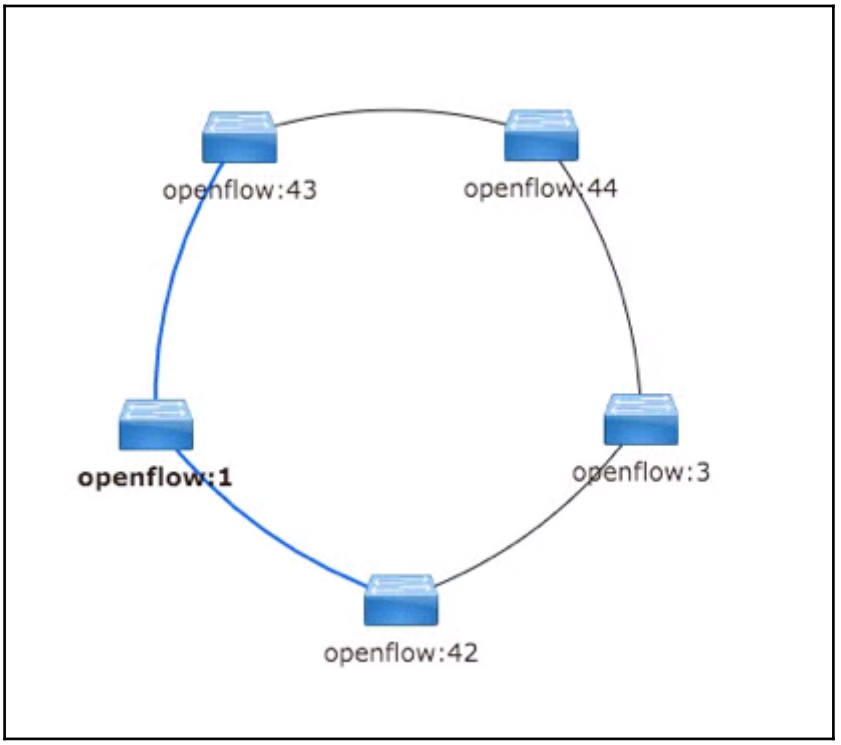
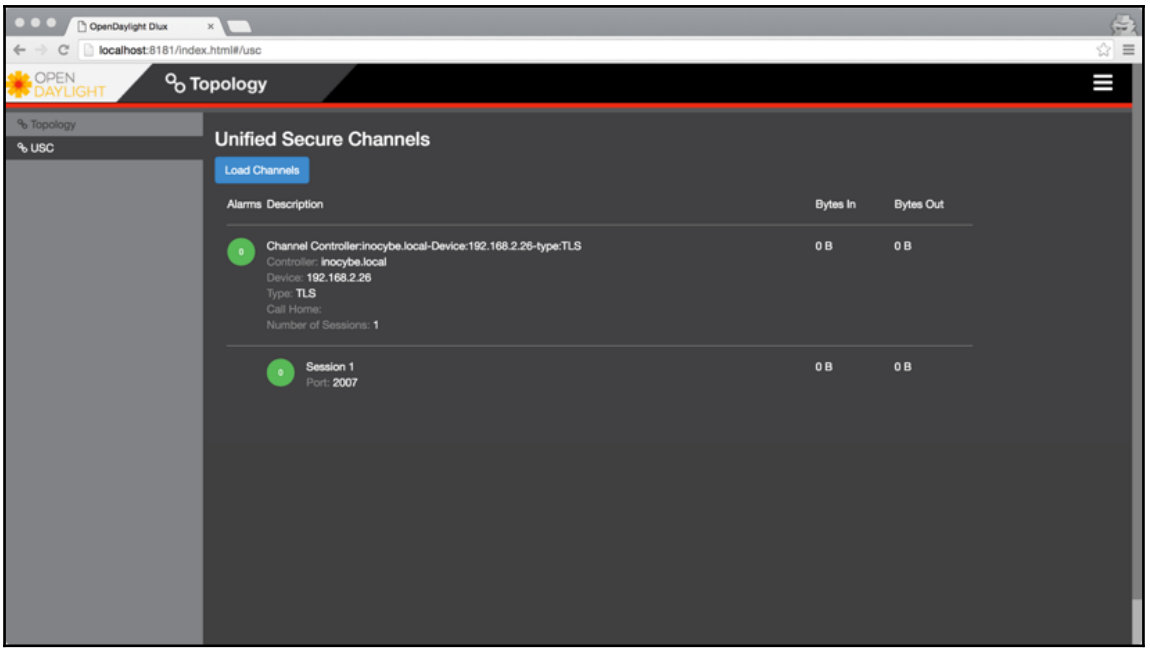
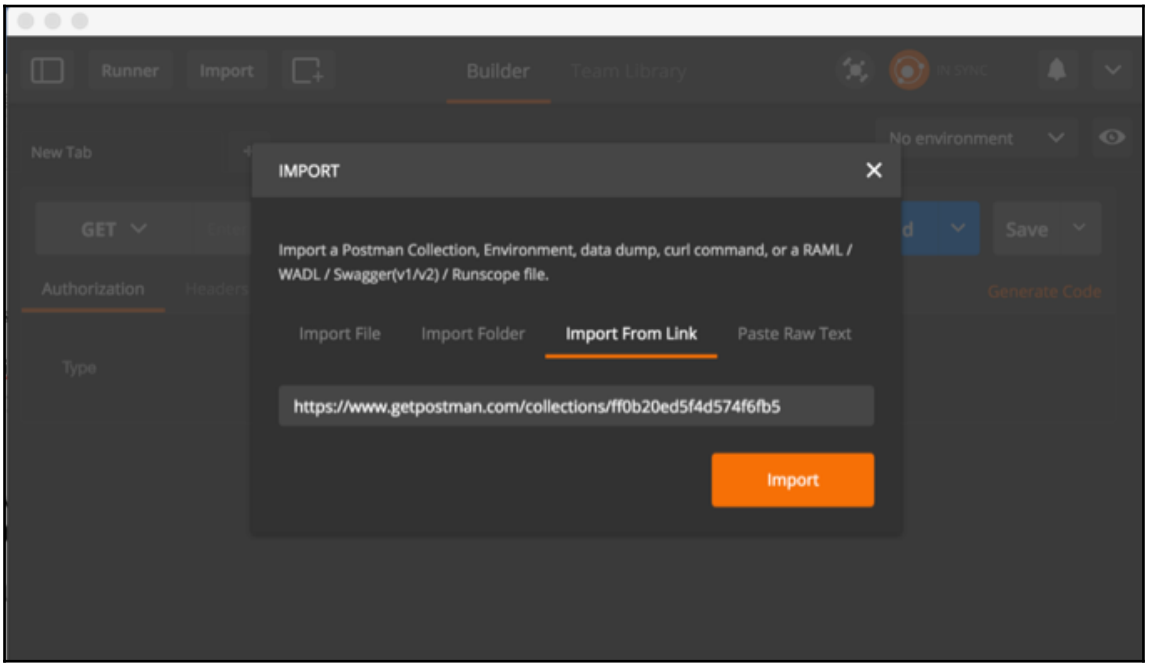
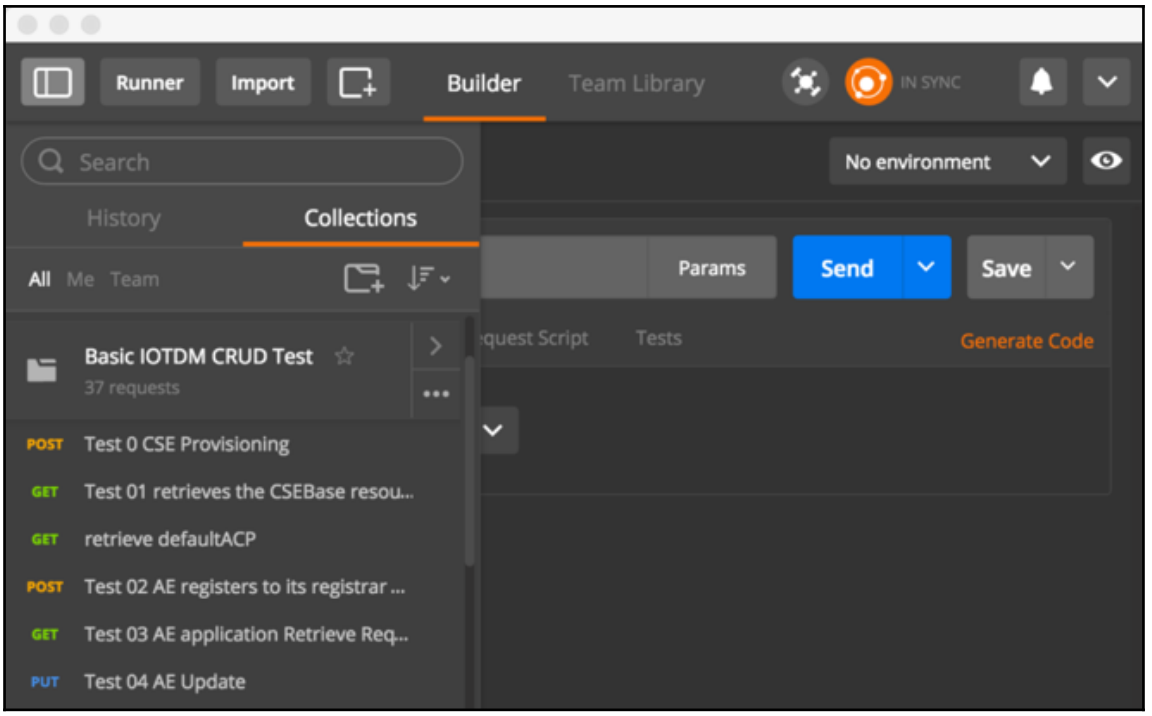
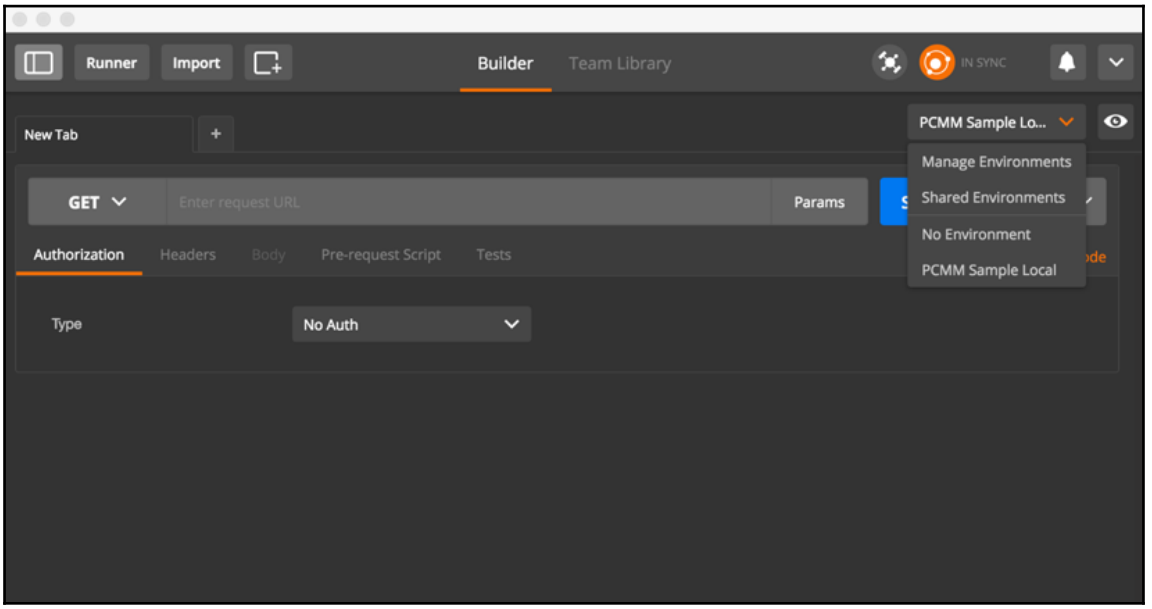
Chapter 2: Virtual Customer Edge




OpenDaylight Dlux
localhost:8181/index.html#/usc
OPEN DAYLIGHT
Topology
Topology
USC
Unified Secure Channels
Load Channels
Alarms Description
Bytes In
Bytes Out
Channel Controller:inocybe.local-Device:192.168.2.26-type:TLS
Controller: inocybe.local
Device: 192.168.2.26
Type: TLS
Call Home:
Number of Sessions: 1
0 B
0 B
Session 1
Port: 2007
0 B
0 B


Runner
Import
Builder
Team Library
New Tab
No environment
GET
Save
Authorization
Generate Code
Type
IMPORT
Import a Postman Collection, Environment, data dump, curl command, or a RAML / WADL / Swagger(v1/v2) / Runscope file.
Import File
Import Folder
Import From Link
Paste Raw Text
https://www.getpostman.com/collections/ff0b20ed5f4d574f6fb5
Import

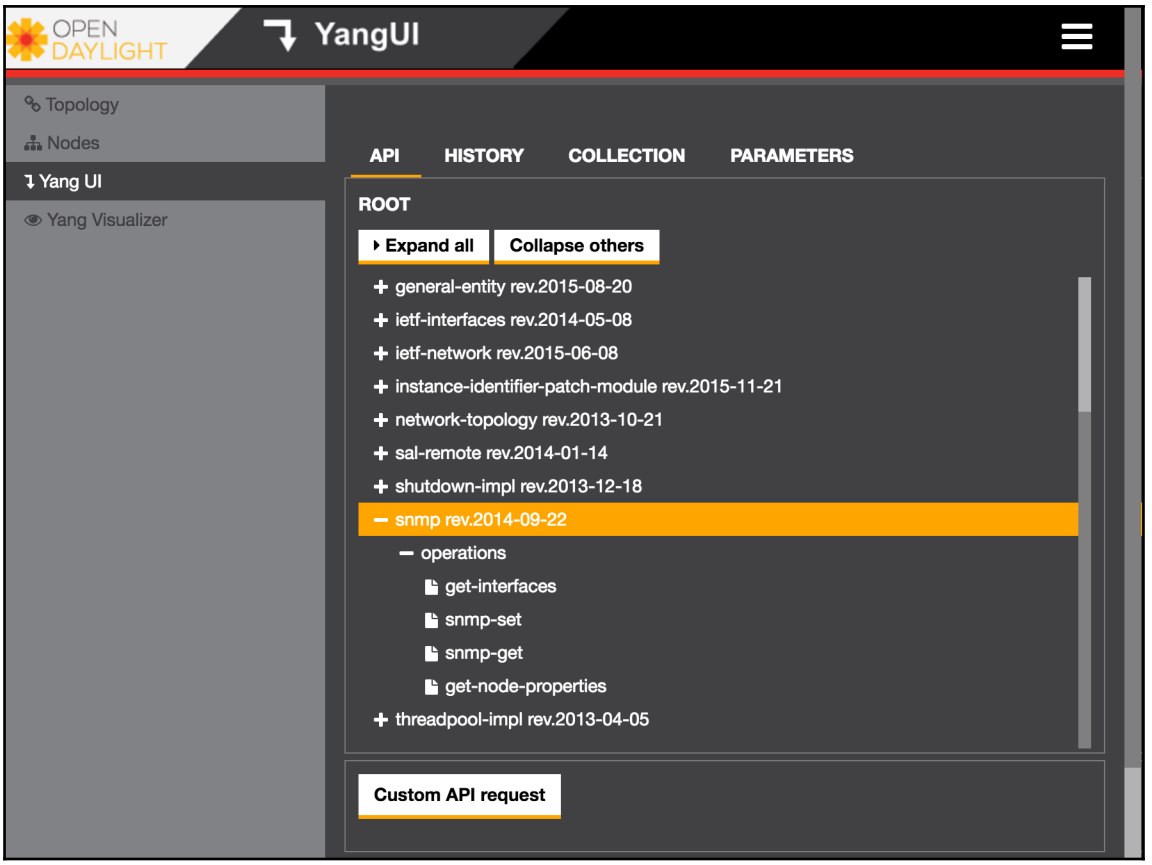

Runner
Import
Builder
Team Library
IN SYNC
Search
No environment
History
Collections
All
Me
Team
Params
Send
Save
Basic IOTDM CRUD Test
37 requests
Tests
Generate Code
POST
Test 0 CSE Provisioning
GET
Test 01 retrieves the CSEBase resou...
GET
retrieve defaultACP
POST
Test 02 AE registers to its registrar ...
GET
Test 03 AE application Retrieve Req...
PUT
Test 04 AE Update

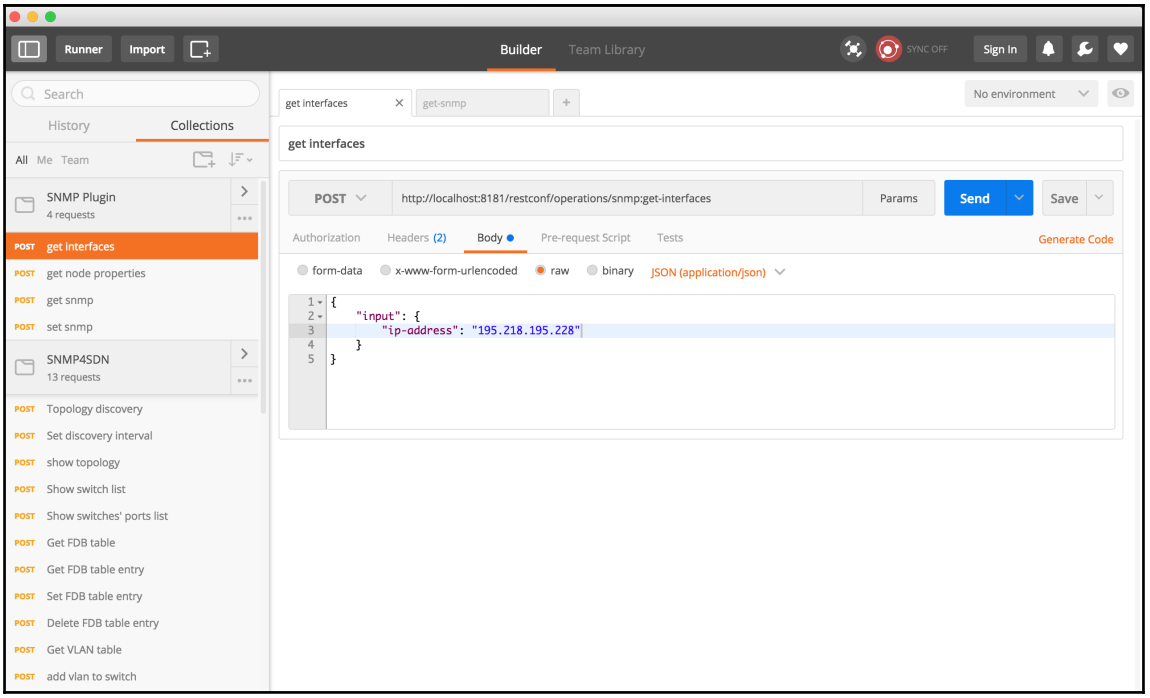

Runner
Import
Builder
Team Library
IN SYNC
New Tab
PCMM Sample Lo...
Manage Environments
Shared Environments
No Environment
PCMM Sample Local
GET
Enter request URL
Params
Authorization
Headers
Body
Pre-request Script
Tests
Type
No Auth

Chapter 3: Dynamic Interconnects

```
opendaylight-user@root>feature:list | grep snmp
odl-snmp4sdn-all                          | 0.3.1-Beryllium-SR1 |           | odl-snmp4sdn                          | OpenDaylight :: SNMP4SDN :: All

odl-snmp4sdn-snmp4sdn                     | 0.3.1-Beryllium-SR1 |           | odl-snmp4sdn                          | OpenDaylight :: SNMP4SDN :: Plugin

odl-tsdr-snmp-data-collector              | 1.1.1-Beryllium-SR1 |           | odl-tsdr-1.1.1-Beryllium-SR1          | OpenDaylight :: TSDR :: SNMP Data Collec
tor
odl-snmp-plugin                           | 1.1.1-Beryllium-SR1 | x         | odl-snmp-1.1.1-Beryllium-SR1          | OpenDaylight :: snmp-plugin :: SNMP
```

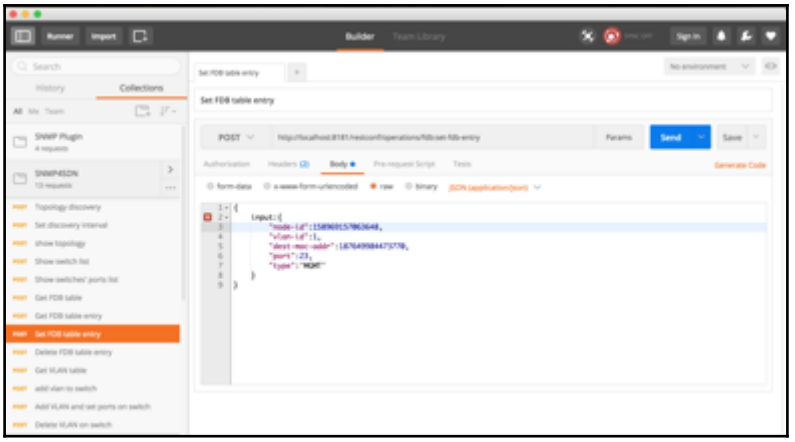
```
SNMP version 2c, Community name: public
Querying UDP/IPv4 agent at 195.218.195.228:161
Agent response timeout: 3.00 secs, retries: 3
Sending initial GETBULK request for 1.3.6 (stop at <end-of-mib>)....
1.3.6.1.2.1.1.1.0|4x|53756e4f53207a6575732e736e6d706c6162732e636f6d20342e312e335f553120312073756e346d
1.3.6.1.2.1.1.2.0|6|1.3.6.1.4.1.20408
1.3.6.1.2.1.1.3.0|67|150288885
1.3.6.1.2.1.1.4.0|4x|534e4d50204c61626f7261746f726965732c20696e666f40736e6d706c6162732e636f6d
1.3.6.1.2.1.1.5.0|4x|7a6575732e736e6d706c6162732e636f6d
1.3.6.1.2.1.1.6.0|4x|4d6f73636f772c20527573736961
1.3.6.1.2.1.1.7.0|2|72
1.3.6.1.2.1.1.8.0|67|150288886
1.3.6.1.2.1.1.9.1.2.1|6|1.3.6.1.4.1.20408.1.1
1.3.6.1.2.1.1.9.1.3.1|4x|4e6577207379737465 6d20646573637269707469 6f6e
1.3.6.1.2.1.1.9.1.4.1|67|12
1.3.6.1.2.1.2.2.1.1.1|2|1
1.3.6.1.2.1.2.2.1.1.2|2|2
1.3.6.1.2.1.2.2.1.2.1|4|eth0
1.3.6.1.2.1.2.2.1.2.2|4|eth1
1.3.6.1.2.1.2.2.1.3.1|2|6
1.3.6.1.2.1.2.2.1.3.2|2|6
1.3.6.1.2.1.2.2.1.4.1|2|1500
1.3.6.1.2.1.2.2.1.4.2|2|1500
1.3.6.1.2.1.2.2.1.5.1|66|100000000
1.3.6.1.2.1.2.2.1.5.2|66|100000000
1.3.6.1.2.1.2.2.1.6.1|4x|00127962f940
1.3.6.1.2.1.2.2.1.6.2|4x|00127962f941
1.3.6.1.2.1.2.2.1.7.1|2|1
```

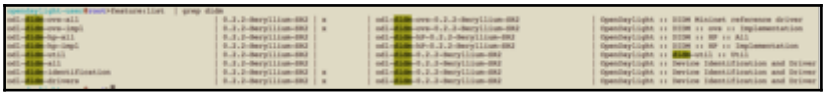

OPEN DAYLIGHT
YangUI
Topology
Nodes
Yang UI
Yang Visualizer
API
HISTORY
COLLECTION
PARAMETERS
ROOT
Expand all
Collapse others
general-entity rev.2015-08-20
ietf-interfaces rev.2014-05-08
ietf-network rev.2015-06-08
instance-identifier-patch-module rev.2015-11-21
network-topology rev.2013-10-21
sal-remote rev.2014-01-14
shutdown-impl rev.2013-12-18
snmp rev.2014-09-22
operations
get-interfaces
snmp-set
snmp-get
get-node-properties
threadpool-impl rev.2013-04-05
Custom API request

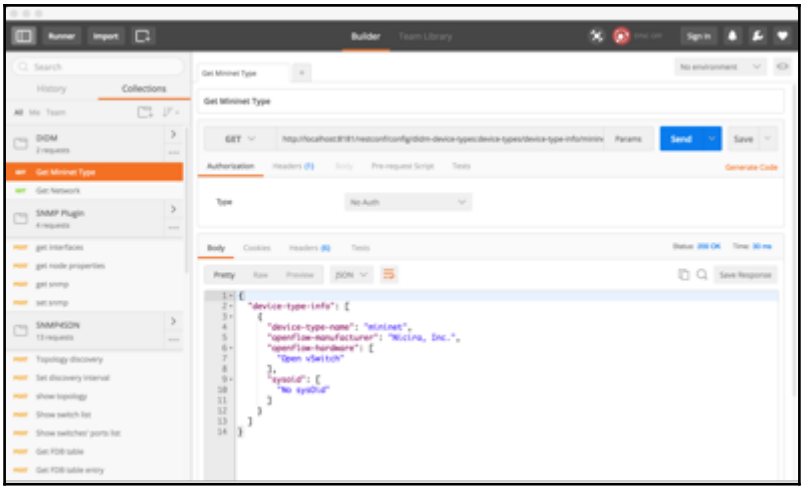



```
opendaylight-user@root>feature:list | grep snmp4sdn
odl-snmp4sdn-all                          | 0.3.2-Beryllium-SR2 | x        | odl-snmp4sdn                          | OpenDaylight :: SNMP4SDN :: All

odl-snmp4sdn-snmp4sdn                     | 0.3.2-Beryllium-SR2 | x        | odl-snmp4sdn                          | OpenDaylight :: SNMP4SDN :: Plugin

opendaylight-user@root>
```

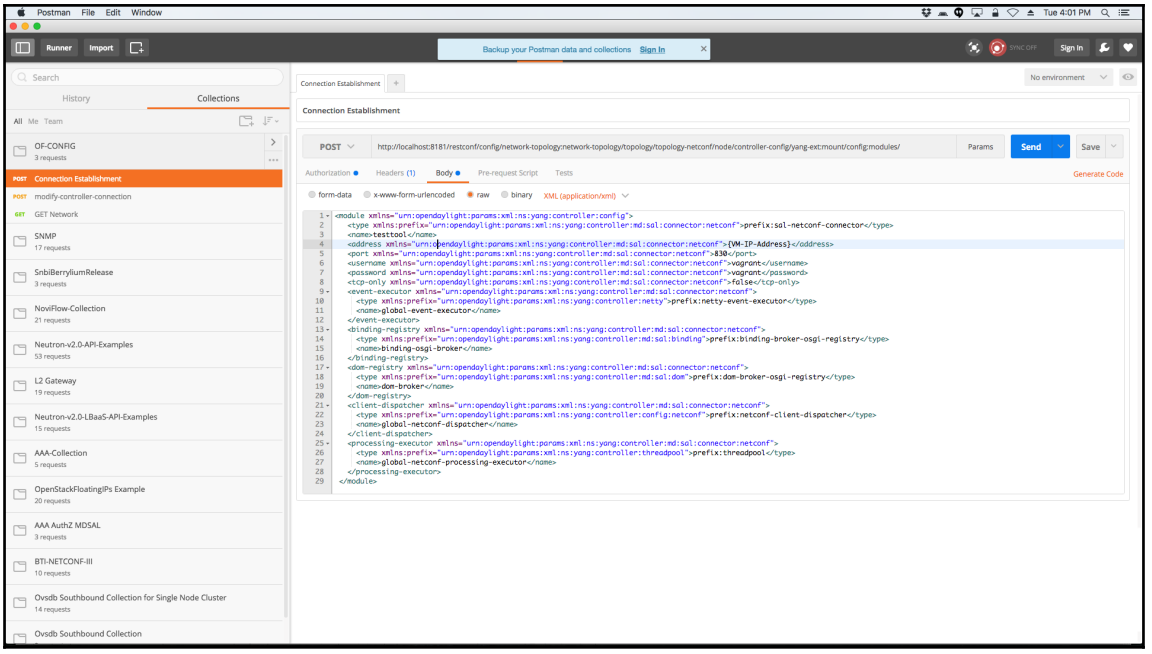
```
opendaylight-user@root>snmp4sdn:ReadDB etc/snmp4sdn_swdb.csv
MAC_address (sid)                                IP_address      SNMP_community  CLI_username    CLI_password    Model_name
=====================================================================
00:00:90:94:e4:23:13:e0 (158969157063648     )  192.168.0.32    private         admin           password        D-Link_DGS3650
00:00:90:94:e4:23:0b:00 (158969157061376     )  192.168.0.33    private         admin           password        D-Link_DGS3650
00:00:90:94:e4:23:0b:20 (158969157061408     )  192.168.0.34    private         admin           password        D-Link_DGS3650
```

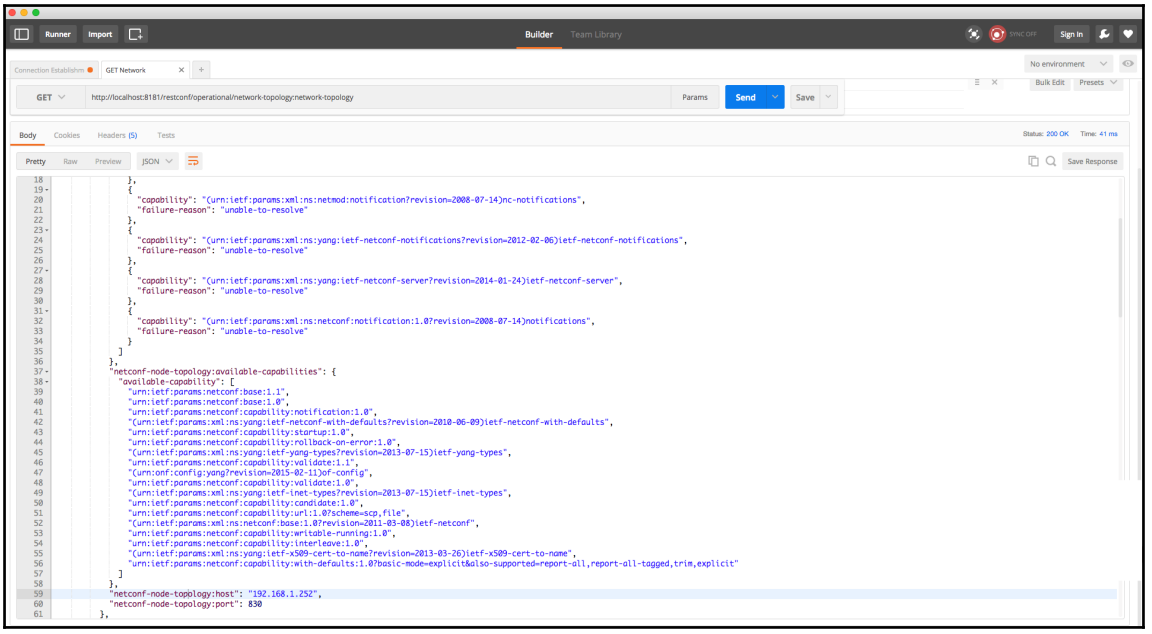


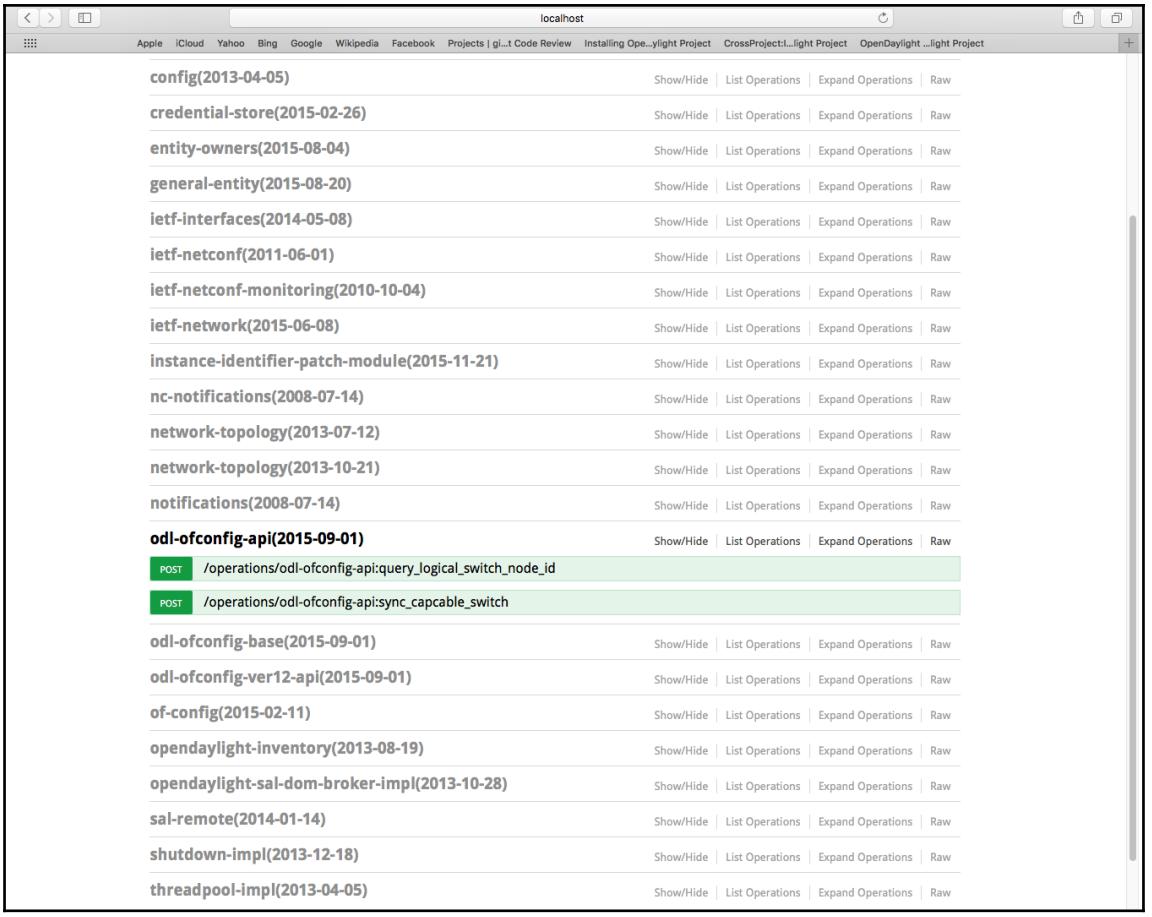




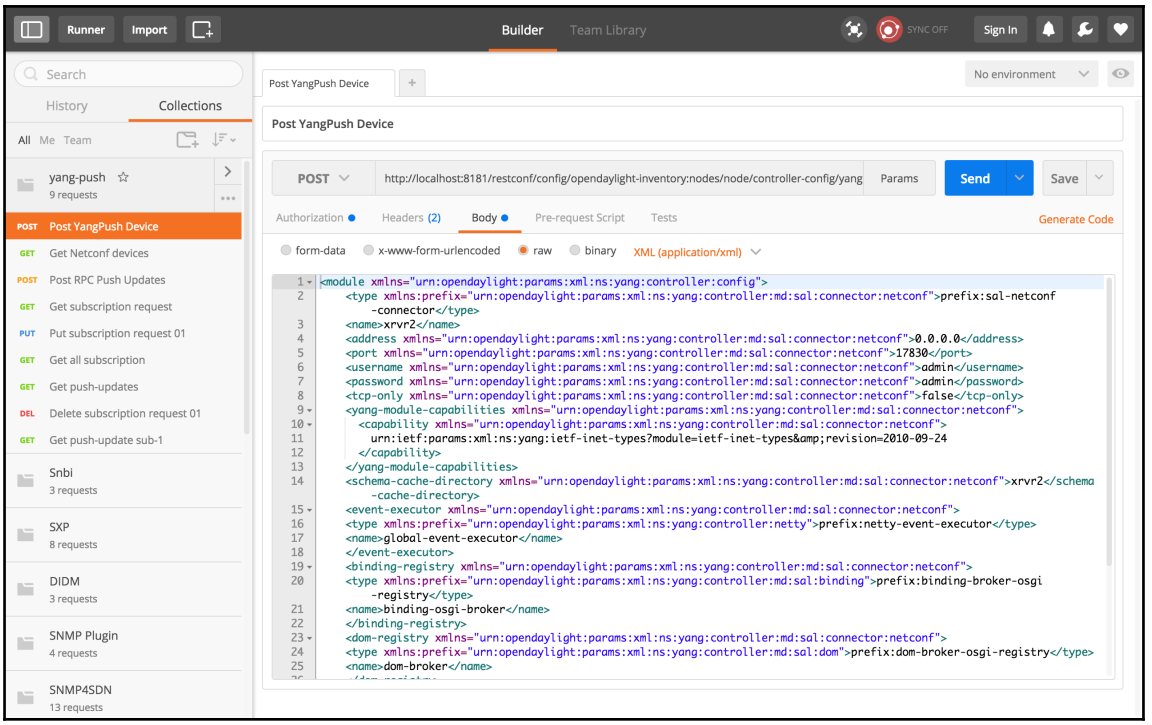
```
opendaylight-user@root>feature:list -i | grep of-config
odl-of-config-all                        | 1.0.1-Beryllium-SR1 | x         | odl-of-config-1.0.1-Beryllium-SR1            | OpenDaylight :: of-config :: ALL

odl-of-config-southbound-api             | 1.0.1-Beryllium-SR1 | x         | odl-of-config-southbound-1.0.1-Beryllium-SR1 | OpenDaylight :: of-config:: southbound :: api

odl-of-config-southbound-ofconfigmodels  | 1.0.1-Beryllium-SR1 | x         | odl-of-config-southbound-1.0.1-Beryllium-SR1 | OpenDaylight :: of-config:: southbound :: ofconfi
g
odl-of-config-southbound-all             | 1.0.1-Beryllium-SR1 | x         | odl-of-config-southbound-1.0.1-Beryllium-SR1 | OpenDaylight :: of-config:: southbound

odl-of-config-southbound-rest            | 1.0.1-Beryllium-SR1 | x         | odl-of-config-southbound-1.0.1-Beryllium-SR1 | OpenDaylight :: of-config:: southbound :: REST
```


Postman File Edit Window
Tue 4:01 PM
Runner
Import
Backup your Postman data and collections Sign In
Sign In
Search
History
Collections
All Me Team
OF-CONFIG
3 requests
POST Connection Establishment
POST modify-controller-connection
GET GET Network
SNMP
17 requests
SnbiBerryliumRelease
3 requests
NoviFlow-Collection
21 requests
Neutron-v2.0-API-Examples
53 requests
L2 Gateway
19 requests
Neutron-v2.0-LBaaS-API-Examples
15 requests
AAA-Collection
5 requests
OpenStackFloatingIPs Example
20 requests
AAA AuthZ MDSAL
3 requests
BTI-NETCONF-III
10 requests
Ovsdb Southbound Collection for Single Node Cluster
14 requests
Ovsdb Southbound Collection
Connection Establishment
No environment
Connection Establishment
POST
http://localhost:8181/restconf/config/network-topology:network-topology/topology/topology-netconf/node/controller-config/yang-ext:mount/config:modules/
Params
Send
Save
Authorization
Headers (1)
Body
Pre-request Script
Tests
Generate Code
form-data
x-www-form-urlencoded
raw
binary
XML (application/xml)
<module xmlns="urn:opendaylight:params:xml:ns:yang:controller:config">
<type xmlns:prefix="urn:opendaylight:params:xml:ns:yang:controller:md:sal:connector:netconf">prefix:sal-netconf-connector</type>
<name>testtool</name>
<address xmlns="urn:opendaylight:params:xml:ns:yang:controller:md:sal:connector:netconf">{VM-IP-Address}</address>
<port xmlns="urn:opendaylight:params:xml:ns:yang:controller:md:sal:connector:netconf">830</port>
<username xmlns="urn:opendaylight:params:xml:ns:yang:controller:md:sal:connector:netconf">vagrant</username>
<password xmlns="urn:opendaylight:params:xml:ns:yang:controller:md:sal:connector:netconf">vagrant</password>
<tcp-only xmlns="urn:opendaylight:params:xml:ns:yang:controller:md:sal:connector:netconf">false</tcp-only>
<event-executor xmlns="urn:opendaylight:params:xml:ns:yang:controller:md:sal:connector:netconf">
<type xmlns:prefix="urn:opendaylight:params:xml:ns:yang:controller:netty">prefix:netty-event-executor</type>
<name>global-event-executor</name>
</event-executor>
<binding-registry xmlns="urn:opendaylight:params:xml:ns:yang:controller:md:sal:connector:netconf">
<type xmlns:prefix="urn:opendaylight:params:xml:ns:yang:controller:md:sal:binding">prefix:binding-broker-osgi-registry</type>
<name>binding-osgi-broker</name>
</binding-registry>
<dom-registry xmlns="urn:opendaylight:params:xml:ns:yang:controller:md:sal:connector:netconf">
<type xmlns:prefix="urn:opendaylight:params:xml:ns:yang:controller:md:sal:dom">prefix:dom-broker-osgi-registry</type>
<name>dom-broker</name>
</dom-registry>
<client-dispatcher xmlns="urn:opendaylight:params:xml:ns:yang:controller:md:sal:connector:netconf">
<type xmlns:prefix="urn:opendaylight:params:xml:ns:yang:controller:config:netconf">prefix:netconf-client-dispatcher</type>
<name>global-netconf-dispatcher</name>
</client-dispatcher>
<processing-executor xmlns="urn:opendaylight:params:xml:ns:yang:controller:md:sal:connector:netconf">
<type xmlns:prefix="urn:opendaylight:params:xml:ns:yang:controller:threadpool">prefix:threadpool</type>
<name>global-netconf-processing-executor</name>
</processing-executor>
</module>


Runner
Import
Builder
Team Library
Sign In
Connection Establishm
GET Network
No environment
GET
http://localhost:8181/restconf/operational/network-topology:network-topology
Params
Send
Save
Bulk Edit
Presets
Body
Cookies
Headers (5)
Tests
Status: 200 OK
Time: 41 ms
Pretty
Raw
Preview
JSON
Save Response
},
{
"capability": "(urn:ietf:params:xml:ns:netmod:notification?revision=2008-07-14)nc-notifications",
"failure-reason": "unable-to-resolve"
},
{
"capability": "(urn:ietf:params:xml:ns:yang:ietf-netconf-notifications?revision=2012-02-06)ietf-netconf-notifications",
"failure-reason": "unable-to-resolve"
},
{
"capability": "(urn:ietf:params:xml:ns:yang:ietf-netconf-server?revision=2014-01-24)ietf-netconf-server",
"failure-reason": "unable-to-resolve"
},
{
"capability": "(urn:ietf:params:xml:ns:netconf:notification:1.0?revision=2008-07-14)notifications",
"failure-reason": "unable-to-resolve"
}
]
},
"netconf-node-topology:available-capabilities": {
"available-capability": [
"urn:ietf:params:netconf:base:1.1",
"urn:ietf:params:netconf:base:1.0",
"urn:ietf:params:netconf:capability:notification:1.0",
"(urn:ietf:params:xml:ns:yang:ietf-netconf-with-defaults?revision=2018-06-09)ietf-netconf-with-defaults",
"urn:ietf:params:netconf:capability:startup:1.0",
"urn:ietf:params:netconf:capability:rollback-on-error:1.0",
"(urn:ietf:params:xml:ns:yang:ietf-yang-types?revision=2013-07-15)ietf-yang-types",
"urn:ietf:params:netconf:capability:validate:1.1",
"(urn:onf:config:yang?revision=2015-02-11)onf-config",
"urn:ietf:params:netconf:capability:validate:1.0",
"(urn:ietf:params:xml:ns:yang:ietf-inet-types?revision=2013-07-15)ietf-inet-types",
"urn:ietf:params:netconf:capability:candidate:1.0",
"urn:ietf:params:netconf:capability:url:1.0?scheme=scp,file",
"(urn:ietf:params:xml:ns:netconf:base:1.0?revision=2011-03-08)ietf-netconf",
"urn:ietf:params:netconf:capability:writable-running:1.0",
"urn:ietf:params:netconf:capability:interleave:1.0",
"(urn:ietf:params:xml:ns:yang:ietf-x509-cert-to-name?revision=2013-03-26)ietf-x509-cert-to-name",
"urn:ietf:params:netconf:capability:with-defaults:1.0?basic-mode=explicit&also-supported=report-all,report-all-tagged,trim,explicit"
]
},
"netconf-node-topology:host": "192.168.1.252",
"netconf-node-topology:port": 830
},




```
opendaylight-user@root>feature:list -i | grep yangpush
odl-yangpush-api                | 1.0.2-Beryllium-SR2 | x         | odl-yangpush-1.0.2-Beryllium-SR2          | OpenDaylight :: yangpush :: api
odl-yangpush                    | 1.0.2-Beryllium-SR2 | x         | odl-yangpush-1.0.2-Beryllium-SR2          | OpenDaylight :: yangpush
odl-yangpush-rest               | 1.0.2-Beryllium-SR2 | x         | odl-yangpush-1.0.2-Beryllium-SR2          | OpenDaylight :: yangpush :: REST
odl-yangpush-ui                 | 1.0.2-Beryllium-SR2 | x         | odl-yangpush-1.0.2-Beryllium-SR2          | OpenDaylight :: yangpush :: UI
```



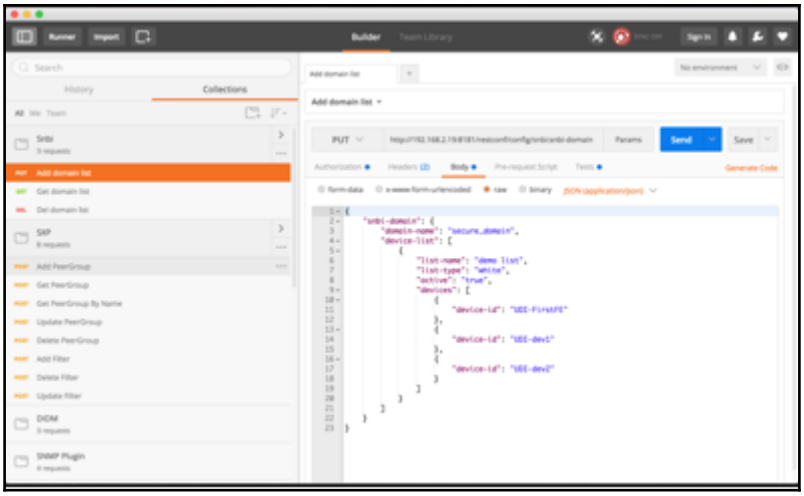

```
19:09:30.220 [nioEventLoopGroup-2-3] DEBUG o.o.p.f.AbstractProtocolSession - Message was received: <rpc xmlns="urn:
ietf:params:xml:ns:netconf:base:1.0" message-id="m-0">
<create-subscription xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0">
<stream>push-update</stream>
<filter type="subtree">
<interface-configurations xmlns="http://cisco.com/ns/yang/Cisco-IOS-XR-ifmgr-cfg"/>
</filter>
<period xmlns="urn:opendaylight:params:xml:ns:yang:yangpush">60</period>
<subscription-id xmlns="urn:opendaylight:params:xml:ns:yang:yangpush">sub-2</subscription-id>
</create-subscription>
</rpc>
```

```
Mohameds-MacBook-Pro:SnbiODL-VM mohamedel-serngawy$ vagrant status
Current machine states:

snbiODL-vm                running (virtualbox)
snbi1-vm                  running (virtualbox)
snbi2-vm                  running (virtualbox)
```

```
opendaylight-user@root>feature:list -i | grep snbi
odl-snbi-all                    | 1.2.2-Beryllium-SR2 | x         | odl-snbi-1.2.2-Beryllium-SR2          | OpenDaylight :: snbi :: All

odl-snbi-southplugin            | 1.2.2-Beryllium-SR2 | x         | odl-snbi-1.2.2-Beryllium-SR2          | OpenDaylight :: SNBI :: SouthPlugin

odl-snbi-shellplugin            | 1.2.2-Beryllium-SR2 | x         | odl-snbi-1.2.2-Beryllium-SR2          | OpenDaylight :: SNBI :: ShellPlugin

odl-snbi-dlux                   | 1.2.2-Beryllium-SR2 | x         | odl-snbi-1.2.2-Beryllium-SR2          | OpenDaylight :: SNBI :: Dlux
```

```
vagrant@snbi-vm:~$ sudo ip6tables --list
Chain INPUT (policy ACCEPT)
target     prot opt source               destination
DROP       udp      anywhere             anywhere             udp dpt:4936

Chain FORWARD (policy ACCEPT)
target     prot opt source               destination

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination
```

```
snbi-ra   Link encap:Ethernet  HWaddr 0e:22:f7:22:cf:0b
          inet6 addr: fd08::aaaa:bbbb:1/128 Scope:Global
          inet6 addr: fe80::c22:f7ff:fe22:cf0b/64 Scope:Link
          UP BROADCAST RUNNING NOARP  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:3 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:210 (210.0 B)
```

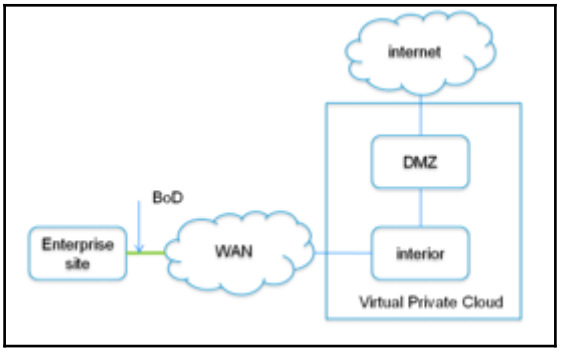


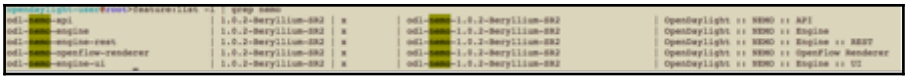

```
opendaylight-user@root>snbi:start secure_domain
Starting SNBI for domain:secure_domain
```

```
snbi.d >   ure   show snbi device

              Device UDI                - UDI-FirstFE
              Device ID                 - 0e22.f722.cf0b-1
              Domain ID                 - secure_domain
              Domain Certificate        - (subs) /name=0e22.f722.cf0b-1/CN=0e22.f722.cf0b-1/OU=secure_domain/serialNumber=UDI-FirstFE
              Certificate Serial Number - 015569900671
              Device Address            - fd02:a8f9:890b:0:e22:f722:cf0b:1
              Domain Cert is Valid
```

```
fd02:a8f9:890b:0:e22:f722:cf0b:1 dev snbi-fe  proto kernel  metric 256
fd02:a8f9:890b:0:e22:f722:cf0b:3 via fe80::e9f:33f9:83b:2 dev snbi_tun_2  metric 1024
fd08::aaaa:bbbb:1 dev snbi-ra  proto kernel  metric 256
unreachable fd00::/8 dev lo  metric 1024  error -113
fe80::/64 dev eth0  proto kernel  metric 256
fe80::/64 dev eth1  proto kernel  metric 256
fe80::/64 dev snbi-ra  proto kernel  metric 256
fe80::/64 dev snbi-fe  proto kernel  metric 256
fe80::/64 dev snbi_tun_2  proto kernel  metric 256
fe80::/64 dev snbi_tun_3  proto kernel  metric 256
```

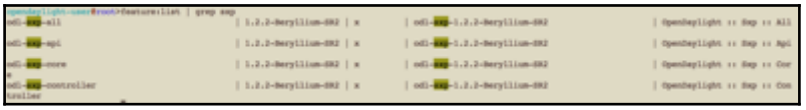
```
PING fd02:a8f9:890b:0:e22:f722:cf0b:1(fd02:a8f9:890b:0:e22:f722:cf0b:1) 56 data bytes
64 bytes from fd02:a8f9:890b:0:e22:f722:cf0b:1: icmp_seq=1 ttl=64 time=0.071 ms
64 bytes from fd02:a8f9:890b:0:e22:f722:cf0b:1: icmp_seq=2 ttl=64 time=0.037 ms
64 bytes from fd02:a8f9:890b:0:e22:f722:cf0b:1: icmp_seq=3 ttl=64 time=0.037 ms
64 bytes from fd02:a8f9:890b:0:e22:f722:cf0b:1: icmp_seq=4 ttl=64 time=0.040 ms
64 bytes from fd02:a8f9:890b:0:e22:f722:cf0b:1: icmp_seq=5 ttl=64 time=0.040 ms
64 bytes from fd02:a8f9:890b:0:e22:f722:cf0b:1: icmp_seq=6 ttl=64 time=0.041 ms
64 bytes from fd02:a8f9:890b:0:e22:f722:cf0b:1: icmp_seq=7 ttl=64 time=0.040 ms
```

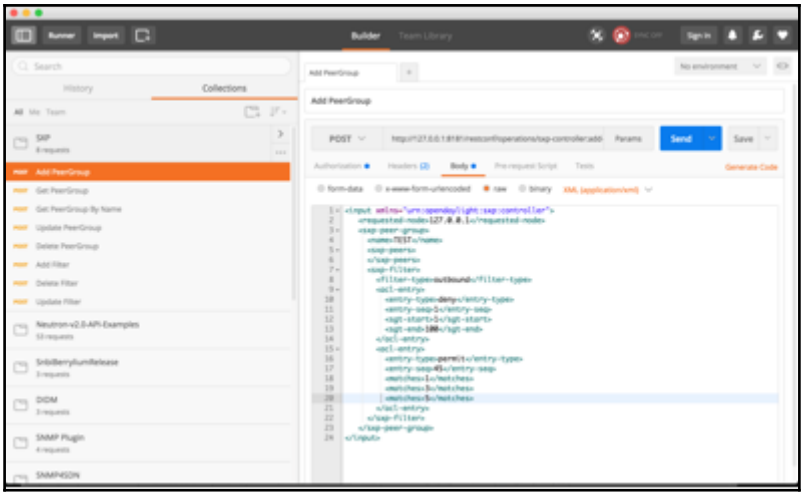


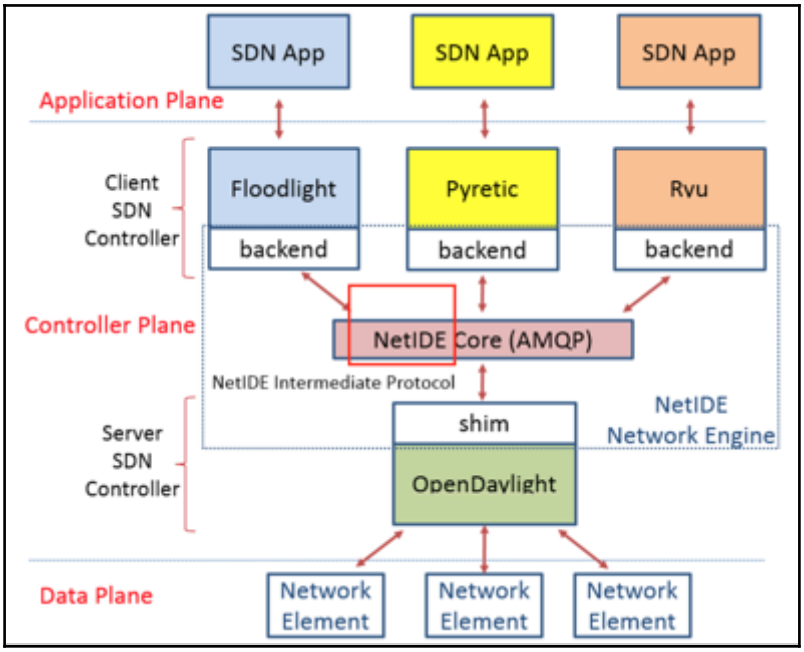


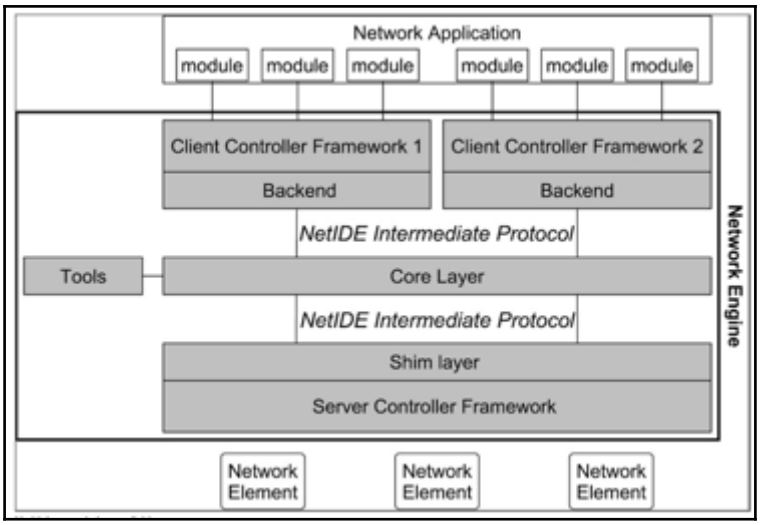
Nemo
Hello Admin! Logout
Tenant: user2
Query
Physical Network
NEMO Intent
Virtual Network
VN-PN Mapping
Physical Node
Physical Node ID
Physical Node Type
Internal Physical Port Number
External Physical Port Number

Nemo
Hello Admin! Logout
Tenant: user2
Query
Physical Network
NEMO Intent
Virtual Network
VN-PN Mapping
NEMO Language

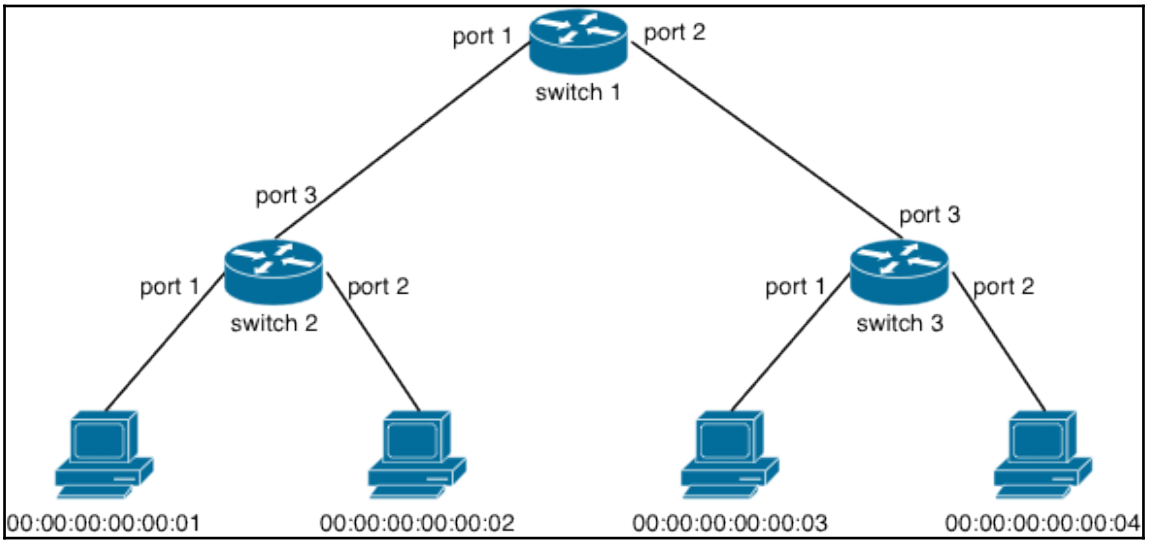

odl-nemo-all | 1.2.2-Beryllium-SR2 | x | odl-nemo-1.2.2-Beryllium-SR2 | OpenDaylight :: Nemo :: All
odl-nemo-api | 1.2.2-Beryllium-SR2 | x | odl-nemo-1.2.2-Beryllium-SR2 | OpenDaylight :: Nemo :: Api
odl-nemo-core | 1.2.2-Beryllium-SR2 | x | odl-nemo-1.2.2-Beryllium-SR2 | OpenDaylight :: Nemo :: Cor
e
odl-nemo-controller | 1.2.2-Beryllium-SR2 | x | odl-nemo-1.2.2-Beryllium-SR2 | OpenDaylight :: Nemo :: Con
troller



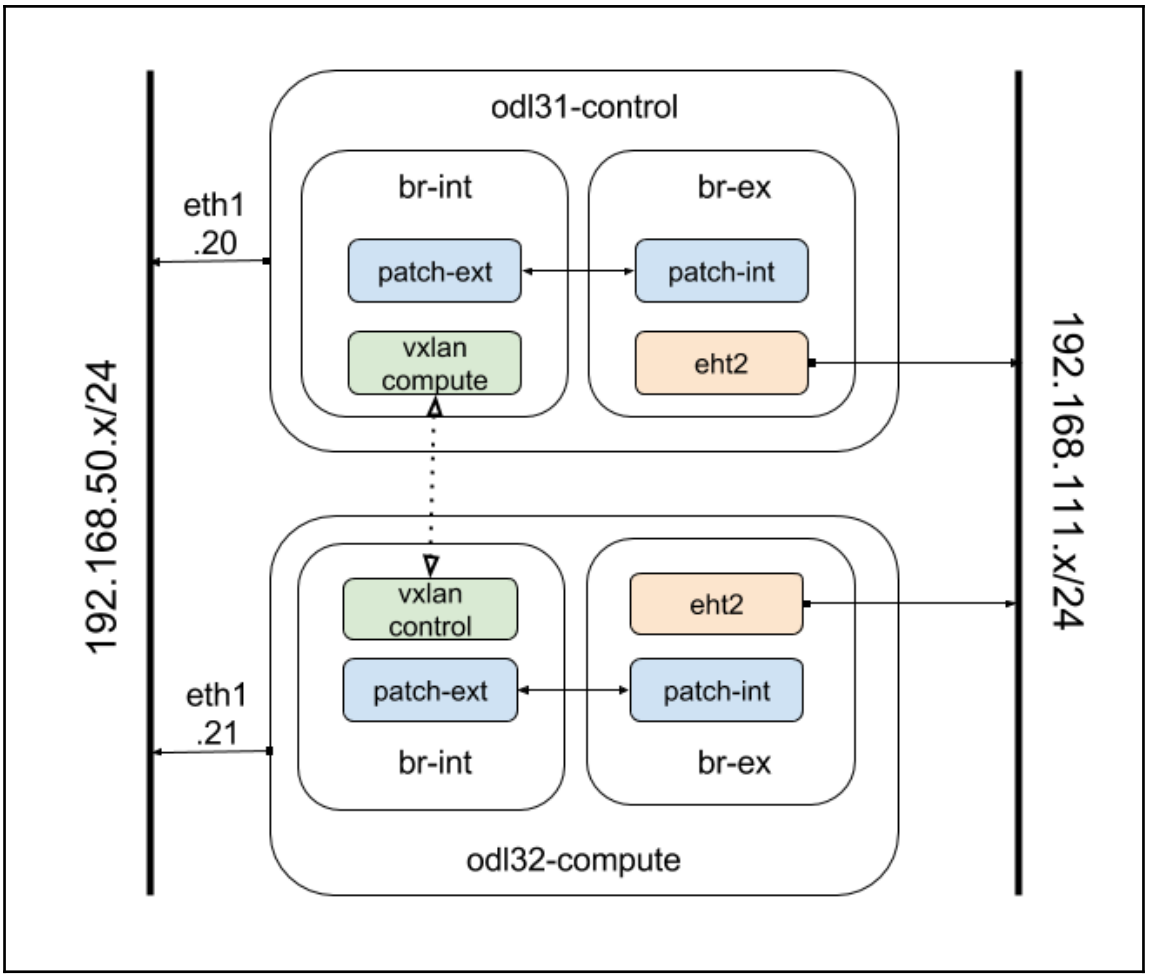

SDN App
SDN App
SDN App
Application Plane
Client
SDN
Controller
Floodlight
Pyretic
Rvu
backend
backend
backend
Controller Plane
NetIDE Core (AMQP)
NetIDE Intermediate Protocol
NetIDE
Network Engine
shim
Server
SDN
Controller
OpenDaylight
Data Plane
Network
Element
Network
Element
Network
Element


Network Application
module
module
module
module
module
module
Client Controller Framework 1
Client Controller Framework 2
Backend
Backend
NetIDE Intermediate Protocol
Tools
Core Layer
NetIDE Intermediate Protocol
Shim layer
Server Controller Framework
Network Engine
Network Element
Network Element
Network Element

Chapter 4: Network Virtualization




```
opendaylight-user@root>web:list
ID  | State       | Web-State    | Level | Web-ContextPath           | Name
-----------------------------------------------------------------------------------------------------------------
220 | Active      | Deployed     | 80    | /oauth2                   | aaa-authn-sts (0.3.2.Beryllium-SR2)
226 | Active      | Failed       | 80    | /auth                     | aaa-idmlight (0.3.2.Beryllium-SR2)
234 | Active      | Deployed     | 80    | /oauth2/federation        | aaa-authn-federation (0.3.2.Beryllium-SR2)
237 | Active      | Deployed     | 80    | /controller/nb/v2/neutron | org.opendaylight.neutron.northbound-api (0.6.2.Beryllium-SR2)
opendaylight-user@root>
```


odl31-control
br-int
br-ex
patch-ext
patch-int
vxlan
compute
eht2
eth1
.20
192.168.50.x/24
192.168.111.x/24
vxlan
control
eht2
patch-ext
patch-int
eth1
.21
br-int
br-ex
odl32-compute

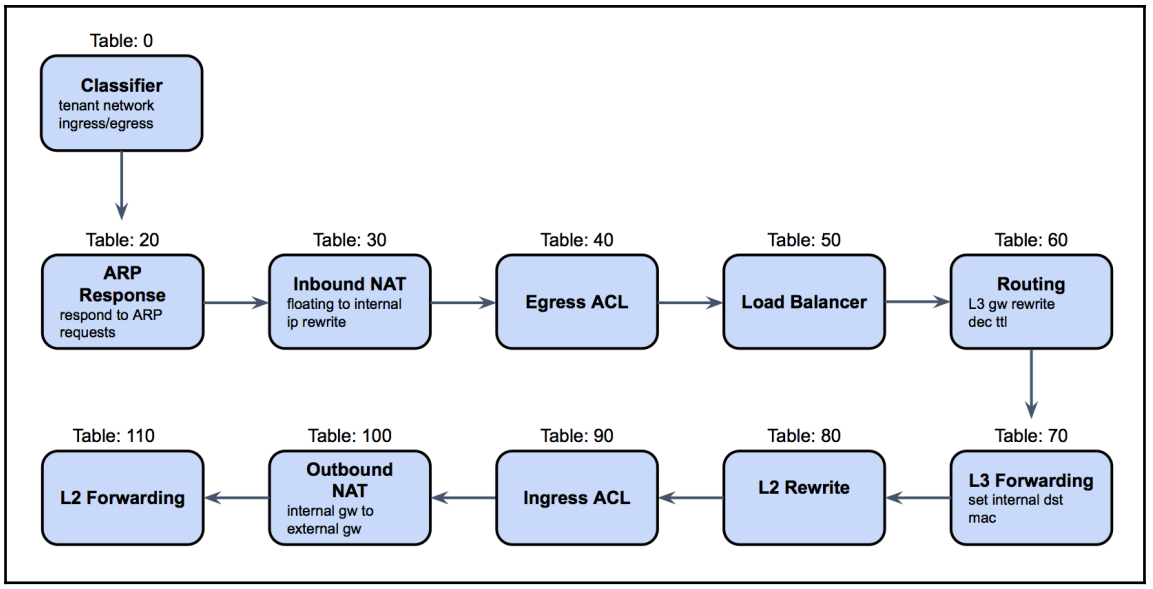
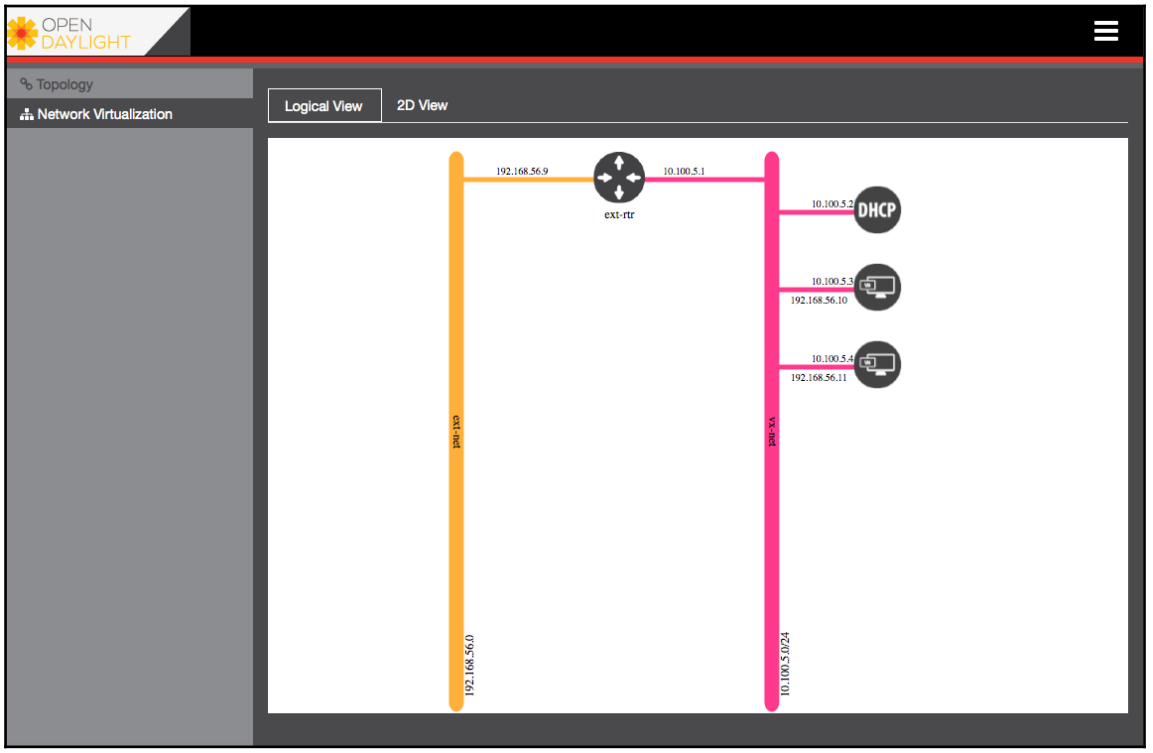
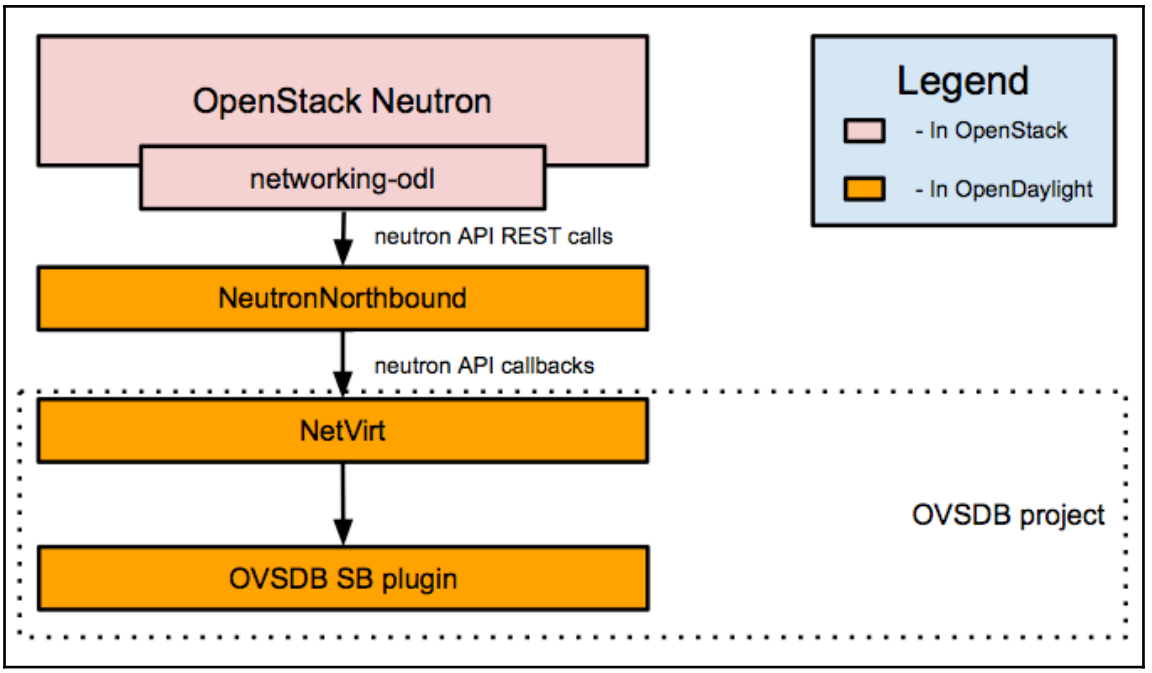
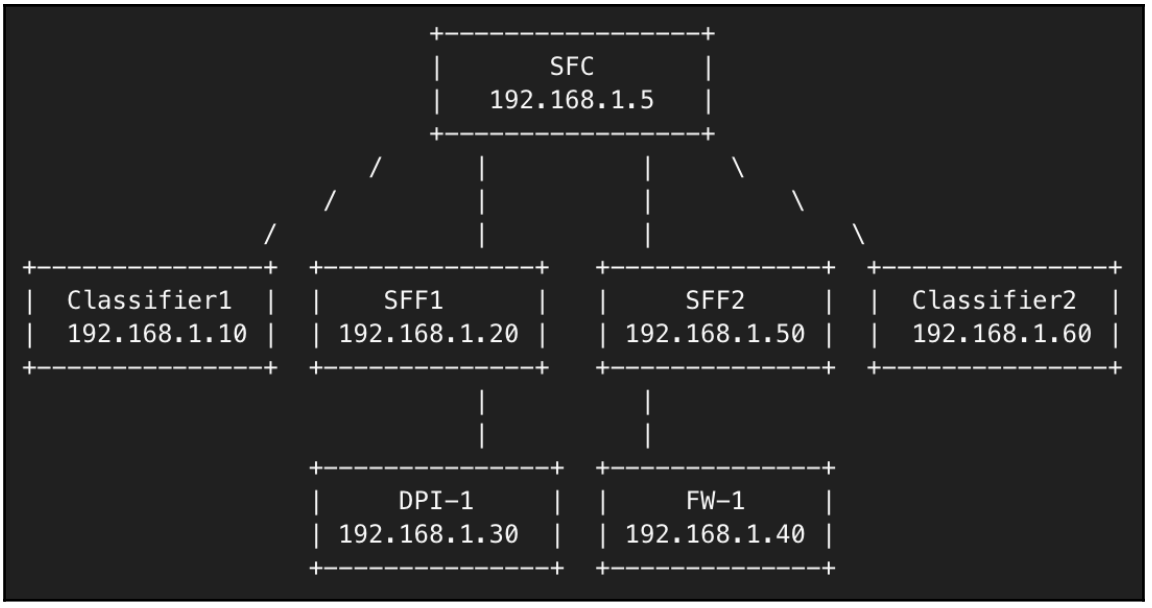
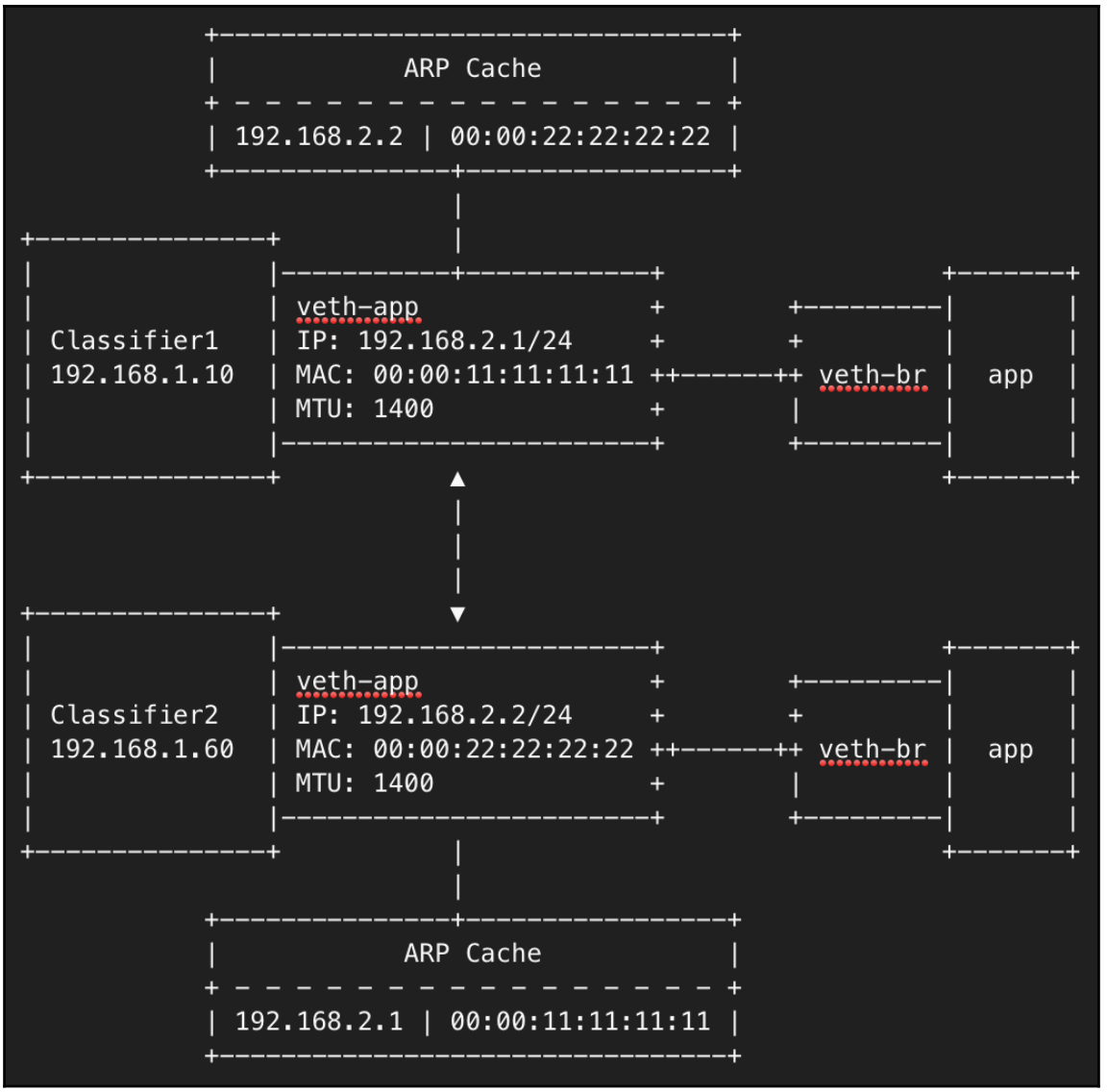


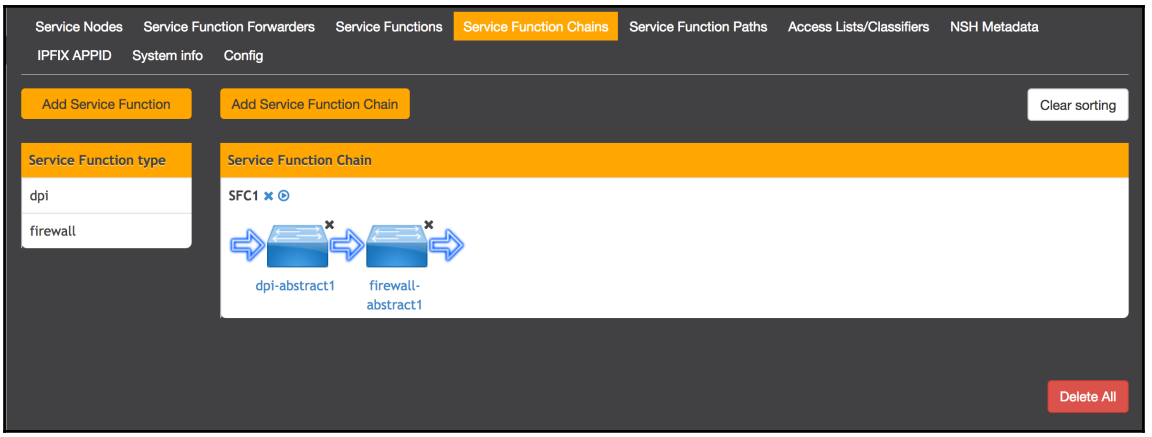
Table: 0
Classifier
tenant network
ingress/egress
Table: 20
ARP Response
respond to ARP requests
Table: 30
Inbound NAT
floating to internal ip rewrite
Table: 40
Egress ACL
Table: 50
Load Balancer
Table: 60
Routing
L3 gw rewrite
dec ttl
Table: 70
L3 Forwarding
set internal dst mac
Table: 80
L2 Rewrite
Table: 90
Ingress ACL
Table: 100
Outbound NAT
internal gw to external gw
Table: 110
L2 Forwarding

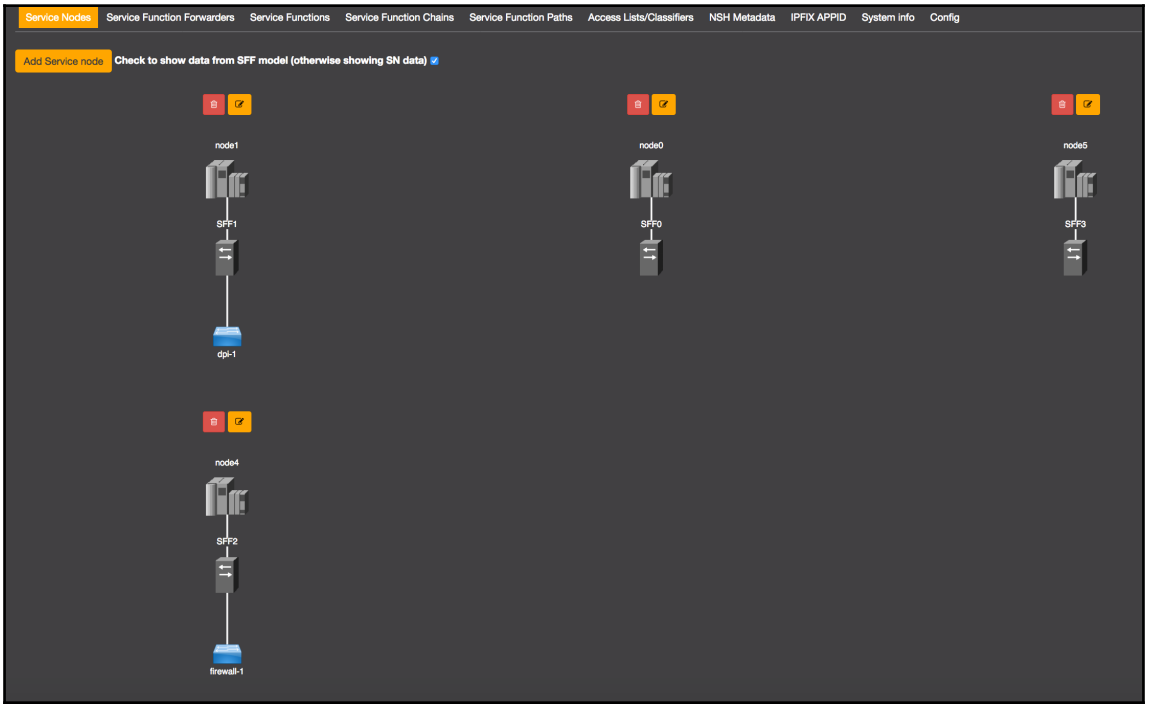

OPEN DAYLIGHT
Topology
Network Virtualization
Logical View
2D View
192.168.56.9
ext-rtr
10.100.5.1
10.100.5.2
DHCP
10.100.5.3
192.168.56.10
10.100.5.4
192.168.56.11
ext-net
192.168.56.0
vx-net
10.100.5.0/24


OpenStack Neutron
networking-odl
neutron API REST calls
NeutronNorthbound
neutron API callbacks
NetVirt
OVSDB SB plugin
OVSDB project
Legend
- In OpenStack
- In OpenDaylight


SFC
192.168.1.5
Classifier1
192.168.1.10
SFF1
192.168.1.20
SFF2
192.168.1.50
Classifier2
192.168.1.60
DPI-1
192.168.1.30
FW-1
192.168.1.40

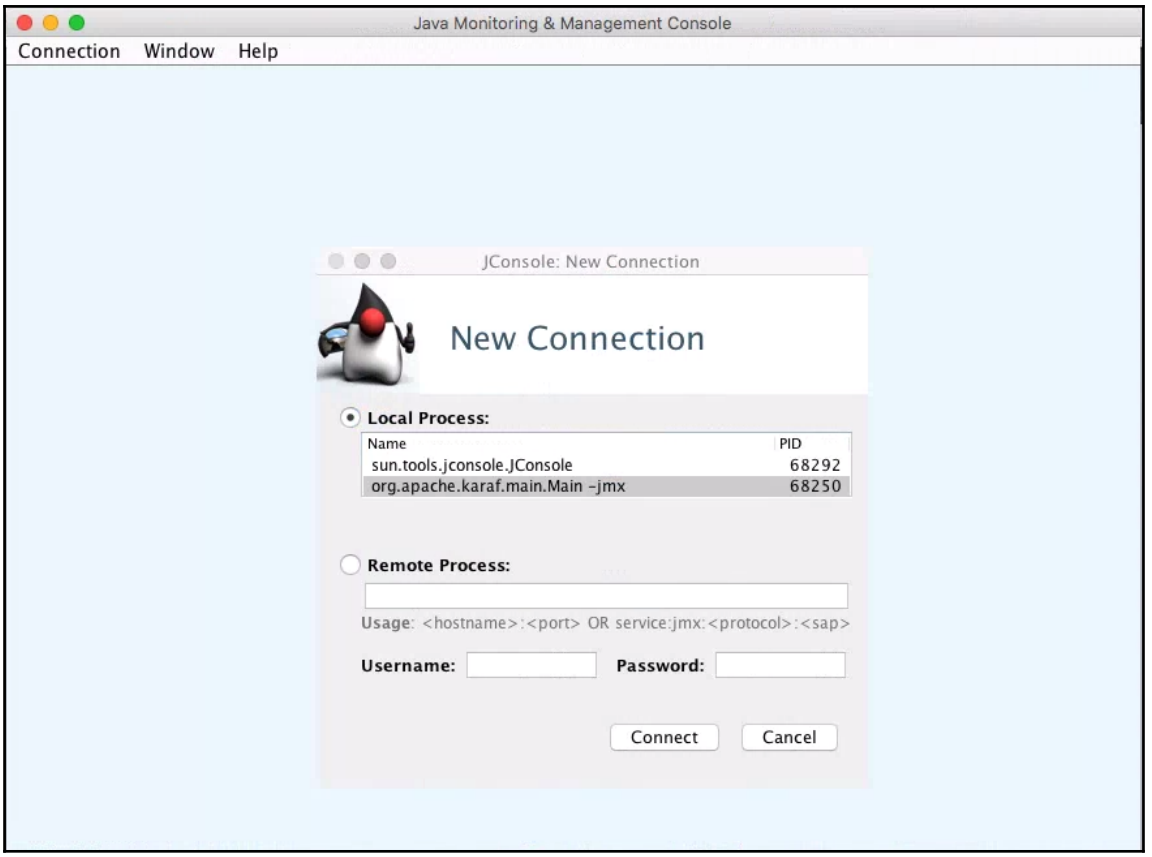

ARP Cache
192.168.2.2 | 00:00:22:22:22:22
Classifier1
192.168.1.10
veth-app
IP: 192.168.2.1/24
MAC: 00:00:11:11:11:11
MTU: 1400
veth-br
app
Classifier2
192.168.1.60
veth-app
IP: 192.168.2.2/24
MAC: 00:00:22:22:22:22
MTU: 1400
veth-br
app
ARP Cache
192.168.2.1 | 00:00:11:11:11:11

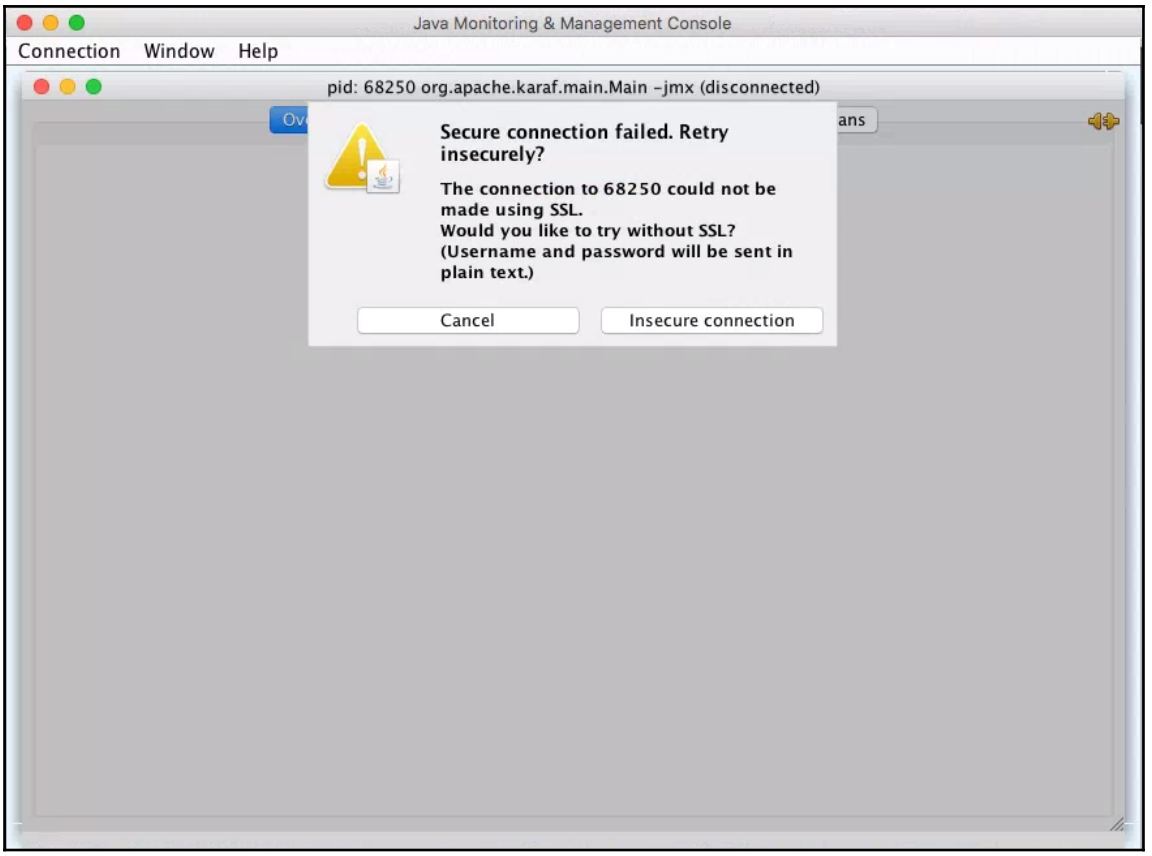

Service Nodes
Service Function Forwarders
Service Functions
Service Function Chains
Service Function Paths
Access Lists/Classifiers
NSH Metadata
IPFIX APPID
System info
Config
Add Service Function
Add Service Function Chain
Clear sorting
Service Function type
dpi
firewall
Service Function Chain
SFC1
dpi-abstract1
firewall-abstract1
Delete All

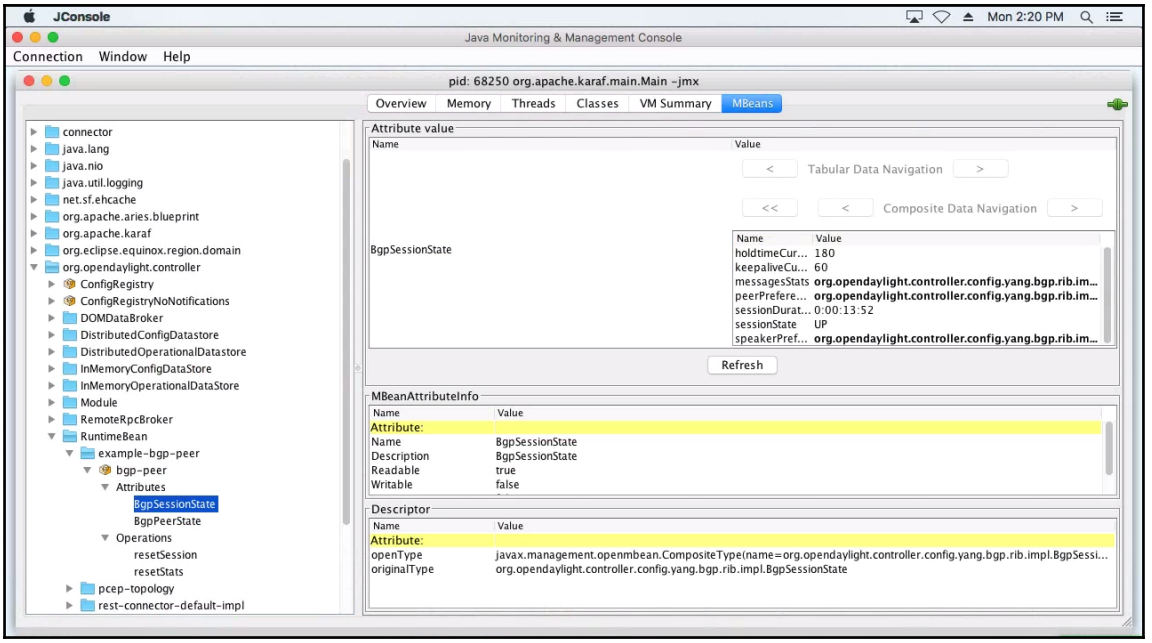

Service Nodes
Service Function Forwarders
Service Functions
Service Function Chains
Service Function Paths
Access Lists/Classifiers
NSH Metadata
IPFIX APPID
System info
Config
Add Service node
Check to show data from SFF model (otherwise showing SN data)
node1
SFF1
dpi-1
node0
SFF0
node5
SFF3
node4
SFF2
firewall-1

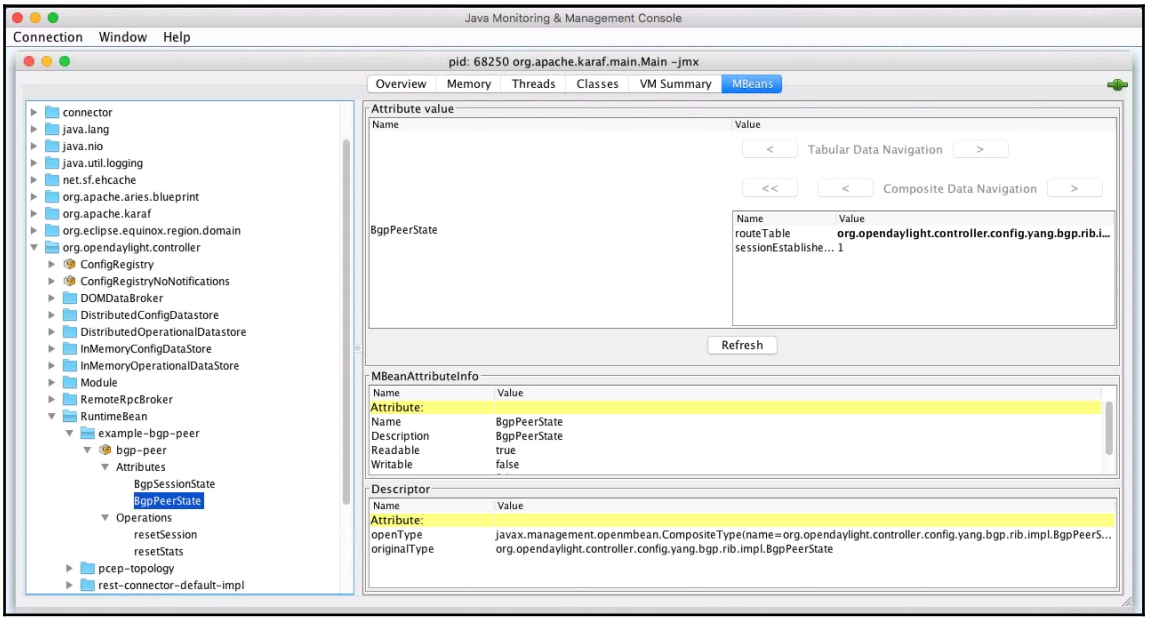
Chapter 5: Virtual Core and Aggregation

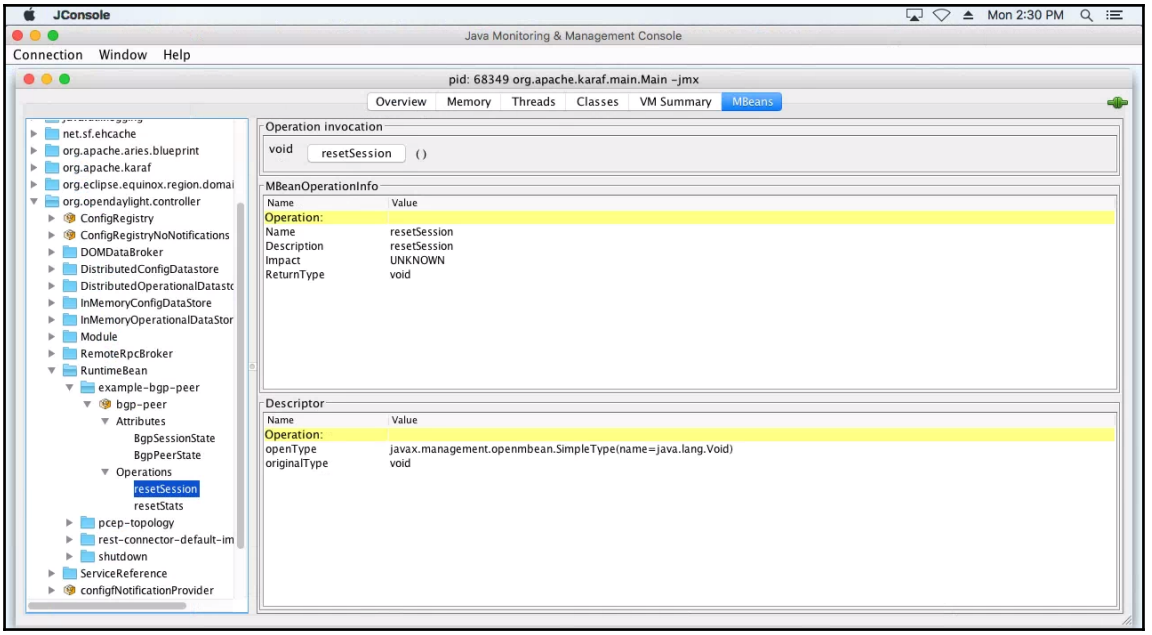
```
06:11:52.119 [main] INFO  o.o.t.jni.NativeKeyAccessFactory - Library /tmp/libt
cpmd5-jni.so2285157135999201656.tmp loaded
06:11:52.332 [nioEventLoopGroup-2-1] INFO  o.o.p.p.impl.PCEPSessionNegotiator
- Replacing bootstrap negotiator for channel [id: 0xba788ebc, L:/192.168.1.208
:54663 - R:/192.168.1.102:4189]
06:11:52.478 [nioEventLoopGroup-2-1] INFO  o.o.p.p.i.AbstractPCEPSessionNegoti
ator - PCEP session with [id: 0xba788ebc, L:/192.168.1.208:54663 - R:/192.168.
1.102:4189] started, sent proposal Open [_deadTimer=120, _keepalive=30, _sessi
onId=0, _tlvs=Tlvs [augmentation=[Tlvs1 [_stateful=Stateful [_lspUpdateCapabil
ity=true, augmentation=[Stateful1 [_deltaLspSyncCapability=true, _includeDbVer
sion=true, _triggeredInitialSync=true, _triggeredResync=true], Stateful1 [_ini
tiation=true]]]], Tlvs3 [_lspDbVersion=LspDbVersion [_lspDbVersionValue=1, aug
mentation=[]]]]], augmentation=[]]
06:11:52.756 [nioEventLoopGroup-2-1] INFO  o.o.p.p.i.AbstractPCEPSessionNegoti
ator - PCEP peer [id: 0xba788ebc, L:/192.168.1.208:54663 - R:/192.168.1.102:41
89] completed negotiation
06:11:52.761 [nioEventLoopGroup-2-1] INFO  o.o.p.pcep.impl.PCEPSessionImpl - S
ession /192.168.1.208:54663[0] <-> /192.168.1.102:4189[0] started
```

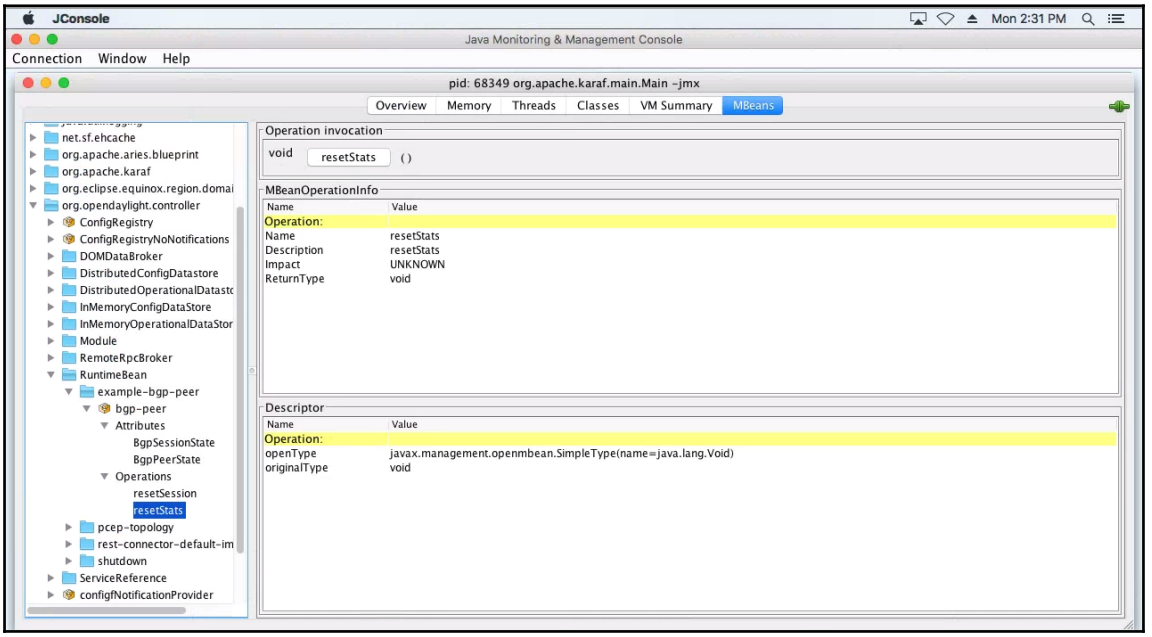

Java Monitoring & Management Console
Connection
Window
Help
JConsole: New Connection
New Connection
Local Process:
Name
PID
sun.tools.jconsole.JConsole
68292
org.apache.karaf.main.Main -jmx
68250
Remote Process:
Usage: <hostname>:<port> OR service:jmx:<protocol>:<sap>
Username:
Password:
Connect
Cancel

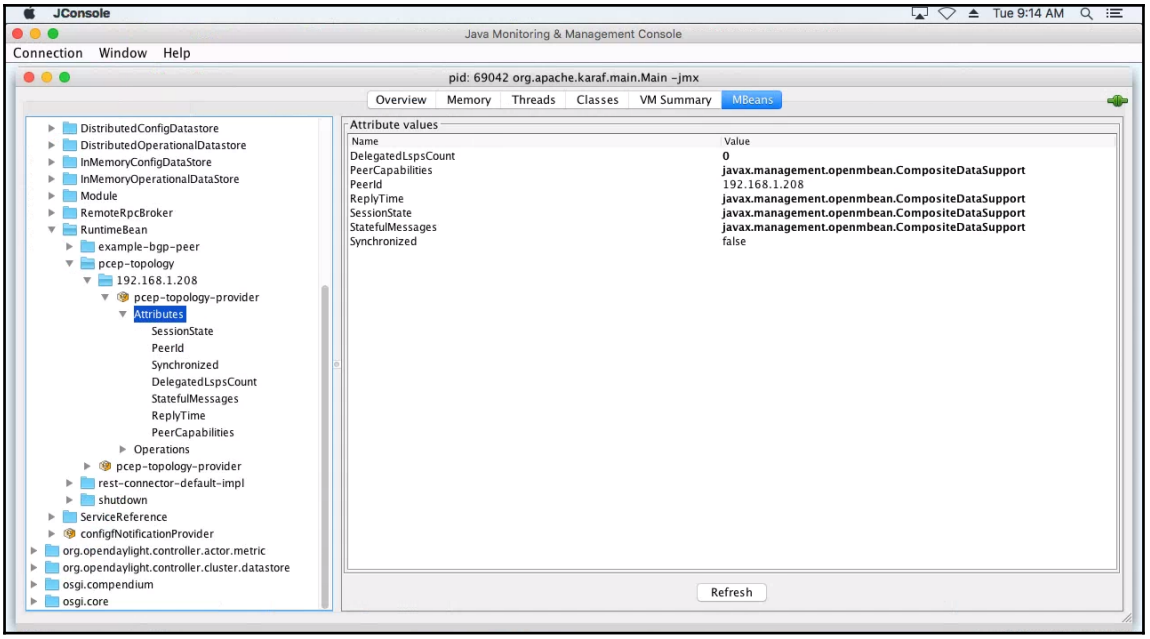

Java Monitoring & Management Console
Connection
Window
Help
pid: 68250 org.apache.karaf.main.Main -jmx (disconnected)
Secure connection failed. Retry insecurely?
The connection to 68250 could not be made using SSL.
Would you like to try without SSL?
(Username and password will be sent in plain text.)
Cancel
Insecure connection

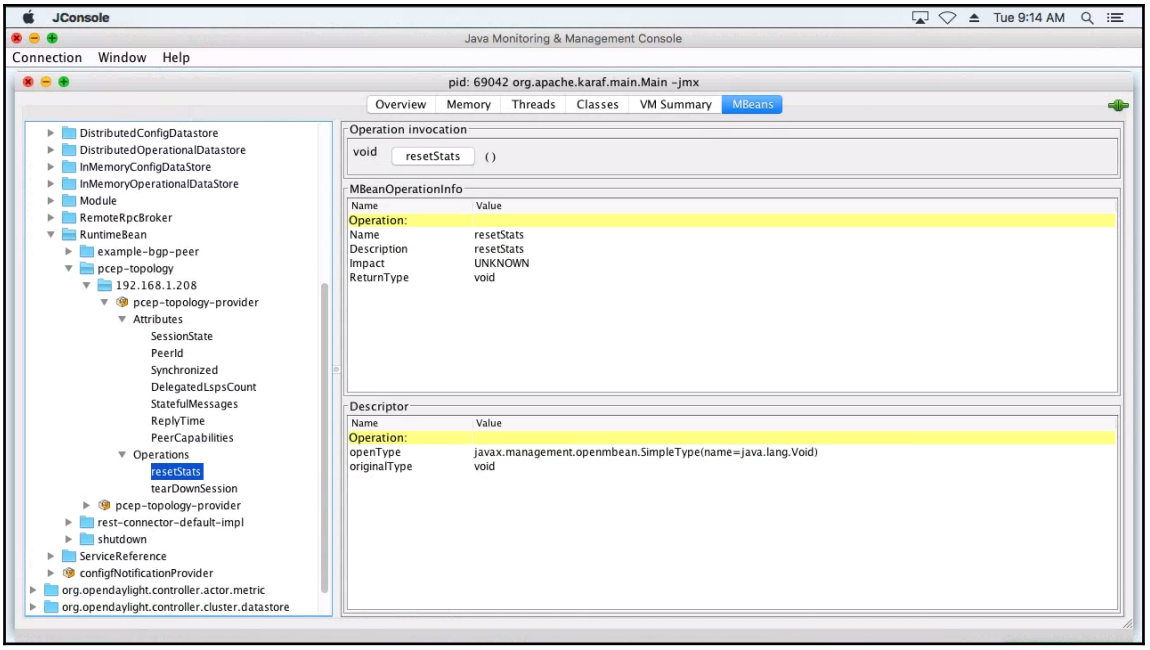

JConsole
Mon 2:20 PM
Java Monitoring & Management Console
Connection Window Help
pid: 68250 org.apache.karaf.main.Main -jmx
Overview Memory Threads Classes VM Summary MBeans
connector
java.lang
java.nio
java.util.logging
net.sf.ehcache
org.apache.aries.blueprint
org.apache.karaf
org.eclipse.equinox.region.domain
org.opendaylight.controller
ConfigRegistry
ConfigRegistryNoNotifications
DOMDataBroker
DistributedConfigDatastore
DistributedOperationalDatastore
InMemoryConfigDataStore
InMemoryOperationalDataStore
Module
RemoteRpcBroker
RuntimeBean
example-bgp-peer
bgp-peer
Attributes
BgpSessionState
BgpPeerState
Operations
resetSession
resetStats
pcep-topology
rest-connector-default-impl
Attribute value
Name
Value
Tabular Data Navigation
Composite Data Navigation
BgpSessionState
holdtimeCur... 180
keepaliveCu... 60
messagesStats org.opendaylight.controller.config.yang.bgp.rib.im...
peerPrefere... org.opendaylight.controller.config.yang.bgp.rib.im...
sessionDurat... 0:00:13:52
sessionState UP
speakerPref... org.opendaylight.controller.config.yang.bgp.rib.im...
Refresh
MBeanAttributeInfo
Attribute:
Name BgpSessionState
Description BgpSessionState
Readable true
Writable false
Descriptor
Attribute:
openType javax.management.openmbean.CompositeType(name=org.opendaylight.controller.config.yang.bgp.rib.impl.BgpSessi...
originalType org.opendaylight.controller.config.yang.bgp.rib.impl.BgpSessionState

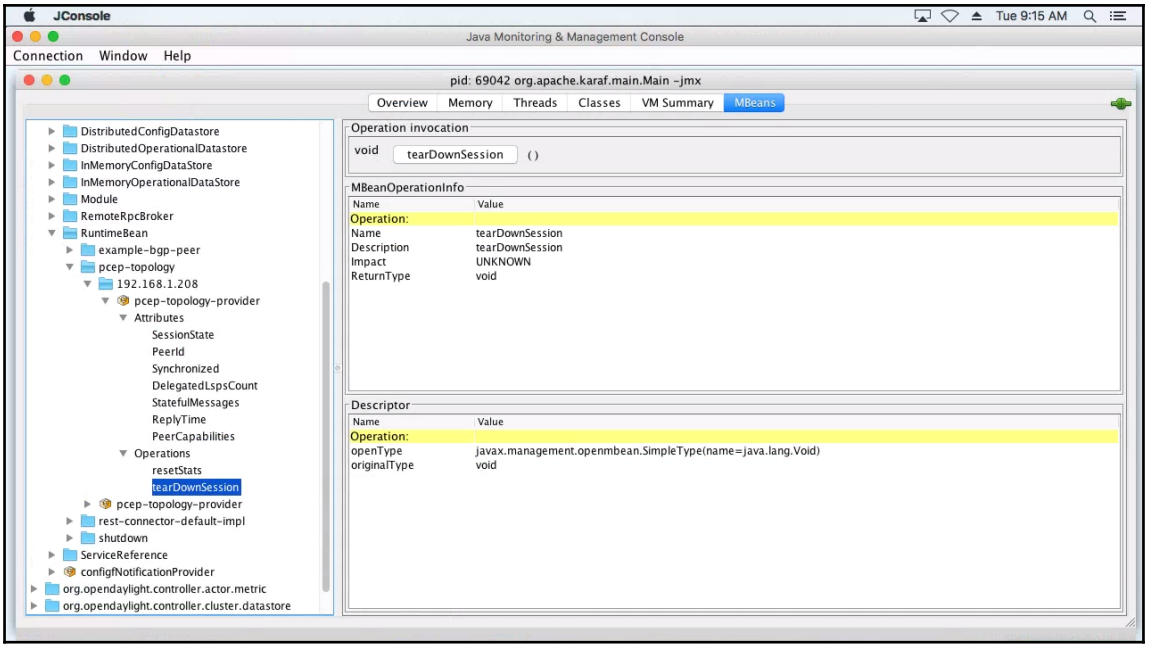

Java Monitoring & Management Console
Connection Window Help
pid: 68250 org.apache.karaf.main.Main -jmx
Overview Memory Threads Classes VM Summary MBeans
connector
java.lang
java.nio
java.util.logging
net.sf.ehcache
org.apache.aries.blueprint
org.apache.karaf
org.eclipse.equinox.region.domain
org.opendaylight.controller
ConfigRegistry
ConfigRegistryNoNotifications
DOMDataBroker
DistributedConfigDatastore
DistributedOperationalDatastore
InMemoryConfigDataStore
InMemoryOperationalDataStore
Module
RemoteRpcBroker
RuntimeBean
example-bgp-peer
bgp-peer
Attributes
BgpSessionState
BgpPeerState
Operations
resetSession
resetStats
pcep-topology
rest-connector-default-impl
Attribute value
Name
Value
Tabular Data Navigation
Composite Data Navigation
BgpPeerState
routeTable org.opendaylight.controller.config.yang.bgp.rib.i...
sessionEstablishe... 1
Refresh
MBeanAttributeInfo
Attribute:
Name BgpPeerState
Description BgpPeerState
Readable true
Writable false
Descriptor
Attribute:
openType javax.management.openmbean.CompositeType(name=org.opendaylight.controller.config.yang.bgp.rib.impl.BgpPeerS...
originalType org.opendaylight.controller.config.yang.bgp.rib.impl.BgpPeerState


JConsole
Mon 2:30 PM
Java Monitoring & Management Console
Connection Window Help
pid: 68349 org.apache.karaf.main.Main -jmx
Overview Memory Threads Classes VM Summary MBeans
net.sf.ehcache
org.apache.aries.blueprint
org.apache.karaf
org.eclipse.equinox.region.domai
org.opendaylight.controller
ConfigRegistry
ConfigRegistryNoNotifications
DOMDataBroker
DistributedConfigDatastore
DistributedOperationalDatastc
InMemoryConfigDataStore
InMemoryOperationalDataStor
Module
RemoteRpcBroker
RuntimeBean
example-bgp-peer
bgp-peer
Attributes
BgpSessionState
BgpPeerState
Operations
resetSession
resetStats
pcep-topology
rest-connector-default-im
shutdown
ServiceReference
configNotificationProvider
Operation invocation
void
resetSession
()
MBeanOperationInfo
Name
Value
Operation:
Name resetSession
Description resetSession
Impact UNKNOWN
ReturnType void
Descriptor
Name
Value
Operation:
openType javax.management.openmbean.SimpleType(name=java.lang.Void)
originalType void

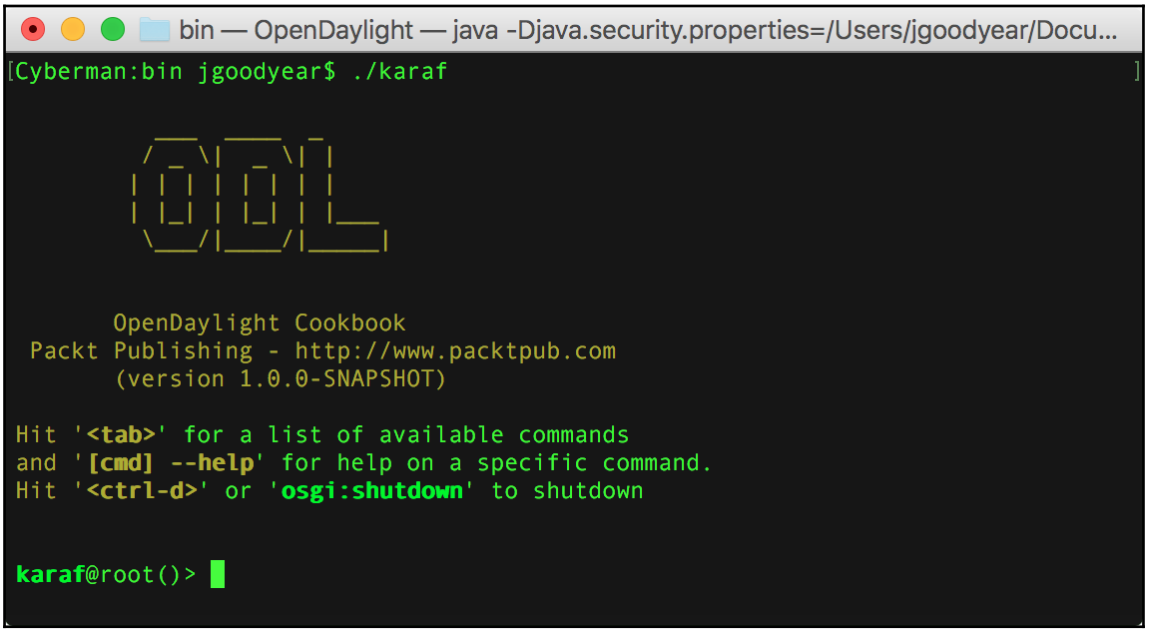

JConsole
Mon 2:31 PM
Java Monitoring & Management Console
Connection Window Help
pid: 68349 org.apache.karaf.main.Main -jmx
Overview Memory Threads Classes VM Summary MBeans
net.sf.ehcache
org.apache.aries.blueprint
org.apache.karaf
org.eclipse.equinox.region.domai
org.opendaylight.controller
ConfigRegistry
ConfigRegistryNoNotifications
DOMDataBroker
DistributedConfigDatastore
DistributedOperationalDatastc
InMemoryConfigDataStore
InMemoryOperationalDataStor
Module
RemoteRpcBroker
RuntimeBean
example-bgp-peer
bgp-peer
Attributes
BgpSessionState
BgpPeerState
Operations
resetSession
resetStats
pcep-topology
rest-connector-default-im
shutdown
ServiceReference
configNotificationProvider
Operation invocation
void
resetStats
()
MBeanOperationInfo
Name
Value
Operation:
Name resetStats
Description resetStats
Impact UNKNOWN
ReturnType void
Descriptor
Name
Value
Operation:
openType javax.management.openmbean.SimpleType(name=java.lang.Void)
originalType void

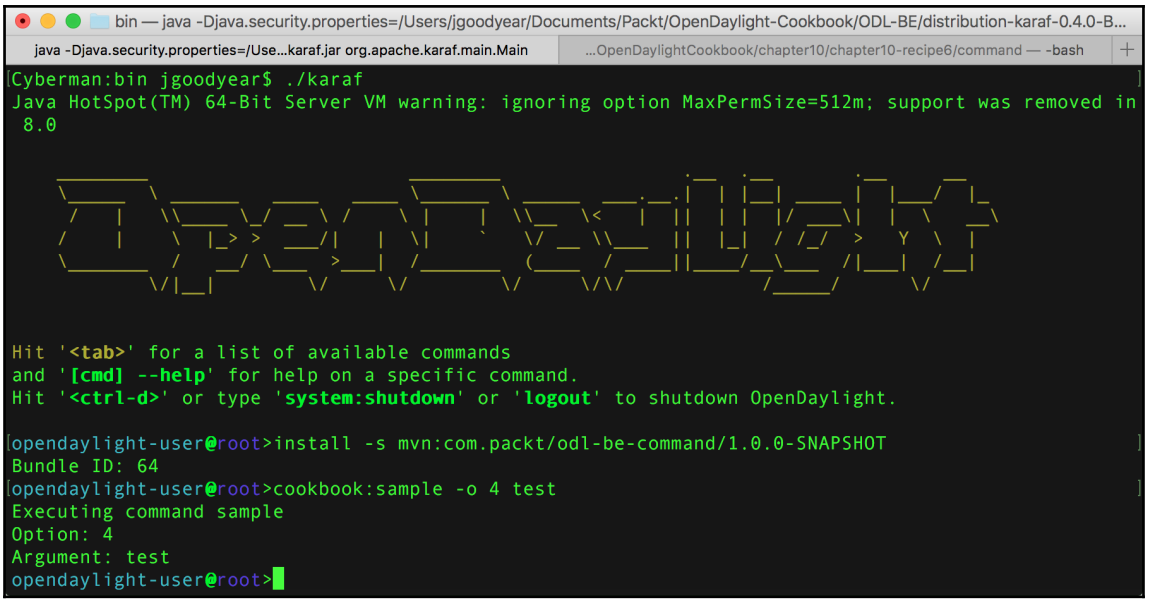

JConsole
Tue 9:14 AM
Java Monitoring & Management Console
Connection Window Help
pid: 69042 org.apache.karaf.main.Main -jmx
Overview Memory Threads Classes VM Summary MBeans
DistributedConfigDatastore
DistributedOperationalDatastore
InMemoryConfigDataStore
InMemoryOperationalDataStore
Module
RemoteRpcBroker
RuntimeBean
example-bgp-peer
pcep-topology
192.168.1.208
pcep-topology-provider
Attributes
SessionState
PeerId
Synchronized
DelegatedLspsCount
StatefulMessages
ReplyTime
PeerCapabilities
Operations
pcep-topology-provider
rest-connector-default-impl
shutdown
ServiceReference
configNotificationProvider
org.opendaylight.controller.actor.metric
org.opendaylight.controller.cluster.datastore
osgi.compendium
osgi.core
Attribute values
Name
Value
DelegatedLspsCount
0
PeerCapabilities
javax.management.openmbean.CompositeDataSupport
PeerId
192.168.1.208
ReplyTime
javax.management.openmbean.CompositeDataSupport
SessionState
javax.management.openmbean.CompositeDataSupport
StatefulMessages
javax.management.openmbean.CompositeDataSupport
Synchronized
false
Refresh

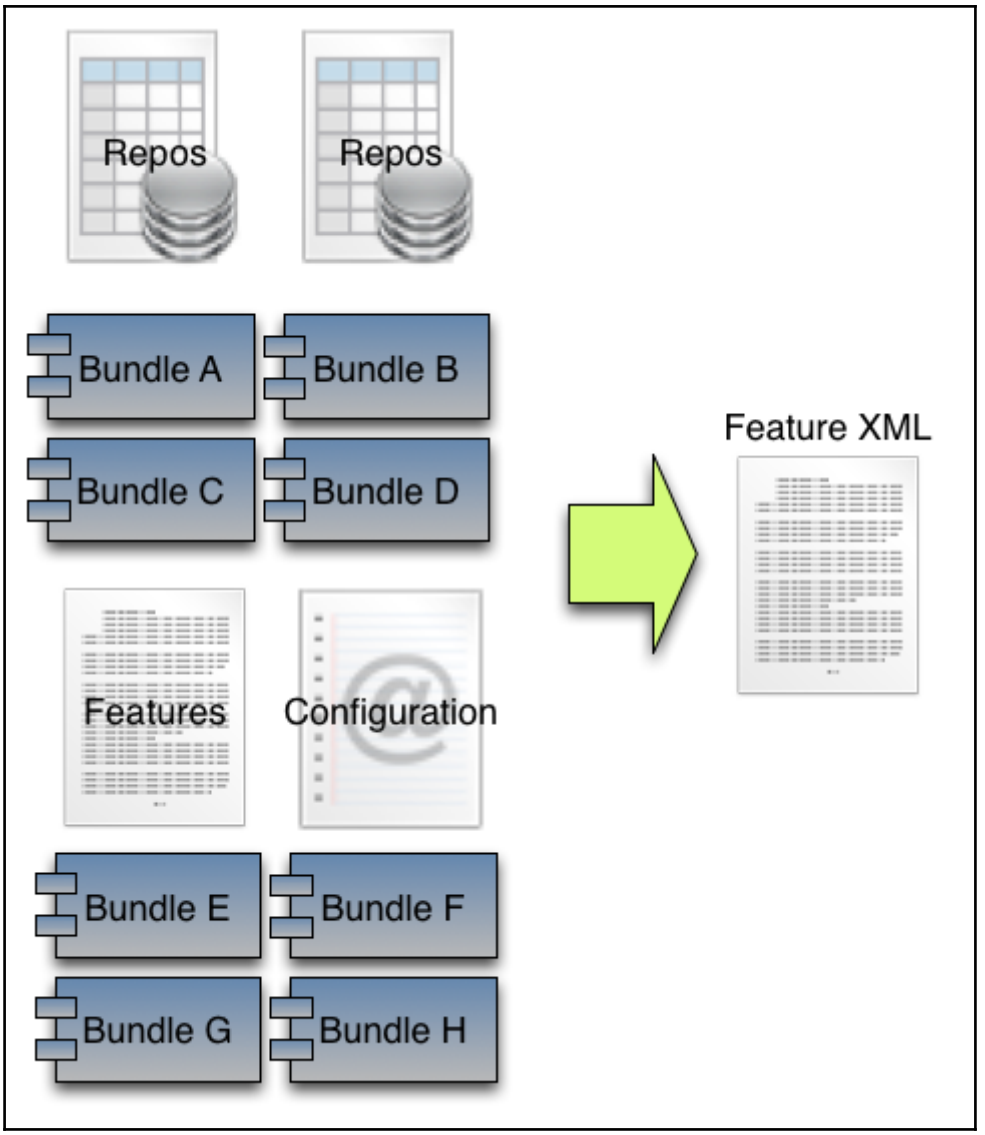

JConsole
Tue 9:14 AM
Java Monitoring & Management Console
Connection Window Help
pid: 69042 org.apache.karaf.main.Main -jmx
Overview Memory Threads Classes VM Summary MBeans
DistributedConfigDatastore
DistributedOperationalDatastore
InMemoryConfigDataStore
InMemoryOperationalDataStore
Module
RemoteRpcBroker
RuntimeBean
example-bgp-peer
pcep-topology
192.168.1.208
pcep-topology-provider
Attributes
SessionState
PeerId
Synchronized
DelegatedLspsCount
StatefulMessages
ReplyTime
PeerCapabilities
Operations
resetStats
tearDownSession
pcep-topology-provider
rest-connector-default-impl
shutdown
ServiceReference
configNotificationProvider
org.opendaylight.controller.actor.metric
org.opendaylight.controller.cluster.datastore
Operation invocation
void
resetStats
()
MBeanOperationInfo
Name
Value
Operation:
Name
resetStats
Description
resetStats
Impact
UNKNOWN
ReturnType
void
Descriptor
Name
Value
Operation:
openType
javax.management.openmbean.SimpleType(name=java.lang.Void)
originalType
void

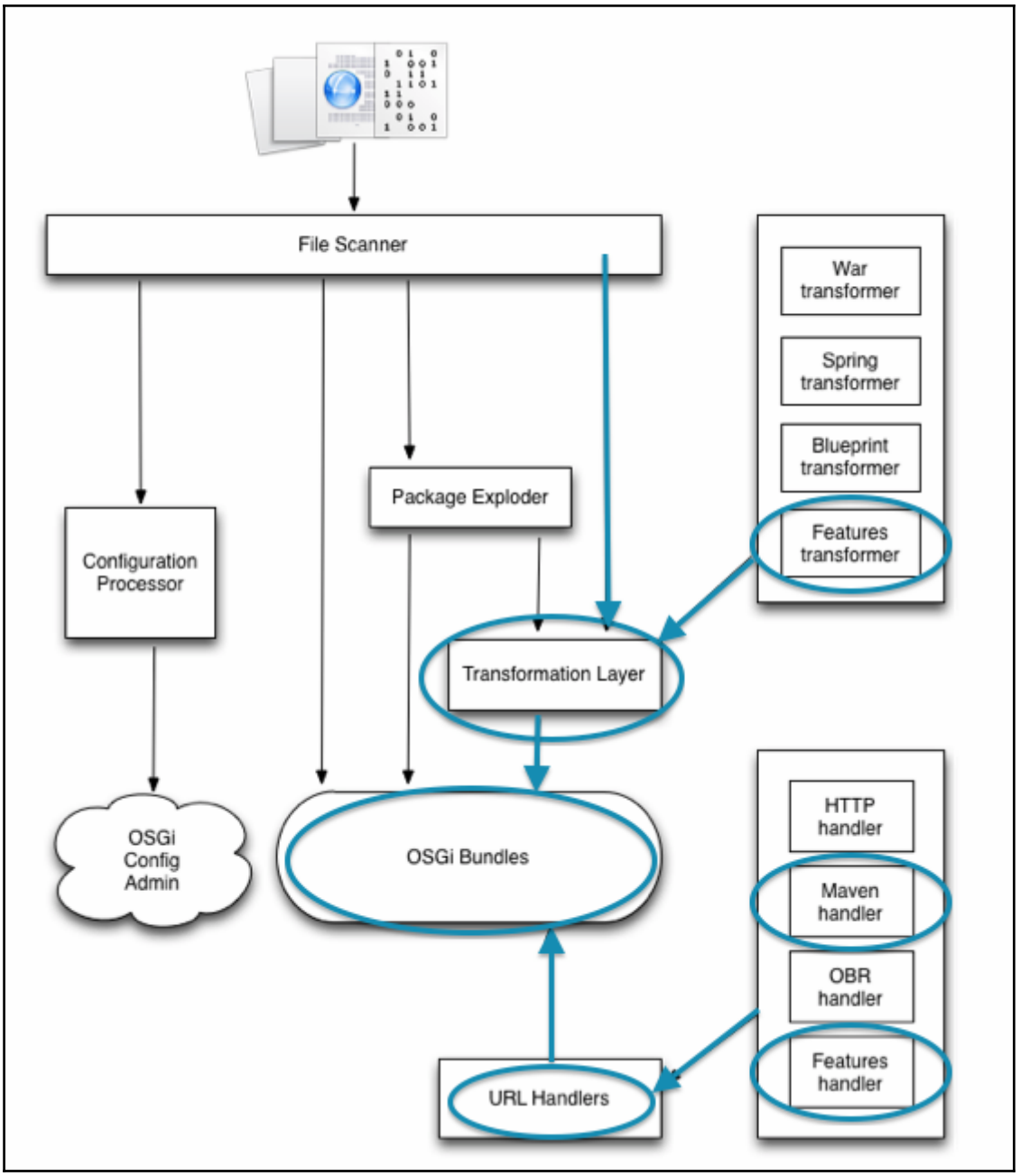

JConsole
Tue 9:15 AM
Java Monitoring & Management Console
Connection Window Help
pid: 69042 org.apache.karaf.main.Main -jmx
Overview Memory Threads Classes VM Summary MBeans
DistributedConfigDatastore
DistributedOperationalDatastore
InMemoryConfigDataStore
InMemoryOperationalDataStore
Module
RemoteRpcBroker
RuntimeBean
example-bgp-peer
pcep-topology
192.168.1.208
pcep-topology-provider
Attributes
SessionState
PeerId
Synchronized
DelegatedLspsCount
StatefulMessages
ReplyTime
PeerCapabilities
Operations
resetStats
tearDownSession
pcep-topology-provider
rest-connector-default-impl
shutdown
ServiceReference
configNotificationProvider
org.opendaylight.controller.actor.metric
org.opendaylight.controller.cluster.datastore
Operation invocation
void
tearDownSession
( )
MBeanOperationInfo
Name Value
Operation:
Name tearDownSession
Description tearDownSession
Impact UNKNOWN
ReturnType void
Descriptor
Name Value
Operation:
openType javax.management.openmbean.SimpleType(name=java.lang.Void)
originalType void

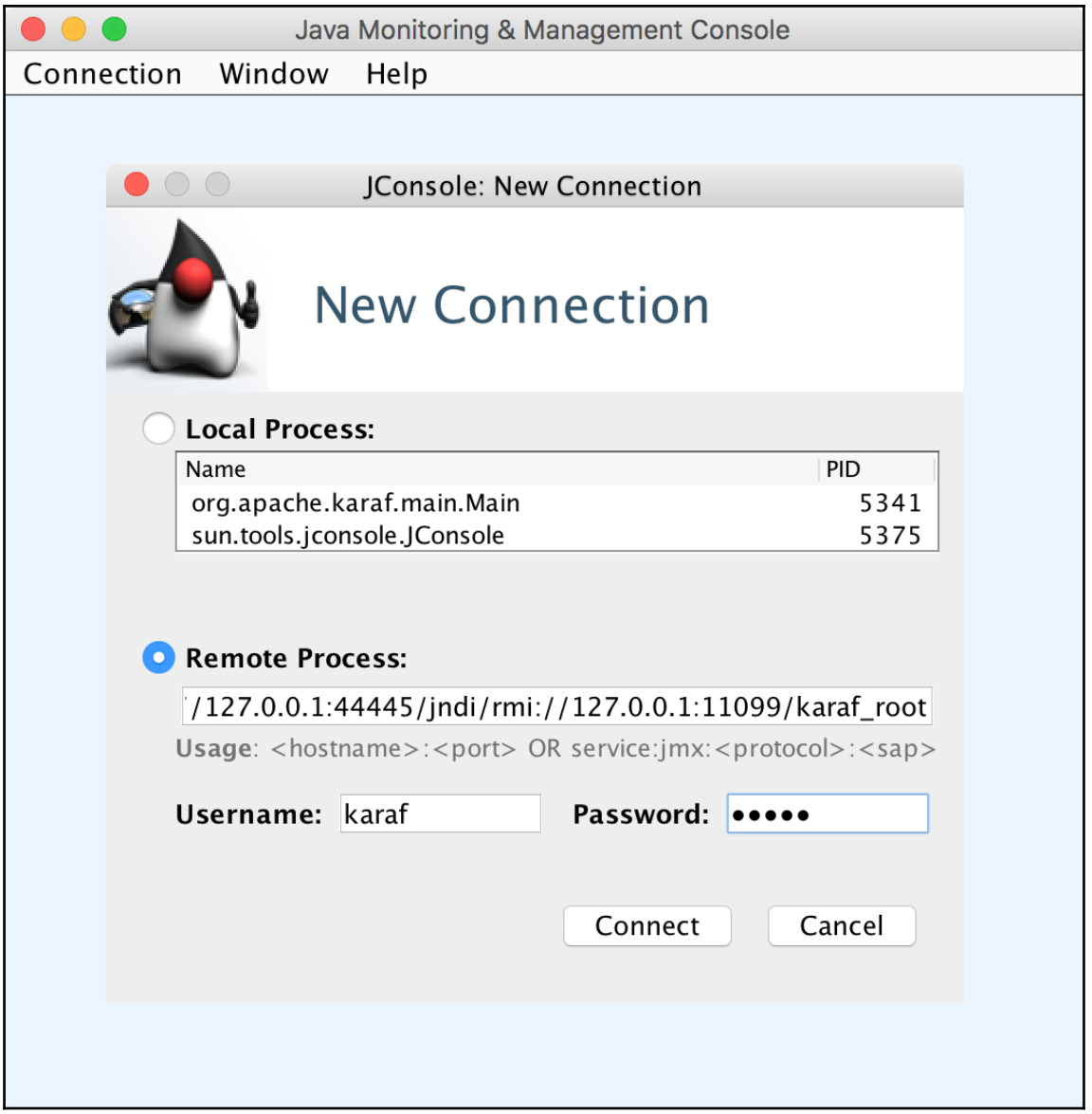
Chapter 7: OpenDaylight Container Customizations

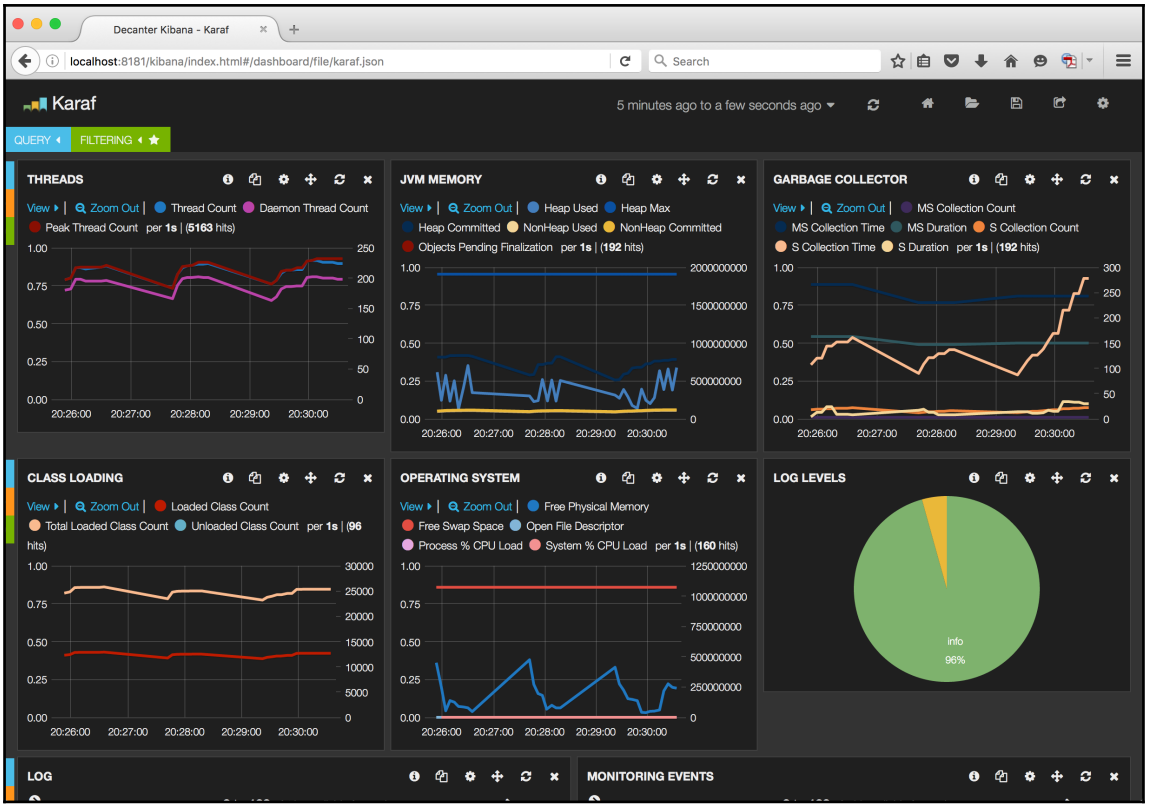


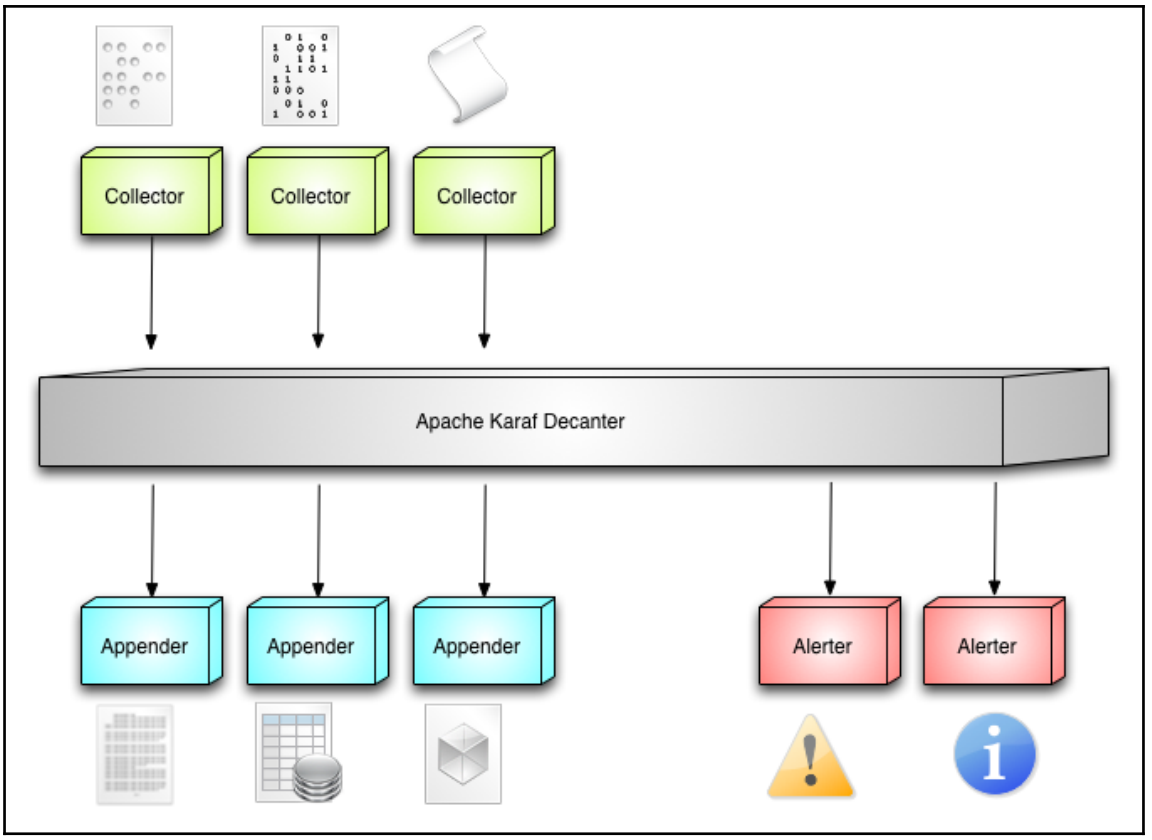

bin — java -Djava.security.properties=/Users/jgoodyear/Documents/Packt/OpenDaylight-Cookbook/ODL-BE/distribution-karaf-0.4.0-B...
java -Djava.security.properties=/Use...karaf.jar org.apache.karaf.main.Main
...OpenDaylightCookbook/chapter10/chapter10-recipe6/command — -bash
Cyberman:bin jgoodyear$ ./karaf
Java HotSpot(TM) 64-Bit Server VM warning: ignoring option MaxPermSize=512m; support was removed in 8.0
Hit '<tab>' for a list of available commands
and '[cmd] --help' for help on a specific command.
Hit '<ctrl-d>' or type 'system:shutdown' or 'logout' to shutdown OpenDaylight.
opendaylight-user@root>install -s mvn:com.packt/odl-be-command/1.0.0-SNAPSHOT
Bundle ID: 64
opendaylight-user@root>cookbook:sample -o 4 test
Executing command sample
Option: 4
Argument: test
opendaylight-user@root>


Repos
Repos
Bundle A
Bundle B
Bundle C
Bundle D
Features
Configuration
Bundle E
Bundle F
Bundle G
Bundle H
Feature XML


File Scanner
War transformer
Spring transformer
Blueprint transformer
Features transformer
Package Exploder
Configuration Processor
Transformation Layer
OSGi Config Admin
OSGi Bundles
HTTP handler
Maven handler
OBR handler
Features handler
URL Handlers

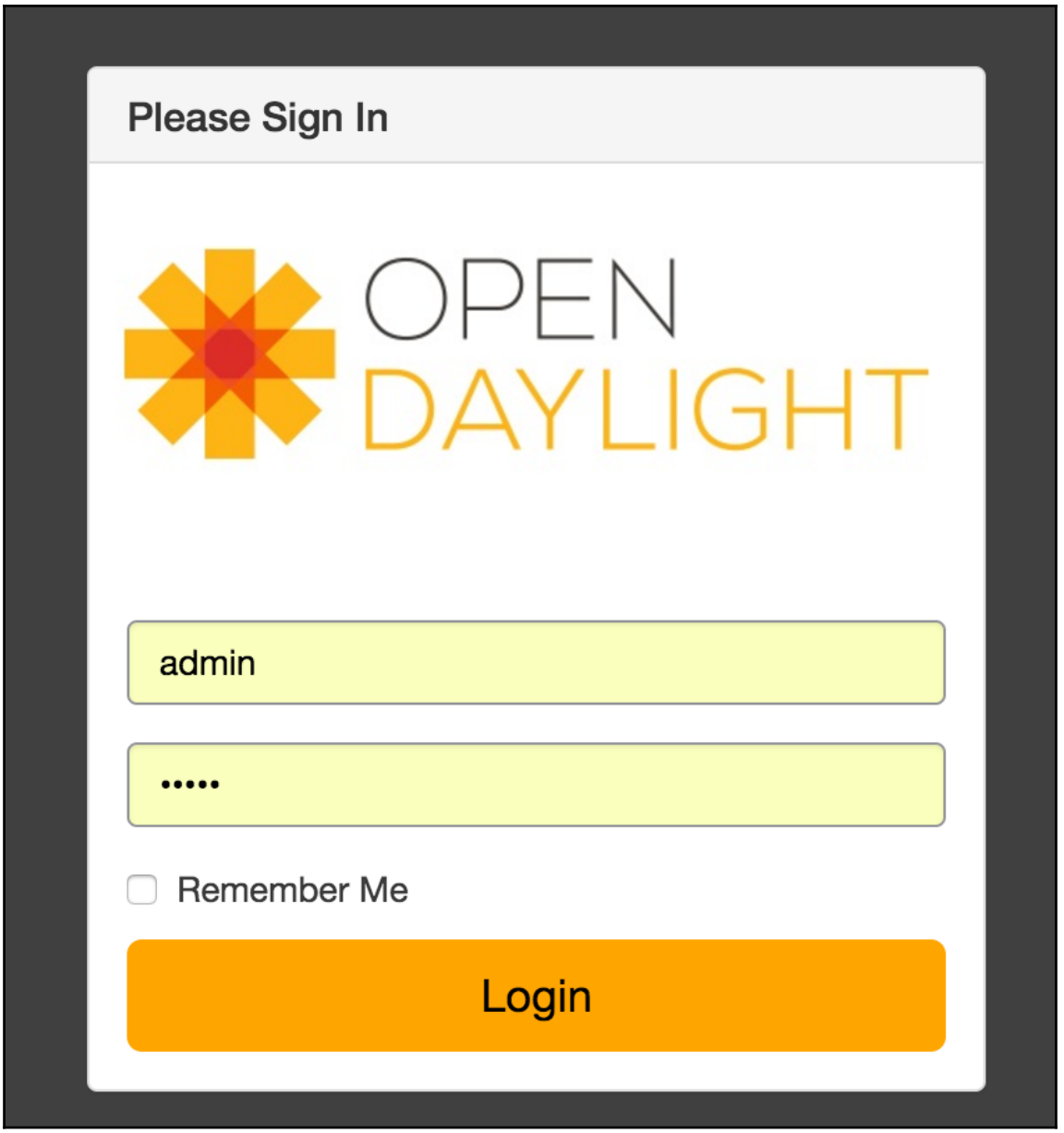

Java Monitoring & Management Console
Connection
Window
Help
JConsole: New Connection
New Connection
Local Process:
Name
PID
org.apache.karaf.main.Main
5341
sun.tools.jconsole.JConsole
5375
Remote Process:
/127.0.0.1:44445/jndi/rmi://127.0.0.1:11099/karaf_root
Usage: <hostname>:<port> OR service:jmx:<protocol>:<sap>
Username:
karaf
Password:
Connect
Cancel

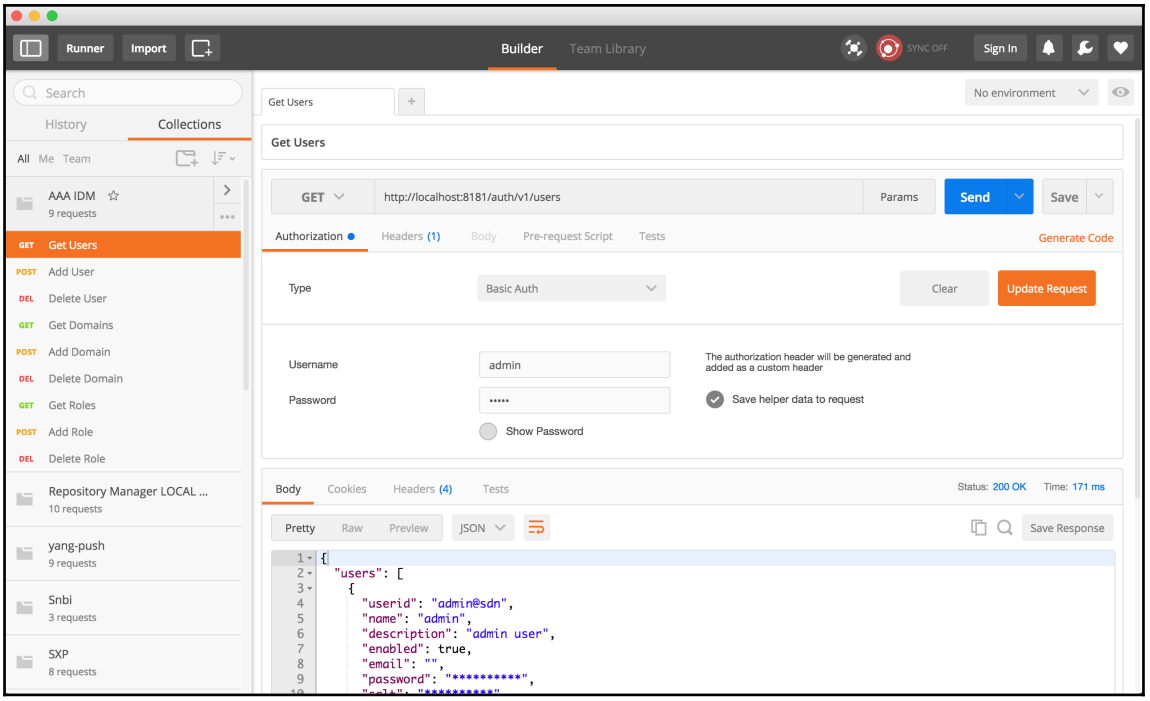

Decanter Kibana - Karaf
localhost:8181/kibana/index.html#/dashboard/file/karaf.json
Search
Karaf
5 minutes ago to a few seconds ago
QUERY
FILTERING
THREADS
View | Zoom Out | Thread Count Daemon Thread Count
Peak Thread Count per 1s | (5163 hits)
JVM MEMORY
View | Zoom Out | Heap Used Heap Max
Heap Committed NonHeap Used NonHeap Committed
Objects Pending Finalization per 1s | (192 hits)
GARBAGE COLLECTOR
View | Zoom Out | MS Collection Count
MS Collection Time MS Duration S Collection Count
S Collection Time S Duration per 1s | (192 hits)
CLASS LOADING
View | Zoom Out | Loaded Class Count
Total Loaded Class Count Unloaded Class Count per 1s | (96 hits)
OPERATING SYSTEM
View | Zoom Out | Free Physical Memory
Free Swap Space Open File Descriptor
Process % CPU Load System % CPU Load per 1s | (160 hits)
LOG LEVELS
info
96%
LOG
MONITORING EVENTS

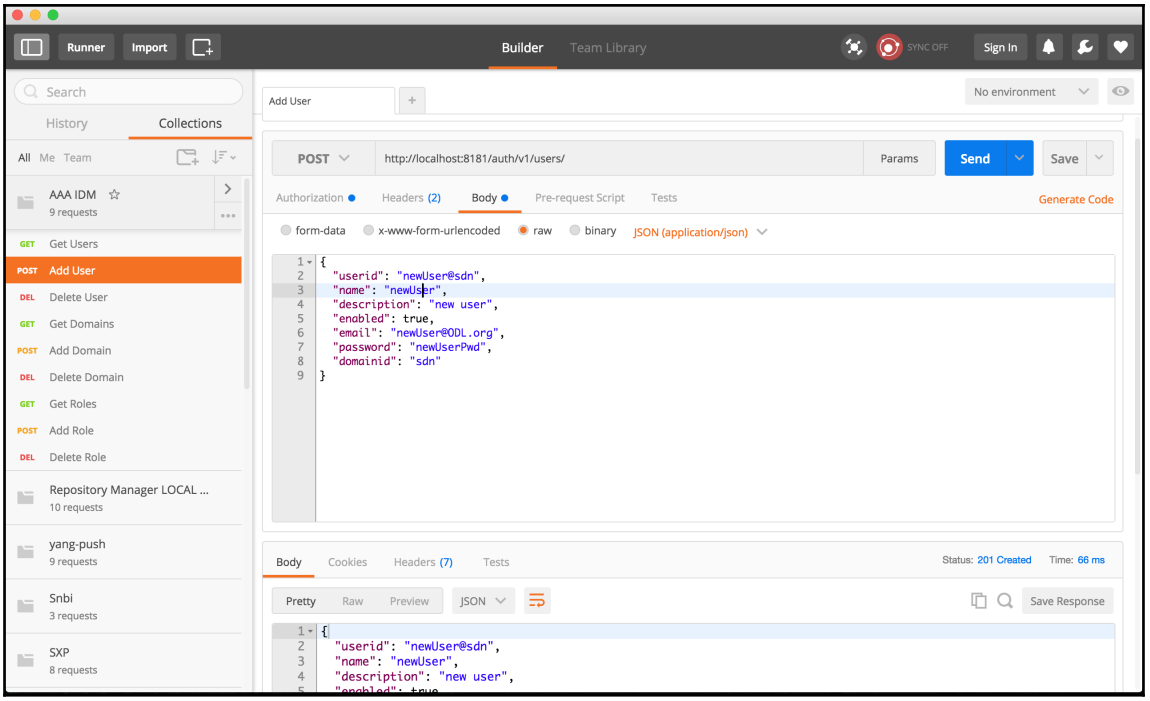

Collector
Collector
Collector
Apache Karaf Decanter
Appender
Appender
Appender
Alerter
Alerter

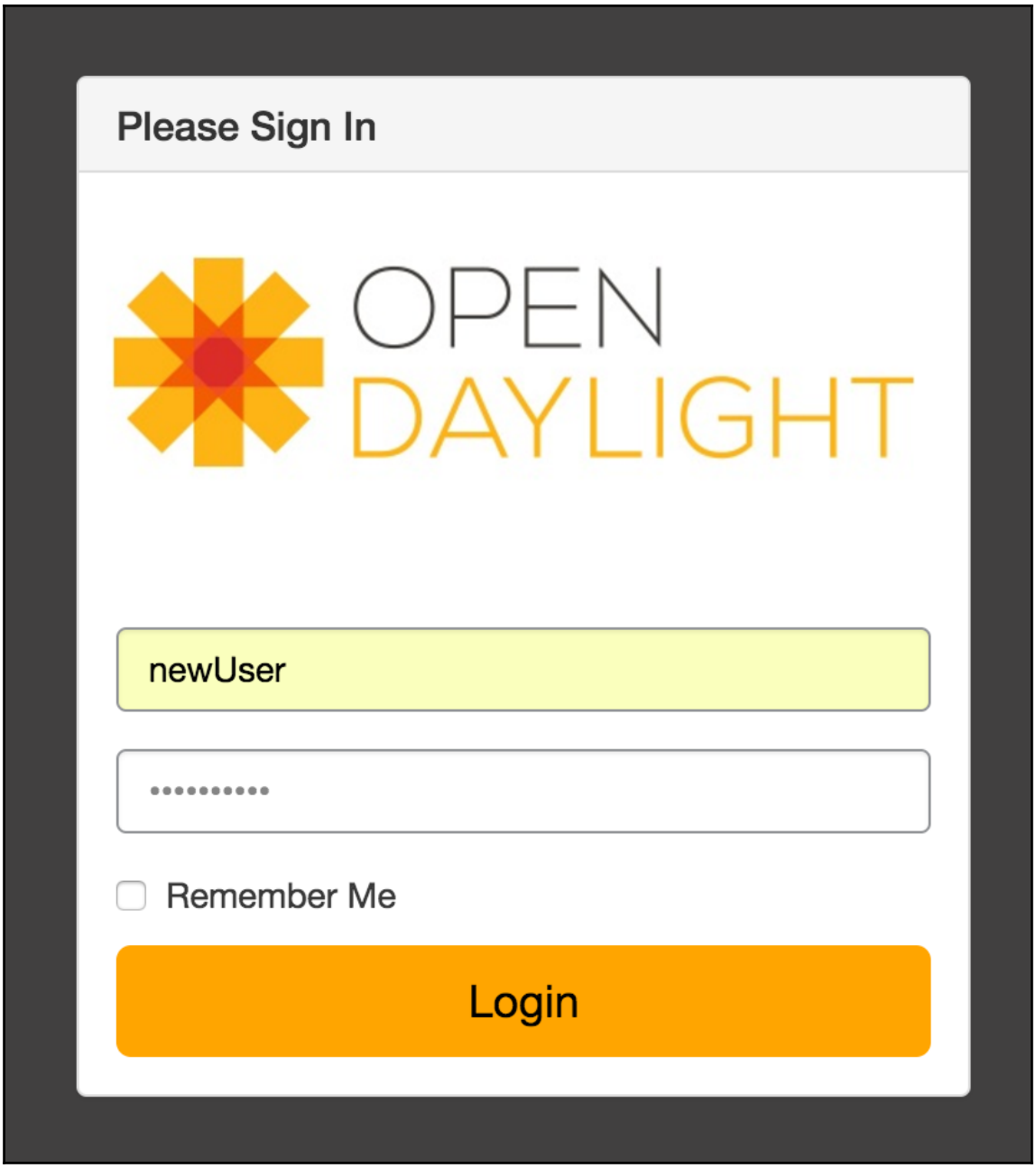
Chapter 8: Authentication and Authorization

```
opendaylight-user@root>feature:list -i | grep aaa
odl-aaa-api                     | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: APIs

odl-aaa-authn                   | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: Authentication - NO CLU
STER
odl-aaa-shiro                   | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: Shiro
```


Please Sign In
OPEN
DAYLIGHT
admin
•••••
Remember Me
Login


Runner
Import
Builder
Team Library
SYNC OFF
Sign In
Search
History
Collections
All Me Team
AAA IDM
9 requests
GET Get Users
POST Add User
DEL Delete User
GET Get Domains
POST Add Domain
DEL Delete Domain
GET Get Roles
POST Add Role
DEL Delete Role
Repository Manager LOCAL ...
10 requests
yang-push
9 requests
Snbi
3 requests
SXP
8 requests
Get Users
No environment
Get Users
GET
http://localhost:8181/auth/v1/users
Params
Send
Save
Authorization
Headers (1)
Body
Pre-request Script
Tests
Generate Code
Type
Basic Auth
Clear
Update Request
Username
admin
Password
Show Password
The authorization header will be generated and added as a custom header
Save helper data to request
Body
Cookies
Headers (4)
Tests
Status: 200 OK
Time: 171 ms
Pretty
Raw
Preview
JSON
Save Response
{
"users": [
{
"userid": "admin@sdn",
"name": "admin",
"description": "admin user",
"enabled": true,
"email": "",
"password": "**********",


Runner
Import
Builder
Team Library
SYNC OFF
Sign In
Search
History
Collections
All Me Team
AAA IDM
9 requests
GET Get Users
POST Add User
DEL Delete User
GET Get Domains
POST Add Domain
DEL Delete Domain
GET Get Roles
POST Add Role
DEL Delete Role
Repository Manager LOCAL ...
10 requests
yang-push
9 requests
Snbi
3 requests
SXP
8 requests
Add User
No environment
POST
http://localhost:8181/auth/v1/users/
Params
Send
Save
Authorization
Headers (2)
Body
Pre-request Script
Tests
Generate Code
form-data
x-www-form-urlencoded
raw
binary
JSON (application/json)
{
"userid": "newUser@sdn",
"name": "newUser",
"description": "new user",
"enabled": true,
"email": "newUser@ODL.org",
"password": "newUserPwd",
"domainid": "sdn"
}
Body
Cookies
Headers (7)
Tests
Status: 201 Created
Time: 66 ms
Pretty
Raw
Preview
JSON
Save Response
{
"userid": "newUser@sdn",
"name": "newUser",
"description": "new user",

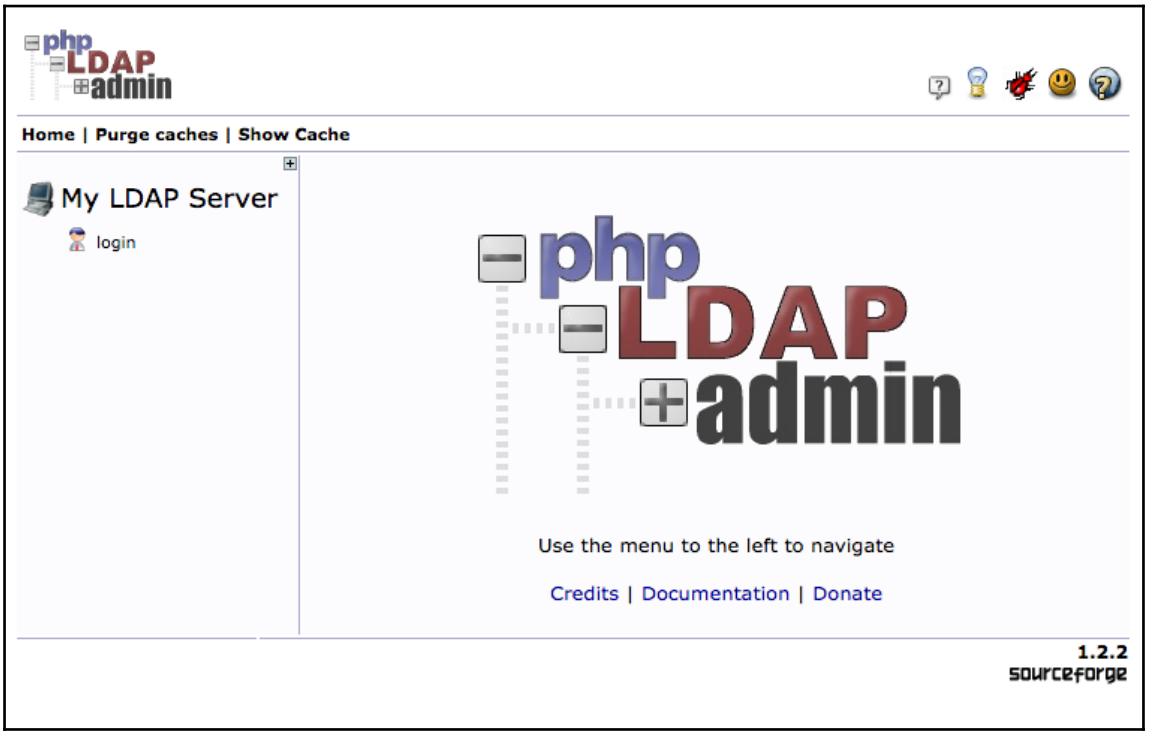

Please Sign In
OPEN
DAYLIGHT
newUser
Remember Me
Login

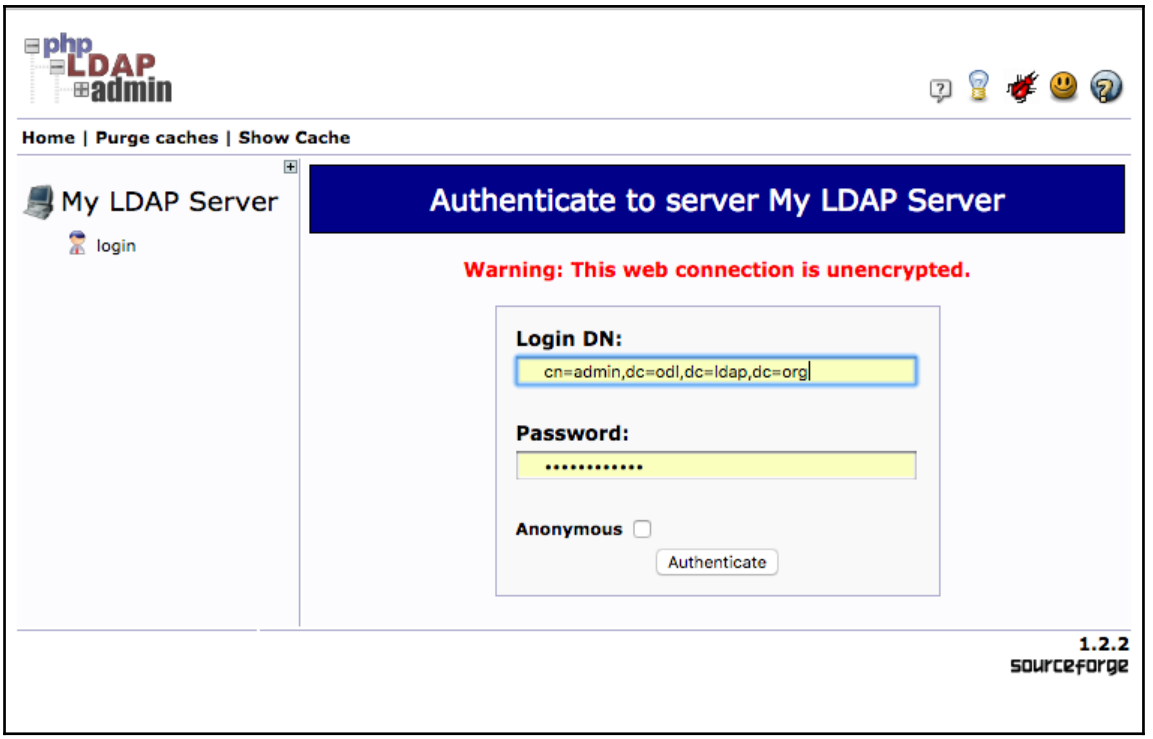
```
opendaylight-user@root>feature:list -i | grep aaa
odl-aaa-api                     | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: APIs

odl-aaa-shiro                   | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: Shiro

odl-aaa-authn                   | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: Authentication - NO
CLUSTER
```

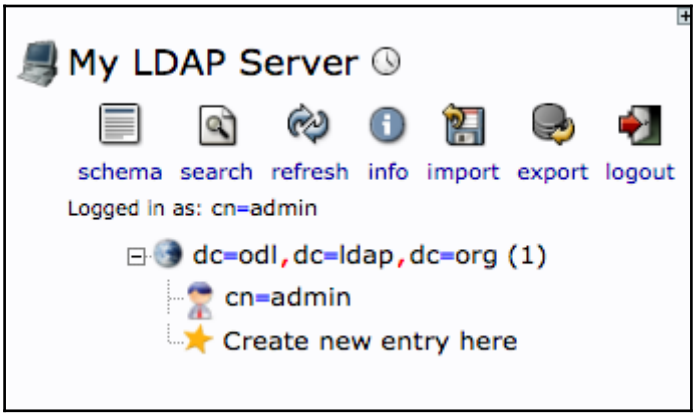

```
opendaylight-user@root>feature:list -i | grep aaa
odl-aaa-api                     | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: APIs

odl-aaa-shiro                   | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: Shiro

odl-aaa-authn                   | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: Authentication - NO
CLUSTER
```

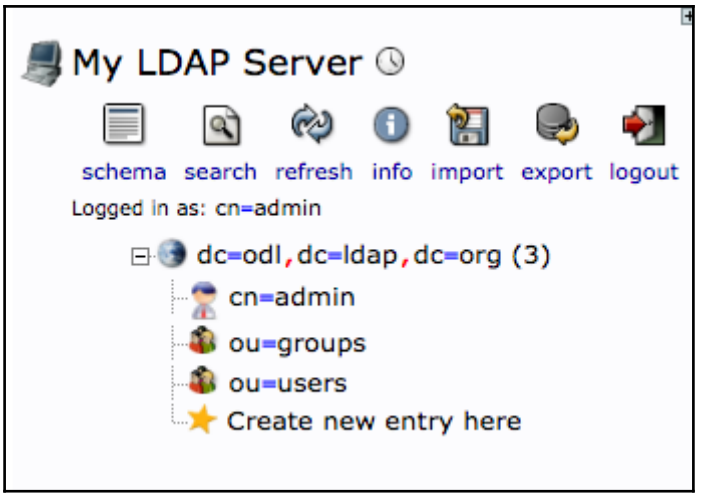


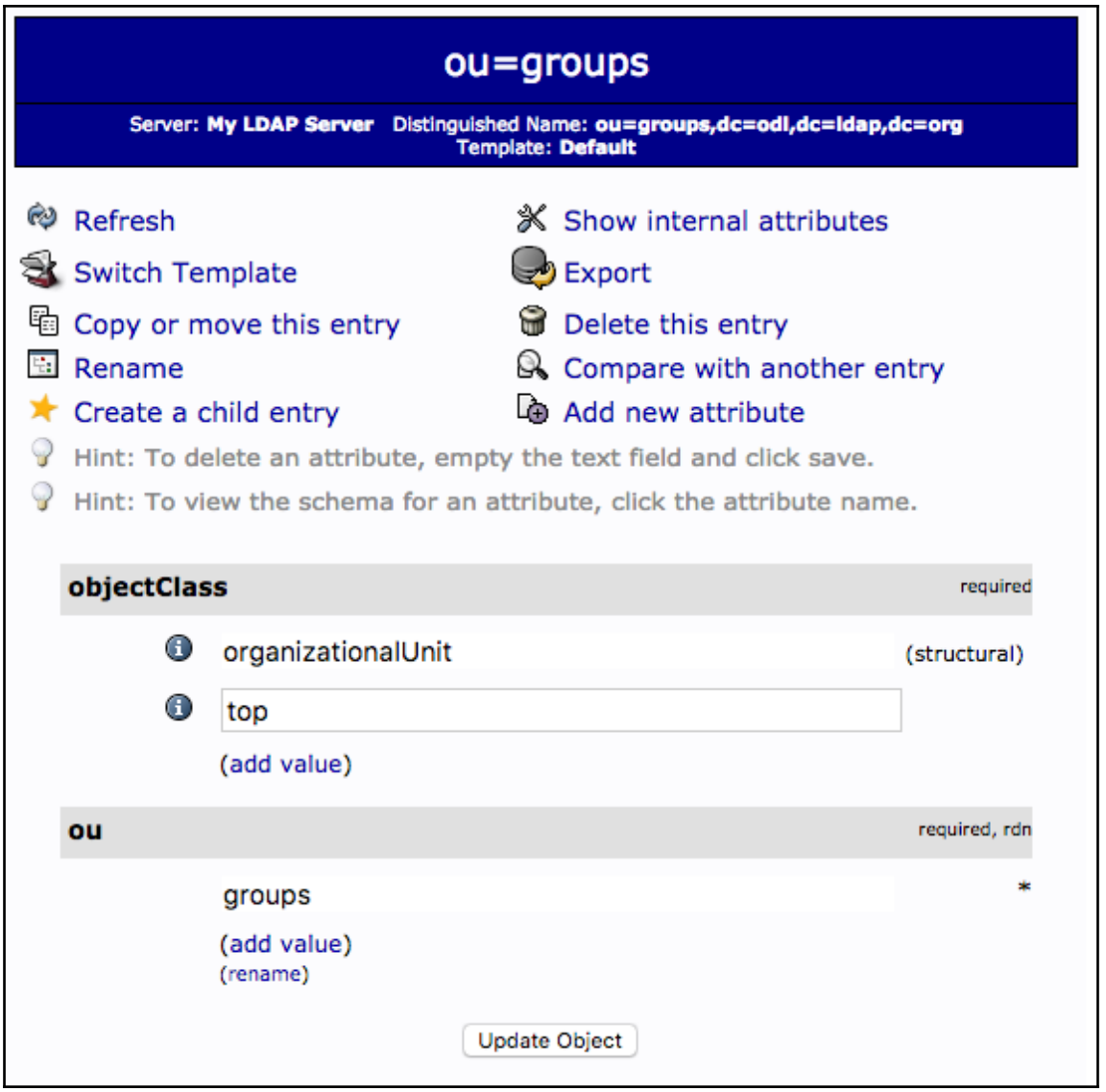
```
opendaylight-user@root>feature:list -i | grep aaa
odl-aaa-api                     | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: APIs

odl-aaa-shiro                   | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: Shiro

odl-aaa-authn                   | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: Authentication - NO
CLUSTER
```


php LDAP admin
Home | Purge caches | Show Cache
My LDAP Server
login
Authenticate to server My LDAP Server
Warning: This web connection is unencrypted.
Login DN:
cn=admin,dc=odl,dc=ldap,dc=org
Password:
Anonymous
Authenticate
1.2.2
SOURCEFORGE


My LDAP Server
schema search refresh info import export logout
Logged in as: cn=admin
dc=odl,dc=ldap,dc=org (1)
cn=admin
Create new entry here


My LDAP Server
schema
search
refresh
info
import
export
logout
Logged in as: cn=admin
dc=odl,dc=ldap,dc=org (3)
cn=admin
ou=groups
ou=users
Create new entry here


ou=groups
Server: My LDAP Server Distinguished Name: ou=groups,dc=odl,dc=ldap,dc=org
Template: Default
Refresh
Show internal attributes
Switch Template
Export
Copy or move this entry
Delete this entry
Rename
Compare with another entry
Create a child entry
Add new attribute
Hint: To delete an attribute, empty the text field and click save.
Hint: To view the schema for an attribute, click the attribute name.
objectClass
required
organizationalUnit
(structural)
top
(add value)
ou
required, rdn
groups
*
(add value)
(rename)
Update Object

Server: **My LDAP Server** Container: **ou=users,dc=odl,dc=ldap,dc=org**
Template: **Generic: User Account (posixAccount)**

New User Account (Step 1 of 1)

Common Name alias, required, rdn

odlAdmin *

First name alias

odl

GID Number alias, required, hint

odlUsers *

Home directory alias, required

/home/users/odladmin *

Last name alias, required

Admin *

Login shell alias

Password alias, hint

md5

(confirm)

Check password...

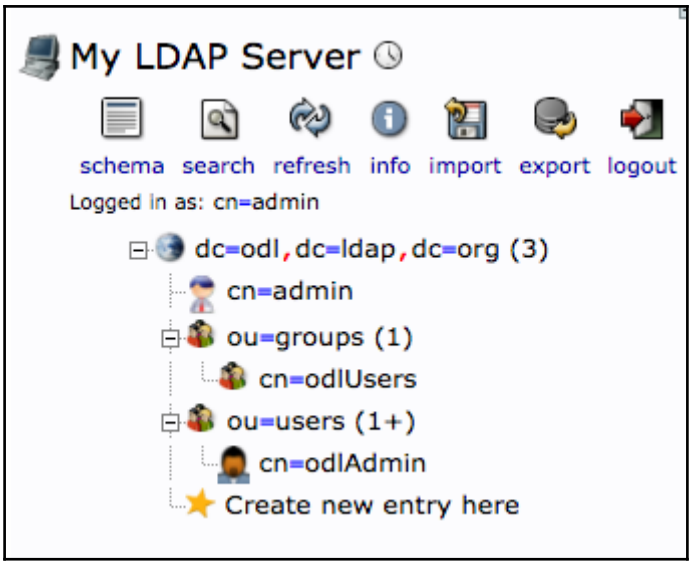
UID Number alias, required, hint, ro

1000

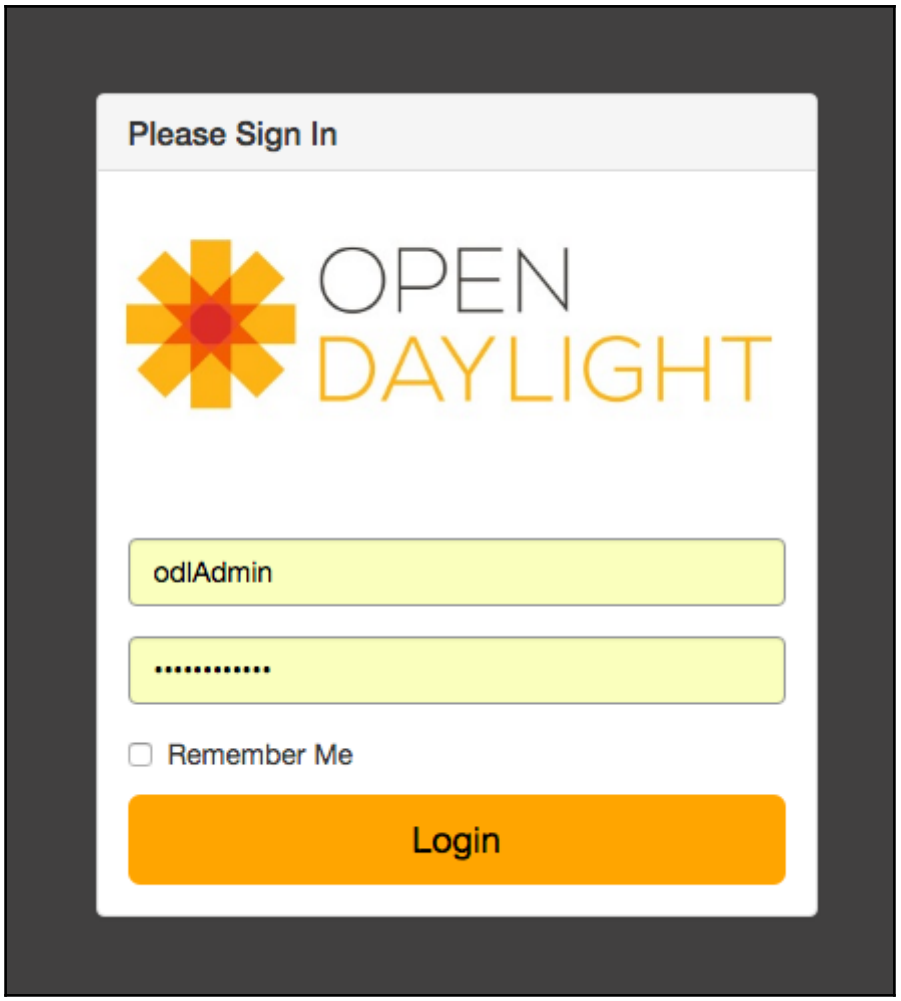
User ID alias, required

oadmin *

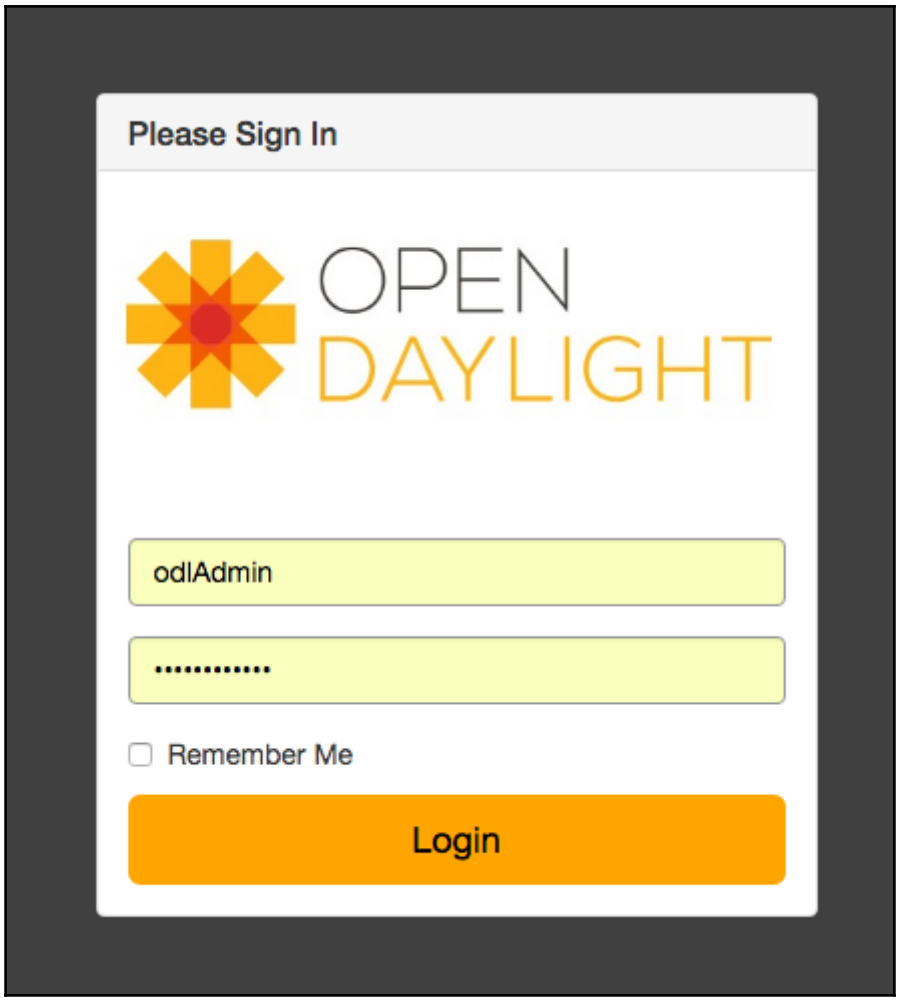
Create Object




```
opendaylight-user@root>feature:list -i | grep aaa
odl-aaa-api                     | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: APIs

odl-aaa-shiro                   | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: Shiro

odl-aaa-authn                   | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: Authentication - NO
CLUSTER
```




```
opendaylight-user@root>feature:list -i | grep aaa
odl-aaa-api                     | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: APIs

odl-aaa-shiro                   | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: Shiro

odl-aaa-authn                   | 0.3.2-Beryllium-SR2 | x         | odl-aaa-0.3.2-Beryllium-SR2             | OpenDaylight :: AAA :: Authentication - NO
CLUSTER
```


Please Sign In
OPEN
DAYLIGHT
odlAdmin
Remember Me
Login