CISCO *Live!*   Let's go

Internet for the Future

Journey to the Next Generation SP Architecture
and Operating Model

Rob Piasecki, Principal Architect, CX PD Provider Connectivity

Agenda

- What's Driving the Internet for the Future?

- Redefining Silicon

- Redefining Optics

- Redefining Architectures
  - Simplifying IP & Optical Transport
  - Simplifying the Edge
  - Simplifying Routing

- Redefining Operations

- Summary

What's Driving the Internet for the Future?
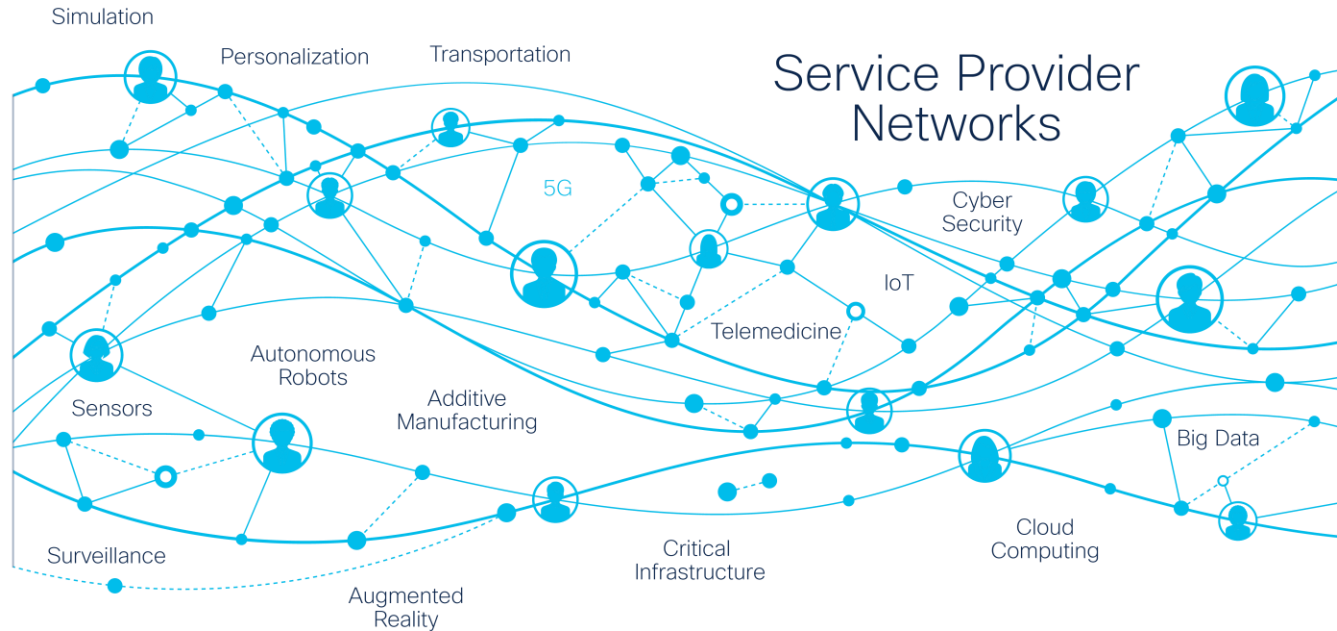
The Internet for the Future

New Norms
For the way we Work, Live, Play, and Learn

New Participants
Many remain unconnected and emerging IoT

New Potentials
The foundation of economies, governments, and societies

Simulation

Personalization

Transportation

Service Provider Networks

5G

Cyber Security

IoT

Telemedicine

Autonomous Robots

Additive Manufacturing

Sensors

Big Data

Surveillance

Critical Infrastructure
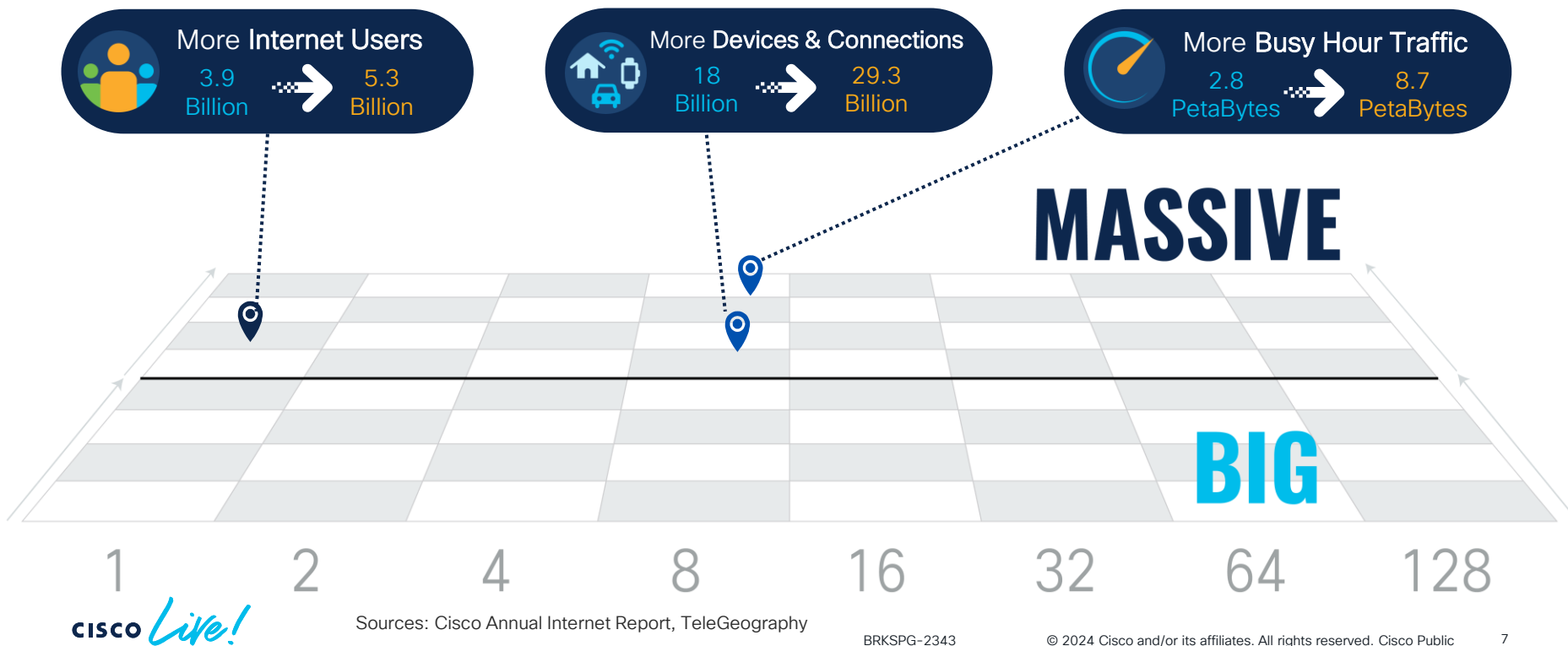
Cloud Computing

Augmented Reality

The Exponential Growth of the Internet

The Story of the Emperor, Inventor, and the Game of Chess

Mt. Everest of rice

Second Half of the Chessboard is **MASSIVE**

2,147,483,648 grains of rice

One grain of rice

First Half of the Chessboard is **BIG**

1 2 4 8 16 32 64 128
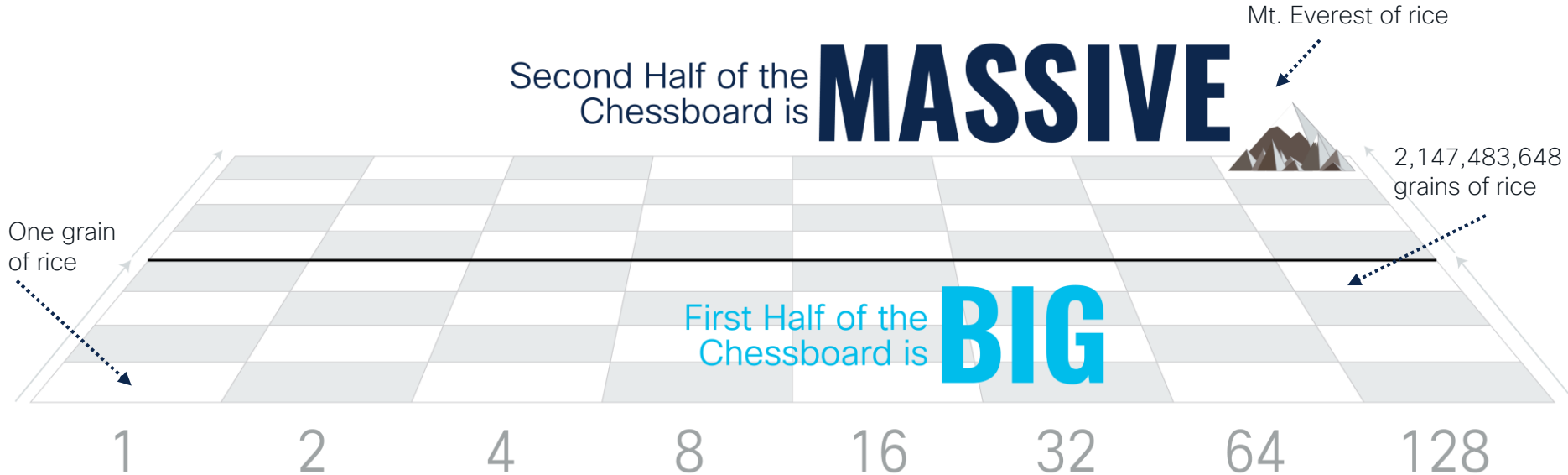
The Internet Enters the 2nd Half of the Chessboard

Massive Scale with Exponential Growth

More Internet Users
3.9 Billion → 5.3 Billion

More Devices & Connections
18 Billion → 29.3 Billion

More Busy Hour Traffic
2.8 PetaBytes → 8.7 PetaBytes

MASSIVE

BIG

1   2   4   8   16   32   64   128

Sources: Cisco Annual Internet Report, TeleGeography

Traditional Economics Begin to Break

What Got Us Here, Won't Get Us There...

SP CapEx Expenditure [$Billions]

Consumer IP Traffic [$Billions]

~5:1 OPEX

Projected based on exponential growth

>5:1 OPEX

Desired to ensure network profitability

<5:1 OPEX

2010

2020+
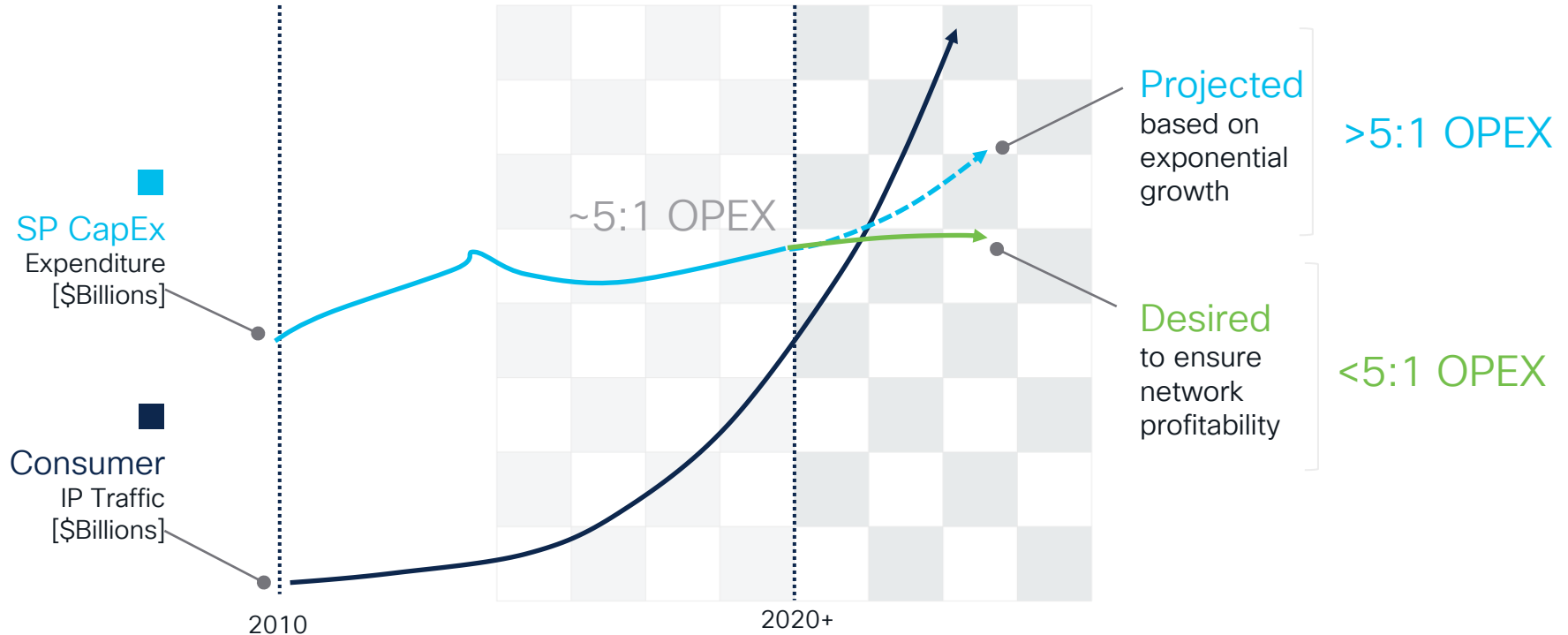
Redefining the Economics of the Internet

software

optics

trustworthy
systems
cloud
enhanced

silicon
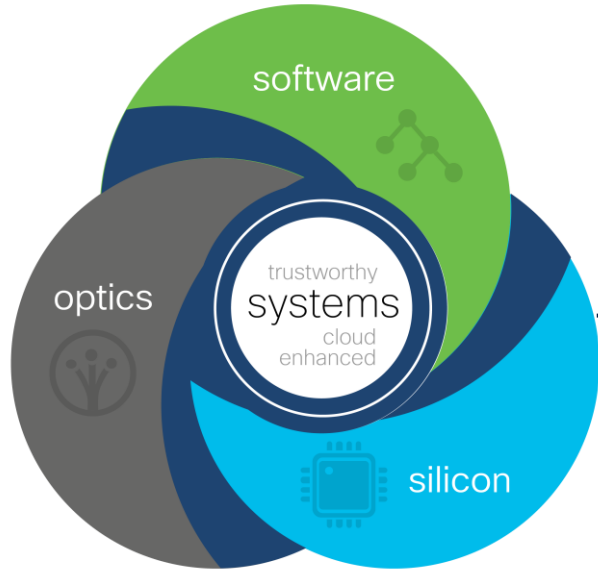
Innovation across multiple dimensions
can shift the paradigm.

New Possible Network Architectures

Converged

Cloud Enhanced

Fabric Based

Delivering Unprecedented

Cost & Power Efficiency

Prioritized Operations

Augmented Intelligence

Redefining
Silicon

Why did we need new ASIC architecture?

- Requirements change

  Increased focus on bandwidth and power

  Fundamental design laws reach headwinds (Moore, Dennard, etc.)

- Underlying component technologies change

  SerDes, xRAMs, Silicon processes, Optics

- ASIC architectures usually last around 10-15 years

- Adoption curve for chips and systems

  Silicon One is currently in the sweet spot

  Balancing innovation and maturity

  Most advanced chip design

  Deployed by major Web and SP networks

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CISCO.

Silicon One ™
P100
©Cisco 2021

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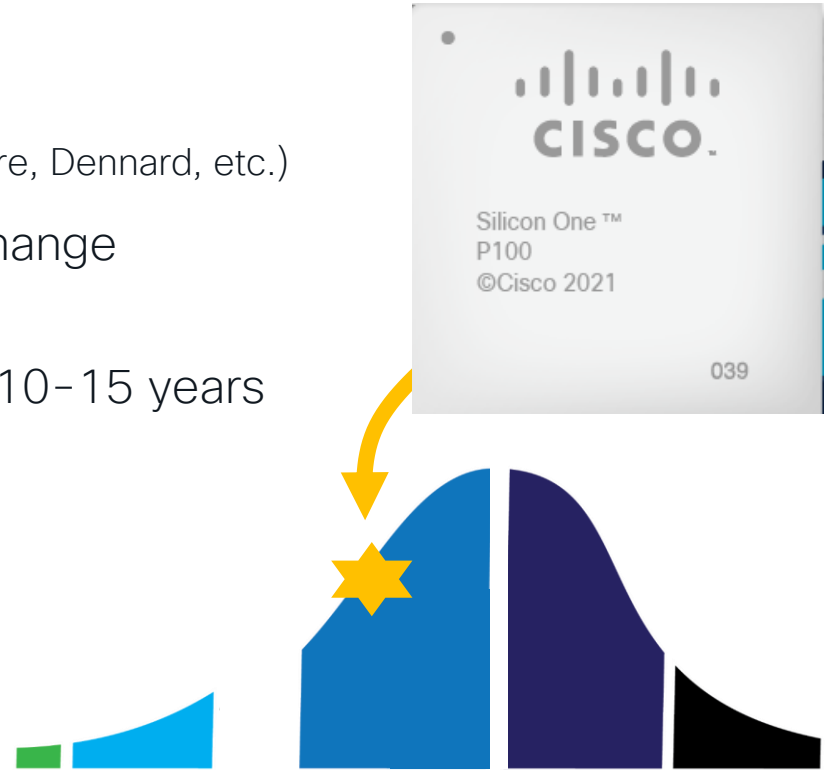
Introducing
Cisco Silicon One

A New Silicon Architecture

Cisco Silicon One
Industry Leading
Router on a Chip
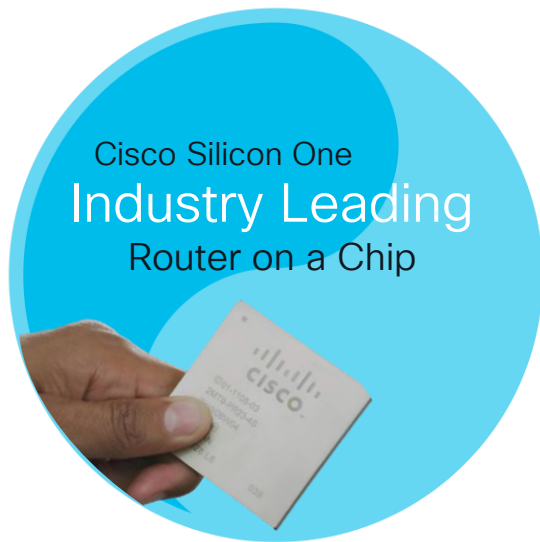
ONE Unified Silicon Architecture

- Comprehensive routing with switching efficiency
- Multiple segments: web and service provider
- Multiple functions: system-on-a-chip, line card, and fabric
- Multiple form-factors: fixed or modular

Delivers Performance Without Compromise

- First routing silicon to break 10Tbps barrier
- Leading performance providing 25.6T in 7nm design
  - G200 announced (51.2T in 5nm design)
- Game changing power efficiency
- Global route scale, deep buffering, P4 programmable
- Enables 32x800G and 32x400G in 1RU form factor

Cisco Silicon One Family
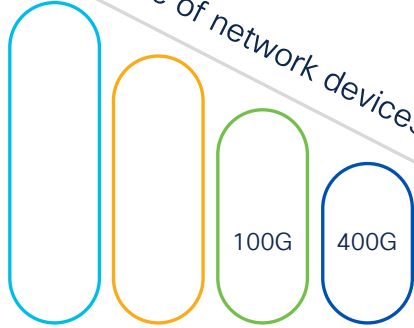

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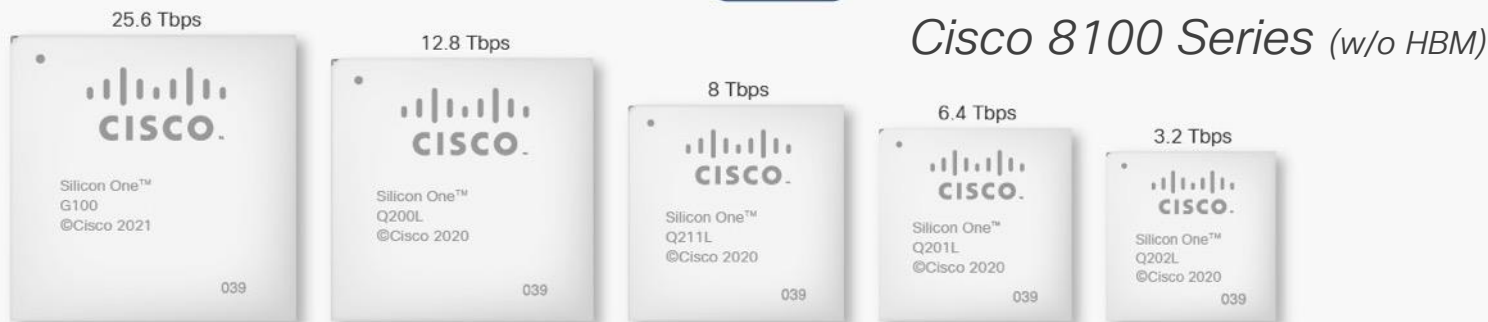
Redefining
Optics

The Changing Economics of Networking

Over time, network device cost per gigabit of bandwidth is going down as speed and density increases
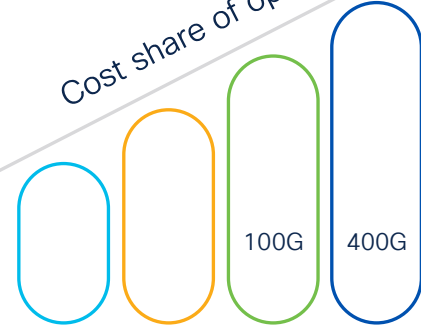
Over time, pluggable optics costs reduce slower as speed increases because complexity increases

Silicon Photonics
Fundamental Technology To Change The Economics of Optics

Silicon photonics accelerates data transfer speeds, reduces complexity to support bandwidth at scale, and removes network infrastructure constraints in a cost-effective manner.

CMOS Electrical IC

Silicon Photonic IC

Hybrid Opto-Electronic
Design and Integration

Wafer Scale
Photonics Manufacturing

Highly Automated
Assembly & Test

Coherent Pluggables
Combine with DSP

Co-Packaging
For 20Tb ASICs and beyond

Core Optics

LUXTERA

LIGHTWIRE

ACACIA
COMMUNICATIONS, INC.
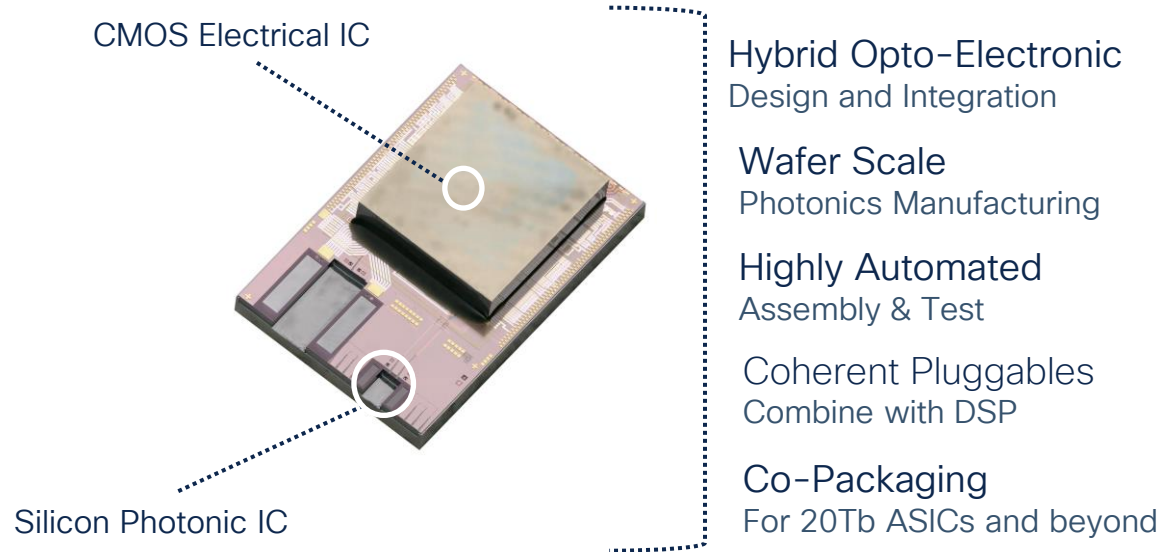
Leading to Digital Coherent Optics (DCO)

Traditional Transponder

Digital Coherent Optics

Typical 100G Coherent
transponder line card
for 300x300mm layouts

$$$
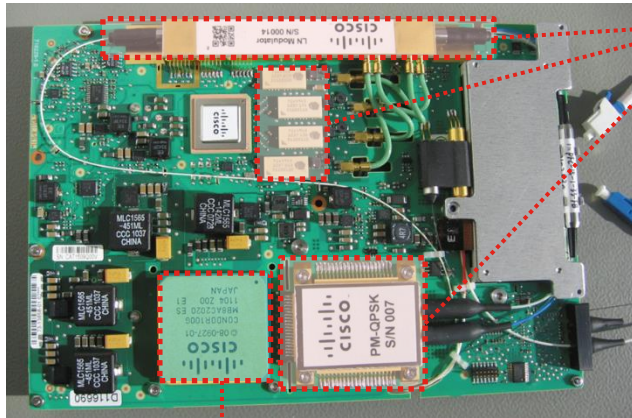
Discrete
Photonic
Elements

Digital Signal
Processor
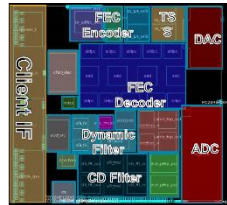
28nm

Silicon
Photonics
Integration
Advanced
Packaging
Integration

Moore's
Law

PIC with
Multi Chip
Packaging

7nm

QSFP–DD
400G DCO
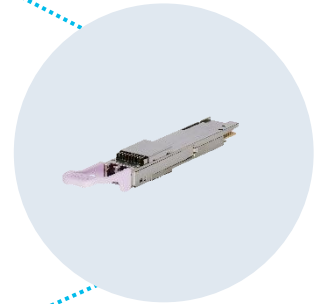
$
Uses standard
400G host port
> 10x decrease
in power/bit

Benefits of Coherent Optics Integration

100G MSA — DSP ASIC, E-mux, Modulator, CRX, DRV

100G CFP

200G/400G CFP2

400G QSFP-DD

Standard form factor
Significantly lower power
No additional space
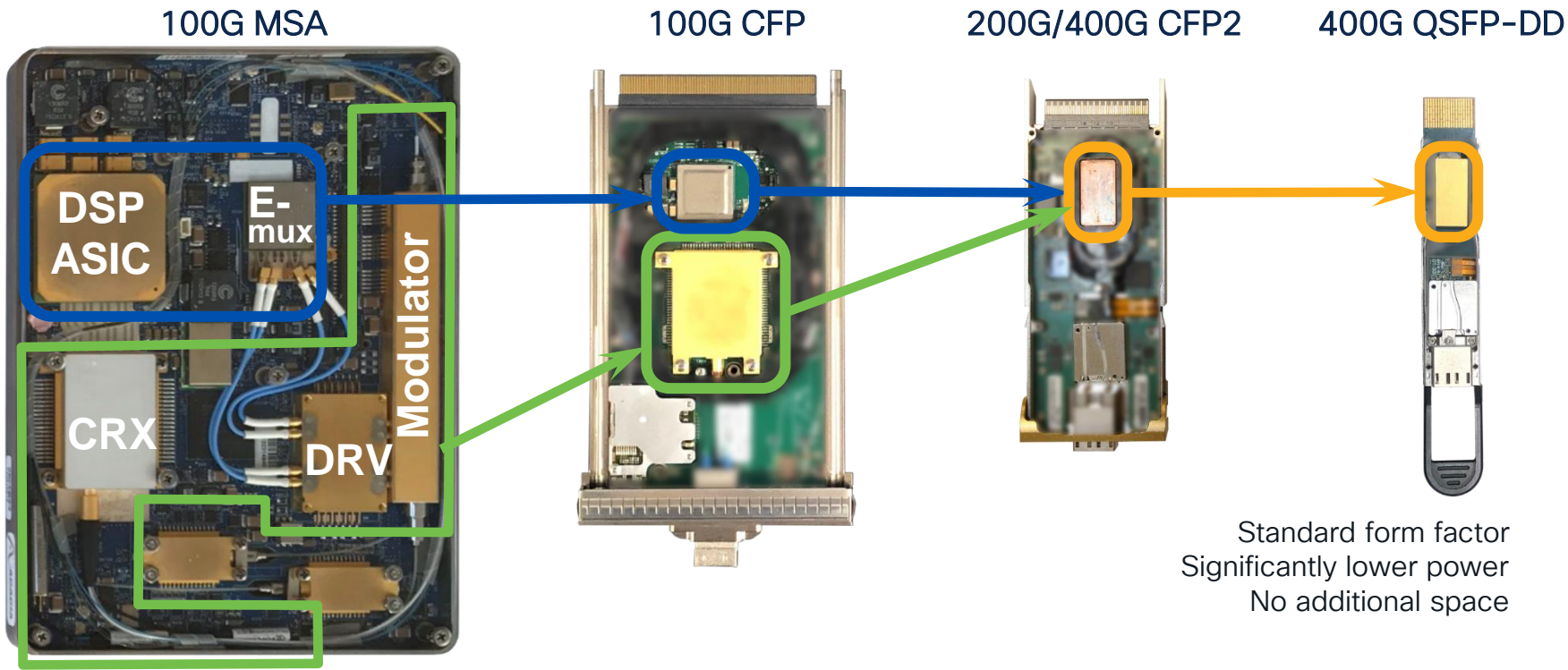
2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2021

400G DCO Power and Space Efficiency

vs 4x100g transponders

Transponder Chassis +

4x 100G transponder line cards

8x QSFP-28 Grey Optics

QSFP-DD 400G DCO

=

Same Capacity Excellent Optical performance

+
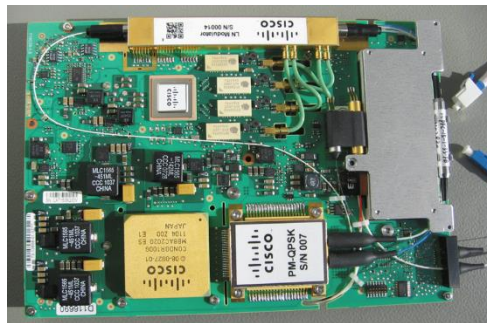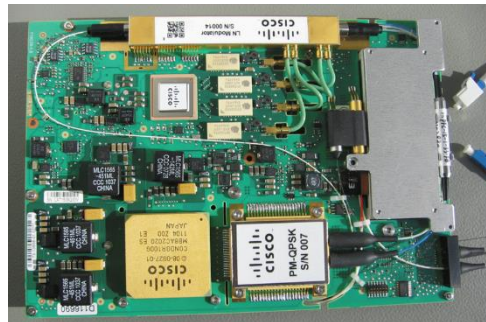
Routed PON Solution

Disaggregated & Scalable PON Deployment

Aggregation

IP Routers

PON

OLT Chassis

Cisco Routed PON

Router + OLT SFP+ Pluggable
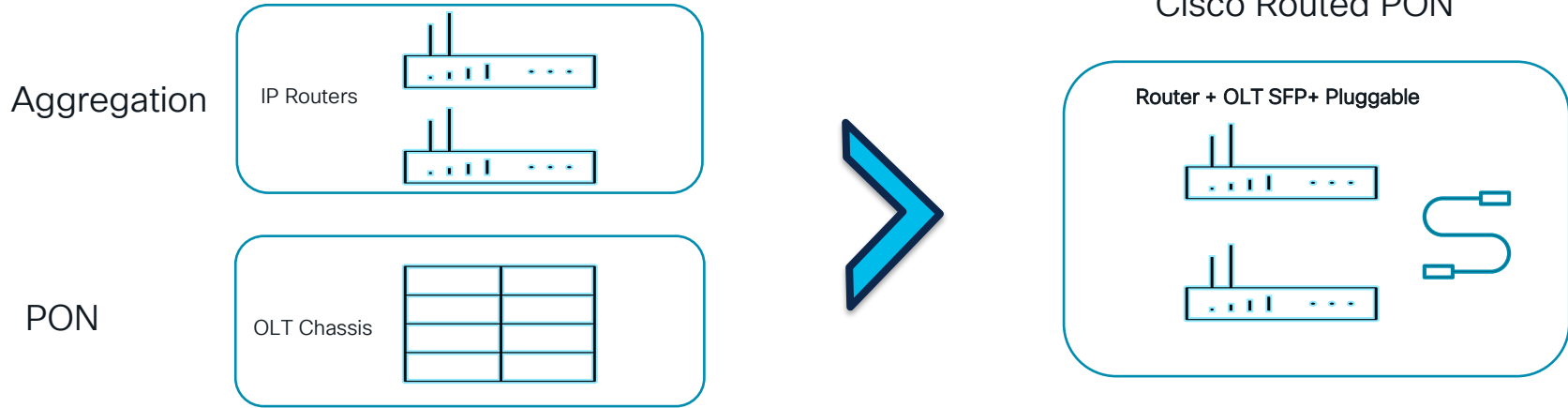
- Broadband Service Providers can converge the IP and Optical on single layer

- Take advantage of converging rich router capabilities and the cost effectiveness of passive optical networking

- Leverage EVPN and Segment Routing to provide a diverse and feature rich access network servicing multi and single tenant residential, commercial/business, and mobile backhaul networks

- Roll out the deployment as per XGS-PON standard

Redefining
Architectures

Changing the Economics of Networking

Incremental Improvements:
Important but not enough

Build faster networks (Moore's Law)

Higher chassis capacities

Higher interface speeds

More capacity at lower cost

Improve network utilization

Better traffic engineering

Telemetry + Analytics

Maximize use of assets

Disruptive Changes:
Critical to the future of networks

Transform Network Operations

Consistent operations

Automation + Orchestration

Services agility, speed

Re-architect end-to-end network

Simplify, collapse layers

Remove functional overlaps

Remove complexity

Simplifying IP & Optical Transport

Traditional Transport Network Building Blocks

Technology	Services	Service Attributes and Capabilities	
Routers	**MPLS VPNs, Internet** *L3VPN, L2VPN* *L1 Circuit Emulation*	**Statistical multiplexing Multi-CoS, SLAs** *Guaranteed BW or Best Effort*	**Point-to-Point, multipoint Granular services at scale** *10's of thousands of services/subscribers per node*
OTN Switches	**TDM Private Lines** *GE, 10GE, OTU-2 (10G)*	**High SLAs** *Guaranteed BW* *>99.9% Availability*	**Traffic Grooming** *Optimize OTU-4/OTUCn interface utilization*
Transponders (Muxponders)	**Wavelengths** *OTU-4 (100G)* *Superchannels*	**Optical Performance** *1000s of kms/miles*	**Maximum Wavelength Capacity** *Grooming (Muxponders)* *600 Gbps and beyond*
ROADMs	**Switched Spectrum** *50GHz, 100GHz* *FlexGrid/FlexSpectrum* *Nx12.5GHz*	**Optical Protection and Restoration** *WSON/SSON Control Plane* *1+1, 1+R, 1+1 +R*	**Extended reach** *Optical Amplifiers: EDFA, RAMAN* **Fiber Management** *OTDR, OSC*

What if We Could...

Fully converge services

Focus on services, not on technology layers

Build a **fully converged** network to efficiently support all services:

L1, L2 and L3

Simplify architecture

Integrate technologies

Use fewer protocols

Simplify network topology

Reduce network footprint (plus power and cooling)

Focus on automation

Make no compromises

DWDM integration with zero router capacity trade-offs

Maintain transport grade SLAs

Address different operational models: Integrated or separated IP and Optical teams

Implementing a New Network Paradigm

Fully converge services

Use IP/MPLS as unified network services and data planes

Extend IP/MPLS transport end-to-end across Access, Aggregation and Core networks

Leverage packet-based traffic aggregation, statistical multiplexing and traffic engineering to maximize network utilization

Simplify architecture

De-layer the network: Connect Routers with integrated transponder functionality via hop-by-hop links over simplified DWDM networks

Reduce IP/MPLS protocol stack adopting Segment Routing and EVPN

Adopt open and standard APIs and data models for software integration

Make no compromises

Remove the tax for integrating DWDM in routers by using Digital Coherent Optics pluggables to replace transponders in standard router line cards

Leverage industry innovations on Segment Routing for delivering high-SLA services
(TI-LFA, Circuit-Style Segment Routing, SR-PCE and Network Controllers)

Use modular, SDN-centric software architectures to address different operational requirements

Routed Optical Networking Solution Pillars

Full services convergence: L1, L2 and L3 services with rich SLAs over IP/MPLS, including Private Line Emulation for bit transparent services over packet switching

Mass-Scale Routing Platforms

Multi Tbps NPUs and line cards
(Cisco and Merchant)

Less space/power per bit

Cost-effective for all services
(Port + Optics, OTN + IP)

Common Hardware

No dedicated or specialized hardware on routers or optical

No hidden hardware costs

Standardized Optics

Digital Coherent Optics over QSFP-DD form factor
Standardized Re-usable

Multi-vendor ecosystem

Gains of scale

Simplified Operations

Single IP/MPLS control plane with Segment Routing

End-to-end model-driven, and programmable

Modular standards-based control architecture

Technology Innovations Driving Routed Optical Networking

Silicon
Multi Tbps NPUs
Power-efficient, compact DSPs

Optics
400Gbps Digital Coherent Optics – DCO
Silicon Photonics
Quad SFP – Double Density – QSFP-DD

Software
Programmable
Model driven
Secure and resilient
Feature rich
Segment Routing and EVPN

Systems
Multi Tbps Routers
Simplified ROADMs
Modern management and automation frameworks
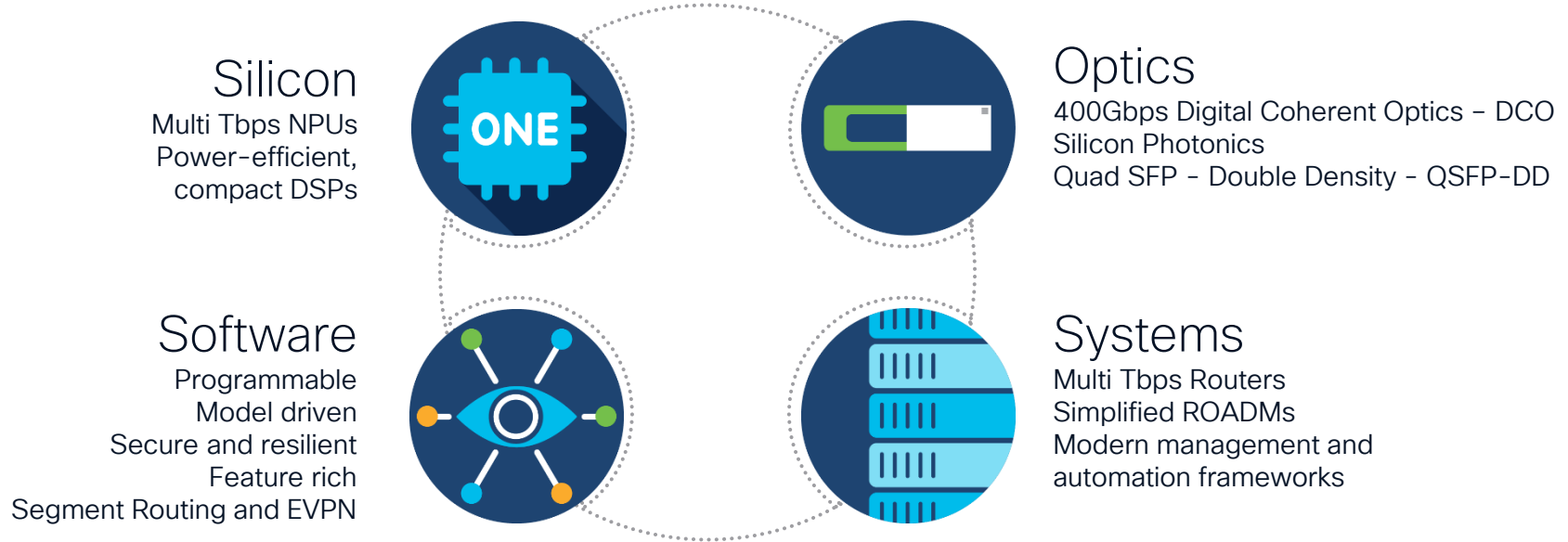
Traditional Layered Network

Lifecycle Management

DWDM Management Plane
OTN Management Plane
Packet Management Plane

Packet Services

Private Line Services

Packet Control Plane (IP/MPLS, SR)

OTN Control Plane (ASON/GMPLS)

DWDM Control Plane (WSON/SSON)
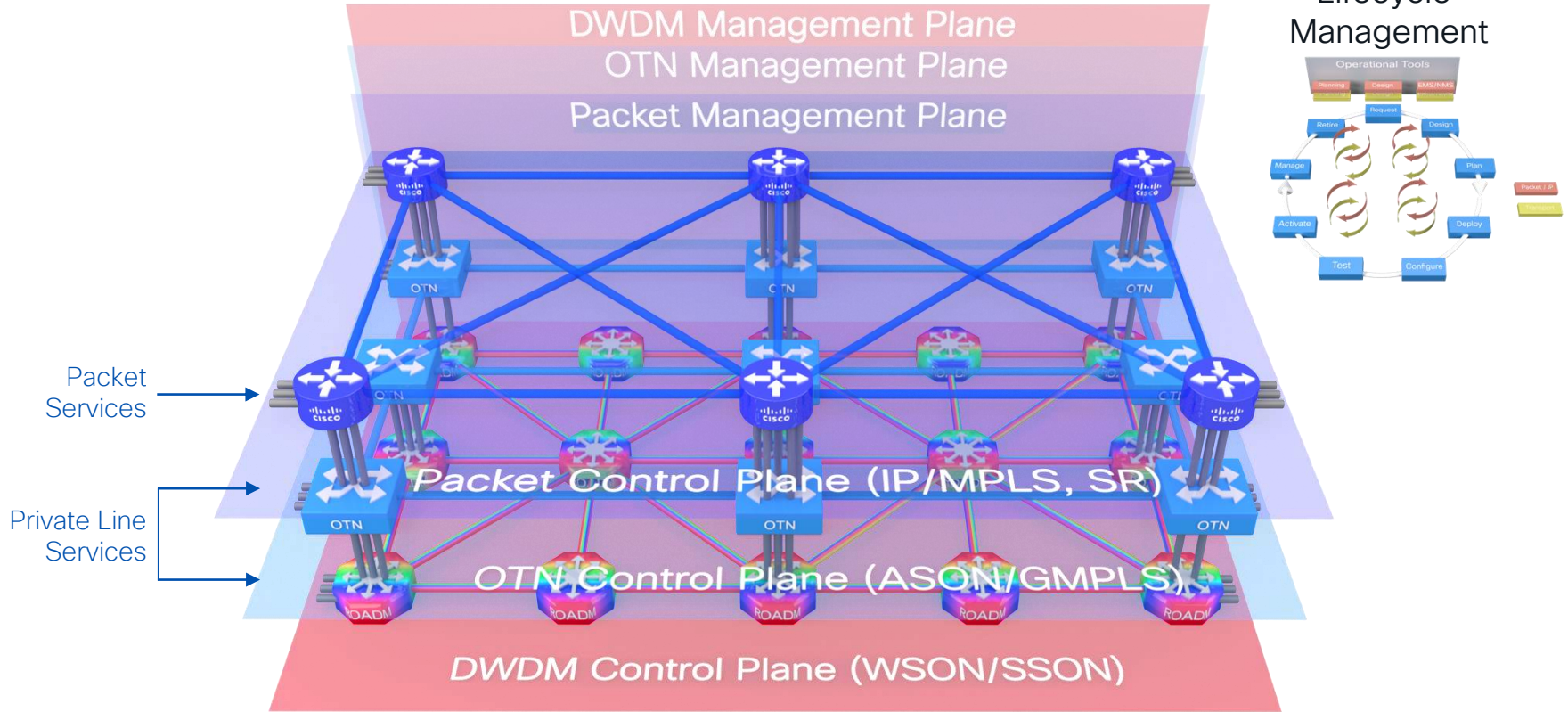
Challenges of the Layered Network

Better integration between IP + Optical is needed to improve efficiency and reduce complexity

Each layer treated individually

- Multiple control planes – IP/MPLS, GMPLS, WSON/SSON

IP can be as dynamic as is the transport layer

- Adjustable Data Rate, Modulation, Baud Rate, Spectrum, etc.

Operational lifecycle is complex

- Optical / OTN switching adds complexity

Simpler Network Topology and Software Stack

400ZR/ZR+
QSFP–DD DCO
Pluggable Optics

Unified Management and Automation Plane

Packet Services

Private Line Services

Simplified IP/MPLS Control Plane

SR + EVPN
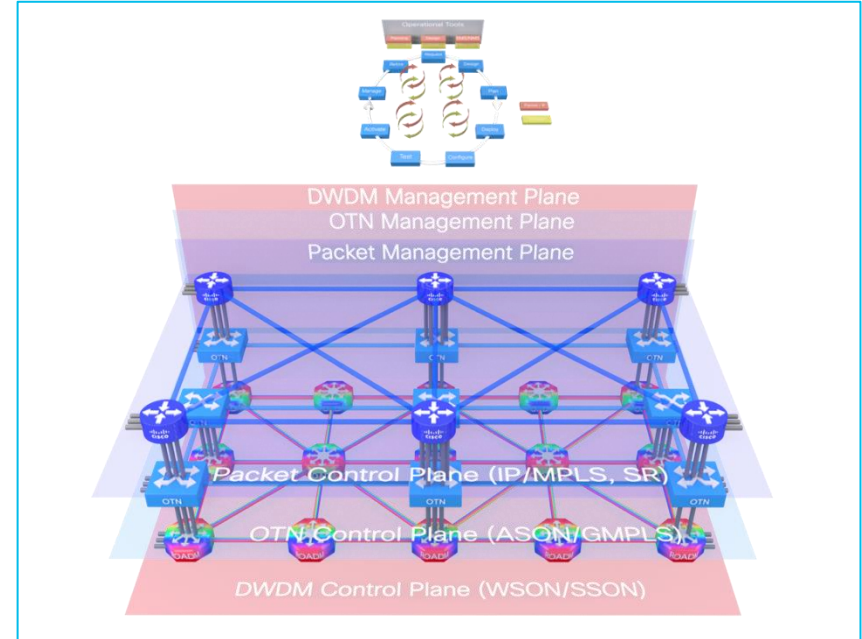
Removing Complexity

Previous

Router/switch + Grey pluggable + 4x fiber jumpers + Grey pluggable + Transponder/muxponder + Optical chassis + Fiber jumper + ROADM-OLS layer

Outside plant fiber

Today

400G capable router/switch + QDD-400G ZR/ZR+ + Fiber jumper

Reduces redundant client pluggable optic module spend on optical line system

Eliminates need for optical transponder/muxponder chassis spend

Zero wavelength blocking probability
Lower cost power space
Better fiber usage
Better availability

ROADM

Outside plant fiber

ROADM or simpler OLS layer

~**45% to 70%** less CapEx
95% less power
100% less TXP/MXP rack space

Advantages of a Simplified Network Architecture

Focus on services

- De-layered architecture
- Simple, static DWDM wavelengths

Hop-to-hop optical network design

- Reduces the optical distance – maximizes bandwidth/distance
- Allows zero port density trade off on routers via QSFP-DD DCO
- Leverages cost efficiency of 400Gig ZR/ZR+ DCO pluggables
- Hop-by-hop router connectivity is supported by any physical network topology, e.g. rings, mesh, linear

Simplified network lifecycle

- Planning, Design, Activation, Management, Troubleshooting, Restoration, etc.

Unified Network Lifecycle Management

Management and Automation Plane

Services Orchestration

EMS/NMS — FM — PM — SDN Controller — Optimization Engine — PCEs — Data Collector — Telemetry

IP/MPLS Control Plane (SR or LDP/RSVP-TE) + Simple Optical Control Plane
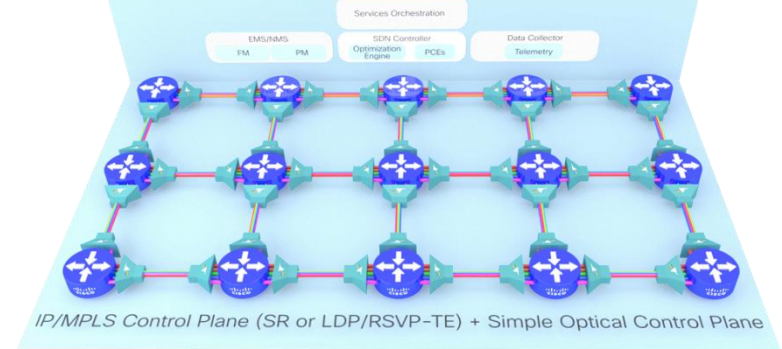
Routed Optical Network Architecture Vision

Enabled by industry innovations in Silicon, Optics, Platforms and Software

Point-to-point DWDM circuits (hop-by-hop IP)

Private Line Emulation for OTN services (PLE)

Modern Management and Automation Stack:
- Software defined
- Model Driven
- Open APIs
- Traffic engineering

DWDM Line system of choice

Routers with DCO I/Fs (ex. 400ZR/ZR+)

Much simpler, lower TCO, fully integrated. All services over IP/MPLS.
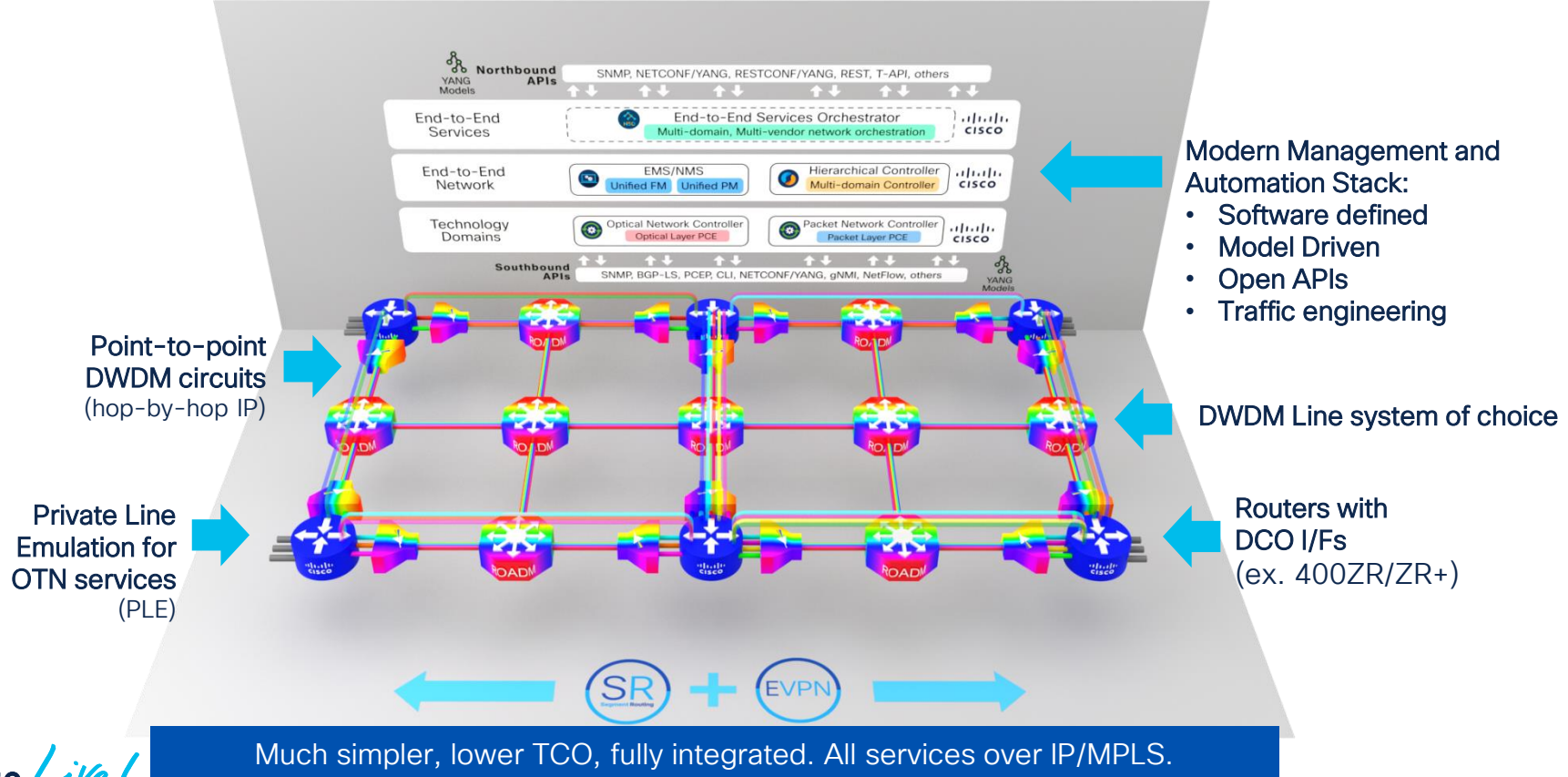
Routed Optical Networking is Applicable End-to-End
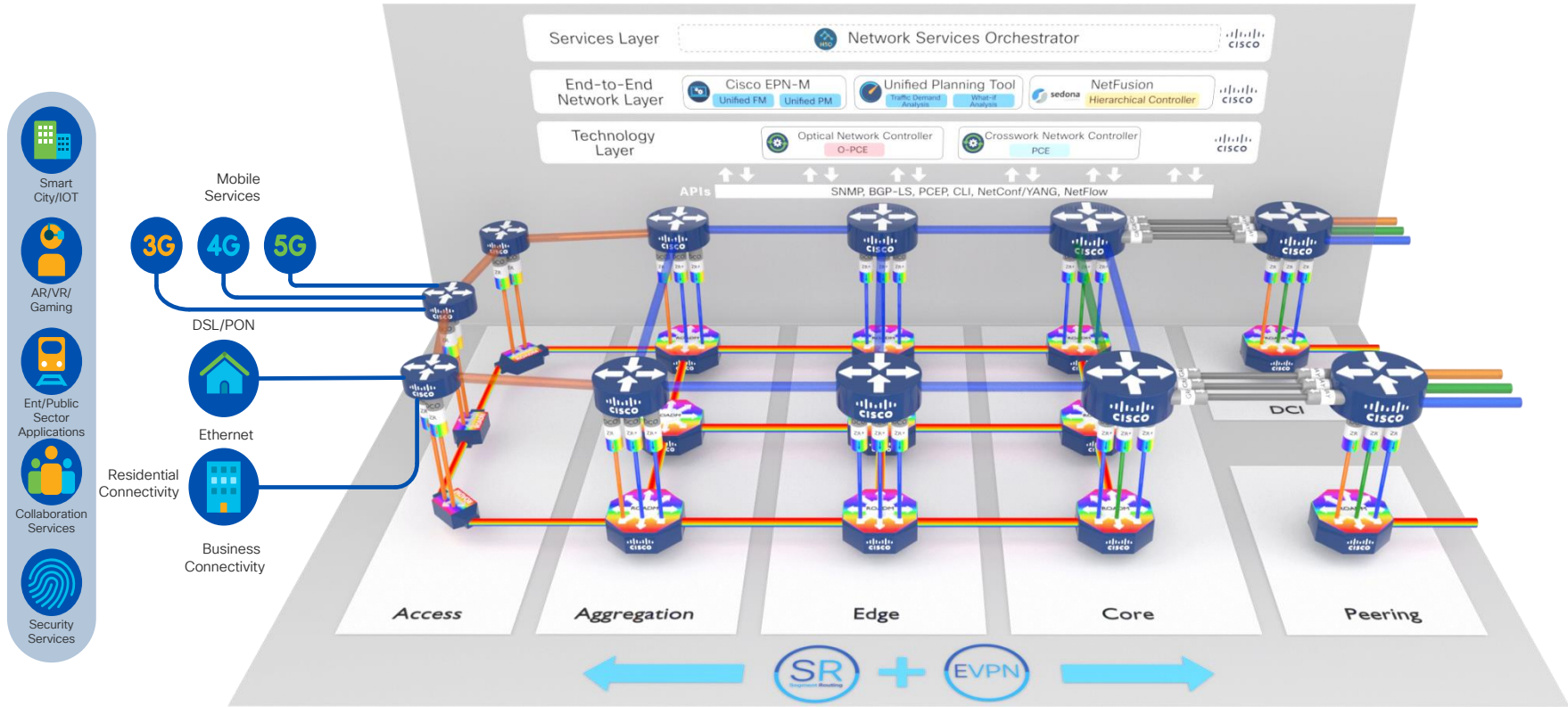
Routed Optical Networking Use Cases

Routed Optical Networking Convergence

Packet Network: Router + DCI or OTN + ROADM > Optical Network
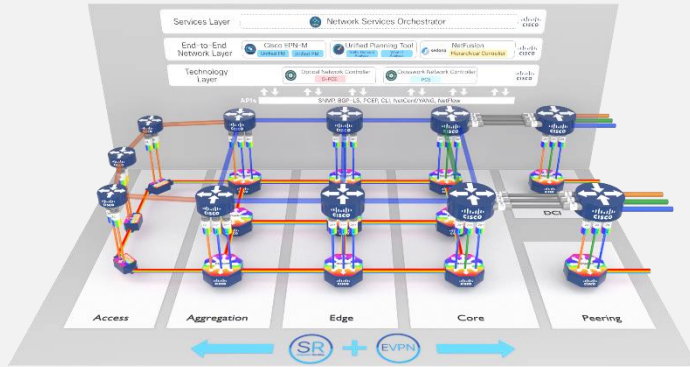
✓ Transponder replacement by DCO transceivers

✓ Full services convergence over IP/MPLS – L1/L2/L3

✓ Network automation across IP and Optical

✓ Services orchestration across IP and Optical

✓ Applicable network scenarios:

 – Nx100G to Nx400G **Access** and **Aggregation** networks for residential broadband, mobile and business services

 – Nx400G connectivity for **Edge**, **Core** and **Peering**

 – **Data Center Interconnects**

 – **Metro**, **Regional** and **Long-Haul** networks

 – **Linear**, **Ring** or **Mesh** network topologies

Do You Need a New Network?

Routed Optical Networking deployable in these three different scenarios
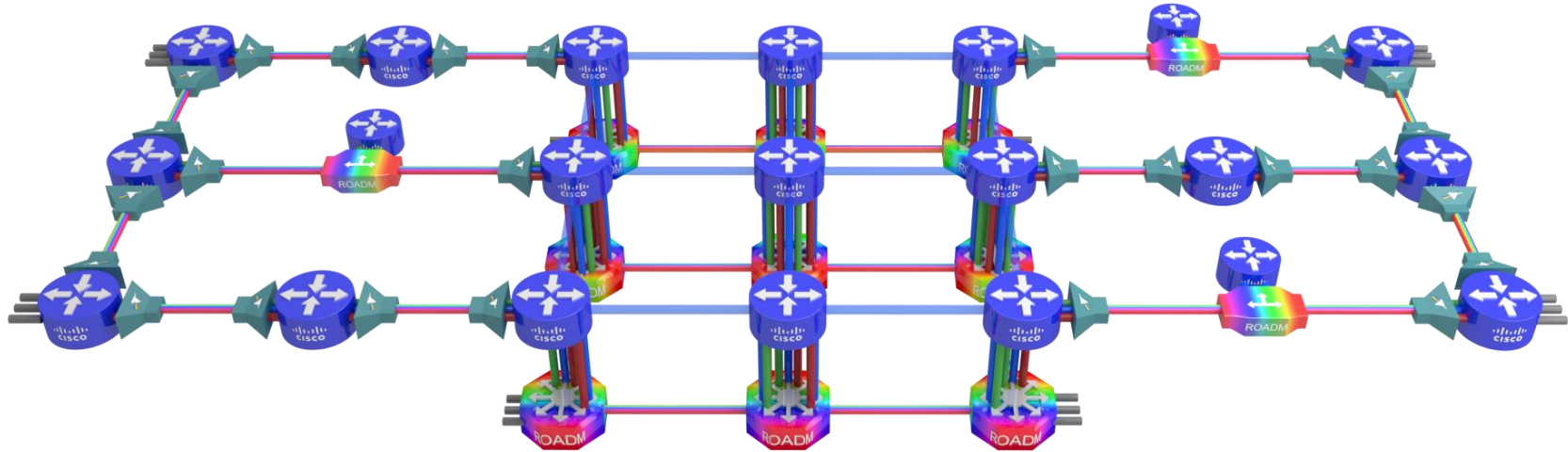
Greenfield
Cisco on Cisco

Existing Cisco on Cisco
with NCS 2000

Cisco optics over
existing 3rd party DWDM
(e.g. Ciena, Infinera)

Routed Optical Networking Architecture Transition
Up to ~45% TCO Savings – ACG Research
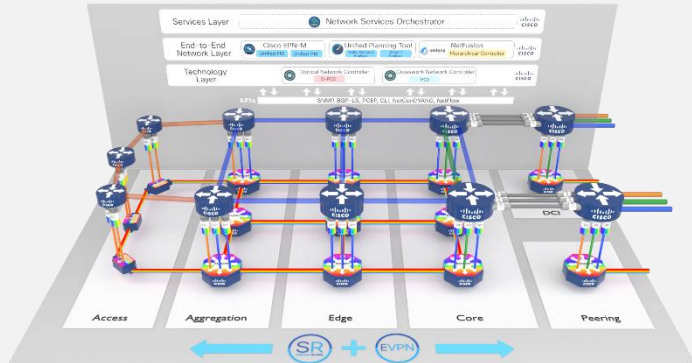
- Converges all services onto a single network layer
- Eliminates siloed IP & Optical operational layers
- Integrates transponders & eliminates "grey" optics
- Integrates OTN Services & ROADMs
- Space, power & operational savings
- Shorter Time-to-Market for services

Routed Optical Networking Convergence

Packet Network + DCI or OTN + ROADM > Optical Network

Router + DCI or OTN + ROADM

~45% TCO Savings

5 Years Savings Breakdown

0%
1%
1%
3%
11%
5%
4%
75%

- Equipment Cost
- 2nd Installation
- Power
- Cooling
- Space
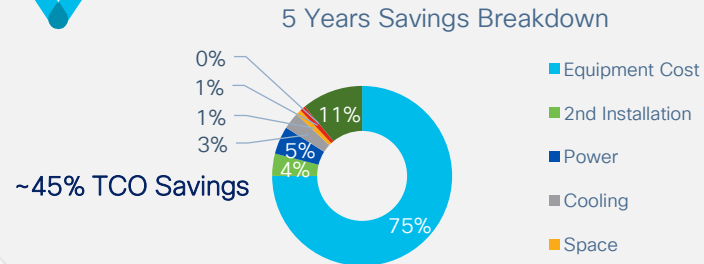
Simplifying the Edge
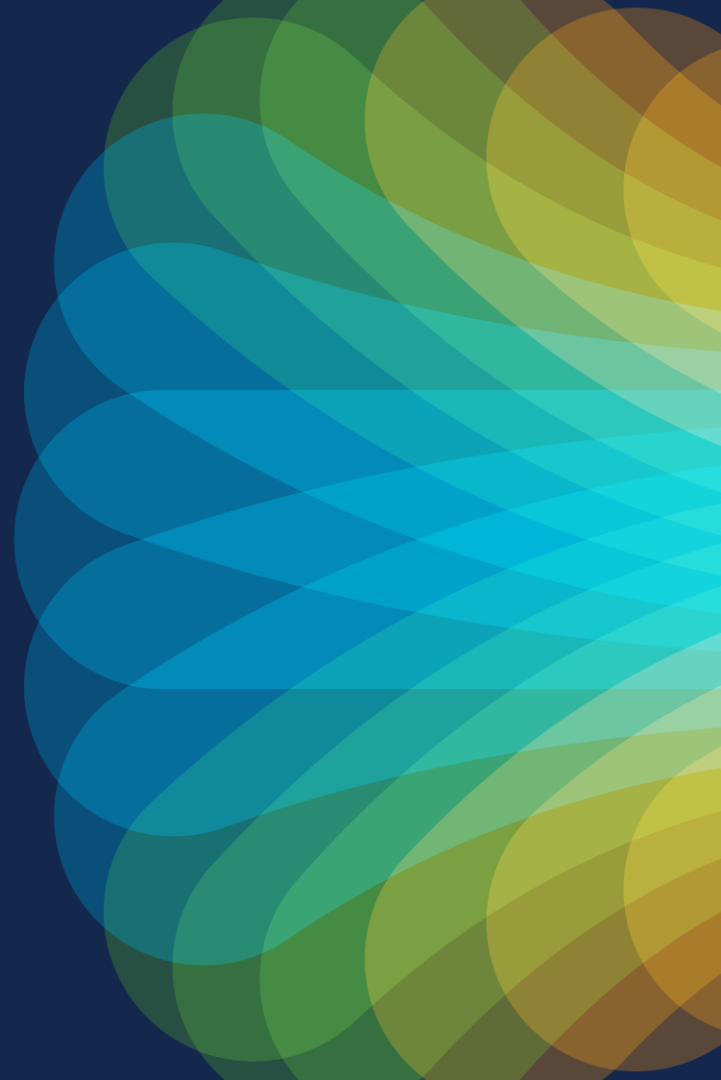
Traditional Edge Network Architecture
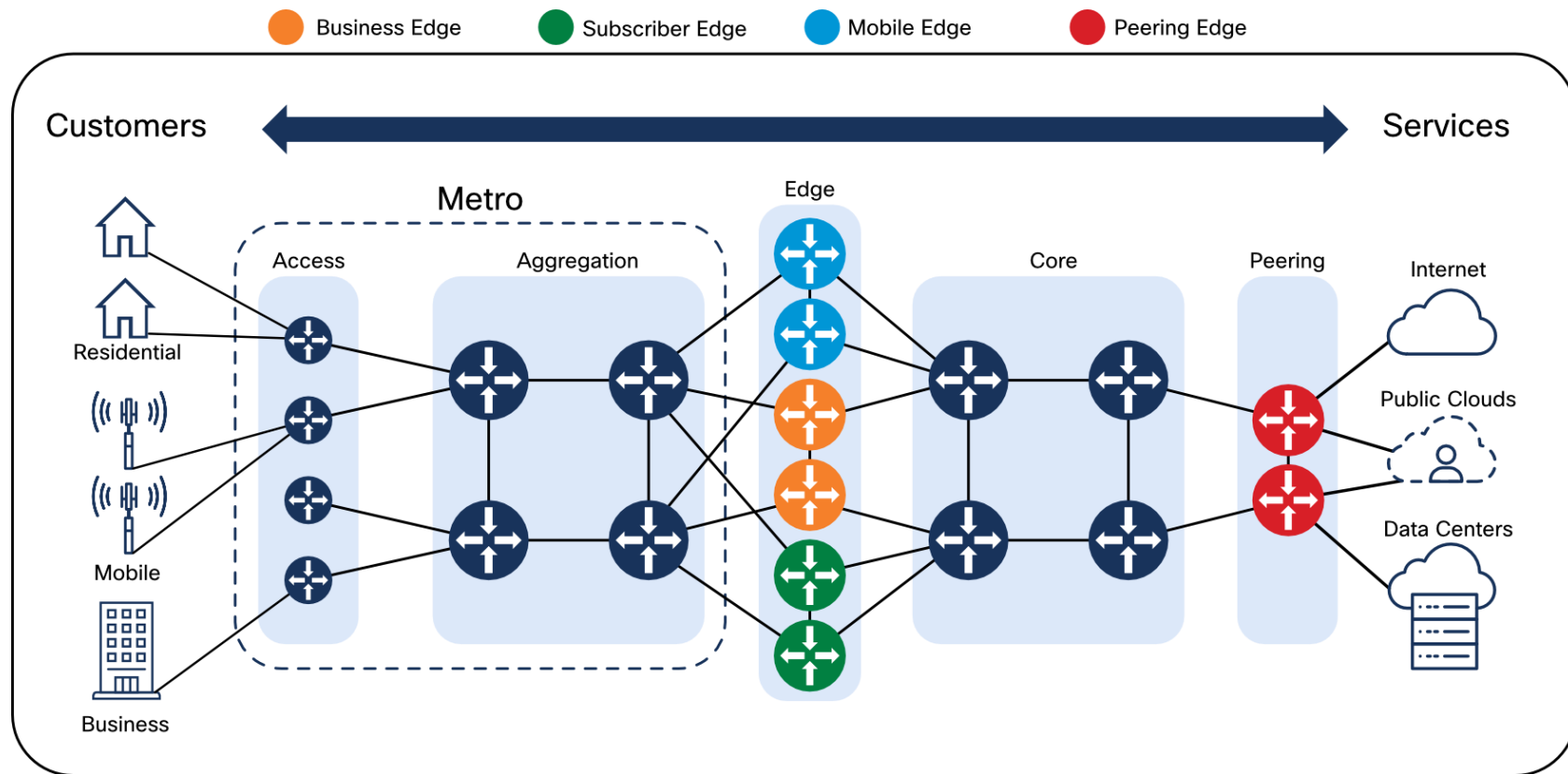
Cisco's Vision – Evolving Metro Networks

Floating edge functions: ⚙ Business Edge   ⚙ Subscriber Edge – BNG CUPS UPF   ⚙ Mobile Edge – 5G CUPS UPF   ⚙ Peering

Customers ← → Services

Evolved Metro

Access | Aggregation | CUPS Control Plane | Core | Peering | Internet

Residential
Mobile
Business

CDN · Edge Cloud · Internet · Public Cloud

Public Clouds
Data Centers
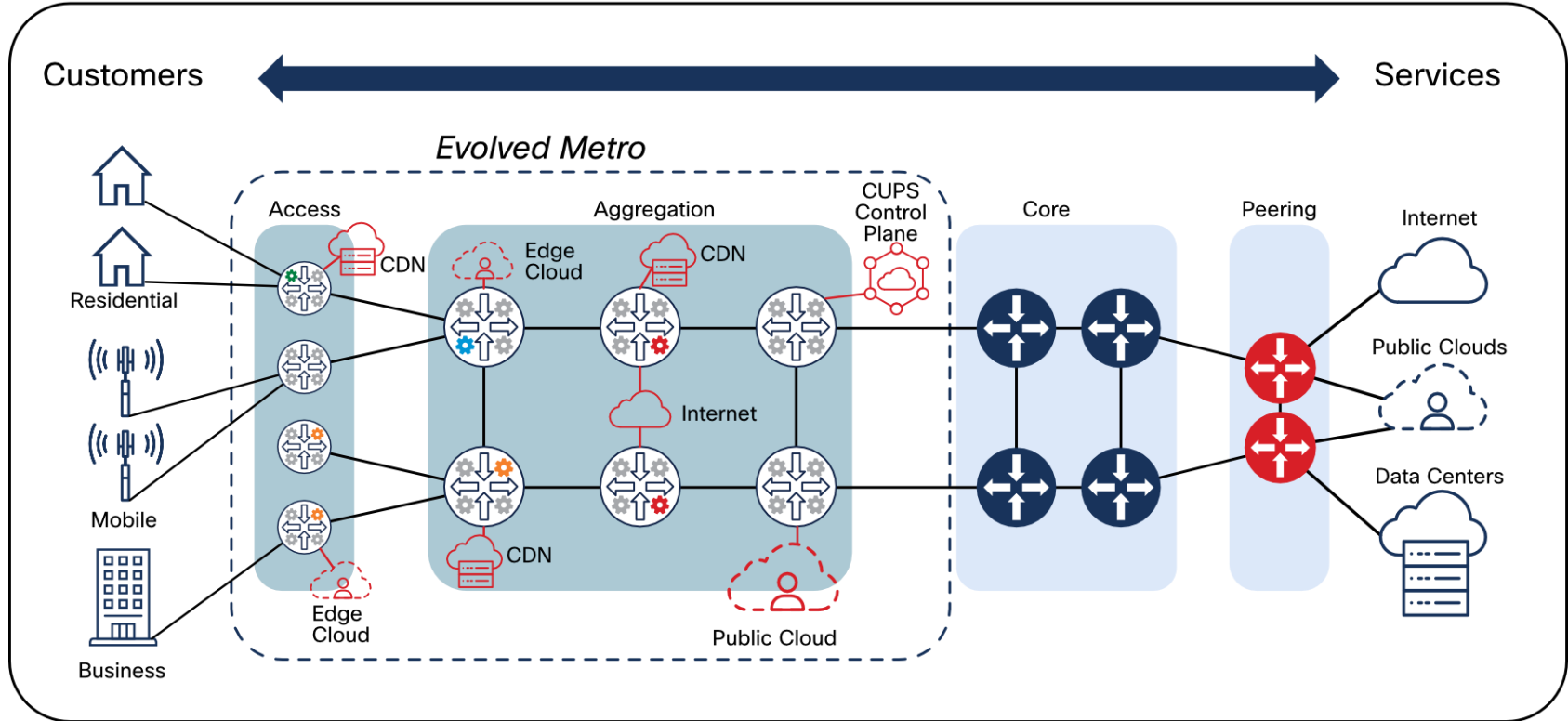
Edge Routing Evolution

Triggered by new points of service delivery closer to consumers

Technology Drivers

- High-capacity edge silicon
- Convergence of functions
- Smaller systems and form factors

Business Drivers

- Deliver services closer to user/apps
- Cost savings
- Sustainability

Operational Drivers

- Improved services resiliency
- Network simplification
- Automation

Technology Building blocks

Edge as a function | Networking Silicon | Fixed and centralized systems | Distributed architectures | Network Controllers

Floating edge functions: Business Edge | Subscriber Edge - BNG CUPS UPF | Mobile Edge - 5G CUPS UPF | Peering
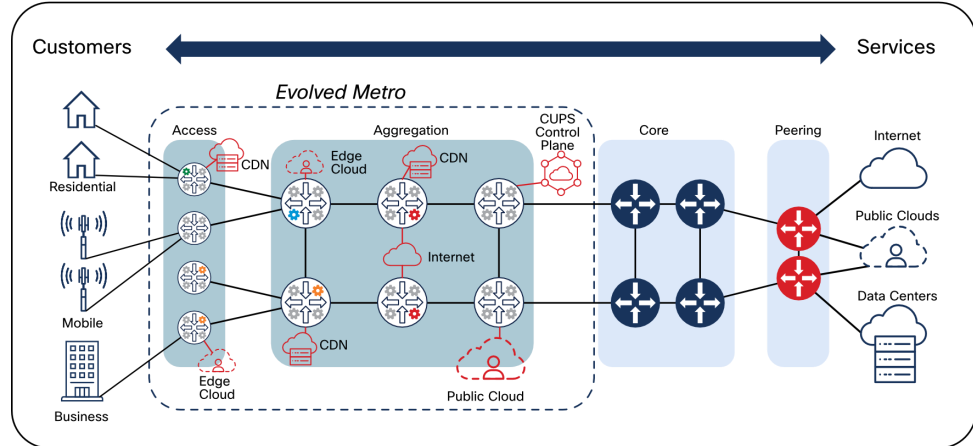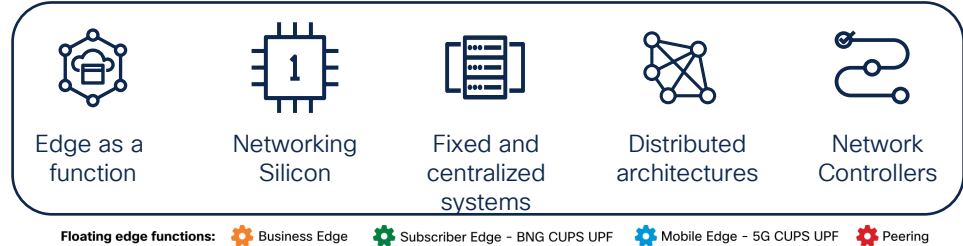
Edge Routing Platform Evolution

New and emerging technologies can be applied to new architectures

Networking processor silicon:

- Consistent features across the network. Ex. Cisco Silicon One
- Tbps of capacity, high-speed at very low power consumption. All you need to build metro fabric architectures.
- Feature rich and "on-demand"

Simpler fixed form factor platforms:

- Deliver services at right scale and cost points required for distributed architectures
- Can be used in-line for full featured router with edge capabilities *as-a-function, on-a-stick* or as edge *fabric* leaves

Disaggregated models (Control/User Plane Separation – CUPS)

- Further simplifying edge routing, moving control plane load to compute nodes

Simplifying Routing

Converged SDN IP Transport Architecture

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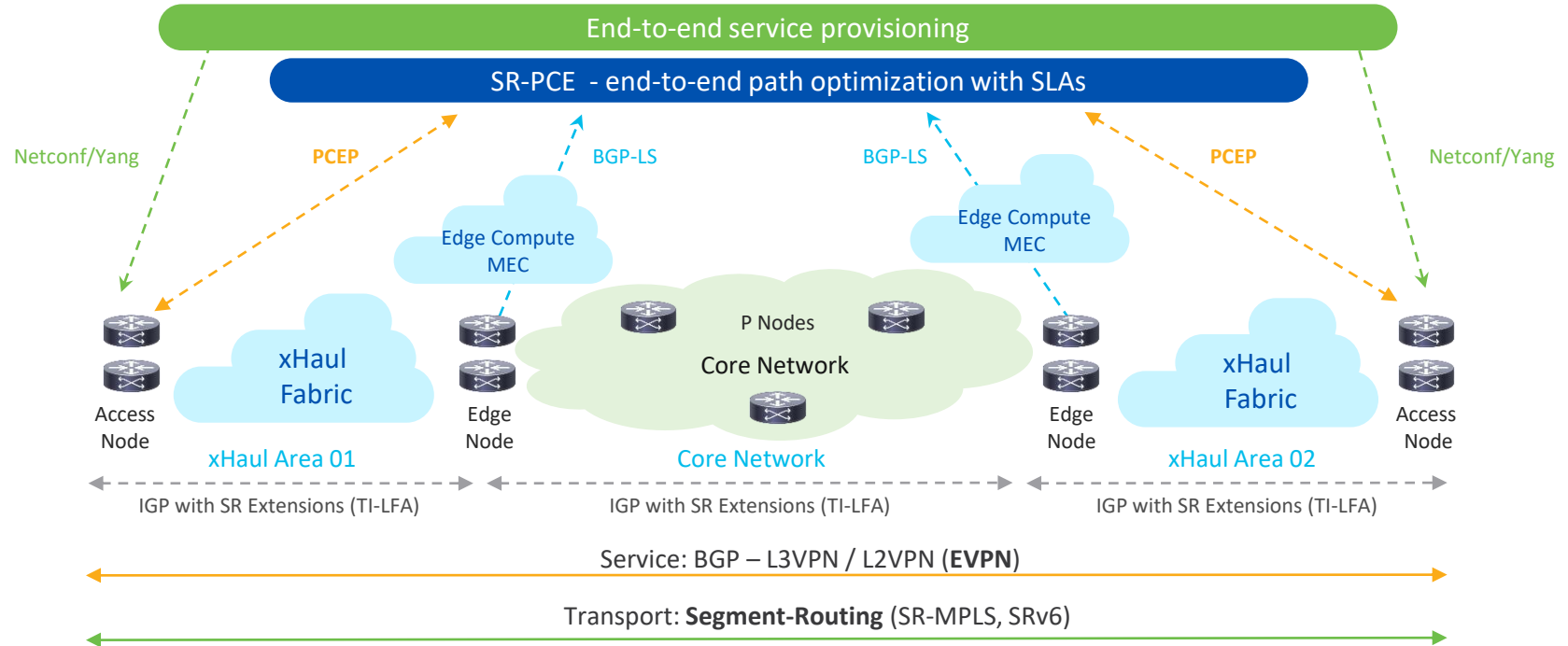
Understanding Today's Service Creation

Limited Cross-domain Automation, Cumbersome Service Assurance

Legacy Central Office

Access

Aggregation

Hardware Appliances
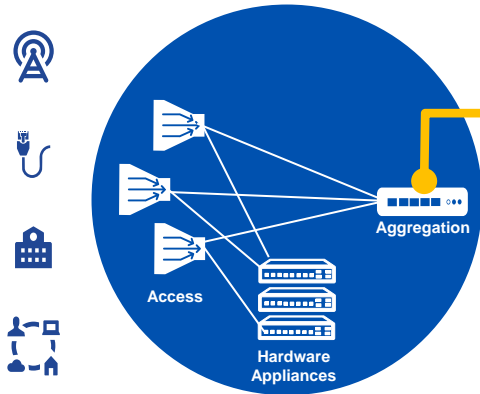
Complex E2E Quality of Service (QoS)

Metro Network Domain	Core Network Domain	Data Center Domain
L2VPN	**L3VPN**	**VXLAN**
Ethernet	**MPLS**	**IP**

Centralized Services Delivery

VNF VNF
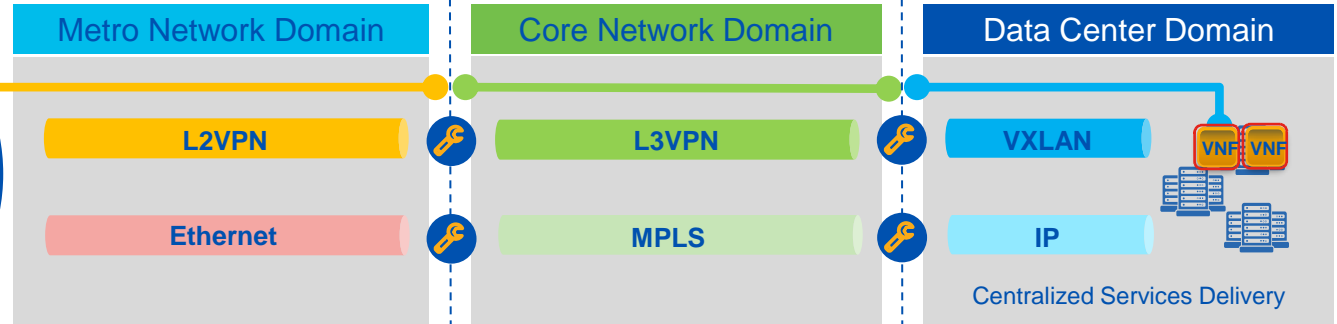
End-to-end service provisioning is lengthy and complex
- Multiple network domains under different management teams
- Manual operations
- Heterogeneous underlay and overlay networks

SR-MPLS: SDN ready "Network as a Fabric" for Service Creation
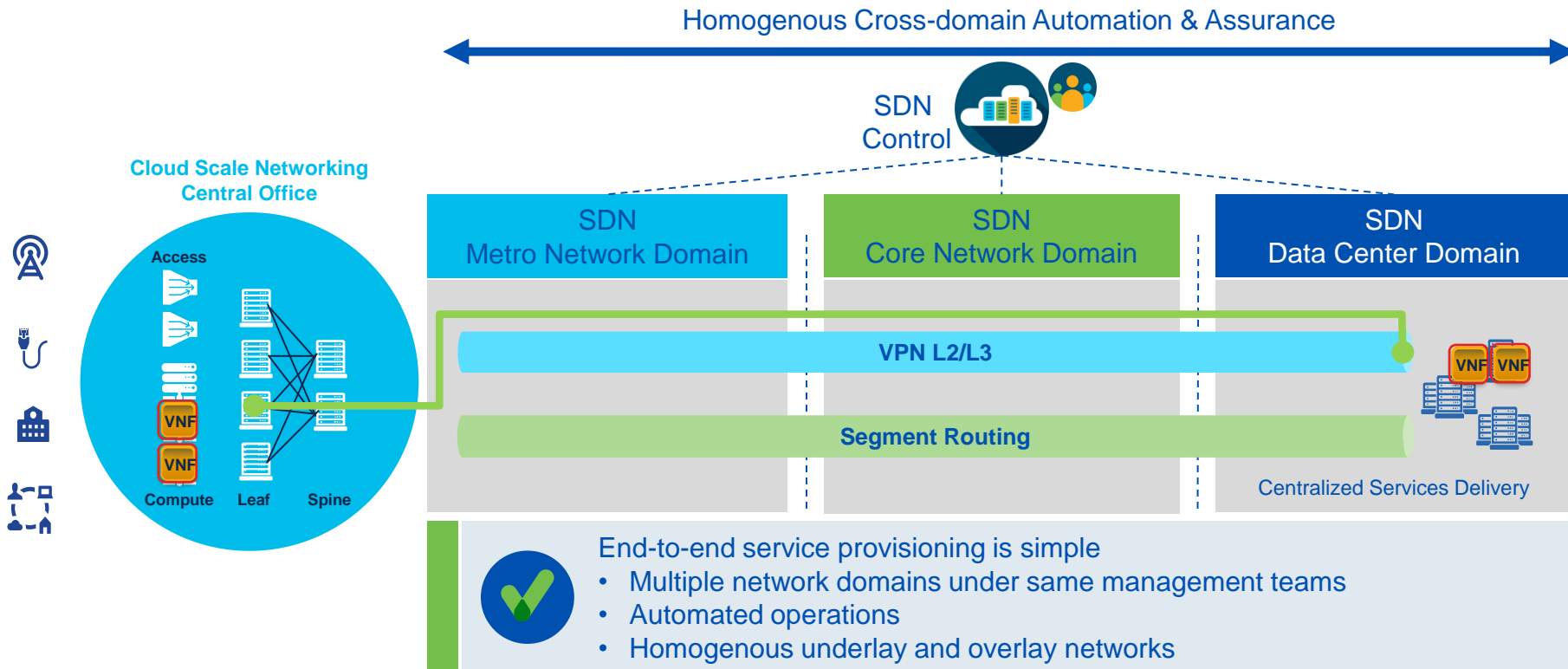
SRv6: Universality
"Network as an API" for Service Creation

Homogenous Cross-domain Automation & Assurance

SDN Control

Cloud Scale Networking Central Office

Access

SDN Metro Network Domain

SDN Core Network Domain

SDN Data Center Domain

Segment Routing v6 (transport, services and programmability)

VNF

VNF

Compute   Leaf   Spine

Centralized Services Delivery
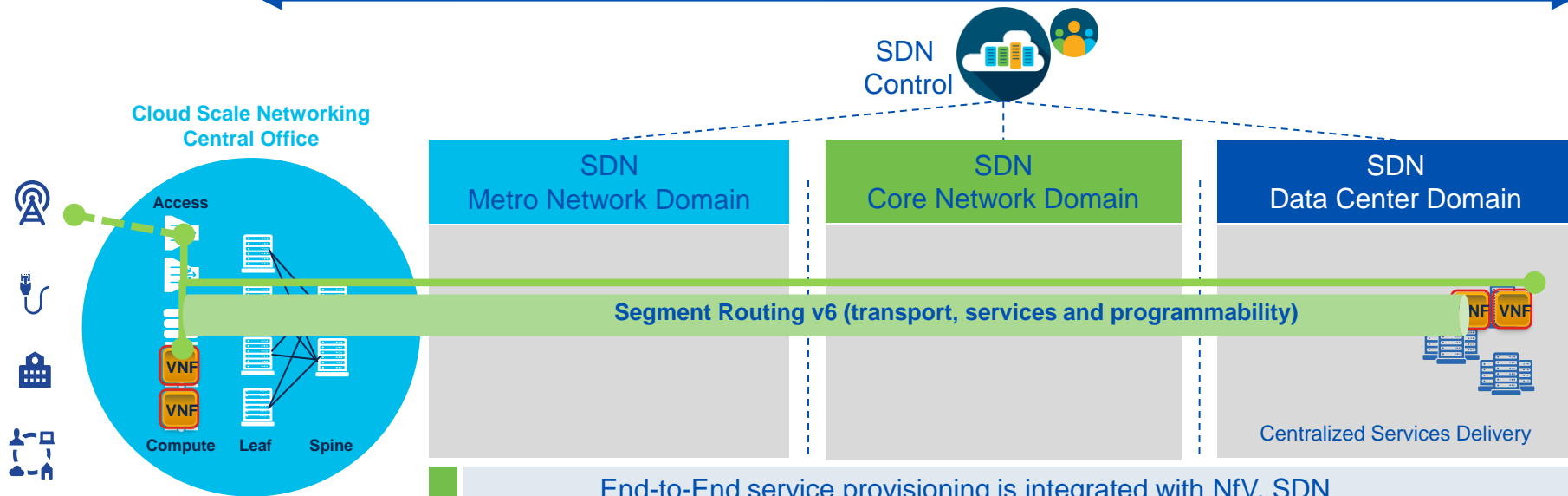
End-to-End service provisioning is integrated with NfV, SDN
- Multiple network domains under same management teams
- Automated operations
- Integrated underlay and overlay networks (NfV)
- Network as API (NfV) – Complete handset to Server Solution
- Hyper Scale (5G)

Evolution of IP Routing

Unified MPLS

| MP-BGP |
| LDP |
| BGP-LU |
| RSVP |
| LDP |
| IGP |
| MPLS |

Services
- - - - - - - -
Transport

- Operational complexity
- Integrated HW & SW
- Limited data plane scaling

MPLS SR with Controller

Services
- - - - - - - -
Transport

MP-BGP	
IGP/SR	SDN
MPLS	

- Leaner & optimised routing
- Centralised orchestration
- Distributed control plane
- Limited data plane scaling

SRv6
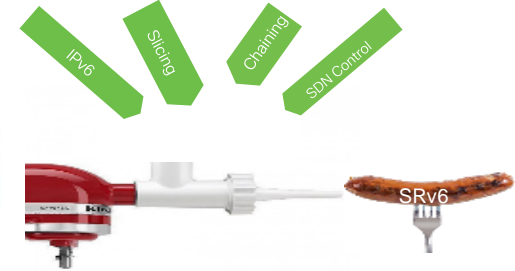
IPv6 Slicing Chaining SDN Control

SRv6

Services
- - - - - - - -
Transport

MP-BGP	
IGP/SR	SDN
IPv6	

- All of SR-MPLS features plus
- Massive data plane scaling
- Programmable control plane
- Service chaining

Segment Routing Benefits

Standardized

10+ years of IETF work
key Cisco contributions

Transport and Services

Transport : IS-IS, OSPF, BGP-LU
Services: L3VPN, 6PE, 6vPE,
EVPN-ELAN, EVPN-VPWS,
Multicast … over SR or SR-TE …

SR
Segment Routing

CISCO

Proven by many Live Deployments

300+ Production Deployments
900+ Planned Deployments
SP, Web, Enterprise, Public Sector

IPv4 to IPv6 migration

IPv4 to IPv6 migration: SRv6
shipping since Jan 2019 w/
strong lead operators and eco-
system support

TiLFA · Microloop avoidance · Seamless deployment Day-1 · SRTE Native algorithms ·
Horizontal Network Automation · Value-added OAM · Performance Monitoring toolkit

Redefining
Operations
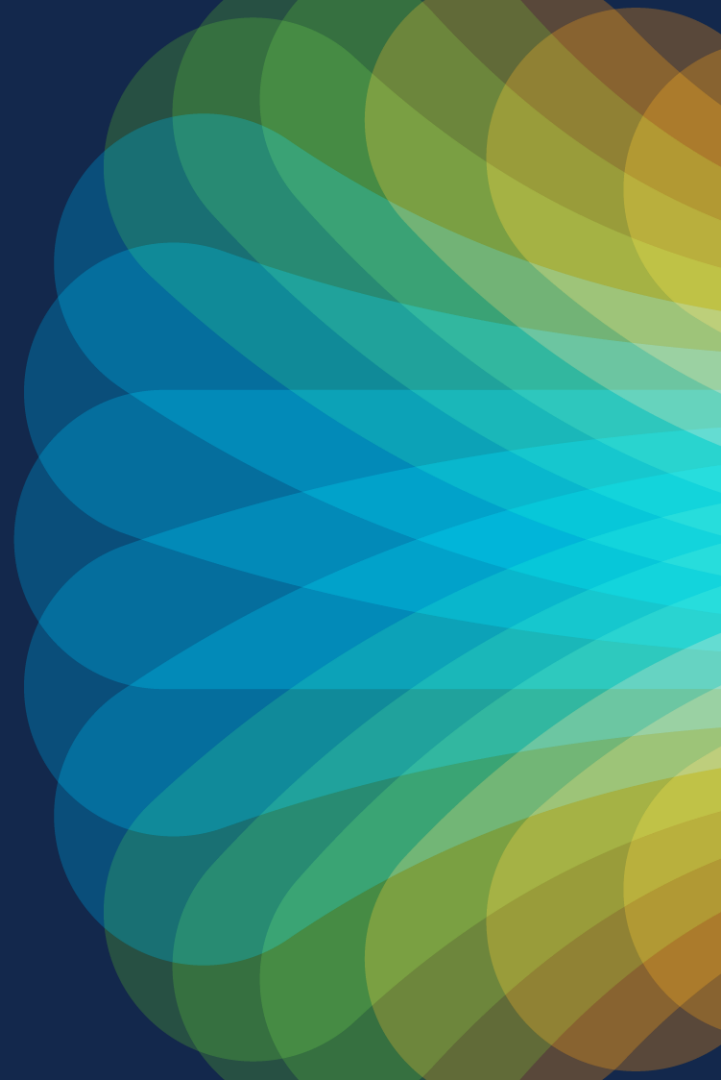
SPs Are Facing Various Challenges Which Are Driving the Need for Next-Gen Operations

Service Agility

Opex Reduction

Operational Efficiency

Improved Customer Experience

Cross-Operational Alignment

Org. Streamlining

Revenue Enhancement

Processes Standardization

In Order to Successfully Manage Adoption of These Trends, SPs Need to Think Holistically

Technology Transformation

- RON
- Next-Gen Routing
- T-SDN
- Remote PHY & DAA
- Telco Cloud
- 4G -> 5G

Automation & Service Assurance

Operations Transformation

- Key Processes Evolution
- CI/CD
- Site Reliability Engineering
- DevOps
- New Skills and Roles
- AI Ops
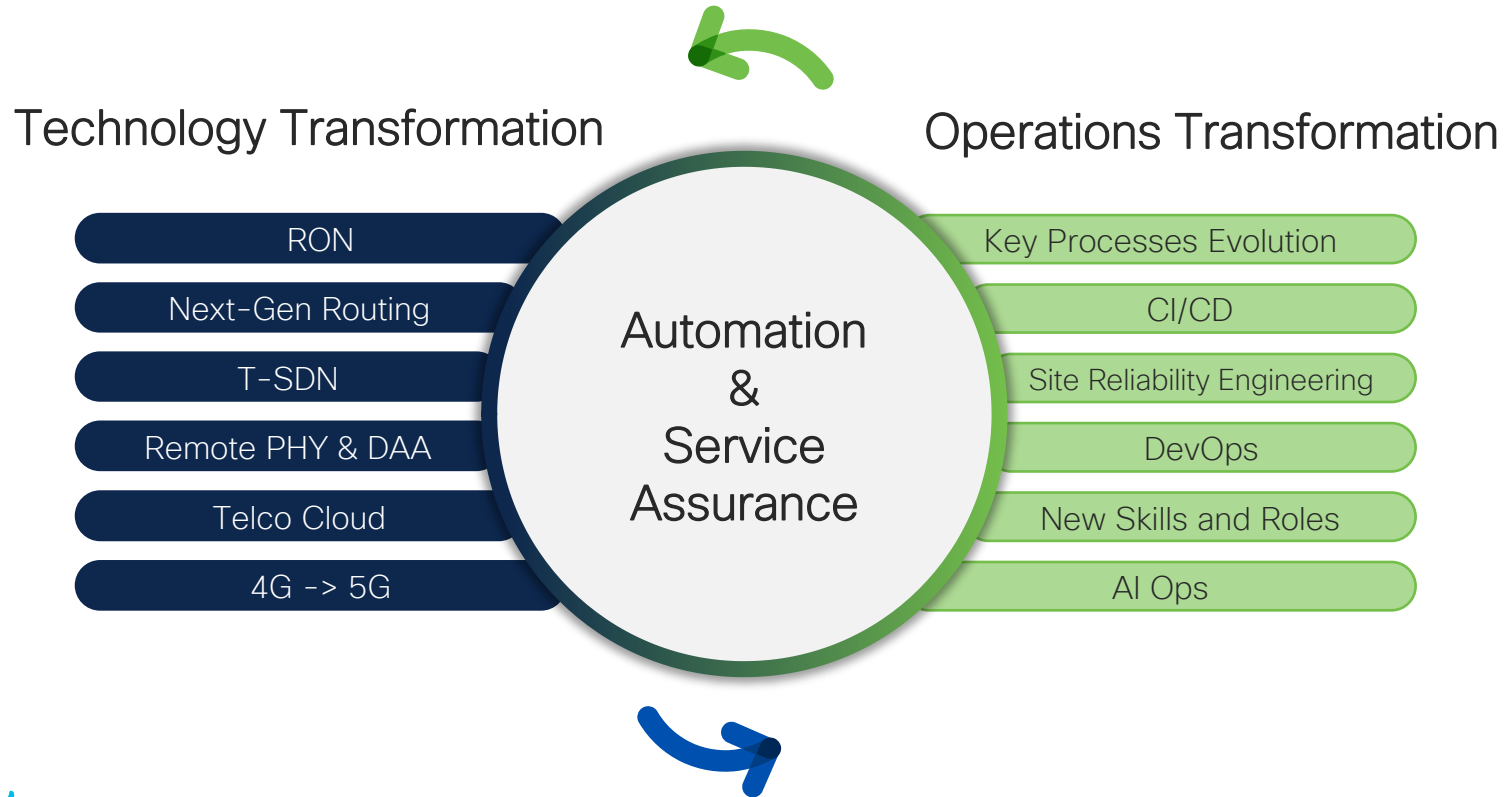
Operational Challenges in Numbers

80%
MTTI/MTTK

VISIBILITY /
AGILITY

74%
*Issue found
by end-user*

CUSTOMER
EXPERIENCE

30%
*Repetitive
Issues*

PRODUCTIVITY

* Forrester Research

A Different Approach is Needed ...

1 — Is my Service Healthy?

2 — Is Service meeting SLA?

3 — Service is degrading! Where is the problem?
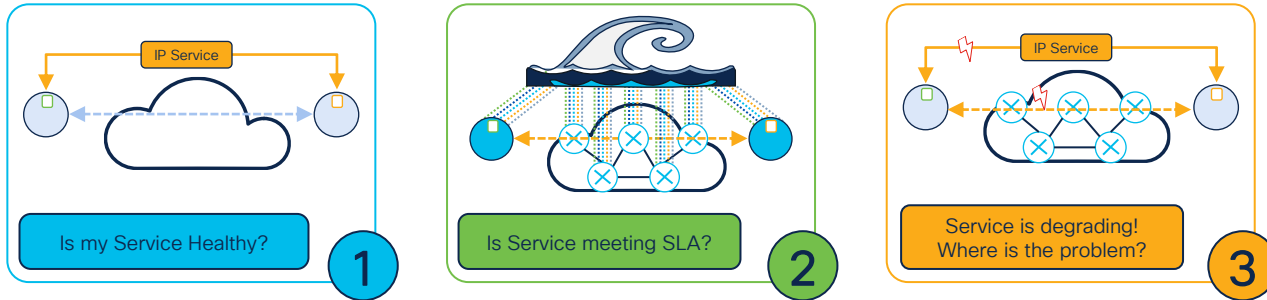
Challenge	Requirement	How
1 Visibility	End-to-end service visibility	Service centric operations
2 Insight	Bridge customer experience to network health	Dynamically tie Intent to telemetry
3 Action	Expedite MTTI/MTTK	Capture knowledge to automate troubleshooting

Mass Scale Network Assurance

Personas: Role and Know-How its different

First level
Service operation center

Is the service **degrading?**
Is the service meeting **SLAs?**

Services and SLA dashboard

Proactive service quality analytics

(Accedian Skylight)

AIOps based Incident and performance management

(Vitria VIA AIOps)

Second level
Network operation center

Service is DEGRADING!
Where is the problem and **Why**?
I see a congestion in the network, **What** is the cause?

Hierarchical controller

Topology-based correlation and assurance
(Crosswork Hierarchical Controller)

Domain SME

Is the infrastructure **Operating** according to planned performance objectives ?

Domain controller
Domain controller
Domain controller

Cisco Multivendor IP Controller
(Crosswork Network Controller)

···

Cisco Optical Controller

···

Any 3rd Party Controller

Tenets of Next-Gen Operations

Software Defined

API-centric, unlocking of operational data and simpler tool chain integration

Standards-Based

Architecture based on standard APIs and protocols giving customers the needed flexibility.

Autonomous

Real-time visibility, assurance, and analytics to support zero-touch operations

Multivendor + Multidomain

Robust support for vendors across technologies for the entire service

Action

Visibility

Insights

Scalable + Adaptive

Effortlessly adjust to changes in size, volume, and frequency of workflows

SP Automation & Assurance Function Taxonomy

Customer Facing Services

- Service Catalog
- Service Administration
- Service Monitoring
- External API Gateway

Resource Facing Services

Design-Time Services

Service Design Center	Network Design
Service Catalog	Workflow Design
Resource Catalog	Capacity Planning
VNF Catalog	Simulation & Staging

Run-Time Services

Assurance

Inventory Management	Resource Management	Fault Management
Topology	VNF Management	Policy Management
Service Assurance	Container Management	SLA Management
Network Optimization	Capacity Management	Compliance Management

Orchestration

- Service Implementation & Testing
- Resource Onboarding
- VNF Onboarding
- Workflow Management

Analytics

- Network Analytics
- Service Analytics
- Customer Experience Analytics
- ML Service

Baseline Services

Security

Data Protection	Identity Management	Access Control	Intrusion Detection / Prevention	Firewalling	Lawful Intercept	Policy Enforcement	Security Analytics

CI/CD & Test Automation

CI/CD Pipeline	RFS Check	Deployment Automation	Service Activation Test	Test Case Library	Test Regression Suite	Test Automation Framework	Version Management

Automation and Service Assurance is Required in the Domain as Well as the Cross-Domain Levels

BSS / Customer Order Management

Common Services

Cross Domain Level

Cross-Domain Automation and Service Assurance

| Cross Domain Orchestration | Cross Domain Assurance |

NOC/SOC Systems

Domain Level

| RAN-Domain Automation | Transport-Domain Automation | DC/NFV/EDGE Automation | Cable Automation | Mobile Core Domain Automation |

CI/CD

Security

Managed Resources

VNF CNF
VIM CISM

SDN
PNF

Compute

CNF VNF

Public Cloud

End-to-End Cross Domain Automation

BSS / Customer Order Management

Cross-Domain Orchestration

Common Services

Cross Domain Level

Cross Domain Automation
- Rollout Automation
- Incident Resolution Automation
- Optimization Execution

Slicing
- CSMF
- NSMF

Cross Domain Inventory

Cross Domain Assurance

Mobile Subscriptions Orchestration

NOC/SOC Systems
- NOC/SOC Umbrella Assurance/Dashboards
- Incident/Problem/ Maintenance Tickets Mgmt.
- Consolidated CMDB/Inventory
- SP IT Operations Monitoring
- RBAC
- ITSM – SLA Management
- Cyber Security Analytics & Monitoring
- Portal

Domain Level

RAN-Domain Orchestration
- NSSMF
- Service LCM
- Active Inventory
- Config Mgmt.
- FM
- PM
- cSON
- EMS
- Probing

Transport-Domain Orchestration
- Domain Workflow
- NSSMF
- Active Inventory
- FM
- PM
- Provisioning
- Traffic Engineering
- Optical Controller
- Service LCM
- Config Mgmt.
- Cisco Element Manager
- Transport Planning

DC/NFV/EDGE Orchestration
- Domain Workflow
- NSSMF
- Active Inventory
- FM
- PM
- NFVO
- Service LCM
- Config Mgmt.
- Infrastructure Orchestration
- G-VNFM
- CISM
- VIM
- SDN Controller
- CaaS

Cable Domain Orchestration
- Domain Workflow
- NSSMF
- Active Inventory
- FM
- PM
- cnBR Manager
- SmartPHY
- iNode Manager
- Service LCM
- Config Mgmt.
- Provisioning

Mobile Core Domain Orchestration
- Domain Workflow
- NSSMF
- Active Inventory
- FM
- PM
- MDAF
- Mobility Controller
- NWDAF
- NFVO
- Service LCM
- Config Mgmt.
- VNFM
- CNF Services

Mobile Subscription Management
- Mobile Subscription Mgmt.
- SMI/Device Mgmt.
- Provisioning GW System

CI/CD

Security

Managed Resources

RAN
- RU
- vDU
- vCU

X-Haul Transport Network (IP Overlay)
- CSR
- AAR
- CAR
- RAR
- MAR

Distributed Telco Cloud
- VNF
- CNF
- PNF
- Fabric
- Compute Storage

E2E Mobile Core Systems
- Converged Core
- Voice/IMS (Media)
- LI System
- Signalling Firewall
- Charging
- Subscriber Data Mgmt./ Signalling
- Voice/IMS (CP)
- Messaging
- Devices Mgmt.

Transport Domain Automation

TMF 640 to NSMF/X-domain orch.
(NSSI/Service Mgmt)

TMF 638/639 to Central Inventory
Resource/Service Inventory

FM/PM/Telemetry to Message
Bus

Manager
- Domain Workflow
- NSSMF
- Active Inventory

Orchestrator
- ML – Provisioning
- ML – Computation

RESTCONF

IP Controller
- Provisioning
- Traffic Engineering

Optical Controller
- Provisioning
- Path Computation

TAPI

Operator
- Service LCM
- Config Mgmt.

MDAF
- FM/PM/Analytics

Transport Planner
- Engineering
- Capacity

Element Manager
- IP
- Optical

IP Elements

Optical Elements

Key Requirements

- Topology Modeling
- NSSMF service Modeling
- PM & Telemetry Modeling
- Local RFS Inventory
- Transport element provisioning, LCM & Day N config
- NSSMF Instantiation, LCM & Day N configuration
- Transport element PM & Telemetry Collection
- Alarm and PM analytics for local closed loop, SLA reporting and Trouble shooting
- Open and Standard APIs

Tomorrow's Operation Experience ... Today

End to End View of the services shared across operator and adapted to the operator knowledge.

⬇ MTTI/MTTK
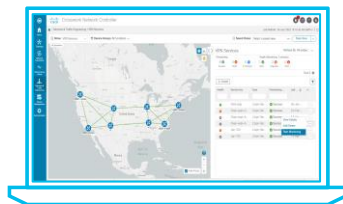
Eye on Glass

Proactively notify customer with possible causes

Proactive Problem Management

Proactively notify Level 2 and Level 3 and frontline support

Automate Troubleshooting

Extend Heuristic Package with additional subservices.

Hi, cannot reach sales force.

Yes, the device supporting your area is dropping packet.

Customer

Front Line Support

Level 1 Operation

Level 2 and Level 3

Summary

Changing the Economics of the Internet

Thank you!

Internet for the Future

Efficient network utilization

Simplified architecture

Reduced network complexity

Faster time to market

Automation empowerment

Differentiated service offering

References

Technologies and Architectures (1/2)

Session ID	Title	Speakers
BRKSP-2551	Introduction to Segment Routing	Alberto Donzelli
BRKSPG-2203	Introduction to SRv6 uSID Technology	Jakub Horn
BRKSP-2468	Migrate your network and services to SRv6 with simplicity	Loïc Roque
BRKSPG-3624	Troubleshooting Segment Routing	Luc De Ghein
BRKMPL-2253	EVPN Deep Dive with IOS-XR Configuration examples for Service Provider Metro and Data Center	Jiri Chaloupka
BRKSPG-2473	EVPN Troubleshooting and Debugging	Davide Pacifico
BRKSP-1169	Unified Access and Aggregation with Cisco Routed PON	Tejas Lad
BRKSP-2776	Modernizing mission-critical Utility & Transportation WAN Transport with Segment Routing & EVPN	Ananya Bose
TECSPG-2014	Cisco Converged SDN Transport	Alberto Donzelli, Stefano Novello

Technologies and Architectures (2/2)

Session ID	Title	Speakers
BRKSPG-2343	Internet for the Future: Journey to the Next Generation SP Architecture and Operating Model	Rob Piasecki
BRKSPM-2024	The New, Encrypted Protocol Stack Taking over the Internet and How to Deal with It	Andreas Enotiadis, Bart Van de Velde
BRKSP-2133	SP Architectural & Service Evolution with the Cisco SP NaaS Framework	Brian Meaney
BRKSP-2612	Modernizing Broadband Services with Cisco Subscriber Edge Architecture and EVPN access	Gurpreet Dhaliwal
BRKSPG-2133	Evolution of the Transport Network Architecture for 5G and behind	Roberta Maglione
BRKSPG-3050	Synchronizing 5G Mobile Networks	Dennis Hagarty
BRKSP-2170	Converging 5G Transport and Telco Data Center architectures	Waris Sagheer, Sonu Kumar Khandelwal
BRKSP-2189	Cisco Validated blueprint architecture for building 5G networks across DC and transport	Sonu Kumar Khandelwal
BRKSPG-2315	Cloud-Ready Converged SDN Transport	Waris Sagheer

Platforms

Session ID	Title	Speakers
BRKSPG-2397	Demystify NCS5500/NCS5700 Resources for Effective Network Design and Operations	Bala Murali Krishna Sanka
BRKSPG-2944	Cisco 8000 Technical Update: powered by Silicon One and IOS XR	Frederic Cuiller, Chang Soo Lee
BRKSP-2275	Rethink your Edge Routing Architecture	Emerson Moura
TECSPG-2003	Cisco 8000 Powered by Silicon One & IOS XR: Architecture, positioning, deployments, and troubleshooting deep dive	Frederic Cuiller, Chang Soo Lee

Routed Optical Networking

Session ID	Title	Speakers
BRKOPT-2130	The Journey towards Routed Optical Networking	Moustafa Kattan
BRKOPT-2015	Lessons Learned from designing Routed Optical Networks	Emerson Moura
BRKOPT-2016	Building transport grade packet-based networks with Routed Optical Networking	Kent Dailey, Bradley Riapolov
BRKOPT-1005	High Value Wavelength / Private Line Services Understanding the Customer and Provider Perspective	Christian Schmutzer
BRKSPG-2029	Designing Routed Optical Networks: IP/MPLS Considerations	Emerson Moura
BRKOPT-2017	Scaling Enterprise Networks with Routed Optical Networking	Errol Roberts
TECSPG-2435	Routed Optical Networking Technical Deep Dive	Kent Dailey, Bradley Riapolov

Automation & Assurance

Session ID	Title	Speakers
BRKOPT-2637	Network Automation with Routed Optical Networking (RON) Architecture	Domenico Zini
BRKSPG-2474	Reduce Resolution Time with a Service-Centric Approach to Troubleshooting	Paola Arosio
BRKSPG-2263	Design, Deploy and Manage Transport Slices using SDN Controller and Assurance	Sujay Murthy
BRKSPG-2643	Differentiating B2B services and transport with QoE and proactive service assurance	Ramesh Reddy

Security and Sustainability

Session ID	Title	Speakers
BRKSPG-2868	Building & Maintaining Trust in Service Provider Networks	Rakesh Kandula
BRKSPG-2401	Cisco Secure Edge Protection – Protecting the 5G Edge against DDoS attacks	Mike Geller
BRKSPG-2583	Enhancing IP traffic flow visibility to support sustainability in Communication Service Providers' networks	Bart Van de Velde, Andreas Enotiadis

Thank you

CISCO *Live!*

Let's go