



# Virtualized Broadband Access: SEBA

Saurav Das  
VP of Engineering, ONF

Open Networking Conference Asia 2019  
July 22<sup>nd</sup>, 2019

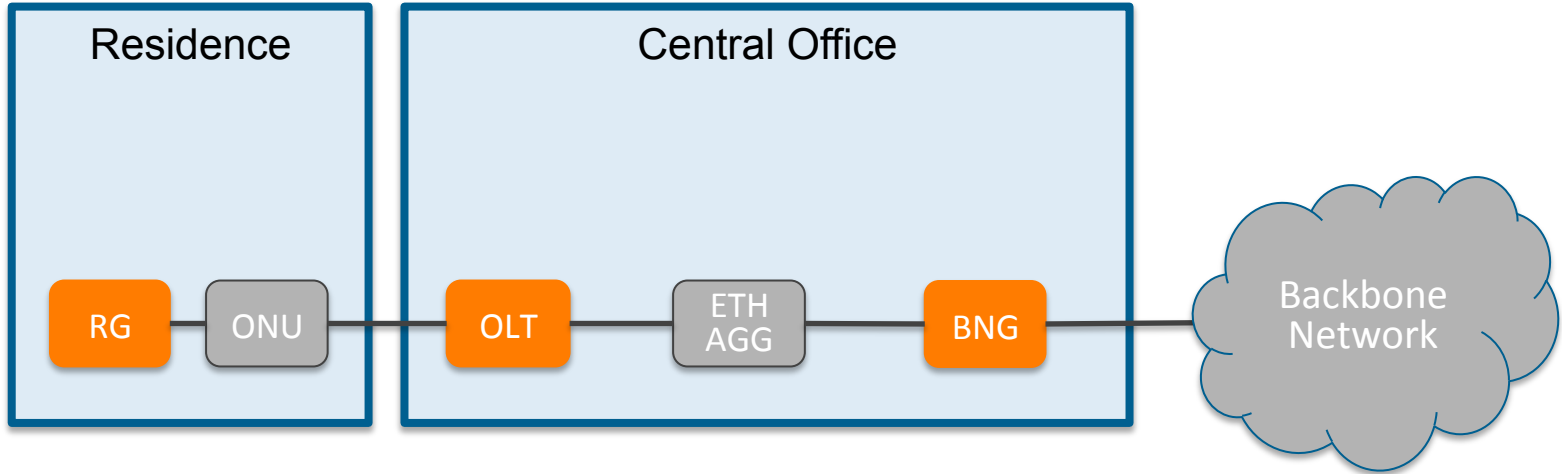
# Outline

- How to virtualize broadband access?
- Who's working on it?
- What's coming next?



# SEBA: SDN Enabled Broadband Access

# Traditional Residential Access



RG – Residential Gateway

OLT – Optical Line Termination

BNG – Broadband Network Gateway

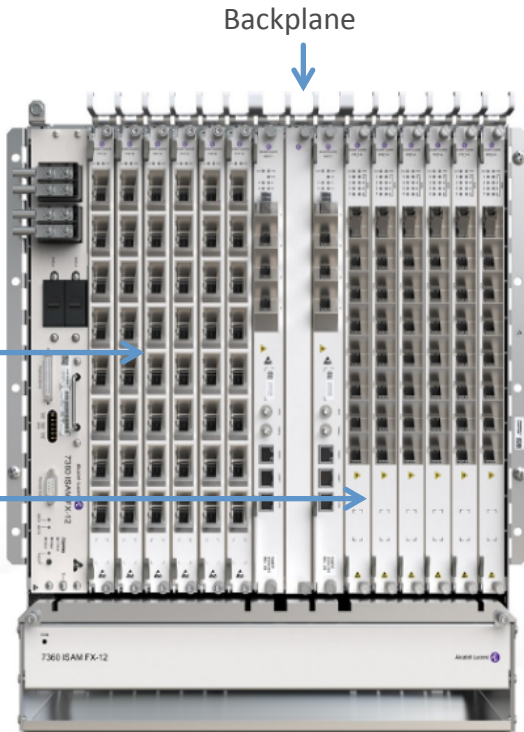
# OLT Disaggregation → VOLTHA

EMS

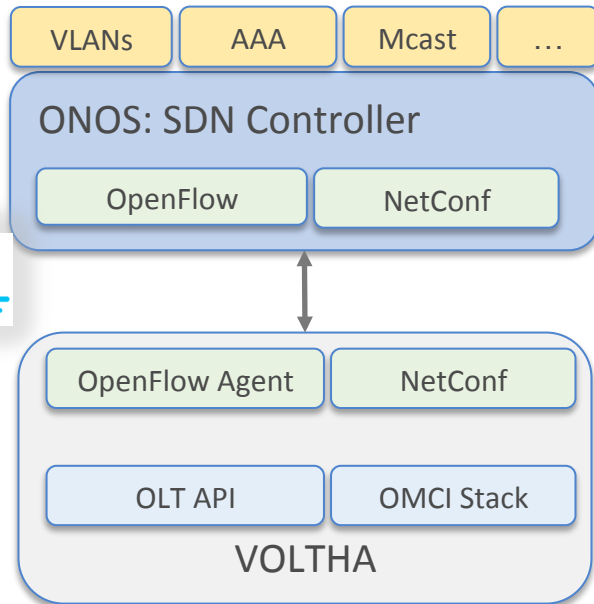
VLANs, IGMP,  
802.1x, Mcast ...

PON  
MAC  
blades

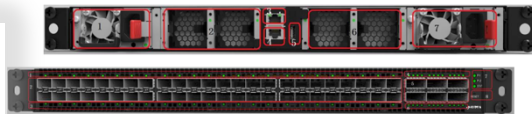
Compute  
blades



Traditional Chassis based  
Vendor OLT for PONs  
(Passive Optical Networks)

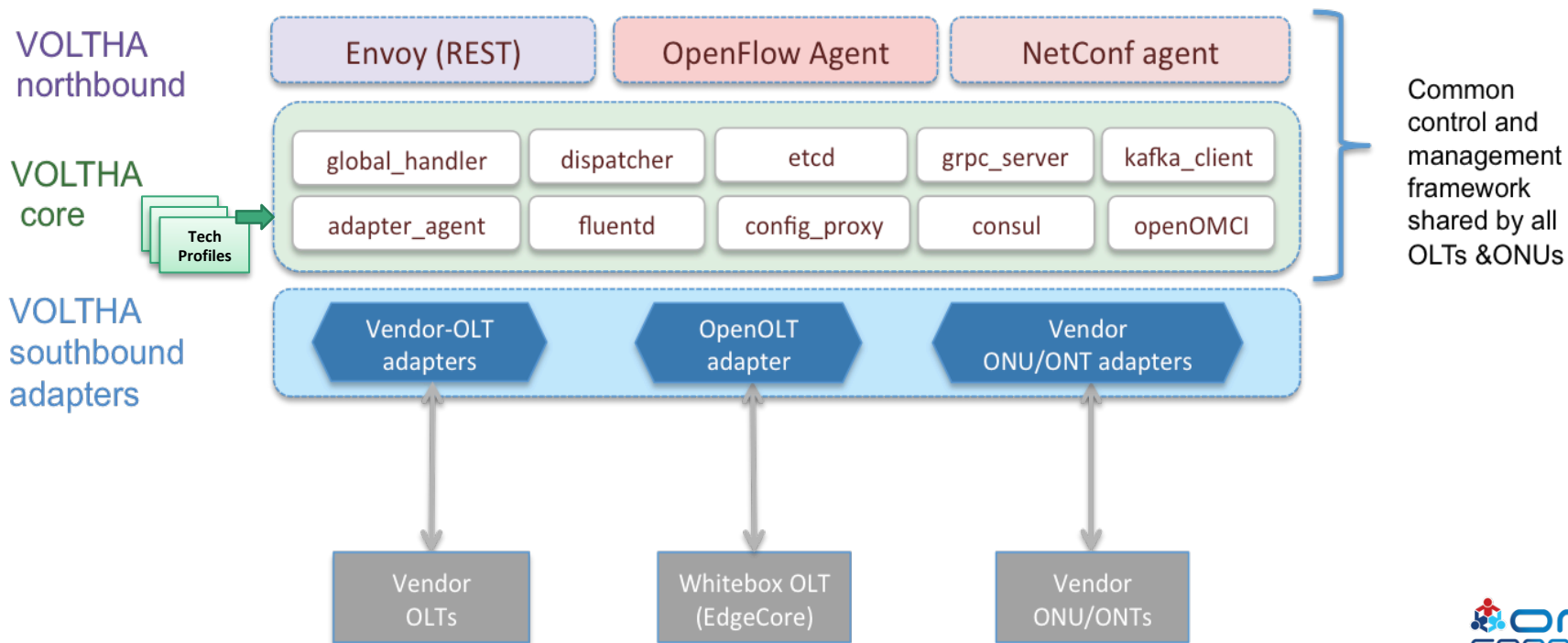


VOLTHA: Virtual OLT  
Hardware Abstraction

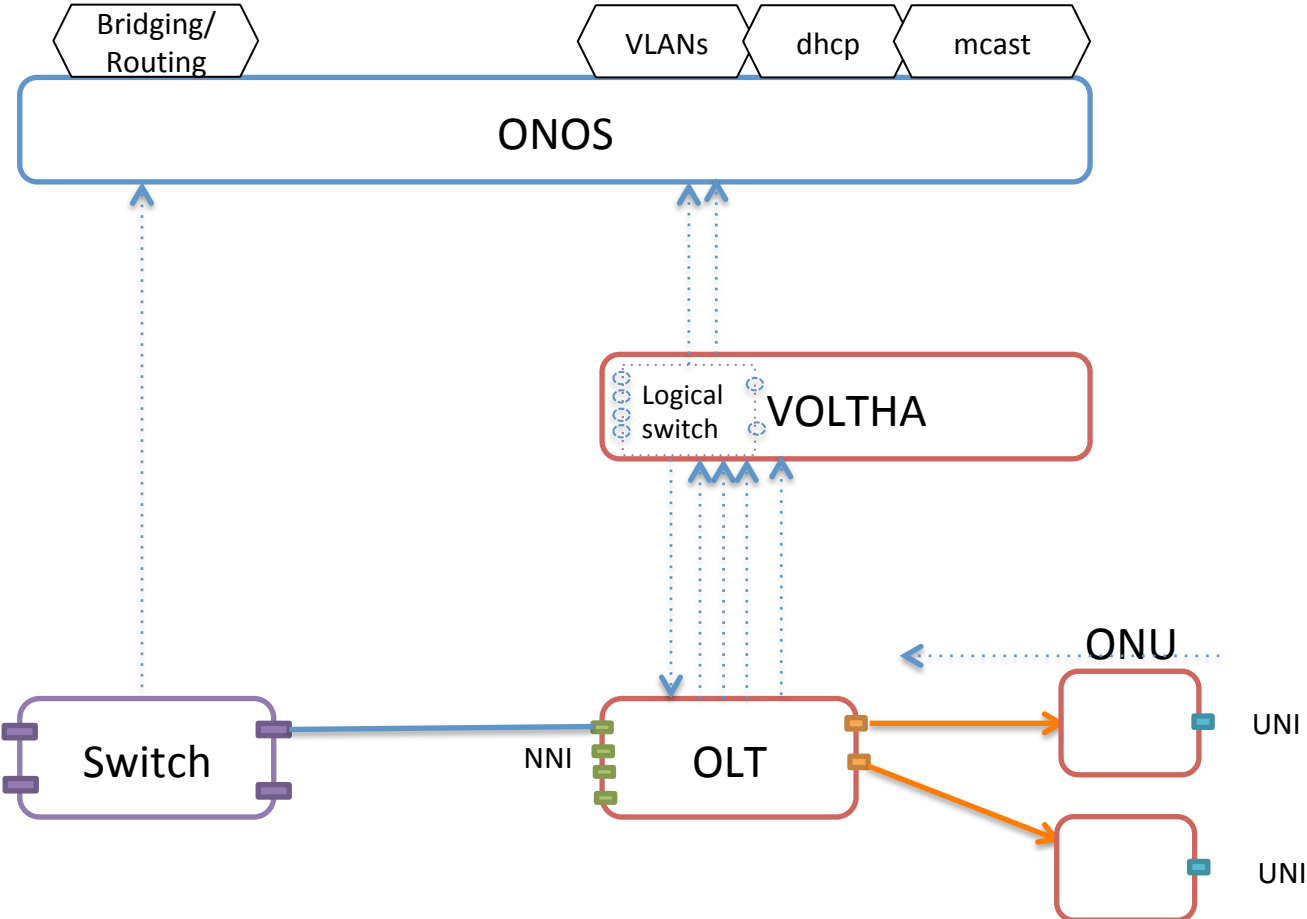


# VOLTHA Architecture

VOLTHA hides PON-level details (T-CONT, GEM ports, OMCI etc.) from the SDN controller, and abstracts each PON as a pseudo-Ethernet switch easily programmed by the SDN controller

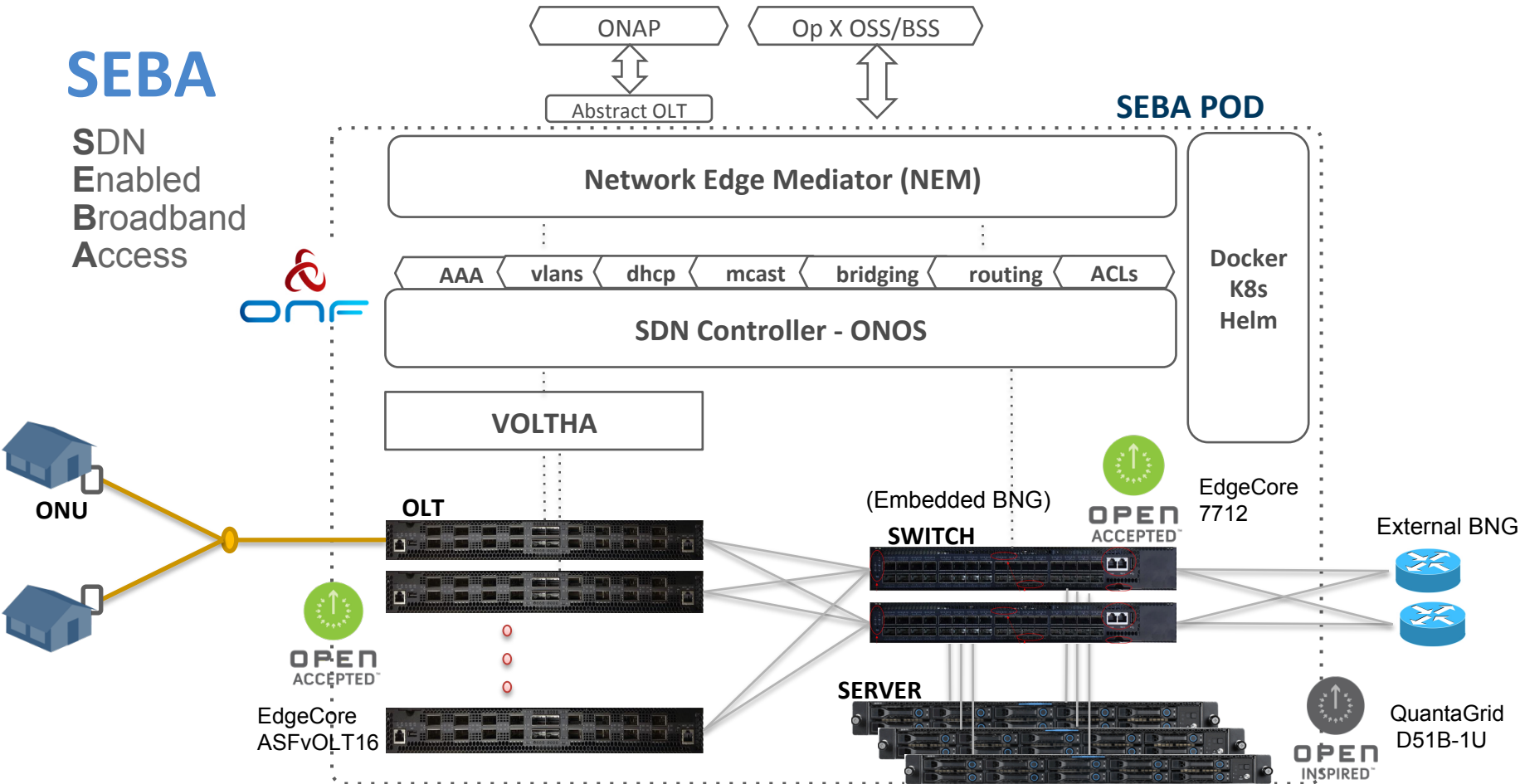


# VOLTHA Operation



# SEBA

SDN  
Enabled  
Broadband  
Access



## SEBA POD

Docker  
K8s  
Helm

Network Edge Mediator (NEM)

AAA | vlans | dhcp | mcast | bridging | routing | ACLs

SDN Controller - ONOS

VOLTHA

OLT

(Embedded BNG)  
SWITCH

SERVER

EdgeCore 7712

External BNG

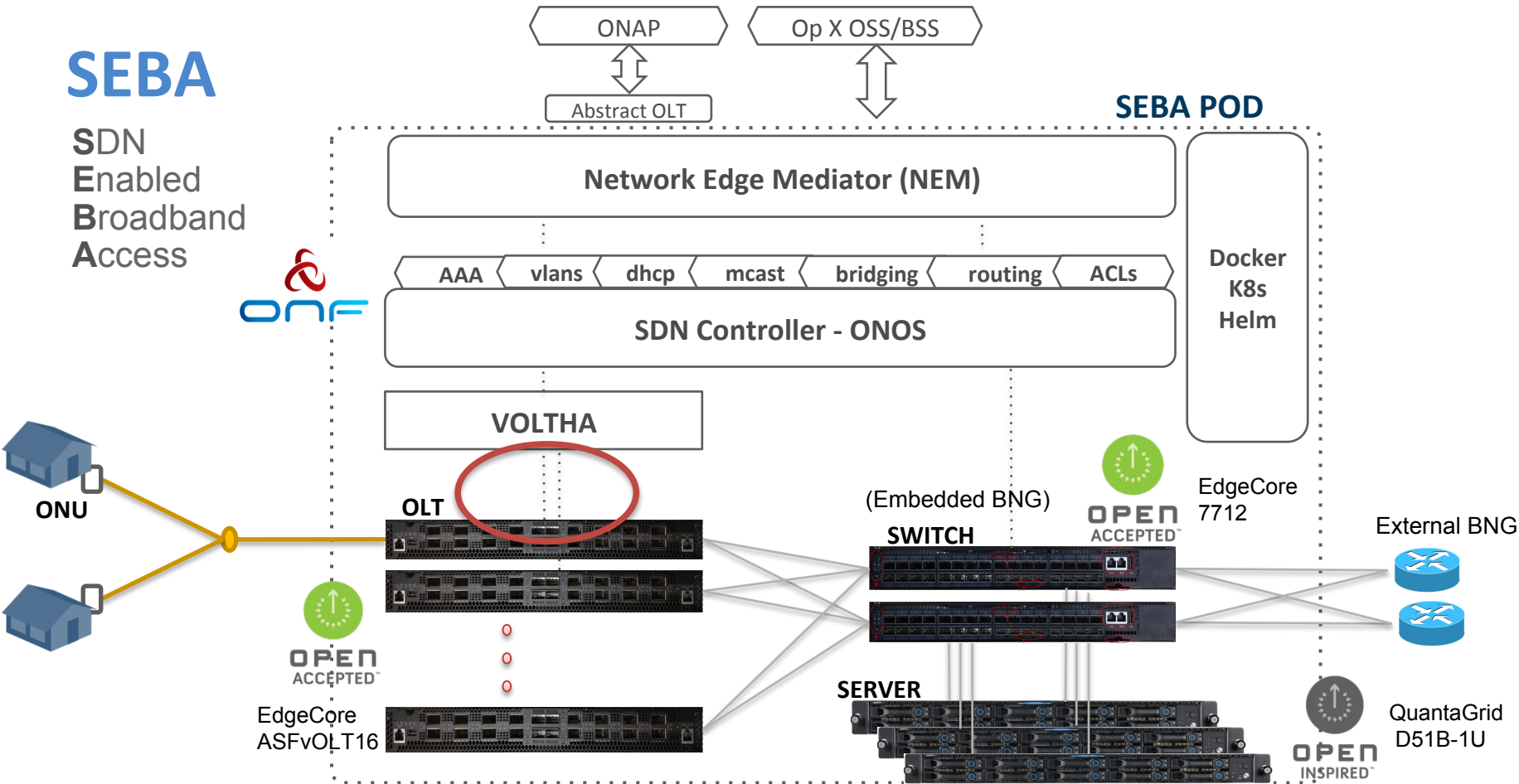
QuantaGrid D51B-1U





# SEBA

SDN  
Enabled  
Broadband  
Access



## SEBA POD

ONAP

Op X OSS/BSS

Abstract OLT

Network Edge Mediator (NEM)

AAA

vlans

dhcp

mcast

bridging

routing

ACLs

SDN Controller - ONOS

Docker  
K8s  
Helm

VOLTHA

ONU

OLT

(Embedded BNG)

SWITCH

EdgeCore  
7712

External BNG

OPEN  
ACCEPTED™

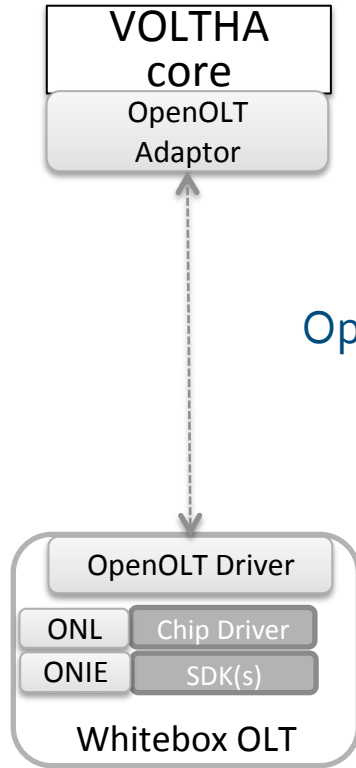
EdgeCore  
ASFvOLT16

SERVER

QuantaGrid  
D51B-1U

OPEN  
INSPIRED™

# Industry's First White-Box XGS-PON OLT

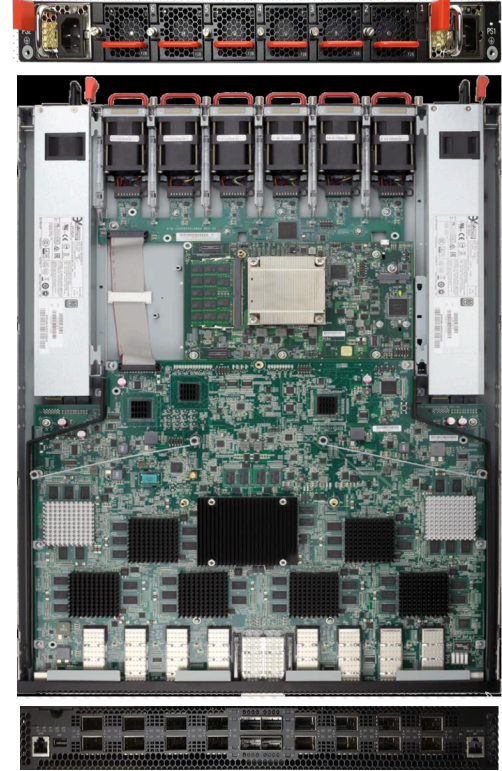


OpenOLT



White-Box =  
Open-Hardware Specs (OCP)  
+ Open-Source Software (ONF & OCP)

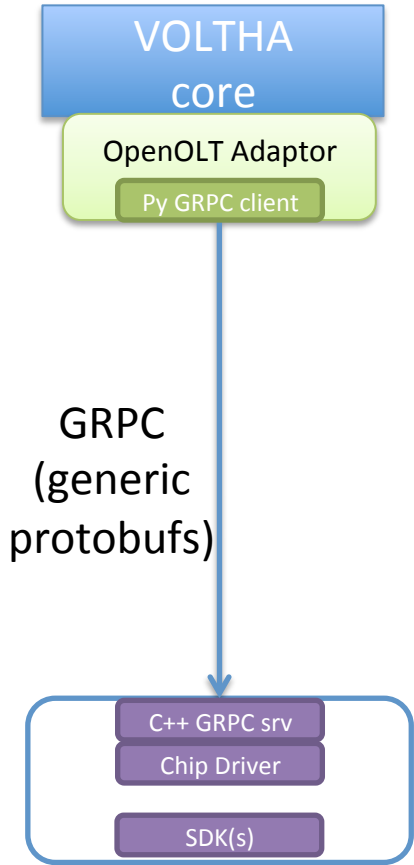
Edgecore  
ASFvOLT16  
Whitebox OLT



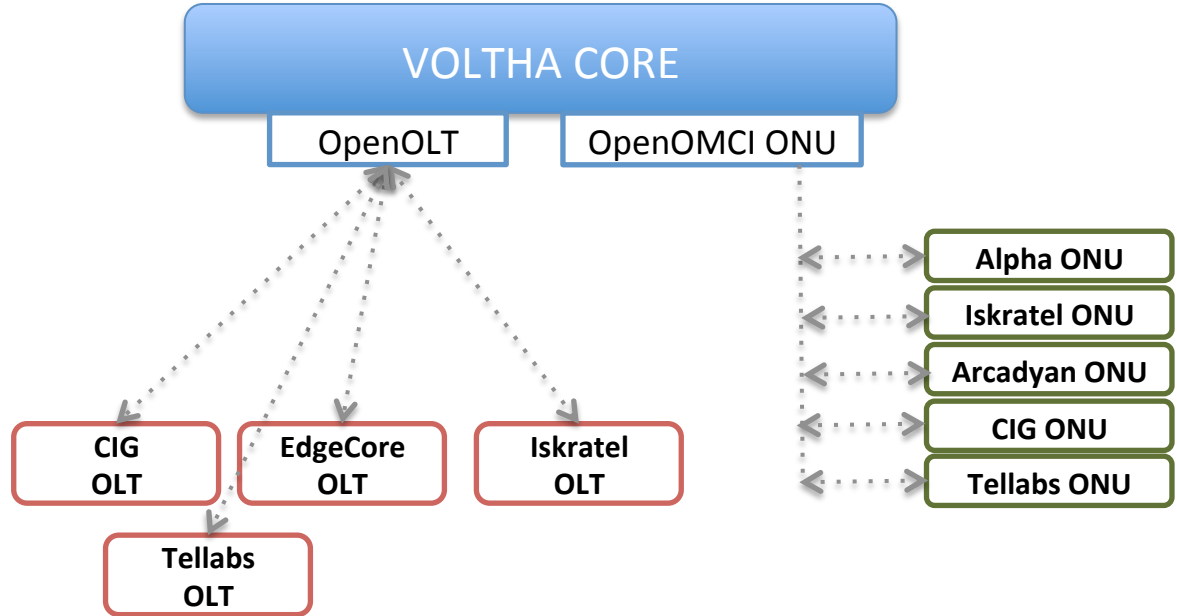
March 2018

# Why OpenOLT Adaptor?

Generic OLT adaptor - ease of onboarding for new vendors (including whitebox vendors)

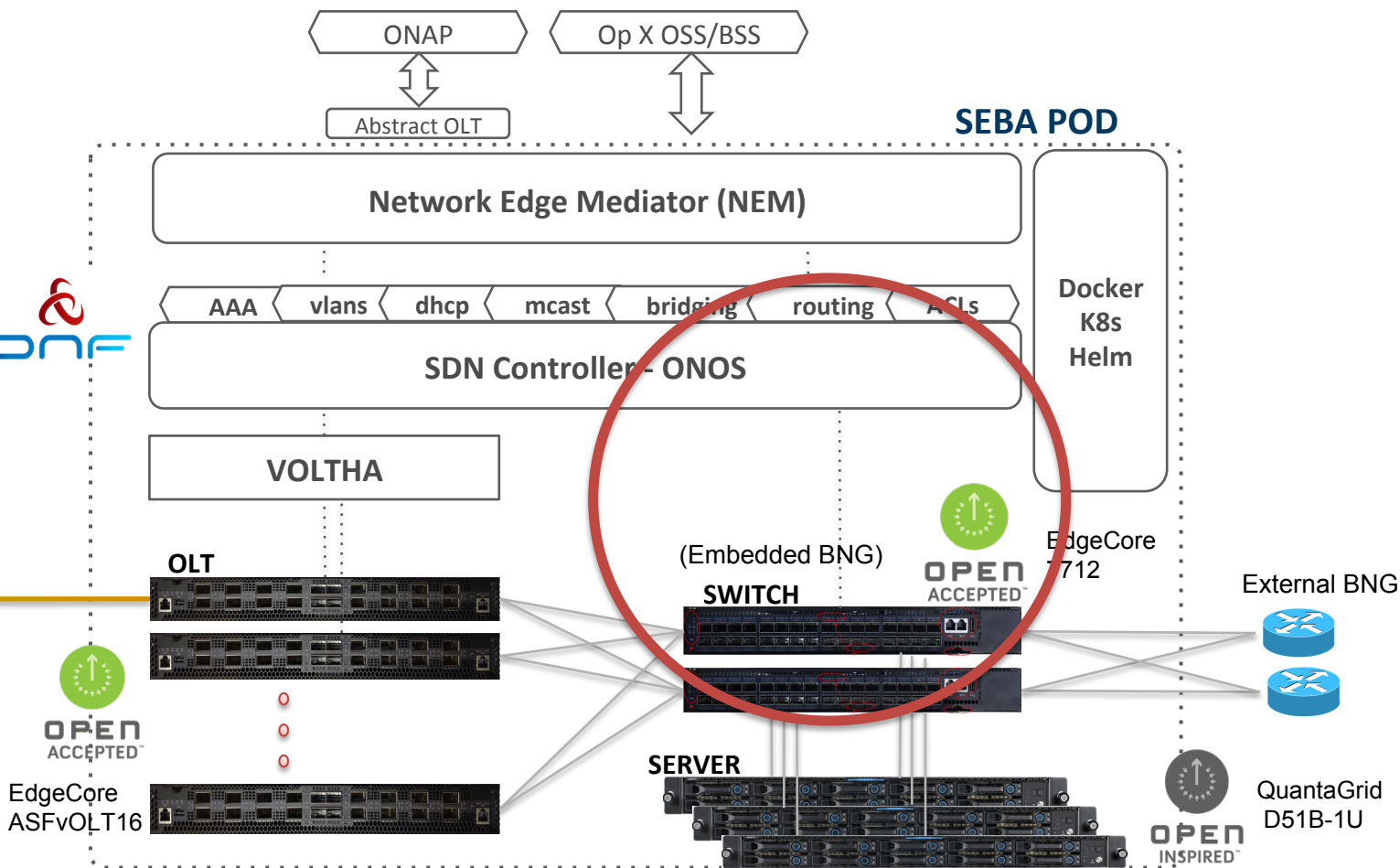


Whitebox OLT  
(including EdgeCore)



# SEBA

SDN  
Enabled  
Broadband  
Access



## SEBA POD

ONAP

Op X OSS/BSS

Abstract OLT

Network Edge Mediator (NEM)

AAA vlans dhcp mcast bridging routing APIs

SDN Controller - ONOS

VOLTHA

OLT

(Embedded BNG)

SWITCH

SERVER

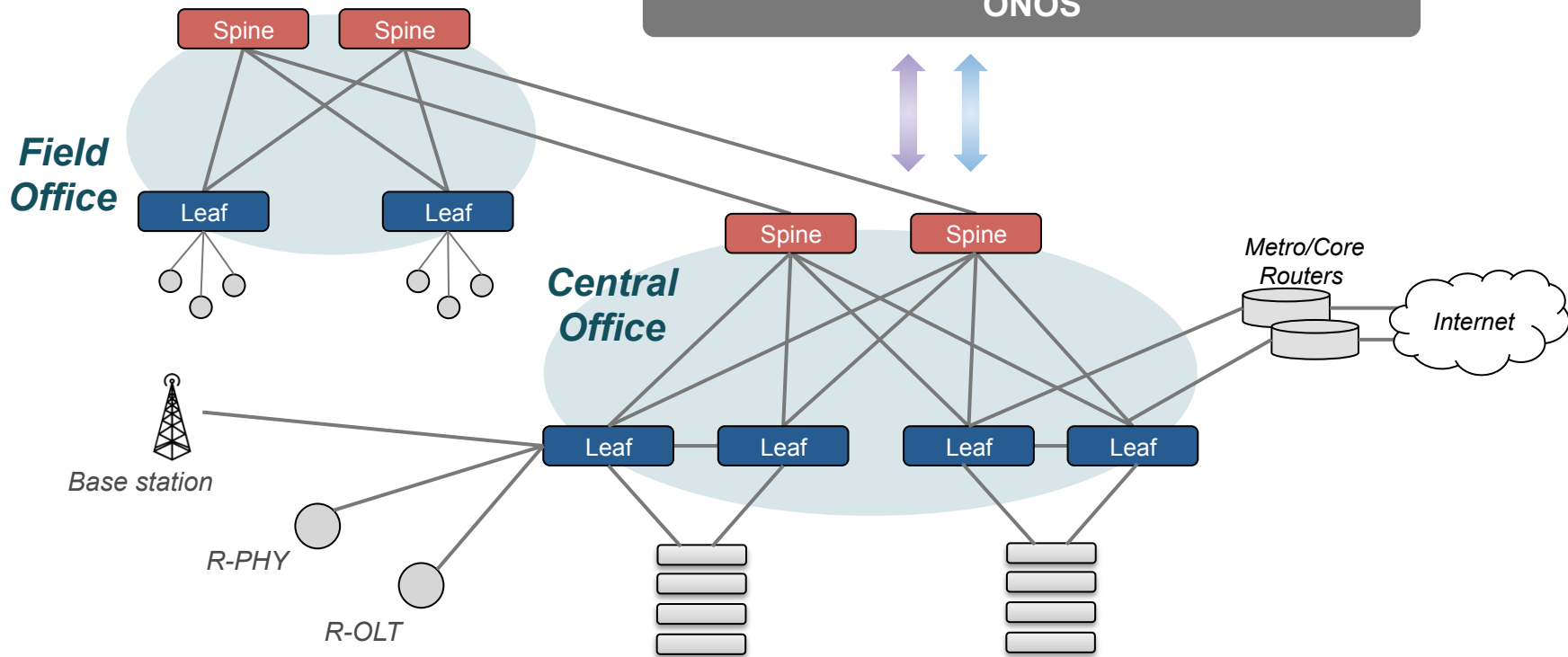
EdgeCore 7712

External BNG

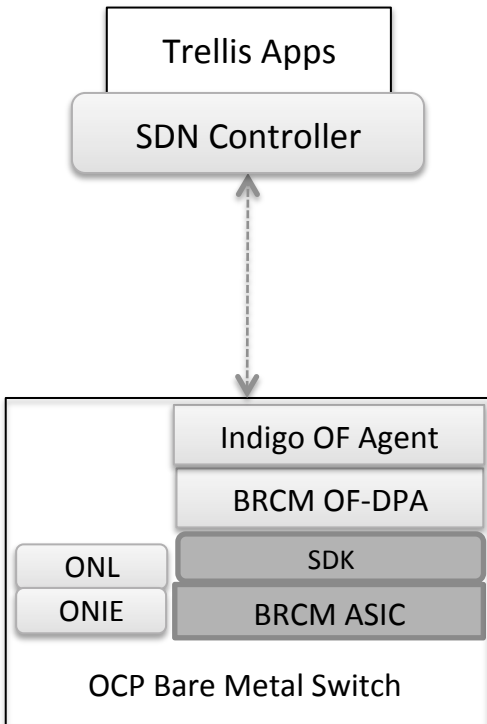
QuantaGrid D51B-1U

# Trellis

## Open-Source Leaf-Spine Fabric



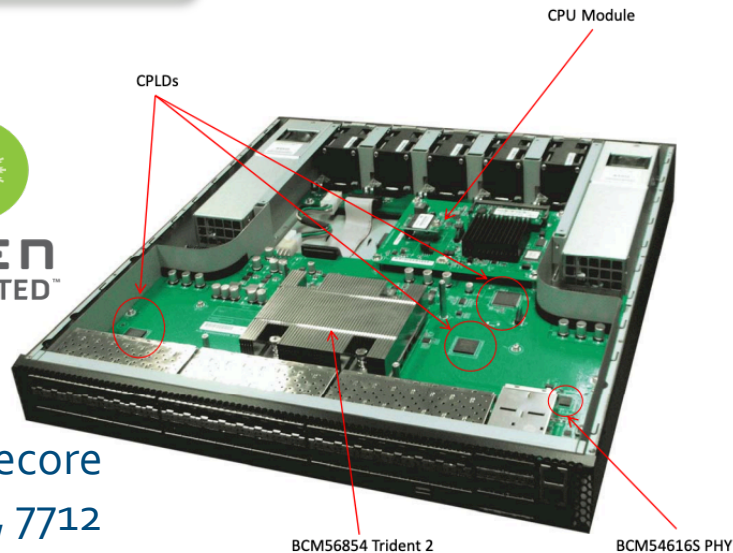
# Whitebox ToR Switching



**White-Box =  
Open-Hardware Specs (OCP)  
+ Open-Source Software (ONF & OCP)**

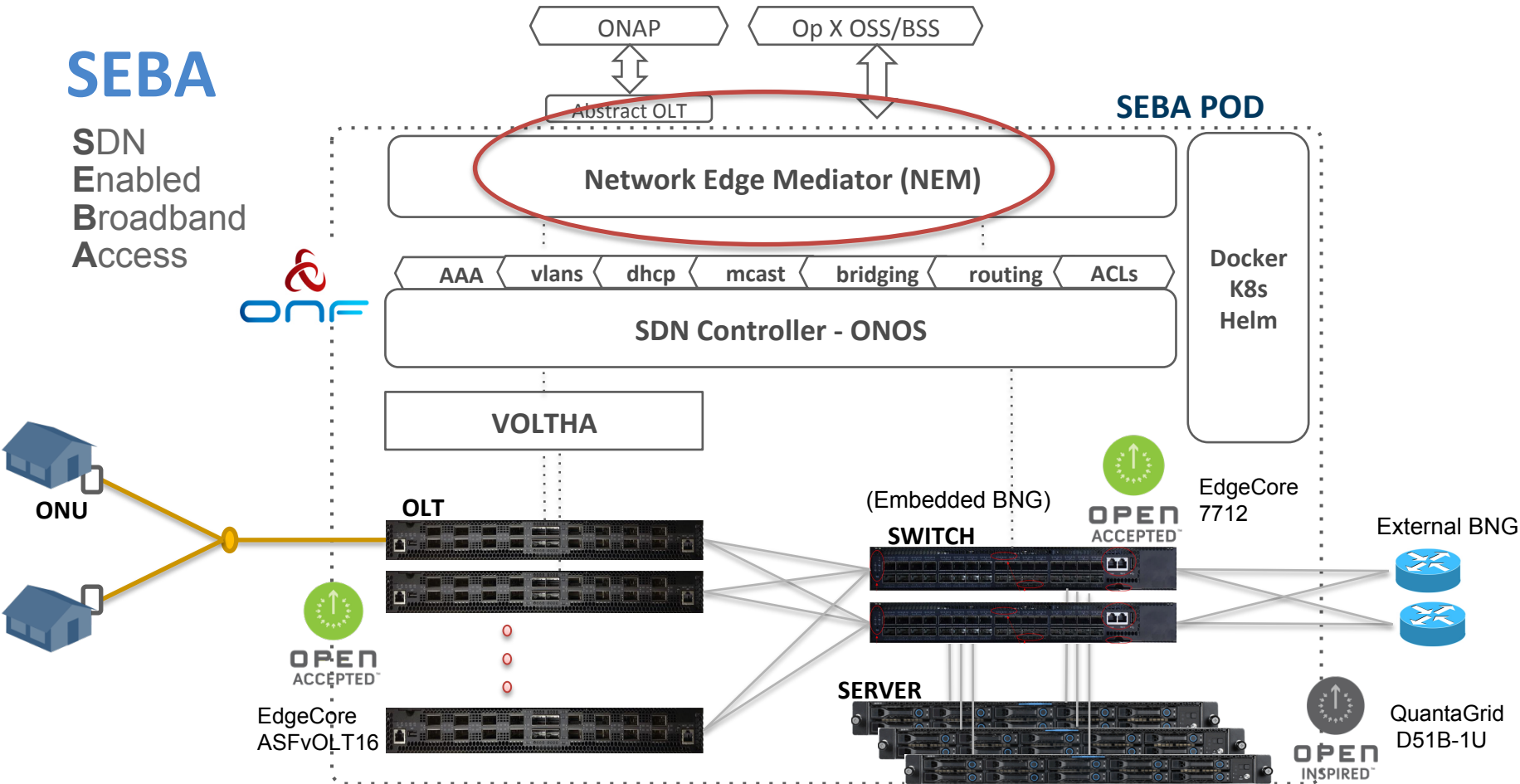


Edgecore  
5712, 6712, 7712



# SEBA

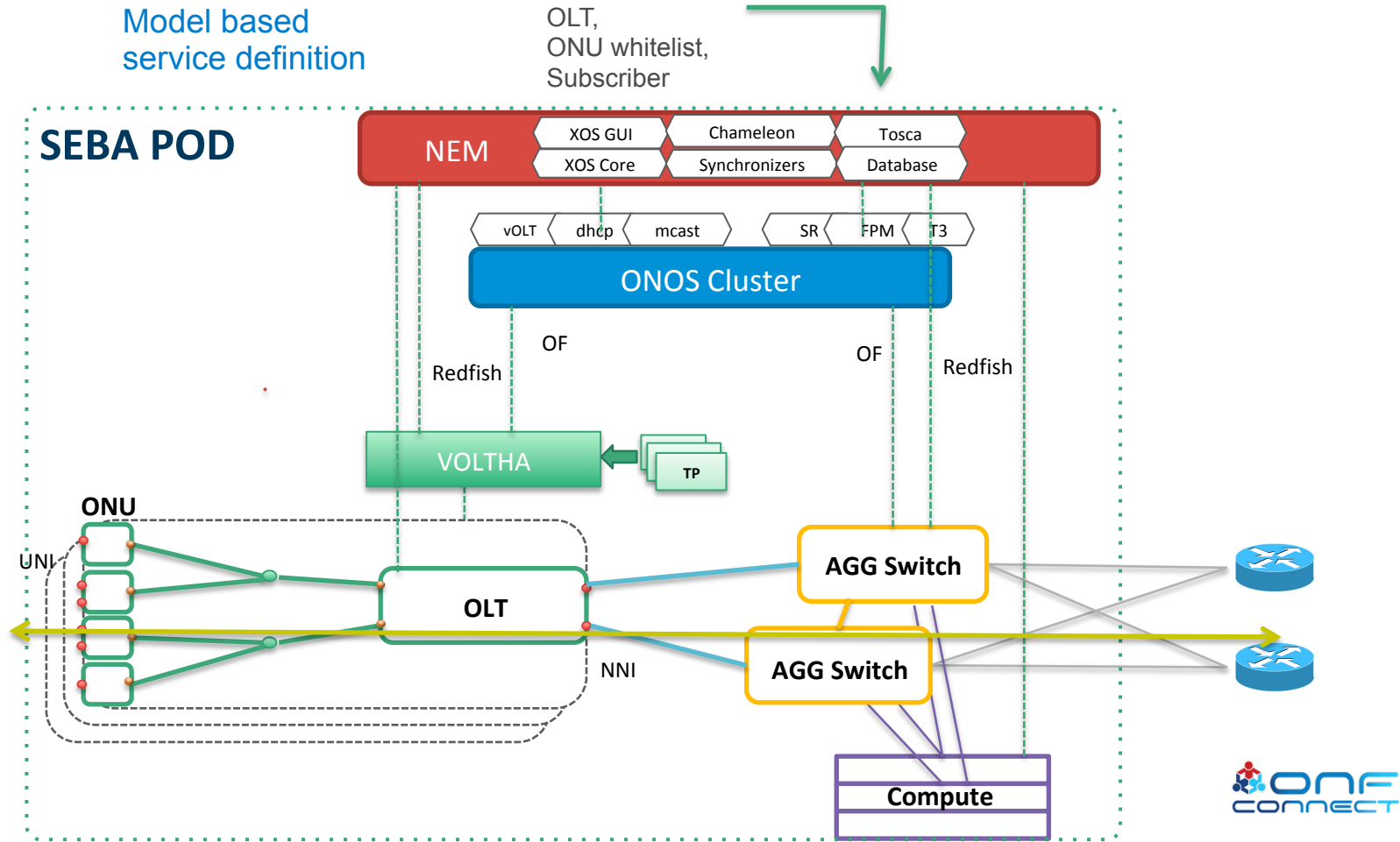
SDN  
Enabled  
Broadband  
Access



# NEM Orchestration & NBI

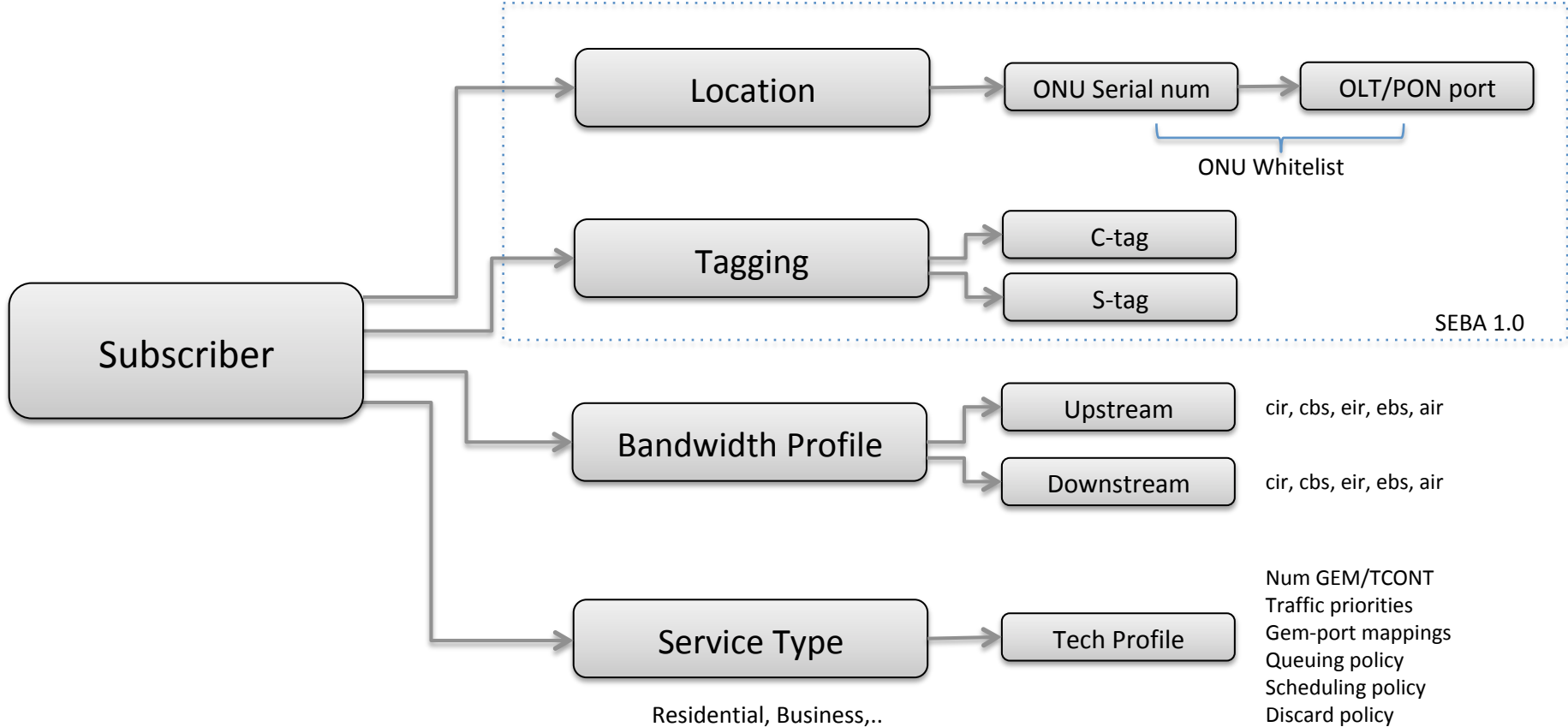
Model based  
service definition

OLT,  
ONU whitelist,  
Subscriber





# Subscriber Model



# NEM Orchestration & SEBA Workflows

Different operators

=

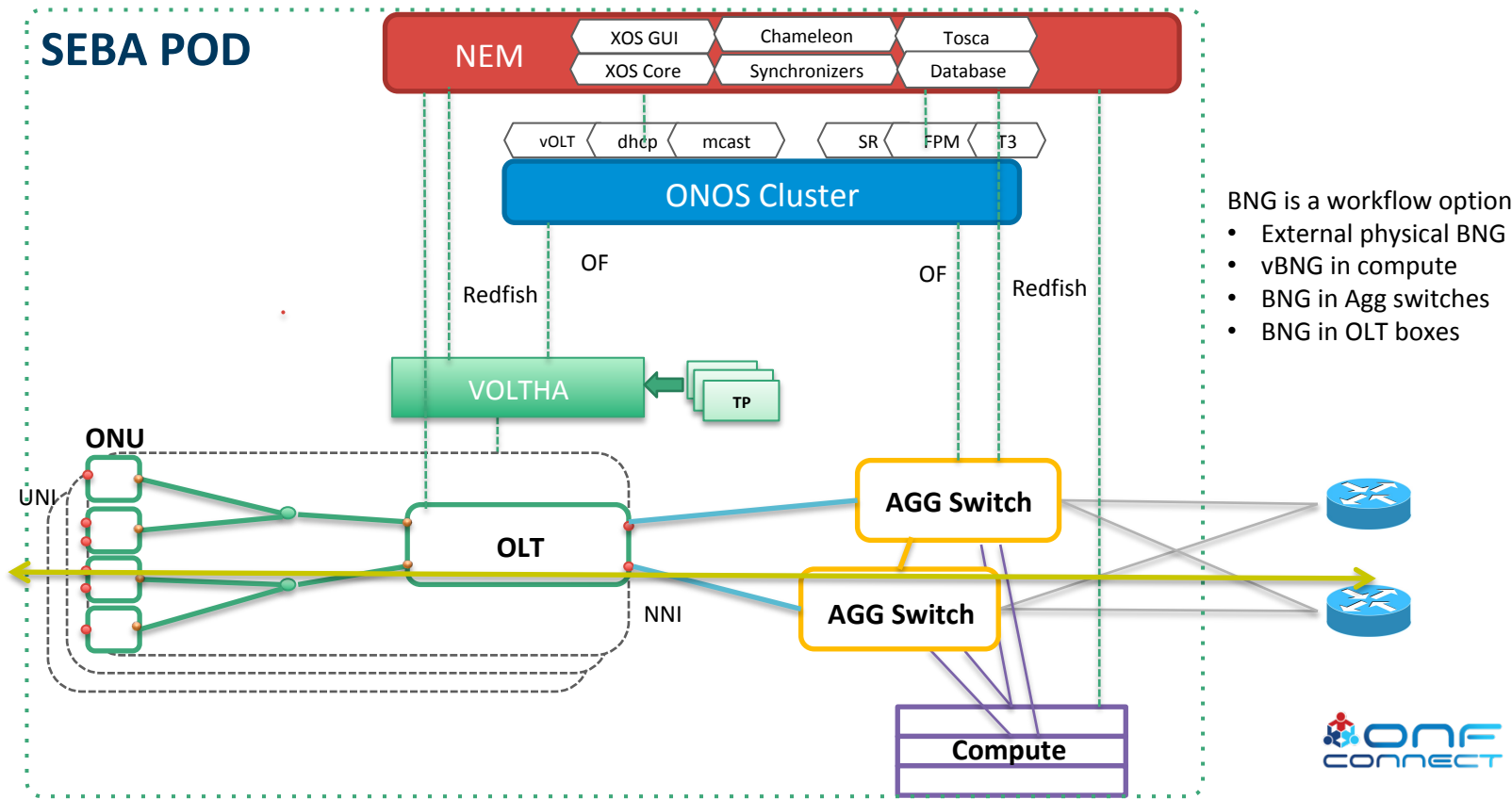
Different workflows

Authentication is a workflow option

- 802.1x based
- PPPOE based
- DHCP based


Subscriber services are workflow options

- HSIA
- Voice
- IPTV
- Business services
- Technology profiles
- Speed profiles



# NEM Dashboards: XOS GUI

runtime service instantiation, inventory, workflow status

v.6.1.0-devel

Core  
Slices  
Nodes  
Instances  
Att workflow driver  
AttWorkflowDriver Service Instances  
AttWorkflowDriver Services  
ONU Whitelists  
Fabric crossconnect  
Fabric  
Volt  
Onos  
Rcord

Logout

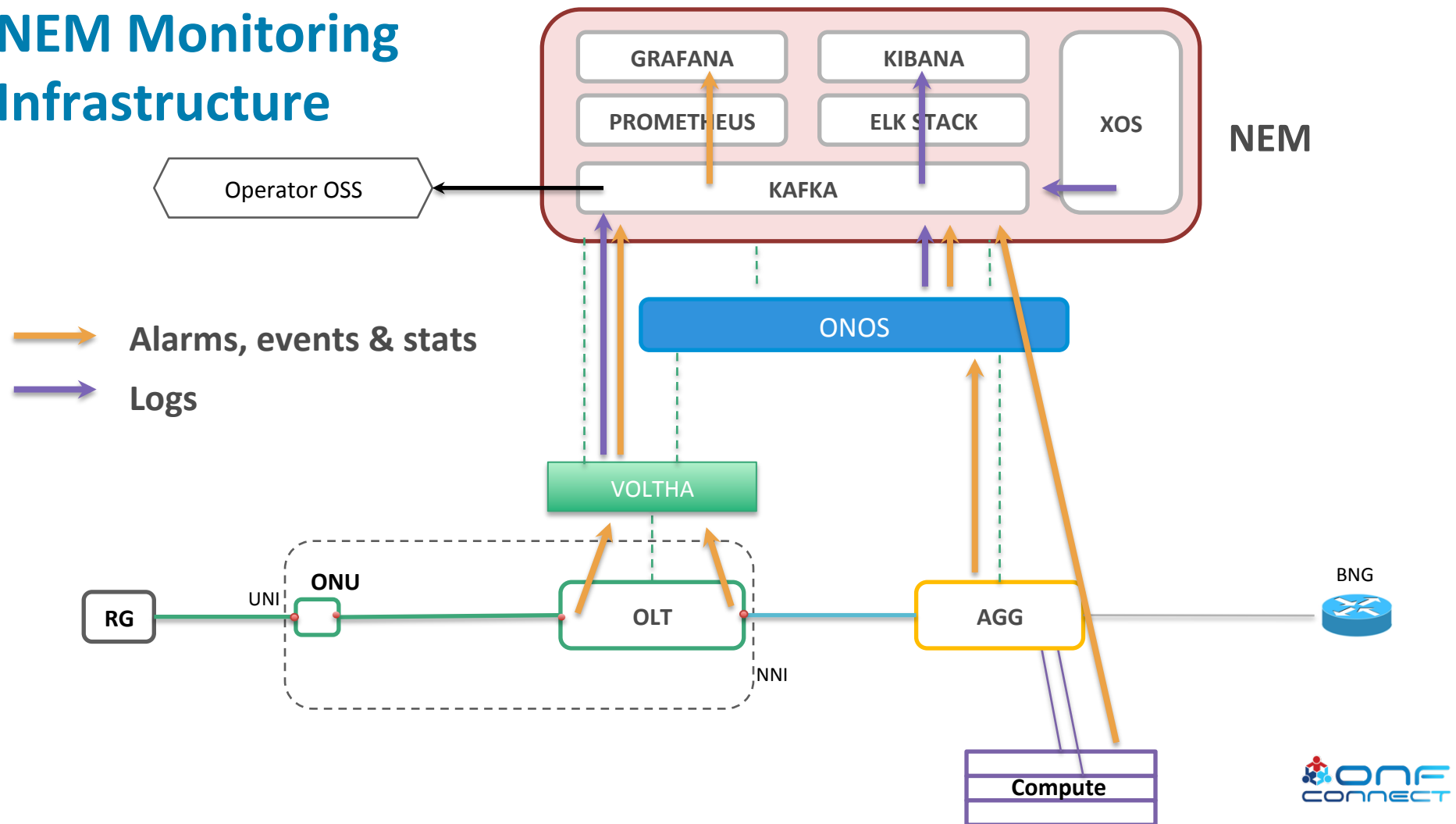
Service Status

## AttWorkflowDriver Service Instances

Add

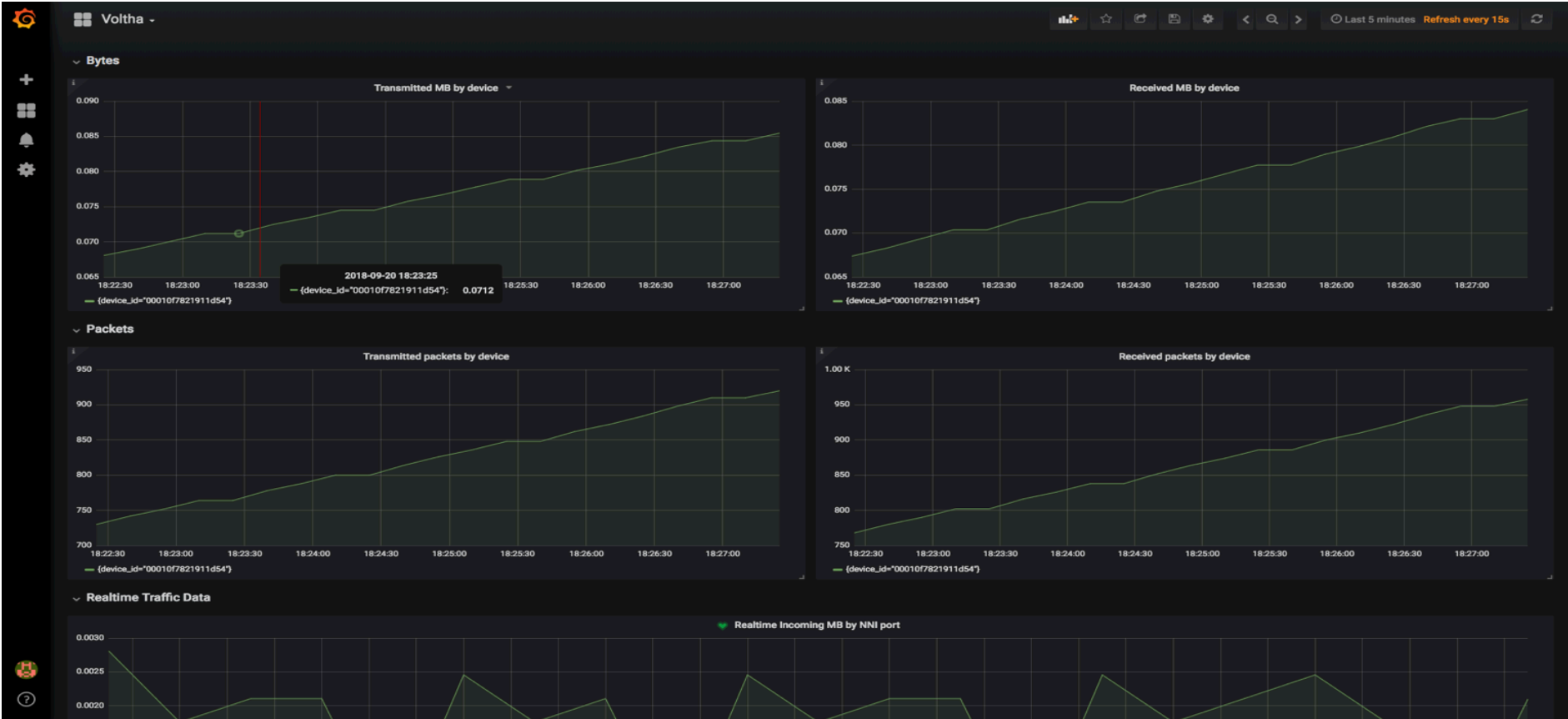
Actions:	Authentication state	Backend status	Dhcp state	Id	Ip address	Mac address	Name	Of dpid	Onu state	Owner id	Policy status	Serial number	Status message	Uni port id
<span>Q</span> <span>✖</span>	AWAITING	⊖	AWAITING	56				of:00000000c0a8646f	ENABLED	att-workflow-driver	✓	ISKT71e81130	ONU has been validated - Awaiting Authentication	32
<span>Q</span> <span>✖</span>	APPROVED	⊖	DHCPACK	57	10.11.1.107	90:E2:BA:8E:70:64		of:00000000c0a8646f	ENABLED	att-workflow-driver	✓	ALPHe3d1cee9	ONU has been validated - Authentication succeeded	16
<span>Q</span> <span>✖</span>	APPROVED	⊖	DHCPACK	58	10.33.1.105	90:E2:BA:8E:70:66		of:00000000c0a86471	ENABLED	att-workflow-driver	✓	CIGG18a00002	ONU has been validated - Authentication succeeded	2064
<span>Q</span> <span>✖</span>	APPROVED	⊖	AWAITING	59				of:00000000c0a86473	ENABLED	att-workflow-driver	✓	ISKT45f2c688	ONU has been validated - Authentication succeeded	16
<span>Q</span> <span>✖</span>	APPROVED	⊖	DHCPACK	60	10.44.1.101	90:E2:BA:8E:70:67		of:00000000c0a86472	ENABLED	att-workflow-driver	✓	ISKT71e81070	ONU has been validated - Authentication succeeded	16
<span>Q</span> <span>✖</span>	APPROVED	⊖	DHCPACK	61	10.22.1.101	90:E2:BA:8E:70:65		of:00000024454a6be4	ENABLED	att-workflow-driver	✓	ADTN17510028	ONU has been validated - Authentication succeeded	10240

# NEM Monitoring Infrastructure



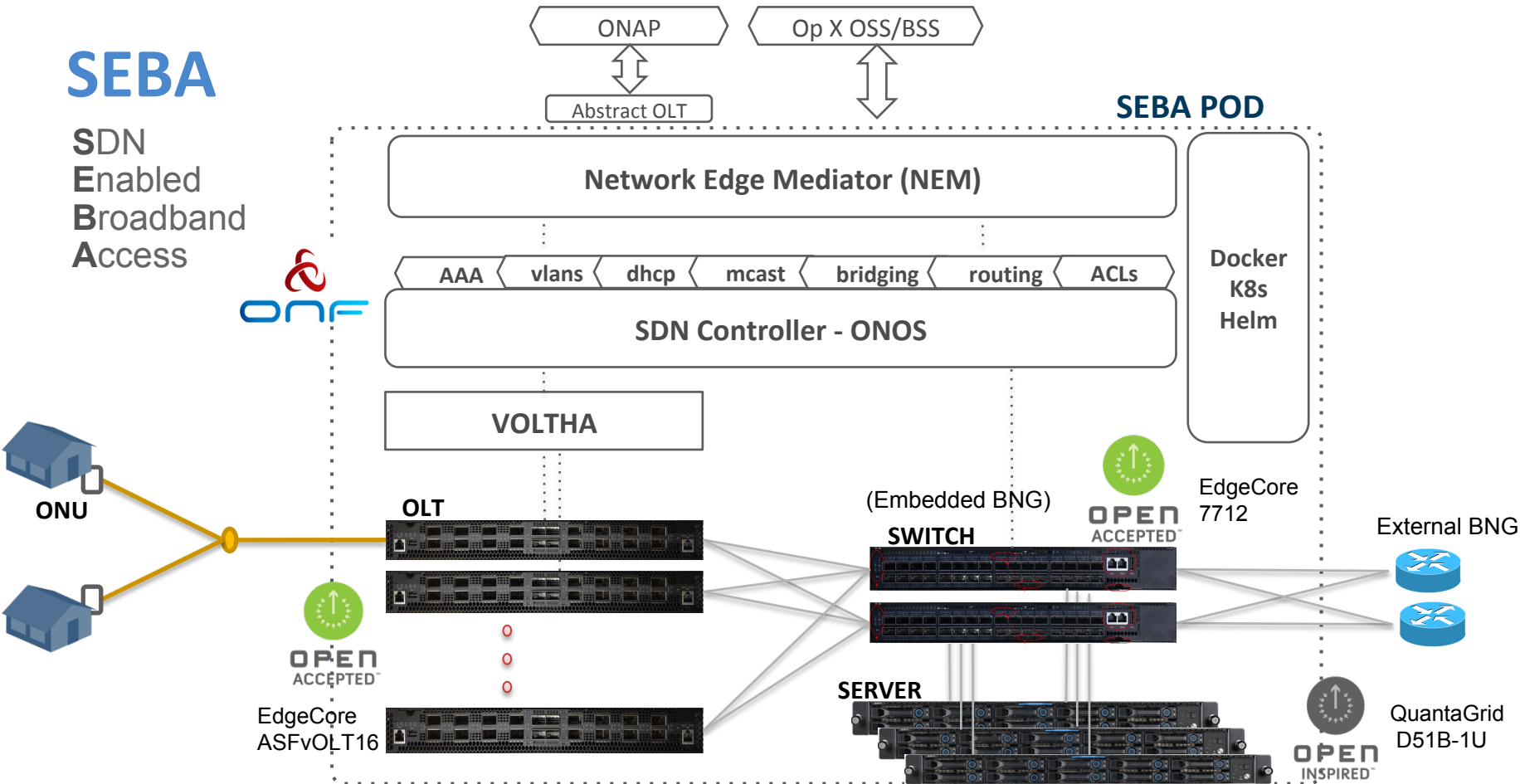
# NEM Dashboards: Kibana, Grafana

stats, events, logs (FCAPS)



# SEBA

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Broadband  
Access



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Op X OSS/BSS

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Network Edge Mediator (NEM)

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dhcp

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ACLs

SDN Controller - ONOS

VOLTHA

Docker  
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Helm

ONU

OLT

(Embedded BNG)

SWITCH

EdgeCore  
7712

External BNG

OPEN  
ACCEPTED™

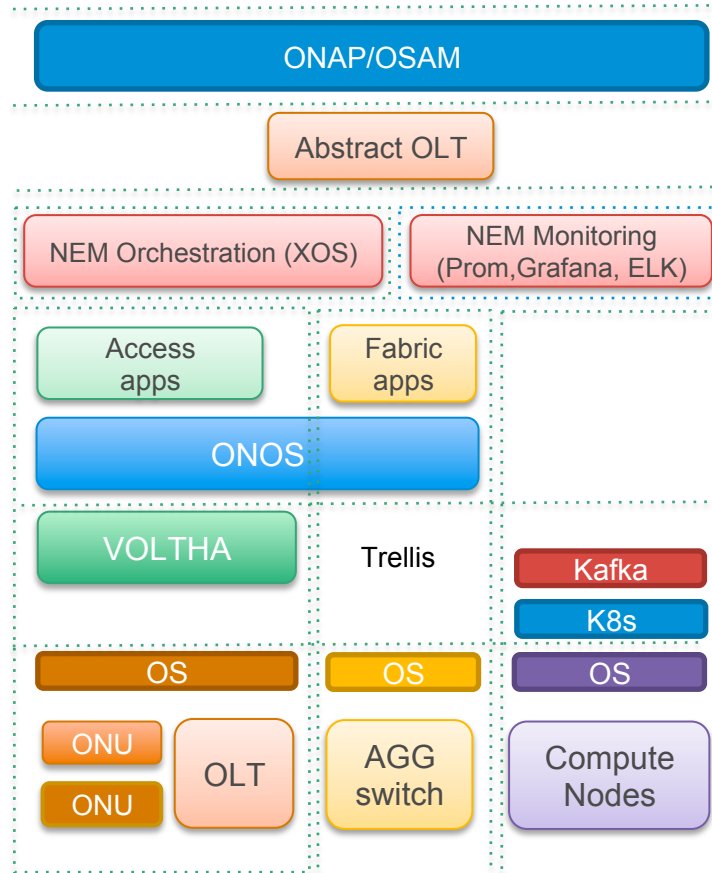
EdgeCore  
ASFvOLT16

SERVER

OPEN  
INSPIRED™

QuantaGrid  
D51B-1U

# SEBA Modularity



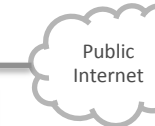
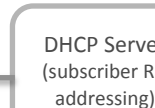
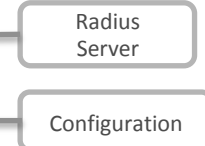
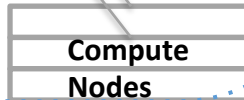
# Demo setup BBWF 2018

Network Edge Mediator (NEM)

SEBA Peripheral/PNF/Pod



ONU

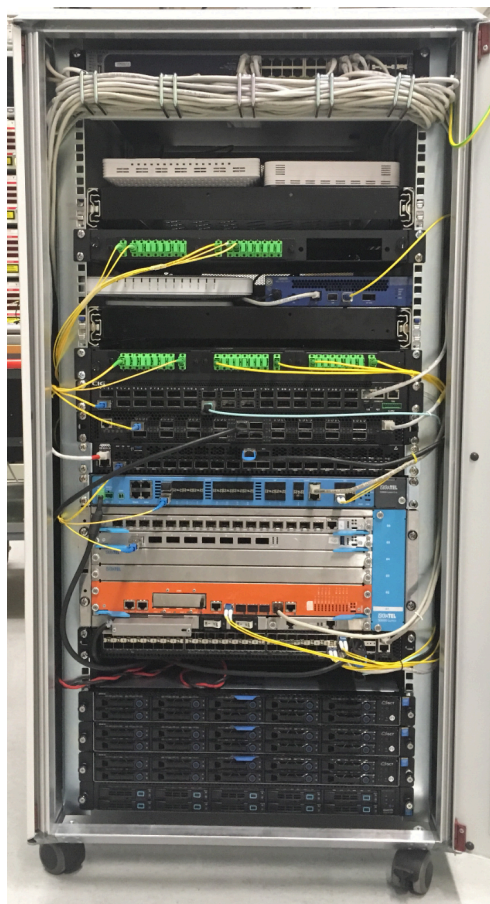


Software Stack

Hardware



# Demo setup BBWF 2018



**ONUs:** Arcadyan,  
Alpha, Adtran, CIG,  
Iskratel

**OLTs:** Adtran, CIG,  
EdgeCore & Iskratel

**AGG switch:** EdgeCore

**Servers:** VOLTHA, ONOS, XOS,  
K8s, ELK, Docker, Prometheus,  
Grafana, Kibana



# SEBA Community

# SEBA (and VOLTHA) Community



**NETSIA**



**JABIL**



**ISKRATEL**

























**CIG**

**flex**



# SEBA/VOLTHA Brigades

Brigade	Technology Profiles	BAL 3.0 upgrade	VOLTHA FCAPS	ONOS FCAPS	Multicast	BBSim	Certification
ONF Mentor	Saurav/ Matteo	Shad	Scott	Saurav	Saurav	Shad	Suchitra
Contributors							
							
							And many others
							

# Technology Profile Brigade(s)

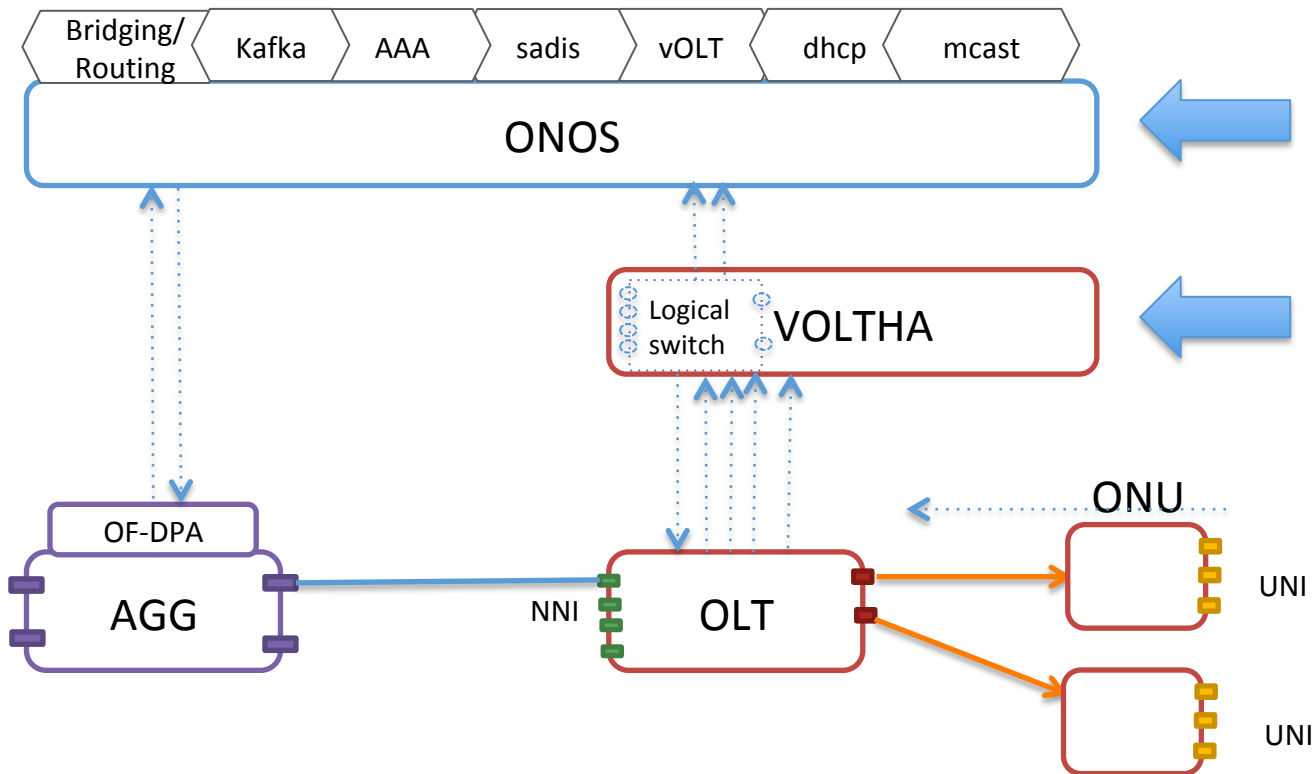
Contributors



NETSIA



JABIL



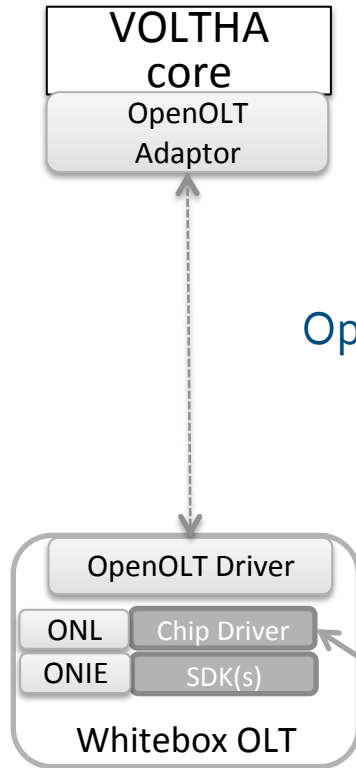
Speed Profile

Per subscriber  
up/down bw profile  
cir/eir/cbs/ebs

Tech Profile

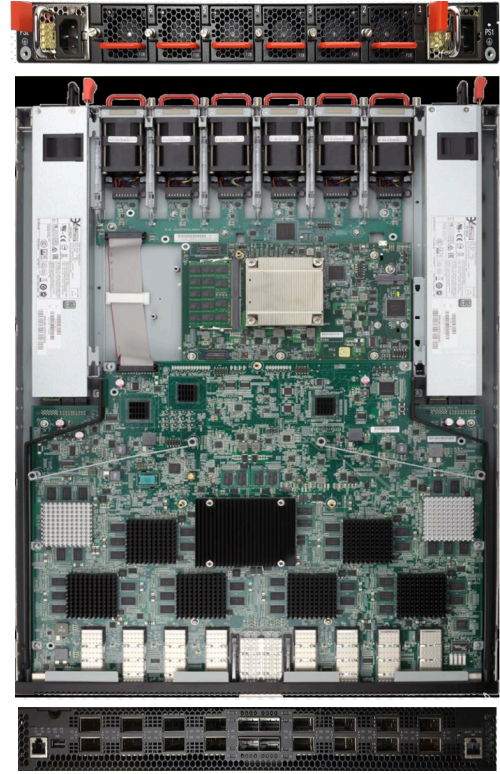
Access Tech type  
# Gems/TCONTS  
Sched policy  
Pbit mapping  
Discard policy

# BAL 3.0 Brigade



White-Box =  
Open-Hardware Specs (OCP)  
+ Open-Source Software (ONF & OCP)

Edgecore  
ASFvOLT16  
Whitebox OLT

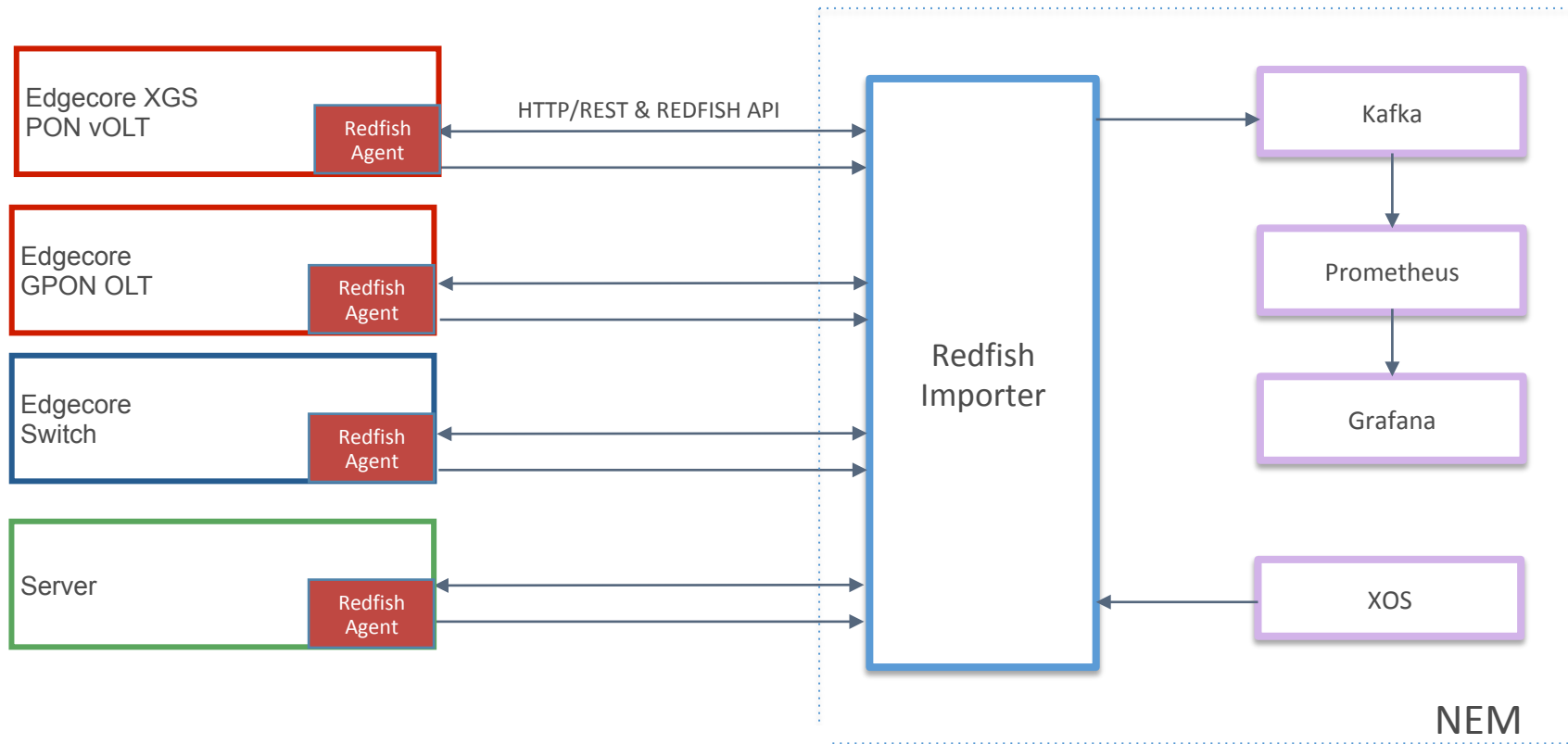


BAL

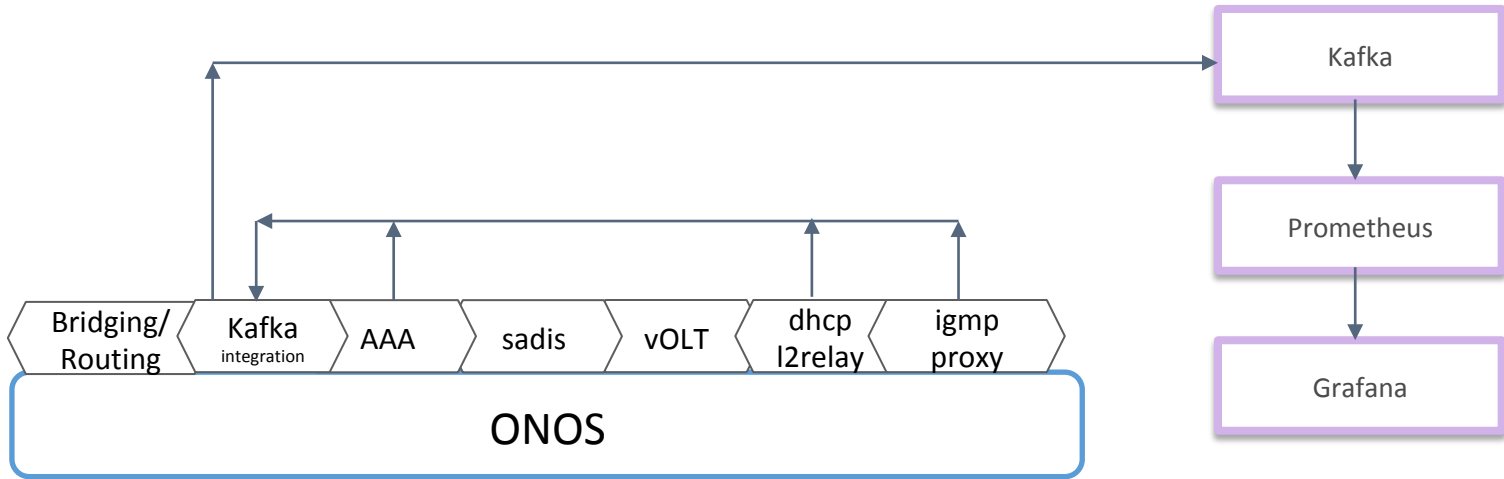
Contributors



# SEBA Pod Management & VOLTHA FCAPS Brigade



# ONOS FCAPS Brigade

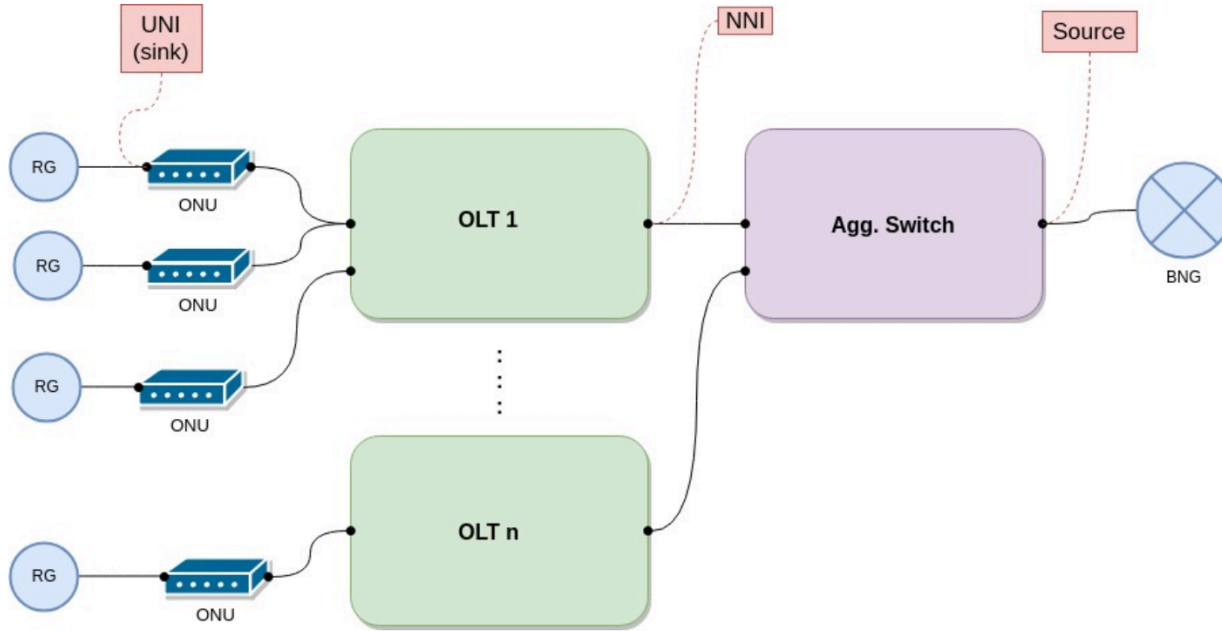


Contributors





# Multicast Brigade

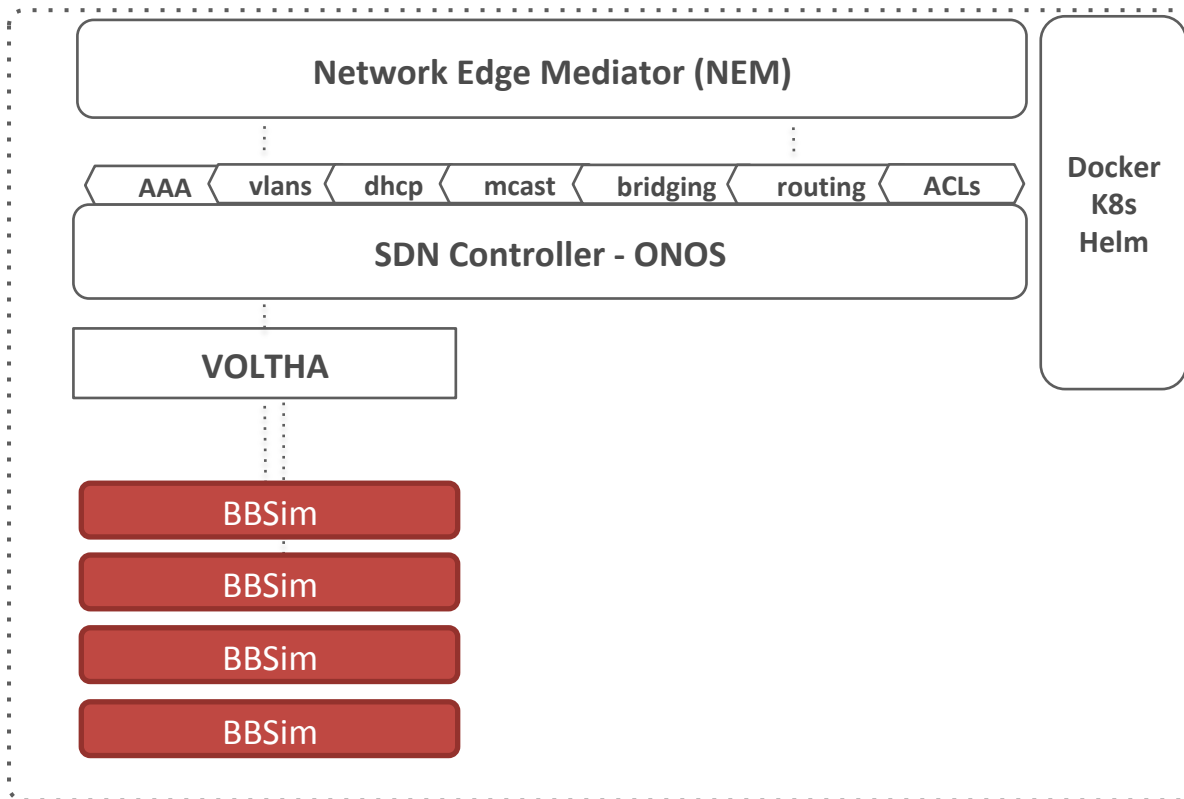


Contributors



# BBSim Brigade

## SEBA POD



Contributors



NETSIA



# Related Work

VOLTHA 2.0  
Core



Adaptor  
Containerization  
For VOLTHA 2.0



Service Upgrades



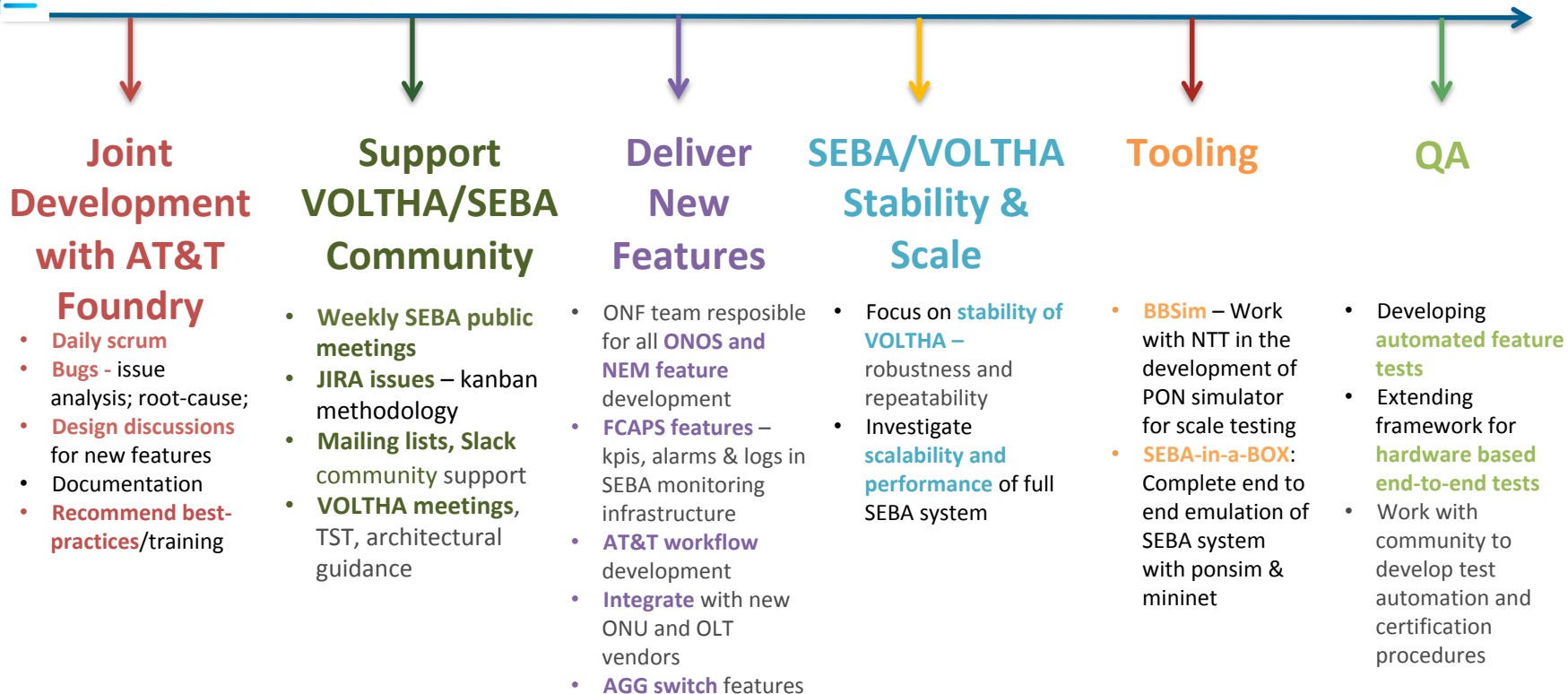
Micro-OLTs



Certification  
Brigade



# SEBA Distributed DevOps – ONF Responsibilities





# SEBA Roadmap

# Roadmap

## SEBA 2.0 (July 3<sup>rd</sup> 2019)

- Technology & Speed Profile
- AT&T workflow, HSIA service
- VOLTHA 1.7, BAL 2.6

## SEBA 2.1 (Sept 30<sup>th</sup> 2019)

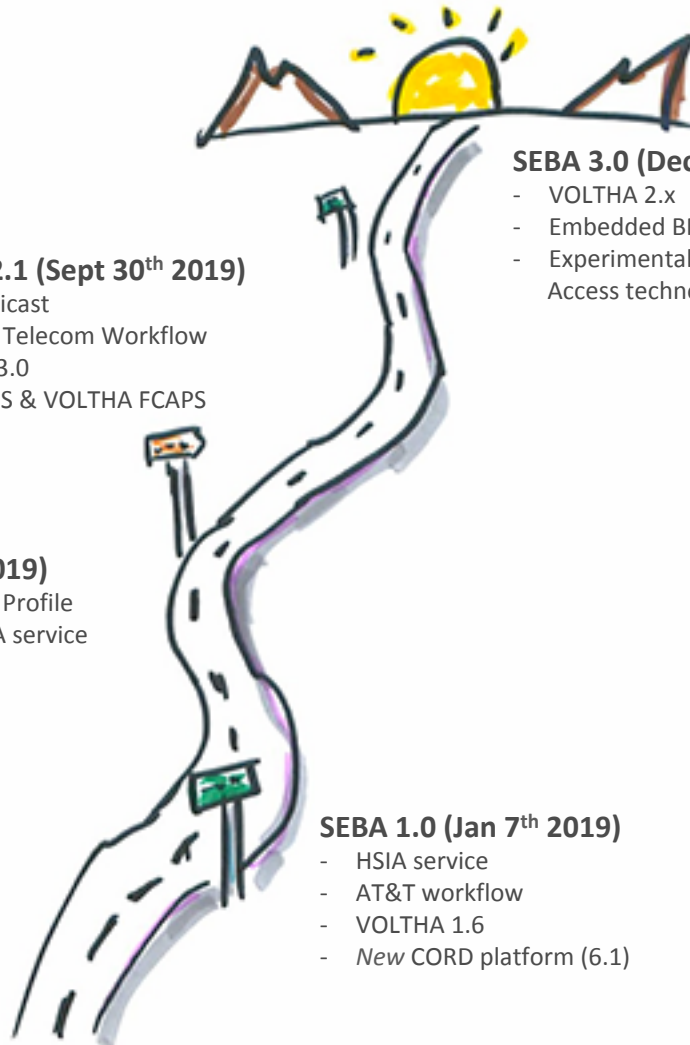
- Multicast
- Turk Telecom Workflow
- BAL 3.0
- ONOS & VOLTHA FCAPS

## SEBA 1.0 (Jan 7<sup>th</sup> 2019)

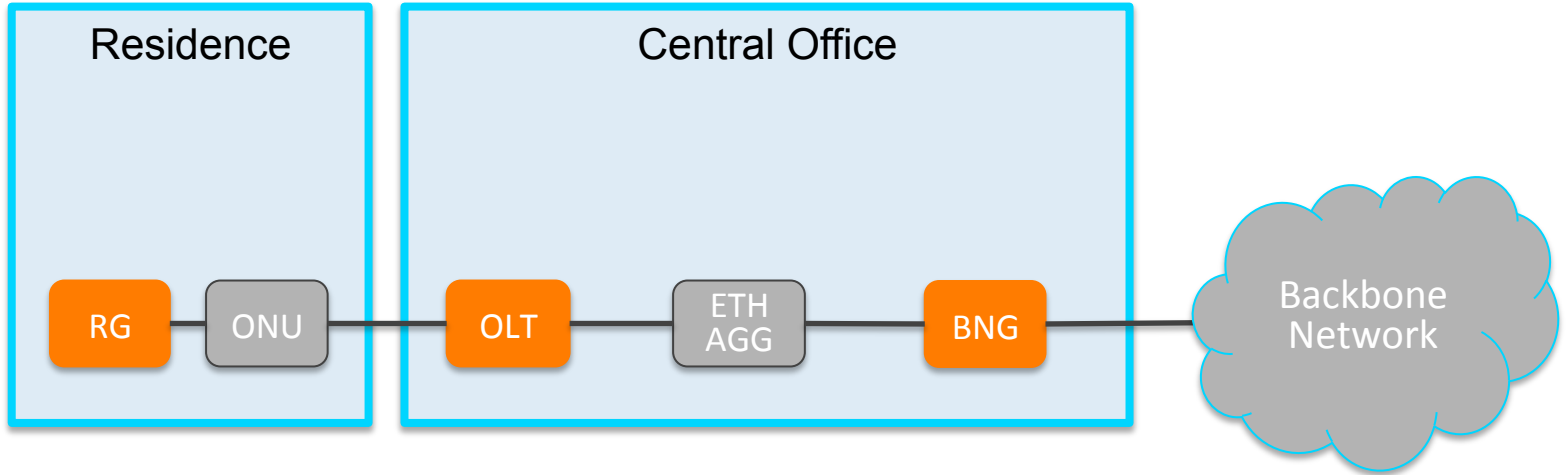
- HSIA service
- AT&T workflow
- VOLTHA 1.6
- New CORD platform (6.1)

## SEBA 3.0 (Dec 20<sup>th</sup> 2019)

- VOLTHA 2.x
- Embedded BNG
- Experimental support for other Access technologies



# Traditional Residential Access

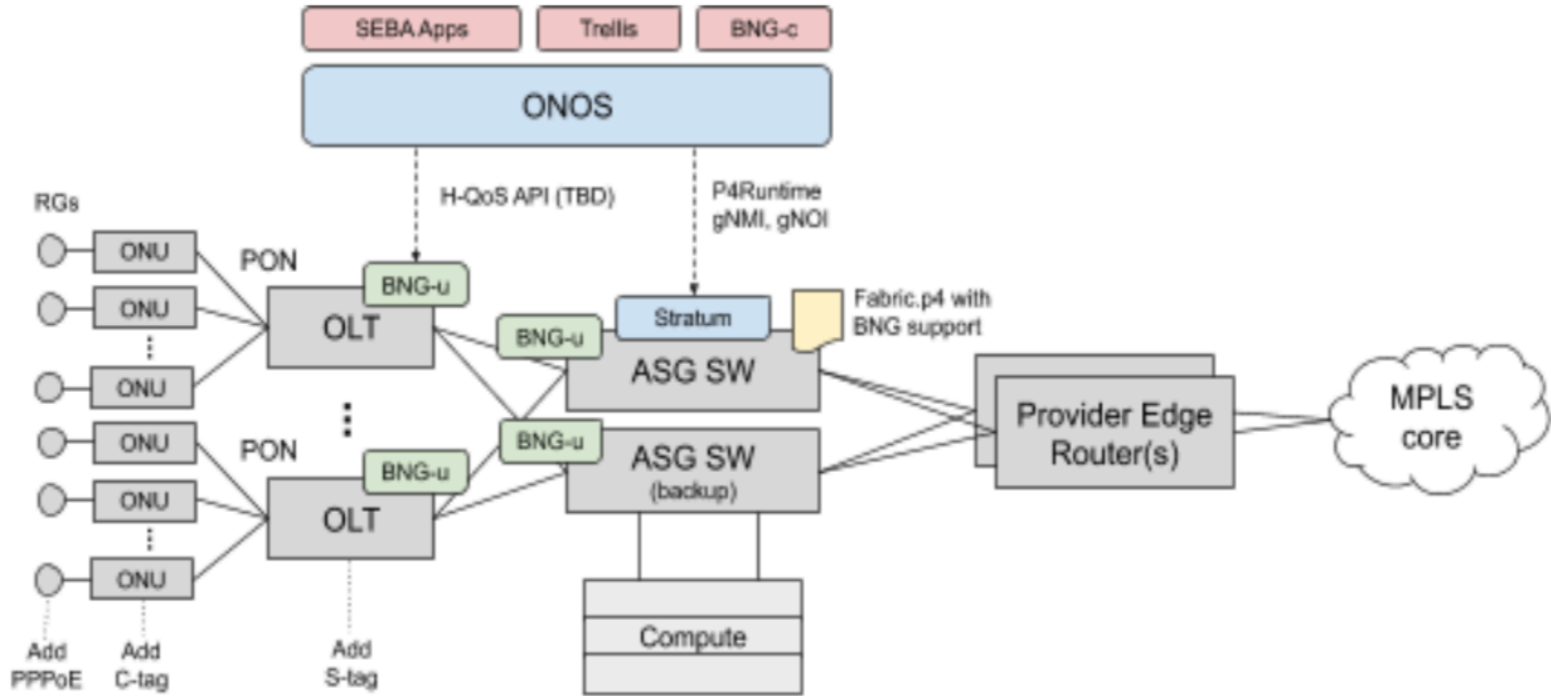


RG – Residential Gateway

OLT – Optical Line Termination

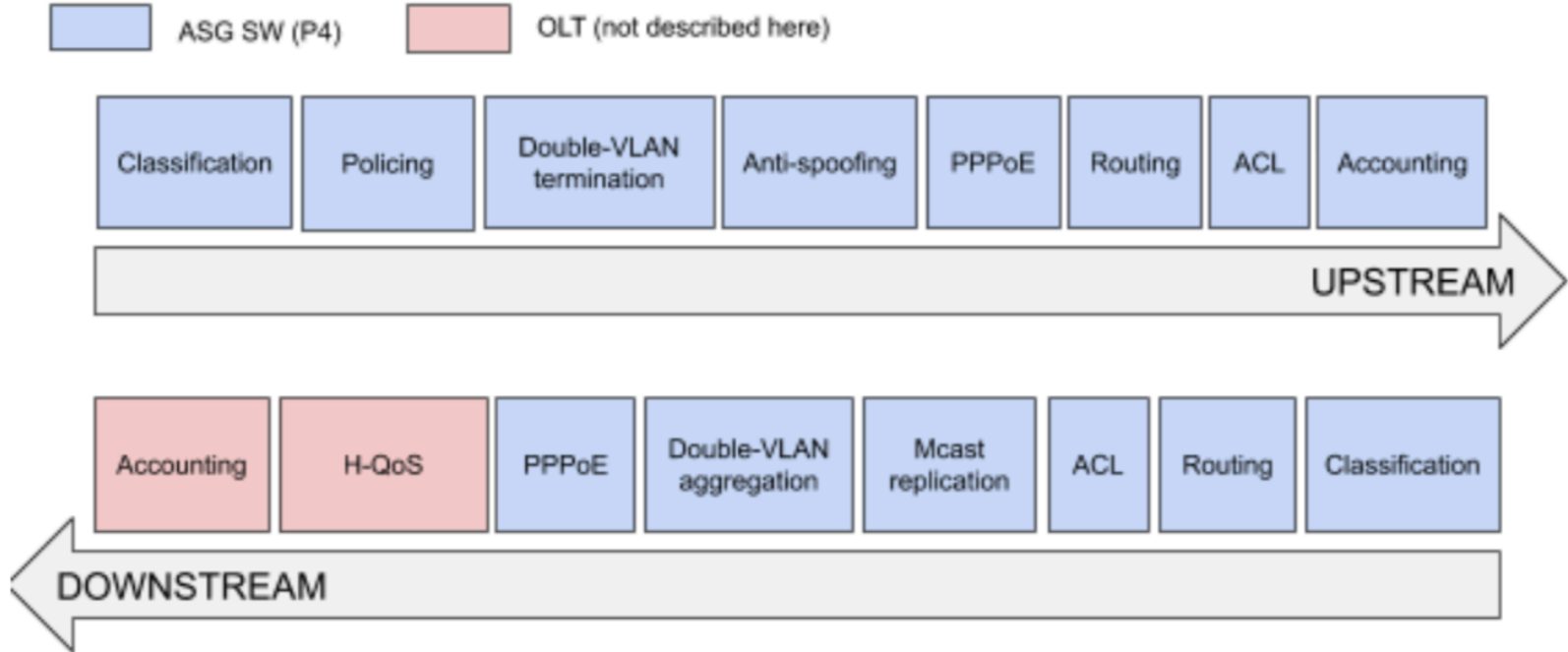
BNG – Broadband Network Gateway

# Disaggregating the BNG





# Fabric-BNG.p4



# CORD – Central Office Rearchitected as a Datacenter



Residential  
vOLT, vSG, vRouter, vCDN

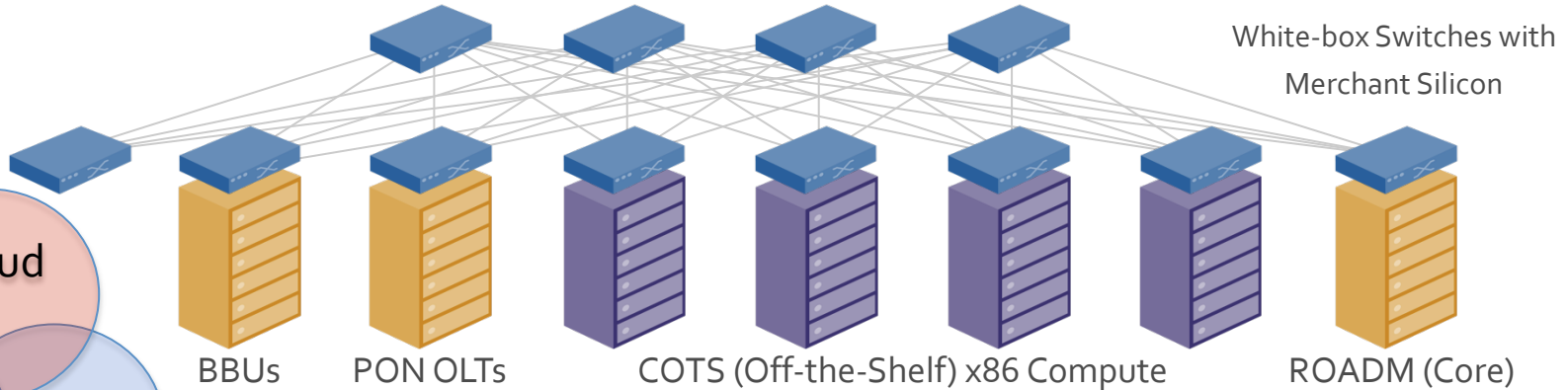


Mobile  
vBBU, vMME, vSGW, vPGW, vCDN



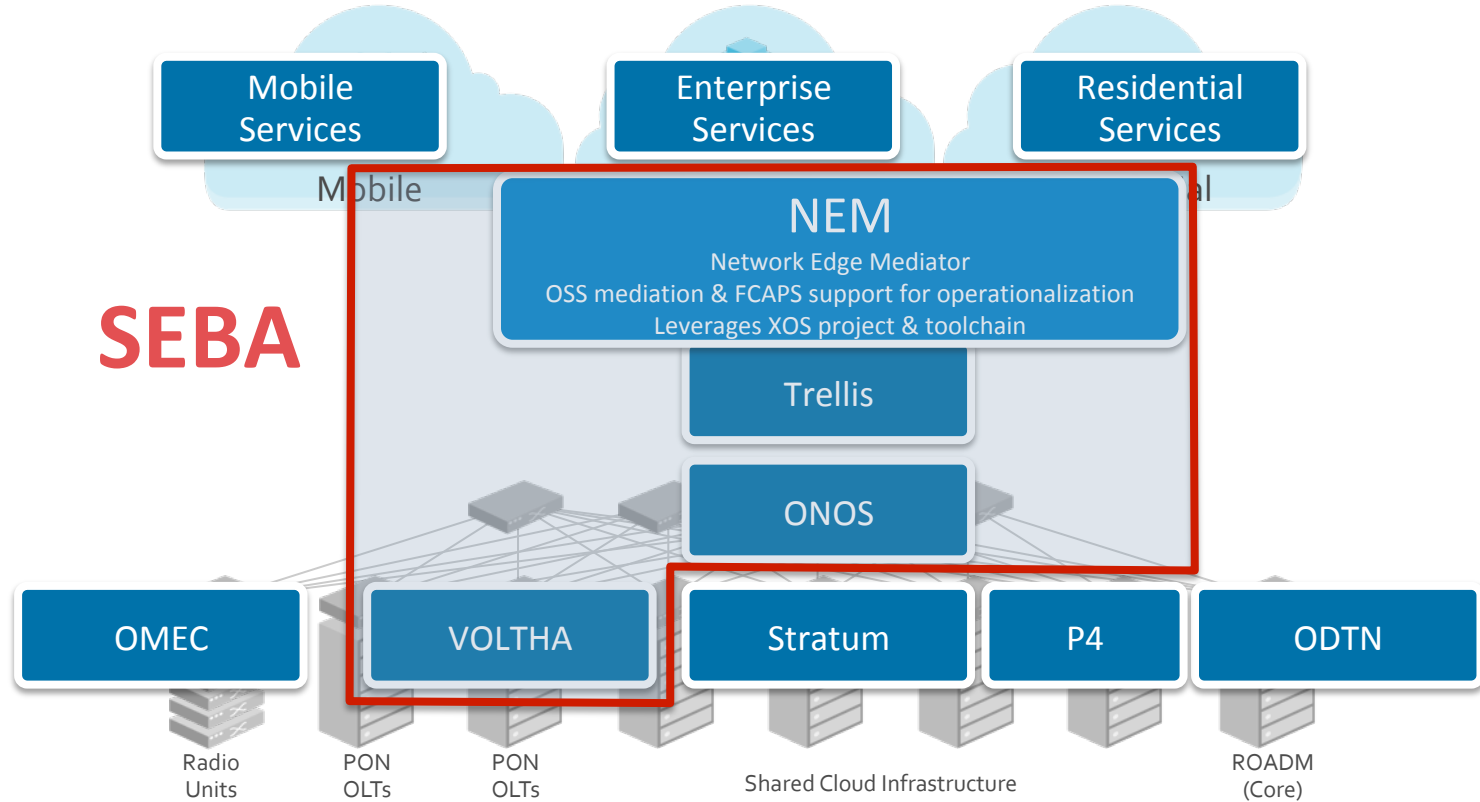
Enterprise  
vCarrierEthernet, vOAM, vWanEx, vIDS

Access Service Orchestration & Control

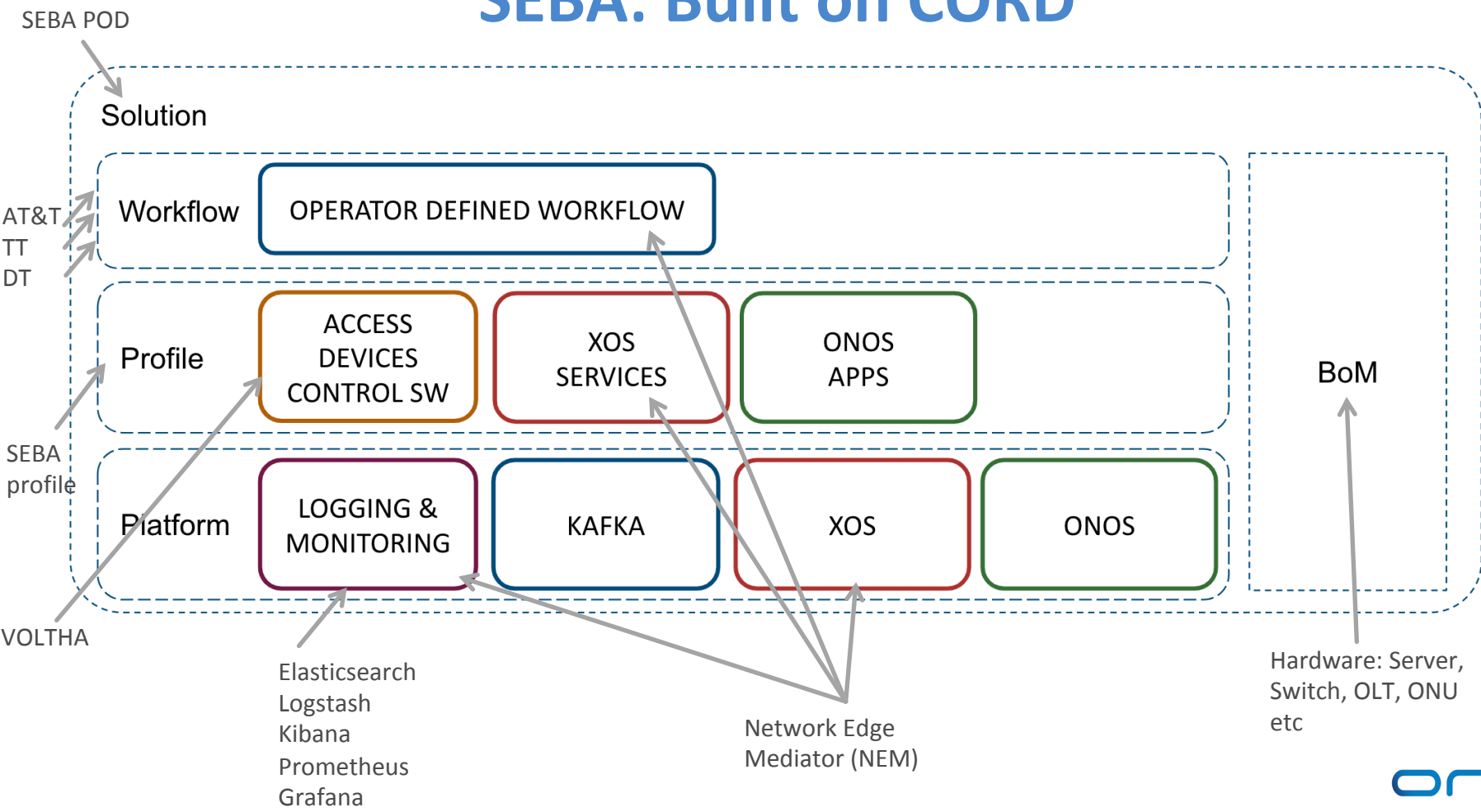


*Economies of a datacenter, Agility of a cloud provider*

# SEBA: Built on CORD



# SEBA: Built on CORD



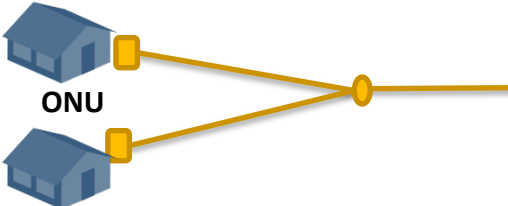
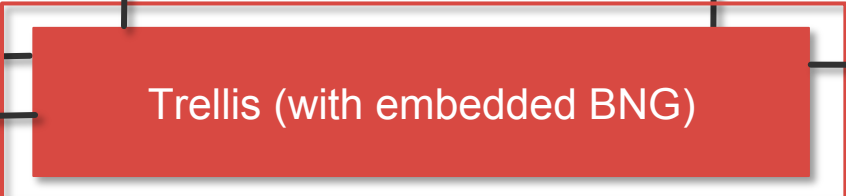
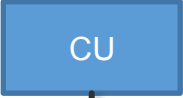
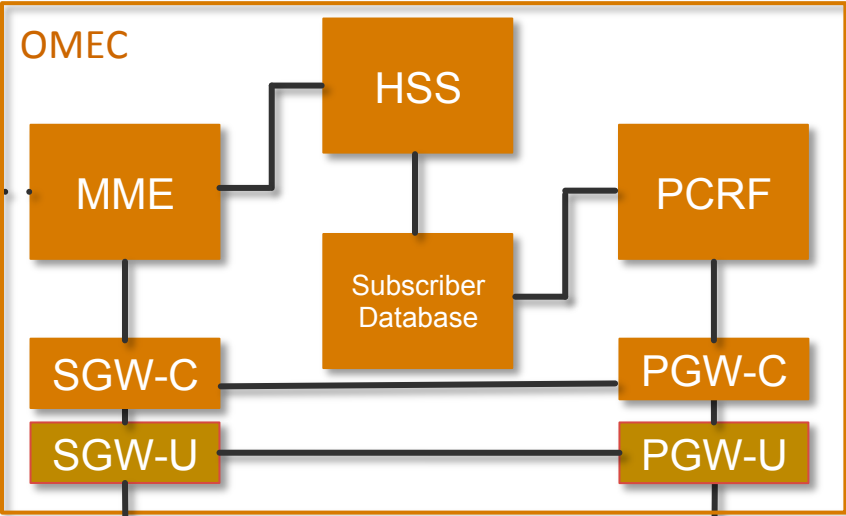
# Multi-Access CORD

Demo @ MWC  
Barcelona  
2019

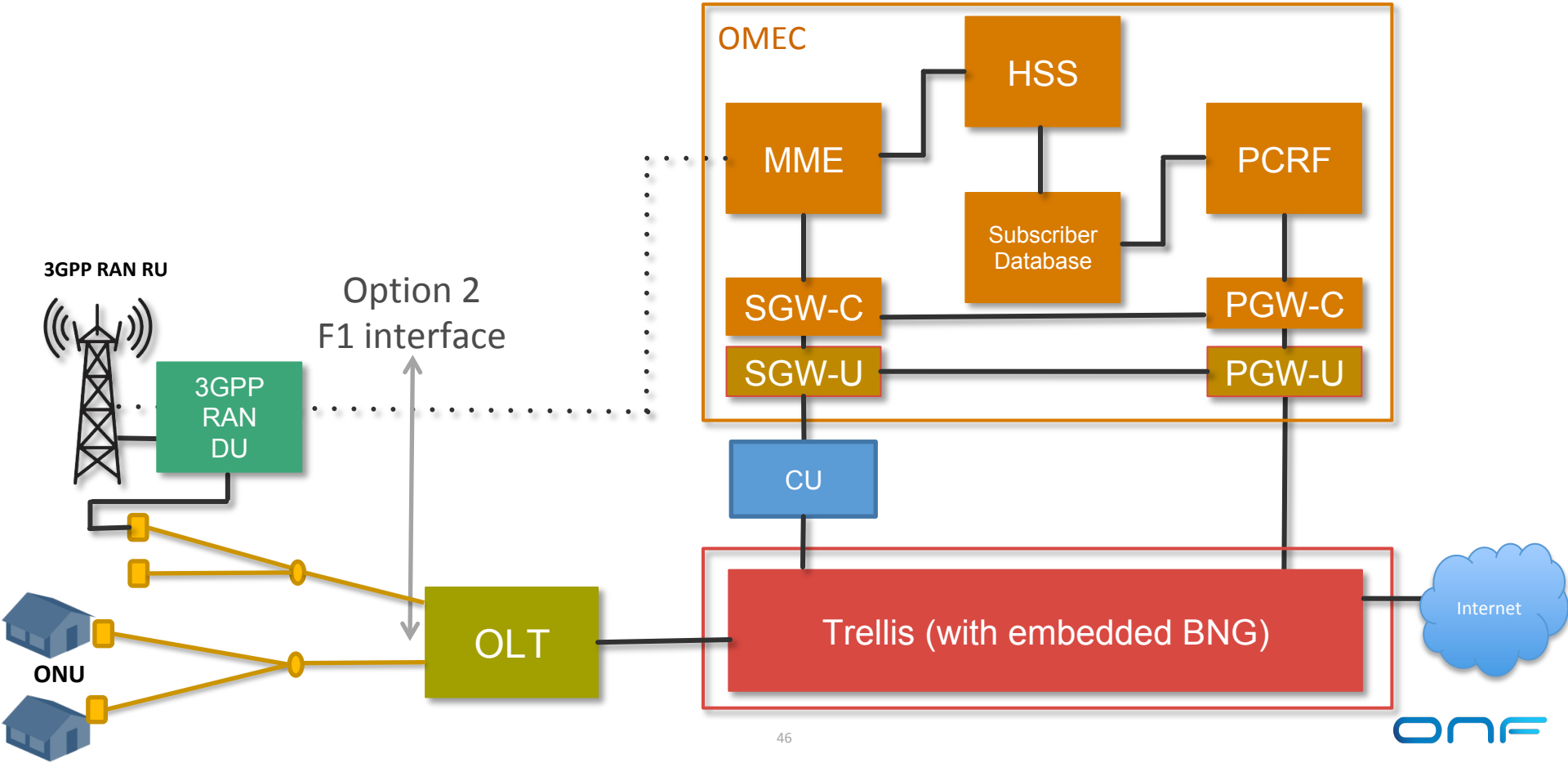
3GPP RAN RU



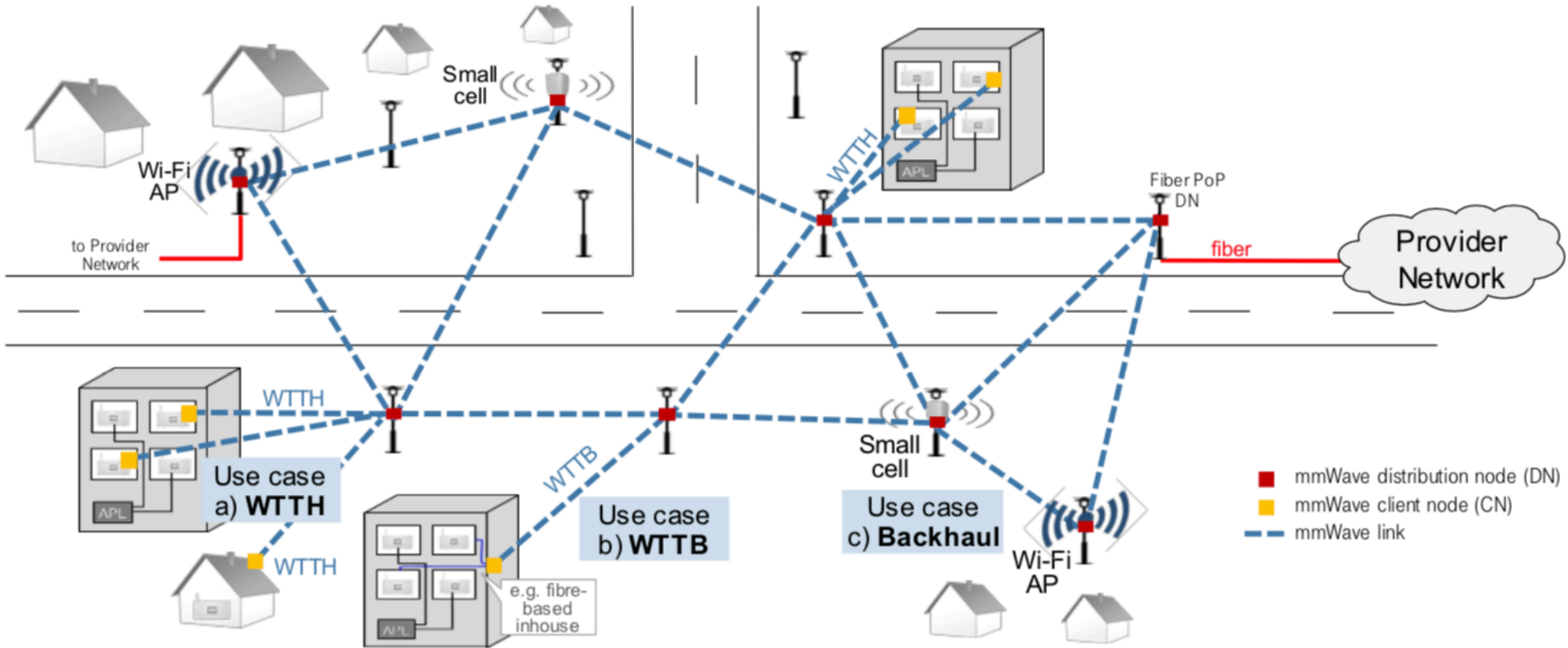
Option 2  
F1 interface



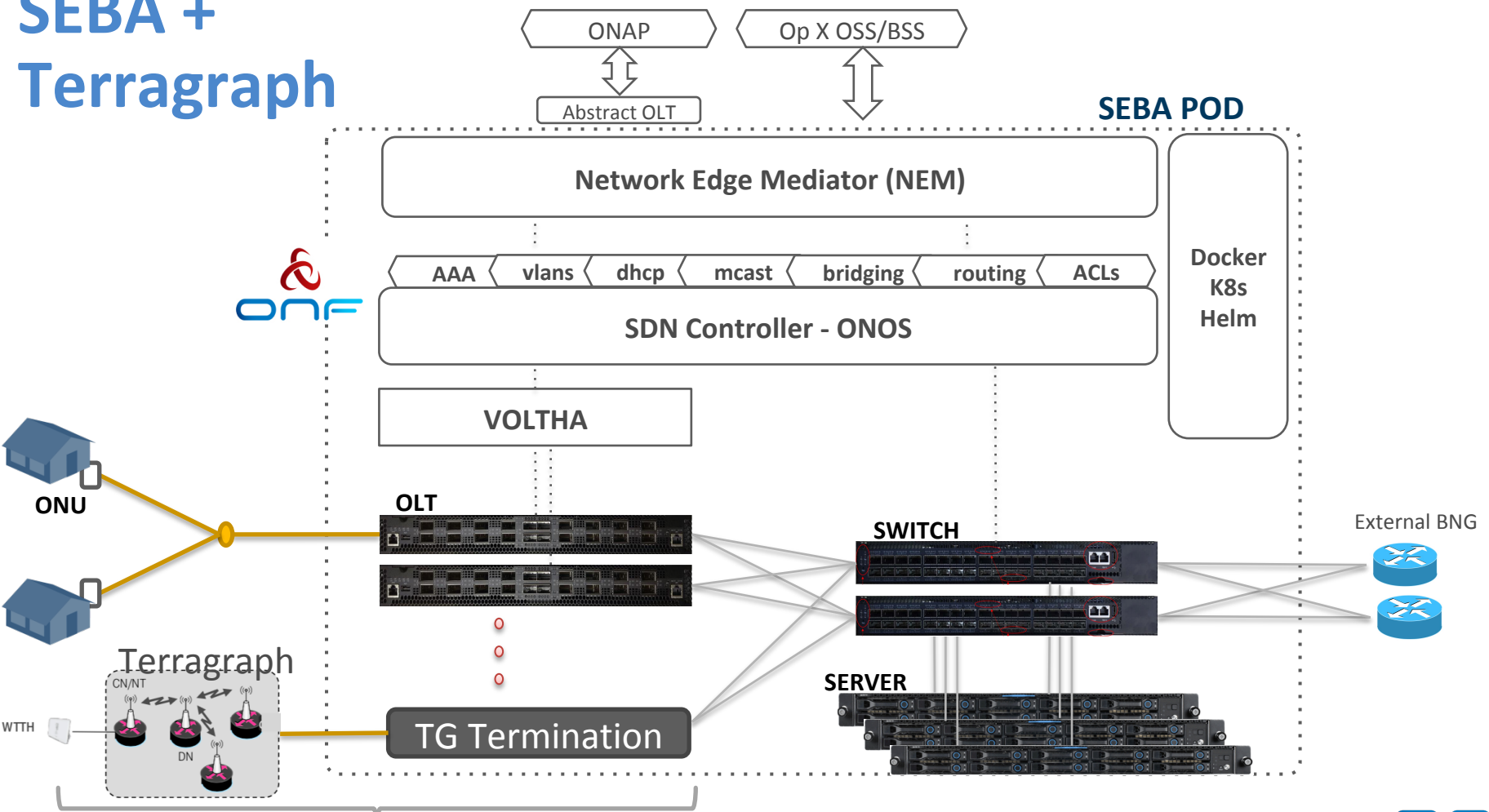
# Fronthaul F1 over PON



# mmWave Backhaul



# SEBA + Terragraph





# Summary

- **ONF: Operator driven curated open source**
  - *CORD is the flagship umbrella project*
  - *SEBA – SDN Enabled Broadband Access, built on the CORD platform*
- **Community**
  - *VOLTHA and SEBA have healthy active communities*
  - *Brigades: a way to effectively manage community resources*
  - *Many brigades in progress, more to come – get involved ([CORD Calendar](#))*
- **Roadmap**
  - *2<sup>nd</sup> release of SEBA July 2019 – Tech & Speed profiles a big step forward*
  - *Big focus areas 2<sup>nd</sup> half 2019 – Embedded BNG & VOLTHA 2.x integration*
- **Learn More**
  - *Community: <https://wiki.opencord.org/display/cord/seba>*
  - *Release: <https://guide.opencord.org/cord-7.0/profiles/seba/BoM>*
  - *<https://guide.opencord.org/cord-7.0/prereqs/hardware.html>*