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Performance analysis of ABR point-to-multipoint connections for bursty and non-bursty traffic with and without VBR background

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- Issues in Multipoint ABR
- Point-to-multipoint ERICA
- Simulation results for various configurations and traffic patterns

Issues

- Minimum of ER from branches is sent upstream
  Should we wait for all branches?
- If you send BRM on every FRM, you may give feedback without receiving any
  ⇒ Need to ensure that at least one feedback has been received before sending a BRM.
  Otherwise, you may give PCR
- Not all downstream feedbacks in an upstream feedback
  ⇒ Consolidation noise
- Additional delay due to FRM wait and BRM consolidation at each level ⇒ Slower transient response

Point-to-Multipoint ERICA

- Framework from Larry Roberts' 94-0772R1
- At the end of Averaging Interval:
  - Compute input rate and # of active sources
- Upon receiving an FRM:
  - Process as usual (note CCR)
  - Multicast to all branches
  - MXR = ER from FRM
  - MER = Min{MER, ER_ERICA}
  - Return BRM with ER = MER
  - MER = MXR

- Upon Receiving a BRM:
  - MER = Min{MER, ER from BRM}
  - Discard BRM
- When sending a BRM:
  - Compute ER for each branch
  - ER_ERICA = Min ER for all branches
- For NI, CI, use "or" in place of "min"
- Multipoint ERICA with one leaf ⇒ Unicast ERICA

Parameters

- Unless indicated otherwise:
  - All links 155.52 Mbps, 1 km (LAN), 1000 km (WAN)
  - All VCs (unicast and multicast) are unidirectional
  - RIF = 1, ICR = PCR
  - TBE = Large (disable rule 6)

- ERICA (not ERICA+):
  - Target Utilization = 95% (LAN), 90% (WAN)
  - Averaging Interval
    = Min{50 cells, 1 ms} for LANs
    = Min{100 cells, 1 ms} for WANs
- Traffic:
  - VBR 3 ms on, 3 ms off (LAN)
  - 20 ms on, 20 ms off (WAN)
  - VBR amplitude = 80% (on), 0% (off)

Configurations

- Several variations of Parking lot and others
- Unicast and multicast mix
- Transient sources
- VBR background
- Multiple VBRs at different times
  $\Rightarrow$ moving bottlenecks
- Widely varying link lengths
- Infinite sources, Bursty Sources,
  Infinite, bursty, and VBR sources mixed

Simulation Results

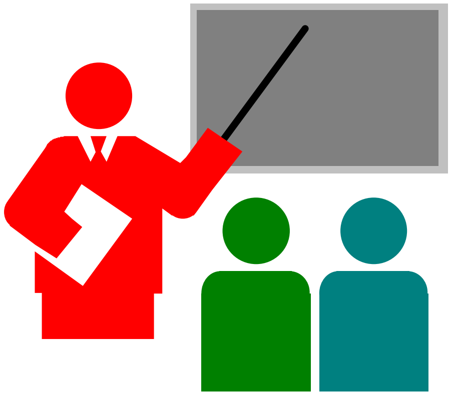
- ACRs stabilize quickly
- Queue lengths are small in most cases
- Fast transient response
- Utilization of bottleneck links are high
- There is max-min fairness
- Size of the oscillations (consolidation noise) depends upon the feedback asynchronousness

Parking Lot and 2 VBR

- Two unicast VBRs
- When one is on, the other is off and vice versa
- Either link 1 is bottleneck or link 2 is bottleneck
- Non-bottleneck link gets low utilization since minimum of all feedbacks is given
- RIF=1 and 0.03125
- ICR = 12 Mbps, 150 Mbps
- See Figures 11 through 14

- High ICR and High RIF give the fastest transient response and best throughput.
- Long feedback delay $\Rightarrow$ longer stabilization time but does reach steady state

Summary



- Larry Roberts multipoint framework + ERICA work ok
- Efficiency, fairness, responsiveness is maintained
- Consolidation noise due to asynchronous arrival of feedback from different leaves appears as oscillations
- Additional delay due to FRM wait and BRM consolidation
  $\Rightarrow$ slower transient response than point-to-point

- Minimum of all paths is allocated
  ⇒ some links are underutilized
- Low RIF
  ⇒ Low Queues but also lower responsiveness
  ⇒ Lower throughput
- Low ICR
  ⇒ Low initial queues but also lower throughput
- Queue control (ERICA+) is required for stability