



Optical Fundamentals for IP experts

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Agenda

- 1 Understand IP & Optical Convergence
- 2 Why should we care about optical networks ?
- 3 Evolution of Optical Technology
- 4 Role of Coherent plug on IP & Optical Convergence

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T&Cs apply

What does IP and Optical convergence mean?

Q: What does IP and Optical Convergence mean to you?



Automation for service management and more

P1



Simple Operations: Single Pane of glass

P2



Multi-Layer Control Plane

P2

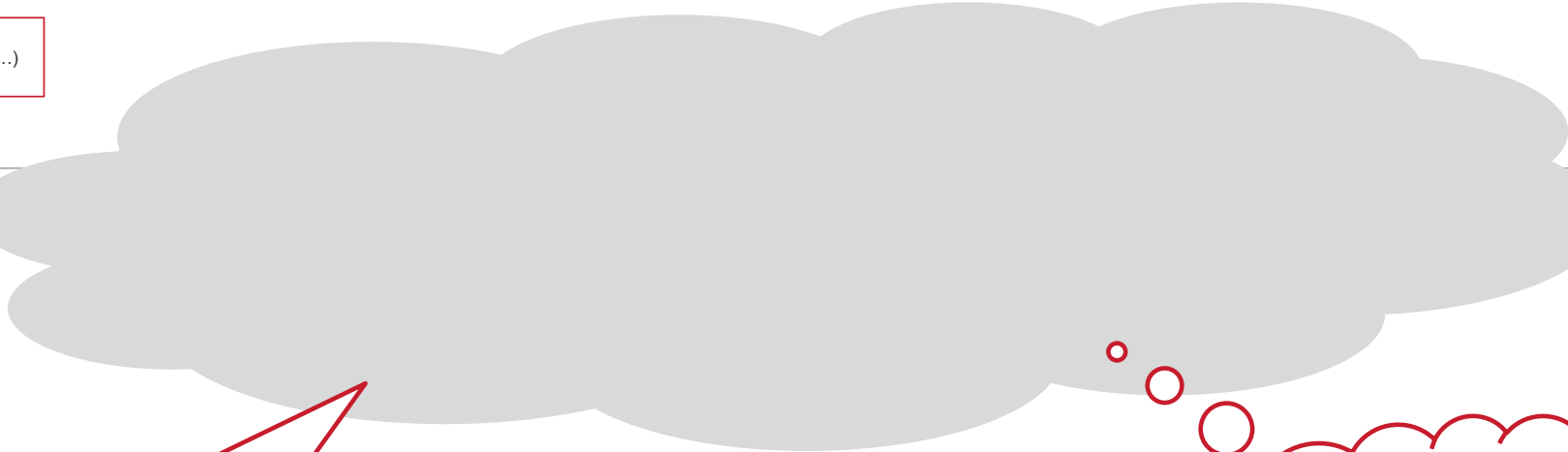


Platform convergence

P3

Functional components of Optical Networks

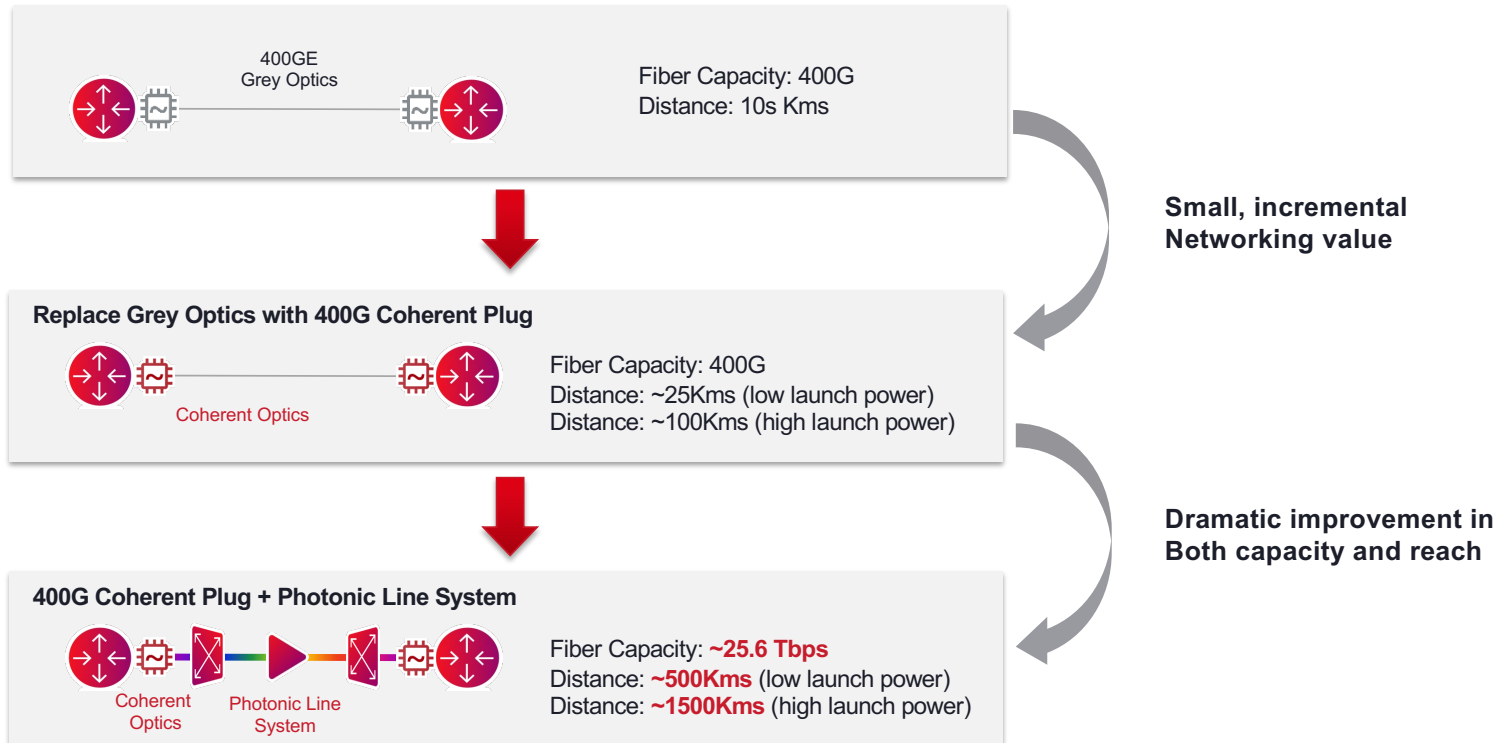
Grey Optics
(QSFP28, QSFP-DD, CFP2...)
(100G, 400G, 800G)



What does "light & mirrors"
do to my data?

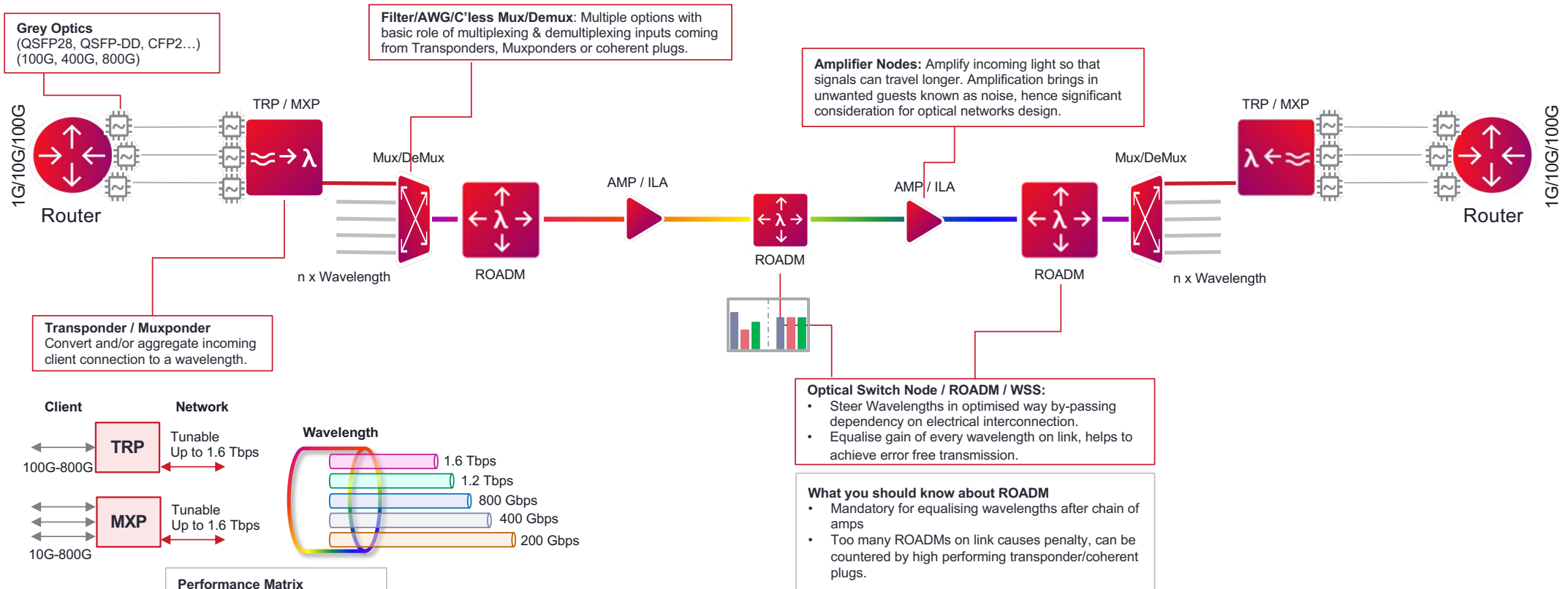
Can this
knowledge help
us to optimise
end to end
networks?

Simple example explaining value of optical layer

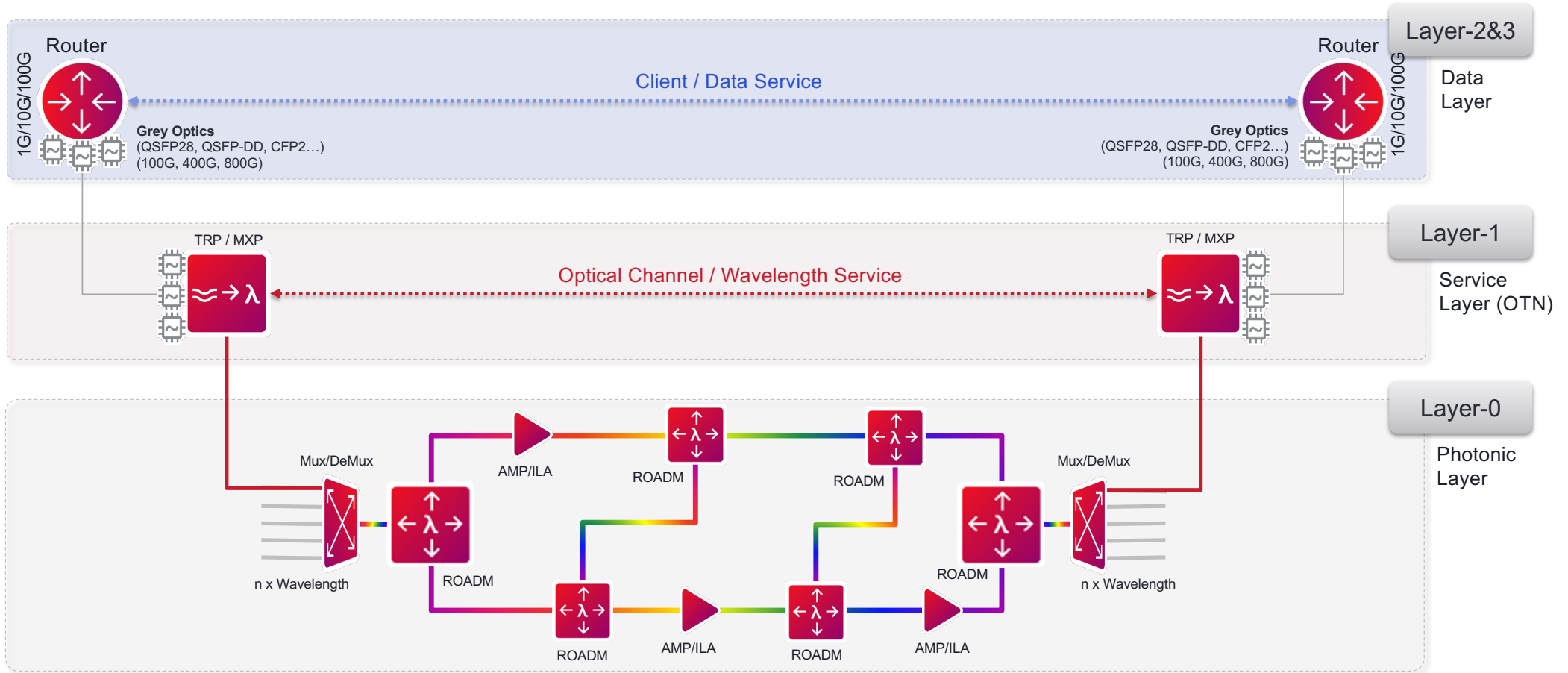


Coherent optics works the photonic line system to maximize fiber capacity and performance

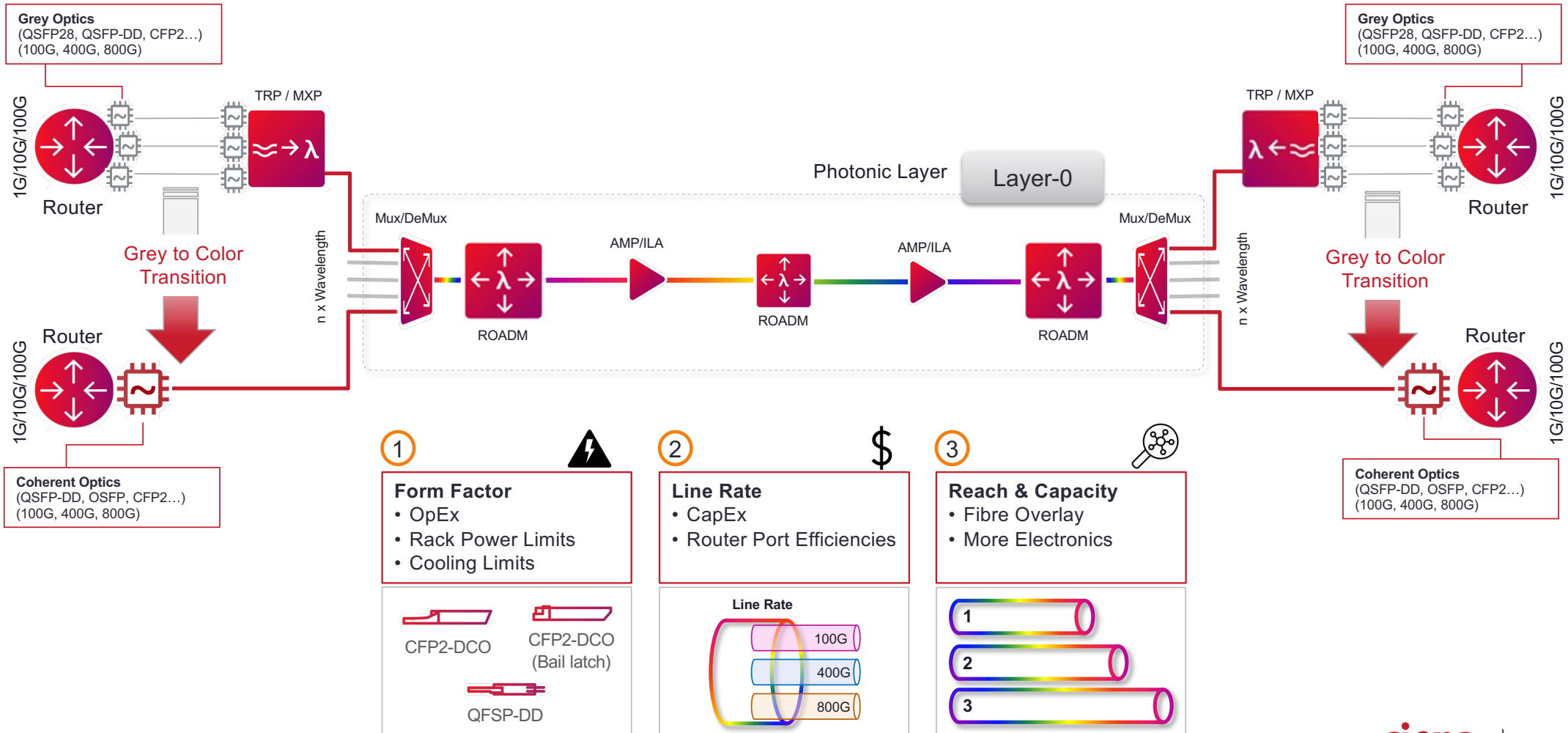
Functional components of Optical Networks



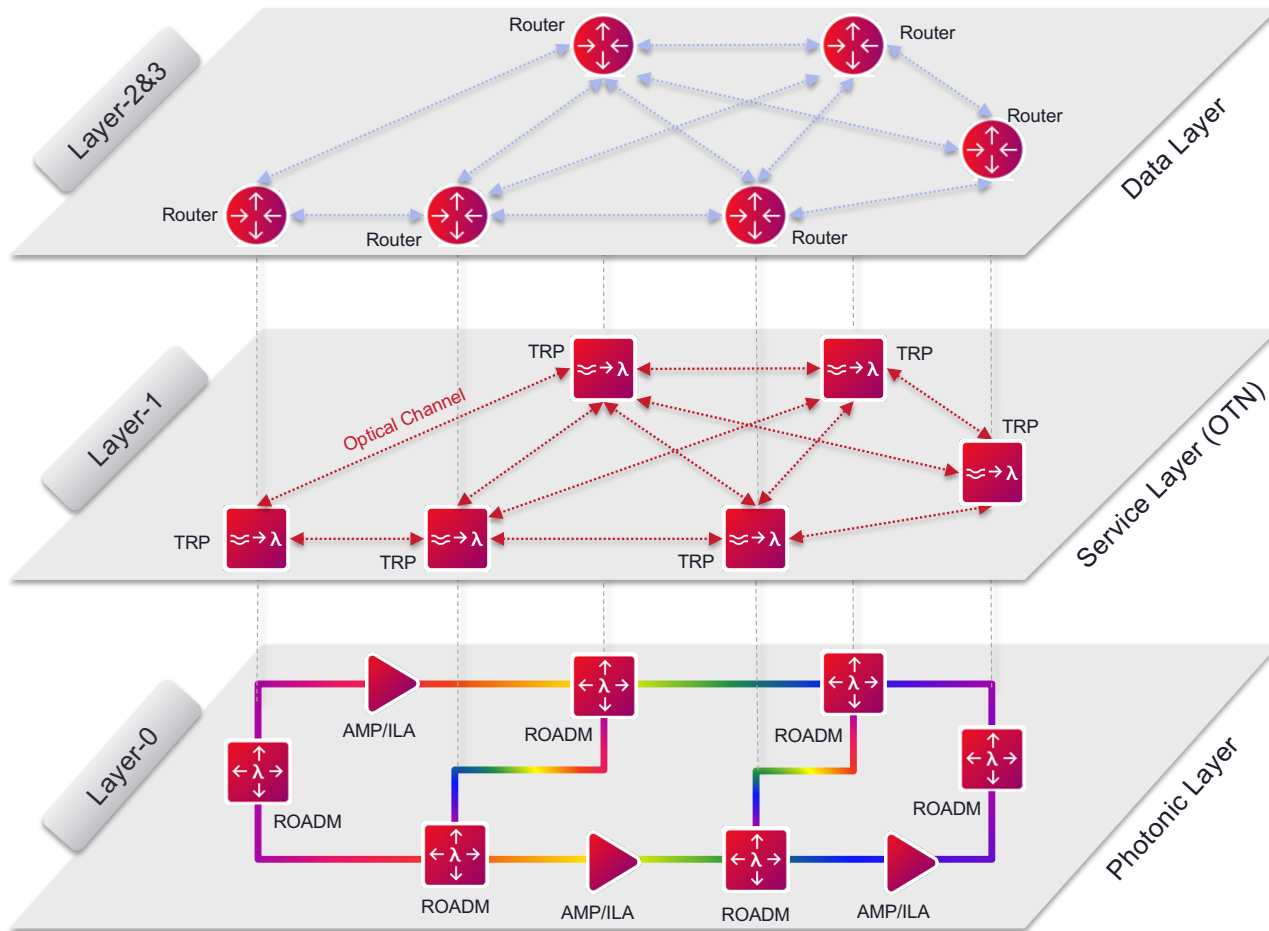
Functional components of Optical Networks



Why should we care about Optical Networks?



Why should we care about Optical Networks?



1

Visualisation

- Understanding of optical underlay for IP services
- Enabling holistic planning of L0 to L3 infrastructure

2

Service Assurance

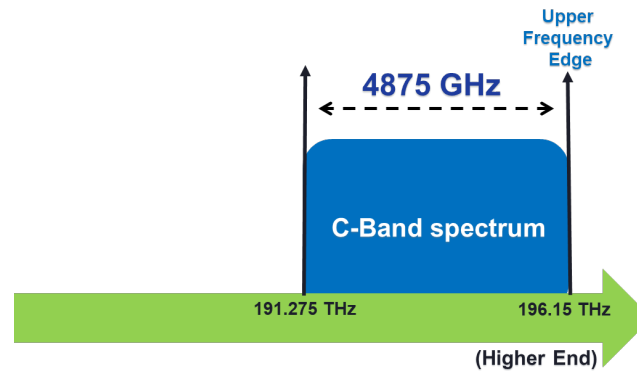
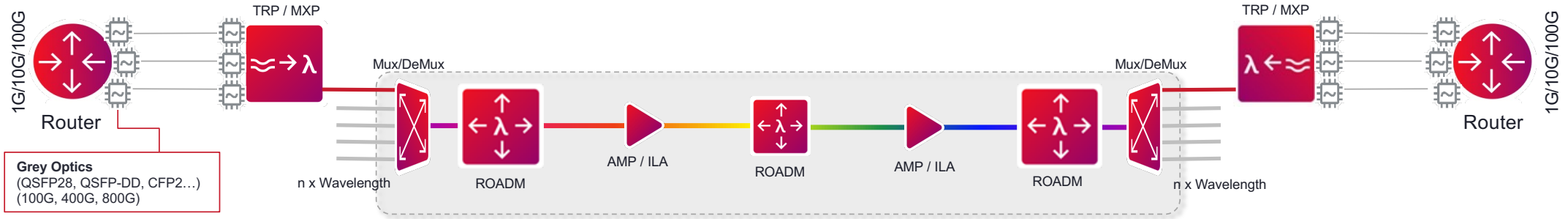
- Layer-1&0 Network alarms & how they can impact IP Services

3

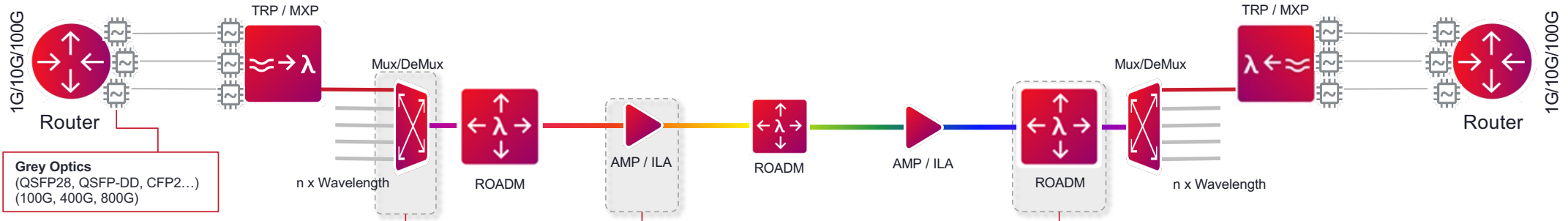
Multi Layer Control Plane

- Provides autonomous control of a network
- Enables Topology discovery, Path computation, resulting in faster roll out of services
- Understanding Photonic control plane helps to appreciate value of Multi-Layer PCE
- Multi layer awareness assures optimization and path computation based on real network conditions

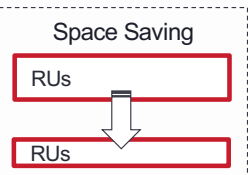
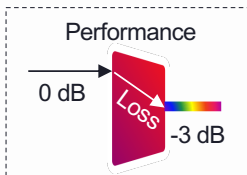
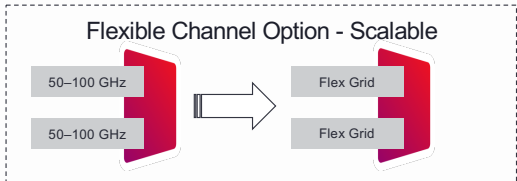
Evolution of Optical Technology



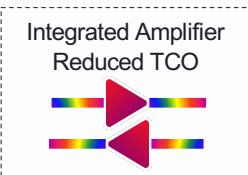
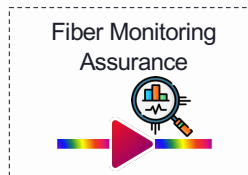
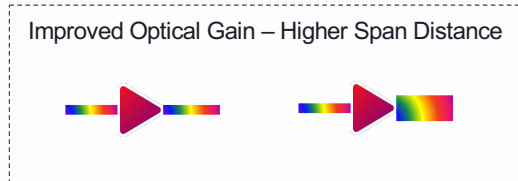
Evolution of Optical Technology



- Flexible channel width options
- Reduction in insertion loss
- Constant improvement in form factor



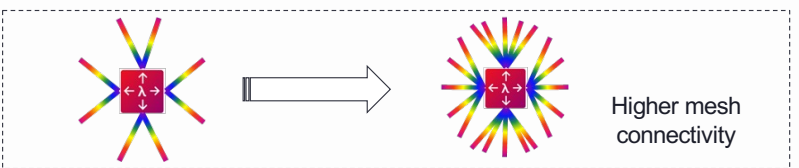
- Improvement in optical power gain
- Integration of fiber monitoring capabilities
- Integration leading to form factor reduction.



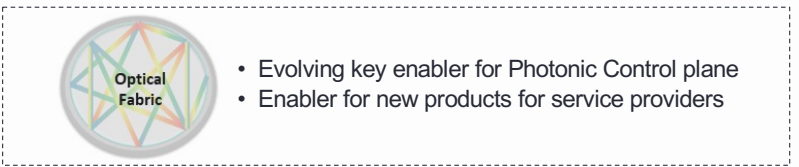
Integration led cost optimisation



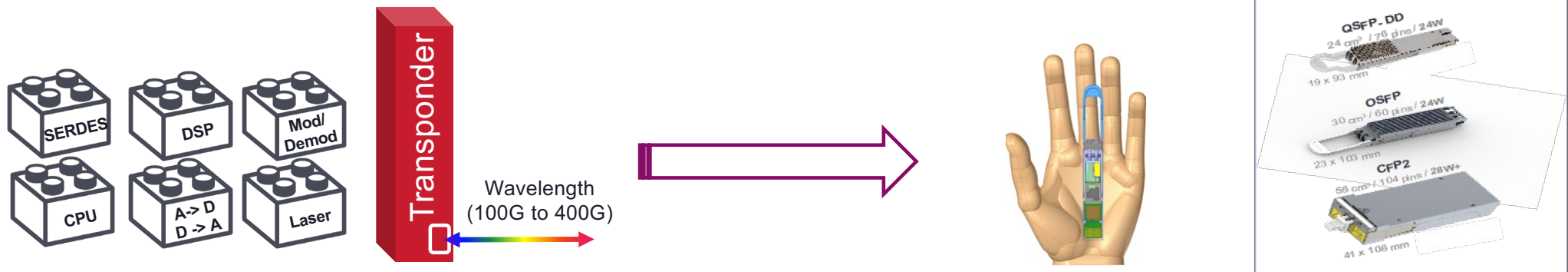
Increased Scalability



Application Evolution



Overview of Coherent Plugs



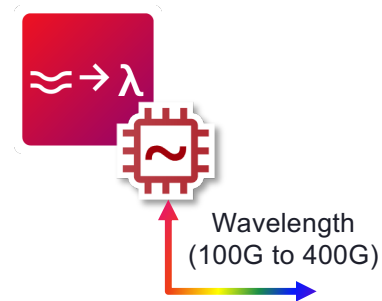
Data Rates & Standards

	Standards	Line Rates (Gbps)	FEC	Reach
OIF	OIF 400ZR	400G	CFEC	~120 kms
	Open 400ZR+ MSA	400G	OFEC	~1000 kms
ITU-T / Open ROADM / CableLabs (*)		400G	OFEC	~1100 Kms
		200G*	OFEC	~3000 Kms
		200G*	OFEC	~1100 Kms
		100G	OFEC	~3000 Kms

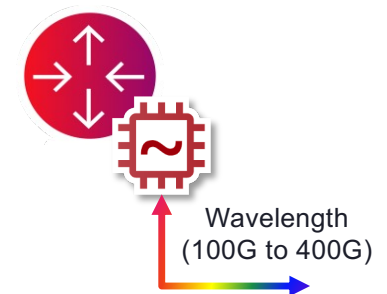
Vendor specific proprietary modes

- Enables higher reach with more data rates
- Optimised power budgets

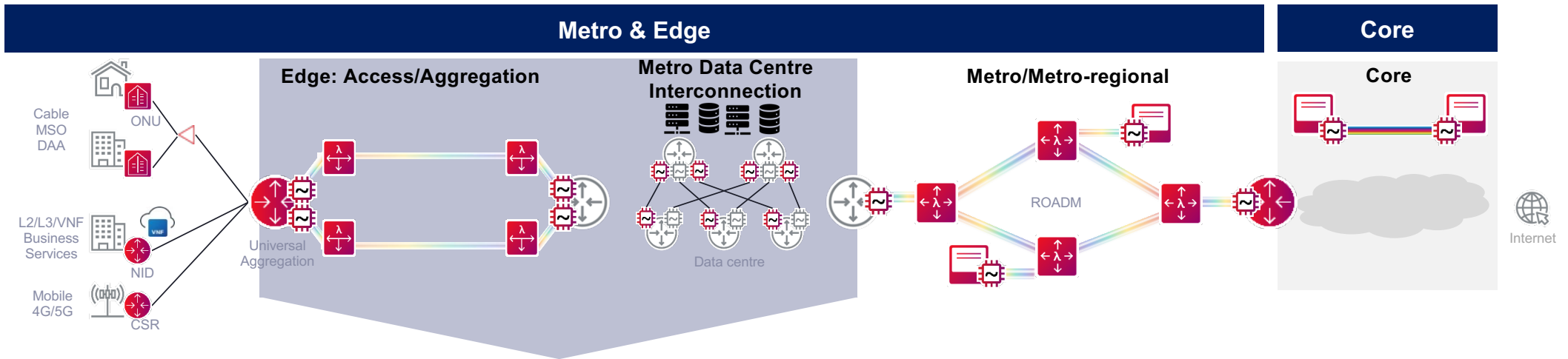
MUXPONDER



ROUTER



Coherent Plug Use Case Example



400G ZR



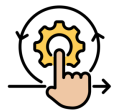
QSFP-DD



Optimised Power consumption ~ 16W



Achievable Router port Efficiencies



Simple to integrate in existing optical Layer

Physical Infrastructure

- Link distances are limited to 120 kms
- Easier to integrate with existing OLS

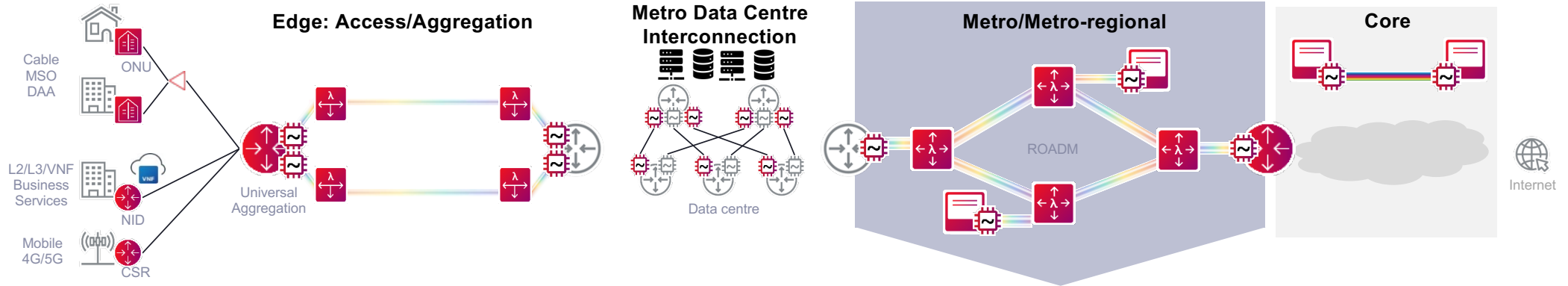
Point to Point topology without multiple ROADM spans enables easier adaptation

Standards have enabled non-bookended scenarios

Coherent Plug Use Case Example

Metro & Edge

Core



Physical Infrastructure

- Link distances fall in range of 100 to 600 kms

Complexities of Optical Line Systems

- Multiple ROADM By-pass required
- Challenging deployment scenario for Standard QSFP-DD
- High launch power required in small formfactor

Thermal budget & Router port efficiency

400G ZR+



In built EDFA reduces dependency of deploying additional amplifiers



Simple to integrate in existing optical Layer with right plug



Power consumption ~22 W

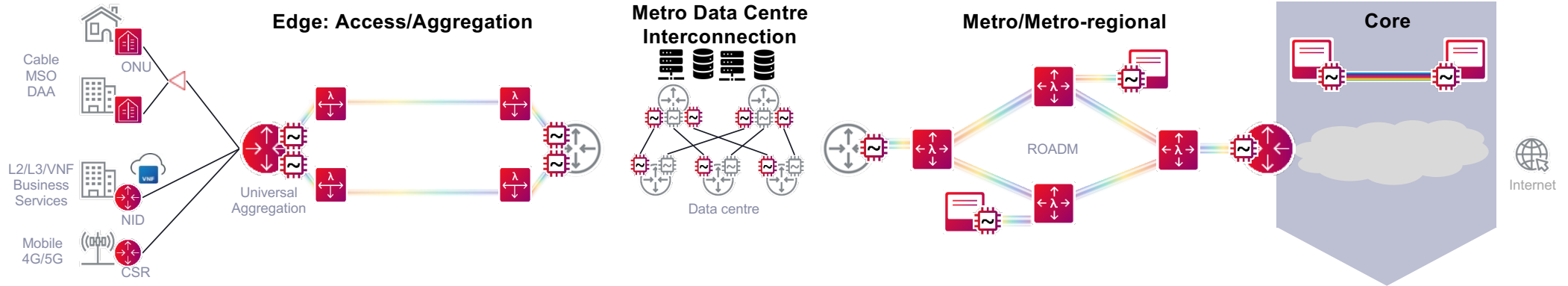


Efficiently utilising router ports will be a balancing act

Coherent Plug Use Case Example

Metro & Edge

Core



Physical Infrastructure

- Link distances can range between 1000 to 5000 kms.

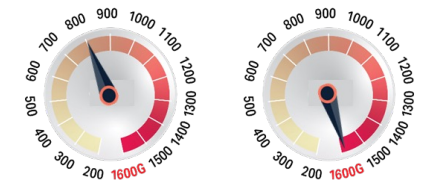
Cost implications

- Maximise ROI for fibre assets
- Optimised assurance through photonic control plane

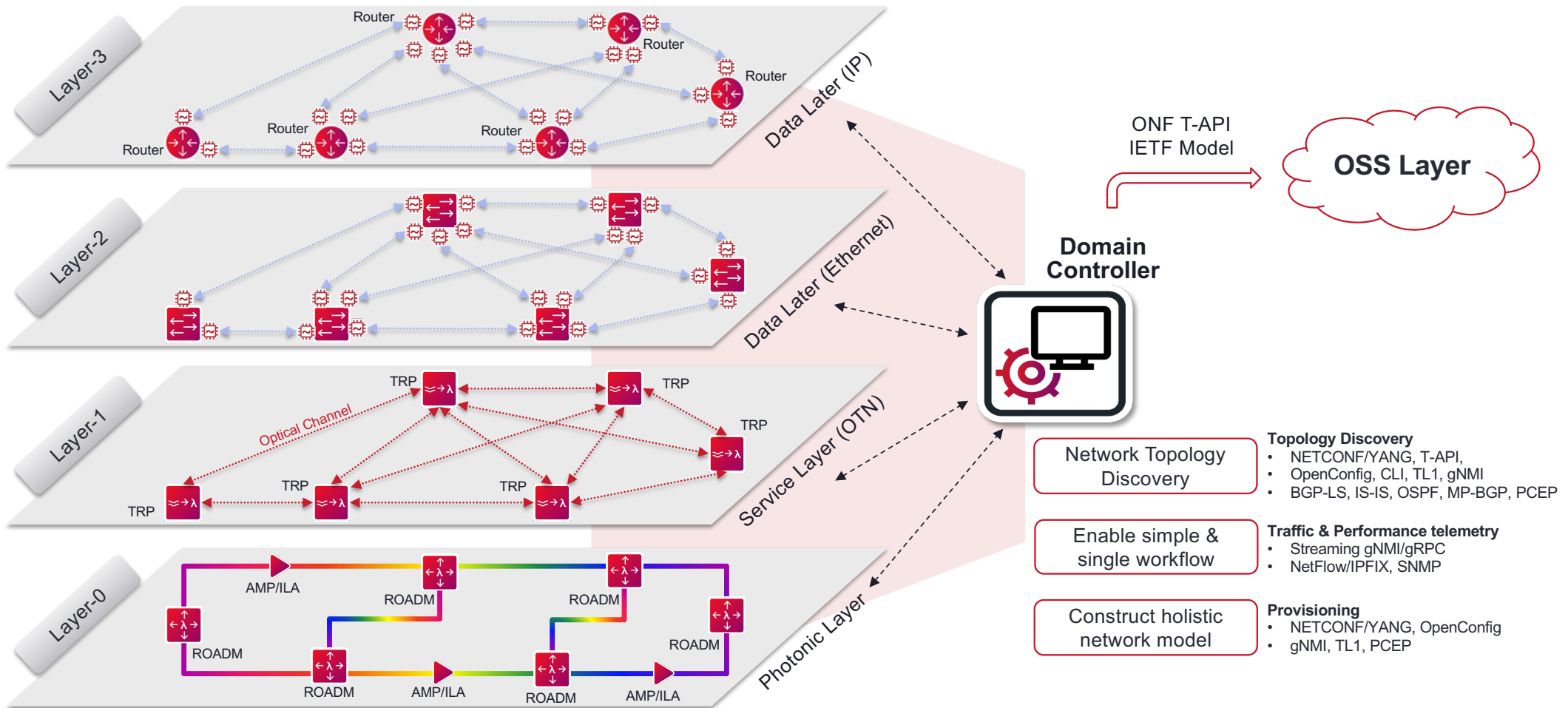
Sustainability

- Lesser number of coherent electronics in network

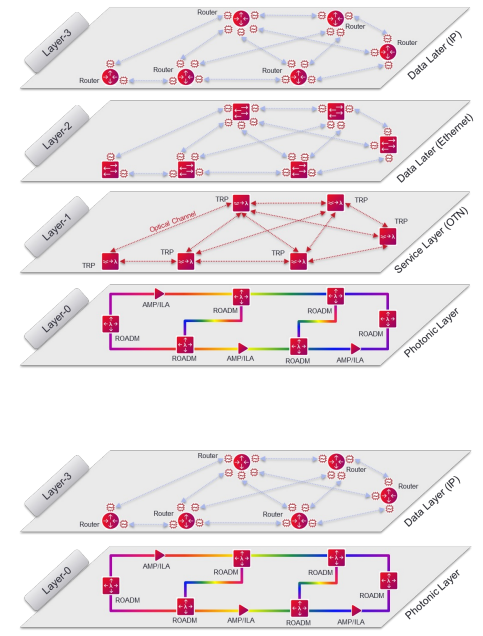
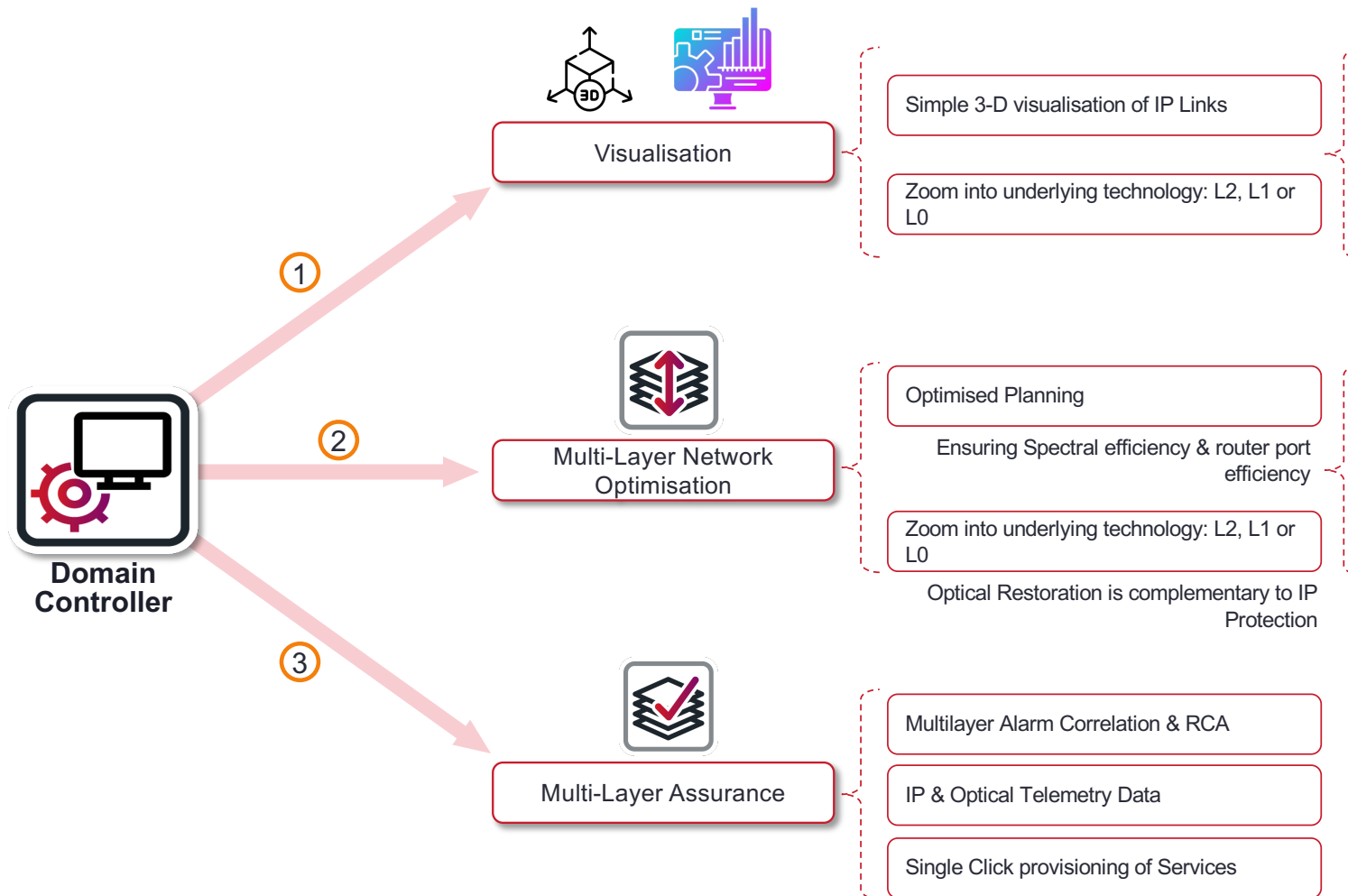
Performance Optics



Multi Layer Management – The Bedrock of Convergence



Multi Layer IP/Optical Convergence Operational Benefits



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