Neutron On-boarding Room

Miguel Lavalle, irc mlavalle
Boston, May 2017

Agenda

- ***Neutron project overview***
- Neutron API
- Core resources, extensions, plugins and service plugins
- Reference back-end implementation
- ML2 plug-in

Get your devstack instances ready

We will use them for exercises!

Neutron Stadium

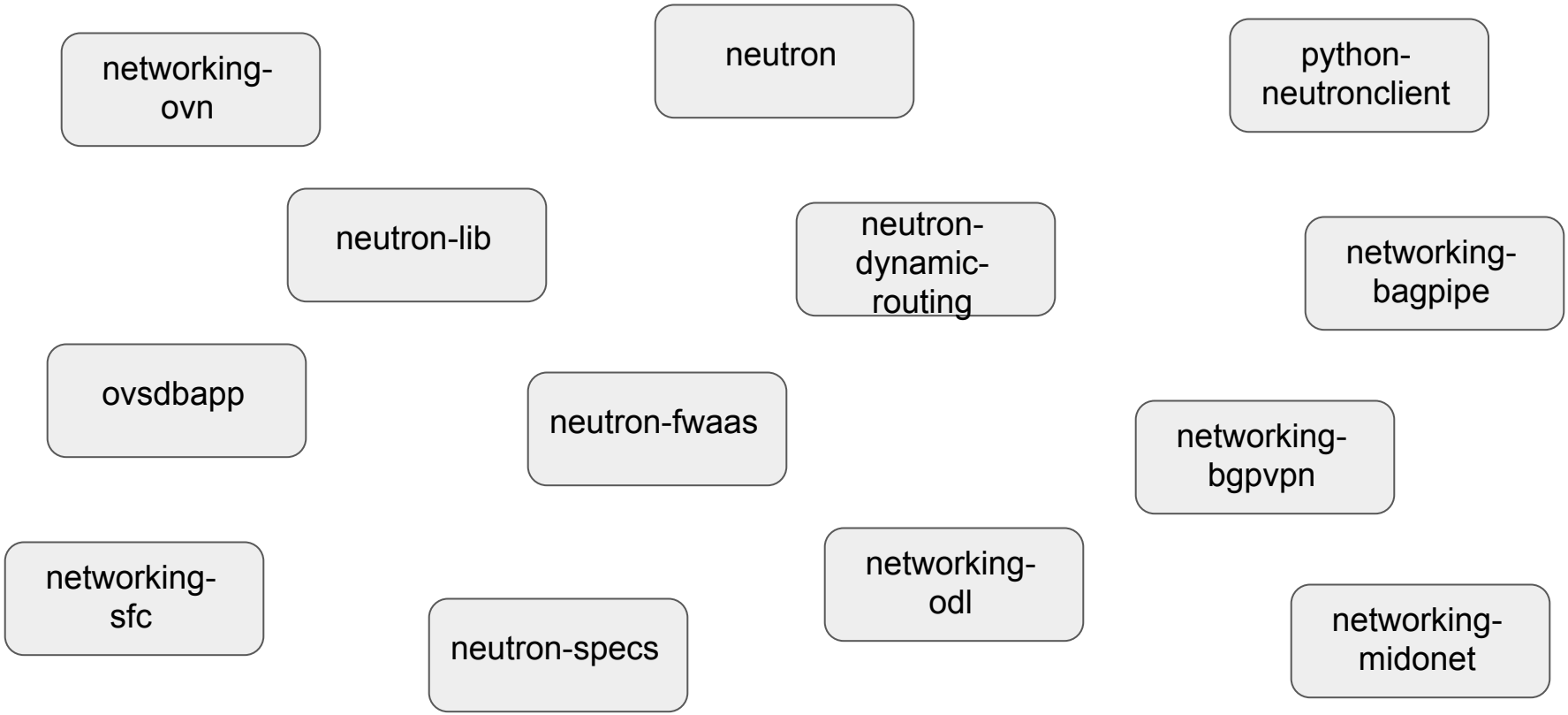
- Mission, as defined by the OpenStack governance document

  "To implement services and associated libraries to provide on-demand, scalable, and technology-agnostic network abstraction."

- This mission is big and ambitious. To properly tackle it, the Neutron Stadium is defined as (https://docs.openstack.org/developer/neutron/stadium/index.html):

  "… projects that the Neutron PTL and core team are directly involved in, and manage on a day to day basis."

Neutron Stadium



Neutron Stadium

- Projects have to demonstrate a track record meeting a well defined criteria to be part of the Stadium
  - Exhaustive documentation
  - Exhaustive OpenStack CI coverage
  - Good release model adherence
  - Adherence to deprecation and stable backport policies
  - Demonstrated ability to do upgrades and rolling upgrades, where applicable
  - Client bindings and CLI developed according to the OpenStack Client plugin model
  - Integrate with Neutron via one of the supported, advertised and maintained public Python APIs
  - **Above all: be open source from the ground up**
- To be considered to join the Stadium, a project must prove compliance with the above criteria for at least two OpenStack releases

Neutron team

- Current PTL: Kevin Benton (IRC: kevinbenton)
- Liaison with on-boarding process: Miguel Lavalle (IRC: mlavalle)
- IRC channel: #openstack-neutron in Freenode
- Weekly Neutron IRC meeting:
  - Convenes on alternating weeks on Mondays at 2100 UTC and on Tuesdays at 1400 UTC
- Subteams (L3, QoS, CI, etc) meet also regularly
  - See scheduled times and days here: http://eavesdrop.openstack.org/
- Neutron has a good developer reference documentation. ***Please use it!:***
  - https://docs.openstack.org/developer/neutron/index.html

Project mascot: get your sticker with me!

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Neutron API

Neutron, like all the other OpenStack projects, exposes a ReST API where:

- Requests and responses are sent using HTTP
- HTTP methods (POST, PUT, GET, DELETE) are applied through requests sent to the API...
- ...to a set of resources represented by URIs (Universal Resource Identifier) that identify resources
- The HTTP verbs correspond to CRUD (Create, Read, Update and Delete) operations.
- Every request sent by the user gets a response from the API
- Resources are represented in API requests and responses in JSON

Exercise: create a neutron port

$ openstack --debug port create --network private port-1

Exercise: create a neutron port request

$ openstack --debug port create --network private port-1

REQ: curl -g -i -X POST http://192.168.33.12:9696/v2.0/ports -H "User-Agent: openstacksdk/0.9.14 keystoneauth1/2.19.0 python-requests/2.12.5 CPython/2.7.12" -H "Content-Type: application/json" -H "X-Auth-Token: {SHA1}f42605a7b844675fd5ec4abf79f093b8cd045f22" -d '{"port": {"network_id": "b1aa112b-04ae-481e-b652-a233c96deaab", "name": "port-1", "admin_state_up": true}}'

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HTTP method

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Public endpoint and API version

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URI

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Request headers

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The body of the request: resource representation in JSON

Exercise: create a neutron port response

Response code

RESP: [201] Content-Type: application/json Content-Length: 1129 X-Openstack-Request-Id: req-63329334-d903-46a3-8fcd-840ffa6e13ee Date: Wed, 12 Apr 2017 18:59:11 GMT Connection: keep-alive

RESP BODY:

{"port":{"allowed_address_pairs":[],"extra_dhcp_opts":[],"updated_at":"2017-04-12T18:59:11Z","device_owner":"","revision_number":6,"port_security_enabled":true,"fixed_ips":[{"subnet_id":"368a67c8-d1ae-452e-b134-23d7d002a1f5","ip_address":"10.0.0.8"},{"subnet_id":"f8c10064-a3b1-4e7c-8ff6-741ed02dbadc","ip_address":"fdd8:76d6:991f:0:f816:3eff:fe31:d576"}],"id":"55fc71a4-eabb-43f9-8335-bdbd1b62599f","security_groups":["c4bcfdfb-9b03-4e89-a4d4-dafef1985588"],"mac_address":"fa:16:3e:31:d5:76","project_id":"87eda0fcff204327800a17c2bb9a4df3",... }}

Exercise: create a neutron port response

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dd8:76d6:991f:0:f816:3eff:fe31:d576"}],"id":"55fc71a4-eabb-43f9-8335-bdbd1b625
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RESP BODY: Resource representation in JSON

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Exercise: update a port

$ openstack --debug port set --name updated-port-name 55fc71a4-eabb-43f9-8335-bdbd1b62599f

Exercise: update a port request

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HTTP method

REQ: curl -g -i -X PUT http://192.168.33.12:9696/v2.0/ports/55fc71a4-eabb-43f9-8335-bdbd1b62599f -H "User-Agent: openstacksdk/0.9.14 keystoneauth1/2.19.0 python-requests/2.12.5 CPython/2.7.12" -H "Content-Type: application/json" -H "X-Auth-Token: {SHA1}2b22d5669c22b8ccda3c70f98a1c3d5f6b119412" -d '{"port": {"name": "updated-port-name"}}'

RESP: [200] Content-Type: application/json Content-Length: 1140 X-Openstack-Request-Id: req-639af99a-9ba7-4082-bc5c-b75938200a29….

Exercise: update a port request

$ openstack --debug port set --name updated-port-name 55fc71a4-eabb-43f9-8335-bdbd1b62599f

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Resource representation in JSON

RESP: [200] Content-Type: application/json Content-Length: 1140 X-Openstack-Request-Id: req-639af99a-9ba7-4082-bc5c-b75938200a29….

Frequently seen response codes

Response code	webob.exc exception	Meaning
Success		
200	HTTPOk	OK
201	HTTPCreated	Created
204	HTTPNoContent	No Content (deleted)
Client error		
400	HTTPBadRequest	Bad Request
404	HTTPNotFound	Not Found
409	HTTPConflict	Conflict
Server error		
500	HTTPServerError	Internal Server Error

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Core resources

Ports

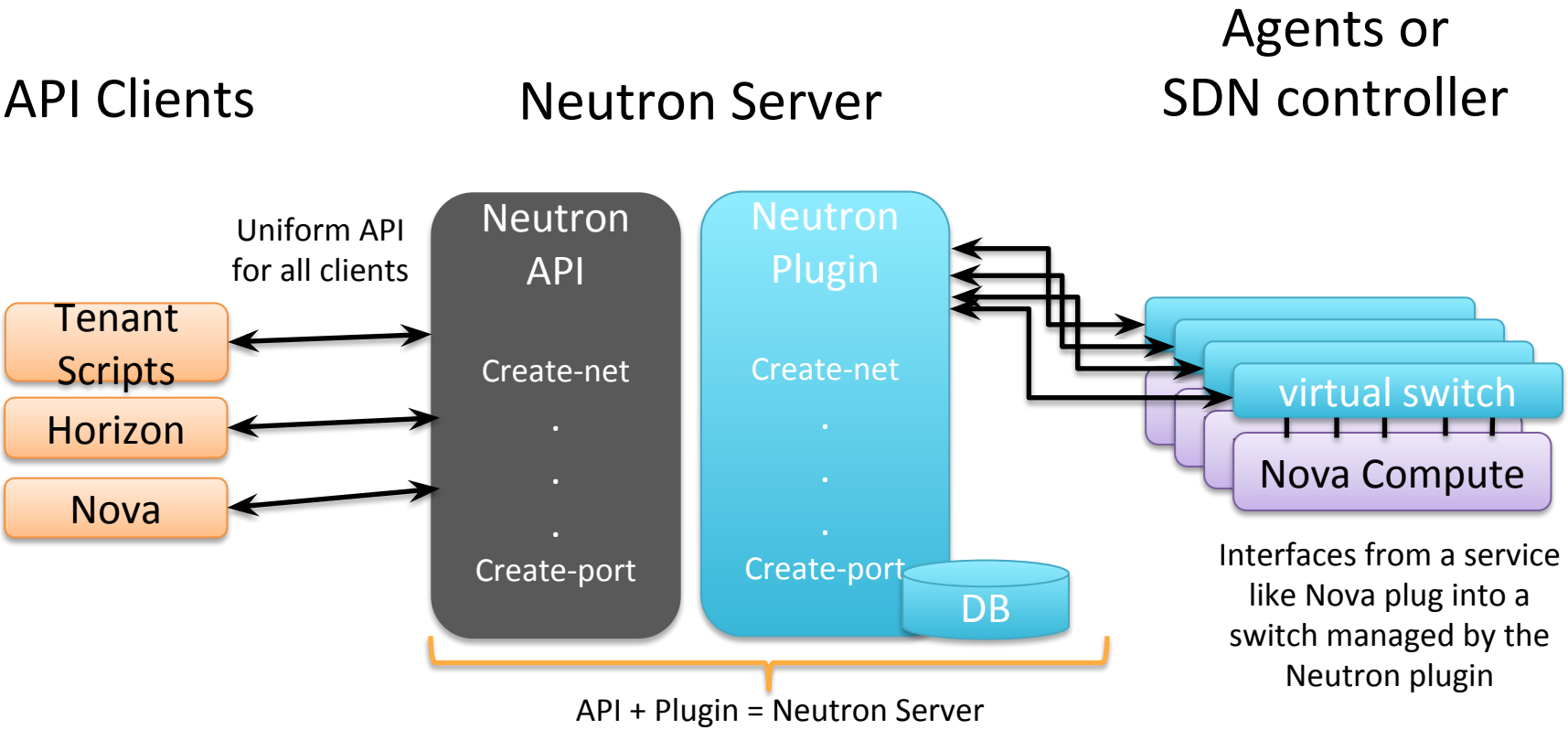
10.0.0.8 10.0.0.9 10.2.0.4

Networks (L2)

Subnets

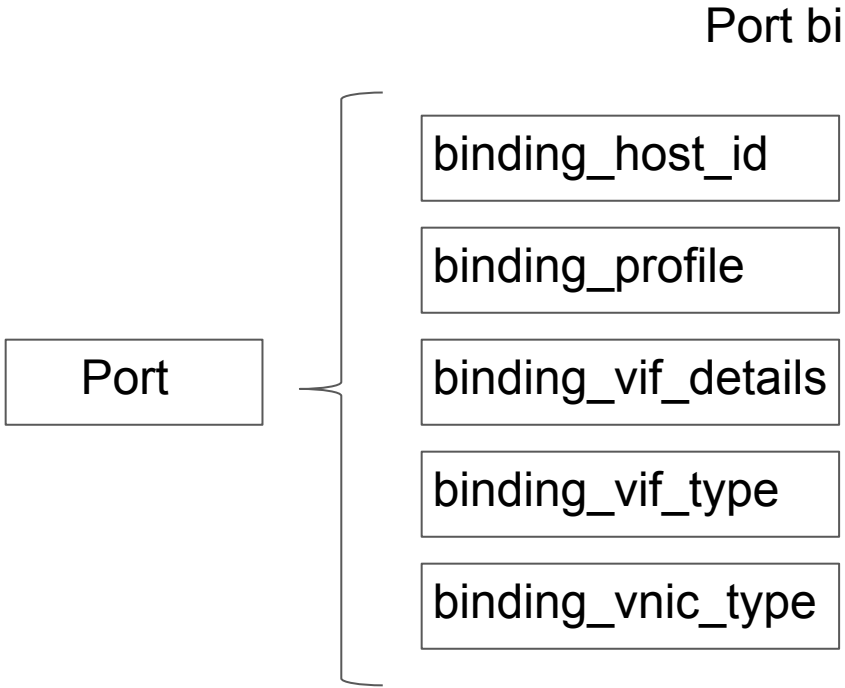
10.0.0.0/24 10.2.0.0/16

Neutron plugin architecture



Extensions

- Add attributes to core / existing resources

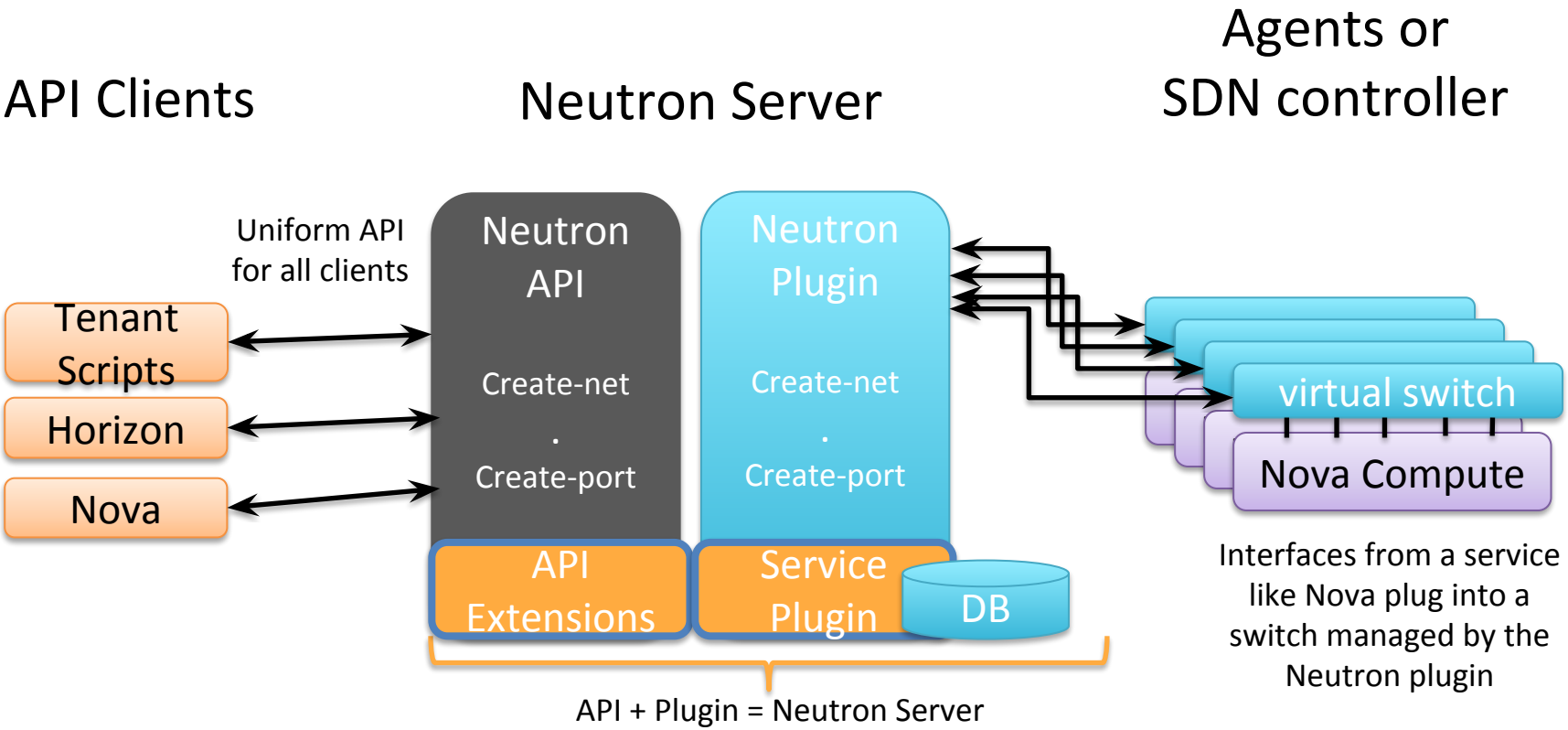


Extensions

- Add new resources and sub-resources

Neutron L3 Router	/v2.0/routers
	/v2.0/floatingips
security-group	/v2.0/security-groups
	/v2.0/security-group-rules
Quality of Service	/v2.0/qos/policies
	/v2.0/qos/policies/{policy_id}/bandwidth_limit_rules
	/v2.0/qos/policies/{policy_id}/dscp_marking_rules
	/v2.0/qos/policies/{policy_id}/minimum_bandwidth_rules

Neutron with API extensions and service plugin



Exercise

- $ openstack extension list --network
- Open /etc/neutron/neutron.conf
  - Search for core_plugin
  - Search for service_plugins

Exercise

- Enable the DNS integration extension:
  - $ openstack port list
  - $ openstack port show <port-id>
  - Edit the /etc/neutron/neutron.conf file and assign a value different to openstacklocal (its default value) to the dns_domain parameter in the [default] section
  - Add dns to extension_drivers in the [ml2] section of /etc/neutron/plugins/ml2/ml2_conf.ini
  - $ screen -r stack
  - <ctrl-a>“
  - With the <down-arrow> or <up-arrow> select screen q-svc and press enter
  - <ctrl-c> to stop the Neutron server
  - <up-arrow> once to recall the startup command
  - <enter> to restart the Neutron server
  - <ctrl-a>d to leave the screen command
  - $ openstack port show <port-id>

Exercise

- Enable the DNS integration extension:
  - sudo systemctl restart devstack@q-svc.service

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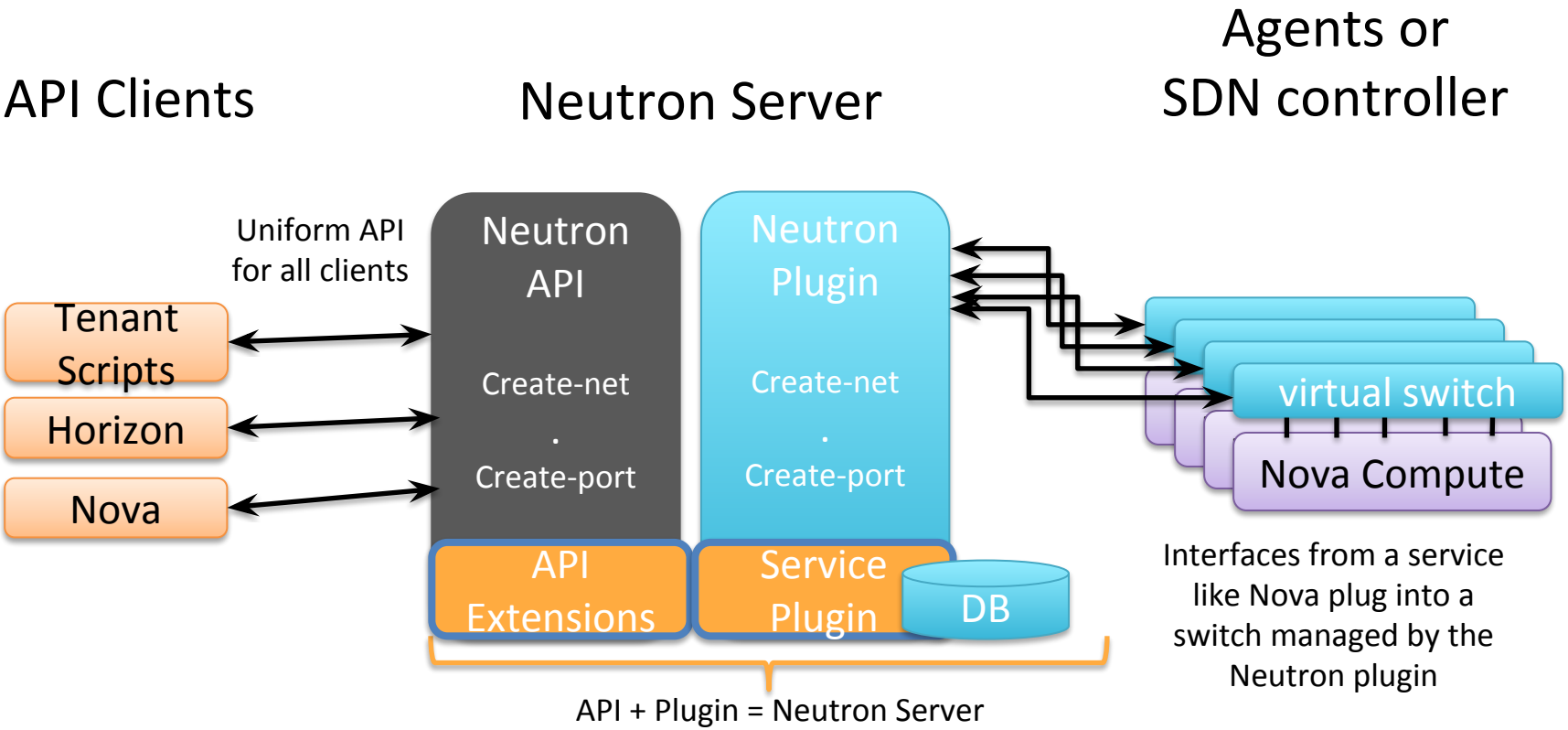
The back end


API Clients
Neutron Server
Agents or
SDN controller
Uniform API
for all clients
Tenant
Scripts
Horizon
Nova
Neutron
API
Create-net
.
Create-port
Neutron
Plugin
Create-net
.
Create-port
API
Extensions
Service
Plugin
DB
virtual switch
Nova Compute
Interfaces from a service
like Nova plug into a
switch managed by the
Neutron plugin
API + Plugin = Neutron Server

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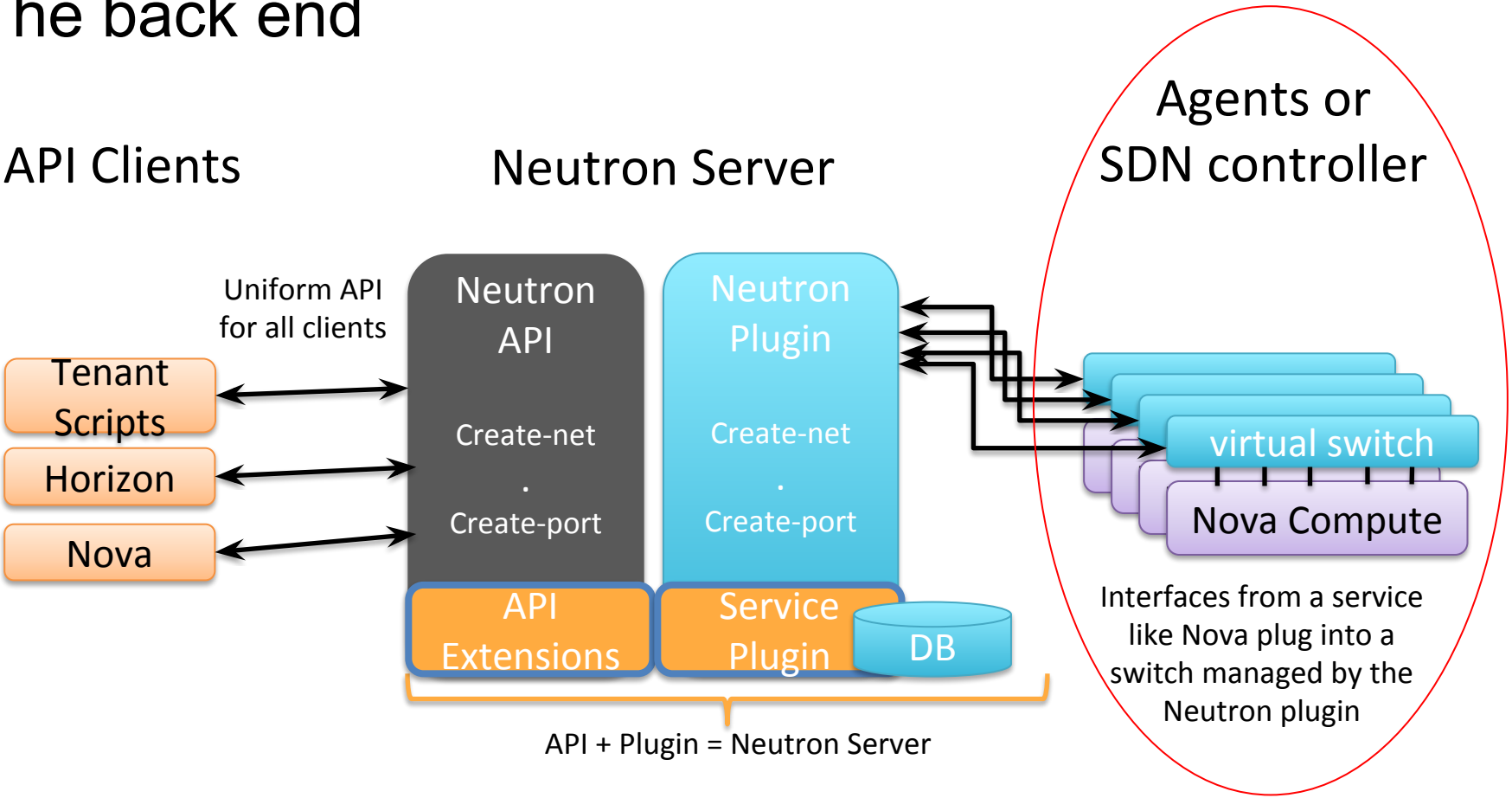
API Clients
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API Extensions
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Interfaces from a service like Nova plug into a switch managed by the Neutron plugin
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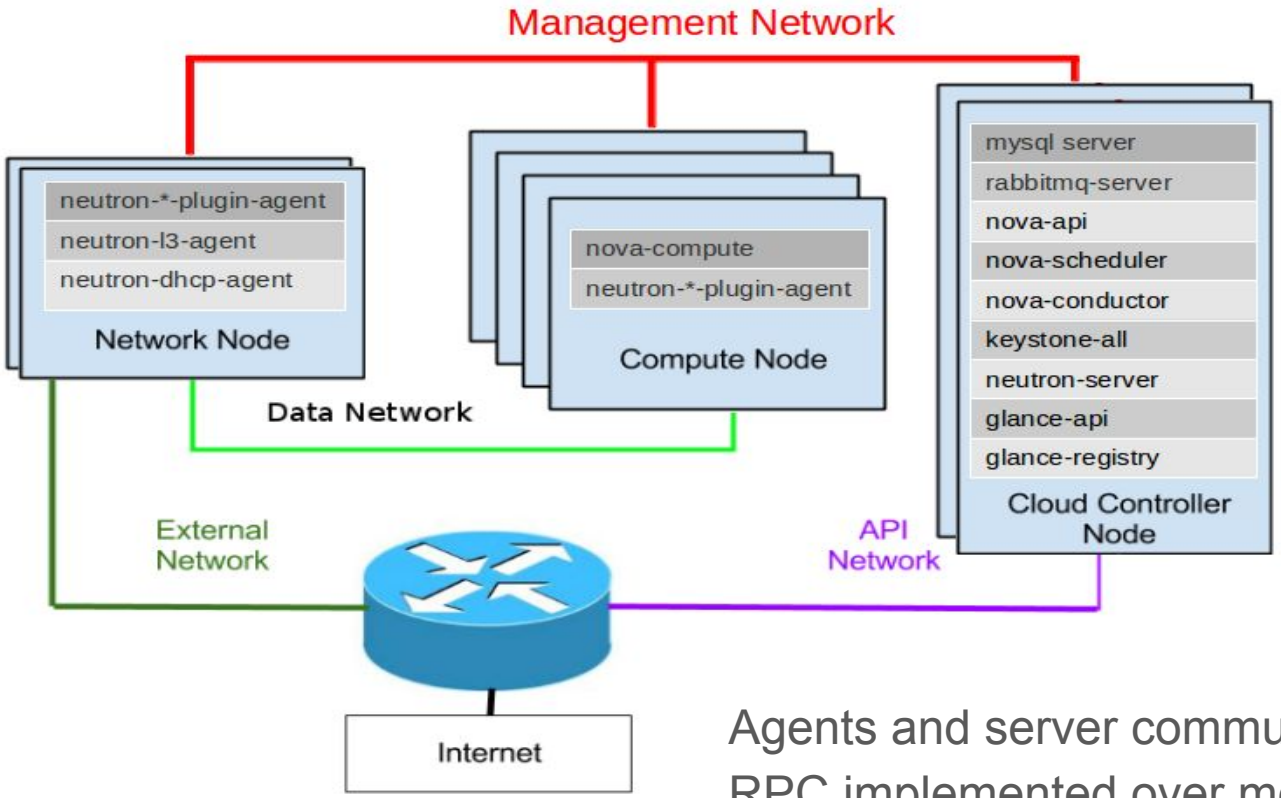
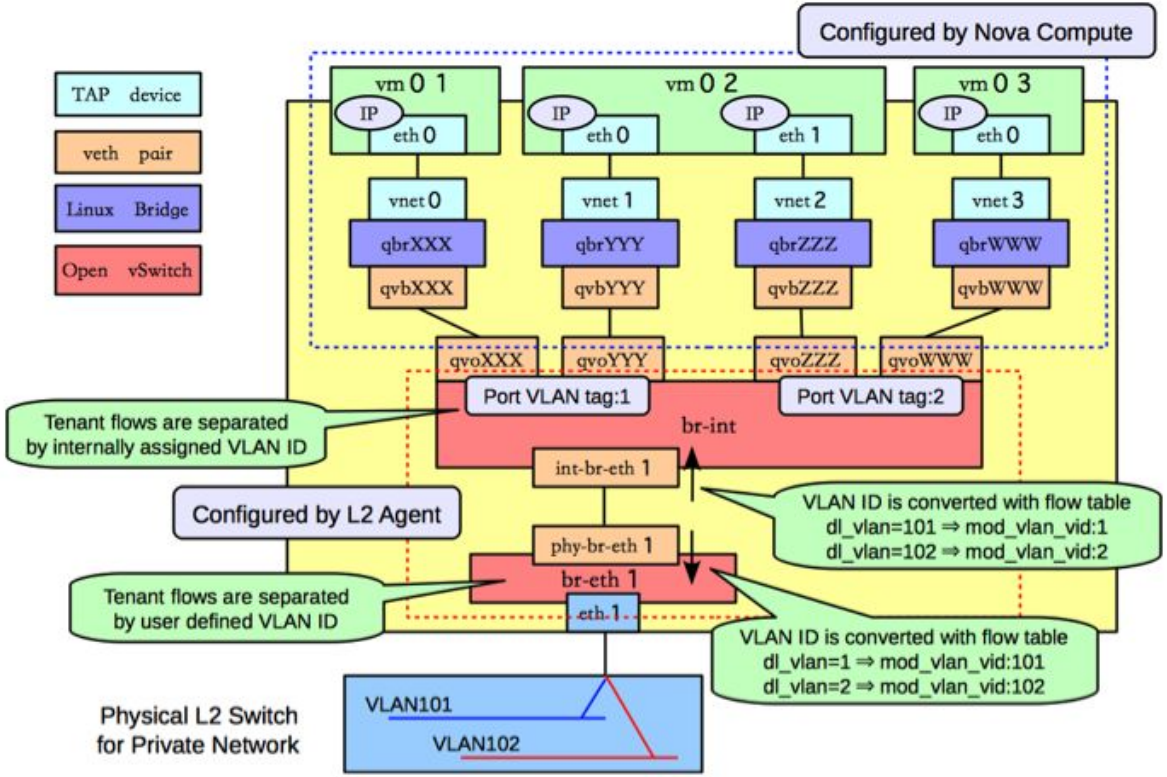
Agents based reference implementation



Agents and server communicate using RPC implemented over message queue

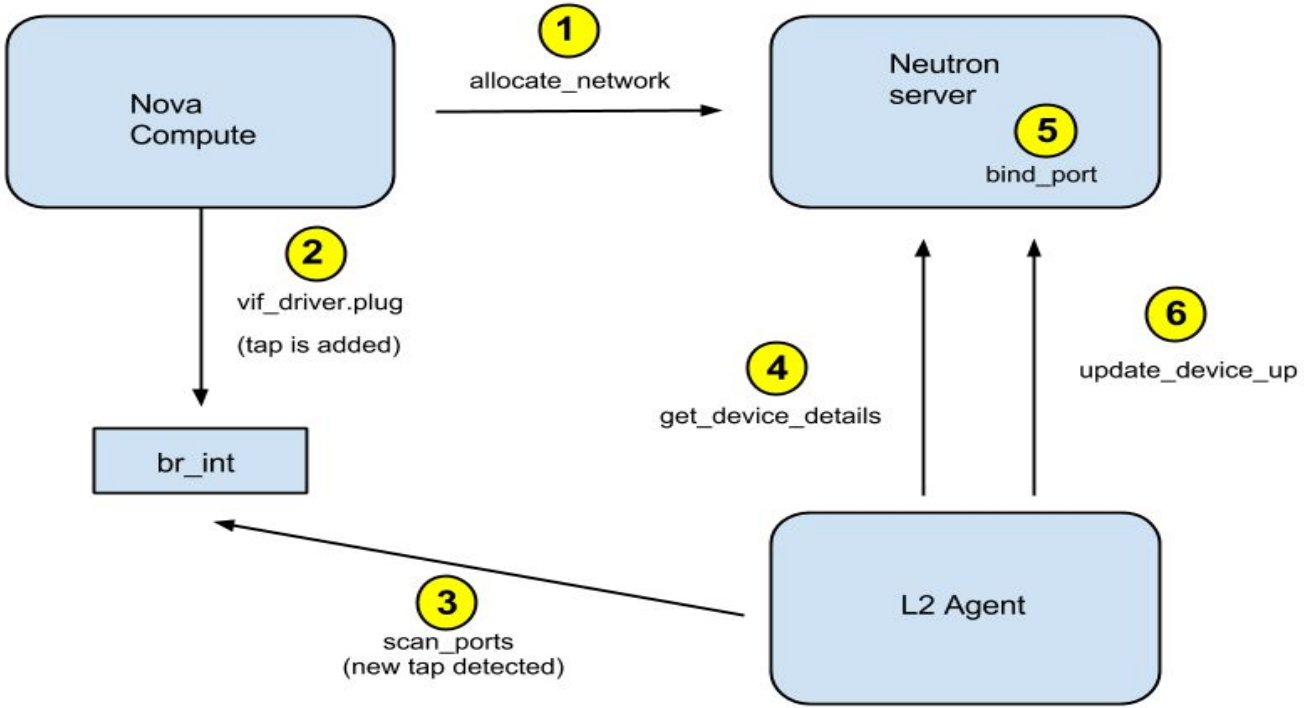
Under the hood scenario: compute node with OVS



OVS L2 agent

- Runs on compute nodes
- Configures the local virtual bridges: br-int, br-ethx, br-tun
- Wires ports
- Applies security group rules
- Communicates with Neutron server over remote procedure calls (RPC)

OVS L2 Agent: when a VM is created



OVS L2 agent: loop events (method rpc_loop)

- OVSDB monitor has updates
- Neutron server messages
  - Security group change
  - Port update
- OVS re-started

OVS L2 agent: detect port changes

- OVSDB signals if something has changed in the host
- Agent scans all the ports in the host
- Agent keeps track of the ports it has already processed using a set named ***ports***
- The difference between ***ports*** and the result of the scanning enables the agent to infer the devices added and deleted

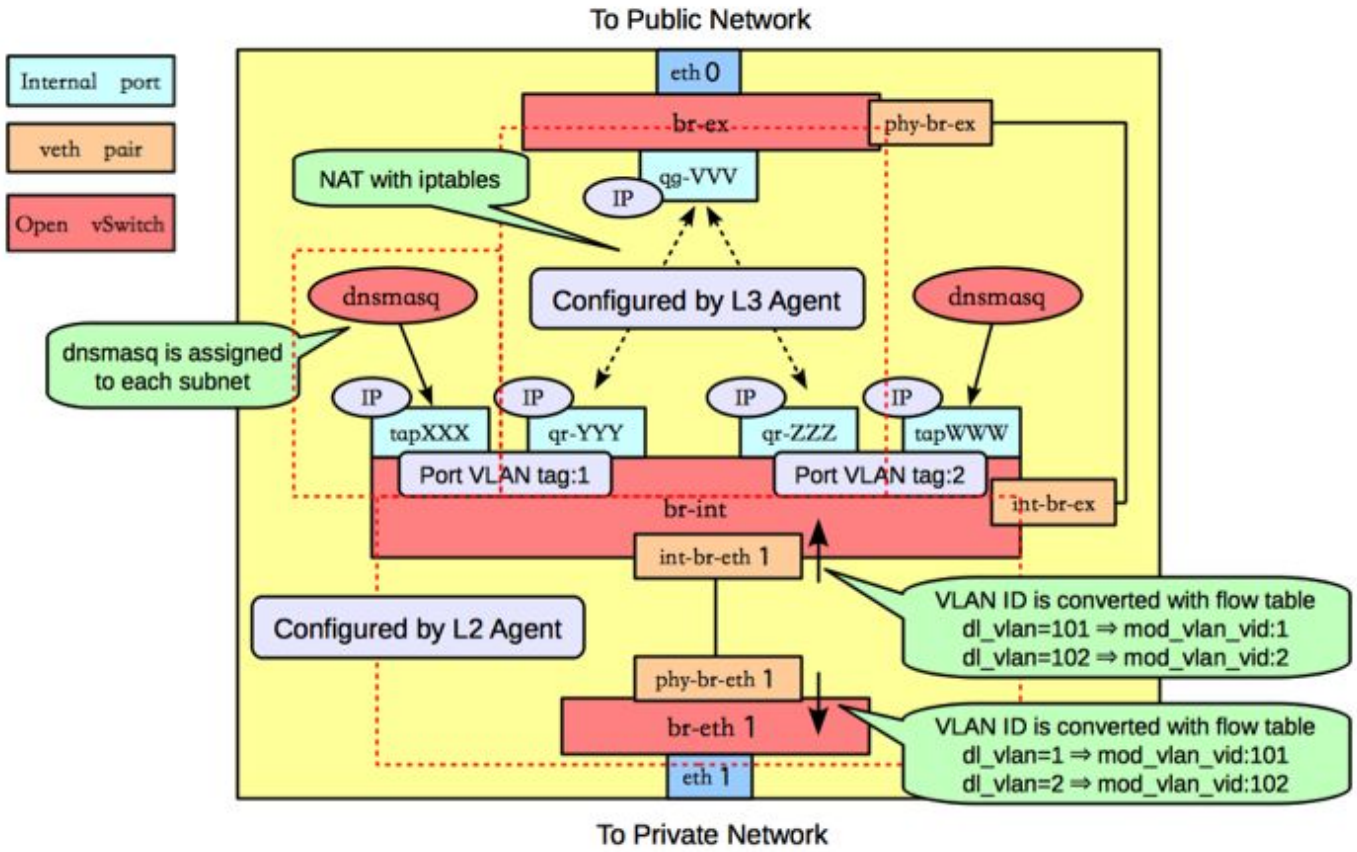
OVS L2 agent: process port added

- Request the device details (get_devices_details_and_failed_devices)
- Provision local vlan and install proper flows
- Set up filters
- Call plugin’s update_device_up (update_device_list)

Exercise: OVS L2 agent

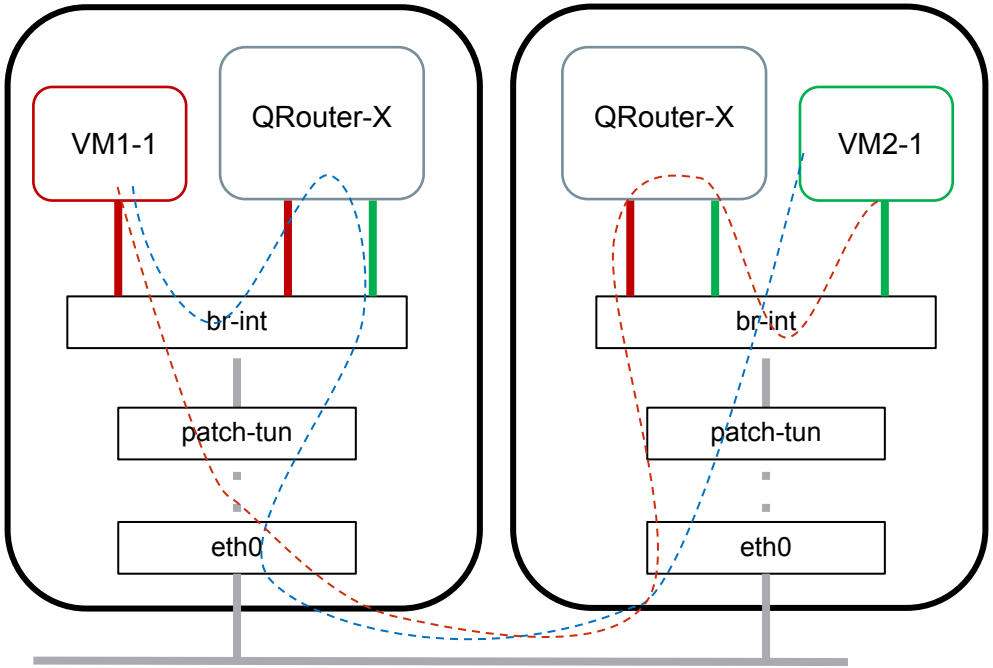
- Review OVS L2 related code
  - Agent side of the RPC API: /opt/stack/neutron/agent/rpc.py
  - Neutron server side of the RPC API: neutron/plugins/ml2/rpc.py
  - Method rpc_loop in agent: neutron/plugins/ml2/drivers/openvswitch/agent/ovs_neutron_agent.py
- Boot an instance and locate OVS and Linux bridge bridges and interfaces
  - $ openstack image list
  - $ openstack server create --flavor 42 --image <image-id> --nic net-id=<private-net-id> test-vm
  - $ openstack server list
  - $ openstack port list
  - $ sudo ovs-vsctl show
  - $ sudo brctl show

Under the hood scenario: routers and DHCP

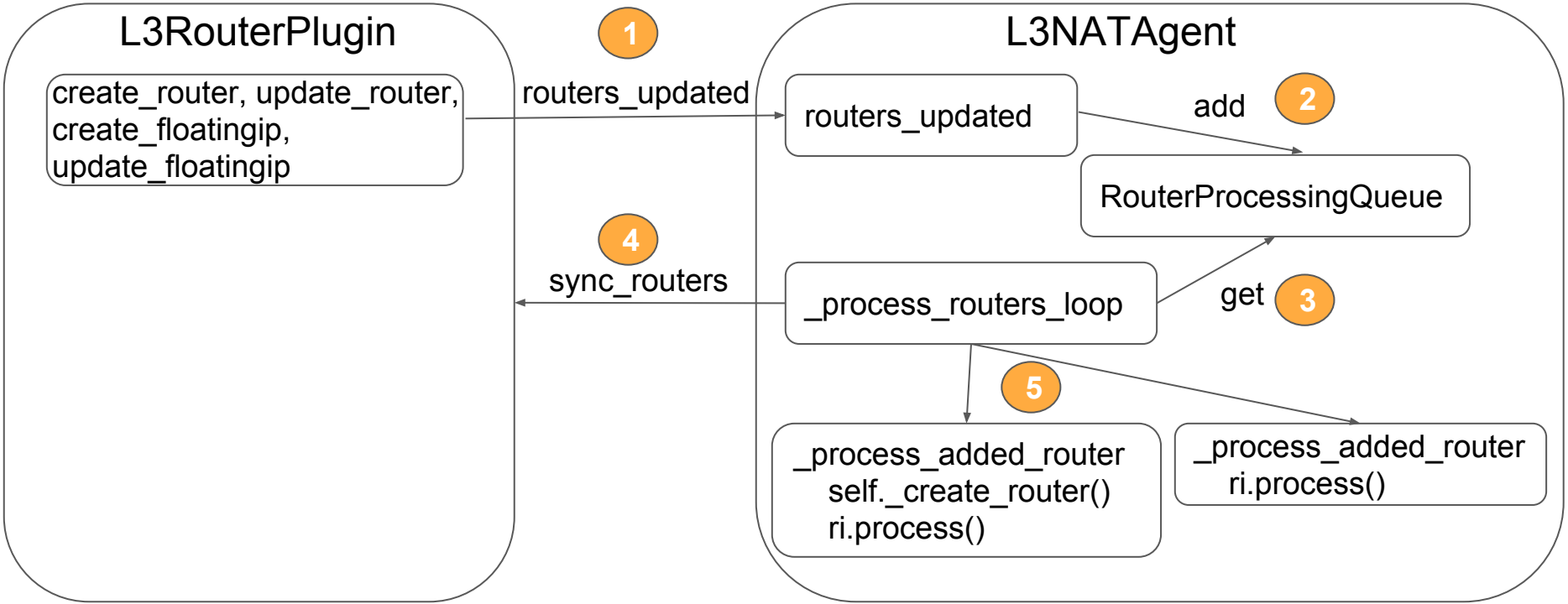


Distributed Virtual Router (DVR) in compute nodes

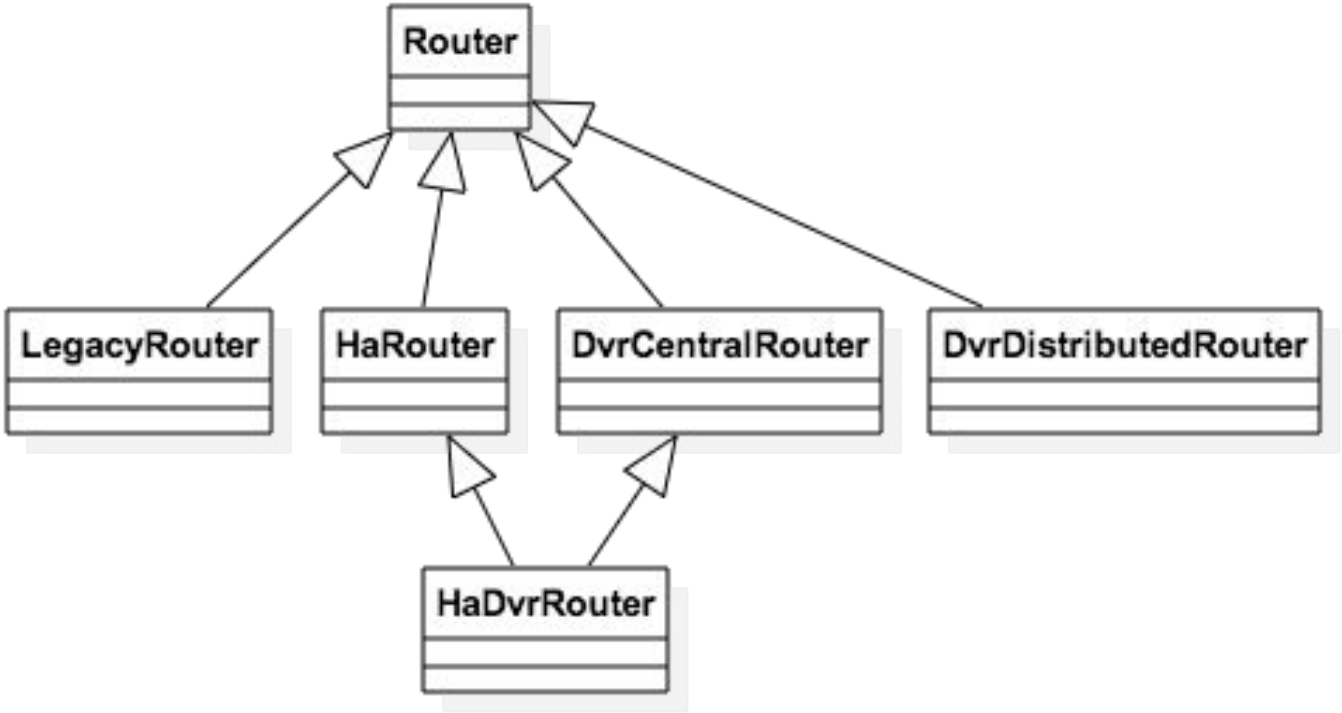
- Floating IPs for north / south IPv4 routing
- East / west IPv4 routing



Router and floating ip processing



Specialist router classes



Exercise: L3 agent

- Review L3 related code:
  - L3 router plugin: neutron/services/l3_router/l3_router_plugin.py
  - L3 DB mixin classes: neutron/db/l3_db.py
    - L3_NAT_db_mixin
    - L3RpcNotifierMixin
    - L3_NAT_dbonly_mixin
  - Server notifier L3 RPC notifier: neutron/api/rpc/agentnotifiers/l3_rpc_agent_api.py
  - L3 agent: neutron/agent/l3/agent.py
    - routers_updated
    - _process_routers_loop
    - get_routers in L3PluginApi
    - _process_added_router
    - _process_updated_router
  - L3 server RPC callbacks: neutron/api/rpc/handlers/l3_rpc.py
  - Router classes example: neutron/agent/l3/router_info.py

Exercise: L3 agent

- Identify the name spaces:
  - $ openstack router list
  - $ openstack network list
  - $ sudo ip netns
  - $ sudo ip netns exec qrouter-<router-id> ip addr list
- Identify router and dhcp ports in OVS:
  - $ openstack port list
  - $ sudo ovs-vsctl show
- Identify iptables entries
  - $ sudo ip netns exec qrouter-<router-id> iptables-save | grep 172
  - $ openstack network list
  - $ openstack floating ip create <external-net-id> --port <instance-port-id>
  - $ sudo ip netns exec qrouter-<router-id> iptables-save | grep 172
  - $ sudo ip netns exec qrouter-<router-id> ip addr list

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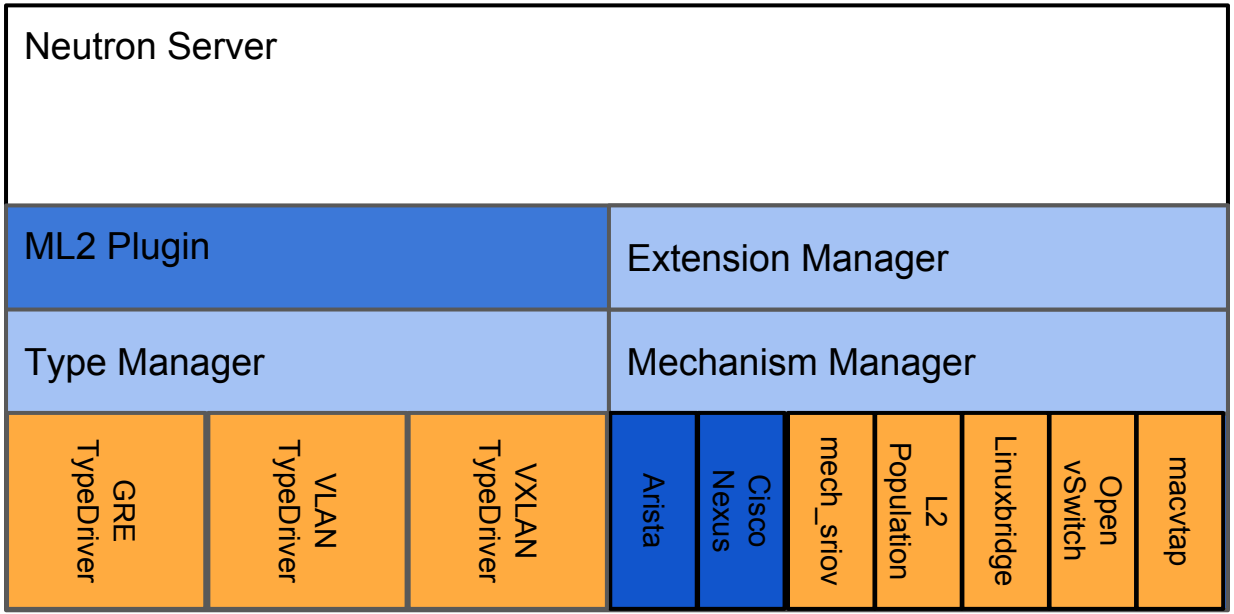
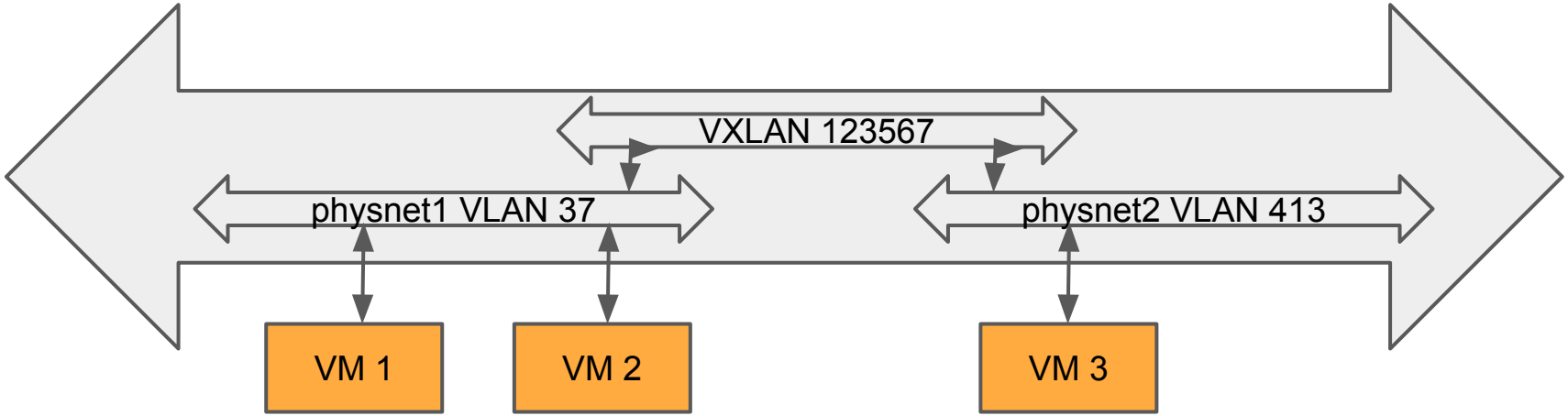
ML2 plug-in architecture

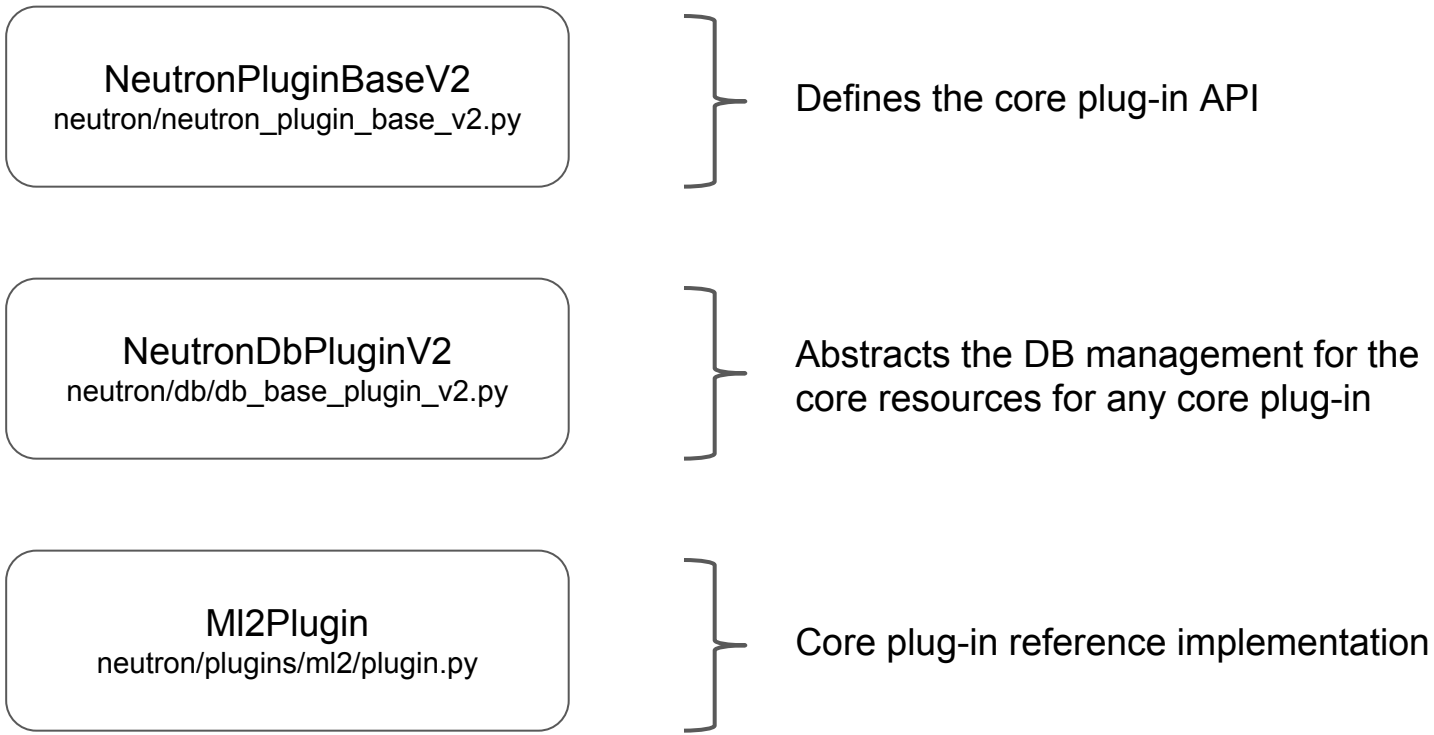


Multi-segment networks



- Created via multi-provider API extension
- Segments bridged administratively
- Ports associated with network, not specific segment
- Ports bound automatically to segment with connectivity

Plug-in inheritance hierarchy



ML2 plug-in create_network method pseudo-code

```
def create_network(self, context, network):
    with db_api.context_manager.writer.using(context):
        result = self.create_network_db(context, network)
        self.type_manager.create_network_segments(context, network)
        mech_context = driver_context.NetworkContext(self, context, result)
        self.mechanism_manager.create_network_precommit(mech_context)
    self.mechanism_manager.create_network_postcommit(mech_context)
    return self._make_network_dict(result)
```

ML2 plug-in create_network method pseudo-code

```
def create_network(self, context, network):
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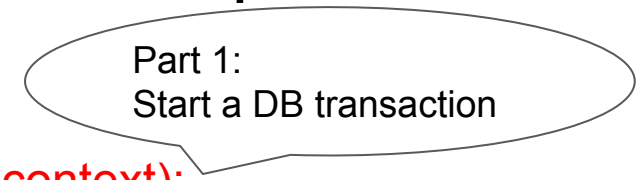

ML2 plug-in create_network method pseudo-code

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    with db_api.context_manager.writer.using(cont
        result = self.create_network_db(context, network)
        self.type_manager.create_network_segments(context, network)
        mech_context = driver_context.NetworkContext(self, context, result)
        self.mechanism_manager.create_network_precommit(mech_context)
    self.mechanism_manager.create_network_postcommit(mech_context)
    return self._make_network_dict(result)
```

Part 2:
Code that needs to be executed inside DB transaction. ***It has to be fast fast, with no blocking calls!***

ML2 plug-in create_network method pseudo-code

```
def create_network(self, context, network):
    with db_api.context_manager.writer.using(c
        result = self.create_network_db(conte
        self.type_manager.create_network_seg
        mech_context = driver_context.NetworkCon
        self.mechanism_manager.create_network_prec  mit(mech_context)
    self.mechanism_manager.create_network_postcommit(mech_context)
    return self._make_network_dict(result)
```

Part 3:
Set up the networking infrastructure. Since this code is outside the DB transaction, the mechanism manager post_commit can interact with networking infrastructure. ***It can execute blocking calls***

ML2 plug-in create_network method pseudo-code

```
def create_network(self, context, network):
    with db_api.context_manager.writer
        result = self.create_netw
        self.type_manager.cre
        mech_context = driver_                                    ult)
        self.mechanism_manager.                                   _context)
    self.mechanism_manager.create_netw                            mech_context)
    return self._make_network_dict(result)
```

Part 4
Build the resource (network in this example) dictionary that will be returned to the user through the ReST API. ***It has to be structured properly to avoid generating additional queries to the DB when adding extensions attributes!***

ML2 plug-in create_network: inside DB transaction

```
def create_network(self, context, network):
    with db_api.context_manager.writer.using(context):
        result = self.create_network_db(context, network)
        self.type_manager.create_network_segments(context, network)
        mech_context = driver_context.NetworkContext(self, context, result)
        self.mechanism_manager.create_network_precommit(mech_context)
    self.mechanism_manager.create_network_postcommit(mech_context)
    return self._make_network_dict(result)
```

ML2 plug-in create_network: inside

```
def create_network(self, context, network):
    with db_api.context_manager.writer.using(context):
        result = self.create_network_db(context, network)
        self.type_manager.create_network_segments(context, network)
        mech_context = driver_context.NetworkContext(self, context, result)
        self.mechanism_manager.create_network_precommit(mech_context)
    self.mechanism_manager.create_network_postcommit(mech_context)
    return self._make_network_dict(result)
```

Call the DB plug-in to create the row in the networks table. It can be called directly like here, or as *super*, since the ML2 plugin inherits from NeutronDbPluginV2

ML2 plug-in create_network: inside DB transaction

```
def create_network(self, context, network):
    with db_api.context_manager.writer.using(context):
        result = self.create_network_db(context, network)
        self.type_manager.create_network_segments(context, network)
        mech_context = driver_context.NetworkContext(self, context, result)
        self.mechanism_manager.create_network_precommit(mech_context)
    self.mechanism_manager.create_network_postcommit(mech_context)
    return self._make_network_dict(result)
```

Call the type driver (through the type manager) to reserve the segments

ML2 plug-in create_network: inside DB transaction

```
def create_network(self, context, network):
    with db_api.context_manager.writer.using(contex
        result = self.create_network_db(context, netwo
        self.type_manager.create_network_segments(conte
        mech_context = driver_context.NetworkContext(self, context, result)
        self.mechanism_manager.create_network_precommit(mech_context)
    self.mechanism_manager.create_network_postcommit(mech_context)
    return self._make_network_dict(result)
```

Create the mechanism context, that stores the previous and the current state of the resource. It is passed to the mechanism driver precommit and postcommit

ML2 plug-in create_network: inside DB transaction

```
def create_network(self, context, network):
    with db_api.context_manager.writer.using(context):
        result = self.create_network_db(context, net
        self.type_manager.create_network_segmen
        mech_context = driver_context.NetworkContext(se
        self.mechanism_manager.create_network_precommit(mech_context)
    self.mechanism_manager.create_network_postcommit(mech_context)
    return self._make_network_dict(result)
```

Call the mechanism driver precommit to store in the DB any state that needs to be remembered

ML2 plug-in create_port method pseudo-code

```
def create_port(self, context, port):
    with db_api.context_manager.writer.using(context):
        result = self.create_port_db(context, port)
        mech_context = driver_context.PortContext(self, context, result)
        self.mechanism_manager.create_port_precommit(mech_context)
    self.mechanism_manager.create_port_postcommit(mech_context)
    bound_context = self._bind_port_if_needed(mech_context)
    return bound_context.current
```

Port binding as a black box

Port binding

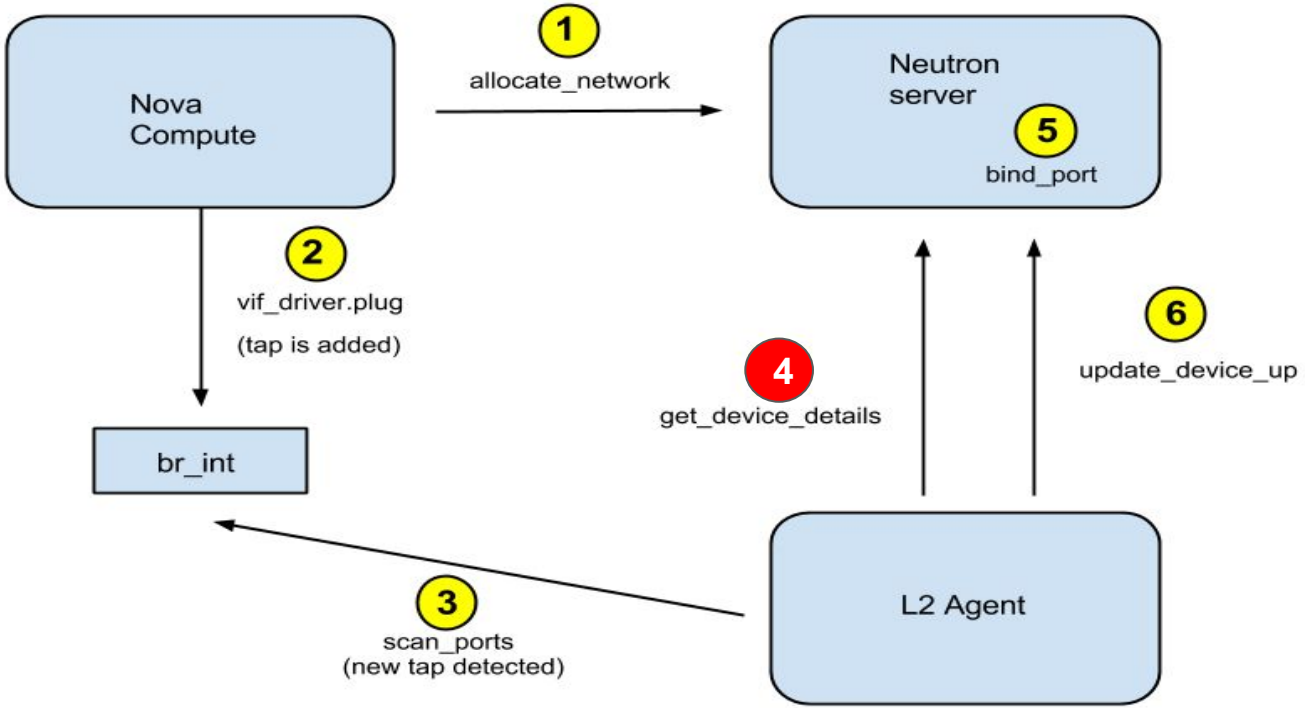
- Plug-in calls bind_port() on registered mechanism drivers in order listed in config, until one succeeds or all have been tried
- Driver determines if it can bind based on
  - context.network.network_segments
  - context.host
  - context.host_agents()
- Binding requires live L2 agent on port's host that:
  - Supports a network type of a segment of the port's network
  - Has a mapping for that segment's physical_network if applicable
- If bind possible, driver calls context.set_binding(). Otherwise, port's binding:vif_type set to VIF_TYPE_BINDING_FAILED

```
def PortContext(object):

    @abstractproperty
     def current(self):
          pass

    @abstractproperty
     def network(self):
          pass

    @abstractmethod
     def set_binding(self, segment_id, vif_type,
                                  vif_details, status):
          pass
```

Port postcommit and binding in little a more detail

```
try:
    self.mechanism_manager.create_port_postcommit(mech_context)
except ml2_exc.MechanismDriverError:
        with excutils.save_and_reraise_exception():
            LOG.error(_LE("mechanism_manager.create_port_postcommit "
                          "failed, deleting port '%s'"), result['id'])
            self.delete_port(context, result['id'], l3_port_check=False)
try:
    bound_context = self._bind_port_if_needed(mech_context)
except ml2_exc.MechanismDriverError:
        with excutils.save_and_reraise_exception():
            LOG.error(_LE("_bind_port_if_needed "
                          "failed, deleting port '%s'"), result['id'])
            self.delete_port(context, result['id'], l3_port_check=False)
```

OVS L2 Agent: when a VM is created



Exercise: ML2 plugin

- ML2 related code:
  - Drivers and context API definitions: neutron/plugins/ml2/driver_api.py
  - Network, subnet and port contexts: neutron/plugins/ml2/driver_context.py
  - Drivers: neutron/plugins/ml2/drivers
  - Drivers managers: neutron/plugins/ml2/managers.py
  - Create port in ML2 plugin: neutron/plugins/ml2/plugin.com
- Port binding related code:
  - get_devices_details_list_and_failed_devices in class RpcCallbacks in neutron/plugins/ml2.rpc.py
  - get_bound_port_context in ML2 plugin
    - Add a LOG.debug statement before returning the port context. Log the resulting binding vif_type
    - Re-start the server
    - Create a VM