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Evaluating 10GBASE-SX4 850CWDM

Bill Wiedemann

Blaze Network Products Inc.

billw@blazenp.com

IEEE 802.3ae Interim Meeting
New Orleans September 2000



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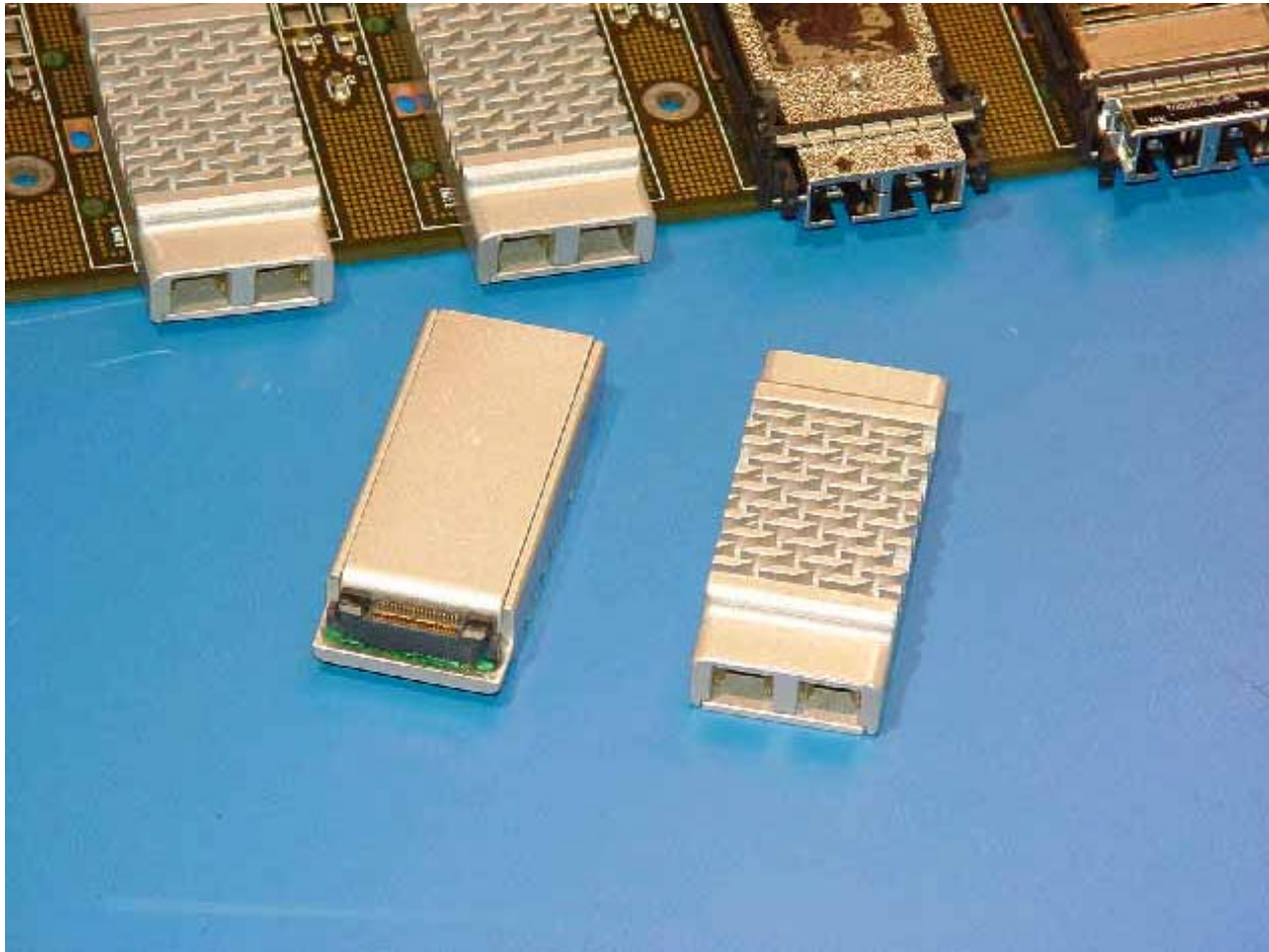
10GBASE-SX4 850CWDM

- Most Broadly Supported Presentation
71 Individuals – 38 Companies
- IEEE San Diego Room Voting
1550 Serial 100% 1310 WWDM 58%
1310 Serial 98% 850 Serial 64%
850 CWDM 73% Parallel Fiber 35%
- Fibre Channel - Baseline Standard
- OIF – OC192 VSR – Sent to Straw Ballot



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10GBASE-SX4 850CWDM



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10GBASE-SX4 850CWDM

- Exceeds MMF distance objectives
 - 100m on installed fiber
62.5 μm , 160 MHz*km
 - 300m on MMF
50 μm , 500 MHz*km
 - 550m on MMF
50 μm , 1000 MHz*km
- Ability to meet the IEEE 802.3ae schedule



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10GBASE-SX4 850CWDM

- Meets all five criteria
 - Broad Market Potential
 - Compatibility with 802.3
 - Distinct Identity
 - Technical Feasibility
 - Economic Feasibility

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10GBASE-SX4 850CWDM

- Criteria 1 - Broad Market Potential
 - short-reach market size >80%
 - supported by Nortel Market presentations
 - Roy Bynum POP reflector discussion
 - IEEE distance surveys
 - Technical Essence Webs
 - CDT

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10GBASE-SX4 850CWDM

- Criteria 1 - Broad Market Potential
 - market acceptance depends on how well we match solutions to customer needs
 - 10GBASE-SX4 850CWDM is the lowest cost solution for Very Short Reach interconnect
 - 10GBASE-SX4 850CWDM reaches more than three times farther than 850 Serial



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10GBASE-SX4 850CWDM

- Criteria 1 - Broad Market Potential
 - “To prevent the proliferation of customized solutions and resultant interoperability problems, IEEE 802.3 should standardize on an optimized, high volume, short-reach PMD for our customer requirements. I believe this solution is best accomplished with 850 nm technology and multimode fiber.”

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10GBASE-SX4 850CWDM

- Criteria 1 - Broad Market Potential
 - “IEEE 802.3ae needs to standardize on a low cost 850nm PMD. In data centers, the construction cost for single mode fiber plant is 4 times the cost of multimode. Ribbon interconnects in the data center, such as OIF or Infiniband, are not acceptable due to the inability to field terminate ribbons. The mode conditioning patch cords are unacceptable due to the high cost and complexity added to the cable plant. I would much rather have IEEE standardize on 850 nm PMDs for 10 gigabit Ethernet than have many proprietary 850 nm PMDs.”

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10GBASE-SX4 850CWDM

- Criteria 1 - Broad Market Potential
 - “Regardless of what happens in IEEE, <company name> will be making a CWDM 10G product”
 - “WWDM and CWDM are the two best solutions to meet the LAN market needs”



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10GBASE-SX4 850CWDM

- Criteria 2 - Compatibility with 802.3
 - PMD / PCS interface defines compatibility with higher layers for all PMDs.
 - PMD specifications confirmed with accepted link model
 - 10GBASE-SX4 850CWDM is directly compatible with XAUI, SUPI.
NO SERDES REQUIRED

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10GBASE-SX4 850CWDM

- **Criteria 3 – Distinct Identity**
 - 850 CWDM is the only short-wave PMD to meet the approved 100 meter and 300 meter distance objectives

Application

Optimal Solution

Longest Distance (40+ km)

1550 Serial

Med. Reach, lower cost, transponder compat.

1310 Serial

Max reuse of installed MM / SM (Building LAN)

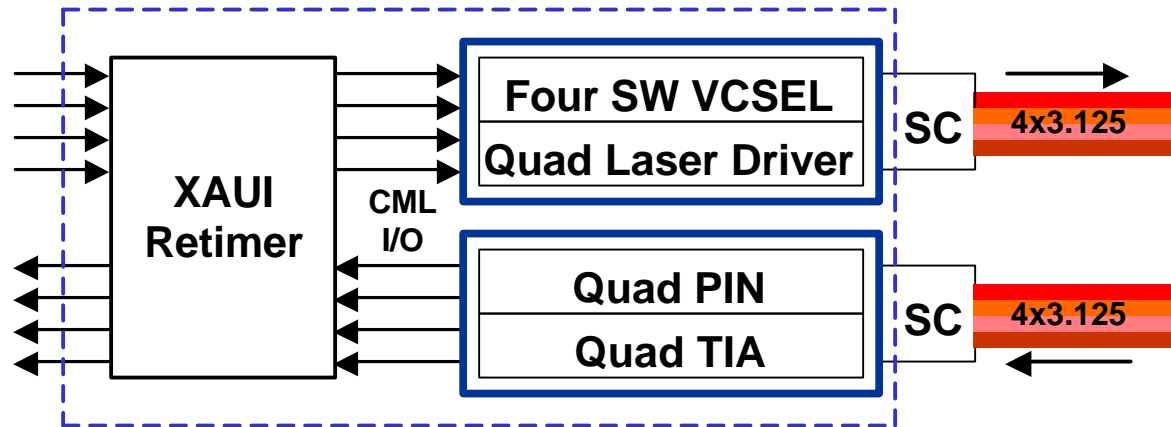
1310 WWDM

Lowest Cost on MM (Equipment Room)

850 CWDM

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Functional Blocks



- No single mode alignments
- Injection molded plastic optics for multiplexer and demultiplexer
- Low power, low cost VCSELs
- Simple, low power, and low cost electronics

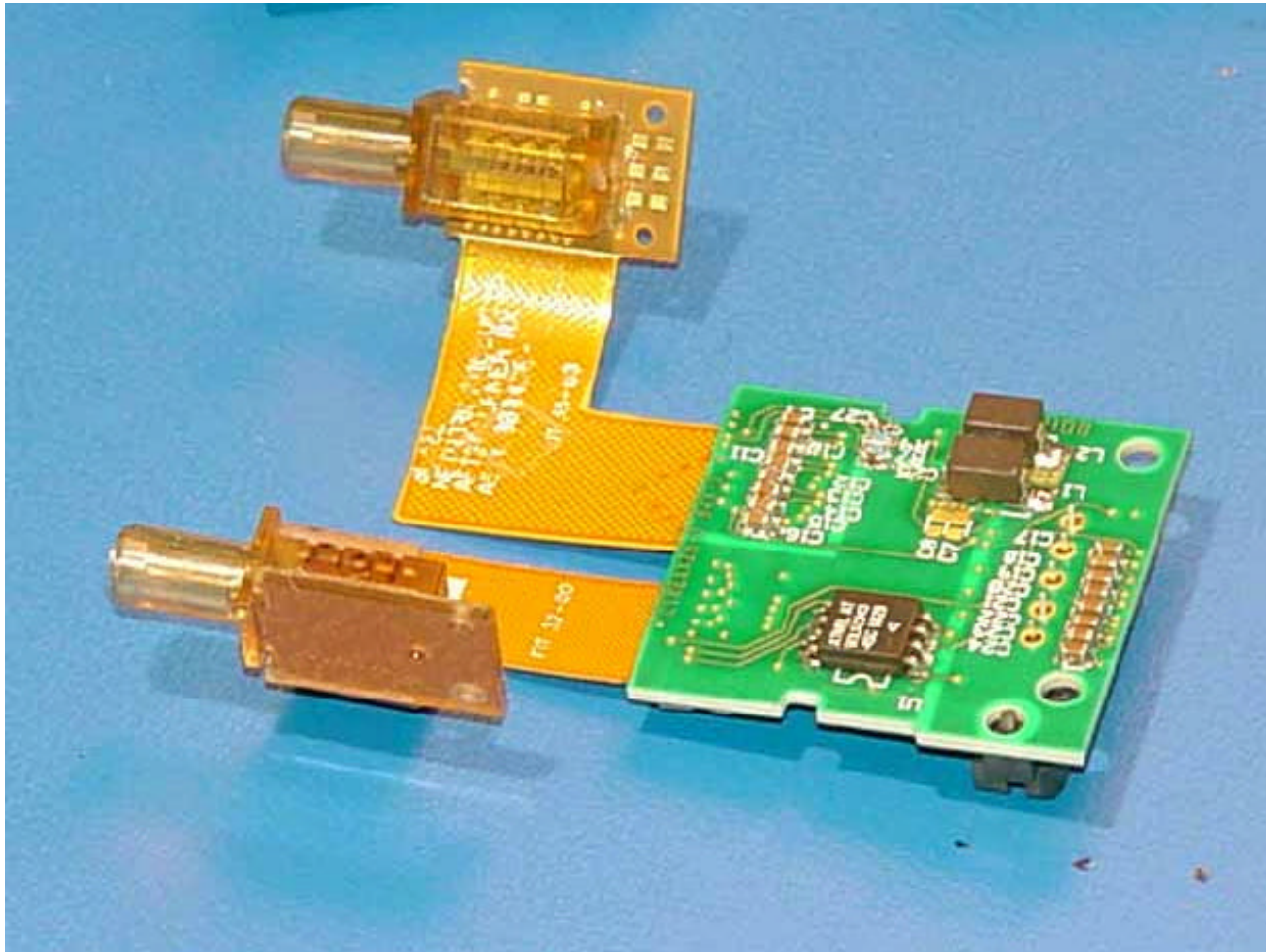
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10GBASE-SX4 850CWDM

- Criteria 4 – Technical Feasibility
 - 850 CWDM demonstrated
 - Required integrated circuits identical to 850 parallel fiber approach, available from multiple suppliers
 - VCSELs available today from multiple suppliers

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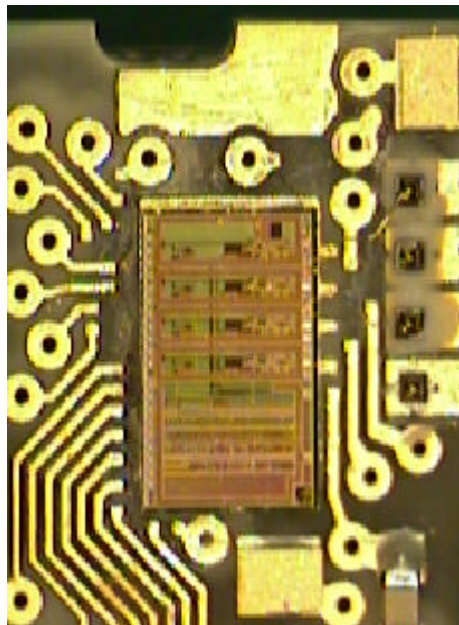
10GBASE-SX4 850CWDM



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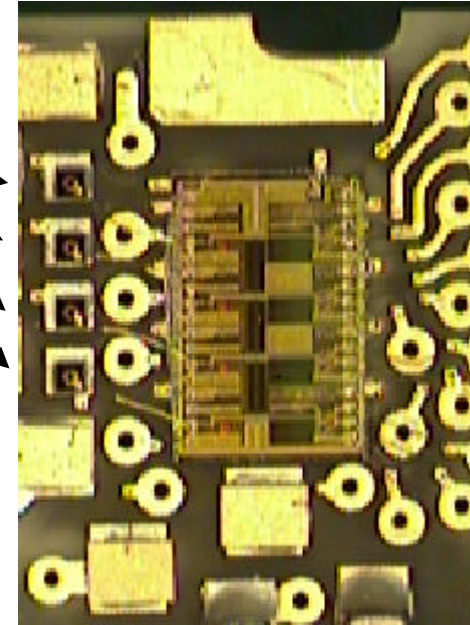
10GBASE-SX4 850CWDM

- Criteria 4,5 – Technical, Economic



VCSELs

Quad Laser Driver



Detectors

Quad TIA / Post Amp

Both attach directly to XAUI, SUPI

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10GBASE-SX4 850CWDM

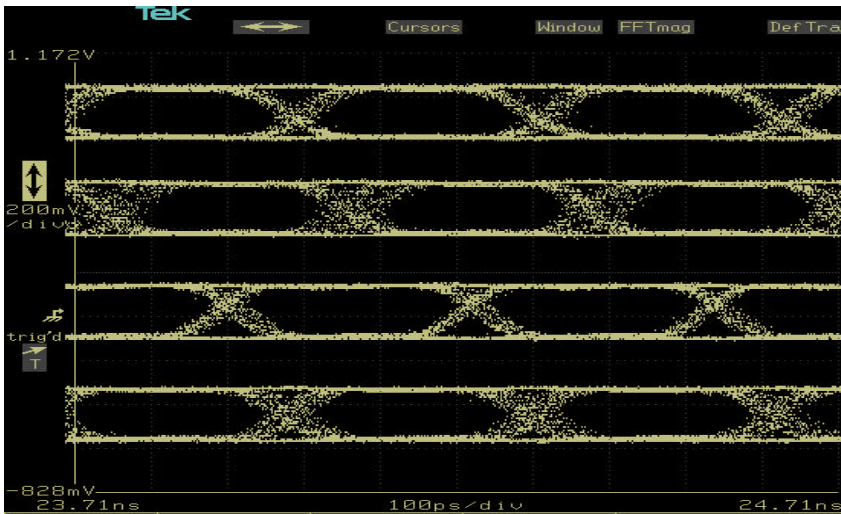
- Criteria 4,5 – Technical, Economic
 - Blaze has qualified over **23** LDs, TIAs, Lasers, and Detectors currently being used in parallel fiber solutions
 - Several companies are working to supply 10GBASE-SX4 850CWDM transceivers
 - Blaze is working directly with **four** companies that have a strong interest to be suppliers of 10GBASE-SX4 850CWDM



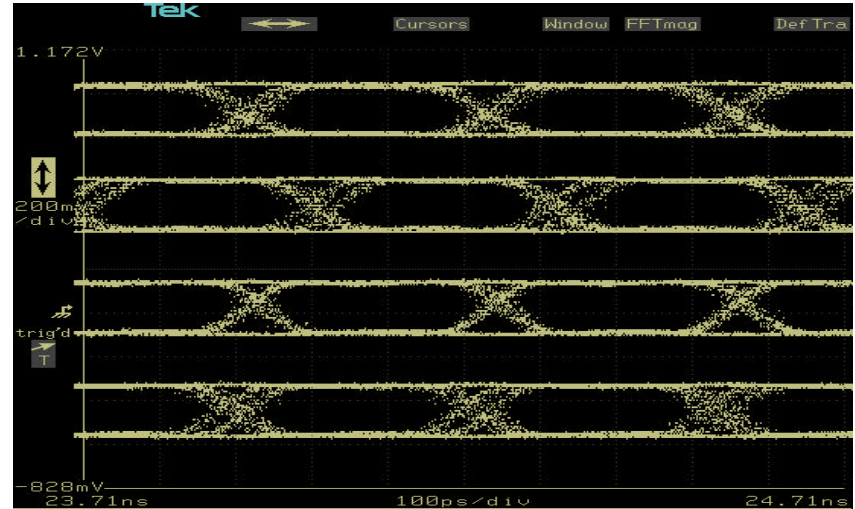
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62.5 mm at 3.125 Gbps

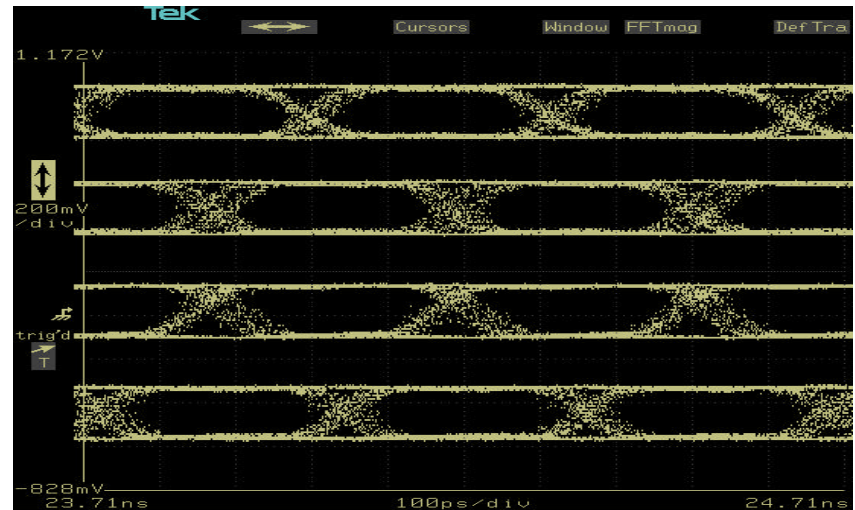
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100 m



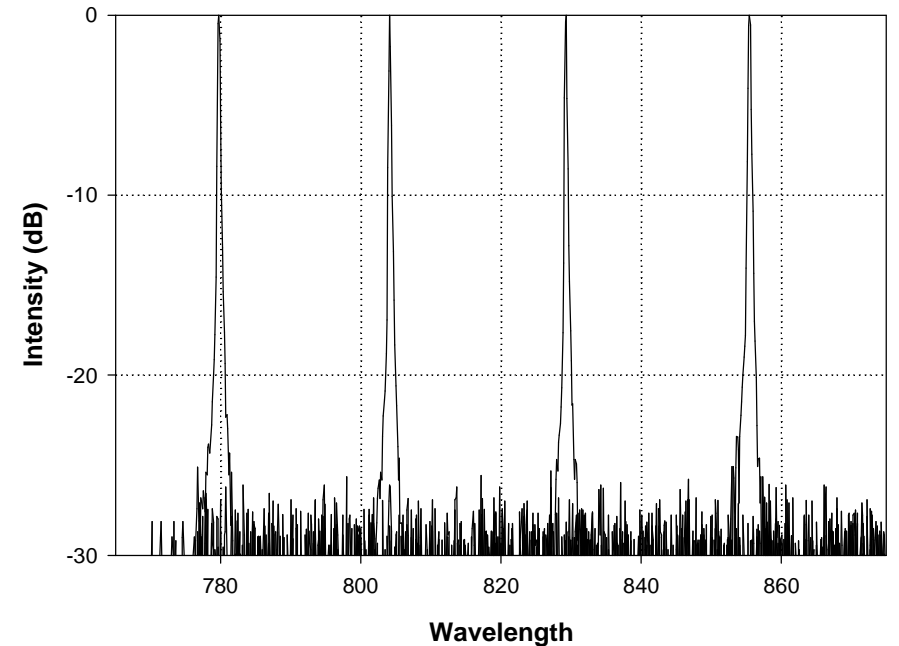
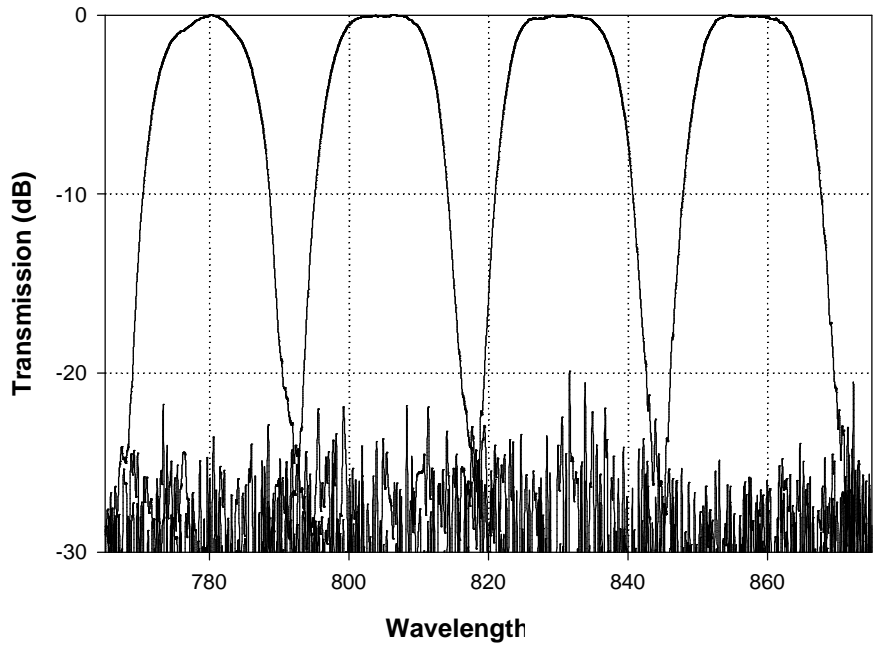
300 m



Measured at Receiver Outputs

Optical Performance

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CWDM Optics Scalability

- CWDM optics are modulation rate independent
- First CWDM optic was designed and implemented for eight channels
- Eight channel optic and 5 Gig VCSELs enable early to market 40 Gigabit solutions
- Combining 10 Gig VCSELs with CWDM enable early to market 100 Gigabit solutions
- Combining 10 Gig VCSELs with CWDM and parallel fiber yields **Terabit** solutions

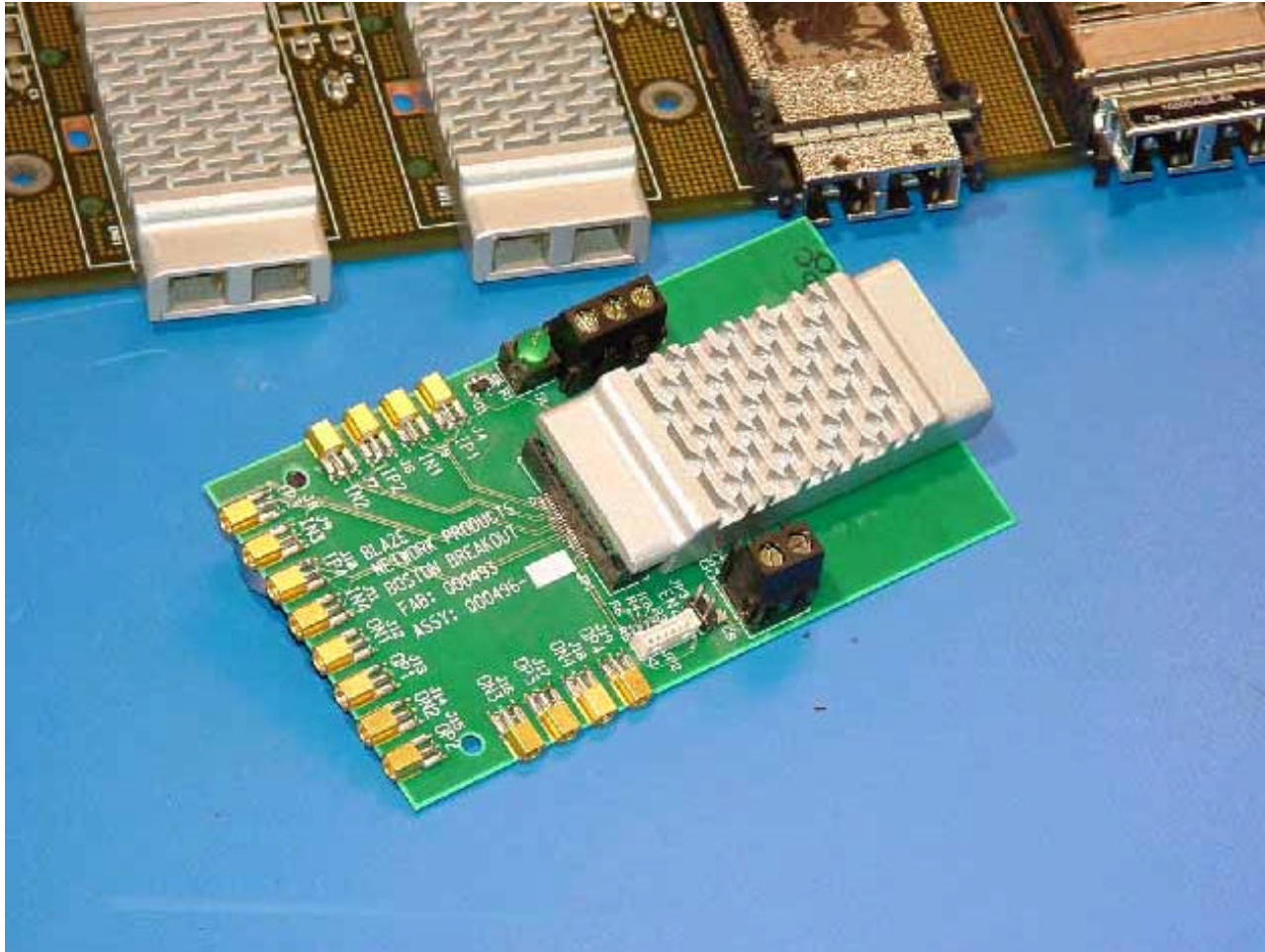
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Early Availability

- All parts available from multiple suppliers
- Customer specific sampling Dec 2000
- Product Qualification units Q1 2001
- General Availability April 2001

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10GBASE-SX4 850CWDM



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Table 38-2* Operating Range

Fiber type	Modal bandwidth @ 850nm (MHz*km)	Minimum range (meters)
62.5µm MMF	160	2-100
50.0 µm MMF	500	2-300
50.0 µm MMF (new)	2200	2-550
10µm SMF	N/A	Not supported

* Equivalent for 10GBASE-SX4 850CWDM



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Table 38-3* Transmit

Description	62.5 mm MMF	Unit
	50 mm MMF 50 mm MMF (new)	
Transmitter Type	Shortwave Laser	
Signaling speed per channel (range)	3.125 ± 100 ppm	GBd
Wavelength (range), four channels	780 to 860	nm
Channel center wavelengths	780, 805, 830, 855 ± 6.5 nm	nm
Channel separation	25.0	nm
Trise/Tfall (max. 20-80% response time)	85	ps
RMS spectral width (max)	0.5	nm
Average launch power, four channels (max)	+4.7	dBm
Average launch power per channel (max)	-1.3	dBm
Average launch power per channel (min)	-5.5	dBm
Extinction ratio, (min)	7	dB
RIN (max)	-120	dB/Hz

* Equivalent for 10GBASE-SX4 850CWDM



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Table 38-4* Receive

Description	62.5mm MMF	50.0 mm MMF	50.0 mm MMF (new)	Unit
Signaling speed per channel (range)	3.125 ± 100 ppm			Gbd
Wavelength (range), four channels	780 to 860			nm
Channel center wavelengths	780, 805, 830, 855 ±6.5nm			nm
Channel separation	25.0			nm
Avg receive power, four channels (max)	+4.7			dBm
Avg receive power, per channel (max)	-1.3			dBm
Return loss	12			dB
Receive electrical 3 dB upper cutoff freq (max)	3750			MHz
Receive sensitivity	-13.5	-13.5	-13.5	dBm
Stressed receive sensitivity	-7.8	-8.7	-9.7	dBm
Vertical eye closure penalty	3.6	3.4	0.9	dB

* Equivalent for 10GBASE-SX4 850CWDM

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Table 38-5* Link Power Budget

Parameter	62.5mm	50.0 mm		Unit
	MMF	MMF		
Modal bandwidth as measured at 850nm (min overfilled launch)	160	500	2200	MHz*km
Link power budget	8.0	8.0	8.0	dB
Operating distance	100	300	550	m
Wavelength	780 - 860			nm
Channel insertion loss	1.9	2.7	3.8	dB
Link power penalties	4.3	4.3	1.6	dB
Unallocated margin in link power budget	1.8	1.0	2.6	dB

* Equivalent for 10GBASE-SX4 850CWDM



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Table 38-10* Equivalent Jitter

Compliance point	Total Jitter		Deterministic Jitter	
	UI	ps	UI	ps
TP1	0.240	76.8	0.100	32.0
TP1 to TP2	0.284	90.9	0.100	32.0
TP2	0.431	138.0	0.200	64.0
TP2 to TP3	0.170	54.4	0.050	16.0
TP3	0.510	163.4	0.250	80.0
TP3 to TP4	0.332	106.2	0.212	67.8
TP4	0.749	239.6	0.462	147.8

* Equivalent for 10GBASE-SX4 850CWDM



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850 CWDM 1310 WWDM

62.5 mm 160 MHz*km installed	100 m	100 m*
50 mm 500 MHz*km installed	300 m	300 m
50 mm 2000 MHz*km	550 m	300 m
Lasers Multi-sourced	Yes	No
Integrated Circuits Available	Yes	Yes
Multi-mode Fiber Objectives	100 meter 300 meter	100 meter 300 meter
Chip functions	Retimer	Retimer
Power Consumption	Low 2 watts	Medium >3 watts
EMI	Low	Medium
Footprint	1" x 2.5" 1X	3" x 4" 5X
Cost	1X	4X**

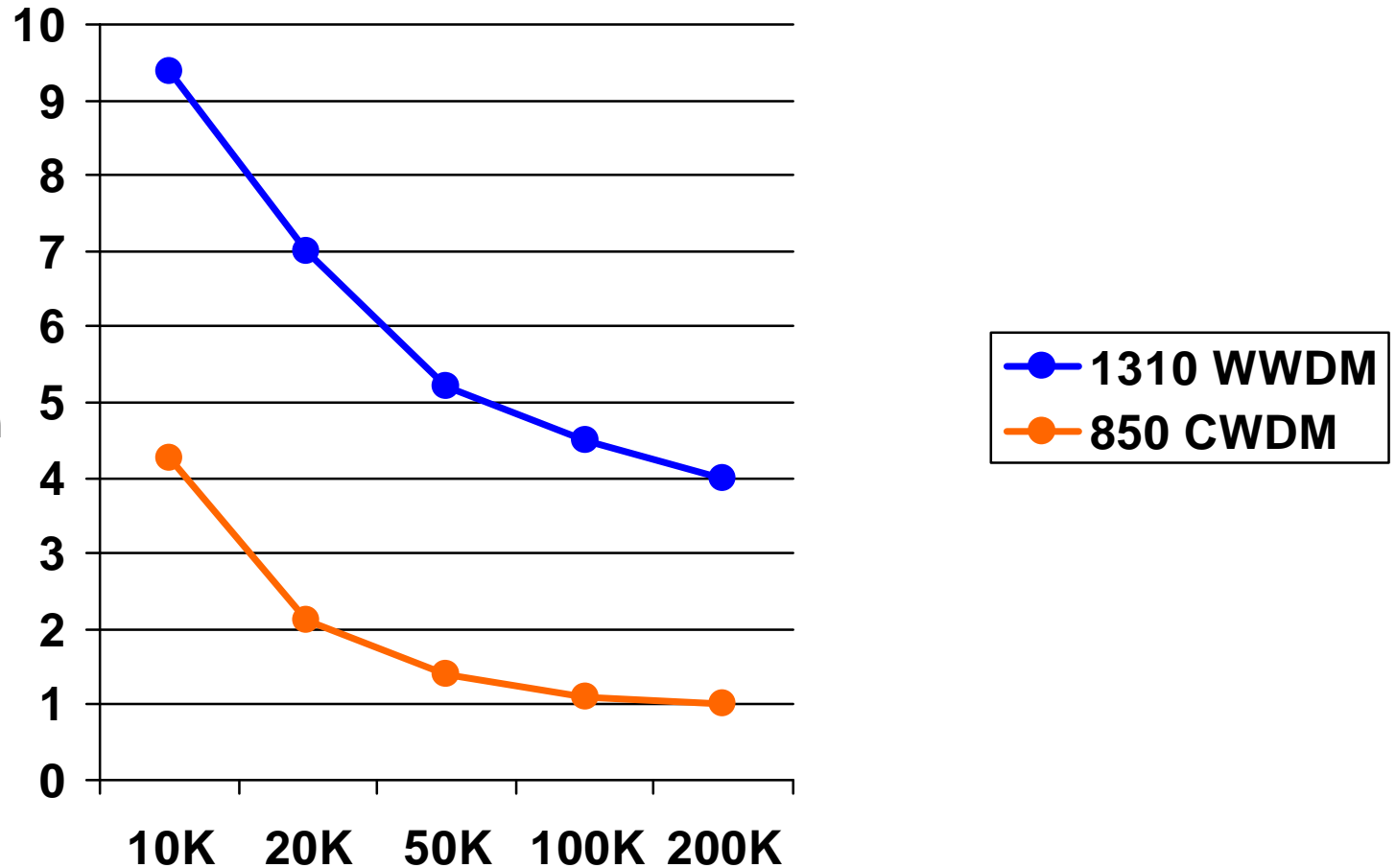
** does *not* include cost of offset launch patch cord

* 300 meters with offset launch patch cord

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850 CWDM / 1310 WWDM

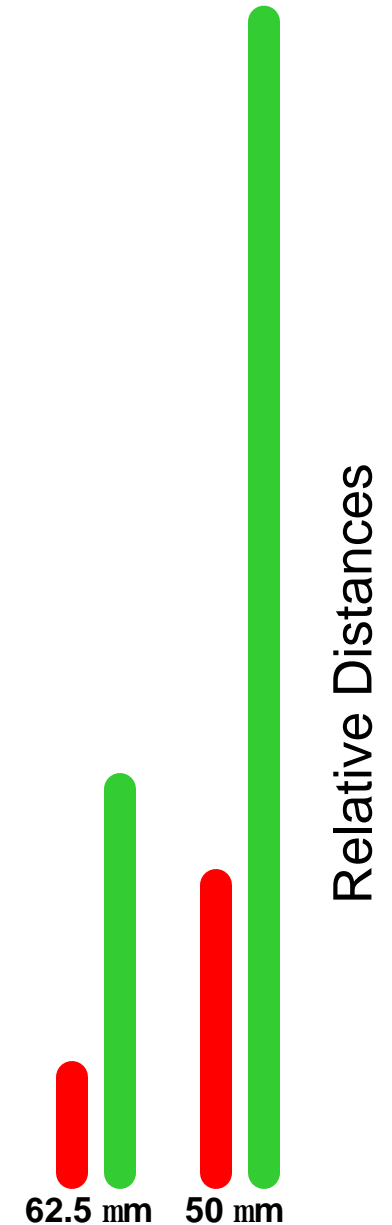
Cost
Comparison



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850 CWDM 850 Serial

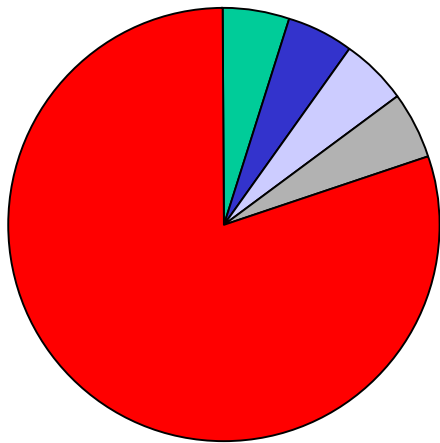
62.5 mm 160 MHz*km installed	100 m	25 m
50 mm 500 MHz*km installed	300 m	75 m
50 mm 2000 MHz*km	550 m	????
Lasers Multi-sourced	Yes	Yes
Integrated Circuits Available	Yes	Yes
Multi-mode Fiber Objectives	100 meter 300 meter	None
Chip functions	Retimer	Retimer 8B/10B, 64/66, 4:1Mux 1:4 Demux
Power Consumption	Low <2 watts	High >4 watts
EMI	Low	High
Footprint	1" x 2.5" 1X	2" x 3.5" 3X
Cost	1X	1.5X



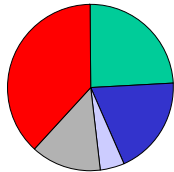
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SX Relative Costs: 10G/1G

850 Serial

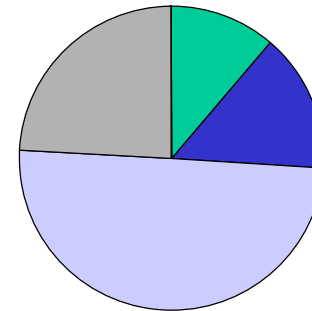


Cost Today = 19

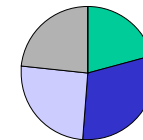


Final Cost = 1.94

850 CWDM



Cost Today = 7.6



Final Cost = 1.3

- Detector&Amp
- VCSEL/Driver
- Optical Interface
- High Speed Package
- Serdes

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Motion

- Move that P802.3ae adopt the 850nm CWDM PMD as presented in wiedemann _1_0700 as the basis for one of the PMDs in draft 1.0

Moved: Wiedemann

Second:

Yes:

No:

