Software Driven Network Transformation

OPEN SOLUTIONS FOR PACKET-OPTICAL NETWORKING

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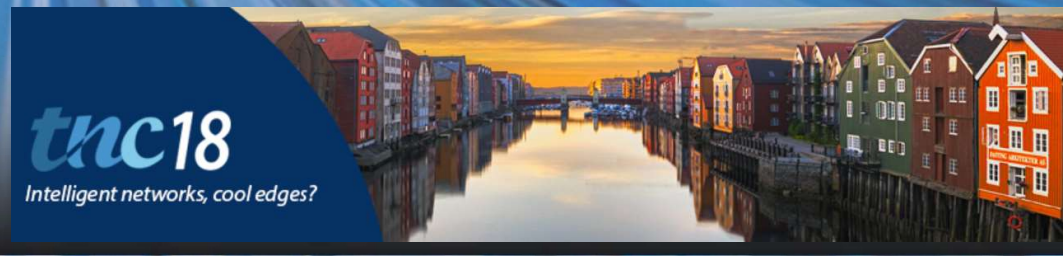


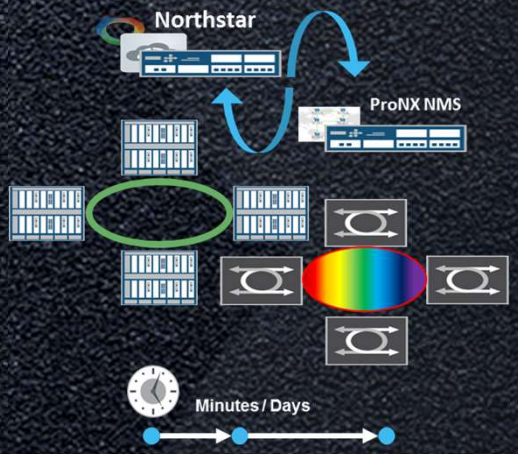
LEGAL STATEMENT

- This statement of direction sets forth Juniper Networks' current intention and is subject to change at any time without notice.
- No purchases are contingent upon Juniper Networks delivering any feature or functionality depicted in this presentation.

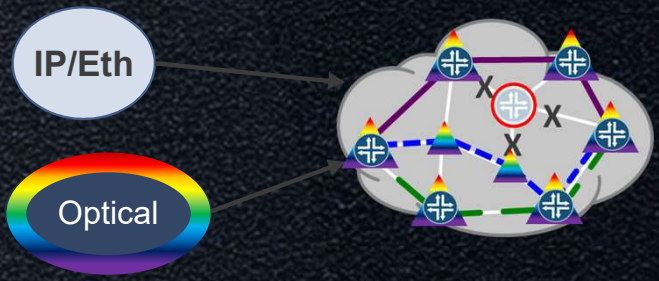
PACKET OPTICAL INTEGRATION
Outline and Motivation

OPEN

PROGRAMMABLE



SIMPLE



Common Design Rules

Common Data (Yang) –API

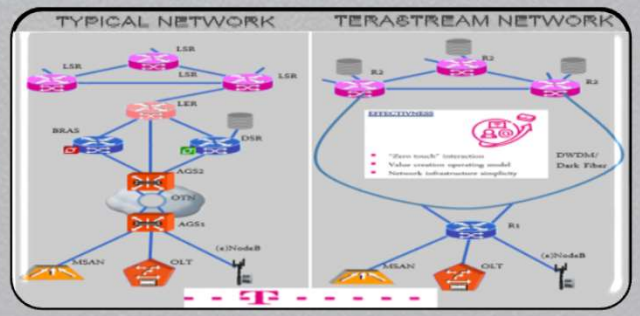
ONE SW Controller

Multi-vendors, Interoperable

Common Infrastructure

E2E Service Automation

BEHIND MEGATRENDS THERE ARE ……
Industry Initiatives for Packet-Optical Networking



TERASTREAM

- ✓ SDN , NetConf/Yang
- ✓ Common HG-FEC
- ✓ Multivendor
- ✓ Single SPs (DT)

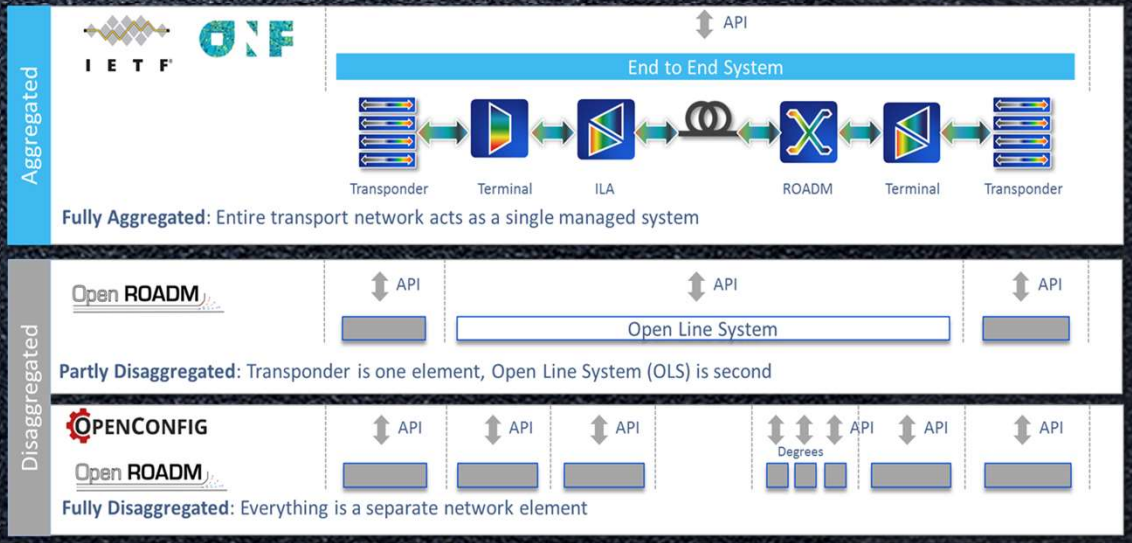
Open ROADM

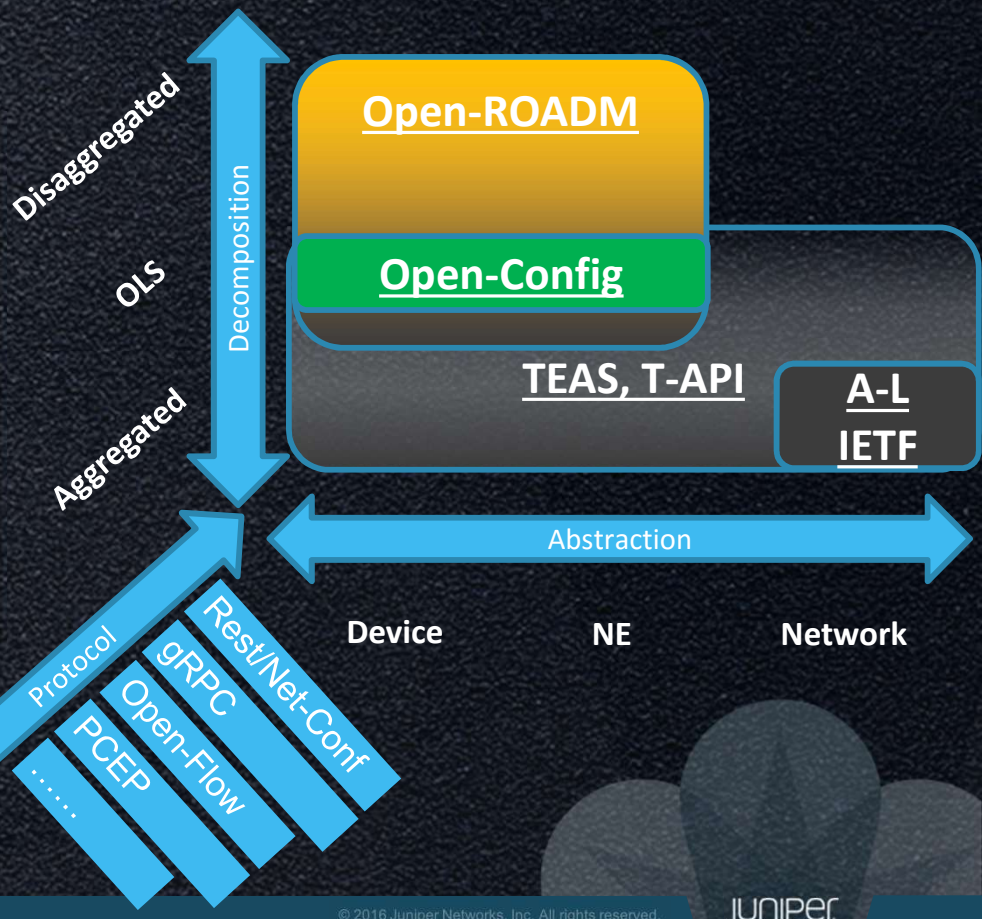
- ✓ Open SDN architecture
- ✓ Interoperability (O-FEC)
- ✓ Multivendor
- ✓ MSA of SPs

TIP

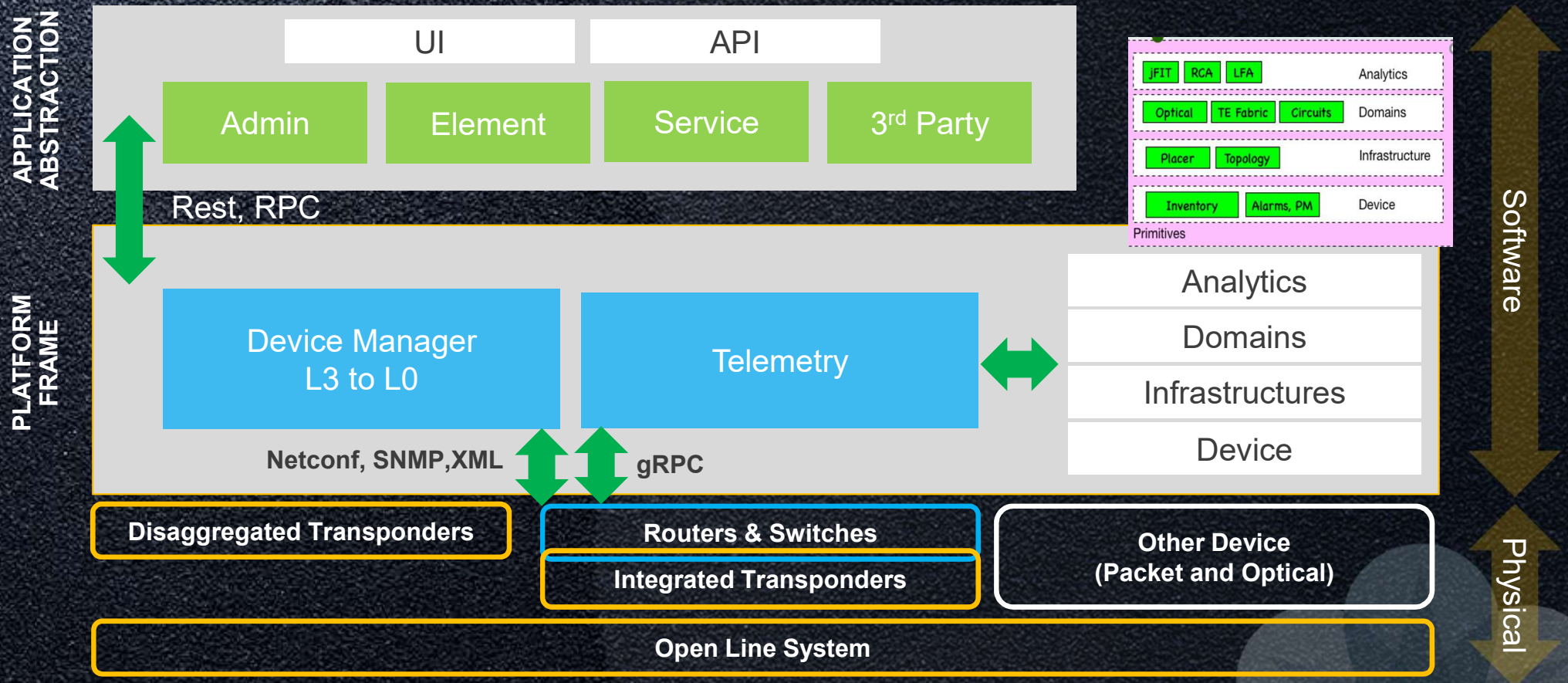
- ✓ Open line system
- ✓ Common API
- ✓ Multi-layer-simulation
- ✓ Large Community

OPEN LINE SYSTEM
API for Open Optical System





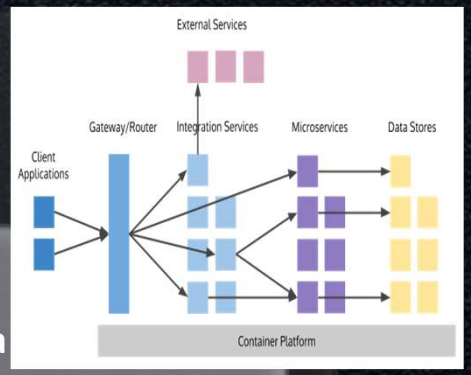
PACKET-OPTICAL *SIMPLIFICATION*
Software Network Architecture: ONE-Controller



PACKET-OPTICAL *SCALING & PERFORMANCES*
Software Network Architecture: Microservices

Low cost x 86 system (standard HW)

HA via Multi-Node Cluster and Replica SW on each Node



Microservice Solution trough Independent Containers

Availability and Scaling (Load Sharing) through Orchestrated Replica

State-less Solution through Messaging for Service-to-Service Communication

docker

kubernetes by Google

Linux base Container OS and Runtime based on Docker

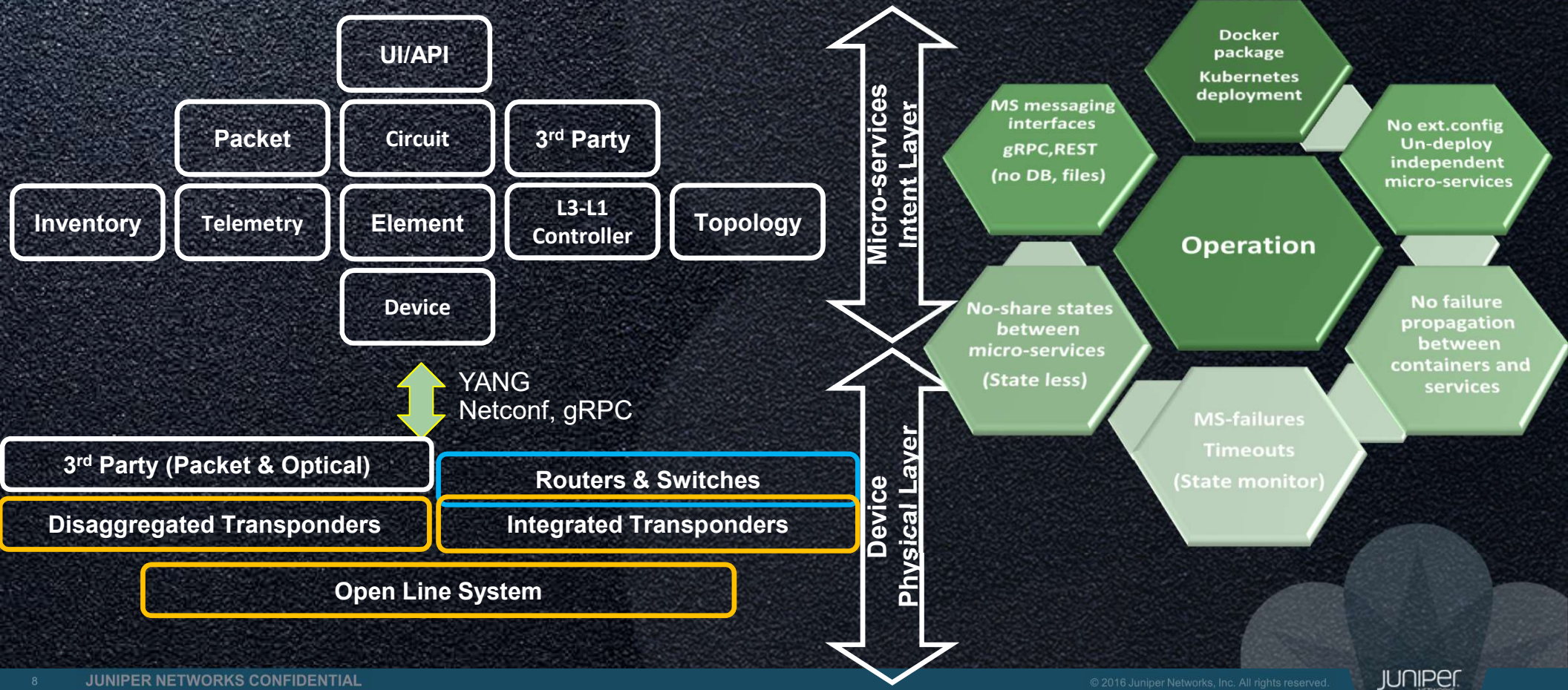
Atomic project umbrella for LDK stack

PROJECT ATOMIC

LDK stands for Linux Development Kit

Abbreviations.com

JUNIPER PACKET-OPTICAL *AUTOMATION*
Software Network Architecture: Simplicity



Product Portfolio for Metro

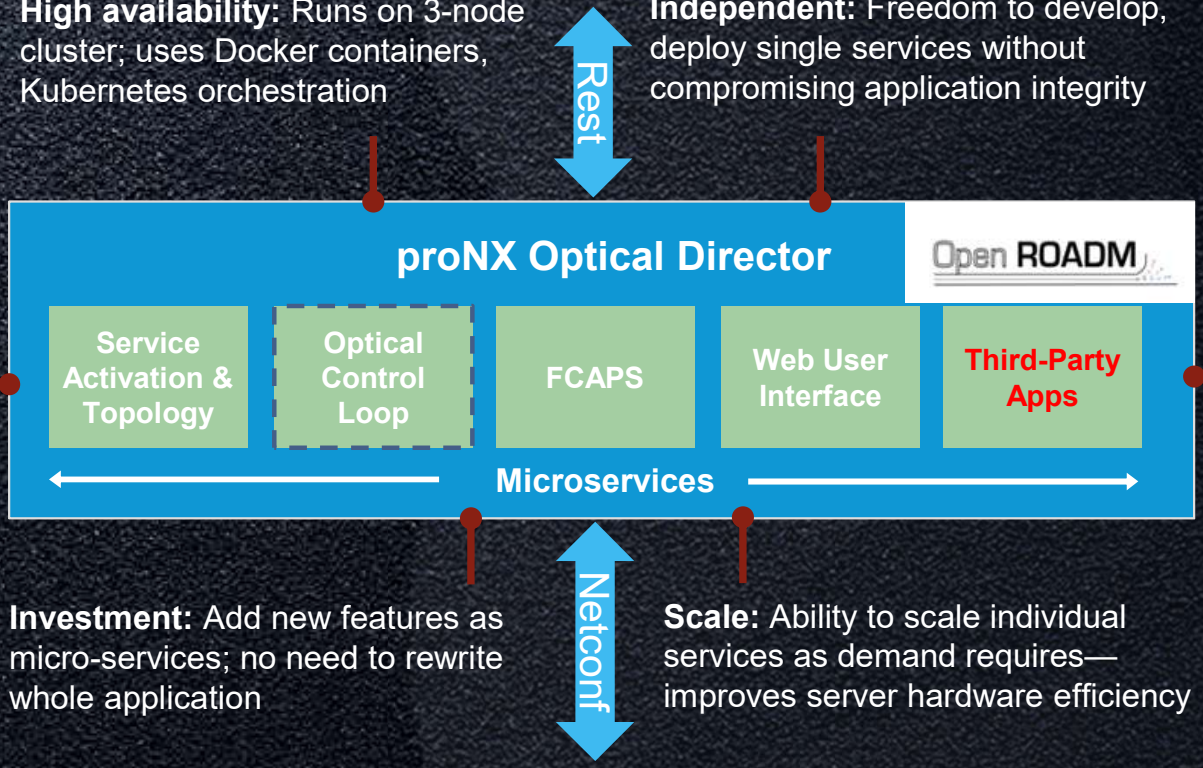
Juniper Open Solutions for Packet-Optical Networking

June 2018, Europe

OPTICAL NETWORKING CONTROLLER
ProNX OD©: SW disaggregation for Open Line System

High availability: Runs on 3-node cluster; uses Docker containers, Kubernetes orchestration

Independent: Freedom to develop, deploy single services without compromising application integrity



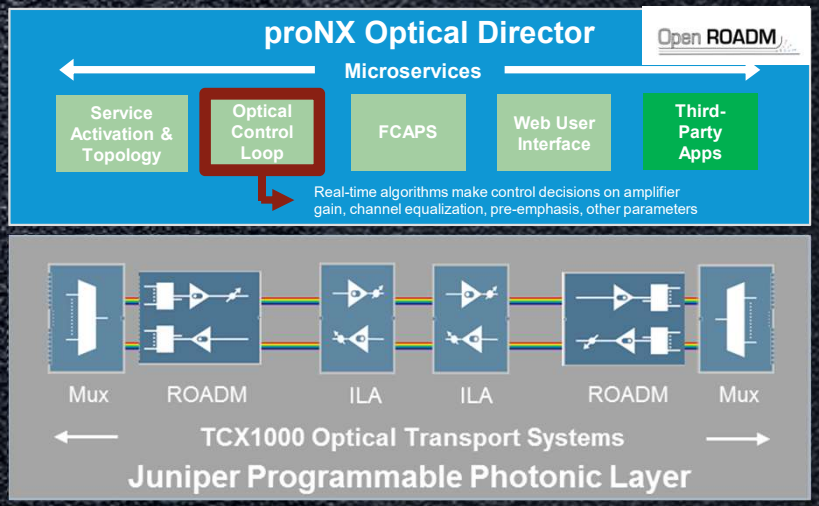
DevOps-ready: Allows more efficient software deployment

Extensible: Easy third-party application onboarding

Investment: Add new features as micro-services; no need to rewrite whole application

Scale: Ability to scale individual services as demand requires—improves server hardware efficiency

JUNIPER OPEN LINE SYSTEM TCX1K
Scalable, Programmable, Flexible Optical Transport



Programmable 20 flex ports ROADM

Inline bidirectional Amplifier

96-Channel Mux-Demux

PRODUCT

- ✓ ProNX OD provisioning
- ✓ Multi-Degree Solution
- ✓ Fixed/Flex-Grid De/Mux
- ✓ CD-Flex architecture
  - ✓ Up to 20x20 ports
- ✓ Extended Span solution

ROAD MAP

- ✓ OpenROADM
- ✓ CDC-Flex architecture
  - ✓ Up to 8 x 24 ports
- ✓ OTDR 1x16 programmable
- ✓ Raman solution
- ✓ C+L band up-grade

DWDM PLUGGABLE OPTIC ROAD MAP
Transponder disaggregation

Application	Form Factor:	QSFP28	QSFP-DD	QSFP-DD	CFP2			CFP8
	Depiction:							
	Electrical Lanes:	25G NRZ	50G PAM-4 (QSFP56-DD)	100G PAM-4 QSFP128-DD	25G NRZ	50G PAM-4	100G PAM-4	100G PAM-4
	Elect. Lane Count:	4	8	8		8		16
	Dissipated Power:	4.5 W	15-18 W	15-18 W	20.5 W	24 W	24 W	30 W
Dark-Fiber ER (40 km)		100G	NA	NA	NA	NA	NA	NA
DWDM PAM-4 (up tp 80 km)		100G	NA	NA	NA	NA	NA	NA
DWDM ZR Coh. (up to 80 km)			400G n x 100G	800G n x 100G	NA	NA	NA	NA
Metro DWDM Coherent			400G n x 100G	800G n x 100G n x 400G	200G 2x100G	400G 4 x 100G 1 x 400G Flex Rate	800G 8 x 100G 2 x 400G Flex Rate	800G 1.6T Flex Rate

2018/2019

2018/2019

CONCLUSIONS?
Scale, Automate, Simplify

“Multiple industry initiatives are driving adoption of common (standard?) and open solutions: challenges for lock-in and proprietary solutions”

“Open SW architectures are critical to design Open, Scalable and Multi-vendor networking solutions”

“Disaggregation (SW, HW) provides the path to maximize innovation adoption cycles. Opportunity creations for challengers to disrupt traditional business model: TCO and Simplicity KPI”


Thank you