Virtual Network Applications (VNFs)

Virtual Network Functions (VNFs)

Commodity Servers
Network Application Types

- IP layer network functions
- Application layer network functions
Application layer VNF example: LTE-EPC

- UE
- eNodeB
- MME
- HSS
- S-GW
- P-GW
- PDN

Control: red
Data: blue
Multi-core VNF over a kernel bypass stack
Multi-core VNFs Challenges

- Partitioning of packets- at hardware or software layer?
- Basis for packet distribution: 4 tuple or application semantics
Software layer distribution of packets

- BESS switch
- PMDport to VM
S/W packet distribution on DPDK network stack

- mTCP over DPDK
- Single consumer single producer lockless rings
Setup

- 24-core Intel Xeon CPU E5-2670 v3 @ 2.30GHz with 64GB RAM
- 10 Gbps Intel X540 NICs
- OS: Ubuntu 16.04 and kernel 4.8 on both host and VMs
Software vs Hardware Packet Distribution

<table>
<thead>
<tr>
<th>#Cores</th>
<th>S/W (Gbps)</th>
<th>H/W (Gbps)</th>
<th>S/W (Mbps)</th>
<th>H/W (Mbps)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Payload=1448 Bytes</td>
<td>Payload=64 Bytes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>6.85</td>
<td>9.07</td>
<td>0.27</td>
<td>0.61</td>
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<tr>
<td>3</td>
<td>9.17</td>
<td>9.11</td>
<td>2.26</td>
<td>1.18</td>
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<tr>
<td>4</td>
<td>9.16</td>
<td>9.12</td>
<td>5.13</td>
<td>4.98</td>
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Software based packet distribution

Performance on a single core VM

Scalability of software based packet distribution
RSS vs Application-aware steering

**RSS**
- Server
- KV Store
- VM cores

**Client**
- Server
- VM cores

**App-Aware**
- Server
- Per core KV Store
- VM cores

**Client**
Application Steering

3 way handshake

Server

0 1 2 3

Client

0 1 2 3
Application Steering

Server

- 0
- 1
- 2
- 3

1st data packet with key

Connection Map

Client

- 0
- 1
- 2
- 3

4-tuple | Core
---|---

---|---
| 4-tuple | Core
---|---

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Application aware packet steering vs RSS
Summary

• Evaluation of hardware and software distribution
• Performance evaluation of single hardware queue + software distribution to multiple application cores
• Evaluation of packet steering using TCP 4 tuple and application semantics.
THANK YOU
Application Steering

Server

0 1 2 3

FIN

Client

0 1 2 3

FIN ACK

Connection Map

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FIN Map

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Application Steering

4-tuple Core

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