Framework for Automating Service and Network Management with YANG

draft-wu-model-driven-management-virtualization-02

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Objectives of the Draft

Goal:

- Provide a framework that discusses the architecture for service and network management automation
- Discuss top to bottom service delivery using coordinated YANG models
- Investigate an applicability of YANG data model to automation of virtualized network service

Motivation:

• The large number of data models including configuration models and service models developed or under development in IETF covering much of networking protocols and techniques.

- More and more get published since last IETF meeting and mature enough

• These models standardization is scattered around different WG, hard for operators to Decide which models fit into their use cases(e.g.,DCN or DCI).

•How these models work together to fully configure a device, or manage a set of devices involved in a service aren't developed yet in IETF.

Data Model Layering
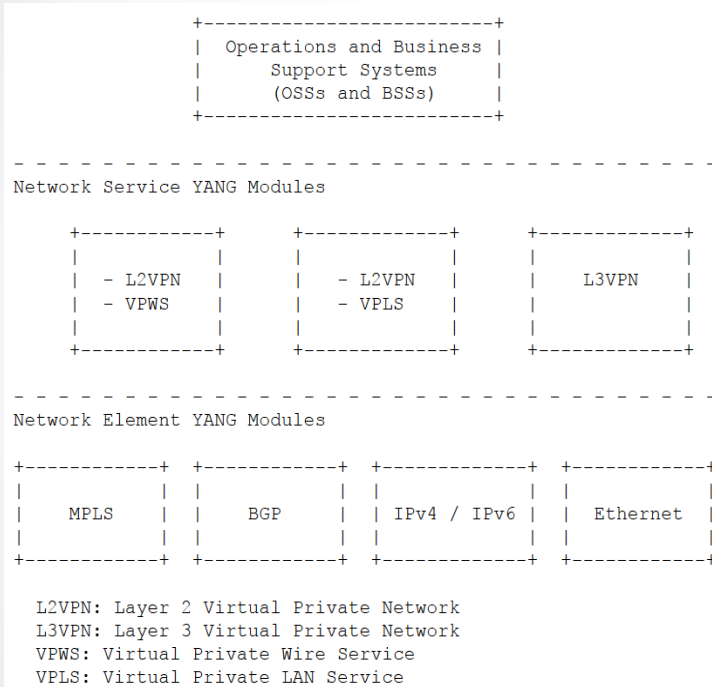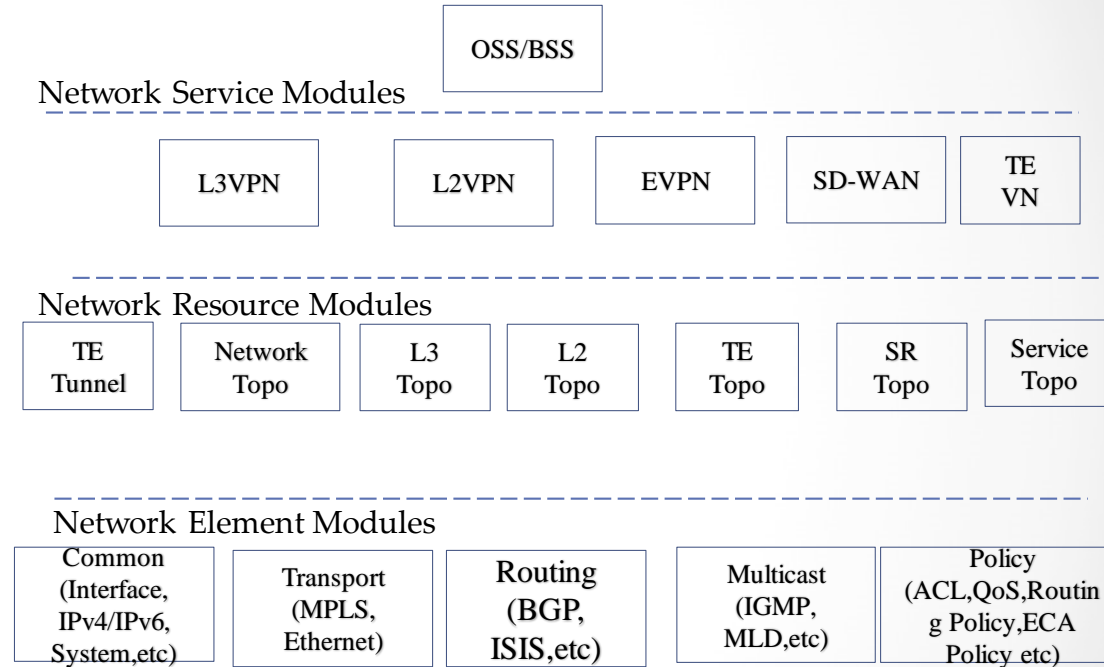
YANG Model Classification described in RFC8199

```
+--------------------------+
|  Operations and Business |
|     Support Systems      |
|     (OSSs and BSSs)      |
+--------------------------+

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Network Service YANG Modules

+-------------+   +-------------+   +-------------+
|             |   |             |   |             |
|  - L2VPN    |   |  - L2VPN    |   |   L3VPN     |
|  - VPWS     |   |  - VPLS     |   |             |
|             |   |             |   |             |
+-------------+   +-------------+   +-------------+

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Network Element YANG Modules

+-------------+ +-------------+ +-------------+ +-------------+
|             | |             | |             | |             |
|   MPLS      | |    BGP      | | IPv4 / IPv6 | |  Ethernet   |
|             | |             | |             | |             |
+-------------+ +-------------+ +-------------+ +-------------+

   L2VPN: Layer 2 Virtual Private Network
   L3VPN: Layer 3 Virtual Private Network
   VPWS: Virtual Private Wire Service
   VPLS: Virtual Private LAN Service

        Figure 1: YANG Module Abstraction Layers
```

YANG Model Classification described in this document

OSS/BSS

Network Service Modules

| L3VPN | L2VPN | EVPN | SD-WAN | TE VN |

Network Resource Modules

| TE Tunnel | Network Topo | L3 Topo | L2 Topo | TE Topo | SR Topo | Service Topo |

Network Element Modules

| Common (Interface, IPv4/IPv6, System,etc) | Transport (MPLS, Ethernet) | Routing (BGP, ISIS,etc) | Multicast (IGMP, MLD,etc) | Policy (ACL,QoS,Routing Policy,ECA Policy etc) |

Observation: policy related model, especially technology independent policy model make slow progress. WHY?
But Policy model is crucial to glue service-level, technology-level, device-level modules together

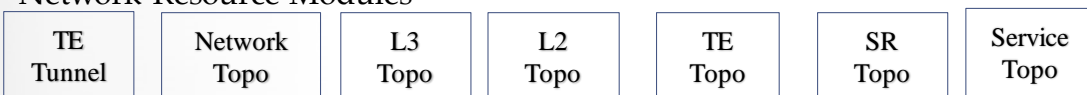# Data Model Representation

House Consumer

Network Service Modules

- -

L3VPN	L2VPN	EVPN	SD-WAN	TE VN

House Building Blueprint

- -

Network Resource Modules

TE Tunnel	Network Topo	L3 Topo	L2 Topo	TE Topo	SR Topo	Service Topo

Electricity   **Water Supply**   **Trench for sewerage**

- -

House building Block

Network Element Modules

Common (Interface, IPv4/IPv6, System,etc)	Transport (MPLS, Ethernet)	Routing (BGP, ISIS,etc)	Multicast (IGMP, MLD,etc)	Policy (ACL,QoS,Routing Policy,etc)
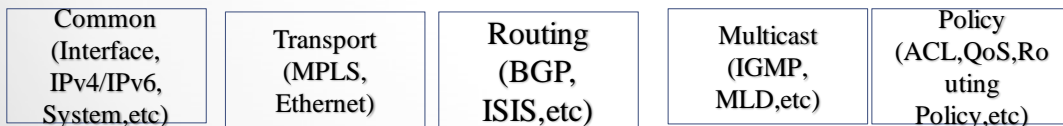
House building Foundation

IETF NETCONF YANG Update

IETF YANG Models Update(2018-11)

OPENCONFIG **OPENDAYLIGHT**

NMDA, YANG Push BGP, Routing Policy Consolidated MPLS, Device Model, Network Instance model, Logical Network Element Model
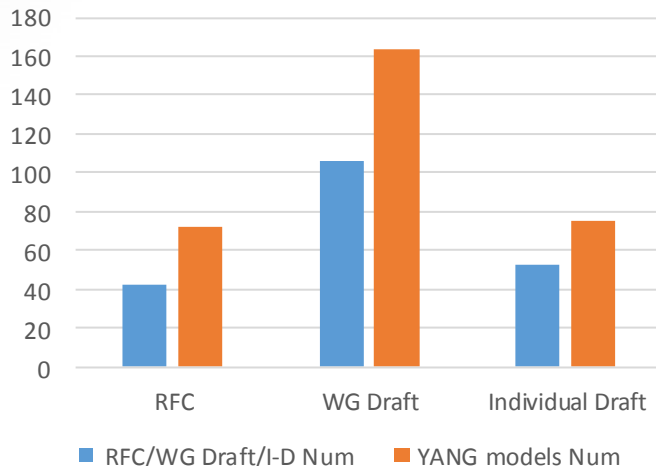
3GPP A GLOBAL INITIATIVE — 5G Transport Network Slicing Management

broadband forum — IPFIX,Common YANG, BBF YANG tool

MEF — IP Service, EVC Service, Optical Service,SD-WAN Service definition
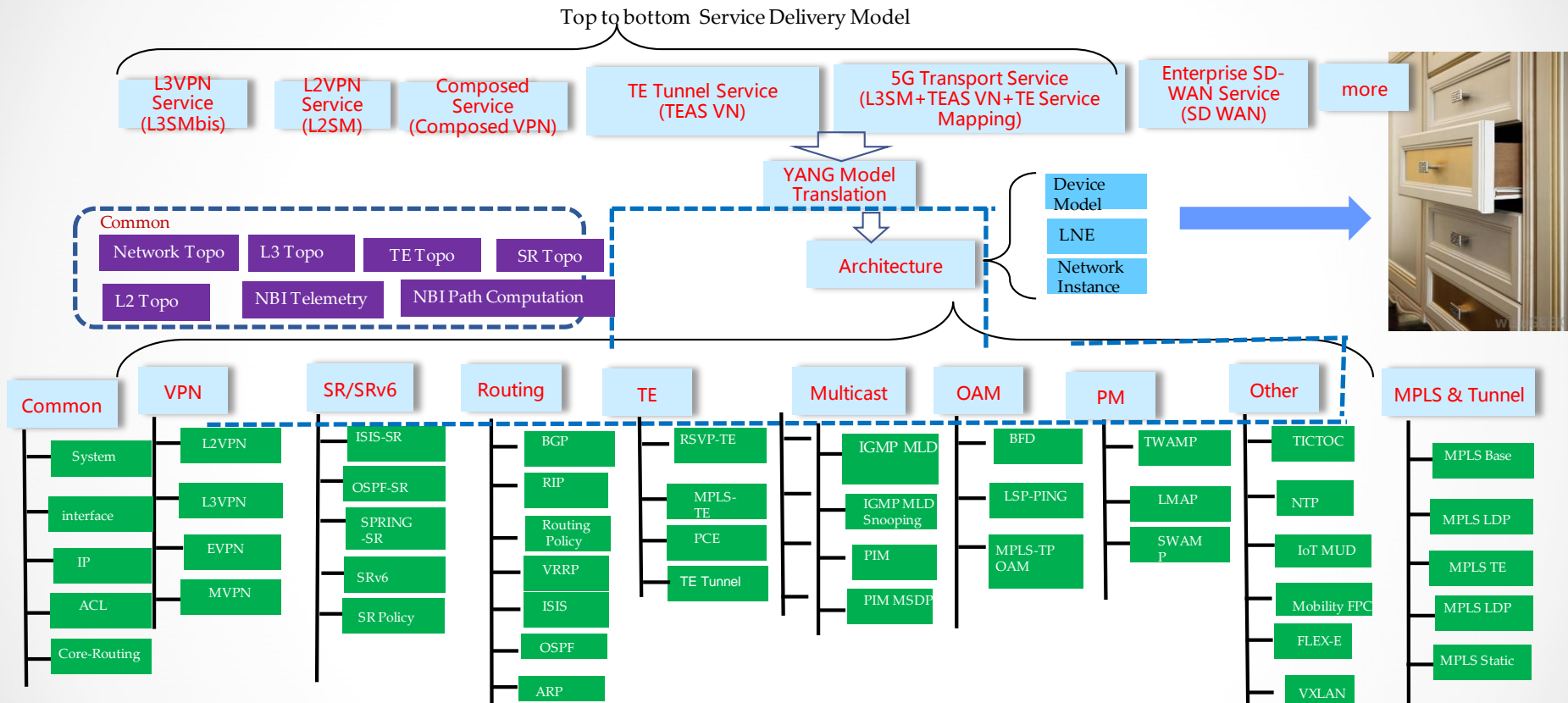
IEEE — Common Interface, Sub-interface

ONUG — SD-WAN YANG model

IETF Routing Architecture Design team

IETF YANG Coordination Group team

IETF YANG Doctor team

IETF hackathon YANG Catalog Team

Multicast Design Team

MPLS Design Team

PCE Design Team

TE Design Team

Others
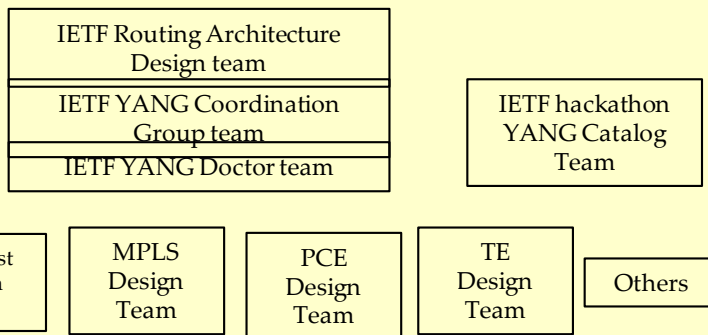
Summary：
1. Most of YANG models are standardized in IETF Routing area and applicable to SDN SBI. YANG models are distributed in several WGs in OPS and RTG area.
2. Until now, more than 106 YANG model WG drafts and around 80 Individual drafts are produced, 42 YANG model RFCs get published, YANG Pub/Sub/telemetry are ready for publication process, NMDA NC/RC will be published soon.
3. Getting input from Openconfig and ODL, have coordination with BBF,MEF, IEEE, ONUG.
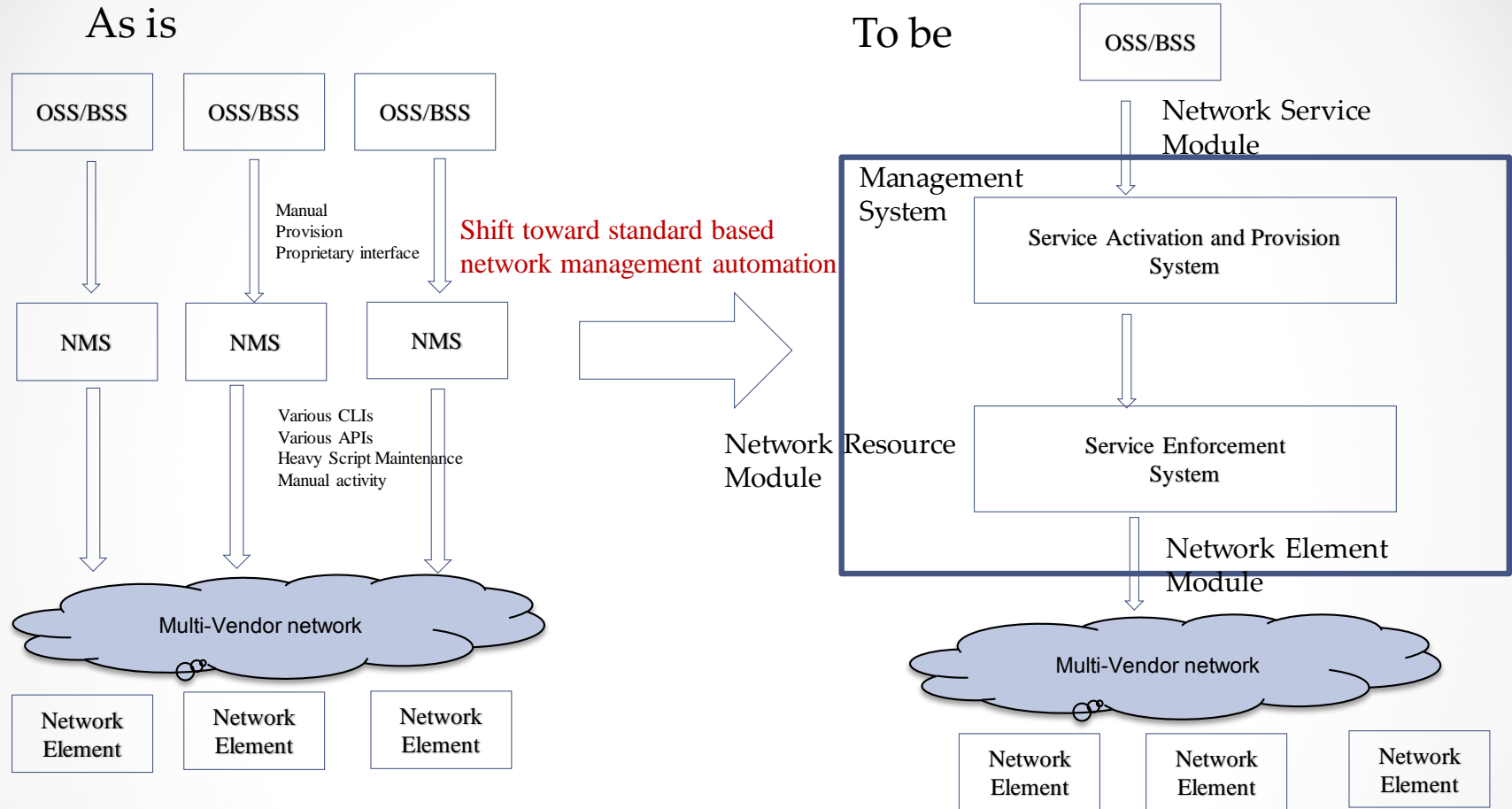
IETF YANG Model Standardization Overview

Top to bottom Service Delivery Model

L3VPN Service (L3SMbis)	L2VPN Service (L2SM)	Composed Service (Composed VPN)	TE Tunnel Service (TEAS VN)	5G Transport Service (L3SM+TEAS VN+TE Service Mapping)	Enterprise SD-WAN Service (SD WAN)

more

YANG Model Translation

Architecture

Device Model
LNE
Network Instance

Common

Network Topo	L3 Topo	TE Topo	SR Topo
L2 Topo	NBI Telemetry	NBI Path Computation	

Common	VPN	SR/SRv6	Routing	TE	Multicast	OAM	PM	Other	MPLS & Tunnel
System	L2VPN	ISIS-SR	BGP	RSVP-TE	IGMP MLD	BFD	TWAMP	TICTOC	MPLS Base
interface	L3VPN	OSPF-SR	RIP	MPLS-TE	IGMP MLD Snooping	LSP-PING	LMAP	NTP	MPLS LDP
IP	EVPN	SPRING-SR	Routing Policy	PCE	PIM	MPLS-TP OAM	SWAMP	IoT MUD	MPLS TE
ACL	MVPN	SRv6	VRRP	TE Tunnel	PIM MSDP			Mobility FPC	MPLS LDP
Core-Routing		SR Policy	ISIS					FLEX-E	MPLS Static
			OSPF					VXLAN	
			ARP						

Observation: BGP YANG and BESS EVPN and L3VPN have been parked for several IETF meetings without progress However, they are crucial to many service?

Issues to be addressed:

IETF YANG is not use case driven and scattered in different protocol WG for standardization, therefore hard to track of maturity of YANG Model pertaining to specific use case.

Service and Network management Evolving

As is

OSS/BSS   OSS/BSS   OSS/BSS

Manual
Provision
Proprietary interface

Shift toward standard based network management automation

NMS   NMS   NMS

Various CLIs
Various APIs
Heavy Script Maintenance
Manual activity

Multi-Vendor network

Network Element   Network Element   Network Element

To be

OSS/BSS

Network Service Module

Management System

Service Activation and Provision System

Network Resource Module

Service Enforcement System

Network Element Module

Multi-Vendor network

Network Element   Network Element   Network Element

- **Traditional Service Delivery**
  o Preconfigured with customer service requirements and has slow response to customer needs
  o Vendor specific tools, CLI, manual activity and therefore has slow response to network changes

- **Modern Service Delivery**
  o Separate service definition from how the service is realized and drive service innovation faster
  o Decouple Service activation and provision from Service Enforcement

Service management automation vs Network Management Automation
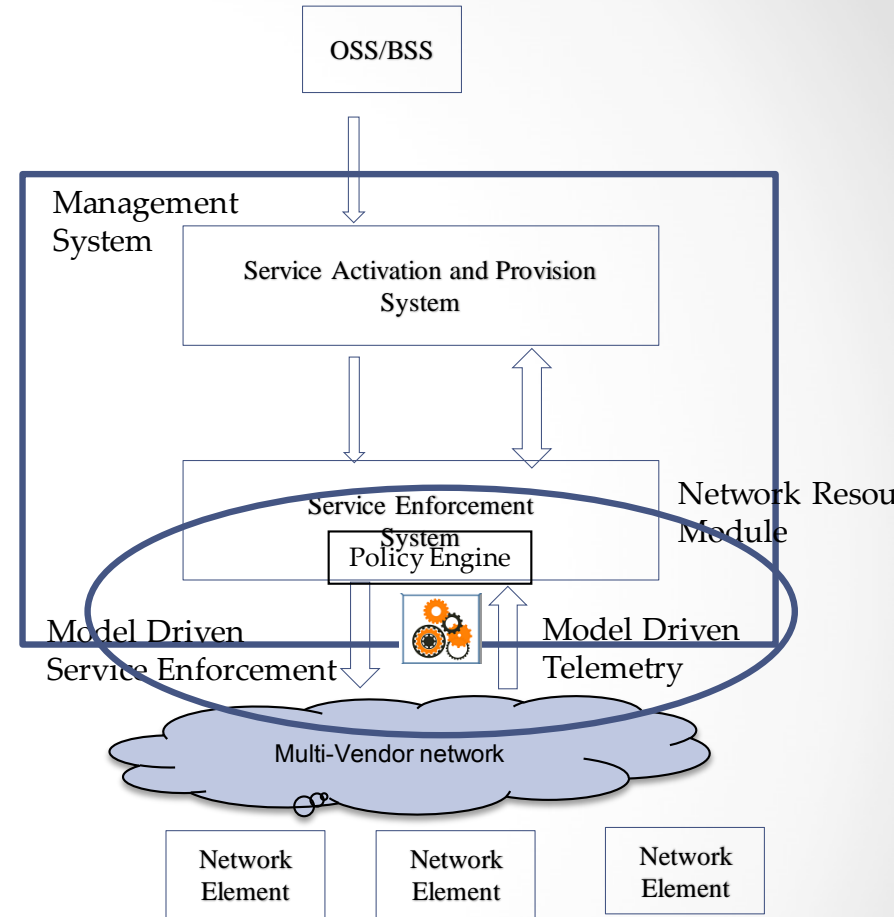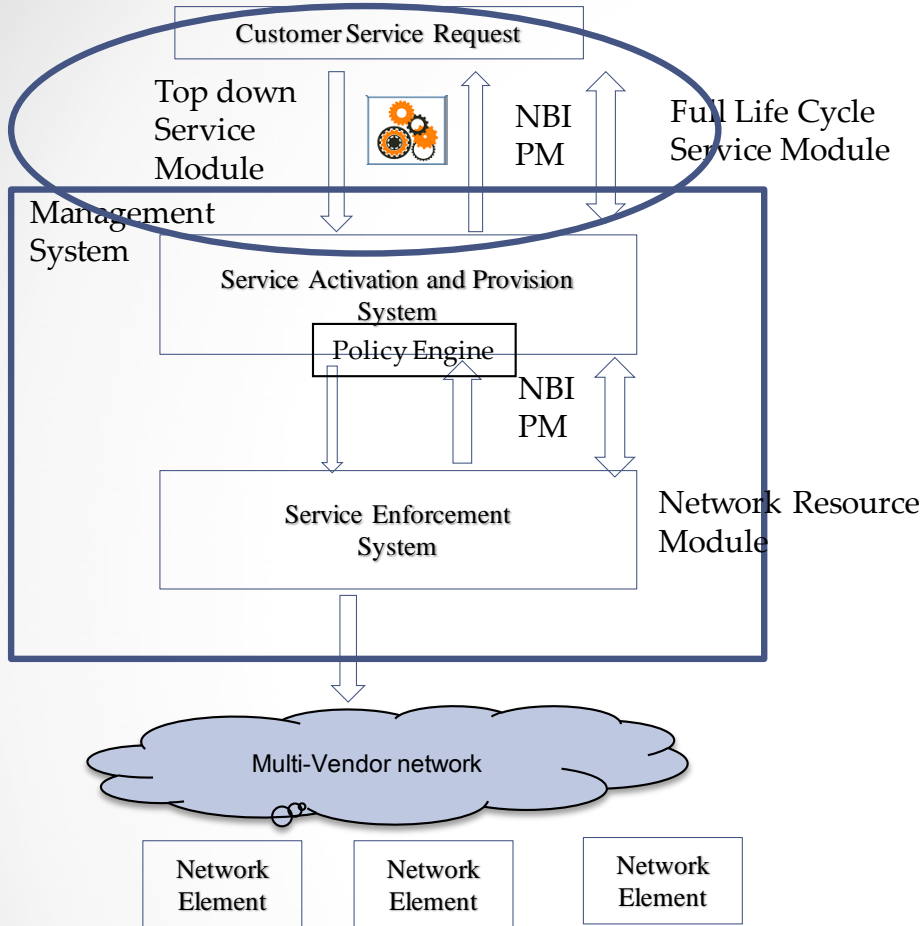
- **Northbound Service management Automation**
  - Provide full life cycle Service management
    - Top down service request module + NBI Telemetry module +NBI alarm module +ECA Policy module
    - Service module for both service request and service assurance, monitoring

- **Southbound Network management Automation**
  - Provide full life cycle of network management and device management
    - Device module for service enforcement+ Device module for Telemetry data + ECA Policy module

End to End Service Delivery and Enforcement:
IP Service Mapping vs TE Service Mapping
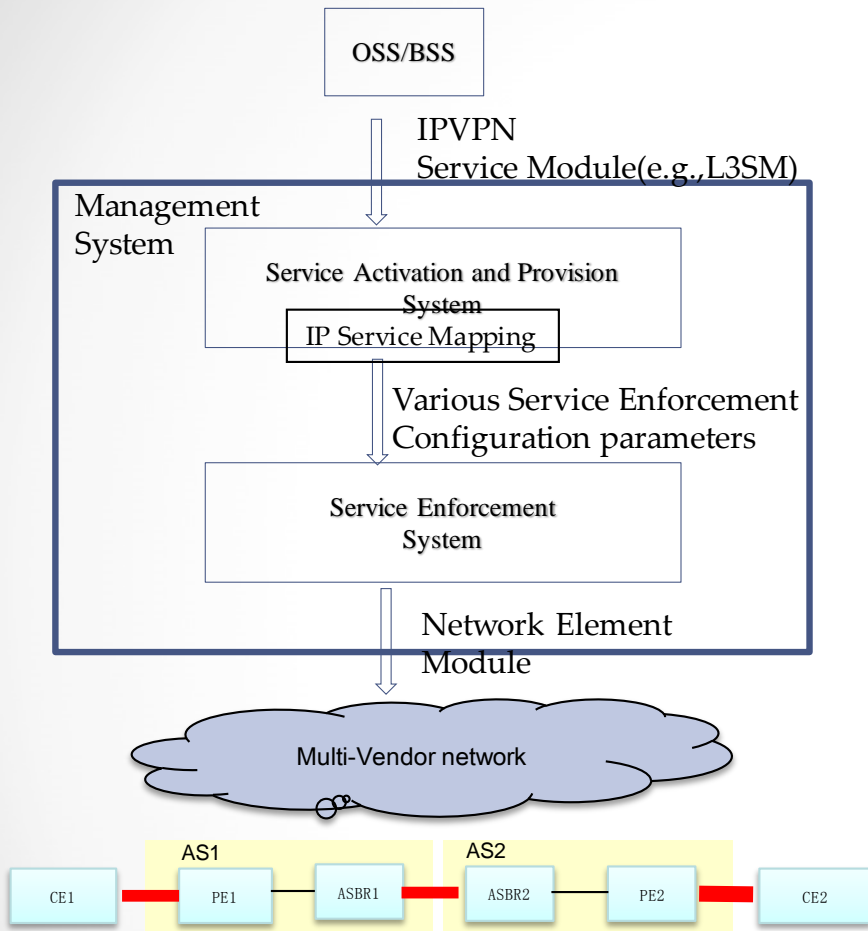
- **IP Service Mapping**
  - Site Location, Network Access,Svc QoS(bandwidth, Delay, Jitter) per connectivity(PE-CE, ASBR-ASBR),
  - BGP, VRF, ACL, Multicast, NAT, ISIS, OSPF,
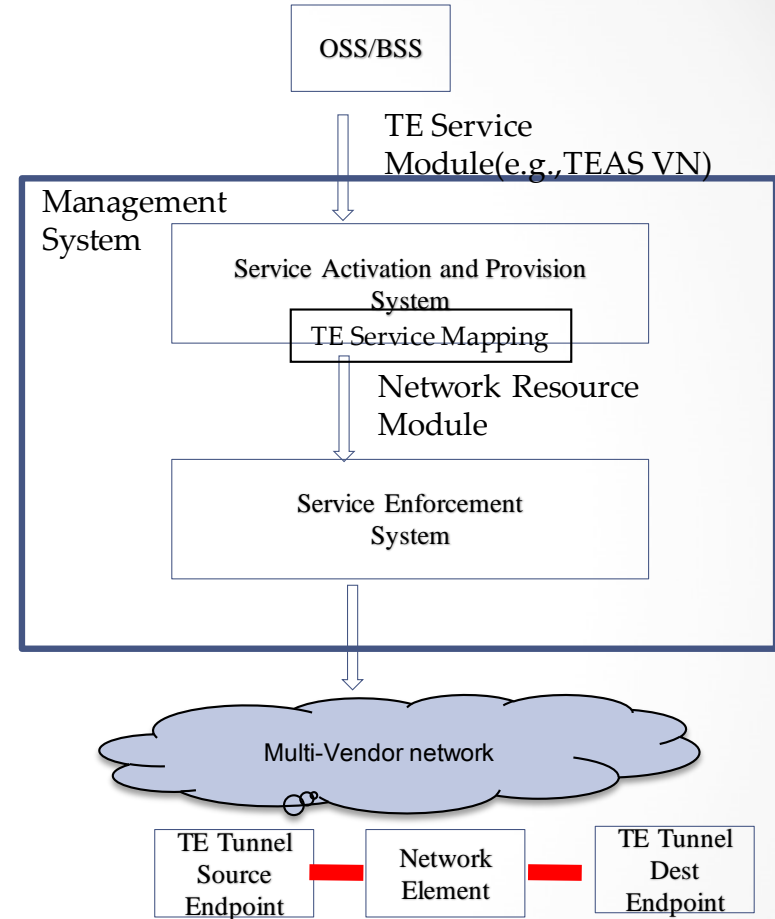
- **TE Service Mapping**
  - VPN(VPN-id), Network Access(Network Access-id)
  - VN (vn-id,src,dest, connectivity-matrix)Access Point(Access-point-id)
  - TE Topo (TE-Topo-id)
  - TE Tunnel list

Applicability of YANG data model to automation of virtualized network service
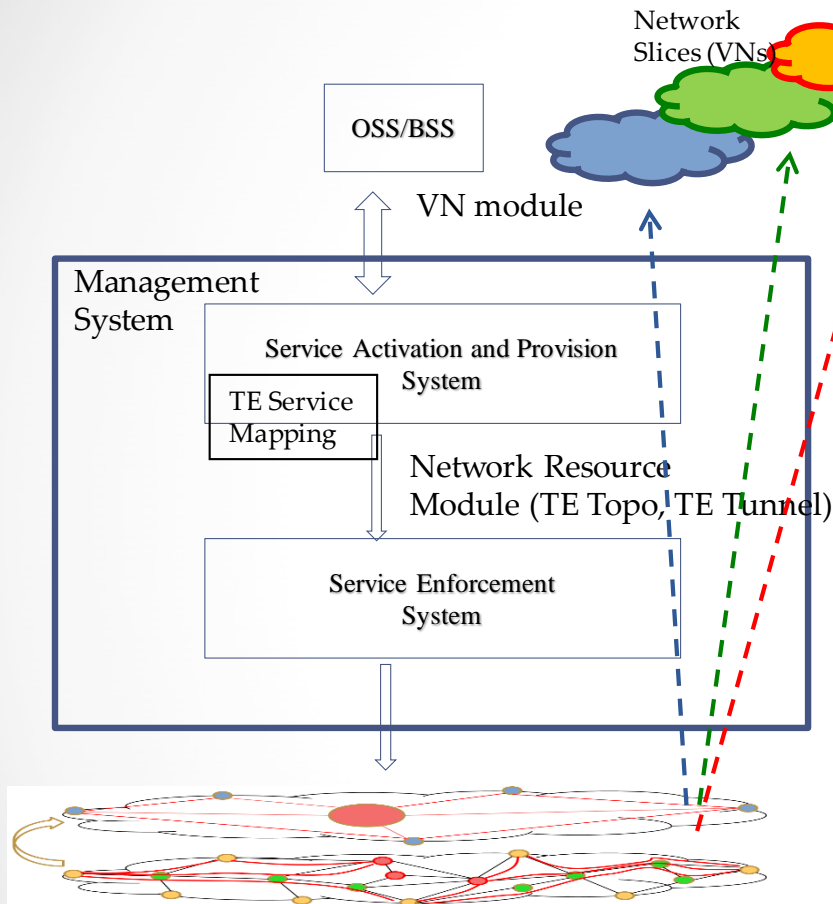
Pre-provision VN: Pre-provision multiple VNs on top of the same basic network infrastructure based on pre-configured service requirements and establish resource pool for each VN and expose to the customer with several service templates through web portal.

VN Selection: Customer Selects and uses one which fulfills most its requirement among the service templates.

TE Service Mapping: Create resource facing VN Network based on selected service template, and calculate the node resource, link resource corresponding to connectivity between sites. Setup tunnels between sites and map them into the selected VN topology and establish resource facing VN topology based on TEAS VN model [I-D.ietf-teas-actn-vn-yang] and TE tunnel based on TE Tunnel model.

TE Service assurance and Monitoring:
The resource facing VN model extension and corresponding TE Tunnel model can be further used to notify all the parameter changes and event related to VN topology or Tunnel.
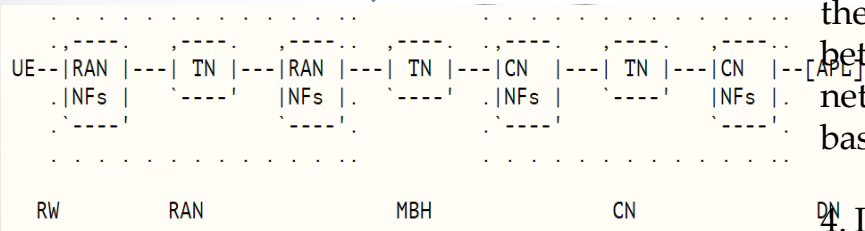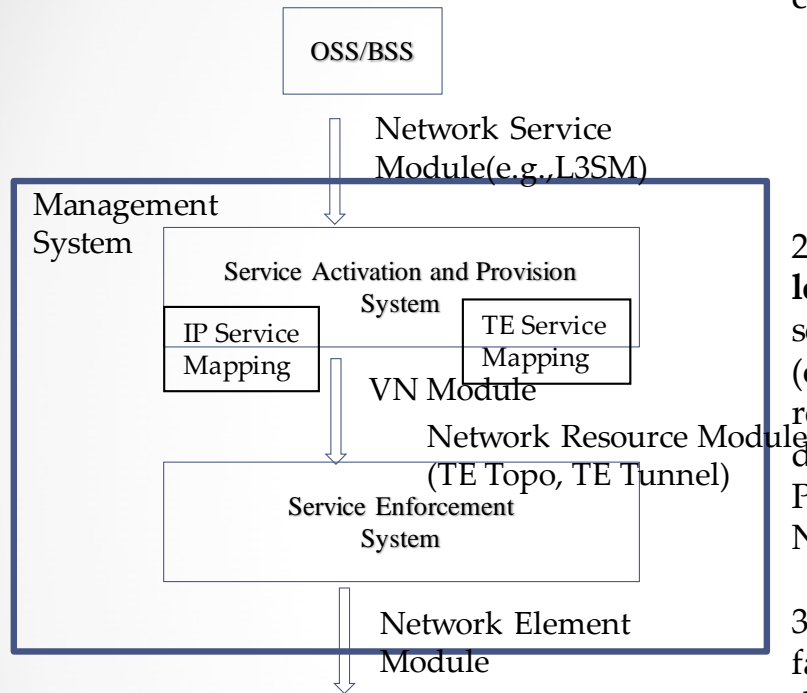
Network as a Service
Legend:
MBH: Mobile Backhaul   CN: Core Network
TN: Transport Network   RAN: Radio Access Network

Applicability of YANG data model to automation of IPVPN+TE tunnel service

Management System

OSS/BSS

Network Service Module(e.g.,L3SM)

Service Activation and Provision System

IP Service Mapping

TE Service Mapping

VN Module

Network Resource Module (TE Topo, TE Tunnel)

Service Enforcement System

Network Element Module

UE--|RAN |---| TN |---|RAN |---| TN |---|CN |---| TN |---|CN |--[APL]
    .|NFs |. `----'  |NFs |.  `----' .|NFs |. `----' |NFs |.
    `----'            `----'   `----'            `----'

RW   RAN   MBH   CN   DN

Legend:
MBH: Mobile Backhaul   CN: Core Network
TN: Transport Network   RAN: Radio Access Network

1. **Customer Service Request:** Request to create two sites based on L3SM Service model with each having one network access connectivity:
   Site A: Network-Access A, Bandwidth=20M, for class "foo", guaranteed-bw-percent = 10, One-Way-Delay=70 msec
   Site B: Network-Access B, Bandwidth=30M, for class "foo1", guaranteed-bw-percent = 15, One-Way-Delay=60 msec

2: **IP Service Mapping: Select network attachment point based on location info and access diversity constraints and** Create a new service topology based on Service Type and service requirements (e.g., Slice Service Type, Slice location, Number of Slices, QoS requirements corresponding to network connectivity within a Slice) defined in L3SM service model. Translate L3SM service model into PE configuration and CE configuration(such as BGP, QoS, Multicast, NAT,etc)

3: **TE Service Mapping:** Translate L3SM service model into resource facing TEAS VN Model [I-D.ietf-teas-actn-vn-yang], and calculate the node resource, link resource corresponding to connectivity between sites. Setup tunnels between sites and map them into basic network infrastructure and establish resource facing VN topology based on TEAS VN model and TE tunnel based on TE Tunnel model.

4. IP Servce&**TE Service assurance:**
The resource facing TEAS VN Telemetry model The VPN performance measurement model can be used to notify all the parameter changes and event related to VN topology or Tunnel.

Take away

- **IETF process is slow**
  - Some of IETF YANG data model needs more attention from IETF community and operator community such as BGP model, BESS L3VPN, EVPN model, ECA Policy model, QoS model, etc.
- **Create YANG standards for protocols and data modeling that meet all relevant network operator requirements**
  - Conduct Survey on operator model selection and main automation use case
  - Operator design team should be established to drive typical use case for IETF model deployment.
  - Adopt YANG Catalog tool, increase operator visibility to IETF YANG maturity and a variety of application developed by vendor, user, open source project
  - IETF YANG model standardization should be changed into use case driven or project driven:
  - YANG data model list for typical use case should be provide as a reference.
- **Top to bottom service delivery using coordinated YANG models**
  - Framework for management automation should be specified to provide usage guideline for developer, implementer, operator to make a fully integrated YANG-based system.
- **It is time for operators to deploy these IETF models now**
  - Implement a single network element model is not sufficient, top down service delivery require implementing a set of Network elements modules
  - Report implementation issues back to IETF YANG model github

Q&A

Or talk to us on the mailing list

THANK YOU

Related Work

- RFC8199 discusses YANG model classification.
  - Define a set of concepts and associated terms to support consistent classification of YANG modules
- RFC8299 defines L3VPN service model
  - provide an example of the translation of service provisioning requests to router configuration lines.
- RFC8528 defines schema mount mechanism
  - allows for mounting one data model consisting of any number of YANG modules at a specified location of another (parent) schema.
- draft-clacla-netmod-model-catalog-03
- draft-openconfig-netmod-model-catalog-02
  - a YANG model catalog and registry that allows users to find models relevant to their use cases
  - define bundles of YANG modules required to realize a particular service or function.
- [draft-arkko-arch-virtualization-01]provides a summary of IETF technologies that relate to network virtualization