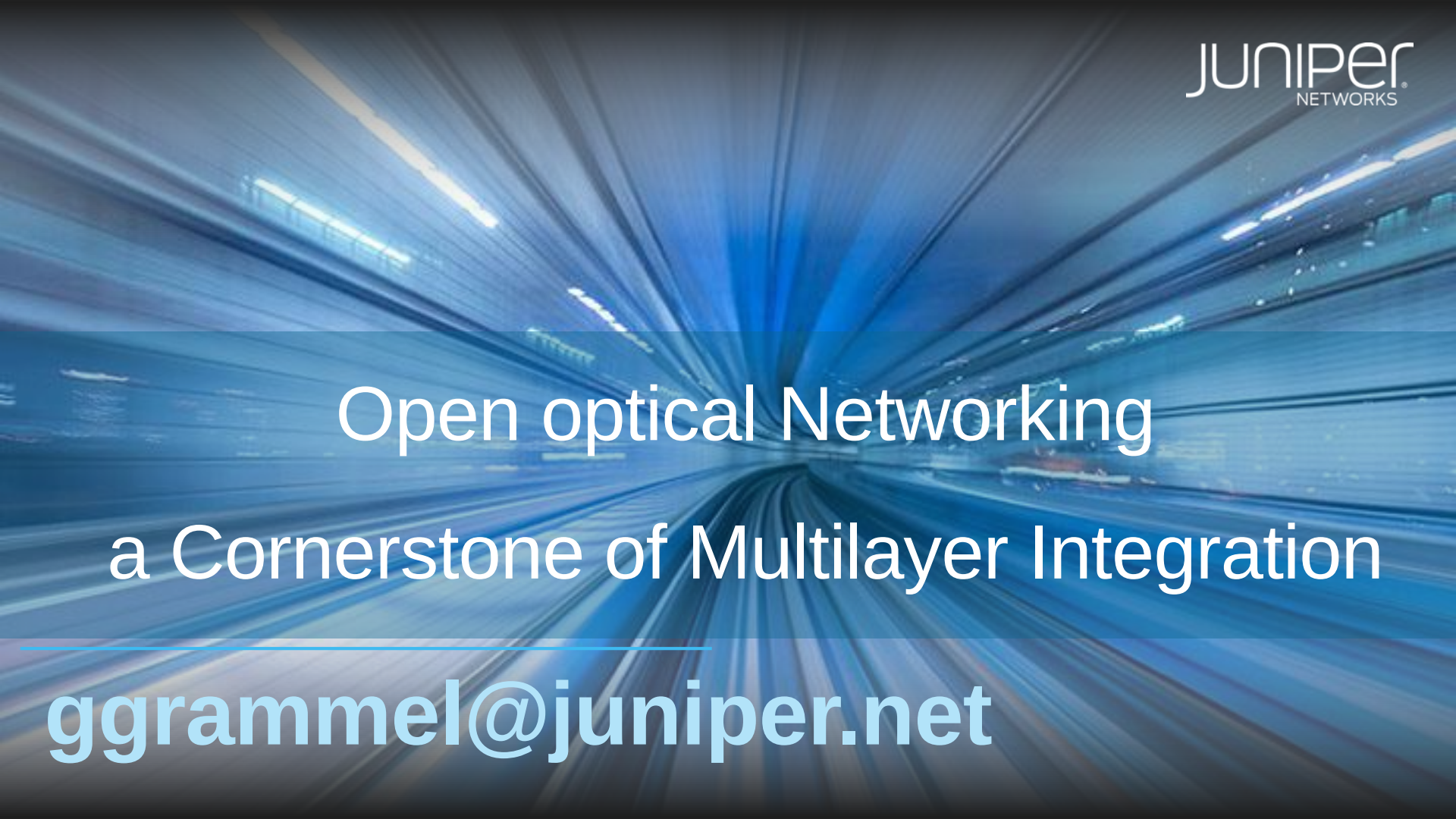

Open optical Networking

a Cornerstone of Multilayer Integration

ggrammel@juniper.net

Content

1. Packet vs. Optical - a cultural problem!
2. (Open) Optical Networks - a culture evolution
3. Reassembling the Remains
4. Where do we go from here?
5. Summary: Packet-Optical Networking

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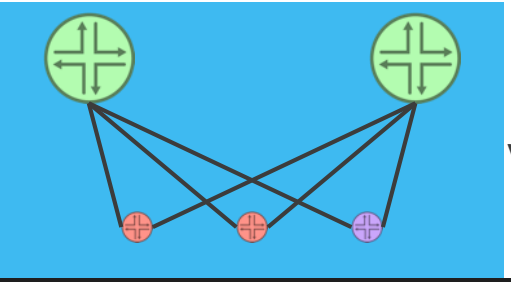
Packet vs. Optical - a cultural problem!

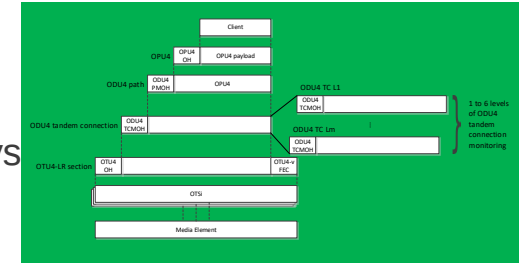
Networking paradigms

IP Networking

1. A network consists of nodes and links
2. All processing is done at nodes, links have no processing capabilities
3. The boundary of a network is determined by protocols and policy rules
4. IP traffic is a common denominator
5. Network management means configuring end-points, the rest is left to the control plane
6. Setting up MPLS-LSPs is “for free”. Enough labels are available, no bandwidth wasted.



VS



Transport networking

1. A layered network consists of node and links, all networks are layered
2. Processing is performed in layers, a link is a server-layer trail that is processed
3. The boundary of a network is either
   1. A layer boundary or
   2. A implementation boundary (i.e. vendor specific) or
   3. An administrative boundary (different organizations)
4. There is no single payload format
5. Network management is about configuring each point along a route
6. Setting up circuits has high cost. Only limited number of Time/Lambda-slots, bandwidth is reserved.

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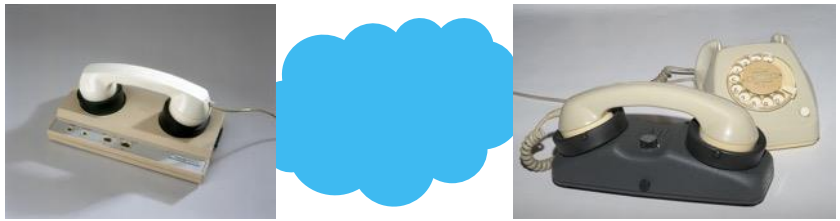
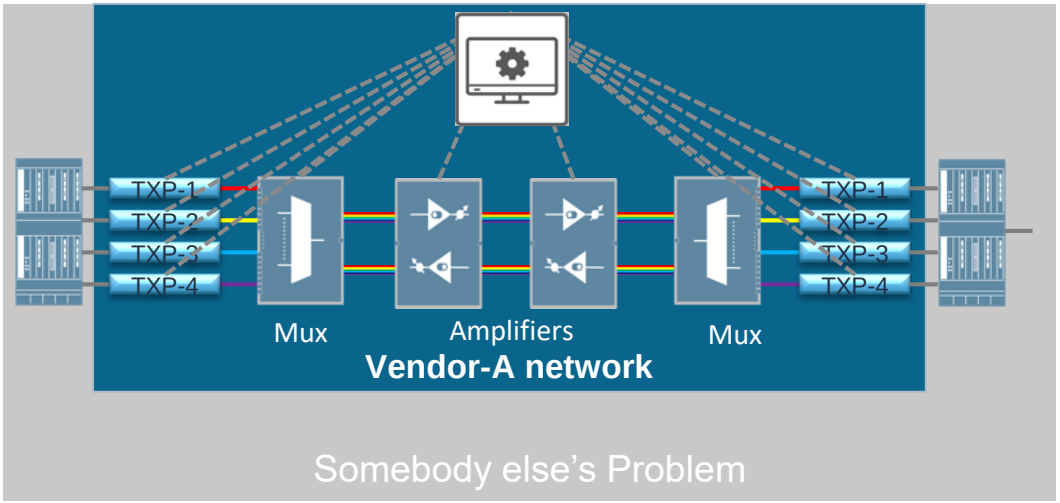
Optical Networks - 1





Somebody else's Problem

Cloud Networking in 1980s:

- Dial-tones between different countries differed
- Basic connectivity could be achieved
- Use same modem vendor for best performance

→ vendors had the incentive to keep interoperable performance low or non-existent

The beginning of DWDM technology 1990s:

- Every Transponder module has it's own proprietary format
- Basic frame format is the same (OTN) and can be supervised similarly
- Vendors have the incentive to stay proprietary
- Boundary is considered a layer transition

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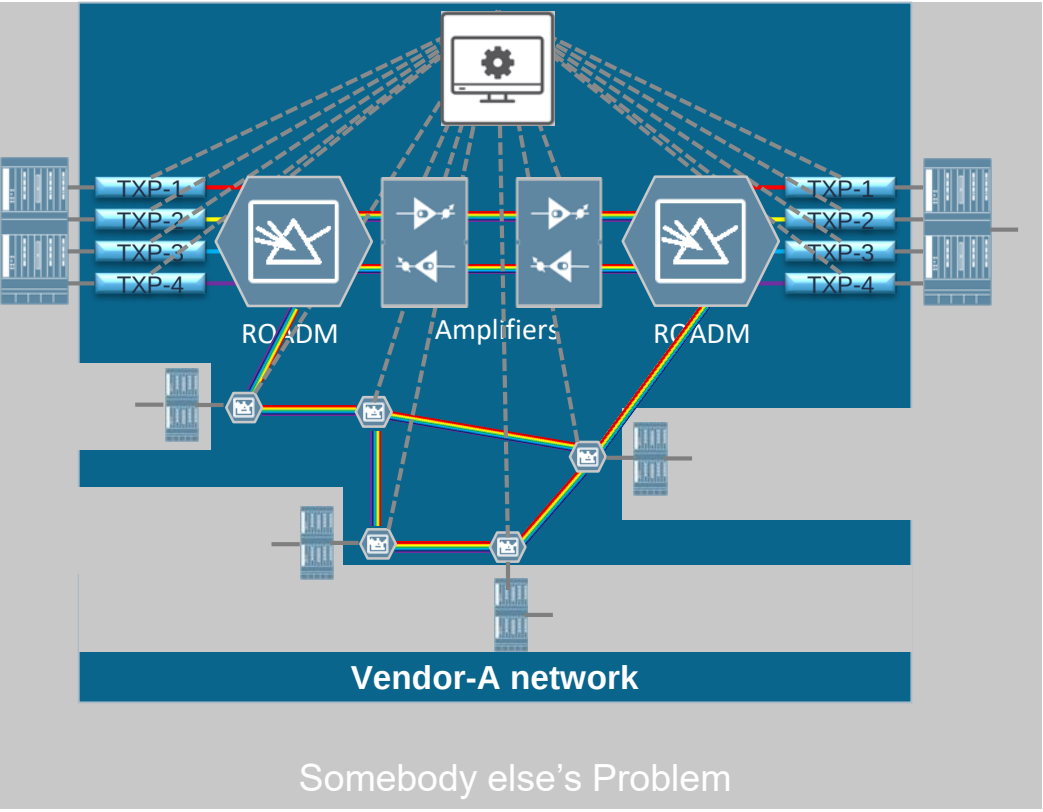
Optical Networks - 2



Somebody else's Problem

Evolution from DWDM to Optical Networks 2000s

- ROADM becomes an Element of optical networking
- Wavelength route is configurable
- The optical network remains a closed system
- Still a single vendor play
- Boundary is still considered a layer transition
- Network planning for optical performance is key

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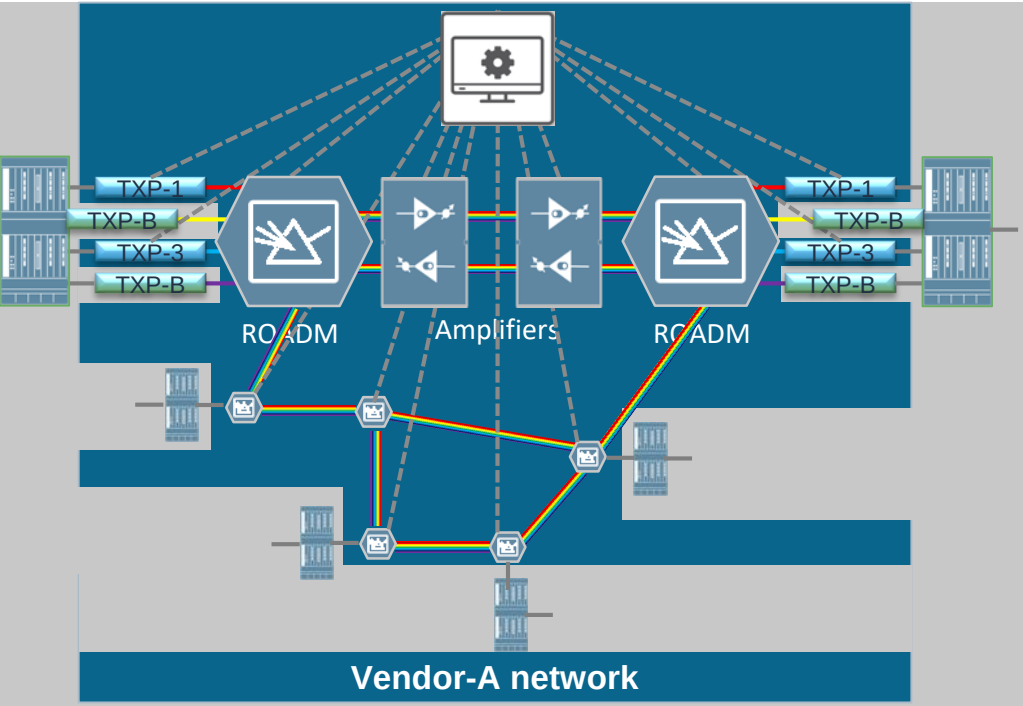
Open Optical Networks - a culture evolution - 3



Somebody else's Problem

Evolution towards **Open** Optical Networks 2010

Transport view!

- Boundary is no more a layer transition:
- Alien Wavelength: both ends still supplied by the same vendor (TXP-B to TXP-B)
- Network reserving some spectrum for 3rd party Transponders
- Configure ROADM to pass/drop the spectrum
- no idea how to manage, so leave everything to somebody else:
  - How to plan alien wavelength?
  - What should be the expected Signal quality?
  - How to measure signal quality?
  - How to configure a TXP?
  - Problem resolution: if receiver doesn't receive a signal: who's problem is it?
    a) Transmitter doesn't transmit
    b) ROADM is not in pass-through
    c) ROADM doesn't add/drop
    d) Receiver doesn't receive

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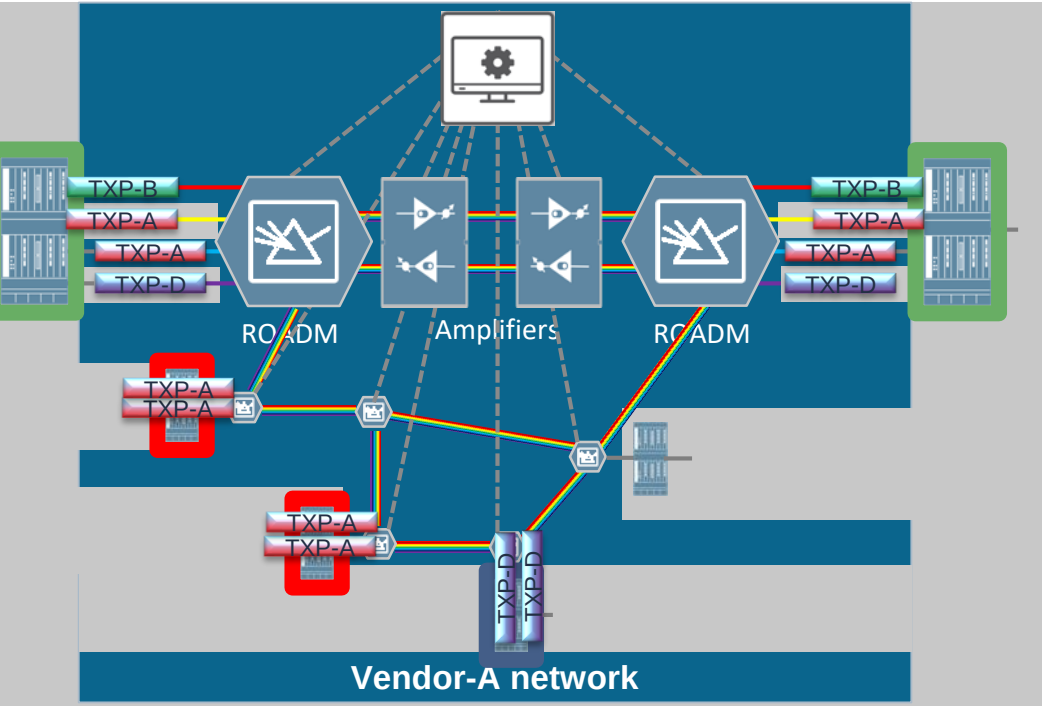
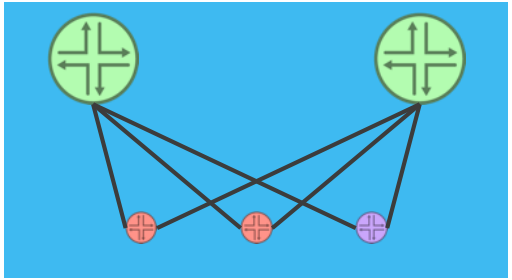
Open Optical Networks - a culture **shock** - 4



Somebody else's Problem

This is the network we wanted to build:



1. We do not want to care about which vendor provides which node
2. Hub&spoke architecture, not p2p
3. P and PE routers are different beasts from different vendors.

So this means

1. Requires to install the same single vendor TXP-modules on both ends of the wavelength
2. System vendors obliged to integrate TXP-modules from multiple vendors
3. Control software needs to manage pieces in a third party equipment

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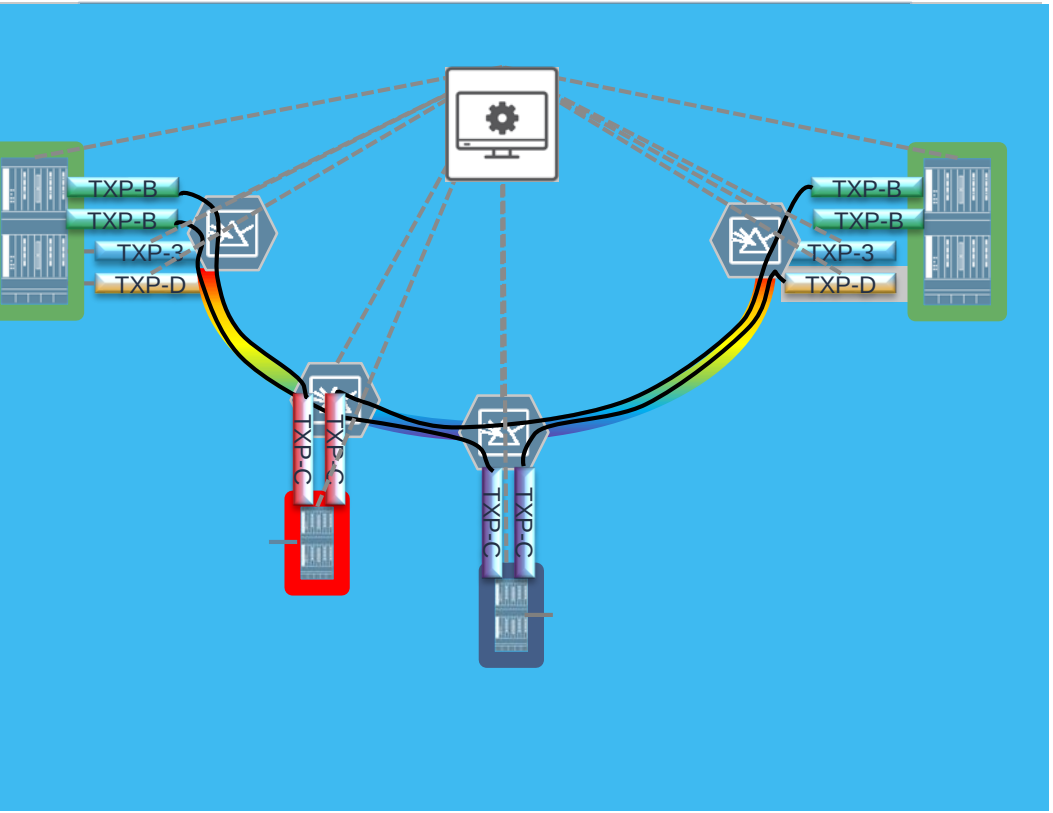
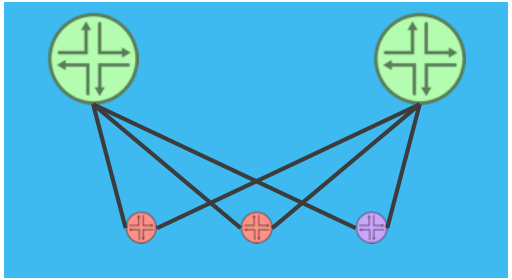
Open Optical Networks - a culture shock - 5



Packet-optical Networks this is the network we want to build:



1. We do not want to care about which vendor provides which node: Interoperability of TXP Interfaces!
2. Hub&spoke architecture, not p2p
3. P and PE routers are different beasts from different vendors.

So this means

1. Transponders of different vendors need to talk to each other!
2. Line system designed to transport any wavelength from any vendor
3. Control software disaggregated from the HW

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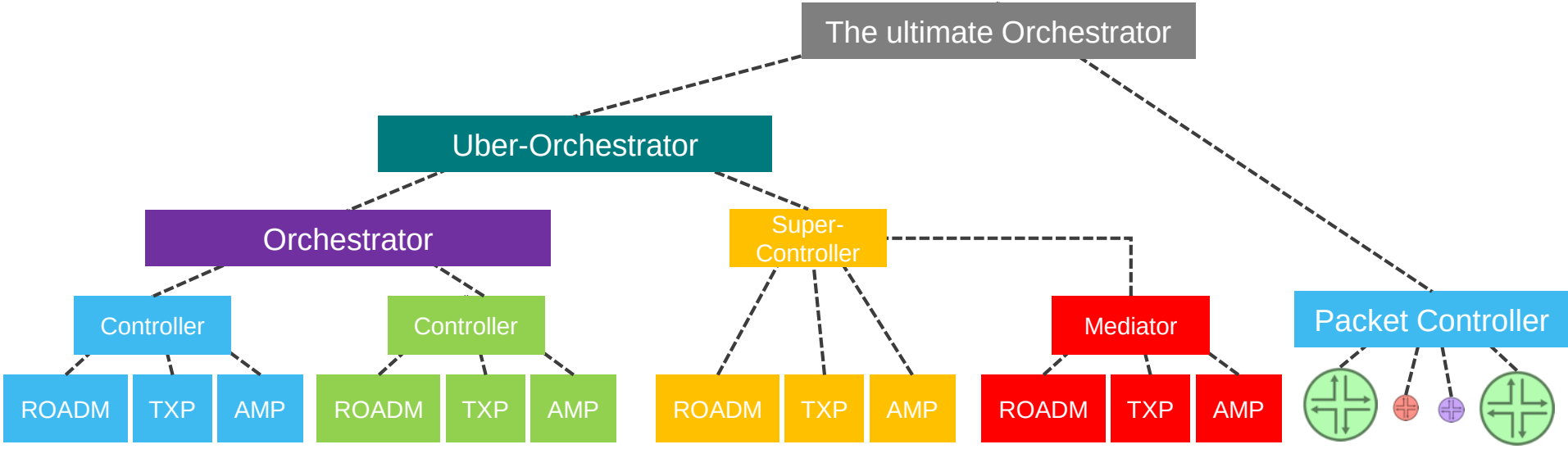
Managing Multivendor Optical Networks

Managing Networks composed of vendor islands is a pain
Adding different technologies makes things worse



Here how it works combining two controllers:
https://www.youtube.com/watch?v=z8qo-uiAq58&pbjreload=10

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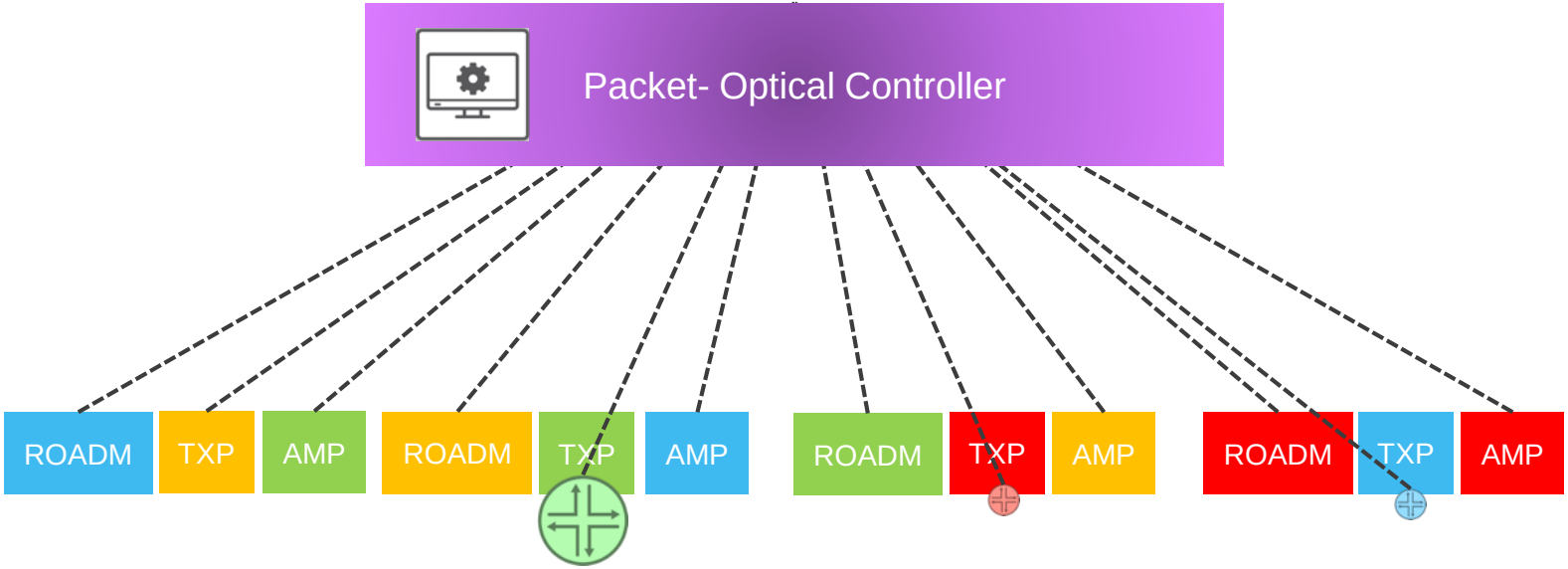
Open Optical Networks: Reassembling the Remains



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Reassembling the Remains

Where are we in 2018?

- Network Planning
  - TIP-PSE: Multi-vendor optical performance planning
- TXP interoperability
  - 100G ITU-T 709.3 (target approval 2018)
  - 200G and beyond: OpenROADM-MSA (target approval 2018)
  - 400G-ZR Ethernet: OIF (target approval 2018)
- Management and control
  - OpenROADM version 3.1 (under approval)
  - OpenConfig
  - ONF

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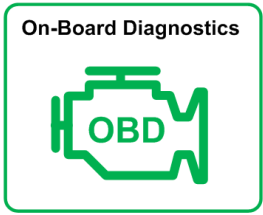
Where do we go from here?

Changing the Ecosystem

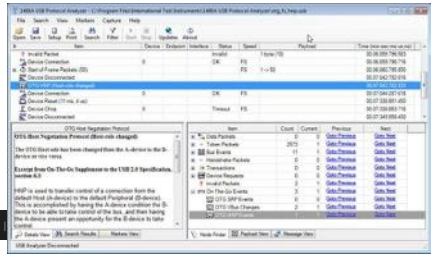
Opportunities in managing optical networks:

- Like the car manufacturers that open up for diagnostics (OBD) systems to give the vehicle owner or repair technician access to the status of the various vehicle subsystems.
  - Neutral third party network check.
  - Facilitates Training, Hiring and Outsourcing.



- Opening up; potential for simpler fault management:
  - Interoperable transponders allows simple-to-use test instruments.
  - Test instruments allow to localize analog **and** digital performance issues and associate to degraded units.

Opening up packet-optical network control



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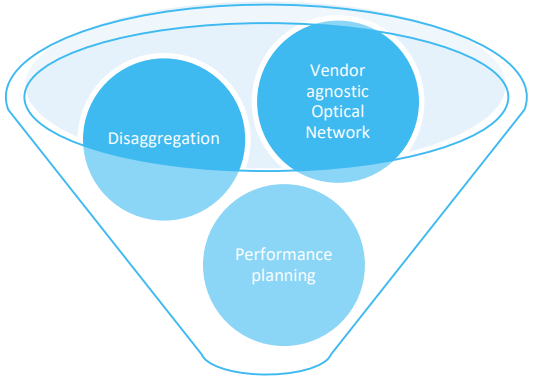
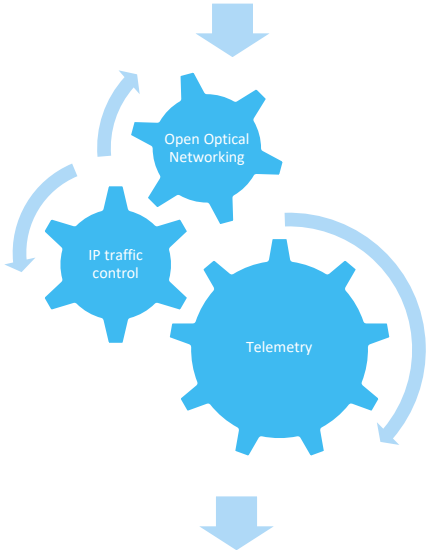
Summary

Packet-Optical Networking

1. Vendor agnostic interoperability in optical networks facilitates Network planning and operations
2. Performance targets of open optical Networks enable reliable be planning
3. disaggregating HW and SW simplifies Operating packet-optical networks
4. IP traffic control combined with Open optical Networks enable deep insight into network performance through telemetry
5. Telemetry data fuels the automation of networking





Packet-Optical Networking

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