

XR-P2MP Coherent Optical Subcarrier Aggregation Technology

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What's the Problem?

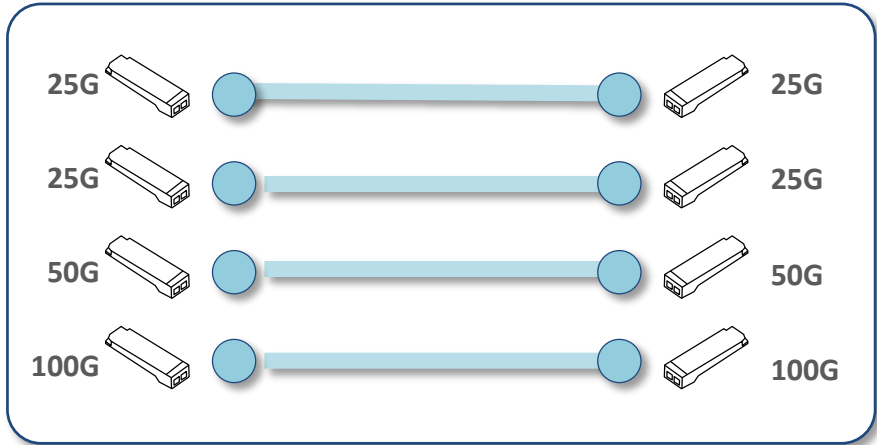
For 50+ years, the industry has been

USING A POINT TO POINT TECHNOLOGY FOR A POINT TO MULTI-POINT APPLICATION

NETWORK TRAFFIC PATTERN



OPTICAL NETWORKING TECHNOLOGY

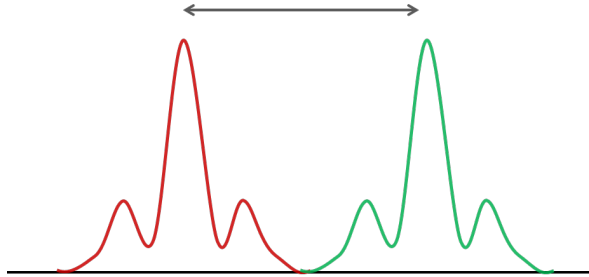


Tutorial on Nyquist Subcarriers

1st Generation Coherent ~2010 onwards

Only Rx DSP

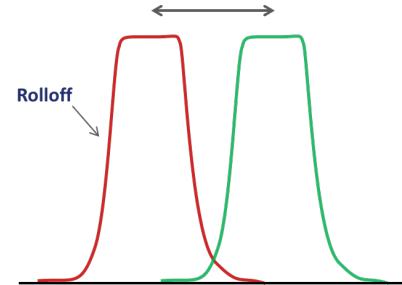
Minimum spacing for 100G QPSK is 50GHz (2bps/Hz)



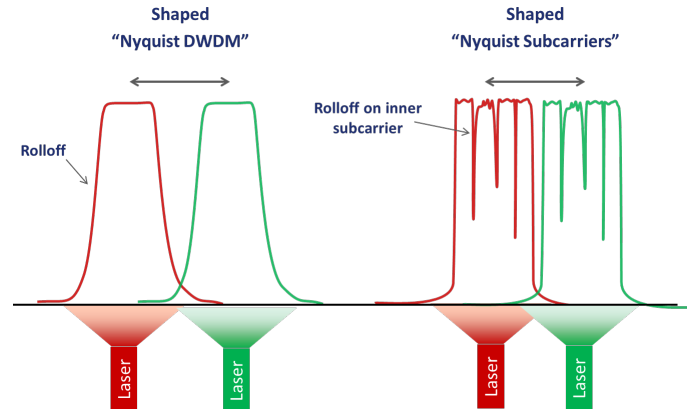
2nd Generation Coherent ~2016 onwards

Tx DSP shapes the signal with a "Nyquist Filter"

Spacing for 200G 16QAM can be 34.375GHz (5.8bps/Hz)

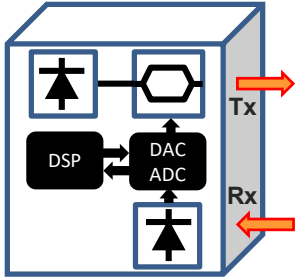


Introduction of Sub-Carriers
in 2nd Generation Coherent



Sub-Carriers operate at
lower baud rate, which
improves transmission
performance

Routeable Digital Sub-Carriers



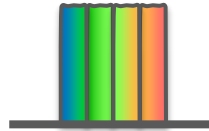
- Coherent Optical Engine
- Single Laser, Modulator, Rx and DSP
- DSP-enabled spectrum shaping

Conventional WDM



- Single optical carrier
- Spectrum = information bandwidth
- Centered on laser wavelength

Nyquist Sub-Carriers



- Multiple FDM sub-carriers
- Co-propagate on end-end path
- Lower impairments / improve reach
- Superior performance for Long-Haul and Subsea Transmission

Routeable Sub-Carriers



- Independently routed sub-carriers
- Different end-points
- Separate information channels
- Point-to-multipoint connections

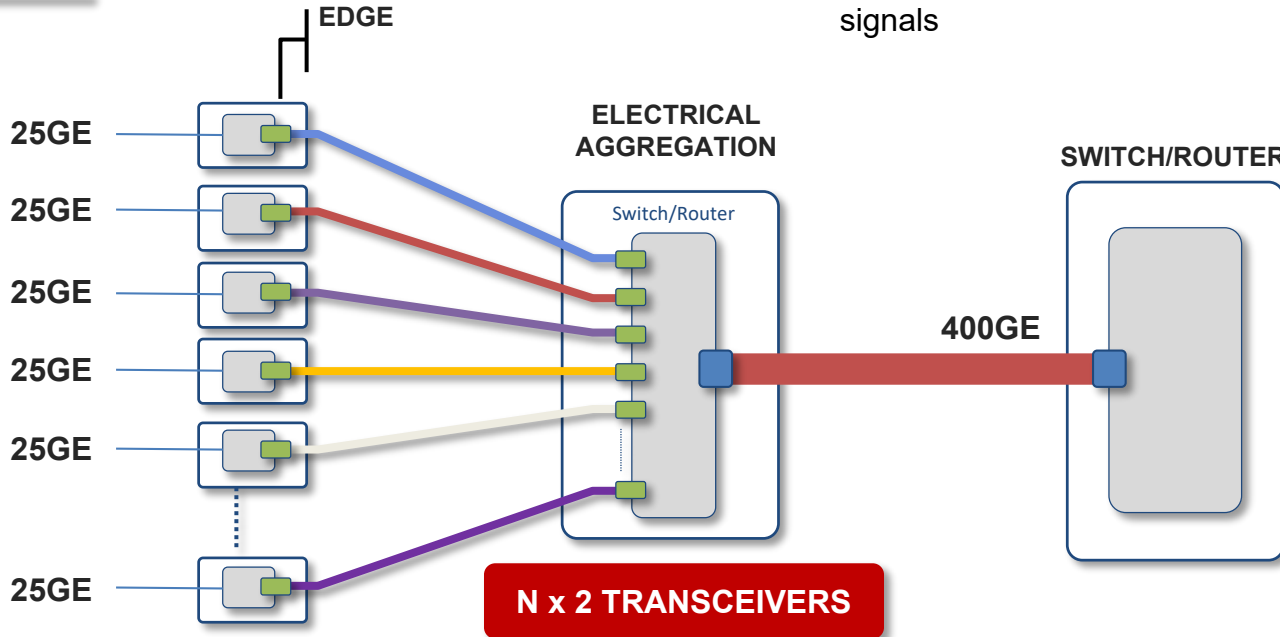
What's the Problem?

For 50+ years, the industry has been

**USING A POINT-TO-POINT TECHNOLOGY
FOR A POINT-TO-MULTIPOINT
APPLICATION**

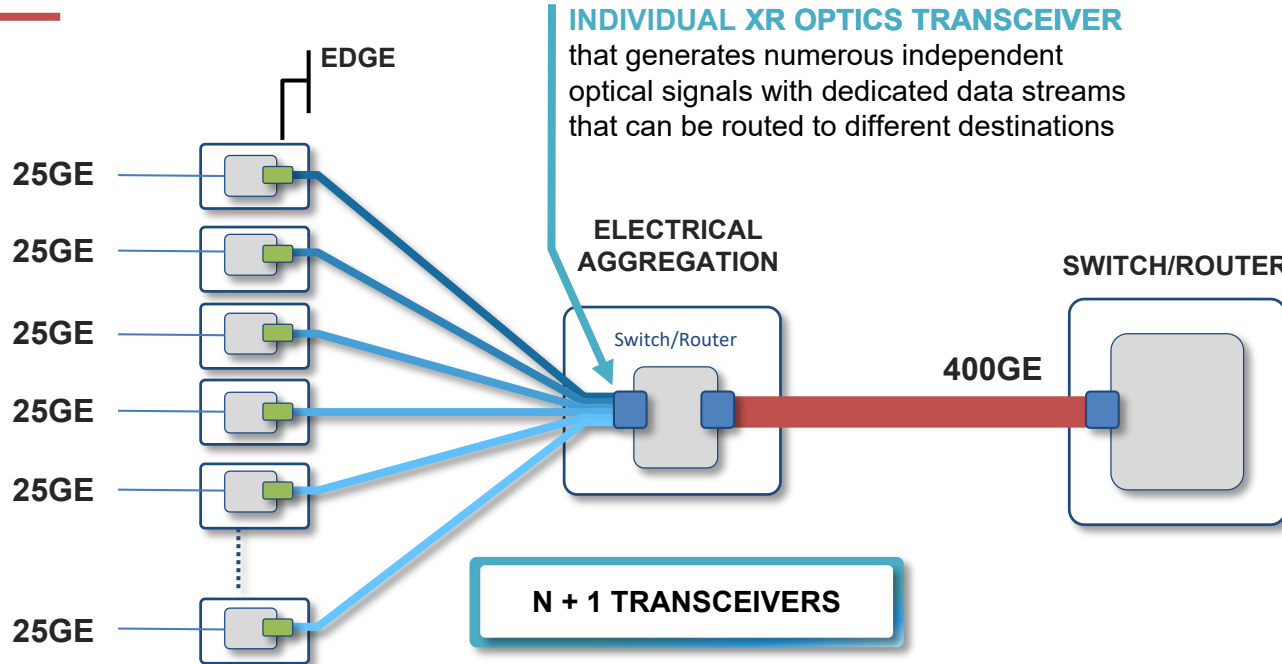
INTERMEDIATE AGG
devices/locations with
 $N \times 2$ TRANSCEIVERS
required to “up-speed”
signals

Architecture leads to
**INEFFICIENTLY USED
TRANSCEIVERS AND
ROUTER PORTS**



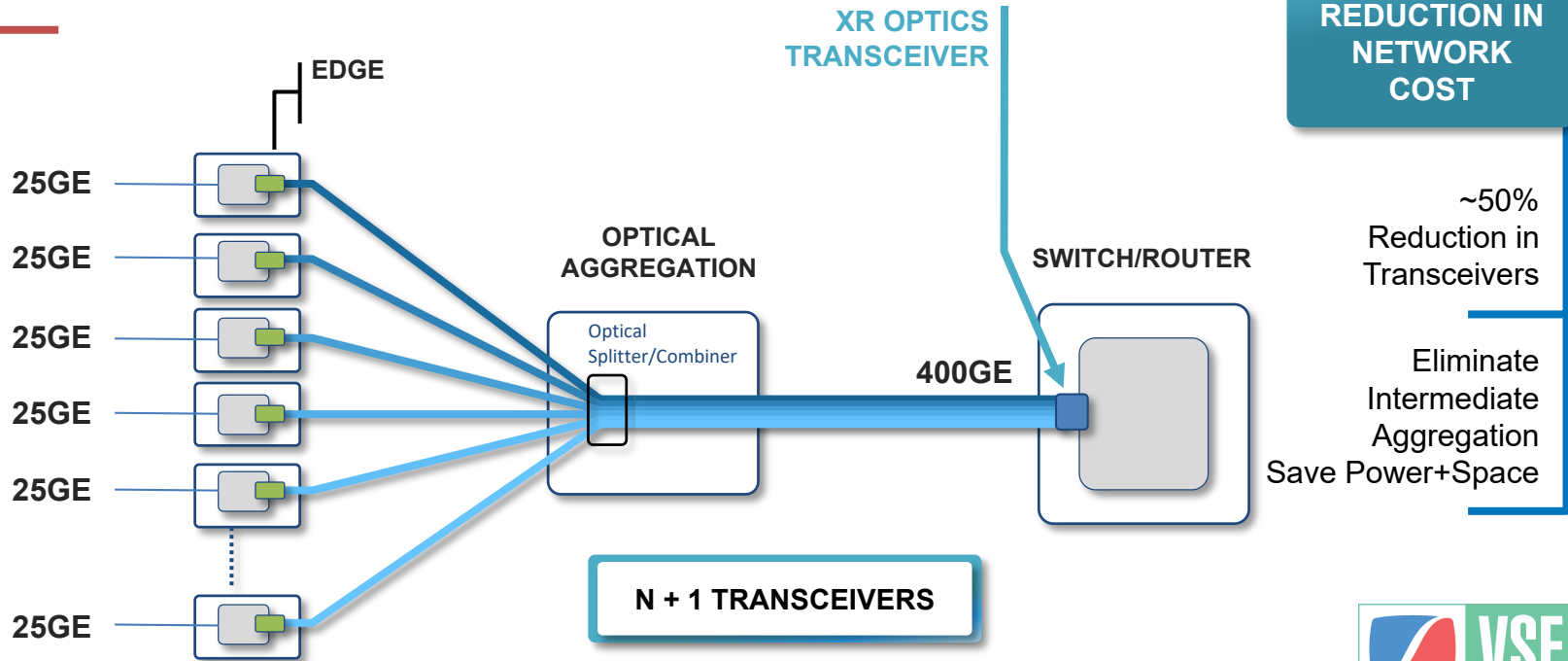
The Solution: XR Optics

COHERENT POINT-TO-MULTIPOINT OPTICAL SOLUTION



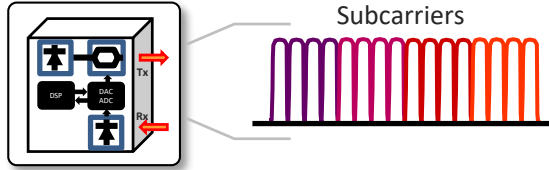
The Solution: XR Optics

COHERENT POINT-TO-MULTIPOINT OPTICAL SOLUTION



XR Subcarrier Flexibility

XR Optics Transceiver



Subcarriers can be flexibly sized

Examples:

- 25G subcarriers in 64 GHz at 16QAM, 4 Gbaud
- 10G subcarriers in 64 GHz at QPSK, 4 Gbaud

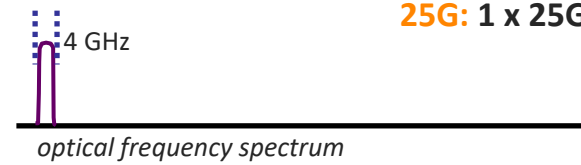
Transceivers can be designed with different numbers of subcarriers

Can be supported by a variety of form factors

ALL OPTICS BECOME N by X SUBCARRIERS

(XR optics – optics based on a flexible, interworkable number or “X” subcarriers)

EXAMPLE OF SOLUTIONS USING 25G SUBCARRIERS
ANY TWO TRANSCEIVERS CAN CONNECT TO EACH OTHER AT Nx25G



25G: 1 x 25G

SFP28

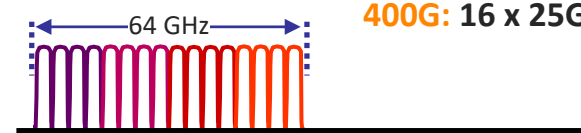


100G: 4 x 25G

QSFP28

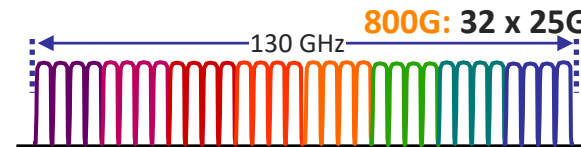


CFP2



400G: 16 x 25G

QSFP-DD

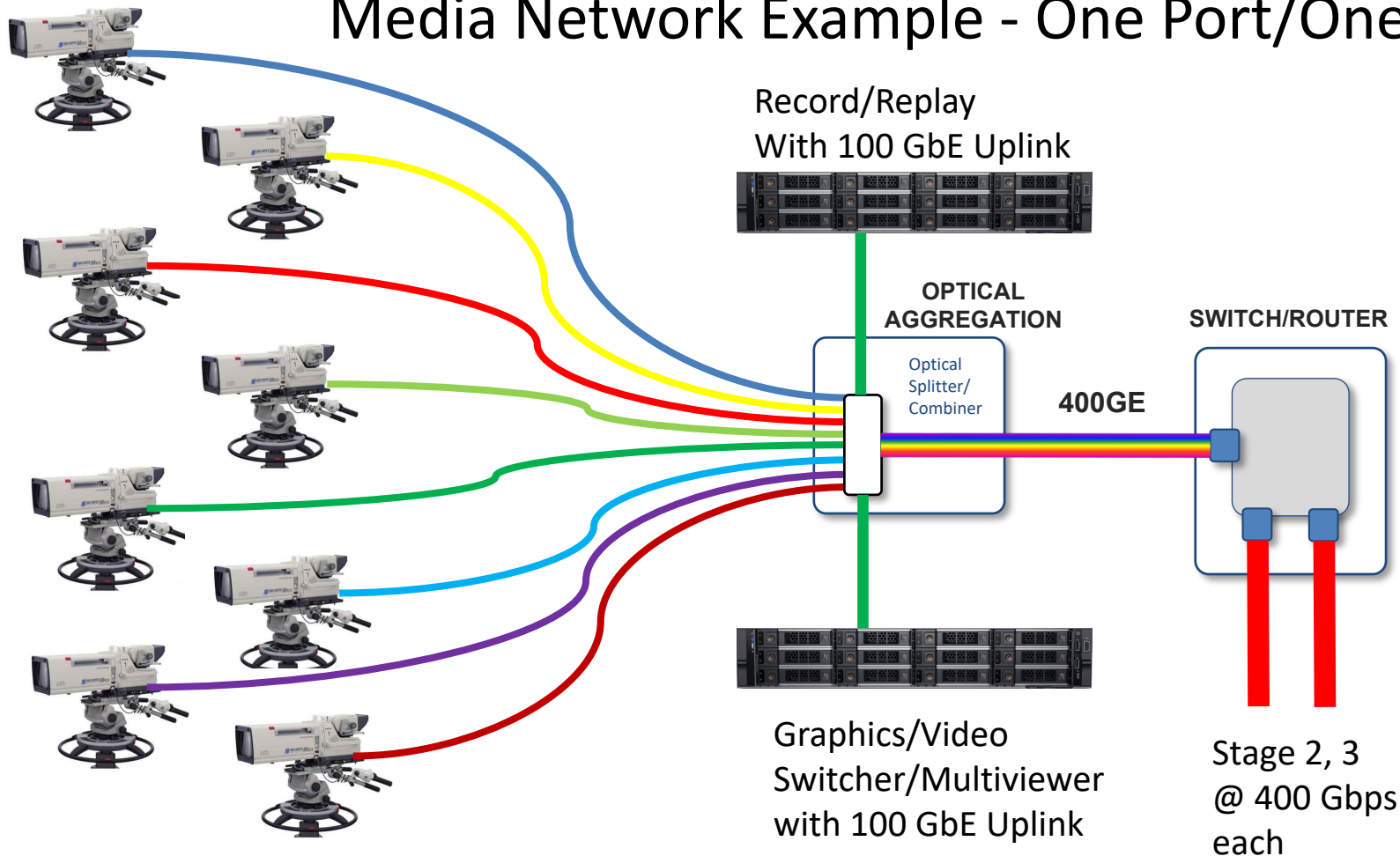


800G: 32 x 25G

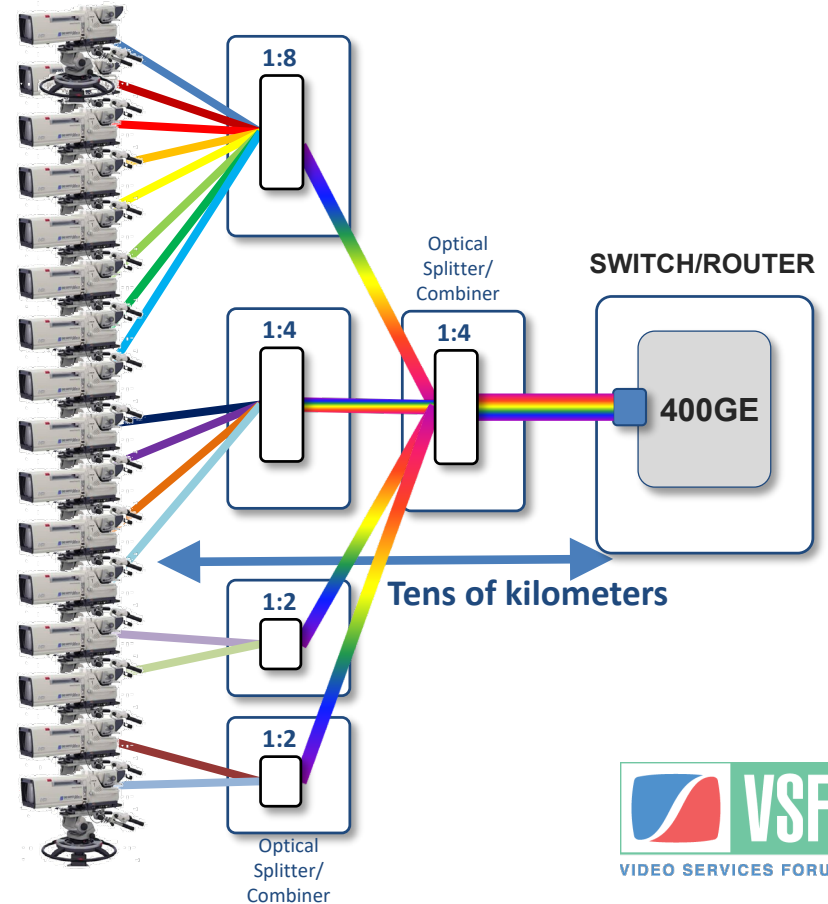
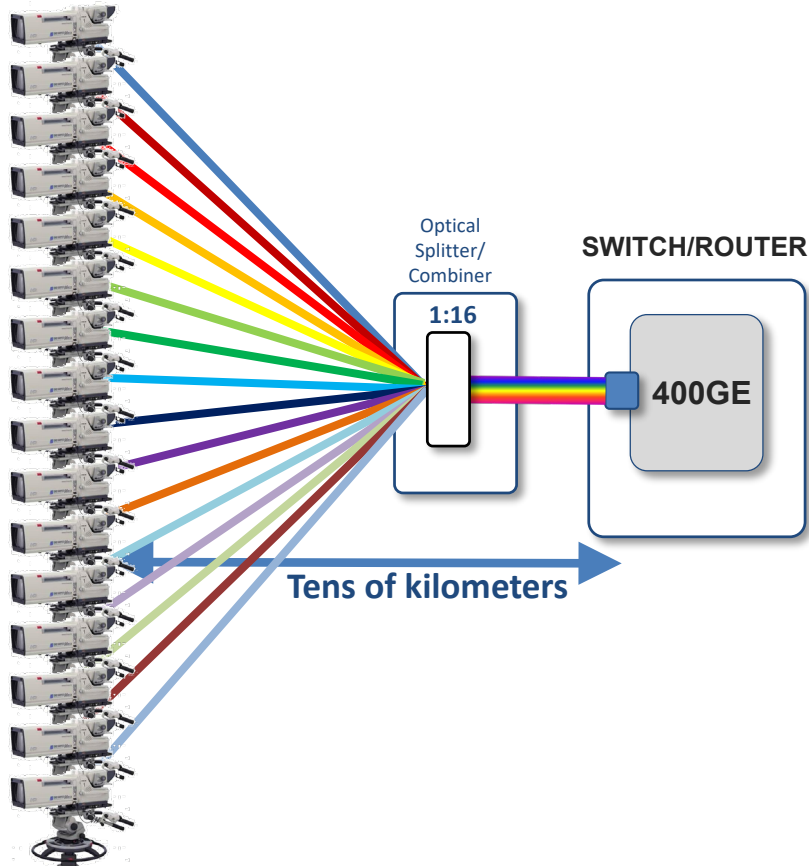
OSFP



Media Network Example - One Port/One Stage

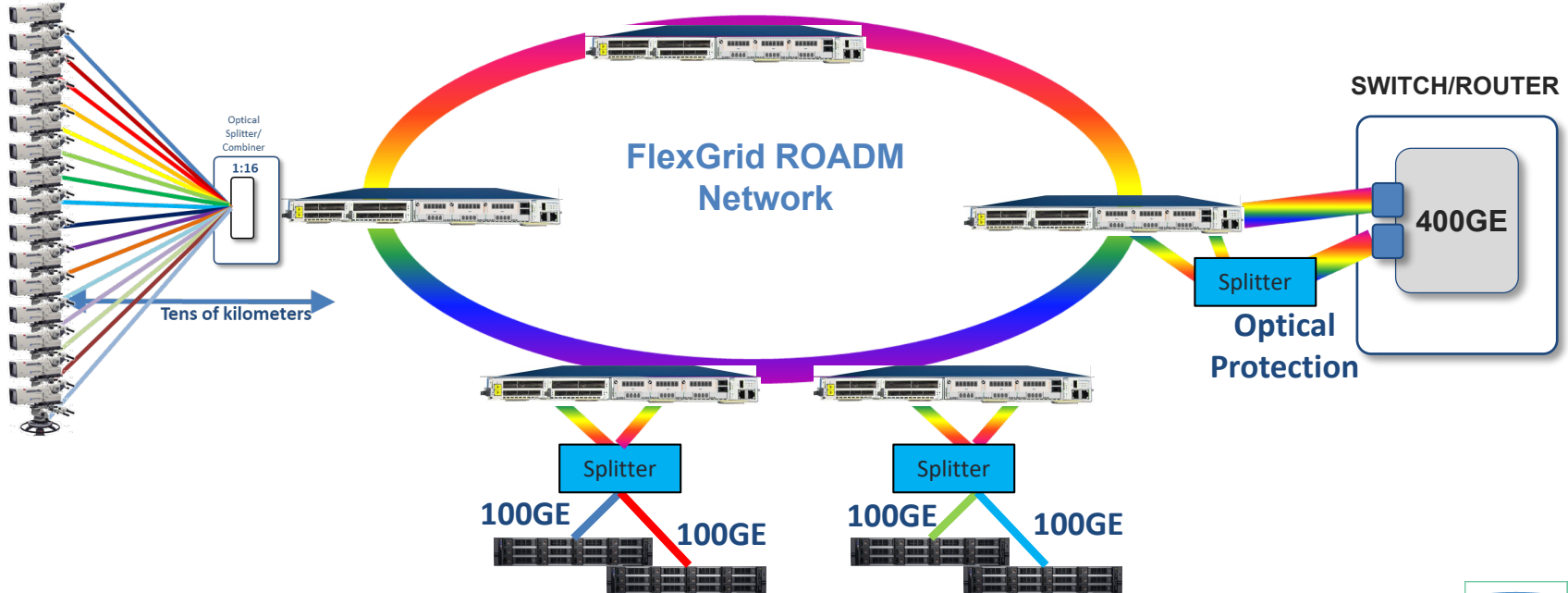


Splitter/Combiner Examples



ROADM Examples

Up to a 1000km



Industry Collaboration around XR Optics

Press Release

February 18, 2020, 8:00 a.m. ET

Infinera and Lumentum Collaborate to Bring XR Optics-based Networking Solutions to Market



<https://www.infinera.com/wp-content/uploads/pr20200218-Infinera-and-Lumentum-Collaborate-to-Bring-XR-Optics-based-Networking-Solutions-to-Market.pdf>

Infinera and II-VI Collaborate to Bring XR Optics-based Networking Solutions to Market



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Conclusions on XR Optics

- XR is based on routable Nyquist Sub-Carriers
- XR supports Point-to-Multipoint topologies, which match the real traffic patterns
 - Single high-speed transceiver (for example 400GE) can send individual Nyquist Sub-Carriers to multiple lower speed transceivers (for example 16 x 25GE)
- Replacement of electrical aggregation switches with optical aggregation generates cost and space savings
- XR increases transceiver utilization
- XR is available in Standard Pluggable Form Factors

THANK YOU

