Lecture 23

CS625: Advanced Computer Networks
Fall 2003

Thursday, 09 October 2003

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http://www.cse.iitk.ac.in/users/braman/courses/cs625-fall2003/outline.html

Topic for Today

- Overlay Networks
- *Scribe for today?*

Overlay Network

- Overlay: a network on top of another network
  - IP itself is an overlay network
  - The term generally means a network on top of IP

Purpose of Overlay

- Add a functionality to IP
- Examples:
  - Multicast
  - Resilience or fault tolerance
    - Resilient Overlay Network (RON) [ABK01]
    - Resilient service composition [Raman02]
Motivation to Provide Resilience

- IP (BGP) takes a long time to recover
  - Up to several minutes! [Labovitz et al. 2000]

Motivation (continued)

- BGP hides topological details
- Policy routing takes priority over any metric
- Not good for fault tolerance or congestion-free routing
- BGP availability:
  - 10% of routes are available only 95% of the time
- Multi-homing not a solution
- Early ARPANET: unscalable

RON Model

- Designated RON nodes for an overlay
- Exchange of performance and reachability
- And, routing based on these
- 2-50 nodes (only) on overlay
- Advantages:
  - Fast recovery from failures
  - Application specific metric
  - Packet classification policies are possible

RON Architecture

- Software modules at RON node
  - RON client
  - Router
  - Forwarder
  - Membership manager
- Full mesh network among members
- Link-state based dissemination
**Possible Usage Models**

- A specific application (like video conferencing) constructs and uses RON
- A network administrator constructs an overlay
- Overlay ISP

**Path Metrics**

- Latency (EWMA)
- Loss rate
- Bandwidth
  - Relatively unstable
  - But stable over several 10s of minutes within 50% variation
  - TCP throughput: \( \text{max} = \sqrt{1.5} \times [\text{RTT} \times \sqrt{p}] \)
    - Difficult to combine
    - Consider only two-hop alternate paths

**Failure Detection**

- Monitoring for liveness of path using keep-alive heartbeat
  - (a) Monitoring for liveness of path using keep-alive heartbeat
  - (b) Failure: detected by timeout
  - (c) False-positive: failure detected incorrectly due to intermittent congestion
    - Overhead versus detection time trade-off
    - False positives possible
    - Application-specific notion of failure

**Further topics...**

- Peer-to-peer networks
- Internet Security
- Reminder:
  - Assignment-2 will be assigned today