Software Defined Networking

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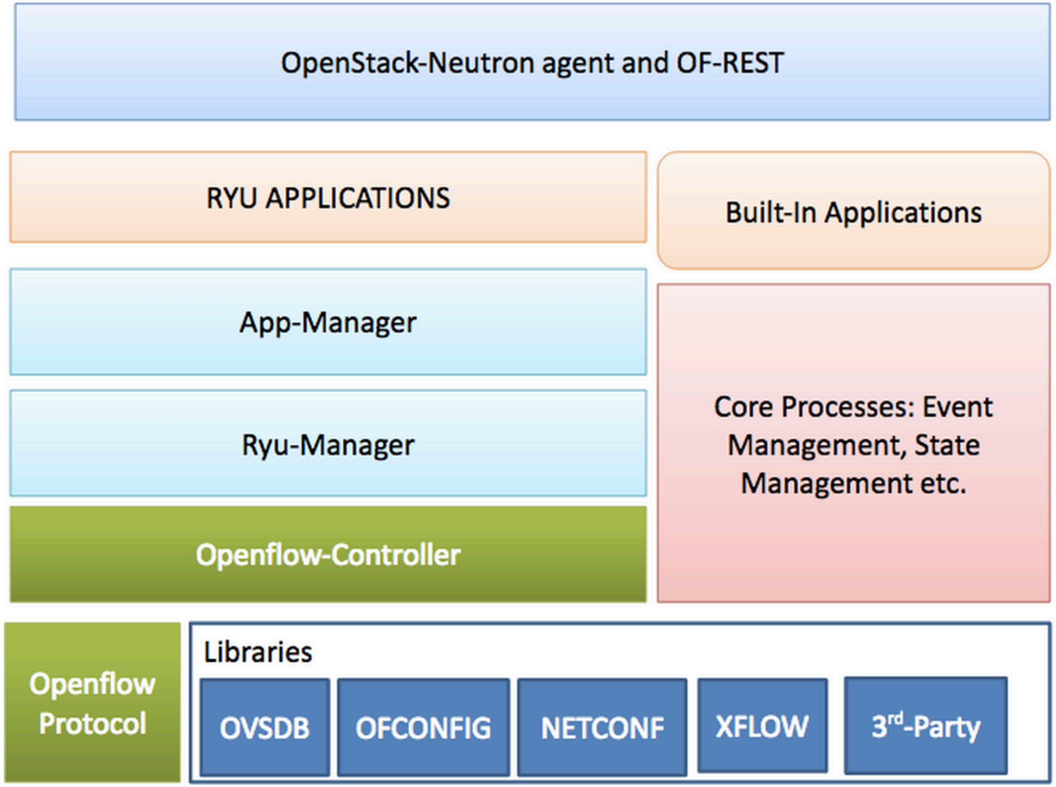
In this course, you will learn about software defined networking and how it is changing the way communications networks are managed, maintained, and secured.

Commercial Grade Controllers: Ryu

- Overview of Ryu Controller
- API Overview
- Demonstration of Layer 2 Learning Switch

Ryu Architecture



OpenStack-Neutron agent and OF-REST

RYU APPLICATIONS

Built-In Applications

App-Manager

Ryu-Manager

Core Processes: Event Management, State Management etc.

Openflow-Controller

Openflow Protocol

Libraries

OVSDB

OFCONFIG

NETCONF

XFLOW

3rd-Party

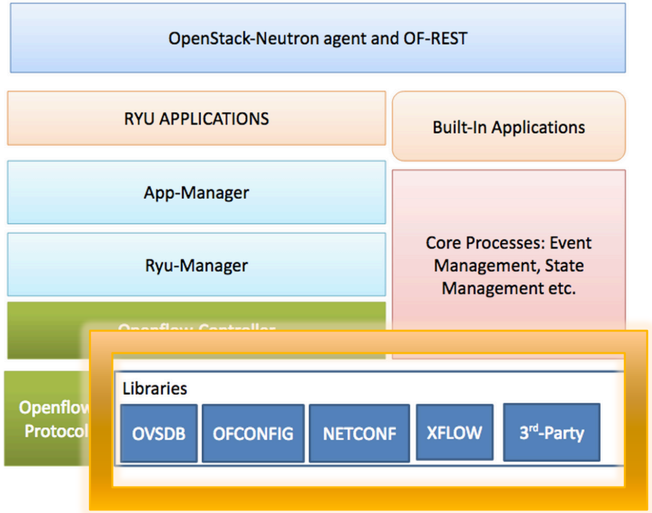
- Libraries
- OpenFlow Controller
- Managers / Core Processes
- Northbound
- Applications

Like other SDN controllers, ability to handle asynchronous events, packet in.

https://github.com/osrg/ryu

Ryu: Libraries

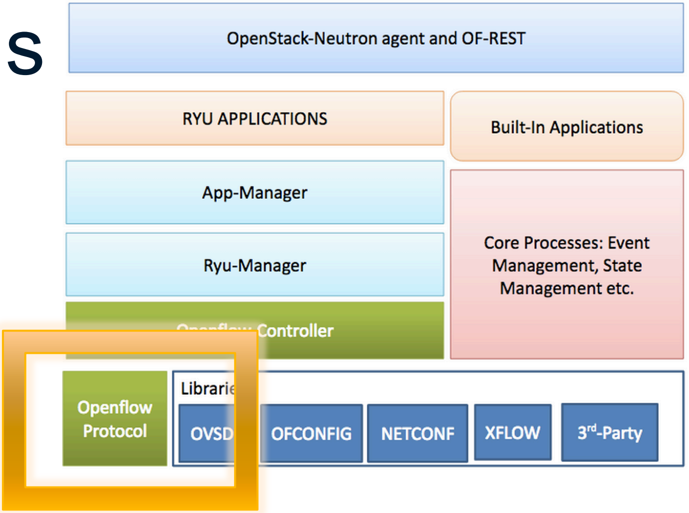
- Support for multiple southbound protocols
  - OF-CONFIG
  - OVSDB
  - NETCONF
  - XFLOW (Netflow, Sflow)
  - Oopen vSwitch Python Binding
- Support for parsing, building various protocol packets



http://goo.gl/TOBwJ4

Ryu: OpenFlow Support

- Support for OpenFlow up to version 1.4
- Controller-to-switch messags
  - Handshake, switch-config, flow-table config, read/modify state, queue config, barrier, …
- Asynchronous messages
  - Packet-in, flow-removed, port-status



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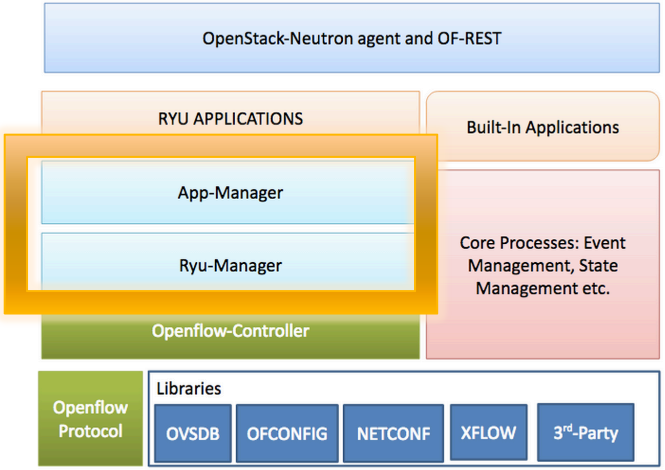
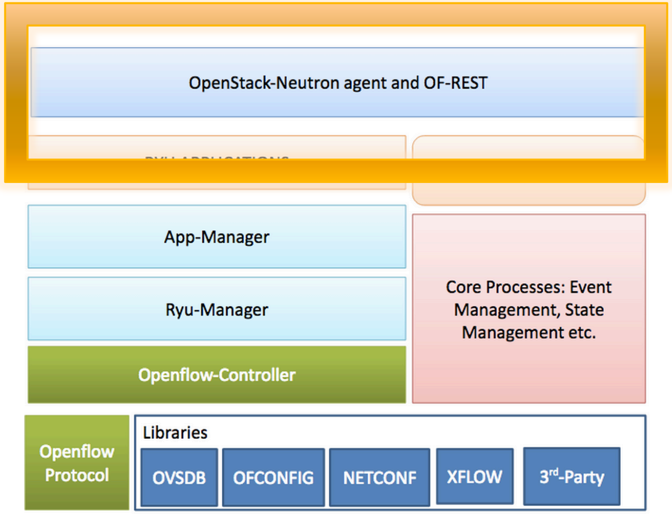
Ryu: Managers and Core-Processes

- Ryu-manager is the main executable
  - Listens to port 6633 by default
  - Any OpenFlow switch can connect to the manager
- All applications inherit from `RyuApp` class



Ryu: Northbound API

- Support for Openstack Neutron
  - Supports GRE-based overlay, VLAN
- REST interface to OpenFlow Operations
- Easy to introduce new REST APIs



OpenStack-Neutron agent and OF-REST

RYU APPLICATIONS

App-Manager

Ryu-Manager

Openflow-Controller

Core Processes: Event Management, State Management etc.

Openflow Protocol

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Ryu: Applications

- Ryu ships with many applications
  - Simple switch
  - Router
  - Firewall
  - …
- Application has a FIFO event queue
  - Event processing is blocking

Simple Switch Overview

- Simple Python program
- Decorated set_ev_cls function is called for every packet_in

```
from ryu.base import app_manager

class L2Switch(app_manager.RyuApp):
    def __init__(self, *args, **kwargs):
        super(L2Switch, self).__init__(*args, **kwargs)


@set_ev_cls(ofp_event.EventOFPPacketIn, MAIN_DISPATCHER)
    def packet_in_handler(self, ev):
        msg = ev.msg
        dp = msg.datapath
        ofp = dp.ofproto
        ofp_parser = dp.ofproto_parser

        actions = [ofp_parser.OFPActionOutput(ofp.OFPP_FLOOD)]
        out = ofp_parser.OFPPacketOut(
            datapath=dp, buffer_id=msg.buffer_id,
                                                      in_port=msg.in_port,
                                                      actions=actions)
        dp.send_msg(out)
```

Code Structure

- **app/** – Contains set of applications that run on-top of the controller.
- **base/** – Contains the base class for RYU applications. The RyuApp class in the app_manager.py file is inherited when creating a new application.
- **controller/** – Contains the required set of files to handle OpenFlow functions (e.g., packets from switches, generating flows, handling network events, gathering statistics etc).
- **lib/** – Contains set of packet libraries to parse different protocol headers and a library for OFConfig. In addition, it includes parsers for Netflow and sFlow too.
- **ofproto/** – Contains the OpenFlow protocol specific information and related parsers to support different versions of OF protocol (1.0, 1.2, 1.3, 1.4)
- **topology/** – Contains code that performs topology discovery related to OpenFlow switches and handles associated information (e.g., ports, links etc). Internally uses LLDP.