Synchronisation Analysis over Concurrent TCP Flows

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Outline

- Motivation
- Implementation
- Method
- Results
- Conclusion
- Further Work
Motivation

- Flow characteristics focus on single TCP flows
- Characteristics of concurrent TCP flows are unknown
- There may or may not be global synchronisation

Motivation

- TCP flows should share the bandwidth
- Convergence time to fairly share bandwidth
- Synchronised packet losses increase convergence time
Implementation

- Modified FreeBSD 5.4 host at Swinburne
  - TCP stack modified to include current RTT estimates in TCP packets
- Remote hosts in various locations
  - South Australia
  - China
  - Germany
  - USA

Implementation

- Generate tcpdump trace data
- Unix cron utility to schedule data collection
- Script to automatically run various programs
  - tcpdump to capture the TCP/IP headers
  - scp to perform a data transfer
**Implementation**

- Analysis of the data
  - Six gigabytes of trace files for a 1 week trial
  - Custom Java program

**Method**

- Loss events vs. lost packets
- Correlate lost packets into loss events
  - Period between sending time and detection time of the first lost packet
  - Any lost packets in that time increase the duration of the loss event
  - Verified
Method

- Compare the flow with the most loss events to all other flows
- Count how many other flows have losses at the same time

Results

- South Australian remote host (12ms round trip time)
Results

- **German remote host (340ms RTT)**
  - Synchronised Loss Events (7 day trial - Germany)
  - 100.0%
  - 61.5%
  - 48.3%
  - 36.9%
  - 27.1%
  - 20.5%
  - 15.8%
  - 9.8%
  - 8.2%
  - 6.9%
  - 5.7%
  - 4.4%
  - 3.8%
  - 2.2%
  - 2.2%
  - 1.9%
  - 1.9%
  - 1.6%
  - 1.3%
  - 0.9%
  - 0.9%
  - 0.6%
  - 0.6%
  - 0.6%
  - 0.6%
  - 0.6%
  - 0.6%
  - 0.3%
  - 0.0%

- **USA remote host (230ms RTT)**
  - Synchronised Loss Events (3 day trial - USA)
  - 100.0%
  - 15.7%
  - 13.7%
  - 11.8%
  - 9.8%
  - 7.8%
  - 7.8%
  - 7.8%
  - 7.8%
  - 7.8%
  - 7.8%
  - 7.8%
  - 7.8%
  - 7.8%
  - 3.9%
  - 0.0%
  - 10.0%
  - 20.0%
  - 30.0%
  - 40.0%
  - 50.0%
  - 60.0%
  - 70.0%
  - 80.0%
  - 90.0%
  - 100.0%
**Results**

- Chinese remote host (170ms RTT)

![Graph showing同步丢失事件](http://caia.swin.edu.au)

<table>
<thead>
<tr>
<th>Number of TCP flows synchronised</th>
<th>Percentage of loss events synchronised</th>
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<tbody>
<tr>
<td>2</td>
<td>100.0%</td>
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<tr>
<td>3</td>
<td>96.3%</td>
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<tr>
<td>7</td>
<td>20.1%</td>
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<tr>
<td>8</td>
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<td>9</td>
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<td>11</td>
<td>5.0%</td>
</tr>
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<tr>
<td>15</td>
<td>0.0%</td>
</tr>
<tr>
<td>16</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

**Conclusion**

- Some new TCP algorithms assume 100% synchronisation
- Losses are not 100% synchronised
- Serious congestion likely to be synchronised
Further Work

- Analyse the data in more depth
  - Correlate round trip times
  - Group flows together
- Capture the congestion window size
  - Accidentally captured the advertised size
- Use different versions of TCP
- Attempt method again in a controlled environment