

# IEEE 802.3 Study Group **10Gb/s PHY for EPON**

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Report to IEEE 802.3 WG

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# May SG Meeting Report

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- 10G EPON SG had a 2-day meeting in Austin, TX
- 65 people attended
- Had two very busy days – 18 presentations
- Discussed and approved
  - PAR
  - 5 criteria
  - Objectives

# PAR (Essential Items)

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**2.1 Title of Standard:** ... - Amendment: Physical Layer Specifications and Management Parameters for 10Gb/s Passive Optical Networks. (Y:46, N:0, A:4)

**5.2 Scope of Proposed Standard:** The scope of this project is to amend IEEE Std 802.3 to add physical layer specifications and management parameters for symmetric and/or asymmetric operation at 10 Gb/s on point-to-multipoint passive optical networks. (Y:48, N:1, A:2)

**5.5 Need for the Project:** The project is applicable to subscriber access, back-haul, and multi-dwelling unit environments. The project is needed to enable telecommunications operators and multiple system operators to provide advanced bandwidth-intensive services, such as high-definition television, while

- reducing footprint and power consumption of central office equipment
- minimizing service upgrade cost
- minimizing fiber deployment costs.

(Y:49, N:0, A:4)

# Objectives

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- Support subscriber access networks using point to multipoint topologies on optical fiber  
(Passed by voice vote without opposition)
- PHY(s) to have a BER better than or equal to  $10^{-12}$  at the PHY service interface  
(Passed by voice vote without opposition)
- Provide physical layer specifications:
  - PHY for PON, 10 Gbps downstream/1 Gbps upstream, single SM fiber
  - PHY for PON, 10 Gbps downstream/10 Gbps upstream, single SM fiber  
(Y: 34, N: 0, A: 2)
- Define up to 3 classes of PMD. Define PMD(s) to operate with split ratios of 16 and 32, and with distances of 10 or 20 km. Investigate split ratios of 64 and 128.  
(Y: 39, N: 0, A: 1)

# Broad Market Potential

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- a) **Broad set of applications**
  - b) **Multiple vendors, multiple users**
  - c) **Balanced cost, LAN vs. attached stations**
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- 10G EPON is applicable in multiple environments to support bandwidth-intensive applications that will require fast, reliable, scalable, first-mile connections. Such applications include Broadcast TV (expanded HDTV content), IPTV, time-shifted TV, rich unicast based VOD content libraries, 3D Online Interactive Games, UltraHigh Speed Internet, Personal Video Casting, Business Ethernet Access, Distributed Network Attached Storage, Medical Imaging, HDTV Video Conferencing, Video Email, Virtualized Multimedia Network applications, Grid Computing Interconnect, Next Generation Wireless Access Backhaul, MDU backhaul, and BPL backhaul.
- In an overwhelming response at the March, 2006, IEEE 802 LMSC meeting in Denver, attendees voted 52 to 2 to form a 10Gb/s EPON study group. Among those represented were 31 companies including optical component manufacturers and semiconductor manufacturers, equipment vendors, and service providers and 58 individuals who expressed interest in participating in the activities of 10GEPON study group and consequent task force.
- 10G interfaces will eventually exhibit a similar cost balance as 1G 802.3ah for PON ports versus per attached stations.

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**Y:42 N:0 A:4**

*July 17, 2006*

*IEEE 802 Plenary Meeting, San Diego, CA*

5

# Compatibility

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- a) **Conformance with 802 Overview and Architecture**
  - b) **Conformance with 802.1D, 802.1Q, 802.1f**
  - c) **Compatible managed object definitions**
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- The proposed standard will conform to the simplified full-duplex media access control defined in Annex 4A in IEEE Std. 802.3-2005.
- The proposed standard will conform to the requirements of IEEE Std 802-2001. Conformance with 802.1D, 802.1Q, and 802.1f is provided by use of the existing overlying 802.3 MAC and MAC Control sublayer interfaces.
- The Management Information Base (MIB) for 10Gb/s PHY for EPON will maintain compatibility with the current 802.3 MIB, allowing a consistent management model at all operating speeds.

# Distinct Identity

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- a) **Substantially different from other IEEE 802 standards**
  - b) **One unique solution per problem (not two solutions to a problem)**
  - c) **Easy for the document reader to select the relevant specification**
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- There is no existing 802 standard or approved project appropriate for wire line access using point-to-multipoint topology at 10Gb/s.
- The proposed project is a 10Gb/s upgrade for users of Ethernet Passive Optical Networks specified in IEEE Std 802.3-2005. The solution may include more than one Physical Media Dependent sublayer specification to support different optical link budgets. The solution may include a 10Gbps symmetric solution and/or an asymmetric 10Gbps downstream/1Gbps upstream solution.
- The proposed project will be formatted as a set of clauses in IEEE Std 802.3, making it easy for the document reader to select the relevant specification.

# Technical Feasibility

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- a) **Demonstrated system feasibility**
  - b) **Proven technology, reasonable testing**
  - c) **Confidence in reliability**
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- Presentations made to the 10Gb/s PHY for EPON Study Group illustrate the technical feasibility of 10Gb/s EPON system. The 10Gb/s EPON prototype system was implemented by adding the 10Gb/s EPON PHY to 802.3-compliant devices. Two options supporting 10Gb/s EPON PHY were studied: asymmetric (10Gb/s downstream/ 1Gb/s upstream) mode and symmetric (10Gb/s downstream/ 10Gb/s upstream) mode.
- This project reuses the Ethernet point-to-multipoint and point-to-point technologies that proved to be stable and credible. The project will extend burst mode technology to 10Gb/s. The reasonable throughput and latency for the 10Gb/s burst mode interface was demonstrated by using the continuous mode optics available for 10Gb/s point-to-point Ethernet devices. This study group will develop the specifications of the 10Gb/s EPON PHY, considering the performance of the 10Gb/s burst mode interface and the compatibility with the 802.3 standards. The testing is expected to be straightforward, based on experience gained from testing of 1Gb/s EPON and 10Gb/s point-to-point products.
- This study group has received contributions from PHY and system vendors; service providers; and industry/academic experts. The 1Gb/s point-to-multipoint and 10Gb/s point-to-point technologies are mature and reliability data exists which provides a high level of confidence in reliability of 10Gb/s EPON systems.

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**Y:24 N:0 A:19**

*July 17, 2006*

*IEEE 802 Plenary Meeting, San Diego, CA*

8



# Economic Feasibility

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- a) **Known cost factors, reliable data**
  - b) **Reasonable cost for performance**
  - c) **Consideration of installation costs**
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- The cost factors for the components and systems are well known because 10Gb/s Ethernet and EPON architectures are massively deployed for commercial services.
- Point-to-multipoint topology is optimal for broadcast services and IP-based TV, providing cost-efficient subscriber access architecture. Coupled with a reduction of the footprint and power consumption of CO equipment, reduction of trunk fiber count, and lower maintenance and repair costs, the introduction of 10Gb/s EPON results in the overall reduction of infrastructure cost and reasonable cost for performance ratio.
- The installation costs of cable plant and maintenance costs are similar to 1Gb/s EPON.

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**Y:38 N:0 A:1**

# Locations of Study Group Documents

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PAR (printout from new online PAR submission form):

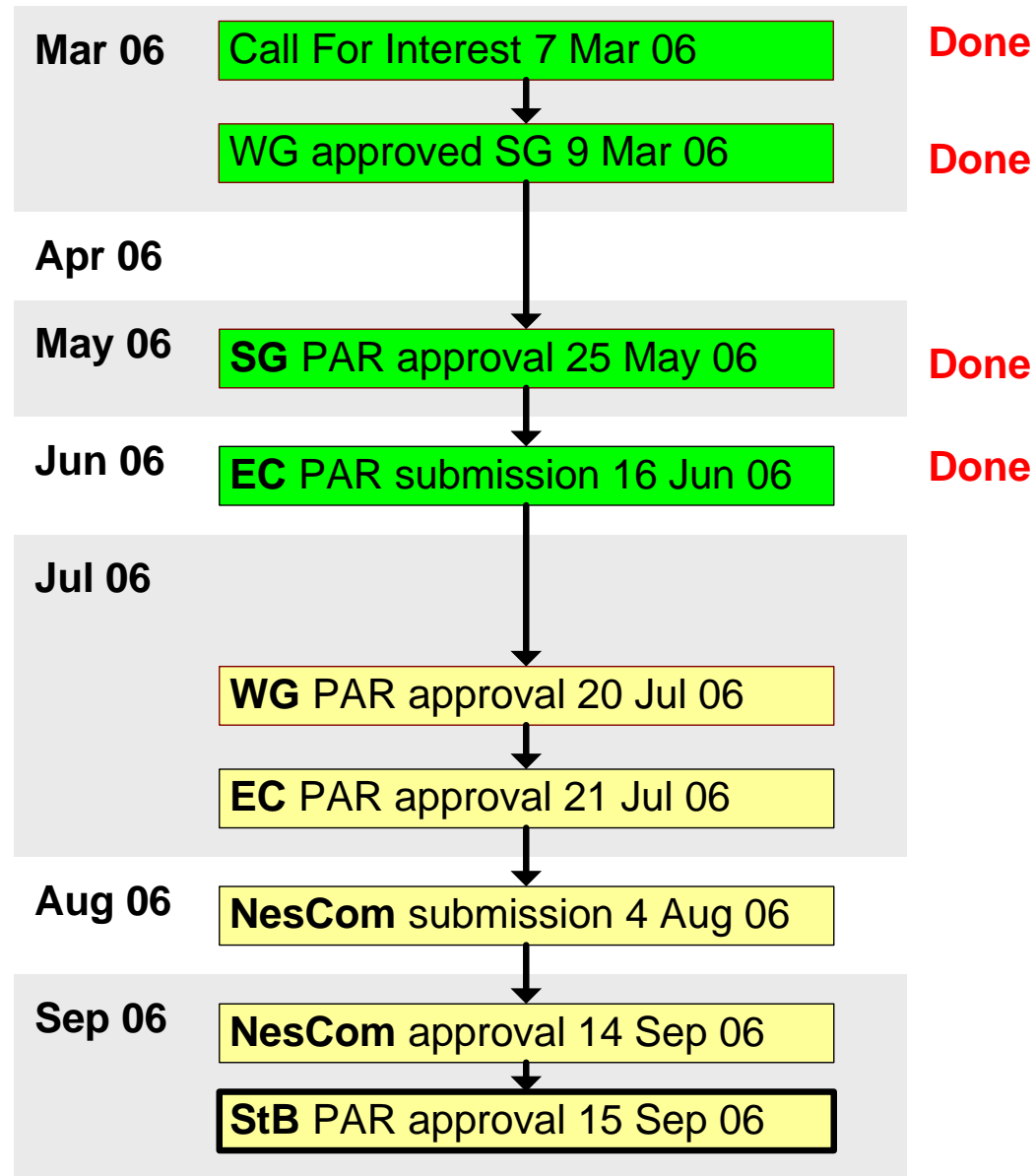
- [http://www.ieee802.org/3/10GEPON\\_study/public/may06/10gepon\\_PAR.pdf](http://www.ieee802.org/3/10GEPON_study/public/may06/10gepon_PAR.pdf)
- PAR (with SG voting results)
  - [http://www.ieee802.org/3/10GEPON\\_study/public/may06/10gepon\\_PAR\\_vote\\_0506.pdf](http://www.ieee802.org/3/10GEPON_study/public/may06/10gepon_PAR_vote_0506.pdf)
- 5 Criteria (with SG voting results)
  - [http://www.ieee802.org/3/10GEPON\\_study/public/may06/10gepon\\_5C\\_vote\\_0506.pdf](http://www.ieee802.org/3/10GEPON_study/public/may06/10gepon_5C_vote_0506.pdf)
- Objectives (with SG voting results)
  - [http://www.ieee802.org/3/10GEPON\\_study/public/may06/10gepon\\_objectives\\_vote\\_0506.pdf](http://www.ieee802.org/3/10GEPON_study/public/may06/10gepon_objectives_vote_0506.pdf)

# PAR and 5 Criteria Status

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- In May we passed the following motion:  
Request that the working group chair forward the draft PAR and 5 criteria to the 802 EC for consideration at the July 2006 Plenary session.
- Correspondingly, PAR and 5 criteria were submitted to LMSC EC on June 13<sup>th</sup> for consideration at its meeting on July 21<sup>th</sup>.
- We will present our PAR and 5 Criteria to IEEE 802.3 WG during 802.3 Closing Plenary on Thursday, July 20<sup>th</sup>.

# Study Group Timeline



# July SG Meeting Agenda

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1. Discuss requirements for backward compatibility, co-existence with 1 Gb/s EPON, wavelength plan.
2. Hear presentations on technical feasibility of 29 dB power budget.
3. Other topics:
  - Asymmetric rates
  - Higher-gain FEC
4. Refine wording of 10G EPON Objectives
  - Crisp text, clear and measurable criteria

# Schedule for Tuesday, July 18, 2006

Start	Finish	Presenter	Company	Title
9:00 AM	9:30 AM	Glen Kramer		Agenda, Information, Patent Policy
<b>Backward Compatibility/Co-existence/Wavelength plan</b>				
9:30 AM	9:45 AM	Ryan Hirth	Teknovus	1Gbps to 10 Gbps Migration
9:45 AM	10:00 AM	Toshiaki Mukojima	Oki	Backward Compatibility and Co-Existence
10:00 AM	10:20 AM	Roger Merel	Luxtera	Backward Compatibility
10:20 AM	10:45 AM	Coffee Break		
10:45 AM	12:00 PM	Akihiro Otaka	NTT	Motion and Discussions, Voting
12:00 PM	1:30 PM	Lunch		
1:30 PM	2:15 PM	Pat Thaler	Broadcom	64B/66B Encoding
<b>Technical Feasibility of 29 dB Power Budget</b>				
2:15 PM	2:40 PM	Frank Chang	Vitesse	10G EPON Optical Budget Considerations
2:40 PM	3:00 PM	Frank Effenberger	Huawei	10Gb/s PMD Considerations
3:00 PM	3:30 PM	Roger Merel	Luxtera	PMD Proposal Considerations
3:30 PM	3:45 PM	Coffee Break		
3:45 PM	4:00 PM	Akihiro Otaka	NTT	Background of the 29dB Requirement
4:00 PM	4:15 PM	Motoyuki Takizawa	Fujitsu	Optical Budget for 10G-EPON
4:15 PM	4:30 PM	Akira Takahashi	Mitsubishi	Experimental Consideration on EPON Transmission
4:30 PM	4:45 PM	Mitsunobu Kimura	Hitachi	Feasibility at 29dB Loss Budget
4:45 PM	5:00 PM	Hiroshi Murata	Sumitomo	A PMD Class Supporting 29 dB Link Budget

# Schedule for Wednesday, July 19, 2006

Start	Finish	Presenter	Company	Title
<b>Technical Feasibility of 29 dB Power Budget (continued)</b>				
9:00 AM	9:30 AM	Hiroataka Wada	NEC	29dB Budget Technical Feasibility for "10Gb/s EPON"
9:30 AM	10:30 AM	Haim Ben-Amram	PMC Sierra	Serial 10G Downstream using FEC
10:30 AM	10:45 AM	Coffee Break		
10:45 AM	11:00 AM	Dong-Soo Lee	ETRI	Technical Feasibility of 10Gb/s EPON
11:00 AM	11:15 AM	Toshiaki Mukojima	Oki	Considerations for 10Gb/s EPON PHY
<b>Other Topics</b>				
11:15 AM	12:00 PM	Bin Yeong Yoon	ETRI	Advent of 10G Asymmetric EPON
12:00 PM	1:30 PM	Lunch		
1:30 PM	1:45 PM	Keiji Tanaka	KDDI R&D	System Configuration
1:45 PM	2:30 PM	Jeff Mandin	PMC Sierra	FEC Framing

Wednesday afternoon or Thursday morning – may visit other work groups to answer questions

# Reflector and Web

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- To subscribe to 10GEPON reflector, send email to:

**[listserv@ieee.org](mailto:listserv@ieee.org)**

and include this line in the *body of the message*:

***subscribe stds-802-3-10GEPON*** *firstname lastname*

(Currently 220 subscribers on 10GEPON SG reflector)

- Our web site is located at:

**[http://www.ieee802.org/3/10GEPON\\_study/](http://www.ieee802.org/3/10GEPON_study/)**

- No private area yet