A Use Case for Short Haul Metro WDM related to 10-40 km 100 Gb/s PHY Definition

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- Jason Weil, Cox Communications
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- Nils Kolstein, Ad Bresser, KPN
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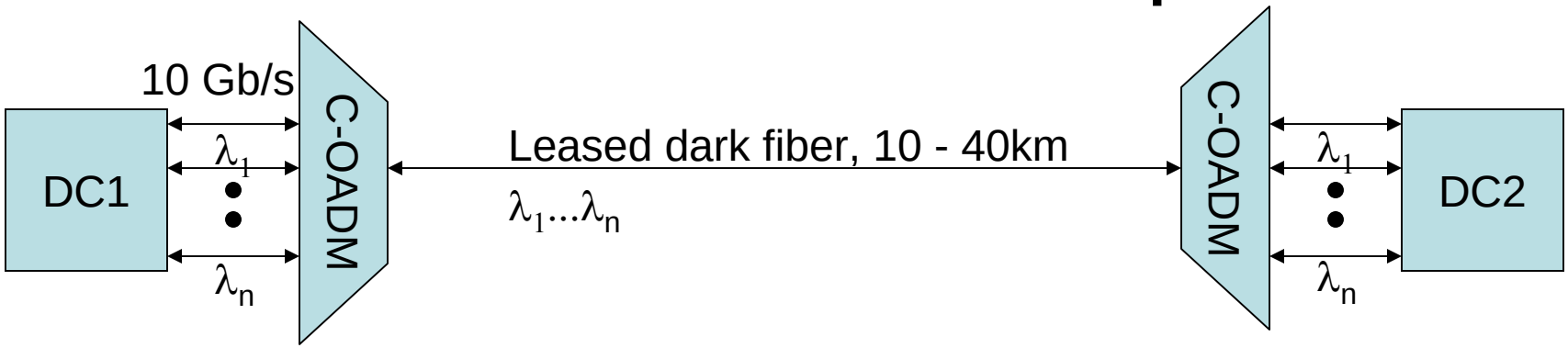
Purpose of this contribution

- Highlight a use case for Ethernet in Metro regions that makes use of WDM and specified wavelengths of operation.
- Point out potential relevance of this use case to the determination of wavelengths used for 100 Gb/s PHY at 10 and 40 km.
- Request that 802.3ba task force take this use case into account in definition of the 100 Gb/s PHY at 10 and 40 km.
- NOT a discussion of extended range applications (> 40 km)

Motivation

- Many data center operators have interconnection demands between local serving offices that justify deployment of ‘Private WDM’ links in the 10 - 40 km range.
- Such operators include
  - Internet exchanges
  - Internet Companies
  - Financial institutions
  - Campus data center operators
- Economics and geography drive choices
  - Lease dark fiber
  - Lease ‘wavelengths’ (e.g. an OC-48, OC-192, or 10 GbE private line)
  - Purchase Ethernet interconnection from a carrier.
- Demands can exceed 10 Gb/s
- Capacity growth for dark fiber users often addressed by adding WDM:
  - Purchase commercial WDM systems
  - ‘Transponder-free’ WDM using DWDM XFP and C-band OADM.
- Deployed systems with 8 – 16 x 10 GbE exist today worldwide
- This application can be expected to grow in the future as traffic increases

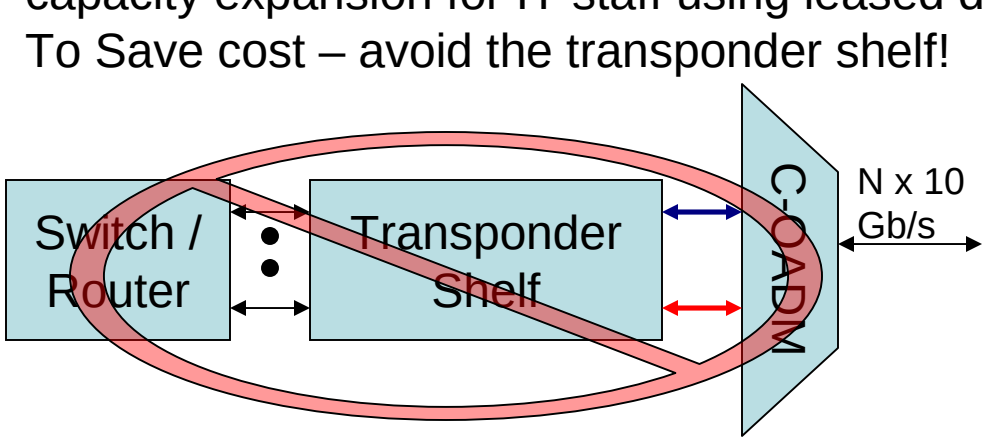
Illustration: Current Dark Fiber Private WDM Example

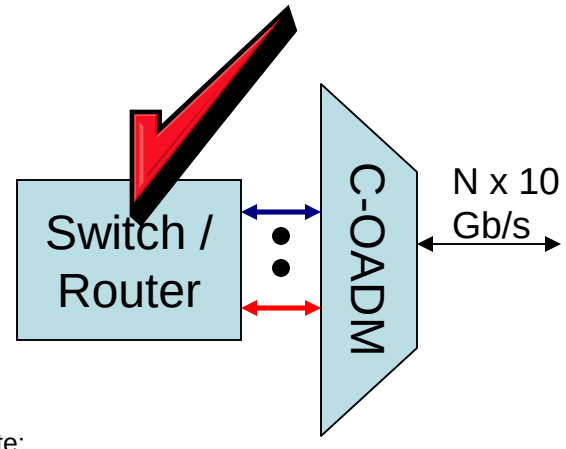


Typically a C-band WDM multiplexer is used, but other types (e.g. CWDM) are possible

Enabled by availability of WDM XFP and stand-alone OADM, for simple WDM capacity expansion for IT staff using leased dark fiber.

To Save cost – avoid the transponder shelf!





*note:
DC1,2 : Data center 1, 2
C-OADM refers to an optical add drop multiplexer operating in the 'C-band'

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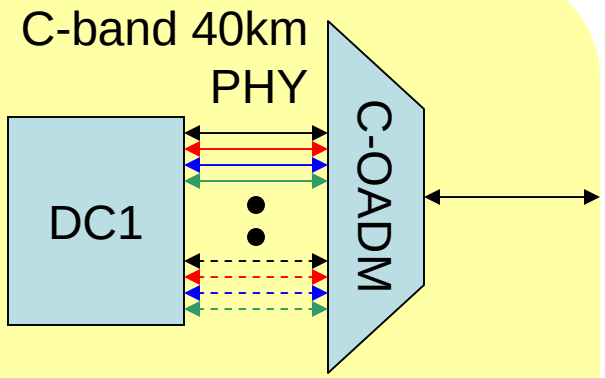
This application can either be enabled or penalized by 802.3ba

- Enabling: Define parameters that support
  - Seamless interworking of 100 Gb/s channels into infrastructure of private short haul WDM systems.
  - Substitution of 100 Gb/s channels for existing 10 Gb/s channels
  - Overlay capability for 100 Gb/s on top of current 10 Gb/s system
- Penalized: Drive custom solutions
  - Specifications that compel transponding of signals from LAN format into ‘WAN / WDM’ format place barriers to adoption.
  - Forklift upgrade requirements can create obstacles to adoption.

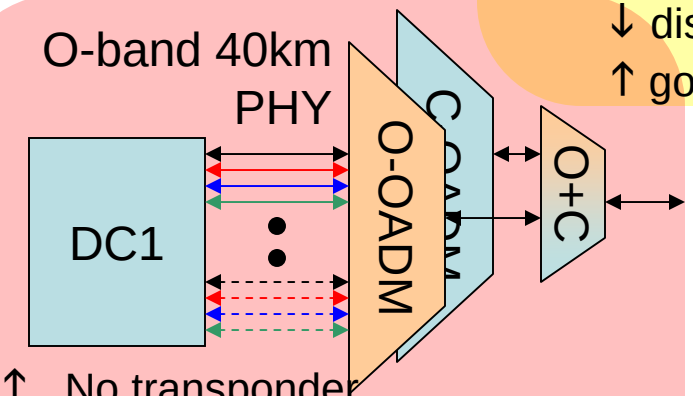
Need to define

- Channel count:
  - Select the number of wavelengths for 10 / 40 km PHY (e.g. 4, or some other number between 1 and 10)
- Channel parameters
  - Selection of operating wavelength bands for 10 km / 40 km PHY.
  - Selection of the valid wavelength groups for a 100 Gb/s channel.
  - Specification of multiple acceptable wavelength groups in an operating wavelength band
    - Allows for, but does not require, realization of multiple, distinct, high rate groups in a wavelength band
    - Number of groups / wavelengths is a technical determination of the task force. Driven by cost and complexity of implementation.
    - Suggest at least 4 wavelength groups (i. e. 16 λ), more if feasible
  - Option to omit integral OADM (i.e. 4-λ filter) from internal packaging
  - Specification of appropriate wavelength stability, power, and other physical parameters
- Goals: Interworking with existing optical filter technology

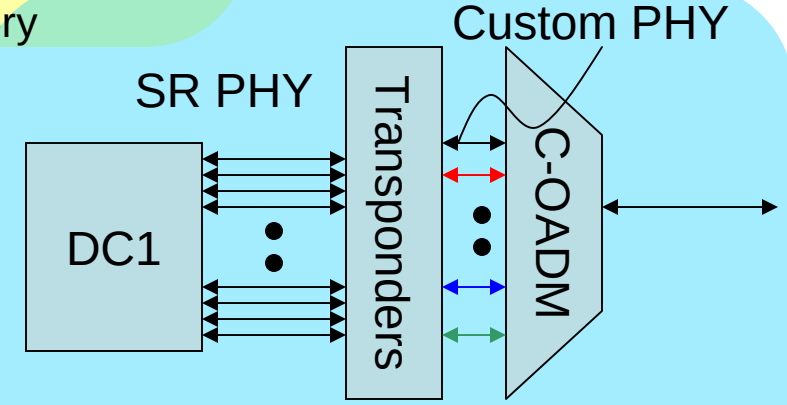
Illustration of possible upgrades*



↑ No transponder
↓ C-band PHY (not planned)
↓ dispersion management
↑ good upgrade story



↑ No transponder
↓ O-band OADM (new?)
↯ Overlay upgrade story
? Available channels ?
↓ Power budget and loss



↓↓ Transponder shelf required
↓ Custom PHY needed
↑ C-band OADM
↑ SR PHY of any type

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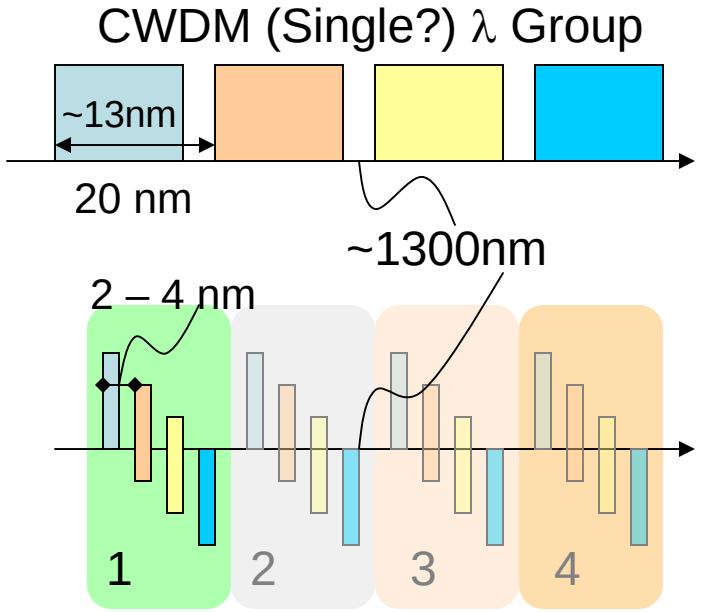
*Intended to stimulate discussion and not as a technical recommendation.

Options presented

- Channel count
  - Discussion of 4 λ operating at 25 Gb/s each.
- Channel characteristics
  - Wavelength bands: Two discussed, both in 1300 nm region (O-band) for 10, 40 km
    - ITU G.694.2: CWDM Grid (20 nm / spacing). Considered for 10 km.
    - ITU G.694.1: Widely spaced DWDM Grid (400 - 800 GHz spacing (2 – 4 nm)). Favored for 40km
  - Wavelength groups: only 1 group discussed so far
  - Multiple wavelength groups: not discussed.
    - CWDM might preclude this?
  - Unpackaged filters – not discussed
  - Technical cost factors:
    - Cooled vs. uncooled transmitters.
    - Cost and form factor impacts for removal of the filter.
  - Other physical performance parameters under consideration of fiber optic ad hoc



LAN WDM Group

Multiple λ Groups (e.g. 4)
Not discussed, but possible?

See more complete review in: Cole_01_0907.pdf, Traverso_01_0907
http://grouper.ieee.org/groups/802/3/hssg/public/sept07/cole_01_0907.pdf
http://grouper.ieee.org/groups/802/3/hssg/public/sept07/traverso_01_0907.pdf

Thank You!

Note: this presentation was motivated by discussions within the Higher Speed Users Group (HSUG), a forum for Operators, Service Providers and Content Distribution Networks that have an interest in managing the challenges of rapid Internet traffic growth.