

New Technologies Revamping the ISP landscape

Chowdhury Muktadir Rahman
Solutions Engineer, Cisco Systems

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- Router Optical Networking (RON)
- Router Passive Optical Networking (RPON)

Router Optical Networking (RON)

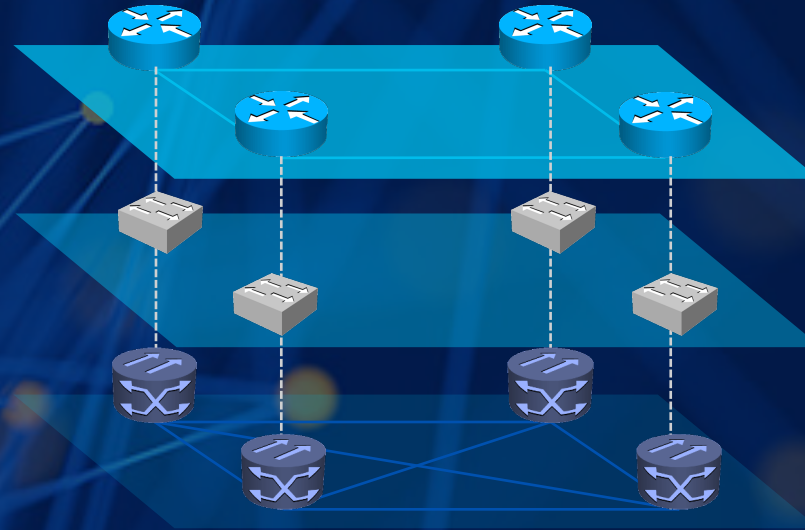
The Complexity of Legacy Architecture

Distinct IP and Optical Networks
Engineered and operated by different internal organizations

Legacy Burden
Accumulation of new and old technologies over time

Asset Utilization
Medium to low utilization of network assets

Mounting OpEx
Automation of complex networks comes with inefficiencies



1 IP Routing

2 OTN

3 Optical (ROADMs)

redundant | complex | expensive

Simplicity is the ultimate sophistication

Leonardo da Vinci

Shifts in Economics and Technologies

Optics and Routing

Routing Scale Evolution

Silicon
3.2Tbps to
51.2Tbps



Router capacity outpaces
projected traffic demand

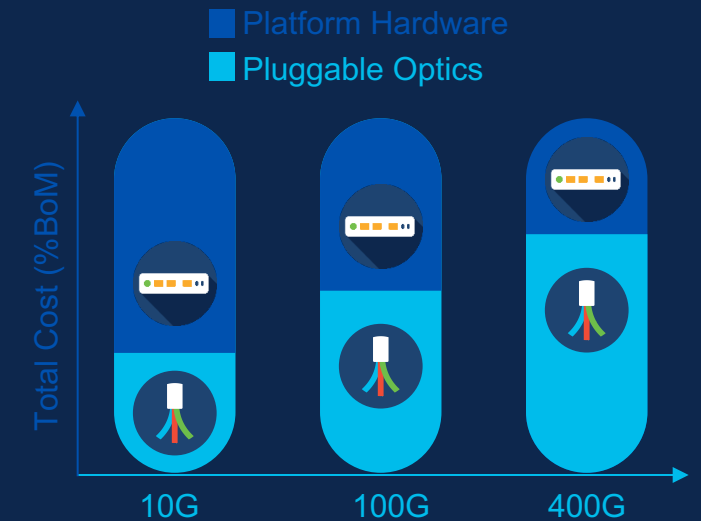
Optical Systems Evolution

Optics
100GbE ZR
400GbE ZR/OpenZR+



Chassis-based solutions
replaced by pluggable optics
for short to medium distance
applications

Shift in Economics



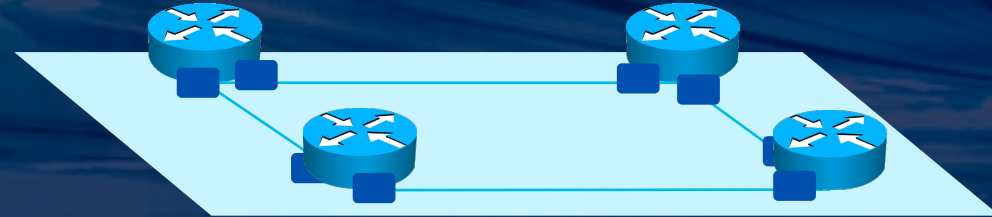
Optics cost becomes greater
than router port cost

Introducing Routed Optical Networking

35% CapEx Savings*

57% OpEx Savings*

46% TCO Savings*



- Modernized operations and procurement
- Interoperability and standardization
- Efficiency gains

Removing Complexity



Router



SR Optic



Fiber Jumper



SR Optic



Transponder



ZR/ZR+ Optic



Fiber Jumper

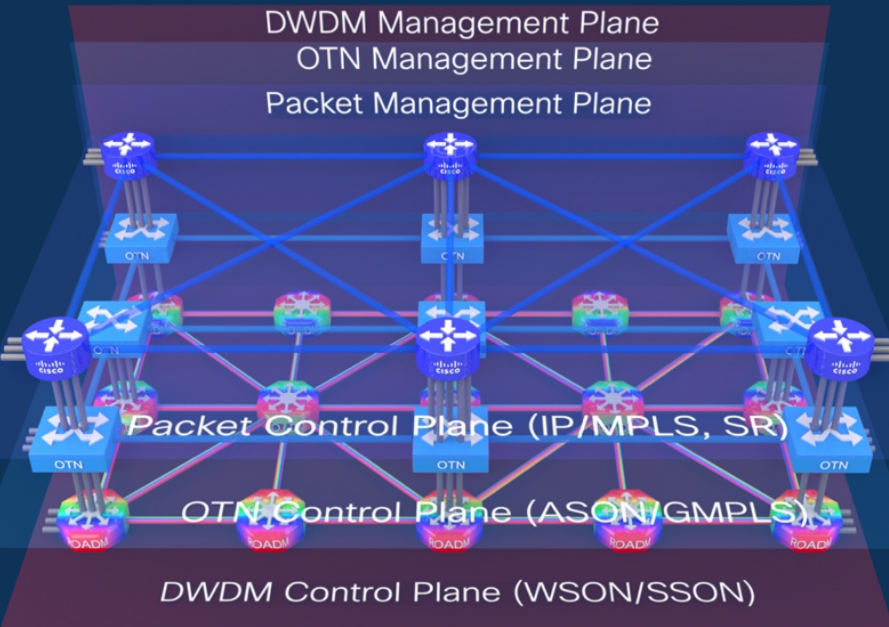
ROADM



Toward a Routed Optical Network Future

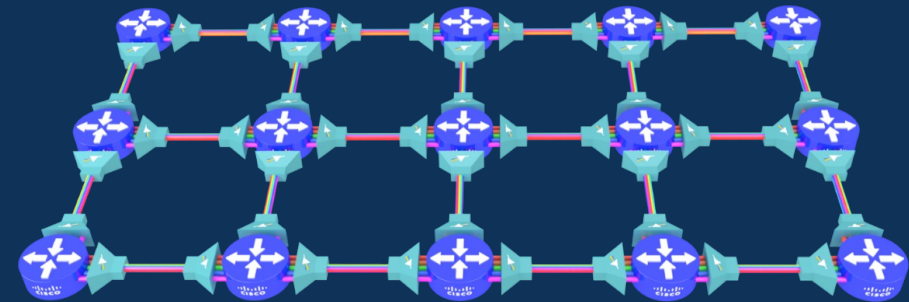
Estimated total TCO savings of 45%

Today's Network Layered Architecture



Tomorrow's Network Flat Hop-by-Hop Architecture

Unified Management & Automation Plane



Automation

Routed Optical Networking

Putting it all together



>250Tbps



Coherent
Optics



Simple DWDM
Line System



Modern
Software &
Control Plane



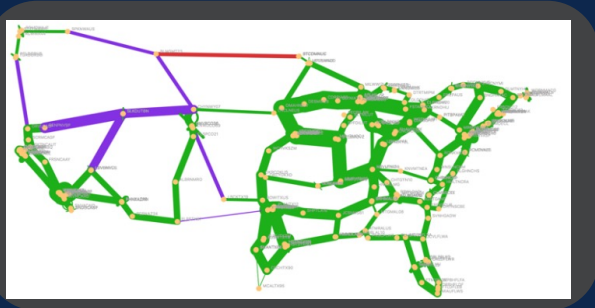
New Network
Paradigm

Hop-by-Hop
Optical
Transport

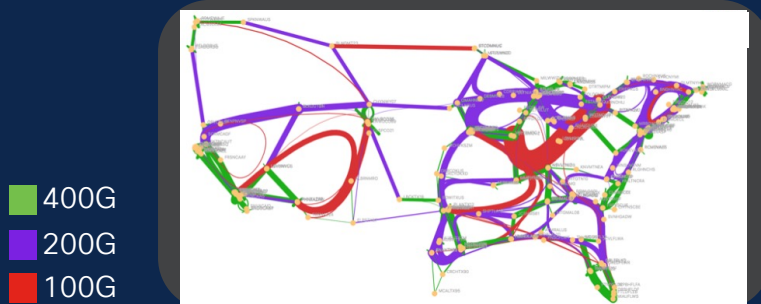
Nationwide Core Network

Routed Optical Network reduces cost of ownership and improves resiliency

Routed Optical Network increases capacity

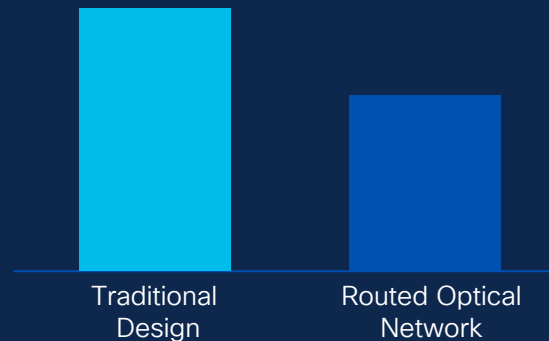


Present mode of operation has capacity constraints



Lower CapEx





Large core network comparison



The capital expense of a Routed Optical Network node can be up to 55% of the cost of today's networks

Lifecycle Savings

Today's typical node vs. a Routed Optical Network node:

-  74% less power
-  58% less rack space
-  35% CapEx reduction
-  56% OpEx reduction

Entire industry is following the trend..

Cisco Routed Optical Networking

Simple, scalable, and sustainable

Streamline management, upgrades, and services.

Juniper Networks

Products & Solutions Customers Partners Company

Solutions & Technologies > Converged Optical Routing Architecture

Converged Optical Routing Architecture

An extensible, sustainable, automated solution for converged IP-optical networks.

Coherent Routing

Build application-optimized IP-optical networks using coherent optics

The Nokia Coherent Routing solution brings together the power of pluggable digital coherent optics (DCOs) with Nokia's advanced IP service routers, optical transport systems and network automation expertise to enable more efficient and scalable IP-optical network designs.

Is your network ready for 400GE and beyond?

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Network insights Software-based transformation Routing and switching DCI Optical networking More

What is coherent routing?

Coherent routing provides network operators a path to achieve IP/Optical convergence that is designed to optimize network performance through multi-layer operations, dynamic scalability, and improved overall network sustainability.

OMDIA IP Optical Networks

Figure 2: The "multi-variant challenge"

IPoWDM with QSFP-DD	IP + WDM with CFP2
IPoWDM pros: <ul style="list-style-type: none">High port densityLow power drawFit for modern racksAttractive economics	IP + WDM pros: <ul style="list-style-type: none">CFP2 grade reach and ROADM pass-throughHighest optical efficiencyLeverages ROADM installed baseLeverages optical system economics

5 B400G Standards Progress

ITU-T, IEEE, OIF and CCSA are the major organizations involved in B400G standard formulation.

5.1 ITU-T

The Q6 and Q11 of the ITU-T SG15 are responsible for the standardization of the optical physical layer and the logical layer of OTN. The Q6 is standardizing the code parameters of the 80km and 200-450km application scenarios of the 200G and 400G. The Q11 has finished the standardization of the frame structure, timeslot granularity, format and rate of the interconnection interface (PloN), service mapping and multiplexing of the 8100G (OTU-10), and has completed the FEC specifications for the interconnection interfaces of 80km and 200-450km. It is about to start the discussion about B400G.

5.2 IEEE

The IEEE 802.3 group works on the standardization of 400GE Ethernet interface physical layer, and has completed the specifications for multiple distances (100m/150m/300m/2km/10km/40km) of 400GBASE-SR8, 400GBASE-SR4.2, 400GBASE-DR4, 400GBASE-FR8, 400GBASE-LR8 and 400GBASE-ER8. At the same time, for the data center interconnection scenarios not exceeding 120km, it has formed the first draft of the 400GBASE-ZR. It determines the physical layer parameters of 400G-ZR and employs DP-16QAM and coherent receiving to support multi-wavelength applications and implement at least 80km transmission.

Architecture Link

<https://www.cisco.com/site/us/en/solutions/routed-optical-networking/index.html>

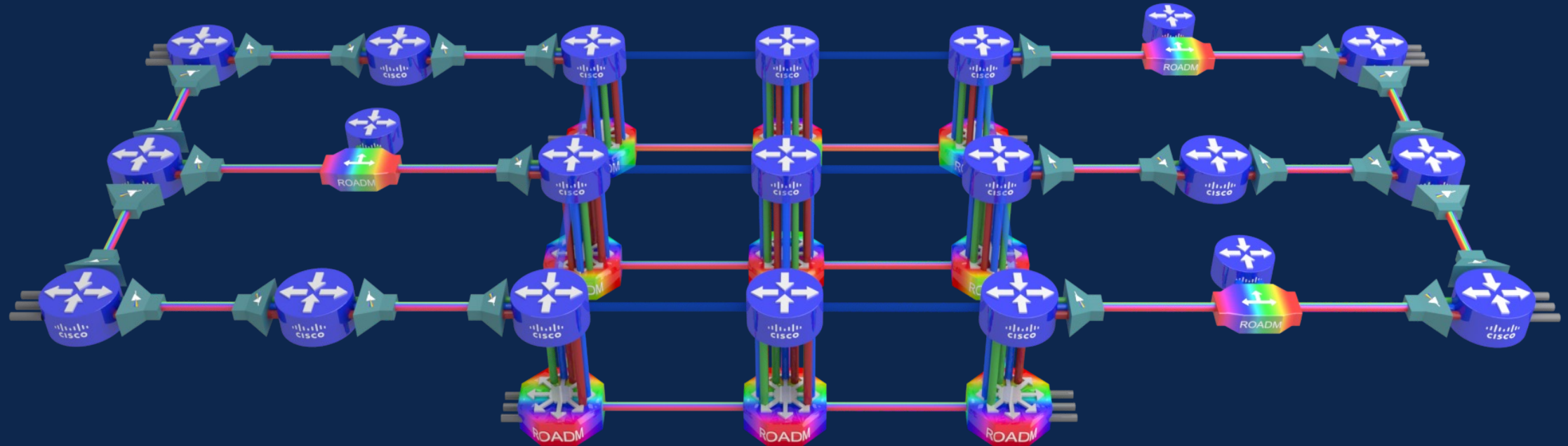
<https://www.juniper.net/us/en/solutions/converged-optical-routing-architecture-cora.html>

<https://www.nokia.com/networks/ip-networks/coherent-routing/#:~:text=The%20Nokia%20Coherent%20Routing%20solution,scalable%20IP%20Optical%20network%20designs>

<https://www.ciena.com/insights/what-is/what-is-coherent-routing>

Where Do I Start?

Routed Optical Networking can be deployed in these three different scenarios

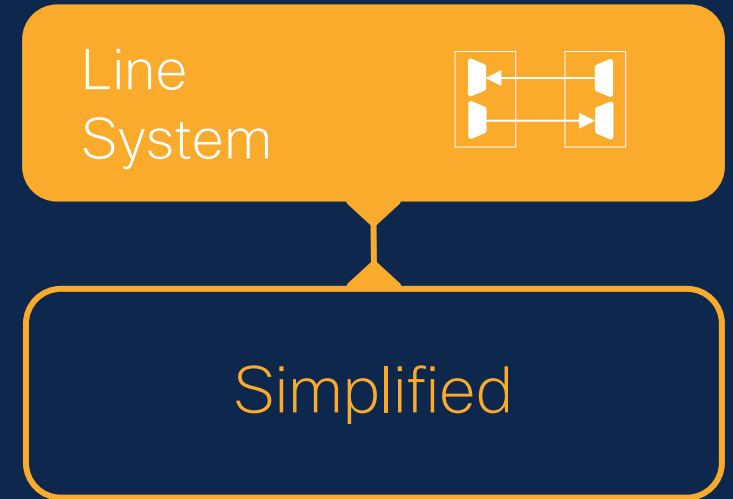
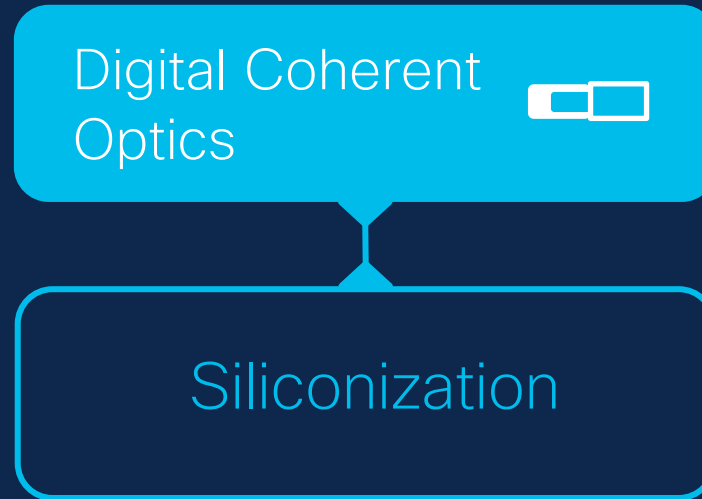
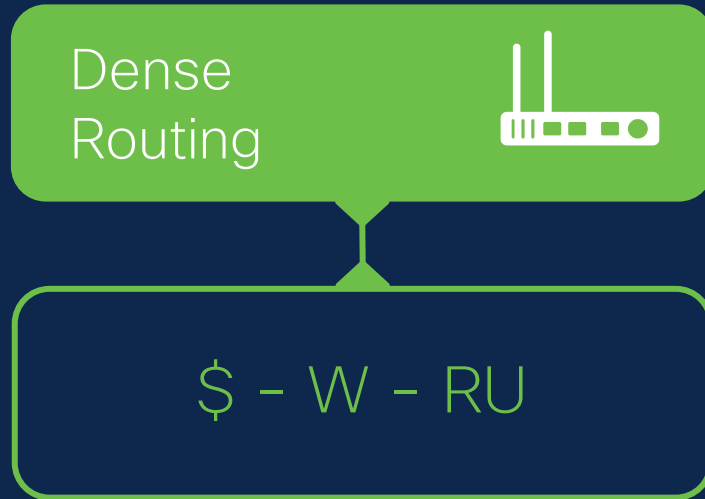


Greenfield

Existing DWDM Layer

Coherent optics over 3rd Party
line systems

Cost Saving Factors



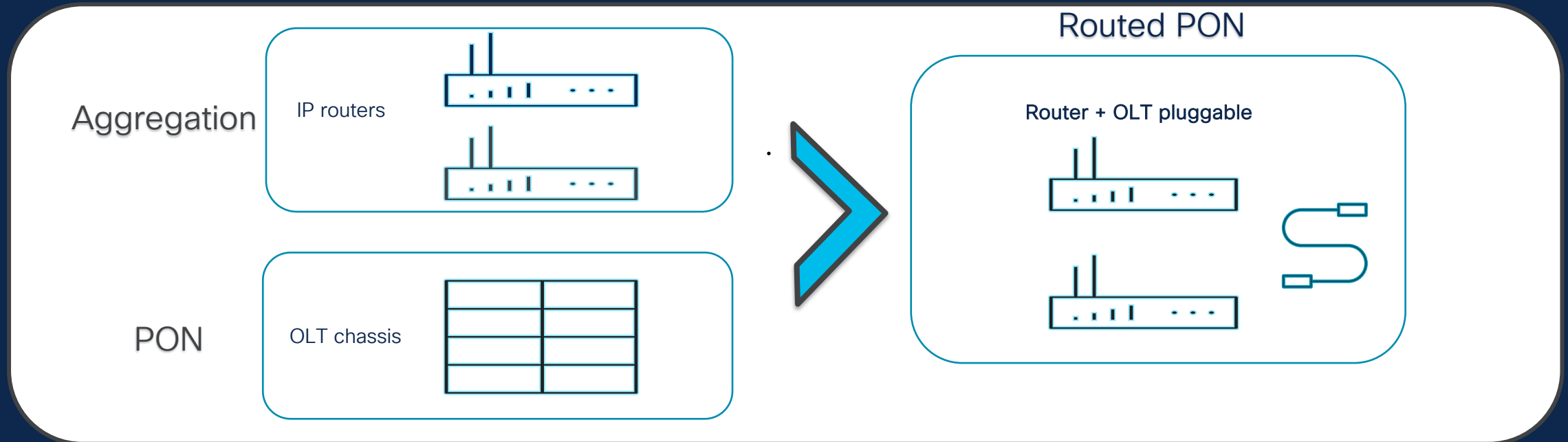
Routed Optical Networking Solution



Router Passive Optical Networking (RPON)

Routed PON Solution

Disaggregated and scalable PON deployment



OpEx benefits:

14%-20% CapEx savings*

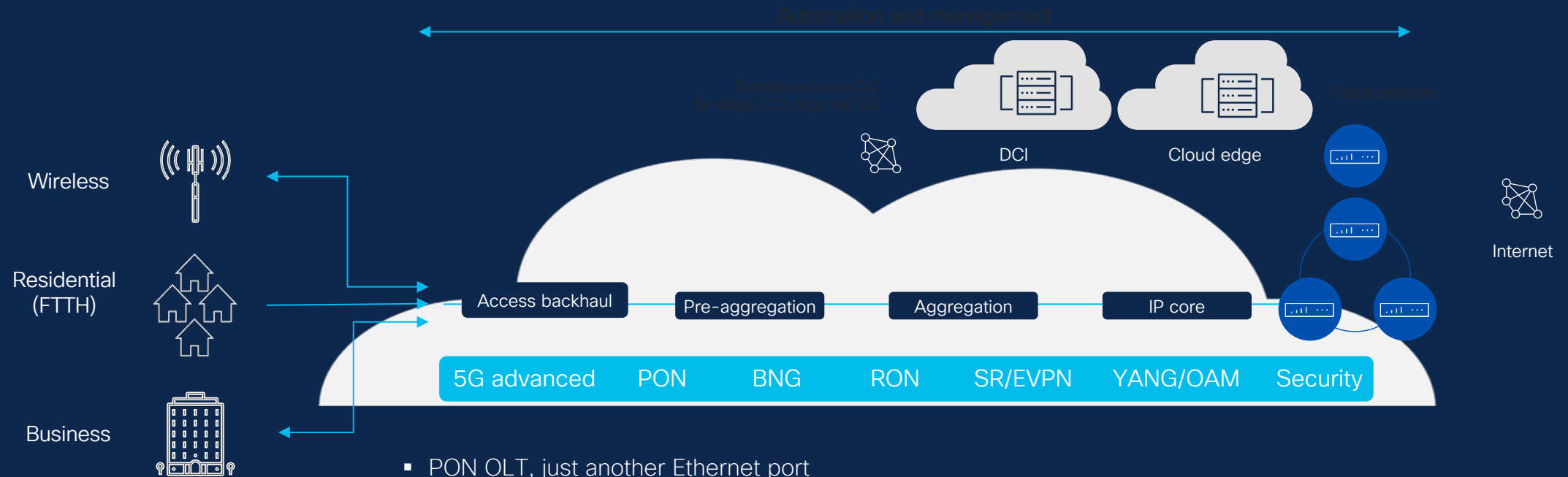
*Compared to Standard PON access concentrators

- Broadband service providers can **converge** the IP and optical on single layer. Leverage a **rich feature set of NOS** and the **cost-effectiveness** of passive optical networking
- Reduction and simplification of OLT hardware from dedicated shelf to **pluggable**
- Port-based **scalable model** enabling deployments to be rolled out as per **XGS-PON standards**

Path to **future upgrades** - 10G to 25G PON

Reference: DELL'ORO Broadband Access Report Q124

Converge services on Metro Architecture



- PON OLT, just another Ethernet port
- Seamlessly integrate PON with the existing metro architecture
- Deliver PON services with open standards
- Maintain single operating system for operational simplicity
- 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
- Better subscriber policy management with distributed BNG
- In-built hardware security with TAM chips

Routed PON + Assurance Architecture

Simplified way to deploy next-gen passive optical networks



Hardware+ PON Controller

- Leverage your existing Routing Platforms
- PON Controller simply runs as a container on these Router
- Future compatibility to 25G PON



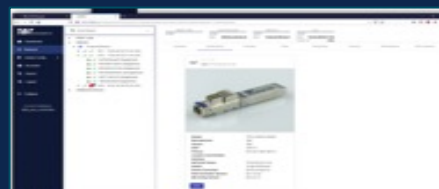
OLT

- Pluggable hot swappable form factor
- SFP+ contains both L1 optics and L2 PON MAC
- Roadmap for low power i-temp version based DML laser



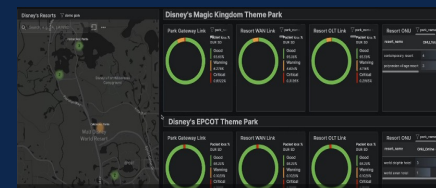
ONT/ONU

- G.9807.1 XGS PON Compliance
- 10G/1G/POTS/POE/POE++
- Pluggable Capability



PON Manager

- A powerful network management software for Routed PON Solution
- Configure and monitor end-to-end devices, including OLT and ONT



Service Assurance

- Network Performance observability and SA
- KPIs from the PON Manager and relevant correlations

XGS-PON OLT SFP+ Module

Enabling Software Defined Broadband Network

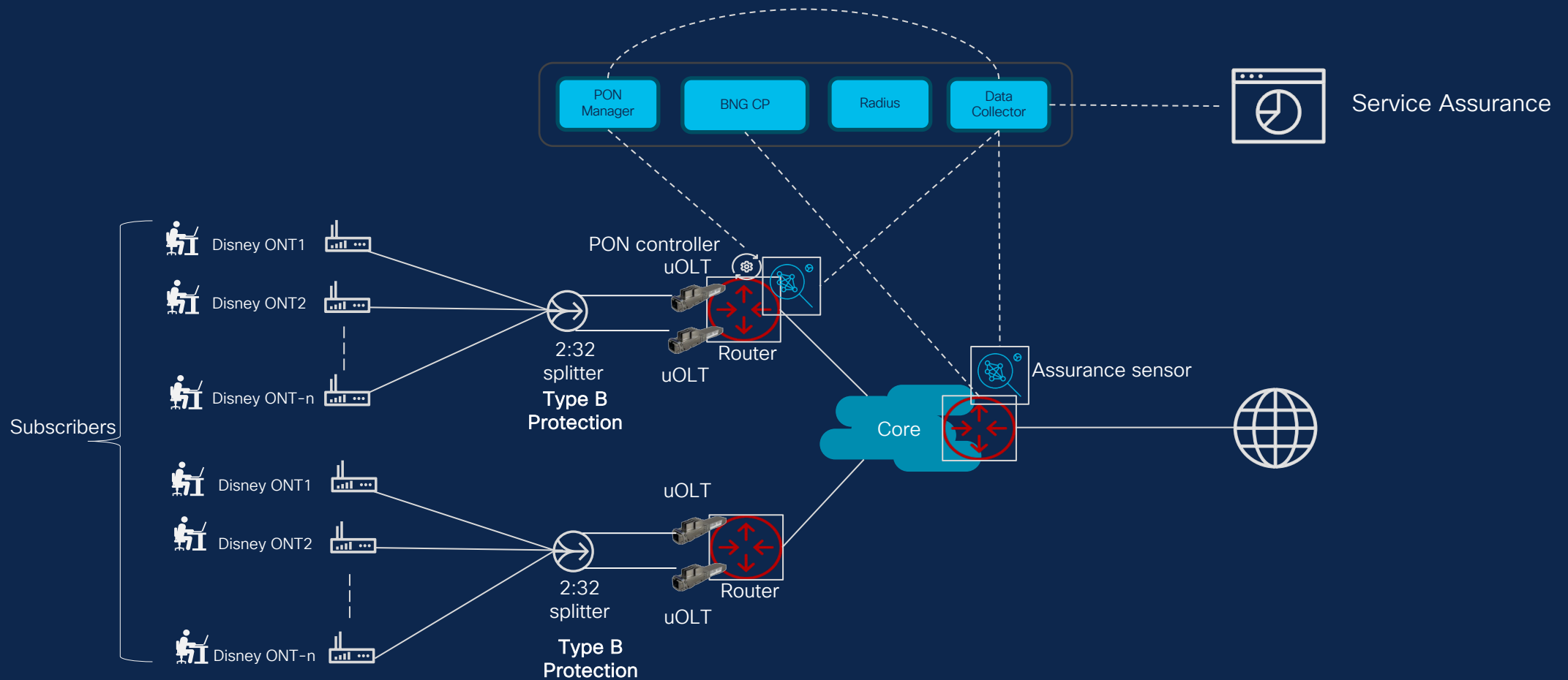


- Simplifies the network with hot swappable pluggable form factor with embedded Ethernet-PON OLT MAC bridge
- Open and Disaggregated Software
- Compliant with ITU-T G.9807.1 XGS-PON specifications
- Interoperable with non-proprietary ONTs supporting OMCI standards
- Ideal for converging PON services along with existing Ethernet services onto a single transport network, delivering high bandwidth PON connectivity, High density PON aggregation
- RoHS 6 compliant

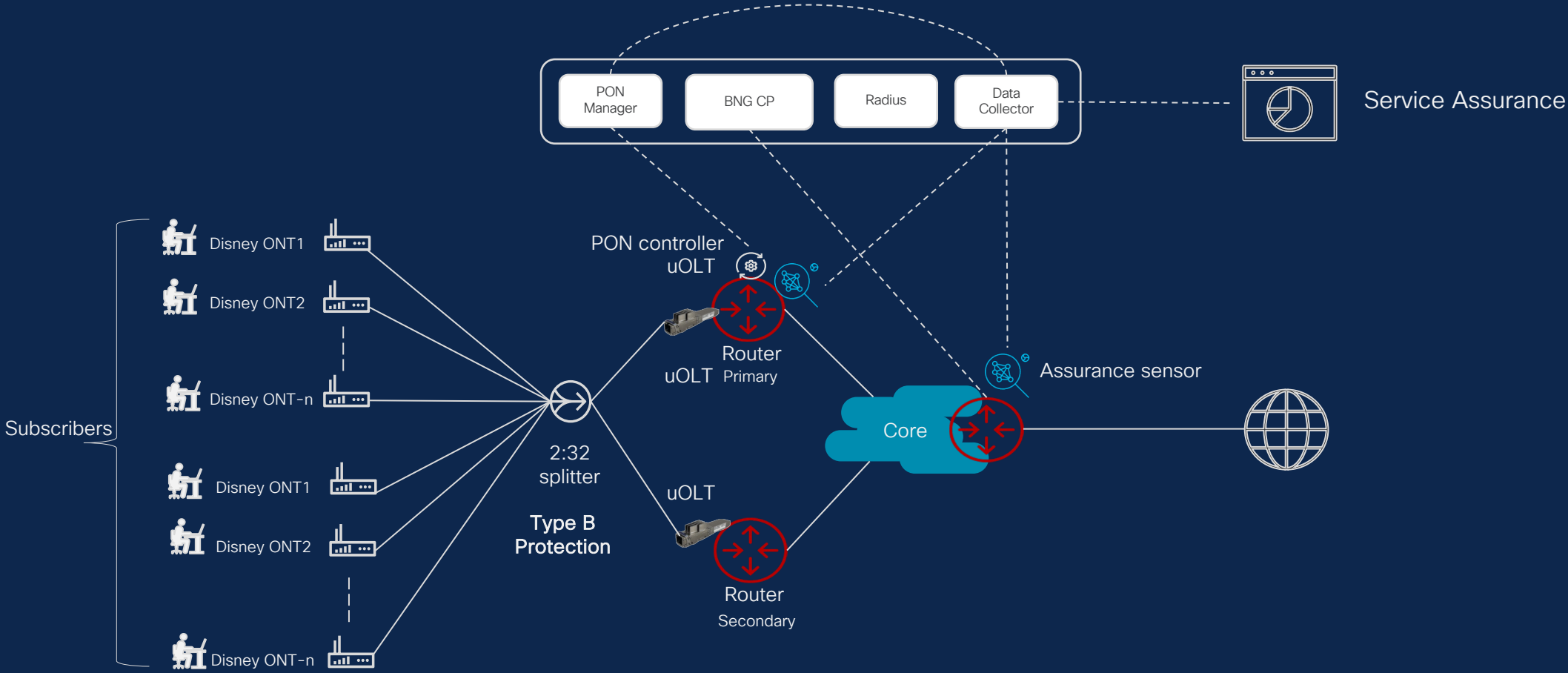
Quick Facts

Dimension(H x W x D)	8.55mm x 13.4mm x 80.65mm
PID	SFP-10G-OLT20-X
Data rate	Symmetric rates: 9.95G upstream/9.95G downstream
Connector Type	SC/UPC
Maximum Distance	20 km
Operating Temperature	-20° C to 75° C
Typical Power Consumption	2.475W
Cable Type	Single Mode Fiber
ODN Class	N2

Single Chassis Protection



Multi Chassis Protection



謝謝

བཀའ་དྲིན་ཆེ

DZIĘKUJĘ CI

TAPADH LEIBH

KEA LEBOHA

NGIYABONGA

БАЯРЛАЛАА

MISAOTRA ANAO

TEŞEKKÜR EDERİM

WHAKAWHETAI KOE

धन्यवाद

DANKIE

TERIMA KASIH

DANKON TANK TAPADH LEAT

धन्यवाद

KÖSZÖNÖM

СПАСИБО

GRAZIE

MATUR NUWUN

ХВАЛА ВАМ

MULTUMESC

РАКМЕТ СИЗГЕ

고맙습니다

GRAZIE شكرا

HVALA

FAAFETAI

GO RAIBH MAITH AGAT

ESKERRIK ASKO

БЛАГОДАРЯ

GRACIAS

THANK YOU

HVALA

ТИ БЛАГОДАРАМ

TEŞEKKÜR EDERİM

TAK DANKE

MAHADSANID

DANKJE

ΕΥΧΑΡΙΣΤΩ GRATIAS TIBI

ДЗЯКУМ

OBRIGADO

AČIŪ

SALAMAT

MAHALO IĀ 'ŌE

TAKK SKALDU HA

MERCI

РАНМАТ

MERCI

GRAZZI

PAKKA PÉR

FALEMINDERIT

ありがとうございました

DI OU MÈSI

HATUR NUHUN

PAKHMAT CAĠA

SIPAS JI WERE

TERIMA KASIH

ĎAKUJEM

CẢM ƠN BẠN

UA TSAUG RAU KOJ

WAZVIITA

ТИ БЛАГОДАРАМ

СИПОС