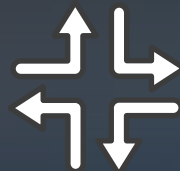


Product Update – SP Solution

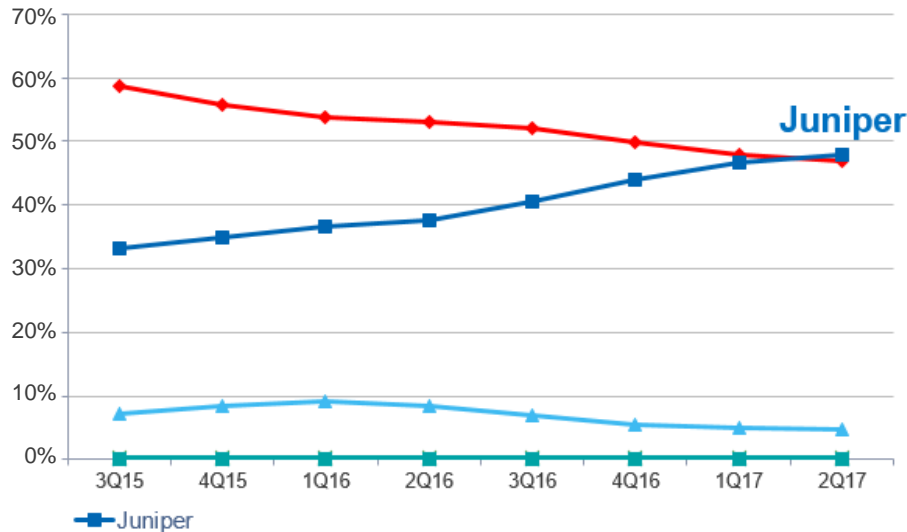
박종학 부장 / jpark@juniper.net



ROUTING

Juniper Takes #1 Market Share Leadership North America IP Core Routing

Rolling 4Q Average Revenue Market Share



Juniper leads #1 in the North American core routing market at 48% share for the last twelve months (3Q'16-2Q'17)

Long-term patterns are better seen by viewing rolling 4-quarter market share. In this view, Juniper increased its market share in this segment from 33% in 3Q'15 to 43% in 2Q'17

SOURCE: IHS Markit – Service Provider Routers and Switches Market Tracker, September 2017, © IHS Markit

Juniper Routing: Business Update



MX

- 75K chassis deployed & growing
- 4000+ customers and over \$10B in installed base
- 100x capacity growth: 40G to 4T (to 8T)
- Metro (2007) + Core (2008) + Business Edge (2009) + DC SDN GW (2010) + BNG (2011)



PTX

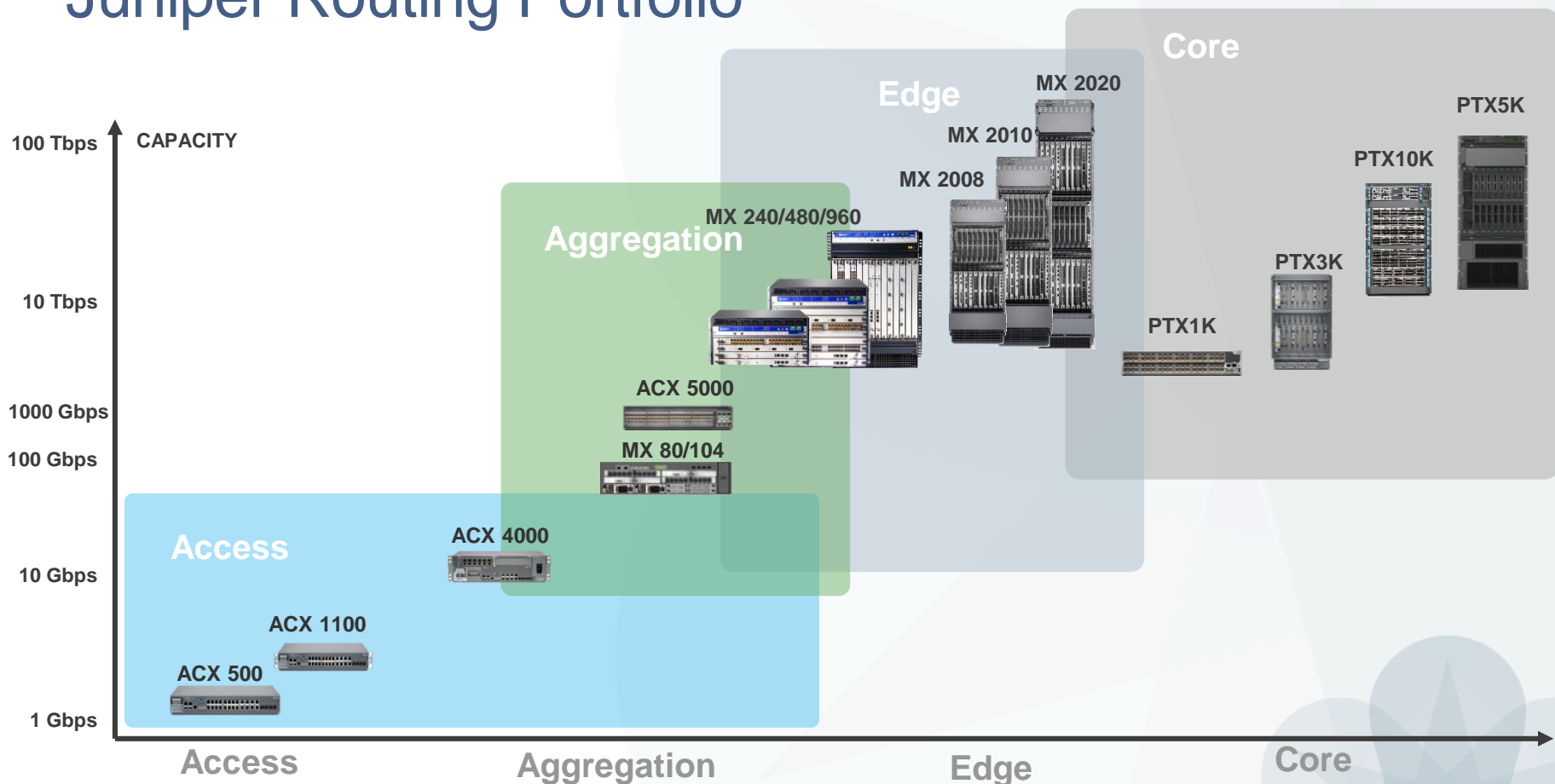
- 1500+ chassis deployed and growing
- Deployed at multiple large SP and Web Services Core
- LSR to Full IP Core Use cases
- 150x capacity growth: 480G to 3T to 7.2T+



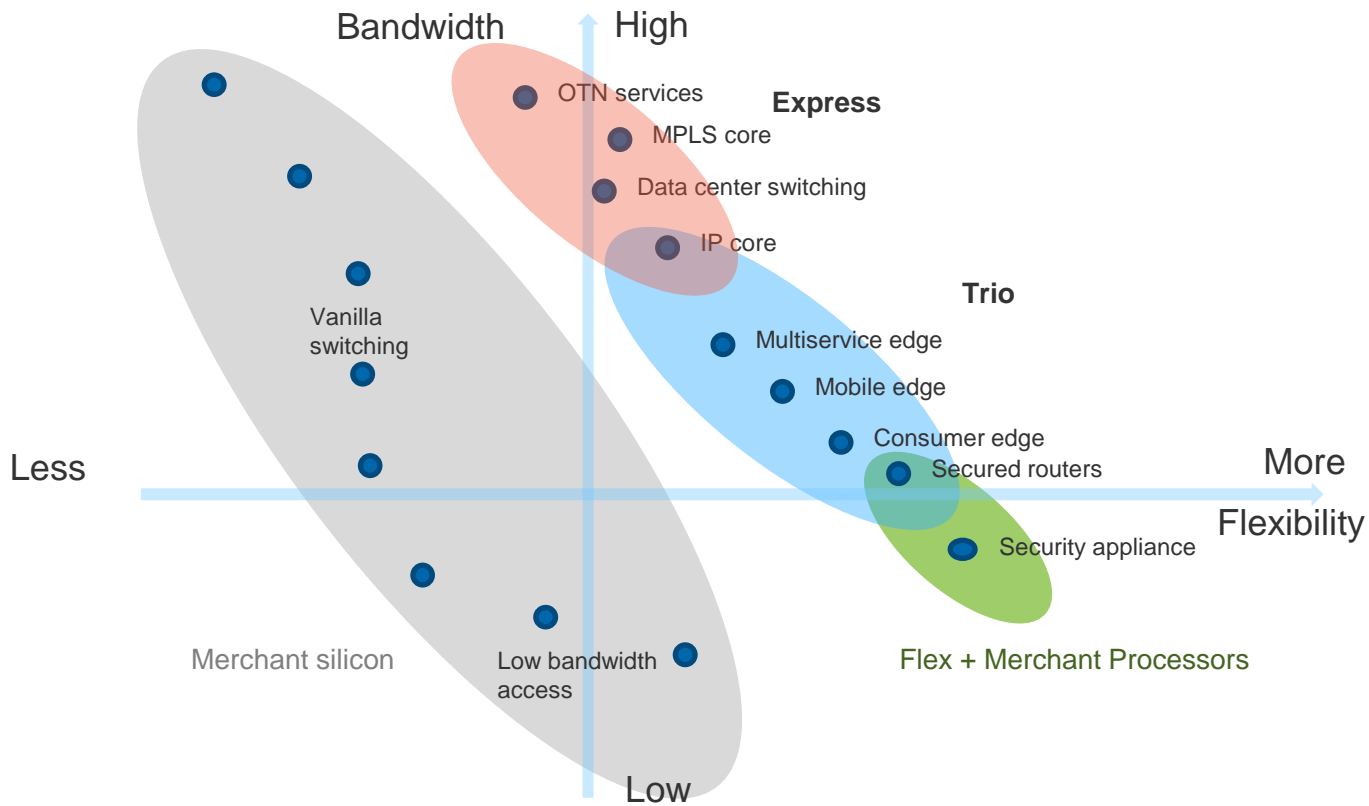
Deployments

- Business Edge: TIM, Orange, BT, DT, Telenor, Verizon, AT&T, CenturyLink, NTT, KDDI, Telstra
- BNG: TIM, Orange, DT, Telenor, Verizon, CenturyLink, Telstra, Google Fiber
- Core: Verizon, CenturyLink, Google, FB, Amazon, Apple, Orange, DT, NTT, Microsoft, Telefonica
- Metro: TIM, Telefonica, Bell Canada, CenturyLink, AT&T, Verizon, Comcast, TWC, Cox
- DC Edge: Google, Microsoft, Amazon, FB, Alibaba, AT&T, DT

Juniper Routing Portfolio



SILICON ARCHITECTURAL COVERAGE

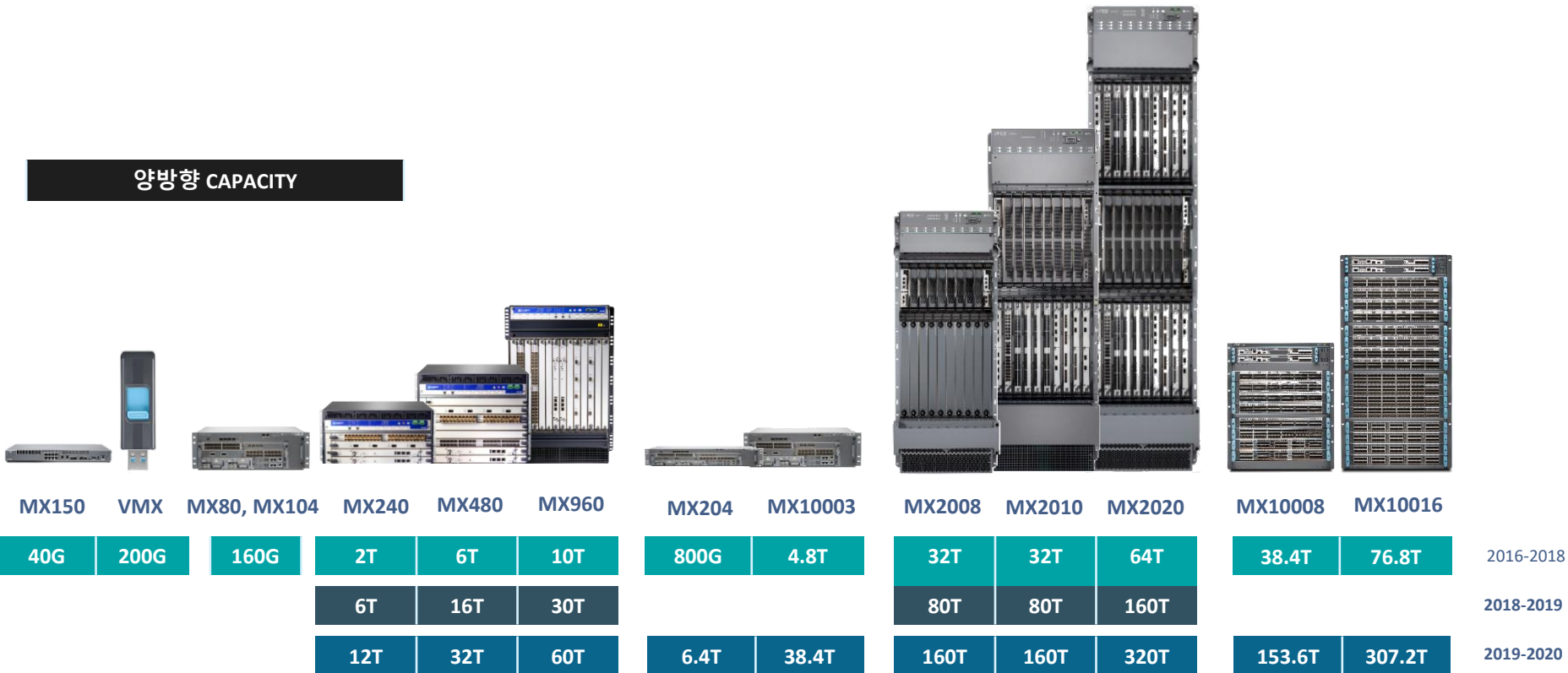




MX Update

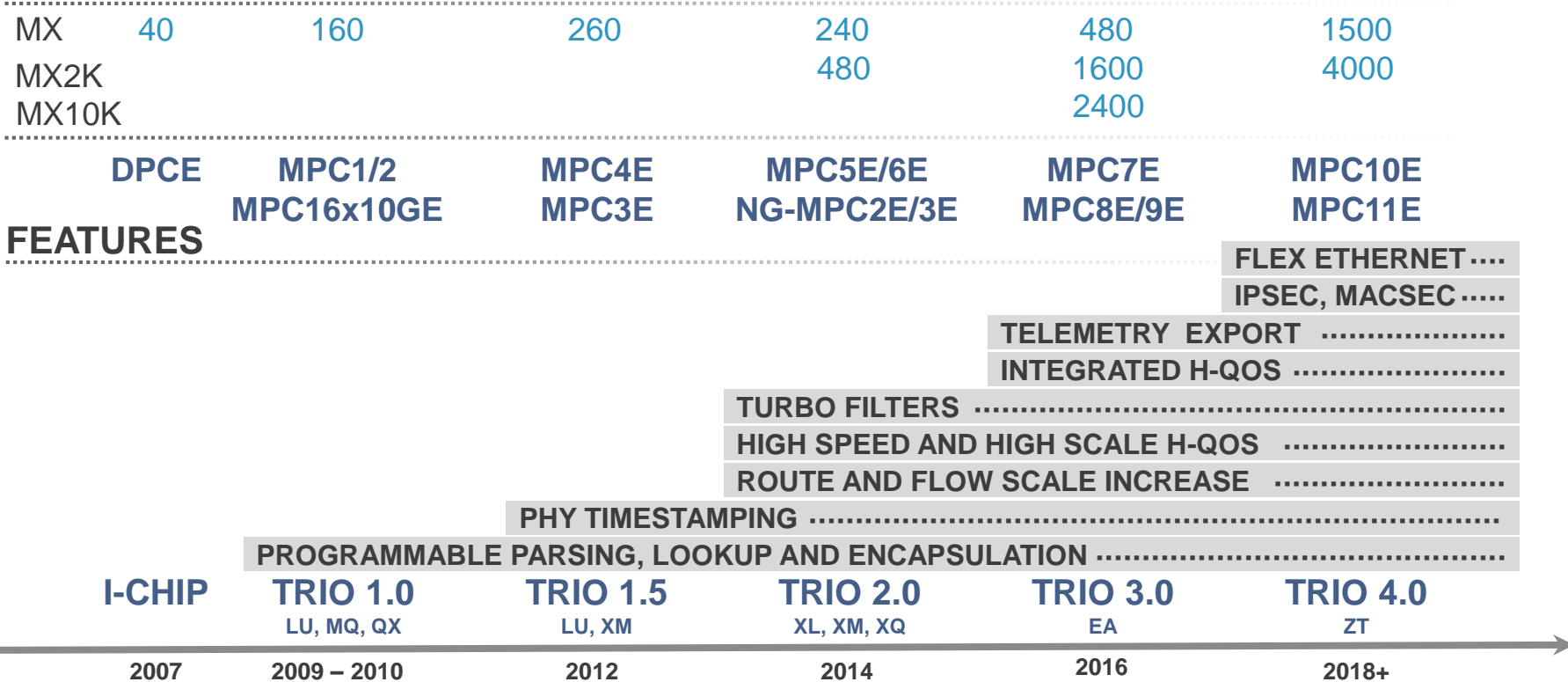
The MX Family – Longevity to 2020+

양방향 CAPACITY



MX ASIC Evolution

SLOT CAPACITIES, GBPS, AND LINE CARDS



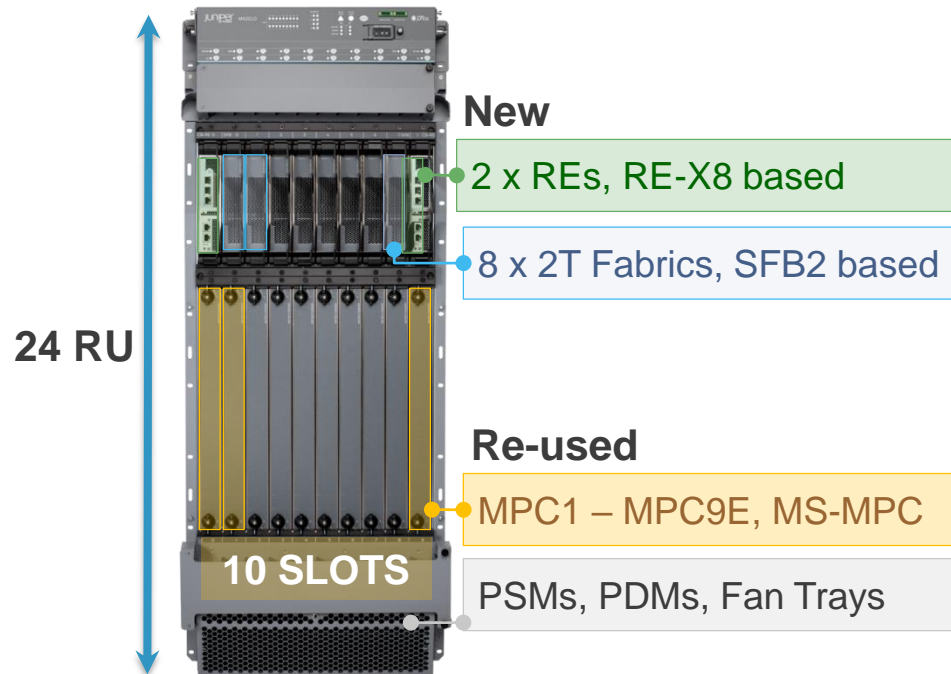
MX2008 : 1/2 Rack MX2K



Dense 10GE/100GE Aggregation, 160x100GE

Versatile Platform, all MX applications supported

Scalable with 1.6T per slot now, 4.0T in the future



MAIN FEATURES

COMPACT AND COST EFFICIENT

GR-63 NEBS COMPLIANT

PARITY WITH MX2020

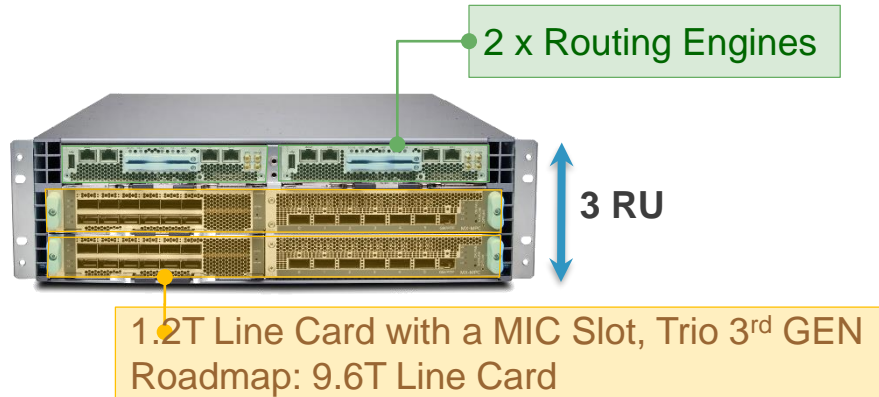
15.1F7, 17.2R1 RELEASE

~2KW LESS POWER THAN MX2010



17.3R1

MX10003



KEY FEATURES

Compact Design

- Modular, 2 Line card slot 3RU Platform
- 19 in standard rack mountable, 760mm deep

Line Card

- 1.2T per slot; upgradeable to 9.6T per slot
- Multi-rate 100GE, 40GE and 10GE ports
- 12x100GE, 18x40GE or 72x10GE/1GE per linecard
- 12x100GE MACSec MIC support
- Full HQoS and 1588 and SyncE

X86 Based Routing Engine

- Modular, Redundant and Upgradable

Power

- Power efficient ~ 0.9W/G
- AC/DC PSMs with N+N redundancy

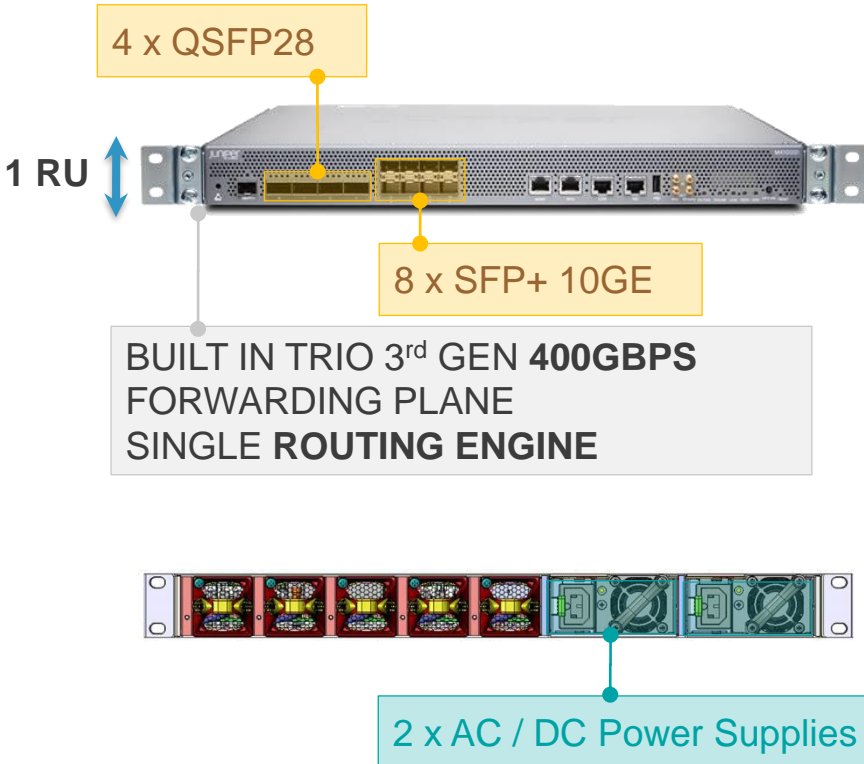
Cooling and NEBS

- Redundant, Front to back air-cooling, NEBS Compliant



17.4R1

MX204 Compact Router



KEY FEATURES

Compact Design

- Fixed form factor 1RU platform
- 19 inch, 515mm depth, ETSI 600 compliant
- 400G bandwidth
- Multi-rate (4)100GE, (4)40GE or (24)10/1GE ports
- Full HQoS, 1588, SyncE

Routing Engine

- Multi-core X86 based single RE

Power

- Power efficient ~ 0.9W/G
- AC/DC PSMs; 1+1 redundancy

Cooling & NEBS

- Redundant, Front to back air-cooling, NEBS Compliant

MX10008 and MX10016

Universal chassis across all product families

Dense 10GE, 40GE and 100GE

Optimal power and cooling design for DC / COLO

Scalable card/fabric interconnect, future upgrade to 9.6T/slot

2.4T Line Card, 24 x QSFP/QSFP28 Interfaces
Roadmap : 9.6T per slot

MAIN FEATURES

COMPACT, OPTIMIZED FOR DC AND COLO

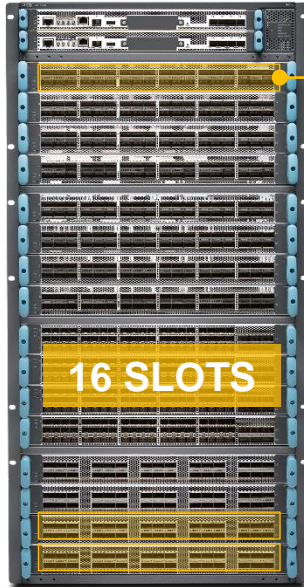
GR-3160 (DC-NEBS) COMPLIANT, EXCEPT ACOUSTICS

AIR FILTER OPTION

MACSEC SUPPORT

2 PER 19" RACK

21 RU

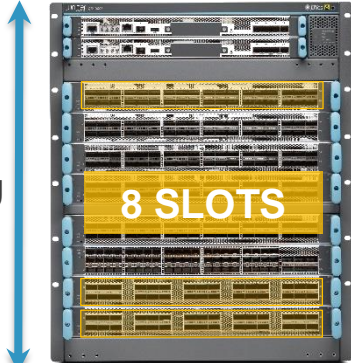


16 SLOTS

MX10016

3 PER 19" RACK

13 RU

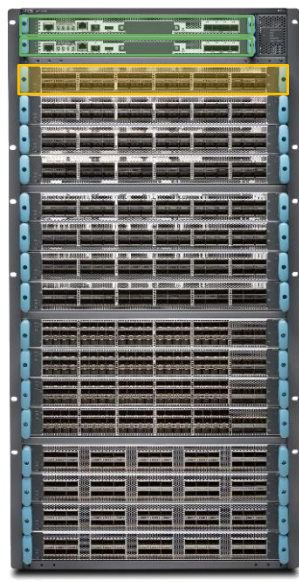


8 SLOTS

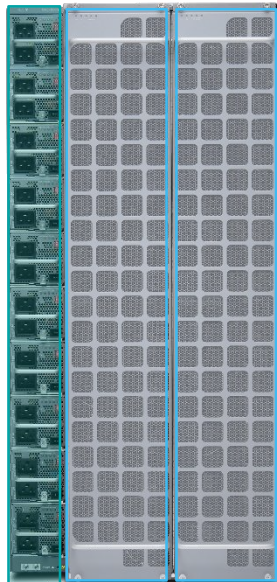
MX10008

Universal Chassis

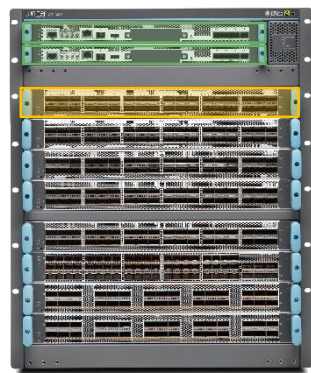
Common Components for MX, PTX and QFX



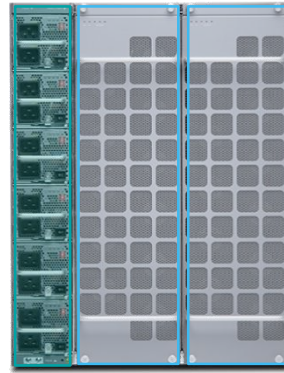
10016 Front



10016 Rear



10008 Front



10008 Rear

Line Cards (PTX and QFX)

Power Supplies

Routing Engines

Fan

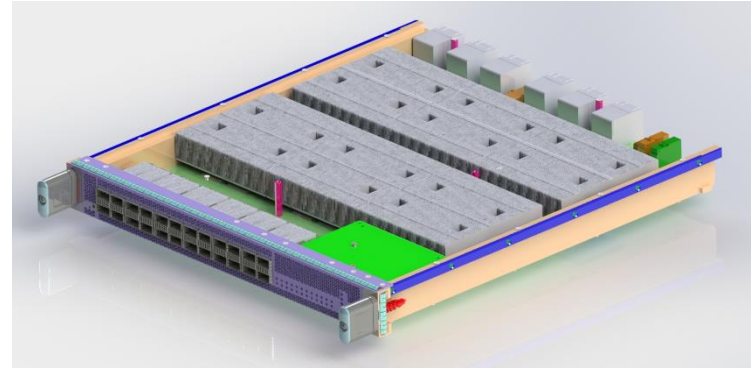
Chassis

Fabric Controllers

Fabrics

MX10K-LC2101 Line Card Design

- Form factor unique to MX10K
 - Cannot be used on MX960 or MX2K
 - Difference limited to mechanical form factor
 - Feature parity with MX2K-MPC9E line cards
- Single line card based on EA ASIC
 - 2.4T and 1.44T modes
 - 1.44T configuration using a CLI configuration command
- Hardware License Options
 - Fine Grain Queueing
 - Precision Timing
- Max Port Configuration
 - 24x100GE / 24x40GE / 96x10GE
 - 10GE support using 4x10GE breakout cables
- Direct connection to SIBs

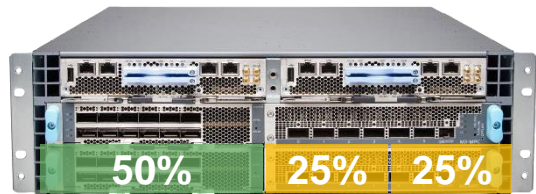


MX10K-LC2101
(2.4T/1.44T)

Pay as you grow pricing



Available now



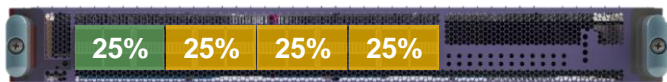
MX10003 1.2T Line Card



MPC7E-MRATE, MPC7E-10G



MPC9E



MX10008 2.4T Line Card

BASE SKU LIST PRICE %

ADDON LICENSE LIST PRICE %

Virtual MX



NFX250 : 10-20Gbps



2 x 10GE SFP+
8 x 1GE Copper
2 x 1GE Copper or SFP

AMAZON WEB SERVICES IMAGE

Available July 2016

Best for MX customers migrating to cloud

VMX IMAGE

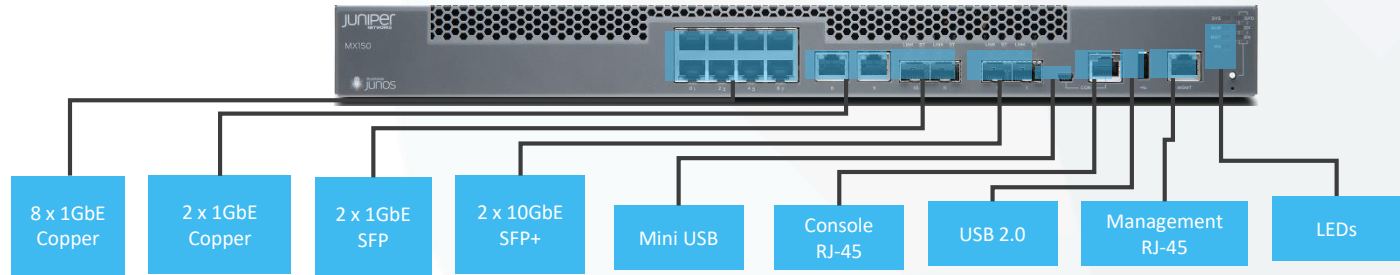
Elastic Scale

Best for new cloud deployments

NFX APPLIANCE

Comes with VMX JUNOS pre-installed
Same maintenance cycle as regular MX
Best for small remote sites

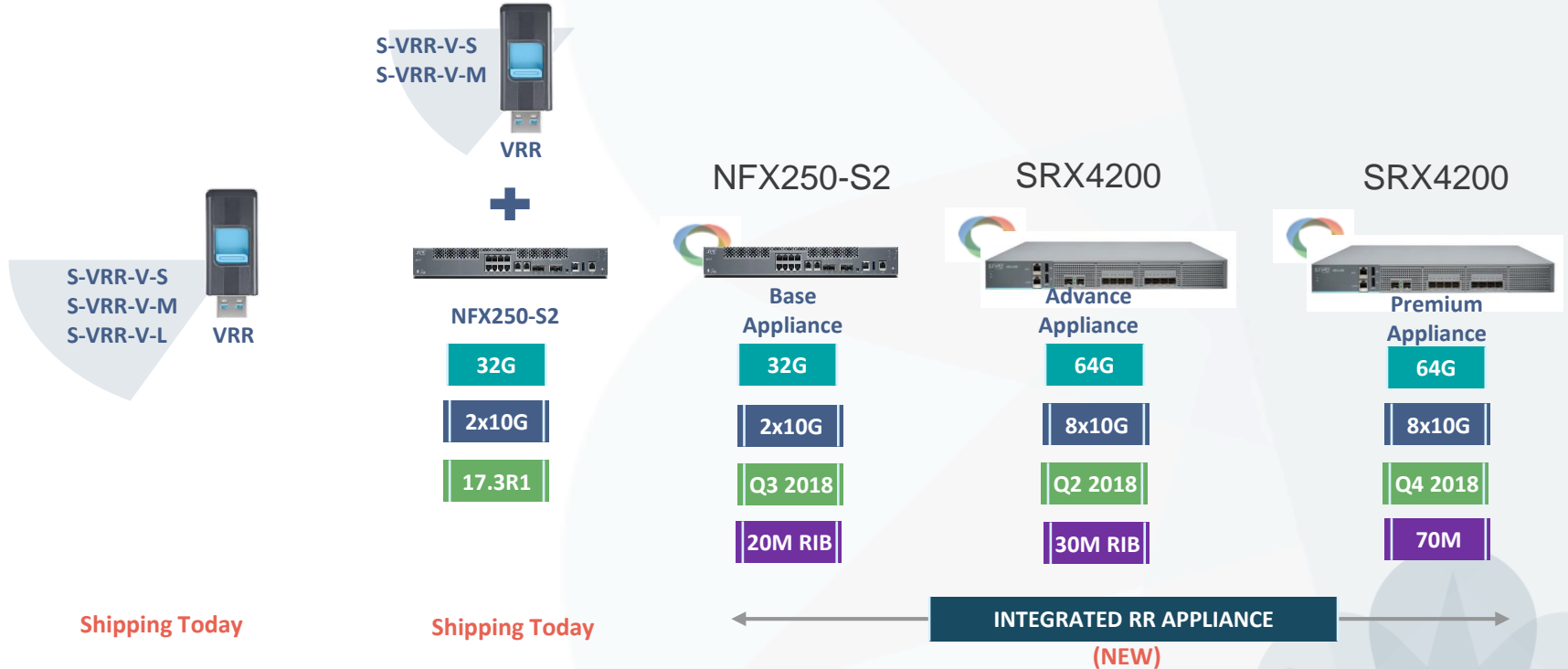
MX150 Hardware Specs



Capacity	40Gbps
Dimensions (H x W x D)	1.72 x 17.36 x 12 in (4.37 x 44.09 x 30.48 cm)
Rack units (U)	1 U
Weight	4.3 kg (9.48 lb)
Airflow	Front-to-back (AFO) forced cooling
Power	Fixed PSU 100-240 VAC
CPU	Intel 6 Core Xeon D
Memory	32 GB DDR4 RAM
Storage	400 GB SSD

Software	Junos
10/100/1000BASE-T RJ-45 ports	10
100/1000BASE-X SFP ports	2
1GbE/10GbE SFP+ ports	2
10/100/1000BASE-T RJ-45 management port	1
RJ-45 console port	1
Mini USB console port	1
USB 2.0 port	1

vRR Product Portfolio



Shipping Today

Shipping Today

INTEGRATED RR APPLIANCE
(NEW)



MX Business Prioritization

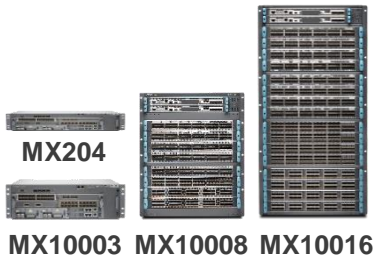
MX Business Prioritization



MAINTAIN AND GROW FOOT PRINT

Long term roadmap for the next two generations

Interoperability with multiple generation of line cards

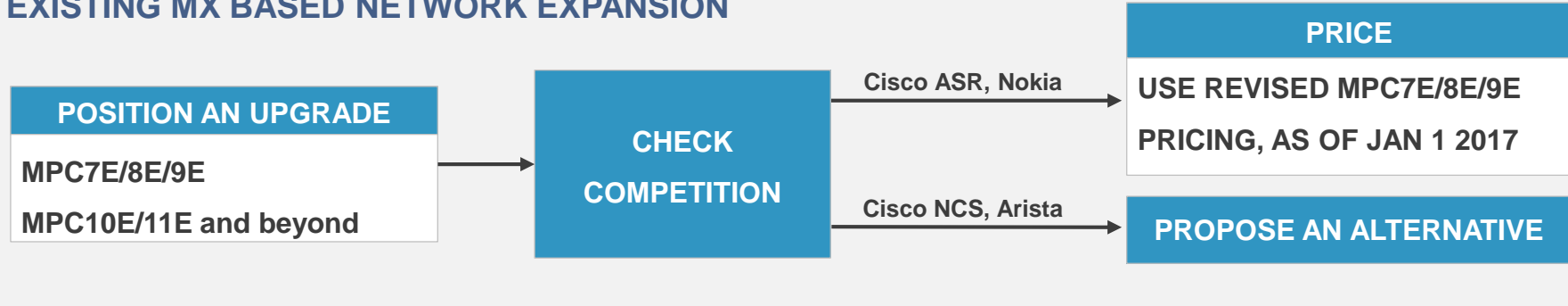


ESTABLISH NEW FOOT PRINT

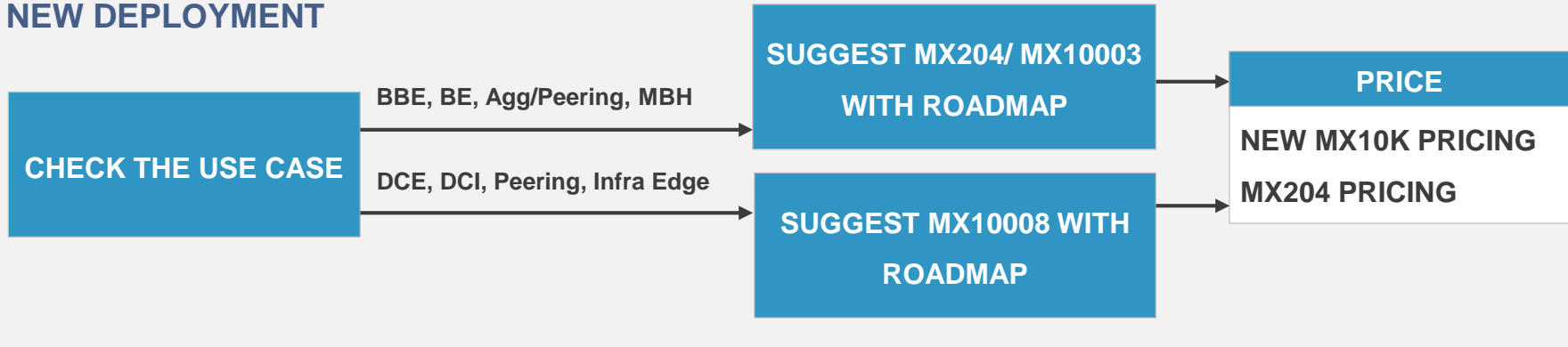
Power and Cost Optimized with Trio Feature Set

MX Chassis Positioning Flow

EXISTING MX BASED NETWORK EXPANSION



NEW DEPLOYMENT



MX960 Upgrade Scenarios



Bandwidth Expansion

- No new RFP

Investment Protection

- Interoperability with MPCs
- No upgrade to chassis, fan, power

NEBS Compliant

MX240/480/960 Roadmap

Two Upgrades in Pipeline

- 15x100GE per slot by 2018
- 32x100GE per slot by 2020



Greenfield Deployment

- New RFPs
- Small Form Factor (3RU)

With Trio Performance and Scale

- 1GE, PTP/SyncE

NEBS Compliant

MX10003

New pricing model with

- 24x100GE in 3RU
- Roadmap : 14.4T to 19.2T



Bandwidth Requirement

More than MX960 plans

Densest MX-Trio Router

- Power, Performance, and Scale
- Universal Chassis, MACSec

DC NEBS Compliant

MX10008

New pricing model with

- 24x100GE per slot
- Roadmap : 9.6T per slot

MX2K Upgrade Scenarios



Bandwidth Expansion

- No new RFP

Investment Protection

- Interoperability with MPCs
- No upgrade to chassis, fan, power

NEBS Compliant

MX2K Roadmap

Two Upgrades in Pipeline

- 4T per slot by 2019
- 8T per slot by 2021



Bandwidth and Space

- 192x100GE in 13RU (MX10008)

Densest MX-Trio Router

- Power, Performance, and Scale
- Universal Chassis, MACSec

DC NEBS Compliant

MX10008 / MX10016

New pricing model with

- 24x100GE per slot
- Roadmap : 9.6T per slot



Technology Updates

MACsec Overview

W
H
Y

L2 Threats: Passive wiretapping

Intrusion, Man in the middle

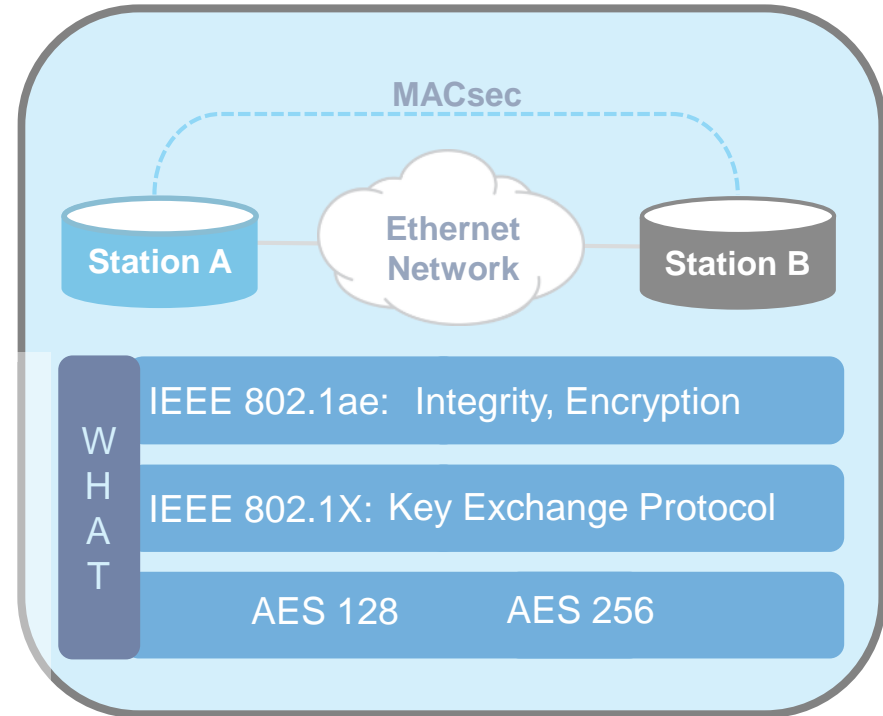
DHCP, VLAN, L2 headers

W
H
E
R
E

L2 Host to L2 Host

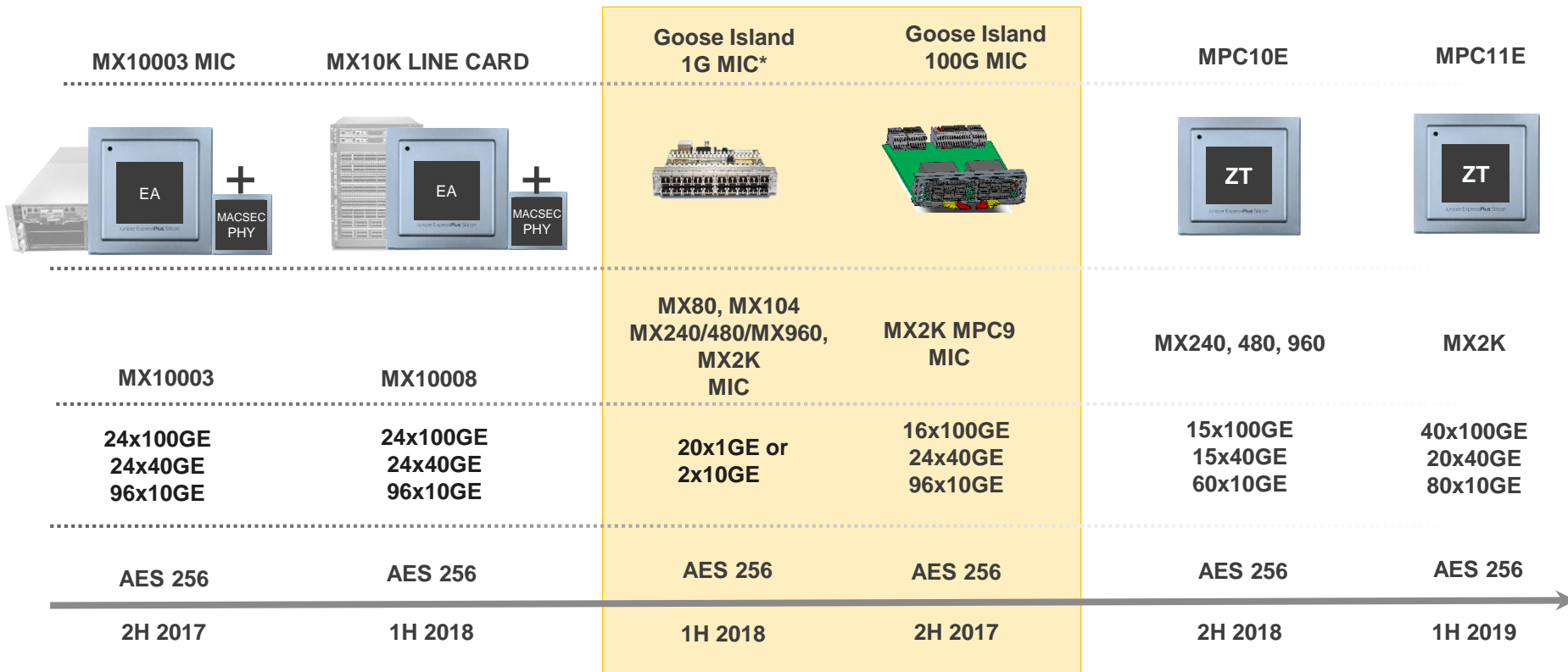
L2 Host to Switch/Router

Switch/Router to Switch/Router

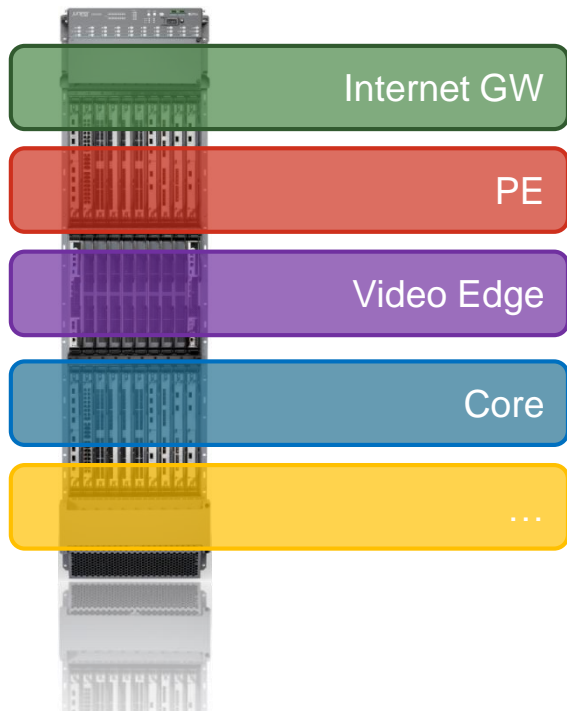


MACSec Hardware Roadmap

* Not yet committed



JUNOS Node Slicing



- Run multiple services over the same infrastructure.
- Keep those services functionally, operationally and administratively isolated in their own slices.
- Enable the evolution and operation to be independent.
- Shorter software qualification cycles.
- Simpler and faster service deployment
- Reduce failure impact
- Independent function scale
- Network Slicing enable a more operationally friendly multiservice infrastructure

Reduce CAPEX

Reduce OPEX

Faster Time to Market

Improve SLAs

More efficient growth

More sustainable business

JUNOS Fusion Edge

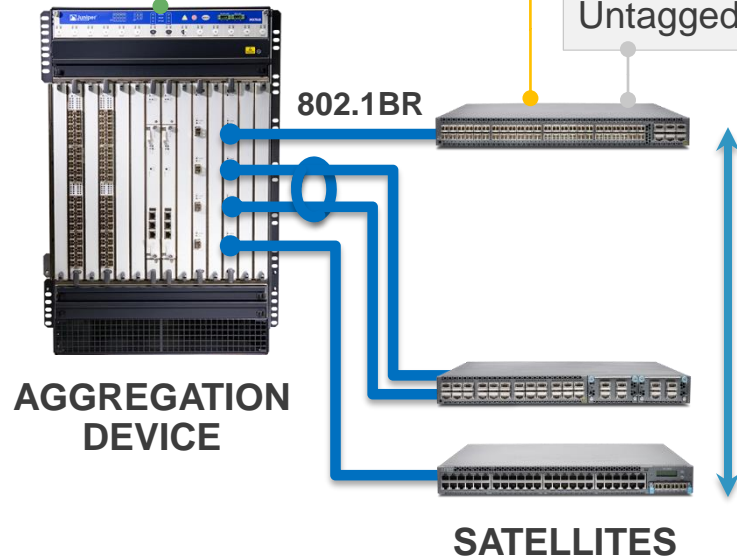
MX80/MX104
MX240 – MX960
MX2K

EX4300, QFX 5100
Run SNOS image
Modeled as a line card

Scalable solution for low speed interface aggregation

Simple management, configuration, upgrades via MX

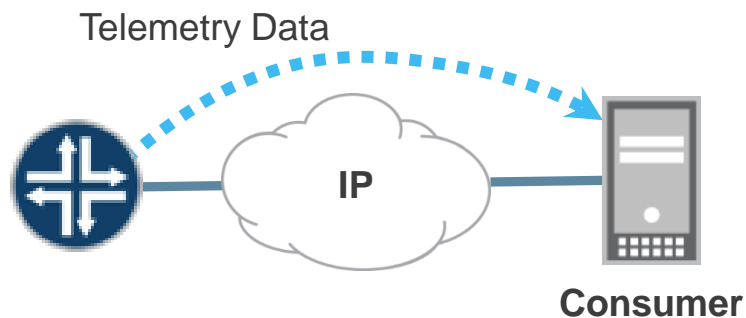
Untagged, Single / Dual-tagged interfaces



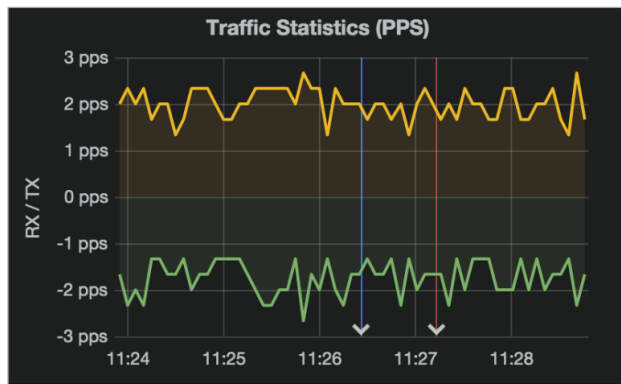
16.1R2 / 17.1R1 HIGHLIGHTS

**MPC7E-MRATE AND MPC7E-10G
LOCAL MULTICAST REPLICATION**

JUNOS Telemetry Interface



Open Network Telemetry Insights



Performance Management Dashboard

GOALS

- Scalable Telemetry Framework
- Virtual Network Functions (VNF) acceleration
- Standards based

USE CASES

- Performance Management
- PCE Controller, other SDN/NFV Application

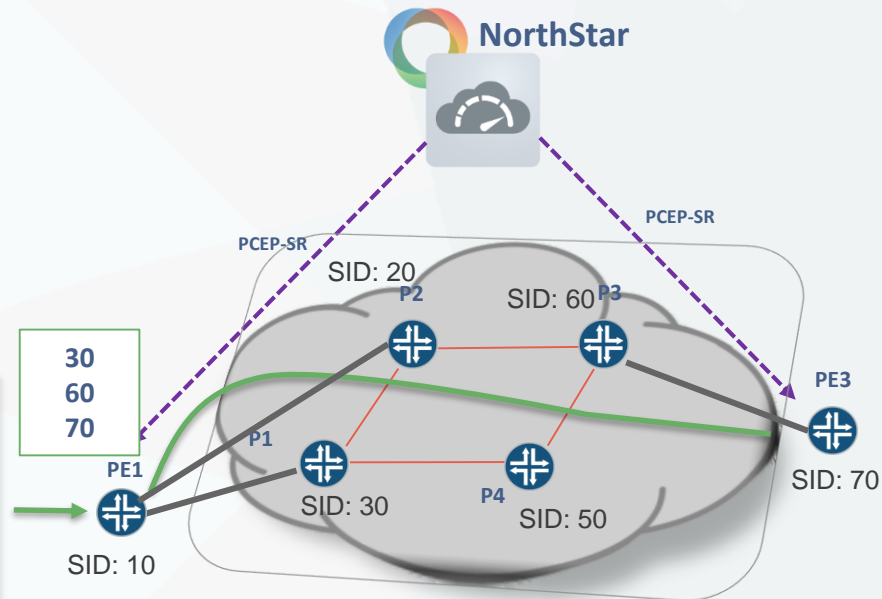
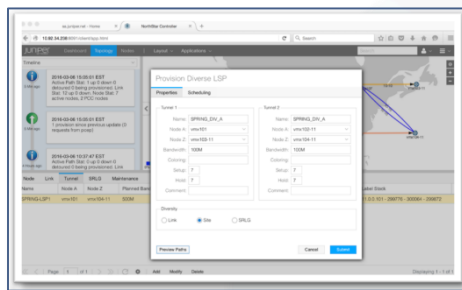
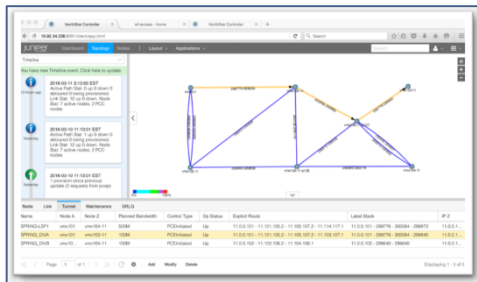
ADVANTAGES

- Distributed export closer to the source
- Simplifies collector infrastructure, no polling
- OpenConfig** and Native Streaming options

NS3.0: SEGMENT ROUTING (SPRING) -17.2R1

NORTHSTAR 3.0

- IPv4 Prefix & IPv4 node SID learning via ISIS &/or BGP-LS
- New PCEP capability, ERO subobject and TLVs
 - ✓ draft-ietf-pce-segment-routing
- SPRING-TE LSP creation, visualization & optimization





The background features a complex financial chart with multiple data series. The chart is overlaid with a grid of dashed lines. Several numerical values are scattered across the chart, including 717.2457, 467.2463, 345.7475, 225.0043, 117.2457, 125.2457, 848.7479, 225.0043, 467.24, 345.7, and 225.0. The chart is set against a dark blue background with various colored lines (white, red, green, yellow) representing different data series.

PTX Update

PTX Product Family



PTX1000

NEBS LEVEL 3

5.76T

24 x 100 GE
288 x 10GE

1KW

PTX3000

NEBS LEVEL 3

16T

10 x 100 GE
96 x 10GE

3.9KW

PTX5000

NEBS LEVEL 3

48T

30 x 100 GE
192 x 10GE

10KW

PTX10008

NEBS LEVEL 3

48T

30 x 100GE
144 x 10GE

9KW

PTX10016

NEBS LEVEL 3

96T

30 x 100GE
144 x 10GE

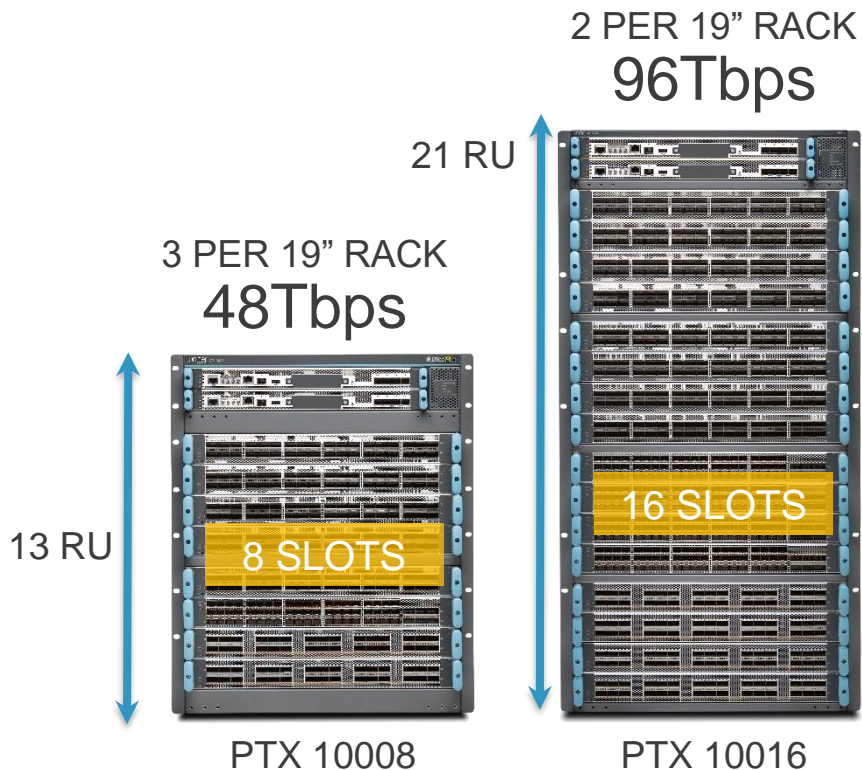
~18KW

Express+

* In Development

Universal Chassis PTX 10K Highlights

 PTX10008 : Junos 17.2
PTX10016 : Junos 17.4



Supports all product profiles (MX/PTX/QFX)
Compact & Optimal power and cooling design
Scalable card/fabric interconnect, capacity increase

FPC	10G	40G	100G
3T FPC	96	30	30
1.5T FPC	144	36	12
3T FPC w/ MacSec*	96	30	30
1.2T Packet Optical*	6 x 200G Coherent DWDM		

*Target 1H'2018

PTX10000 Line Cards

- Form factor unique to PTX10000
 - At FRS (17.2R1), full feature parity with PTX FPC3 up to 16.1R3 feature set
- Line Cards at FRS
 - 30x100G/30x40G/96x10G Line Card
 - 36x40G/144x10G/12x100G Line Card
- Additional Cards (post FRS)
 - 1.2T Packet Optical Line Card
 - 30x100G MACsec enabled Line Card
 - 60x1G/10G + 6x40G/2x100G Line Card
- 10GE support via 4:1 breakout cable

Line Card	100G	40G	10G
PTX10K-LC1101	30	30	96
PTX10K-LC1102	12	36	144

Available



30x100G/30x40G/96x10G Card

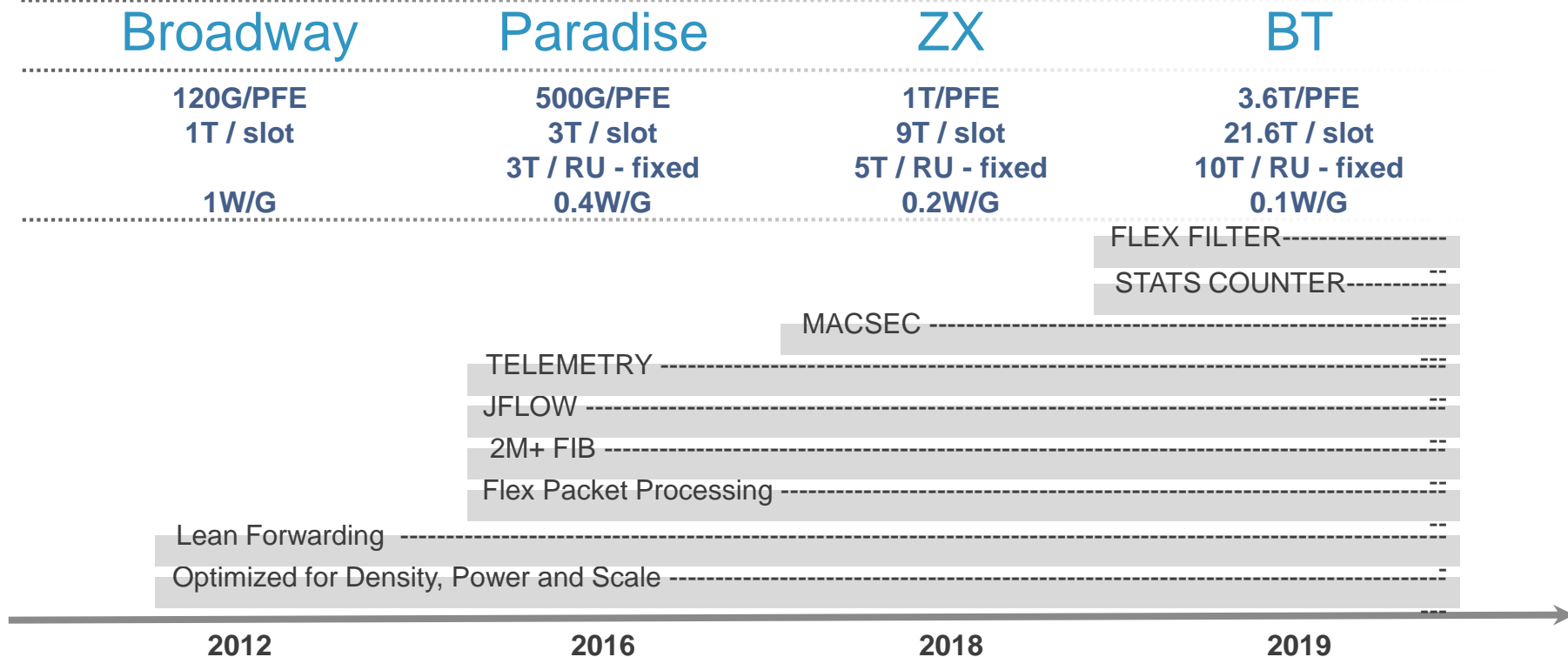


36x40G/144x10G/12x100G Card

Enabling Routing Profile with PTX SW
(Resiliency, Fabric Hardening, S&P)

Express ASIC Evolution

CAPACITIES, FEATURES



Scale & Performance



PTX Universal Core

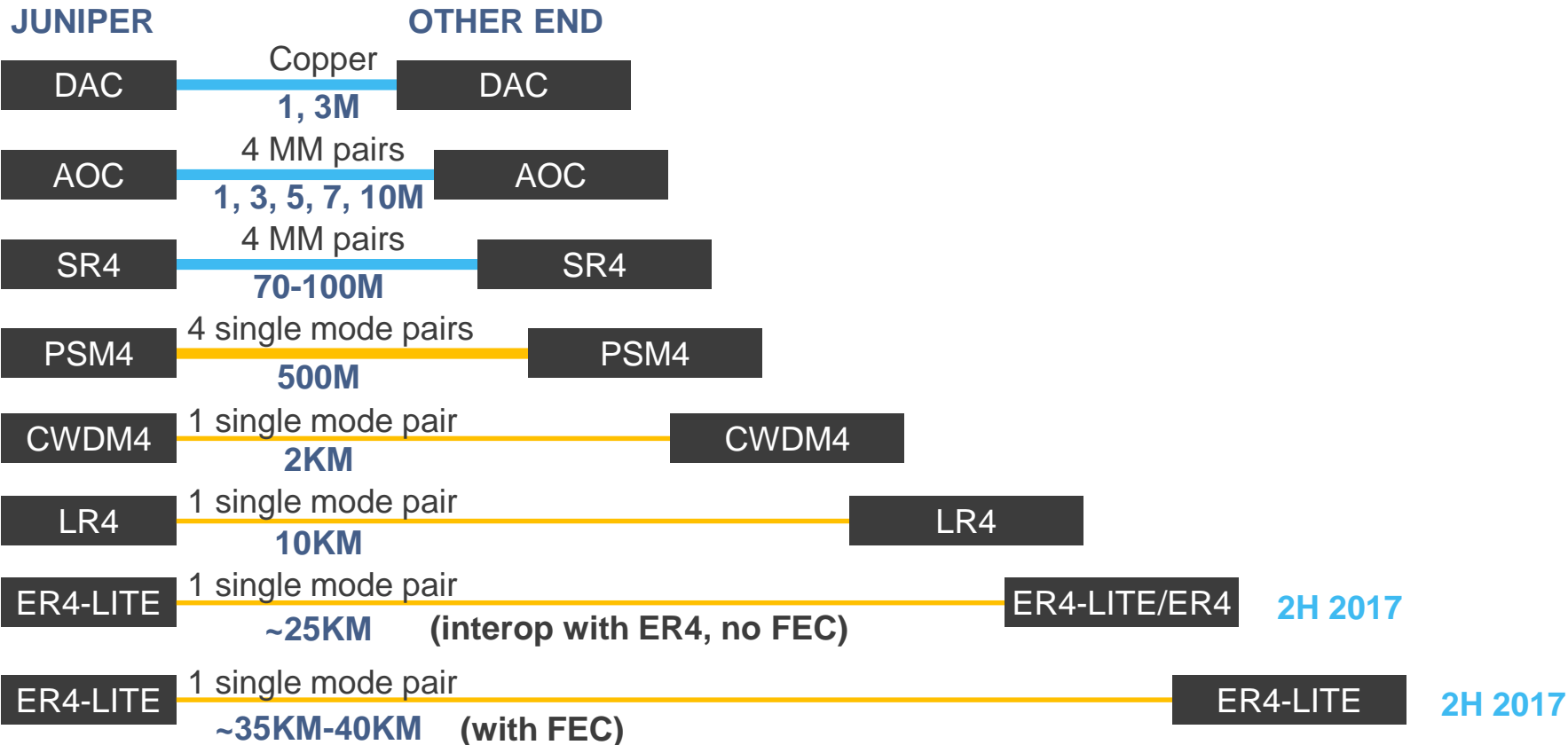
- Full-featured IP + MPLS
- Highly Scalable
- High Performance
- Resilient
- Carrier-grade
- Future Proof

Parameter	Offering
IP FIB	2M => 4M IPv4/v6
MPLS LSP	40K ingress 128K => 200K transit 100K egress
OSFP / ISIS / BGP	OSPF adjacencies - 3000 ISIS adjacencies - 4000 BGP sessions - 4000
Inline jFlow	1:1000 sample rate 1.2M flows/FPC3
Forwarding Latency	5-11 usec
FRR Convergence	10ms
GRES & NSR	Zero packet loss



Optics

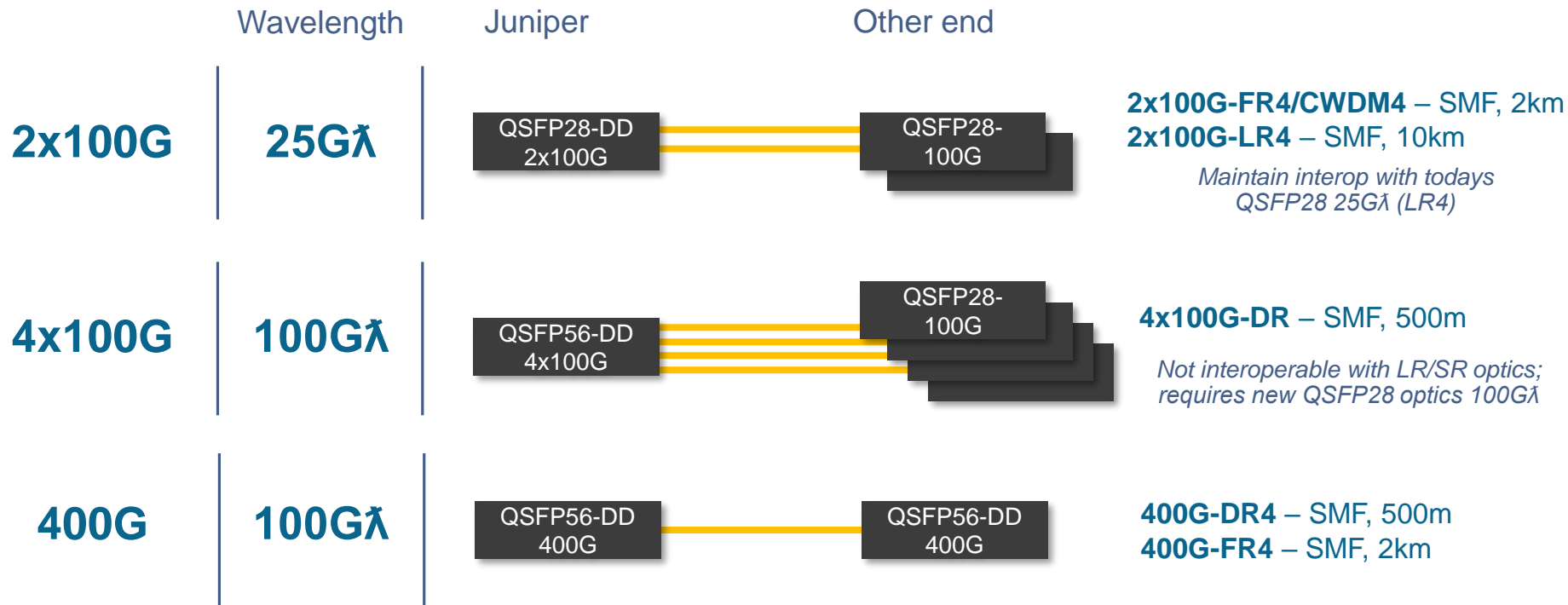
QSFP28 Client Optics



QSFP-DD Client Optics



2x100GE, planned for 2018
400GE/4x100GE, planned for 2019
Further optics options tbd





The background features a complex financial chart with several data series. The chart is overlaid with a grid of dashed lines. Various numerical values are scattered across the chart, including 717.2457, 467.2463, 345.7475, 225.0043, 117.2457, 125.2457, 848.7475, 225.0043, 467.24, 345.7, and 225.0. The chart also includes several curved lines in white, green, and blue, and a horizontal red line.

ACX Update

ACX Family Today – 1/10/40GE Backhaul optimized



ACX1000



ACX1100



ACX2100



ACX2200



ACX4000



ACX 5048



ACX 5096

Universal Mobile backhaul (LTE, 2G/3G), residential and MEF services platform

Optimized configurations TDM, GE, 10GE and 40GE

Flexible Services, Timing , Protocols with JUNOS

Complements Universal Edge

	Description	
ACX1000 ACX 1100	1RU, <300mm, Hardened, Fan-less Access Router, 1GE and TDM	Integrated precision timing (IEEE1588v2, SyncE)
ACX2100 ACX 2200 ACX 4000	1RU/3RU, <300mm, Hardened, Fan-less Access Router, 1GE, 10GE and TDM, POE	Embedded RFC 2544 Extensive end-to-end network monitoring: Latency, jitter, OAM
ACX 5048 ACX 5096	1RU, 48*1/0GE + 6*40GE 2 RU, 96*1/10GE + 8 *40GE	




Coherent Solution

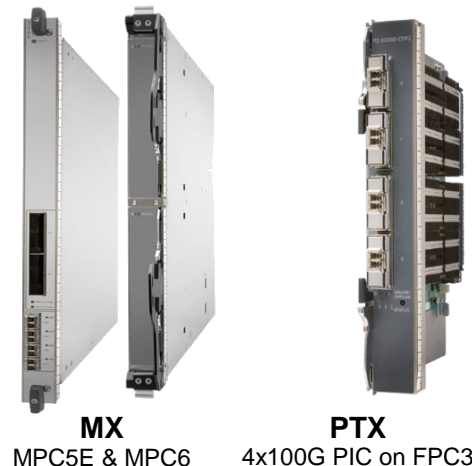


100G (DCO) Coherent Pluggable

CFP2	Industry Standard Form Factor
100G DCO	Coherent Optic, Embedded DSP: 100GE over OTU4
1	Modulation Type QPSK
Strong FEC	SD-FEC
MPC5E (MX960)	2x 100G-Coherent/Slot
MPC6E (MX2K)	4x 100G-Coherent/Slot
FPC3 (PTX3K/5K)	8x 100G-Coherent/Slot



CFP2-DCO-T-WDM-1



DCO=BACKWARDS COMPATIBLE

Coherent components are embedded: Compatible with Installed Interfaces

OPERATIONAL FLEXIBILITY

100G + FEC + ITU-C Grid
SD-FEC for 2,000km+

Juniper-INTEROP

MIC3-100G-DWDM +
PTX-5-100G-WDM +
UFM3/6 + Voodoo

Integrated Transponder (1.2 Tbps)



6 x 100G/150G/200G Coherent Ports



QFX 10008/ 10016



PTX 10008/ 10016

KEY FEATURES

Capacity

- 1.2 Tbps DWDM lineside capacity
 - 6 x 100G (QPSK); 150G (8QAM); 200G (16QAM)
 - Fixed onboard Coherent optics

Modulation Flexibility

- 100G DP-QPSK (~ 4,000 km)
- 150G DP-8QAM (~ 2,000 km)
- 200G DP-16QAM (~1,000 km)

L2/L3 Features

- JUNOS support
- 12 x 100GE MACsec (AES-256)
- Scale same as respective platforms

Platform support:

- QFX10008/ 10016
- PTX10008/ 10016

The image features a blue-tinted background showing a crowd of people. The text "Thank you" is prominently displayed in the center in a large, white, sans-serif font. The overall mood is appreciative and professional.

Thank you