IEEE P802.3ae TF – 10 Gigabit Ethernet MINUTES
Task Force Interim Meeting
May 23 – 25, 2000
Ottawa, ON

Prepared by: Jeff Warren

Administrative:

The meeting convened at 8:50AM, May 23, 2000. Jonathan Thatcher, the 10 GE Task Group Chairman, opened the meeting with a presentation of the agenda, now available at the IEEE web site http://grouper.ieee.org/groups/802/3/ae/public/may00/index.html

Jonathan then volunteered Jeff Warren to act as recording secretary for the meeting and went on to review the agenda. A motion to approve the agenda was made by Tom Dineen, it passed by acclamation. Jonathan then reviewed all the administrative items such as reflector and web locations, membership, voting and sign-in rules.

The next meeting is a plenary meeting and will be held in La Jolla, CA. From July 10th – 14th. This July meeting is dedicated to nailing down the basis for the initial draft.

An e-mail reflector has been set up for the IEEE802.3ae 10 Gigabit Ethernet task group, http://grouper.ieee.org/groups/802/3/10G_study/email/thrd1.html To be added to the reflector go to the IEEE P802.3ae 10Gb/s Ethernet Task Force Reflector Information page and follow instructions. http://grouper.ieee.org/groups/802/3/ae/reflector.html

The voting rules can be found at http://grouper.ieee.org/groups/802/3/rules/member.html
The 802.3 patent policy can be found at http://grouper.ieee.org/groups/802/3/patent.html
Mr. Geoff Thompson, the chair of 802.3 reviewed the current patent policy rules with the HSSG group.

This interim meeting closed with mixed results; most significantly the group is divided on the issue of narrowing down the PMD options to an acceptable number. On one hand the system vendors are united on a minimum set of 3 PMDs (or less) that are optimized for three distinct 10GbE markets, i.e. short reach (SR-100m/300m) over multi-mode fiber, medium reach (MR-2km/10km) over single-mode fiber and long reach (LR-40km) over single-mode fiber. The PMD component suppliers have coalesced around a 5 PMD set. The PMD sub-group chairman stated that neither camp has sufficient strength to win a 75 % technical vote in this committee. Therefore to avoid deadlock, this group must work together over the coming weeks leading up to the start of the July plenary. Coming out of this July plenary the group **must have consensus on the minimal PMD set possible that addresses all GE objectives.** The chair conducted an unofficial show-of-hands poll asking people to choose their preference for the number of PMDs from 2 PMDs through 6 PMDs. No count was taken. Only two choices received substantial support: 3 PMDs and 5 PMDs. Only a small fraction of the TF membership participated.

The interim 10 GE Task Group meeting was adjourned at 12:30pm on Thursday the 25th of May 2000.

Outline:

Meeting Goals:

We are currently in the "Selection Phase" which runs from March – July 2000. During March 2000 the group surveyed the 10 GbE membership for their current "state of mind" and decided that a reduction in the number of PMD proposals should be 7 or less.

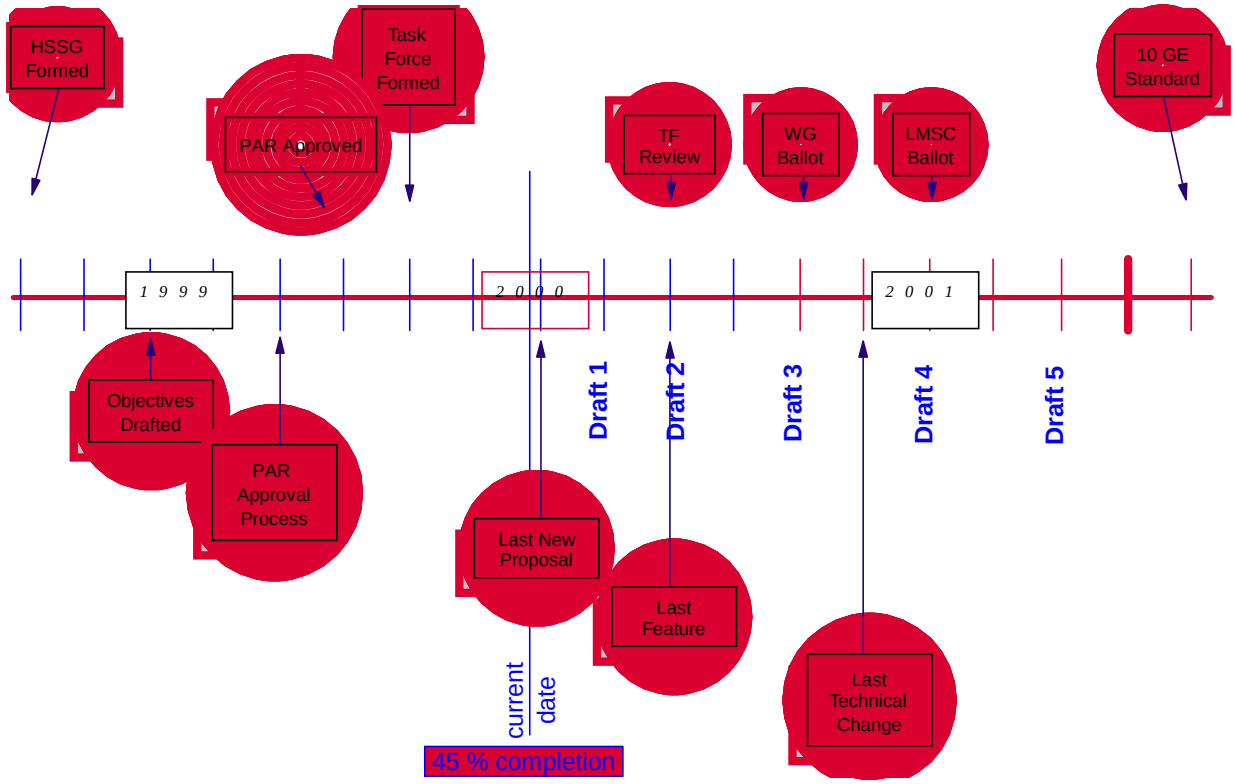
The goals for this May 200 meeting are to stage for the July final selection of proposals, identify final candidates (e.g. coding schemes) and consolidate proposals including identifying clause structure.

During the July meeting the group will adopt and refine baseline proposals as well as plan the 1st draft for a September 2000 availability. We must keep options for new proposals open until July 2000. We have twice as much time at this interim as we will have in July 2000. Our focus is to refine the proposals and make the July meeting quick and effective.

Future Meetings:

- July 10th – 14th Plenary meeting La Jolla, CA
- September 12th – 14th Interim meeting Boston, Mass
- November 12th – 16th Plenary meeting Tampa, Florida

IEEE 802.3ae Standards Timeline:



Group Demographics

- Total Number in Room: **191**
- Would 1st Time Attendees Please Stand: **48**
- How many of you plan to attend only this meeting: **0**
- How many plan to become regular members of 802.3ae: **29**
- Would 802.3 Voters Please Stand: **89**
- Would Those On Track to Become 802.3 Voters in July Please Stand: **130**
- Number of 802.3ae System Integrators: **47**
- Number of Chip Vendors: **59**
- Number of Optical Transceiver Vendors: **43**
- Number of Software Vendors**: 0**
- Number of Fiber Infrastructure Vendors: **19**
- Number of Consultants**: 4**
- Number of "End Users": **3**
- Would everyone who hasn't raised their hand for a Business Type Please Stand: **12**
  - 4 consultants
  - 3 end users
  - 5 other (e.g. universities)

Objectives:

- Preserve the 802.3/Ethernet frame format at the MAC Client service interface.
- Meet 802 Functional Requirements, with the possible exception of Hamming Distance.
- Preserve minimum and maximum FrameSize of current 802.3 Std.
- Support full-duplex operation only.
- Support star-wired local area networks using point-to-point links and structured cabling topologies.
- Specify an optional Media Independent Interface (MII).
- Support proposed standard P802.3ad (Link Aggregation)
- Support a speed of 10.000 Gb/s at the MAC/PLS service interface
- Define two families of PHYs
  - A LAN PHY, operating at a data rate of 10.000 Gb/s
  - A WAN PHY, operating at a data rate compatible with the payload rate of OC-192c/SDH VC-4-64c
- Define a mechanism to adapt the MAC/PLS data rate to the data rate of the WAN PHY
- Provide Physical Layer specifications which support link distances of:
  - At least 100 m over installed MMF
  - At least 300 m over MMF
  - At least 2 km over SMF
  - At least 10 km over SMF
  - At least 40 km over SMF
- Support fiber media selected from the second edition of ISO/IEC 11801 (802.3 to work with SC25/WG3 to develop appropriate specifications for any new fiber media).

Agenda:

802.3ae Agenda

Speaker	T	Topic	Time Req	Time Allc	Start Time
Tue, 23 May 2000		**Call to Order**			8:30 AM
Jonathan Thatcher	Z	Opening Business	0:45	0:45	8:30 AM
Bruce Tolley		"Prospective Applications and market opportunities"	0:15	0:15	9:15 AM
Booth, Bradley	T	P802.3ae Document Structure	0:30	0:30	9:30 AM
Howard Frazier	T	Comparison of Rate Control Methods		0:20	10:00 AM
Shimon Muller		Proposal for an Open Loop PHY Rate Control Mechanism	0:20	0:20	10:20 AM
		Break	0:20	0:30	10:40 AM
Roy Bynum	T	WAN compatible PHY Operational Maintenance Recommendations	0:30	0:30	11:10 AM
Osamu ISHIDA	T	Link Signaling Sublayer (LSS) Proposal	0:20	0:20	11:40 AM
		Lunch	1:20	1:30	12:00 PM
Rich Taborek	T	XAUI/XGXS Proposal	0:30	0:50	1:30 PM

Rich Taborek	T	8B/10B Idle EMI Reduction		0:25	2:20 PM
		Break	0:20	0:30	2:45 PM
Rick Walker	T	64b/66b PCS	0:25	0:25	3:15 PM
Paul Bottorff	T	10GE WAN PHY Overview (UniPHY WIS)	0:40	0:40	3:40 PM
Rich Taborek		Wide/Coarse WDM Wide/Coarse WDM LAN PCS/PMA	0:20	0:20	4:20 PM
Stuart Robinson	T	Optional Physical Instantiation of a PMA Service Interface for Serial PMD's		0:20	8:30 AM
David Law	T	10Gb/s Ethernet MDC/MDIO Proposal	0:20	0:20	4:40 PM
		Adjourn			5:00 PM

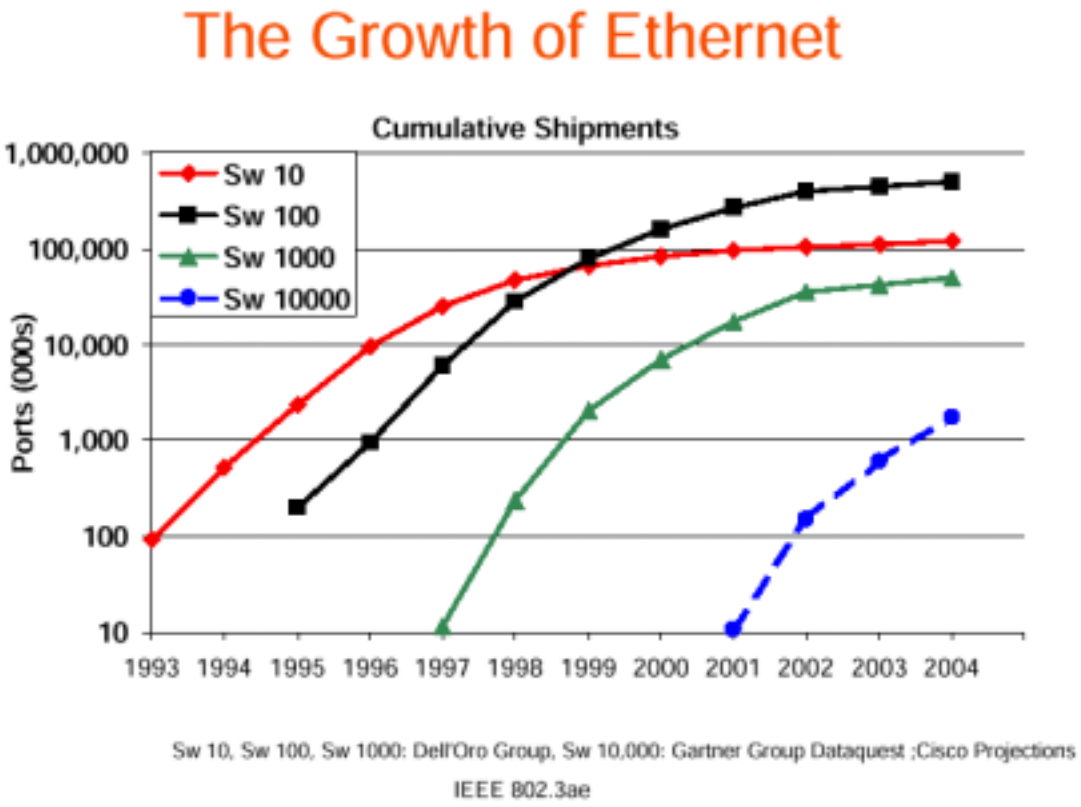
Wed, 24 May 2000		**Call to Order**			8:30 AM
Joseph N. Babanezhad		10 Gb/s Copper Solution		0:20	8:50 AM
Chris Diminico		TIA-IEEE-liaision	0:10	0:10	9:10 AM
Michael J Hackert	T	TIA FO-2.2.1 liaison report	0:15	0:15	9:20 AM
Edward Chang	T	10GbE CWDM 850 nm VCSEL for Installed & New MMF	0:20	0:20	9:35 AM
Jack Jewell		Merits of 850nm Serial PMD	0:10	0:15	9:55 AM
Jack Jewell		850nm Serial Experimental Update	0:10	0:15	10:10 AM
		Break	0:20	0:35	10:25 AM
Jim Tatum		10000BASE-X PMD Proposal	0:15	0:20	11:00 AM
Paul F Kolesar		Modeling, Simulation, and Experimental Study of a 50um MMF Serial 10Gb Link	0:25	0:25	11:20 AM
Bill Wiedemann	T	CWDM 10GBASE-SX Proposal	0:30	0:30	11:45 AM
		Lunch	1:20	1:30	12:15 PM
Paul F Kolesar		Proposed set of PMDs, related specifications & rationale	0:50	0:50	1:45 PM
Michael M. Fisk		1550 Long Distance CDWM Transcievers		0:20	2:35 PM
Krister Fröjdh	T	1300 and 1550 nm single mode serial PMDs	0:20	0:20	2:55 PM
		Break	0:20	0:35	3:15 PM
Edward Chang		Support of All 10 GbE PMD Options		0:15	3:50 PM
Del Hanson	T	3-PMD proposal	0:25	0:25	4:05 PM
Jonathan Thatcher	Z	Oh, no. Not Another Survey	0:30	0:30	4:30 PM
		Adjourn			5:00 PM

Thurs, 25 May 2000		**Call to Order**			8:30 AM
Jonathan Thatcher	Z	Report on Survey	0:20	0:20	8:30 AM
David Law	T	10Gb/s Ethernet Management MIB Proposal	0:15	0:15	8:50 AM
Howard Frazier	Z	"Warriors of the Net - IP for Peace"	0:15	0:15	9:05 AM
Jonathan Thatcher	Z	Business	2:00	2:00	9:20 AM
		Adjourn			11:20 AM

Presentations:

1. 10 Gigabit Ethernet: Customer Applications (Bruce Tolley)
   http://grouper.ieee.org/groups/802/3/ae/public/may00/tolley_1_0500.pdf

   Mr. Tolley started by stating that our customer's installed infrastructure will be used to run new networking equipment. The latest statistics on Ethernet technology shows that 75% of the new Ethernet gear being installed is 100T, however 1 GE is picking up nicely at 250,000 ports per month. The usual estimated growth curves were shown, they estimate that 10 GE shipments will grow to 1M ports by 2004. The areas where 10 GE will be used is in the LAN (ISP's and enterprise), MAN (dark fiber and DWDM) and WAN (access router attachment edge connections). A question on 10 GE links by distance was asked by Steve Swanson, Bruce does not have a market projection on this but did say his customers link distances are bi-modal, they want either very long links or very short links.



2. Document Structure (Brad Booth)
   http://grouper.ieee.org/groups/802/3/ae/public/may00/booth_1_0500.pdf

   Mr. Booth gave an update to his document structure plans for our 10 GbE standard. This document is evolving as we work out what the core proposals will be. There may be some clause numbering interaction with other on going task groups such as DTE Power. Draft 1 will come out in September. There was a request to please be very complete when making these final proposal presentations. There was a brief

discussion of the optional portions of the architecture, but we can be assured that all these optional items will be in the 10 GbE specification. An estimate of the skill level of individuals needed to write the various clause sub-sections was discussed. The section difficulties were classified as, hot – senior – pro – mild – junior – medium – minor. New clauses were outlined and the current list of clause editor volunteers (as of 6/13/00) are as follows:

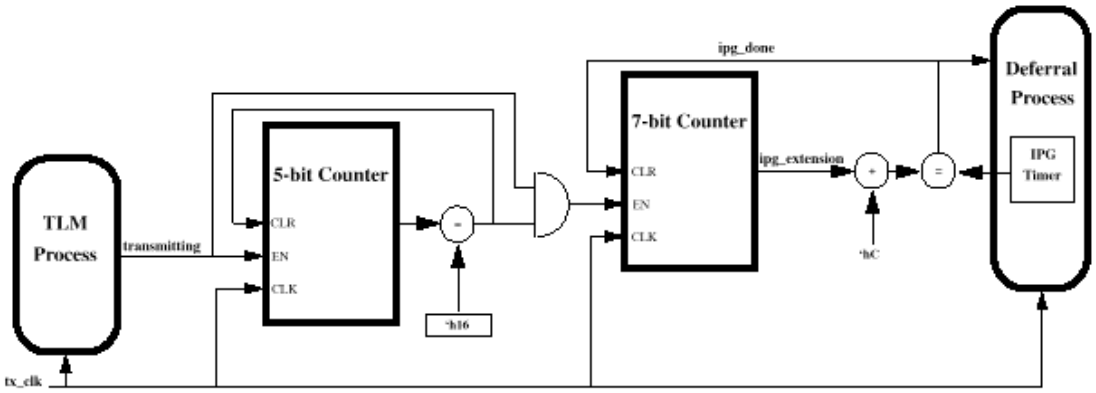
- Clause 1 - Shimon Muller
- Clause 2 - Shimon Muller
- Clause 3 - Shimon Muller
- Clause 4 - Shimon Muller
- Clause 5 - Larry Rubin
- Clause 6 - Brad Booth
- Clause 22 - Ed Turner
- Clause 30 - David Law
- Clause 31B - Shimon Muller
- Clause 44 (Intro.) - Brad Booth
- Clause 45 (XGMII) - Bob Grow
- Clause 46 (XGXS/XAUI) - Rich Taborek
- Clause 47 (PCS) - Pat Thaler
- Clause 48 (WIS) - Tom Alexander
- Clause 49 (PMA) - Justin Chang
- Clause 50 (PMD) - David Cunningham
- Clause 51 (PMD) - Jay Hoge

3. Proposal for an Open Loop PHY Rate Control Mechanism (Shimon Muller)
http://grouper.ieee.org/groups/802/3/ae/public/may00/muller_1_0500.pdf

Mr. Muller gave a recap of his rate control mechanism. This function is needed because we have an objective to do this due to the desire to have one MAC that supports both the LAN and WAN Phys that support different data rates. Shimon discussed why some alternative proposals were not as easy to implement as his. For example the word-by-word proposal does not work with the Hari interface, is difficult to get the timing right, and in general complicates the pipeline processing of data flow processing. Since the MAC can have prior knowledge of the Phys data rate this information can be used to simplify the rate control mechanism. Shimon says just worry about sustaining the maximum size frame data rate. The implementation is simple, a couple of counters are used for example to keep track of the number of bytes transmitted to develop the average data rate offered to the Phy. Ultimately this "Self-Pacing" rate control mechanism will dynamically alter the IPG size after each and every frame transmission. In keeping with Mr. Thatcher's rules of complete proposals, Shimon presented the Pascal Code changes needed to support this proposal. Shimon discussed an XGXS concern, he said that since XGXS requires alignment of the first byte of a frame to lane 0 there is a worse case XGXS overhead of 4.62% for small packets. During the week Shimon will ask for support of his proposal. Mr. Grow asked how he handles clocks that are out of spec? If your clocks are out of spec there are a lot of things that can go wrong. There was discussion about

concerns for the WAN Phy because of its synchronous nature and jumbo frames. Answer Ethernet is not a synchronous system, jumbo frame discussions are out-of-order.

MAC Self-Pacing Proposal --- Implementation



Notes:

* **transmitting --- signal that frames the transmission of a frame in the MAC**
* **ipg_done --- signal that indicates the completion of IPG transmission**

4. WAN compatible PHY Operational Maintenance Recommendations (Roy Bynum)
   http://grouper.ieee.org/groups/802/3/ae/public/may00/bynum_1_0500.pdf

   Mr. Bynum has investigated the differences of how 10 GE WAN & LAN systems might be implemented. Roy's pitch started with a reference model of the service provider transmission (on-site at PoP) and customer owned fiber networks (off-site from PoP). The SONET overhead bytes that Roy feels are relevant were shown. The vast majority of the bytes are not used, the ones that are used include Framing A1/A2 for synchronization, H1,2,3 pointers for locating 1st byte of payload, B1 for overhead integrity, J1 trace, B3, C2 label, G1 Status and FEBE far end bit error rate. The B3 path bit interleaved parity byte is sent from the near end system to the xGbE Data Switch at the PoP. Together the B3 & G1 error indicators give the enterprise network management operational performance information for the full link span. The B1 is also sent from the near end system to the SONET Lite LTE Network Element, this gives us a granularity of error detection down to the customer owned fiber network. If B3 is showing bit errors but the B1 is not you can assume these errors are coming from the service provider. There was a question about why was K1/K2 and DCC bytes were dropped? The answer was this committee has defined a WAN Phy in the past and these bytes were not included.

Roy summarized with some recommendations (see below) for operations and maintenance functions that would exist between the MAC and the WAN Phy, these would also end up in the WAN Phy MIB.

From PHY to MAC:

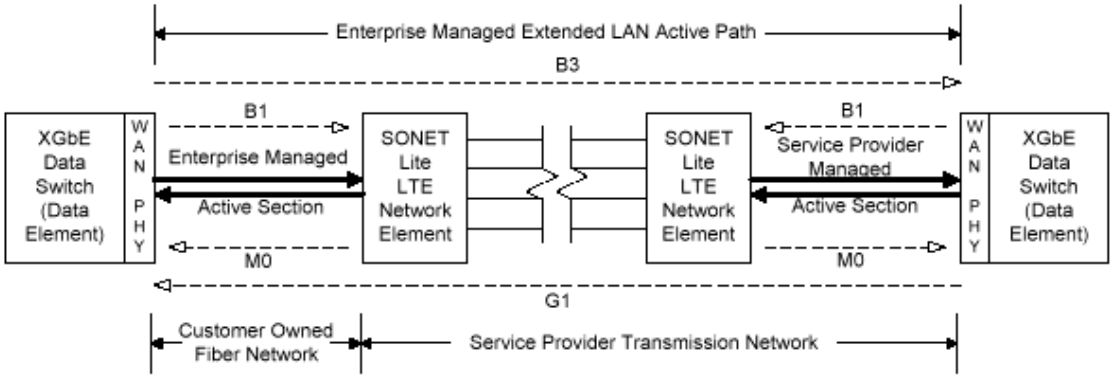
- **Local Optical Link Up/ Down** - reports condition of optical signal into the local interface
- **Remote Optical Link Up/ Down** - reports condition of optical signal into the remote interface
- **Local link Sync Valid/ Invalid** - reports condition of signal sync into the local interface
- **Remote link Sync Valid/ Invalid** - reports condition of signal sync into the remote interface
- **Local Path BIP/ Second** - reports the bit error rate of signal into the local interface for the end to end path
- **Remote Path BIP/ Second** - reports the bit error rate of signal into the remote interface for the end to end path
- **Local Section BIP/ Second** - reports the bit error rate of signal into the local interface for the directly connected fiber facilities
- **Remote Section BIP/ Second** - reports the bit error rate of the signal into the remote interface of the directly connected fiber facilities
- **Remote Path Trace** (16 octet alpha) (from PHY to MAC) - reports the user defined path

From MAC to PHY:

- **Local Path Trace** (16 octet alpha) - writes a user defined path identifier into the path trace byte for identification of the local interface to the remote end
- identifier from the path trace byte to identify the interface at the remote end

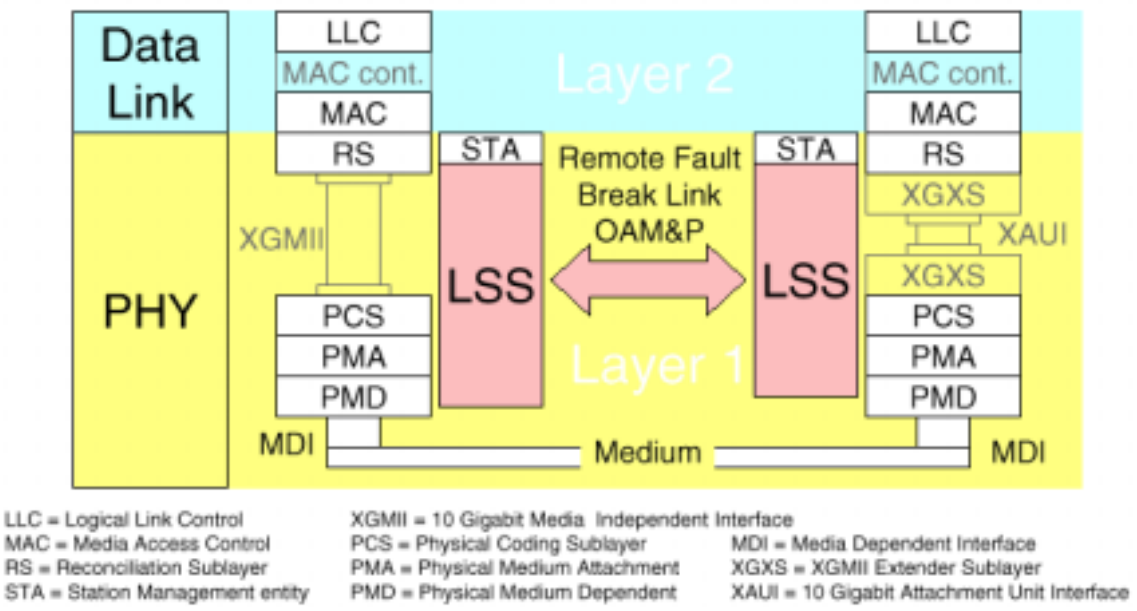
From remote MAC to local MAC through remote path error indicator:

- **Remote Data Link Valid/ Invalid** - reports condition of data link between interfaces at the end to end path level



5. Link Signaling Sublayer (LSS) Proposal (Osamu ISHIDA)
http://grouper.ieee.org/groups/802/3/ae/public/may00/ishida_1_0500.pdf

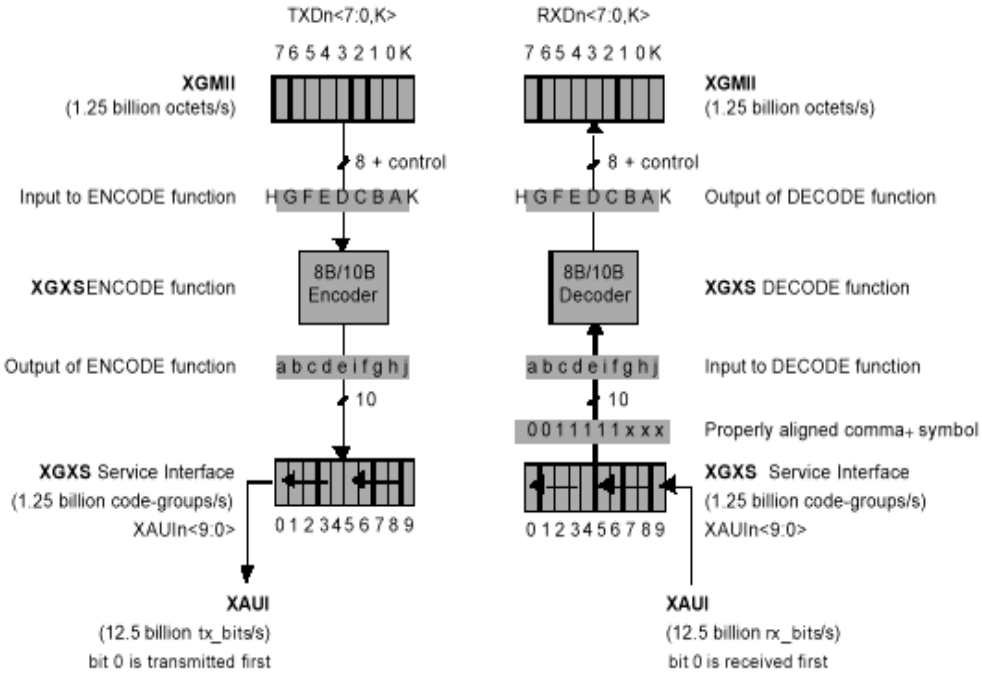
Mr. Ishida presented a LAN "Link Signaling Sublayer (LSS) Proposal" on behalf of a group of 10 companies and 20 individuals. The representative set of companies are nSerial, Intel, Nortel, World Wide Packets, NTT, Vitesse, Avici, Giga, Hitachi Cable and Agilent. LSS is a Phy layer function used to convey remote fault, break link and OAM&P (e.g. monitoring BER). The functions of break link and remote fault are very important. In the past remote fault was not implemented very well, Howard Frazier expressed his concern with this proposals complexity on the implementation of remote fault. Howard encouraged the group to focus on a much more simple (simpler than LSS) mechanism for indicating remote fault. The LSS proposal calls for link signaling to be transmitted during the inter-packet gap by replacing a column of Idle symbols with LS control codes, this would only happen in every other IPG between frames. Therefore the bandwidth is approximately (9 bytes of useful LS control codes / LSS insertion)*(50 LSS insertions / 156,250 bytes) * 10 Gbps = 28.8 Mbps LSS channel.



6. XAUI/XGXS Proposal (Rich Taborek)
   http://grouper.ieee.org/groups/802/3/ae/public/may00/taborek_2_0500.pdf

   Mr. Taborek gave the group a review on the XAUI/XGXS technology with one significant update, the inclusion of an 8b/10b IDLE EMI reduction proposal. XGXS performs parallel column striping across the 4 serial lanes. You can achieve receiver synchronization on just the IDLE pattern. Synchronization is maintained on all four links. Loss of Sync on any one of the four lanes will cause Loss-Of-Sync for the entire XAUI links. The 8B/10B transmission code is used across this link extension. The three inch reach of the 74 pin XGMII interface is extended to greater than 20 inches via 16 pin XAUI interface. This 10 GE standard also uses the same 1 GE code groups, with the addition of a few new ones, e.g. /LS/ K28.1 (Link Signaling) - LSS proposal. The XGMII to XAUI mapping was shown, see diagram below. Rich feels that the XAUI meets HSSG objectives and PAR 5 criteria. Can the A-column be used for remote fault? I need to think about that. How does the clock tolerance compensation work? Same as Fiber Channel. The comma character is used to get code group boundaries. It is simpler to deal with two clocks (i.e. 8B/12B and 66/64) than to deal with running the serial optics at 12.5 Gbaud as opposed to 10.3 Gbaud.

Data Mapping: XGMII to XAUI



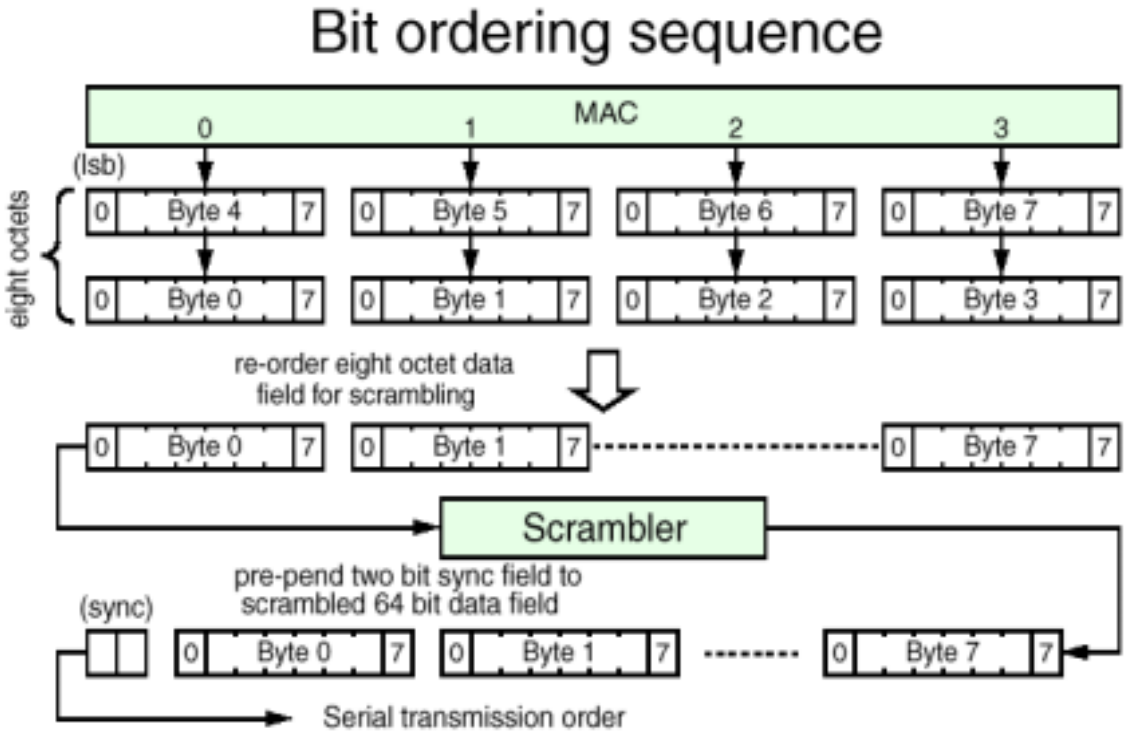
7. 8B/10B Idle EMI Reduction (Rich Taborek)
   http://grouper.ieee.org/groups/802/3/ae/public/may00/taborek_1_0500.pdf

   Mr. Taborek addressed an 8b/10b IDLE pattern XAUI EMI concern with this pitch backed by nSerial, IBM, Agilent and HP. Rich stated that implementing this proposal does not mean all EMI concerns go away. The solution centers on a change to the IDLE pattern coding, more specifically to randomize it. The change should be added to XAUI/XGXS and the PCS for WWDM. Rich claimed that "clocks and repetitive signals that are high in frequency and close to the bulkhead are primary EMI sources". It turns out that the idle pattern case is most challenging to deal with. The group that recently studied this concern decided to randomize the AKR Idle pattern. Rich summarized by stating that the 8B/10B concerns have been addressed with a simple coding scheme. By doing so none of the benefits of XAUI/XGXG or 8B/10B coding have been compromised.

8. 64b/66b PCS (Rick Walker)
   http://grouper.ieee.org/groups/802/3/ae/public/may00/walker_1_0500.pdf

   Mr. Walker's 64b/66b PCS proposal has been worked on by seventeen individuals since the IEEE802.3ae group has seen it last. A Blue book is coming together on this PCS technology. This pitch was mostly a review of the 64b/66b code. Each code group (i.e. S, T, I, E and D) is comprised of two column's worth of data and these

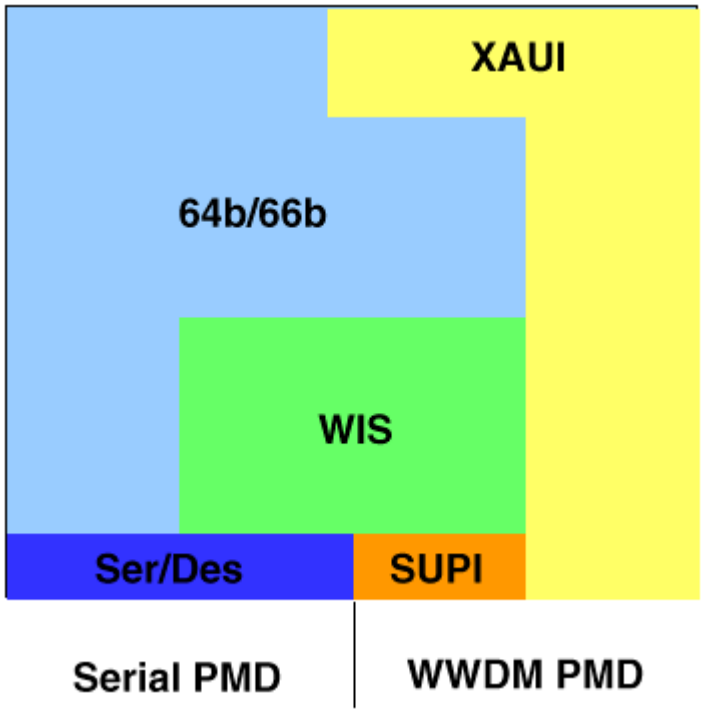
results in twelve possibilities. The first two bits of a 66-bit codeword are used for synchronization and delineation of either a data_codeword or mixed data & control words, the other 64 bits of these codewords are scrambled. The code relies on 'S' always being in lane 0. The 7-bit control code mapping was modified since presented last. Other new material included the bit ordering sequencing diagram, that shows how the parallel data is serialized and then scrambled, see the diagram below. An understanding of the bit ordering on the wire is important and was explained in detail. Rick's test vectors were included to help others implementing this code. These test vectors are a reference design that can be tested against to verify other designs and implementations. Frame alignment and synchronization specs were detailed, including a synchronization state machine. A 3 bit hamming condition was discovered. This problem was dealt with in the receiver state machine. Special frames are reserved to support ordered sets for both Fiber Channel and the new 10GbE Link Signaling Sublayer (LSS) proposal. Mr Dineen pointed out that the test vector frame did not completely comply with a well formed Ethernet frame.



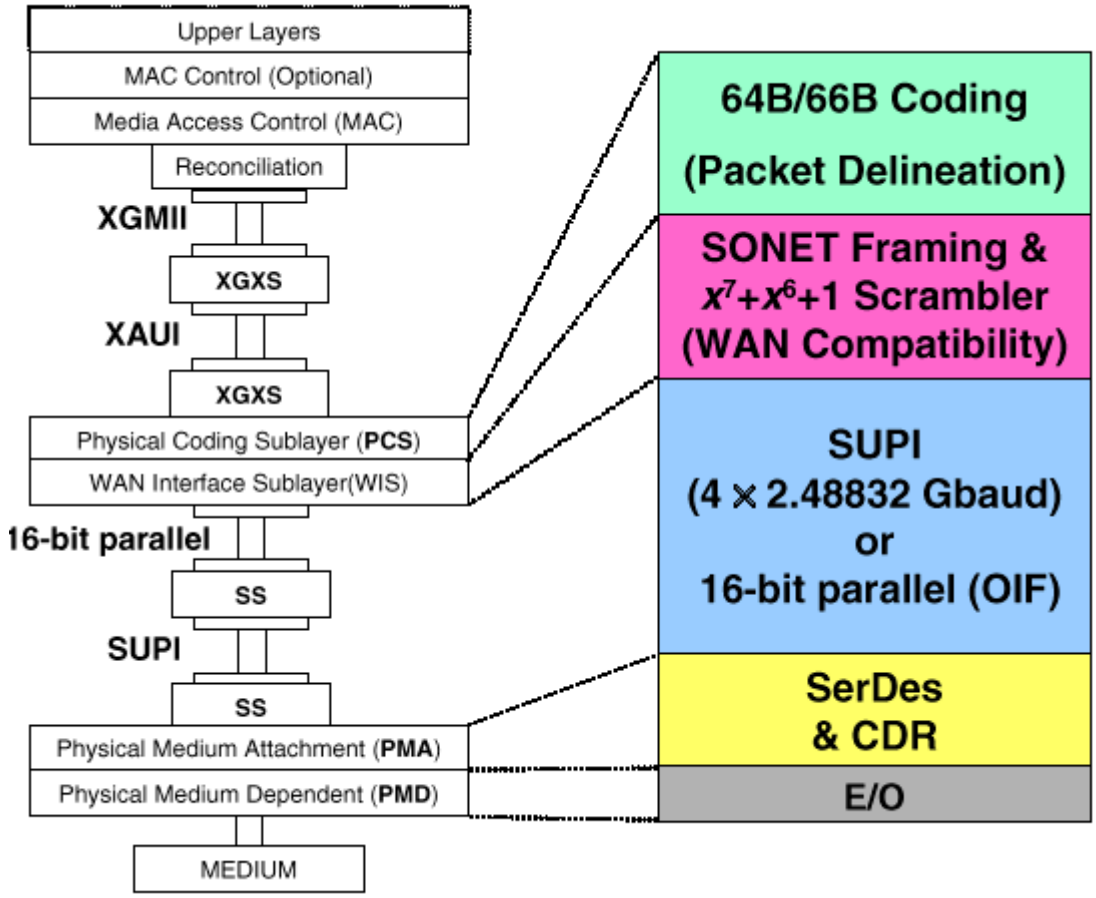
9. 10GE WAN PHY Overview (UniPHY WIS) (Paul Bottorff)
   http://grouper.ieee.org/groups/802/3/ae/public/may00/bottorff_1_0500.pdf

Mr. Bottorff gave an update to the WAN Phy. There are two interfaces on the table for PMD's, in the case of WWDM transceivers the SUPI (4 x 2.48832 Gbaud) interface is used and other transceivers use a 16-bit parallel OIF interface. The main application for WAN Phys is under 300meters in the PoP, however the WAN Phy has very long distance requirements over dark fiber, so both Serial and WDM optics should be used. The

SONET framing component (also called WIS for WAN Interface Sublayer) includes a scrambler that is implemented in MSB fashion. The scrambler is used to assure a sufficient number of transitions for clock recovery at the receiver. Paul took us through the overhead bytes again. Paul stated that the K1/K2 bytes are not used to perform APS, but are used to simply indicate that the single channel used is for the working channel. A bit reversal is required above the WIS. The bit reversal occurs on the PCS side of the WIS. As compared to Roy Bynum's pitch, there were differences in the minimum set of overhead bytes required. The overhead of 64/66 reduces the data rate by approximately 3 percent.



The above diagram is useful for visualizing the various WAN and LAN Phy components. The XGMII is on the top of this diagram.



The above diagram is the WAN PHY Layer model advocated by the proponents of this presentation; the full list of supports includes:

- **Nortel Networks:** Norival Fi gueira, Paul Bottorff, David Martin, Tim Armstrong, Bijan Raahemi
- **Cisco Systems:** Howard Frazier
- **Lucent (Bell Labs):** Enrique Hernandez
- **Lucent Microelectronics:** Nevin Jones
- **Extreme Networks:** Steve Haddock
- **Intel:** Panka j Kumar, Bradley Booth
- **Juniper Networks:** Bjørn Liencres
- **AMCC:** Tom Palkert
- **PMC Sierra:** Iain Veri gin, Stuart Robinson, Tom Alexander
- **Lantern Communications:** Nader Vijeh
- **Vitesse:** Frederick Weniger
- **Sun Microsystems:** Shimon Muller

10. Comparison of Rate Control Methods (Howard Frazier)
http://grouper.ieee.org/groups/802/3/ae/public/may00/frazier_1_0500.pdf

Mr. Frazier's goal for this meeting was to get the group thinking about how to zero in on one rate control method. There are five possible ways to accomplish rate control. 1. Clock stretching (timing is very difficult and doesn't work with XAUI), 2. Word hold (needs extra pins), 3. Busy idle (constrains physical distance between MAC and PHY because of the response time issue), 4. Open loop (MAC controls the rate) and 5. Frame based (very bad because a large amount of logic is required in the PHY). Howard briefly described each option, then gave the group a list of pros and cons for each option. A set of straw polls was taken to gauge the will of the group on the topic of rate adaptations.

STRAWPOLL # 1 – Chicago rules.

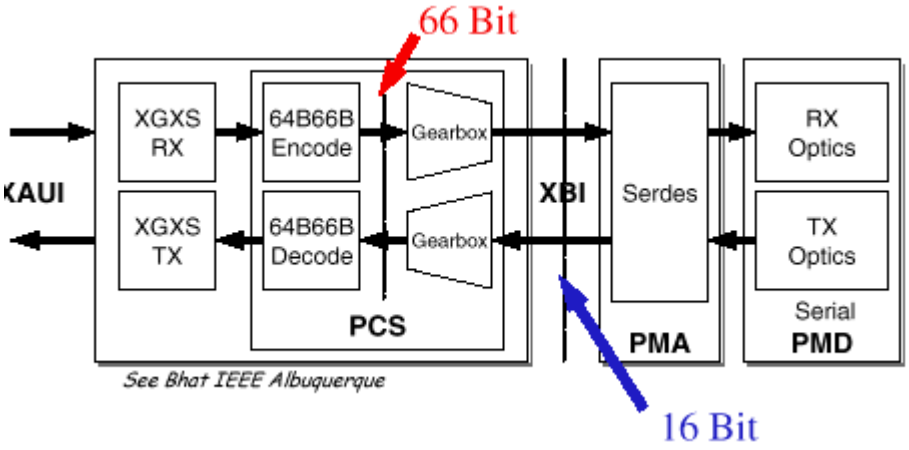
- Clock stretching 0
- Word hold 3
- Busy idle 50
- **Open loop 74 (most popular option)**
- Frame based 4

STRAWPOLL # 2 – Chicago rules.

- Busy idle 20
- **Open loop 63 (most popular option) 76 %**

11. Optional Physical Instantiation of a PMA Service Interface for Serial PMD's (S. Robinson)
http://grouper.ieee.org/groups/802/3/ae/public/may00/robinson_1_0500.pdf

Mr. Robinson described an optional PMA interface, called XBI which is used to ensure interoperability between the Serial WAN/LAN PCS (CMOS) and SERDES (SiGe, GaAs or Bipolar) chips usually within an optical module. In layer terminology this interface is between the PCS (64B/66B encoder/decoder) and the PMA (serializer/deserializer). A "gearbox" is used at the 66bit PCS interface to get this interface down to a manageable number of pins, like 16 pins.



This interface definition comes from the OIF consortium, the OIF is not a standards body so if this were pulled into IEEE 802.3ae for standardization this IEEE group would take control of this interface definition. Using this OIF work helps the 10 GE committee with time to market because there is a large set of component and system vendors in support of this interface proposal. This covers both the WAN and LAN Phy rates, which leads us to an open item that needs clarification, which is clocking. A 622MHz for the WAN Phy and 645 for the LAN Phy is currently required. The XBI interface would support the 9.95328 Gbaud WAN Phy rate with 622.08 MHz clock and the 10.3125 Gbaud serial LAN Phy rate using a 645 MHz clock. Data is transferred across a sixteen differential pair using LVDS I/O.

12. 10 GbE PMA architecture (Joseph Baranezhad)
http://grouper.ieee.org/groups/802/3/ae/public/may00/babanezhad_1_0500.pdf

Mr. Baranezhad's presentation discussed the market for 10 GE running over a copper medium for very short distances, used as jumper cables in the server room or switch to switch interconnect in the wiring closet. The architecture includes four pairs of copper running over UTP (CAT 6), this implies an 800 ps pulse width at each transceiver. This is based on PAM5 signaling, same as used by 1000BT. The insertion loss and NEXT loss were plotted for two different lengths. Some preliminary transistor level simulation was shown, however this was based on 400ps pulse widths (more stringent) and MLT3 over CAT 5 cabling. The simulations considered both 0.35 & 0.18 micron technology and link distances from 25 – 50 meters.

13. TIA-IEEE-liaison (Chris Diminico)

Mr. Diminico gave a liaison report about TIA activities – this deals with structured cabling. TIA is working on 10 GE enhanced BW capabilities for 850-nm optics and distances for 850 nm optical fiber transmission systems running at 10 GE. There is a TIA detailed specification dated 11/9/99 that will be posted to the Web. The TIA group represents a collection of people that develop technical specifications that will ultimately find their way into IEEE physical specifications. There is an upswing in the usage (installation) of hybrid cabling product (e.g. riser cables with both MMF & SMF), however Chris stated that MMF is still the primary product in the customer premise.

14. TIA FO-2.2.1 liaison report (Michael Hackert)
http://grouper.ieee.org/groups/802/3/ae/public/may00/hackert_1_0500.pdf

Mr. Hackert gave an update on FO-2.2.1. The 62.5 work has concluded. A final technical service bulletin is under way and this group is shifting their focus to 50-micron cabling. The target for documenting 50-micron performance is one year. A powerful modeling tool is available and used to direct the groups modeling capabilities. Jonathan questioned the probability of evaluating risk on these proposals. Michael said that the installed based would require both transmitter and fiber characterizations. Over 3000 new fibers and transceivers combinations showed a 10th

of 1 % risk. This small percentage was challenged based on the large difference of encircled flux measurements lab to lab. Yes encircled flux measurements are tricky measurements to make, but if done properly it gives meaningful results. The modeling tool for 50-micron development will be deferred to Paul Kolesar's pitch. There was a statement that mechanical tolerances will cause problems. This issue is not closed for 50-micron technology. What percentage of installed 62.5 will meet the RML spec. Michael could not answer, but thought 50 % might be reasonable. The equipment for lab cable and transceiver measurements are commercially available, however the field measurements is another matter. Steve Swanson clarified the scope of the 2.2.1 task group. He said there was never an attempt to apply this work to the installed base and all the fiber and transceiver vendors were present when these objectives were established. So the 2.2.1 group has met their original objects and how to use these results are now up to the IEEE task groups.

15. 10GbE CWDM 850 nm VCSEL for Installed & New MMF (Edward Chang)
http://grouper.ieee.org/groups/802/3/ae/public/may00/chang_1_0500.pdf

Mr. Chang's presentation on VCSEL's for use at 850nm on both installed and new MMF was co authored by nine companies, they are NetWorth Technologies, Unisys, Digital Optics, BLAZE, Corning, Micro Linear, Digital Optics, nSerial and Honeywell. Ed's passion for this technology comes from the fact that this is readily available technology and is a low cost solution. Target distances supported by this 850 WDM technology range from 100 to 550 meters and are based on fiber type (50 'vs' 62.5) and fiber BW as well as OFL or RML. Ed took the group through a very detailed link design that factored in all the link design variables. Ed concluded by stating that 850 WDM can be used for both installed and on the new MMF, it is a low cost solution that is available for both 50 & 62.5 micron fibers at distances objectives ranging from 100m to 550m. Think of this option as the SX version, it is proven and mature technology. Why do you have to do re-timing in the PMD. The re-timing is just a clock recovery process. There was a question on how to do the FO 2.2.1 measurements for a WDM system and the answer was that these modal BW measurements are not that difficult because of the large separation in wavelengths.

16. Merits of 850nm Serial PMD (Jack Jewell)
http://grouper.ieee.org/groups/802/3/ae/public/may00/jewell_1_0500.pdf

Mr. Jewell's pitch is tied into Paul Kolesar's pitch so Jack deferred to Paul when it came to the details of the specs on these 850 nm components. The main theme here is that if 10 GE desires low cost, they should embrase 850 nm optics. The group should learn from the previous Ethernet standard (1 GE). If they did, the findings would show that the high volume application is for the short distances, i.e. less than 300 meters. The applications where this makes sense include campus backbones in the LAN, aggregation of Ethernet in the metro and intra/inter PoP connections. The 850 work leverages the efforts from OIF and Fiber Channel. Another relavent point here is that the customers will make the choice for lower cost if the choice is given to

them, this was the case for LX 'vs' SX in the past. Jack recommends that 802.3ae add 850 Serial to the PMD set.

17. 850nm Serial Experimental Update (Jack Jewell)
http://grouper.ieee.org/groups/802/3/ae/public/may00/jewell_2_0500.pdf

Mr. Jewell gave an update on their 850nm efforts, in particular in the areas of spectral width, misalignment and encircled flux. They are continuing to study misalignment of couplers, and assess modal partition noise, and other areas. A number of 850nm serial PMD technical feasibility demonstrations have occurred. There are a number of ongoing work items, such as assessing modal partition noise, spectral width and encircled flux requirements in fibers. Also some testing with Alcatel's new MMF has yet to be performed.

18. 10000BASE-X PMD Proposal (Jim Tatum)
http://www.ieee802.org/3/ae/public/may00/tatum_1_0500.pdf

Mr. Tatum suggests that 5 PMD types makes sense, same as 1 GE. The 5 PMD's would be Serial (850, 1310 & 1550) and WDM (850 & 1310). These five meet all the objectives developed in Albuquerque and Jim felt this set of PMD's stands the best chance of getting a 75 % majority vote into the draft standard. Jim showed a relative cost comparison of these five types normalized to the 850 Serial option, see the diagram below. The group that supports this 850 effort are saying that a tremendous amount of effort has gone into this and they believe that a 5 PMD set is as low as it gets. Jim made the point that the 802.3ae objective is to get the PMD list down to 7, so since 5 is less than 7 lets move forward at this time with a 5 PMD option. There was a concern that the 500/500 installed MMF is not the norm installed in the field, in fact during 1 GE standardization it came out that 400/400 is more prevalent. A leading service provider stated support for the 5 PMD option. The WWDM WAN Phy versions are they compliant with VSR, SR and IR requirements. Del Hanson answered this by stating that this group needs to decide if we want to do this. There was a comment that we need to line up with the four channel OIF proposal, i.e. four parallel fibers. The problem is that this group does not have anything on the table at this time and time is running out very fast! There was concern that the system integrators are not in support of a 5 PMD option and that they are in support of a small PMD set. Even though SX was successful for 1 GE at least one person said it was not successful primarily because of price it was more for other customer needs like short distance support. When doing a relative cost analysis the cost of new fiber was not included, Howard Frazier would like to see those new fiber costs added in. In response to that point Jim said the new fiber is mainly a factor for new facilities so the comparison is difficult and the best way the group could do cost comparisons was to look exclusively at the transceivers. Hold that thought because Paul Kolesar has some data on these types of comparisons.

Comparison of PMD Technologies

Technology	λ	Rel. Cost	Maximum Link length: 62.5um Fiber (160/500) MHz*km	50um Fiber (500/500) MHz*km	50um Fiber (2000/500) MHz*km	SMF
Serial	1550nm	5X	NA	NA	NA	40km
	1300nm	1.8X	86m	86m	86m	10km
	850nm	X	28m	86m	300m	NA
WWDM	1300nm	3X	300m	300m	300m	10km
	850nm	1.5X	100m	300m	550m	NA

This presentation was supported by a large group of individuals and companies, they are:

- Rick McCormick and Doug Collins from Emcore
- Mike Dudek, Todd Hudson and Jason Yorks fom Cielo
- John George and Georgio Giaretta from Lucent
- Eric Grann, Brian Peters, Bill Wiedemann, Ken Herrity, and Kirk Bovill from Blaze
- Gerard Kuyt from Plasma Opt Fiber
- Dave Hyer from Compaq
- Chris DiMinico from CDT corp
- John Dallesase and Tony Whitlow from Molex
- Ladd Fritagg, John Ewing and Petar Pepuljogoski from IBM
- Sid Berglund and Tad Szostak from 3M
- Dave Hiner as a Consultant
- Jim Tatum and Phil Auld from Honeywell
- Steve Swanson, Corning
- Peter Pondillo, Len Young and Mike Hackert from Corning
- Herb Congdon from Tyco
- Herman Chui, Rob Marsland and Rob Williamson from New Focus
- Mark Donahowe from W.L. Gore
- Hari Naidu from Fujikura
- Ed Chang from Network Elements
- Schelto van Doorn from Infineon
- Rich Taborek, Don Alderrou and Steve Dreyer from Nserial
- Van Lening from QED
- Nariamn Yousefi from Broadcom

19. Modeling, Simulation, and Experimental Study of a 50um MMF Serial 10Gb Link (Paul Kolesar)
http://grouper.ieee.org/groups/802/3/ae/public/may00/golowich_1_0500.pdf

Mr. Kolesar's pitch is supported by 51 individuals and 21 companies and is focused around proving that the new fiber and laser transcievers are reliable and a robust system can be deployed using this cutting edge technology. Paul presented an

overview of a multimode system simulator (along with supporting experimental data) that models the behavior of 850-nm, 10Gb, VCSEL-based multimode fiber (MMF) links. The effort includes the effects of transmitter modal excitation characteristics, fiber differential mode delay, and link configuration (i.e. connection offset effects and segment concatenation) variables. The goal of the effort is to explore many more combinations of these variables than would be possible using experimentation, culminating in a robust specification for both the transmitter launch condition and fiber modal delay properties that ensures reliable system operation. The approach uses classical MMF modal theory, which is shown to agree well with recent experimental data. The result is two specifications. One defines the transmitter launch condition using encircled flux (EF) as the metric. The EF test procedure is defined in draft standard TIA 455-203 (FOTP 203). The second specification is a limit on differential mode delay (DMD) for new MMF, as measured by scanning an 850-nm singlemode source across the end-face of the MMF and recording the arrival times of the impulse responses as a function of radial launch position. The simulation examines thousands of EF / DMD combinations for each of four link configurations (which include up to three worst case connections). The output clearly indicates the limiting values of the two specifications. This model will be heavily employed to speed the work of TIA FO2.2.1 in refining the specification. Jonathan asked about the 86% encircled flux within 15 micron radius specification. It seems tight for low-cost manufacturing practices supported by laser manufactures. Paul said the intention is to create a specification that is supportable by many transceiver manufacturers. Several are participating in the definition of the specification in TIA FO2.2.1. This parameter may be adjusted as the specification evolves. New data provided by Jack Jewell of Picolight at this meeting suggests that the present specification is achievable. Jonathan asked what is a 40 micron fiber study? Paul responded by explaining that during the development of next generation MMF, several core sizes were created and examined before settling on 50 um core size. The data shown was from a detailed examination of 40 um properties. It showed excellent agreement between simulated and experimental beam diameter evolution as a function of launch offsets and connection offsets. The excellent agreement holds for any core size as shown in the 50 um graphs on the same slide. How are the VCSEL modal properties generated? The weights for the various transverse modes are randomly selected superpositions of the 6 lowest order Gaussian modes, the choice is not weighted towards one particular mode. The simulator is not publicly available but will be used for the FO 2.2.1 work. Will this simulation be brought back in July with more detail? We will report on further refinements of the model and any related specification adjustments.

20. CWDM 10GBASE-SX Proposal (Bill Wiedemann)
http://www.ieee802.org/3/ae/public/may00/wiedemann_1_0500.pdf

Mr. Wiedemann's pitch is a pro-850 nm CWDM pitch, a.k.a. 10GBASE-SX CWDM. There are many supporters of this proposal, 53 individuals and 29 companies. There are multiple suppliers for this technology, both the IC's and optical components. This proposal meets both the 100 and 300 meter distance objectives, up to 550 meters with the new MMF and is able to achieve this in a time line (4Q00) consistent with the

802.3ae standards schedule. The transceivers include a XAUI Retimer IC, and optical sub-assembly for the transmitter and receiver. The receiver is a Quad PIN and the transmitter is a quad SW VCSEL plus quad laser driver. They also feel that the low power will translate to the lowest EMI solution. Since this is a MM solution this solution will be very low cost. The wavelengths are 20-nm separation, i.e. 805, 825, 845 and 865 nm. Some performance charts were shown for 3.125G, this is for parts designed at 2.5G so expect much better performance charts when the 3.125G parts come in. Early availability shows that this summer systems integrators can get a complete transceiver by 4Q00. The strong support for this technology translates into a universal specification that includes all the various component suppliers that supply components used in this solution. SC connectors are used on the parts. The filters plotted were simulation not actual measurements.

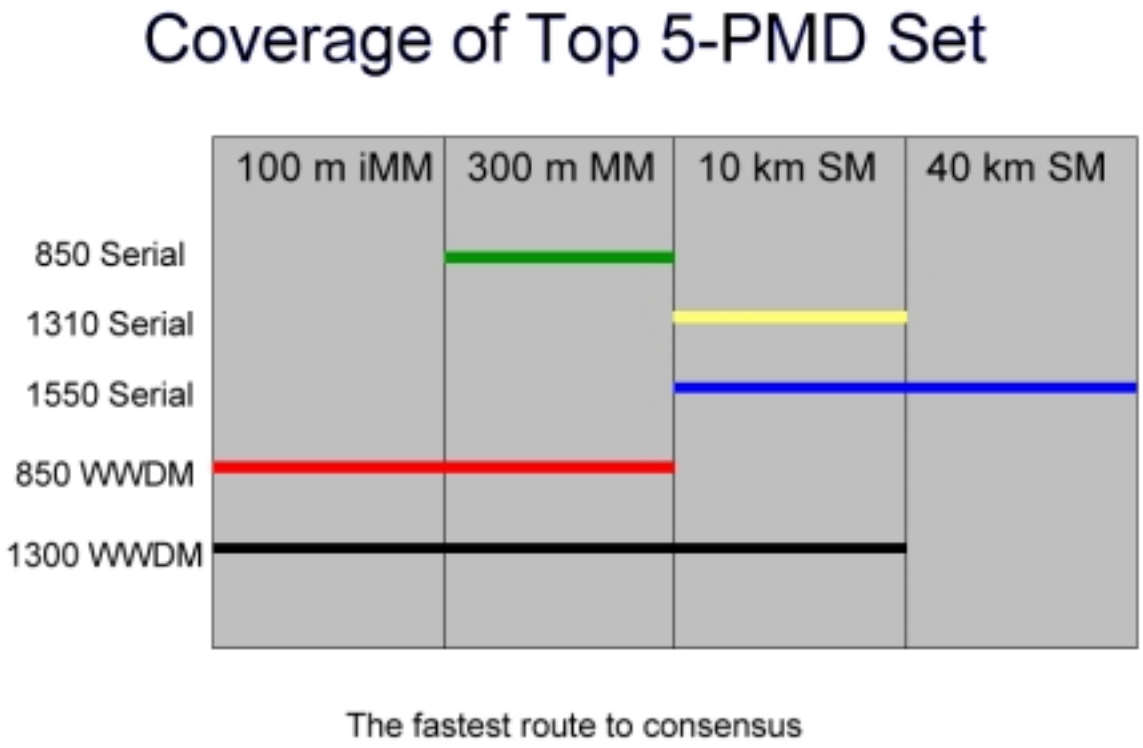
21. Proposed set of PMDs, related specifications & rationale (Paul Kolesar)
http://www.ieee802.org/3/ae/public/may00/kolesar_1_0500.pdf

Mr. Kolesar's presentation discusses a set of specifications for a short-wave serial solution. This proposal has significant support within 802.3ae, 51 individuals representing 21 companies. There are several areas for considering optimization, cost, risk, manufacturability, multi-vendor support, proven technology, implementation complexity and market acceptance. The short reach space is the most cost sensitive space. Keep in mind that over 90 % of the enterprise backbones have distance requirements less than 300 meters. The many conversations on the reflector associated with cost have been averaged together. That resulted in the following ranking.

- Serial 850 1.94 (2002)
- 1000SX 0.62
- 1000LX 1.00
- Serial 1300 2.46 (2002)
- WDM 1300 3.43 (2002)

Since the cost changes over time are downward and that there are different drivers influencing cost, the above cost ranking is just a snapshot. Optics cost in the end will determine the low-end cost, not IC's. Optics decline at a slower rate. IC's for the 1 GE market declined by factors of 20 – 30 times. The system upgrade paths were discussed. Moving from MM to SM is approx. 14.5 units however moving to the advanced MMF is only 11 units for new installations or 12 units for replacing old MMF with the advanced MMF. Lucent's new MMF has been installed at some major accounts; they went with the new MMF as opposed to SMF. This market acceptance by Agilent, BMW, Merrill Lynch, Nokia, Peco Genco, Pike's Peak College, University of Texas and Wells Fargo can be attributed to the low cost as compared to SMF and the fact that SMF is very difficult to terminate. A one size that fits all is not going to be accepted well by the market. Serial optics are less complex than WDM optics, however the serial IC's are more complex than WDM IC's. Increased volumes of either SW serial solution will lower cost for both SW & LW Serial solutions since both Serial solutions could use the same IC's. Technical feasibility have shown very good results with early prototype devices, the early companies include Lucent, Gore,

Corning, Cielo, Picolight, Alcatel and New Focus. Paul developed the various optics standards specification tables for link power budgets & penalties, plus link jitter budgets. Transmitter and receiver characteristics were also specified. The latest Piers Dawe link model was used to develop the transmitter and receiver parameters. Paul summarized by stating that from a broad market potential and application space coverage of the bulk of the market is short reach and 10GbE must provide a solution that is optimized for this <300 meter application space. Economic feasibility is addressed because the 850-nm serial will be the lowest cost, primarily due to IC costs declining and the cost determined by intrinsic optics complexity. Technical feasibility is not a concern because serial 850 nm has been demonstrated by more companies than any other emerging 10 GbE technology and target specifications are realistic. Multi-vendor support and supply is evident due to the overwhelming support for 850-nm serial technology. Paul also closed with his view of the fastest route to consensus, that being the 5 PMD set depicted in the diagram below.



The fastest route to consensus

22. 1550 Long Distance CDWM Transceivers (Michael Fisk)
http://www.ieee802.org/3/ae/public/may00/fisk_1_0500.pdf

Mr. Fisk discussed Luminent's four channel CWDM 1550 nm solution. This uses 4 uncooled DFB lasers and PIN diodes with an integrated optical MUX/DEMUX. This solution covers three objectives, 10, 20 and 40 km. The part is currently shipping and they have been used in applications up to 60 km. This transceiver works at 10 or 12.5 Gbps and is claimed to be the lowest cost long distance solution. An extremely conservative cost comparison chart was show, in fact the cost differential will decrease over time, the two (1550 Serial and 1550 WDM) will come together around

the year 2003. This 1550 nm CWDM could be used to do 4 x 10 GE, or (40 GE). Wavelength separation is 20 nm (1501, 1521, 1541 and 1561 +/- 5.5nm). The BER is coming in at 10EE-10; our 10 GE spec will require W/C 10EE-12. They have a migration strategy to 40 GE for their same physical package.

23. 1300 and 1550 nm single mode serial PMDs (Krister Frojdh)
http://www.ieee802.org/3/ae/public/may00/frojdh_1_0500.pdf

Mr. Frojdh summarized his serial PMD proposal with the following text. Low requirement on extinction ratio, 3 dB. Uses optical modulated power for transmitter power to remove extinction ratio dependence in link budget. Specify both 1300 nm and 1550 nm in standard (preferably for 2,10 and 40 km) and specify receiver for both wavelengths. Ensure interoperability between PMDs. Keep 2 km distance. Allows low-cost transmitters without costly isolators. Include fiber link specification in standard. To handle each and every 40 km link will be costly.

24. Support of All 10 GbE PMD Options (Ed Chang)
http://www.ieee802.org/3/ae/public/may00/chang_2_0500.pdf

Mr. Chang suggested the 10 GbE committee should adopt ten PMD's because each PMD provides a unique technology option for cost effectiveness. There was little discussion or support for this idea of ten PMD's. Ed's diagram below nets out the ten proposed PMD's.

Meter / Fibers, um	100 (VSR)	300	10,000	40,000
62.5 Installed	CWDM	WWDM		
50, Installed	CWDM	CWDM WWDM		
50, New	CWDM 850 serial	CWDM WWDM 850 serial		
10, SM			1310 serial WWDM	1550 serial

25. 3 PMD Proposal (Del Hanson)
http://www.ieee802.org/3/ae/public/may00/hanson_1_0500.pdf

Mr. Hanson's pitch is supported by a number of 10 GE member companies, they are Agilent Technologies, Finisar, Avici Systems, E2O Communications, Intel, Lucent, PMC-Sierra, Sun and World Wide Packets. The three PMD's that achieve all distance objectives this group suggests includes WWDM and Serial at 1310 nm plus Serial

1550 nm. Complete sets of typical optics specification tables were presented. Del outline some additional work to be done on the various link specifications. The mode conditioning patch cord does not apply to the Serial solution but does for the WDM case. The return loss of 12 dB is a carry over from GE. Receiver sensitivity at 20 dBm is a very aggressive number.

26. Wide/Coarse WDM LAN PCS/PMA (Rich Taborek)
http://www.ieee802.org/3/ae/public/may00/taborek_3_0500.pdf

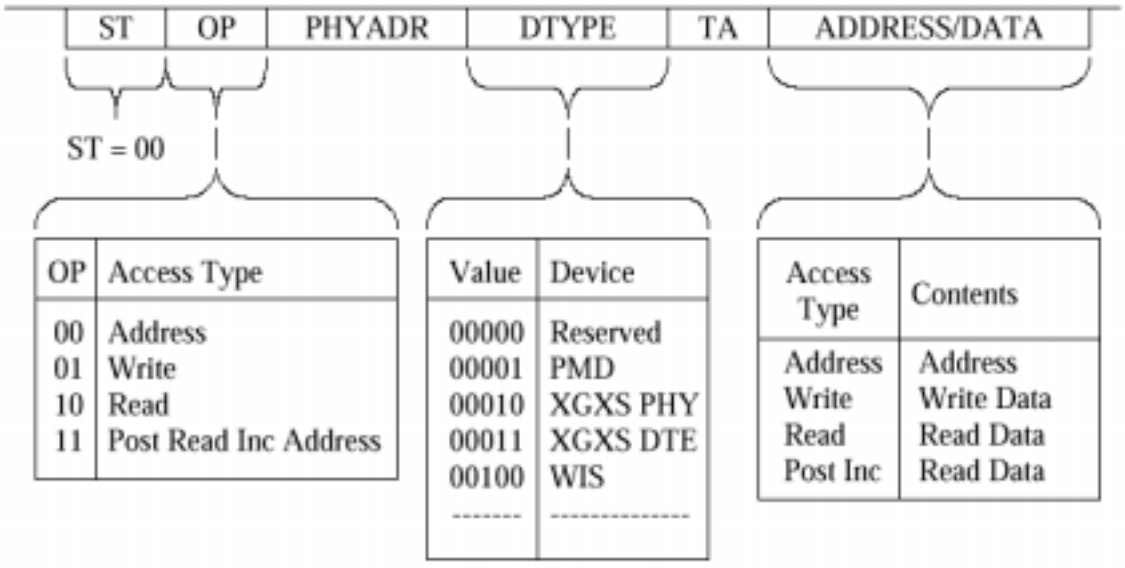
Mr. Taborek began with a review of the 10 GbE layer reference model as it pertains to the WDM Phys and focusing in on details of the PCS/PMA such as encoding, data mappings, packet delineation, synchronization, EMI, baud rates, technology options, pin counts, power and electrical interfaces. Rich highlighted some complex and simple implementation options that stressed the partitioning of logic in "big" MAC chips, "little" XGXS chips, optical modules that incorporated XGXS, PCS, PMA and PMD. Rich also presented a block diagram of a Layer 1 Bridge with a WDM LAN Phy on one interface and an ITU-T Phy on the other interface. In this case the WIS "WAN Interface Sublayer" is used within the 10 GbE LAN Phy stack to interconnect with the ITU-T Phy. An "XGXS-WIS-XBI" device was shown to interconnect a WDM LAN Optical module with an ITU DWDM Optical module. Here the XAUI interface is used on the WDM LAN side and the optional XBI interface is used on the ITU DWDM side.

27. 10Gb/s Ethernet Management MIB Proposal (David Law)
http://www.ieee802.org/3/ae/public/may00/law_2_0500.pdf

Mr. Law outlined some initial MIB management proposals that deal with new objects and that the resultant clause 30 changes must be made to the Annex 30A & 30B - GDMO MIB as well as some minor link aggregation modifications in Annex 30C. David took as first cut at all the modifications that will be required in each clause and annex, for example we'll probably need a new object class such as WIS for the WIS related feature.

28. IEEE802.3 10Gb/s Ethernet MDC/MDIO Proposal
http://www.ieee802.org/3/ae/public/may00/law_1_0500.pdf

Mr. Law's presentation highlighted a valid concern that with these external devices (such as XGXS) we'll need MDC/MDIO access plus the new LSS and WIS entities will need some register allocations. The available spare registers is getting down to a low number. A proposal for using indirect address register access provides many more registers, e.g. 65536 registers per device. Accessing registers consists of a two cycle process, in the 1st cycle we identify a device, on the 2nd cycle we do the actual read or write. Both a LAN and a WAN example were discussed.



29. SONET Definition for WIS (Gary Nicholl)
http://www.ieee802.org/3/ae/public/may00/nicholl_1_0500.pdf

Mr. Nicholl's presentation is a follow on to other WIS presentations. Three issues need additional consideration; they are clock tolerance, overhead definitions and jitter. Since current SONET clock references are +/- 20 ppm and the cost delta (relative to overall cost of a 10 GE interface) between a 100 +/- ppm clock that is currently spec'd for the 10 GE WAN Phy and a +/- 20ppm clock is minimal, why not use a tighter tolerance clock. This tighter tolerance clock will enable interoperability with the installed base of SONET regenerators and transponders. There also may be pointer processing concerns at the transponder 10 GE WAN Phy attach to. If so, this too could increase the complexity of the transponder, thereby driving up costs. It is not sufficient to just implement B1 because its performance monitoring is only accurate to BERs in the range of 10EE-7. We should also implement B2 for performance monitoring due to its accuracy, plus there may be some concerns with test equipment if B2 is not implemented. The accuracy of B2 can also be used to trigger APS functionality. The cost of implementing B2 can be high because 192 8-bit registers in TX and RX will be required. The remote error indication reflected in M1 should also be implemented, a single 32-bit register in RX. In the future one may want to implement 1+1 APS on a tributary OC-192c interface to and ADM. We need the ability to modify the SS-bits to '10' because in SDH implementations if they are not set to '10' the H1 pointer interpreter will discard the SONET traffic. The addition of B2, K1, K2 and M1 bytes goes well beyond the current WAN Phy proposal that is on the table. These additional bytes are typically found in SONET compliant devices. If we take on the SONET jitter specs we will increase the cost of the WAN Phy. As a compromise Gary suggested we may use the LAN Phy jitter specs so that we can use the same optical PMDs. This may dictate changes to the current jitter specifications.

In summary we do need a SONET compatible UniPHY whose WAN functionality has a minimum set of SONET functionality so that it operates with other SONET gear without causing alarm errors. Gary clarified his view on the cost reduction of a 20 'vs' 100 ppm clock in a recent e-mail to the reflector, the text from that e-mail has been duplicated below. The big cost reduction from eliminating approximately 95% of the synchronization functionality that is required on a SONET Add Drop Multiplexor, and not from relaxing the tolerance on an oscillator from 20ppm to 100ppm. Examples of synchronization functions which are required in a SONET TDM box but which would not be required in an Ethernet switch include (note this is identical to packet-over-SONET (POS) interfaces on routers which also only require simple, low cost synchronization based on 20ppm clocking):

- ability to lock all interfaces on the box to a central clock
- backup central clock
- ability to meet very stringent phase transient requirements when switching between the working and standby central clock
- ability to lock the central clock to a reference from any one of the user interfaces
- ability to lock the central clock to a BITS reference
- backup BITS reference
- ability to meet stringent phase transient requirements when switching between BITS references.
- ability to source BITS
- monitor and alarm all timing references
- Stratum 3 oscillator
- meet stringent 24 hour holdover requirements on reference failures
- ability to meet stringent phase transient requirements going into and out of holdover
- implement synchronization status messaging protocol to control reference switching

As a further data point there are 42 pages in GR-253, which define all the synchronization requirements for a SONET ADM. Only about 1/2 page of these are applicable to a POS interface on a router. Gary expects it to be the same for the WAN PHY. This is where the cost savings come from.

30. Clause Editors (Brad Booth)
http://www.ieee802.org/3/ae/public/may00/booth_2_0500.pdf

Mr. Booth's latest list of clause editors is as follows:

– Clause 1	- Shimon Muller
– Clause 2	- Shimon Muller
– Clause 3	- Shimon Muller
– Clause 4	- Shimon Muller
– Clause 5	- Larry Rubin
– Clause 6	- Brad Booth
– Clause 22	- Ed Turner
– Clause 30	- David Law
– Clause 31B	- Shimon Muller

- Clause 44 (Intro.) - Brad Booth
- Clause 45 (XGMII) - Bob Grow
- Clause 46 (XGXS/XAUI) - Rich Taborek
- Clause 47 (PCS) - Pat Thaler
- Clause 48 (WIS) - Tom Alexander
- Clause 49 (PMA) - Justin Chang
- Clause 50 (PMD) - David Cunningham
- Clause 51 (PMD) - Jay Hoge

31. P802.3 Nomenclature (Brad Booth)
http://www.ieee802.org/3/ae/public/may00/booth_3_0500.pdf

Mr. Booth's presentation stressed the un-managablility of defining the P802.3ae Port_Type nomenclature using a 5 PMD set. This was a topic of much debate over the reflector after the interim meeting, both the interim meeting and post interim meeting proposals are summarized below.

Port Type	Interim Meeting Proposal	New Proposal
850nm LAN Serial	10kBASE-SLR	10GBASE-SX
1300nm LAN Serial	10kBASE-LLR	10GBASE-LX
1500nm LAN Serial	10kBASE-ELR	10GBASE-EX
850nm WAN Serial	10kBASE-SWR	10GBASE-SW
1300nm WAN Serial	10kBASE-LWR	10GBASE-LW
1500nm WAN Serial	10kBASE-EWR	10GBASE-EW
850nm LAN CWDM	10kBASE-SLV	10GBASE-SX4
1300nm LAN WWDM	10kBASE-LLV	10GBASE-LX4
850nm WAN CWDM	10kBASE-SWV	10GBASE-SW4
1300nm WAN WWDM	10kBASE-LWV	10GBASE-LW4

Interim Meeting Suffix Decode: 10kBASE-xyz

- Wavelength
  - S = Short wavelength (850nm)
  - L = Long wavelength (1300nm)
  - E = Extra long wavelength (1500nm)
- Network environment
  - L = LAN
  - W = WAN
- PMD type
  - R = Serial
  - V = WDM

Post Interim Meeting Suffix Decode: 10GBASE-xyz

- Wavelength
  - S = Short wavelength (850nm)
  - L = Long wavelength (1300nm)
  - E = Extra long wavelength (1500nm)

- Network environment / PMD Type
  - X = LAN (8b/10b WDM; 64b/66b Serial block encoding)
  - W = WAN
- Number of Wavelengths
  - Omitted = one, e.g. serial
  - 4 = four, e.g. WDM

Identifying a Port_Type from a systems integrator point of view means "If I plug in a cable in my switching gear and then plug the other end into another switch I have a 1 in 10 chance for the link working". Port_Type needs to define the protocol that is running on the link, not just the front-end physical hardware. When a user looks at a Port_Type this will dictate the type of fiber that is required. Some people objected to these Port_Types. In the past the Port_Type was required to be labeled on the port to help with the problems of interoperability, with this many Port_Types we are either going to need connector keying or bring back auto-negotiation. Neither of these is desirable.

32. How Many PMDs? (Steve Haddock)
http://www.ieee802.org/3/ae/public/may00/haddock_1_0500.pdf

Mr. Haddock's presentation came from the perspective of a systems provider. Steve's proposal includes all PMD proposals that are currently being given serious consideration. A two dimensional matrix with three rows that are optimized by markets (i.e. application space) and two columns differentiated by technology (i.e. Serial or WDM) were discussed. The rows are optimized for, 1. Long reach (LR) 40km over single-mode fiber, 2. Medium reach (MR) 2km/10km over single-mode fiber and 3. Short reach (SR) 100m/300m over multi-mode fiber. An interesting 3-PMD set might include:

Technology	Market	IEEE 10 GE Distance Objective
850 WWDM	Short Reach (SR)	100m/300m **(note: 1)**
1300 WWDM	Medium Reach (MR)	2km/10km
1500 Serial	Long Reach (LR)	40km

Note 1: The 850 WWDM does not exclude or require new MMF, however it does actually achieve significantly longer distances on new MMF than the 850 serial does.

So how many PMDs satisfy the distance objectives? The answer is three is best. More than three is chaos, some say let the market decide, well if this is the will of the committee then just go to market and battle it out there, disband the standard. If we can all agree that we need a short-wave solution that is optimized for cost it would be the 850 CWDM using restricted mode launch to achieve reasonable short haul distances in the 220m range over MMF. Customer's do not care what technology is used (i.e. CWDM or Serial) they just want it to work. If we require the customers to make the technology choices this will delay the acceptance of 10 GE. If we end up with more than three options the systems vendors will REQUIRE them to ALL be

hot-pluggable small form factor (SFF). We should down select the PMD options to the correct number by July and these remaining PMD's will be the final PMD's we place in the standard. After July any PMD's in the draft will require a 75 % vote to remove them, with one exception, that being if the technology is proven not technically feasible. It's better to have one solution for an application space. These single market space solutions need multiple vendor support. The hard part of all of this is to resolve the conflicting desires between system and component vendors.

33. Business (Jonathan Thatcher)

During this session Jonathan opened up the discussion period. The discussions were centered on the PMD sets this committee would embrace. A total of 37 individuals each spoke for one minute or less, their comments are summarized below.

- The major issue is should this group decide ahead of time what the best options are or let the market decide.
- We should trim down the list.
- Upgrading fibers is a natural process; we should not consider the introduction of new fiber as a disruption.
- Votes for letting the market decide.
- In 1 GE we had four distance objectives, and the standard ended up with a unique solution for each space, in fact an additional one for very long reach popped up and is not in the standard.
- In 1 GE we actually had more information available for the application space and were much further along with understanding how to optimize the solution set. This time around we don't have the same level of understanding and should wait a little longer before making the cut.
- There was a vote in favor of 5 PDM's and that should include both serial and WDM and competition within the same space.
- Howard spoke in favor of just two PMD's because this is the least amount of work and we'd get the standard done much quicker.
- Volume will drive cost, the more choices we have the lower the chance of getting high volume on any one.
- Point of order, when we speak about the favorite three, which ones are we talking about? Ruled out of order.
- Should have multiple PMD's because there are multiple application spaces we are trying to fill.
- There is incomplete evidence that three will be sufficient for all application spaces. Need more time.
- Shimon from Sun complemented Steve Haddock from Extreme Networks because it is thinking on behalf of the customer and what is best for customers.
- The customers are smart, they don't care about technology, they care about Ethernet and that it is every where. These customers don't like confusion; in fact they want one solution that works every where.
- Bob Grow from Intel felt that three was the correct number and he fully supports Steve Haddock's presentation on getting the correct three identified.

- We will not get the focus in the market place if we have to talk to the market about 12 PMDs.
- Another vote for just 2 PMDs.
- Another vote for as few as possible.
- A vote for five PMD's.
- Another vote for five because of the timing of this down selection – need flexibility to allow the best solutions to rise to the top.
- Ten options is way too many for me as a systems provider, my customers will throw me out of their office.
- There were five individuals that raised their hands in support of making additional proposals for PMD's at the July plenary.
- A very important point was to list the vendors that will provide solutions for the various individual PMD proposals.
- There is a false sense that all proposals have multi-vendor support.
- History has shown us that standards bodies can not always pick the most popular PMD options. I'm not sure which standard this was in reference to.
- The group is not focused on the hard decision Bruce Tolley from Cisco spoke in favor of the two PMD options.
- Paul Borttoff from Nortel also agreed with Steve Haddock's proposal.
- There was a vote to have the system vendors make the call on how many PMD options are appropriate.
- David Law a systems vendor from 3Com said less is good.
- Another systems vendor said less is best but not as low as 2.
- The history has shown us that when there are multiple options the systems vendors will settle in on the best ones so lets move forward with a larger set now and allow the market conditions to make the cut.
- Another systems vendor voted in favor of 3 PMD's but qualified this by saying the three are not known at this time.
- Jonathan is very concerned about risk to the standard, he's worried about FO 2.2.1 impacting this committee's standards progress and he's worried about laser safety concerns.
- Time to market is very key.
- Optics are moving into commodity type products, so the costs will be driven down if we go with choices that have applications here with 10 GE and other areas.
- The problem with allowing 5 options is that you have to supporting all five long term.
- Ed from Lucent spoke in favor of three PMD's.

STRAWPOLL: 84 in favor of cutting off the above discussion and 30 in favor of continuing. We did stop and Walt closed by stating that there is a strong desire by systems suppliers to have a few as possible, like maybe 3 PMD's. On the other hand the components suppliers will block a vote to down select. No census is a decision to not move the standard forward with any kind of speed. Sliding the schedule to the right will have an extremely negative impact on 10 GbE. We need to re-focus ourselves on the 5 criteria and objectives. So in July be sure to bring in a solution set.

34. "Warriors of the Net - IP for Peace" (Howard Frazier)

Mr. Frazier entertained us with a 12-minute video. Howard did not produce this video; it was produced by Erricson and is an entertaining video of how the Internet works. http://www.warriorsofthe.net/

Motions:

- **Motion # 1**
  - **Description:** Of the proposals seen to date, P802.3ae adopt the Open Loop Rate control method (per S. Muller May presentation) as basis for future work.
  - Motion Type: Technical > 75% required
  - Moved By: Shimon Muller
  - Seconded By: Tom Dineen
  - Results: **Passes by acclimation.**

- **Motion # 2**
  - **Description:** Accept Dallas minutes and Albuquerque minutes.
  - Motion Type: Business 50 % required
  - Results: **Passes by acclimation.**

STRAWPOLL: Should we include an XBI interface for Serial LAN & WAN PHY's?
45 in favor
10 opposed.