Tutorial Overview (Morning)

● Session 1 (9AM-10:30AM)
  ○ The big picture - an overview of PON networking and SEBA
  ○ Lab: Setting up SEBA-in-a-Box

● Session 2 (11AM-12:30PM)
  ○ Community - who’s involved in SEBA and VOLTHA
  ○ Operating the POD
  ○ Lab: Exploring and operating SEBA-in-a-Box
Tutorial Overview (Afternoon)

- **Session 3 (1:30PM-3PM)**
  - Operator Workflow and FCAPS
  - Lab: Workflow and FCAPS Exploration

- **Session 4 (3:30PM-5PM)**
  - SEBA Development Loop
  - Testing SEBA
  - Next steps for SEBA (4:30PM) - Roadmap & Operator Trials
Overview of SEBA and PON Networking

Session 1: 9am - 10:30am
In this session

- What are all the parts of a PON networking solution?
- What is VOLTHA and how is it abstracting the PON?
- How is the SEBA profile launched on the CORD platform with Kubernetes and Helm charts?
- What is SEBA-in-a-Box and why is it useful?
Traditional FTTH Residential Access

- RG – Residential Gateway
- ONU - Optical Network Unit
- OLT – Optical Line Termination
- BNG – Broadband Network Gateway

- Each device closed, proprietary, and not programmable
- Source of high capex and opex for operators
- Opportunity to bring SDN, disaggregation, and open source as operators deploy next gen broadband with GPON, XGS-PON, G.Fast, …
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: SDN Enabled Broadband Access

Residence
- RG
- ONU

Central Office
- Virtual OLT manages and abstracts PON
- VOLTHA
- OLT MAC
- ETH AGG
- BNG

Backbone Network
OLT Disaggregation → VOLTHA

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

EMS

VLANs, IGMP, 802.1x, Mcast ...

PON MAC blades

Compute blades

Backplane

SDNize

VOLTHA: Virtual OLT Hardware Abstraction

ONOS: SDN Controller

VLANs, AAA, Mcast, ...

OpenFlow Agent, NetConf

OLT API, OMCI Stack

VOLTHA: Virtual OLT Hardware Abstraction
VOLTHA architecture 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

- Bridging/Routing
- VLANs
- dhcp
- mcast

ONOS

Switch

OLT

VOLTHA

Logical switch

ONU

UNI

UNI

NNI
Industry’s First White-Box XGS-PON OLT

White-Box = Open-Hardware Specs (OCP) + Open-Source Software (ONF & OCP)
Why OpenOLT Adaptor?

Generic OLT adaptor - ease of onboarding for new vendors (including whitebox vendors)
SEBA: SDN Enabled Broadband Access

Residence

- RG
- ONU

Virtual OLT manages and abstracts PON

- VOLTHA

Central Office

- OLT MAC
- Whitebox Switch
- Trellis

Manages 1 or more switches

- ETH

BNG

Backbone Network
Trellis: Whitebox Switching

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

Trellis Apps
- SDN Controller
- Indigo OF Agent
- BRCM OF-DPA
- ONL
- ONIE
- SDK
- BRCM ASIC
- OCP Bare Metal Switch

Edgecore
5712, 6712, 7712
SEBA with SD-BNG

- **Residence**
  - RG
  - ONU

- **Central Office**
  - Virtual OLT manages and abstracts PON
  - VOLTHA
  - Trellis
  - BNG-c
  - P4 based WhiteBox Switch with BNG-user plane

- **Backbone Network**

Discussion:

- SD-BNG

Discussed in Session 4
SEBA

SDN Enabled Broadband Access

ONAP

Op X OSS/BSS

Abstract OLT

Network Edge Mediator (NEM)

VOLTHA apps

Trellis apps

SDN Controller - ONOS

VOLTHA

OLT

(Embedded BNG)

SWITCH

SERVER

External BNG

ONU

OLT

ONAP

Op X OSS/BSS

Abstract OLT

Network Edge Mediator (NEM)

VOLTHA apps

Trellis apps

SDN Controller - ONOS

VOLTHA

OLT

(Embedded BNG)

SWITCH

SERVER

External BNG

ONU
SEBA: Built on CORD

- Mobile Services
- Enterprise Services
- Residential Services

**SEBA**

- SD-RAN
- VOLTHA
- ONOS
- Trellis
- Stratum
- NEM

**Network Edge Mediator**
OSS mediation & FCAPS support for operationalization
Leverages XOS project & toolchain

SEBA: Built on CORD
SEBA: Built on CORD

Solution
- Workflow: OPERATOR DEFINED WORKFLOW
- Profile: ACCESS DEVICES, CONTROL SW, XOS SERVICES, ONOS APPS
- Platform: LOGGING & MONITORING, KAFKA, XOS, ONOS
- BoM: Hardware: Server, Switch, OLT, ONU etc

Software:
- Elasticsearch
- Logstash
- Kibana
- Prometheus
- Grafana
- Network Edge Mediator (NEM)

AT&T TT DT

SEBA profile

VOLTHA

SEBA POD
SEBA deployment: basic concepts

- **Microservices**: structure applications as a set of modular, lightweight services
- **Docker**: deploy containerized applications
  - An **image** packages all dependencies needed by an application
  - A **container** is a running image - like a lightweight VM
- **Kubernetes** (k8s): automate application deployment, scale, management
  - A **cluster** consists of one or more **nodes** running pods
  - A **pod** is a set of co-located Docker containers
  - A **service** represents an application endpoint
  - A **namespace** is a partition of k8s resources
- **Helm**: deploy sets of k8s resources
  - A **chart** is a set of YAML templates for k8s resources
  - A **values file** is a YAML file with values for instantiating the templates
SEBA deployment summary

● Deploy microservices in a k8s cluster using Helm charts
  ○ SEBA 2.0-alpha release based on CORD 7.0 (July 2019)
  ○ Helm charts enable a modular, layered deployment process

● Install CORD platform charts
  ○ ONOS, Kafka, XOS core, Monitoring, Logging

● Install SEBA profile charts
  ○ VOLTHA, etcd, XOS services, ONOS apps

● Install operator-specific workflow chart
  ○ XOS’s att-workflow-driver service

● Site-specific configuration (e.g., via TOSCA)
Configuring SEBA using TOSCA

https://guide.opencord.org/profiles/seba/configuration.html

- Configure Switch ports (location of BNG, DHCP server)
- Configure Technology Profiles (T-CONTs, GEM Ports)
- Provision OLTs (OLT S/N, VOLTHA host+port, connection point)
- Configure ONU whitelist (ONU S/N -> PON port map)
- Configure Bandwidth Profiles for subscribers
- Provision subscribers (ONU S/N, c/s-tags, BwProf)
SEBA-in-a-Box

- SiaB: Virtual SEBA pod for development and testing
  - VOLTHA’s PONSIM module virtualizes the RG / ONU / OLT
  - Use Mininet to virtualize the agg switch / BNG / DHCP server
- Fast: Installs in 10 minutes
  - Downloads pre-built Docker images from Docker Hub
- Easy: Download a repo and run “make”
  - Sets up a single-node K8S cluster, VOLTHA, ONOS, NEM, Mininet
- Lightweight: run in a VM (on EC2 or a laptop)
  - m1.large VM on EC2: 8GB RAM, 2 vCPUs, 10 cents / hour
- Customizable: Use local copies of Helm charts, Docker images during development
**SEBA-in-a-Box Dataplane**

Flows programmed into OLT / ONU / agg switch

Upstream topology emulated in Mininet

Linux bridges for Ethernet (L2) connectivity btw components
Lab #1: Install SiaB

- [https://tinyurl.com/SEBALabManual](https://tinyurl.com/SEBALabManual)
- Get a CloudLab machine and login with SSH
  - Username: seba
  - Password: OnfConnect2019!
- Perform the steps under Lab #1 in the Lab Manual
- Raise your hand if you run into problems
- Add comments to the Lab Manual where things are unclear
Connect to your node now!

ssh seba@nodeX.seba-tutorial.cord-testdrive-pg0.utah.cloudlab.us

*password:* OnfConnect2019!