Nokia Contributions to R-CORD
CORD Build 2017

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Introduction

• Nokia contributions to ONOS
• Nokia contributions to VOLTHA
• Gaps and potential areas for improvement in VOLTHA
Nokia Contributions to ONOS
DHCPv6 Relay Application

- [https://jira.opencord.org/browse/CORD-1430](https://jira.opencord.org/browse/CORD-1430) Support DHCPv6 by DHCPRelay App
- DHCPv6 App contributed to ONOS supporting requirements for MSO’s
- Support for Direct and Indirect connected hosts
- Add learned routes to ONOS
- The orchestration provisions the link address
- Document: [https://wiki.opencord.org/display/CORD/DHCPv6+Relay](https://wiki.opencord.org/display/CORD/DHCPv6+Relay)
- [https://wiki.opencord.org/display/CORD/DHCP-relay+additional+features](https://wiki.opencord.org/display/CORD/DHCP-relay+additional+features)
Nokia Contribution to ONOS
IPv6 Multicast Driver

- https://jira.opencord.org/browse/CORD-1622 Update McastHandler in Segment Routing to support IPv6
- https://jira.opencord.org/browse/CORD-1624 Add IPv6 multicast in McastHandler and OFDPA2.0 Drivers
- IPv6 Multicast support was added
- Orchestration will provision the static multicast streams
- Documentation: https://wiki.opencord.org/display/CORD/IPv6+Multicast
Nokia Contribution to ONOS
IGMP Proxy Application

ONOS IGMP Proxy app:
- Processes IGMP join and leave messages updates mfib. Implements proxy function and sends join/leave towards BNG
- Installs OpenFlow rules on the VOLTHA for MC traffic to flow downstream
- Responds to queries received from BNG
- Send GMQs and GSQs towards the PON users

VOLTHA:
- Sends/Receives OF encapsulated IGMP packets from ONOS
- Provides a mechanism for the adapters to send/receive control packets

SD-OLT:
- Sends/Receives IGMP packets through the RPC channel to VOLTHA
- Updates mfib upon receiving MC flow RPC

vOLT Control Plane
IGMP Proxy
ONOS
OpenFlow
OF(IGMP)
VOLTHA
GPB(IGMP)
gRPC
OLT
MC FIB

STB
ONT

MC
MC

Video Source
BNG

IGMP proxy application added to R-CORD by Nokia

GPB – Google Proto Buf
Nokia Contribution to ONOS
AAA Application Enhancements

ONOS AAA app:
- Implements 802.1x Authenticator state machines
- Processes EAPoL messages from the supplicant
- Implements Radius Client function
- Exchanges RADIUS messages with the radius server [with EAP payload]
- Authenticates the port when EAP_SUCCESS is received from the radius server

RG:
- Implements 802.1x Supplicant state machines

New features added to AAA app by Nokia:

VOLTHA:
- Sends/Receives OF encapsulated EAPoL packets from ONOS
- Provides a mechanism for the adapters to send/receive control packets

SD-OLT:
- Sends/Receives EAPoL packets through the RPC channel to VOLTHA
Other Nokia Contributions to ONOS

- Enhancements and bug-fixes to AaaManager, State machine and RADIUS
- Bug fixes in XoSIntegration impacting AAA app
- Command to show current authenticated users
- Enhancements and bug fixes to R-CORD IGMP snooping app and CORD mcast app
- Support for MCVLAN configuration in CORD mcast app
- Nokia pipeline driver in ONOS
- 802.1x packet lift installed with a higher priority than l2fwd OF rule
- Support for DHCP flow rules
- GET/GET ALL/SET ALL subscribers via REST interface in olt app
- Enhanced mcast app to clear flows and groups while multicast vlan changes
- Fixed bug in multicast app where more than one device cannot join into same group
- Added REST interface for Set/Get/Delete Qos configuration
- ...

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VOLTHA Architecture in June 2017
Hard-coded PON and ONU provisioning

- Use to relay OMCI messages between the ONU and OLT adapters
- Supports configuration for flows
- No configuration support for PON related attributes
- Handles ONU-id assignment (based on a hard-coded formula)
- UNI Port numbers are hard-coded
- Harcoded GEM ports/alloc-ids

- Direct interface into core
- ONU Device automatically created when ONU is detected.
- All the ONU attributes are hard-coded
- No pre-configuration
- UNI port numbers are hard-coded
- Some ONU adapters (e.g. BCM ONU) use hard-coded VLAN ids (same as in-port)

- No support for ONU pre-provisioning from NBI
- No support for PON provisioning from NBI
- OLT device can be pre-configured
- OLT device-id is auto-generated (improvement required in future for NBI configurable ID/name)

•  No support for ONU pre-provisioning from NBI
•  No support for PON provisioning from NBI
•  OLT device can be pre-configured
•  OLT device-id is auto-generated (improvement required in future for NBI configurable ID/name)
PON and ONU provisioning introduced by Nokia
Introduction of xPON Handler & xPON Agent

- Support PON and ONU provisioning via NBI
- Derive protos from WT-385 xPON models
- xPON Handler responsible for handling PON and ONU provisioning
  - Responsible for validation and saving provisioning to database
  - TC-Id allocation (i.e. Gem-port and Alloc-IDs)
- xPON Agent handles all the post-processing of PON and ONU provisioning following the database save
  - Responsible for sending the configuration towards the adapters

- OF-Agent
- Envoy
- NC Server (bottom-up RPCs)

- Flows
- CLI
- REST
- NC Server

- Global Handler
- Local Handler
- Device Agent
- Adapter Agent
- Config Handler
- xPON Handler
- xPON Agent
- omei

- Proxy itf

- OLT Adapter
- ONU Adapter

- IAdapter interface extended for PON and ONU provisioning in a generic fashion
Nokia Contributions to VOLTHA

xPON

xPON handler
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- Responsible for validation and saving provisioning to database
- TC-Id allocation (i.e. Gem-port and Alloc-IDs)

xPON Agent
- Handles all the post-processing of PON and ONU provisioning following the database save
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gRPC Protobuf
- Support PON and ONU provisioning via NBI
- Protobuf is derived from WT-385 xPON YANG model (https://wiki.broadband-forum.org/display/BBF/Software+Release+Registry?preview=/20744764/24346720/WT-385_draft1.pdf#WT-385_draft1)

xPON CLI added for all supported xPON objects
IAdapter interface is extended for PON and ONU provisioning in a generic fashion
WT-385 xPON transport YANG Model
Used for protobuf between NBI <-> CORE and CORE <-> adapters

Missing in VOLTHA 1.0

Data needed by OLT device for its operation (xPON Infrastructure and ONU related)

Data needed by ONU device for its operation

In case of TR-156 ONU

Link table for {OLT-ONUs} Combined-NE mode

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Hardware Entity management for OLTs and ONUs
Missing in VOTLHA 1.0

OLT device can be created. However, ONU device is auto-created in VOTLHA. The OLT ports are discovered and hardcoded. No provision for configuration of ONU slots/ports in VOTLHA 1.0.
Current Architecture gaps
Lack of NC/Y framework, tightly-coupled adapters, in-memory data-store etc.

- REST and CLI are offered directly from the CORE.
- Validations are hand-crafted!

- Config is stored as protobuf inside the core
- Coupled with the core

- Non Standard
- Not YANG driven
- No validations
- Has no concept of data-store (candidate, running etc.)
- Does not support basic NC primitives like edit-config, copy-config, etc.

VOLTHA CORE

OF-Agent | CLI | Envoy | NC Server (bottom-up RPCs) | gRPC (protobuf)
Potential for Improvement

- Render REST and CLI over NC Server automatically
- Unified management interfaces
- All YANG validations are free
- Common interface for data-base management for all NBI

- Standard NC server with standard YANG models (IETF, BBF), model-driven
- Support for full-blown validations
- Supports working with external highly-available databases
- Easy to support features like database persistency, backup-restore, ingesting DBs

- External database (use proven data base implementation)
- Highly-Available
- Available for all components that need access to data-store (single-place)

- De-couple Adapters from core (remove tight coupling)
- Allows for easy integration of Adapters
- Core has dependency on the adapters

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ONF Booth @ Broadband World Forum

- ONF demonstrated multivendor E2E unicast and multicast services using R-CORD & VOLTHA @ BBWF, Berlin in Oct 2017
- Link to ONF BBFW Page
Nokia Lightspan CF-24W
Delivers industry’s highest NG-PON capacity in a 1U box

Features
- Small and compact 1U shelf size
- Modular and scalable data center practices
- Full non-blocking data path architecture
- 240 Gb/s NG-PON capacity in single rack unit
- Redundant 300 Gb/s uplink capacity to external leaf-spine switching fabric
- Open and programmable interfaces and standard device models (NETCONF/YANG)
- Rack mountable with front-to-back airflow for cloud central office and data center

Downlink ports: 24 x XGS PON (XFP)
Uplink ports: 6 x 40G/100G Uplink (QSFP28)