802.3 NEA – Additional WDM Applications
Initial Discussions
21 August 2018

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Recap from 7th August

Additional areas in Ethernet & WDM

1. The presenter believes there is a need for a CFI/Project/Standard, and is targeting in March 2019 (Vancouver) for the CFI.
2. 802.3 does not specify how to use CDWM/DWDM with existing single lane optical Ethernet rates (e.g., 1G, 10G, 25G).
3. There is increasing interest in the industry to simplify deployment of WDM.
4. 1G/10G CWDM/DWDM transceivers are widely available (e.g. Cisco, Finisar, Lumentum, …), so a significant market exists.

My interests

1. Use existing CWDM and DWDM grids (no new grid).
2. 10/40Km reaches for 1/10 Gbps
3. Target 10/40KM 25Gbps (subject to physics) .
4. Do this work as simply as possible.
5. Looking for:
    a. Additional system vendors current product offerings.
    b. More use cases.

Use Case Anecdotes - Cisco

Initial feedback from Cisco field contacts (US Federal, Higher Ed, …):

- Typically the customers control their fiber infrastructure and have OADM's. Using WDM transceivers saves money compared to using transponders in the fiber infrastructure.
- Customers have their own dark fiber, and are looking to increase bandwidth (e.g., N x 10G) or to offer segmented services to different groups. The beauty of WDM optics was not having to do a OEO transition saving costs

Todays Updates: Use Cases

More on use cases: US Federal Government

1. Senior Cisco Field Engineer's customers
    a. Control a private OTN and have OADM's in the OTN
    b. xWDM from networking equipment reduces transponder need.
    c. Example use cases
        i. DCI
        ii. Metro-E designs over dark fiber (99%) or a lambda service.
        iii. Large campus networks (e.g., military bases) with onsite OTN and WDM modules in switches/routers.

More on use cases: Education and Local Government

1. Senior Cisco Field Engineer's customers
    a. Cover a wide range, e.g., city, county, public school districts, higher education, etc.
    b. Have their own fiber
    c. xWDM from networking equipment reduces transponder need.
    d. Example use cases
        i. More BW on single fiber (e.g., ***N***x10G because 100G not available).
        ii. Act as SP for agencies within the larger org.
        iii. Delivered star topology over a fiber ring using DWDM/ROADM.
        iv. Internet handoff
        v. Private transport services for MAN, MPLS, research, inter/intra campus links, etc
        vi. Geographically diverse L2 interconnect for a Firewall DMZ

More on use cases: Financial Services Industry

1. Senior Cisco Field Engineer's customers
    a. Have their own fiber, or purchase dark fiber services.
    b. xWDM from networking equipment reduces transponder need.
    c. Example use cases
        i. Low latency 10G applications (trading??)
        ii. DCI (looking to move up from 10Gb/s).

More on use cases:

1. This is privately from a contact at the last minute.
2. If possible I will get the information attributed in the next meeting. Example use cases include:
    a. Large Campuses deploying their own private networks (universities, large hospitals)
    b. MSO's (e.g. Comcast, Charter, etc. in HFC Broadband, Fiber to the Business and in Access Rings. Loss budget key due to drop/insert points in a ring.

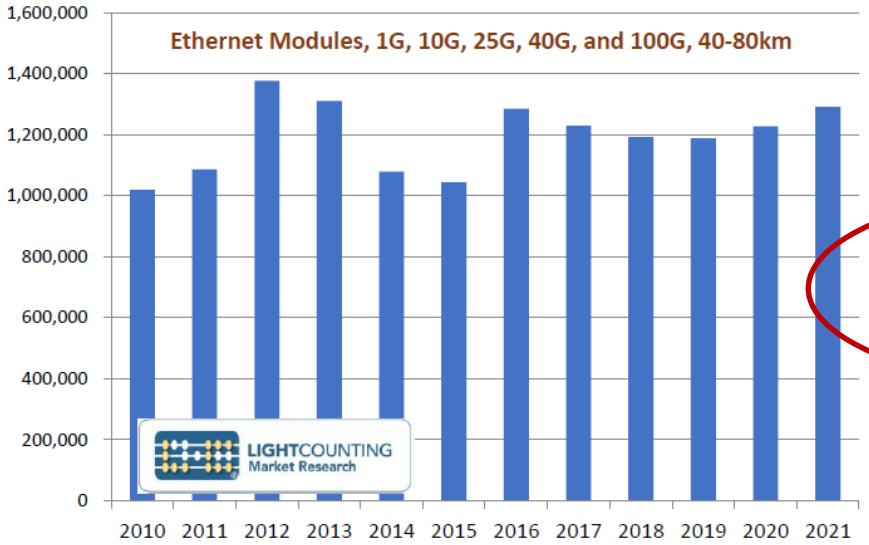
More on use cases: Interesting public links

1. The Art of DWDM Wavelength-Case Study of DWDM Networking
   http://www.fiber-optic-tutorial.com/dwdm-networking-case-study.html
2. Imperial Hospital Trust DWDM Network
   http://e.huawei.com/uk/case-studies/uk/2017/imperial_healthcare_case_study
3. Introduction to DWDM Technology
   https://www.cisco.com/c/dam/global/de_at/assets/docs/dwdm.pdf
4. Application of DWDM architectures in cable-TV networks
   https://www.lightwaveonline.com/articles/print/volume-16/issue-9/special-report/application-of-dwdm-architectures-in-cable-tv-networks-53488942.html
5. The case for Ethernet over DWDM
   https://www.lightwaveonline.com/articles/print/volume-19/issue-6/special-report/the-case-for-ethernet-over-dwdm-53447152.html
6. Optical Networking Case Study: How Cisco IT Used CWDM to Interconnect Japanese Data Center Sites
   https://www.cisco.com/c/en/us/about/cisco-on-cisco/enterprise-networks/cwdm-japanese-data-centers-web.html
7. Single-Fiber CWDM MUX/DEMUX Analysis
   http://www.fiberopticshare.com/single-fiber-cwdm-muxdemux-analysis.html

Todays Updates: Market Info

From Beyond 10km Optical PHYs CFI

Annual Shipments for 40km+ Applications



- For 100GbE, 40km, LightCounting projects a market that will roughly triple in value from 2017 to 2021.
- SONET 40-80km shipments represent another half-million units in 2016. SONET is transitioning to Ethernet.
- 1 / 2.5 / 10 Gb/s DWDM / CWDM 40km & 80km optics will exceed 1M units this year and growing
- Totals are for merchant supplier shipments. Captive supply could add another half-million units.
- Data courtesy of LightCounting

Draft 1.03 – Beyond 10km Optical PHYs
CFI Consensus Presentation

IEEE 802 July 2017 Plenary
Berlin, Germany

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From http://www.ieee802.org/3/cfi/0717_1/CFI_01_0717.pdf

Market data – More from LightCounting

Stay Tuned

More data coming

Right LightCounting folks are on PTO.

Anecdotal Market trends (In the absence of real market data)

1. 1Gbps/10Gbps/CWDM/DWDM are all active. Some combinations declining, some growing.
2. 25Gb/s (enterprise distances) is not here yet.
3. Validation of ~1M from LightCounting

Todays Updates: Product Spec Survey

10Gb/s SFP+ - Spec Survey

Type	Tunable	Reach (Km)	Limited/ Linear	TX Av Power Max(dBm)	Tx Extinct. Ratio Min(dBm)	Tx Side mode suppression ratio (dB)	Return loss(dB)	Rx overload min (dBm)	Rx reflectance Max (dB)
DWDM	Y	80KM	Limited	3.0	9.0	35.0	24.0	-7.0	-27.0
DWDM	Y			3.0	9.0	30.0	??	-7.0	??
DWDM	Y	80	Limited	3.0	8.2	30.0	??	-7.0	-27.0
DWDM	N	80	??	4.0	??	??	??	??	??
DWDM	N	80	??	4.0	9.0	30.0	-21.0	??	-27.0
DWDM	y	80	??	3.0	9.0	??	??	-7.0	??
DWDM	y	80	??	3.0	9.0	35.0	-27.0	-7.0	

Lots of common numbers, but significant format variations between different product documents.
What are the important numbers?

Moving On

What next?

I plan to work to build consensus on this topic.

All advice, opinions, data, etc are welcome

Please reach out to me at peterjone@cisco.com to express interest, and copy the NEA reflector.

Thank You!