
Report of the 10G MMF SG to the 802.3 Closing Plenary

**Bruce Tolley
Cisco Systems**

Accomplishments

- Held a very successful tutorial
- Heard over 22 technical presentations
- Tweaked our PAR, five criteria, and objectives
- Chose a name for our IEEE 802.3 port type
- Discussed a strawman schedule, role of consensus, proposals, distinctions between specification and implementation
- Overwhelming consensus to request that 802.3 support our moving forward to become a TF

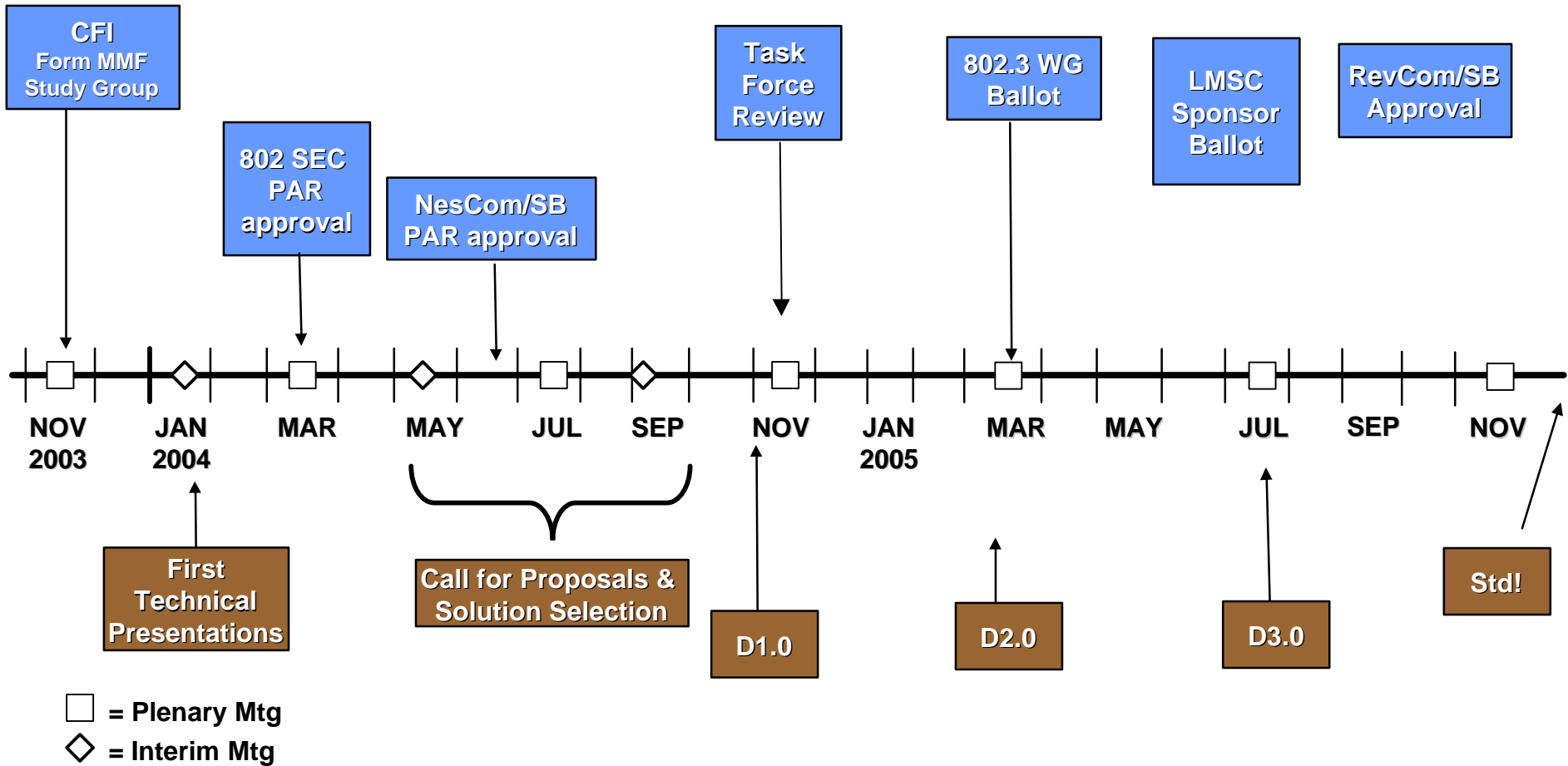
Presentations to MMF SG

Name	Company	Title	Day	Duration	Time
Bruce Tolley	Cisco	Introduction, Agenda Review, ...	Tu	0:15	8:30
John George	OFS	10G over FDDI Grade MMF Study Group Minutes, Vancouver BC	Tu	0:05	8:45
Petar Pepeljugin	IBM	Enhanced Spreadsheet Model for 10 Gbps MMF Links	Tu	0:20	8:50
Paul Voois	Clariphy	Extending the 10 Gigabit Ethernet Link Model for EDC	Tu	0:30	9:10
David Cunningham	Agilent	Multimode Fiber Channel Modelling	Tu	0:10	9:40
		Break		0:15	9:50
Petar Pepeljugin	IBM	Legacy and OM3 Fiber DMD Characterization @ 1300 nm	Tu	0:25	10:05
Kevin Witt	Vitesse	MMF Channel Experimental & Scaling Simulation	Tu	0:25	10:30
Martin Lobel	Intel	Channel Simulation and estimation of filter complexity	Tu	0:30	10:55
Alan Flatman	LAN	In Premises Optical Fibre Installed Base Analysis to 2007	Tu	0:40	11:25
		Lunch		1:00	12:05
Nick Weiner	Phyworks	Receiver Yield vs. Distance prediction using MMF emulation and simulation	Tu	0:30	13:05
Martin Lobel	Intel	Technical feasibility, constraints and definition of worst case space	Tu	0:30	13:35
Sudeep Bhoja	BBN	EDC coverage simulations on the Cambridge MMF model.	Tu	0:30	14:05
		Break		0:15	14:35
Norm Swenson	Clariphy	Worst case impulse responses for various EDC architectures	Tu	0:30	14:50
Abhijit Shanbhag	Scintera	EDC in a module - Practical issues	Tu	0:20	15:20
Pete Hallemer	Optium	300 meter Transmission Using Optical Mode Filtering and Limited Function EDC	Tu	0:45	15:40
Jen Fiedler	Infineon	EDC Optical Link Budget	Tu	0:20	16:25
Abhijit Shanbhag	Scintera	Compliance Testing for EDC revised	Tu	0:20	16:45
Bruce Tolley	Cisco	Agenda Review, ...	We	0:05	13:00
Abhijit Shanbhag	Scintera	Relaxed Optics Allowances for serial binary NRZ	We	0:20	13:05
Jim Morris	Digital Optics	Design Study for optimized receptacle based launch condition	We	0:20	13:25
Lew Aronson	Finisar	TX Launch Considerations for 10 GbE FDDI Links	We	0:25	13:45
Hank Blauvert	Xponent	Spiral Launch Method for Enhanced Multimode Fiber Bandwidth	We	0:30	14:10

The Tutorial Summary

- Support for installed FDDI-grade MM fiber means that we have broad market potential. Increasing density of 10 GBASE- solutions is key to lowering cost to end users
- Distinct identity: one problem - one solution
 - Need a serial solution to support installed FDDI-grade fiber. Serial interface enables not just lower power and lower cost but also higher-density system solutions.
- Technical feasibility: We have at least three possible approaches
- Economic feasibility: costs are expected to be comparable to or less than 10GBASE-LR
- Compatibility. Yes. This project would just be a PMD/PHY

Strawman:10GBASE-LRM Schedule



SG Motions

To amend the title of the PAR by deleting the letters -XX and inserting the suffix -LRM

– Passed: All: 53/0/0; dot3: 16/0/0

To amend the list of objectives to insert the word “selected” before the word MM in the last bullet

– Passed: All: 49/0/2; dot3: 49/0/2

To have 802.3 approve the 10G MMF objectives

– Passed: All 48/0/0 dot3: 16/0/0

To amend the distinct identity criterion

– Passed: all 41/0/2; dot3: 11/0/2

To have 802.3 approve the five criteria and forward them to the 802 SEC for approval

– Passed: All: 40/2/1 dot3: 13/3/0

To have 802.3 approve the amended PAR and forward it to the SEC and NESCOM for approval

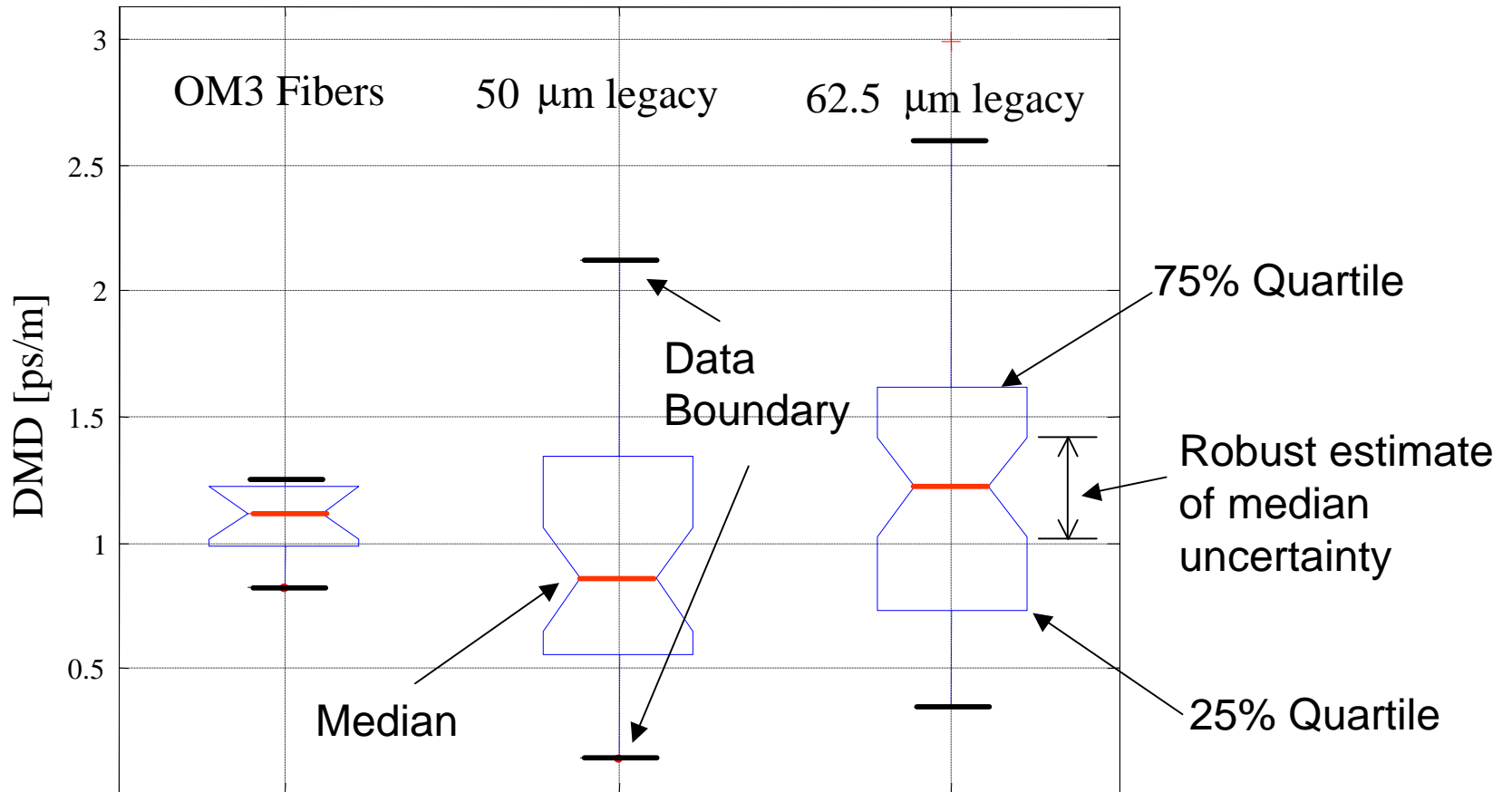
– Passed: All: 53/0/0; dot3: 16/0/0

Objectives as amended by SG 18 Mar 04

- Use the existing 10GBASE-R PCS
- Support a BER of better than or equal to 10^{-12} .
- Support fiber media selected from IEC 60793-2-10: 2003
 - 62.5 μ m
 - 160/500 MHz-km (A1b, 60793-2-10: 2003)
 - 200/500 MHz-km (A1b, 60793-2-10: 2003)
 - 50 μ m
 - 500/500 MHz-km (A1a.1, 60793-2-10: 2003)
 - 400/400 MHz-km (A1a.1, 60793-2-10: 2003)
 - 1500/500 MHz-km (A1a.2, 60793-2-10: 2003)
- Provide a Physical Layer specification which supports link distances of:
 - At least 220 m on installed 500MHz.km multimode fiber
 - At least 300 m on **selected** multimode fiber

Multi-mode Fiber DMD Distribution

(measured from 99 fibers, 5 TIA round robin fiber spools since 1996)



Source: pepeljugoski_1_0304

Fiber Type

WG Motion: Objectives Approval

Move that 802.3 approve the SG objectives as amended by SG 18.March.04

M: Bruce Tolley on behalf of the SG

Technical ($\geq 75\%$)

802.3 Voters

Yes: 30 No: 0 Abstain: 12

Passes

10Gb/s on FDDI-grade MMF Cable

Five Criteria

Adopted by SG 14 Jan 2004

Amended by SG 18 Mar 2004

Broad Market Potential 1

- Broad sets of applicability
- Multiple vendors and numerous users
- Balanced costs (LAN versus attached stations)

Current trends suggest the steady migration of LAN speeds from 100 Mb/s (100BASE-TX) today toward 1000 Mb/s (1000BASE-T). In particular, as the density of computer devices (desktops, servers, switches, routers and storage modules) located in enterprise networks and data centers increases, so will the demand for higher speeds at data aggregation points. A critical aggregation point is represented by the interconnection of distribution equipment within the building backbone cabling subsystem. Clearly there is a need for a low cost 10Gb/s solution that will utilize the installed base multimode fiber infrastructure.

Broad Market Potential 2

Interest in 10Gb/s on FDDI-grade multimode fiber has been demonstrated by the attendance of more than 156 vendor and user representatives at CFI meeting at the November 2003 Plenary, and by the attendance & 30 contributions received towards advancing a technical solution at the subsequent January Interim meeting. Forty (40) companies have indicated they will participate in the technical development of a standard for 10Gb/s on FDDI-grade multimode fiber. This level of commitment indicates that the standard will be supported by multiple vendors, and that there will be a wide variety of equipment available to support 10 gigabit speed applications on multimode fiber links.

The cost balance is no different from any other point-to-point Ethernet link.

WG Motions: BMP Criterion

Move that 802.3 approve the broad market potential criterion

M: Bruce Tolley on behalf of the SG

Technical ($\geq 75\%$)

802.3 Voters

Yes: 33 No: 0 Abstain: 9

Passes/Fails

Compatibility with IEEE Standard 802

- IEEE 802 defines a family of standards. All standards shall be in conformance with the IEEE 802.1 Architecture, Management and Interworking documents as follows: 802. Overview and Architecture, 802.1D, 802.1Q and parts of 802.1f. If any variances in conformance emerge, they shall be thoroughly disclosed and reviewed with 802.
- Each standard in the IEEE 802 family of standards shall include a definition of managed objects which are compatible with systems management standards.

The proposed standard will conform to the full-duplex operating mode of the 802.3 MAC. In a manner similar to the 10GBASE fiber standards, a Physical layer will be defined for operation at 10Gb/s over structured fiber cabling.

The proposed standard will conform to the requirements of IEEE Std 802-2001. Conformance with 802.1 and 802.2 is provided by use of the overlying 802.3 MAC sub-layer.

The Management Information Base (MIB) for the 10Gb/s on FDDI-grade multimode fiber PHY will maintain compatibility with the current 802.3 MIB, allowing a consistent management model at all operating speeds.

WG Motions: Compatibility Criterion

Move that 802.3 approve the compatibility criterion

M: Bruce Tolley on behalf of the SG

Technical ($\geq 75\%$)

802.3 Voters

Yes: 33 No: 0 Abstain: 10

Passes/Fails

Distinct Identity

as Amended by SG 18 March 2004
amended by WG 18Mar04

- Substantially different from other IEEE 802 & 802.3 standards
- One unique solution per problem (not two solutions to a problem)
- Easy for the document reader to select the relevant specification

The proposed standard is a 10Gb/s upgrade for 802.3 users based on the 802.3 CSMA/CD MAC.

Currently the industry is moving towards smaller form factor serial solutions, and it is expected that with time these will become dominant. This multimode PHY will be the only one that supports a link distance of at least 220m over installed FDDI-grade multimode fiber **and that supports compatibility with the 10GBASE-R PMA interface which will be the attachment unit interface (AUI) for this PMD.**

The proposed standard will be formatted as a new clause to the 802.3 standard.

Distinct Identity

as Amended by SG 18 March 2004, amended
by WG, amended by WG

- Substantially different from other IEEE 802 & 802.3 standards
- One unique solution per problem (not two solutions to a problem)
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The proposed standard will be formatted as a new clause to the 802.3 standard.

Distinct Identity

as Amended by SG 18 March 2004

amended by WG, amended by WG, amended by WG (final version voted on by WG)

- Substantially different from other IEEE 802 & 802.3 standards
- One unique solution per problem (not two solutions to a problem)
- Easy for the document reader to select the relevant specification

The proposed standard is a 10Gb/s upgrade for 802.3 users based on the 802.3 CSMA/CD MAC.

Currently the industry is moving towards smaller form factor serial solutions, and it is expected that with time these will become dominant. This **serial** multimode PHY will be the only one that supports a link distance of at least 220m over installed FDDI-grade multimode fiber **and that supports compatibility with** the 10GBASE-R PMA.

The proposed standard will be formatted as a new clause to the 802.3 standard.

WG Motions: Distinct Identity Criterion

Move that 802.3 approve the distinct identity
criterion as amended by the WG

M: Bruce Tolley on behalf of the SG

Technical ($\geq 75\%$)

802.3 Voters

Yes: 39 No: 6 Abstain: 6

Passes

Technical Feasibility 1

- Demonstrated system feasibility
- Proven technology, reasonable testing
- Confidence in reliability

Presentations made to the 10Gb/s on FDDI-grade multimode fiber Study Group illustrate the technical feasibility of 10Gb/s signaling using structured fiber cabling as defined by IEC 60793-2. These presentations included several different technical approaches, covered numerous aspects of feasibility including simulation and theoretical analysis based on known technology, specified cabling technology, and state of the art process technology; and demonstrated that there is sufficient channel capacity for the transmission of 10Gb/s.

Technical Feasibility 2

The technology to be utilized in the realization of the 10Gb/s on FDDI-grade multimode fiber PHY will rely on the work of previous 802.3 standards and activities; both extension to the multimode efforts of 1000BASE-SX/LX, and the PHY is expected to leverage available 10GBASE-R technology. It is recognized that the relevant technologies have greatly advanced at every level since the inception of work on the 1000BASE-SX/LX standard over six years ago and the original 802.3ae work from 3 years ago.

This study group has received contributions from PHY, system and cabling vendors; end users; and industry/academic experts.

WG Motion: Technical Feasibility Criterion

Move that 802.3 approve the technical feasibility
criterion

M: Bruce Tolley on behalf of the SG

Technical ($\geq 75\%$)

802.3 Voters

Yes: 38 No: 0 Abstain: 6

Passes

Economic Feasibility

- Known cost factors, reliable data
- Reasonable cost for performance
- Consideration of installation costs

The implementation cost of the 10Gb/s on FDDI-grade multimode fiber PHY device is estimated to be lower than that of 10GBASE-LR devices. The experience curve of the industry ensures the future reduction of the size and the cost of implementations. With production volume and anticipated relaxation of optical component requirements, the 10Gb/s on FDDI-grade multimode fiber PHY device is projected to meet the 3x-4x cost versus 10x performance guidelines applied to comparable previous advanced Ethernet standards. Additionally, it is expected that serial solutions will have the highest volumes and this standard will therefore have economies of scale.

The continued use of the installed multimode structured fiber cabling systems supports economic feasibility with regards to total cost of upgrades to 10Gb/s and takes into considerations the constraints of industry IT budgets.

WG Motion: Economic Feasibility Criterion

Move that 802.3 approve the economic feasibility
criterion

M: Bruce Tolley on behalf of the SG

Technical ($\geq 75\%$)

802.3 Voters

Yes: 39 No: 3 Abstain: 7

Passes

WG Motion

Move that 802.3 WG forward the 10G MMF SG Five Criteria to the 802 SEC for approval

M: Bruce Tolley on behalf of the SG

Technical ($\geq 75\%$)

802.3 Voters

Yes: 39

No: 0

Abstain: 9

Passes

Title of PAR as adopted by SG in Vancouver

- 4. Title of Document: Information technology -- Telecommunications and information exchange between systems -- Local and metropolitan area networks -- specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Amendment: Physical Layer and Management Parameters for 10 Gb/s Operation, Type 10GBASE-**xx**

Title of PAR as amended by SG

18 March 04

- 4. Title of Document: Information technology -- Telecommunications and information exchange between systems -- Local and metropolitan area networks -- specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Amendment: Physical Layer and Management Parameters for 10 Gb/s Operation, Type 10GBASE-LRM

Options

- We have to use R
 - because we are using 10GBASE PCS

Options

- 10GBASE-LRQ
- 10GBASE-LRM
- 10GBASE-LRZ
- 10GBASE-MR
- 10GBASE-FR

Criteria for Port Type Choice

- Consistency with 10GbE
 - Use L and R, not M
- Clear communication of interoperability
 - Will someone expect to be able plug LRQ into LR?
- Legible labels / manufacturing friendly
 - Will Q be legible as a Q when stamped on metal or printed on label

Port Type Name

What we chose:

- 10GBASE-LRM

Why:

- L = long wavelength.
 - To date all presentations have been on 1310 nm
 - Our goals specify 500MHz*km window
- R: Our goals specify the use of the LAN PHY
- M: We need to clearly identify the port type

WG Motion: Par Approval as amended by **WG (motion was edited for correctness)**

Move that 802.3 WG approve the 10GBASE-LRM amended PAR and to forward the PAR and five Criteria to the 802 SEC for approval (please consider under continuous process).

M: Bruce Tolley on behalf of the SG

Technical ($\geq 75\%$)

802.3 Voters

Yes: 43 No: 0

Abstain: 3

Passes

WG Motion: Extension of SG

Move that 802.3 WG approve the extension of the SG until the close of the July Plenary.

M: Bruce Tolley on behalf of the SG

Technical ($\geq 75\%$)

802.3 Voters

Yes: No: Abstain:

Passed by acclamation

Passes