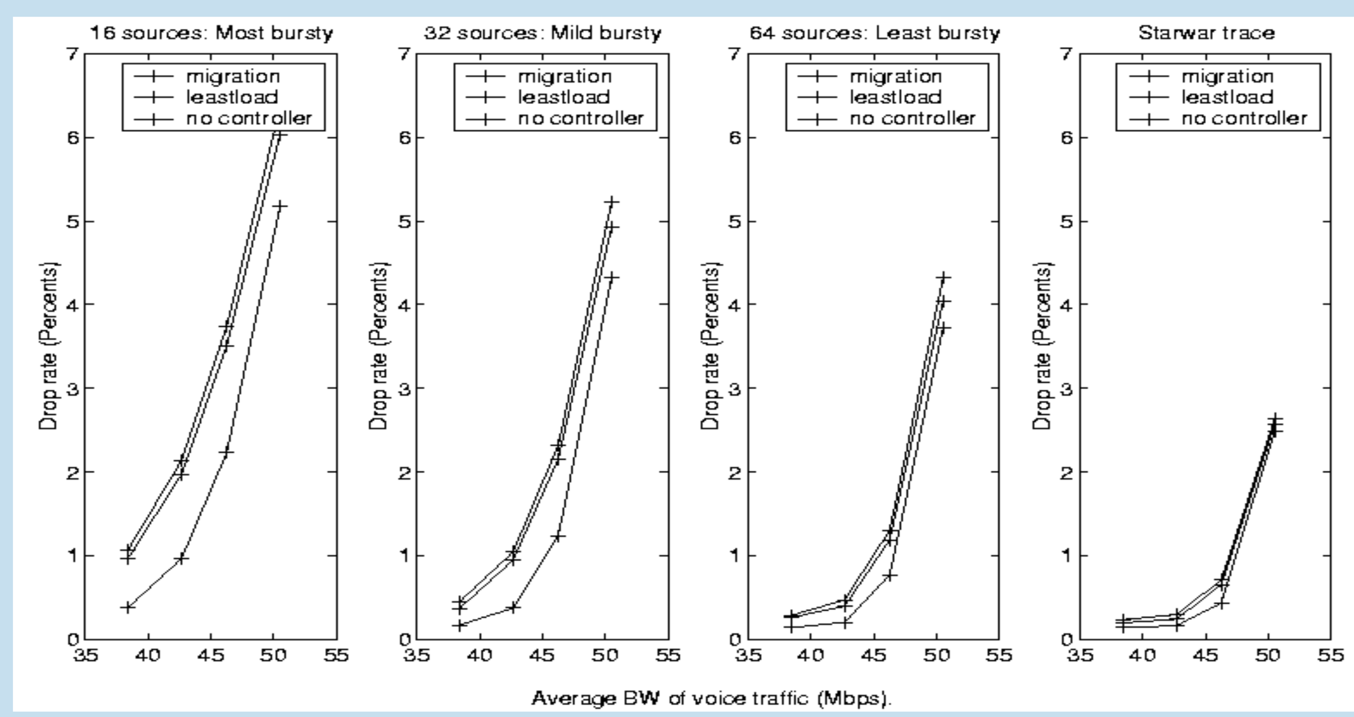
Testbed Results



Max voice BW to get 1.5% drop rate requirement



Relative bandwidth gain over no controller



The drop rate at different voice load

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