SEBA: SDN Enabled Broadband Access

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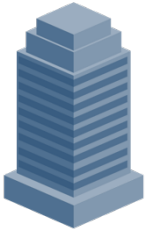
Director of Engineering, ONF

December 4th, 2018

CORD – Central Office Rearchitected as a Datacenter

Residential
vOLT, vSG, vRouter, vCDN

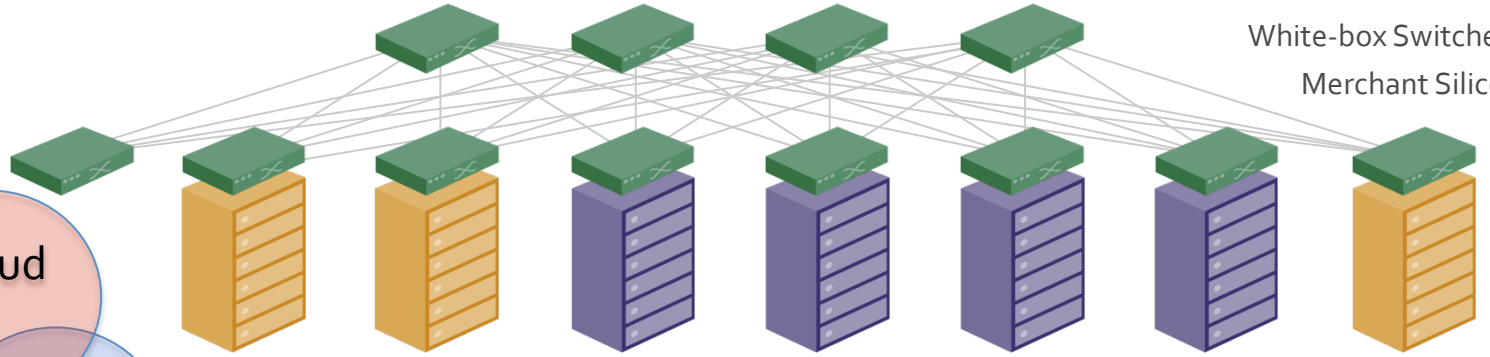
Mobile
vBBU. vMME, vSGW, vPGW, vCDN



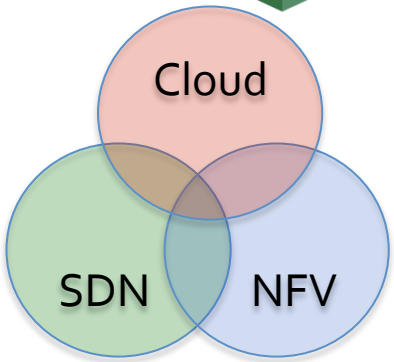
Enterprise
vCarrierEthernet, vOAM, vWanEx, vIDS

Access Service Orchestration & Control

White-box Switches with Merchant Silicon

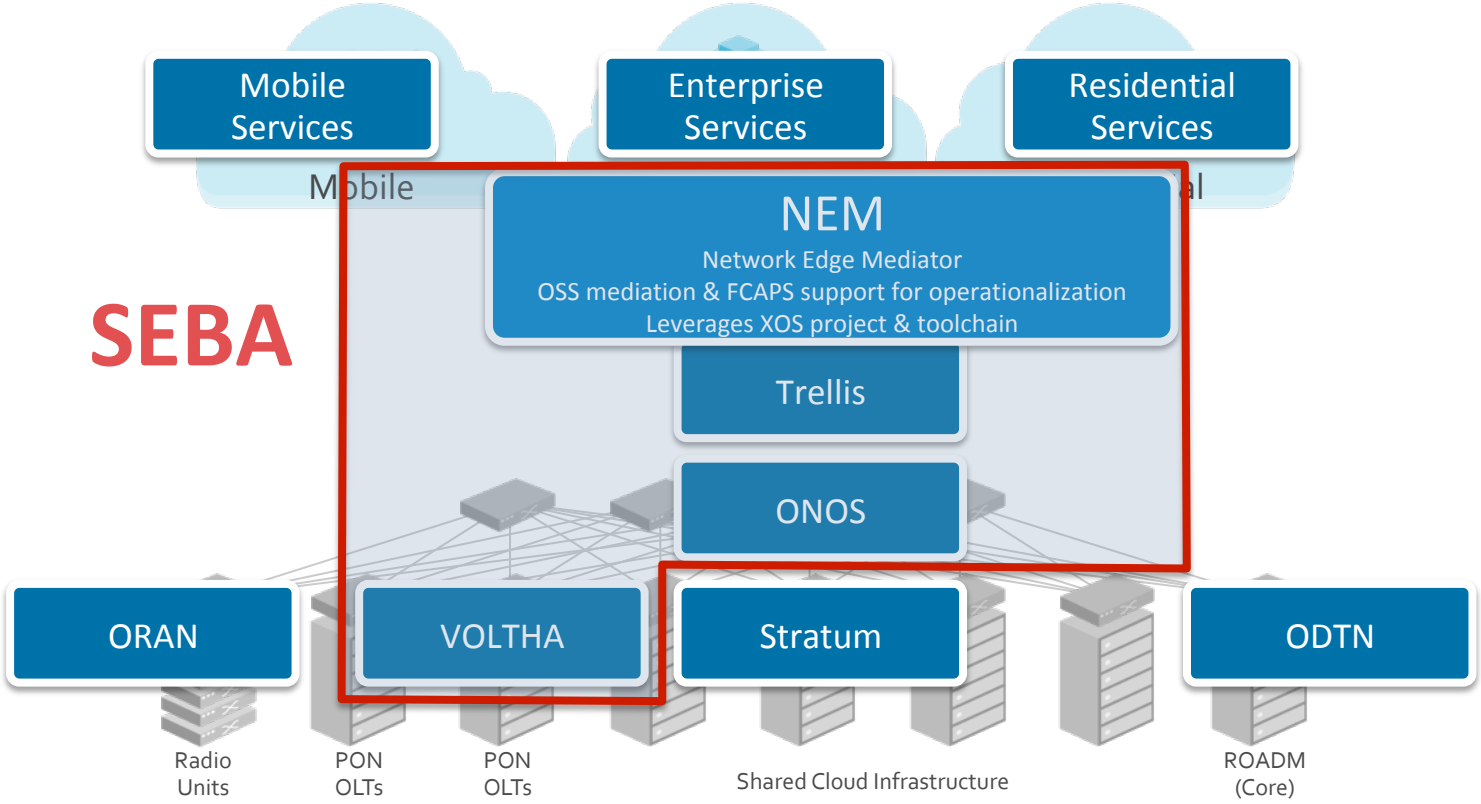


BBUs PON OLTs COTS (Off-the-Shelf) x86 Compute ROADM (Core)

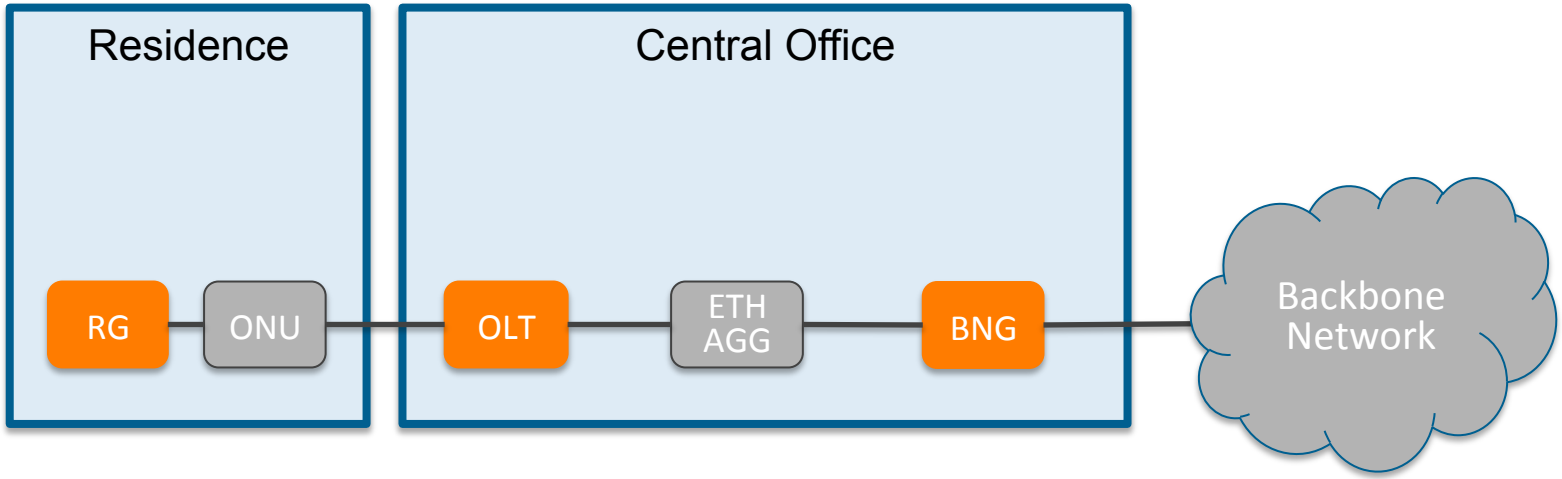


Economies of a datacenter, Agility of a cloud provider

SEBA: Built on CORD

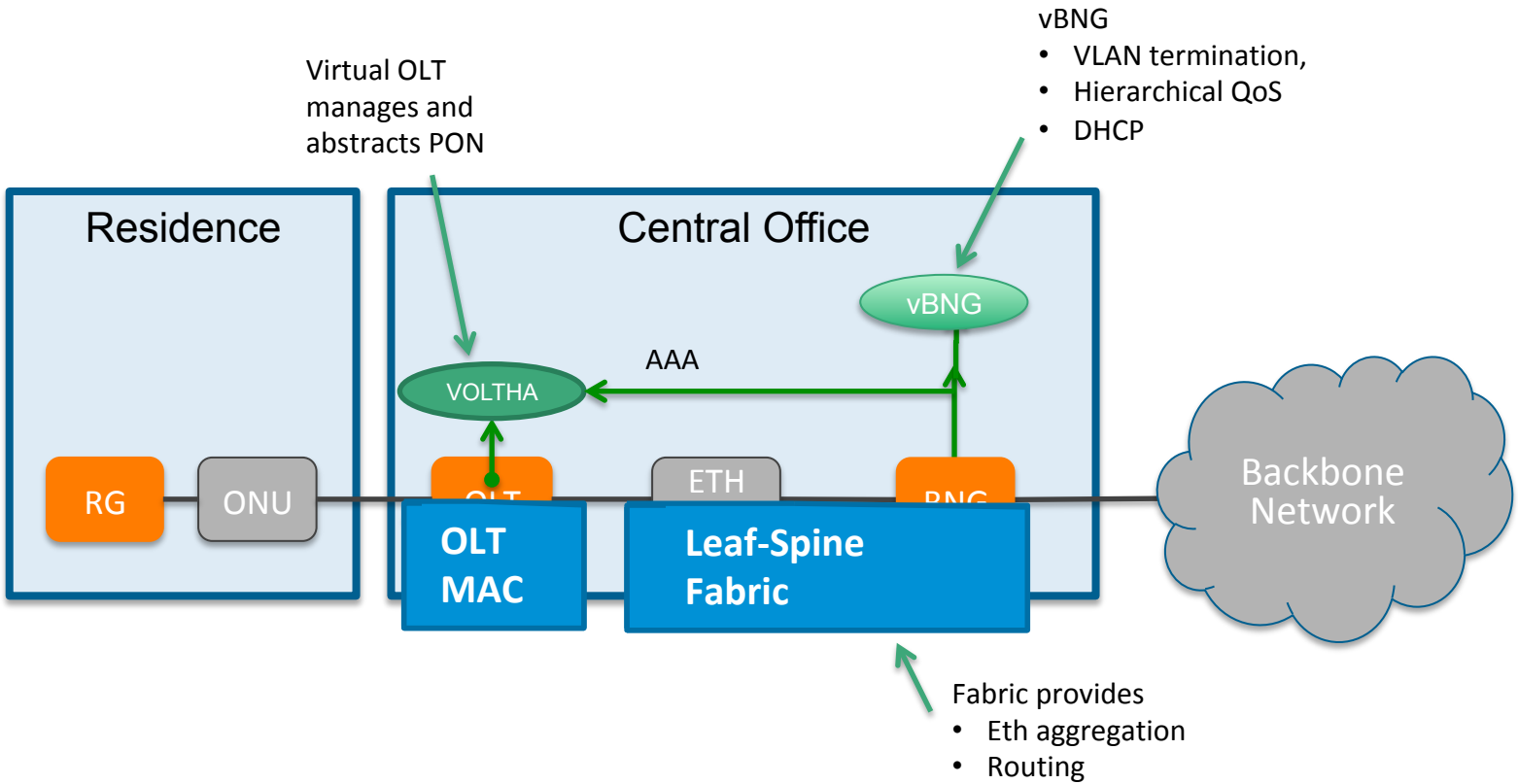


Traditional Residential Access



RG – Residential Gateway
OLT – Optical Line Termination
BNG – Broadband Network Gateway

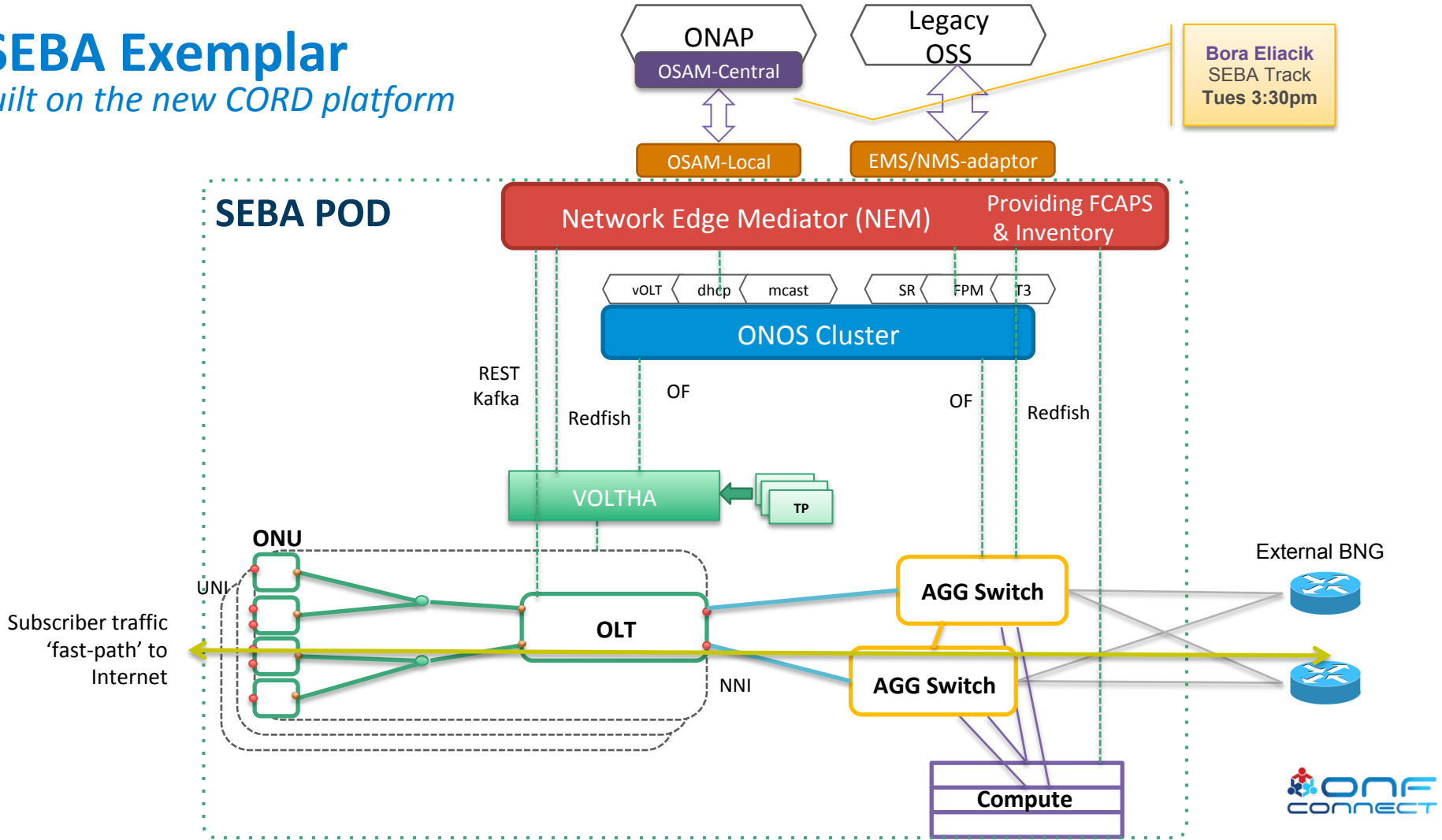
Disaggregated Residential Access



+ the ability to introduce other edge-compute services per subscriber

SEBA Exemplar

Built on the new CORD platform

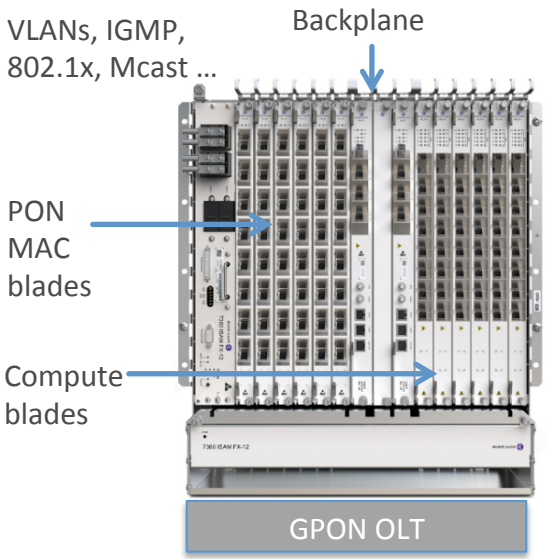


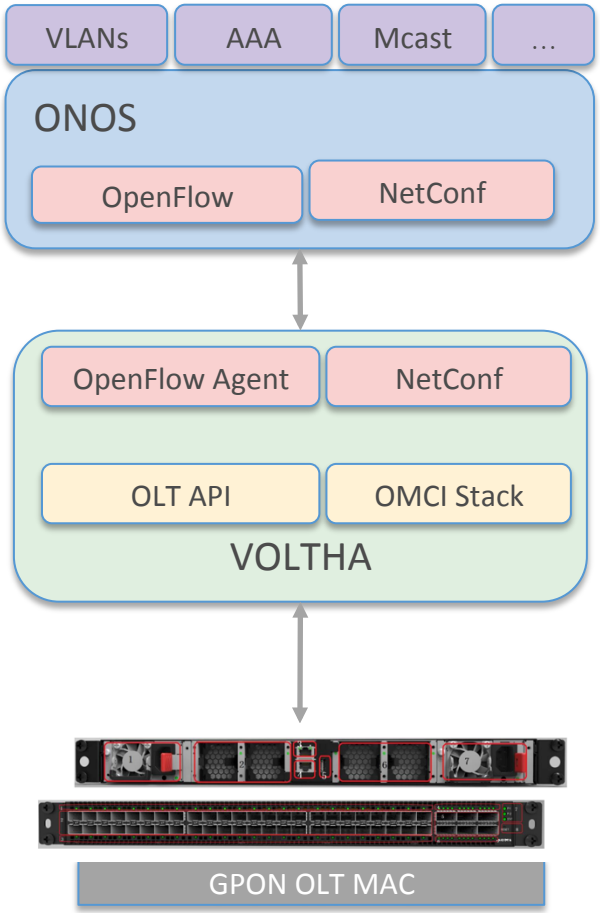
Outline

- VOLTHA – Disaggregated OLTs
- Trellis – Multi-purpose Leaf-Spine Fabric
- CORD platform – Service Delivery at the Edge
- SEBA Exemplar Implementation
- SEBA Development & Roadmap

VOLTHA: Disaggregated OLTs

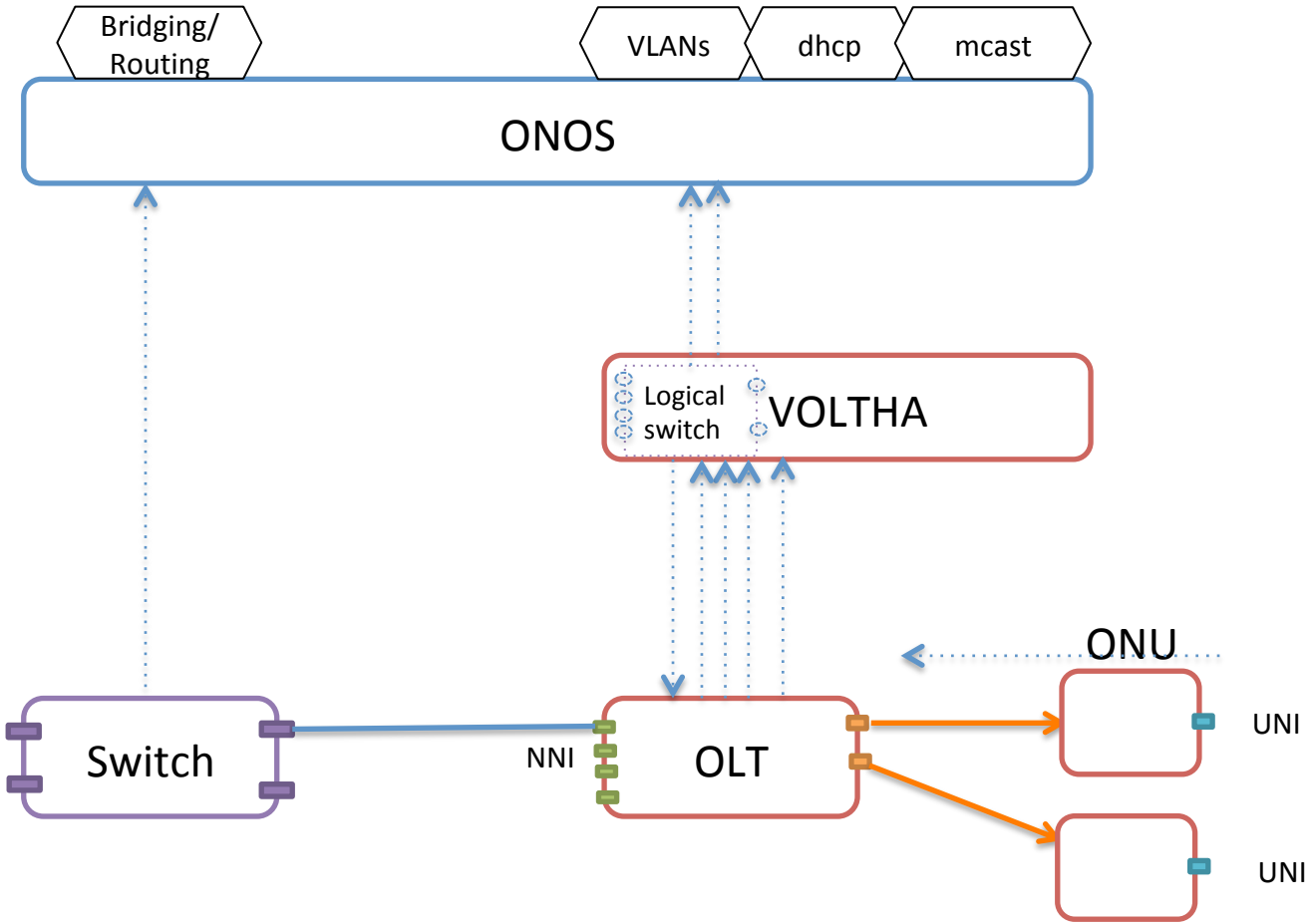
OLT Disaggregation → VOLTHA





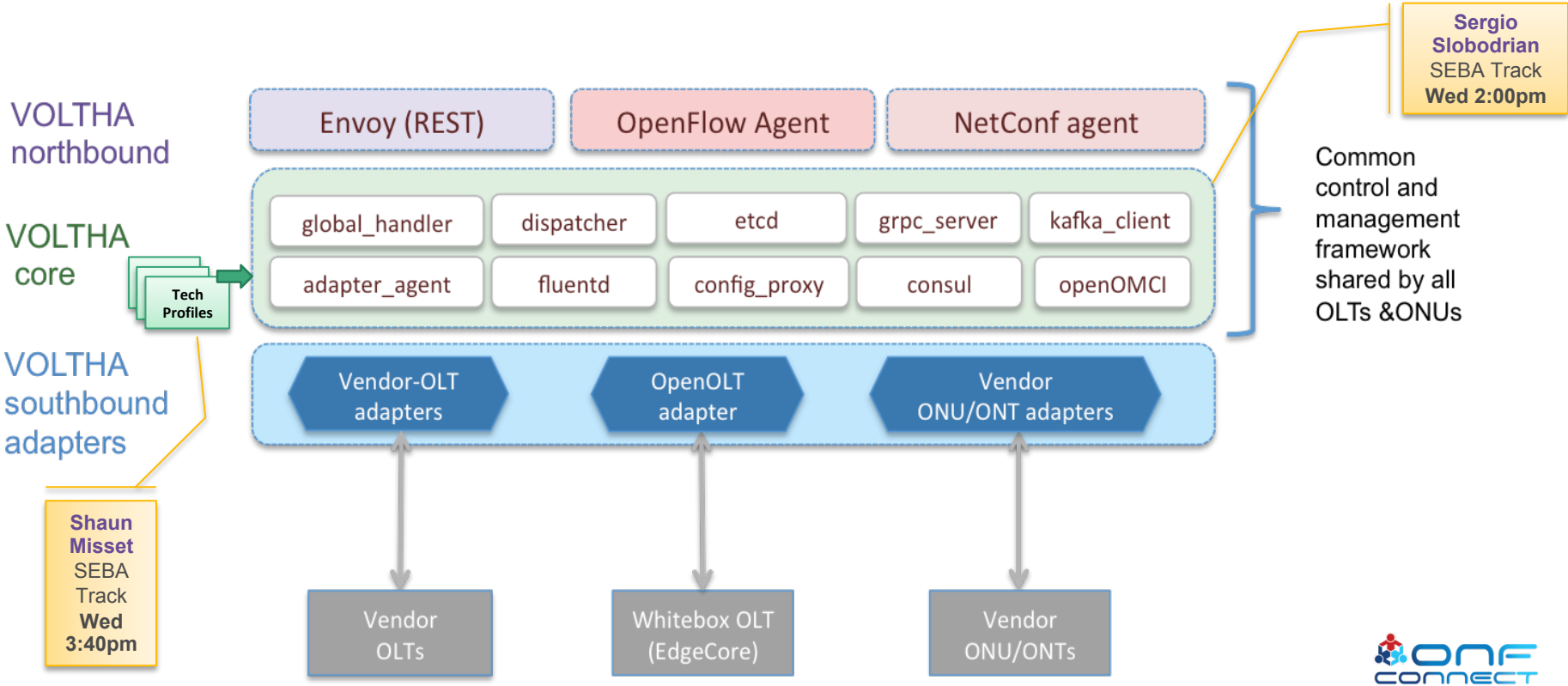
VOLTHA: Virtual OLT Hardware Abstraction

VOLTHA Operation

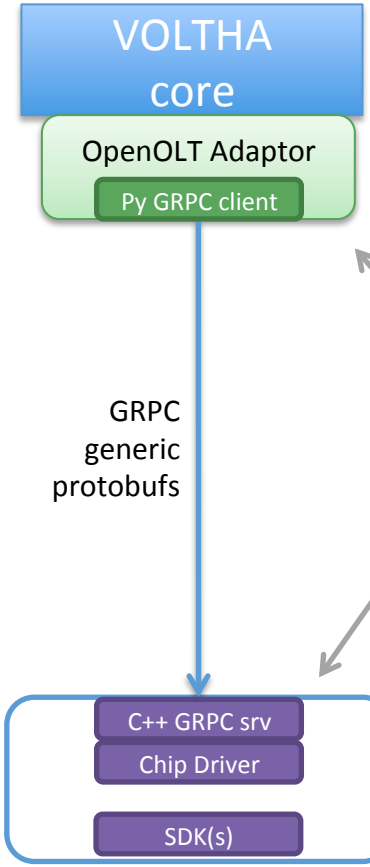


VOLTHA Architecture

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



Industry's First White-Box XGS-PON OLT

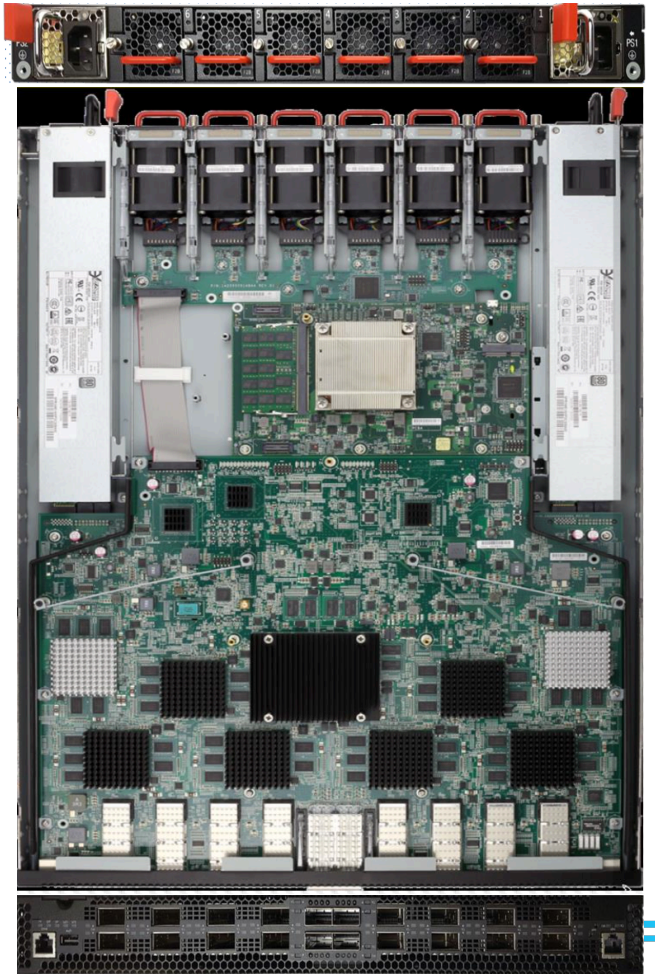


Whitebox OLT
(including EdgeCore)

White-Box = Open-Hardware Specs (OCP)
+ Open-source software (ONF+OCP)

OpenOLT
Software

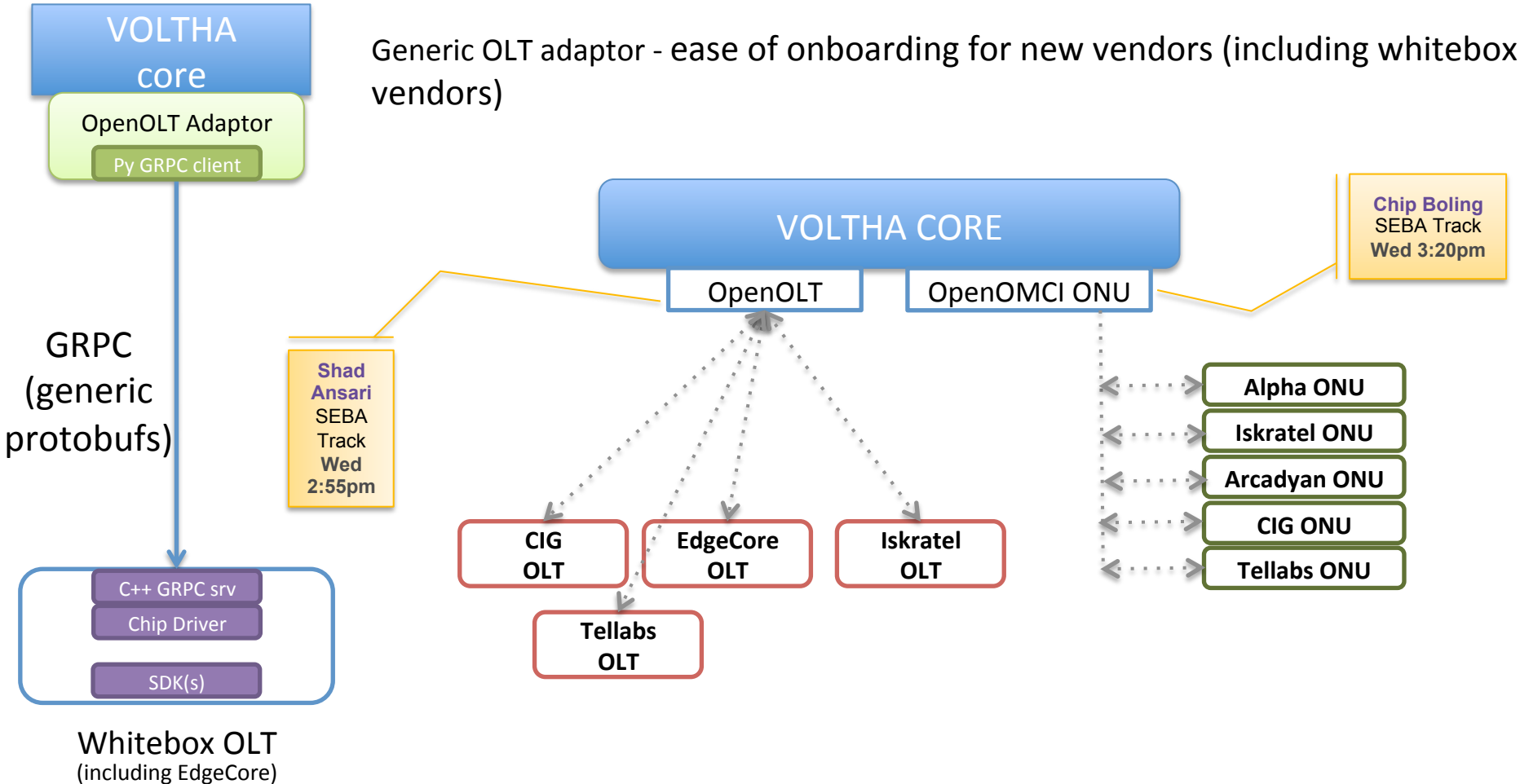
Edgecore
ASFvOLT16
Whitebox OLT



March 2018

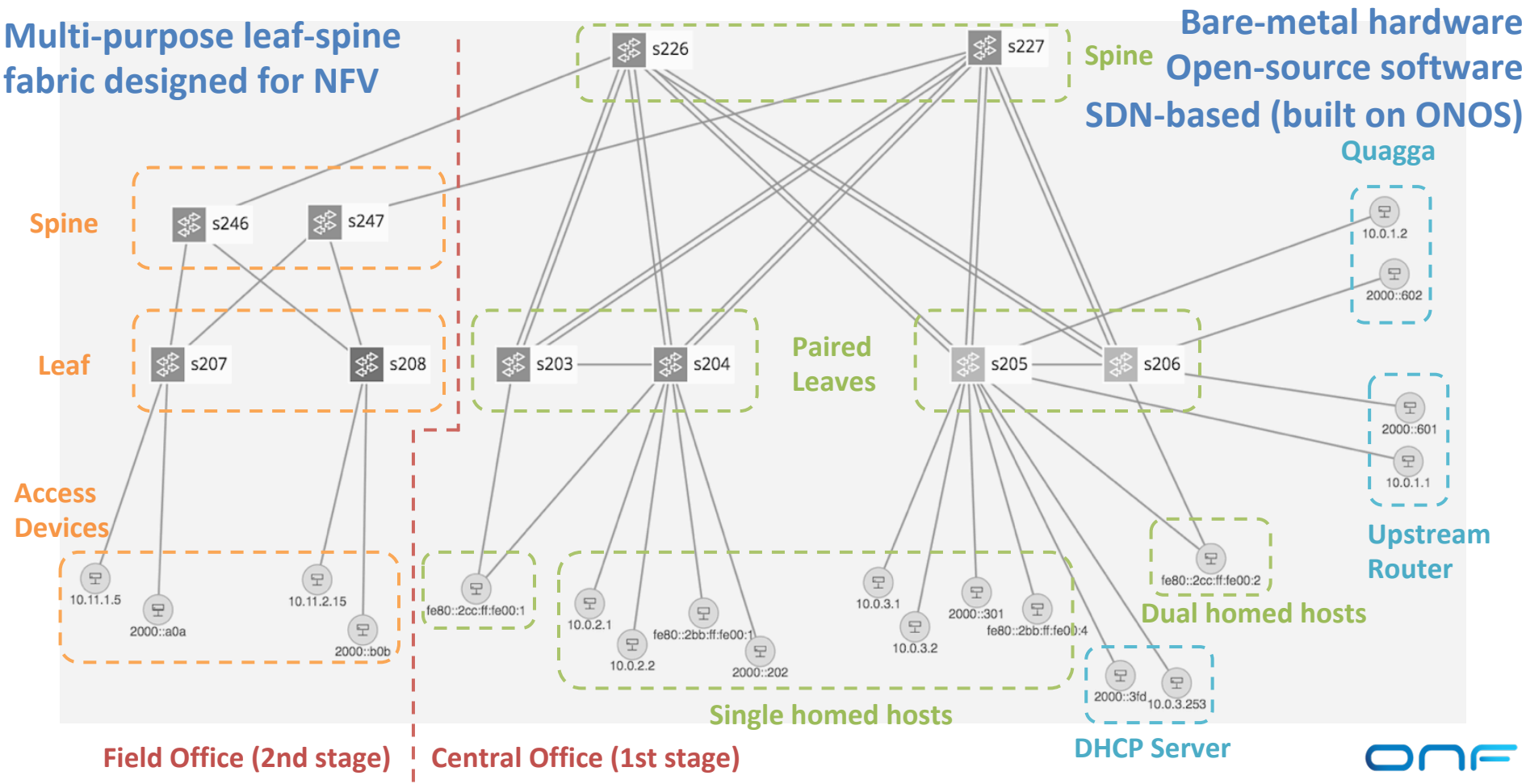
Why OpenOLT Adaptor?

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



Trellis: Multi-purpose leaf-spine fabric

Trellis Overview

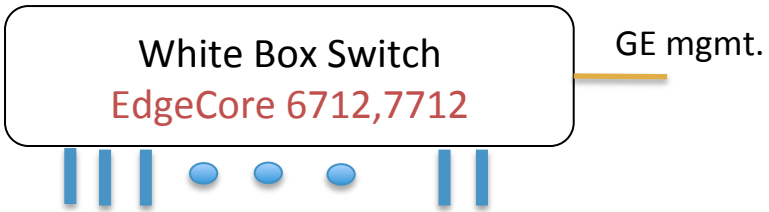


Trellis Features

- **Bridging** with Access & Trunk VLANs (within a rack)
- **Routing** (inter-rack)
  - IPv4 & IPv6 Unicast routing with MPLS Segment-Routing
  - IPv4 & IPv6 Multicast routing
- **Dual-homing** for compute-nodes and external routers
- **Multi-stage** fabrics (2 layers of spines)
- **vRouter** - entire fabric behaves as a single router
  - BGP (v4/v6) support for external (upstream) connectivity
  - Static routes, route blackholing
  - DHCP L3 relay (IPv4/v6)
- **MPLS Pseudowires**
- **QinQ termination**
- **T3** - Trellis Troubleshooting Tool
- **ASIC Support**
  - Broadcom Qumran, Tomahawk, Trident2 switches from EdgeCore & QCT
  - Preliminary support for Cavium Xpliant switches and P4-based Tofino switches

White-Box = Bare-metal hw + Open-Source sw

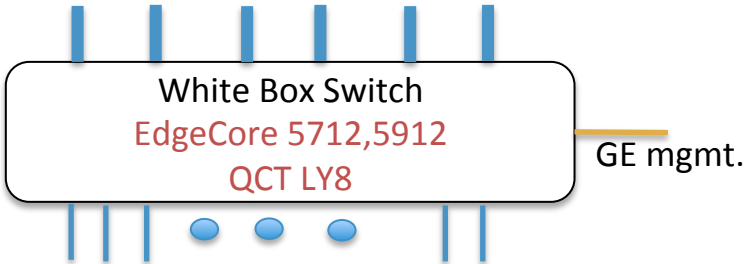
Spine Switch



32 x 40G/100G ports downlink to leaf switches

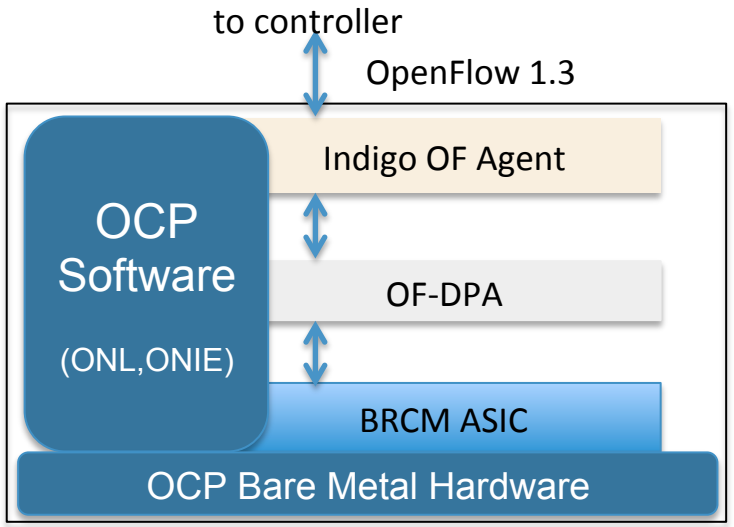
Trident2, Tomahawk, Qumran

Leaf Switch



48 x 10G, 6 x 40G/100G

Leaf/Spine Switch Software Stack



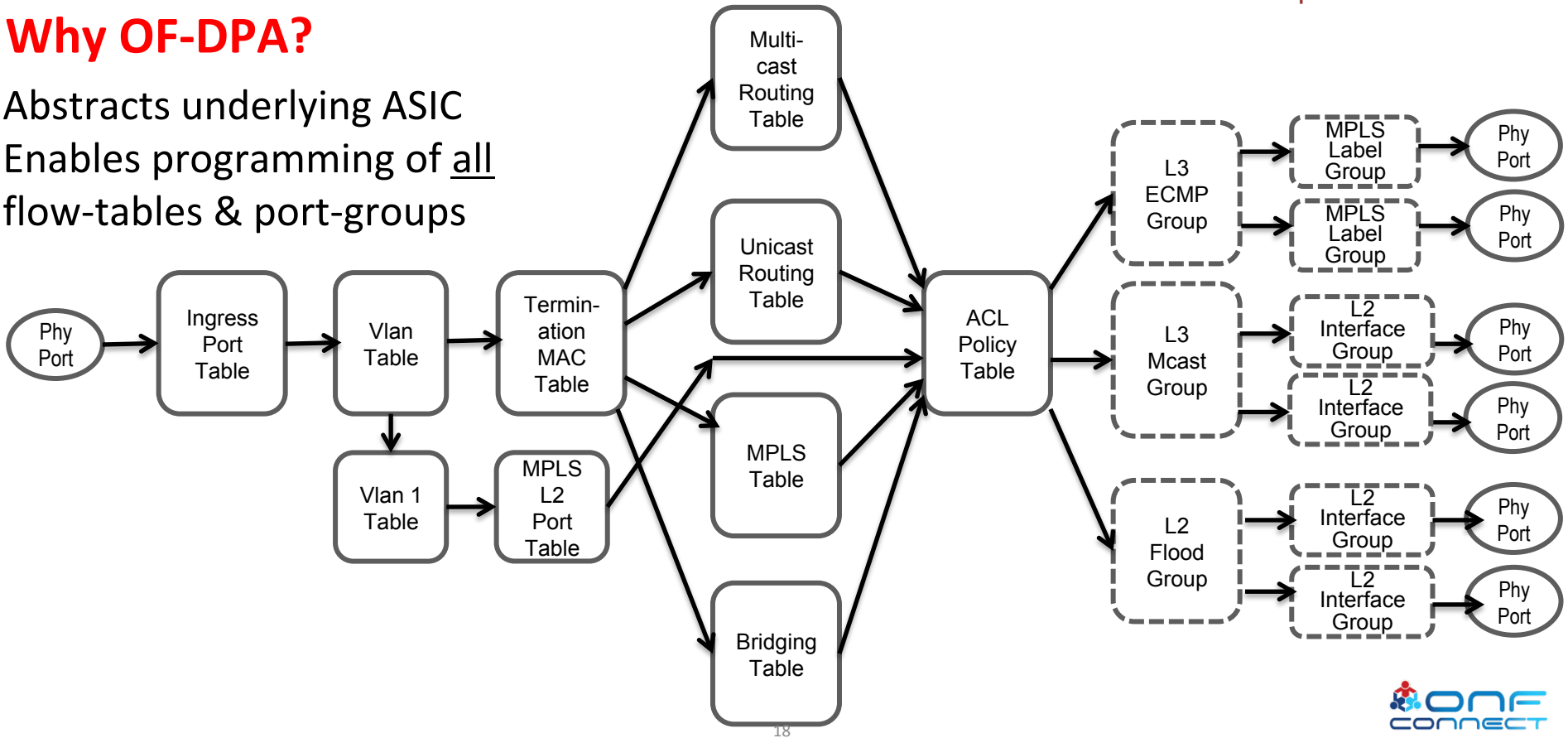
OCP: Open Compute Project
ONL: Open Network Linux
ONIE: Open Network Install Environment
BRCM: Broadcom Merchant Silicon ASICs
OF-DPA: OpenFlow Datapath Abstraction

Fabric ASIC Pipeline* (BRCM's OF-DPA)

* Simplified view

Why OF-DPA?

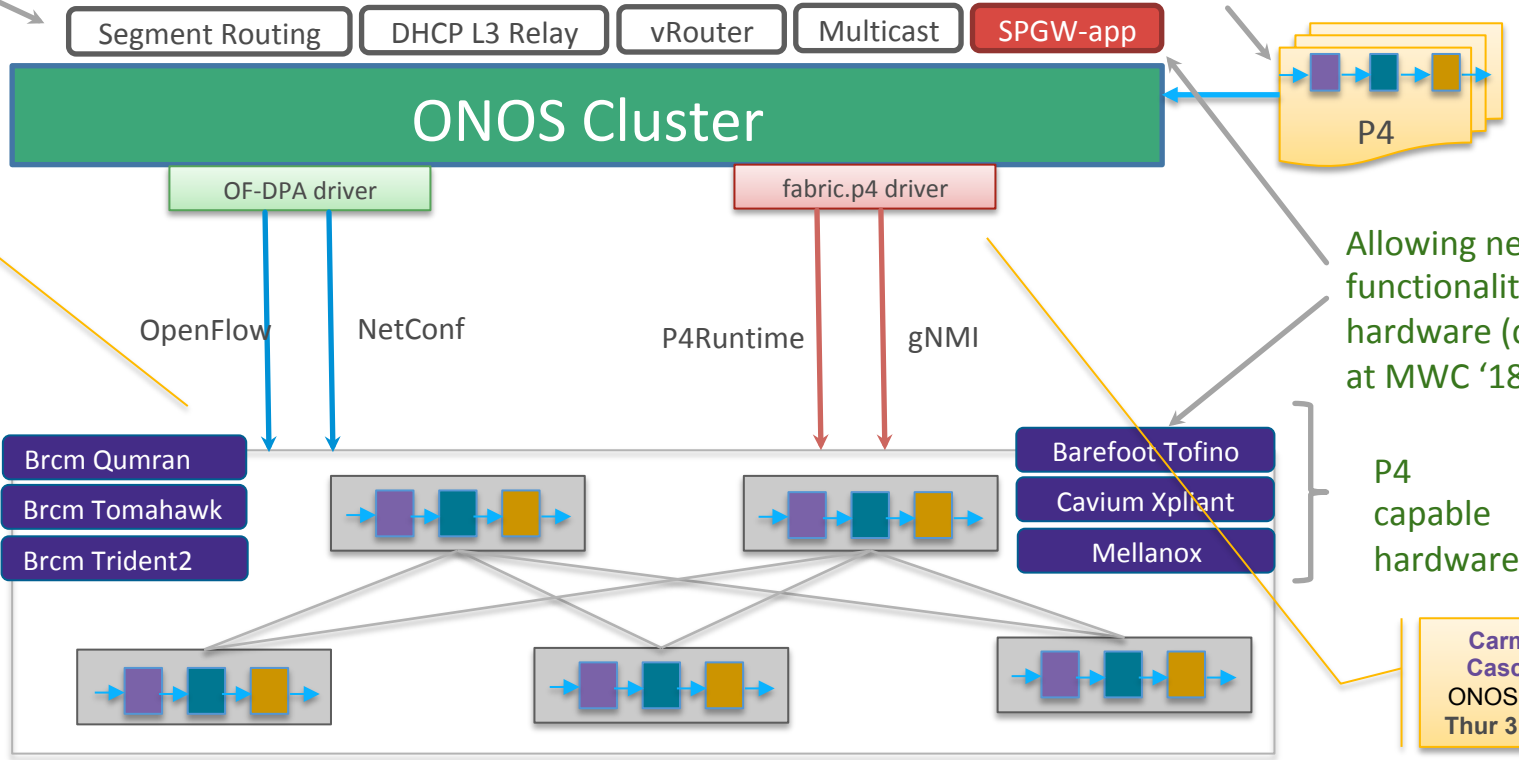
Abstracts underlying ASIC
Enables programming of all flow-tables & port-groups



Trellis & P4

Same set of Trellis applications on ONOS

Enhanced with P4 program deployment and pipeline configuration



Allowing new functionality on hardware (demo at MWC '18)

P4 capable hardware

Charles Chan
NG SDN Track
Tue 4:30pm

Carmelo Cascone
ONOS Track
Thur 3:00pm

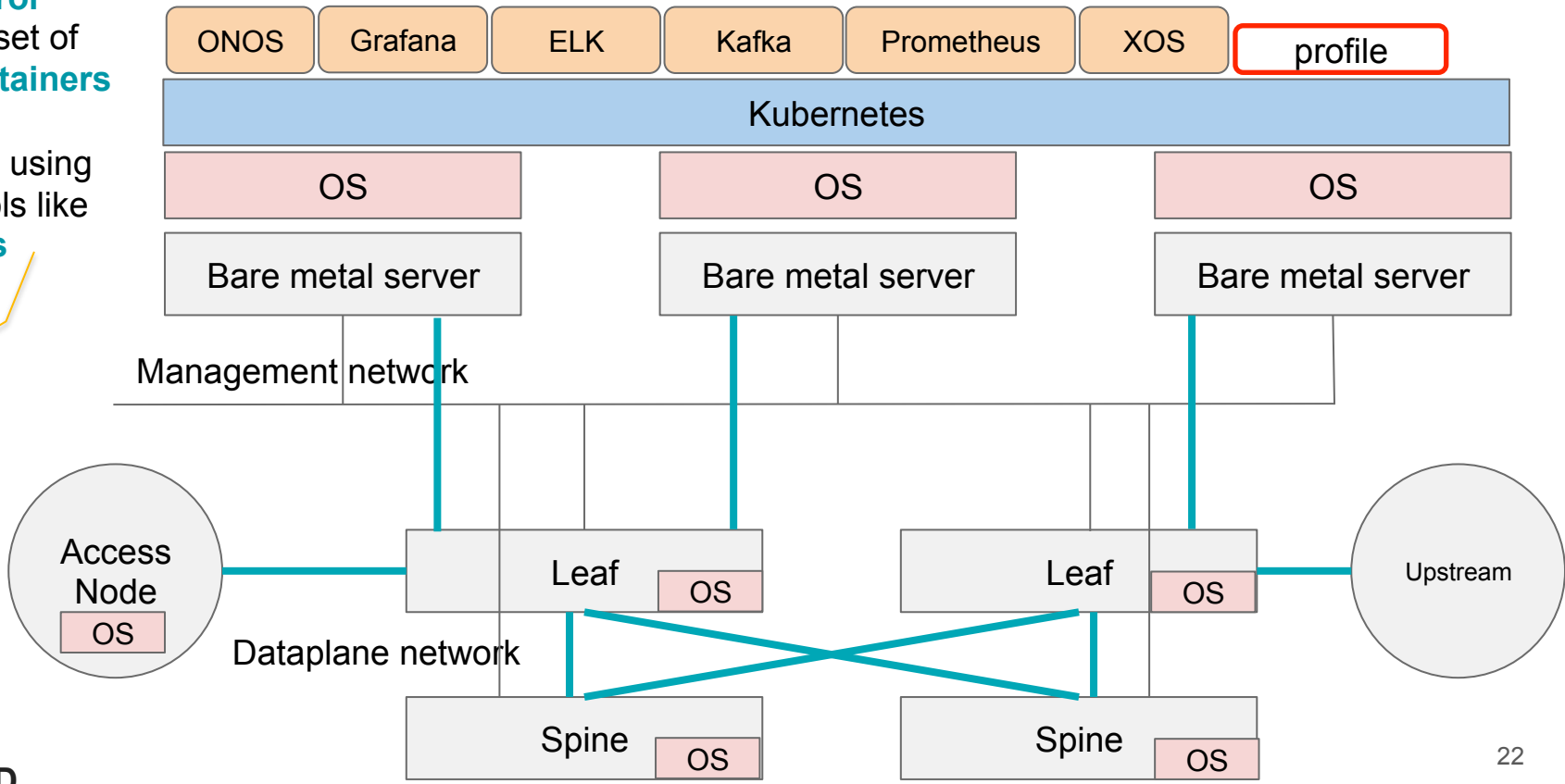
CORD Platform: service delivery @ the edge

Issues with the previous CORD platform & build

- No distiniction between development vs deployment
  - Most of the software built from source at “deploy time”
  - Big scripts, scripts calling scripts, long process
  - Monolithic: If something breaks, wipe and start from scratch
  - Brittle: Small variations of hardware/connectivity could break build
- Not flexible or modular
  - Required specific versions of server OS
  - Tightly coupled components – cannot exclude or replace components
  - Required internet access for install
- Hard to use
  - Choose a profile at start; to change profiles reinstall
  - No means for adding services at runtime

New CORD 6.0 platform (July-2018)

CORD control software → set of **Docker containers** deployed on **Kubernetes** using standard tools like **Helm charts**

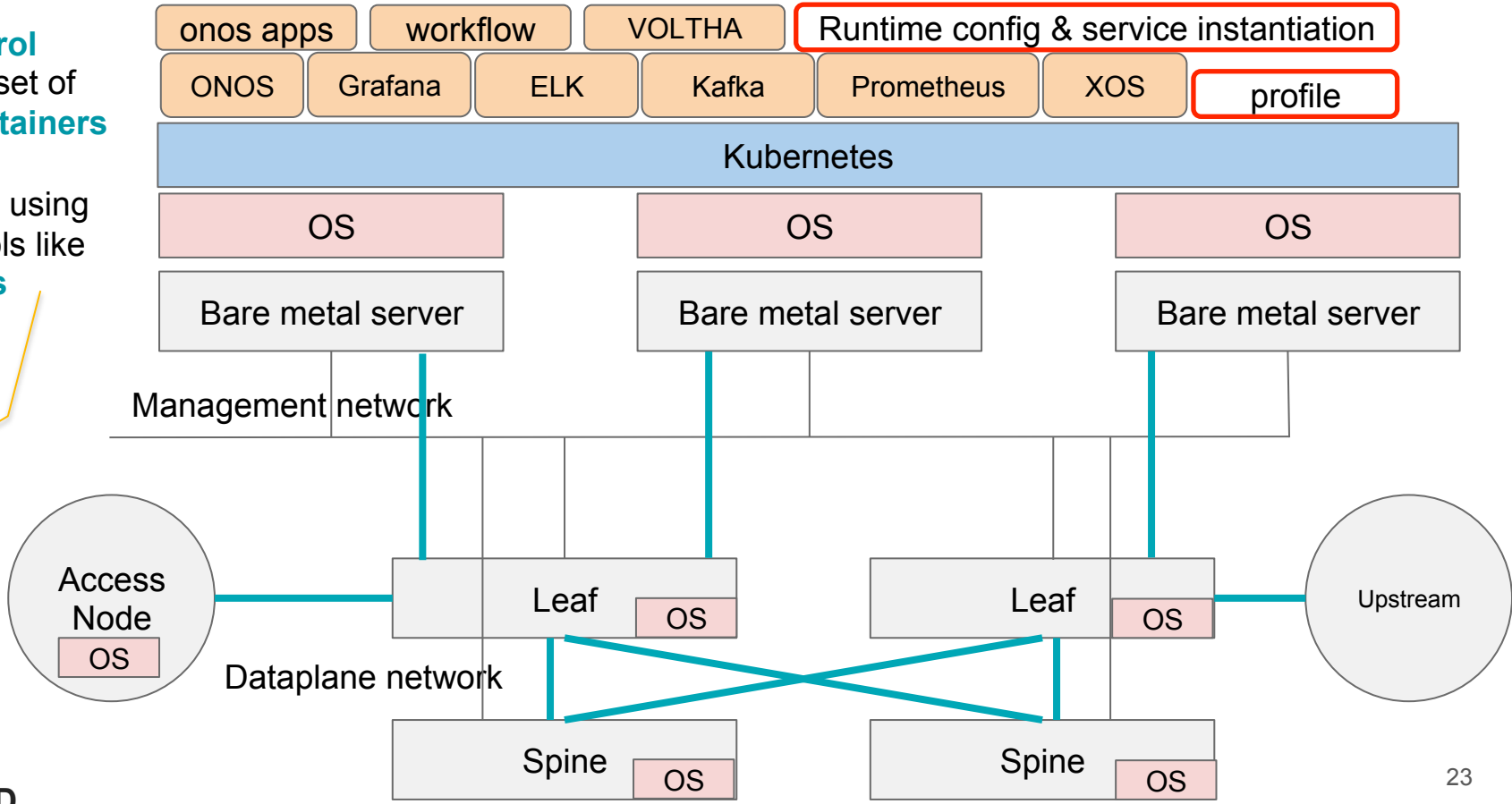


Luca Prete CORD Track Wed 2:00pm

#OpenCORD

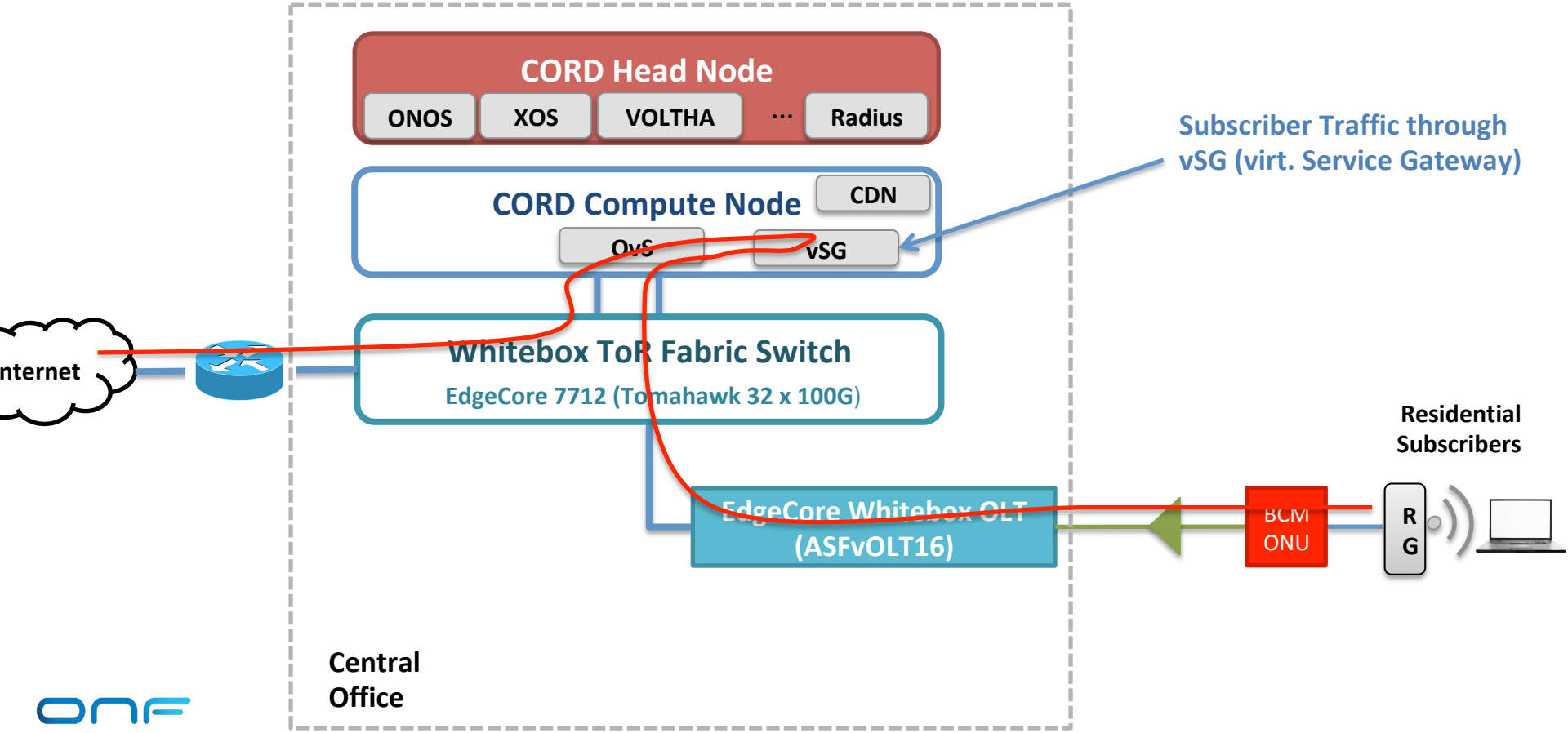
SEBA – A profile loaded on the CORD platform

CORD control software → set of **Docker containers** deployed on **Kubernetes** using standard tools like **Helm charts**



Matteo Scandolo CORD Track Thur 3:30pm

Issues with the previous R-CORD

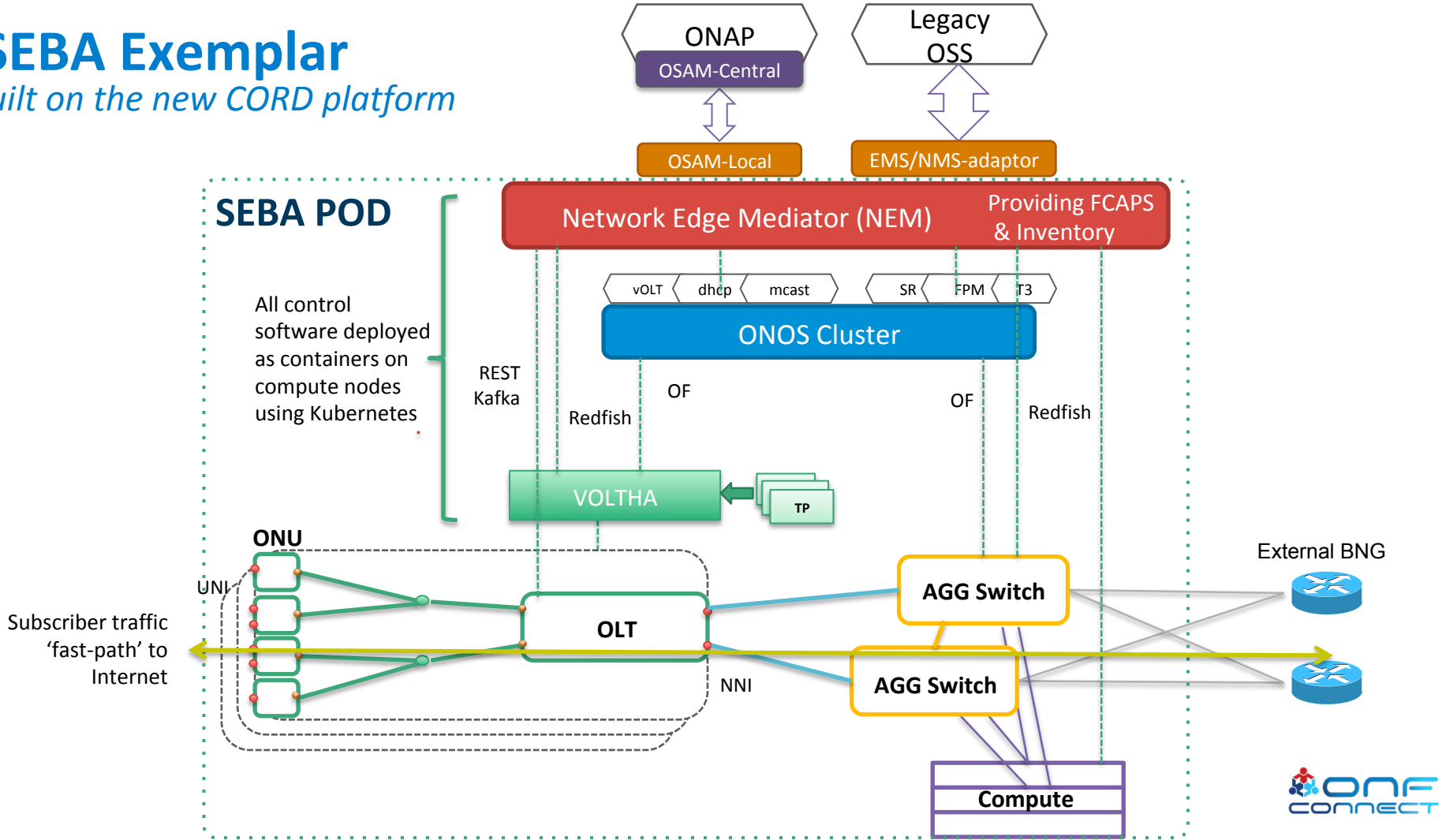


SEBA Exemplar Implementation

- putting it all together

SEBA Exemplar

Built on the new CORD platform



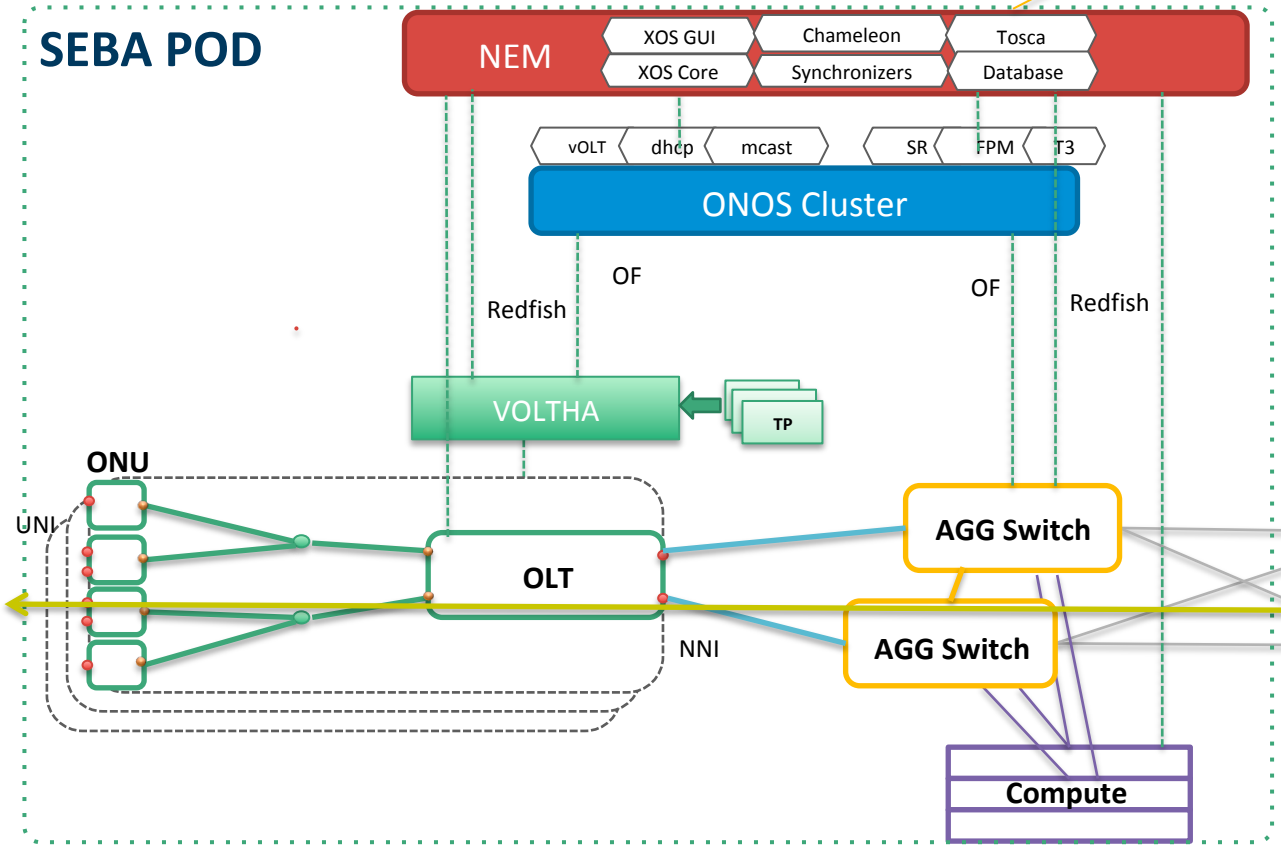
NEM Orchestration & SEBA Workflows

Different operators == Different workflows

Scott Baker
CORD Track
Wed 3:00pm

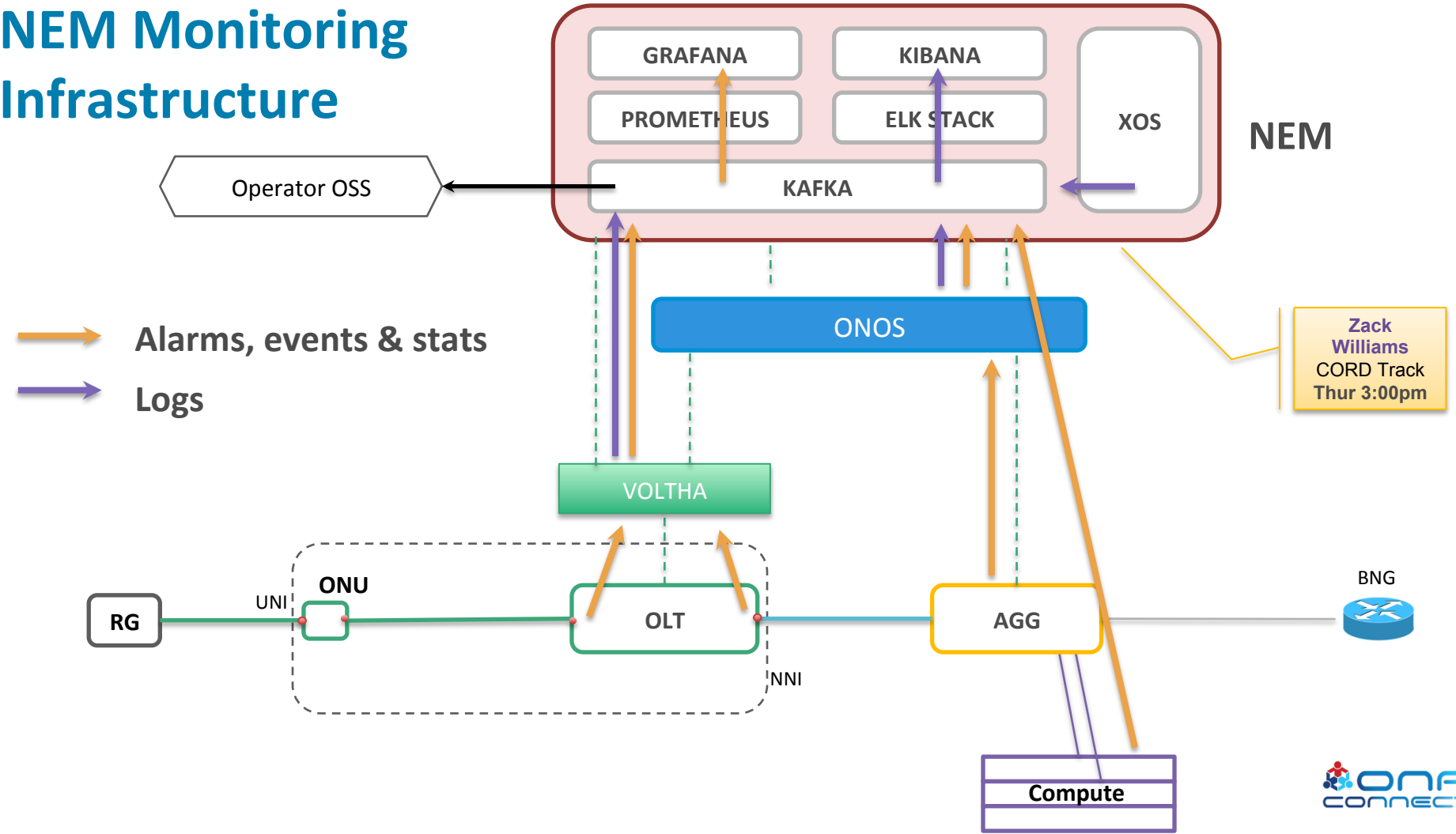
Authentication is a workflow option
- 802.1x based
- PPPOE based
- DHCP based

Subscriber services are workflow options
- HSIA
- Voice
- IPTV
- Business services
- Technology profiles
- Speed profiles

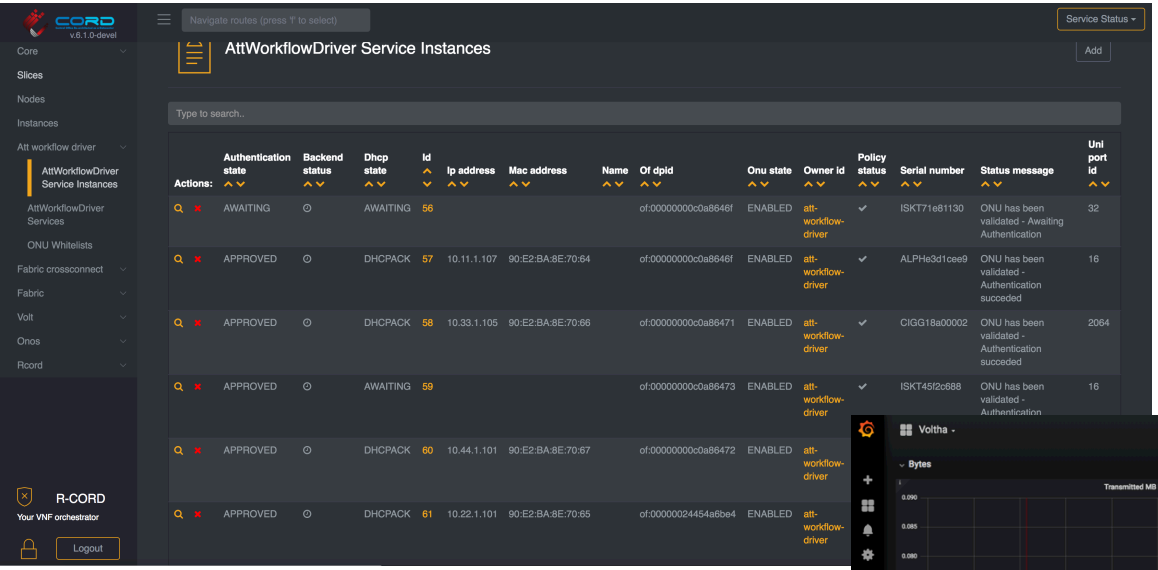


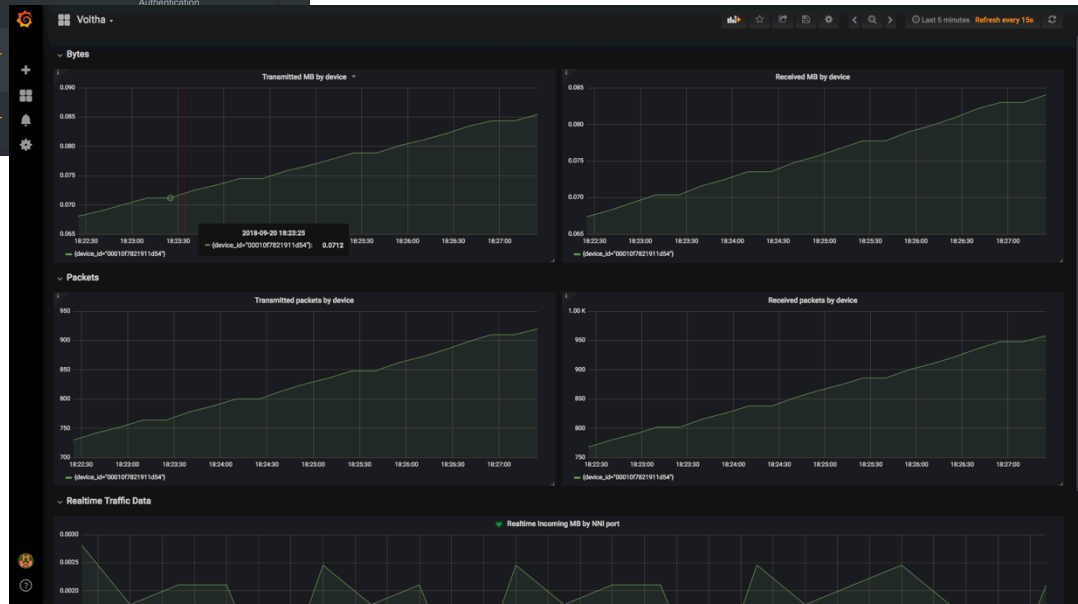
BNG is a workflow option
- External physical BNG
- vBNG in compute
- BNG in Agg switches
- BNG in OLT boxes

NEM Monitoring Infrastructure



NEM Dashboards

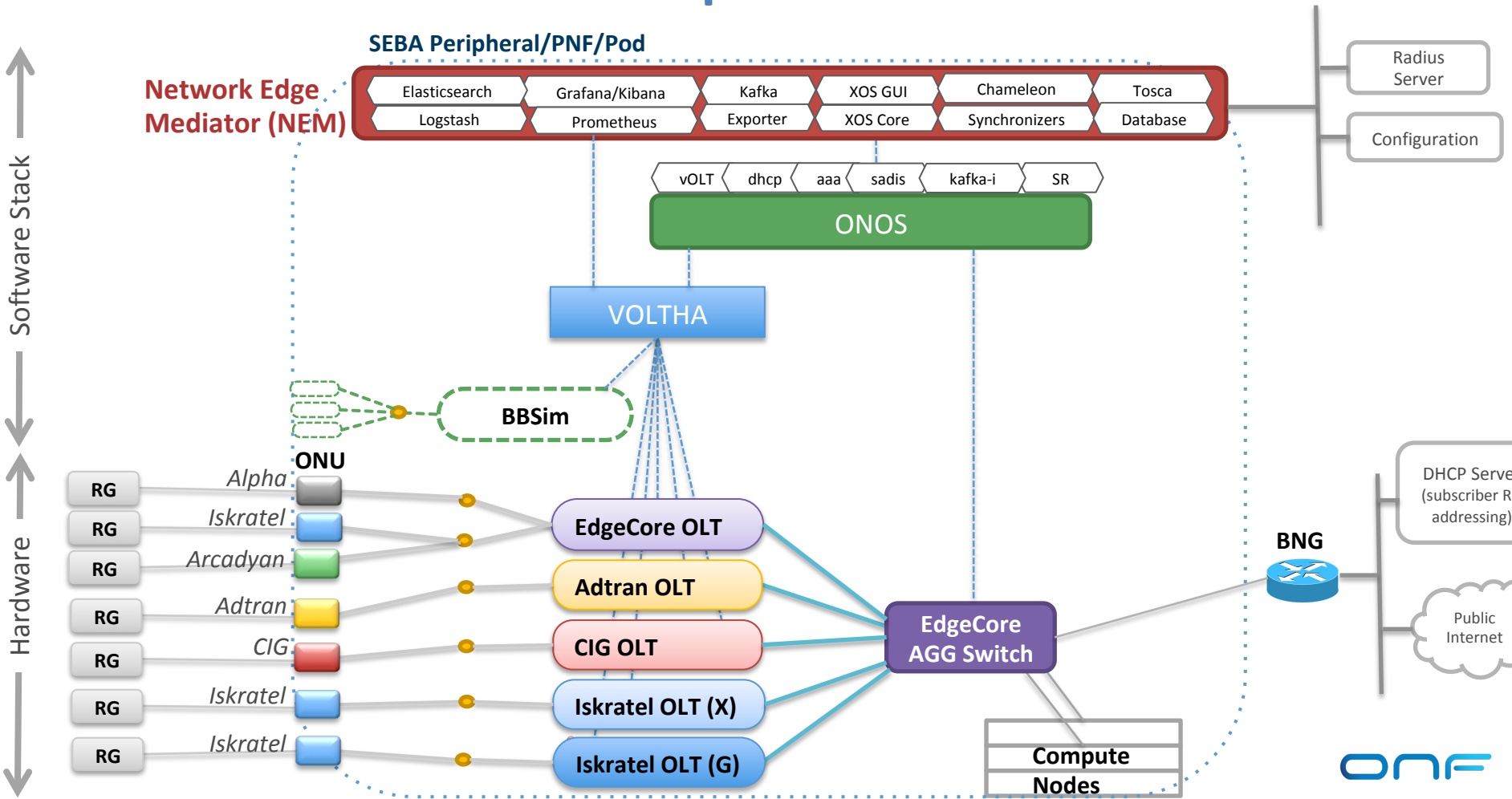




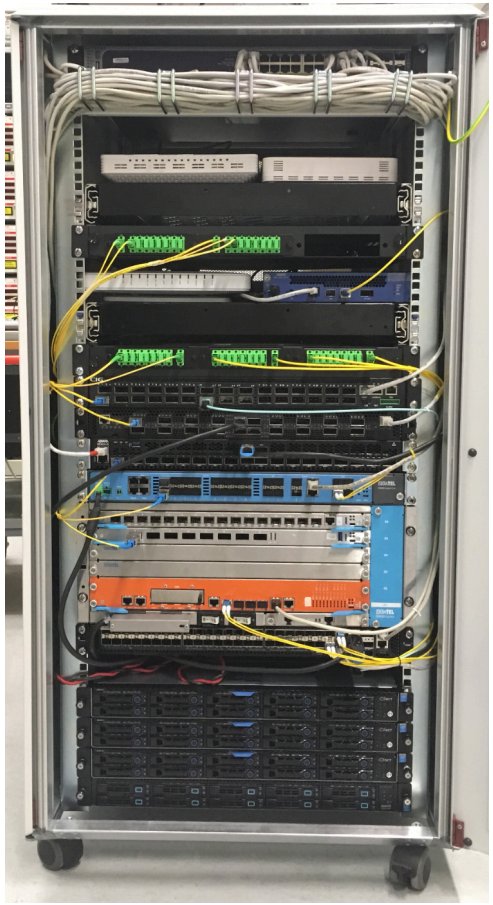
NEM User Interface: runtime service instantiation, inventory, workflow status

NEM Monitoring Dashboard: stats, events, logs (FCAPS)

Demo setup BBWF 2018



Demo setup BBWF 2018



ONUs: Arcadyan, Alpha, Adtran, CIG, Iskratel

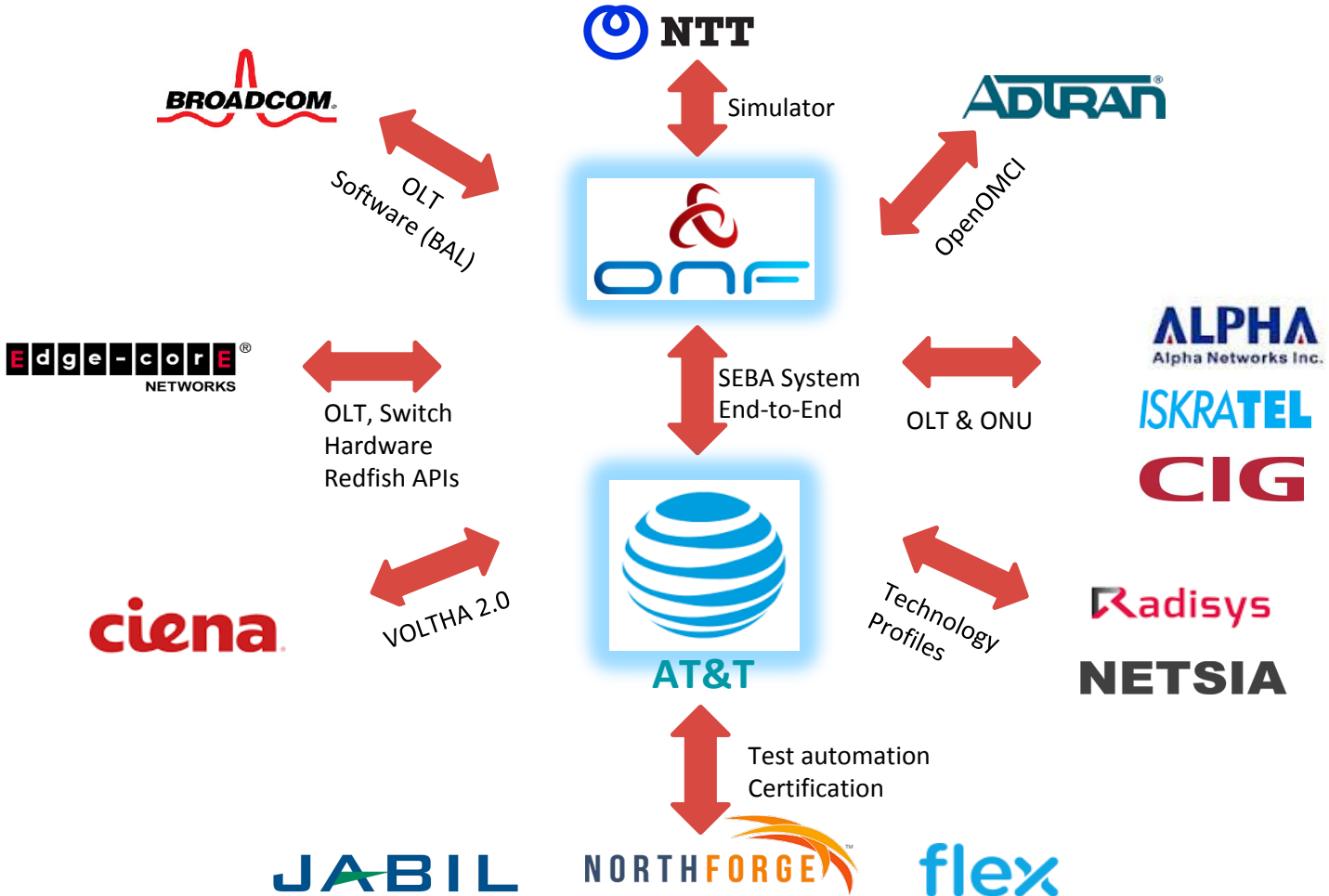
OLTs: Adtran, CIG, EdgeCore & Iskratel

AGG switch: EdgeCore

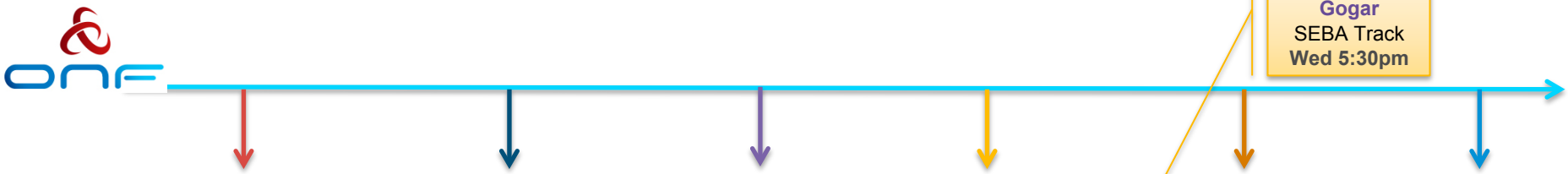
Servers: VOLTHA, ONOS, XOS, K8s, ELK, Docker, Prometheus, Grafana, Kibana

SEBA Development & Roadmap

Distributed DevOps - SEBA



SEBA Distributed DevOps – ONF Responsibilities



Siddharth Gogar
SEBA Track
Wed 5:30pm

Joint Development with AT&T Foundry

- **Daily scrum**
- **Bugs -** issue analysis; root-cause;
- **Design discussions** for new features
- Documentation
- **Recommend best-practices**/training

Support VOLTHA/SEBA Community

- **Weekly SEBA public meetings**
- **JIRA issues** – kanban methodology
- **Mailing lists, Slack** community support
- **VOLTHA meetings**, TST, architectural guidance

Deliver New Features

- ONF team resposible for all **ONOS and NEM feature** development
- **FCAPS features** – kpis, alarms & logs in SEBA monitoring infrastructure
- **AT&T workflow** development
- **Integrate** with new ONU and OLT vendors
- **AGG switch** features

SEBA/VOLTHA Stability & Scale

- Focus on **stability of VOLTHA –** robustness and repeatability
- Investigate **scalability and performance** of full SEBA system

Tooling

- **BBSim** – Work with NTT in the development of PON simulator for scale testing
- **SEBA-in-a-BOX**: Complete end to end emulation of SEBA system with ponsim & mininet

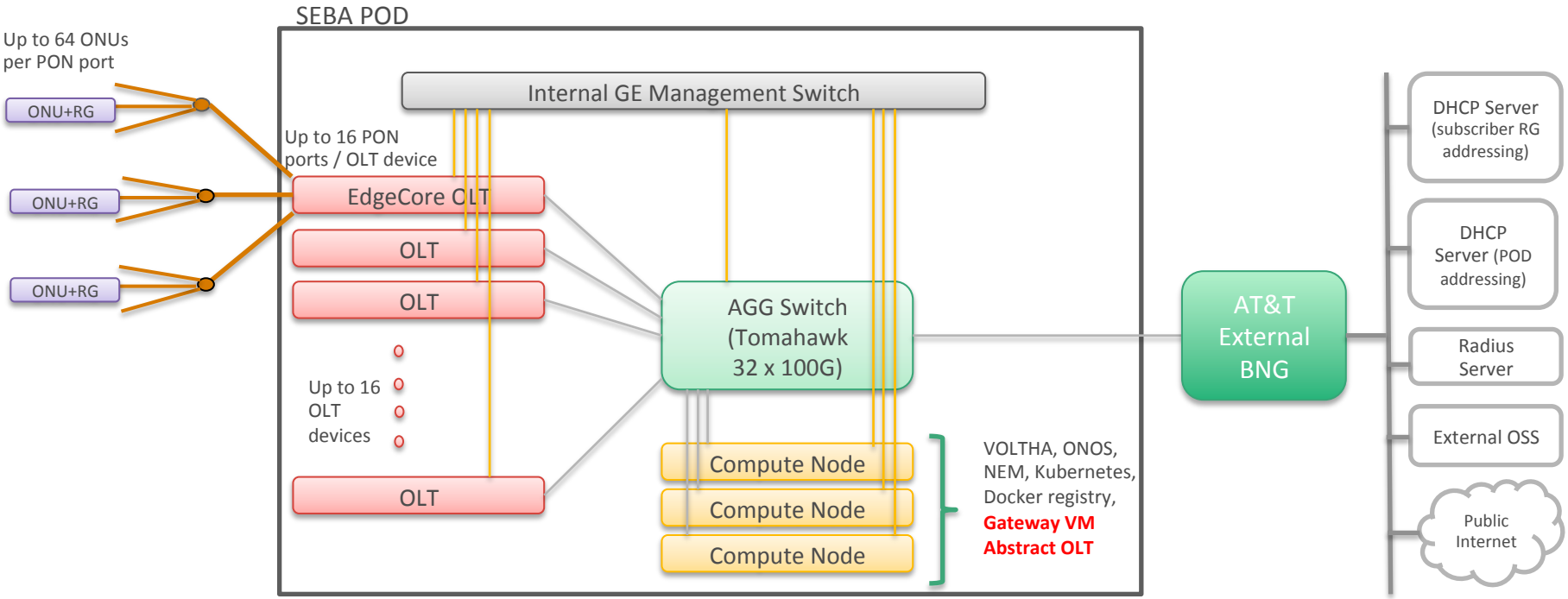
Andy Bavier
SEBA Track
Wed 5:00pm

QA

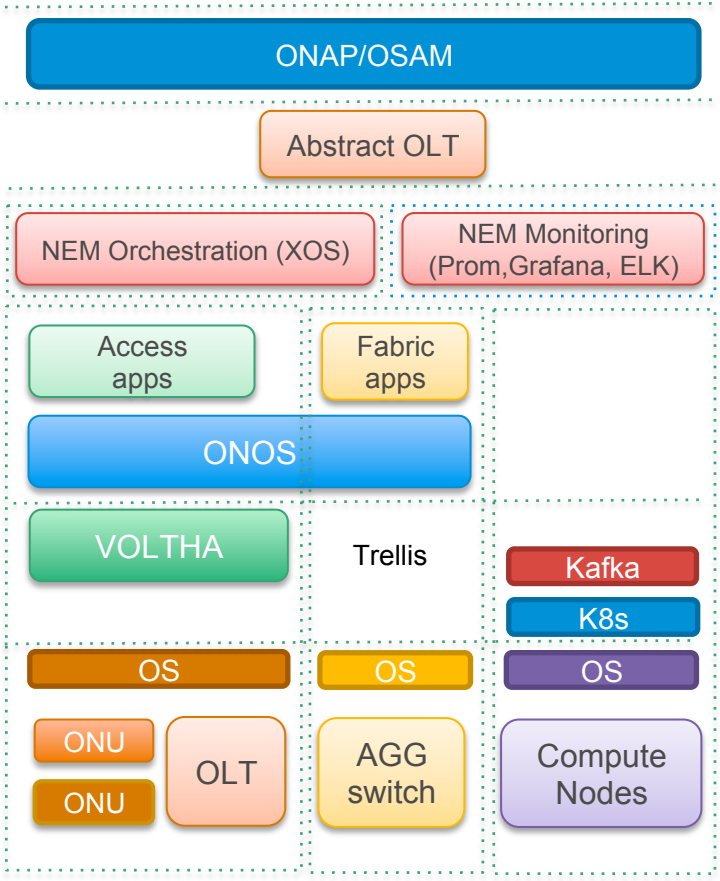
- Developing **automated feature tests**
- Extending framework for **hardware based end-to-end tests**
- Work with community to develop test automation and certification procedures

ONF CONNECT

SEBA Deployment Goal @ AT&T



SEBA Modularity



Roadmap

Hans-Joerg Kolbe
NG SDN Track
Wed 3:00pm

- *BNG Disaggregation*
- *Using P4 in Aggregation switch*
- *Implementing more operator workflows*
- *Performance & scale improvements for Trials*
- *Redundancy*
- *Integrating VOLTHA 2.0 & Technology profiles*
- *ISSU*
- *Integrating M-CORD profile to use SEBA as mobile backhaul*

Summary

- **ONF: Operator driven curated open source**
  - *CORD is the flagship umbrella project*
  - *SEBA exemplar implementation is built on the CORD platform*
- **Modular Components:**
  - *VOLTHA abstracts the PON as a quasi-Ethernet switch to the SDN controller*
  - *Trellis manages a multi-purpose leaf-spine fabric*
  - *ONOS – SDN controller for both VOLTHA & Trellis*
  - *XOS: service delivery & orchestration of workflows*
  - *CORD platform: set of Docker containers managed by K8s*
- **SEBA: SDN Enabled Broadband Access**
  - *SEBA – a profile instantiated on CORD, jointly developed by ONF, AT&T & community*
  - *NEM – provides northbound interfaces for integration with operator backends*
  - *Significant focus on FCAPS infrastructure, multiple operator workflows*
  - *Headed to trials at AT&T, significant interest from operators worldwide*