SONiC for Optical Transport Networks(OTN)

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Optical Transport Network Introduction

- DCI(Data Center Interconnection) optical networks connect data centers in different regions and locations

- The traffic in hyperscaler's networks doubles every one to two years

- Optical networks consist of not only optical transponders, but many optical line devices

- A simple metro-DCI optical network with a point-to-point topology has following optical devices
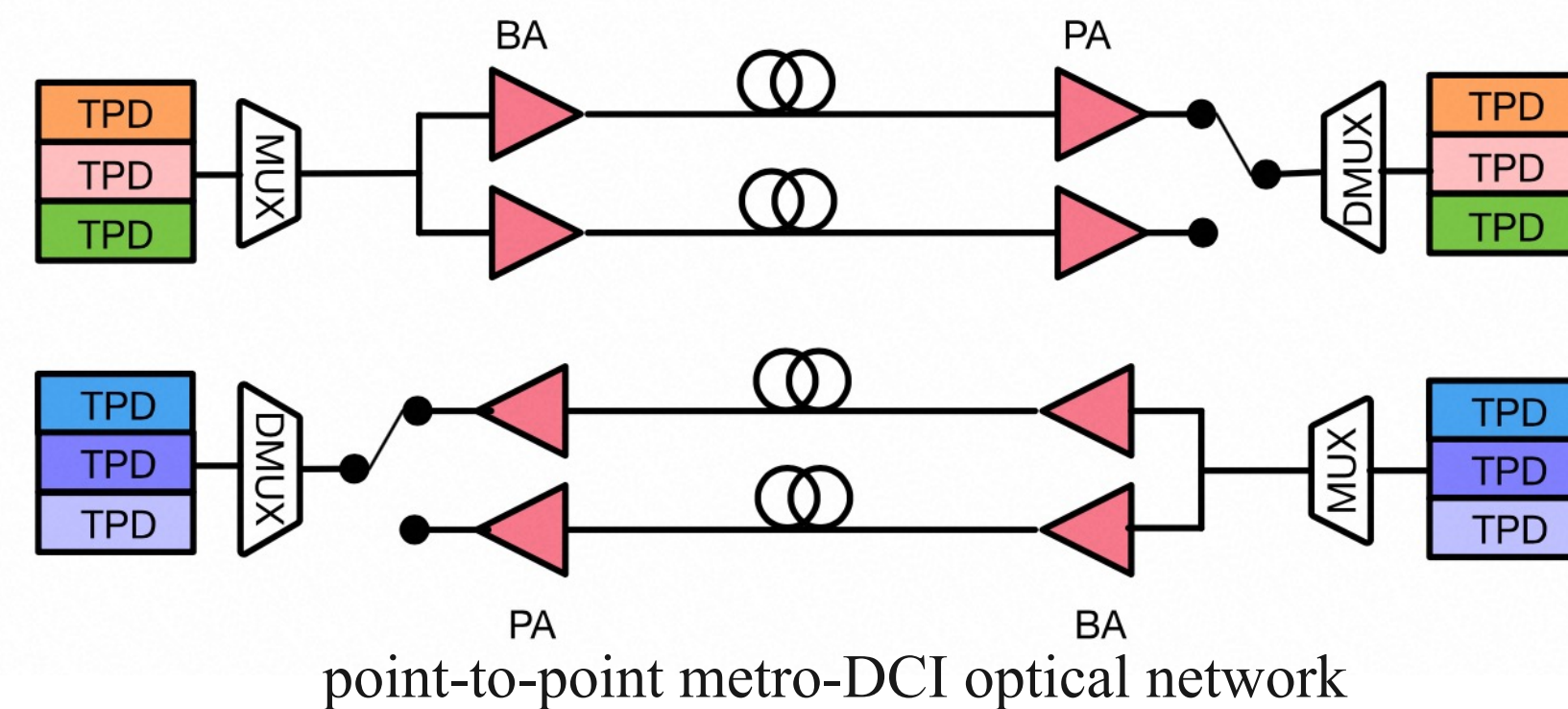
TPD: transponder
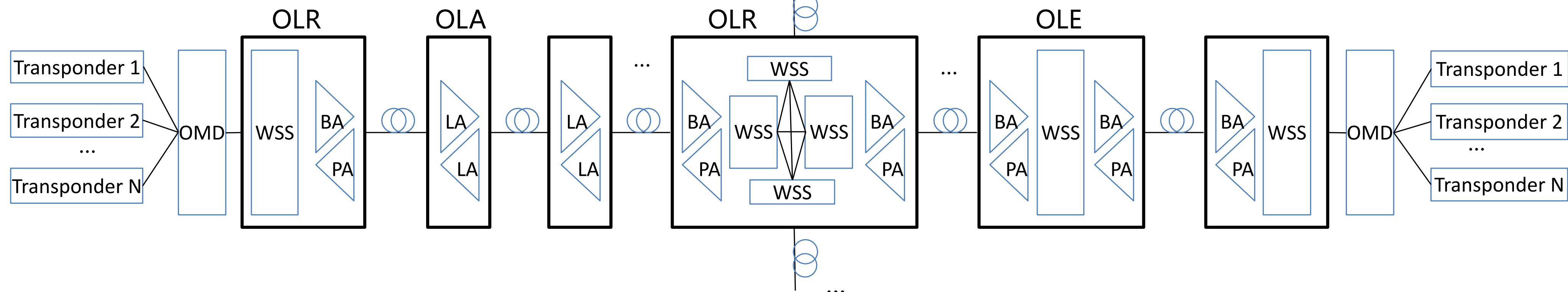**PA**: pre-amplifier.
BA: booster amplifier
MUX: wavelength multiplexer
DMUX: wavelength demultiplexer.
OLP: Optical Line Protection

point-to-point metro-DCI optical network

- A wide area optical networks have many more optical devices

NOSes on Optical Transport Equipment

- Most optical equipment is a black box, with proprietary hardware & software

- Open and disaggregated optical transport networks start to use gray boxes
  - Operating System: proprietary NOSes from equipment vendors
  - Modular hardware equipment with standardized interfaces and data model
    - Standardized interfaces: NETCONF, RESTCONF, gNMI Telemetry
    - Data models: OpenROADM, OpenConfig YANG models

- There are some efforts on whitebox optical equipment

- The Open Optical & Packet Transport group (OOPT) in TIP
  - Defined packet transport whitebox such as Cassini, including both switch chips & optical transponders
  - Using Transponders Abstraction Interface (TAI)
  - NOS: TIP's Goldstone and other commercial NOSes
  - The whitebox has no optical line devices such as optical amplifiers, wavelength switches …
  - Optical transponder management is based on TAI and Sysrepo, not SONiC based architecture, difficult to share SONiC ecosystem


Gray box
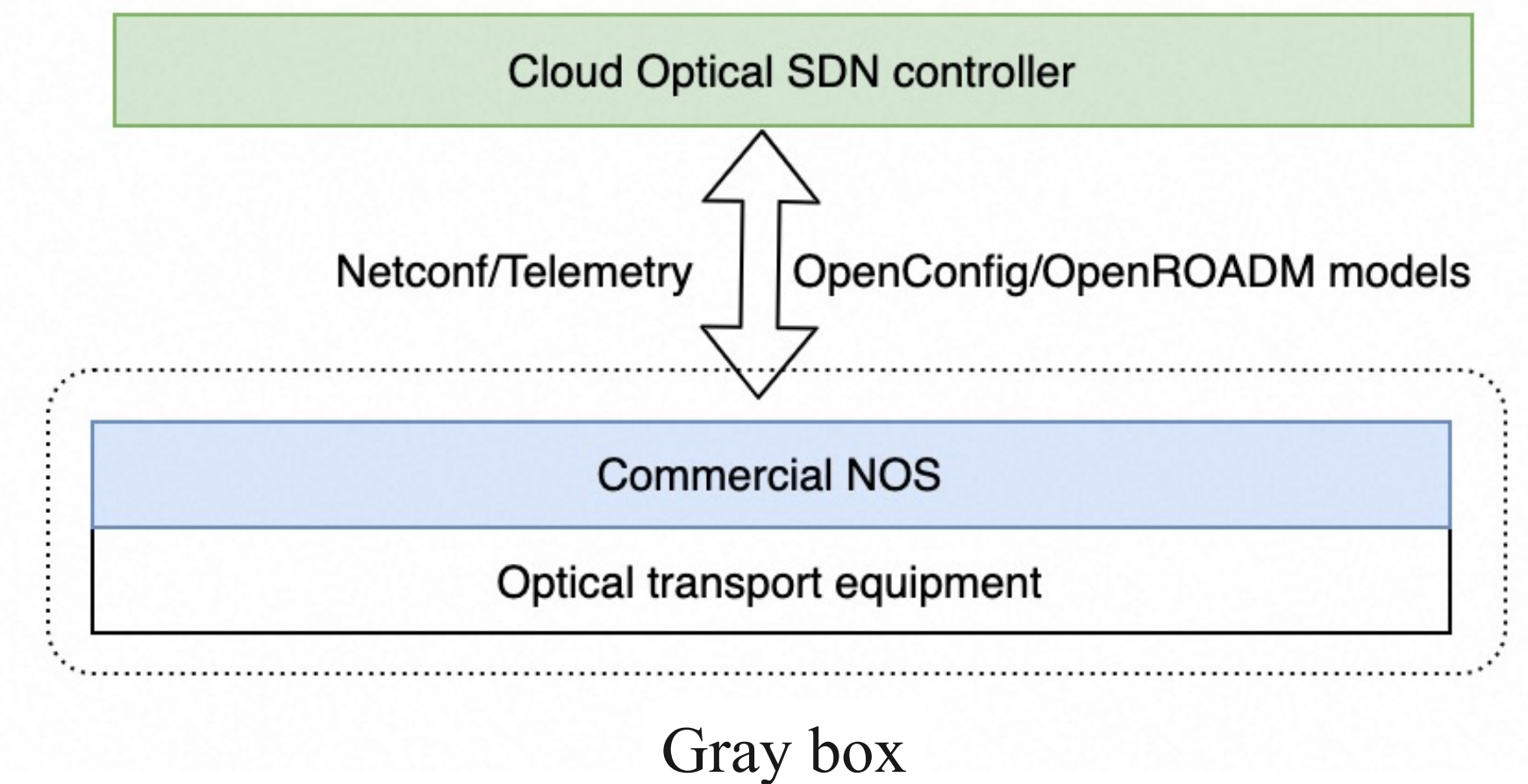
Whitebox packet-optical device Cassini

SONiC and Optical Transport Networks

- We propose & demonstrate a SONiC based NOS for open whitebox optical transport equipment
- We name it AONOS (Another Optical Network Operating System)
  - Supports pluggable optical transponders from different vendors
  - Supports optical line devices including OAs and OLP switches
  - The NOS runs on main control card and manages different linecards
  - Provides standardized northbound interfaces, RESTCONF, Telemetry, and CLI
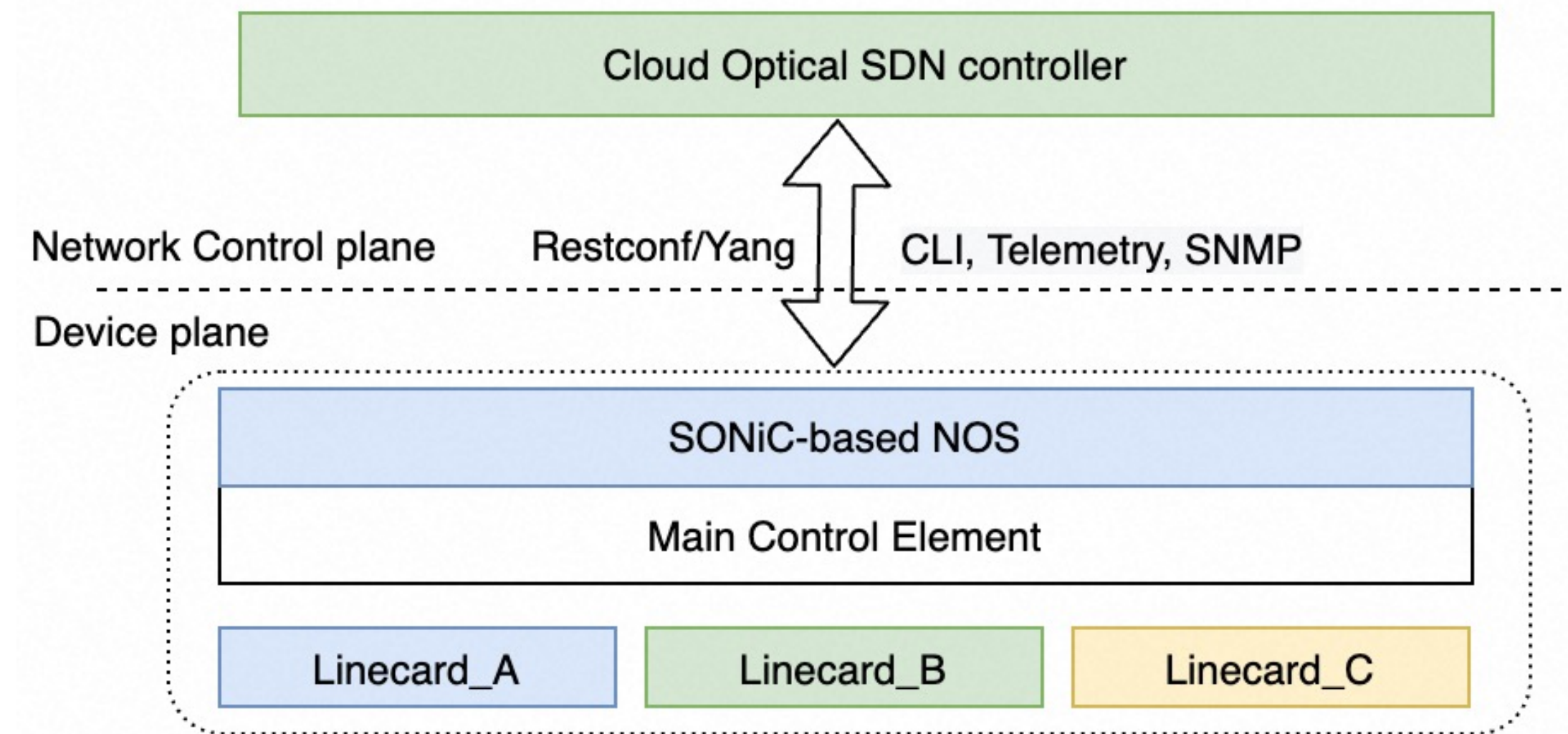

NOS on Optical Transport Equipment
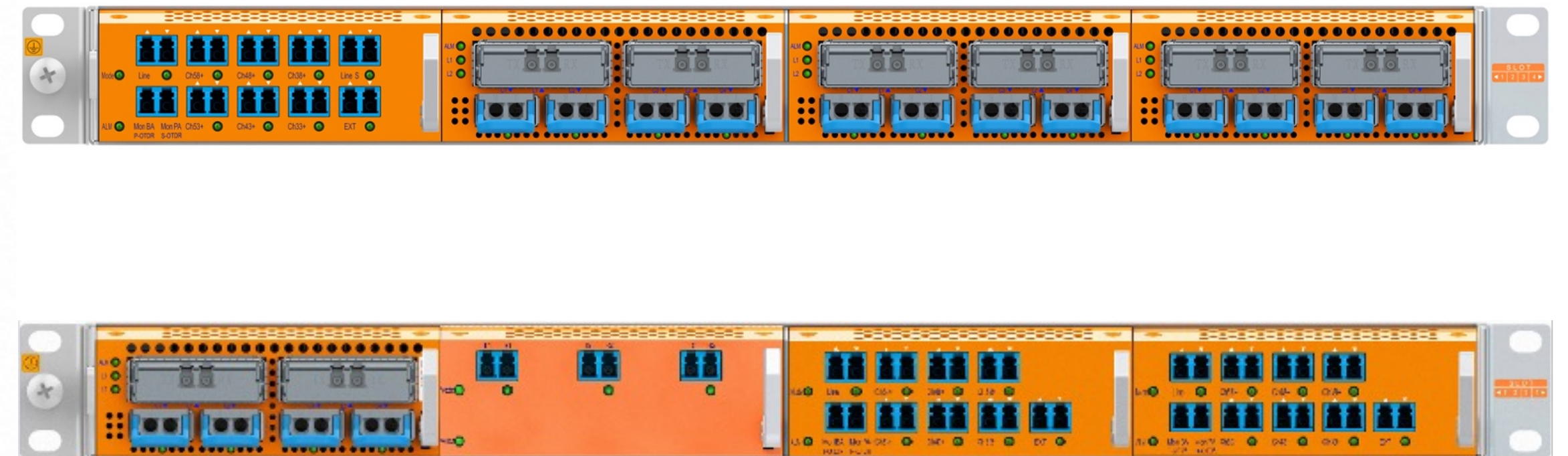
Whitebox OTN Equipment with SONiC based AONOS

AONOS Architecture

The proposed SONiC-based NOS for whitebox OTN equipment

- Re-uses Redis, PMON, and platform drivers from SONiC

- Adds optical abilities to the SONiC platform

  o Supports OpenConfig optical YANG models in RESTCONF and Telemetry container

  o Defines Linecard Abstraction Interface (LAI) to control optical linecards

  o Introduces Optical Linecard State Service (OLSS) to manage all kinds of optical components on linecards

  o Defines standard Thrift APIs control FAN, PSU, LEDs, EEROM, etc.
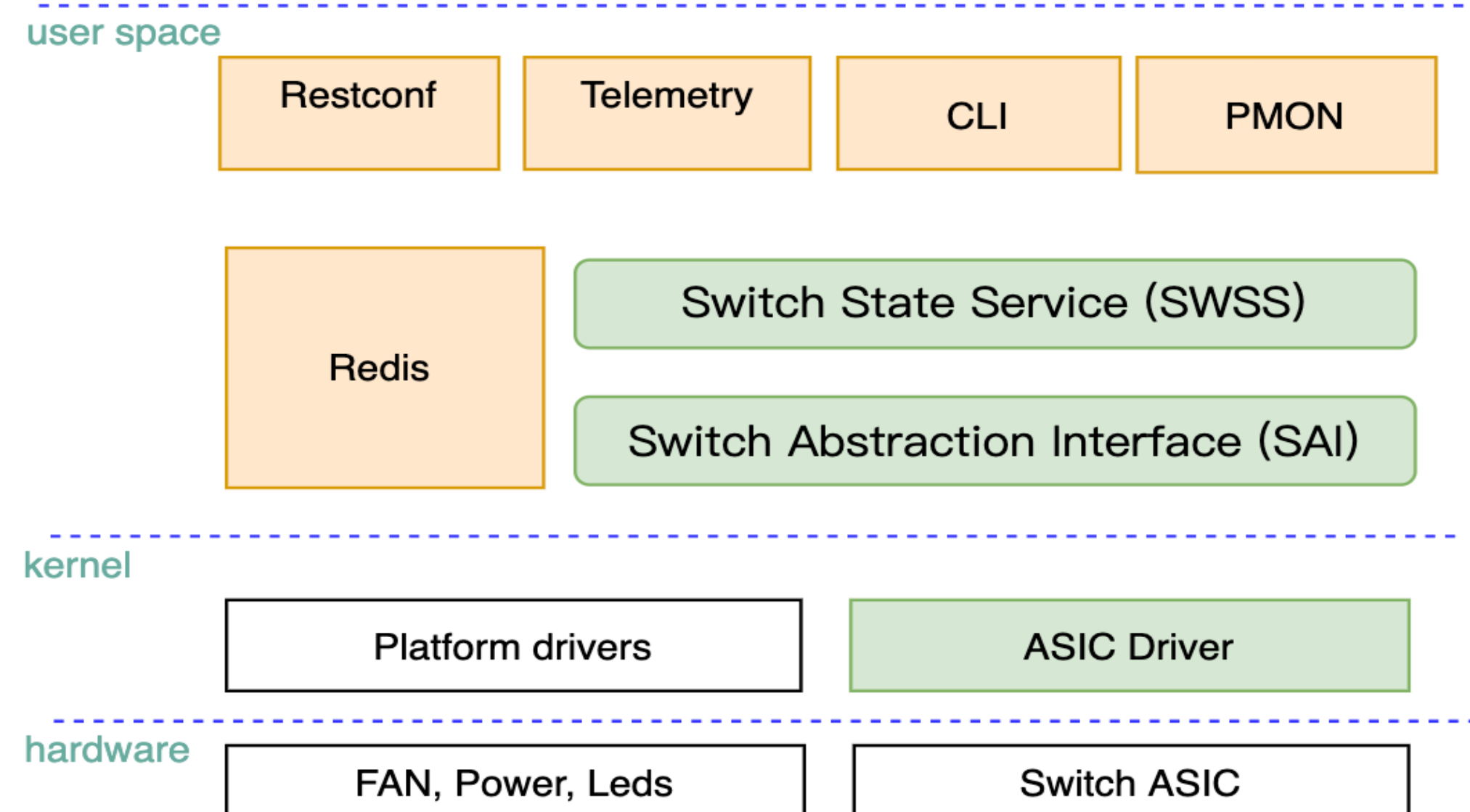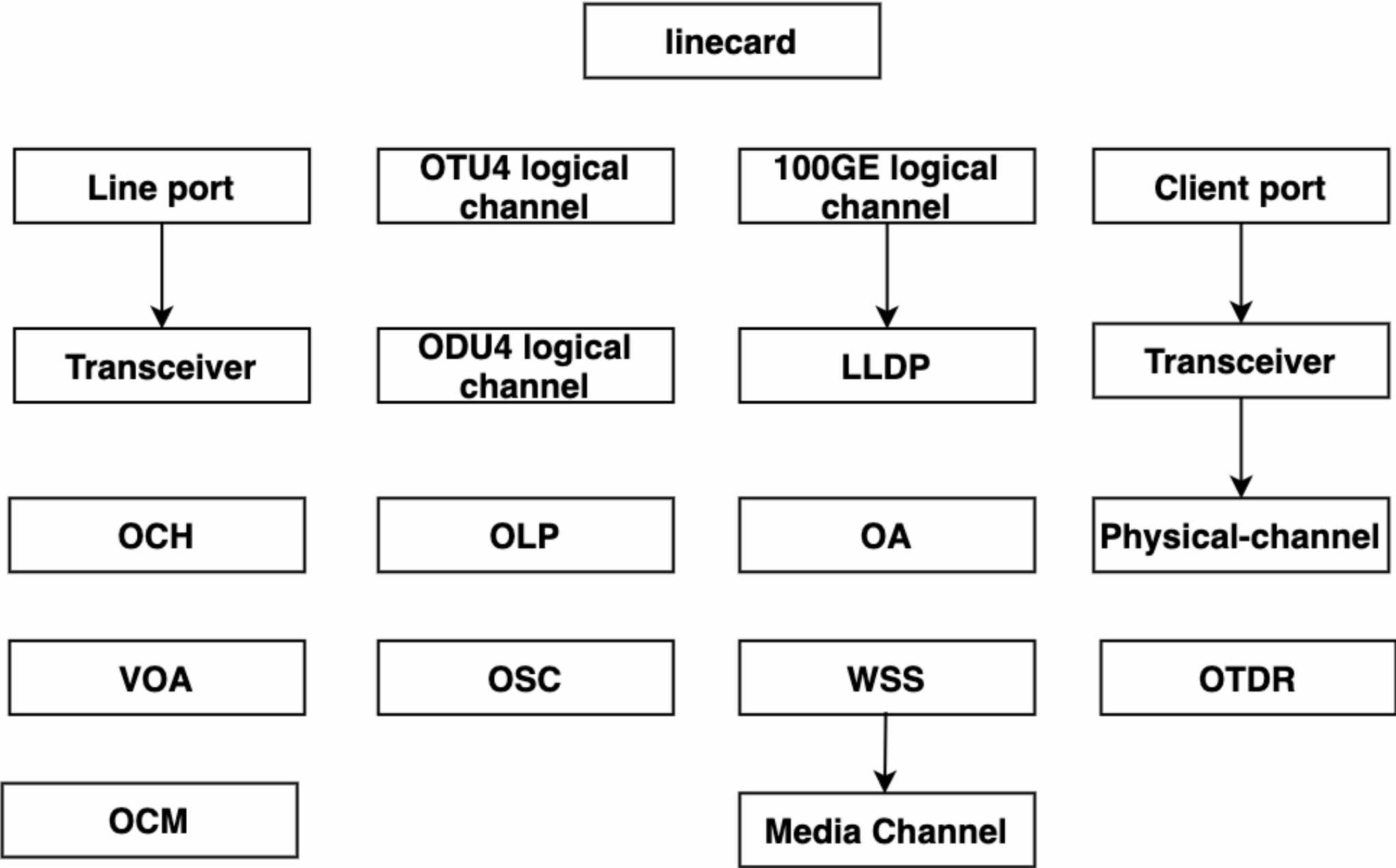

SONiC Architecuture
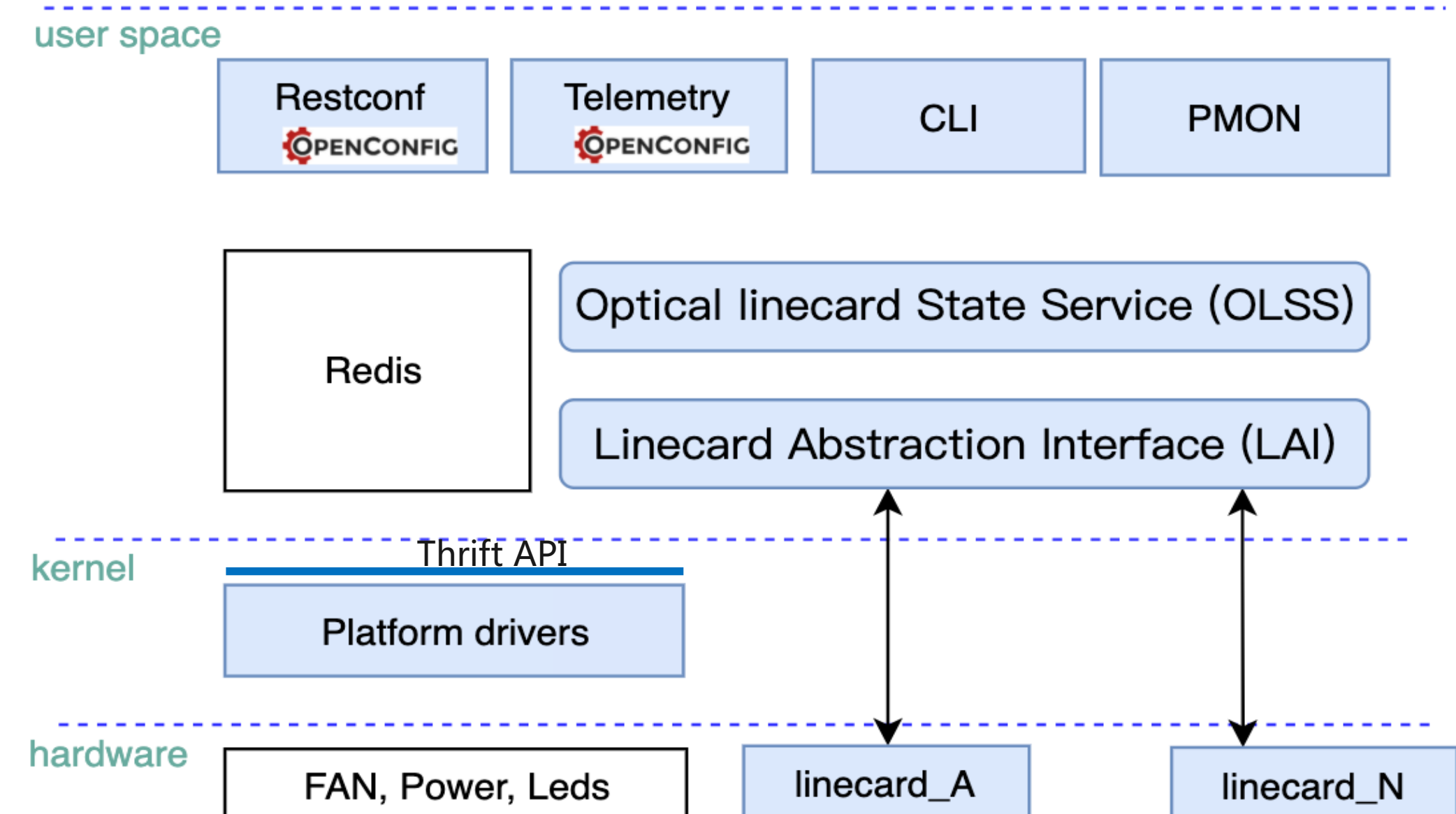
AONOS Architecture

Linecard Abstraction Interface (LAI) Overview

- LAI contains a group of optical model objects

- Depending on hardware, vendors can support desired LAI objects

- LAI defines the APIs to create and remove optical objects, and set and get attributes and statistics

LAI object model and hierarchy in ref. [1]

The definition of LAI transceiver object

Ref. 1: Weitang Zheng et al,, ECOC'2022, paper Tu5.61, 2022.

AONOS Key New Features

❑ Architecture

- Supports multiple pluggable linecards via SONiC multi-ASIC architecture

- Supports equipment pre-configuration on day 1, service provisioning on day 2

- Introduces the OLSS and LAI to manage different linecards from vendors

- Defines thrift interface to manage FAN, PSU, Switch, LED, EEPROM, etc.

❑ Northbound management

- Supports standard Openconfig YANG optical data models in Restconf and Telemetry

- Enhances CLI feature for Optical network management

- Supports alarm reporting via SNMP-trap and 7 days history alarm

- Enhances TACACS+ AAA feature for CLISH CLI shell

❑ Device management

- Introduces In-service One-packet System Upgrading feature

- Supports Chassis, CU, Linecards cold and warm restart

- Supports 15min, 24 hour current and history performance monitor

- Supports LLDP on OSC interfaces

- ……

Differences between AONOS and SONiC

Key Modules	AONOS	SONiC
Restconf	Different(Openconfig, Multi-AISC)	Sonic Yang
Telemetry	Different(Openconfig, Multi-AISC)	
SWSS	No	Yes
SAI	No	Yes
OLSS	Yes	No
LAI	Yes	No
SNMP	No	Yes
FRR	Yes	Yes
LLDP	Yes	Yes
TACACS	Enhanced(Clish support)	Yes
Muti-ASIC	Default-4	1 ASIC
CLI	Different(CLish, Optical features)	Sonic-utilities
Installer	Different(Linecards, one-packet)	Sonic-installer
Alarm/PM	Different(15m/24m, current/history)	
PMON	Different(power-control, pluggable linecard present, thrift)	Yes
Ztp, ptf, gobgp, quagga, libteam, Pddf, router-advertiser,fast-reboot, ...	NO	Yes

AONOS System CLI Demo

● show version

Kernel: 4.19.0-12-2-amd64

LAI Version: 0.1.20-17-g19d004b

● show docker

Database

Olss<0-3>

Syncd<0-3>

```
winterzheng@B-T9WRMD6M-2148:~| →
```
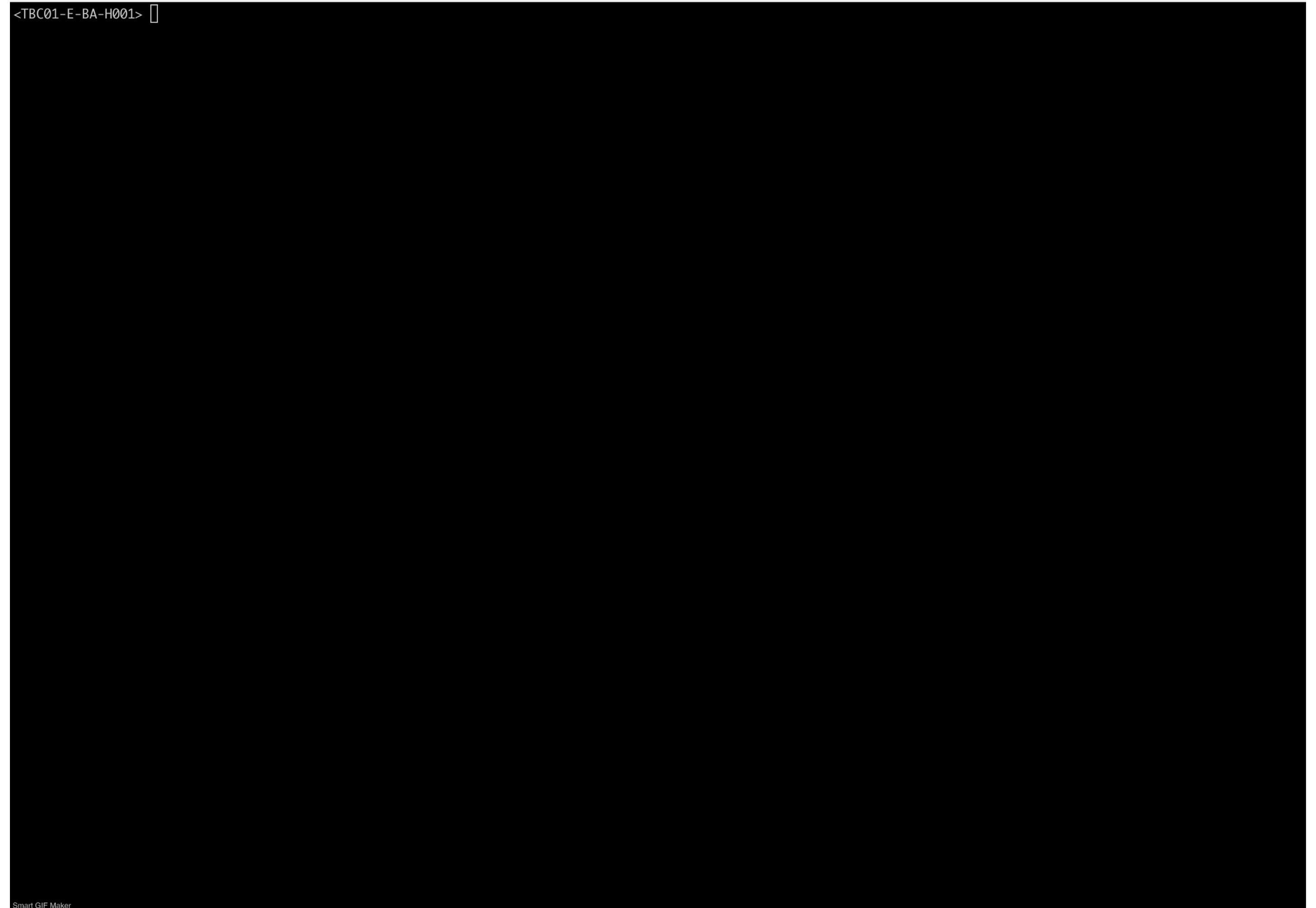
Smart GIF Maker

AONOS System feature CLI demo

- With LAI, Syncd, and OLSS, we can manage different kinds of optical linecards.

- show slot-info

- show alarm current

- show slot 1 line 1 module

```
<TBC01-E-BA-H001> []




















Smart GIF Maker
```

AONOS Roadmap

- Open Source in SONiC-OTN community

    * Submit AONOS source code to SONiC branches

    * Provide Wiki and Development instructions

    * Review the LAI definition with the community

    * Review the platform Thrift API with community

    * Discussion on whether/how to merge SONiC-OTN to the SONiC

    * Keep contributing source code to the group

- Supports WSS, OCM, OTDR, ROADM, Optical Equalizer, … and more vendor's equipment

- Supports ARM CPU

- Introduce Alarm suppression, Optical control algorithm

- 1+1 main cards with SONiC

- ……

Build SONiC-OTN Ecosystem Together

- Involve Operators:

  Alibaba, Microsoft …

- Involve OEM:

  Accelink, Sino-Telecom, Infinera, Cisco…

- Involve Optical components :

  Accelink, Innolight, Acacia…

Operator

NOS

OEM

Optical

AONOS Ecosystem

Thanks !

Q&A

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