We are pleased to announce the OpenContrail Advisory Board (OCAB)

We are taking the next step to evolve the governance model by formally announcing the formation of the OpenContrail Advisory Board (OCAB). Click to see who is on the board...
Agenda

Introduction
OpenStack Architecture and Overview
OpenContrail and OpenStack Integration
OpenStack Neutron Overview
OpenContrail Architecture
How to configure OpenContrail Overlay Network
Demo
OpenStack Overview

Dashboard (Horizon)
Networking (Neutron)
Object Storage

Computing (Nova)
Identity (Keystone)
Image Service (Glance)

http://www.openstack.org/software
OpenStack as IaaS

Value Visibility to End Users

End Users

Application Developer

Network Architects

SaaS

PaaS

IaaS

(OPEN CONTRAIL)
OpenStack Overview (Grizzly)

Network (Neutron)

Dashboard (Horizon)

Provides Network Connectivity

Provides UI for Services & Modules

Provides Volume

Provides Authentication And service catalog for All Services & Modules

Image Repo (Glance)

Provides Images

Store Images as Objects

Compute (Nova)

Block Storage (Cinder)

Object Storage (Swift)

Identity (Keystone)
OpenStack Overview (Havana)

- **Network (Neutron)**: Provides network connectivity.
- **Dashboard (Horizon)**: Provides UI for services and modules.
- **Image Repo (Glance)**: Provides images.
- **Object Storage (Swift)**: Stores images and objects.
- **Compute (Nova)**: Provides authentication and service catalog for all services & modules.
- **Block Storage (Cinder)**: Provides volume.
- **Heat (Orchestration)**: Orchestration using templates.
- **Identity (Keystone)**: Billing and resource usage.
- **Ceilometer (Metering)**: Orchestration using templates.
OpenStack Architecture Overview

- **Keystone** (Identity/Access Mgmt)
  - Keystone Server
  - Keystone DB

- **Nova Compute** (Orchestration)
  - Nova Agent
  - Hypervisor
  - VMs Spawned
  - Cinder Vol
  - Storage

- **Cinder** (Block Storage)
  - API SRV
  - Scheduler
  - Cinder Vol
  - Cinder DB

- **Glance** (Image Service)
  - API SRV
  - Registry
  - Glance DB

- **Neutron** (Network Management)
  - Neutron Server
  - Neutron Plugin/Agent
  - DHCP/IPAM

- **Swift** (Object Storage)
  - API SRV
  - Proxy
  - Object Store

- **Horizon GUI**

- **OpenStack GUI**

- **Queue**
Contrail/OpenStack Overview (Grizzly)

- **Identity (Keystone)**
  - Provides Authentication and service catalog for all services & modules

- **Dashboard (Horizon)**
  - Provides UI for services & modules

- **Network (vRouter)**
  - Provides network connectivity

- **Controller (Contrail)**
  - Provides network connectivity

- **CFMG (Contrail)**
  - Provides configuration and analytics

- **Analytics (Contrail)**
  - Provides configuration and analytics

- **Image Repo (Glance)**
  - Provides images

- **Object Storage (Swift)**
  - Stores images as objects

- **Compute (Nova)**
  - Provides volume
  - Provides authentication and service catalog for all services & modules
Contrail Architecture

- Compute Node (vRouter)
- Gateway Node (MX, EX, QFX)
- Service Node (SRX, Firefly)
- Orchestration (OpenStack)
- Contrail Controller
- Control Node
- Configuration Node
- Analytics Node

Communication Protocols:
- XMPP
- REST
- IF-MAP
- IBGP
- BGP + NetConf
OpenContrail Integration with OpenStack

User Logs in, Create tenant (Projects), Create IPAM, Create Virtual Network, Launch VMS

Authentication, Authorization, etc.

Launch VM/Instance

Get VM Image to Spawn

Get Virtual Network Info

Select Compute Node to spawn Instance (VM)

Bilateral Interaction (XMPP Interaction)

Bi-directional Message Bus

Networking Interaction (VN, IPAM, Port, VIF..etc.)

Networking Interaction

User Logs in, Create tenant (Projects), Create IPAM, Create Virtual Network, Launch VMS

Authentication, Authorization, etc.

Launch VM/Instance

Get VM Image to Spawn

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Select Compute Node to spawn Instance (VM)

Bilateral Interaction (XMPP Interaction)

Bi-directional Message Bus

Networking Interaction (VN, IPAM, Port, VIF..etc.)
OpenContrail Integration with OpenStack

1. Create an Instance (VM info, Network, IPAM, Policies, etc.)
2. Schedule an Instance on the Compute Node
3. VM Network properties
4. Create VM Interface
5. Add Port
6. Publish VM Intf on IFMap
7. VM Interface Config Over XMPP
OpenStack Neutron

"network-as-a-service"

SDN
OpenStack Neutron

**Neutron:**
Pluggable, scalable, API-driven network and IP Management

Provides a rich and tenant-facing API for defining network connectivity and addressing in the cloud
Neutron Networking API Functionalities

- **Network**
  - An isolated L2 Segment, analogous to VLAN in the physical networking world.

- **Subnet**
  - A block of v4 or v6 IP addresses and associated configuration state.

- **Port**
  - A connection point for attaching a single device, such as a NIC of a virtual server to a virtual network.

- **Virtual Router & NAT**

- **“Local” & “External” networks**
Neutron Architecture
API Overview

Pluggable Back-End using Vif
- OVS Plugin
- Linux Bridge Plugin
- NEC Plugin
- Big Switch Plugin
- Hyper-V Plugin
- Brocade Plugin
- OpenContrail

Gateway Service

Firewall Service

REST API Neutron
Neutron Components

- Neutron Server - API
- Data Base
- Queue
- L3 Agent
- DHCP Agent
- Plugin Agent
Neutron Plugin & Agent Summary

OpenStack Neutron

- Open vSwitch (OVS)
  - Flat
  - VLAN
  - GRE

- Nicira
  - NVP
  - XMPP/BGP
  - GRE

- OpenContrail
  - VxLAN

- Ryu
  - OpenFlow
  - Others

- Others
  - HAProxy
  - F5

- DNSmasq
- NAT
- Router
- iptables
- Firewall Agent
- L-B Agent
- L3 Agent
- DHCP Agent
Floating IP (Neutron)

- **Internal Private Pool (VN1)**
  - 10.1.1.0/24

- **Floating POOL (Public)**
  - 75.1.1.0/24

- **Instance 1**: VM1
- **Instance 2**: VM2
- **Instance 3**: VM3

- **Router (L2/L3)**
  - Basic L3 router construct to route between L2 networks
  - Provides a gateway to external networks
  - Support for SNAT and Floating IPs

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- **NAT**
Security Groups

- Allows L3-L4 packet filtering for security policies to protect the instances (VMs)
- Collection of network access rules that specify traffic allowed to and from a VM
- Associated with a VM at startup
  - If not specified, a VM is assigned to the default Security Group, which allows traffic from all other members of the group
- VM can be associated with many Security Groups
- Security Group rule specifies:
  - Source of traffic (IP/CIDR or another Security Group)
  - Protocol (TCP, UDP, ICMP, …etc.)
  - Destination port on VM
Physical Network Design
(OpenStack Architecture)
OpenContrail Architecture
OpenContrail

• What is OpenContrail?
  • SDN solution
    • Automates and orchestrates highly scalable virtual networks
    • Network programmability
    • NFV
    • Big data analytics
    • Open system architecture
    • Visualization

• Two primary drivers
  • Cloud networking
  • NFV in service provider network
Two Main Components

• **Contrail Controller**
  • Control plane
  • Logically centralized, physically distributed
  • Management, control, and analytics
  • Manages the vRouters

• **Contrail vRouter**
  • Forwarding plane
  • Extends physical network to virtual overlay network
    • Provides Layer 2 and Layer 3 services
Bridging Physical and Virtual Networks

• **Virtual Networks**
  • Implemented on top of physical networks
  • Replaces VLAN-based isolation
    • Virtual networks isolated from each other – unless permitted by security policies
  • Provides multi-tenancy in a virtualized data center
  • MPLS L3VPN and EVPN technologies
  • Used to implement NFV
Overlay Networking

- Overlay Networking
  - Physical – underlay network
    - Routers and switches
    - Provides IP connectivity
    - Uniform low-latency, non-blocking, high-bandwidth connectivity
    - No per-tenant state
  - Virtual – overlay network
    - vRouters create overlay network on top of the underlay network
    - Per-tenant state
    - MPLS over GRE tunnels
    - MPLS over UDP tunnels
    - VXLAN tunnels
Example (1 site)

- Contrail within a data center
  - MPLS over GRE tunnel automatically setup when VMs are deployed
  - VN to VN communication requires a security policy
Example (2 Sites)

- Data Centers connected over the WAN
  - One tunnel per vRouter connection
Logical Architecture & Interface Overview

Contrail Logical Architecture

Contrail vRouter
Contrail Controller
Contrail CFMG/Analytics/GUI
Contrail vRouter
Control Plane (IF-MAP)
Control Plane (IBGP)
Control Plane (XMPP)
Control Plane (Sandesh)
Control Plane (IBGP)
Control Plane (IF-MAP)
Control Plane (XMPP)
MX-GW
Server 2
Server 3
Server 4
Server 5
Server 6
VM01
VM02
VM03
VM04
VM05
VM06
OpenStack GUI
Contrail GUI
Server 2
Contrail CFMG/Analytics/GUI
Server 3
Contrail Controller
Server 4
Contrail Controller
Server 5
Contrail vRouter
Server 6
Contrail vRouter
Data Plane MPLSoGRE
Data Plane MPLSoGRE
VM01
VM02
VM03
VM04
VM05
VM06
MX-GW
Server 2
Server 4
Server 5
Server 6
VM01
VM02
VM03
VM04
VM05
VM06
Data Plane MPLSoGRE
Data Plane MPLSoGRE
Control Plane (IF-MAP)
Control Plane (IBGP)
Control Plane (XMPP)
Control Plane (Sandesh)

OpenStack GUI
Contrail GUI
Contrail Stack
*Compute Node and vRouter*

- Customer OSS/BSS
- OpenStack
- CloudStack
- REST APIs (Configuration, Operational, Analytics)
- Analytics Engine
- Analytics Engine
- Analytics Engine
- Configuration Nodes
- Control Plane
- Control Plane
- Control Plane
- Compute Node (vRouter)
- Gateway Node (MX, EX, QFX)
- Service Node (SRX, Firefly)
Contrail vRouter (SW Overview)

**Compute Node (vRouter)**
- Replaces the Linux bridge or OVS module in Hypervisor kernel
- Performs bridging (E-VPN) and routing (L3VPN)
- Performs network services like security policies, NAT, multicast, mirroring, and load balancing
- No need for Service Nodes or L2/L3 gateways for routing, broadcast, multicast, or NAT
- Routes automatically leaked into VRFs based on policy
- Multiple interfaces support on VMs
- Multiples interface support from Compute Nodes to switching fabric

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**Support Services**
- libvirtd

**Nova Services**
- openstack-nova-compute
Contrail Stack: Control Layer

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- Analytics Engine
- Analytics Engine
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Contrail Controller (SW Overview)

Control Node
- All Control Nodes are active-active
- Each vRouter uses XMPP to connect with multiple Control Nodes for redundancy
- Each Control Node connects to multiple Configuration Nodes for redundancy
- BGP and NetConf is used to connect with physical gateway routers or Service Nodes
- Control Nodes federate using BGP
- Control Nodes can run different software versions for test-before-deploy and live upgrades

Contrail Config
- ssupervisor-config
- contrail-api
- contrail-config-nodemgr
- contrail-discovery
- contrail-schema
- contrail-svc-monitor
- contrail-zookeeper
- Ifmap
- redis-config

Contrail Database
- supervisord-contrail-database
- contrail-database

Contrail Control
- supervisor-control
- contrail-control
- contrail-control-nodemgr
- supervisor-dns
- contrail-dns
- contrail-named

Quantum Services
- quantum-server

Support Services
- rabbitmq-server
Route Distribution

Control Plane (XMPP)

Configuration Node

REST API

IF-MAP

Control Plane (XMPP)

IP Network

10.1.1.2: NH = 151.10.10.1; LBL = 17
10.1.1.1: NH = 70.10.10.1; LBL = 39

PubDstIP = 150.10.10.1, PubSrcIP = 70.10.10.1, GRE LBL=17
PriDstIP = 10.1.1.2, PriSrcIP = 10.1.1.1, PAYLOAD

VM-A

10.1.1.1: NH = 70.10.10.1; LBL = 39
10.1.1.2: NH = 151.10.10.1; LBL = 17

VM-B

10.1.1.2
10.1.1.1
PAYLOAD

VRF (Dynamic Tunnel Encapsulation)

Outer MAC headers left out to reduce clutter
Route Distribution: L3VPN

- **REST API**
  - Config Mgmt. DC-1
  - Control Plane XMPP
  - BGP Control Nodes
  - 10.1.1.2: NH = 80.20.20.1; LBL = 417; RD; RT
  - 10.1.1.2: NH = 200.1.1.1; LBL = 317; RD; RT
  - 10.1.1.2: NH = 100.1.1.1; LBL = 217; RD; RT
  - 10.1.1.2: NH = 160.20.20.1; LBL = 117; RD; RT

- **Service Provider**
  - 100.1.1.1
  - 160.20.20.1

- **BGP Control Nodes**
  - 80.20.20.1
  - 200.1.1.1

- **IP Network**
  - 70.10.10.1
  - 151.20.20.1

- **MPLS**
  - 80.20.20.1
  - 200.1.1.1
  - 160.20.20.1

- **PAYLOAD**
  - PriDstIP
  - PriSrcIP
  - PubDstIP
  - PubSrcIP

- **VMs**
  - VM-A
  - VM-B

- **OPENCONTRAIL**
Route Distribution: E-VPN

1. **Control Plane (XMPP)**
   - Server 1: MAC1: NH = 70.10.10.1; LBL = 39
   - Server 2: MAC2: NH = 151.10.10.1; LBL = 17

2. **IP Network**
   - IP Addresses:
     - PubDstIP: 150.10.10.1
     - PubSrcIP: 70.10.10.1
     - DstMAC: MAC1
     - SrcMAC: MAC2
     - Payload: Dynamic Tunnel Encapsulation

3. **VRF**
   - Server 1: VRF (Dynamic Tunnel Encapsulation)
   - Server 2: VRF (Dynamic Tunnel Encapsulation)
Contrail Stack: Configuration Nodes

- Customer OSS/BSS
- OpenStack
- CloudStack

REST APIs (Configuration, Operational, Analytics)

- Analytics Engine
- Analytics Engine
- Analytics Engine

Configuration Nodes

- Control Plane
- Control Plane
- Control Plane

- Compute Node (vRouter)
- Gateway Node (MX, EX, QFX)
- Service Node (SRX, Firefly)
Contrail CFMG/Analytics/GUI (SW Overview)

**Contrail Database**
- supervisord-contrail-database
- contrail-database

**Contrail Config**
- ssupervisor-config
- contrail-api
- contrail-config-nodemgr
- contrail-discovery
- contrail-schema
- contrail-svc-monitor
- contrail-zookeeper
- Ifmap
- redis-config

**Contrail Analytics**
- supervisor-analytics
- contrail-analytics-nodemgr
- contrail-collector
- contrail-opserver
- contrail-ql
- redis-query
- redis-sentinel
- redis-uve

**Contrail Web UI**
- supervisor-webui
- contrail-webui
- contrail-webui-middleware
- redis-webui

**Support Services**
- Mysqld
- Httpd
- Libvirtd
- rabbitmq-server
- memcached

**Configuration Node**
- API server provides northbound REST interface -- orchestration system provisions using this API service
- DHT/NoSQL database is used for persistence and High Availability of configuration
- Schema transformer “compiles” the high level data model to low level model for vRouter, Service Nodes, and Gateway Routers
- IF-MAP is used to represent the data-model -- Control Nodes subscribe to a subset of the configuration

**Horizon Services**
- openstack-dashboard

**Keystone Services**
- openstack-keystone

**Quantum Services**
- quantum-server

**Cinder Services**
- openstack-cinder-api
- openstack-cinder-scheduler

**Glance Services**
- openstack-glance-api
- openstack-glance-registry

**Nova Services**
- openstack-nova-api
- openstack-nova-cert
- openstack-nova-scheduler
- openstack-nova-conductor
### Contrail CFMG/Analytics/GUI (SW Overview)

#### Contrail Database
- supervisord-contrail-database
- contrail-database

#### Contrail Config
- supervisor-config
- contrail-api
- contrail-config-nodemgr
- contrail-discovery
- contrail-schema
- contrail-svc-monitor
- contrail-zookeeper
- ifmap
- redis-config

#### Contrail Analytics
- supervisor-analytics
- contrail-analytics-nodemgr
- contrail-collector
- contrail-opserver
- contrail-queue
- redis-query
- redis-sentinel
- redis-uve

#### Contrail Web UI
- supervisor-webui
- contrail-webui
- contrail-webui-middleware
- redis-webui

#### Support Services
- Mysql
- Httpd
- Libvirtd
- rabbitmq-server
- memcached

#### Contrail Web UI
- supervisor-webui
- contrail-api
- contrail-webui-middleware
- redis-webui

#### Support Services
- Mysql
- Httpd
- Libvirtd
- rabbitmq-server
- memcached

### Analytics Node
- API server provides northbound REST Interface for Applications
- SQL-style query language for NoSQL access -- object traces, flow records, syslog
- DHT/NoSQL database is used for scale and persistence
- Sandesh Protocol (XML over TCP) is used by all nodes (Control, Configuration, Compute, and physical network) to deposit data in the NoSQL DB
- Rules engine automatically collects operational state on specific events
- Collector supports NetFlow for non-Juniper devices
- Operational state of any node can be queried by the analytics engine
Analytics Access Through the Northbound API

• Configuration
  • Virtual network (L2/L3)
  • Security and QoS policies
  • IPAM rules, floating IP
  • Analyzer and mirroring

• Operational
  • Control Nodes and vRouters
  • Datacenter gateway router
  • Virtual router connected networks and ACLs
  • Virtual router statistics

• Analytics
  • Query tables
  • Flow records
  • System objects
  • Aggregated traffic statistics
Contrail Stack: REST APIs

- Customer OSS/BSS
- OpenStack
- CloudStack

REST APIs (Configuration, Operational, Analytics)

- Analytics Engine
- Analytics Engine
- Analytics Engine

Configuration Nodes

- Control Plane
- Control Plane
- Control Plane

Computes
- Compute Node (vRouter)

Gateways
- Gateway Node (MX, EX, QFX)

Services
- Service Node (SRX, Firefly)
APIs

Juniper Contrail Configuration API server documentation

The Juniper Contrail configuration API server allows for manipulation of configuration elements exposed by the VNS interface or by a python library (which internally uses the same REST API).

This document provides:
- Tutorials for using the REST and library interface,
- Generalizes the examples to work on different configuration elements
- Provides tips to use the system effectively
- Reference of the package, module and classes involved.

- REST API Tutorial
  - Create virtual-network and network-policy objects
  - Update virtual-networks to use the policy
  - Read the objects to verify
  - List the virtual-networks
  - Delete the objects

- Library API Tutorial
  - Initialize the library
  - Create virtual-network and network-policy objects
  - Update virtual-networks to use the policy
  - Reading the objects to verify
  - List the virtual-networks
  - Deleting the objects

Contrail Stack: OpenStack

- Customer OSS/BSS
- OpenStack
- CloudStack

REST APIs (Configuration, Operational, Analytics)

- Analytics Engine
- Analytics Engine
- Analytics Engine

Configuration Nodes

- Control Plane
- Control Plane
- Control Plane

- Compute Node (vRouter)
- Gateway Node (MX, EX, QFX)
- Service Node (SRX, Firefly)
OpenStack Horizon

VM States:
- Scheduling
- Networking
- Spawning
- **Active**
Contrail Dashboard

The Dashboard page shows a at a glance view of the Infrastructure components including the number of virtual routers, control nodes, analytics nodes, and Config nodes currently operational, bubble chart of virtual routers showing the CPU and memory utilization, logs, system information and alerts.
OpenContrail References:

Github link:
https://github.com/Juniper

OpenContrail & DevStack:
https://etherpad.openstack.org/p/contrail-devstack

Configuring Contrail for OpenStack:
https://github.com/Juniper/contrail-controller/wiki/Configuring-Contrail-for-OpenStack

OpenContrail Users Mailing List:
http://lists.opencontrail.org/mailman/listinfo/users_lists.opencontrail.org

OpenContrail Dev Mailing List:
http://lists.opencontrail.org/mailman/listinfo/dev_lists.opencontrail.org
OpenContrail References:

• Network Virtualization Architecture Deep Dive
  • http://opencontrail.org/networkirtualization-architecture-deep-dive/

• Software architecture
  • http://juniper.github.io/contrail-vnc/architecture.html
  • http://opencontrail.org/blog/
  • http://juniper.github.io/contrail-vnc/README.html

• Day One Book:
  • http://www.amazon.com/Day-One-Understanding-OpenContrail-Architecture-
ebook/dp/B00GTXGP7O/ref=sr_1_1?ie=UTF8&qid=1386871850&sr=8-
1&keywords=opencontrail
Thank you