



The Fallacies of IP/Optical Convergence and a Case for Smart Coherent Pluggables

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Netnod Meeting, March 14-15, 2024





we are vertically integrated – meat to bun

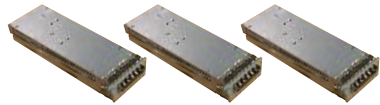
Optical Transport Building Blocks



OPEN LINE SYSTEM



COHERENT OPTICAL TRANSCEIVERS



Power Monitor; Amplifiers, Add/Drop, 4D ROADM, OTDR

PLUGGABLE OLS



Multi-Degree ROADM



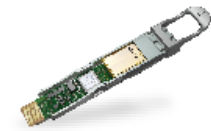
CDC Add/Drop

RAMAN + BiDi-EDFA

MULTI-HAUL OLS



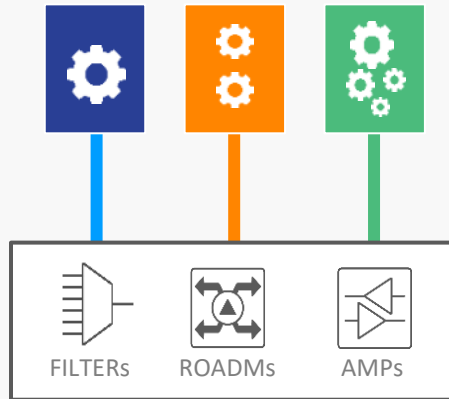
EMBEDDED



PLUGGABLE

What Are Open Optical Solutions?

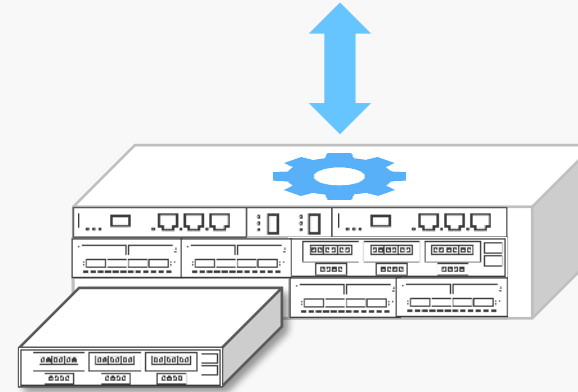
SEPARATION OF TRANSCEIVERS AND LINE SYSTEMS



TRANSCEIVERS

LINE SYSTEM

OPERATIONALLY SIMPLIFIED PLATFORMS



STANDARDIZED DATA MODELING

OPEN, AGILE SOFTWARE

MODULAR PLATFORMS



ELIMINATE
VENDOR LOCK-IN



ACCELERATE
INNOVATION CYCLES



ACCELERATE
NEW TECHNOLOGY
INTRODUCTION



INCREASE
NETWORK FLEXIBILITY

Different Line Systems per Application



Typical Feature Set

	FOADM		Flexgrid			ROADM			
Passive WDM	Pt-Pt WDM	Small ROADM (2D, 4D, 9D)	CD	ROADM (9D, 12D, 20D)	RAMAN	CDC	Large ROADM (20D, 32D)	C+L	Super C+L
		OPSM	OTDR	OCM	DGE				

Sometimes the line system is just a plain dark fiber!

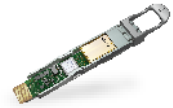
What's the Purpose of an Optical Transceiver?



DWDM TRANSCEIVERS



EMBEDDED



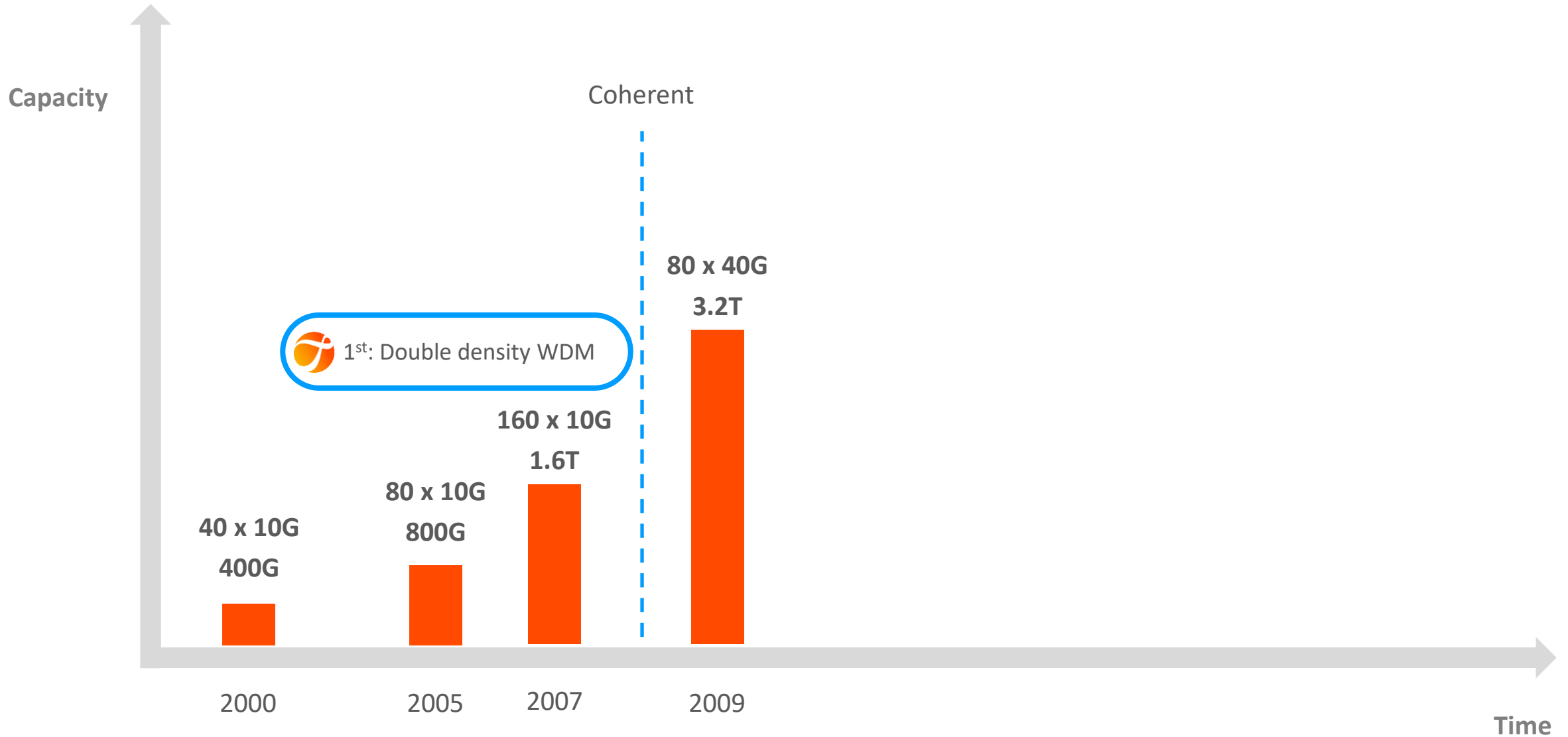
PLUGGABLE

To send/receive optical signals over sufficient distance,

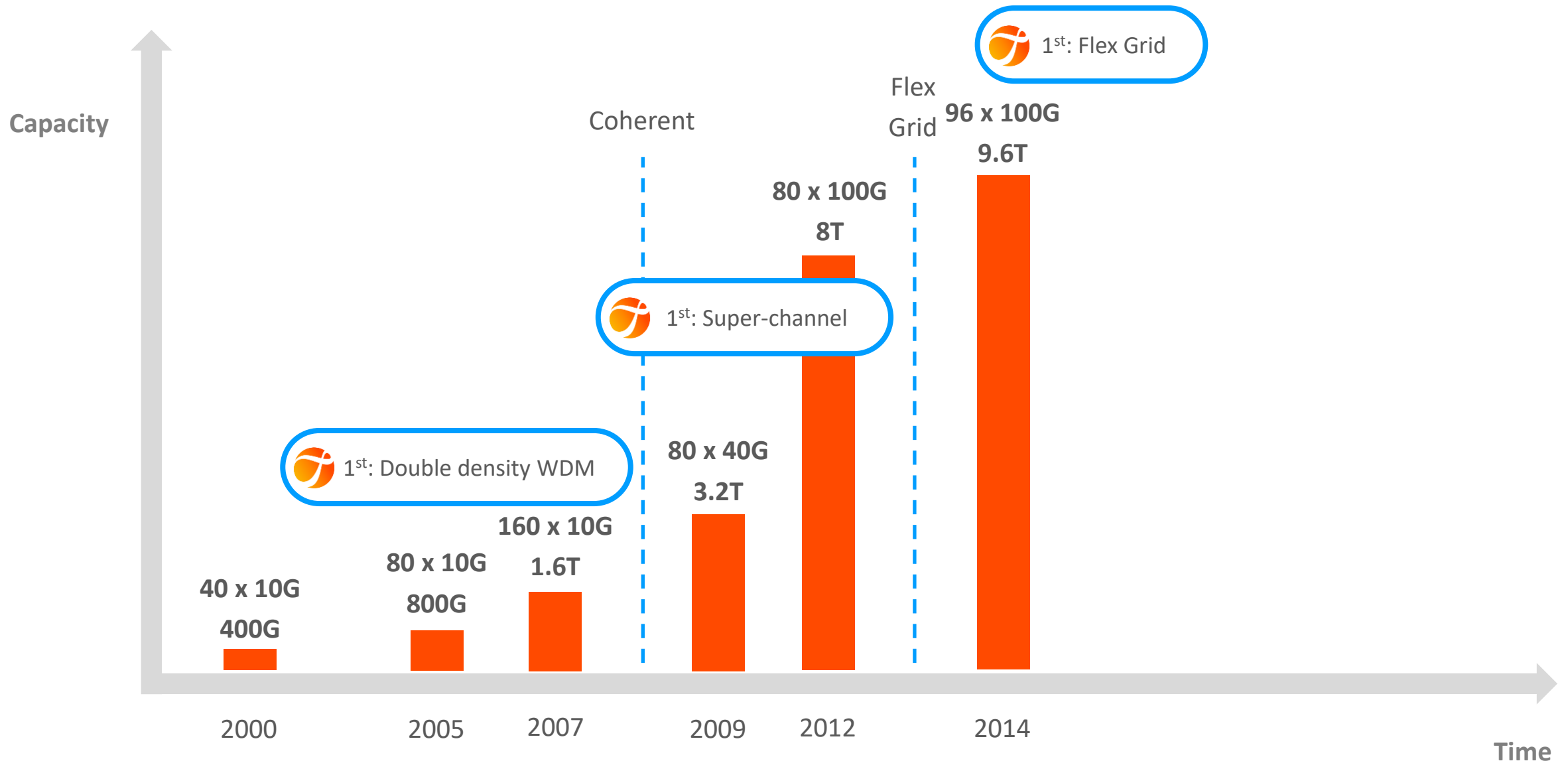
to provide a proper handoff, and

not use too much optical spectrum

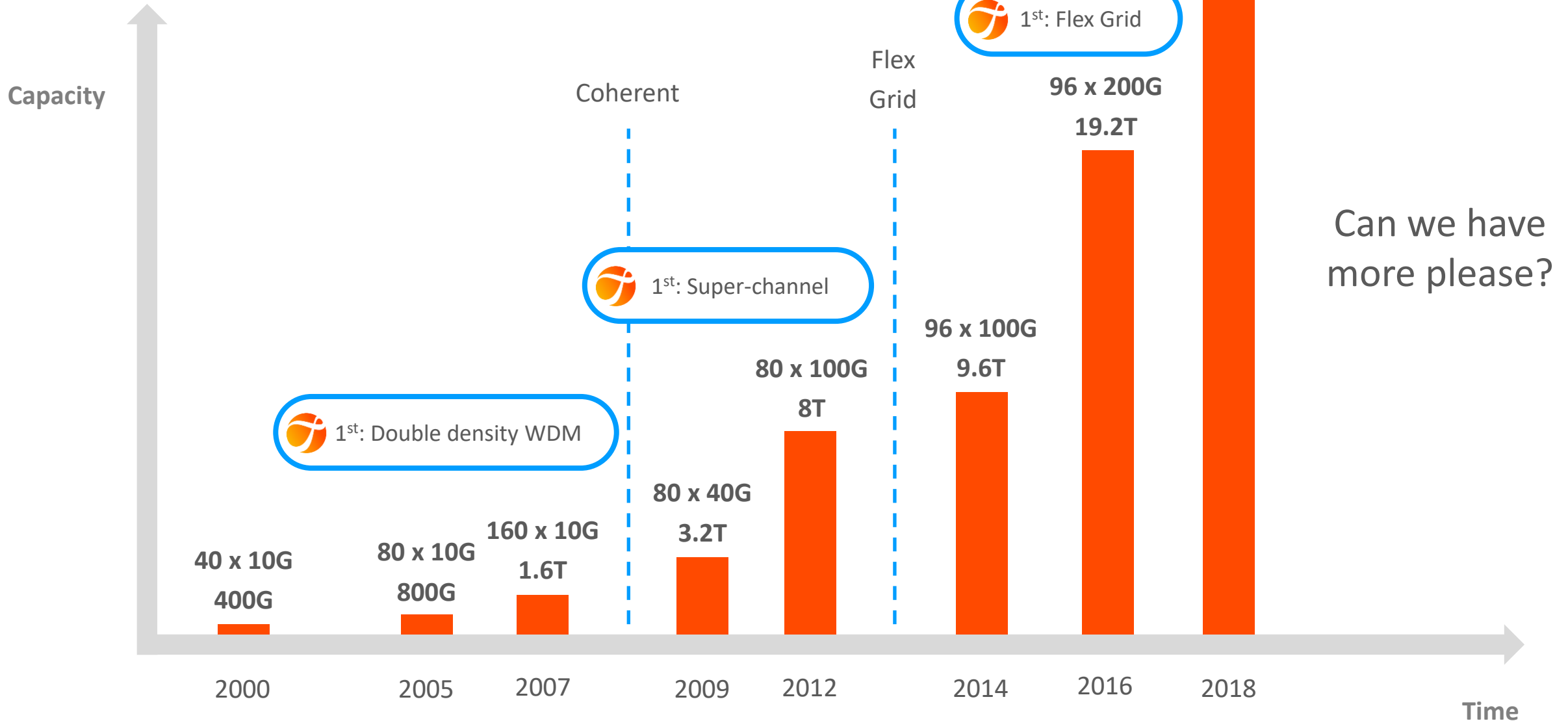
Evolution of DWDM Capacity over Time



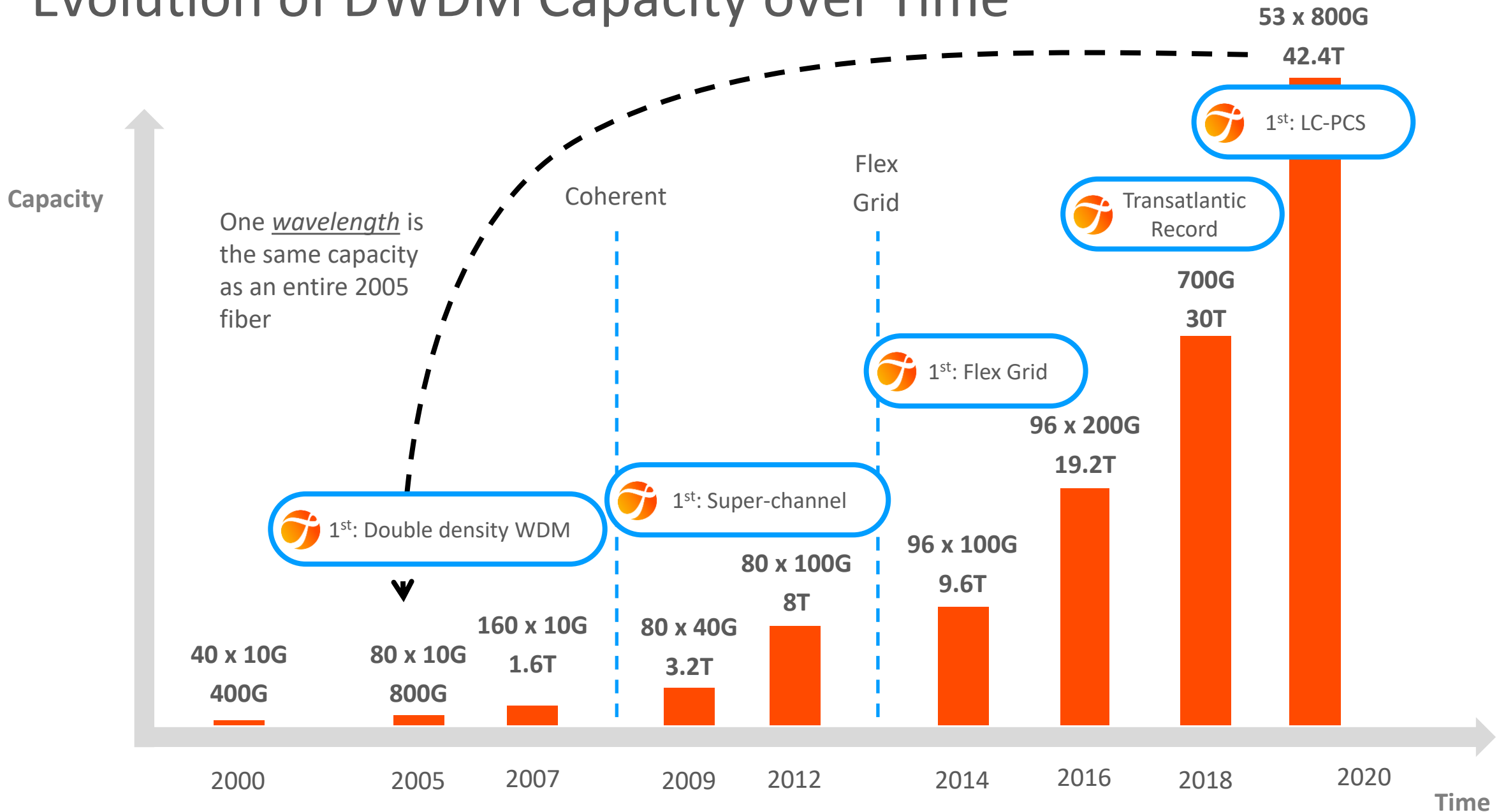
Evolution of DWDM Capacity over Time



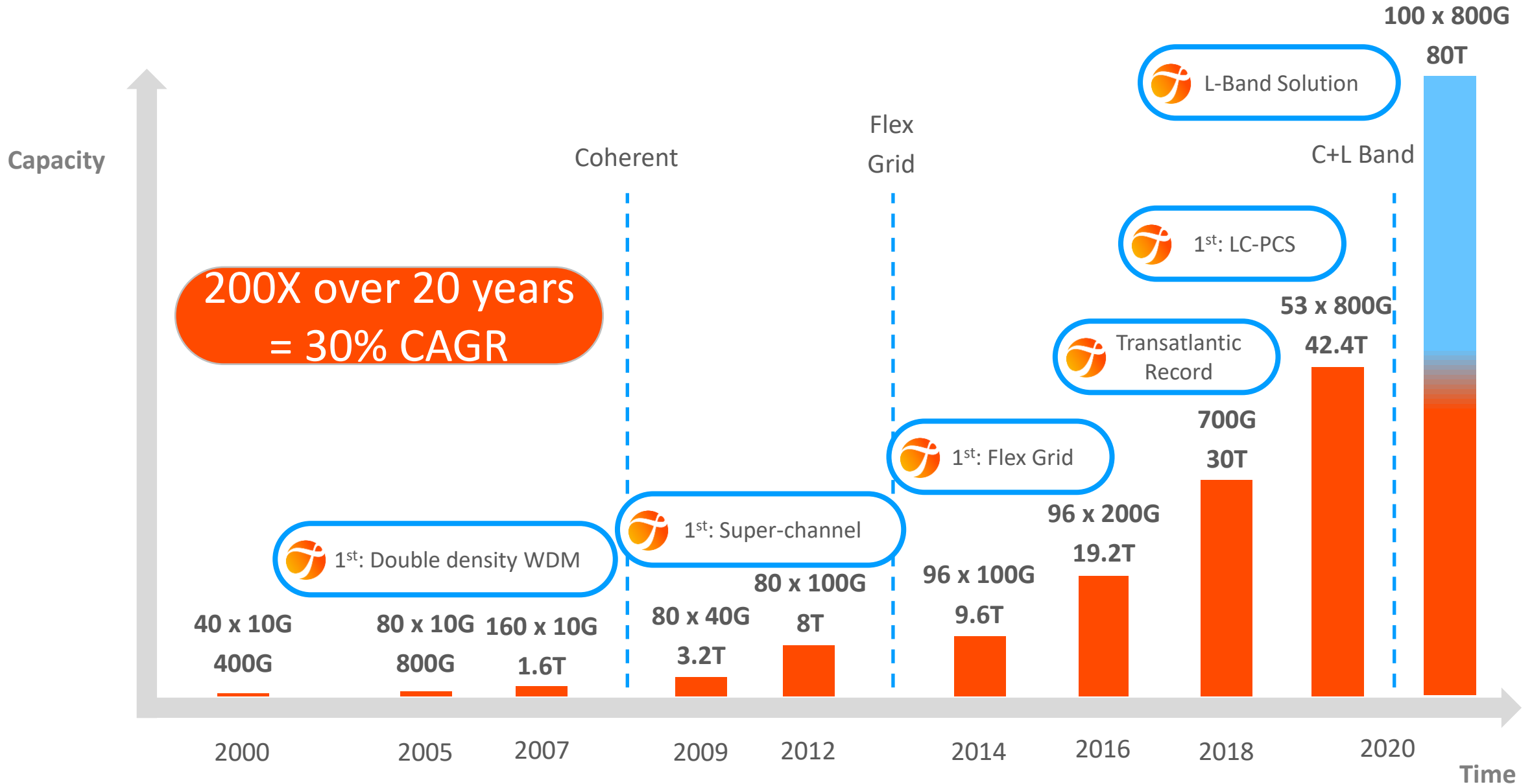
Evolution of DWDM Capacity over Time



Evolution of DWDM Capacity over Time



Evolution of DWDM Capacity over Time







Enter Coherent Pluggable Optics



PERFORMANCE



Maximize resource utilization

PROGRAMMABILITY



Maximize addressable applications

MANAGEABILITY



“A tool is ever only as good as
your ability to use it”

Optical Performance is Good Enough



1,800KM – LIVE NETWORK

400G QSFP-DD

Spectrum shared with multiple vendors

400G 16QAM and SMF-28 fiber

*Arelion

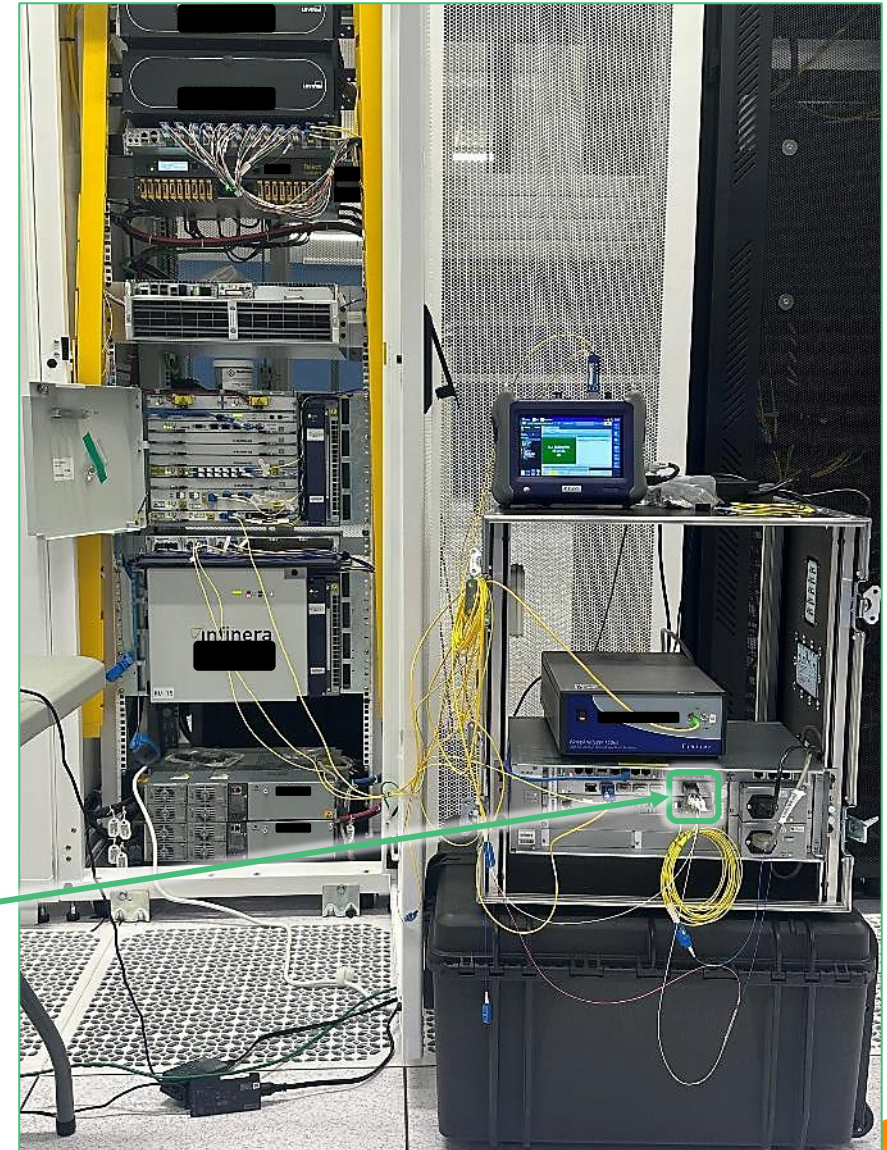


DALLAS

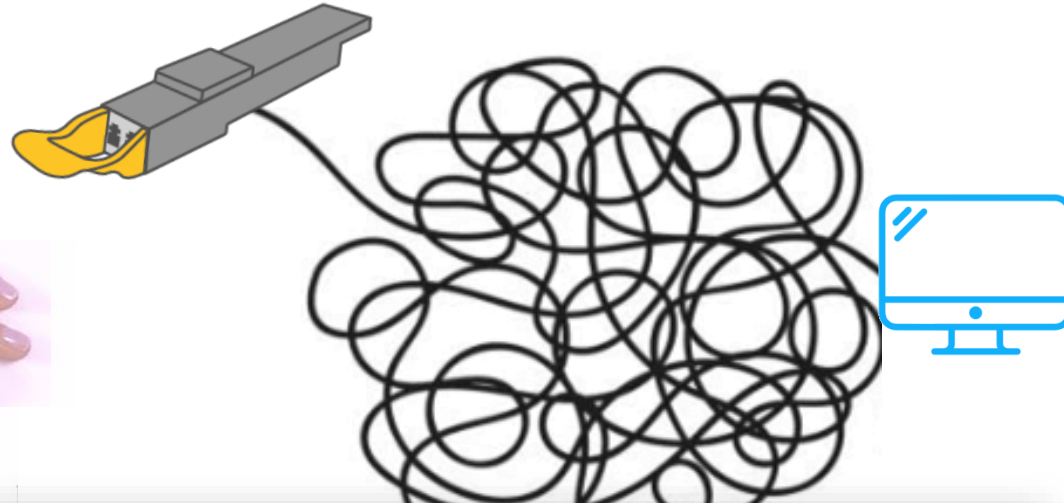


MEMPHIS

ICE-X 400G ZR+



Managing Coherent Pluggables is a **MAJOR** challenge



- **Management of 400ZRx continues to be a barrier.** It is always fascinating to listen to higher-layer engineers talk about optics because their perspective is very different from that of optical engineers. In general, router engineers want the optics to plug in and be a dumb pipe with minimal management, which isn't always the case with 400ZR. XKL, an optical vendor with a router background, reiterated what Cignal AI has heard repeatedly over the last two years – the optical layer is interoperable in most cases, **but the management interface (CMIS) has huge issues. Getting one 400ZRx plug to work does not mean that any other pluggable will work, and the problem is worse when trying to get modes beyond the OIF standard 400ZR enabled.** Cisco's talk on coherent optical management (based on its RON architecture) showed practical and open ways to manage the optics in a router, with a ton of programmability and telemetry now accessible inside the optics. However, Cisco admitted that most operators using the plugs over a short distance won't use any advanced features. This view of router operators – that optics should be dumb and “just work” – is an advantage for 400ZR over 100G PAM4 DWDM (e.g., ColorZ), but this attitude will limit the use of 400G pluggables in longer reach, more complex networks.

Cignal Ai, “NANOG 87 – Optics Speak to the Higher Layers” report
Feb 16th 2023



Ignorance is bliss



Ignorance **about layer 1** is bliss



Ignorance **about layer 3** is bliss

IP-optical convergence complete solution

Networks with separate IP and optical layers are an unnecessary resource overhead. Management mechanisms, given performance target, need to be. Like many other solutions, they increase complexity and lowers the ability to evolve.

MAGAZINE | MAY 28, 2014

#ericssonstechnologyreview

WHITE PAPER

A Framework for IP-Optical Convergence Building from Existing Networks

The communications landscape is changing. Market dynamics are changing enterprise cloud applications and data center connectivity cases and exciting revenue opportunities. Communications Service Providers (CSPs) are also creating new cases from an IP networking perspective. New traffic patterns, the rise of distributed applications, bandwidth and lower latency requirements from end-users. Many networks are evaluating IP/Optical convergence as a key element of IP network modernization to meet emerging requirements for cost-efficient, resilient and unified networks. What are the key elements required to realize the benefits of IP/Optical convergence? There is no 'one size fits all' solution, as architecture evolution needs to start with the CSP's current network reality. While the

them as part of their...
87 percent of providers...
important or critical for their next...



Optical Networking /

Pioneering Transport

Cisco Router



Tracking IP-over-DWDM Momentum as the Industry Turns Toward Convergence

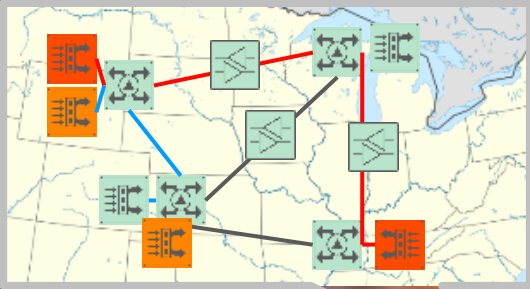
Home / Service Provider Transformation / Tracking IP-over-DWDM Momentum...

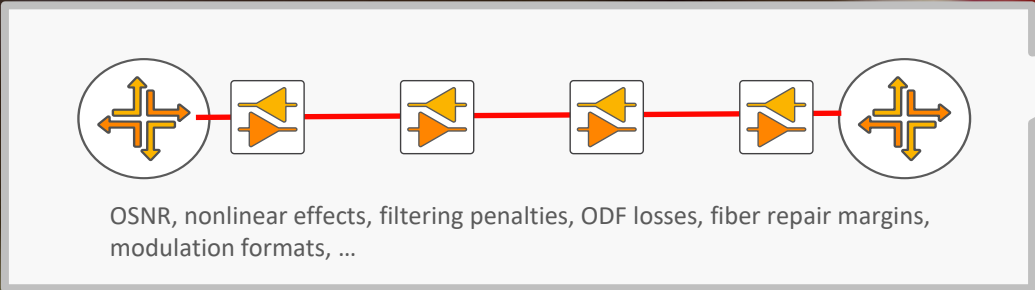
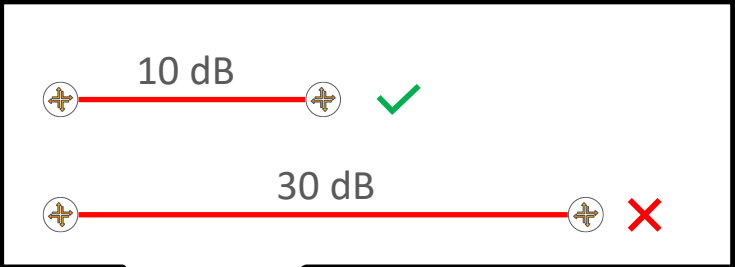
Tracking IP-over-DWDM Momentum as the Industry Turns Toward Convergence

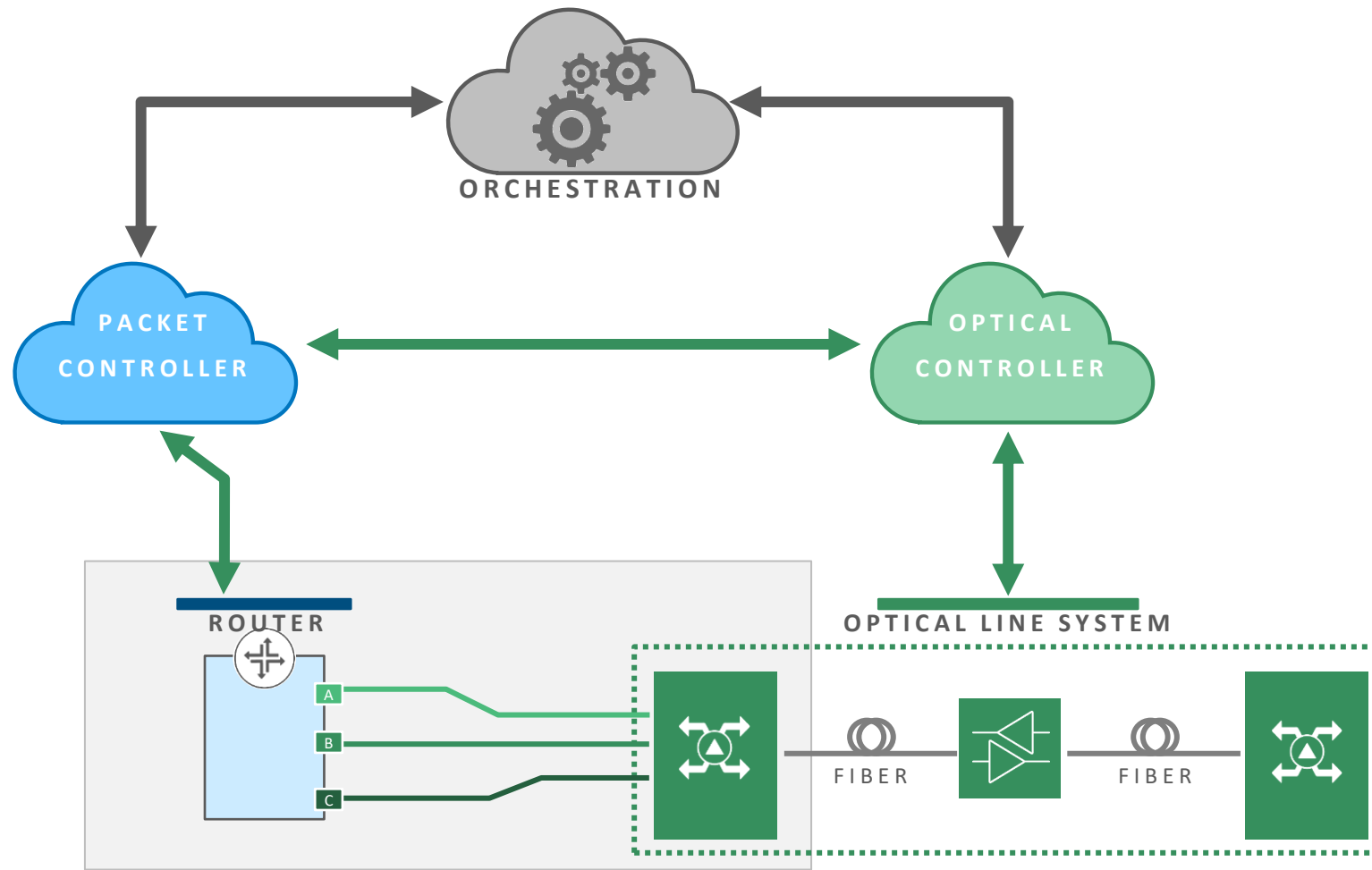
September 12, 2023
by [Moran Roth](#)

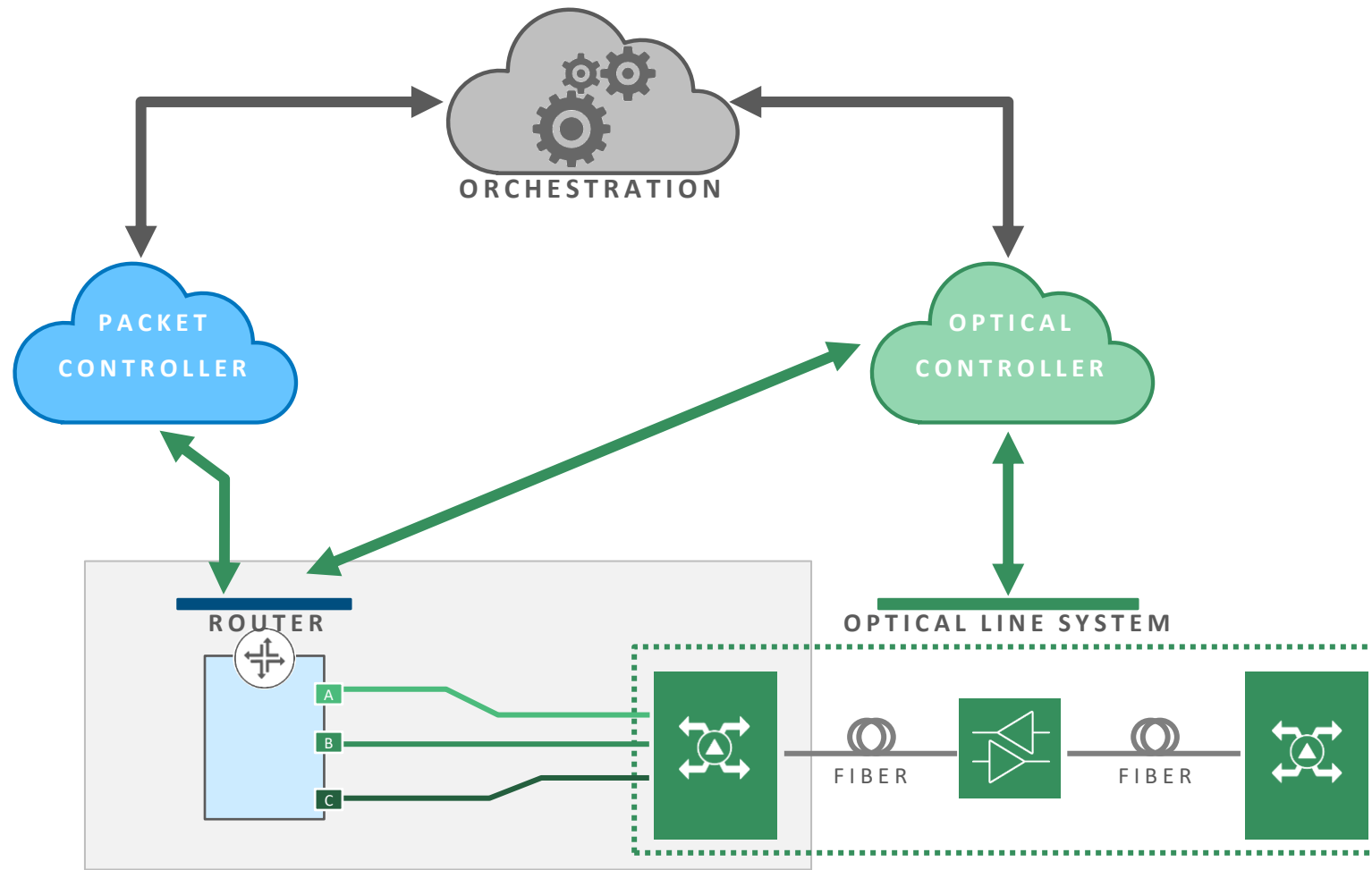
Search

```
# connector breakout ?
breakout <keyword>
<keyword> - (c1-40g|c4-10g|c1-100g|c4-
25g|c10-10g|c1-400g|c2-100g|c4-100g|c1-
10g|c1-25g|c1-50g|c8-50g|c1-800g|c3-
100g|c8-100g|c2-400g|c1-1g|c1-100g-
aii2|c2-100g-aii2)
```





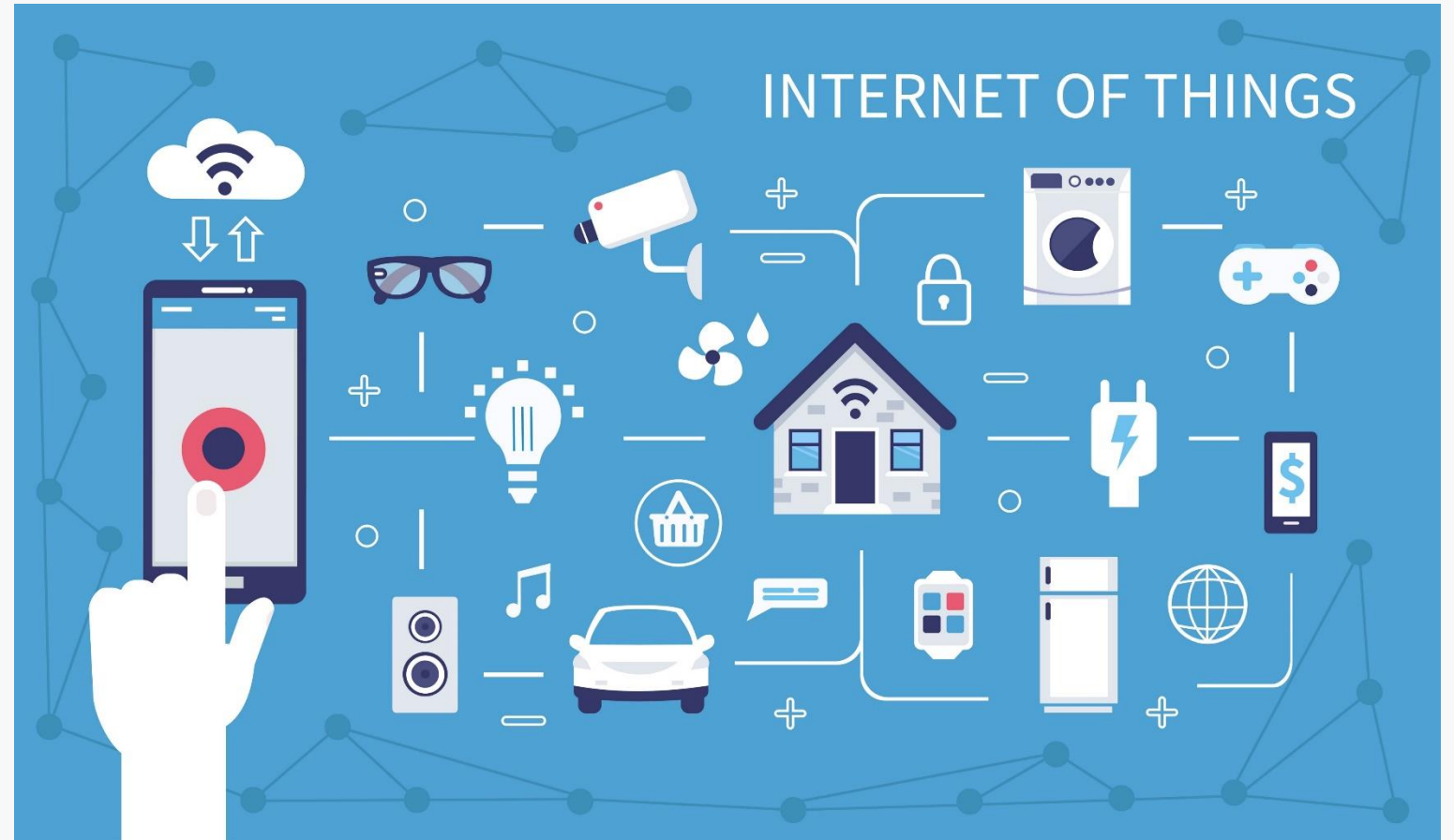




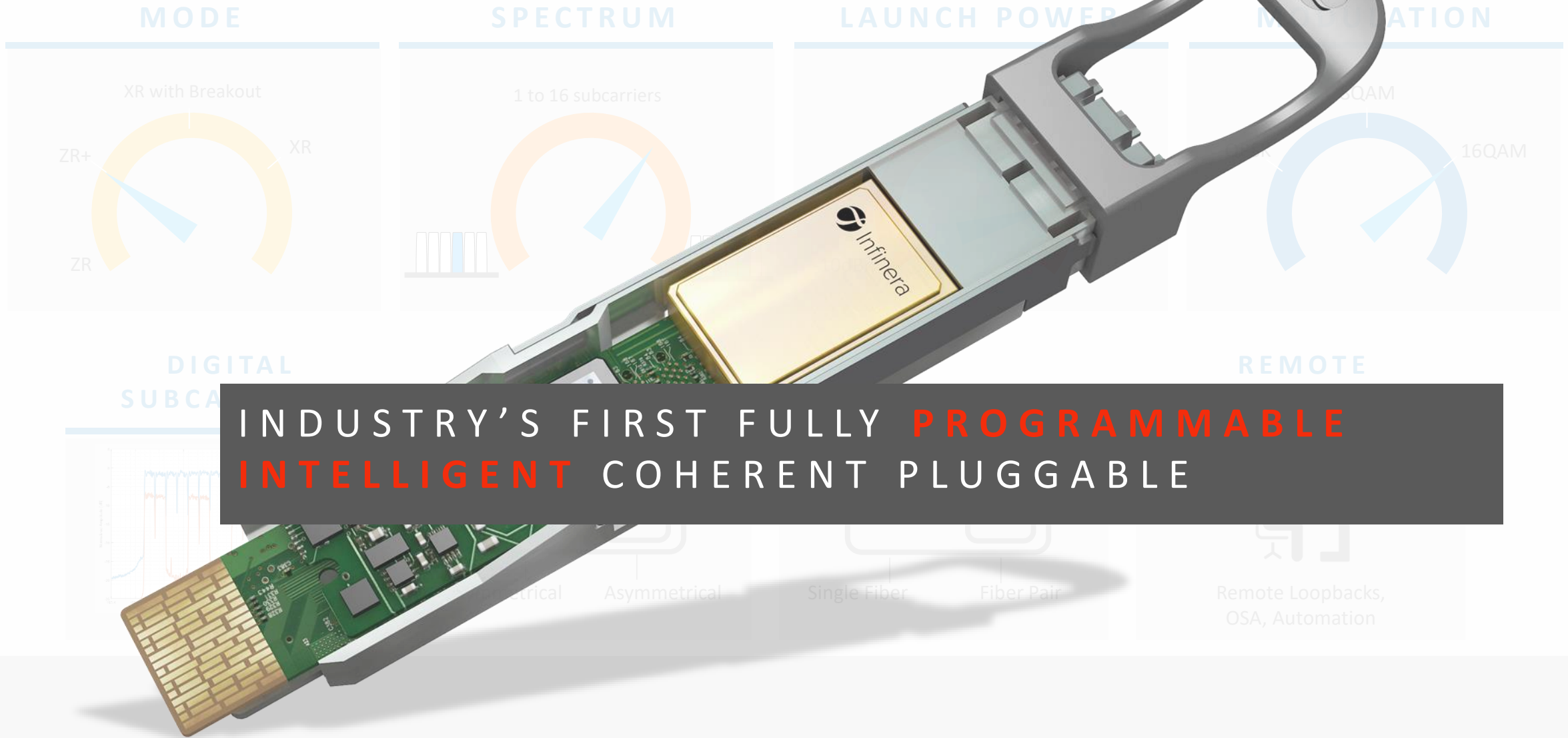
Taking Cues from Adjacent Markets I



Taking Cues from Adjacent Markets II

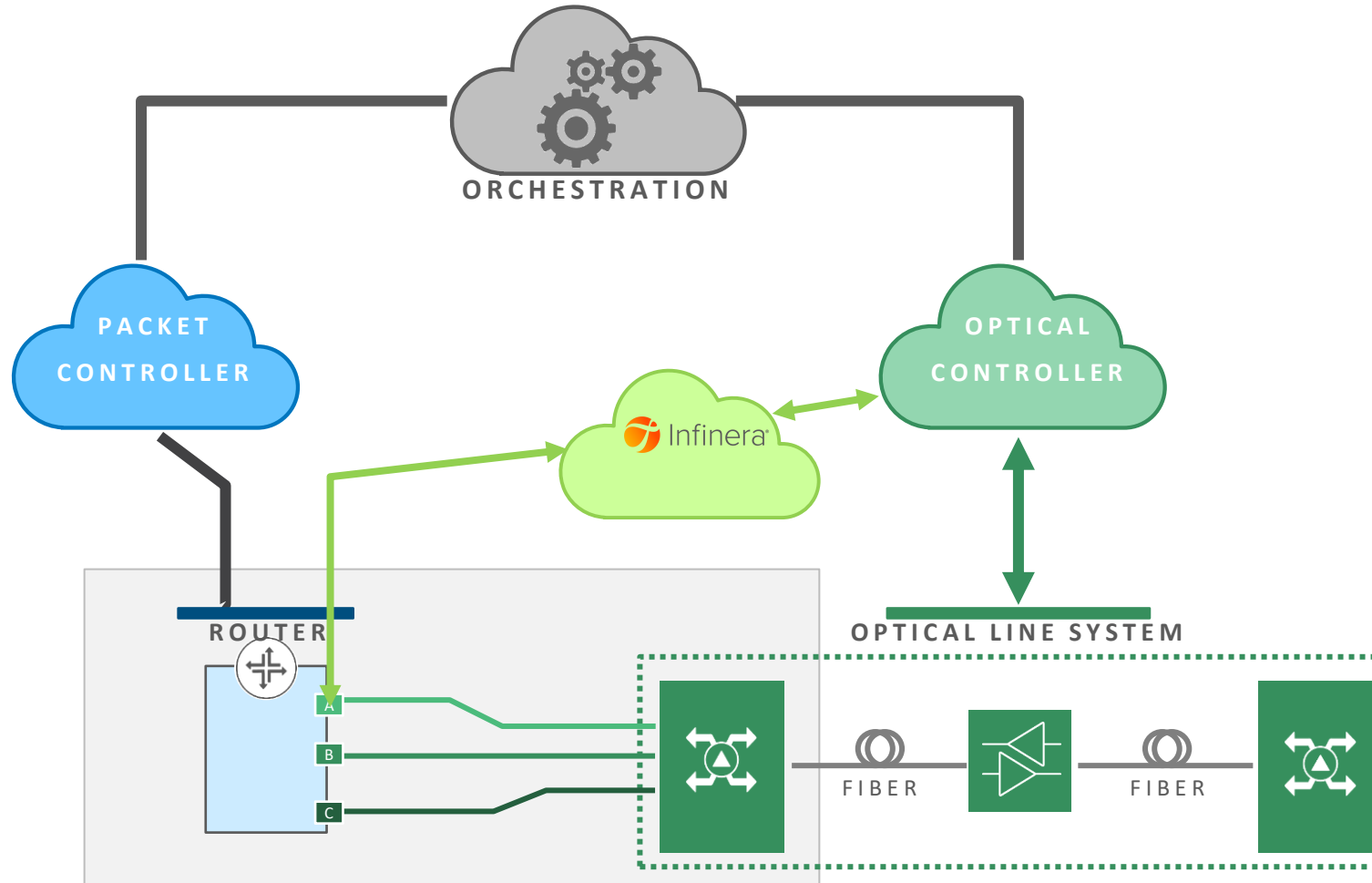


Programmable Intelligent Coherent Pluggable

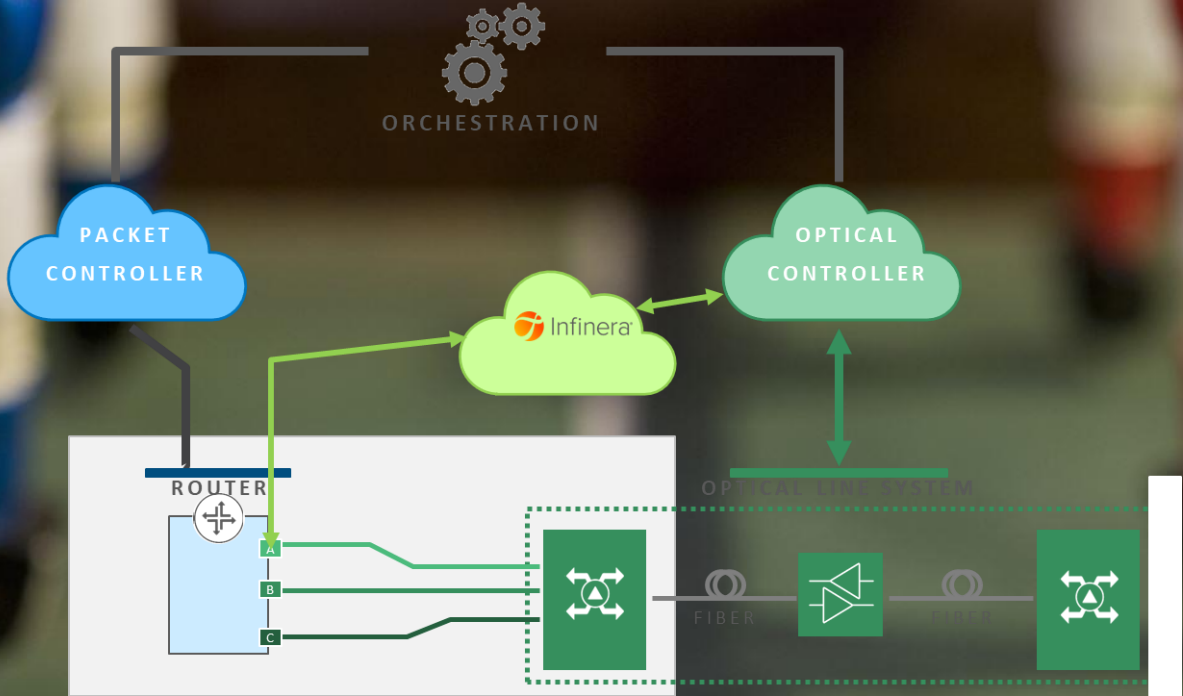
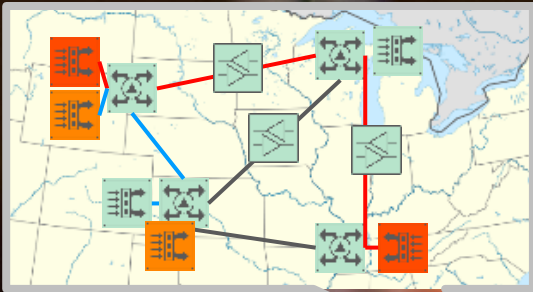


INDUSTRY'S FIRST FULLY **PROGRAMMABLE**
INTELLIGENT COHERENT PLUGGABLE

Host-Independent IPoDWDM Management




```
# connector breakout ?
breakout <keyword>
<keyword> - (c1-40g|c4-10g|c1-100g|c4-
25g|c10-10g|c1-400g|c2-100g|c4-100g|c1-
10g|c1-25g|c1-50g|c8-50g|c1-800g|c3-
100g|c8-100g|c2-400g|c1-1g|c1-100g-
aii2|c2-100g-aii2)
```





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