96-0519: General Considerations for Frame-Level Performance Measurement of ATM Switches

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Overview

- Traffic Pattern
- Configurations
- Protocol Layers
- Performance Metrics
Traffic Patterns

- Open loop traffic:
  Loss does not result in load reduction, e.g., UDP

- Closed loop traffic:
  Has built in congestion control.
  Loss results in load reduction, e.g., TCP

- Frame loss rate is low for closed loop traffic
Test Configurations

- N-to-1:

- N-by-N: N-to-1 or N-to-N flows; Unidirectional or bi-directional
Protocol Layer

- AAL5 Layer: Can’t compare with non-ATM technologies
- IP over LANE vs IP over Ethernet vs IP over RFC1577
- Data application over TCP or UDP

<table>
<thead>
<tr>
<th>Application (FTP)</th>
<th>TCP</th>
<th>UDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RFC 1577</td>
<td>LANE</td>
<td></td>
</tr>
<tr>
<td>AAL5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABR</td>
<td>UBR</td>
<td></td>
</tr>
<tr>
<td>ATM</td>
<td></td>
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<tr>
<td>PHY</td>
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</tbody>
</table>
Which Layer?

- Goal: To minimize the number of measurement points.
- For TCP Applications:
  Lower TCP throughput $\Rightarrow$ Lower application throughput and vice versa. There is one-to-one correspondence.
- For UDP applications:
  UDP performance is a good indicator.
  $\text{UDP} = \text{IP} + \text{header}$. No protocol messages (such as acks).
  $\Rightarrow$ IP performance is an equally good indicator.
- LANE performance allows ATM to be compared with legacy LANs.
- AAL5 is the lowest layer where frame level performance can be studied.
### Performance Metrics

<table>
<thead>
<tr>
<th>Output</th>
<th>AAL5</th>
<th>TCP</th>
<th>IP/ LANE</th>
<th>IP/ RFC1577</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Throughput</td>
<td>X</td>
<td>Note 1</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Zero-loss Throughput</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Latency</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Frame Loss Rate</td>
<td>X</td>
<td>Note 2</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Call Establishment Latency</td>
<td>X</td>
<td>Note 3</td>
<td>Note 3</td>
<td>Note 3</td>
</tr>
<tr>
<td>Max Call Establishment Rate</td>
<td>X</td>
<td>Note 3</td>
<td>Note 3</td>
<td>Note 3</td>
</tr>
</tbody>
</table>

1. For TCP, Peak throughput = zero-loss throughput
2. For TCP, frame loss rate = 0
3. Call establishment relates to VCs and is meaningful only at AAL5.
Summary

- Test configurations: n to 1, n to n
- Traffic Patterns: n to 1, n to n. Closed loop, open loop.
- Protocol Layers: TCP, IP over RFC1577, IP over LANE, AAL5
- Performance Metrics: Throughput, latency, frame loss rate, connection setup time