MuL Controller – Command line Reference Guide

Contents

1 Entering the command shell

MUL cli shell is accessible using the following:

```
$ telnet localhost  <cli-port>
```

cli-port: The port which listens for cli clients. (Usually cli-port is 10000)

Note: "mulcli" component needs to be running for users to be able to access the cli shell. Please refer to the release doc: MUL-HOW-TO guide which explains how to run various MuL controller components.

2 CLI Commands

2.1 Enable mode

Once inside the cli shell, the user can then use enable command to gain EXEC mode privilege

Command	Description
enable	Enables higher privilege level access, such as privileged EXEC mode

Example:

```
root@sdn-server:~# telnet localhost 10000
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

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sdn-server>
sdn-server> enable
sdn-server#
```

2.2 Enable mode commands

Command	Description
configure terminal	Configuration from vty interface
disable	Turn off privileged mode command
exit	Exit current mode and down to previous mode
quit	Exit current mode and down to previous mode
show	Show running system information

2.3 Enable mode show commands

Once in enable mode, various system specific information can be viewed using the following commands.

Command	Openflow version	Description
show of-switch all	OF1.0, OF1.3	Show brief information about all switches
show of-switch <dpid> general-features	OF1.0, OF1.3	Show generic switch features
show of-switch <dpid> meter-features	OF1.3	Show switch's metering features
show of-switch <dpid> group-features	OF1.3	Show switch's group features
show of-switch <dpid> table-features <table-id>	OF1.3	Show switch's per-table features
show of-switch <dpid> table-stats <table-id>	OF1.3	Show switch's per table stats
show of-switch <dpid> port-stats port <port-num>[1]	OF1.3	Show switch's port stats
show of-switch <dpid> port-queues <port-num>[2]	OF1.3	Show queues configured for a switch port
show of-switch <dpid> rx-rlimit	N/A	Show controller's per switch RX packet-in rate-limit
show of-switch <dpid> tx-rlimit	N/A	Show controller's per switch TX packet-out rate-limit
show of-flow all	OF1.0, OF1.3	Show all flows installed in all connected switches
show of-flow all-static	OF1.0, OF1.3	Show all static flows installed in all connected switches
show of-flow switch <dpid>	OF1.0, OF1.3	Show all flows installed in a switch

show of-meter switch <dpid>	OF1.3	Show all meters installed in a switch
show of-group switch <dpid>	OF1.3	Show all groups installed in a switch
show neigh switch <dpid> detail	OF1.0, OF1.3	Show all neighbors connected to the specified switch
show running-config	N/A	Show running configuration
show startup-config	N/A	Show startup configuration

Note: 1. *Port stats have to be enabled first. Refer* *Set switch debug/misc attributes*
Note: 2. *Port stats have to be enabled first for checking queue configuration. Refer* *Set switch debug/misc attributes*

Examples:

```
sdn-server#  show of-switch all
-------------------------------------------------------------------------------
Switch-DP-id              |  State          |  Peer              | Ports
-------------------------------------------------------------------------------
0x0000782bcb684d8d    Registered      127.0.0.1: 41886      3
-------------------------------------------------------------------------------
sdn-server# show of-switch 0x0000782bcb684d8d general-features
-------------------------------------------------------------------------
Datapath-id       : 0x782bcb684d8d
Alias-id          : 0
OFP-ver           : 4
Buffers           : 0
Tables            : 255
Capabilities      : 0x4f(FLOW_STATS TABLE_STATS PORT_STATS GROUP_STATS QUEUE_STATS )
Num Ports         : 3
-------------------------------------------------------------------------------------------
                        Port info
-------------------------------------------------------------------------------------------
0x2         Port2     b8:ca:3a:62:f6:74  UP RECV FWD PKTIN RUNNING LIVE
0x1         Port1     b8:ca:3a:62:f6:72  UP RECV FWD PKTIN RUNNING LIVE
0x3         Port3     b8:ca:3a:62:f6:75  UP RECV FWD PKTIN RUNNING LIVE
-------------------------------------------------------------------------------------------
sdn-server#
sdn-server# show of-flow all
-------------------------------------------------------------------------
Flow:  smac:00:01:02:03:04:05: in-port:0x1
instructions: write-act: act-out-port(2):max-len(0x5ee),
Prio: 0 Flags: static no-clone non-local  Datapath-id: 0x782bcb684d8d
-------------------------------------------------------------------------
sdn-server#  show of-switch 0x0000782bcb684d8d group-features
-------------------------------------------------------------------------
Supported-groups: grp-all grp-select grp-indirect grp-fast-failover
Capability:
Grp-all-max 16777216 grp-select-max 16777216 grp-ind-max 16777216 grp-ff-max 16777216
Grp-all-actions: act-output act-copy-ttl-out act-copy-ttl-in act-mpls-ttl act-mpls-dec-ttl act-push-vlan act-
pop-vlan act-push-mpls act-pop-mpls act-set-queue act-set-group act-set-nw-ttl act-dec-nw-ttl act-set-field
act-push-pbb
Grp-select-actions: act-output act-copy-ttl-out act-copy-ttl-in act-mpls-ttl act-mpls-dec-ttl act-push-vlan act-
```

```
pop-vlan act-push-mpls act-pop-mpls act-set-queue act-set-group act-set-nw-ttl act-dec-nw-ttl act-set-field
act-push-pbb
Grp-indirect-actions: act-output act-copy-ttl-out act-copy-ttl-in act-mpls-ttl act-mpls-dec-ttl act-push-vlan
act-pop-vlan act-push-mpls act-pop-mpls act-set-queue act-set-group act-set-nw-ttl act-dec-nw-ttl act-set-
field act-push-pbb
Grp-FF-actions: act-output act-copy-ttl-out act-copy-ttl-in act-mpls-ttl act-mpls-dec-ttl act-push-vlan act-
pop-vlan act-push-mpls act-pop-mpls act-set-queue act-set-group act-set-nw-ttl act-dec-nw-ttl act-set-field
act-push-pbb
------------------------------------------------------------------------------
sdn-server# show of-switch 0x0000782bcb684d8d meter-features
------------------------------------------------------------------------------
Max-meter: 16777216
Supported Bands: band-drop band-dscp-mark
Supported flags: meter-kbps meter-pps meter-burst meter-stats
Max-bands 255 max-color 0
------------------------------------------------------------------------------
```

2.4 Configure mode

To configure any item using the cli, one has to enter the configure mode from enable mode. For example:

```
sdn-server> enable
sdn-server#
sdn-server# configure  terminal
sdn-server(config)#
```

2.5 Configure mode generic commands

The configure mode provides the following general options for the user :

Command	Description
enable	Modify enable password parameters
end	End current mode and change to enable mode
exit	Exit current mode and down to previous mode
hostname	Set system's host name
no	Undo a command
show	Show running system information
password	Assign the terminal connection password
service	Set up miscellaneous service
set	Set system values
show	Show running system information

vty-config	Configure vty parameters like enabling login password, timeout etc
write	Write running configuration to persistent store

Examples:

2.5.1 Setting login password

```
sdn-server> enable
sdn-server#
sdn-server# configure  terminal
sdn-server(config)#
sdn-server(config)# password mul@123
sdn-server(config)#
sdn-server(config)# vty-config
sdn-server(config-line)#
sdn-server(config-line)# login
sdn-server(config-line)# exit
sdn-server(config)#
sdn-server(config)# write
(mul-main)#
```

2.5.2 Setting enable mode password

```
sdn-server> enable
sdn-server#
sdn-server# configure  terminal
sdn-server(config)#
sdn-server(config)# enable password mul@123
sdn-server(config)#
sdn-server(config)# write
sdn-server(config)# exit
sdn-server# exit
root@sdn-server:/ telnet localhost 1000
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

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Password:
sdn-server > en
Password:
sdn-server#
```

2.5.3 Configure mode service-specific commands

Once in configure mode, the cli also provides the option to configure services specific to the MuL controller. The commands available are:

Command	Description
mul-conf	Core controller configuration. To be used for flows, group and meter configurations as well as setting various switch parameters

Example:

```
sdn-server> enable
sdn-server#
sdn-server# configure  terminal
sdn-server(config)#
sdn-server(config)# mul-conf
(mul-main)#
```

2.6 mul-conf mode commands

2.6.1 Flow add/modify command

Command	Description
of-flow add switch X smac (X|*) dmac (X|*) eth-type (X|*) vid (<0-4095>|*) vlan-pcp (<0-7>|*) mpls-label (<0-1048575>|*) mpls-tc (<0-7>|*) mpls-bos (<0-1>|*) dip (A.B.C.D/M|*) sip (A.B.C.D/M|*) proto (<0-255>|*) tos (<0-63>|*) dport (<0-65535>|*) sport (<0-65535>|*) in-port (*|<0-65535>) table <0-254>	IPv4 Flow add command
of-flow add switch X smac (X|*) dmac (X|*) eth-type (X|*) vid (<0-4095>|*) vlan-pcp (<0-7>|*) mpls-label (<0-1048575>|*) mpls-tc (<0-7>|*) mpls-bos (<0-1>|*) dip6 (X:X::X:X/M|*) sip6 (X:X::X:X /M|*) proto (<0-255>|*) tos (<0-63>|*) dport (<0-65535>|*) sport (<0-65535>|*) in-port (*|<0-65535>) table <0-254>	IPv6 Flow add command

This command can be used to modify the flow if it has already been installed.

2.6.1.1 Flow add configuration commands

The flow-add command leads the user to the flow configuration node. In this configuration node, the following commands can be used. (*Please note that only one type of instruction should be used otherwise it will lead to undefined behavior*)

Command	Openflow version	Description
instruction-apply[1]	OF1.3, OF1.0	Add an apply instruction
instruction-write	OF1.3	Add a write instruction
instruction-meter <meter-id>	OF1.3	Add a meter instruction with specified meter-id
instruction-goto <table-id>	OF1.3	Add a goto table instruction to specified table-id

flow-stats-enable	OF1.0, OF1.3	Enable stats gathering for flow
flow-priority <0- 65535>	OF1.0, OF1.3	Add a priority to the flow
flow-tunnel X	OF1.3	Add a tunnel-id to flow match tuple (in 0xXX hex format)
flow-barrier-enable	OF1.3	Send an accompanying barrier after flow-add command

Note: *There is no apply instruction in openflow 1.0 but is used as a place holder for entering into action configuration mode.*

2.6.1.2 Apply and Write instructions: Action configuration commands

Once the user enters apply or write instruction, the following actions can be added to the instruction:

Command	Openflow version	Description
action-add cp-ttl-in	OF1.3	Copy ttl-in action
action-add cp-ttl-out	OF1.3	Copy ttl-out action
action-add dec-mpls-ttl	OF1.3	Decrement mpls ttl action
action-add dec-nw-ttl	OF1.3	Decrement L3 layer ttl action
action-add drop	OF1.0, OF1.3	Drop the packet
action-add group-id <0-65535>	OF1.3	Set group-id action[1]
action-add nw-daddr A.B.C.D	OF1.0, OF1.3	Set destination ipv4 address action
action-add nw-saddr A.B.C.D	OF1.0, OF1.3	Set source ipv4 address action
action-add nw-daddr6 X:X::X:X	OF1.3	Set destination ipv6 address action
action-add nw-saddr6 X:X::X:X	OF1.3	Set source ipv6 address action
action-add set-nw-dscp <0-63>	OF1.0, OF1.3	Set DSCP value action
action-add output <0-65535>	OF1.0, OF1.3	Output port action to specified port
action-add push-mpls-header	OF1.3	Push mpls header action
action-add push-pbb-header	OF1.3	Push pbb header action
action-add push-svlan-header	OF1.3	Push svlan header action
action-add push-vlan-header	OF1.3	Push vlan header action
action-add set-dmac xx:xx:xx:xx:xx:xx	OF1.0, OF1.3	Set Destination Mac
action-add set-eth-type <1-65535>	OF1.0, OF1.3	Set eth-type action
action-add set-mpls-bos <0-1>	OF1.3	Set mpls bos action

action-add set-mpls-label <1-1048575>	OF1.3	Set mpls label action
action-add set-mpls-tc <0-8>	OF1.3	Set mpls tc action
action-add set-mpls-ttl <1-255>	OF1.3	Set mpls ttl action
action-add set-nw-ttl <1-255>	OF1.3	Set nw ttl action
action-add set-queue <0-4294967295>	OF1.3	Set output to a queue to given queue-id
action-add set-smac xx:xx:xx:xx:xx:xx	OF1.0, OF1.3	Set Source Mac
action-add set-vlan-id <0-4094>	OF1.0, OF1.3	Set vlan-id action
action-add set-vlan-pcp <0-7>	OF1.0, OF1.3	Set vlan-pcp action
action-add strip-mpls-header <1-65535>	OF1.3	Pop mpls header action and set inner header eth-type to given value
action-add strip-pbb-header	OF1.3	Pop outer PBB header action
action-add strip-vlan	OF1.0, OF1.3	Pop outer-vlan header
action-list-end	N/A	Actions add operation is complete. Proceed to add another instruction or commit the action
commit	N/A	Commit the flow and associated instructions/actions to the switch.

Note: 1. *Not available for apply instruction*

2.6.2 Flow delete command

Command	Description
of-flow del switch X smac (X|*) dmac (X|*) eth-type (X|*) vid (<0-4095>|*) vlan-pcp (<0-7>|*) mpls-label (<0-1048575>|*) mpls-tc (<0-7>|*) mpls-bos (<0-1>|*) dip (A.B.C.D/M|*) sip (A.B.C.D/M|*) proto (<0-255>|*) tos (<0-63>|*) dport (<0-65535>|*) sport (<0-65535>|*) in-port (*|<0-65535>) table <0-254>	IPv4 Flow delete command
of-flow del switch X smac (X|*) dmac (X|*) eth-type (X|*) vid (<0-4095>|*) vlan-pcp (<0-7>|*) mpls-label (<0-1048575>|*) mpls-tc (<0-7>|*) mpls-bos (<0-1>|*) dip6 (X:X::X:X/M|*) sip6 (X:X::X:X /M|*) proto (<0-255>|*) tos (<0-63>|*) dport (<0-65535>|*) sport (<0-65535>|*) in-port (*|<0-65535>) table <0-254>	IPv6 Flow delete command

The following command can be used to delete a flow when flow has an associate priority.

Command	Description
of-flow del switch X smac (X|*) dmac (X|*) eth-type (X|*) vid (<0-4095>|*)	IPv4 Flow delete

vlan-pcp (<0-7>|*) mpls-label (<0-1048575>|*) mpls-tc (<0-7>|*) mpls-bos (<0-1>|*) dip (A.B.C.D/M|*) sip (A.B.C.D/M|*) proto (<0-255>|*) tos (<0-63>|*) dport (<0-65535>|*) sport (<0-65535>|*) in-port (*|<0-65535>) table <0-254> **flow-priority** <0-65535>	command when flow has a priority
of-flow del switch X smac (X|*) dmac (X|*) eth-type (X|*) vid (<0-4095>|*) vlan-pcp (<0-7>|*) mpls-label (<0-1048575>|*) mpls-tc (<0-7>|*) mpls-bos (<0-1>|*) dip6 (X:X::X:X/M|*) sip6 (X:X::X:X /M|*) proto (<0-255>|*) tos (<0-63>|*) dport (<0-65535>|*) sport (<0-65535>|*) in-port (*|<0-65535>) table <0-254> **flow-priority** <0-65535>	IPv6 Flow delete command when flow has a priority

The following command can be used to delete a flow when flow has an associated tunnel-id.

Command	Description
of-flow del switch X smac (X|*) dmac (X|*) eth-type (X|*) vid (<0-4095>|*) vlan-pcp (<0-7>|*) mpls-label (<0-1048575>|*) mpls-tc (<0-7>|*) mpls-bos (<0-1>|*) dip (A.B.C.D/M|*) sip (A.B.C.D/M|*) proto (<0-255>|*) tos (<0-63>|*) dport (<0-65535>|*) sport (<0-65535>|*) in-port (*|<0-65535>) table <0-254> flow-priority <0-65535> **tunnel-id** X	IPv4 Flow delete command when flow has a tunnel
of-flow del switch X smac (X|*) dmac (X|*) eth-type (X|*) vid (<0-4095>|*) vlan-pcp (<0-7>|*) mpls-label (<0-1048575>|*) mpls-tc (<0-7>|*) mpls-bos (<0-1>|*) dip6 (X:X::X:X/M|*) sip6 (X:X::X:X /M|*) proto (<0-255>|*) tos (<0-63>|*) dport (<0-65535>|*) sport (<0-65535>|*) in-port (*|<0-65535>) table <0-254> flow-priority <0-65535> **tunnel-id** X	IPv6 Flow delete command when flow has a tunnel

2.6.3 Flow modification examples

2.6.3.1 Direct matching flow to an output port

(Exact port number used in actions can be found using the command – "show of-switch <dpid> general-features")

```
(mul-main)# of-flow add switch 0x782bcb684d8d smac 00:01:02:03:04:05 dmac 00:01:02:03:04:06
eth-type 0x0800 vid * vlan-pcp * mpls-label * mpls-tc * mpls-bos * dip 9.1.1.2/32 sip 1.1.1.1/32 proto
6 tos * dport 4455 sport 4455 in-port 1 table 0
(config-flow-instruction)# instruction-write
(config-inst-action)# action-add output 2
(config-inst-action)# action-list-end
(config-flow-instruction)# commit
(mul-main)#
(mul-main)# do show of-flow all
--------------------------------------------------------------------------------
Flow: smac:00:01:02:03:04:05: dmac:00:01:02:03:04:06: eth-type:0x800 dst-ip:9.1.1.2 (0xffffffff) src-
ip:1.1.1.1 (0xffffffff) ip-proto:0x6 src-port:0x1167 dst-port:0x1167 in-port:0x1
instructions: write-act: act-out-port(2):max-len(0x5ee),
Prio: 0 Flags: static no-clone non-local Datapath-id: 0x782bcb684d8d
--------------------------------------------------------------------------------
```

2.6.3.2 Modify MPLS label for matching flows and send to an output port

```
(mul-main)# of-flow add switch 0x782bcb684d8d smac * dmac * eth-type 0x8847 vid * vlan-pcp *
mpls-label 100 mpls-tc 7 mpls-bos 1 dip * sip * proto * tos * dport * sport * in-port * table 0
(config-flow-instruction)# instruction-write
```

```
(config-inst-action)# action-add set-mpls-label 200
(config-inst-action)# action-add set-mpls-tc 7
(config-inst-action)# action-add output 1
(config-inst-action)# action-list-end
(config-flow-instruction)# commit
(mul-main)#
(mul-main)#  do show of-flow all
--------------------------------------------------------------------------------
Flow:  eth-type:0x8847  mpls-label:0x64  mpls-tc:0x7  mpls-bos:0x1
instructions: write-act: set-field: set-mpls-label-0xc8set-field: set-mpls-tc-0x7act-out-port(1):max-
len(0x5ee),
Prio: 0 Flags: static no-clone non-local  Datapath-id: 0x782bcb684d8d
--------------------------------------------------------------------------------
```

2.6.3.3 Pop MPLS header for matching flows and send to an output port

```
(mul-main)# of-flow add switch 0x782bcb684d8d smac * dmac * eth-type 0x8847 vid * vlan-pcp *
mpls-label 200 mpls-tc 7 mpls-bos 1 dip * sip * proto * tos * dport * sport * in-port * table 0
(config-flow-instruction)#  instruction-write
(config-inst-action)#  action-add strip-mpls-header 2048
(config-inst-action)#  action-add output 2
(config-inst-action)#  action-list-end
(config-flow-instruction)# commit
(mul-main)#
(mul-main)#
(mul-main)#  do show of-flow all
--------------------------------------------------------------------------------
Flow:  eth-type:0x8847  mpls-label:0xc8  mpls-tc:0x7  mpls-bos:0x1
instructions: write-act: pop-mpls:next_eth_type(0x800),act-out-port(2):max-len(0x5ee),
Prio: 0 Flags: static no-clone non-local Datapath-id: 0x782bcb684d8d
--------------------------------------------------------------------------------
```

2.6.3.4 Push VLAN header, set VLAN-ID for matching flows and send to an output port

```
(mul-main)# of-flow add switch 0x782bcb684d8d smac 00:01:02:03:04:05 dmac 00:01:02:03:04:06
eth-type 0x0800 vid * vlan-pcp * mpls-label * mpls-tc * mpls-bos * dip 0.0.0.0/0 sip 0.0.0.0/0 proto *
tos *  dport * sport * in-port * table 0
(config-flow-instruction)# instruction-write
(config-inst-action)#  action-add push-vlan-header
(config-inst-action)#  action-add set-vlan-id 200
(config-inst-action)#  action-add output 2
(config-inst-action)#  action-list-end
(config-flow-instruction)# commit
(mul-main)#
(mul-main)#
(mul-main)# do show of-flow all
--------------------------------------------------------------------------------
Flow:  smac:00:01:02:03:04:05: dmac:00:01:02:03:04:06: eth-type:0x800
instructions: write-act: push-vlan:eth-type(0x8100),set-field: set-vlan-0xc8,act-out-port(2):max-len(0x5ee),
Prio: 0 Flags: static no-clone non-local  Datapath-id: 0x782bcb684d8d
--------------------------------------------------------------------------------
```

2.6.3.5 Push Q-in-Q headers and set inner and outer vlan-ids for matching flows and send to an output port

```
(mul-main)# of-flow add switch 0x782bcb684d8d smac 00:01:02:03:04:05 dmac 00:01:02:03:04:06
eth-type 0x0800 vid * vlan-pcp * mpls-label * mpls-tc * mpls-bos * dip 0.0.0.0/0 sip 0.0.0.0/0 proto *
tos * dport * sport * in-port * table 0
(config-flow-instruction)#  instruction-apply
(config-inst-action)#  action-add push-vlan-header
(config-inst-action)#  action-add set-vlan-id 200
(config-inst-action)#  action-list-end
(config-flow-instruction)#  instruction-write
(config-inst-action)#  action-add push-svlan-header
(config-inst-action)#  action-add set-vlan-id 100
(config-inst-action)#  action-add output 2
(config-inst-action)#  action-list-end
(config-flow-instruction)#  commit
(mul-main)#
(mul-main)#
(mul-main)# do show of-flow all
--------------------------------------------------------------------------------
Flow:  smac:00:01:02:03:04:05: dmac:00:01:02:03:04:06: eth-type:0x800
instructions: apply-act: push-vlan:eth-type(0x8100),set-field: set-vlan-0xc8,write-act: push-vlan:eth-
type(0x88a8),set-field: set-vlan-0x64,act-out-port(2):max-len(0x5ee),
Prio: 0 Flags: static no-clone non-local  Datapath-id: 0x782bcb684d8d
--------------------------------------------------------------------------------
```

2.6.3.6 Direct a matching flow to a queue

```
(mul-main)# of-flow add switch 0x782bcb684d8d smac 00:01:02:03:04:05 dmac 00:01:02:03:04:06
eth-type 0x0800 vid * vlan-pcp *  mpls-label * mpls-tc * mpls-bos * dip 1.1.1.2/32 sip 1.1.1.1/32 proto
6 tos * dport 4455 sport 4455 in-port 1 table 0
(config-flow-instruction)# instruction-write
(config-inst-action)# action-add set-queue 3
(config-inst-action)# action-list-end
(config-flow-instruction)# commit
(mul-main)#
(mul-main)#
(mul-main)# do show of-flow all
--------------------------------------------------------------------------------
Flow:  smac:00:01:02:03:04:05: dmac:00:01:02:03:04:06: eth-type:0x800  dst-ip:1.1.1.2 (0xffffffff)  src-
ip:1.1.1.1 (0xffffffff)  ip-proto:0x6  src-port:0x1167  dst-port:0x1167  in-port:0x1
instructions: write-act: set-queue:0x3,
Prio: 0 Flags: static no-clone non-local  Datapath-id: 0x782bcb684d8d
--------------------------------------------------------------------------------
```

2.6.3.7 Drop packets matching a flow

```
(mul-main)# of-flow add switch 0x782bcb684d8d smac 00:01:02:03:04:05 dmac 00:01:02:03:04:06
eth-type 0x0800 vid * vlan-pcp *  mpls-label * mpls-tc * mpls-bos * dip 10.11.1.2/32 sip 1.1.1.1/32
proto 6 tos * dport 5455 sport 6455 in-port 1 table 0
(config-flow-instruction)# instruction-write
(config-inst-action)# action-add drop
(config-inst-action)# action-list-end
```

```
(config-flow-instruction)# commit
Ignoring all non-drop actions if any
(mul-main)#
(mul-main)# do show of-flow all
---------------------------------------------------------------------------
Flow:  smac:00:01:02:03:04:05: dmac:00:01:02:03:04:06: eth-type:0x800  dst-ip:10.11.1.2 (0xffffffff)  src-ip:1.1.1.1 (0xffffffff)  ip-proto:0x6  src-port:0x1937  dst-port:0x154f  in-port:0x1
instructions:
Prio: 0 Flags: static no-clone non-local  Datapath-id: 0x782bcb684d8d
---------------------------------------------------------------------------
```

2.6.3.8 Delete a flow

```
(mul-main)# of-flow  del switch 0x782bcb684d8d smac * dmac * eth-type 0x8847 vid * vlan-pcp * mpls-label 100 mpls-tc 7 mpls-bos 1 dip * sip * proto * tos * dport * sport * in-port * table 0
(mul-main)#
(mul-main)#
```

2.6.4 Create meter command

Command	Description
of-meter add switch X meter-id (<0-4294967295>) meter-type (kbps | pktps) burst (yes | no) stats (yes | no)	Create a meter instance in switch

This command can be used to modify a meter if it has already been installed.

Note- Meter configuration is only available for Openflow 1.3

2.6.4.1 Meter configuration Commands

The create meter command leads the user to the meter configuration node. In this configuration node, the following commands can be used.

Command	Description
meter-band drop rate <1-4294967295> burst-size <0-4294967295>	Configure a drop meter band
meter-band dscp-remark rate <1-4294967295> burst-size <0-4294967295> prec-level <0-7>	Configure a dscp remark meter band
meter-band-next	Save the current band and add another meter band
meter-barrier-enable	Send an accompanying barrier after meter-add command
commit-meter	Commits the meter and its meter bands to the switch

Examples:

```
(mul-main)# of-meter add switch 0x782bcb684d8d meter-id 1 meter-type kbps burst yes stats no
(config-meter)# meter-band dscp-remark rate 1024 burst-size 100 prec-level 1
(config-meter)# meter-band-next
(config-meter)# meter-band drop rate 2048 burst-size 300
(config-meter)# commit-meter
```

2.6.5 Delete meter command

Command	Description
of-meter del switch X meter-id (<0-4294967295>)	Delete a meter instance from switch

Examples:

```
(mul-main)#
(mul-main)# of-meter del switch 0x782bcb684d8d meter-id 1
```

2.6.6 Create group command

Command	Description
of-group add switch X group <0-65535> type <all |ff | indirect | select>	Create a group instance in switch

This command can be used to modify a group if it has already been installed.

Note- Group configuration is only available for Openflow 1.3

2.6.6.1 Group Configuration commands

The create group command leads the user inside the group node configuration. In this configuration node, the following commands can be used.

Command	Description
group-act-vector <ff-group| ff-port| weight> <value>	Command to create a group action bucket
group-act-vector weight <0-65535>	Set weight for this bucket (Only for select action)
action-add	Add action(s) to the bucket
group-act-vector-next	Save the current action bucket and add a new bucket
group-stats-enable	Enable stats gathering for this group
group-barrier-enable	Send an accompanying barrier after group-add command

commit-group	Commits the group to switch

Users can select the following actions to add to each of the group's action bucket:

Command	Description
action-add cp-ttl-in	Copy ttl in action
action-add cp-ttl-out	Copy ttl out action
action-add dec-mpls-ttl	Decrement mpls ttl action
action-add dec-nw-ttl	Decrement mpls ttl action
action-add drop	Drop the packet
action-add nw-daddr A.B.C.D	Set destination ip address action
action-add nw-saddr A.B.C.D	Set source ip address action
action-add set-nw-dscp <0-63>	Set DSCP value action
action-add output <0-65535>	Send the packet to out-port
action-add push-mpls-header	Push mpls header action
action-add push-pbb-header	Push pbb header action
action-add push-svlan-header	Push svlan header action
action-add push-vlan-header	Push vlan header action
action-add set-dmac xx:xx:xx:xx:xx:xx	Set Destination Mac
action-add set-eth-type <1-65535>	Set eth-type action
action-add set-mpls-bos <0-1>	Set mpls bos action
action-add set-mpls-label <1-1048575>	Set mpls label action
action-add set-mpls-tc <0-8>	Set mpls tc action
action-add set-mpls-ttl <1-255>	Set mpls ttl action
action-add set-nw-ttl <1-255>	Set nw ttl action
action-add set-queue <0-4294967295>	Enqueue the packet to a queue
action-add set-smac xx:xx:xx:xx:xx:xx	Set Source Mac
action-add set-vlan-id <0-4094>	set vlan-id action
action-add set-vlan-pcp <0-7>	set vlan-pcp action
action-add strip-mpls-header <1-65535>	Pop mpls header action and set inner header eth-type to given value
action-add strip-pbb-header	Pop outer PBB header action
action-add strip-vlan	Pop outer-vlan header

2.6.7 Group Delete

Command	Description
of-group del switch X group <0-65535	Command to delete a group with given id

2.6.8 Direct flow to a group

Please refer to “action-add group-id <0-65535>” in section Section 2.6.1.2

2.6.9 Group modification examples

2.6.9.1 Create a group of type “ALL”.

```
(mul-main)# of-group add switch 0x782bcb684d8d group 1 type all
(config-grp-act-vectors)# action-add set-dmac 00:02:03:04:05:01
(config-grp-act-vectors)# action-add output 1
(config-grp-act-vectors)# commit-group
```

2.6.9.2 Create a group of type “FAST FAILOVER”.

```
(mul-main)# of-group add switch 0x782bcb684d8d group 1 type ff
(config-grp-act-vectors)# group-act-vector ff-group 1
(config-grp-act-vectors)# group-act-vector ff-port 2
(config-grp-act-vectors)# action-add set-dmac 00:02:03:04:05:01
(config-grp-act-vectors)# action-add output 1
(config-grp-act-vectors)# group-act-vector-next
(config-grp-act-vectors)# action-add set-queue 1
(config-grp-act-vectors)# commit-group
```

2.6.9.3 Create a group of type “INDIRECT”.

```
(mul-main)# of-group add switch 0x782bcb684d8d group 1 type indirect
 (config-grp-act-vectors)# action-add set-dmac 00:02:03:04:05:01
(config-grp-act-vectors)# action-add output 1
 (config-grp-act-vectors)# action-add set-queue 2
(config-grp-act-vectors)# commit-group
```

2.6.9.4 Create a group of type “SELECT”.

```
(mul-main)# of-group add switch 0x782bcb684d8d group 1 type select
(config-grp-act-vectors)# group-act-vector weight 12
(config-grp-act-vectors)# action-add set-dmac 00:02:03:04:05:01
(config-grp-act-vectors)# action-add output 1
(config-grp-act-vectors)# group-act-vector-next
(config-grp-act-vectors)# group-act-vector weight 10
(config-grp-act-vectors)# action-add set-queue 1
(config-grp-act-vectors)# commit-group
```

2.6.10 Port modification command

Command	Description
of-port mod switch <dpid> port-no <port-num> port-down (<set|unset|no-change>) no-stp (<set|unset|no-change>) no-recv (<set|unset|no-change>) no-recv-stp (<set|unset|no-change>) no-flood (<set|unset|no-change>) no-fwd (<set|unset|no-change>) no-packet-in (<set|unset|no-change>)	Change a port's attributes, Available for OF1.0 and OF1.3

2.6.11 Set switch debug/misc attributes

Command	Openflow version	Description
set of-switch X pkt-dump rx (enable|disable) tx (enable|disable)*	OF1.3	Enable or Disable Openflow frame dump
set of-switch X rx-rlim-disable	OF1.0, OF1.3	Disable packet-in rate-limit
set of-switch X rx-rlim-enable <1-1000000>	OF1.0, OF1.3	Enable packet-in rate limit throttling to specified packets per second
set of-switch X tx-rlim-disable	OF1.0, OF1.3	Disable packet-out rate-limit
set of-switch X tx-rlim-enable <1-1000000>	OF1.0, OF1.3	Enable packet-out rate limit throttling to specified packets per second
set of-switch X stats-gather flow (bulk|single) group (bulk|single) meter-conf (bulk|single)	Only flow conf - OF1.0, OF1.3. Rest only OF1.3	Configure how controller gathers various statistics whether per flow/group/meter or with a single get all multipart message
set of-switch X port-stats (enable|disable)	OF1.3	Enable or disable port-stats collection per switch

2.6.12 Set switch asynchronous message Config

Command	Openflow version	Description
set-async-config switch X master packet-in <mask> port-status <mask> flow-removed <mask> slave packet-in <mask> port-status <mask> flow-removed <mask>*	OF1.3	Command to configure asynchronous message handling behavior of a switch