Genius Overview

Contents

Background

Application Co-existence and Integration Challenges

- **Partitioning of OpenFlow Resources**
    1. Every application must have their private flow state space (on every switch)
        a. Flow tables, group table, meter table, cookies
- **Ingress demultiplexing (aka “Table 0 Problem”)**
    1. Packets entering the switch have to be directed to the correct application pipeline
    2. Applications cannot simply write ingress flow entries into table 0 without coordination
    3. Need smaller granularity than OF port (e.g. VLAN, VNI, etc)? generalized interface concept
    4. Co-existence of multiple applications on the same interface
    5. Multi-tenancy: Several isolated service instances of the same application
- **Integration/Co-operation of different applications**
    1. Control plane: Service APIs between applications
    2. Data plane: Transfer packets between the pipelines of different applications
        a. Take the use of various packet metadata into account!
    3. Each application comes with its own overlay solution

Case-by-Case Approach

- **Chosen approach in ODL Beryllium between SFC, GPB and Netvirt**
    1. Partitioning of OpenFlow Resources
        a. Design time coordination between different applications
    2. Ingress demultiplexing (aka “Table 0 Problem”)
        a. All application write into table 0, but the flow entries and priorities have been agreed at design time to avoid unwanted interference
    3. Integration/Co-operation of different applications
        a. Control plane: MD-SAL service APIs between applications?
        b. Data plane: Direct GOTO Table to transfer the packet from one application pipeline to another
- **Analysis**
    1. Can lead to an optimal solution for a group of specific applications
    2. Design time coordination needed for every detail
    3. Hard-coded dependencies between applications
    4. Does not scale to many applications

Ingress De-multiplexing

- Multiple applications writing into table 0 (directly or through an Ingress Manager function)
- Flow conflict detection mechanisms do not allow for any overlap between flows
- Overlap (or rather refinement) should be allowed using priorities to disambiguate:

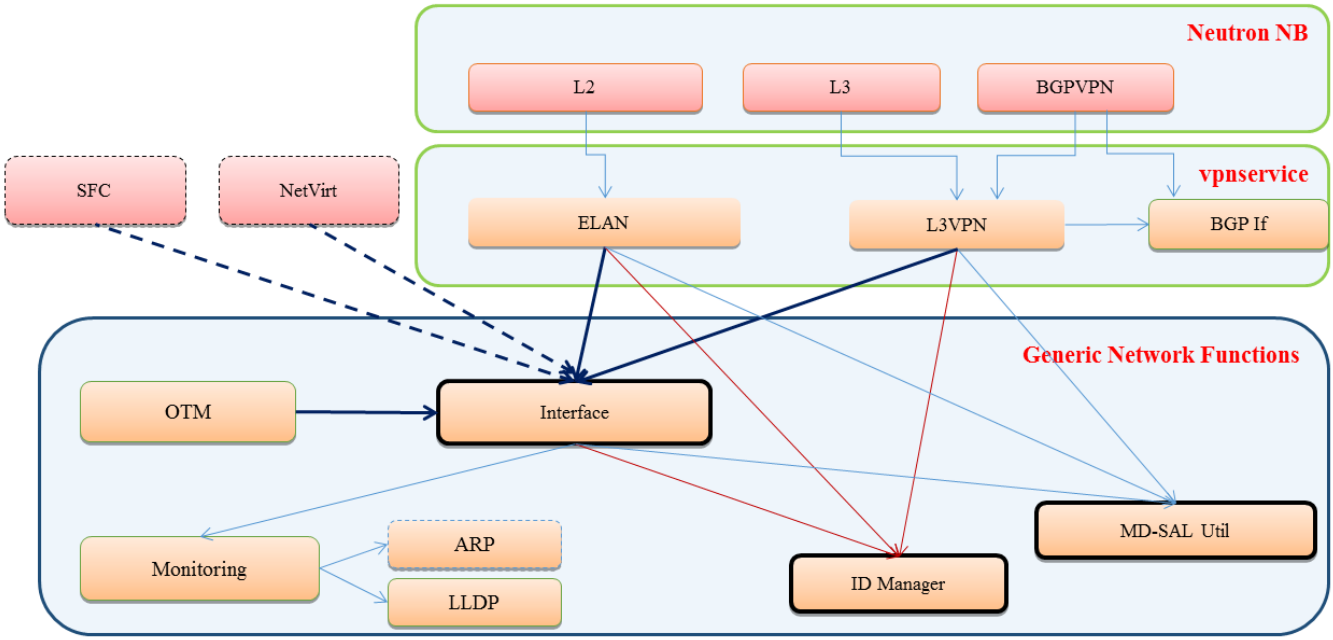
    1. e.g. packets on in_port with certain DMAC to application A, all the rest to application B
- How can a generic Ingress Manager ensure that there is no semantic conflict between the flows if the simple non-overlap criterion is not sufficient?

Genius Proposal

Generic Functions for Multi-Network Service Support

- Any ODL application can use these to achieve at minimum interference-free co-existence with other applications using the services
- Provide support for co-operation between applications with the minimal amount of design-time coordination and hard-coded dependencies
- Use APIs to move design-time coordination to run-time
    1. Generic infrastructure APIs to avoid direct coupling where possible
    2. Direct inter-application (client-server) APIs where necessary for stronger coupling
- Factor out commonly used functions into shared services to avoid duplication & waste of resources, e.g.
    1. Overlay Tunnel Manager
    2. ID manager
    3. MD-SAL Util

VPN Service Modules and Inter-relationships



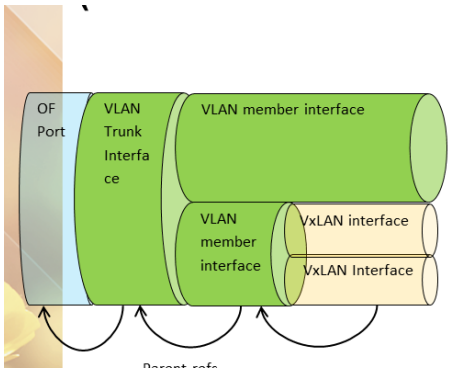
Interface Manager

- **Models generic interfaces as attachment point for applications**
    1. Supports Hierarchy of: Port, VLAN, VXLAN Trunk, VXLAN VNI, GRE Tunnel, ...
    2. Extendible to arbitrary other types of interfaces (virtual link, VPN interface, …)
    3. Interface ID/tag system wide unique identifier in control/data plane.
    4. Ingress interface tag stored in metadata

- **Handles ingress de-capsulation and de-multiplexing**
    1. Owns table 0 (and possibly additional tables needed for demultiplexing of interfaces)
    2. Application bind to interfaces through API and register application-specific instructions/actions to be added to the interfaces ingress flow entry (e.g. write metadata, goto table)
    3. Each bound service is assigned to a separate interface handle, no risk of interference on ingress traffic

- **South bound protocol agnostic**
    1. Ability to plug in different south bound renderers
    2. Provides tunnel monitoring services
    3. Handles egress encapsulation and output, service processing priority

Defining Granular interfaces (ODL-interfaces data-model)

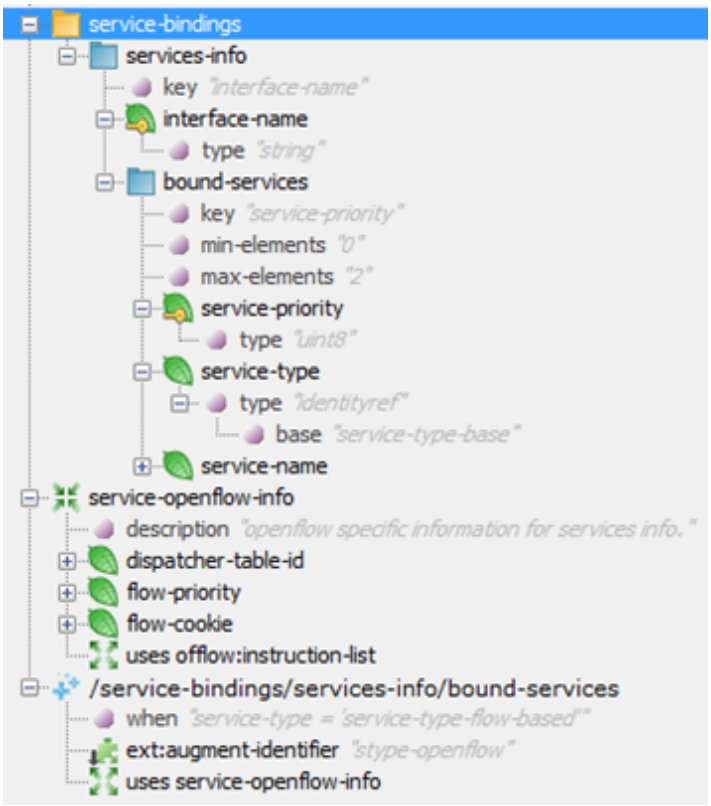


Black – From ietf-interfaces data-model
Blue – Augmentations added from odl-interfaces
Bold – mandatory

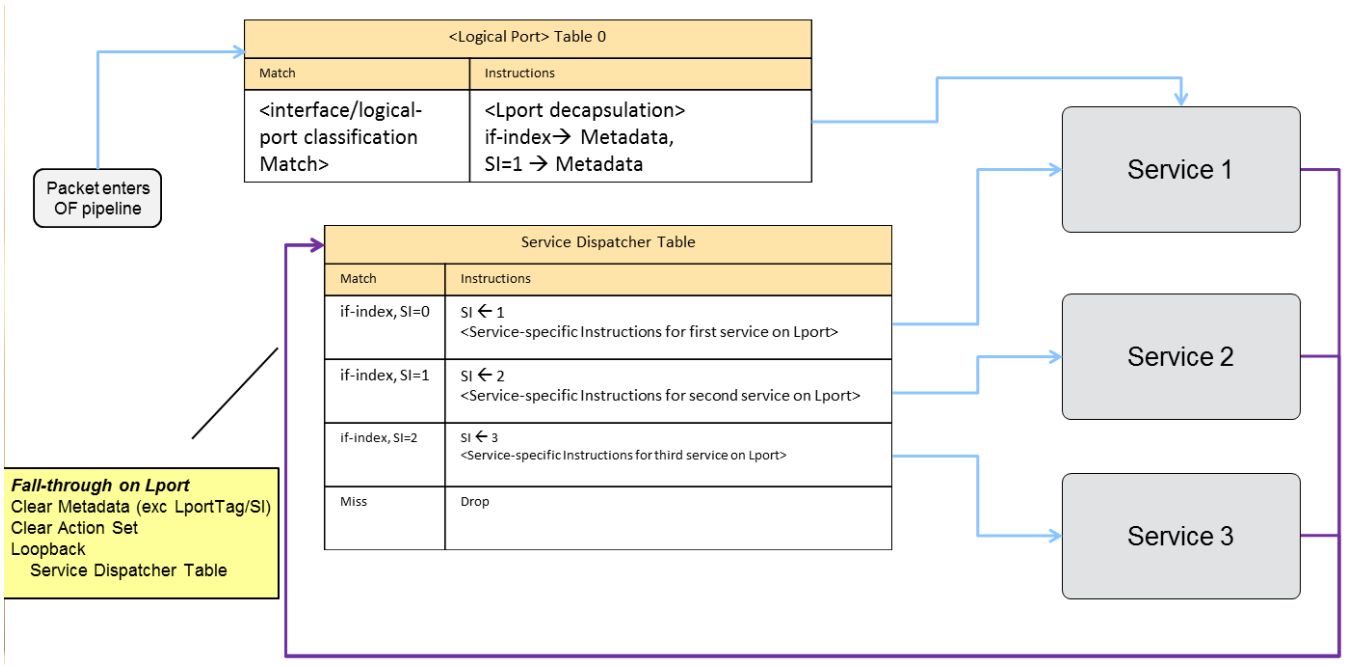
Base params		Vlan-trunk	Vlan-trunk-member	vxlan	gre
Configuration Data					
Name		**<unique-name/uuid>**	**<unique-name/uuid>**	**<unique-name/uuid>**	**<unique-name/uuid>**
description					
Type		**l2valn**	**l2valn**	**tunnel**	**tunnel**
enabled		enabled	enabled	enabled	enabled
Parent-refs	Datapath-node-id	<64 bit dpnid>	<64 bit dpnid>	<64 bit dpnid>	<64 bit dpnid>
	Parent-interface	<port_name on SBI>	<Parent vlan-trunkIf>	<Parent l2vlanIf>	<Parent l2vlanIf>
		l2vlan-mode =trunk	**l2vlan-mode =trunk-member**	**tunnel-type = vxlan**	**tunnel-type = gre**
		Vlan-Id (N.A.)	**Vlan-Id = trunk-vlanId**	dpn-id	dpn-id
				Vlan-id	Vlan-id
				source-ip	**source-ip**
				destination-ip	**destination-ip**
				gayeway-ip	gayeway-ip
				Monitor-enabled	Monitor-enabled
				Monitor-interval	Monitor-interval
Operational Data					
name		**name**	**name**	**name**	**name**
type		**type**	**type**	**type**	**type**
admin-status		**admin-status**	**admin-status**	**admin-status**	**admin-status**
oper-status		**oper-status**	**oper-status**	**oper-status**	**oper-status**
List higher-layer-if		**List higher-layer-if**	List higher-layer-if	List higher-layer-if	List higher-layer-if
List lower-layer-if		List lowerplayer-if	**List lowerplayer-if**	List lowerplayer-if	List lowerplayer-if
Phys-address		Phys-address	Phys-address	Phys-address	Phys-address
Ifindex		**Ifindex**	**Ifindex**	**Ifindex**	**Ifindex**
Node-cnnector-id		Node-cnnector-id		Node-cnnector-id	Node-cnnector-id
Statistics		Statistics	Statistics	Statistics	Statistics

Binding Services on an Interface

- **Service binding data model used to bind a service on a particular interface**
- **Service module configures following parameters**
  - Service-Priority
  - Service-Name
  - Service-Type
  - Service-Info
    - (for service-type openflow-based)
    - Flow-priority
    - Instruction-list
- **Interface Manager maintains a Service dispatcher table to regulate pipeline dynamically between services**
- **Listens to service-binding changes and accordingly programs the dataplane (Table 0 & Service Dispatcher)**

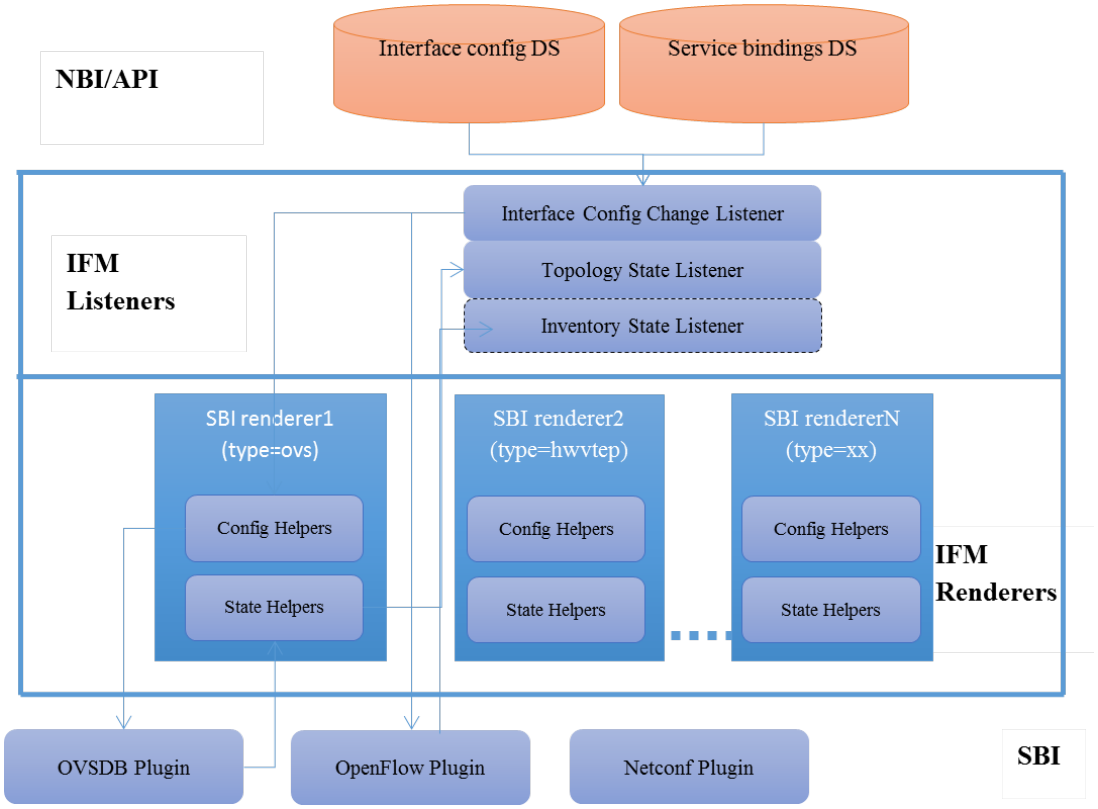


Service binding dataplane semantics



Making SBI protocol agnostic (South bound renderers)

- Provide a flexible way to support multiple south bound protocols
- North-bound interface/data-model is decoupled from south bound plugins
- NBI Data change listeners select and interact with appropriate SBI renderers
- New renderers can be added to support new Southbound interfaces/protocols/plugins
- Needs to be re-concilied with Netvirt re-design proposal



Shared Overlay Tunnel Service

- Provides tunnel creation/management services
    1. Can be configured to automatically create a homogenous bi-directional tunnel mesh (VxLAN/GRE/others) between agiven group of DPNs
    2. API to add new nodes into an existing tunnel mesh
    3. API to create uni-directional tunnels from a DPN to an external IP node (CE router) which may not be under SDN control
    4. Support for tunnel level redundancy by creating a logical-group-interface, combining more than one tunnel interfaces, and allow for load-balancing or failovers in the group
- API support to control monitoring of tunnel interfaces
- API to get egress-actions and ingress-rules/bindService for specified uni-directional tunnel
- NB Tunnel Up/Down events for services/ user-facing / analytics apps

Aliveness Monitor

- Provides Controller driven monitoring services for
    1. Point-to-point interfaces (VxLAN/GRE)
    2. From an interface to destination IP Node
- Consumes services from ARP, LLDP, Ping Modules
- Generate Aliveness Events
- Interface manager listens to Aliveness events and updates operational-state of interfaces
- Consumers register for monitoring services specifying monitored interfaces and monitoring parameters
- Uses –
    1. Physical topology monitoring
    2. monitoring of non-BFD transport tunnels
    3. Service Function Monitoring

ID Manager

- Generates and provides unique integer IDs from a pre-configured ID-Pool with configured range to requesting services
    1. APIs for C/D of ID-Pool, assignment and lookups of IDs to services
- Dual modes of operation
    1. Consistent ID generation – consistently provide the same ID for a particular unique key String, Id-value is retained across cluster restarts, and associated with unique key (implemented)
    2. Generic ID assignment, no guarantees of consistency or persistence (not implemented)
- Can be used to assign IDs for and manage resources such as Openflow Tables, Groups, Meters, Service IDs
- Used by Interface Manager for mapping service instances to logical tags in the data plane

MD-SAL UTIL

- Provides Java interfaces to interact with MD-SAL DS and southbound OF-plugin.
    1. APIs for programming Flows & Groups
    2. APIs for Data-Store Read/write
    3. Generic CDN listener

- Others?