SDN Controller Performance Evaluation

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Challenges

• Fast evolving speed of SDN

• Growing requirements for various scenarios

• Lack of benchmark tools

• Distributed system
Centralized Controller

- Baseline (Single CPU, single switch)

<table>
<thead>
<tr>
<th>Controller</th>
<th>Throughput (rps/ms)</th>
<th>Latency (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pox (Python)</td>
<td>105</td>
<td>0.0416</td>
</tr>
<tr>
<td>Ryu (Python)</td>
<td>106</td>
<td>0.037</td>
</tr>
<tr>
<td>Nox (C++)</td>
<td>687</td>
<td>0.0179</td>
</tr>
<tr>
<td>FloodLight (Java)</td>
<td>670</td>
<td>0.0222</td>
</tr>
<tr>
<td>Beacon (Java)</td>
<td>2302</td>
<td>0.0164</td>
</tr>
</tbody>
</table>

- Various factors investigated
  - Number of switches and threads
  - System-wide settings
  - Specifically crafted scenarios
Evaluation Result

- Performance degradation with more than 200 switches
- Python interpreter: PyPy outperforms CPython over 4 times.
- Hyper-Threading is useful for Java-based controllers.
- Correlation between throughput and latency
Distributed Controller

- Baseline (Single CPU, single switch)

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<th>Controller</th>
<th>Throughput (rps/ms)</th>
<th>Latency (ms)</th>
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</thead>
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<tr>
<td>ODL (Java)</td>
<td>9</td>
<td>0.111</td>
</tr>
<tr>
<td>ONOS (Java)</td>
<td>49</td>
<td>0.026</td>
</tr>
</tbody>
</table>

- Two types of control traffic
  - Controller-Switch
  - Controller-Controller (Synchronization)

- Control latency due to synchronization
Controller Synchronization

- Evaluation on ONOS v1.1.0 (Hazelcast-based)
  - Peak synchronization traffic rate less than 150Mbps (5 nodes)
  - The flow installation latency could be enlarged by 2~3 times.

- Control message priority
  - Various types of control message: Flow_Add vs Packet_Out
  - Impact on distributed controller with two-layer synchronization
Summary

• The usability, reliability and security are equally important as the performance in choosing the controller.
• Centralized controllers show clear limitations on large scale deployment, and distributed controllers are required.
• The efficient synchronization system is critical to the success of distributed controller, and various modifications are required.
• Related IETF Drafts
  • Benchmarking Methodology for SDN Controller Performance
  • Priority based Flow Rule Request Message Processing Mechanism in the OpenFlow Switch
• Benchmark tools
Thanks for your attention!