Open vSwitch with P4

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Overview

- P4
- Benefits of P4 with OVS
- Packet Processing in OVS
- OVS vs OVS + P4 Comparison
- Questions
- **Programming Protocol-Independent Packet Processors**
- High-level Domain Specific Language
- Describes packet processing applications
- Open source

Protocol Independent/Reconfigurable

```p4
table routing {
  reads {
    ipv4.dstAddr : lpm;
  }
  actions {
    do_drop;
    route_ipv4;
  }
  size: 2048;
}
ccontrol ingress {
  apply(routing);
}
```
Benefits of P4 with OVS

- Easy addition of new protocols
- Performance
  - Match and parse only on the fields relevant to our switch. E.g. an L2 switch doesn’t need to parse L3 headers
- Separation of concerns
- Bring OVS-DPDK Userspace Datapath on par with Kernel Datapath
  - Datapath is implementation-agnostically defined in P4

<table>
<thead>
<tr>
<th>Change</th>
<th>OVS LOC</th>
<th>P4 LOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP Flags</td>
<td>370</td>
<td>4</td>
</tr>
<tr>
<td>Connection Label</td>
<td>411</td>
<td>5</td>
</tr>
</tbody>
</table>
In current OVS, the set of fields extracted and hashed is hardcoded.

Implementation has to support a lot of different protocols.
Packet Processing in OVS

- Extract and Hash stages dynamically generated
- OVS tuned to specific use case
OVS vs OVS + P4 Comparison

Phy-Phy, L3 router case, 1 Core, 64Byte, 1 flow.

Test and System Configurations: Estimates are based on internal Intel analysis using Intel® Server Board S2600WT, Intel(R) Xeon(R) CPU E5-2695 v3 @ 2.30GHz, Intel® 82599ES 10 Gigabit Ethernet Controller
Questions?

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Support Slides
P4 program can be used to define API/capabilities for an SDN controller

Open vSwitch

Control Plane

Data Plane

Parser (flow.c)

\[
\text{miniflow_extract()}
\]

\[
\text{\{...
OVS_MINIFLOW_EXTRACT ...
\}
\]

Match

Actions (odp-execute.c)

\[
\text{\{...
OVS_ODP_EXECUTE_SET_ACTION_CASES ...
\}
\]

gcc compiles OVS as normal

p4c-behavioural (forked)

p4c-behavioural uses P4 program to generate openvswitch data plane and control plane c code:
e.g. \#define OVS_MINIFLOW_EXTRACT ... 
e.g. \#define OVS_ODP_EXECUTE_SET_ACTION_CASES ... 
... etc

OpenFlow Controller

OpenFlow + OXM extensions program P4-enabled OVS
References

• Main web portal
  • http://pisces.cs.princeton.edu/

• Pisces Papers

• OVS Trees
  • https://github.com/mshahbaz/ovs/tree/p4
  • https://github.com/mshahbaz/p4c-behavioral/tree/ovs

• OVS Patches
  • http://openvswitch.org/pipermail/dev/2016-September/079647.html
  • http://openvswitch.org/pipermail/dev/2016-September/079647.html