10 Gigabit Ethernet on FDDI Grade Multimode Fiber: A User's Perspective

Mike Bennett

1/8/2004

Discussion

- **Why do we need this PHY?**
- **MMF Distribution at LBNL**
- **Brief Background on MBI data**
- **Conclusion**

Why do we need this PHY?

- **Currently 10 GbE has PMDs that support the following distances on optical fiber:**
  - **Up to 26 m on multimode (160 MHz*Km)**
    - 10GBASE-SR/SW (Table 52-6 802.3ae)
  - **Up to 10 Km on single mode fiber**
    - 10GBASE-LR/LW (Table 52-11 802.3ae)
  - **Up to 40 Km on single mode fiber**
    - 10GBASE-ER/EW (Table 52-15 802.3ae)
- **No other parts shipping that I know of**

Why do we need this PHY? (cont.)

- **850 nm PMD is just now shipping**
- **We still can't get 10GBASE-LX4**
- **It's still expensive to provision optical 10 GbE**
- **IT budgets are still declining or flat**
- **There could be a significant cost savings if we could use the existing infrastructure**

Why do we need this PHY? (cont.)

- **Simply put, 10 GbE still costs too much**
  - **Although the costs are coming down**

Cost of 10GbE Compared to 1 GbE

MMF Distribution at LBNL
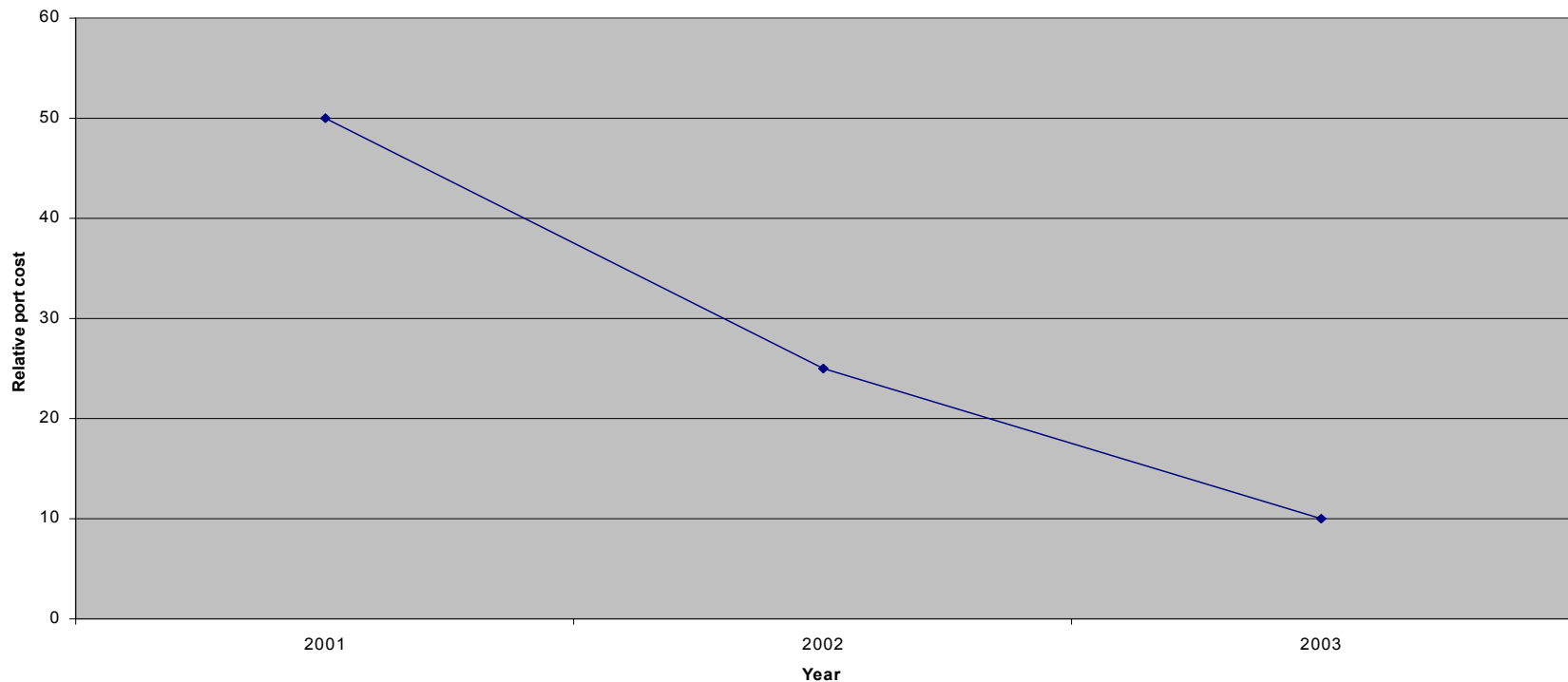
- **LBNL's enterprise network:**
  - **4000 employees**
  - **6000 desktop computers**
  - **More than 13,800 network attached devices**
  - **Star topology**
  - **99% Ethernet**
- **3048 Multimode fibers installed total**
  - **Includes 160 MHz*Km and 200 MHz*Km (850nm)**
  - **1556 of these are less then or equal to 300m long**
- **Several of these fibers are among the worlds worst!**

Brief Background on MBI data

- **July 1997**
  - **David Cunningham and Mark Nowell presentation to 802.3z task force regarding modal bandwidth and laser launch behavior on MMF**

- **November 1997**
  - **DMD is a problem**
  - **Modal Bandwidth Investigation subtask group presents initial field test results**
    - **Needed a bigger sample of installed MMF**
  - **MBI group came to LBNL, LLNL and SNL to measure "real" installed fibers**

Brief Background on MBI data (cont.)

- **Several LBNL fibers were known to have problems**
  - We ordered new fibers to prepare for FDDI in the early 90's
  - Made our own modal BW measurements with a Tektronix OF 192
  - Found that the fiber that was installed did not meet our specifications
  - The vendor made their own measurements and found the same

- **Many of the "bad" fibers were used for MBW tests**
  - In case you're interested, detailed information and the data can be found at:
    http://grouper.ieee.org/groups/802/3/z/mbi/index.html

Cable name/ ID tag	Fiber name/ ID tag	Transmit GBICID/ JMPRID	Receive GBICID/ JMPRID	Test time (min)	Err ???	CRC error count	Symbol error count	Packet count	Sequence error count	Length error count	P[r] (dBm)	Modal B/W 850 nm (MHz*km)	Modal B/W 1300 nm (MHz*km)	
Lawrence Berkeley National Lab 1-November-1997														
Node 2 to building 25.			Over filled Modal Bandwith is spec'd, not measured											
ATT 62.5 um			433 m	inc. 5 meter jumpers										
N2-B25														
	C1-3	A3/J2	D1/J3	nom	no							200	500	
		B1/J2	D1/J3	nom	no							200	500	
		C1/J2	D1/J3	nom	no							200	500	
		D2/J2	D1/J3	nom	no							200	500	
		A1/J2	A2/J3	nom	no							200	500	
	C1-4	A3/J2	D1/J3	nom	no							200	500	
		B1/J2	D1/J3	nom	no							200	500	
		C1/J2	D1/J3	nom	YES	15,714,783	93,476,026	23,634,283	23,611,074	6,804,795		200	500	
		D2/J2	D1/J3	nom	no							200	500	
		A1/J2	A2/J3	nom	YES	not recorded, testing continued below when failure seen						200	500	
		A1/J1	A2/J4	14.5	YES	38,021	20,068	101,777,083	17,627	780		200	500	
		A1/J1/SMF	A2/J4	5	no			35,515,680				200	500	
		A1/J1/OFS	A2/J4	5	no			35,577,170				200	500	
		B1/J1	D1/J4	5	no			35,507,387				200	500	
		D2/J1	D1/J4	5	no			35,532,209				200	500	
	C1-5	A1/J2	A2/J3	nom	no							200	500	
	C1-6	A1/J2	A2/J3	nom	no							200	500	
	C1-7	A1/J2	A2/J3	nom	no							200	500	
	C1-8	A1/J2	A2/J3	nom	no							200	500	
	C1-9	A1/J2	A2/J3	nom	no							200	500	
	C1-10	A1/J2	A2/J3	nom	no							200	500	
	C1-11	A1/J2	A2/J3	nom	no							200	500	
	C1-12	A1/J2	A2/J3	nom	no							200	500	
	C1-13	A3/J2	D1/J3	nom	no							200	500	
		B1/J2	D1/J3	nom	no							200	500	
		C1/J2	D1/J3	nom	YES	n/a	n/a	n/a	n/a	n/a		200	500	
		D2/J2	D1/J3	nom	no							200	500	
		A1/J2	A2/J3	nom	YES	28,178,323	23,172,271	42,523,538	23,016,162	724,027		200	500	
		A1/J1/OFS	A2/J4	5	YES		high	0				200	500	
		A1/J1/SMF	A2/J4	5	YES	323,547	182,815	35,534,574	50,098	1,457		200	500	
		A1/J1	A2/J4	5	YES	23,212,444	31,863,922	35,386,542	29,016,055	1,774,800		200	500	
	**********	B1/J1	D1/J4	5	YES		high	0				200	500	
	**********	D2/J1	D1/J4	5	YES		high	0				200	500	
	**********		results marked with asterisks may reflect configuration error											
	C1-14	A1/J2	A2/J3	nom	no							200	500	
	C1-15	A1/J2	A2/J3	nom	no							200	500	
	C1-16	A1/J2	A2/J3	nom	no							200	500	
	C1-17	A1/J2	A2/J3	nom	no							200	500	
	C1-18	A1/J2	A2/J3	nom	no							200	500	
	C1-19	A1/J2	A2/J3	nom	no							200	500	
	C1-20	A1/J2	A2/J3	nom	no							200	500	

LAWRENCE BERKELEY NATIONAL LABORATORY

Brief Background on MBI data (cont.)

HP Fiber ID	Starting Location	Ending Location	Fiber Number/Label	Site	Length(m)	Type	Nom. Cell	Manufacturer	Comment
2524	Bldg. 25, Cabinet 1	Node 2, Cabinet 2	4	LBL	419	62/125	200/500?	ATT Lightguide	
2525	Bldg. 25, Cabinet 1	Node 2, Cabinet 2	5	LBL	419	62/125	200/500?	ATT Lightguide	
2526	Bldg. 25, Cabinet 1	Node 2, Cabinet 2	6	LBL	419	62/125	200/500?	ATT Lightguide	
2527	Bldg. 25, Cabinet 1	Node 2, Cabinet 2	7	LBL	419	62/125	200/500?	ATT Lightguide	
2528	Bldg. 25, Cabinet 1	Node 2, Cabinet 2	8	LBL	419	62/125	200/500?	ATT Lightguide	
25213	Bldg. 25, Cabinet 1	Node 2, Cabinet 2	3	LBL	419	62/125	200/500?	ATT Lightguide	

Multimode Fiber Bandwith Test:	12/16/1997	16:41:28
Filename:	C:\Field Test Data\25240000L0c.dat	
Repetition:	c	
Fiber ID:	2524	
Fiber Info 1:	tx Building 25 to rx node 2, cabinet 2	
Fiber Info 2:	at&t lightguide	
Test Location:	LBL	
Fiber Length (m):	419	
Fiber Type:	62 MMF	
Launch Type:	0.5 dB ROFL	
Wavelength:	1300 nm	
Estimated DMD (ps):	1219	
Comments:		
	nb: 500ps/div	
Number of Averages:	1024	

Brief Background on MBI data (cont.)

- **The field test data files contain 1024 data points (time and amplitude) which is convenient for analysis**

- **Recently folks have come back to look as the same fibers in preparation for work to be done for the study group**
  - **Fibers are still "bad" ;-)**
  - **Interesting results that will be presented later**

Conclusions

- **There is a void in 10 GbE solution set**
  - **Even though a PMD was specified we don't have a MMF choice that works on the installed base**
- **IT budgets are no longer blank checks**
  - **Need low cost choices for optical 10 GbE**
- **Specifying a MMF solution that will operate on 300m of FDDI grade fiber will enable end users to save money on infrastructure**
  - **51% of installed MMF at LBNL fall into that category**