Network Programming
TDC 561
Lecture # 9: Reliable Multicast Protocols

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Agenda
- Midterm Exam (review), Demo Sched.
- Reliable Multicasting
  - concept and examples
  - RMP 1.3 b: operation and example
  - Advanced application (HiFi)
  - Independent studies
- Techniques for Network Programming
- Deadlock and Starvation in Network Prog.

Reliable Transport Multicast Protocols
- What is “Reliable”?
  - Loss Recovery (for all members?)
  - ordered Delivery
  - No Duplicates
  - Isolating Independent failures
- What is “Transport”?  
  - ISO and Internet Transport layers
  - No Network layer support is expected
  - End-to-end Reliability
- Which “Multicast”?  
  - IP Multicast proposed in RFC 1112
TRMP: Token-ring Multicast Protocols

**Basic Concept**
- Token site is responsible for ACK
- Ack (timestamp) is multicasted for total ordering
- Next token-site must have all previous packets
- Avoid Ack-implosion: only token-site Ack
- Avoid Nack-implosion: Receivers send NACK to the token-site
- Bounded Buffering: memory release after a message gets “stable” (token cycles)

**Avoid Nack-implosion:** Receivers send NACK to the token-site

Bounded Buffering: memory release after a message gets “stable” (token cycles)

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**Retransmission**
- Unicast (Nack-response-avoidance)
- Advantages of Token-Ring:
  - Message stability (all receivers got it)
  - Immediate delivery (QoS=just reliable)
  - Delayed delivery (QoS=total ordering)
  - Limit the buffering requirements
  - Distribute the retransmission overhead
  - Crash recovery (resiliency)
- Examples: Reliable Multicast Protocol (RMP)

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**RMP Error control Mechanism (Cont.)**

**NACK Mechanism in RMP 1.0**
- Unicast NACK to token-site (NO implosion avoidance)
- Unicast NACK response: takes O(Receivers)

**NACK Mechanism in RMP 1.3b**
- SRM request/repair NACK randomization
- Implosion avoidance (NACK, reply)
- Token-site ACK instead of “periodic polling”
RMP 1.3b Flow Control
Mechanism
- TCP-like Flow Control!
  - Round-trip-time variance estimation
  - slow start
  - Dynamic window sizing on congestion
  - exponential retransmission timer backoff
- Sender and Token-site Flow Control only
- Any NACK Reduces the Sender Window too!!

Examples of Reliable Multicast Protocols
- SRM: Scalable Reliable Multicast (UCB)
- RMP: Reliable Multicast Protocol (UWV)
- TMTP: Tree-based Multicast Transport Protocol (UK)
- SCE: Single Connection Emulation (GaTech)
- RMTP: Reliable Multicast Transport Protocol (AT&T)
- Horus: Cornell university/Ken Birman
- Log-based Multicast Protocol (Stanford)
- LORAX: UCSC
- MTP-2: Multicast Transport Protocol (RFC1301)
- RAMP: Reliable Adaptive Multicast Protocol (RFC1458)

Application-layer Reliable Multicast Server
- RMS Extended Group Communication Services
  - Group Communication Fault Recovery
  - Inter-Protocol Multicast Communication
  - Extended Protocol Services
    - Selective Re-transmission
    - Dynamic Group Masking
  - Simple Declarative API
  - Extended Group Management Service