A Selective Retransmission Protocol for Multimedia on the Internet

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Proceedings of SPIE Multimedia, Systems and Applications Conference
Boston, November 2000

Applications:
Text-Based vs. Multimedia

- Text
  - Strict loss constraints
  - Minimal timing constraints

- Multimedia
  - Forgiving to loss
  - Requires timing constraints

Protocols:
TCP vs. UDP

- TCP
  - No loss
  - Retransmits all lost messages
  - Potentially large latency

- UDP
  - Potentially unbounded loss
  - Does no retransmission
  - Minimal latency

- Neither is what you want!

Our Solution:
A Selective Retransmission Protocol

- Balances the extremes of TCP and UDP
- Tradeoff between loss and latency
- Retransmits a percentage of lost packets
  - If end-to-end delay is large, may accept loss
  - If end-to-end delay is small, may always request retransmission
  - If loss rate is very high, may request retransmission
  - How to decide?

Groupwork

- Measure of loss
- Measure of latency
- Packet is lost
- ... Do you request retransmission?

- Consider:
  - Quiet WAN, interactive audio
  - LAN, broadcast video
  - Lossy MAN, interactive audio

Decision Algorithms

(Kleinrock, 1992)
**Decision Algorithms**

![Graph of Decision Algorithms](image)

**Approach**

- Implement SRP and “application”
- Setup “WAN” test-bed
- Run “application” over
  - TCP: No loss, Low latency
  - UDP: Medium loss, Medium latency
  - SRP: High loss, High latency
- Measure “Quality”
- Analyze Results

**Policies**

- OQ
- ELL

**Acceptable Quality Approach**

- Implement SRP and “application”
- Setup “WAN” test-bed
- Run “application” over
  - TCP: No loss, Low latency
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**Implementation of SRP**

- Application layer client/server protocol
  - No “kernel hacking” (yet)
  - Built on top of UDP
- Measure loss and latency
  - Use to decide when to request retransmission
- Decision algorithm modular
  - Equal Loss Latency (ELL)
  - Optimum Quality (OQ)

**Sample SRP Session**

<table>
<thead>
<tr>
<th>Data Block</th>
<th>Client</th>
<th>Server</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sample SRP Session**

- Do not request retransmission

**Experiments**

- UDP traffic generator
- Token bucket router to control loss and latency
- Audio session 8000 bytes/sec
  - Sample rate 160ms, packet size 1280
Sample Data

Low Loss, Low Latency

High Loss, High Latency

Conclusions

- TCP and UDP provide extremes
  - Not what Multimedia wants
- SRP can provide a balance
- Tuning of SRP depends upon
  - Application
  - Measure of “quality”
  - Measurement of network (loss, RTT)

Future Work

- Repair (FEC)
- Congestion control
- Loss detection (timeout)
- Additional decision algorithms
- Multicast

Evaluation of Science?

- Category of Paper
- Science Evaluation (1-10)?
- Space devoted to Experiments?