Faucet Documentation

Faucet Developers

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Contents

CHAPTER 1

User Documentation

1.1 Introduction to Faucet

1.1.1 What is Faucet?

Faucet is a compact open source OpenFlow controller, which enables network operators to run their networks the same way they do server clusters. Faucet moves network control functions (like routing protocols, neighbor discovery, and switching algorithms) to vendor independent server-based software, versus traditional router or switch embedded firmware, where those functions are easy to manage, test, and extend with modern systems management best practices and tools. Faucet controls OpenFlow 1.3 hardware which delivers high forwarding performance.

You can read more about our approach to networking by reading our ACM Queue article Faucet: Deploying SDN in the Enterprise.

1.1.2 What is Gauge?

Faucet has two main OpenFlow controller components, Faucet itself, and Gauge. Faucet controls all forwarding and switch state, and exposes its internal state, e.g. learned hosts, via Prometheus (so that an open source NMS such as Grafana graph it).

Gauge also has an OpenFlow connection to the switch and monitors port and flow state (exporting it to Prometheus or InfluxDB, or even flat text log files). Gauge, however, does not ever modify the switch's state, so that switch monitoring functions can be upgraded, restarted, without impacting forwarding.

1.1.3 Why Faucet?

Design

Faucet is designed to be very small, simple (1000s of lines of code, versus millions in other systems), and keep relatively little state. Faucet does not have any implementation-specific or vendor driver code, which considerably reduces complexity. Faucet does not need connectivity to external databases for forwarding decisions. Faucet provides

"hot/hot" high availability and scales through the provisioning of multiple Faucets with the same configuration - Faucet controllers are not inter-dependent.

Performance and scaling

As well as being compact, Faucet offloads all forwarding to the OpenFlow switch, including flooding if emulating a traditional switch. Faucet programs the switch pre-emptively, though will receive packet headers from the switch if, for example, a host moves ports so that the switch's OpenFlow FIB can be updated (again, if traditional switching is being emulated). In production, Faucet controllers have been observed to go many seconds without needing to process a packet from a switch. In cold start scenarios, Faucet has been observed to completely program a switch and learn connected hosts within a few seconds.

Faucet uses a multi-table packet processing pipeline as shown in *Faucet Openflow Switch Pipeline*. Using multiple flow tables over a single table allows Faucet to implement more complicated flow-based logic while maintaining a smaller number of total flows. Using dedicated flow tables with a narrow number of match fields, or limiting a table to exact match only, such as the IPv4 or IPv6 FIB tables allows us to achieve greater scalability over the number of flow entries we can install on a datapath.

A large network with many devices would run many Faucets, which can be spread over as many (or as few) machines as required. This approach scales well because each Faucet uses relatively few server resources and Faucet controllers do not have to be centralized - they can deploy as discrete switching or routing functional units, incrementally replacing (for example) non-SDN switches or routers.

An operator might have a controller for an entire rack, or just a few switches, which also reduces control plane complexity and latency by keeping control functions simple and local.

Testing

Faucet follows open source software engineering best practices, including unit and systems testing (python unittest based), as well static analysis (pytype, pylint, and codecov) and fuzzing (python-afl). Faucet's systems tests test all Faucet features, from switching algorithms to routing, on virtual topologies. However, Faucet's systems tests can also be configured to run the same feature tests on real OpenFlow hardware. Faucet developers also host regular PlugFest events specifically to keep switch implementations broadly synchronized in capabilities and compatibility.

1.1.4 Release Notes

1.7.0

We are making a few potentially breaking features in faucet 1.7.0. This document covers how to navigate the changes and safely upgrade from earlier versions to 1.7.0.

1. **Configuration and log directory changed**

   Starting in 1.7.0 and onwards faucet has changed which directories it uses for configuration and log files. The new paths are:

Old path	New path
/etc/ryu/faucet	/etc/faucet
/var/log/ryu/faucet	/var/log/faucet

   Faucet 1.7.0 when being installed by pip will automatically attempt to migrate your old configuration files to `/etc/faucet` assuming it has permissions to do so. Failing this faucet when started will fallback to loading configuration from `/etc/ryu/faucet`. The search paths for configuration files are documented on the *Environment variables* page.

Note: Consider the `/etc/ryu/faucet` directory deprecated, we will in a future release stop reading config files stored in this directory.

If you currently set your own configuration or log directory by setting the appropriate environment variables you will be unaffected. In most other cases the migration code or the fallback configuration search path will allow the upgrade to 1.7.0 to be seamless. We have however identified two cases where manual intervention is required:

Dockers

Dockers will need to be started with new mount directories, the commands to start a 1.7.0 docker version of faucet or gauge are detailed in the *Docker* section.

Virtualenvs

We are unable to migrate configuration files automatically when faucet is run inside of a virtualenv, please copy the configuration directory over manually.

2. **Changing default flood mode**

   Currently faucet defaults to using `combinatorial_port_flood` when it comes to provisioning flooding flows on a datapath, faucet implicitly configures a datapath like this today:

```
dps:
    mydp:
        combinatorial_port_flood: True
```

   The default is `True`, in 1.7.0 and previously. The default will change to `False` in 1.7.1.

   When `True`, flood rules are explicitly generated for each input port, to accommodate early switch implementations which (differing from the OpenFlow standard - see below) did not discard packets output to the packet input port. `False` generates rules per faucet VLAN which results in fewer rules and better scalability.

   See OpenFlow 1.3.5 specification, section B.6.3:

```
The behavior of sending out the incoming port was not clearly defined
in earlier versions of the specification. It is now forbidden unless
the output port is explicitly set to OFPP_IN_PORT virtual port
(0xfff8) is set.
```

1.1.5 Getting Help

We use maintain a number of mailing lists for communicating with users and developers:

- faucet-announce
- faucet-dev
- faucet-users

We also have the #faucetsdn IRC channel on freenode.

A few tutorial videos are available on our YouTube channel.

The faucetsdn blog and faucetsdn twitter are good places to keep up with the latest news about faucet.

If you find bugs, or if have feature requests, please create an issue on our bug tracker.

1.2 Tutorials

1.2.1 Installing faucet for the first time

This tutorial will run you through the steps of installing a complete faucet system for the first time.

We will be installing and configuring the following components:

Component	Purpose
faucet	Network controller
gauge	Monitoring controller
prometheus	Monitoring system & time series database
grafana	Monitoring dashboard

This tutorial was written for Ubuntu 16.04, however the steps should work fine on any newer supported version of Ubuntu or Debian.

Package installation

1. Add the faucet official repo to our system:

```
sudo apt-get install curl gnupg apt-transport-https lsb-release
echo "deb https://packagecloud.io/faucetsdn/faucet/$(lsb_release -si | awk '
↪{print tolower($0)}')/ $(lsb_release -sc) main" | sudo tee /etc/apt/sources.
↪list.d/faucet.list
curl -L https://packagecloud.io/faucetsdn/faucet/gpgkey | sudo apt-key add -
sudo apt-get update
```

2. Install the required packages, we can use the `faucet-all-in-one` metapackage which will install all the correct dependencies.

```
sudo apt-get install faucet-all-in-one
```

Configure prometheus

We need to configure prometheus to tell it how to scrape metrics from both the faucet and gauge controllers. To help make life easier faucet ships a sample configuration file for prometheus which sets it up to scrape a single faucet and gauge controller running on the same machine as prometheus. The configuration file we ship looks like:

Listing 1: prometheus.yml

```
# my global config
global:
  scrape_interval:     15s # Set the scrape interval to every 15 seconds. Default is␣
↪every 1 minute.
  evaluation_interval: 15s # Evaluate rules every 15 seconds. The default is every 1␣
↪minute.
  # scrape_timeout is set to the global default (10s).

# Load rules once and periodically evaluate them according to the global 'evaluation_
↪interval'.
rule_files:
  - "faucet.rules.yml"
```

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```
# A scrape configuration containing exactly one endpoint to scrape:
# Here it's Prometheus itself.
scrape_configs:
  # The job name is added as a label `job=<job_name>` to any timeseries scraped from␣
↪this config.
  - job_name: 'prometheus'
    static_configs:
      - targets: ['localhost:9090']
  - job_name: 'faucet'
    static_configs:
      - targets: ['localhost:9302']
  - job_name: 'gauge'
    static_configs:
      - targets: ['localhost:9303']
```

To learn more about what this configuration file does you can look at the Prometheus Configuration Documentation. The simple explanation is that it includes an additional `faucet.rules.yml` file that performs some automatic queries in prometheus for generating some additional metrics as well as setting up scrape jobs every 15 seconds for faucet listening on `localhost:9302` and gauge listening on `localhost:9303`.

Steps to make prometheus use the configuration file shipped with faucet:

1. Change the configuration file prometheus loads by editing the file `/etc/default/prometheus` to look like:

   Listing 2: /etc/default/prometheus

   ```
   # Set the command-line arguments to pass to the server.
   ARGS="--config.file=/etc/faucet/prometheus/prometheus.yml"
   ```

2. Restart prometheus to apply the changes:

   ```
   sudo systemctl restart prometheus
   ```

Configure grafana

Grafana running in it's default configuration will work just fine for our needs. We will however need to make it start on boot, configure prometheus as a data source and add our first dashboard:

1. Make grafana start on boot and then start it manually for the first time:

   ```
   sudo systemctl daemon-reload
   sudo systemctl enable grafana-server
   sudo systemctl start grafana-server
   ```

2. To finish setup we will configure grafana via the web interface.

   First load `http://localhost:3000` in your web browser (by default both the username and password are `admin`).

3. The web interface will first prompt us to add a data source. Use the following settings then click `Save & Test`:

   ```
   Name:   Prometheus
   Type:   Prometheus
   ```

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```
URL:    http://localhost:9090
Access: proxy
```

4. Next we want to add some dashboards so that we can later view the metrics from faucet.

   Hover over the + button on the left sidebar in the web interface and click `Import`.

   We will import the following dashboards, just download the following links and upload them through the grafana dashboard import screen:

   - Instrumentation
   - Inventory
   - Port Statistics

Configure faucet

For this tutorial we will configure a very simple network topology consisting of a single switch with two ports.

1. Configure faucet

   We need to tell faucet about our topology and VLAN information, we can do this by editing the faucet configuration `/etc/faucet/faucet.yaml` to look like:

   Listing 3: /etc/faucet/faucet.yaml

```
vlans:
    office:
        vid: 100
        description: "office network"

dps:
    sw1:
        dp_id: 0x1
        hardware: "Open vSwitch"
        interfaces:
            1:
                name: "host1"
                description: "host2 network namespace"
                native_vlan: office
            2:
                name: "host2"
                description: "host2 network namespace"
                native_vlan: office
```

Note: Tabs are forbidden in the YAML language, please use only spaces for indentation.

   This will create a single VLAN and a single datapath with two ports.

2. Verify configuration

   The `check_faucet_config` command can be used to verify faucet has correctly interpreted your configuration before loading it. This can avoid shooting yourself in the foot by applying configuration with typos. We recommend either running this command by hand or with automation each time before loading configuration.

```
check_faucet_config /etc/faucet/faucet.yaml
```

This script will either return an error, or in the case of successfully parsing the configuration it will return a JSON object containing the entire faucet configuration that would be loaded (including any default settings), for example:

```
{'drop_spoofed_faucet_mac': True, 'hardware': 'Open vSwitch', 'lowest_priority':␣
↪0, 'highest_priority': 9099, 'faucet_dp_mac': '0e:00:00:00:00:01', 'metrics_
↪rate_limit_sec': 0, 'use_idle_timeout': False, 'max_resolve_backoff_time': 32,
↪'high_priority': 9001, 'timeout': 300, 'pipeline_config_dir': '/etc/faucet',
↪'drop_lldp': True, 'learn_ban_timeout': 10, 'ofchannel_log': None, 'drop_
↪broadcast_source_address': True, 'max_hosts_per_resolve_cycle': 5, 'proactive_
↪learn': True, 'lldp_beacon': {}, 'cookie': 1524372928, 'stack': None, 'dp_id':␣
↪1, 'priority_offset': 0, 'description': 'sw1', 'max_host_fib_retry_count': 10,
↪'learn_jitter': 10, 'interfaces': {'p1': {'lldp_beacon': {}, 'unicast_flood':␣
↪True, 'enabled': True, 'tagged_vlans': [], 'number': 1, 'description': 'port1',
↪'acls_in': None, 'mirror': None, 'acl_in': None, 'opstatus_reconf': True,
↪'hairpin': False, 'native_vlan': VLAN office vid:100 ports:Port 1,Port 2, 'loop_
↪protect': False, 'stack': None, 'lacp': 0, 'override_output_port': None,
↪'receive_lldp': False, 'max_hosts': 255, 'permanent_learn': False, 'output_only
↪': False}, 'p2': {'lldp_beacon': {}, 'unicast_flood': True, 'enabled': True,
↪'tagged_vlans': [], 'number': 2, 'description': 'port2', 'acls_in': None,
↪'mirror': None, 'acl_in': None, 'opstatus_reconf': True, 'hairpin': False,
↪'native_vlan': VLAN office vid:100 ports:Port 1,Port 2, 'loop_protect': False,
↪'stack': None, 'lacp': 0, 'override_output_port': None, 'receive_lldp': False,
↪'max_hosts': 255, 'permanent_learn': False, 'output_only': False}},
↪'combinatorial_port_flood': True, 'packetin_pps': 0, 'ignore_learn_ins': 10,
↪'interface_ranges': {}, 'group_table_routing': False, 'advertise_interval': 30,
↪'group_table': False, 'low_priority': 9000, 'arp_neighbor_timeout': 250, 'drop_
↪bpdu': True}
```

3. Reload faucet

   To apply this configuration we can reload faucet which will cause it to compute the difference between the old and new configuration and apply the minimal set of changes to the network in a hitless fashion (where possible).

```
sudo systemctl reload faucet
```

4. Check logs

   To verify the configuration reload was successful we can check `/var/log/faucet/faucet.log` and make sure faucet successfully loaded the configuration we can check the faucet log file `/var/log/faucet/faucet.log`:

Listing 4: /var/log/faucet/faucet.log

```
faucet INFO     Loaded configuration from /etc/faucet/faucet.yaml
faucet INFO     Add new datapath DPID 1 (0x1)
faucet INFO     Add new datapath DPID 2 (0x2)
faucet INFO     configuration /etc/faucet/faucet.yaml changed, analyzing␣
↪differences
faucet INFO     Reconfiguring existing datapath DPID 1 (0x1)
faucet.valve INFO     DPID 1 (0x1) skipping configuration because datapath not up
faucet INFO     Deleting de-configured DPID 2 (0x2)
```

If there were any issues (say faucet wasn't able to find a valid pathway from the old config to the new config) we could issue a faucet restart now which will cause a cold restart of the network.

Configure gauge

We will not need to edit the default gauge configuration that is shipped with faucet as it will be good enough to complete the rest of this tutorial. If you did need to modify it the path is `/etc/faucet/gauge.yaml` and the default configuration looks like:

Listing 5: gauge.yaml

```
# Recommended configuration is Prometheus for all monitoring, with all_dps: True
faucet_configs:
    - '/etc/faucet/faucet.yaml'
watchers:
    port_status_poller:
        type: 'port_state'
        all_dps: True
        #dps: ['sw1', 'sw2']
        db: 'prometheus'
    port_stats_poller:
        type: 'port_stats'
        all_dps: True
        #dps: ['sw1', 'sw2']
        interval: 10
        db: 'prometheus'
        #db: 'influx'
    flow_table_poller:
        type: 'flow_table'
        all_dps: True
        interval: 60
        db: 'prometheus'
dbs:
    prometheus:
        type: 'prometheus'
        prometheus_addr: '0.0.0.0'
        prometheus_port: 9303
    ft_file:
        type: 'text'
        compress: True
        file: 'flow_table.yaml.gz'
    influx:
        type: 'influx'
        influx_db: 'faucet'
        influx_host: 'influxdb'
        influx_port: 8086
        influx_user: 'faucet'
        influx_pwd: 'faucet'
        influx_timeout: 10
```

This default configuration will setup a prometheus exporter listening on port `0.0.0.0:9303` and write all the different kind of gauge metrics to this exporter.

We will however need to restart the current gauge instance so it can pick up our new faucet configuration:

```
sudo systemctl restart gauge
```

Connect your first datapath

Now that we've set up all the different components let's connect our first switch (which we call a `datapath`) to faucet. We will be using Open vSwitch for this which is a production-grade software switch with very good OpenFlow support.

1. Add WAND Open vSwitch repo

   The bundled version of Open vSwitch in Ubuntu 16.04 is quite old so we will use WAND's package repo to install a newer version (if you're using a more recent debian or ubuntu release you can skip this step).

   Note: If you're using a more recent debian or ubuntu release you can skip this step

```
sudo apt-get install apt-transport-https
echo "deb https://packages.wand.net.nz $(lsb_release -sc) main" | sudo␣
↪tee /etc/apt/sources.list.d/wand.list
sudo curl https://packages.wand.net.nz/keyring.gpg -o /etc/apt/trusted.
↪gpg.d/wand.gpg
sudo apt-get update
```

2. Install Open vSwitch

```
sudo apt-get install openvswitch-switch
```

3. Add network namespaces to simulate hosts

   We will use two linux network namespaces to simulate hosts and this will allow us to generate some traffic on our network.

   First let's define some useful bash functions by coping and pasting the following definitions into our bash terminal:

```
create_ns () {
    NETNS=$1
    IP=$2
    sudo ip netns add ${NETNS}
    sudo ip link add dev veth-${NETNS} type veth peer name veth0 netns
↪$NETNS
    sudo ip link set dev veth-${NETNS} up
    sudo ip netns exec $NETNS ip link set dev veth0 up
    sudo ip netns exec $NETNS ip addr add dev veth0 $IP
    sudo ip netns exec $NETNS ip link set dev lo up
}

as_ns () {
    NETNS=$1
    shift
    sudo ip netns exec $NETNS $@
}
```

   Now we will create `host1` and `host2` and assign them some IPs:

```
create_ns host1 192.168.0.1/24
create_ns host2 192.168.0.2/24
```

2. Configure Open vSwitch

We will now configure a single Open vSwitch bridge (which will act as our datapath) and add two ports to this bridge:

```
sudo ovs-vsctl add-br br0 \
-- set bridge br0 other-config:datapath-id=0000000000000001 \
-- set bridge br0 other-config:disable-in-band=true \
-- set bridge br0 fail_mode=secure \
-- add-port br0 veth-host1 -- set interface veth-host1 ofport_request=1 \
-- add-port br0 veth-host2 -- set interface veth-host2 ofport_request=2 \
-- set-controller br0 tcp:127.0.0.1:6653 tcp:127.0.0.1:6654
```

The Open vSwitch documentation is very good if you wish to find out more about configuring Open vSwitch.

3. Verify datapath is connected to faucet

   At this point everything should be working, we just need to verify that is the case. If we now load up some of the grafana dashboards we imported earlier, we should see the datapath is now listed in the `Faucet Inventory` dashboard.

   If you don't see the new datapath listed you can look at the faucet log files `/var/log/faucet/faucet.log` or the Open vSwitch log `/var/log/openvswitch/ovs-vswitchd.log` for clues.

4. Generate traffic between virtual hosts

   With `host1` and `host2` we can now test our network works and start generating some traffic which will show up in grafana.

   Let's start simple with a ping:

```
as_ns host1 ping 192.168.0.2
```

   If this test is successful this shows our Open vSwitch is forwarding traffic under faucet control, `/var/log/faucet/faucet.log` should now indicate those two hosts have been learnt:

Listing 6: /var/log/faucet/faucet.log

```
faucet.valve INFO     DPID 1 (0x1) L2 learned 22:a6:c7:20:ff:3b (L2 type␣
↪0x0806, L3 src 192.168.0.1, L3 dst 192.168.0.2) on Port 1 on VLAN 100␣
↪(1 hosts total)
faucet.valve INFO     DPID 1 (0x1) L2 learned 36:dc:0e:b2:a3:4b (L2 type␣
↪0x0806, L3 src 192.168.0.2, L3 dst 192.168.0.1) on Port 2 on VLAN 100␣
↪(2 hosts total)
```

   We can also use iperf to generate a large amount of traffic which will show up on the `Port Statistics` dashboard in grafana, just select `sw1` as the Datapath Name and `All` for the Port.

```
sudo apt-get install iperf3
as_ns host1 iperf3 -s &
as_ns host2 iperf3 -c 192.168.0.1
```

Further steps

Now that you know how to setup and run faucet in a self-contained virtual environment you can build on this tutorial and start to make more interesting topologies by adding more Open vSwitch bridges, ports and network namespaces. Check out the faucet *Configuration* document for more information on features you can turn on and off. In future we will publish additional tutorials on layer 3 routing, inter-vlan routing, ACLs.

You can also easily add real hardware into the mix as well instead of using a software switch. See the *Vendor-specific Documentation* section for information on how to configure a wide variety of different vendor devices for faucet.

1.3 Installation

1.3.1 Common Installation Tasks

These tasks are required by all installation methods.

You will need to provide an initial configuration files for FAUCET and Gauge, and create directores for FAUCET and Gauge to log to.

```
mkdir -p /etc/faucet
mkdir -p /var/log/faucet
$EDITOR /etc/faucet/faucet.yaml
$EDITOR /etc/faucet/gauge.yaml
```

This example `faucet.yaml` file creates an untagged VLAN between ports 1 and 2 on DP 0x1. See *Configuration* for more advanced configuration. See *Vendor-specific Documentation* for how to configure your switch.

```
vlans:
    100:
        description: "dev VLAN"
dps:
    switch-1:
        dp_id: 0x1
        interfaces:
            1:
                native_vlan: 100
            2:
                native_vlan: 100
```

This example `gauge.yaml` file instructs Gauge to poll the switch at 10s intervals and make the results available to Prometheus. See *Configuration* for more advanced configuration.

```
faucet_configs:
    - '/etc/faucet/faucet.yaml'
watchers:
  port_stats:
      dps: ['switch-1']
      type: 'port_stats'
      interval: 10
      db: 'prometheus'
  flow_table:
      dps: ['switch-1']
      type: 'flow_table'
      interval: 10
      db: 'prometheus'
dbs:
  prometheus:
      type: 'prometheus'
      prometheus_port: 9303
      prometheus_addr: ''
```

1.3.2 Installation using APT

We maintain a apt repo for installing faucet and its dependencies on Debian based Linux distributions.

Here is a list of packages we supply:

Package	Description
python3-faucet	Install standalone faucet/gauge python3 library
faucet	Install python3 library, systemd service and default config files
gauge	Install python3 library, systemd service and default config files
faucet-all-in-one	Install faucet, gauge, prometheus and grafana. Easy to use and good for testing faucet for the first time.

Installation on Debian 8 (jessie)

Installing faucet on jessie requires jessie-backports.

First follow the official instructions on adding the backports repo to jessie.

```
sudo apt-get install curl apt-transport-https gnupg lsb-release
echo "deb https://packagecloud.io/faucetsdn/faucet/$(lsb_release -si | awk '{print␣
↪tolower($0)}')/ $(lsb_release -sc) main" | sudo tee /etc/apt/sources.list.d/faucet.
↪list
curl -L https://packagecloud.io/faucetsdn/faucet/gpgkey | sudo apt-key add -
sudo apt-get install -t jessie-backports python3-oslo.config libjs-jquery libjs-
↪mustache
sudo apt-get update
```

Then to install all components for a fully functioning system on a single machine:

```
sudo apt-get install faucet-all-in-one
```

or you can install the individual components:

```
sudo apt-get install faucet
sudo apt-get install gauge
```

Installation on Debian 9+ and Ubuntu 16.04+

```
sudo apt-get install curl gnupg apt-transport-https lsb-release
echo "deb https://packagecloud.io/faucetsdn/faucet/$(lsb_release -si | awk '{print␣
↪tolower($0)}')/ $(lsb_release -sc) main" | sudo tee /etc/apt/sources.list.d/faucet.
↪list
curl -L https://packagecloud.io/faucetsdn/faucet/gpgkey | sudo apt-key add -
sudo apt-get update
```

Then to install all components for a fully functioning system on a single machine:

```
sudo apt-get install faucet-all-in-one
```

or you can install the individual components:

```
sudo apt-get install faucet
sudo apt-get install gauge
```

1.3.3 Installation with Docker

We provide official automated builds on Docker Hub so that you can easily run Faucet and it's components in a self-contained environment without installing on the main host system.

See our *Docker* section for detauls on how to install and start the Faucet and Gauge docker images.

You can check that Faucet and Gauge are running via systemd or via docker:

```
service faucet status
service gauge status
docker ps
```

1.3.4 Installation with pip

You can install the latest pip package, or you can install directly from git via pip.

First, install some python dependencies:

```
apt-get install python3-dev python3-pip
pip3 install setuptools
pip3 install wheel
```

Then install the latest stable release of faucet from pypi, via pip:

```
pip3 install faucet
```

Or, install the latest development code from git, via pip:

```
pip3 install git+https://github.com/faucetsdn/faucet.git
```

Starting Faucet Manually

Faucet includes a start up script for starting Faucet and Gauge easily from the command line.

To run Faucet manually:

```
faucet --verbose
```

To run Gauge manually:

```
gauge --verbose
```

There are a number of options that you can supply the start up script for changing various options such as OpenFlow port and setting up an encrypted control channel. You can find a list of the additional arguments by running:

```
faucet --help
```

Starting Faucet With Systemd

Systemd can be used to start Faucet and Gauge at boot automatically:

```
$EDITOR /etc/systemd/system/faucet.service
$EDITOR /etc/systemd/system/gauge.service
systemctl daemon-reload
systemctl enable faucet.service
systemctl enable gauge.service
systemctl restart faucet
systemctl restart gauge
```

`/etc/systemd/system/faucet.service` should contain:

Listing 7: faucet.service

```
[Unit]
Description="Faucet OpenFlow switch controller"
After=network-online.target
Wants=network-online.target

[Service]
EnvironmentFile=/etc/default/faucet
User=faucet
Group=faucet
ExecStart=/usr/local/bin/faucet --ryu-config-file=${FAUCET_RYU_CONF} --ryu-ofp-tcp-
↪listen-port=${FAUCET_LISTEN_PORT}
ExecReload=/bin/kill -HUP $MAINPID
Restart=always

[Install]
WantedBy=multi-user.target
```

`/etc/systemd/system/gauge.service` should contain:

Listing 8: gauge.service

```
[Unit]
Description="Gauge OpenFlow statistics controller"
After=network-online.target
Wants=network-online.target

[Service]
EnvironmentFile=/etc/default/gauge
User=faucet
Group=faucet
ExecStart=/usr/local/bin/gauge --ryu-config-file=${GAUGE_RYU_CONF} --ryu-ofp-tcp-
↪listen-port=${GAUGE_LISTEN_PORT} --ryu-wsapi-host=${WSAPI_LISTEN_HOST} --ryu-
↪app=ryu.app.ofctl_rest
Restart=always

[Install]
WantedBy=multi-user.target
```

1.3.5 Virtual Machine Image

We provide a VM image for running FAUCET for development and learning purposes. The VM comes pre-installed with FAUCET, GAUGE, prometheus and grafana.

Openstack's diskimage-builder (DIB) is used to build the VM images in many formats (qcow2,tgz,squashfs,vhd,raw).

We provide DIB elements for configuring each component installed in the VM.

Pre-built images are available on our build host https://builder.faucet.nz.

Building the images

If you don't want to use our pre-built images, you can build them yourself:

1. Install the latest disk-image-builder
2. Install a patched vhd-util
3. Run build-faucet-vm.sh

Security Considerations

This VM is not secure by default, it includes no firewall and has a number of network services listening on all interfaces with weak passwords. It also includes a backdoor user (faucet) with weak credentials.

Services

The VM exposes a number of ports listening on all interfaces by default:

Service	Port
SSH	22
Faucet OpenFlow Channel	6653
Gauge OpenFlow Channel	6654
Grafana Web Interface	3000
Prometheus Web Interface	3000

Default Credentials

Service	Username	Password
VM TTY Console	faucet	faucet
SSH	faucet	faucet
Grafana Web Interface	admin	admin

Post-Install Steps

Grafana comes installed but unconfigured, you will need to login to the grafana web interface at `http://VM_IP:3000` and configure a data source and some dashboards.

After logging in with the default credentials shown above, the first step is to add a prometheus data source, please add `http://localhost:9090` as your data source. Next step is to configure some dashboards, you can add some we have prepared earlier or create your own.

You will need to supply your own faucet.yaml and gauge.yaml configuration in the VM. There are samples provided at /etc/faucet/faucet.yaml and /etc/faucet/gauge.yaml.

Finally you will need to point one of the supported OpenFlow vendors at the controller VM, port 6653 is the Faucet OpenFlow control channel and 6654 is the Gauge OpennFlow control channel for monitoring.

1.4 Docker

1.4.1 Installing docker

We recommend installing Docker Community Edition (CE) according to the official docker engine installation guide.

1.4.2 Initial configuration

```
sudo mkdir -p /etc/faucet
sudo vi /etc/faucet/faucet.yaml
sudo vi /etc/faucet/gauge.yaml
```

See *Installation* and *Configuration* for configuration options.

In particular, see vendor specific docs for additional files that may be necessary in /etc/faucet to configure the switch pipeline.

1.4.3 Official builds

We provide official automated builds on Docker Hub so that you can run Faucet easily without having to build your own.

We use Docker tags to differentiate between versions of Faucet. The latest tag will always point to the latest stable release of Faucet. All tagged versions of Faucet in git are also available to use, for example using the `faucet/faucet:1.7.0` Docker will run the released version 1.7.0 of Faucet.

By default the Faucet and Gauge images are run as the *faucet* user under UID 0, GID 0. If you need to change that it can be overridden at runtime with the Docker flags: `-e LOCAL_USER_ID` and `-e LOCAL_GROUP_ID`.

To pull and run the latest version of Faucet:

```
mkdir -p /var/log/faucet/
docker pull faucet/faucet:latest
docker run -d \
    --name faucet \
    --restart=always \
    -v /etc/faucet/:/etc/faucet/ \
    -v /var/log/faucet/:/var/log/faucet/ \
    -p 6653:6653 \
    -p 9302:9302 \
    faucet/faucet
```

Port 6653 is used for OpenFlow, port 9302 is used for Prometheus - port 9302 may be omitted if you do not need Prometheus.

To pull and run the latest version of Gauge:

```
mkdir -p /var/log/faucet/gauge/
docker pull faucet/gauge:latest
docker run -d \
    --name gauge \
    --restart=always \
    -v /etc/faucet/:/etc/faucet/ \
    -v /var/log/faucet/:/var/log/faucet/ \
    -p 6654:6653 \
```

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```
    -p 9303:9303 \
    faucet/gauge
```

Port 6654 is used for OpenFlow, port 9303 is used for Prometheus - port 9303 may be omitted if you do not need Prometheus.

1.4.4 Additional Arguments

You may wish to run faucet under docker with additional arguments, for example: setting certificates for an encrypted control channel. This can be done by overriding the docker entrypoint like so:

```
docker run -d \
    --name faucet \
    --restart=always \
    -v /etc/faucet/:/etc/faucet/ \
    -v /etc/ryu/ssl/:/etc/ryu/ssl/ \
    -v /var/log/faucet/:/var/log/faucet/ \
    -p 6653:6653 \
    -p 9302:9302 \
    faucet/faucet \
    faucet \
    --ctl-privkey /etc/ryu/ssl/ctrlr.key \
    --ctl-cert /etc/ryu/ssl/ctrlr.cert  \
    --ca-certs /etc/ryu/ssl/sw.cert
```

You can get a list of all additional arguments faucet supports by running:

```
docker run -it faucet/faucet faucet --help
```

1.4.5 Dockerfile

If building Faucet yourself, you first need to build the base images from this repo:

```
cd docker/base
docker build -t faucet/faucet-base .
cd ../python
docker build -t faucet/faucet-python3 .
cd ../..
docker build -t faucet/faucet .
```

It can be run as following:

```
mkdir -p /var/log/faucet/
docker run -d \
    --name faucet \
    --restart=always \
    -v /etc/faucet/:/etc/faucet/ \
    -v /var/log/faucet/:/var/log/faucet/ \
    -p 6653:6653 \
    faucet/faucet
```

By default the Dockerfile for Faucet will build an image that will run as the *faucet* user, if you need to change that it can be overridden at runtime with the Docker *-e LOCAL_USER_ID* flag.

By default it listens on port 6653 for an OpenFlow switch to connect. Faucet expects to find the configuration file faucet.yaml in the config folder. If needed the -e option can be used to specify the names of files with the FAUCET_LOG, FAUCET_EXCEPTION_LOG, FAUCET_CONFIG environment variables.

1.4.6 Dockerfile.gauge

If building Gauge yourself, you first need to build the base images from this repo:

```
cd docker/base
docker build -t faucet/faucet-base .
cd ../python
docker build -t faucet/faucet-python3 .
cd ../..
docker build -f Dockerfile.gauge -t faucet/gauge .
```

It can be run as following:

```
mkdir -p /var/log/faucet
docker run -d \
    --name gauge \
    --restart=always \
    -v /etc/faucet/:/etc/faucet/ \
    -v /var/log/faucet/:/var/log/faucet/ \
    -p 6654:6653 \
    faucet/gauge
```

By default the Dockerfile for Gauge will build an image that will run as the *faucet* user, if you need to change that it can be overridden at runtime with the Docker *-e LOCAL_USER_ID* flag.

By default listens on port 6653. If you are running this with Faucet you will need to modify the port one of the containers listens on and configure your switches to talk to both. The faucet configuration file faucet.yaml should be placed in the config directory, this also should include to configuration for gauge.

1.4.7 Docker compose

This is an example docker-compose file that can be used to set up gauge to talk to Prometheus and InfluxDB with a Grafana instance for dashboards and visualisations.

It can be run with:

```
docker-compose pull
docker-compose up
```

The time-series databases with the default settings will write to `/opt/prometheus/` `/opt/influxdb/shared/data/db` you can edit these locations by modifying the `docker-compose.yaml` file.

On OSX, some of the default shared paths are not accessible, so to overwrite the location that volumes are written to on your host, export an environment varible name `FAUCET_PREFIX` and it will get prepended to the host paths. For example:

```
export FAUCET_PREFIX=/opt/faucet
```

When all the docker containers are running we will need to configure Grafana to talk to Prometheus and InfluxDB. First login to the Grafana web interface on port 3000 (e.g http://localhost:3000) using the default credentials of `admin:admin`.

Then add two data sources. Use the following settings for prometheus:

```
Name: Prometheus
Type: Prometheus
Url: http://prometheus:9090
Access: proxy
```

And the following settings for InfluxDB:

```
Name: InfluxDB
Type: InfluxDB
Url: http://influxdb:8086
Access: proxy
With Credentials: true
Database: faucet
User: faucet
Password: faucet
```

Check the connection using test connection.

From here you can add a new dashboard and a graphs for pulling data from the data sources. See the Grafana's documentation for more on how to do this.

1.5 Configuration

Faucet is configured with a YAML-based configuration file, `faucet.yaml`. The following is example demonstrating a few common features:

Listing 9: faucet.yaml

```
include:
    - acls.yaml

vlans:
    office:
        vid: 100
        description: "office network"
        acls_in: [office-vlan-protect]
        faucet_mac: "0e:00:00:00:10:01"
        faucet_vips: ['10.0.100.254/24', '2001:100::1/64', 'fe80::c00:00ff:fe00:1001/
↪64']
        routes:
            - route:
                ip_dst: '192.168.0.0/24'
                ip_gw: '10.0.100.2'
    guest:
        vid: 200
        description: "guest network"
        faucet_mac: "0e:00:00:00:20:01"
        faucet_vips: ['10.0.200.254/24', '2001:200::1/64', 'fe80::c00:00ff:fe00:2001/
↪64']

routers:
    router-office-guest:
        vlans: [office, guest]

dps:
```

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```
    sw1:
        dp_id: 0x1
        hardware: "Open vSwitch"
        proactive_learn: True
        interfaces:
            1:
                name: "h1"
                description: "host1 container"
                native_vlan: office
                acls_in: [access-port-protect]
            2:
                name: "h2"
                description: "host2 container"
                native_vlan: office
                acls_in: [access-port-protect]
            3:
                name: "g1"
                description: "guest1 container"
                native_vlan: guest
                acls_in: [access-port-protect]
            4:
                name: "s1"
                description: "services1 container"
                native_vlan: office
                acls_in: [service-port-protect]
            5:
                name: "trunk"
                description: "VLAN trunk to sw2"
                tagged_vlans: [office]
                acls_in: [access-port-protect]
    sw2:
        dp_id: 0x2
        hardware: "Allied-Telesis"
        interfaces:
            1:
                name: "pi"
                description: "Raspberry Pi"
                native_vlan: office
                acls_in: [access-port-protect]
            2:
                name: "laptop"
                description: "Guest Laptop"
                native_vlan: guest
                acls_in: [access-port-protect]
            24:
                name: "trunk"
                description: "VLAN trunk to sw1"
                tagged_vlans: [office, guest]
```

Listing 10: acls.yaml

```
acls:
    office-vlan-protect:
        # Prevent IPv4 communication betwen Office/Guest networks
        - rule:
            dl_type: 0x800      # ipv4
```

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```
            ipv4_src: 10.0.100.0/24
            ipv4_dst: 10.0.200.0/24
            actions:
                allow: 0        # drop
        - rule:
            actions:
                allow: 1        # allow

    access-port-protect:
        # Drop dhcp servers
        - rule:
            dl_type: 0x800      # ipv4
            nw_proto: 17        # udp
            udp_src: 67         # bootps
            udp_dst: 68         # bootpc
            actions:
                allow: 0        # drop
        # Drop dhcpv6 servers
        - rule:
            dl_type: 0x86dd     # ipv6
            nw_proto: 17        # udp
            udp_src: 547        # dhcpv6-server
            udp_dst: 546        # dhcpv6-client
            actions:
                allow: 0        # drop
        # Drop icmpv6 RAs
        - rule:
            dl_type: 0x86dd     # ipv6
            nw_proto: 58        # icmpv6
            icmpv6_type: 134    # router advertisement
            actions:
                allow: 0        # drop
        # Drop SMTP
        - rule:
            dl_type: 0x800      # ipv4
            nw_proto: 6         # tcp
            tcp_dst: 25         # smtp
            actions:
                allow: 0        # drop
        # Force DNS to our DNS server
        - rule:
            dl_type: 0x800      # ipv4
            nw_proto: 17        # udp
            udp_dst: 53         # dns
            actions:
                output:
                    dl_dst: "72:b8:3c:4c:dc:4d"
                    port: 5     # s1 container
        # Force DNS to our DNS server
        - rule:
            dl_type: 0x800      # ipv4
            nw_proto: 6         # tcp
            tcp_dst: 53         # dns
            actions:
                output:
                    dl_dst: "72:b8:3c:4c:dc:4d"
                    port: 5     # s1 container
```

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```
        - rule:
            actions:
                allow: 1        # allow

    service-port-protect:
        # Drop icmpv6 RAs
        - rule:
            dl_type: 0x86dd     # ipv6
            nw_proto: 58        # icmpv6
            icmpv6_type: 134    # router advertisement
            actions:
                allow: 0        # drop
        # Drop SMTP
        - rule:
            dl_type: 0x800      # ipv4
            nw_proto: 6         # tcp
            tcp_dst: 25         # smtp
            actions:
                allow: 0        # drop
        - rule:
            actions:
                allow: 1        # allow
```

The datapath ID may be specified as an integer or hex string (beginning with 0x).

A port not explicitly defined in the YAML configuration file will be left down and will drop all packets.

Gauge is configured similarly with, `gauge.yaml`. The following is example demonstrating a few common features:

Listing 11: gauge.yaml

```
# Recommended configuration is Prometheus for all monitoring, with all_dps: True
faucet_configs:
    - '/etc/faucet/faucet.yaml'
watchers:
    port_status_poller:
        type: 'port_state'
        all_dps: True
        #dps: ['sw1', 'sw2']
        db: 'prometheus'
    port_stats_poller:
        type: 'port_stats'
        all_dps: True
        #dps: ['sw1', 'sw2']
        interval: 10
        db: 'prometheus'
        #db: 'influx'
    flow_table_poller:
        type: 'flow_table'
        all_dps: True
        interval: 60
        db: 'prometheus'
dbs:
    prometheus:
        type: 'prometheus'
        prometheus_addr: '0.0.0.0'
        prometheus_port: 9303
```

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```
    ft_file:
        type: 'text'
        compress: True
        file: 'flow_table.yaml.gz'
    influx:
        type: 'influx'
        influx_db: 'faucet'
        influx_host: 'influxdb'
        influx_port: 8086
        influx_user: 'faucet'
        influx_pwd: 'faucet'
        influx_timeout: 10
```

1.5.1 Verifying configuration

You can verify that your configuration is correct with the `check_faucet_config` script:

```
check_faucet_config /etc/faucet/faucet.yaml
```

1.5.2 Configuration examples

For complete working examples of configuration features, see the unit tests, `tests/faucet_mininet_test.py`. For example, `FaucetUntaggedACLTest` shows how to configure an ACL to block a TCP port, `FaucetTaggedIPv4RouteTest` shows how to configure static IPv4 routing.

1.5.3 Applying configuration updates

You can update FAUCET's configuration by sending it a HUP signal. This will cause it to apply the minimum number of flow changes to the switch(es), to implement the change.

```
pkill -HUP -f faucet.faucet
```

1.5.4 Configuration in separate files

Extra DP, VLAN or ACL data can also be separated into different files and included into the main configuration file, as shown below. The `include` field is used for configuration files which are required to be loaded, and Faucet will log an error if there was a problem while loading a file. Files listed on `include-optional` will simply be skipped and a warning will be logged instead.

Files are parsed in order, and both absolute and relative (to the configuration file) paths are allowed. DPs, VLANs or ACLs defined in subsequent files overwrite previously defined ones with the same name.

`faucet.yaml`

```
include:
    - /etc/faucet/dps.yaml
    - /etc/faucet/vlans.yaml

include-optional:
    - acls.yaml
```

dps.yaml

```
# Recursive include is allowed, if needed.
# Again, relative paths are relative to this configuration file.
include-optional:
    - override.yaml

dps:
    test-switch-1:
        ...
    test-switch-2:
        ...
```

1.5.5 Configuration options

Top Level

Table 1: Faucet.yaml

Attribute	Type	Default	Description
acls	dictionary	{}	Configuration specific to acls. The keys are names of each acl, and the values are config dictionaries holding the acl's configuration (see below).
dps	dictionary	{}	Configuration specific to datapaths. The keys are names or dp_ids of each datapath, and the values are config dictionaries holding the datapath's configuration (see below).
routers	dictionary	{}	Configuration specific to routers. The keys are names of each router, and the values are config dictionaries holding the router's configuration (see below).
version	integer	2	The config version. 2 is the only supported version.
vlans	dictionary	{}	Configuration specific to vlans. The keys are names or vids of each vlan, and the values are config dictionaries holding the vlan's configuration (see below).

DP

DP configuration is entered in the 'dps' configuration block. The 'dps' configuration contains a dictionary of configuration blocks each containing the configuration for one datapath. The keys can either be string names given to the datapath, or the OFP datapath id.

Table 2: dps: <dp name or id>: {}

Attribute	Type	Default	Description
arp_neighbor_timeout	type	500	ARP and neighbour timeout in seconds
description	string	None	Description of this datapath, strictly informational
dp_id	integer	The configuration key	the OFP datapath-id of this datapath
drop_bpdu	boolean	True	If True, Faucet will drop all STP BPDUs arriving at the datapath. NB: Faucet does not handle BPDUs itself, if you disable this then you either need to configure an ACL to catch BDPUs or Faucet will forward them as though they were normal traffic.
drop_broadcast_source_address	boolean	True	If True, Faucet will drop any packet from a broadcast source address
drop_lldp	boolean	True	If True, Faucet will drop all LLDP packets arriving at the datapath.
drop_spoofed_faucet_mac	bool	True	If True, Faucet will drop any packet it receives with an ethernet source address equal to a MAC address that Faucet is using.
group_table	bool	False	If True, Faucet will use the OpenFlow Group tables to flood packets. This is an experimental feature that is not fully supported by all devices and may not interoperate with all features of faucet.
hardware	string	"Open vSwitch"	The hardware model of the datapath. Defaults to "Open vSwitch". Other options can be seen in the documentation for valve.py
ignore_learn_ins	integer	3	Ignore every approx nth packet for learning. 2 will ignore 1 out of 2 packets; 3 will ignore 1 out of 3 packets. This limits control plane activity when learning new hosts rapidly. Flooding will still be done by the dataplane even with a packet is ignored for learning purposes.
interfaces	dictionary	{}	configuration block for interface specific config (see below)
interface_ranges	dictionary	{}	contains the config blocks for sets of multiple interfaces. The configuration entered here will be used as the defaults for these interfaces. The defaults can be overwritten by configuring the interfaces individually, which will also inherit all defaults not specifically configured. For example, if the range specifies tagged_vlans: [1, 2, 3], and the individual interface specifies tagged_vlans: [4], the result will be tagged_vlans: [4]. The format for the configuration key is a comma separated string. The elements can either be the name or number of an interface or a range of port numbers eg: "1-6,8,port9".
learn_ban_timeout	integer	10	When a host is rapidly moving between ports Faucet will stop learning mac addresses on one of the ports for this number of seconds.
learn_jitter	integer	10	In order to reduce load on the controller Faucet will randomly vary the timeout for learnt mac addresses by up to this number of seconds.
lldp_beacon	dict	{}	Configuration block for LLDP beacons
max_host_fib_retry_count	integer	10	Limit the number of times Faucet will attempt to resolve a next-hop's l2 address.
max_hosts_per_resolve_cycle	integer	5	Limit the number of hosts resolved per cycle.
max_resolve_backoff_time	integer	32	When resolving next hop l2 addresses, Faucet will back off exponentially until it reaches this value.
name	string	The configuration key	A name to reference the datapath by.

Stacking (DP)

Stacking is configured in the dp configuration block and in the interface configuration block. At the dp level the following attributes can be configured withing the configuration block 'stack':

Table 3: dps: <dp name or id>: stack: {}

Attribute	Type	Default	Description
priority	integer	0	setting any value for stack priority indicates that this datapath should be the root for the stacking topology.

LLDP (DP)

LLDP beacons are configured in the dp and interface configuration blocks.

Note: the LLDP beacon service is specifically NOT to discover topology. It is intended to facilitate physical troubleshooting (e.g. a standard cable tester can display OF port information). A seperate system will be used to probe link/neighbor activity, addressing issues such as authenticity of the probes.

The following attributes can be configured withing the 'lldp_beacon' configuration block at the dp level:

Table 4: dps: <dp name or id>: lldp_beacon: {}

Attribute	Type	Default	Description
system_name	string	The datapath name	seconds between sending beacons
send_interval	integer	None	seconds between sending beacons
max_per_interval	integer	None	the maximum number of beacons, across all ports to send each interval

Interfaces

Configuration for each interface is entered in the 'interfaces' configuration block withing the config for the datapath. Each interface configuration block is a dictionary keyed by the interface name.

Defaults for groups of interfaces can also be configured under the 'interface-ranges' attribute within the datapath configuration block. These provide default values for a number of interfaces which can be overwritten with the config block for an individual interface. These are keyed with a string containing a comma separated list of OFP port numbers, interface names or with OFP port number ranges (eg. 1-6).

Table 5: dps: <dp name or id>: interfaces: <interface name or OFP port number>: {}

Attribute	Type	Default	Description
acl_in	integer or string	None	Deprecated, replaced by acls_in which accepts a list. The acl that should be applied to all packets arriving on this port. referenced by name or list index
acls_in	a list of ACLs, as integers or strings	None	A list of ACLs that should be applied to all packets arriving on this port. referenced by name or list index. ACLs listed first take priority over those later in the list.
description	string	None	Description, purely informational
enabled	boolean	True	Allow packets to be forwarded through this port.
hairpin	boolean	True	If True it allows packets arriving on this port to be output to this port. This is necessary to allow routing between two vlans on this port, or for use with a WIFI radio port.
lldp_beacon	dict	{}	Configuration block for lldp configuration
max_hosts	integer	255	the maximum number of mac addresses that can be learnt on this port.
mirror	a list of integers or strings	None	Mirror all packets recieved and transmitted on the ports specified (by name or by port number), to this port.
name	string	The configuration key.	a name to reference this port by.
native_vlan	integer	None	The vlan associated with untagged packets arriving and leaving this interface.
number	integer	The configuration key.	The OFP port number for this port.
permanent_learn	boolean	False	When True Faucet will only learn the first MAC address on this interface. All packets with an ethernet src address not equal to that MAC address will be dropped.
stack	dictionary	None	configuration block for interface level stacking configuration
tagged_vlans	list of integers or strings	None	The vlans associated with tagged packets arriving and leaving this interfaces.
unicast_flood	boolean	True	If False unicast packets will not be flooded to this port.
output_only	boolean	False	If True, no packets will be accepted from this port.
opstatus_reconf	boolean	True	If True, FAUCET will reconfigure the pipeline based on operational status of the port.

Stacking (Interfaces)

Stacking port configuration indicates how datapaths are connected when using stacking. The configuration is found under the 'stack' attribute of an interface configuration block. The following attributes can be configured:

Table 6: dps: <dp name or id>: interfaces: <interface name or port number: stack: {}

Attribute	Type	Default	Description
dp	integer or string	None	the name of dp_id of the dp connected to this port
port	integer or string	None	the name or OFP port number of the interface on the remote dp connected to this interface.

LLDP (Interfaces)

Interface specific configuration for LLDP.

Table 7: dps: <dp name or id>: interfaces: <interface name or port number: lldp_beacon: {}

Attribute	Type	Default	Description
enable	boolean	False	Enable sending lldp beacons from this interface
org_tlvs	list	[]	Definitions of Organisational TLVs to add to LLDP beacons
port_descr	string	Interface description	Port description to use in beacons from this interface
system_name	string	lldp_beacon (dp) system name	The System Name to use in beacons from this interface

LLDP Organisational TLVs (Interfaces)

Faucet allows defining organisational TLVs for LLDP beacons. These are configured in a list under lldp_beacons/org_tlvs at the interfaces level of configuration.

Each list element contains a dictionary with the following elements:

Table 8: dps: <dp name or id>: interfaces: <interface name or port number: lldp_beacon: org_tlvs: - {}

Attribute	Type	Default	Description
info	string	None	the info field of the tlv, as a hex string
oui	integer	None	the Organisationally Unique Identifier
subtype	integer	None	The organizationally defined subtype

Router

Routers config is used to allow routing between vlans. Routers configuration is entered in the 'routers' configuration block at the top level of the faucet configuration file. Configuration for each router is an entry in the routers dictionary and is keyed by a name for the router. The following attributes can be configured:

Table 9: routers: <router name>: {}

Attribute	Type	Default	Description
vlans	list of integers or strings	None	Enables inter-vlan routing on the given vlans

VLAN

VLANs are configured in the 'vlans' configuration block at the top level of the faucet config file. The config for each vlan is an entry keyed by its vid or a name. The following attributes can be configured:

Table 10: vlans: <vlan name or vid>: {}

Attribute	Type	Default	Description
acl_in	string or integer	None	Deprecated, replaced by acls_in which accepts a list. The acl to be applied to all packets arriving on this vlan.
acls_in	a list of ACLs, as integers or strings	None	The acl to be applied to all packets arriving on this vlan. ACLs listed first take priority over those later in the list.
bgp_as	integer	0	The local AS number to used when speaking BGP
bgp_connect_mode	string	"both"	Whether to try to connect to natives ("active"), listen only ("passive"), or "both".
bgp_local_address	string (IP Address)	None	The local address to use when speaking BGP
bgp_neighbour_addresses	list of strings (IP Addresses)	None	The list of BGP neighbours
bgp_neighbour_as	integer	0	The AS Number for the BGP neighbours
bgp_port	integer	9179	Port to use for bgp sessions
description	string	None	Strictly informational
faucet_vips	list of strings (IP address prefixes)	None	The IP Address for Faucet's routing interface on this vlan
max_hosts	integer	255	The maximum number of hosts that can be learnt on this vlan.
name	string	the configuration key	A name that can be used to refer to this vlan.
proactive_arp_limit	integer	None	Do not proactively ARP for hosts once this value has been reached (unlimited by default)
proactive_nd_limit	integer	None	Don't proactively discover IPv6 hosts once this value has been reached (unlimited by default)
routes	list of routes	None	static routes configured on this vlan (see below)
unicast_flood	boolean	True	If False packets to unknown ethernet destination MAC addresses will be dropped rather than flooded.
vid	integer	the configuration key	The vid for the vlan.

Static Routes

Static routes are given as a list. Each entry in the list contains a dictionary keyed with the keyword 'route' and contains a dictionary configuration block as follows:

Table 11: vlans: <vlan name or vid>: routes: - route: {}

Attribute	Type	Default	Description
ip_dst	string (IP subnet)	None	The destination subnet.
ip_gw	string (IP address)	None	The next hop for this route

ACLs

ACLs are configured under the 'acls' configuration block. The acls block contains a dictionary of individual acls each keyed by its name.

Each acl contains a list of rules: a packet will have the first matching rule applied to it.

Each rule is a dictionary containing the single key 'rule' with matches and actions. Matches are key/values based on the ryu RESTFul API. Actions is a dictionary of actions to apply upon match.

Table 12: : acls: <acl name>: - rule: actions: {}

Attribute	Type	Default	Description
allow	boolean	False	If True allow the packet to continue through the Faucet pipeline, if False drop the packet.
cookie	int, 0-2**16	defaults to datapath cookie value	If set, cookie on this flow will be set to this value.
meter	string	None	meter to apply to the packet
mirror	string or integer	None	Copy the packet, before any modifications, to the specified port (NOTE: mirroring is done in input direction only)
output	dict	None	used to output a packet directly. Details below.

The output action contains a dictionary with the following elements:

Table 13: : acls: <acl name>: - rule: actions: output: {}

Attribute	Type	Default	Description
set_fields	list of dicts	None	A list of fields to set with values, eg. eth_dst: "1:2:3:4:5:6"
port	integer or string	None	The port to output the packet to.
ports	list of [integer or string]	None	The list of ports the packet will be output through.
pop_vlans	boolean	False	Pop vlan tag before output.
vlan_vid	integer	False	Push vlan tag before output.
swap_vid	integer	None	Rewrite the vlan vid of the packet when outputting
vlan_vids	list of [integer or { integer, eth_type }]	None	Push vlan tags on output, with optional eth_type.
failover	dict	None	Output with a failover port (see below).

Failover is an experimental option, but can be configured as follows:

Table 14: : acls: <acl name>: - rule: actions: output: failover: {}

Attribute	Type	Default	Description
group_id	integer	None	The OFP group id to use for the failover group
ports	list	None	The list of ports the packet can be output through.

1.5.6 Environment variables

You can use environment variables to override default behaviour of faucet such as paths for configuration files and port numbers.

Environment Variable	Type	Default	Description
FAUCET_CONFIG	Colon-separated list of file paths	/etc/faucet/faucet.yaml:/etc/ryu/faucet/faucet.yaml	Faucet will load configuration from the first valid file in list
FAUCET_CONFIG_STAT_RELOAD	Boolean	False	If true, faucet will automatically reload itself and apply new configuration when FAUCET_CONFIG changes
FAUCET_LOG_LEVEL	Python log level	INFO	Log verbosity
FAUCET_LOG	File path or STDOUT or STDERR	/var/log/faucet/faucet.log	Location for faucet to log messages to, can be special values STDOUT or STDERR
FAUCET_EXCEPTION_LOG	File path or STDOUT or STDERR	/var/log/faucet/faucet_exception.log	Location for faucet to log exceptions to, can be special values STDOUT or STDERR
FAUCET_EVENT_SOCK	Socket path		Location to a UNIX socket where faucet will write events to, or empty to disable events
FAUCET_PROMETHEUS_PORT	Port	9302	TCP port to listen on for faucet prometheus client
FAUCET_PROMETHEUS_ADDR	IP address	0.0.0.0	IP address to listen on for faucet prometheus client
FAUCET_PIPELINE_DIR	Colon-separated list of file paths	/etc/faucet:/etc/ryu/faucet	Faucet will load pipeline definitions from the first valid directory in list
GAUGE_CONFIG	Colon-separated list of file paths	/etc/faucet/gauge.yaml:/etc/ryu/faucet/gauge.yaml	Gauge will load configuration from the first valid file in list
GAUGE_CONFIG_STAT_RELOAD	Boolean	False	If true, gauge will automatically reload itself and apply new configuration when GAUGE_CONFIG changes
GAUGE_LOG_LEVEL	Python log level	INFO	Log verbosity
GAUGE_LOG	File path or STDOUT or STDERR	/var/log/faucet/gauge.log	Location for gauge to log messages to, can be special values STDOUT or STDERR
GAUGE_EXCEPTION_LOG	File path or STDOUT or STDERR	/var/log/faucet/gauge_exception.log	Location for faucet to log exceptions to, can be special values STDOUT or STDERR
GAUGE_PROMETHEUS_ADDR	IP address	0.0.0.0	IP address to listen on for gauge prometheus client

1.6 Configuration Recipe Book

In this section we will cover some common network configurations and how you would configure these with the Faucet YAML configuration format.

1.6.1 Forwarding

1.6.2 Routing

1.6.3 Policy

1.7 Vendor-specific Documentation

1.7.1 Faucet on Allied Telesis products

Introduction

Allied Telesis has a wide portfolio of OpenFlow enabled switches that all support the Faucet pipeline. These OpenFlow enabled switches come in various port configurations of 10/18/28/52 with POE+ models as well. Here is a list of some of our most popular switches:

- AT-x930
- AT-x510
- AT-x230

Setup

Switch

OpenFlow supported Firmware

OpenFlow has been supported since AlliedWarePlus version 5.4.6 onwards. To inquire more about compatibility of versions, you can contact our customer support team.

OpenFlow configuration

For a **Pure OpenFlow** deployment, we recommend the following configurations on the switch. Most of these configuration steps will be shown with an example.

```
/* Create an OpenFlow native VLAN */
awplus (config)# vlan database
awplus (config-vlan)# vlan 4090

/* Set an IP address for Control Plane(CP)
 * Here we will use vlan1 for Management/Control Plane */
awplus (config)# interface vlan1
awplus (config-if)# ip address 192.168.1.1/24

/* Configure the FAUCET controller
 * Let's use TCP port 6653 for connection to Faucet */
awplus (config)# openflow controller tcp 192.168.1.10 6653

/* (OPTIONAL) Configure GAUGE controller
 * Let's use TCP port 6654 for connection to Gauge */
awplus (config)# openflow controller tcp 192.168.1.10 6654

/* User must set a dedicated native VLAN for OpenFlow ports
 * OpenFlow native VLAN MUST be created before it is set!
```

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```
 * VLAN ID for this native VLAN must be different from the native VLAN for control␣
↪plane */
awplus (config)# openflow native vlan 4090

/* Enable OpenFlow on desired ports */
awplus (config)# interface port1.0.1-1.0.46
awplus (config-if)# openflow

/* Disable Spanning Tree Globally */
awplus (config)# no spanning-tree rstp enable

/* OpenFlow requires that ports under its control do not send any control traffic
 * So it is better to disable RSTP and IGMP Snooping TCN Query Solicitation.
 * Disable IGMP Snooping TCN Query Solicitation on the OpenFlow native VLAN */
awplus (config)# interface vlan4090
awplus (config-if)# no ip igmp snooping tcn query solicit
```

Once OpenFlow is up and running and connected to Faucet/Gauge controller, you should be able to verify the operation using some of our show commands.

```
/* To check contents of the DP flows */
awplus# show openflow flows

/* To check the actual rules as pushed by the controller */
awplus# show openflow rules

/* To check the OpenFlow configuration and other parameters */
awplus# show openflow status
awplus# show openflow config
awplus# show openflow coverage
```

Some other OPTIONAL configuration commands, that may be useful to modify some parameters, if needed.

```
/* Set the OpenFlow version other than default version(v1.3) */
awplus (config)# openflow version 1.0

/* Set IPv6 hardware filter size
 * User needs to configure the following command if a packet needs to be forwarded by␣
↪IPv6 address matching!
 * Please note that this command is supported on AT-x510 and AT-x930 only */
awplus (config)# platform hwfilter-size ipv4-full-ipv6

/* Set the datapath ID(DPID)
 * By default, we use the switch MAC address for datapath-ID.
 * To change the DPID to a hex value 0x1, use the following */
awplus (config)# openflow datapath-id 1

/* NOTE - For all software versions prior to 5.4.7, all VLAN(s) must be included in␣
↪the vlan database config
 * on the switch before they can be used by OpenFlow.
 * Here is an example to create DP VLANs 2-100 */
awplus (config)# vlan database
awplus (config-vlan)# vlan 2-100
```

Faucet

Edit the faucet configuration file (/etc/faucet/faucet.yaml) to add the datapath of the switch you wish to be managed by faucet. This yaml file also contains the interfaces that need to be seen by Faucet as openflow ports. The device type (hardware) should be set to `Allied-Telesis` in the configuration file.

Listing 12: /etc/faucet/faucet.yaml

```
    dps:
        allied-telesis:
            dp_id: 0x0000eccd6d123456
            hardware: "Allied-Telesis"
            interfaces:
                1:
                    native_vlan: 100
                    name: "port1.0.1"
                2:
                    tagged_vlans: [2001,2002,2003]
                    name: "port1.0.2"
                    description: "windscale"
```

References

- Allied Telesis x930
- OpenFlow Configuration Guide

1.7.2 Faucet on HPE-Aruba Switches

Introduction

All the Aruba's v3 generation of wired switches support the FAUCET pipeline. These switches include:

- 5400R
- 3810
- 2930F

The FAUCET pipeline is only supported from `16.03` release of the firmware onwards.

For any queries, please post your question on HPE's SDN forum.

Setup

System & Network Requirements

- Use Serial Console cable to login to the box.
- Use `minicom` for serial terminal @ 115Kbps. Minicom is available on Linux and MacOS (macports) systems.
- Connected Port 1 of Switch to Top of the Rack (TOR) switch which had DHCP and DNS enabled. Mac Address was programmed into DNS/DHCP Server so that IP address of 10.20.5.11 was provided to this box.
- Need a TFTP Server on the network with write access so that we can store system software for upgrade and also certificates. The switch can copy files from a TFTP Server.

Tip: How to clear the password settings

Simultaneously press “Reset” and “Clear” buttons using a paper clip. Release “Reset” button only first. Once the orange power light comes up (after ~5 seconds), release the “Clear” button.

Switch

VLAN/PORT configuration

To ensure any port/vlan configuration specified in the *faucet.yaml* file works, one needs to pre-configure all `vlans` on the switch. Every dataplane port on the switch is made a tagged member of every vlan. This permits FAUCET to perform flow matching and packet-out on any port/vlan combination. The control-plane port (either OOBM or a front-panel port) is kept separate, so that FAUCET does not attempt to modify the control-plane port state.

- *Using OOBM control-plane (3810, 5400R)*

```
// Increase the maximum number of allowed VLANs on the box and save the configuration.
switch (config)# max-vlans 4094
switch (config)# write mem

// Reboot the box for the new max-vlan configuration to take affect.
switch (config)# boot system

// Configure the control-plane IP address
switch (config)# oobm ip address 20.0.0.1/24

// Create maximum number of VLANs and tag every dataplane port available to each vlan.
↪ Takes up to 30 minutes.
switch (config)# vlan 2-4094 tagged all
```

- *Using VLAN control-plane (2930)*

```
// Increase the maximum number of allowed VLANs on the box and save the configuration.
switch (config)# max-vlans 2048
switch (config)# write mem

// Reboot the box for the new max-vlan configuration to take affect.
switch (config)# boot system

// If you have mixed both management and control-plane vlan to a single port (port 1)
switch (config)# vlan 2048 untagged 1

// Alternatively, you can have a separate port for control plane traffic
// Create a control-plane vlan and add a single control-plane port (port 48)
switch (config)# vlan 2048 untagged 48

// Configure the control-plane IP address
// May Not be needed if you have port 1 set to DHCP/Bootp/DNS IP address of 10.20.5.11
switch (config)# vlan 2048 ip address 10.20.5.11/16

// Alternatively, to configure only the control-plane IP address
switch (config)# vlan 2048 ip address 20.0.0.1/24

// Create maximum number of VLANs and tag every dataplane port available to each vlan,
// except for the control-plane vlan (above). Note that the command below assumes it
```

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```
// is run on a 52-port switch, with port 48 as the control-plane. Takes up to 20␣
↪minutes.
switch (config)# vlan 2-2047 tagged 1-47,49-52

// Configure DNS.  Here DNS is set to a local LAN DNS server
switch (config)# ip dns server-address priority 1 10.20.0.1
```

OpenFlow configuration

Aruba switches reference a controller by ID, so first configure the controllers which will be used. The controller-interface matches the control-plane configuration above.

- *Using OOBM control-plane (3810, 5400R)*

```
// Enter OpenFlow context
switch (config)# openflow

// Configure an OpenFlow controller connection for FAUCET over tcp-port 6653
switch(openflow)# controller-id 1 ip 20.0.0.2 port 6653 controller-interface oobm

// Faucet Controller name can be FQDN
switch(openflow)# controller-id 1 hostname controller-1.tenant1.tenants.
↪servicefractal.com port 6653 controller-interface oobm

// Configure an OpenFlow controller connection for Gauge over tcp-port 6654
switch(openflow)# controller-id 2 ip 20.0.0.2 port 6654 controller-interface oobm

// Gauge Controller name can be FQDN
switch(openflow)# controller-id 2 hostname controller-1.tenant1.tenants.
↪servicefractal.com port 6654 controller-interface oobm
```

- *Using VLAN control-plane (2930)*

```
// Enter OpenFlow context
switch (config)# openflow

// Configure an OpenFlow controller connection for FAUCET over tcp-port 6653
switch(openflow)# controller-id 1 ip 20.0.0.2 port 6653 controller-interface vlan 2048

// Faucet Controller name can be FQDN
switch(openflow)# controller-id 1 hostname controller-1.tenant1.tenants.
↪servicefractal.com port 6653 controller-interface vlan 2048

// Configure an OpenFlow controller connection for Gauge over tcp-port 6654
switch(openflow)# controller-id 2 ip 20.0.0.2 port 6654 controller-interface vlan 2048

// Gauge Controller name can be FQDN
switch(openflow)# controller-id 2 hostname controller-1.tenant1.tenants.
↪servicefractal.com port 6654 controller-interface vlan 2048
```

Aruba switches support two OpenFlow instance types:

- **Aggregate** - Every VLAN on the switch apart from the controller/management VLANs are OpenFlow managed.
- **Virtualization** - A set of VLANs configured as members are OpenFlow managed.

Since FAUCET is designed for a pure OpenFlow environment, we choose the "**aggregate**" instance type.

```
// Enter the OpenFlow instance context
switch(openflow)# instance aggregate

// Associate the controllers to the instance
switch(of-inst-aggregate)# controller-id 1
switch(of-inst-aggregate)# controller-id 2

// Associate the controllers in secure mode to the instance
switch(of-inst-aggregate)# controller-id 1 secure
switch(of-inst-aggregate)# controller-id 2 secure


// Configure the OpenFlow version to be 1.3
switch(of-inst-aggregate)# version 1.3 only

// Configure the pipeline model type of the instance. It is a must to set it to␣
↪custom.
switch(of-inst-aggregate)# pipeline-model custom

// Configure the payload in the packet-ins message to be sent in its original form.
switch(of-inst-aggregate)# packet-in vlan-tagging input-form

// Ensure the switch re-attempts an OpenFlow connection at least once
// every 10 seconds when connection is dropped/inactive.
switch(of-inst-aggregate)# max-backoff-interval 10

// Allow OpenFlow to override some protocols which are otherwise excluded from␣
↪OpenFlow processing in switch CPU.
switch(of-inst-aggregate)# override-protocol all
WARNING: Overriding the protocol can also potentially lead to control packets
         of the protocol to bypass any of the security policies like ACL(s).
Continue (y/n)? y

// Enable the instance
switch(of-inst-aggregate)# enable
switch(of-inst-aggregate)# exit

// Enable OpenFlow globally
switch(openflow)# enable
switch(openflow)# exit

// To save the Configuration
switch# save
switch# write mem

// Show running Configuration
switch# show running-config

// Check the OpenFlow instance configuration (includes Datapath ID associated)
switch# show openflow instance aggregate
...

// Easier way to get the Datapath ID associated with the OpenFlow instance
switch# show openflow instance aggregate | include Datapath ID
               Datapath ID                  : 00013863bbc41800
```

At this point, OpenFlow is enabled and running on the switch. If the FAUCET controller is running and has connected to the switch successfully, you should see the FAUCET pipeline programmed on the switch.

```
switch# show openflow instance aggregate flow-table

 OpenFlow Instance Flow Table Information

 Table                          Flow     Miss
 ID    Table Name               Count    Count          Goto Table
 ----- ---------------------- -------- ------------- -------------
 0     Port ACL                 5        0             1, 2, 3, 4...
 1     VLAN                     10       0             2, 3, 4, 5...
 2     VLAN ACL                 1        0             3, 4, 5, 6...
 3     Ethernet Source          2        0             4, 5, 6, 7, 8
 4     IPv4 FIB                 1        0             5, 6, 7, 8
 5     IPv6 FIB                 1        0             6, 7, 8
 6     VIP                      1        0             7, 8
 7     Ethernet Destination     2        0             8
 8     Flood                    21       0             *


 Table
 ID    Table Name               Available Free Flow Count
 ----- ---------------------- ------------------------------
 0     Port ACL                 Ports 1-52          : 46
 1     VLAN                     Ports 1-52          : 91
 2     VLAN ACL                 Ports 1-52          : 50
 3     Ethernet Source          Ports 1-52          : 99
 4     IPv4 FIB                 Ports 1-52          : 100
 5     IPv6 FIB                 Ports 1-52          : 100
 6     VIP                      Ports 1-52          : 20
 7     Ethernet Destination     Ports 1-52          : 99
 8     Flood                    Ports 1-52          : 280

 * Denotes that the pipeline could end here.

switch# show openflow instance aggregate
                Configured OF Version         : 1.3 only
                Negotiated OF Version         : 1.3
                Instance Name                 : aggregate
                Data-path Description         : aggregate
                Administrator Status          : Enabled
                Member List                   : VLAN 1, 2, 3, 4, 5, 6, 7, 8, 9, 10,␣
↪11, 12,
                ............
                ..............

                Controller Id Connection Status Connection State Secure Role
                ------------- ----------------- ---------------- ------ ------
                1              Connected         Active           Yes    Equal
                2              Connected         Active           Yes    Equal

// To just get openflow controllers
switch (openflow)# show openflow controllers

                Controller Information

                Controller Id IP Address        Hostname          Port   Interface
                ------------- ----------------- ----------------- ------ -------------
↪-
```

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```
                1             0.0.0.0           controller-1.t... 6653   VLAN 2048
                2             0.0.0.0           controller-1.t... 6654   VLAN 2048


// Copy Running Config to a TFTP Server
// (first enable TFTP client)
switch (config)# tftp client
```

PKI Setup on switch

Note: Root certificate container supports only one root certificate not a chain. So, install the one that the CSR (Certificate Signing Request) is signed with.

```
switch# show crypto pki application

        Certificate Extension Validation :

        Application      SAN/CN
        ---------------- ------------
        openflow         Disabled
        syslog           Disabled

// Here, we create Service Fractal CA profile
switch (config)# crypto pki ta-profile SERVICEFRACTAL_CA

// Copy the root certificate for the SERVICEFRACTAL_CA from a tftp server
switch#  copy tftp ta-certificate SERVICEFRACTAL_CA 10.10.22.15 tenant1.tenants.
↪servicefractal.com.cert.pem

switch# show crypto pki ta-profile SERVICEFRACTAL_CA
        Profile Name    Profile Status                  CRL Configured  OCSP Configured
        --------------- ------------------------------ --------------- ---------------
        SERVICEFRACTAL_CA 1 certificate installed         No              No

        Trust Anchor:
        Version: 3 (0x2)
        Serial Number: 4096 (0x1000)
        Signature Algorithm: sha256withRSAEncryption
        ...
        ......

        // Now we are ready to create a CSR so that a switch identity certificate␣
↪that is accepted by the controller can be setup.

switch (config)# crypto pki identity-profile hpe_sf_switch1 subject common-name␣
↪myswitch.tenant1.tenants.servicefractal.com org ServiceFractal org-unit vendor-test␣
↪locality MyCity state CA country US

switch (config)# show crypto pki identity-profile
        Switch Identity:
          ID Profile Name    : hpe_sf_switch1
          Common Name (CN) : myswitch.tenant1.tenants.servicefractal.com
        Org Unit (OU)     : vendor-test
```

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```
        Org Name (O)      : ServiceFractal
        Locality (L)      : MyCity
        State (ST)        : CA
        Country (C)       : US

// Generate CSR
switch (config)# crypto pki create-csr certificate-name hpeswt_switch1_crt ta-profile␣
↪SERVICEFRACTAL_CA usage openflow

// Copy the printed CSR request and send it to "SERVICEFRACTAL_CA"

switch (config)# show crypto pki local-certificate summary
        Name                 Usage         Expiration     Parent / Profile
        -------------------- ------------- -------------- --------------------
        hpeswt_switch1_crt   Openflow      CSR            SERVICEFRACTAL_CA

// Once the signed certificate is received, copy the same to switch.
switch (config)# copy tftp local-certificate 10.10.22.15 myswitch.tenant1.tenants.
↪servicefractal.com.cert.pem
        000M Transfer is successful

switch (config)# show crypto pki local-certificate summary
        Name                 Usage         Expiration     Parent / Profile
        -------------------- ------------- -------------- --------------------
        hpeswt_switch1_crt   Openflow      2019/01/02     SERVICEFRACTAL_CA
```

Faucet

On the FAUCET configuration file (`/etc/faucet/faucet.yaml`), add the datapath of the switch you wish to be managed by FAUCET. The device type (hardware) should be set to `Aruba` in the configuration file.

Listing 13: /etc/faucet/faucet.yaml

```
    dps:
        aruba-3810:
            dp_id: 0x00013863bbc41800
            hardware: "Aruba"
            interfaces:
                1:
                    native_vlan: 100
                    name: "port1"
                2:
                    native_vlan: 100
                    name: "port2"
```

You will also need to install pipeline configuration files (these files instruct FAUCET to configure the switch with the right OpenFlow tables - these files and FAUCET's pipeline must match).

```
$ sudo cp etc/faucet/ofproto_to_ryu.json /etc/faucet
$ sudo cp etc/faucet/aruba_pipeline.json /etc/faucet
```

Scale

Most tables in the current FAUCET pipeline need wildcards and hence use TCAMs in hardware. There are 2000 entries available globally for the whole pipeline. Currently, it has been distributed amongst the 9 tables as follows:

Table	Maximum Entries
Port ACL	50
VLAN	300
VLAN ACL	50
ETH_SRC	500
IPv4 FIB	300
IPv6 FIB	10
VIP	10
ETH_DST	500
FLOOD	300

Based on one's deployment needs, these numbers can be updated for each table (update max_entries in `$(REPO_ROOT)/faucet/aruba/aruba_pipeline.json`).

Note: The summation of max entries across all 9 tables cannot cross 2000 and the minimum size of a given table has to be 2. You need to restart FAUCET for the new numbers to reflect on the switch.

Limitations

- Aruba switches currently does not support all the `IPv6` related functionality inside FAUCET
- Aruba switches currently does not support the `OFPAT_DEC_NW_TTL` action (so when routing, TTL will not be decremented).

Debug

If you encounter a failure or unexpected behavior, it may help to enable debug output on Aruba switches. Debug output displays information about what OpenFlow is doing on the switch at message-level granularity.

```
switch# debug openflow
switch# debug destination session
switch# show debug

 Debug Logging

  Source IP Selection: Outgoing Interface
  Origin identifier: Outgoing Interface IP
  Destination:
   Session

  Enabled debug types:
   openflow
   openflow packets
   openflow events
   openflow errors
   openflow packets tx
   openflow packets rx
   openflow packets tx pkt_in
   openflow packets rx pkt_out
   openflow packets rx flow_mod
```

References

- Aruba OpenFlow Administrator Guide (16.03)
- Aruba OS version as of Dec 2017 is 16.05
- Aruba Switches
- FAUCET
- Model 2390F Product Site
- 2930F top level documentation
- Password settings
- PKI Setup

1.7.3 Faucet on Lagopus

Introduction

Lagopus is a software OpenFlow 1.3 switch, that also supports DPDK.

FAUCET is supported as of Lagopus 0.2.11 (https://github.com/lagopus/lagopus/issues/107).

Setup

Lagopus install on a supported Linux distribution

Install Lagopus according to the quickstart guide. You don't need to install Ryu since we will be using FAUCET and FAUCET's installation takes care of that dependency.

These instructions are for Ubuntu 16.0.4 (without DPDK). In theory any distribution, with or without DPDK, that Lagopus supports will work with FAUCET.

Create lagopus.dsl configuration file

In this example, Lagopus is controlling two ports, enp1s0f0 and enp1s0f1, which will be known as OpenFlow ports 1 and 2 on DPID 0x1. FAUCET and Lagopus are running on the same host (though of course, they don't need to be).

Listing 14: /usr/local/etc/lagopus/lagopus.dsl

```
channel channel01 create -dst-addr 127.0.0.1 -protocol tcp

controller controller01 create -channel channel01 -role equal -connection-type main

interface interface01 create -type ethernet-rawsock -device enp1s0f0

interface interface02 create -type ethernet-rawsock -device enp1s0f1

port port01 create -interface interface01

port port02 create -interface interface02

bridge bridge01 create -controller controller01 -port port01 1 -port port02 2 -dpid␣
↪0x1
bridge bridge01 enable
```

Create faucet.yaml

Listing 15: /etc/faucet/faucet.yaml

```
vlans:
    100:
        name: "test"
dps:
    lagopus-1:
        dp_id: 0x1
        hardware: "Lagopus"
        interfaces:
            1:
                native_vlan: 100
            2:
                native_vlan: 100
```

Start Lagopus

Start in debug mode, in a dedicated terminal.

```
lagopus -d
```

Run FAUCET

```
faucet --verbose --ryu-ofp-listen-host=127.0.0.1
```

Test connectivity

Host(s) on enp1s0f0 and enp1s0f1 in the same IP subnet, should now be able to communicate, and FAUCET's log file should indicate learning is occurring:

Listing 16: /var/log/faucet/faucet.log

```
  May 11 13:04:57 faucet.valve INFO     DPID 1 (0x1) Configuring DP
  May 11 13:04:57 faucet.valve INFO     DPID 1 (0x1) Delete VLAN vid:100 ports:1,2
  May 11 13:04:57 faucet.valve INFO     DPID 1 (0x1) VLANs changed/added: [100]
  May 11 13:04:57 faucet.valve INFO     DPID 1 (0x1) Configuring VLAN vid:100 ports:1,
↪2
  May 11 13:04:57 faucet.valve INFO     DPID 1 (0x1) Configuring VLAN vid:100 ports:1,
↪2
  May 11 13:04:57 faucet.valve INFO     DPID 1 (0x1) Port 1 added
  May 11 13:04:57 faucet.valve INFO     DPID 1 (0x1) Sending config for port 1
  May 11 13:04:57 faucet.valve INFO     DPID 1 (0x1) Port 2 added
  May 11 13:04:57 faucet.valve INFO     DPID 1 (0x1) Sending config for port 2
  May 11 13:04:57 faucet.valve INFO     DPID 1 (0x1) Packet_in src:00:16:41:6d:87:28␣
↪in_port:1 vid:100
  May 11 13:04:57 faucet.valve INFO     learned 1 hosts on vlan 100
  May 11 13:04:57 faucet.valve INFO     DPID 1 (0x1) Packet_in src:00:16:41:32:87:e0␣
↪in_port:2 vid:100
  May 11 13:04:57 faucet.valve INFO     learned 2 hosts on vlan 100
```

1.7.4 Faucet on ZodiacFX

Introduction

ZodiacFX is a small 4 port multi table OF1.3 switch from Northbound Networks.

Caveats

- ZodiacFX allows only one controller (so you cannot run Gauge).
- The default OF port is 6633; it is recommended to use 6653.
- It is recommended to enable ether type filtering to minimize corrupt packets.

Applying recommended config

You can use the following expect script to program the recommended configuration:

Listing 17: conf-zodiac.sh

```
#!/usr/bin/expect

##
## configure ZodiacFX with recommended settings.
##

# Serial port assigned to ZodiacFX
set port /dev/ttyACM0

set timeout 5
set prompt {Zodiac_FX\#}
set configprompt {Zodiac_FX\(config\)\#}
set spawned [spawn -open [open $port w+]]

send_user "get initial prompt\n"
send "\r"
send "\r"
expect -re $prompt
send_user "found initial prompt\n"
send "config\r"
expect -re $configprompt
send_user "setting ethertype-filter\n"
send "set ethertype-filter enable\r"
expect -re $configprompt
send_user "setting of-port"
send "set of-port 6653\r"
expect -re $configprompt
send "save\r"
expect -re $configprompt
send "exit\r"
expect -re $prompt
send "restart\r"
expect -re "Restarting"
```

Example of running the script:

```
$ sudo ./conf-zodiac.sh
spawn [open ...]
get initial prompt


 _____                ___                  _______  __
/__  /  _____  _____/ (_)___ _______    / ____/ |/ /
  / /  / __ \/ __  / / __ `/ ___/  / /_   |   /
 / /__/ /_/ / /_/ / / /_/ / /__   / __/  /   |
/____/\____/\__,_/_/\__,_/\___/  /_/    /_/|_|
                by Northbound Networks


Type 'help' for a list of available commands

Zodiac_FX#
Zodiac_FX# found initial prompt
config
Zodiac_FX(config)# setting ethertype-filter
set ethertype-filter enable
```

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```
EtherType Filtering Enabled
Zodiac_FX(config)# setting of-portset of-port 6653
OpenFlow Port set to 6653
Zodiac_FX(config)# save
Writing Configuration to EEPROM (197 bytes)
Zodiac_FX(config)# exit
Zodiac_FX# restart
Restarting the Zodiac FX, please reopen your terminal application.
```

1.7.5 Faucet on NoviFlow

Introduction

NoviFlow provide a range of switches known to work with FAUCET.

These instructions have been tested on NS1248, NS1132, NS2116, NS2128, NS2122, NS2150, NS21100 switches, using software versions NW400.1.8 to NW400.3.1, running with FAUCET v1.6.4.

When using a more recent FAUCET version, different table configurations may be required.

Setup

Configure the CPN on the switch

In this example, the server running FAUCET is 10.0.1.8; configuration for CPN interfaces is not shown.

```
set config controller controllergroup faucet controllerid 1 priority 1 ipaddr 10.0.1.
↪8 port 6653 security none
set config controller controllergroup gauge controllerid 1 priority 1 ipaddr 10.0.1.8␣
↪port 6654 security none
set config switch dpid 0x1
```

Configure the tables

These matches are known to pass the unit tests as of FAUCET 1.6.18, but take care to adjust ACL tables matches based on the type of ACL rules defined in the configuration file. Different FAUCET releases may also use different match fields in the other tables.

```
set config pipeline tablesizes 1524 1024 1024 5000 3000 1024 1024 5000 1024␣
↪tablewidths 80 40 40 40 40 40 40 40 40
set config table tableid 0 matchfields 0 3 4 5 6 10 11 12 13 14 23 29 31
set config table tableid 1 matchfields 0 3 4 5 6
set config table tableid 2 matchfields 0 5 6 10 11 12 14
set config table tableid 3 matchfields 0 3 4 5 6 10
set config table tableid 4 matchfields 5 6 12
set config table tableid 5 matchfields 5 6 27
set config table tableid 6 matchfields 3 5 10 23 29
set config table tableid 7 matchfields 0 3 6
set config table tableid 8 matchfields 0 3 6
```

Note that this table configuration will allow most of the automated test cases to pass, except FaucetIPv6TupleTest (which requires IPv6 Src and Dst matching in the ACL table). In order to run this test, table 0 must be configured as follows:

```
set config table tableid 0 matchfields 0 5 6 10 26 27 13 14
```

Create faucet.yaml

Listing 18: /etc/faucet/faucet.yaml

```
vlans:
    100:
        name: "test"
dps:
    noviflow-1:
        dp_id: 0x1
        hardware: "NoviFlow"
        interfaces:
            1:
                native_vlan: 100
            2:
                native_vlan: 100
```

Run FAUCET

```
faucet --verbose
```

Test connectivity

Host(s) on ports 1 and 2 should now be able to communicate, and FAUCET's log file should indicate learning is occurring:

Listing 19: /var/log/faucet/faucet.log

```
May 14 17:06:15 faucet DEBUG    DPID 1 (0x1) connected
May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) Configuring DP
May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) Delete VLAN vid:100 ports:1,2,3,4
May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) VLANs changed/added: [100]
May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) Configuring VLAN vid:100 ports:1,
↪2,3,4
May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) Configuring VLAN vid:100 ports:1,
↪2,3,4
May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) Port 1 added
May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) Sending config for port 1
May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) Port 2 added
May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) Sending config for port 2
May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) Port 3 added
May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) Sending config for port 3
May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) Port 4 added
May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) Sending config for port 4
May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) Packet_in src:62:4c:f5:bb:33:3c␣
↪in_port:2 vid:100
```

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```
  May 14 17:06:15 faucet.valve INFO     learned 1 hosts on vlan 100
  May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) Packet_in src:62:4c:f5:bb:33:3c␣
↪in_port:2 vid:100
  May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) Packet_in src:2a:e1:65:3c:49:e4␣
↪in_port:3 vid:100
  May 14 17:06:15 faucet.valve INFO     DPID 1 (0x1) Packet_in src:2a:e1:65:3c:49:e4␣
↪in_port:3 vid:100
  May 14 17:06:15 faucet.valve INFO     learned 2 hosts on vlan 100
```

1.7.6 Faucet on OVS with DPDK

Introduction

Open vSwitch is a software OpenFlow switch, that supports DPDK. It is also the reference switching platform for FAUCET.

Setup

Install OVS on a supported Linux distribution

Install OVS and DPDK per the official OVS instructions, including enabling DPDK at compile time and in OVS's initial configuration.

These instructions are known to work for Ubuntu 16.0.4, with OVS 2.7.0 and DPDK 16.11.1, kernel 4.4.0-77. In theory later versions of these components should work without changes. A multiport NIC was used, based on the Intel 82580 chipset.

Bind NIC ports to DPDK

Note: If you have a multiport NIC, you must bind all the ports on the NIC to DPDK, even if you do not use them all.

From the DPDK source directory, determine the relationship between the interfaces you want to use with DPDK and their PCI IDs:

```
export DPDK_DIR=`pwd`
$DPDK_DIR/tools/dpdk-devbind.py --status
```

In this example, we want to use enp1s0f0 and enp1s0f1.

```
$ ./tools/dpdk-devbind.py --status

Network devices using DPDK-compatible driver
============================================
<none>

Network devices using kernel driver
===================================
0000:01:00.0 '82580 Gigabit Network Connection' if=enp1s0f0 drv=igb unused=
0000:01:00.1 '82580 Gigabit Network Connection' if=enp1s0f1 drv=igb unused=
```

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```
0000:01:00.2 '82580 Gigabit Network Connection' if=enp1s0f2 drv=igb unused=
0000:01:00.3 '82580 Gigabit Network Connection' if=enp1s0f3 drv=igb unused=
```

Still from the DPDK source directory:

```
export DPDK_DIR=`pwd`
modprobe vfio-pci
chmod a+x /dev/vfio
chmod 0666 /dev/vfio/*
$DPDK_DIR/tools/dpdk-devbind.py --bind=vfio-pci 0000:01:00.0 0000:01:00.1 0000:01:00.
↪2 0000:01:00.3
$DPDK_DIR/tools/dpdk-devbind.py --status
```

Confirm OVS has been configured to use DPDK

```
$ sudo /usr/local/share/openvswitch/scripts/ovs-ctl stop
* Exiting ovs-vswitchd (20510)
* Exiting ovsdb-server (20496)
$ sudo /usr/local/share/openvswitch/scripts/ovs-ctl start
* Starting ovsdb-server
* system ID not configured, please use --system-id
* Configuring Open vSwitch system IDs
EAL: Detected 4 lcore(s)
EAL: Probing VFIO support...
EAL: VFIO support initialized
EAL: PCI device 0000:01:00.0 on NUMA socket -1
EAL:   probe driver: 8086:150e net_e1000_igb
EAL:   using IOMMU type 1 (Type 1)
EAL: PCI device 0000:01:00.1 on NUMA socket -1
EAL:   probe driver: 8086:150e net_e1000_igb
EAL: PCI device 0000:01:00.2 on NUMA socket -1
EAL:   probe driver: 8086:150e net_e1000_igb
EAL: PCI device 0000:01:00.3 on NUMA socket -1
EAL:   probe driver: 8086:150e net_e1000_igb
EAL: PCI device 0000:02:00.0 on NUMA socket -1
EAL:   probe driver: 8086:150e net_e1000_igb
EAL: PCI device 0000:02:00.1 on NUMA socket -1
EAL:   probe driver: 8086:150e net_e1000_igb
EAL: PCI device 0000:02:00.2 on NUMA socket -1
EAL:   probe driver: 8086:150e net_e1000_igb
EAL: PCI device 0000:02:00.3 on NUMA socket -1
EAL:   probe driver: 8086:150e net_e1000_igb
Zone 0: name:<rte_eth_dev_data>, phys:0x7ffced40, len:0x30100, virt:0x7f843ffced40,␣
↪socket_id:0, flags:0
* Starting ovs-vswitchd
* Enabling remote OVSDB managers
```

Configure an OVS bridge with the DPDK ports

```
ovs-vsctl add-br br0 -- set bridge br0 datapath_type=netdev protocols=OpenFlow13
ovs-vsctl add-port br0 dpdk0 -- set interface enp1s0f0 type=dpdk options:dpdk-
↪devargs=0000:01:00.0
```

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```
ovs-vsctl add-port br0 dpdk1 -- set interface enp1s0f1 type=dpdk options:dpdk-
↪devargs=0000:01:00.1
ovs-vsctl set-fail-mode br0 secure
ovs-vsctl set-controller br0 tcp:127.0.0.1:6653
ovs-ofctl show br0
ovs-vsctl get bridge br0 datapath_id
```

Create faucet.yaml

Note: Change dp_id, to the value reported above, prefaced with "0x".

Listing 20: /etc/faucet/faucet.yaml

```
  vlans:
      100:
          name: "test"
  dps:
      ovsdpdk-1:
          dp_id: 0x000090e2ba7e7564
          hardware: "Open vSwitch"
          interfaces:
              1:
                  native_vlan: 100
              2:
                  native_vlan: 100
```

Run FAUCET

```
faucet --verbose --ryu-ofp-listen-host=127.0.0.1
```

Test connectivity

Host(s) on enp1s0f0 and enp1s0f1 in the same IP subnet, should now be able to communicate, and FAUCET's log file should indicate learning is occurring:

Listing 21: /var/log/faucet/faucet.log

```
  May 11 14:53:32 faucet.valve INFO     DPID 159303465858404 (0x90e2ba7e7564)␣
↪Configuring DP
  May 11 14:53:32 faucet.valve INFO     DPID 159303465858404 (0x90e2ba7e7564) Delete␣
↪VLAN vid:100 ports:1,2
  May 11 14:53:32 faucet.valve INFO     DPID 159303465858404 (0x90e2ba7e7564) VLANs␣
↪changed/added: [100]
  May 11 14:53:32 faucet.valve INFO     DPID 159303465858404 (0x90e2ba7e7564)␣
↪Configuring VLAN vid:100 ports:1,2
  May 11 14:53:32 faucet.valve INFO     DPID 159303465858404 (0x90e2ba7e7564)␣
↪Configuring VLAN vid:100 ports:1,2
  May 11 14:53:32 faucet.valve INFO     DPID 159303465858404 (0x90e2ba7e7564) Port 1␣
↪added
```

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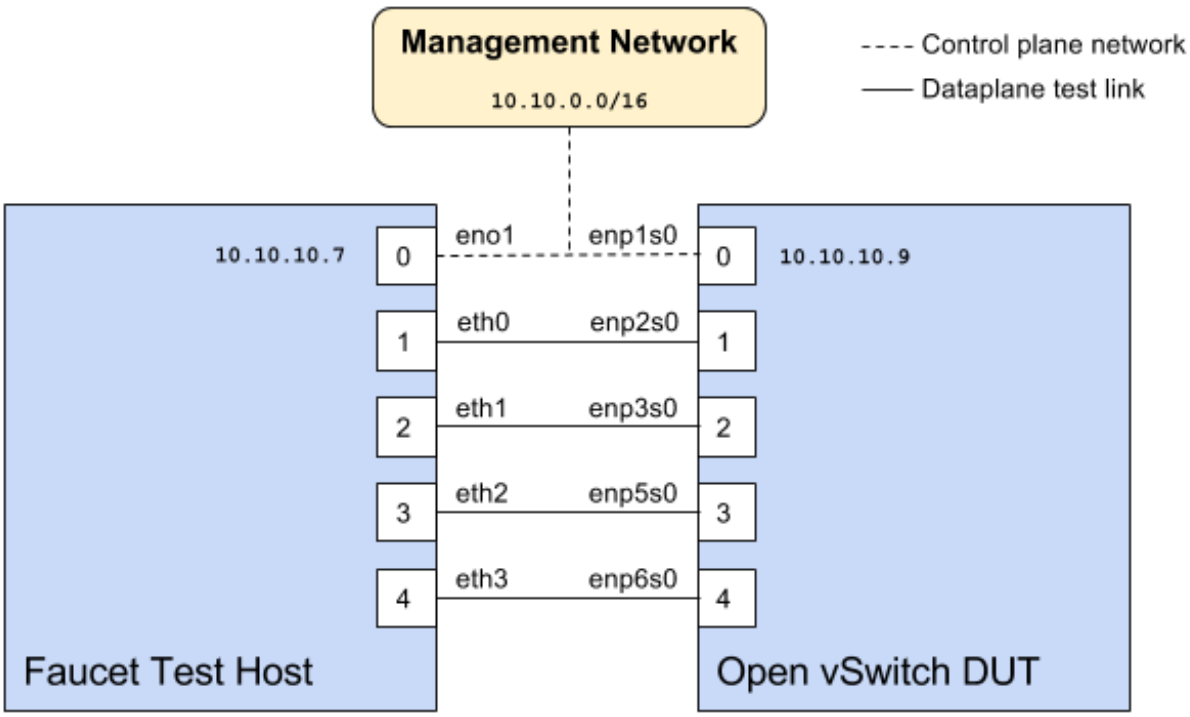
```
 May 11 14:53:32 faucet.valve INFO     DPID 159303465858404 (0x90e2ba7e7564) Sending␣
↪config for port 1
 May 11 14:53:32 faucet.valve INFO     DPID 159303465858404 (0x90e2ba7e7564) Port 2␣
↪added
 May 11 14:53:32 faucet.valve INFO     DPID 159303465858404 (0x90e2ba7e7564) Sending␣
↪config for port 2
 May 11 14:53:33 faucet.valve INFO     DPID 159303465858404 (0x90e2ba7e7564) Packet_
↪in src:00:16:41:6d:87:28 in_port:1 vid:100
 May 11 14:53:33 faucet.valve INFO     learned 1 hosts on vlan 100
 May 11 14:53:33 faucet.valve INFO     DPID 159303465858404 (0x90e2ba7e7564) Packet_
↪in src:00:16:41:32:87:e0 in_port:2 vid:100
 May 11 14:53:33 faucet.valve INFO     learned 2 hosts on vlan 100
```

1.7.7 Faucet Testing with OVS on Hardware

Setup



Faucet configuration file

Listing 22: /etc/faucet/hw_switch_config.yaml

```
# Faucet Configuration file: /etc/faucet/hw_switch_config.yaml
#
# If hw_switch value set to True, map a hardware OpenFlow switch to ports on this␣
↪machine.
```

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```
# Otherwise, run tests against OVS locally.
hw_switch: True
hardware: 'Open vSwitch'
dp_ports:
  1: eth0
  2: eth1
  3: eth2
  4: eth3

# Hardware switch's DPID
dpid: 0xacd28f18b
cpn_intf: eno1
of_port: 6636
gauge_of_port: 6637
```

Hardware

1. For Network Interface Cards (NICs), prefer Intel branded models.
2. I have also used Hi-Speed USB to dual Ethernet which works great

Software

1. Ubuntu 16.04 Xenial
2. Open vSwitch 2.7.2+

Commands

Commands to be executed on each side - **Faucet Test host** and **Open vSwitch**.

Commands on Faucet Test Host

Run these commands as root on the Ubuntu system (v16.04 used)

```
$ sudo mkdir -p /usr/local/src/
$ sudo mkdir -p /etc/faucet/
$ sudo cd /usr/local/src/
$ sudo git clone https://github.com/faucetsdn/faucet.git
$ cd faucet
$ sudo ip address show
  1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default␣
↪qlen 1000
  link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
  inet 127.0.0.1/8 scope host lo
  valid_lft forever preferred_lft forever
  inet6 ::1/128 scope host
  valid_lft forever preferred_lft forever
  2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP group default␣
↪qlen 1000
  link/ether b4:96:91:00:88:a4 brd ff:ff:ff:ff:ff:ff
  inet6 fe80::b696:91ff:fe00:88a4/64 scope link
```

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```
  valid_lft forever preferred_lft forever
  3: eth1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP group default␣
↪qlen 1000
  link/ether b4:96:91:00:88:a5 brd ff:ff:ff:ff:ff:ff
  inet6 fe80::b696:91ff:fe00:88a5/64 scope link
  valid_lft forever preferred_lft forever
  4: eth2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP group default␣
↪qlen 1000
  link/ether b4:96:91:00:88:a6 brd ff:ff:ff:ff:ff:ff
  inet6 fe80::b696:91ff:fe00:88a6/64 scope link
  valid_lft forever preferred_lft forever
  5: eth3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP group default␣
↪qlen 1000
  link/ether b4:96:91:00:88:a7 brd ff:ff:ff:ff:ff:ff
  inet6 fe80::b696:91ff:fe00:88a7/64 scope link
  valid_lft forever preferred_lft forever
  6: eno1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP group default␣
↪qlen 1000
  link/ether 00:1e:67:ff:f6:80 brd ff:ff:ff:ff:ff:ff
  inet 10.10.10.7/16 brd 10.20.255.255 scope global eno1
  valid_lft forever preferred_lft forever
  inet6 cafe:babe::21e:67ff:feff:f680/64 scope global mngtmpaddr dynamic
  valid_lft 86398sec preferred_lft 14398sec
  inet6 fe80::21e:67ff:feff:f680/64 scope link
  valid_lft forever preferred_lft forever
```

Tip: To locate the corresponding physical port, you can make the port LED blink with *Ethtool*.

Commands on Open vSwitch

Login as `root` on the Ubuntu system and install OpenvSwitch and start `openvswitch-switch` service

```
$ sudo apt-get install openvswitch-switch
$ sudo systemctl status openvswitch-switch.service
$ sudo ovs-vsctl add-br ovs-br0
$ sudo ovs-vsctl add-port ovs-br0 enp2s0 -- set Interface enp2s0  ofport_request=1
$ sudo ovs-vsctl add-port ovs-br0 enp3s0 -- set Interface enp3s0  ofport_request=2
$ sudo ovs-vsctl add-port ovs-br0 enp5s0 -- set Interface enp5s0  ofport_request=3
$ sudo ovs-vsctl add-port ovs-br0 enp6s0 -- set Interface enp6s0  ofport_request=4
$ sudo ovs-vsctl set-fail-mode ovs-br0 secure
$ sudo ovs-vsctl set bridge ovs-br0 protocols=OpenFlow13
$ sudo ovs-vsctl set-controller ovs-br0 tcp:10.10.10.7:6636 tcp:10.10.10.7:6637
$ sudo ovs-vsctl get bridge ovs-br0 datapath_id
$ sudo ovs-vsctl show
  308038ec-495d-412d-9b13-fe95bda4e176
      Bridge "ovs-br0"
          Controller "tcp:10.10.10.7:6636"
          Controller "tcp:10.10.10.7:6637"
          Port "enp3s0"
              Interface "enp3s0"
             Port "enp2s0"
              Interface "enp2s0"
           Port "enp6s0"
```

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```
            Interface "enp6s0"
        Port "ovs-br0"
            Interface "ovs-br0"
                type: internal
        Port "enp5s0"
            Interface "enp5s0"
                type: system
    ovs_version: "2.7.0"

$ sudo ovs-vsctl -- --columns=name,ofport list Interface
  name                : "ovs-br0"
  ofport              : 65534

  name                : "enp5s0"
  ofport              : 3

  name                : "enp2s0"
  ofport              : 1

  name                : "enp6s0"
  ofport              : 4

  name                : "enp3s0"
  ofport              : 2
```

Tip: To locate the corresponding physical port, you can make the port LED blink with *Ethtool*.

Check port speed information to make sure that they are at least 1Gbps

```
$ sudo ovs-ofctl -O OpenFlow13 dump-ports-desc ovs-br0
    OFPST_PORT_DESC reply (OF1.3) (xid=0x2):
     1(enp2s0): addr:00:0e:c4:ce:77:25
         config:     0
         state:      0
         current:    1GB-FD COPPER AUTO_NEG
         advertised: 10MB-HD 10MB-FD 100MB-HD 100MB-FD 1GB-FD COPPER AUTO_NEG AUTO_
↪PAUSE
         supported:  10MB-HD 10MB-FD 100MB-HD 100MB-FD 1GB-FD COPPER AUTO_NEG AUTO_
↪PAUSE
         speed: 1000 Mbps now, 1000 Mbps max
     2(enp3s0): addr:00:0e:c4:ce:77:26
         config:     0
         state:      0
         current:    1GB-FD COPPER AUTO_NEG
         advertised: 10MB-HD 10MB-FD 100MB-HD 100MB-FD 1GB-FD COPPER AUTO_NEG AUTO_
↪PAUSE
         supported:  10MB-HD 10MB-FD 100MB-HD 100MB-FD 1GB-FD COPPER AUTO_NEG AUTO_
↪PAUSE
         speed: 1000 Mbps now, 1000 Mbps max
     3(enp5s0): addr:00:0e:c4:ce:77:27
         config:     0
         state:      0
         current:    1GB-FD COPPER AUTO_NEG
         advertised: 10MB-HD 10MB-FD 100MB-HD 100MB-FD 1GB-FD COPPER AUTO_NEG AUTO_
↪PAUSE
```

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```
         supported:  10MB-HD 10MB-FD 100MB-HD 100MB-FD 1GB-FD COPPER AUTO_NEG AUTO_
↪PAUSE
         speed: 1000 Mbps now, 1000 Mbps max
     4(enp6s0): addr:00:0a:cd:28:f1:8b
         config:     0
         state:      0
         current:    1GB-FD COPPER AUTO_NEG
         advertised: 10MB-HD COPPER AUTO_NEG AUTO_PAUSE AUTO_PAUSE_ASYM
         supported:  10MB-HD 10MB-FD 100MB-HD 100MB-FD 1GB-HD 1GB-FD COPPER AUTO_NEG
         speed: 1000 Mbps now, 1000 Mbps max
     LOCAL(ovs-br0): addr:00:0a:cd:28:f1:8b
         config:     PORT_DOWN
         state:      LINK_DOWN
         speed: 0 Mbps now, 0 Mbps max
```

Running the tests

Edit the */etc/faucet/hw_switch_config.yaml* file as shown earlier in this document setting `hw_switch=False` initially for testing.

```
$ sudo cp /usr/local/src/faucet/hw_switch_config.yaml /etc/faucet/hw_switch_config.
↪yaml
$ sudo $EDITOR /etc/faucet/hw_switch_config.yaml
$ cd /usr/local/src/faucet/
```

Install docker by following the *Installing docker* section and then run the hardware based tests by following the *Running the tests* section.

Once the above minitest version is successful with `hw_switch=False`, then edit the */etc/faucet/hw_switch_config.yaml* file and set `hw_switch=True`.

Run tests again, verify they all pass.

Debugging

TCPDump

Many times, we want to know what is coming in on a port. To check on interface `enp2s0`, for example, use

```
$ sudo tcpdump -A -w enp2s0_all.pcap -i enp2s0
```

Or

```
$ sudo tcpdump -A -w enp2s0_all.pcap -i enp2s0 'dst host <controller-ip-address> and␣
↪port 6653'
```

To read the pcap file, use

```
$ sudo tcpdump -r enp2s0_all.pcap
```

More detailed examples are available @ https://www.wains.be/pub/networking/tcpdump_advanced_filters.txt

---

Note: On which machine should one run tcpdump?

Depends, if you want to examine the packet_ins tht are sent from switch to controller, run on the switch listening on the interface that is talking to the controller. If you are interested on what is coming in on a particular test port, then run it on the Test Host on that interface.

Ethtool

To locate a physical port say `enp2s0`, make the LED blink for 5 seconds:

```
$ sudo ethtool -p enp2s0 5
```

To figure out speed on the interface. Note that if Speed on the interface is at least not 1G, then tests may not run correctly.

```
$ sudo ethtool enp2s0
$ sudo ethtool enp2s0 | grep Speed
```

References

https://www.garron.me/en/linux/ubuntu-network-speed-duplex-lan.html

1.8 External Resources

1.8.1 Online Tutorials

- http://docs.openvswitch.org/en/latest/tutorials/faucet/
- http://costiser.ro/2017/03/07/sdn-lesson-2-introducing-faucet-as-an-openflow-controller/
- https://inside-openflow.com/openflow-tracks/faucet-controller-application-technical-track/
- https://blog.cyberreboot.org/building-a-software-defined-network-with-raspberry-pis-and-a-zodiac-fx-switch-97184032cdc1

1.8.2 Tutorial Videos

- https://www.youtube.com/watch?v=fuqzzjmcwlI

CHAPTER 2

Developer Documentation

2.1 Developer Guide

This file contains an overview of architecture, coding design/practices, testing and style.

2.1.1 Before submitting a PR

- All unit and integration tests must pass (please use the docker based tests; see *Software switch testing with docker*).
- You must add a test if FAUCET's functionality changes (ie. a new feature, or correcting a bug).
- Please use the supplied git pre-commit hook (see `../git-hook/pre-commit`), to automatically run the unit tests and pylint for you at git commit time.
- Please enable TravisCI testing on your repo, which enables the maintainers to quickly verify that your changes pass all tests in a pristine environment.
- pylint must show no new errors or warnings.
- Code must conform to the style guide (see below).

2.1.2 Code style

Please use the coding style documented at http://google.github.io/styleguide/pyguide.html. Existing code not using this style will be incrementally migrated to comply with it. New code should comply.

2.1.3 Makefile

Makefile is provided at the top level of the directory. Output of `make` is normally stored in `dist` directory. The following are the targets that can be used:

- **uml**: Uses `pyreverse` to provide code class diagrams.

- **dot**: Uses `dot` to provide hirearchical representation of `faucet.yaml` based on `docs/images/faucet-yaml.dot` file
- **codefmt**: Provides command line usage to "Code Style" the Python file
- **codeerrors**: Uses `pylint` on all Python files to generate a code error report and is placed in `dist` directory.
- **stats**: Provides a list of all commits since the last release tag.
- **release**: Used for releasing FAUCET to the next version, Requires `version` and `next_version` variables.

To *directly install* faucet from the cloned git repo, you could use `sudo python setup.py install` command from the root of the directory.

To *build pip installable package*, you could use `python setup.py sdist` command from the root of the directory.

To *remove* any temporarily created directories and files, you could use `rm -rf dist *egg-info` command.

2.1.4 Key architectural concepts/assumptions:

FAUCET's architecture depends on key assumptions, which must be kept in mind at all times.

- FAUCET is the only controller for the switch, that can add or remove flows.
- All supported dataplanes must implement OpenFlow functionally (hardware, software or both) identically. No TTP or switch specific drivers.

In addition:

- FAUCET provisions default deny flows (all traffic not explicitly programmed is dropped).
- Use of packet in is minimized.

FAUCET depends upon these assumptions to guarantee that the switch is always in a known and consistent state, which in turn is required to support high availability (FAUCET provides high availability, through multiple FAUCET controllers using the same version of configuration - any FAUCET can give the switch a consistent response - no state sharing between controllers is required). The FAUCET user can program customized flows to be added to the switch using FAUCET ACLs (see below).

FAUCET also programs the dataplane to do flooding (where configured). This minimizes the use of packet in. This is necessary to reduce competition between essential control plane messages (adding and removing flows), and traffic from the dataplane on the limited bandwidth OpenFlow control channel. Unconstrained packet in messages impact the switch CPU, may overwhelm the OpenFlow control channel, and will expose the FAUCET controller to unvalidated dataplane packets, all of which are security and reliability concerns. In future versions, packet in will be eliminated altogether. The FAUCET user is expected to use policy based forwarding (eg ACLs that redirect traffic of interest to high performance dataplane ports for NFV offload), not packet in.

FAUCET requires all supported dataplanes to implement OpenFlow (specifically, a subset of OpenFlow 1.3) in a functionally identical way. This means that there is no switch-specific driver layer - the exact same messages are sent, whether the switch is OVS or hardware. While this does prevent some earlier generation OpenFlow switches from being supported, commercially available current hardware does not have as many restrictions, and eliminating the need for a switch-specific (or TTP) layer greatly reduces implementation complexity and increases controller programmer productivity.

2.2 Architecture

2.2.1 Faucet Design and Architecture

Faucet enables practical SDN for the masses (see http://queue.acm.org/detail.cfm?id=3015763).

- Drop in/replacement for non-SDN L2/L3 IPv4/IPv6 switch/router (easy migration)
- Packet forwarding/flooding/multicasting done entirely by switch hardware (controller only notified on topology change)
- BGP and static routing (other routing protocols provided by NFV)
- Multi vendor/platform support using OpenFlow 1.3 multi table
- Multi switch, vendor neutral "stacking" (Faucet distributed switching, loop free topology without spanning tree)
- ACLs, as well as allow/drop, allow packets to be copied/rewritten for external NFV applications
- Monitored with Prometheus
- Small code base with high code test coverage and automated testing both hardware and software

See unit and integration tests for working configuration examples.

2.2.2 Faucet Openflow Switch Pipeline

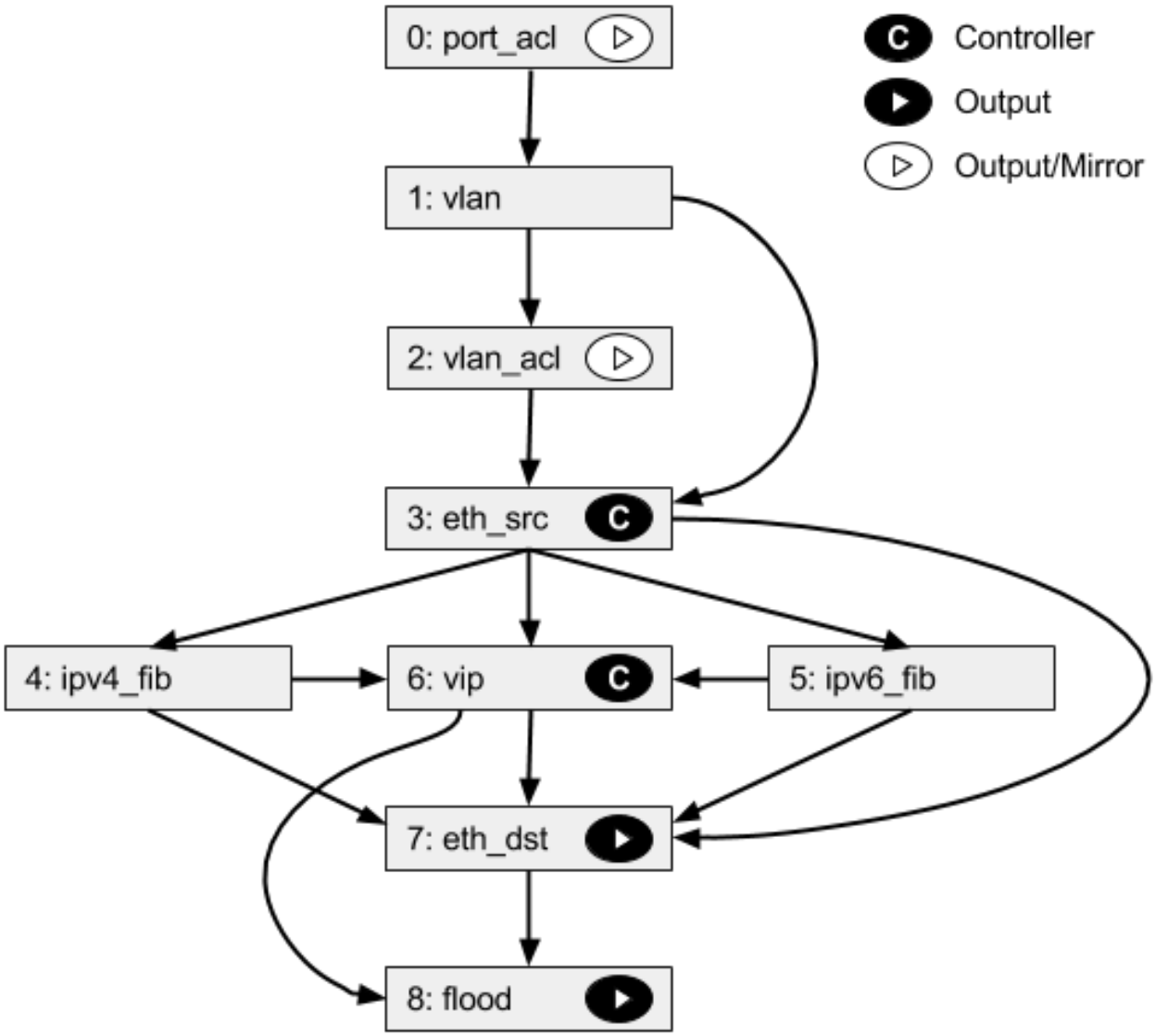


Table 0: PORT_ACL

- Apply user supplied ACLs to a port and send to next table

Table 1: VLAN

- Match fields: `eth_dst, eth_type, in_port, vlan_vid`
- **Operations:**
  - Drop unwanted L2 protocol traffic (and spoofing of Faucet's virtual MAC)
  - **For tagged ports**
    - Match VLAN_VID and send to next table
  - **For untagged ports**

        * Push VLAN frame onto packet with VLAN_VID representing ports native VLAN and send to next table
    - Unknown traffic is dropped

Table 2: VLAN_ACL

- Apply user supplied ACLs to a VLAN and send to next table

Table 3: ETH_SRC

- Match fields: `eth_dst, eth_src, eth_type, in_port, vlan_vid`
- **Operations:**
    - For IPv4/IPv6 traffic where Faucet is the next hop, send to IPV4_FIB or IPV6_FIB (route)
    - For known source MAC, send to ETH_DST (switch)
    - For unknown source MACs, copy header to controller via packet in (for learning) and send to FLOOD

Table 4: IPV4_FIB

- Match fields: `eth_type, ipv4_dst, vlan_vid`
- **Operations:**
    - Route IPv4 traffic to a next-hop for each route we have learned
    - Set eth_src to Faucet's magic MAC address
    - Set eth_dst to the resolved MAC address for the next-hop
    - Decrement TTL
    - Send to ETH_DST table
    - Unknown traffic is dropped

Table 5: IPV6_FIB

- Match fields: `eth_type, ipv6_dst, vlan_vid`
- **Operations:**
    - Route IPv4 traffic to a next-hop for each route we have learned
    - Set eth_src to Faucet's magic MAC address
    - Set eth_dst to the resolved MAC address for the next-hop
    - Decrement TTL
    - Send to ETH_DST table
    - Unknown traffic is dropped

Table 6: VIP

- Match fields: `arp_tpa, eth_dst, eth_type, icmpv6_type, ip_proto`
- **Operations:**
  - Send traffic destined for FAUCET VIPs including IPv4 ARP and IPv6 ND to the controller.
  - IPv6 ND traffic may be flooded also (sent to FLOOD)

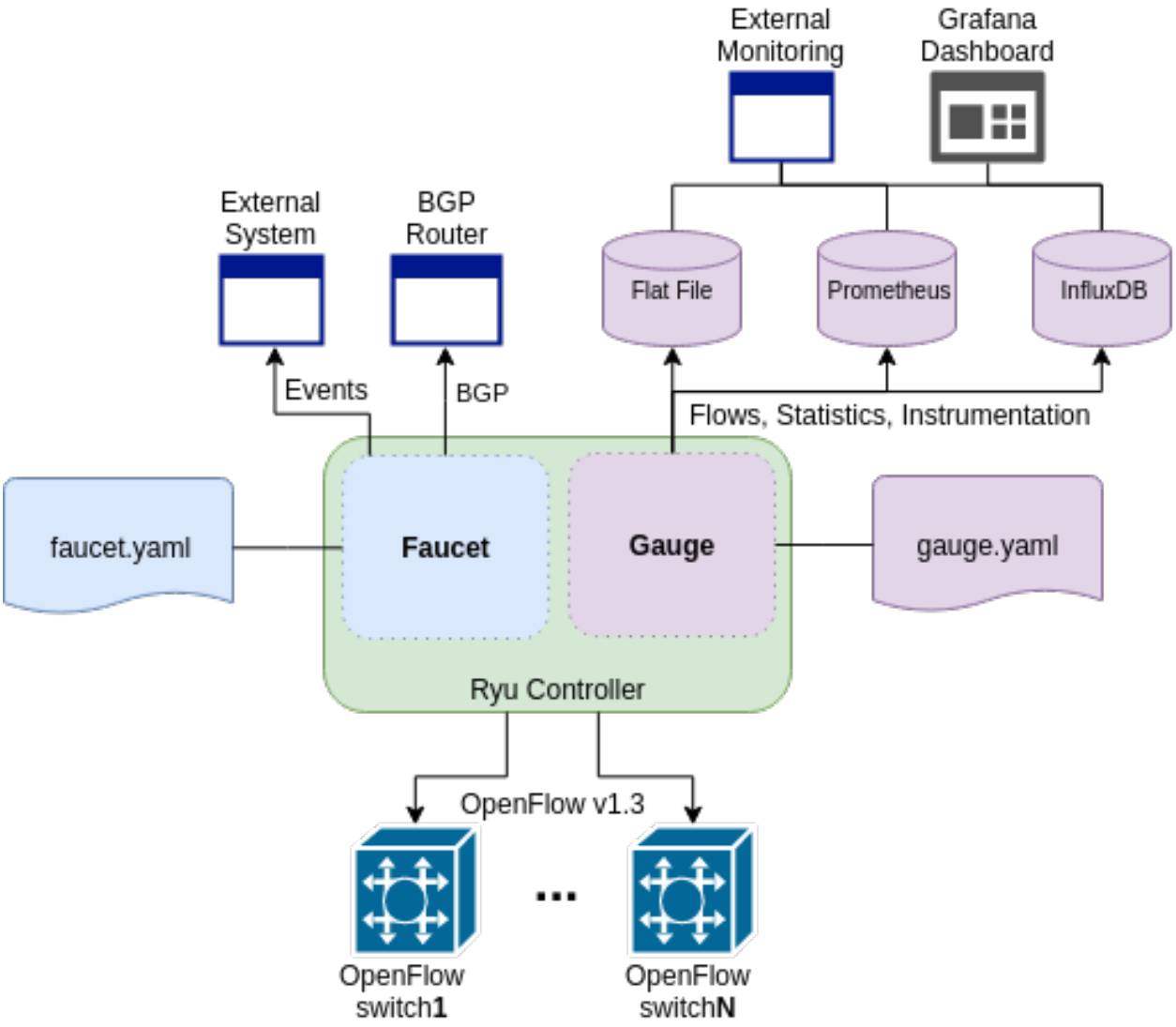
Table 7: ETH_DST

- Match fields: `eth_dst, in_port, vlan_vid`
- **Operations:**
  - For destination MAC addresses we have learned output packet towards that host (popping VLAN frame if we are outputting on an untagged port)
  - Unknown traffic is sent to FLOOD table

Table 8: FLOOD

- Match fields: `eth_dst, in_port, vlan_vid`
- **Operations:**
  - Flood broadcast within VLAN
  - Flood multicast within VLAN
  - Unknown traffic is flooded within VLAN

2.2.3 Faucet Architecture



2.3 Testing

2.3.1 Installing docker

First, get yourself setup with docker based on our *Installing docker* documentation.

2.3.2 Software switch testing with docker

Then you can build and run the mininet tests from the docker entry-point:

```
sudo docker build --pull -t faucet/tests -f Dockerfile.tests .
sudo apparmor_parser -R /etc/apparmor.d/usr.sbin.tcpdump
```

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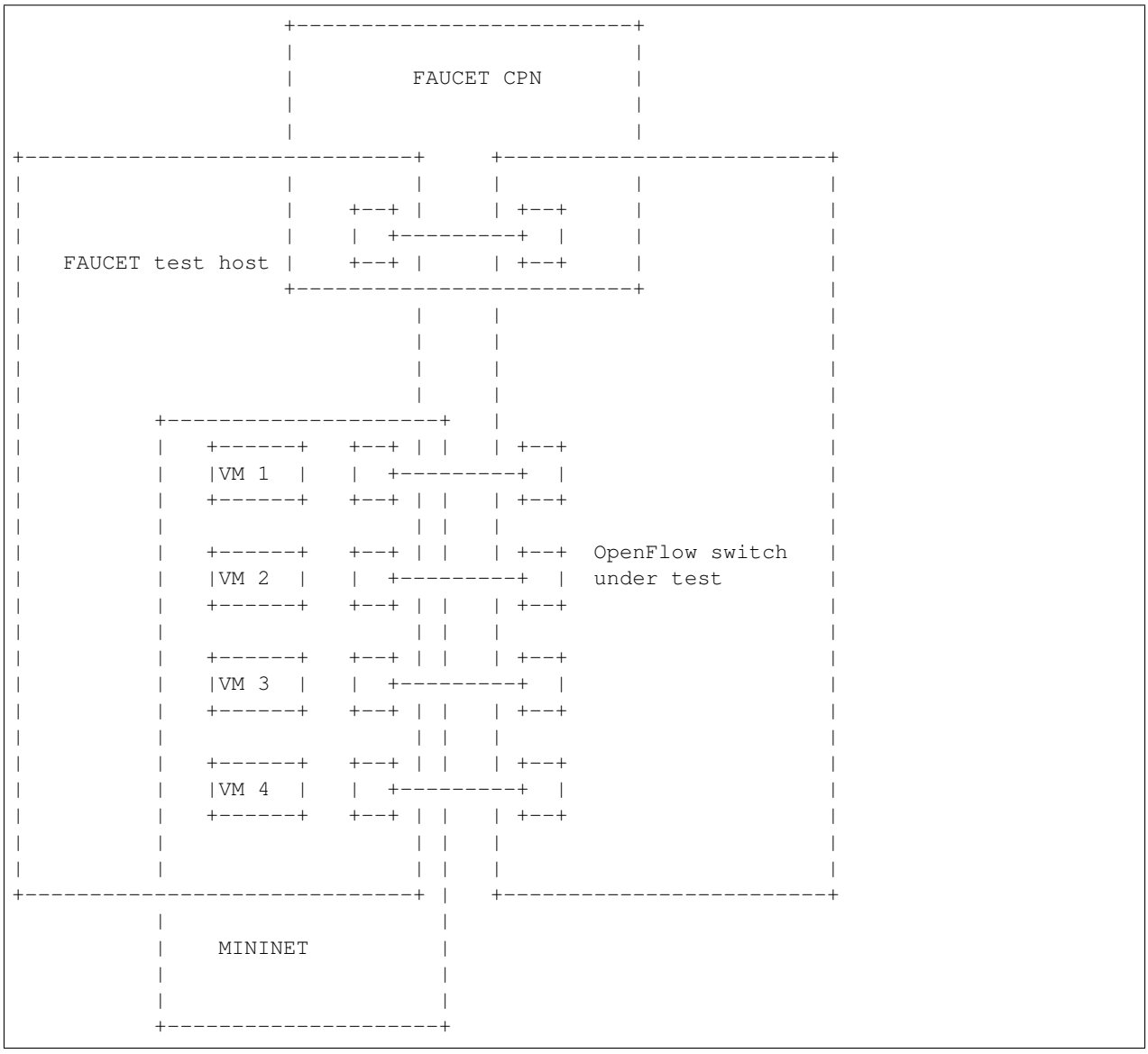
```
sudo modprobe openvswitch
sudo docker run --sysctl net.ipv6.conf.all.disable_ipv6=0 --privileged -ti faucet/
↪tests
```

The apparmor command is currently required on Ubuntu hosts to allow the use of tcpdump inside the container.

2.3.3 Hardware switch testing with docker



Requirements

Your test host, requires at least 5 interfaces. 4 interfaces to connect to the dataplane, and one for the CPN for OpenFlow. You will need to assign an IP address to the CPN interface on the host, and configure the switch with a CPN IP address and establish that they can reach each other (eg via ping).

You will need to configure the switch with two OpenFlow controllers, both with the host's CPN IP address, but with different ports (defaults are given below for *of_port* and *gauge_of_port*).

It is assumed that you execute all following commands from your FAUCET source code directory (eg one you have git cloned).

Test configuration

Create a directory for the test configuration:

```
mkdir -p /etc/faucet
$EDITOR /etc/faucet/hw_switch_config.yaml
```

`hw_switch_config.yaml` should contain the correct configuration for your switch:

```
hw_switch: True
hardware: 'Open vSwitch'
# Map ports on the hardware switch, to physical ports on this machine.
# If using a switch with less than 4 dataplane ports available, run
# FaucetZodiac tests only. A 4th port must still be defined here and
# must exist, but will not be used.
dp_ports:
  1: enp1s0f0
  2: enp1s0f1
  3: enp1s0f2
  4: enp1s0f3
# Hardware switch's DPID
dpid: 0xeccd6d9936ed
# Port on this machine that connects to hardware switch's CPN port.
# Hardware switch must use IP address of this port as controller IP.
cpn_intf: enp5s0
# There must be two controllers configured on the hardware switch,
# with same IP (see cpn_intf), but different ports - one for FAUCET,
# one for Gauge.
of_port: 6636
gauge_of_port: 6637
# If you wish to test OF over TLS to the hardware switch,
# set the following parameters per Ryu documentation.
# https://github.com/osrg/ryu/blob/master/doc/source/tls.rst
# ctl_privkey: ctl-privkey.pem
# ctl_cert: ctl-cert.pem
# ca_certs: /usr/local/var/lib/openvswitch/pki/switchca/cacert.pem
```

Running the tests

```
docker build --pull -t faucet/tests -f Dockerfile.tests .
apparmor_parser -R /etc/apparmor.d/usr.sbin.tcpdump
modprobe openvswitch
sudo docker run --privileged --net=host \
    -v /etc/faucet:/etc/faucet \
    -v /tmp:/tmp \
    -ti faucet/tests
```

Running a single test

```
sudo docker run --privileged --net=host \
    -e FAUCET_TESTS="FaucetUntaggedTest" \
    -v /etc/faucet:/etc/faucet \
    -v /tmp:/tmp \
    -ti faucet/tests
```

Running only the integration tests

Sometimes you will want to skip the pytype, linting and documentation tests in order to complete a faucet test suite run against hardware quicker.

```
sudo docker run --privileged --net=host \
    -e FAUCET_TESTS="-n" \
    -v /etc/faucet:/etc/faucet \
    -v /tmp:/tmp \
    -ti faucet/tests
```

Checking test results

If a test fails, you can look in /tmp - there will be subdirectories created for each test, which will contain all the logs and debug information (including tcpdumps).

2.4 Fuzzing

2.4.1 Fuzzing faucet config with docker

First, get yourself setup with docker based on our *Docker* documentation.

Then you can build and run the afl-fuzz tests:

```
docker build -t faucet/config-fuzzer -f Dockerfile.fuzz-config .

docker run -d \
  -u $(id -u $USER) \
  --name config-fuzzer \
  -v /var/log/afl/:/var/log/afl/ \
  faucet/config-fuzzer
```

AFL then will run indefinitely. You can find the output in /var/log/afl/. You will then need to run the output configs with faucet to see the error produced.

2.4.2 Fuzzing faucet packet handling with docker

Build and run the afl-fuzz tests:

```
docker build -t faucet/packet-fuzzer -f Dockerfile.fuzz-packet .

docker run -d \
```

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```
  -u $(id -u $USER) \
  --name packet-fuzzer \
  -v /var/log/afl/:/var/log/afl/ \
  -v /var/log/faucet/:/var/log/faucet/ \
  -p 6653:6653 \
  -p 9302:9302 \
  faucet/packet-fuzzer
```

AFL will then fuzz the packet handling indefinitely. The afl output can be found in /var/log/afl/. To check the error produced by an afl crash file use display_packet_crash:

```
python3 tests/fuzzer/display_packet_crash.py /var/log/afl/crashes/X
```

Where X is the name of the crash file. The output can then be found in the faucet logs (/var/log/faucet/).

2.5 Source Code

2.5.1 faucet

faucet package

Submodules

faucet.acl module

Configuration for ACLs.

class faucet.acl.**ACL**(*_id*, *dp_id*, *conf*)

Bases: *faucet.conf.Conf*

Contains the state for an ACL, including the configuration.

ACL Config

ACLs are configured under the 'acls' configuration block. The acls block contains a dictionary of individual acls each keyed by its name.

Each acl contains a list of rules, a packet will have the first matching rule applied to it.

Each rule is a dictionary containing the single key 'rule' with the value the matches and actions for the rule.

The matches are key/values based on the ryu RESTFul API. The key 'actions' contains a dictionary with keys/values as follows:

- allow (int): if 1 allow the packet to continue through the Faucet pipeline, if 0 drop the packet.
- force_port_vlan (int): if 1, do not verify the VLAN/port association for this packet and override any VLAN ACL on the forced VLAN.
- meter (str): meter to apply to the packet
- output (dict): used to output a packet directly. details below.
- cookie (int): set flow cookie to this value on this flow

The output action contains a dictionary with the following elements:

- port (int or string): the port to output the packet to

- ports (list): a list of the ports (int or string) to output the packet to
- set_fields (list): a list of fields to set with values
- dl_dst (str): old style request to set eth_dst to a value (set_fields recommended)
- pop_vlans: (int): pop the packet vlan before outputting
- vlan_vid: (int): push the vlan vid on the packet when outputting
- vlan_vids: (list): push the list of vlans on the packet when outputting, with option eth_type
- swap_vid (int): rewrite the vlan vid of the packet when outputting
- failover (dict): Output with a failover port (experimental)

actions_types = {'allow': <class 'int'>, 'force_port_vlan': <class 'int'>, 'meter':

defaults = {'exact_match': False, 'rules': None}

defaults_types = {'exact_match': <class 'bool'>, 'rules': <class 'list'>}

exact_match = None

output_actions_types = {'dl_dst': <class 'str'>, 'failover': <class 'dict'>, 'pop_vl

rule_types = {'actions': <class 'dict'>, 'cookie': <class 'int'>, 'description': <c

rules = None

to_conf()
Return configuration as a dict.

faucet.check_faucet_config module

Standalone script to check FAUCET configuration, return 0 if provided config OK.

faucet.check_faucet_config.**check_config**(*conf_files*, *debug_level=10*)
Return True and successful config dict, if all config can be parsed.

faucet.check_faucet_config.**main**()

faucet.conf module

Base configuration implementation.

class faucet.conf.**Conf**(*_id*, *dp_id*, *conf=None*)
Bases: object

Base class for FAUCET configuration.

check_config()
Check config at instantiation time for errors, typically via assert.

conf_hash(*dyn=False*, *subconf=True*, *ignore_keys=None*)
Return hash of keys configurably filtering attributes.

defaults = {}

defaults_types = {}

dyn_finalized = False

dyn_hash = None

finalize()
Configuration parsing marked complete.

ignore_subconf(*other*, *ignore_keys=None*)
Return True if this config same as other, ignoring sub config.

merge_dyn(*other_conf*)
Merge dynamic state from other conf object.

set_defaults()
Set default values and run any basic sanity checks.

to_conf()
Return configuration as a dict.

update(*conf*)
Parse supplied YAML config and sanity check.

exception faucet.conf.**InvalidConfigError**
Bases: Exception

This error is thrown when the config file is not valid.

faucet.conf.**test_config_condition**(*cond*, *msg*)

faucet.config_parser module

Implement configuration file parsing.

faucet.config_parser.**dp_parser**(*config_file*, *logname*)
Parse a config file into DP configuration objects with hashes of config include/files.

faucet.config_parser.**get_config_for_api**(*valves*)
Return config as dict for all DPs.

faucet.config_parser.**watcher_parser**(*config_file*, *logname*, *prom_client*)
Return Watcher instances from config.

faucet.config_parser_util module

Utility functions supporting FAUCET/Gauge config parsing.

class faucet.config_parser_util.**UniqueKeyLoader**(*stream*)
Bases: yaml.loader.Loader

construct_mapping(*node*, *deep=False*)
Check for duplicate YAML keys.

faucet.config_parser_util.**config_changed**(*top_config_file*, *new_top_config_file*, *config_hashes*)
Return True if configuration has changed.

Parameters

- **top_config_file** (*str*) – name of FAUCET config file
- **new_top_config_file** (*str*) – name, possibly new, of FAUCET config file.
- **config_hashes** (*dict*) – map of config file/includes and hashes of contents.

Returns True if the file, or any file it includes, has changed.

Return type bool

faucet.config_parser_util.**config_file_hash**(*config_file_name*)
Return hash of YAML config file contents.

faucet.config_parser_util.**dp_config_path**(*config_file*, *parent_file=None*)
Return full path to config file.

faucet.config_parser_util.**dp_include**(*config_hashes*, *config_file*, *logname*, *top_confs*)
Handles including additional config files

faucet.config_parser_util.**get_logger**(*logname*)
Return logger instance for config parsing.

faucet.config_parser_util.**read_config**(*config_file*, *logname*)
Return a parsed YAML config file or None.

faucet.dp module

Configuration for a datapath.

class faucet.dp.**DP**(*_id*, *dp_id*, *conf*)
Bases: *faucet.conf.Conf*

Stores state related to a datapath controlled by Faucet, including configuration.

acls = None

add_acl(*acl_ident*, *acl*)
Add an ACL to this DP.

add_port(*port*)
Add a port to this DP.

add_router(*router_ident*, *router*)
Add a router to this DP.

advertise_interval = None

all_valve_tables()
Return list of all Valve tables.

arp_neighbor_timeout = None

bgp_vlans()
Return list of VLANs with BGP enabled.

check_config()
Check config at instantiation time for errors, typically via assert.

combinatorial_port_flood = None

configured = False

cookie = None

defaults = {'advertise_interval': 30, 'arp_neighbor_timeout': 250, 'combinatorial_po

defaults_types = {'advertise_interval': <class 'int'>, 'arp_neighbor_timeout': <class

dp_id = None

drop_bpdu = None

drop_broadcast_source_address = None

drop_lldp = None

drop_spoofed_faucet_mac = None

dyn_last_coldstart_time = None

faucet_dp_mac = None

finalize_config(*dps*)
Perform consistency checks after initial config parsing.

get_config_changes(*logger*, *new_dp*)
Detect any config changes.

Parameters

- **logger** (ValveLogger) – logger instance
- **new_dp** (DP) – new dataplane configuration.

Returns

changes tuple containing:

deleted_ports (set): deleted port numbers. changed_ports (set): changed/added port numbers. changed_acl_ports (set): changed ACL only port numbers. deleted_vlans (set): deleted VLAN IDs. changed_vlans (set): changed/added VLAN IDs. all_ports_changed (bool): True if all ports changed.

Return type (tuple)

get_config_dict()
Return DP config as a dict for API call.

get_native_vlan(*port_num*)
Return native VLAN for a port by number, or None.

get_tables()
Return tables as dict for API call.

group_table = False

group_table_routing = False

groups = None

high_priority = None

ignore_learn_ins = None

in_port_tables()
Return list of tables that specify in_port as a match.

interface_ranges = None

interfaces = None

learn_ban_timeout = None

learn_jitter = None

lldp_beacon = {}

lldp_beacon_defaults_types = {'max_per_interval': <class 'int'>, 'send_interval': <c

low_priority = None

match_tables(*match_type*)
Return list of tables with matches of a specific match type.

max_host_fib_retry_count = None

max_hosts_per_resolve_cycle = None

max_resolve_backoff_time = None

meters = {}

metrics_rate_limit_sec = None

name = None

output_only_ports = None

packetin_pps = None

peer_stack_up_ports(*peer_dp*)
Return list of stack ports that are up towards a peer.

pipeline_config_dir = None

ports = None

priority_offset = None

proactive_learn = None

reset_refs(*vlans=None*)

resolve_stack_topology(*dps*)
Resolve inter-DP config for stacking.

routers = None

running = False

set_defaults()
Set default values and run any basic sanity checks.

shortest_path(*dest_dp*)
Return shortest path to a DP, as a list of DPs.

shortest_path_port(*dest_dp*)
Return first port on our DP, that is the shortest path towards dest DP.

shortest_path_to_root()
Return shortest path to root DP, as list of DPs.

stack = None

stack_defaults_types = {'priority': <class 'int'>}

stack_ports = None

tables = {}

tables_by_id = {}

timeout = None

to_conf()
Return DP config as dict.

use_idle_timeout = None

vlan_match_tables()
Return list of tables that specify vlan_vid as a match.

vlans = None

wildcard_table = <faucet.valve_table.ValveTable object>

faucet.faucet module

RyuApp shim between Ryu and Valve.

class faucet.faucet.**EventFaucetAdvertise**
Bases: ryu.controller.event.EventBase

Event used to trigger periodic network advertisements (eg IPv6 RAs).

class faucet.faucet.**EventFaucetExperimentalAPIRegistered**
Bases: ryu.controller.event.EventBase

Event used to notify that the API is registered with Faucet.

class faucet.faucet.**EventFaucetLLDPAdvertise**
Bases: ryu.controller.event.EventBase

Event used to trigger periodic LLDP beacons.

class faucet.faucet.**EventFaucetMetricUpdate**
Bases: ryu.controller.event.EventBase

Event used to trigger update of metrics.

class faucet.faucet.**EventFaucetResolveGateways**
Bases: ryu.controller.event.EventBase

Event used to trigger gateway re/resolution.

class faucet.faucet.**EventFaucetStateExpire**
Bases: ryu.controller.event.EventBase

Event used to trigger expiration of state in controller.

class faucet.faucet.**Faucet**(**args*, ***kwargs*)
Bases: *faucet.valve_ryuapp.RyuAppBase*

A RyuApp that implements an L2/L3 learning VLAN switch.

Valve provides the switch implementation; this is a shim for the Ryu event handling framework to interface with Valve.

bgp = None

desc_stats_reply_handler(*ryu_event*)
Handle OFPDescStatsReply from datapath.

Parameters **ryu_event** (*ryu.controller.ofp_event.EventOFPDescStatsReply*) – trigger.

error_handler(*ryu_event*)
Handle an OFPError from a datapath.

Parameters **ryu_event** (*ryu.controller.ofp_event.EventOFPErrorMsg*) – trigger

exc_logname = 'faucet.exception'

features_handler(*ryu_event*)
Handle receiving a switch features message from a datapath.

Parameters **ryu_event** (*ryu.controller.ofp_event.EventOFPStateChange*) – trigger.

flowremoved_handler(*ryu_event*)
Handle a flow removed event.

Parameters **ryu_event** (*ryu.controller.ofp_event.EventOFPFlowRemoved*) – trigger.

get_config()
FAUCET experimental API: return config for all Valves.

get_tables(*dp_id*)
FAUCET experimental API: return config tables for one Valve.

logname = 'faucet'

metric_update(*_*)
Handle a request to update metrics in the controller.

metrics = None

notifier = None

packet_in_handler(*ryu_event*)
Handle a packet in event from the dataplane.

Parameters **ryu_event** (*ryu.controller.event.EventReplyBase*) – packet in message.

port_status_handler(*ryu_event*)
Handle a port status change event.

Parameters **ryu_event** (*ryu.controller.ofp_event.EventOFPPortStatus*) – trigger.

reload_config(*ryu_event*)
Handle a request to reload configuration.

start()
Start controller.

valves_manager = None

faucet.faucet_bgp module

BGP implementation for FAUCET.

class faucet.faucet_bgp.**FaucetBgp**(*logger*, *metrics*, *send_flow_msgs*)
Bases: object

Wrapper for Ryu BGP speaker.

reset(*valves*)
Set up a BGP speaker for every VLAN that requires it.

shutdown_bgp_speakers()
Shutdown any active BGP speakers.

update_metrics()
Update BGP metrics.

faucet.faucet_experimental_api module

Implement experimental API.

class faucet.faucet_experimental_api.**FaucetExperimentalAPI**(**args*, ***kwargs*)
Bases: object

An experimental API for communicating with Faucet.

Contains methods for interacting with a running Faucet controller from within a RyuApp. This app should be run together with Faucet in the same ryu-manager process.

add_port_acl(*port*, *acl*)
Add an ACL to a port.

add_vlan_acl(*vlan*, *acl*)
Add an ACL to a VLAN.

delete_port_acl(*port*, *acl*)
Delete an ACL from a port.

delete_vlan_acl(*vlan*, *acl*)
Delete an ACL from a VLAN.

get_config()
Get the current running config of Faucet as a python dictionary.

get_tables(*dp_id*)
Get current FAUCET tables as a dict of table name: table no.

is_registered()
Return True if registered and ready to serve API requests.

push_config(*config*)
Push supplied config to FAUCET.

reload_config()
Reload config from config file in FAUCET_CONFIG env variable.

faucet.faucet_experimental_event module

Experimental FAUCET event notification.

class faucet.faucet_experimental_event.**FaucetExperimentalEventNotifier**(*socket_path*, *metrics*, *logger*)
Bases: object

Event notification, via Unix domain socket.

check_path(*socket_path*)
Check that socket_path is valid.

notify(*dp_id*, *dp_name*, *event_dict*)
Notify of an event.

start()
Start socket server.

faucet.faucet_metrics module

Implement Prometheus statistics.

class faucet.faucet_metrics.**FaucetMetrics**(*reg=None*)
Bases: *faucet.prom_client.PromClient*

Container class for objects that can be exported to Prometheus.

reset_dpid(*dp_labels*)
Set all DPID-only counter/gauges to 0.

faucet.faucet_pipeline module

Standard FAUCET pipeline.

faucet.fctl module

Report state based on FAUCET/Gauge/Prometheus variables.

faucet.fctl.**decode_value**(*metric_name*, *value*)
Convert values to human readible format based on metric name

faucet.fctl.**main**()

faucet.fctl.**parse_args**(*sys_args*)
Parse and return CLI args.

faucet.fctl.**report_label_match_metrics**(*report_metrics*, *metrics*, *display_labels=None*, *nonzero_only=False*, *delim='\t'*, *label_matches=None*)
Text report on a list of Prometheus metrics.

faucet.fctl.**scrape_prometheus**(*endpoints*, *retries=3*)
Scrape a list of Prometheus/FAUCET/Gauge endpoints and aggregate results.

faucet.gauge module

RyuApp shim between Ryu and Gauge.

class faucet.gauge.**Gauge**(**args*, ***kwargs*)
Bases: *faucet.valve_ryuapp.RyuAppBase*

Ryu app for polling Faucet controlled datapaths for stats/state.

It can poll multiple datapaths. The configuration files for each datapath should be listed, one per line, in the file set as the environment variable GAUGE_CONFIG. It logs to the file set as the environment variable GAUGE_LOG,

exc_logname = 'gauge.exception'

logname = 'gauge'

prom_client = None

reload_config(*ryu_event*)
Handle request for Gauge config reload.

update_watcher_handler(*ryu_event*)
Handle port status change event.

Parameters **ryu_event** (*ryu.controller.event.EventReplyBase*) – port status change event.

faucet.gauge_influx module

Library for interacting with InfluxDB.

class faucet.gauge_influx.**GaugeFlowTableInfluxDBLogger**(*conf*, *logname*, *prom_client*)
Bases: *faucet.gauge_pollers.GaugeFlowTablePoller*, *faucet.gauge_influx.InfluxShipper*

Example

```
> use faucet
Using database faucet
> show series where table_id = '0' and in_port = '2'
key
---
flow_byte_count,dp_name=windscale-faucet-1,eth_type=2048,in_port=2,ip_proto=17,
↪priority=9099,table_id=0,udp_dst=53
flow_byte_count,dp_name=windscale-faucet-1,eth_type=2048,in_port=2,ip_proto=6,
↪priority=9098,table_id=0,tcp_dst=53
flow_byte_count,dp_name=windscale-faucet-1,in_port=2,priority=9097,table_id=0
flow_packet_count,dp_name=windscale-faucet-1,eth_type=2048,in_port=2,ip_proto=17,
↪priority=9099,table_id=0,udp_dst=53
flow_packet_count,dp_name=windscale-faucet-1,eth_type=2048,in_port=2,ip_proto=6,
↪priority=9098,table_id=0,tcp_dst=53
flow_packet_count,dp_name=windscale-faucet-1,in_port=2,priority=9097,table_id=0
> select * from flow_byte_count where table_id = '0' and in_port = '2' and ip_
↪proto = '17' and time > now() - 5m
name: flow_byte_count
time                arp_tpa dp_name            eth_dst eth_src eth_type icmpv6_
↪type in_port ip_proto ipv4_dst ipv6_dst priority table_id tcp_dst udp_dst value␣
↪vlan_vid
----                ------- -------            ------- ------- -------- ----------
↪- ------- -------- -------- -------- -------- -------- ------- ------- ----- ---
↪-----
1501154797000000000         windscale-faucet-1                 2048
↪  2       17                           9099     0                53      9414    ␣
1501154857000000000         windscale-faucet-1                 2048
↪  2       17                           9099     0                53      10554   ␣
1501154917000000000         windscale-faucet-1                 2048
↪  2       17                           9099     0                53      10554   ␣
1501154977000000000         windscale-faucet-1                 2048
↪  2       17                           9099     0                53      12164   ␣
1501155037000000000         windscale-faucet-1                 2048
↪  2       17                           9099     0                53      12239   ␣
```

update(*rcv_time*, *dp_id*, *msg*)
Handle the responses to requests.

Called when a reply to a stats request sent by this object is received by the controller.

It should acknowledge the receipt by setting self.reply_pending to false.

Parameters

- **rcv_time** – the time the response was received
- **dp_id** – DP ID
- **msg** – the stats reply message

class faucet.gauge_influx.**GaugePortStateInfluxDBLogger**(*conf*, *logname*, *prom_client*)

Bases: *faucet.gauge_pollers.GaugePortStatePoller*, *faucet.gauge_influx.InfluxShipper*

Example

```
> use faucet
Using database faucet
> precision rfc3339
> select * from port_state_reason where port_name = 'port1.0.1' order by time␣
↪desc limit 10;
name: port_state_reason
-----------------------
time                    dp_name                 port_name       value
2017-02-21T02:12:29Z    windscale-faucet-1      port1.0.1       2
2017-02-21T02:12:25Z    windscale-faucet-1      port1.0.1       2
2016-07-27T22:05:08Z    windscale-faucet-1      port1.0.1       2
2016-05-25T04:33:00Z    windscale-faucet-1      port1.0.1       2
2016-05-25T04:32:57Z    windscale-faucet-1      port1.0.1       2
2016-05-25T04:31:21Z    windscale-faucet-1      port1.0.1       2
2016-05-25T04:31:18Z    windscale-faucet-1      port1.0.1       2
2016-05-25T04:27:07Z    windscale-faucet-1      port1.0.1       2
2016-05-25T04:27:04Z    windscale-faucet-1      port1.0.1       2
2016-05-25T04:24:53Z    windscale-faucet-1      port1.0.1       2
```

update(*rcv_time*, *dp_id*, *msg*)

Handle the responses to requests.

Called when a reply to a stats request sent by this object is received by the controller.

It should acknowledge the receipt by setting self.reply_pending to false.

Parameters

- **rcv_time** – the time the response was received
- **dp_id** – DP ID
- **msg** – the stats reply message

class faucet.gauge_influx.**GaugePortStatsInfluxDBLogger**(*conf*, *logname*, *prom_client*)

Bases: *faucet.gauge_pollers.GaugePortStatsPoller*, *faucet.gauge_influx.InfluxShipper*

Periodically sends a port stats request to the datapath and parses and outputs the response.

Example

```
> use faucet
Using database faucet
> show measurements
name: measurements
------------------
bytes_in
bytes_out
dropped_in
dropped_out
errors_in
packets_in
packets_out
port_state_reason
> precision rfc3339
> select * from packets_out where port_name = 'port1.0.1' order by time desc
↪limit 10;
name: packets_out
-----------------
time                    dp_name                 port_name       value
2017-03-06T05:21:42Z    windscale-faucet-1      port1.0.1       76083431
2017-03-06T05:21:33Z    windscale-faucet-1      port1.0.1       76081172
2017-03-06T05:21:22Z    windscale-faucet-1      port1.0.1       76078727
2017-03-06T05:21:12Z    windscale-faucet-1      port1.0.1       76076612
2017-03-06T05:21:02Z    windscale-faucet-1      port1.0.1       76074546
2017-03-06T05:20:52Z    windscale-faucet-1      port1.0.1       76072730
2017-03-06T05:20:42Z    windscale-faucet-1      port1.0.1       76070528
2017-03-06T05:20:32Z    windscale-faucet-1      port1.0.1       76068211
2017-03-06T05:20:22Z    windscale-faucet-1      port1.0.1       76065982
2017-03-06T05:20:12Z    windscale-faucet-1      port1.0.1       76063941
```

update(*rcv_time*, *dp_id*, *msg*)

Handle the responses to requests.

Called when a reply to a stats request sent by this object is received by the controller.

It should acknowledge the receipt by setting self.reply_pending to false.

Parameters

- **rcv_time** – the time the response was received
- **dp_id** – DP ID
- **msg** – the stats reply message

class faucet.gauge_influx.**InfluxShipper**

Bases: object

Convenience class for shipping values to InfluxDB.

Inheritors must have a WatcherConf object as conf.

conf = None

logger = None

static make_point(*tags*, *rcv_time*, *stat_name*, *stat_val*)

Make an InfluxDB point.

make_port_point(*dp_name*, *port_name*, *rcv_time*, *stat_name*, *stat_val*)
Make an InfluxDB point about a port measurement.

ship_error_prefix = 'error shipping points: '

ship_points(*points*)
Make a connection to InfluxDB and ship points.

faucet.gauge_pollers module

Library for polling dataplanes for statistics.

class faucet.gauge_pollers.**GaugeFlowTablePoller**(*conf*, *logname*, *prom_client*)
Bases: *faucet.gauge_pollers.GaugeThreadPoller*

Periodically dumps the current datapath flow table as a yaml object.

Includes a timestamp and a reference ($DATAPATHNAME-flowtables). The flow table is dumped as an OFFlowStatsReply message (in yaml format) that matches all flows.

no_response()
Called when a polling cycle passes without receiving a response.

send_req()
Send a stats request to a datapath.

class faucet.gauge_pollers.**GaugePoller**(*conf*, *logname*, *prom_client*)
Bases: object

Abstraction for a poller for statistics.

is_active()
Return True if the poller is controlling the requiest loop for its stat

no_response()
Called when a polling cycle passes without receiving a response.

report_dp_status(*dp_status*)
Report DP status.

running()
Return True if the poller is running.

send_req()
Send a stats request to a datapath.

start(*ryudp*, *active*)
Start the poller.

stop()
Stop the poller.

update(*rcv_time*, *dp_id*, *msg*)
Handle the responses to requests.

Called when a reply to a stats request sent by this object is received by the controller.

It should acknowledge the receipt by setting self.reply_pending to false.

Parameters

- **rcv_time** – the time the response was received
- **dp_id** – DP ID

- **msg** – the stats reply message

class faucet.gauge_pollers.**GaugePortStatePoller**(*conf*, *logname*, *prom_client*)
Bases: *faucet.gauge_pollers.GaugePoller*

Abstraction for port state poller.

no_response()
Called when a polling cycle passes without receiving a response.

send_req()
Send a stats request to a datapath.

class faucet.gauge_pollers.**GaugePortStatsPoller**(*conf*, *logname*, *prom_client*)
Bases: *faucet.gauge_pollers.GaugeThreadPoller*

Periodically sends a port stats request to the datapath and parses and outputs the response.

no_response()
Called when a polling cycle passes without receiving a response.

send_req()
Send a stats request to a datapath.

class faucet.gauge_pollers.**GaugeThreadPoller**(*conf*, *logname*, *prom_client*)
Bases: *faucet.gauge_pollers.GaugePoller*

A ryu thread object for sending and receiving OpenFlow stats requests.

The thread runs in a loop sending a request, sleeping then checking a response was received before sending another request.

The methods send_req, update and no_response should be implemented by subclasses.

is_active()
Return True if the poller is controlling the requiest loop for its stat

no_response()
Called when a polling cycle passes without receiving a response.

send_req()
Send a stats request to a datapath.

start(*ryudp*, *active*)
Start the poller.

stop()
Stop the poller.

faucet.gauge_prom module

Prometheus for Gauge.

class faucet.gauge_prom.**GaugeFlowTablePrometheusPoller**(*conf*, *logname*, *prom_client*)
Bases: *faucet.gauge_pollers.GaugeFlowTablePoller*

Export flow table entries to Prometheus.

table_tags = {}

update(*rcv_time*, *dp_id*, *msg*)
Handle the responses to requests.

Called when a reply to a stats request sent by this object is received by the controller.

It should acknowledge the receipt by setting self.reply_pending to false.

Parameters

- **rcv_time** – the time the response was received
- **dp_id** – DP ID
- **msg** – the stats reply message

class faucet.gauge_prom.**GaugePortStatePrometheusPoller**(*conf*, *logname*, *prom_client*)
Bases: *faucet.gauge_pollers.GaugePortStatePoller*

Export port state changes to Prometheus.

update(*rcv_time*, *dp_id*, *msg*)
Handle the responses to requests.

Called when a reply to a stats request sent by this object is received by the controller.

It should acknowledge the receipt by setting self.reply_pending to false.

Parameters

- **rcv_time** – the time the response was received
- **dp_id** – DP ID
- **msg** – the stats reply message

class faucet.gauge_prom.**GaugePortStatsPrometheusPoller**(*conf*, *logger*, *prom_client*)
Bases: *faucet.gauge_pollers.GaugePortStatsPoller*

Exports port stats to Prometheus.

update(*rcv_time*, *dp_id*, *msg*)
Handle the responses to requests.

Called when a reply to a stats request sent by this object is received by the controller.

It should acknowledge the receipt by setting self.reply_pending to false.

Parameters

- **rcv_time** – the time the response was received
- **dp_id** – DP ID
- **msg** – the stats reply message

class faucet.gauge_prom.**GaugePrometheusClient**(*reg=None*)
Bases: *faucet.prom_client.PromClient*

Wrapper for Prometheus client that is shared between all pollers.

metrics = {}

reregister_flow_vars(*table_name*, *table_tags*)

faucet.meter module

Configure meters.

class faucet.meter.**Meter**(*_id*, *dp_id*, *conf*)
Bases: *faucet.conf.Conf*

Implement FAUCET configuration for an OpenFlow meter.

defaults = {'entry': None, 'meter_id': None}

defaults_types = {'entry': <class 'dict'>, 'meter_id': <class 'int'>}

entry = None

entry_msg = None

meter_id = None

faucet.port module

Port configuration.

class faucet.port.**Port**(*_id*, *dp_id*, *conf=None*)

Bases: *faucet.conf.Conf*

Stores state for ports, including the configuration.

acl_in = None

acls_in = None

check_config()

Check config at instantiation time for errors, typically via assert.

defaults = {'acl_in': None, 'acls_in': None, 'description': None, 'enabled': True,

defaults_types = {'acl_in': (<class 'str'>, <class 'int'>), 'acls_in': <class 'list'

description = None

dp_id = None

dyn_lacp_up = None

dyn_lacp_updated_time = None

dyn_last_ban_time = None

dyn_last_lacp_pkt = None

dyn_last_lldp_beacon_time = None

dyn_learn_ban_count = 0

dyn_phys_up = False

enabled = None

finalize()

Configuration parsing marked complete.

hairpin = None

hosts(*vlans=None*)

Return all host cache entries this port has learned (on all or specified VLANs).

hosts_count(*vlans=None*)

Return count of all hosts this port has learned (on all or specified VLANs).

lldp_beacon = {}

lldp_beacon_defaults_types = {'enable': <class 'bool'>, 'org_tlvs': <class 'list'>,

lldp_beacon_enabled()

Return True if LLDP beacon enabled on this port.

lldp_org_tlv_defaults_types = {'info': (<class 'str'>, <class 'bytearray'>), 'oui':

loop_protect = None

max_hosts = None

mirror = None

mirror_actions()
Return OF actions to mirror this port.

name = None

native_vlan = None

number = None

op_status_reconf = None

output_only = None

override_output_port = None

permanent_learn = None

receive_lldp = None

running()
Return True if port enabled and up.

set_defaults()
Set default values and run any basic sanity checks.

stack = {}

stack_defaults_types = {'dp': <class 'str'>, 'port': (<class 'str'>, <class 'int'>)}

tagged_vlans = []

to_conf()
Return configuration as a dict.

unicast_flood = None

vlans()
Return list of all VLANs this port is in.

faucet.prom_client module

Implement Prometheus client.

class faucet.prom_client.**PromClient**(*reg=None*)
Bases: object

Prometheus client.

REQUIRED_LABELS = ['dp_id', 'dp_name']

server = None

start(*prom_port*, *prom_addr*, *use_test_thread=False*)
Start webserver.

thread = None

faucet.prom_client.**make_wsgi_app**(*registry*)
Create a WSGI app which serves the metrics from a registry.

faucet.router module

Configure routing between VLANs.

class faucet.router.**Router**(*_id*, *dp_id*, *conf=None*)
Bases: *faucet.conf.Conf*

Implement FAUCET configuration for a router.

check_config()
Check config at instantiation time for errors, typically via assert.

defaults = {'vlans': None}

defaults_types = {'vlans': <class 'list'>}

vlans = None

faucet.tfm_pipeline module

Parse JSON for TFM based table config.

class faucet.tfm_pipeline.**LoadRyuTables**(*cfgpath*, *pipeline_conf*)
Bases: object

Serialize table features messages from JSON.

load_tables()

class faucet.tfm_pipeline.**OpenflowToRyuTranslator**(*cfgpath*, *pipeline_conf*)
Bases: object

create_ryu_structure()

faucet.valve module

Implementation of Valve learning layer 2/3 switch.

class faucet.valve.**ArubaValve**(*dp*, *logname*, *metrics*, *notifier*)
Bases: *faucet.valve.TfmValve*

Valve implementation that uses OpenFlow send table features messages.

DEC_TTL = False

PIPELINE_CONF = 'aruba_pipeline.json'

class faucet.valve.**OVSValve**(*dp*, *logname*, *metrics*, *notifier*)
Bases: *faucet.valve.Valve*

Valve implementation for OVS.

USE_BARRIERS = False

class faucet.valve.**TfmValve**(*dp*, *logname*, *metrics*, *notifier*)
Bases: *faucet.valve.Valve*

Valve implementation that uses OpenFlow send table features messages.

PIPELINE_CONF = 'tfm_pipeline.json'

SKIP_VALIDATION_TABLES = ()

switch_features(*msg*)
Send configuration flows necessary for the switch implementation.

Parameters **msg** (*OFPSwitchFeatures*) – msg sent from switch.

Vendor specific configuration should be implemented here.

class faucet.valve.**Valve**(*dp*, *logname*, *metrics*, *notifier*)
Bases: object

Generates the messages to configure a datapath as a l2 learning switch.

Vendor specific implementations may require sending configuration flows. This can be achieved by inheriting from this class and overwriting the function switch_features.

DEC_TTL = True

L3 = False

USE_BARRIERS = True

add_route(*vlan*, *ip_gw*, *ip_dst*)
Add route to VLAN routing table.

advertise()
Called periodically to advertise services (eg. IPv6 RAs).

base_prom_labels = None

close_logs()
Explicitly close any active loggers.

datapath_connect(*discovered_ports*)
Handle Ryu datapath connection event and provision pipeline.

Parameters **discovered_ports** (*list*) – datapath OFPorts.

Returns OpenFlow messages to send to datapath.

Return type list

datapath_disconnect()
Handle Ryu datapath disconnection event.

del_route(*vlan*, *ip_dst*)
Delete route from VLAN routing table.

dp_init()
Initialize datapath state at connection/re/config time.

flood_manager = None

flow_timeout(*table_id*, *match*)
Call flow timeout message handler:

Parameters

- **table_id** (*int*) – ID of table where flow was installed.
- **match** (*dict*) – match conditions for expired flow.

Returns OpenFlow messages, if any.

Return type list

get_config_dict()
Return datapath config as a dict for experimental API.

host_manager = None

lacp_down(*port*)
Return OpenFlow messages when LACP is down on a port.

lacp_handler(*pkt_meta*)
Handle a LACP packet.

We are a currently a passive, non-aggregateable LACP partner.

Parameters **pkt_meta** (PacketMeta) – packet for control plane.

Returns OpenFlow messages, if any.

Return type list

lacp_up(*port*)
Return OpenFlow messages when LACP is up on a port.

lldp_handler(*pkt_meta*)
Handle an LLDP packet.

Parameters **pkt_meta** (PacketMeta) – packet for control plane.

logger = None

ofchannel_log(*ofmsgs*)
Log OpenFlow messages in text format to debugging log.

ofchannel_logger = None

ofdescstats_handler(*body*)
Handle OF DP description.

oferror(*msg*)
Correlate OFError message with flow we sent, if any.

Parameters **msg** (*ryu.controller.ofp_event.EventOFPMsgBase*) – message from datapath.

parse_pkt_meta(*msg*)
Parse OF packet-in message to PacketMeta.

parse_rcv_packet(*in_port*, *vlan_vid*, *eth_type*, *data*, *orig_len*, *pkt*, *eth_pkt*)
Parse a received packet into a PacketMeta instance.

Parameters

- **in_port** (*int*) – port packet was received on.
- **vlan_vid** (*int*) – VLAN VID of port packet was received on.
- **eth_type** (*int*) – Ethernet type of packet.
- **data** (*bytes*) – Raw packet data.
- **orig_len** (*int*) – Original length of packet.
- **pkt** (*ryu.lib.packet.packet*) – parsed packet received.
- **ekt_pkt** (*ryu.lib.packet.ethernet*) – parsed Ethernet header.

Returns PacketMeta instance.

port_add(*port_num*)
Handle addition of a single port.

Parameters **port_num** (*list*) – list of port numbers.

Returns OpenFlow messages, if any.

Return type list

port_delete(*port_num*)
Return flow messages that delete port from pipeline.

port_no_valid(*port_no*)
Return True if supplied port number valid on this datapath.

port_status_handler(*port_no*, *reason*, *port_status*)
Return OpenFlow messages responding to port operational status change.

ports_add(*port_nums*, *cold_start=False*, *log_msg='up'*)
Handle the addition of ports.

Parameters

- **port_num** (*list*) – list of port numbers.
- **cold_start** (*bool*) – True if configuring datapath from scratch.

Returns OpenFlow messages, if any.

Return type list

ports_delete(*port_nums*, *log_msg='down'*)
Handle the deletion of ports.

Parameters **port_nums** (*list*) – list of port numbers.

Returns OpenFlow messages, if any.

Return type list

prepare_send_flows(*flow_msgs*)
Prepare to send flows to datapath.

Parameters **flow_msgs** (*list*) – OpenFlow messages to send.

rate_limit_packet_ins()
Return True if too many packet ins this second.

rcv_packet(*other_valves*, *pkt_meta*)
Handle a packet from the dataplane (eg to re/learn a host).

The packet may be sent to us also in response to FAUCET initiating IPv6 neighbor discovery, or ARP, to resolve a nexthop.

Parameters

- **other_valves** (*list*) – all Valves other than this one.
- **pkt_meta** (PacketMeta) – packet for control plane.

Returns OpenFlow messages, if any.

Return type list

recent_ofmsgs = deque([], maxlen=32)

reload_config(*new_dp*)
Reload configuration new_dp.

Following config changes are currently supported:

- **Port config: support all available configs** (e.g. native_vlan, acl_in) & change operations (add, delete, modify) a port
- **ACL config:support any modification, currently reload all** rules belonging to an ACL
- VLAN config: enable, disable routing, etc...

Parameters **new_dp** (DP) – new dataplane configuration.

Returns OpenFlow messages.

Return type ofmsgs (list)

resolve_gateways()
Call route managers to re/resolve gateways.

Returns OpenFlow messages, if any.

Return type list

send_flows(*ryu_dp*, *flow_msgs*)
Send flows to datapath.

Parameters

- **ryu_dp** (*ryu.controller.controller.Datapath*) – datapath.
- **flow_msgs** (*list*) – OpenFlow messages to send.

send_lldp_beacons()
Called periodically to send LLDP beacon packets.

state_expire()
Expire controller caches/state (e.g. hosts learned).

Expire state from the host manager only; the switch does its own flow expiry.

Returns OpenFlow messages, if any.

Return type list

switch_features(*_msg*)
Send configuration flows necessary for the switch implementation.

Parameters **msg** (*OFPSwitchFeatures*) – msg sent from switch.

Vendor specific configuration should be implemented here.

update_config_metrics()
Update gauge/metrics for configuration.

update_metrics(*updated_port=None*, *rate_limited=False*)
Update Gauge/metrics.

class faucet.valve.**ValveLogger**(*logger*, *dp_id*)
Bases: object

Logger for a Valve that adds DP ID.

debug(*log_msg*)
Log debug level message.

error(*log_msg*)
Log error level message.

info(*log_msg*)
Log info level message.

warning(*log_msg*)
Log warning level message.

faucet.valve.**valve_factory**(*dp*)
Return a Valve object based dp's hardware configuration field.

Parameters **dp** (DP) – DP instance with the configuration for this Valve.

faucet.valve_acl module

Compose ACLs on ports.

faucet.valve_acl.**build_acl_entry**(*rule_conf*, *meters*, *acl_allow_inst*, *acl_force_port_vlan_inst*, *port_num=None*, *vlan_vid=None*)

faucet.valve_acl.**build_acl_ofmsgs**(*acls*, *acl_table*, *acl_allow_inst*, *acl_force_port_vlan_inst*, *highest_priority*, *meters*, *exact_match*, *port_num=None*, *vlan_vid=None*)

faucet.valve_acl.**build_output_actions**(*output_dict*)
Implement actions to alter packet/output.

faucet.valve_acl.**push_vlan**(*vlan_vid*)
Push a VLAN tag with optional selection of eth type.

faucet.valve_acl.**rewrite_vlan**(*output_dict*)
Implement actions to rewrite VLAN headers.

faucet.valve_flood module

Manage flooding to ports on VLANs.

class faucet.valve_flood.**ValveFloodManager**(*flood_table*, *eth_src_table*, *flood_priority*, *bypass_priority*, *use_group_table*, *groups*, *combinatorial_port_flood*)

Bases: object

Implement dataplane based flooding for standalone dataplanes.

FLOOD_DSTS = ((True, None, None), (False, '01:80:c2:00:00:00', 'ff:ff:ff:00:00:00'), (

build_flood_rules(*vlan*, *modify=False*)
Add flows to flood packets to unknown destinations on a VLAN.

static edge_learn_port(*_other_valves*, *pkt_meta*)
Possibly learn a host on a port.

Parameters

- **other_valves** (*list*) – All Valves other than this one.
- **pkt_meta** (PacketMeta) – PacketMeta instance for packet received.

Returns port to learn host on.

class faucet.valve_flood.**ValveFloodStackManager**(*flood_table*, *eth_src_table*, *flood_priority*, *bypass_priority*, *use_group_table*, *groups*, *combinatorial_port_flood*, *stack*, *stack_ports*, *dp_shortest_path_to_root*, *shortest_path_port*)

Bases: *faucet.valve_flood.ValveFloodManager*

Implement dataplane based flooding for stacked dataplanes.

build_flood_rules(*vlan*, *modify=False*)
Add flows to flood packets to unknown destinations on a VLAN.

edge_learn_port(*other_valves*, *pkt_meta*)
Possibly learn a host on a port.

Parameters

- **other_valves** (*list*) – All Valves other than this one.
- **pkt_meta** (PacketMeta) – PacketMeta instance for packet received.

Returns port to learn host on, or None.

faucet.valve_host module

Manage host learning on VLANs.

class faucet.valve_host.**ValveHostFlowRemovedManager**(*logger*, *ports*, *vlans*, *eth_src_table*, *eth_dst_table*, *learn_timeout*, *learn_jitter*, *learn_ban_timeout*, *low_priority*, *host_priority*)

Bases: *faucet.valve_host.ValveHostManager*

Trigger relearning on flow removed notifications.

Note: not currently reliable.

---

expire_hosts_from_vlan(*_vlan*, *_now*)
Expire hosts from VLAN cache.

flow_timeout(*table_id*, *match*)
Handle a flow timed out message from dataplane.

learn_host_timeouts(*port*)
Calculate flow timeouts for learning on a port.

class faucet.valve_host.**ValveHostManager**(*logger*, *ports*, *vlans*, *eth_src_table*, *eth_dst_table*, *learn_timeout*, *learn_jitter*, *learn_ban_timeout*, *low_priority*, *host_priority*)

Bases: object

Manage host learning on VLANs.

CACHE_UPDATE_GUARD_TIME = 2

ban_rules(*pkt_meta*)
Limit learning to a maximum configured on this port/VLAN.

Parameters **pkt_meta** – PacketMeta instance.

Returns OpenFlow messages, if any.

Return type list

delete_host_from_vlan(*eth_src*, *vlan*)
Delete a host from a VLAN.

expire_hosts_from_vlan(*vlan*, *now*)
Expire hosts from VLAN cache.

flow_timeout(*_table_id*, *_match*)
Handle a flow timed out message from dataplane.

learn_host_on_vlan_port_flows(*port*, *vlan*, *eth_src*, *delete_existing*, *src_rule_idle_timeout*, *src_rule_hard_timeout*, *dst_rule_idle_timeout*)
Return flows that implement learning a host on a port.

learn_host_on_vlan_ports(*port*, *vlan*, *eth_src*, *delete_existing=True*, *last_dp_coldstart_time=None*)
Learn a host on a port.

learn_host_timeouts(*port*)
Calculate flow timeouts for learning on a port.

faucet.valve_of module

Utility functions to parse/create OpenFlow messages.

faucet.valve_of.**apply_actions**(*actions*)
Return instruction that applies action list.

Parameters **actions** (*list*) – list of OpenFlow actions.

Returns instruction of actions.

Return type ryu.ofproto.ofproto_v1_3_parser.OFPInstruction

faucet.valve_of.**apply_meter**(*meter_id*)
Return instruction to apply a meter.

faucet.valve_of.**barrier**()
Return OpenFlow barrier request.

Returns barrier request.

Return type ryu.ofproto.ofproto_v1_3_parser.OFPBarrierRequest

faucet.valve_of.**bucket**(*weight=0*, *watch_port=4294967295*, *watch_group=4294967295*, *actions=None*)
Return a group action bucket with provided actions.

faucet.valve_of.**build_match_dict**(*in_port=None*, *vlan=None*, *eth_type=None*, *eth_src=None*, *eth_dst=None*, *eth_dst_mask=None*, *icmpv6_type=None*, *nw_proto=None*, *nw_dst=None*)

faucet.valve_of.**controller_pps_meteradd**(*datapath=None*, *pps=0*)
Add a PPS meter towards controller.

faucet.valve_of.**controller_pps_meterdel**(*datapath=None*)
Delete a PPS meter towards controller.

faucet.valve_of.**dec_ip_ttl**()
Return OpenFlow action to decrement IP TTL.

Returns decrement IP TTL.

Return type ryu.ofproto.ofproto_v1_3_parser.OFPActionDecNwTtl

faucet.valve_of.**dedupe_ofmsgs**(*input_ofmsgs*)
Return deduplicated ofmsg list.

faucet.valve_of.**desc_stats_request**(*datapath=None*)
Query switch description.

faucet.valve_of.**devid_present**(*vid*)
Return VLAN VID without VID_PRESENT flag set.

Parameters **vid** (*int*) – VLAN VID with VID_PRESENT.

Returns VLAN VID.

Return type int

faucet.valve_of.**faucet_async**(*datapath=None*, *notify_flow_removed=False*, *packet_in=True*)
Return async message config for FAUCET/Gauge

faucet.valve_of.**faucet_config**(*datapath=None*)
Return switch config for FAUCET.

faucet.valve_of.**flood_tagged_port_outputs**(*ports*, *in_port=None*, *exclude_ports=None*)
Return list of actions necessary to flood to list of tagged ports.

faucet.valve_of.**flood_untagged_port_outputs**(*ports*, *in_port=None*, *exclude_ports=None*)
Return list of actions necessary to flood to list of untagged ports.

faucet.valve_of.**flowmod**(*cookie*, *command*, *table_id*, *priority*, *out_port*, *out_group*, *match_fields*, *inst*, *hard_timeout*, *idle_timeout*, *flags=0*)

faucet.valve_of.**goto_table**(*table*)
Return instruction to goto table.

Parameters **table** (ValveTable) – table to goto.

Returns goto instruction.

Return type ryu.ofproto.ofproto_v1_3_parser.OFPInstruction

faucet.valve_of.**group_act**(*group_id*)
Return an action to run a group.

faucet.valve_of.**group_flood_buckets**(*ports*, *untagged*)

faucet.valve_of.**groupadd**(*datapath=None*, *type_=0*, *group_id=0*, *buckets=None*)
Add a group.

faucet.valve_of.**groupadd_ff**(*datapath=None*, *group_id=0*, *buckets=None*)
Add a fast failover group.

faucet.valve_of.**groupdel**(*datapath=None*, *group_id=4294967292*)
Delete a group (default all groups).

faucet.valve_of.**groupmod**(*datapath=None*, *type_=0*, *group_id=0*, *buckets=None*)
Modify a group.

faucet.valve_of.**groupmod_ff**(*datapath=None*, *group_id=0*, *buckets=None*)
Modify a fast failover group.

faucet.valve_of.**ignore_port**(*port_num*)
Return True if FAUCET should ignore this port.

Parameters **port_num** (*int*) – switch port.

Returns True if FAUCET should ignore this port.

Return type bool

faucet.valve_of.**is_delete**(*ofmsg*)

faucet.valve_of.**is_flowdel**(*ofmsg*)
Return True if flow message is a FlowMod and a delete.

Parameters **ofmsg** – ryu.ofproto.ofproto_v1_3_parser message.

Returns True if is a FlowMod delete/strict.

Return type bool

faucet.valve_of.**is_flowmod**(*ofmsg*)
Return True if flow message is a FlowMod.

Parameters **ofmsg** – ryu.ofproto.ofproto_v1_3_parser message.

Returns True if is a FlowMod

Return type bool

faucet.valve_of.**is_groupadd**(*ofmsg*)
Return True if OF message is a GroupMod and command is add.

Parameters **ofmsg** – ryu.ofproto.ofproto_v1_3_parser message.

Returns True if is a GroupMod add

Return type bool

faucet.valve_of.**is_groupdel**(*ofmsg*)
Return True if OF message is a GroupMod and command is delete.

Parameters **ofmsg** – ryu.ofproto.ofproto_v1_3_parser message.

Returns True if is a GroupMod delete

Return type bool

faucet.valve_of.**is_groupmod**(*ofmsg*)
Return True if OF message is a GroupMod.

Parameters **ofmsg** – ryu.ofproto.ofproto_v1_3_parser message.

Returns True if is a GroupMod

Return type bool

faucet.valve_of.**is_meteradd**(*ofmsg*)
Return True if OF message is a MeterMod and command is add.

Parameters **ofmsg** – ryu.ofproto.ofproto_v1_3_parser message.

Returns True if is a MeterMod add

Return type bool

faucet.valve_of.**is_meterdel**(*ofmsg*)
Return True if OF message is a MeterMod and command is delete.

Parameters **ofmsg** – ryu.ofproto.ofproto_v1_3_parser message.

Returns True if is a MeterMod delete

Return type bool

faucet.valve_of.**is_metermod**(*ofmsg*)
Return True if OF message is a MeterMod.

Parameters **ofmsg** – ryu.ofproto.ofproto_v1_3_parser message.

Returns True if is a MeterMod

Return type bool

faucet.valve_of.**is_table_features_req**(*ofmsg*)
Return True if flow message is a TFM req.

Parameters **ofmsg** – ryu.ofproto.ofproto_v1_3_parser message.

Returns True if is a TFM req.

Return type bool

faucet.valve_of.**match**(*match_fields*)
Return OpenFlow matches from dict.

Parameters **match_fields** (*dict*) – match fields and values.

Returns matches.

Return type ryu.ofproto.ofproto_v1_3_parser.OFPMatch

faucet.valve_of.**match_from_dict**(*match_dict*)

faucet.valve_of.**meteradd**(*meter_conf*)
Add a meter based on YAML configuration.

faucet.valve_of.**meterdel**(*datapath=None*, *meter_id=4294967295*)
Delete a meter (default all meters).

faucet.valve_of.**output_controller**(*max_len=128*)
Return OpenFlow action to packet in to the controller.

Parameters **max_len** (*int*) – max number of bytes from packet to output.

Returns packet in action.

Return type ryu.ofproto.ofproto_v1_3_parser.OFPActionOutput

faucet.valve_of.**output_in_port**()
Return OpenFlow action to output out input port.

Returns ryu.ofproto.ofproto_v1_3_parser.OFPActionOutput.

faucet.valve_of.**output_port**(*port_num*, *max_len=0*)
Return OpenFlow action to output to a port.

Parameters

- **port_num** (*int*) – port to output to.
- **max_len** (*int*) – maximum length of packet to output (default no maximum).

Returns output to port action.

Return type ryu.ofproto.ofproto_v1_3_parser.OFPActionOutput

faucet.valve_of.**packetout**(*port_num*, *data*)
Return OpenFlow action to packet out to dataplane from controller.

Parameters

- **port_num** (*int*) – port to output to.

- **data** (*str*) – raw packet to output.

Returns packet out action.

Return type ryu.ofproto.ofproto_v1_3_parser.OFPActionOutput

faucet.valve_of.**pop_vlan**()
Return OpenFlow action to pop outermost Ethernet 802.1Q VLAN header.

Returns Pop VLAN.

Return type ryu.ofproto.ofproto_v1_3_parser.OFPActionPopVlan

faucet.valve_of.**port_status_from_state**(*state*)
Return True if OFPPS_LINK_DOWN is not set.

faucet.valve_of.**push_vlan_act**(*vlan_vid*, *eth_type=33024*)
Return OpenFlow action list to push Ethernet 802.1Q header with VLAN VID.

Parameters **vid** (*int*) – VLAN VID

Returns actions to push 802.1Q header with VLAN VID set.

Return type list

faucet.valve_of.**set_eth_dst**(*eth_dst*)
Return action to set destination Ethernet MAC address.

Parameters **eth_src** (*str*) – destination Ethernet MAC address.

Returns set field action.

Return type ryu.ofproto.ofproto_v1_3_parser.OFPActionSetField

faucet.valve_of.**set_eth_src**(*eth_src*)
Return action to set source Ethernet MAC address.

Parameters **eth_src** (*str*) – source Ethernet MAC address.

Returns set field action.

Return type ryu.ofproto.ofproto_v1_3_parser.OFPActionSetField

faucet.valve_of.**set_vlan_vid**(*vlan_vid*)
Set VLAN VID with VID_PRESENT flag set.

Parameters **vid** (*int*) – VLAN VID

Returns set VID with VID_PRESENT.

Return type ryu.ofproto.ofproto_v1_3_parser.OFPActionSetField

faucet.valve_of.**table_features**(*body*)

faucet.valve_of.**valve_flowreorder**(*input_ofmsgs*, *use_barriers=True*)
Reorder flows for better OFA performance.

faucet.valve_of.**valve_match_vid**(*value*)

faucet.valve_of.**vid_present**(*vid*)
Return VLAN VID with VID_PRESENT flag set.

Parameters **vid** (*int*) – VLAN VID

Returns VLAN VID with VID_PRESENT.

Return type int

faucet.valve_of_old module

Deprecated OF matches.

faucet.valve_packet module

Utility functions for parsing and building Ethernet packet/contents.

class faucet.valve_packet.**PacketMeta**(*data*, *orig_len*, *pkt*, *eth_pkt*, *port*, *valve_vlan*, *eth_src*, *eth_dst*, *eth_type*)

Bases: object

Original, and parsed Ethernet packet metadata.

ETH_TYPES_PARSERS = {2048: (4, <function ipv4_parseable at 0x7fe9471ac6a8>, <class 'r

MIN_ETH_TYPE_PKT_SIZE = {2048: 38, 2054: 46, 34525: 58}

ip_ver()
Return IP version number.

packet_complete()
True if we have the complete packet.

reparse(*max_len*)
Reparse packet using data up to the specified maximum length.

reparse_all()
Reparse packet with all available data.

reparse_ip(*payload=0*)
Reparse packet with specified IP header type and optionally payload.

faucet.valve_packet.**arp_reply**(*vid*, *eth_src*, *eth_dst*, *src_ip*, *dst_ip*)
Return an ARP reply packet.

Parameters

- **vid** (*int or None*) – VLAN VID to use (or None).
- **eth_src** (*str*) – Ethernet source address.
- **eth_dst** (*str*) – destination Ethernet MAC address.
- **src_ip** (*ipaddress.IPv4Address*) – source IPv4 address.
- **dst_ip** (*ipaddress.IPv4Address*) – destination IPv4 address.

Returns serialized ARP reply packet.

Return type ryu.lib.packet.arp

faucet.valve_packet.**arp_request**(*vid*, *eth_src*, *src_ip*, *dst_ip*)
Return an ARP request packet.

Parameters

- **vid** (*int or None*) – VLAN VID to use (or None).
- **eth_src** (*str*) – Ethernet source address.
- **src_ip** (*ipaddress.IPv4Address*) – source IPv4 address.
- **dst_ip** (*ipaddress.IPv4Address*) – requested IPv4 address.

Returns serialized ARP request packet.

Return type ryu.lib.packet.arp

faucet.valve_packet.**build_pkt_header**(*vid*, *eth_src*, *eth_dst*, *dl_type*)
Return an Ethernet packet header.

Parameters

- **vid** (*int or None*) – VLAN VID to use (or None).
- **eth_src** (*str*) – source Ethernet MAC address.
- **eth_dst** (*str*) – destination Ethernet MAC address.
- **dl_type** (*int*) – EtherType.

Returns Ethernet packet with header.

Return type ryu.lib.packet.ethernet

faucet.valve_packet.**echo_reply**(*vid*, *eth_src*, *eth_dst*, *src_ip*, *dst_ip*, *data*)
Return an ICMP echo reply packet.

Parameters

- **vid** (*int or None*) – VLAN VID to use (or None).
- **eth_src** (*str*) – Ethernet source address.
- **eth_dst** (*str*) – destination Ethernet MAC address.
- **src_ip** (*ipaddress.IPv4Address*) – source IPv4 address.
- **dst_ip** (*ipaddress.IPv4Address*) – destination IPv4 address.

Returns serialized ICMP echo reply packet.

Return type ryu.lib.packet.icmp

faucet.valve_packet.**faucet_lldp_tlvs**(*dp*)
Return LLDP TLVs for a datapath.

faucet.valve_packet.**faucet_oui**(*mac*)
Return first 3 bytes of MAC address (given as str).

faucet.valve_packet.**icmpv6_echo_reply**(*vid*, *eth_src*, *eth_dst*, *src_ip*, *dst_ip*, *hop_limit*, *id_*, *seq*, *data*)
Return IPv6 ICMP echo reply packet.

Parameters

- **vid** (*int or None*) – VLAN VID to use (or None).
- **eth_src** (*str*) – source Ethernet MAC address.
- **eth_dst** (*str*) – destination Ethernet MAC address.
- **src_ip** (*ipaddress.IPv6Address*) – source IPv6 address.
- **dst_ip** (*ipaddress.IPv6Address*) – destination IPv6 address.
- **hop_limit** (*int*) – IPv6 hop limit.
- **id_** (*int*) – identifier for echo reply.
- **seq** (*int*) – sequence number for echo reply.
- **data** (*str*) – payload for echo reply.

Returns Serialized IPv6 ICMP echo reply packet.

Return type ryu.lib.packet.ethernet

faucet.valve_packet.**ipv4_parseable**(*ip_header_data*)
Return True if an IPv4 packet we could parse.

faucet.valve_packet.**ipv6_link_eth_mcast**(*dst_ip*)
Return an Ethernet multicast address from an IPv6 address.

See RFC 2464 section 7.

Parameters **dst_ip** (*ipaddress.IPv6Address*) – IPv6 address.

Returns Ethernet multicast address.

Return type str

faucet.valve_packet.**ipv6_solicited_node_from_ucast**(*ucast*)
Return IPv6 solicited node multicast address from IPv6 unicast address.

See RFC 3513 section 2.7.1.

Parameters **ucast** (*ipaddress.IPv6Address*) – IPv6 unicast address.

Returns IPv6 solicited node multicast address.

Return type ipaddress.IPv6Address

faucet.valve_packet.**lacp_reqreply**(*eth_src*, *actor_system*, *actor_key*, *actor_port*, *partner_system*, *partner_key*, *partner_port*, *partner_system_priority*, *partner_port_priority*, *partner_state_defaulted*, *partner_state_expired*, *partner_state_timeout*, *partner_state_collecting*, *partner_state_distributing*, *partner_state_aggregation*, *partner_state_synchronization*, *partner_state_activity*)
Return a LACP frame.

Parameters

- **eth_src** (*str*) – source Ethernet MAC address.
- **actor_system** (*str*) – actor system ID (MAC address)
- **actor_key** (*int*) – actor's LACP key assigned to this port.
- **actor_port** (*int*) – actor port number.
- **partner_system** (*str*) – partner system ID (MAC address)
- **partner_key** (*int*) – partner's LACP key assigned to this port.
- **partner_port** (*int*) – partner port number.
- **partner_system_priority** (*int*) – partner's system priority.
- **partner_port_priority** (*int*) – partner's port priority.
- **partner_state_defaulted** (*int*) – 1 if partner reverted to defaults.
- **partner_state_expired** (*int*) – 1 if partner thinks LACP expired.
- **partner_state_timeout** (*int*) – 1 if partner has short timeout.
- **partner_state_collecting** (*int*) – 1 if partner receiving on this link.
- **partner_state_distributing** (*int*) – 1 if partner transmitting on this link.
- **partner_state_aggregation** (*int*) – 1 if partner can aggregate this link.

- **partner_state_synchronization** (*int*) – 1 if partner will use this link.
- **partner_state_activity** (*int*) – 1 if partner actively sends LACP.

Returns Ethernet packet with header.

Return type ryu.lib.packet.ethernet

faucet.valve_packet.**lldp_beacon**(*eth_src*, *chassis_id*, *port_id*, *ttl*, *org_tlvs=None*, *system_name=None*, *port_descr=None*)

Return an LLDP frame suitable for a host/access port.

Parameters

- **eth_src** (*str*) – source Ethernet MAC address.
- **chassis_id** (*str*) – Chassis ID.
- **port_id** (*int*) – port ID,
- **TTL** (*int*) – TTL for payload.
- **org_tlvs** (*list*) – list of tuples of (OUI, subtype, info).

Returns Ethernet packet with header.

Return type ryu.lib.packet.ethernet

faucet.valve_packet.**mac_addr_is_unicast**(*mac_addr*)

Returns True if mac_addr is a unicast Ethernet address.

Parameters **mac_addr** (*str*) – MAC address.

Returns True if a unicast Ethernet address.

Return type bool

faucet.valve_packet.**mac_byte_mask**(*mask_bytes=0*)

Return a MAC address mask with n bytes masked out.

faucet.valve_packet.**nd_advert**(*vid*, *eth_src*, *eth_dst*, *src_ip*, *dst_ip*)

Return IPv6 neighbor avertisement packet.

Parameters

- **vid** (*int or None*) – VLAN VID to use (or None).
- **eth_src** (*str*) – source Ethernet MAC address.
- **eth_dst** (*str*) – destination Ethernet MAC address.
- **src_ip** (*ipaddress.IPv6Address*) – source IPv6 address.
- **dst_ip** (*ipaddress.IPv6Address*) – destination IPv6 address.

Returns Serialized IPv6 neighbor discovery packet.

Return type ryu.lib.packet.ethernet

faucet.valve_packet.**nd_request**(*vid*, *eth_src*, *src_ip*, *dst_ip*)

Return IPv6 neighbor discovery request packet.

Parameters

- **vid** (*int or None*) – VLAN VID to use (or None).
- **eth_src** (*str*) – source Ethernet MAC address.
- **src_ip** (*ipaddress.IPv6Address*) – source IPv6 address.

- **dst_ip** (*ipaddress.IPv6Address*) – requested IPv6 address.

Returns Serialized IPv6 neighbor discovery packet.

Return type ryu.lib.packet.ethernet

faucet.valve_packet.**parse_eth_pkt**(*pkt*)
Return parsed Ethernet packet.

Parameters **pkt** (*ryu.lib.packet.packet*) – packet received from dataplane.

Returns Ethernet packet.

Return type ryu.lib.packet.ethernet

faucet.valve_packet.**parse_lacp_pkt**(*pkt*)
Return parsed LACP packet.

Parameters **pkt** (*ryu.lib.packet.packet*) – packet received from dataplane.

Returns LACP packet.

Return type ryu.lib.packet.lacp

faucet.valve_packet.**parse_lldp**(*pkt*)
Return parsed LLDP packet.

Parameters **pkt** (*ryu.lib.packet.packet*) – packet received from dataplane.

Returns LLDP packet.

Return type ryu.lib.packet.lldp

faucet.valve_packet.**parse_packet_in_pkt**(*data*, *max_len*)
Parse a packet received via packet in from the dataplane.

Parameters

- **data** (*bytearray*) – packet data from dataplane.
- **max_len** (*int*) – max number of packet data bytes to parse.

Returns raw packet ryu.lib.packet.ethernet: parsed Ethernet packet. int: Ethernet type of packet (inside VLAN) int: VLAN VID (or None if no VLAN)

Return type ryu.lib.packet.packet

faucet.valve_packet.**parse_vlan_pkt**(*pkt*)
Return parsed VLAN header.

Parameters **pkt** (*ryu.lib.packet.packet*) – packet received from dataplane.

Returns VLAN header.

Return type ryu.lib.packet.vlan

faucet.valve_packet.**router_advert**(*vid*, *eth_src*, *eth_dst*, *src_ip*, *dst_ip*, *vips*, *pi_flags=6*)
Return IPv6 ICMP echo reply packet.

Parameters

- **vid** (*int or None*) – VLAN VID to use (or None).
- **eth_src** (*str*) – source Ethernet MAC address.
- **eth_dst** (*str*) – dest Ethernet MAC address.
- **src_ip** (*ipaddress.IPv6Address*) – source IPv6 address.

- **vips** (*list*) – prefixes (ipaddress.IPv6Address) to advertise.
- **pi_flags** (*int*) – flags to set in prefix information field (default set A and L)

Returns Serialized IPv6 ICMP RA packet.

Return type ryu.lib.packet.ethernet

faucet.valve_route module

Valve IPv4/IPv6 routing implementation.

class faucet.valve_route.**NextHop**(*eth_src*, *port*, *now*)
Bases: object

Describes a directly connected (at layer 2) nexthop.

class faucet.valve_route.**ValveIPv4RouteManager**(*logger*, *arp_neighbor_timeout*, *max_hosts_per_resolve_cycle*, *max_host_fib_retry_count*, *max_resolve_backoff_time*, *proactive_learn*, *dec_ttl*, *fib_table*, *vip_table*, *eth_src_table*, *eth_dst_table*, *flood_table*, *route_priority*, *routers*, *use_group_table*, *groups*)
Bases: *faucet.valve_route.ValveRouteManager*

Implement IPv4 RIB/FIB.

CONTROL_ETH_TYPES = (2048, 2054)

ETH_TYPE = 2048

ICMP_TYPE = 1

IPV = 4

control_plane_handler(*pkt_meta*)

resolve_gw_on_port(*vlan*, *port*, *faucet_vip*, *ip_gw*)

resolve_gw_on_vlan(*vlan*, *faucet_vip*, *ip_gw*)

class faucet.valve_route.**ValveIPv6RouteManager**(*logger*, *arp_neighbor_timeout*, *max_hosts_per_resolve_cycle*, *max_host_fib_retry_count*, *max_resolve_backoff_time*, *proactive_learn*, *dec_ttl*, *fib_table*, *vip_table*, *eth_src_table*, *eth_dst_table*, *flood_table*, *route_priority*, *routers*, *use_group_table*, *groups*)
Bases: *faucet.valve_route.ValveRouteManager*

Implement IPv6 FIB.

CONTROL_ETH_TYPES = (34525,)

ETH_TYPE = 34525

ICMP_TYPE = 58

IPV = 6

advertise(*vlan*)

control_plane_handler(*pkt_meta*)

resolve_gw_on_port(*vlan*, *port*, *faucet_vip*, *ip_gw*)

resolve_gw_on_vlan(*vlan*, *faucet_vip*, *ip_gw*)

class faucet.valve_route.**ValveRouteManager**(*logger*, *arp_neighbor_timeout*, *max_hosts_per_resolve_cycle*, *max_host_fib_retry_count*, *max_resolve_backoff_time*, *proactive_learn*, *dec_ttl*, *fib_table*, *vip_table*, *eth_src_table*, *eth_dst_table*, *flood_table*, *route_priority*, *routers*, *use_group_table*, *groups*)

Bases: object

Base class to implement RIB/FIB.

CONTROL_ETH_TYPES = ()

ETH_TYPE = None

ICMP_TYPE = None

IPV = 0

MAX_LEN = 128

add_faucet_vip(*vlan*, *faucet_vip*)

add_host_fib_route_from_pkt(*pkt_meta*)

Add a host FIB route given packet from host.

Parameters **pkt_meta** (PacketMeta) – received packet.

Returns OpenFlow messages.

Return type list

add_route(*vlan*, *ip_gw*, *ip_dst*)

Add a route to the RIB.

Parameters

- **vlan** (*vlan*) – VLAN containing this RIB.
- **ip_gw** (*ipaddress.ip_address*) – IP address of nexthop.
- **ip_dst** (*ipaddress.ip_network*) – destination IP network.

Returns OpenFlow messages.

Return type list

advertise(*vlan*)

control_plane_handler(*pkt_meta*)

del_route(*vlan*, *ip_dst*)

Delete a route from the RIB.

Only one route with this exact destination is supported.

Parameters

- **vlan** (*vlan*) – VLAN containing this RIB.
- **ip_dst** (*ipaddress.ip_network*) – destination IP network.

Returns OpenFlow messages.

Return type list

resolve_gateways(*vlan*, *now*)
Re/resolve all gateways.

Parameters

- **vlan** (*vlan*) – VLAN containing this RIB/FIB.
- **now** (*float*) – seconds since epoch.

Returns OpenFlow messages.

Return type list

resolve_gw_on_port(*vlan*, *port*, *faucet_vip*, *ip_gw*)

resolve_gw_on_vlan(*vlan*, *faucet_vip*, *ip_gw*)

faucet.valve_ryuapp module

RyuApp base class for FAUCET/Gauge.

class faucet.valve_ryuapp.**EventReconfigure**
Bases: ryu.controller.event.EventBase

Event sent to controller to cause config reload.

class faucet.valve_ryuapp.**RyuAppBase**(**args*, ***kwargs*)
Bases: ryu.base.app_manager.RyuApp

RyuApp base class for FAUCET/Gauge.

OFP_VERSIONS = [4]

connect_or_disconnect_handler(*ryu_event*)
Handle connection or disconnection of a datapath.

Parameters **ryu_event** (*ryu.controller.dpset.EventDP*) – trigger.

exc_logname = ''

get_setting(*setting*, *path_eval=False*)
Return config setting prefaced with logname.

logname = ''

reconnect_handler(*ryu_event*)
Handle reconnection of a datapath.

Parameters **ryu_event** (*ryu.controller.dpset.EventDPReconnected*) – trigger.

reload_config(*_ryu_event*)
Handle reloading configuration.

signal_handler(*sigid*, *_*)
Handle signals.

Parameters **sigid** (*int*) – signal received.

start()
Start controller.

faucet.valve_table module

Abstraction of an OF table.

class faucet.valve_table.**ValveGroupEntry**(*table*, *group_id*, *buckets*)
Bases: object

Abstraction for a single OpenFlow group entry.

add()
Return flows to add this entry to the group table.

delete()
Return flow to delete an existing group entry.

modify()
Return flow to modify an existing group entry.

update_buckets(*buckets*)

class faucet.valve_table.**ValveGroupTable**
Bases: object

Wrap access to group table.

delete_all()
Delete all groups.

entries = {}

get_entry(*group_id*, *buckets*)

static group_id_from_str(*key_str*)
Return a group ID based on a string key.

class faucet.valve_table.**ValveTable**(*table_id*, *name*, *restricted_match_types*, *flow_cookie*, *notify_flow_removed=False*)
Bases: object

Wrapper for an OpenFlow table.

flowcontroller(*match=None*, *priority=None*, *inst=None*, *max_len=96*)
Add flow outputting to controller.

flowdel(*match=None*, *priority=None*, *out_port=4294967295*, *strict=False*)
Delete matching flows from a table.

flowdrop(*match=None*, *priority=None*, *hard_timeout=0*)
Add drop matching flow to a table.

flowmod(*match=None*, *priority=None*, *inst=None*, *command=0*, *out_port=0*, *out_group=0*, *hard_timeout=0*, *idle_timeout=0*, *cookie=None*)
Helper function to construct a flow mod message with cookie.

match(*in_port=None*, *vlan=None*, *eth_type=None*, *eth_src=None*, *eth_dst=None*, *eth_dst_mask=None*, *icmpv6_type=None*, *nw_proto=None*, *nw_dst=None*)
Compose an OpenFlow match rule.

faucet.valve_util module

Utility functions for FAUCET.

faucet.valve_util.**btos**(*b_str*)
Return byte array/string as string.

faucet.valve_util.**close_logger**(*logger*)
Close all handlers on logger object.

faucet.valve_util.**dpid_log**(*dpid*)
Log a DP ID as hex/decimal.

faucet.valve_util.**get_logger**(*logname*, *logfile*, *loglevel*, *propagate*)
Create and return a logger object.

faucet.valve_util.**get_setting**(*name*, *path_eval=False*)
Returns value of specified configuration setting.

faucet.valve_util.**get_sys_prefix**()
Returns an additional prefix for log and configuration files when used in a virtual environment

faucet.valve_util.**kill_on_exception**(*logname*)
decorator to ensure functions will kill ryu when an unhandled exception occurs

faucet.valve_util.**stat_config_files**(*config_hashes*)
Return dict of a subset of stat attributes on config files.

faucet.valves_manager module

Manage a collection of Valves.

class faucet.valves_manager.**ConfigWatcher**
Bases: object

Watch config for file or content changes.

config_file = None

config_file_stats = None

config_hashes = None

content_changed(*new_config_file*)
Return True if config file content actually changed.

files_changed()
Return True if any config files changed.

update(*new_config_file*, *new_config_hashes=None*)
Update state with new config file/hashes.

class faucet.valves_manager.**ValvesManager**(*logname*, *logger*, *metrics*, *notifier*, *bgp*, *send_flows_to_dp_by_id*)
Bases: object

Manage a collection of Valves.

load_configs(*new_config_file*, *delete_dp=None*)
Load/apply new config to all Valves.

new_valve(*new_dp*)

parse_configs(*new_config_file*)
Return parsed configs for Valves, or None.

request_reload_configs(*new_config_file*, *delete_dp=None*)
Process a request to load config changes.

update_metrics()
Update metrics in all Valves.

valve_flow_services(*valve_service*)
Call a method on all Valves and send any resulting flows.

valve_packet_in(*valve*, *pkt_meta*)
Time a call to Valve packet in handler.

valves = {}

faucet.vlan module

VLAN configuration.

class faucet.vlan.**HostCacheEntry**(*eth_src*, *port*, *cache_time*)
Bases: object

Association of a host with a port.

class faucet.vlan.**VLAN**(*_id*, *dp_id*, *conf=None*)
Bases: *faucet.conf.Conf*

Contains state for one VLAN, including its configuration.

acl_in = None

acls_in = None

add_cache_host(*eth_src*, *port*, *cache_time*)

add_route(*ip_dst*, *ip_gw*)
Add an IP route.

all_ip_gws(*ipv*)
Return list of all IP gateways for specified IP version.

bgp_as = None

bgp_connect_mode = None

bgp_local_address = None

bgp_neighbor_addresses = []

bgp_neighbor_as = None

bgp_neighbour_addresses = []

bgp_neighbour_as = None

bgp_port = None

bgp_routerid = None

bgp_server_addresses = []

cached_host(*eth_src*)

cached_host_on_port(*eth_src*, *port*)
Return host cache entry if host in cache and on specified port.

cached_hosts_count_on_port(*port*)
Return count of all hosts learned on a port.

cached_hosts_on_port(*port*)
Return all hosts learned on a port.

check_config()
Check config at instantiation time for errors, typically via assert.

clear_cache_hosts_on_port(*port*)
Clear all hosts learned on a port.

defaults = {'acl_in': None, 'acls_in': None, 'bgp_as': None, 'bgp_connect_mode': '

defaults_types = {'acl_in': (<class 'int'>, <class 'str'>), 'acls_in': <class 'list'

del_route(*ip_dst*)
Delete an IP route.

dp_id = None

dyn_faucet_vips_by_ipv = None

dyn_gws_by_ipv = None

dyn_host_cache = None

dyn_host_cache_by_port = None

dyn_last_time_hosts_expired = None

dyn_learn_ban_count = 0

dyn_neigh_cache_by_ipv = None

dyn_oldest_host_time = None

dyn_routes_by_ipv = None

expire_cache_host(*eth_src*)

expire_cache_hosts(*now*, *learn_timeout*)
Expire stale host entries.

faucet_mac = None

faucet_vips = None

faucet_vips_by_ipv(*ipv*)
Return list of VIPs with specified IP version on this VLAN.

flood_pkt(*packet_builder*, *random_order*, **args*)

flood_ports(*configured_ports*, *exclude_unicast*)

from_connected_to_vip(*src_ip*, *dst_ip*)
Return True if src_ip in connected network and dst_ip is a VIP.

Parameters

- **src_ip** (*ipaddress.ip_address*) – source IP.
- **dst_ip** (*ipaddress.ip_address*) – destination IP

Returns True if local traffic for a VIP.

get_ports()
Return list of all ports on this VLAN.

hairpin_ports()
Return all ports with hairpin enabled.

hosts_count()
Return number of hosts learned on this VLAN.

ip_dsts_for_ip_gw(*ip_gw*)
Return list of IP destinations, for specified gateway.

ip_in_vip_subnet(*ipa*)
Return faucet_vip if IP in same IP network as a VIP on this VLAN.

ips_in_vip_subnet(*ips*)
Return True if all IPs are on same subnet as VIP on this VLAN.

ipvs()
Return list of IP versions configured on this VLAN.

is_faucet_vip(*ipa*)
Return True if IP is a VIP on this VLAN.

lags()
Return dict of LAGs mapped to member ports.

max_hosts = None

mirrored_ports()
Return list of ports that are mirrored on this VLAN.

name = None

neigh_cache_by_ipv(*ipv*)
Return neighbor cache for specified IP version on this VLAN.

neigh_cache_count_by_ipv(*ipv*)
Return number of hosts in neighbor cache for specified IP version on this VLAN.

output_port(*port*, *hairpin=False*)

pkt_out_port(*packet_builder*, *port*, **args*)

port_is_tagged(*port*)
Return True if port number is an tagged port on this VLAN.

port_is_untagged(*port*)
Return True if port number is an untagged port on this VLAN.

proactive_arp_limit = None

proactive_nd_limit = None

reset_caches()

reset_ports(*ports*)

route_count_by_ipv(*ipv*)
Return route table count for specified IP version on this VLAN.

routes = None

routes_by_ipv(*ipv*)
Return route table for specified IP version on this VLAN.

set_defaults()
Set default values and run any basic sanity checks.

tagged = None

tagged_flood_ports(*exclude_unicast*)

targeted_gw_resolution = None

unicast_flood = None

untagged = None

untagged_flood_ports(*exclude_unicast*)

vid = None

static vid_valid(*vid*)
Return True if VID valid.

faucet.watcher module

Gauge watcher implementations.

class faucet.watcher.**GaugeFlowTableLogger**(*conf*, *logname*, *prom_client*)
Bases: *faucet.gauge_pollers.GaugeFlowTablePoller*

Periodically dumps the current datapath flow table as a yaml object.

Includes a timestamp and a reference ($DATAPATHNAME-flowtables). The flow table is dumped as an OFFlowStatsReply message (in yaml format) that matches all flows.

optionally the output can be compressed by setting compressed: true in the config for this watcher

update(*rcv_time*, *dp_id*, *msg*)
Handle the responses to requests.

Called when a reply to a stats request sent by this object is received by the controller.

It should acknowledge the receipt by setting self.reply_pending to false.

Parameters

- **rcv_time** – the time the response was received
- **dp_id** – DP ID
- **msg** – the stats reply message

class faucet.watcher.**GaugePortStateLogger**(*conf*, *logname*, *prom_client*)
Bases: *faucet.gauge_pollers.GaugePortStatePoller*

Abstraction for port state logger.

static no_response()
Called when a polling cycle passes without receiving a response.

static send_req()
Send a stats request to a datapath.

update(*rcv_time*, *dp_id*, *msg*)
Handle the responses to requests.

Called when a reply to a stats request sent by this object is received by the controller.

It should acknowledge the receipt by setting self.reply_pending to false.

Parameters

- **rcv_time** – the time the response was received
- **dp_id** – DP ID

- **msg** – the stats reply message

class faucet.watcher.**GaugePortStatsLogger**(*conf*, *logname*, *prom_client*)
Bases: *faucet.gauge_pollers.GaugePortStatsPoller*

Abstraction for port statistics logger.

update(*rcv_time*, *dp_id*, *msg*)
Handle the responses to requests.

Called when a reply to a stats request sent by this object is received by the controller.

It should acknowledge the receipt by setting self.reply_pending to false.

Parameters

- **rcv_time** – the time the response was received
- **dp_id** – DP ID
- **msg** – the stats reply message

faucet.watcher.**watcher_factory**(*conf*)
Return a Gauge object based on type.

Parameters **conf** (*GaugeConf*) – object with the configuration for this valve.

faucet.watcher_conf module

Gauge watcher configuration.

class faucet.watcher_conf.**WatcherConf**(*_id*, *dp_id*, *conf*, *prom_client*)
Bases: *faucet.conf.Conf*

Stores the state and configuration to monitor a single stat.

Watcher Config

Watchers are configured in the watchers config block in the config for gauge.

The following elements can be configured for each watcher, at the level of /watchers/<watcher name>/:

- type (string): The type of watcher (IE what stat this watcher monitors). The types are 'port_state', 'port_stats' or 'flow_table'.
- dps (list): A list of dps that should be monitored with this watcher.
- db (string): The db that will be used to store the data once it is retreived.
- interval (int): if this watcher requires polling the switch, it will monitor at this interval.

The config for a db should be created in the gauge config file under the dbs config block.

The following elements can be configured for each db, at the level of /dbs/<db name>/:

- type (string): the type of db. The available types are 'text' and 'influx' for port_state, 'text', 'influx'and 'prometheus' for port_stats and 'text' and flow_table.

The following config elements then depend on the type. For text:

- file (string): the filename of the file to write output to.
- compress (bool): compress (with gzip) flow_table output while writing it

For influx:

- influx_db (str): The name of the influxdb database. Defaults to 'faucet'.
- influx_host (str): The host where the influxdb is reachable. Defaults to 'localhost'.
- influx_port (int): The port that the influxdb host will listen on. Defaults to 8086.
- influx_user (str): The username for accessing influxdb. Defaults to ''.
- influx_pwd (str): The password for accessing influxdb. Defaults to ''.
- influx_timeout (int): The timeout in seconds for connecting to influxdb. Defaults to 10.
- influx_retries (int): The number of times to retry connecting to influxdb after failure. Defaults to 3.

For Prometheus:

- prometheus_port (int): The port used to export prometheus data. Defaults to 9303.
- prometheus_addr (ip addr str): The address used to export prometheus data. Defaults to '127.0.0.1'.

add_db(*db_conf*)
Add database config to this watcher.

add_dp(*dp*)
Add a datapath to this watcher.

all_dps = None

db = None

defaults = {'all_dps': False, 'compress': False, 'db': None, 'db_type': 'text', 'd

defaults_types = {'all_dps': <class 'bool'>, 'compress': <class 'bool'>, 'db': <cla

dp = None

prom_client = None

Module contents

CHAPTER 3

Quick References

3.1 Frequently Asked Questions

3.1.1 How are packet-ins handled when a message is generated through table-miss flow entry?

Faucet adds explicit rules for unmatched packets.

3.1.2 Are group actions supported in Faucet?

Yes, just not by default currently. Set the `group_table` option to `True` on a datapath to enable group output actions.

3.1.3 Does Faucet send any multi-part requests? If so, please provide sample use cases

Gauge uses multi-part messages for the stats collection (flow table stats and port stats).

3.1.4 Does Faucet install table-miss entry?

Yes.

3.1.5 Does Faucet clear all all switch table entries on connection?

Faucet gives all entries a specific cookie, and it clears all entries with that cookie. I.e., it clears entries added by itself but not anyone else.

3.1.6 Does Faucet install fresh set of table entries on connection and re-connection?

Yes.

3.1.7 Does Faucet installed flows support priority? How is this defined - who get higher priority than the other and why?

Yes, priority is necessary for a number of things. Example: there are higher priority rules for packets with a known source address, and lower ones to send those packets to the controller.

3.1.8 Is there a gui for generating a YAML file?

No.

3.1.9 Should Faucet detect Management, OF controller ports and gateway ports on the switch or pure OF only ports where hosts are connected?

Out of scope for Faucet as it is currently.

3.1.10 If another controller is connected to the switch in addition to Faucet, what happens to Faucet?

Faucet identifies its own flows using a cookie value, if the other controller doesn't use the same cookie value there shouldn't be a problem (provided the rules don't conflict in a problematic way)

3.1.11 If another controller connected to switch changes role (master, slave, equal) on the switch, what happens to Faucet?

Shouldn't be an issue, if another controller is the master then my understanding is Faucet wouldnt be able to install any flows however?

3.1.12 Does Faucet send LLDP packets?

No.

3.1.13 Some switches always send VLAN info in packet_in messages and some don't. How does Faucet handle this?

Packets should have VLANs pushed before being sent to the controller.

3.1.14 Is there a event handler registered to detect if flows on the switch change?

No.

3.1.15 Does Faucet use auxiliary connections?

No.

3.1.16 Does Faucet support L2.5 (MPLS, etc.)?

No.

3.1.17 Stats - what does Faucet collect (flow count, etc)?

Gauge collects port stats and takes a full flow-table dump periodically.

3.1.18 How do I use Gauge?

Give Gauge a list of Faucet yaml config files and it will poll them for stats (as specified in the config file).

CHAPTER 4

Indices and tables

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