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OpenROADM for Disaggregated Optical Networks: Challenges, Requirements and Evaluation

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Introduction & Motivation

Introduction to SDN in Optical Network and Problem Statement.

INTRODUCTION

SDN for Optical Transport Network.

- Challenges in SDN in Optical Transport Network.
  - Vendor Dependency
  - Vendor Lock-in in the NW
- Unified Communication.

Motivation.

- Challenge in Fully Disaggregated Optical Network.
  - Device Compliance
  - Controller Support
  - Up-to-date Feature

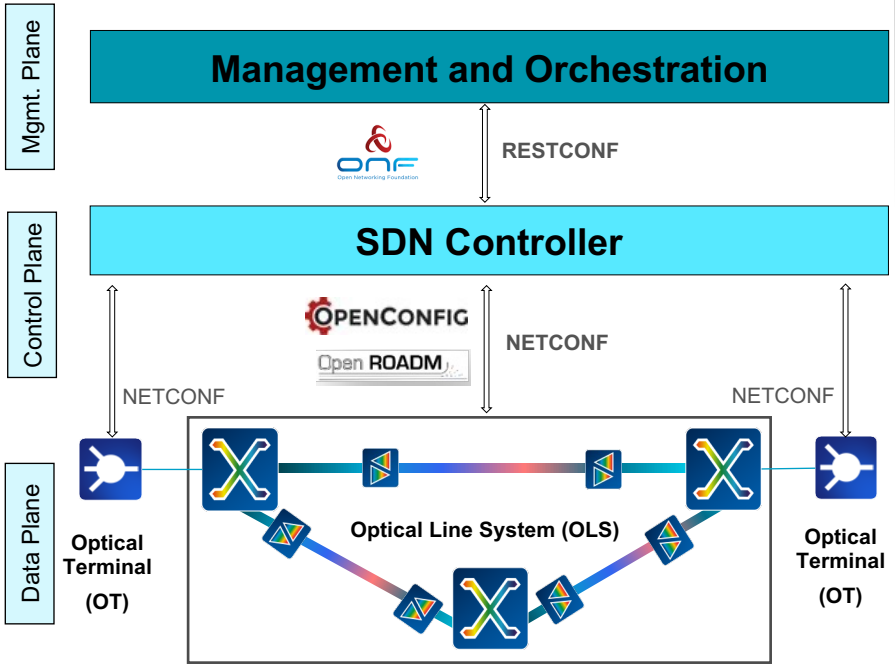
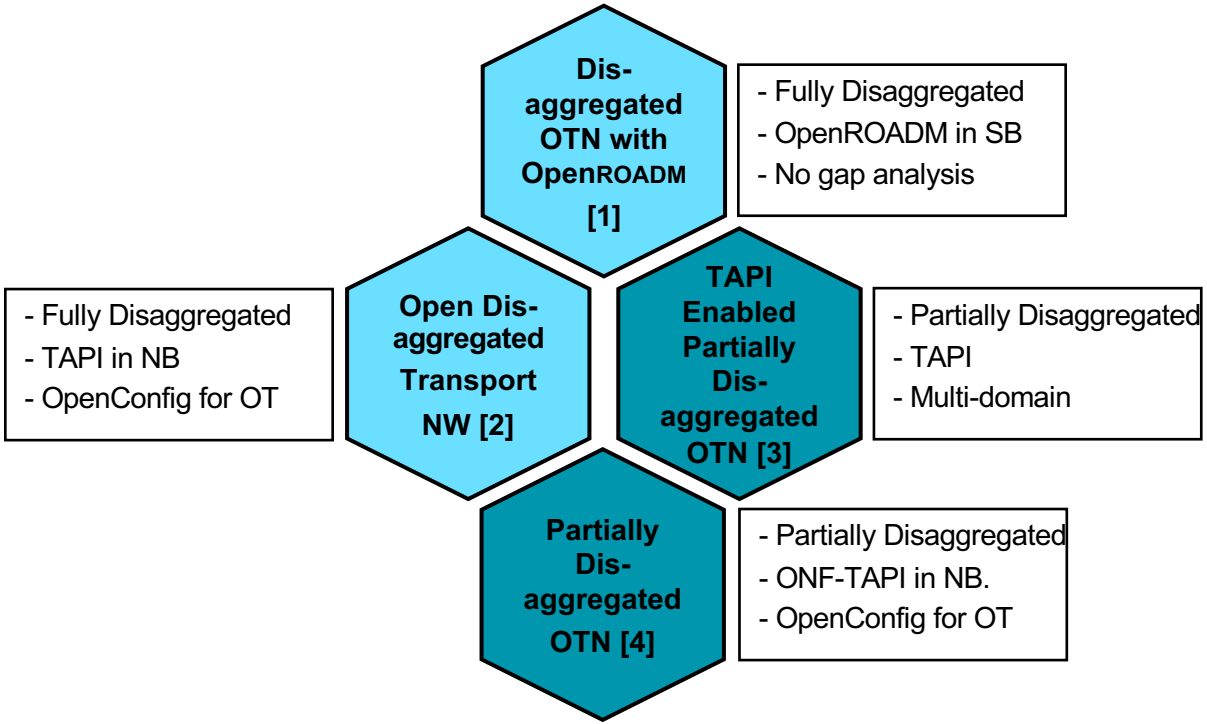


Figure 1: Optical Transport Network Architecture - Overview

State Of The Art



Gaps

1. OpenROADM – Vendor NE Compatibility.
2. Limits to fundamental Operations.
3. Controller Compatibility.

Our proposal

1. Examine YANG structure for vendor neutral support.
2. Gap analysis.
3. Suitable control plane entity.

YANG Specifications

OpenConfig[5]

Aims to support NEs from all technologies.

Pros:

Vendor-neutral, Comprehensive telemetry specifications.

Cons:

Lacks in Complete abstraction.

OpenROADM [6]

Focused on fully disaggregated optical network.

Pros:

Fully disaggregated optical network. Vendor Neutral.

Cons:

Difficult to support all vendor NE capabilities.

ONF-TAPI [7]

Aims to support on functional aspects on NB of the controller.

Pros:

Supported in all major controllers.

Not applicable for NE configuration in SB.

Native YANGs

Specific to NEs from respective vendors.

Pros:

Complete utilization of the UE functionalities.

Cons:

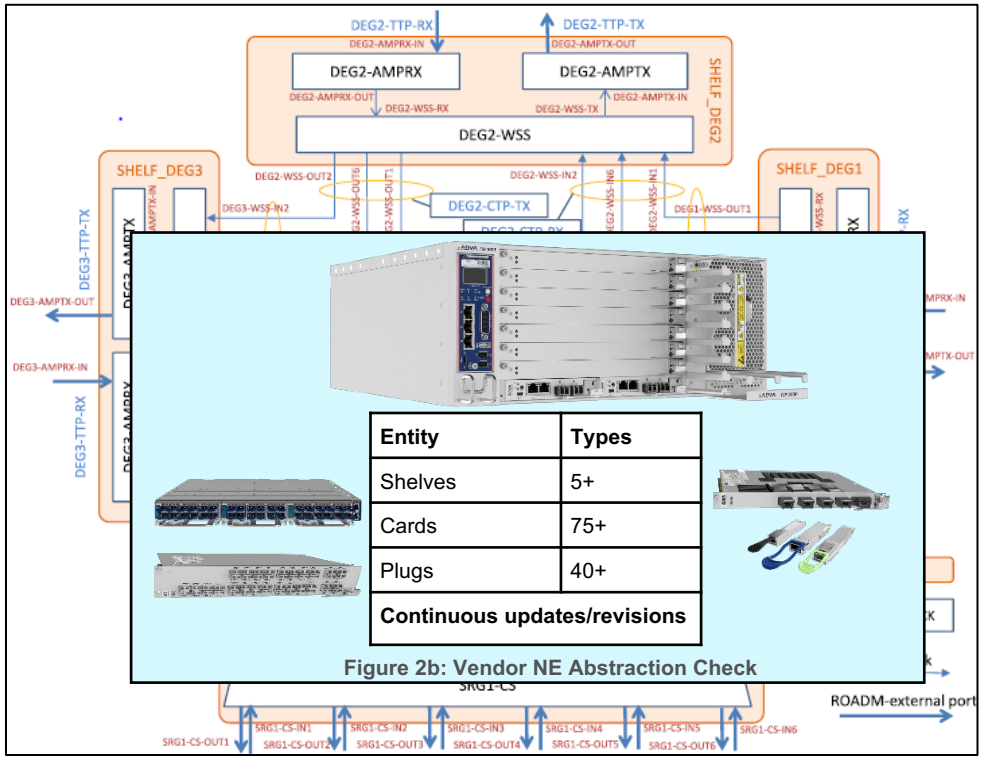
Limited to vendor platform only.

OpenROADM is matured enough?

OpenROADM: Challenges and Requirements

Gap analysis in employing OpenROADM in Fully Disaggregated Optical Network.

Device Abstraction



Entity	Types
Shelves	5+
Cards	75+
Plugs	40+
Continuous updates/revisions	

Figure 2b: Vendor NE Abstraction Check

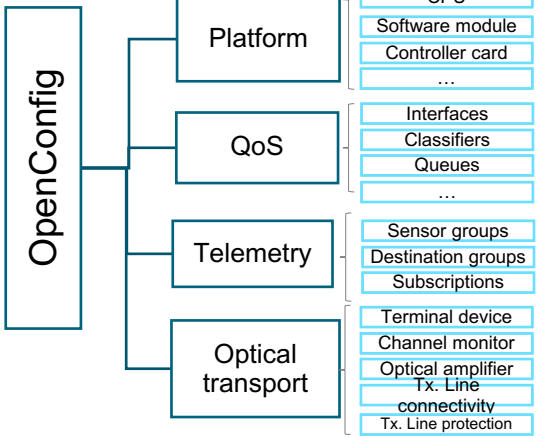
Figure 2a: Sketch of OpenROADM Device Model.

OpenROADM Definition: (Fully Dis-aggregated)

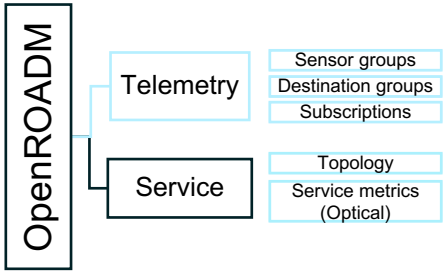
- Circuit pack (replaceable unit) model is followed for device definitions [1].
  - Overview of the device elements is achieved.
  - Granular mapping for each element is questionable.
  - Extensions and augmentations are still required.

Courtesy: Figure 5a: Casellas, et al. " Abstraction and control of multi-domain disaggregated optical networks with OpenROADM device models" [1]

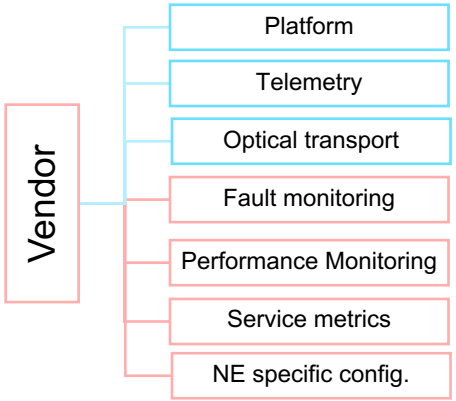
Telemetry Capabilities



(a)



(b)



(c)

OpenROADM Definition: (Fully Dis-aggregated)

- OpenConfig models are used to define telemetry parameters.

Mixed-schema definition: (Partially Dis-aggregated)

- OpenConfig telemetry +
- Native models to augment service, device monitoring metrics.

Further analysis,

- Quality of Transmission,
- Fault and Performance Management,
- Optical Service Configuration, etc.

Figure 3(a,b,c) : Model Analysis (Telemetry & Operational Data) OpenConfig, OpenROADM and Vendor YANGs.

OpenROADM: Evaluation

YANG Models – Quantitative Analysis & Controller Assessment.

YANG Specifications – Quantitative Analysis

- Number of LoC in YANG for the functionalities is observed,
  - Device Configuration.
  - Telemetry.
  - FM/PM.
- No. of LoC might depend on the coding coventions followed in each project.

So, the No. of metrics are compared.

- From the observation, it can be seen,
  - Native YANG has greater definitions on device abstraction.
  - Similar number of telemetry definitions.

```
module org-openroadm-device {
  namespace "http://org/openroadm/device";
  prefix org-openroadm-device;

  import ietf-yang-types {
    prefix ietf-yang-types;
    revision-date 2013-07-15;
  }
  import ietf-inet-types {
    prefix ietf-inet-types;
    revision-date 2013-07-15;
  }
```

```
module: org-openroadm-device
  +--rw org-openroadm-device
     +--rw info
        |  +--rw node-id?
        |  +--rw node-number?
        |  +--rw node-type?
        |  +--rw node-subtype?
        |  +--rw clli?
        |  +--ro macAddress?
        |  +--ro softwareVersion?
```

Figure 4: OpenROADM YANG Example – Module and Tree.

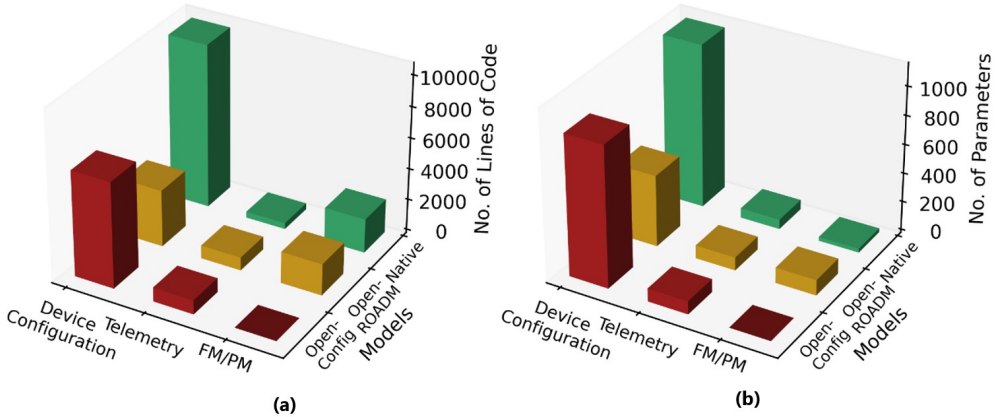


Figure 5(a,b): Evaluation of YANG models w.r.t. (a) No. of lines of code, (b) No. of parameters

Controller Assessment

OpenROADM compatible SDN controllers:

- OpenDaylight [8]
- ONOS [9]

Mining of controller projects:

Repo internals:

1. Both ODL and ONOS are mature having (100+ releases, 600+ commits, 500kLoC, and 100+ contributors).
2. The activeness of the optical projects are evaluated.

It confirms ODL is more active than ONOS.

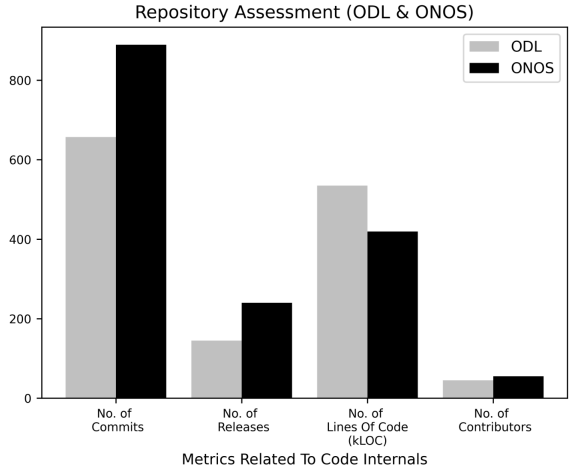


Figure 6: Comparison of Code Internals - ODL and ONOS.

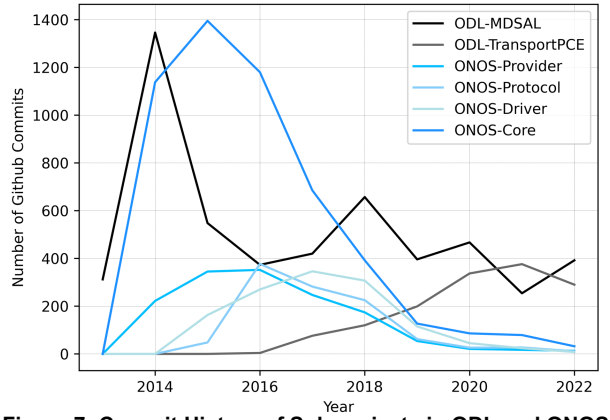


Figure 7: Commit History of Sub-projects in ODL and ONOS.

Conclusions

- The OpenROADM YANG model design and its purpose is explained.
- Gap analysis is conducted by considering following criteria,
  - Device abstraction.
  - Telemetry.
  - Fault and Performance management.

OUTCOME 1: Augmentations and extensions are still required.

- OpenROADM compatibility is assessed from control plane perspective:

OUTCOME 2: ODL is more active when compared to ONOS.

Scope:

- Address the provided gaps by extending the models.
- Develop a Closed loop automation platform with the model-driven approach using Digital Twins.

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Thank you, And Questions…

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