

Global Cloud Network Evolution

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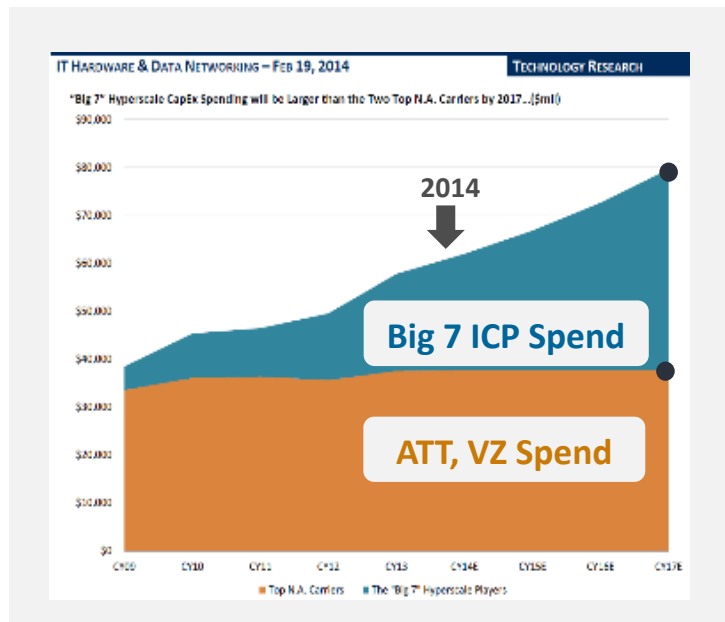
The Tremendous Growth of Cloud

Top Five Tech Spending Increases in 2015:



Source: Computerworld 2015 Forecast Study

ICP's are already investing heavily in network



Source: ISI Group Report on Hyper-scale Capex Trends, Feb 2014

► ICP's: Moving forward fast

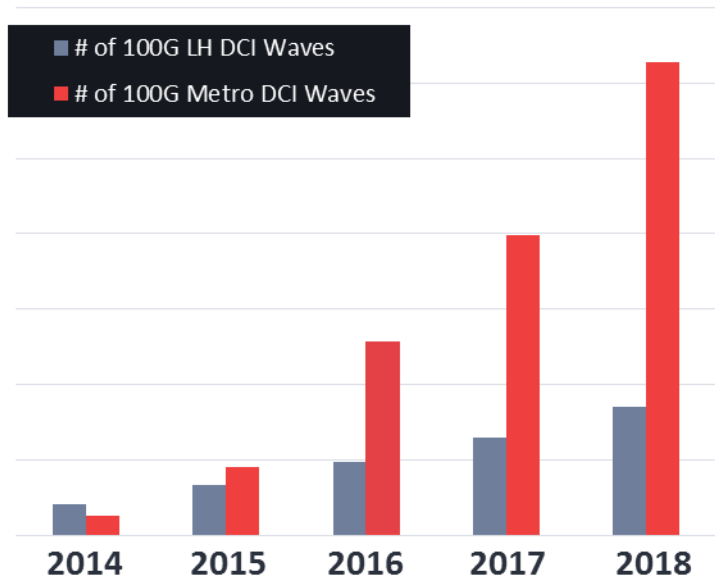
- Greenfield advantage
- No holdbacks from legacy
- Focus on innovation, speed & performance

► Telco's: Forced to respond

- AT&T Domain 2.0 – cloud based architecture
- Verizon acquisition of Terremark
- NTT, Telefonica investment in SDN

100G WDM are essential to the economics

DCI 100G Equivalent Waves



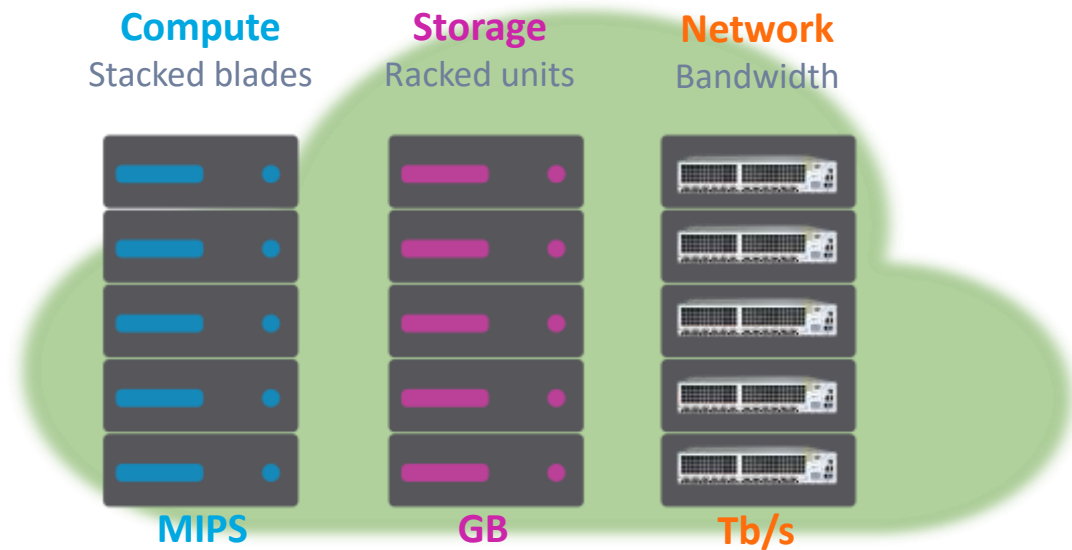
► Client 10G Growing

- Most lucrative customers need 10G
- Financials, Big Data & Data Center Fabric
- IXC seeing strong demand

► Focus on Metro Builds

- Expected to exceed LH Waves by 4x
- Must be Small, Simple & Low Power

Cloud Operator Requirement for Network Bandwidth



- Less Space
- Rack & Stack
- Less Power
- Simple install
- Hyper Scalability
- Reliability

Leveraging Technology to Solve Cloud Scale Issues



Optical Transmission Evolution

Pre-Coherent Era

- Simple intensity modulation
- Direct detection
- No real signal processing
- Hard Decision FEC
- Single wave transponders
- Fixed grid

800Gb/s

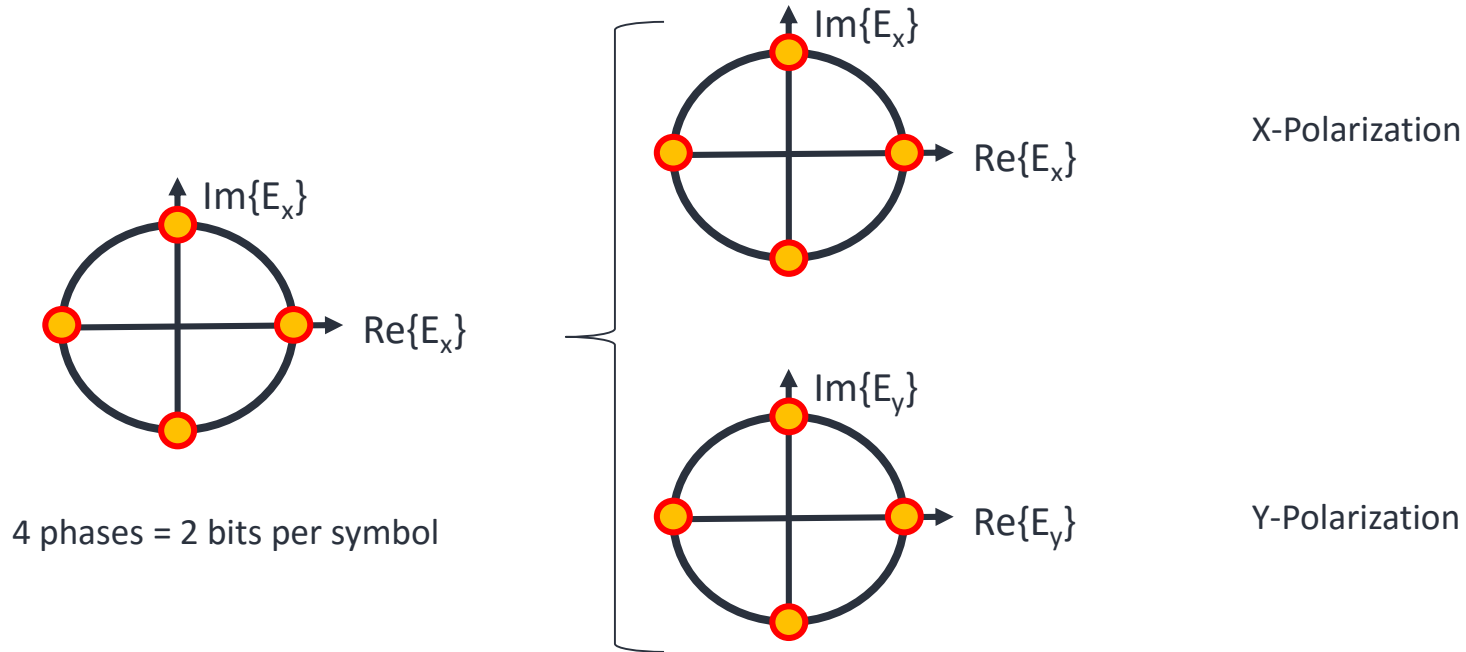
Coherent Era

- Advanced modulation
- Coherent detection
- Digital Signal Processing
- Soft Decision FEC
- Super-channels
- Flexible grid

9.5Tb/s – 24Tb/s

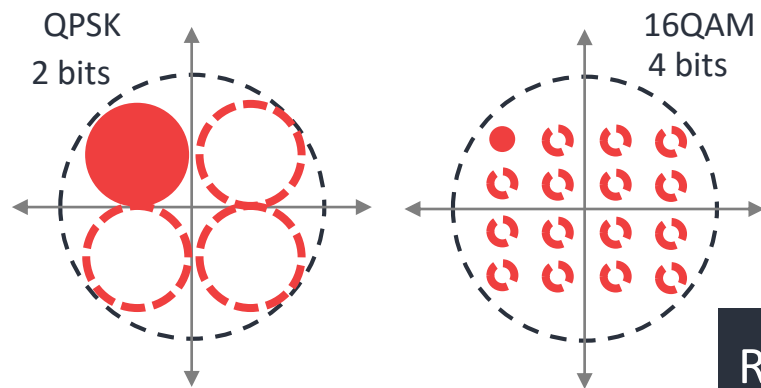
Advanced Modulation

Polarization-Multiplexed Quadrature Phase-Shift-Keyed (PM-QPSK) Modulation 4 bits per symbol



Higher Order Modulation

- Higher order modulation has “fewer photons per bit”, and requires higher symbol resolution

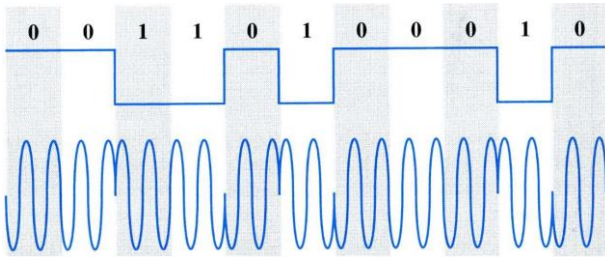


- A given symbol has the same absolute optical power limit, but 16QAM is carrying twice the number of bits
- The resolution between symbol states is much tighter for 16QAM

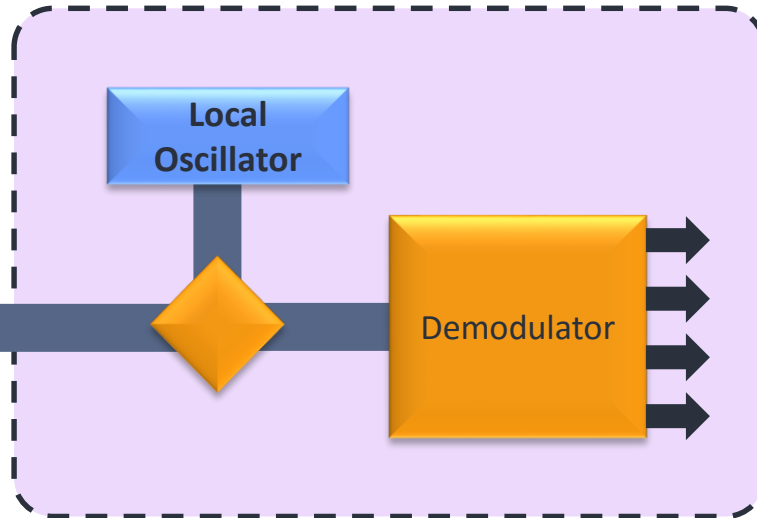
Result: 16QAM has 2X increase in spectral efficiency but 5X shorter reach vs QPSK,

Coherent Detection

Digital Signal Encoded as
Phase Changes



Coherent Detector

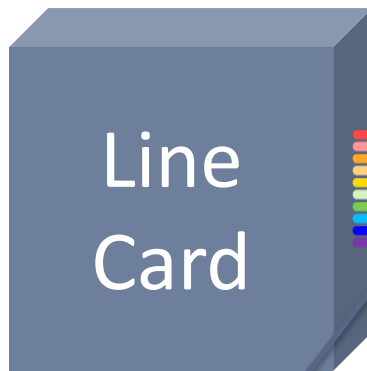


- Photodetect
- Amplify
- Digitize
- Compensate

Super-Channel

A super-channel implements multiple carriers - ideally in a single line card...

It's practical to build...



Line
Card

All carriers are provisioned in a single operational cycle...

It has excellent optical performance

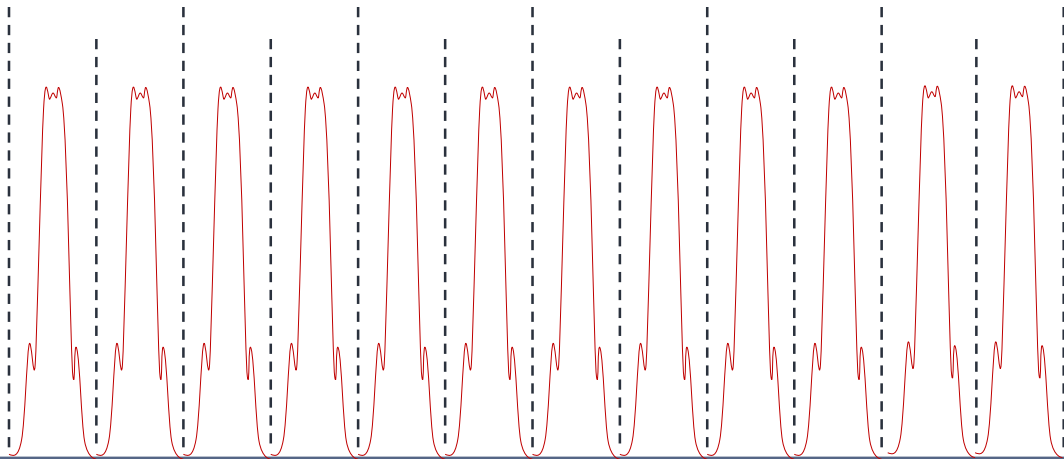
And is seen as a single unit of capacity by the services that use it

Fixed Grid Coherent Transmission

PM-QPSK
100Gb/s
50GHz



In 1st generation coherent, 100G PM-QPSK fits
efficiently into 50GHz grid spacing

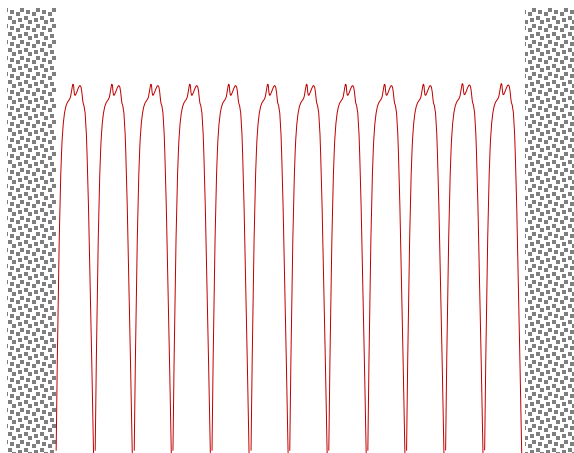


These fixed grids are spaced so
that individual carriers can be
optically added or dropped in
ROADM

Moving to Flexible Grid for Super-Channels

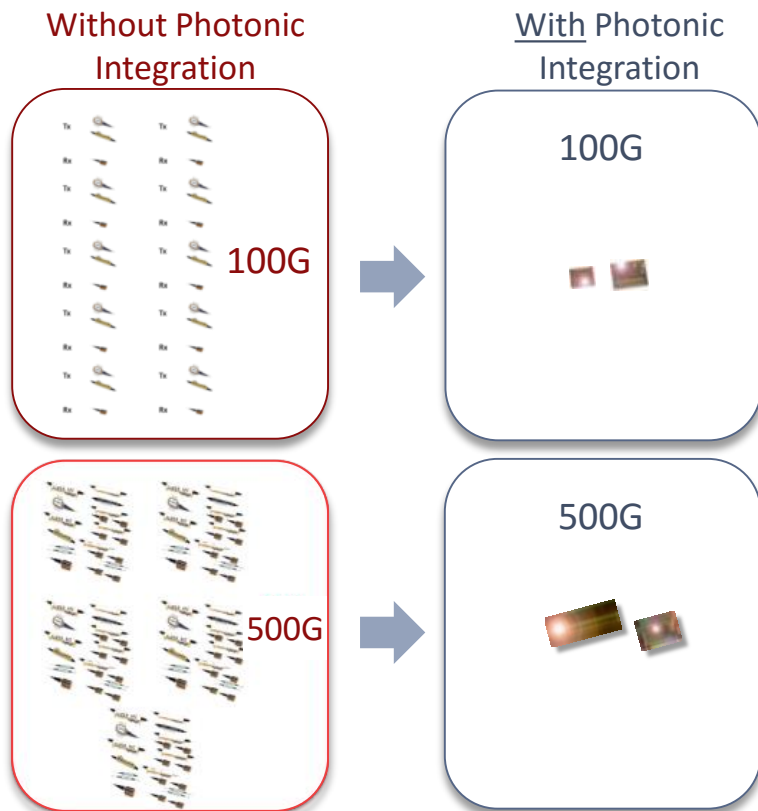
The width of this super-channel can be flexible

Super-Channel



Flexible Grid and Super-Channel
increase Spectral Efficiency and
total fiber capacity

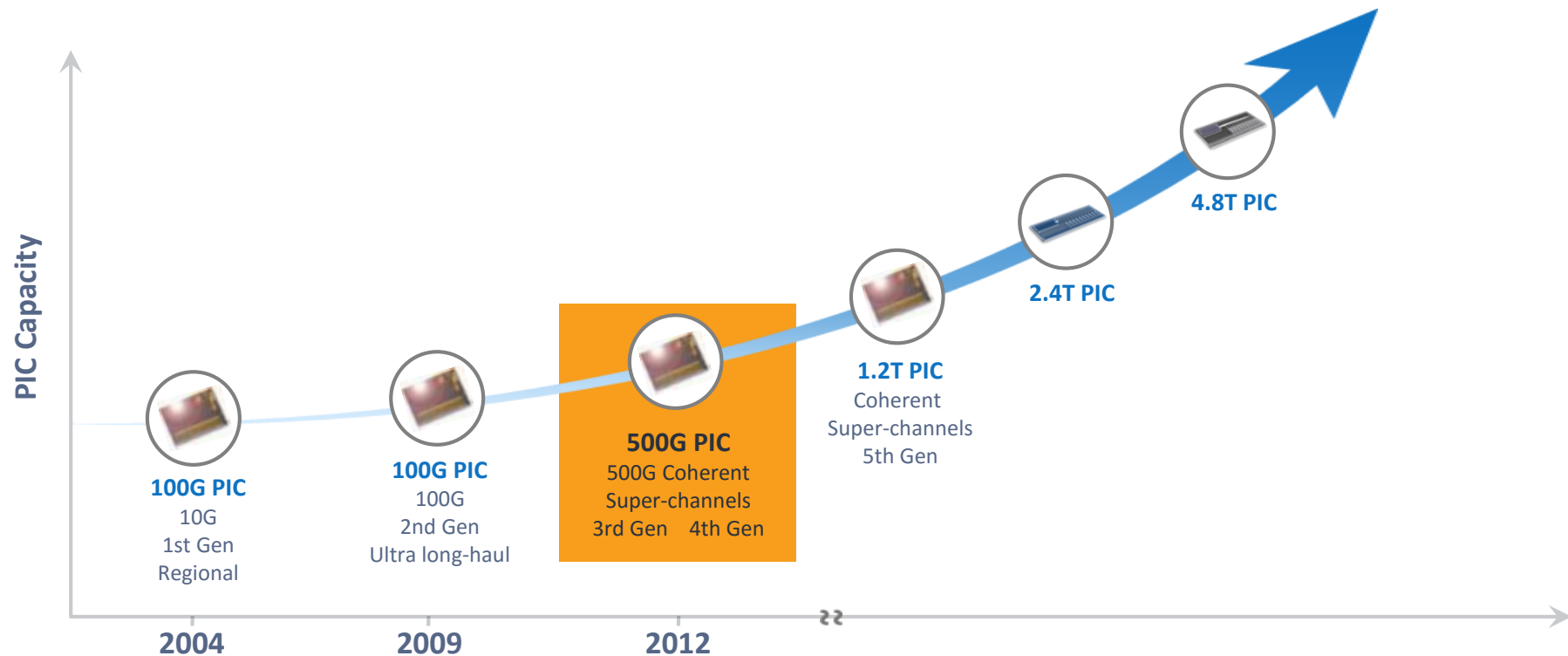
Photonic Integration



“As we move to the 100G era and beyond, the use of photonic integration becomes more pervasive and, ultimately, mandatory.”

—**Sterling Perrin, Heavy Reading**

Photonic Integration Evolution



Photonic Integration Benefits



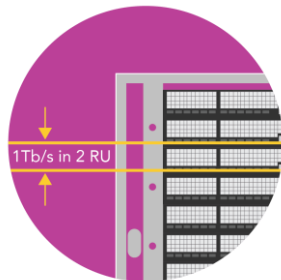
More Capacity	5 x 100G
More Reliable	1.5B+ hrs
Lower Power/Gb	<< 1W/Gb
"Gold Box" Replacements	> 100
Fiber Replacements	> 400

Cloud Xpress – Data Center Interconnect Solution



Cloud Xpress Metro Platform

- 1Tb/s input and output in 2 RU
- 500G PIC based super-channel line side
- 500G client w/mix of 10/40/100 GbE
- Instant Bandwidth™



Hyper-Scale Density

- 2RU, smaller than most servers
- 3X to 10X density improvement



Minimal Power

- ~100W per 100G: ALL INCLUSIVE
- 50% better than industry leaders



Simple Operation

- Simple 1-2-3 step provisioning
- Server-like operational experience

Conclusions

Data Centers networks
are growing fast

Networks are enabling differentiation, and 100G
is essential to economics

Simplicity cannot be
forgotten

Better DCI means more than just new boxes...it
means easier, faster & simpler

Innovation is
paramount

Cloud solutions are moving fast
Infinera: New DCI solutions/quarter

Thank You

www.Infinera.com/go/cloud

