850nm-4WDM-1.25Gbaud transceiver over Multimode Fiber for 10 GbE

By

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IEEE 802.3ae - Albuquerque, New Mexico - March 2000

Advantages of 850nm/1.25 Gbaud

1) It will be the cheapest 10 GbE system that supports the installed multimode fiber. Uses low cost active optics at 1.25 Gbaud (VCSEL lasers) and cheap optical mux/demuxes.

2) It will be the cheapest 10 GbE system that will support the new 850nm-2200 MHz*km MMF, reaching also much longer distances than the serial approaches.

3) It will support 160 meter of installed MMF (160 MHz*km), meeting the HSSG objective without any need for equalizers: the optical eye is wide open at 160m

4) It will meet the BER < 10^(-12) objective. (Ref 1)

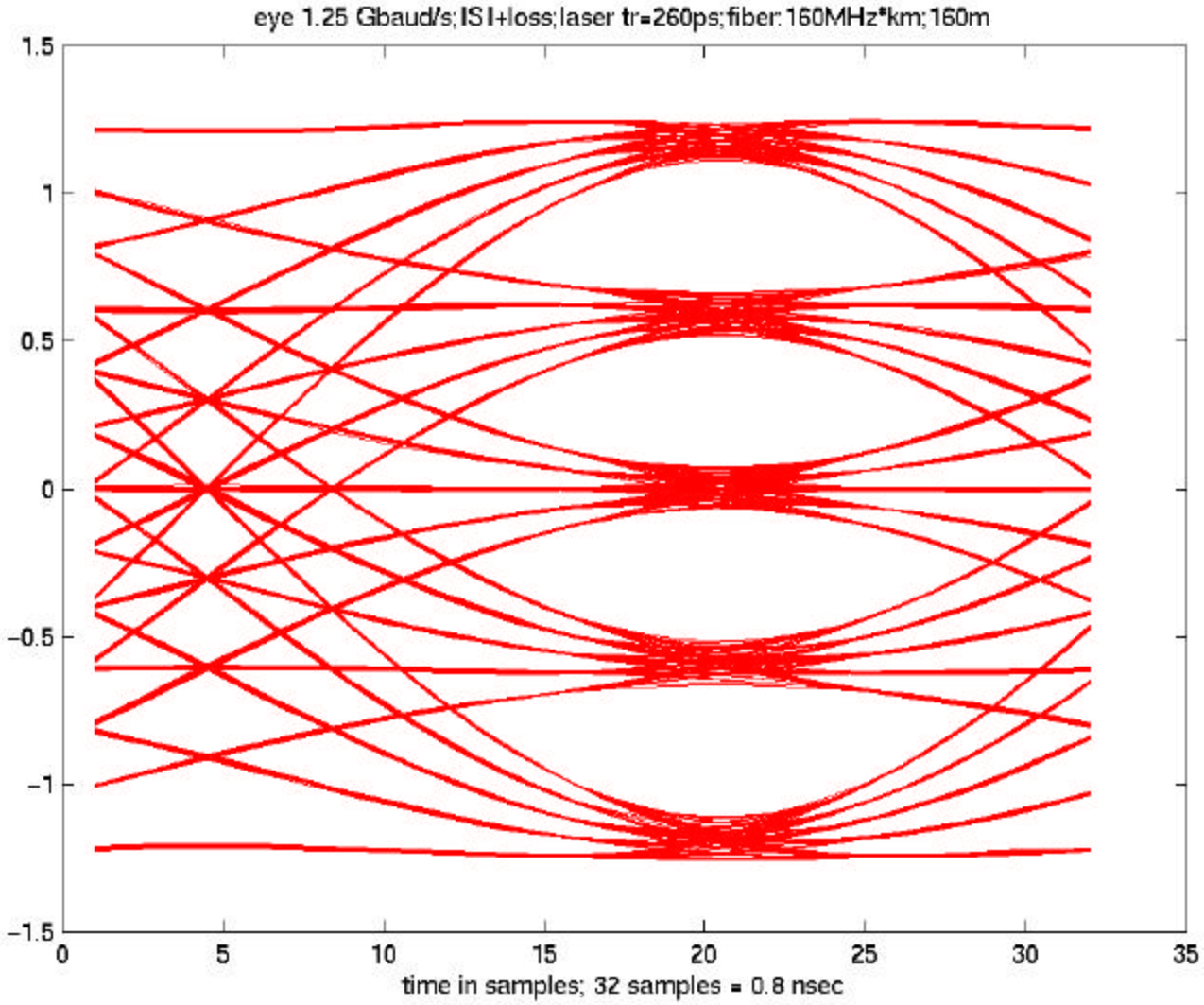
5) Uses mainstream CMOS technology for the Analog Front End (TIA, AGC and ADC), allowing larger integration. (Ref 2)

6) Uses 1.25 Gbaud on Copper traces. Reduces packaging costs and allows the use of standard layout practices and cheap FR4-based PCBs and backplanes.

7) Uses the 1000BASE-T PCS, another Ethernet standard, saving considerable development time.

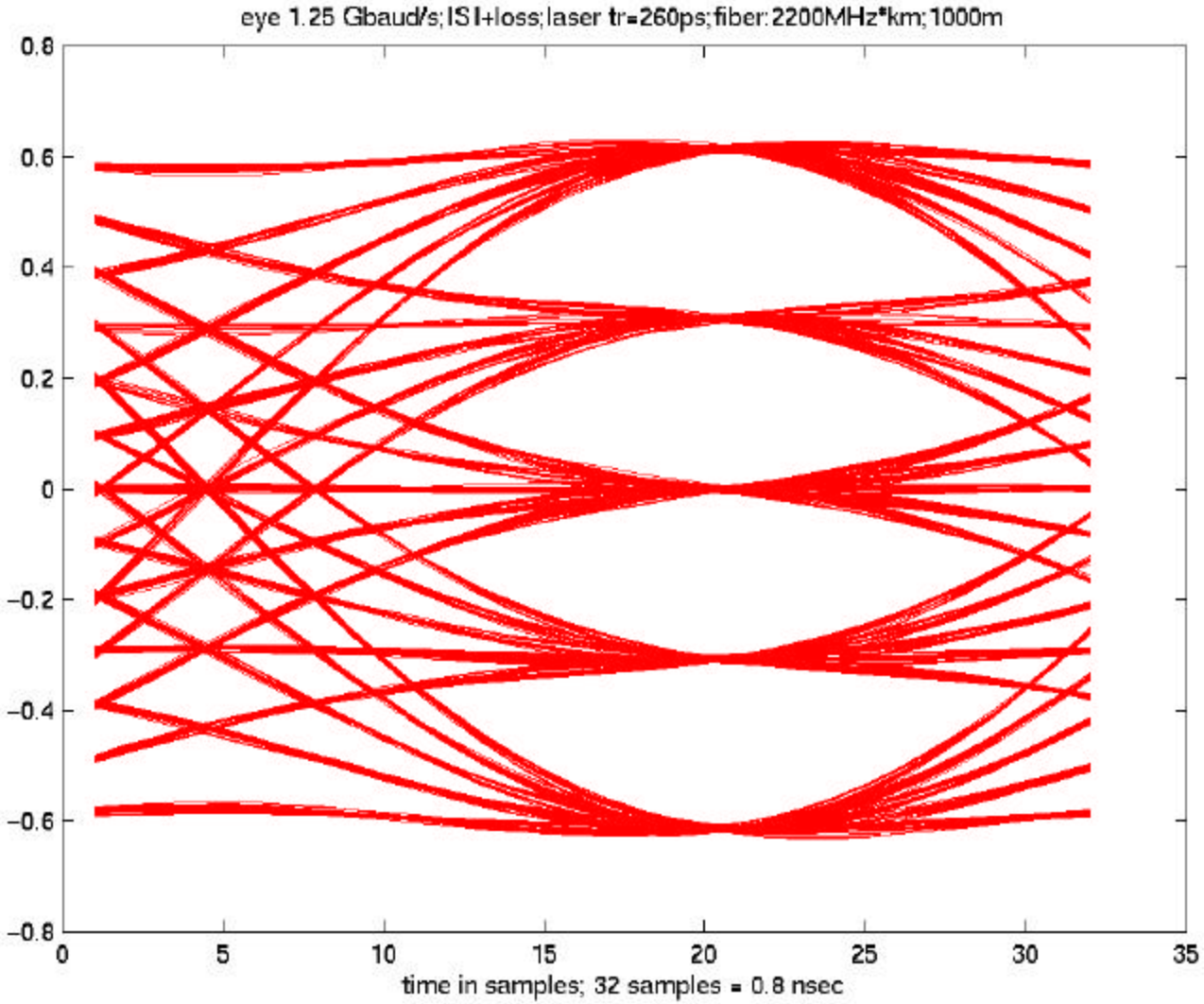
8) Compatible with the addition of DFEs (Decision Feedback Equalizers) by companies that wish to add differentiation in their products and support link lengths above 160 meters.

Optical eye at Rx: 1.25 Gbaud - 160 meters



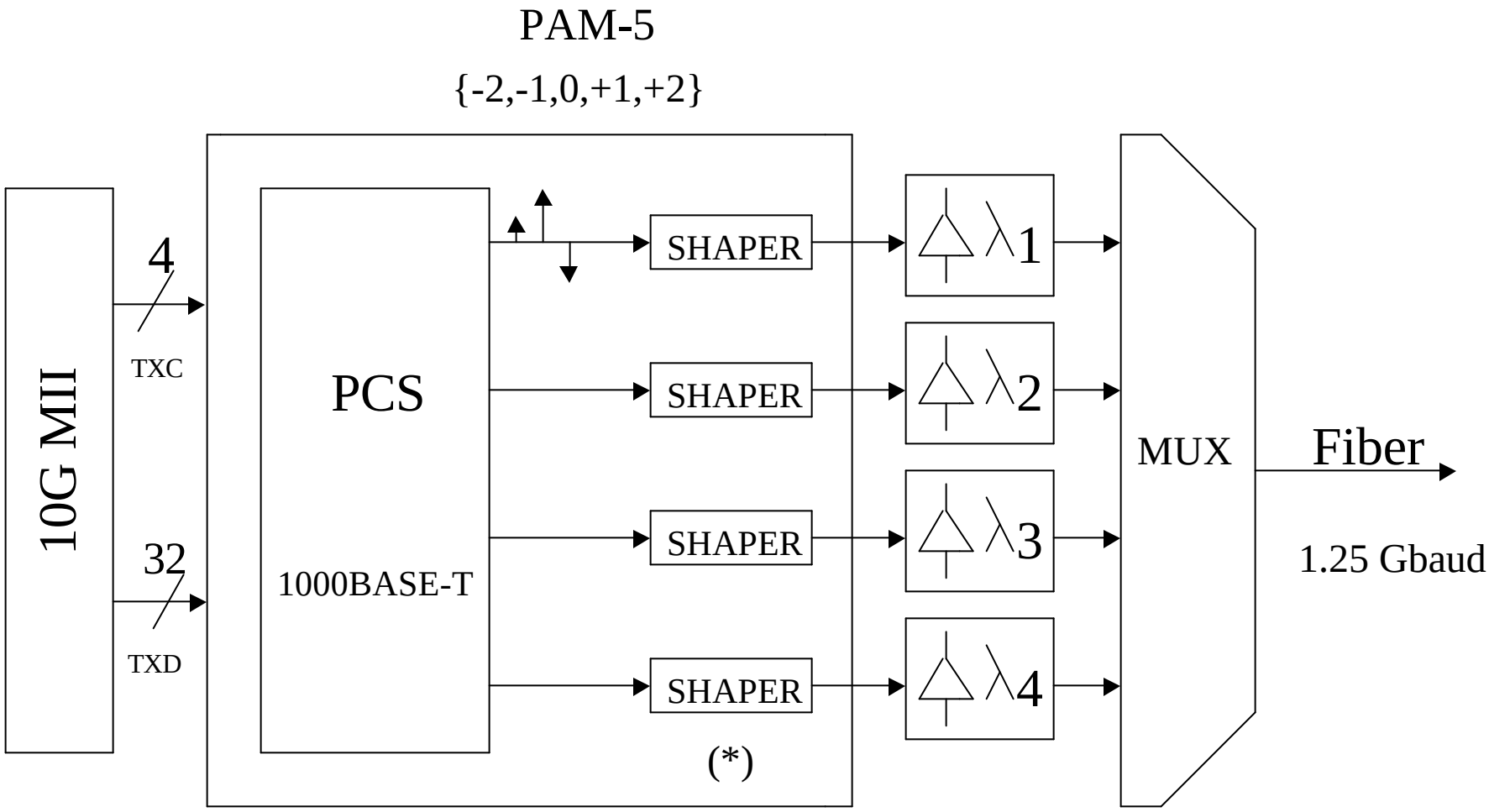
(no need for equalizers: eye is wide open)

Optical eye using 2200 MHz*km fiber: 1000 meters



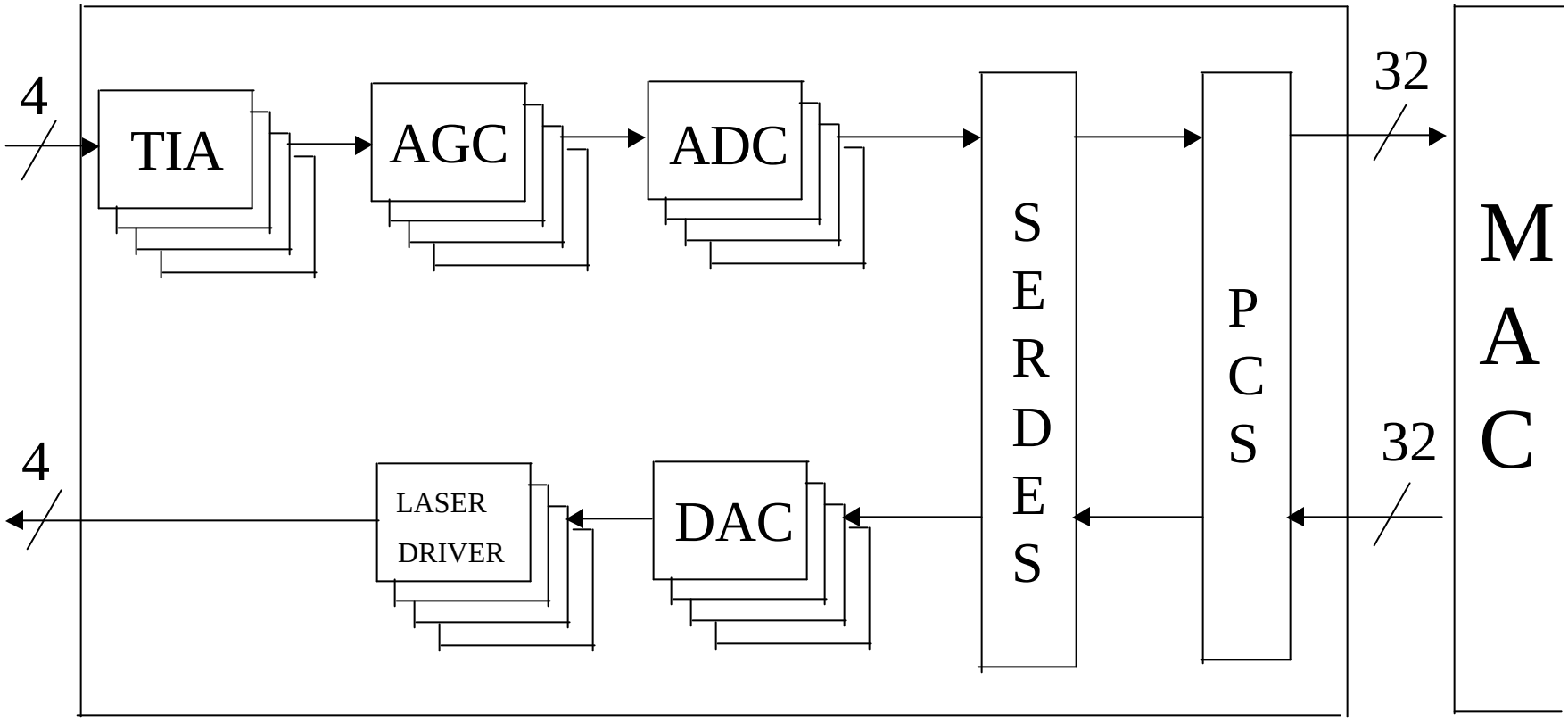
(preliminary results: much more work needed)

PAM5-4WDM-1.25 Gbaud fiber transmitter



(*) optional shaper, may be used to improve the laser linearity

PAM5-4WDM-1.25 Gbaud fiber transceiver



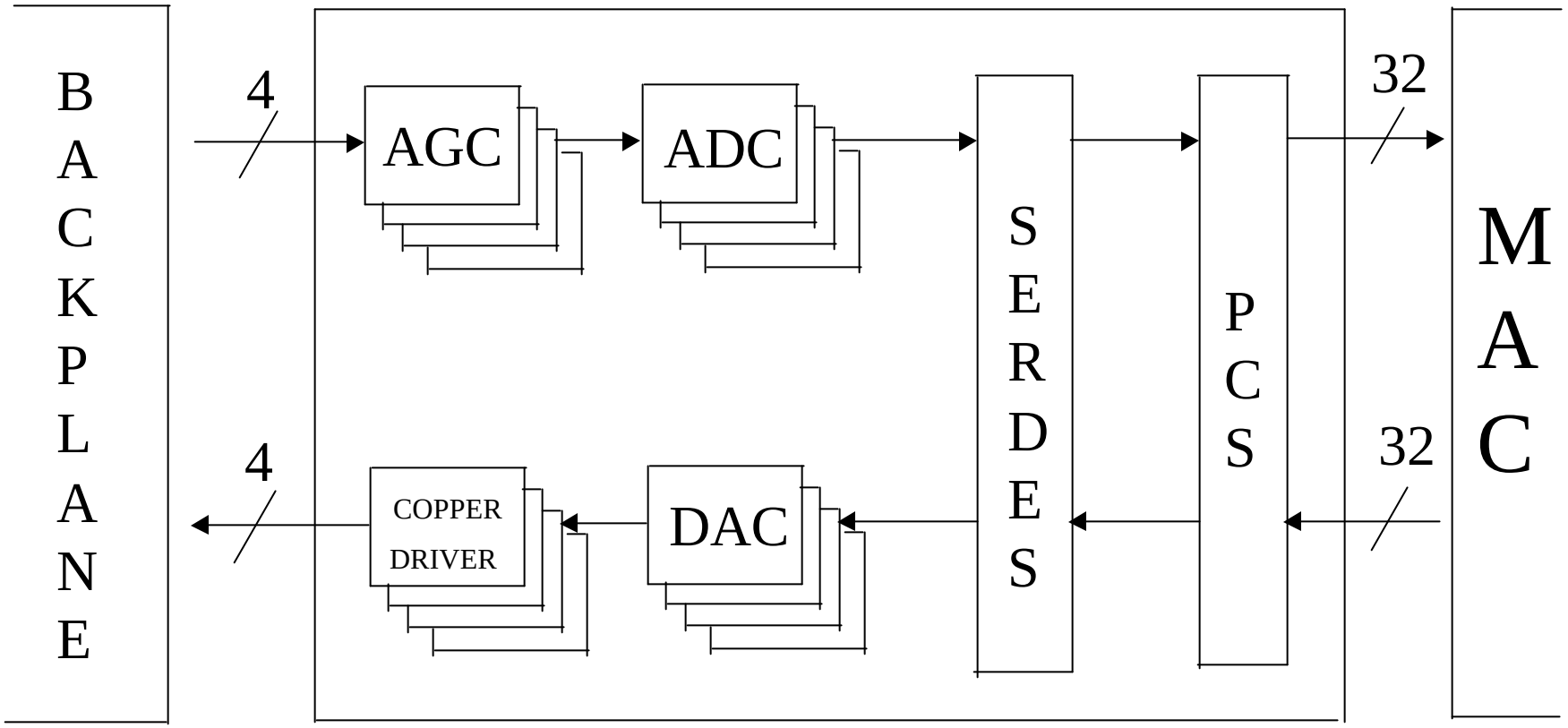
1.25 Gbaud (PAM-5) 312.5 Mbit/s

4-WDM optical mux/demux not shown in picture

TIA = Transimpedance Amplifier

ADC = 18 levels (see Ref 2)

PAM5 -1.25 Gbaud Copper backplane transceiver



1.25 Gbaud (PAM-5)

312.5 Mbit/s

Note:this transceiver is not intended for standardization. It could be used when system considerations will dictate the placement of the optical transceiver far away from the electrical transceiver (~ 20 inches). For more details see Ref 5.

Open fiber control method

Using the open fiber control method (Ref 3) the launched optical power **per channel** in a 4-WDM system can be as large as the total launched power in a serial approach, since 4-WDM does not have a single point of failure. In a 4-WDM architecture the maximum launched power per channel is restricted more by laser linearity at the transmitter and saturation at the receiver.

For the specific implementation of this method see Ref 4.

Open issues

1) Laser linearity

2) Choose between the 6-dB coding option of the PCS (Viterbi decoding) or the simpler 3-dB coding option (straight symbol-by-symbol decoding).

References

1) Jaime E. Kardontchik, “PAM-5, what are your BERs ?”, Feb 27, 2000, 802.3ae email reflector archive

2) Jaime E. Kardontchik, “PAM-5 at 5 Gbaud”, Feb 15, 2000, 802.3ae email reflector archive

3) Eric B. Grann and Ken Herrity, “8 Channel VCSEL Transceiver for 10-Gig”, Dallas presentation, Jan 2000

4) Jaime E. Kardontchik, “Open fiber control in PAM-5”, Feb 22, 2000, 802.3ae email reflector archive

5) Jaime E. Kardontchik and Stefan Wurster, “10000LX-4WDM-1.25 and 10000CX-4T-1.25 Transceivers”, Dallas presentation, Jan 2000

For a full discussion of this proposal see:

6) Jaime E. Kardontchik and Stefan Wurster, “300 meters on installed MMF”, Parts I, II, III and IV, Kauai presentation, Nov 1999

Acknowledgements

We kindly acknowledge many useful discussions with Eric Grann, Ken Herrity and Bill Wiedemann, from Blaze Network Products, regarding the technology of Blaze's optical mux/demuxes.