Options for Repair of Streaming Media

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Introduction

Survey some options for repair of streaming media subject to packet loss:

- Redundant Transmission
- Retransmission
- Interleaving
- Forward Error Correction

Background: developing a loss-resilient audio conferencing application. We need to generalize!
Terminology and Protocol Framework

- We assume RTP as our transport protocol
  - Loss can be detected easily
  - Out of order packets can be reordered
  - Different payload types can be distinguished
- Differentiate *unit* from *packet*
  - A unit is a timed interval of data from a media coder
  - A packet is one, or more, units encapsulated for transmission
Network Loss Characteristics

Some loss length statistics (NASA–UCL, July 1997)

- Single packet losses predominate
- Short burst loss an order of magnitude less common
- Long burst losses are rare

In a large conference, most packets will be lost by at least one receiver.
Redundant Transmission

+ Low latency (1 packet delay)
+ Relatively small bandwidth overhead
  - Additional processing required at sender
  - Approximate repair

RTP payload format: draft-ietf-avt-rtp-redundancy-01.txt
Retransmission

Could use an SRM style retransmission scheme for continuous media, but the delays are probably excessive.

The STORM protocol is possibly better? Need more research...

- Complex control protocol
- Potentially large bandwidth overhead
- Potentially large latency
+ Exact repair
+ Can use redundancy mechanisms for retransmission
+ Individual choice of quality/latency tradeoff
Interleaving

Interleaving disperses the effects of loss, but doesn’t eliminate them.

+ No bandwidth overhead
+ Low processing overhead
- Large increase in latency
Forward Error Correction

Calculate parity packets from the XOR of a number of data packets. Use these to repair loss in the stream. Amount of latency, bandwidth and repair capability can be varied.

+ Media independent
+ Very good repair capability
+ Low processing overhead
  - Potentially high bandwidth/latency

RTP payload formats: draft-ietf-avt-fec-00.txt and draft-budge-media-error-correction-00.txt

Other FEC techniques exist...
Summary

<table>
<thead>
<tr>
<th></th>
<th>Latency</th>
<th>Bandwidth Overhead</th>
<th>Processing Overhead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundancy</td>
<td>Small</td>
<td>Variable</td>
<td>Variable, may be large</td>
</tr>
<tr>
<td>Retransmission</td>
<td>Medium</td>
<td>Variable</td>
<td>High</td>
</tr>
<tr>
<td>Interleaving</td>
<td>High</td>
<td>None</td>
<td>Low</td>
</tr>
<tr>
<td>FEC</td>
<td>Variable</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>

- For interactive use either redundant transmission or FEC would seem to be most suitable.
- For broadcast style applications, interleaving works well.
Open Issues

- Protocols...

- Need a retransmission algorithm which is both timely and network friendly

- What’s a sensible operating point? How much loss should we be designing applications to cope with?
  - Little congestion control in many tools
  - Ability to work in the presence of much loss
    - congestion
  - This is not network friendly!
More information...

Several recent internet drafts:

- draft-ietf-avt-info-repair-00.txt
- draft-ietf-avt-rtp-redundancy-01.txt
- draft-ietf-avt-fec-00.txt
- draft-budge-media-error-correction-00.txt

Copies of these slides:

- http://www.cs.ucl.ac.uk/staff/c.perkins/slides/