OpenSwitch OF-DPA User Guide

OpenSwitch OF-DPA User Guide

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Chapter 1. Revision History

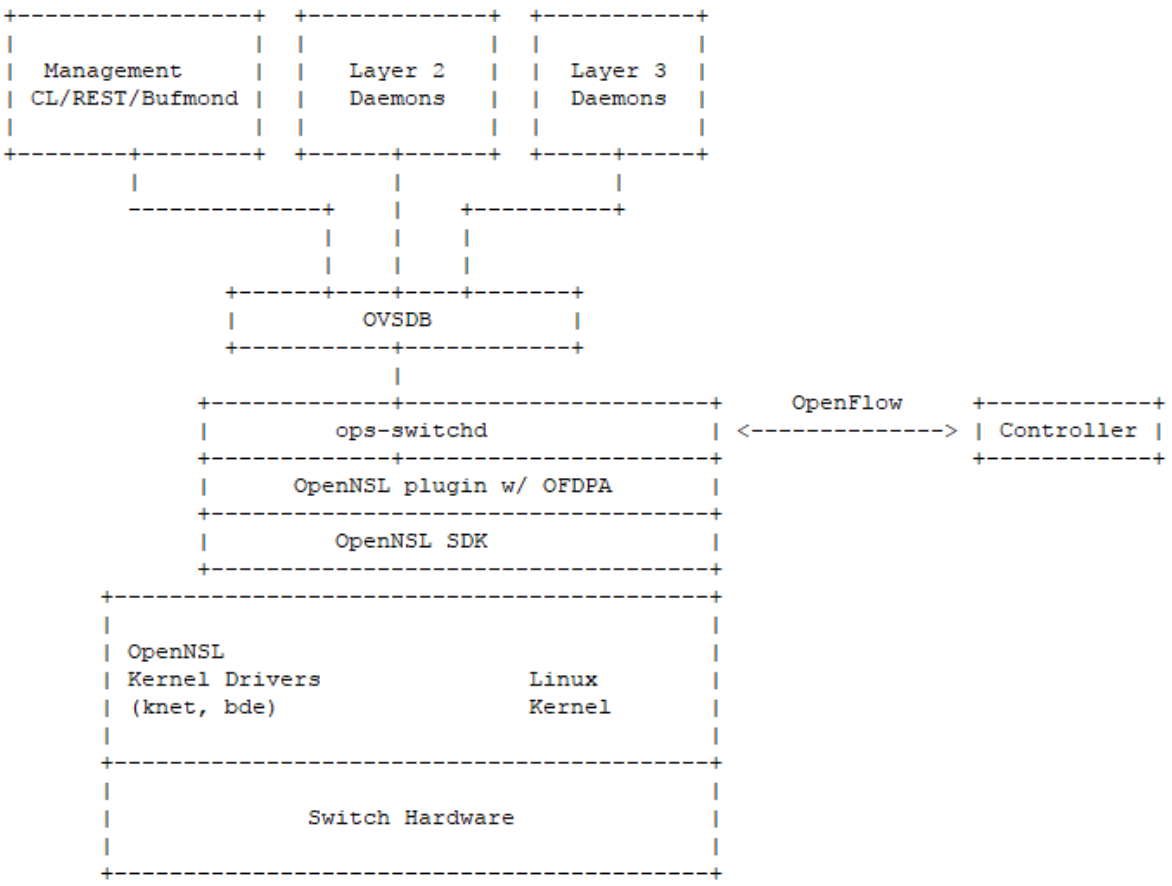
Revision Number	Change
1.0	Initial Release
1.0.1	• Support Packet-In, Flow Timeout, SSL Connection • Add the Scaling Parameters chapter
1.0.2	• Upgrade the supported Group and Flow tables • Add CORD MPLS Segment Routing example

Chapter 2. Overview

The OpenSwitch OF-DPA supports the OpenFlow v1.3.4 and the OF-DPA v2.01 specification.

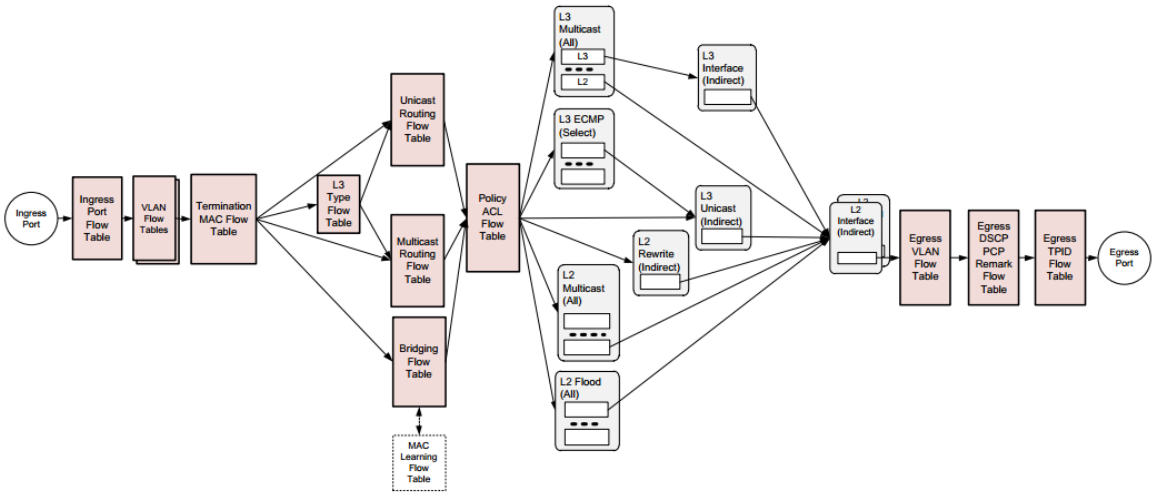
The OF-DPA code version is based on the OF-DPA v3.0.4.0.

Figure 2.1. Architecture



2.1. OF-DPA Pipeline

Figure 2.2. OF-DPA Pipeline



2.2. Supported OF-DPA Flow Tables

Table Name	Table ID
Ingress Port	0
Port DSCP Trust	5
Port PCP Trust	6
Tunnel DSCP Trust	7
Tunnel PCP Trust	8
VLAN	10
VLAN 1	11
MPLS L2 Port	13
MPLS DSCP Trust	15
MPLS PCP Trust	16
MPLS L2 Port QoS Class	17
Termination MAC	20
L3 Type	21
MPLS 1	24
MPLS 2	25
MPLS L3 Type	27
MPLS Label Trust	28
MPLS Type	29
Unicast Routing	30
Multicast Routing	40
Bridging	50
Policy ACL	60
Color Based Actions	65
Egress VLAN	210
Egress VLAN 1	211
Egress DSCP PCP Remark	230
Egress TPID	235

2.3. Supported OF-DPA Groups

Group Name	Group ID
L2 Interface	0
L2 Rewrite	1
L3 Unicast	2
L2 Multicast	3
L2 Flood	4
L3 Interface	5
L3 Multicast	6
L3 ECMP	7
L2_Overlay	8
MPLS_Label	9
MPLS_Forwarding	10
L2_Unfiltered_Interface	11

Chapter 3. OpenFlow CLI Commands

Command	Function
openflow	Enter OpenFlow mode.
controller A.B.C.D {port <1-65535> (tcp/ssl)}	Configure the controller information.
hybridmode	Configure Normal Port to be used to OpenFlow.
openflow-port	Configure Normal Port to be an Openflow Port and dedicate for OpenFlow pipeline.
show openflow	Display the OpenFlow configurations.
show openflow flows	Display the flow information.
show openflow groups	Display the group information.
show openflow meters	Display the meter information.

3.1. openflow

Use this command to enter OpenFlow mode.

Syntax	openflow
Command Mode	Config Mode

Example:

```
switch(config)# openflow
switch(config-openflow)#
```

3.2. controller

Use this command to configure the controller information.

Default	Port 6653 and TCP
Syntax	[no] controller A.B.C.D {port <1-65535> (tcp|ssl)}
Command Mode	OpenFlow Mode

Example:

```
switch(config-openflow)# controller 192.168.1.100
switch(config-openflow)# do show openflow
OpenFlow Configuration:
---------------------------------------
OpenFlow Datapath Type : ofdpa
Number of OpenFlow Ports : 0
Hybrid Port Mode : disable
Controller IP Port Mode
---------------------------------------
192.168.1.100 6653 tcp
OpenFlow Port
---------------------------------------
switch(config-openflow)
```

3.3. hybridmode

Use this command to configure Normal Port (L3 port or L2 port) to be used by OpenFlow in the OpenFlow hybrid switch.

Default	Disable
Syntax	[no] hybridmode
Command Mode	OpenFlow Mode

Example:

```
switch(config-openflow)# hybridmode
switch(config-openflow)# do show openflow
OpenFlow Configuration:
---------------------------------------
OpenFlow Datapath Type : ofdpa
Number of OpenFlow Ports : 0
Hybrid Port Mode : enable
Controller IP Port Mode
---------------------------------------
192.168.1.100 6653 tcp
OpenFlow Port
---------------------------------------
switch(config-openflow)#
```

3.4. openflow-port

Use this command to configure Normal Port (L3 port or L2 port) to be an Openflow Port and dedicate for OpenFlow pipeline in the OpenFlow hybrid switch.

Default	Disable
Syntax	[no] openflow-port
Command Mode	Interface Mode

Example:

```
switch(config-if-range-intf 13,31,47)# openflow-port
switch(config-if-range-intf 13,31,47)# do show openflow
OpenFlow Configuration:
---------------------------------------
OpenFlow Datapath Type : ofdpa
Number of OpenFlow Ports : 3
Hybrid Port Mode : disable
Controller IP Port Mode
---------------------------------------
192.168.1.100 6653 tcp
OpenFlow Port
---------------------------------------
13
31
47
switch(config-if-range-intf 13,31,47)#
```

3.5. show openflow

Use this command to display the OpenFlow configurations.

Syntax	show openflow
Command Mode	EXEC Mode

Example:

```
switch# show openflow
OpenFlow Configuration:
---------------------------------------
OpenFlow Datapath Type : ofdpa
Number of OpenFlow Ports : 3
Hybrid Port Mode : disable
Controller IP Port Mode
---------------------------------------
192.168.1.100 6653 tcp
OpenFlow Port
---------------------------------------
13
31
47
switch#
```

3.6. show openflow flows

Use this command to display the flow information.

Syntax	show openflow flows
Command Mode	EXEC Mode

Example:

```
switch# show openflow flows
Flows:
---------------------------------------
cookie=0x0, duration=418.659s, table=20, n_packets=83, n_bytes=139851186626542,
ip,dl_dst=00:00:00:11:22:33 actions=goto_table:30
cookie=0x0, duration=418.621s, table=30, n_packets=83, n_bytes=139851186626542,
ip,nw_dst=1.1.1.0/24 actions=write_actions(group:536870913),goto_table:60
cookie=0x0, duration=418.588s, table=30, n_packets=83, n_bytes=139851186626542,
ip,nw_dst=2.2.2.0/24 actions=write_actions(group:536870914),goto_table:60
cookie=0x0, duration=418.559s, table=30, n_packets=83, n_bytes=139851186626542,
ip,nw_dst=3.3.3.0/24 actions=write_actions(group:536870915),goto_table:60
cookie=0x0, duration=418.531s, table=30, n_packets=83, n_bytes=139851186626542,
ip,nw_dst=4.4.4.0/24 actions=write_actions(group:1879048193),goto_table:60
cookie=0x0, duration=418.497s, table=60, n_packets=83, n_bytes=139851186626542,
ip,in_port=47,dl_dst=00:00:00:11:22:33,nw_dst=1.1.1.2
actions=write_actions(group:536870914)
switch#
```

3.7. show openflow groups

Use this command to display the group information.

Syntax	show openflow groups
Command Mode	EXEC Mode

Example:

```
switch# show openflow groups
Groups:
----------------------------------------
group_id=536870915,type=all,bucket=actions=set_field:4396->vlan_vid,
set_field:00:00:00:11:22:33->eth_src,set_field:00:00:00:00:00:33->eth_dst,
group:19660847
group_id=6553613,type=all,bucket=actions=output:13
group_id=13107231,type=all,bucket=actions=output:31
group_id=536870913,type=all,bucket=actions=set_field:4196->vlan_vid,
set_field:00:00:00:11:22:33->eth_src,set_field:00:00:00:00:00:11->eth_dst,
group:6553613
group_id=19660847,type=all,bucket=actions=output:47
group_id=1879048193,type=all,bucket=actions=group:536870913,
bucket=actions=group:536870914
group_id=536870914,type=all,bucket=actions=set_field:4296->vlan_vid,
set_field:00:00:00:11:22:33->eth_src,set_field:00:00:00:00:00:22->eth_dst,
group:13107231
switch#
```

3.8. show openflow meters

Use this command to display the meter information.

Syntax	show openflow meters
Command Mode	EXEC Mode

Example:

```
switch# show openflow meters
Meters:
---------------------------------------
meter=1 pktps burst bands=
type=drop,rate=20000,burst_size=100
meter=2 pktps burst bands=
type=drop,rate=40000,burst_size=100
switch#
```

Chapter 4. Linux commands

Command	Description
ovs-vsctl	Utility for querying and configuring ops-switchd
ovs-ofctl	Administer OpenFlow switches

4.1. OF-DPA Bridge

4.1.1. add-br bridge

Create a new bridge named BRIDGE.

```
ovs-vsctl add-br bridge_ofdpa
ovs-vsctl set Bridge bridge_ofdpa datapath_type=ofdpa
```

Must to set the datapath type to OFDPA.

4.1.2. del-br bridge

Delete BRIDGE and all of its ports.

```
ovs-vsctl del-br bridge_ofdpa
```

4.1.3. list-br

Print the names of all the bridges.

```
ovs-vsctl list-br
```

4.2. Ports

4.2.1. add-port bridge port

Add network device PORT to BRIDGE.

```
ovs-vsctl add-port bridge_ofdpa 1
ovs-vsctl add-port bridge_ofdpa 2
ovs-vsctl add-port bridge_ofdpa 3
```

4.2.2. del-port [bridge] port

Delete PORT from BRIDGE.

```
ovs-vsctl del-port bridge_ofdpa 1
ovs-vsctl del-port bridge_ofdpa 2
ovs-vsctl del-port bridge_ofdpa 3
```

4.2.3. list-port bridge

Print the names of all the ports on BRIDGE.

```
ovs-vsctl list-ports bridge_ofdpa
```

4.2.4. port admin up

Set admin to up.

```
ovs-vsctl add Interface 1 user_config admin=up
ovs-vsctl add Interface 2 user_config admin=up
ovs-vsctl add Interface 3 user_config admin=up
```

4.3. Groups

4.3.1. add-group switch group

Add group described by GROUP.

```
ovs-ofctl -O OpenFlow13 add-group bridge_ofdpa group_id=0x640001,
type=all,bucket=output:1
ovs-ofctl -O OpenFlow13 add-group bridge_ofdpa group_id=0x640002,
type=all,bucket=output:2
ovs-ofctl -O OpenFlow13 add-group bridge_ofdpa group_id=0x640003,
type=all,bucket=output:3
```

The “-O” option is to set OpenFlow versions. The OFDPA support OF1.3 only.

4.3.2. del-groups switch [group]

Delete matching GROUPs.

```
ovs-ofctl -O OpenFlow13 del-groups bridge_ofdpa group_id=0x640001
ovs-ofctl -O OpenFlow13 del-groups bridge_ofdpa group_id=0x640002
ovs-ofctl -O OpenFlow13 del-groups bridge_ofdpa group_id=0x640003
```

4.3.3. dump-groups switch [group]

Print group description.

```
ovs-ofctl -O OpenFlow13 dump-groups bridge_ofdpa
```

4.4. Meters

4.4.1. add-meter switch meter

Add meter described by METER.

```
ovs-ofctl -O OpenFlow13 add-meter bridge_ofdpa meter=1,kbps,burst,
bands=type=drop,rate=10000,burst_size=512
ovs-ofctl -O OpenFlow13 add-meter bridge_ofdpa meter=2,pktps,burst,
bands=type=drop,rate=40000,burst_size=512
```

4.4.2. del-meter switch meter

Delete METER.

```
ovs-ofctl -O OpenFlow13 del-meter bridge_ofdpa meter=1
ovs-ofctl -O OpenFlow13 del-meter bridge_ofdpa meter=2
```

4.4.3. dump-meter switch meter

Print METER configuration.

```
ovs-ofctl -O OpenFlow13 dump-meters bridge_ofdpa
```

4.5. Flows

4.5.1. add-flow switch flow

Add flow described by FLOW.

1. ethernet packet

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa table=60,in_port=1,
dl_src=00:00:00:11:22:33,dl_dst=00:00:00:22:33:44,dl_vlan=100,
dl_vlan_pcp=6,actions=write_actions\(group:0x640002\)
```

2. IPV4 packet

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa table=60,in_port=1,
dl_type=0x800,dl_src=00:00:00:11:22:33,dl_dst=00:00:00:22:33:44,
dl_type=0x800,nw_src=1.2.3.4/32,nw_dst=2.3.4.5/24,actions=write_actions\
(group:0x640002\)
```

3. IPV6 packet

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa table=60,in_port=1,
dl_type=0x86dd,ipv6_src=2001:1234:5678::1/128,ipv6_dst=2001:9876:5432::1/128,
ipv6_label=0x1234,actions=write_actions\(group:0x640002\)
```

4. TCP/UDP packet

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa table=60,in_port=1,
dl_src=00:00:00:11:22:33,dl_dst=00:00:00:22:33:44,dl_type=0x800,
nw_src=1.2.3.4/24,nw_dst=2.3.4.5/32,ip_dscp=34,ip_ecn=2,nw_proto=6,
tp_src=0x1234,tp_dst=0x2345,actions=write_actions\(group:0x640002\)
```

4.5.2. del-flows switch [flow]

Delete matching FLOWs.

1. Ethernet packet

```
ovs-ofctl -O OpenFlow13 del-flows bridge_ofdpa table=60,in_port=1,
dl_src=00:00:00:11:22:33,dl_dst=00:00:00:22:33:44,dl_vlan=100,dl_vlan_pcp=6
```

2. IPV4 packet

```
ovs-ofctl -O OpenFlow13 del-flows bridge_ofdpa table=60,in_port=1,
dl_type=0x800,dl_src=00:00:00:11:22:33,dl_dst=00:00:00:22:33:44,
dl_type=0x800,nw_src=1.2.3.4/32,nw_dst=2.3.4.5/24
```

3. IPV6 packet

```
ovs-ofctl -O OpenFlow13 del-flows bridge_ofdpa table=60,in_port=1,
dl_type=0x86dd,ipv6_src=2001:1234:5678::1/128,ipv6_dst=2001:9876:5432::1/128,
ipv6_label=0x1234
```

4. TCP/UDP packet

```
ovs-ofctl -O OpenFlow13 del-flows bridge_ofdpa table=60,in_port=1,
dl_src=00:00:00:11:22:33,dl_dst=00:00:00:22:33:44,dl_type=0x800,
nw_src=1.2.3.4/24,nw_dst=2.3.4.5/32,ip_dscp=34,ip_ecn=2,nw_proto=6,
tp_src=0x1234,tp_dst=0x2345
```

4.5.3. dump-flows switch

Print all flow entries.

```
ovs-ofctl -O OpenFlow13 dump-flows bridge_ofdpa
```

4.5.4. apply the meter

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa table=60,in_port=1,
dl_type=0x800,dl_src=00:00:00:11:22:33,dl_dst=00:00:00:22:33:44,
dl_type=0x800,nw_src=1.2.3.4/24,nw_dst=2.3.4.5/32, actions=meter:1,
write_actions\(group:0x640002\)
```

4.6. Controller

4.6.1. set-controller bridge target

Set the controllers for BRIDGE.

```
ovs-vsctl set-controller bridge_ofdpa tcp:192.168.1.100:6653
```

4.6.2. del-controller bridge

Delete the controllers for BRIDGE.

```
ovs-vsctl del-controller bridge_ofdpa
```

4.6.3. get-controller bridge

Print the controllers for BRIDGE.

```
ovs-vsctl get-controller bridge_ofdpa
```

4.7. Set Up SSL Connection

Use **ovs-vsctl** command to set the SSL configuration.

Command	Function
get-ssl	print the SSL configuration
del-ssl	delete the SSL configuration
set-ssl PRIV-KEY CERT CA-CERT	set the SSL configuration

Example:

E.g. Upload the Private Key (sc.key), Certificate (sc.crt) and CA (ca.crt) to the switch /home/root/openflow_ssl/ directory.

Certificates: Start Date at 2013/02/25 and End Date at 2023/02/23

```
root@switch:~/openflow_ssl# pwd
/home/root/openflow_ssl
root@switch:~/openflow_ssl# ls -l
total 12
-rw-rw-r-- 1 1000 1000 1237 Feb 25 2013 ca.crt
-rw-rw-r-- 1 1000 1000 1216 Feb 25 2013 sc.crt
-rw-rw-r-- 1 1000 1000 1679 Feb 25 2013 sc.key
```

4.7.1. Set SSL Key

```
root@switch:~# ovs-vsctl set-ssl /home/root/openflow_ssl/sc.key
/home/root/openflow_ssl/sc.crt
/home/root/openflow_ssl/ca.crt
```

```
root@switch:~# ovs-vsctl get-ssl
Private key: /home/root/openflow_ssl/sc.key
Certificate: /home/root/openflow_ssl/sc.crt
CA Certificate: /home/root/openflow_ssl/ca.crt
Bootstrap: false
```

4.7.2. Configure Controller with SSL Connection

```
switch# configure
switch(config)# openflow
switch(config-openflow)# controller 192.168.1.100 port 6653 ssl
switch(config-openflow)#
```

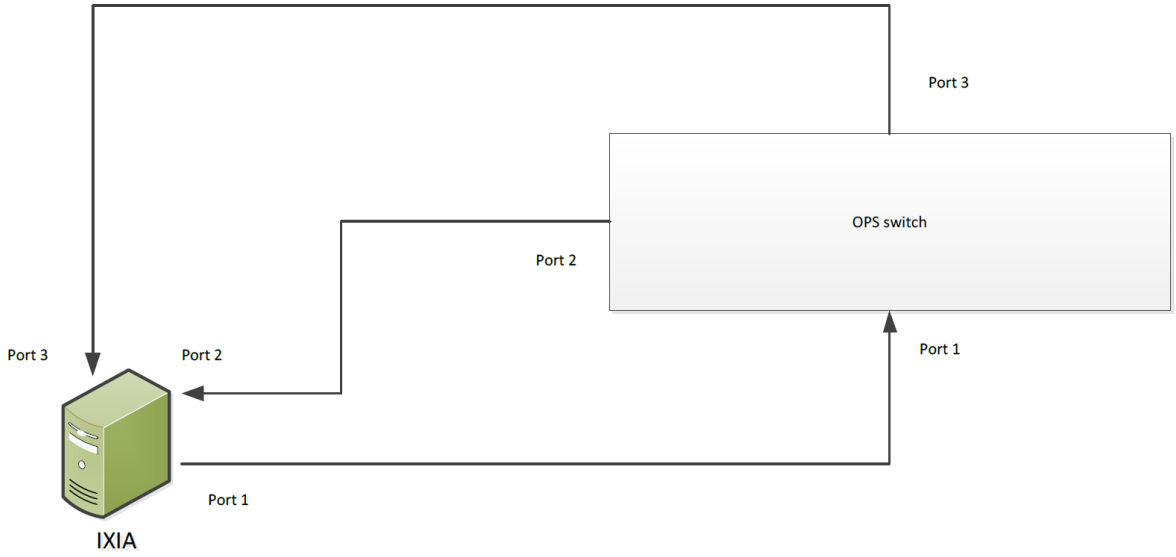
4.7.3. Check Controller Status

```
switch(config-openflow)# do show openflow
```

```
OpenFlow Configuration:
---------------------------------------
OpenFlow Datapath Type : ofdpa
Number of OpenFlow Ports : 3
Hybrid Port Mode : disable
Controller IP Port Mode Status
-----------------------------------------------------
192.168.1.100 6653 ssl Connected
OpenFlow Port
---------------------------------------
13
31
47
switch(config-openflow)#
```

Chapter 5. Example

Figure 5.1. Example



5.1. Port configuration

```
root@switch:~# vtysh
switch# configure
switch(config)# interface range intf 1-3
switch(config-if-range-intf 1-3)# no shutdown
switch(config-if-range-intf 1-3)# autonegotiation off
switch(config-if-range-intf 1-3)# openflow-port
switch(config-if-range-intf 1-3)# do show openflow
OpenFlow Configuration:
---------------------------------------
OpenFlow Datapath Type : ofdpa
Number of OpenFlow Ports : 3
Hybrid Port Mode : disable
Controller IP Port Mode
---------------------------------------
OpenFlow Port
---------------------------------------
1
2
3
switch(config-if-range-intf 1-3)#
```

5.2. Flow configuration

```
root@switch:~#
ovs-ofctl -O OpenFlow13 add-group bridge_ofdpa group_id=0x640001,type=all,
bucket=output:1
ovs-ofctl -O OpenFlow13 add-group bridge_ofdpa group_id=0x640002,type=all,
bucket=output:2
ovs-ofctl -O OpenFlow13 add-group bridge_ofdpa group_id=0x640003,type=all,
bucket=output:3
ovs-ofctl -O OpenFlow13 dump-groups bridge_ofdpa
```

```
ovs-ofctl -O OpenFlow13 add-meter bridge_ofdpa meter=1,pktps,burst,
bands=type=drop,rate=20000,burst_size=512
ovs-ofctl -O OpenFlow13 add-meter bridge_ofdpa meter=2,pktps,burst,
bands=type=drop,rate=40000,burst_size=512
ovs-ofctl -O OpenFlow13 dump-meters bridge_ofdpa
```

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa table=60,in_port=1,
dl_type=0x800,nw_dst=2.2.2.2/32,actions=meter:1,write_actions\
(group:0x640002\)
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa table=60,in_port=1,
dl_type=0x800,nw_dst=3.3.3.3/32,actions=meter:2,write_actions\
(group:0x640003\)
ovs-ofctl -O OpenFlow13 dump-flows bridge_ofdpa
```

Chapter 6. OPS Switch with ONOS

6.1. Example Environment

- ONOS Controller
  - IP: 192.168.1.1
- OPS Switch
  - IP: 192.168.1.2
  - Datapath ID: 00000005642f0f3d

The Datapath ID is the MAC address and can be found in http://192.168.1.1:8181/onos/ui/index.html#/device.

6.2. Config on OPS Switch

- Configure to connect to Controller (192.168.1.1)

```
ops-switch# configure
ops-switch(config)# openflow
ops-switch(config-openflow)# controller 192.168.1.1 port 6653 tcp
```

6.3. Config on ONOS Controller

- Create a network configure file (e.g. ops.json)
  - Configure the device datapath ID and driver
    - "of:00000005642f0f3d"
    - "driver": "ofdpa3“

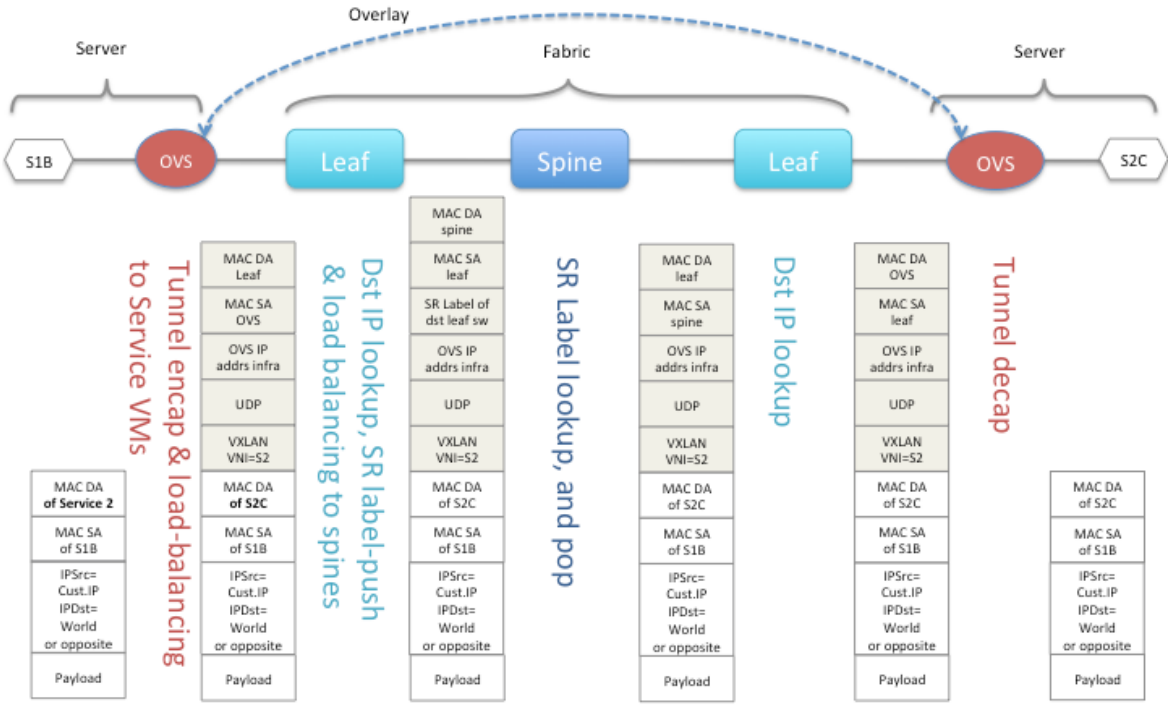
Example ops.json:

```
{
  "devices":
      {
    "of:00000005642f0f3d":
        {
      "basic":
          { "driver": "ofdpa3"
      }
    }
   }
}
```

- Upload the configuration to ONOS controller
  - curl --user onos:rocks -X POST -H "content-type: application/json" http://192.168.1.1:8181/onos/v1/network/configuration -d @./ops.json
- Use ONOS CLI to verify the device driver is correct or not.
  - onos> devices

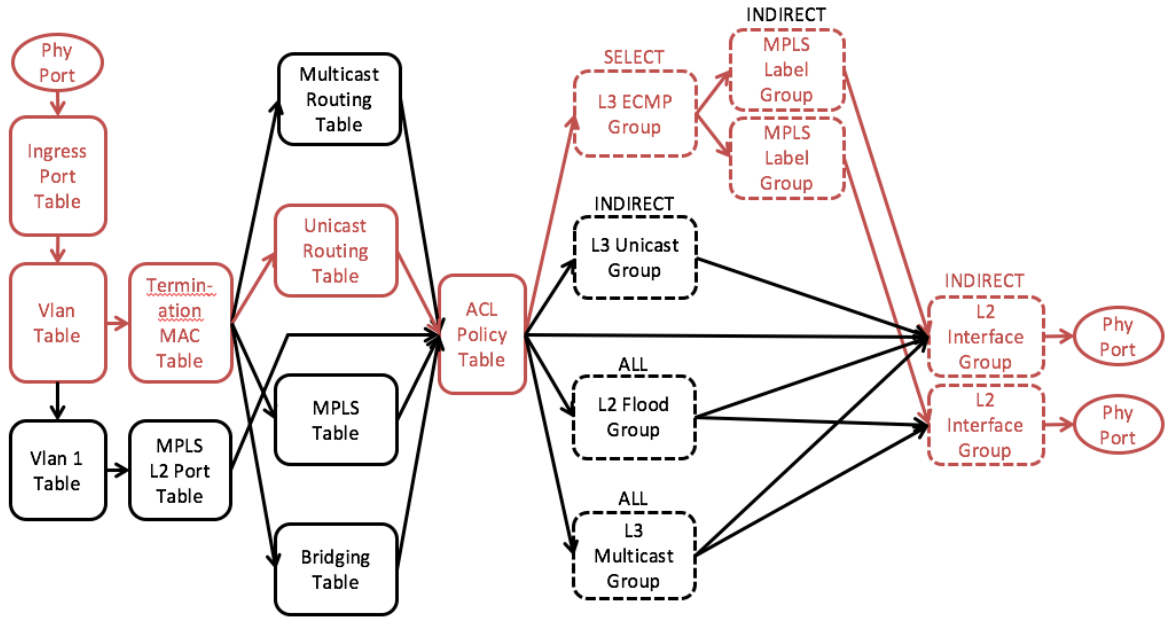
Chapter 7. Example - CORD MPLS Serment Routing

Figure 7.1. Example



7.1. CORD L3 Unicast Pipeline - Source Leaf (MPLS L3 VPN Initiation)

Figure 7.2. Example




```
ovs-ofctl -O OpenFlow13 add-group bridge_ofdpa
group_id=0x64000d,type=indirect,bucket=output:13
```

```
ovs-ofctl -O OpenFlow13 add-group bridge_ofdpa
group_id=0x90000001,type=indirect,bucket=actions=set_field:0x1064-\>vlan_vid,
set_field:70:b3:d5:cc:f1:7a-\>eth_src,set_field:00:00:00:00:00:11-\>eth_dst,
group:0x64000d
```

```
ovs-ofctl -O OpenFlow13 add-group bridge_ofdpa
group_id=0x92000001,type=indirect,bucket=actions=push_mpls:0x8847,
set_field:0x23456-\>mpls_label,set_field:0x1-\>mpls_bos,group:0x90000001
```

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa
table=10,in_port=47,vlan_vid=0x1064,actions=goto_table:20
```

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa
table=10,in_port=47,vlan_vid=0x0/0x1fff,actions=set_field:0x1064-\>vlan_vid,
goto_table:20
```

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa
table=20,dl_type=0x800,eth_dst=00:05:64:2f:1c:01,actions=goto_table:30
```

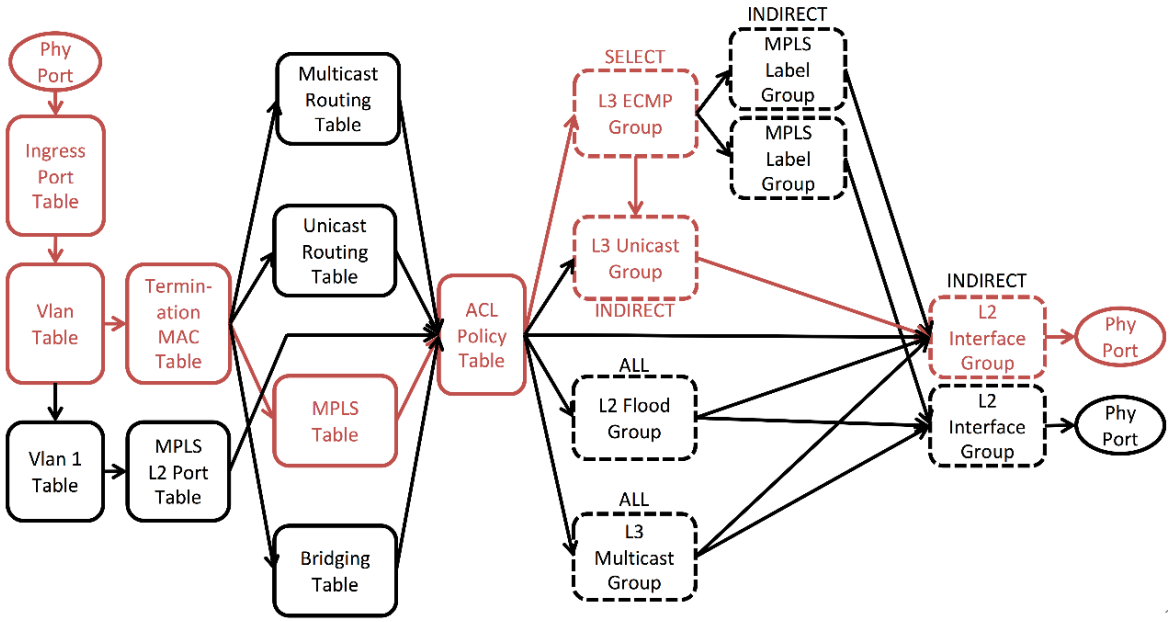
```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa
table=30,dl_type=0x800,nw_dst=1.1.1.2/24,actions=write_actions\
(group:0x92000001\),goto_table:60
```

```
switch# show openflow groups
```

```
Groups:
----------------------------------------
group_id=6553613,type=indirect,bucket=actions=output:13

group_id=2449473537,type=indirect,bucket=actions=push_mpls:0x8847,
set_field:144470->mpls_la bel,set_field:1->mpls_bos,group:2415919105

group_id=2415919105,type=indirect,bucket=actions=set_field:4196->vlan_vid,
set_field:70:b3:d5:cc:f1:7a ->eth_src,set_field:00:00:00:00:00:11->eth_dst,
group:6553613

switch# show openflow flows

Flows:
----------------------------------------
cookie=0x0, duration=21.242s, table=10, n_packets=0, n_bytes=0, in_port=47,
dl_vlan=100
actions=goto_table:20
cookie=0x0, duration=21.207s, table=10, n_packets=0, n_bytes=0,
in_port=47,vlan_tci=0x0000/0x1fff actions=set_field:4196->vlan_vid,
goto_table:20
cookie=0x0, duration=21.175s, table=20, n_packets=0, n_bytes=0, ip,dl_dst=
70:b3:d5:cc:f1:7a
actions=goto_table:30
cookie=0x0, duration=21.142s, table=30, n_packets=0, n_bytes=0, ip,nw_dst=
1.1.1.0/24
actions=write_actions(group:2449473537),goto_table:60
```

7.2. CORD L3 Unicast Pipeline - Spine (MPLS L3 VPN Termination)

Figure 7.3. Example




```
ovs-ofctl -O OpenFlow13 add-group bridge_ofdpa
group_id=0x64000d,type=indirect,bucket=output:13
```

```
ovs-ofctl -O OpenFlow13 add-group bridge_ofdpa
group_id=0x20000001,type=indirect,bucket=actions=set_field:0x1064-\>vlan_vid,
set_field:70:b3:d5:cc:f1:7a-\>eth_src,set_field:00:00:00:00:00:22-\>eth_dst,
group:0x64000d
```

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa
table=10,in_port=47,vlan_vid=0x1064,actions=goto_table:20
```

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa
table=10,in_port=47,vlan_vid=0x0/0x1fff,actions=set_field:0x1064-\>vlan_vid,
goto_table:20
```

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa
table=20,dl_type=0x8847,eth_dst=70:b3:d5:cc:f1:7a,actions=goto_table:24
```

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa
table=24,dl_type=0x8847,mpls_label=0x23456,mpls_bos=1,actions=set_field:1-\>
ofdpa_vrf,set_field:32-\>ofdpa_mpls_type,write_actions\(group:0x20000001\),
goto_table:27
```

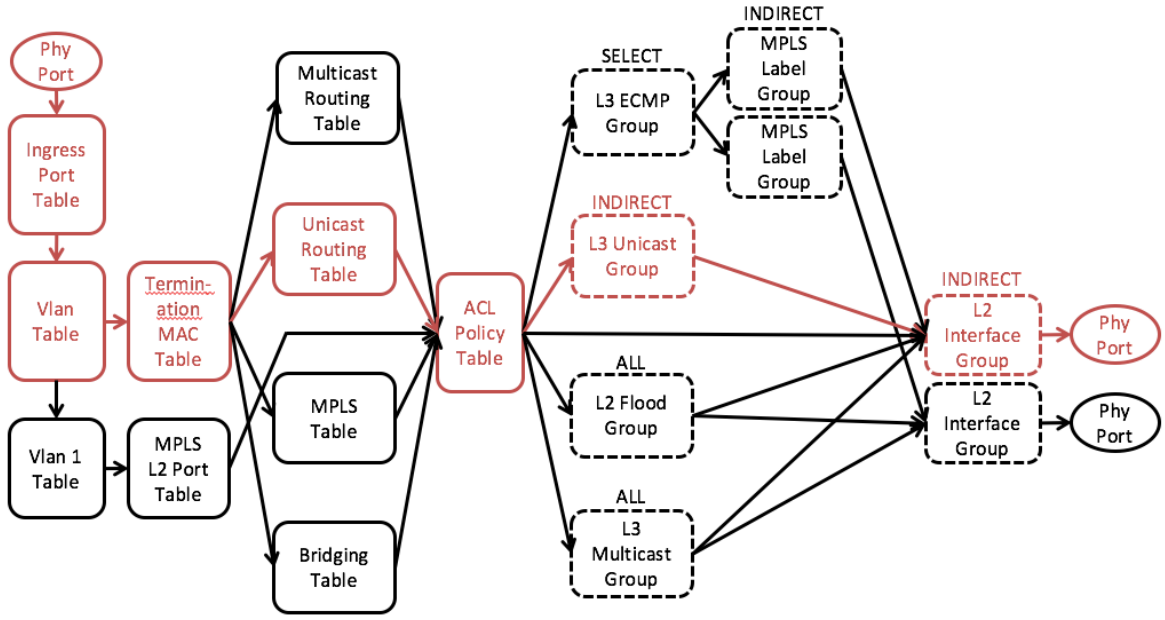
```
switch# show openflow groups
Groups:
----------------------------------------
```

```
group_id=6553613,type=indirect,bucket=actions=output:13
group_id=536870913,type=indirect,bucket=actions=set_field:4196->vlan_vid,
set_field:70:b3:d5:cc:f1:7a->eth_src,set_field:00:00:00:00:00:22->eth_dst,
group:6553613
```

```
switch# show openflow flows
Flows:
---------------------------------------
cookie=0x0, duration=16.549s, table=10, n_packets=0, n_bytes=0, in_port=47,
dl_vlan=100
actions=goto_table:20
cookie=0x0, duration=16.515s, table=10, n_packets=0, n_bytes=0,
in_port=47,vlan_tci=0x0000/0x1fff actions=set_field:4196->vlan_vid,
goto_table:20
cookie=0x0, duration=16.479s, table=20, n_packets=0, n_bytes=0, mpls,
dl_dst=70:b3:d5:cc:f1:7a
actions=goto_table:24
cookie=0x0, duration=16.444s, table=24, n_packets=0, n_bytes=0,
mpls,mpls_label=144470,mpls_bos=1
actions=set_field:1->ofdpa_vrf,set_field:32->ofdpa_mpls_type,write_actions
(group:536870913),goto_table:27
```

7.3. CORD L3 Unicast - Destination Leaf

Figure 7.4. Example




```
ovs-ofctl -O OpenFlow13 add-group bridge_ofdpa
group_id=0x64000d,type=indirect,bucket=output:13
```

```
ovs-ofctl -O OpenFlow13 add-group bridge_ofdpa
group_id=0x20000001,type=indirect,bucket=actions=set_field:0x1064-\>vlan_vid,
set_field:70:b3:d5:cc:f1:7a-\>eth_src,set_field:00:00:00:00:00:33-\>eth_dst,
group:0x64000d
```

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa
table=10,in_port=47,vlan_vid=0x1064,actions=goto_table:20
```

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa
table=10,in_port=47,vlan_vid=0x0/0x1fff,actions=set_field:0x1064-\>vlan_vid,
goto_table:20
```

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa
table=20,dl_type=0x800,eth_dst=70:b3:d5:cc:f1:7a,actions=goto_table:30
```

```
ovs-ofctl -O OpenFlow13 add-flow bridge_ofdpa
table=30,dl_type=0x800,nw_dst=1.1.1.2/32,actions=write_actions\
(group:0x20000001\),goto_table:60
```

```
switch# show openflow groups
Groups:
----------------------------------------
group_id=6553613,type=indirect,bucket=actions=output:13
group_id=536870913,type=indirect,bucket=actions=set_field:4196->vlan_vid,
set_field:70:b3:d5:cc:f1:7a->eth_src,set_field:00:00:00:00:00:33->eth_dst,
```

```
group:6553613
```

```
switch# show openflow flows
Flows:
---------------------------------------
cookie=0x0, duration=20.566s, table=10, n_packets=0, n_bytes=0, in_port=47,
dl_vlan=100
actions=goto_table:20
cookie=0x0, duration=20.529s, table=10, n_packets=0, n_bytes=0,
in_port=47,vlan_tci=0x0000/0x1fff actions=set_field:4196->vlan_vid,
goto_table:20
cookie=0x0, duration=20.496s, table=20, n_packets=0, n_bytes=0, ip,
dl_dst=70:b3:d5:cc:f1:7a
actions=goto_table:30
cookie=0x0, duration=20.461s, table=30, n_packets=0, n_bytes=0, ip,
nw_dst=1.1.1.2
actions=write_actions(group:536870913),goto_table:60
```

Chapter 8. References And Notes

8.1. Release Notes

8.1.1. Version 1.0

- First release

8.1.2. Version 1.0.1

Image: ops_2.0.4

- Support Packet-In
- Support Flow Timeout
- Support SSL Connection
- Add Controller Connection Status
- Add to get the Description of this OpenFlow switch
- Add to get the rule statistics
- Check the invalid Flows and return OFPET_FLOW_MOD_FAILED message to Controller
- Check the Group bucket with more than one group and return OFPET_GROUP_MOD_FAILED message to Controller *CORD Ready Switch

Fixed Issues

- OF-DPA L2 interface group entry install error when set type as "Indirect"
- Untag ICMPv4 packet dropped when set Policy ACL flow table match field as "ICMPv4_TYPE"
- Multipart_Reply shows incorrect counters in "Lookup_count" field
- All flow table’s counters does not show correct matched packets bytes value

8.2. Scaling Parameters

8.2.1. Flow Table Size

Flow Table Name	Aurora 420 Table Size	Aurora 720, 630, 620 Table Size
Ingress Port	2000	2000
VLAN	16384	16384
Termination MAC	512	1024
Unicast Routing	32768	57344
Multicast Routing	8191	8191
Bridging	32767	40959
Policy ACL	3072	1536

8.2.2. Group Table Size

	Aurora 420		Aurora 720, 630, 620	
Group Name	Group Size	Bucket Size	Group Size	Bucket Size
L2 Interface	39936	1	39936	1
L3 Unicast	49152	1	32768	1
L2 Multicast	4095	78	4095	78
L2 Flood	4095	78	4095	78
L3 Interface	8192	1	8192	1
L3 Multicast	8191	312	8191	312
L3 ECMP	1024	32	1024	32

8.2.3. Meter Table Size

Meter Table	Aurora 420 Meter Size	Aurora 720, 630, 620 Meter Size
Meter Table	3072	1536

8.3. OpenFlow v1.3.4 Specification

https://www.opennetworking.org/images/stories/downloads/sdn-resources/onf-specifications/openflow/openflow-switch-v1.3.4.pdf

8.4. The OFDPA v2.01 Specification

https://github.com/Broadcom-Switch/of-dpa/blob/master/OFDPAS-ETP100-R.pdf

8.5. ovs-vsctl

http://openvswitch.org/support/dist-docs-2.5/ovs-vsctl.8.pdf

8.6. ovs-ofctl

http://openvswitch.org/support/dist-docs-2.5/ovs-ofctl.8.pdf