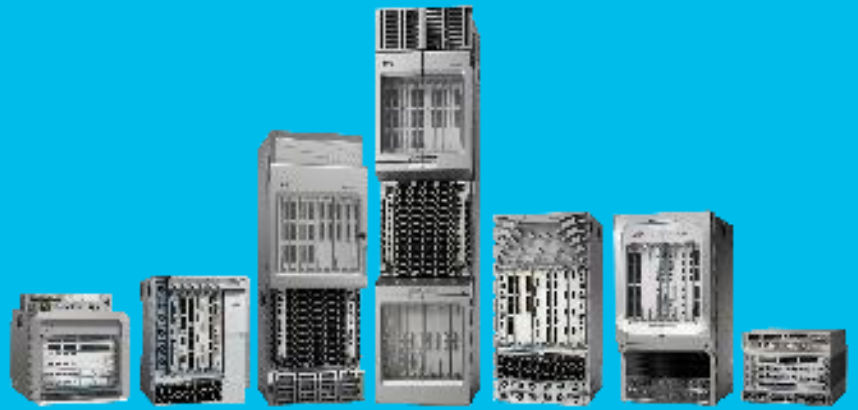
The bridge to possible

Flexibility for the Edge with ASR 9000

Cisco Knowledge Network



Product Management
Technical Marketing

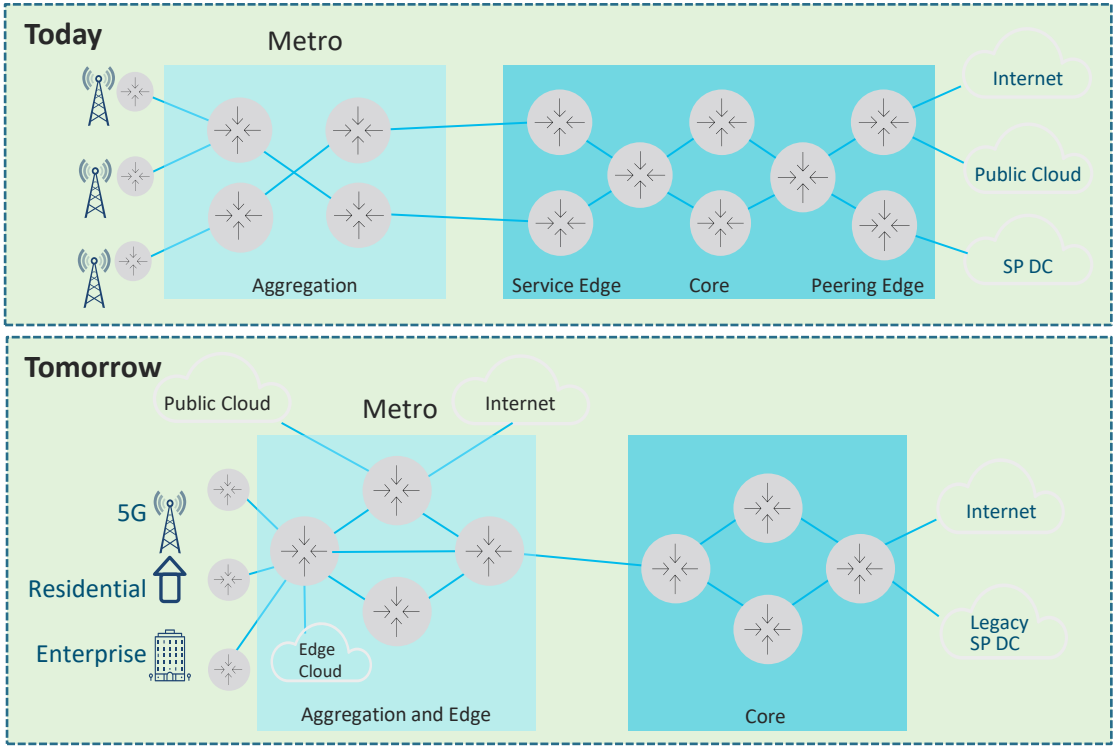
Cisco Networking - Provider Connectivity
November 15, 2022

Agenda

1.  Service Edge Transformation
2.  ASR 9000 5th Generation Innovations
3.  ASR 9000 400G for the 5th Generation

Service Edge Transformation

Communication Service Provider Architecture Shift



Trends

- SP services and cloud handoff moving to Metro
- Growth in broadband driven by hybrid work, SASE, and government spending
- CapEx/OpEx pressures driving convergence of wireless and fixed IP, TDM and optical networks

Implications

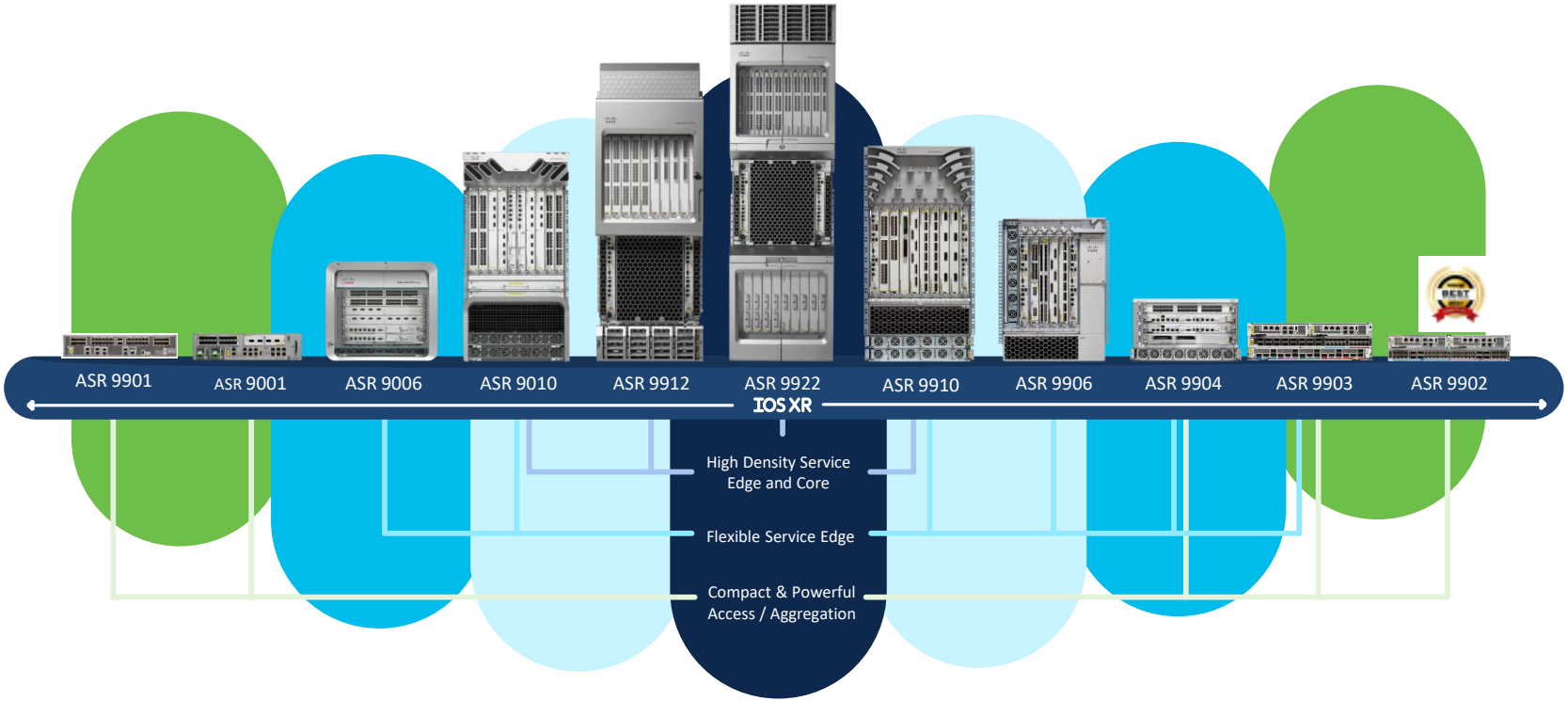
- Shift to converged, service-rich, metro networks
- Metro based broadband delivery architectures

ASR 9000 Portfolio Introduction

Enabling Bandwidth & Embedded Intelligence

Cisco ASR 9000 Series

Hardware portfolio



Cisco ASR 9000 Compact and Modular Routers

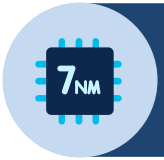
5th Generation: Investment Protection up to 4T per slot

	ASR 9902	ASR 9903	ASR 9904	ASR 9006	ASR 9906	ASR 9010	ASR 9910	ASR 9912	ASR 9922
Capacity	800 Gbps	3.6 Tbps	8 Tbps	8 Tbps	16 Tbps	16 Tbps	32 Tbps	40 Tbps	80 Tbps
QDD Ports	2	5	20	20	40	40	80	100	200

ASR 9000 5th Generation Innovations

ASR 9000 5th Generation Hardware

The World's largest networks are built with the ASR 9000



Refined. Cutting edge 7nm silicon for performance & power efficiency

Reloaded. Increased capacity with 400GE, port flexibility

Reinforced. Hardware Root of Trust, Full Line Rate MACsec

Service Edge. Rich feature set and Superior multi service scales

Cisco ASR 9000 Series

Reloaded with 5th Generation Silicon and support for 400GbE

4 Tbps

3.2 Tbps

2 Tbps

0.8 Tbps

0.4 Tbps

5th Gen Line Cards

- 5th Generation Silicon
- Service Edge scale in compact and modular form-factor
- Flexible interface support for 1, 10, 25, 40, 100 & 400G
- 0.4 Watts/Gbps

3.6 Tbps

ASR 9903

2T PEC

0.8T PEC

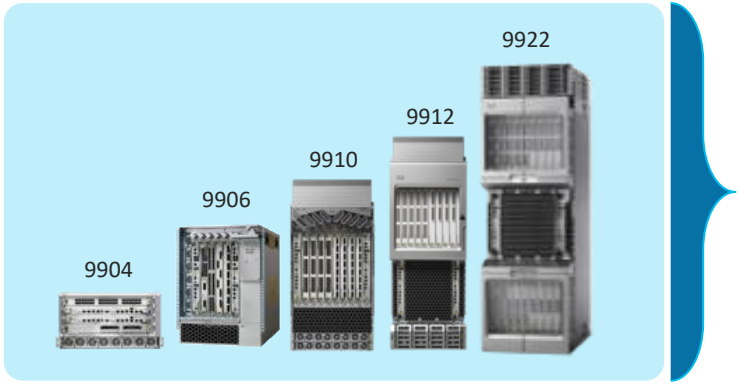
0.8 Tbps

ASR 9902

5th Gen Compact Chassis

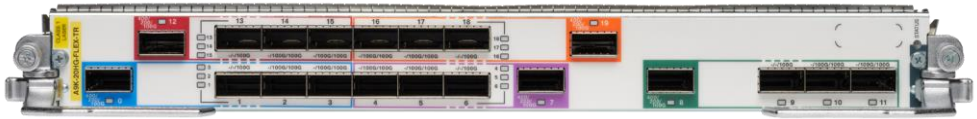
5th Generation Line Card Chassis Portfolio

ASR 9900 Series



400G Enabled

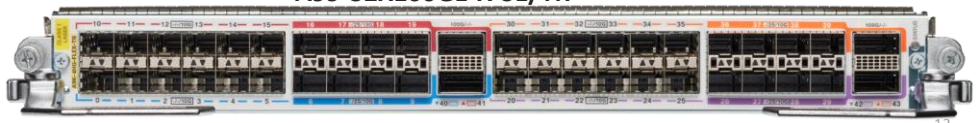
A99-10X400GE-X-SE/TR



A9K-20HG-FLEX-SE/TR

A9K-8HG-FLEX-SE/TR

A99-32X100GE-X-SE/TR

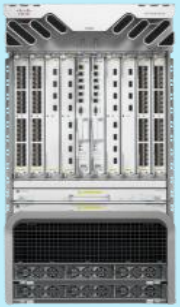


A9K/A99-4HG-FLEX-SE/TR

5th Generation Line Card Chassis Portfolio
ASR 9000 Series

ASR 9006

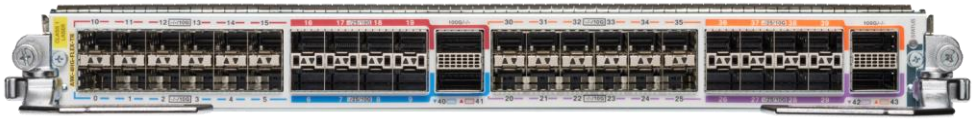
ASR 9010



400G Enabled

A9K-20HG-FLEX-SE/TR

A9K-8HG-FLEX-SE/TR

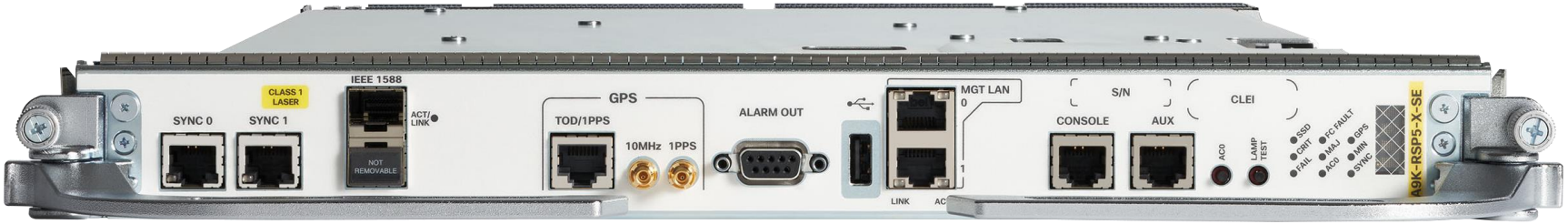


A9K-4HG-FLEX-SE/TR

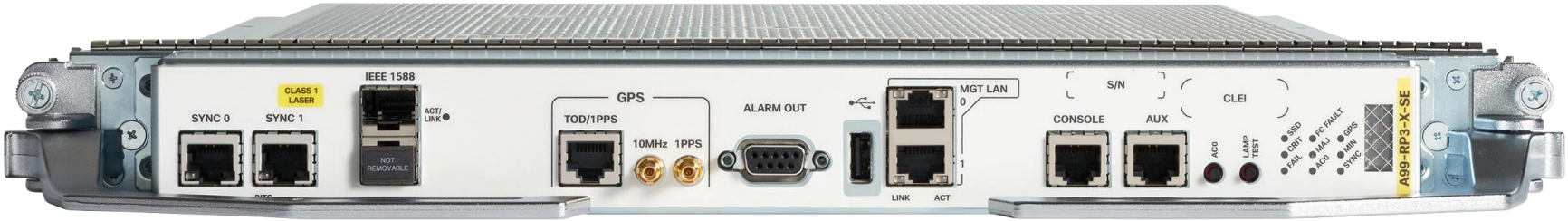
Class C Timing Complaint RSP5-X and RP3-X

Use Case: 5G Packet Core & Converged wireline, wireless edge services

A9K-RSP5-X-SE/TR



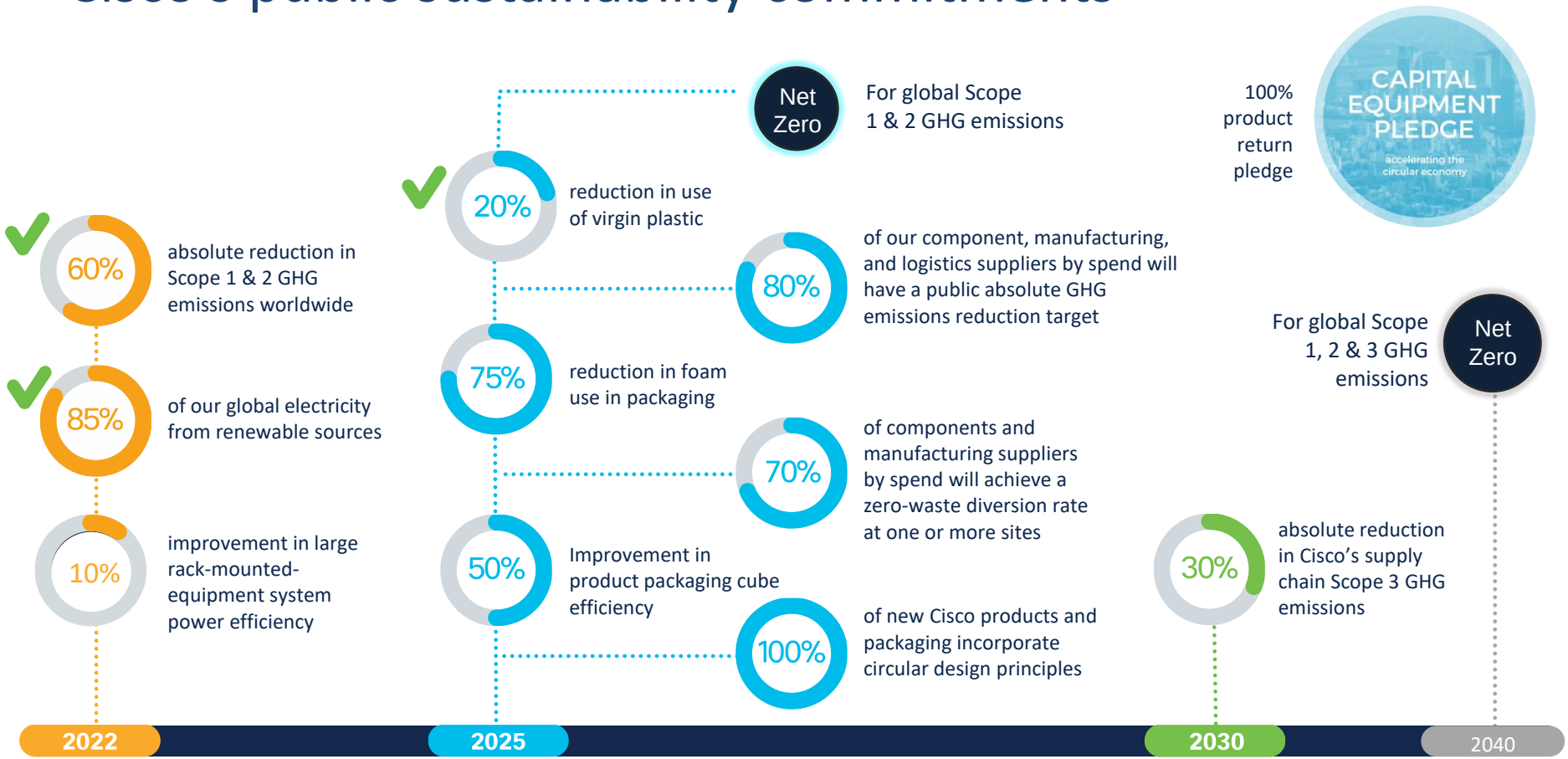
A99-RP3-X-SE/TR



New Class C compliant RSP/RPs enabling Class C timing

ASR 9000
Advanced Power Management APM

Cisco’s public sustainability commitments



Power Management with ASR 9000

Efficiency improvements and Advance Power Management

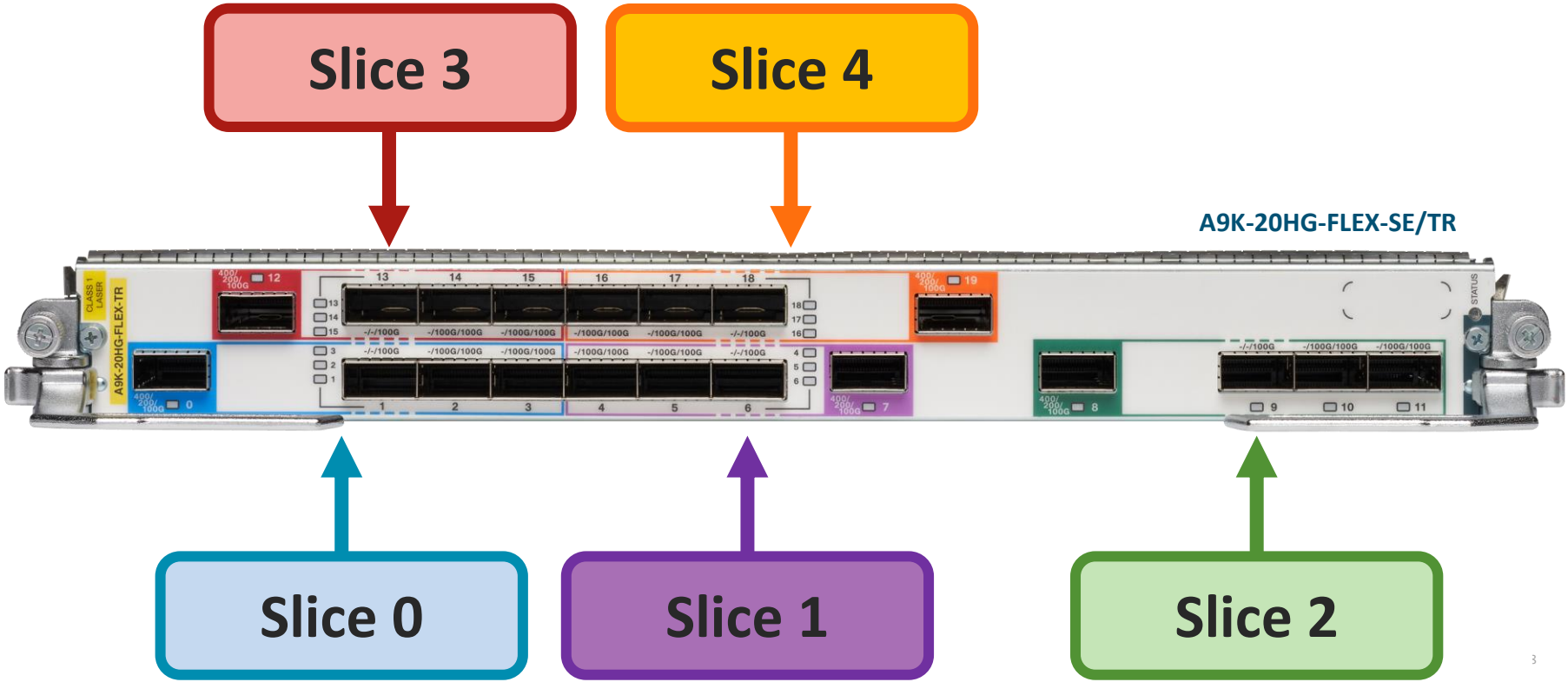
- **Improving ASR 9000 product energy efficiency from Generation to Generation**

3rd Gen	5th Gen
1.06 W/Gbps	0.31 W/Gbps

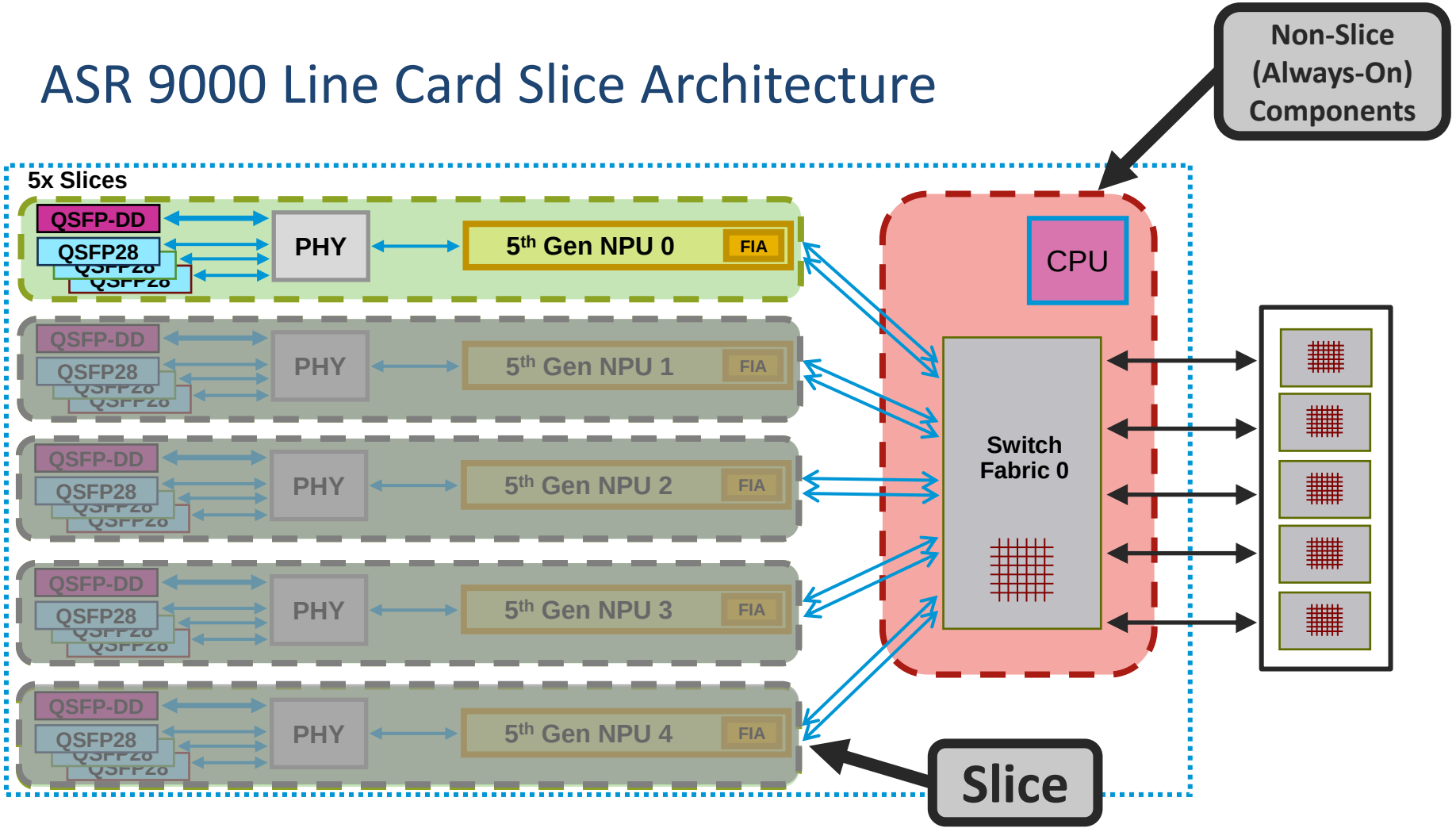
71% Power Efficiency improvement

- **Lower power consumption with Advanced Power Management (APM)**
  - Line cards slices concept
  - Power down slices on demand

A9K-20HG-FLEX-SE/TR Combo Line Card: What is a Slice?



ASR 9000 Line Card Slice Architecture



ASR 9000 Advanced Power Management (APM)

Two APM types are available:

- **"Power-Savings" mode:**
  - Moderate power savings
  - Ports on other slices are not affected by a slice shutdown or restoration
  - Available on 5th Generation ASR 9000 Line Cards and ASR 9902 / ASR 9903
- **"Power-Down" mode:**
  - **Great power savings !**
  - Requires line card reload to bring slice back to operation
  - Available on 5th Generation ASR 9000 Line Cards and ASR 9902 / ASR 9903

ASR 9000 APM: Example A9K-20HG-FLEX-SE/TR

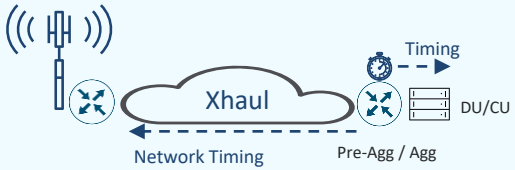
A9K-20HG-FLEX-SE/TR	Power-Savings	Power-Down
Number of slices	5	
Full power draw	100 %	
Power reduction per slice in %	9.1 %	13.5 %
Max. theoretical reduction per slice in %	20 %	20 %
APM efficiency factor in %	**46 %**	**68 %**

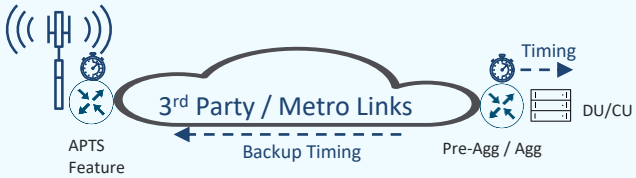
Advanced Power Management (APM)

https://www.youtube.com/watch?v=8YJGgf0ezkU

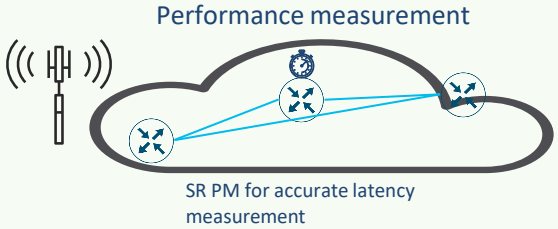
ASR 9000 Time Synchronization – Readiness for 5G, Class C Timing

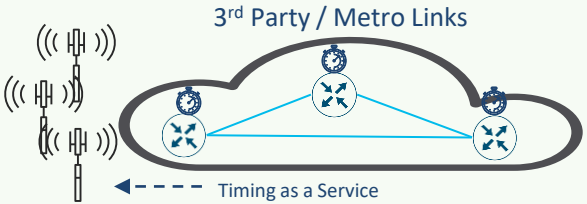
Timing with Evolving Transport Architectures



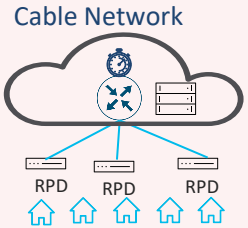


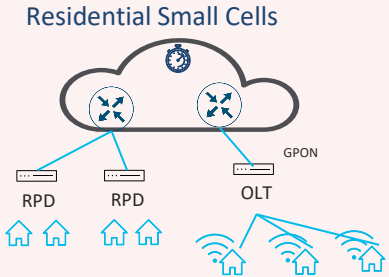
Public or Private 5G





Metro Transport

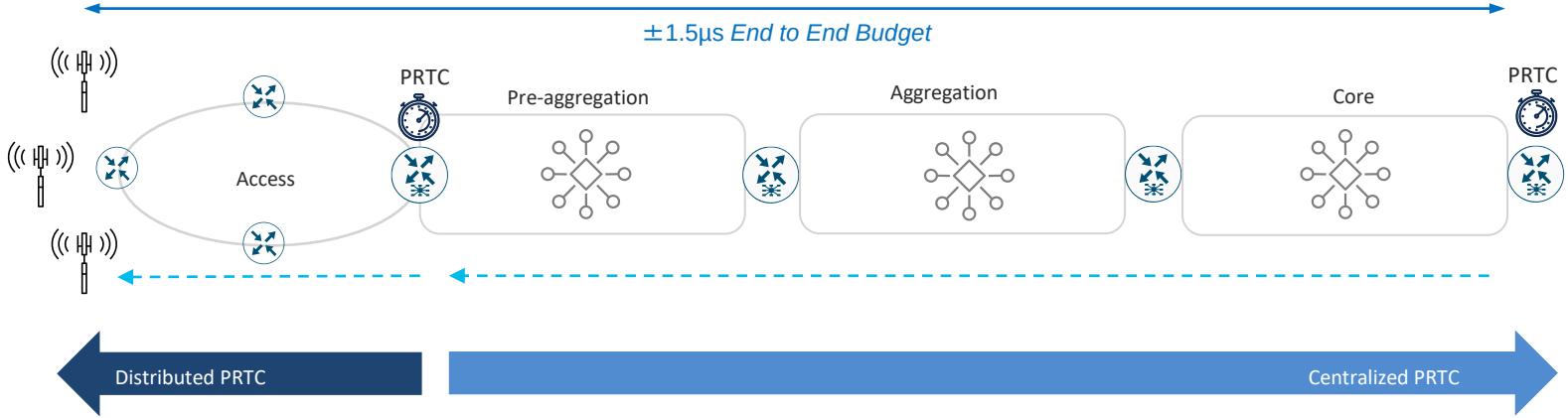




Cable / GPON Transport

APTS - Assisted Partial Timing Support, CU - Centralized Unit, DU - Distributed Unit, RPD - Remote PHY Device, OLT - Optical Line Terminal

Synchronization Architectures



Use case:
- 4G/5G RAN Sync

  - Better relative timing within cluster of radios

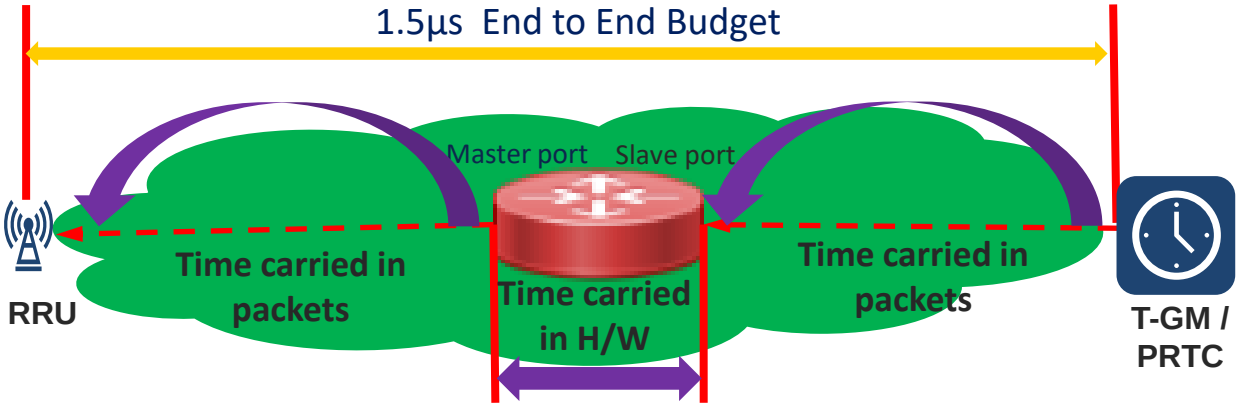
Use Case:
- Backup clock for 4G/5G RAN,
- Accurate synchronization for Metro network

  - More stabilized clock used as backup source for distributed PRTC for better holdover
  - Synchronize Core / Metro networks for accurate service performance measurement (for example: SR PM)

Class C timing + enhance SyncE are critical to maintain timing budget!

PRTC - Primary Reference Time Clock

What is Class C Timing?



G.8273.2 Time Error (Class A, B and C)

G.8273.2 Time Error Class	Constant time error
Class A (10 T-BC's)	±50 ns
Class B (20 T-BC's)	±20 ns
Class C (40+ T-BC's)	±10 ns
Class D (Proposed)	Not finalized

Benefits of Class C Timing:

- Improved end-to-end network accuracy for 5G readiness
- More network devices per chain - timing design efficiency
- Compensate errors of optics, old fiber and legacy transport;
- PRTC centralization: no need to deploy costly PRTC on each Access for 5G services

RRU - Remote Radio Unit, T-GM – Telecom Grandmaster , PRTC - Primary Reference Time Clock, T-BC – Telecom Boundary Clock

ASR 9000 Class C Timing and Synchronization Support

ASR 9000 Series Compact Chassis

ASR 9903

ASR 9902

ASR 9000 Series Modular Chassis

RSP5-X/RP3-X

A9K-RSP5-X-SE/TR

A99-RP3-X-SE/TR

5th Gen LCs

A9K/A99-4HG-FLEX-SE/TR

A9K-8HG-FLEX-SE/TR

A9K-20HG-FLEX-SE/TR

A99-10X400GE-X-SE/TR

PTP Protocols: ITU-T G.8275.1, G.8275.2, G.8265.1, IEEE 1588v2

SyncE, eSyncE and eESMC Support: ITU-T G.8262, G.821, ITU-T G.8262.1*, ITU-T G.8264, enhanced ESMC support

PTP Clock Performance: ITU-T G.8273.2 compliance Class C Boundary Clock

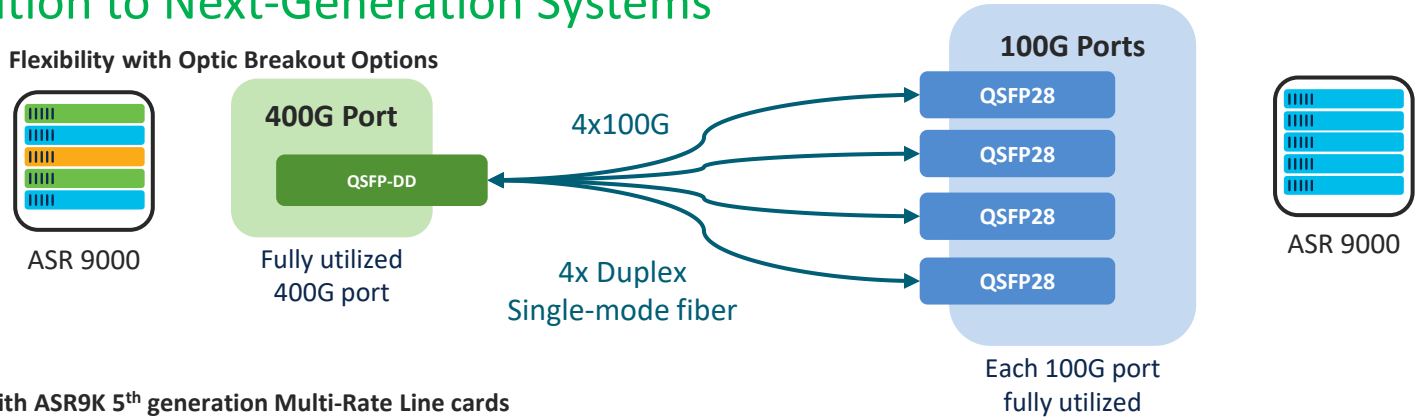
* Roadmap feature

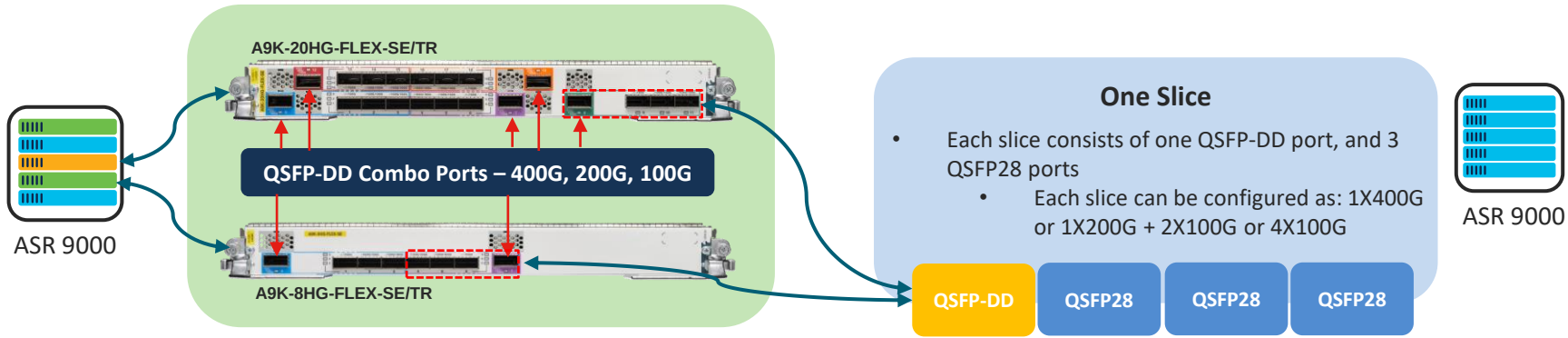
ESMC - Ethernet Synchronization Message Channel

ASR 9000 400G for the 5th Generation

400G to 100G Flexibility

Transition to Next-Generation Systems

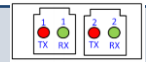




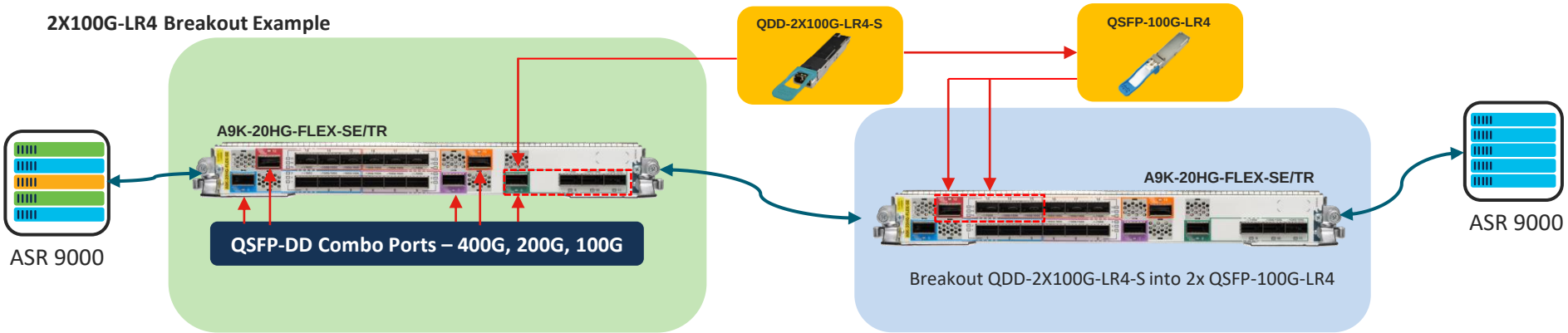
4x 100G breakout for single-mode fiber is only possible with the new QSFP28 Single Lambda 100G optics (100G-FR, 100G-LR), not with first generation of QSFP28 SMF optics (i.e., 100G-LR4)

2x100G QSFP-DD to 100G QSFP28 Breakout

QSFP-DD 2x100G Modules provide ability to connect legacy 100G modules to QSFP-DD ports

Module Type	Range	Mode	Power Consumption	Modulation	Connector	
QDD-2X100-LR4-S	10 km (G.652)	SMF	10W	NRZ	CS (Dual Duplex Interface)	
QDD-2X100-CWDM4-S	2 km (G.652)	SMF	7W	NRZ	CS (Dual Duplex Interface)	
QDD-2X100-SR4-S	100m on OM4	MMF	5W	NRZ	MPO-24	

2X100G-LR4 Breakout Example

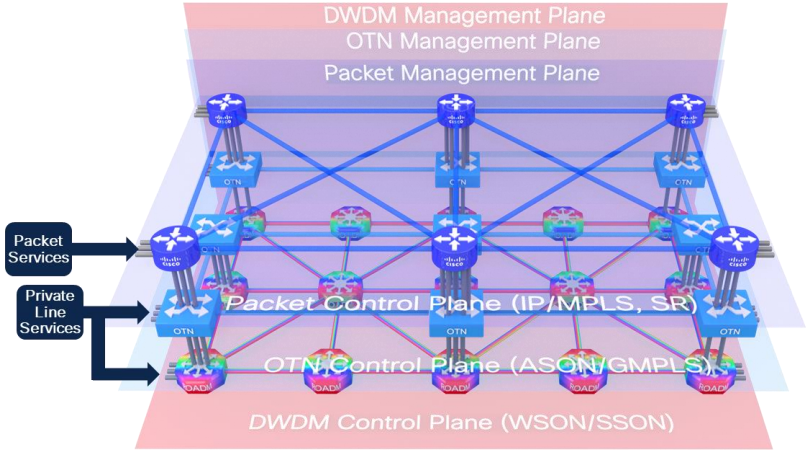


400G/200G/100G Optics and Use Cases

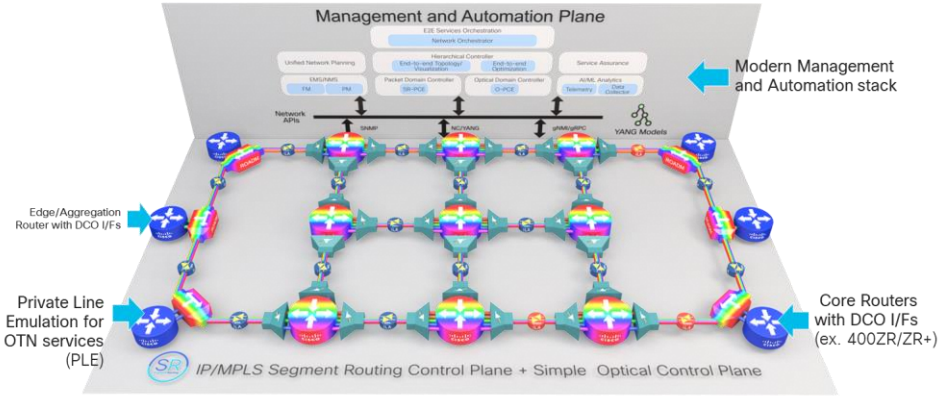
	100 m	500m-2km	10 km	40+ km
400G Optics	400G-DR4 2x100-SR4	400G-DR4 400G-FR4 2X100-CWDM4	400G-LR4 400G-LR8 2X100-LR4-S	400ZR 400ZR+
100G Optics	100G SR MM	100G-CWDM4 100G-FR 100G-PSM4	100G-LR 100G-LR4	100 ZR4

Toward a Routed Optical Network Future

Today's Network



Routed Optical Networking (RON)



Layered Architecture

35% CapEx Savings*

Flat Hop-to-Hop Architecture

57% OpEx Savings*

46% TCO Savings*

ASR 9000 IPoDWDM Solution Before RON

- Solution requires a very select hardware.
- Up to 200G speed (w/1x200G MPA)
- Low port density
- High power consumption

ASR9K 3rd Generation HW

400G IPoDWDM Line Card

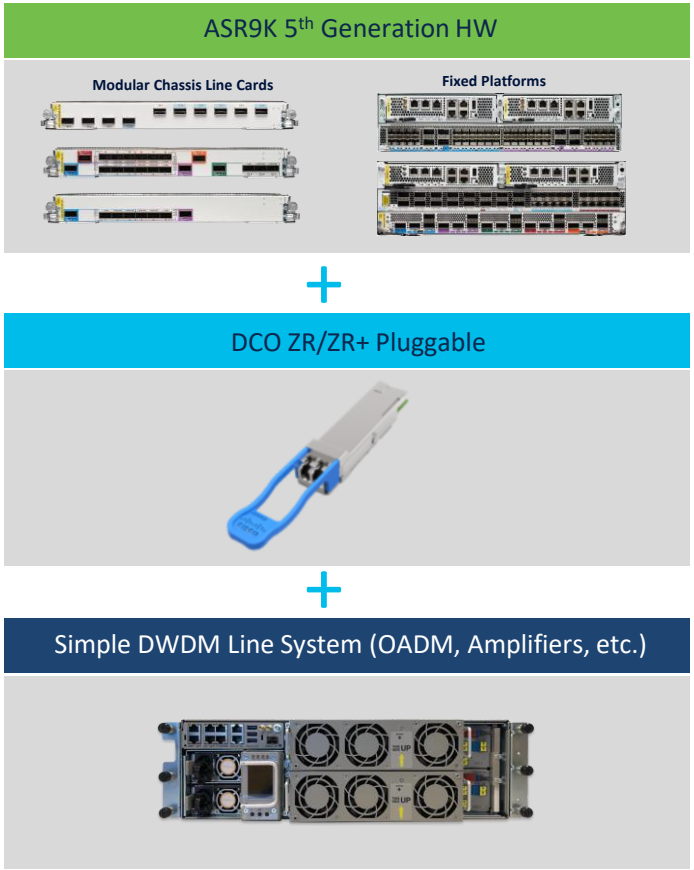
MOD200/400 Line Card with 1x200/2x100G/1x100G MPA

+

CFP2 WDM Pluggable

Where does ASR 9000 play into RON - Now

- Standardized Solution - Available on any ASR9K 5th generation hardware which support DCO optics!
  - No dedicated IPoDWDM hardware and interface
  - Use QSFP-DD interfaces on ASR9K 5th generation line cards
- QSFP-DD Compact form-factor
- Speed variety: 100G; 200G, 300G, 400G
  - Flexibility: Transponder and muxponder modes: 1x100G, 2x100G, 3x100G, 4x100G, 1x100G, 1x400G
- Long reaches of distances



Cisco DCO ZR/ZR+ Portfolio

DCO = Digital Coherent Optic

QDD-400G-ZR-S

Reach*	< 120km
Client	400GE 4x100GE
Application	Campus, Metro, Edge DCI
Form Factor	QSFP-DD
FEC	C-FEC
Max. Power Consumption*	~15W
Multivendor Interop	Yes

QDD-400G-ZRP-S

Reach*	> 120km
Client	Nx100GE, 400GE
Application	DCI, Metro, Regional, Long Haul
Form Factor	QSFP-DD
FEC	oFEC
Max. Power Consumption*	~23W
Multivendor Interop	Yes

References

Cisco ASR 9000 Series Aggregation Services Routers

https://www.cisco.com/c/en/us/products/routers/asr-9000-series-aggregation-services-routers/index.html

ASR 9000 YouTube Channel

https://www.youtube.com/@ciscoasr9000

ASR 9000 Series Datasheets

https://www.cisco.com/c/en/us/products/routers/asr-9000-series-aggregation-services-routers/datasheet-listing.html

The bridge to possible