Wireline Access Network

A Latency Measurement System Using STAMP

Karthik Sundaresan
Distinguished Technologist
CableLabs
Importance of Latency Measurement

Latency Metrics, Active Measurements
Simple Two-way Active Measurement Protocol

RTT & one-way delay, delay variation, packet loss

Port 862 / UDP
Packet formats

STAMP Packets
Symmetrical packets
Stateless / stateful
Packet formats

STAMP Extensions

Additional functionality
Large-Scale Measurement of Broadband Performance

Measurement Agents
LMAP Controller/collector

[Diagram of LMAP architecture]
Latency Measurement Architecture

Measurement Domain
- STAMP

Large Scale Control / Data collection
- LMAP

Large Scale Control / Collection
* LMAP (or alternate model)
  - Control of measurements
  - Reporting & Data Aggregation

Measurement Domain
* STAMP (or other measurement protocol)
  - Measurement peers
  - Latency Measurements (RTT, Loss etc.)
Scaling Considerations

Core network
- Number of peering points (10-30)
- CMTS locations x Interconnect locations
  - (10s to 100s) x (~15)

Access network
- Number of CMTS
- % of devices you want to sub-sample
  - Number of CMs per node

Data aggregation
- Aggregate view of the network
Experimental Results

Prototype & testing

Raspberry Pis
AWS Ubuntu instances
Developed STAMP endpoints
LMAP : Netconf SW : Sysrepo/Netopeer2
- Using IETF YANG Models
LAN WiFi Measurements
### Summary

<table>
<thead>
<tr>
<th>Server/Measurement Agent location (Measurement Peer in Denver)</th>
<th>Min (0\textsuperscript{th} percentile)</th>
<th>50\textsuperscript{th} percentile</th>
<th>95\textsuperscript{th} percentile</th>
<th>99\textsuperscript{th} percentile</th>
<th>Max (100\textsuperscript{th} percentile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. Virginia</td>
<td>49.69 ms</td>
<td>56.3 ms</td>
<td>64.5 ms</td>
<td>172.2 ms</td>
<td>2.794 s</td>
</tr>
<tr>
<td>Ohio</td>
<td>40.63 ms</td>
<td>49.2 ms</td>
<td>56.6 ms</td>
<td>172.1 ms</td>
<td>2.812 s</td>
</tr>
<tr>
<td>California</td>
<td>29.56 ms</td>
<td>35.3 ms</td>
<td>42.5 ms</td>
<td>134.1 ms</td>
<td>2.808 s</td>
</tr>
<tr>
<td>Oregon</td>
<td>25.80 ms</td>
<td>32.7 ms</td>
<td>38.4 ms</td>
<td>116.8 ms</td>
<td>3.163 s</td>
</tr>
<tr>
<td>Local (LAN)</td>
<td>0.83 ms</td>
<td>2.02 ms</td>
<td>5.31 ms</td>
<td>13.41 ms</td>
<td>148.8 ms</td>
</tr>
</tbody>
</table>
Conclusions

STAMP
- Simple, easy to implement, most of features an operator needs

LMAP
- Standardized YANG models, NETCONF

Measurement Architecture
- Separate Measurement domain vs Control & Collection
- Scale
- Core network vs Access network vs Home network

Prototype
- Easy to implement/deploy
Thank You!

Karthik Sundaresan
Distinguished Technologist
CableLabs
k.sundaresan@cablelabs.com