Approved Minutes

IEEE 802.3 Next-generation 200 Gb/s and 400 Gb/s MMF PHYs Study Group

Interim Meeting
January 22-23, 2018
Geneva, Switzerland
Prepared by Mabud Choudhury

Group Name: IEEE 802.3 Next-generation 200 Gb/s and 400 Gb/s MMF PHYs Study Group
Date/Location: Monday & Tuesday, January 22-23, 2018. Geneva, Switzerland, CICG Room 18
Chair: Robert Lingle, Jr.
Recording Secretary: Mabud Choudhury
Meeting Participants: Attendance is listed in Appendix A

Call to order:
IEEE 802.3 Next-generation 200 Gb/s and 400 Gb/s MMF PHYs (NGMMF) Study Group meeting convened at 9:15 am Central European Time (Geneva, Switzerland), Monday, January 22, 2018 by David Law, 802.3 Working Group Chair.

Mr. Law welcomes attendees to the IEEE 802.3 Next-generation 200 Gb/s and 400 Gb/s MMF PHYs Study Group meeting.

David Law appoints Mabud Choudhury as the recording secretary for the IEEE 802.3 Next-generation 200 Gb/s and 400 Gb/s MMF PHYs Study Group meeting.

As announced at the November 2017 Plenary meeting, David Law intends to appoint Robert Lingle, Jr. as the Chair of the IEEE 802.3 Next-generation 200 Gb/s and 400 Gb/s MMF PHYs Study Group.

Motion #1:
Move to confirm Robert Lingle as IEEE 802.3 Next-generation 200 Gb/s and 400 Gb/s MMF PHYs Study Group Chair

- Moved by Paul Kolesar
- Seconded by Alan Flatman
- Y: 15 N: 0 A: 0 (>= 75% by rule)
- Motions Passes!

Mr. Law turned the meeting over to Study Group Chair Robert Lingle, Jr.

The Chair called for introductions and affiliations, the participants introduced themselves, and the Chair then proceeded with the agenda.

Presentation #1:
Title: "Next-Gen 200G & 400G PHYs for MMF Study Group Agenda and General Information"
Presenter: Robert Lingle, Jr., Chair
http://www.ieee802.org/3/NGMMF/public/agenda_NGMMF_01a_jan18.pdf
Chair reviewed Schedule/Agenda.
Chair noted conflict with parallel 802.3cd Task Force meeting in terms of limiting participants.

Motion #2 to approve the agenda in
http://www.ieee802.org/3/NGMMF/public/agenda_NGMMF_01a_jan18.pdf was approved by voice vote without objection.

Chair read aloud and reviewed IEEE 802 Participation and Pre-PAR Patent Policy. There were no questions.
Mr. Lingle provided Study Group information, access to the reflector and website.
Mr. Lingle reminded everyone to sign-in via IMAT on-line attendance (Interim meeting password provided) and to sign-in on Attendance Sheet.
Chair reviewed ground rules, role of the Chair, overall IEEE structure, important bylaws, rules, & references links, overall IEEE 802.3 standards process focusing in on Study Group phase.
Mr. Lingle reviewed Study Group chartering motion and role of Study Group, emphasizing that we are choosing objectives and not solutions.
Mr. Lingle provide Ad Hoc report, summarizing 4 teleconference meetings since November Plenary.
Chair reviewed goals for the week:

- Consensus building on PAR/CSD/Objectives
- 1 Agenda/Administrative/General Information Presentation
- 18 technical presentations (17 technical presentations initially with 1 late submission). 19 total presentations.
- Adoption of PAR /CSD/Objectives
- Groundwork to become Task Force by May 2018

Future meeting dates and locations were reviewed.

Presentation #2:
Title: "The Path Forward Including Foundational Objectives"
Presenter: Robert Lingle, Jr., Chair
http://www.ieee802.org/3/NGMMF/public/lingle_NGMMF_02_jan18.pdf

- Chair presented a path forward. It is a good time to work on MMF PHYs and PMDs – worldwide growth of MMF. There are 2 timeline routes to Task Force: either May 2018 or November 2018. To have the most relevance in the market for 400G PMDs being standardized, chair prefers to approve PAR and CSD in this meeting to pre-submit before the March Plenary, to become a Task Force in May.
- Both foundational project-specific objectives were reviewed. A range of options were discussed, depending on whether both objectives for both 400G and 200G were adopted, and whether objectives for both parallel and duplex MMF were adopted.
- It was objected that chair's recommended timeline may not give sufficient time for studying objectives for duplex fiber. Chair noted that an objective for 200G over duplex must be adopted not later than March, but an objective for 400G over duplex fiber could likely be added in Task Force.

Presentation #3:
Title: "Proposed PMD Progression"
Presenter: Rick Pimpinella
http://www.ieee802.org/3/NGMMF/public/pimpinella_NGMMF_01_jan18.pdf

Presented view that it is too early for a 200G-SR1.4 PMD, suggesting that complexity and cost for 4 wavelength solution is higher than that of 2 wavelength solution. Best application for MMF is in breakout. Alternate views discussed.

Break at 10:30 am. Resumed at 10:45 am.

Presentation #4:
Title: "Objectives for NG 200G and 400G PHYs"
Presenter: Steve Swanson
http://www.ieee802.org/3/NGMMF/public/swanson_NGMMF_01_jan18.pdf
General framework for objectives presented, with objectives supporting 5 criteria. A perspective that objectives must support installed base and align with previous standards was presented.

Vipul Bhatt requested late presentation – no objections to making late presentation.
Presentation #5:
Title: "The Need for 400G Duplex MMF Objective"
Presenter: Vipul Bhatt
http://www.ieee802.org/3/NGMMF/public/bhatt_NGMMF_01_jan18.pdf
Reach may not be 100 meters in order to scale up in number of wavelengths.

Break at 12:00 pm. Resumed at 1:00 pm.

Presentation #6:
Title: "Major PAR form questions – NGMMF SG"
Presenter: Mabud Choudhury
http://www.ieee802.org/3/NGMMF/public/choudhury_ngmmf_01_jan18.pdf
Major PAR form questions presented and reviewed.
Draft PAR document was generated based on discussions on objectives, projected objectives, reviewing prior PAR documents for similar projects/standards to NGMMF SG, review and input from experts, review and discussions from group during Ad Hoc meetings, to form basis for PAR that could be modified once a set (not complete) of objectives and CSD were agreed to, that could be pre-submitted prior to March Plenary.
Primary goal was consensus building for adoption of PAR document.
No changes to draft PAR based on review and discussion.

Presentation #7:
Title: "IEEE 802.3 Criteria for Standards Development (CSD) – NGMMF SG"
Presenter: Mabud Choudhury
http://www.ieee802.org/3/NGMMF/public/choudhury_ngmmf_02_jan18.pdf
Draft CSD presented and reviewed.
Draft CSD document was generated based on discussions on objectives, projected objectives, reviewing prior CSD documents for similar projects/standards to NGMMF SG, review and input from experts, review and discussions from group during Ad Hoc meetings, to support Draft PAR, and to form basis for CSD that could be modified once a set (not complete) of objectives and PAR were agreed to.
Primary goal was consensus building for adoption of CSD document.
All 5 Criteria were discussed. For Broad Market Potential, there was consensus to change "The rate of deployment of MMF continues to grow both globally and in North America, producing a growing

installed base of both OM3 & OM4 1-pair and 4-pair cable." to "The rate of deployment of MMF continues to grow both globally and in North America, adding to a substantial installed base of both OM3 & OM4 1-pair and 4-pair cable."
There was consensus for no additional changes to Draft CSD.

Presentation #8:
Title: "400/200GbE PCS Overview"
Presenter: Mark Gustlin
http://www.ieee802.org/3/NGMMF/public/gustlin_NGMMF_01_jan18.pdf
Contribution showed that the architecture established in the 802.3bs project could be re-used for next-gen MMF PHYs over fewer pairs if BER targets were the same. Broad agreement with contribution.

Presentation #9:
Title: "Towards OM3, OM4 Modal Bandwidth Guidance for WDM"
Presenter: Paul Kolesar
http://www.ieee802.org/3/NGMMF/public/kolesar_NGMMF_02_jan18.pdf
Multi-company contribution described efforts that will be undertaken in other standards bodies to achieve a reference for the bandwidths of OM3 & OM4 at wavelengths away from 850nm, for use by Task Force resulting from the NGMMF Study Group. Liaison letter to IEC 86A suggested However, IEEE does not have liaison with IEC, so liaison letter to IEC cannot be pursued.

Presentation #10:
Title: "OM3, OM4, OM5 Modal Bandwidth Over Wavelengths for WDM"
Presenter: Paul Kolesar
http://www.ieee802.org/3/NGMMF/public/kolesar_NGMMF_01_jan18.pdf
Preliminary guidance by co-authors from multiple companies on bandwidths over wavelength of OM3, OM4 & OM5. General discussion and broad agreement followed.

Presentation #11:
Title: "Channel Performance – 2 vs 4 Wavelengths"
Presenter: Rick Pimpinella
http://www.ieee802.org/3/NGMMF/public/pimpinella_NGMMF_02a_jan18.pdf
[Note: Chair approved presenter late request to update Slide 10 (reflected in link above), showing correlation between Panduit and Corning worst-case modal bandwidth models for OM3 and OM4 at 953nm. One of the supporters indicated that his support was limited to this added Slide 10.]
Presenter indicated that EMB may peak higher or lower than 850nm. DMD interacts differently with chromatic dispersion in these two cases, with implications for 2 and 4 wavelength multiplexing. General discussion followed. Updated presentation (link above) also clarifies Slide 11 reference to Fibre Channel.

Presentation #12:
Title: "Technical Feasibility of 50 Gbit/s PAM4 using VCSELs from 850nm to 1060nm"
Presenter: Earl Parsons
http://www.ieee802.org/3/NGMMF/public/parsons_NGMMF_01_jan18.pdf
Multi-company contribution arguing for TF of using multiple wavelengths with 50 Gb/s PAM4 over MMF. General discussion followed.

Presentation #13:
Title: "400G SR8 for Data Center Interconnect"

Presenter: Zuowei Shen
Contribution argued that 400GBASE-SR8 is fastest to market solution for 400 Gb/s over MMF with reduced pair count. Multiple breakout possibilities and availability are also key. Cost-effectiveness is key to compete with copper for very short reaches. General discussion followed.

Presentation #14:
Title: "Broad market potential, economic feasibility, and distinct identity for an 400GBASE-SR4.2 objective"
Presenter: Robert Lingle Jr.
http://www.ieee802.org/3/NGMMF/public/lingle_ngmmf_03_jan18.pdf
Multi-company presentation arguing for the BMP and EF of 400GBASE-SR4.2 using 4 pairs MMF. General discussion followed.

Break for the day at 6:00 pm.

Tuesday, January 23, 2018
Call to order:
Robert Lingle, Jr., Study Group Chair, convened second day of meeting at 9:00 am Central European Time (Geneva, Switzerland)

Presentation #15:
Title: "Channel Cost Analysis Duplex vs. Parallel Optics"
Presenter: Rick Pimpinella
http://www.ieee802.org/3/NGMMF/public/pimpinella_NGMMF_03_jan18.pdf
An approach for analyzing relative costs of duplex vs parallel optics was presented, arguing against an objective for 200G over duplex MMF. General discussion followed.

Presentation #16:
Title: "In Support of 200G MMF Ethernet PMDs - Broad Market Potential, Economic Feasibility"
Presenter: Jim Young
http://www.ieee802.org/3/NGMMF/public/young_NGMMF_01a_jan18.pdf
An approach for analyzing relative costs of duplex vs parallel optics was presented, arguing in favoring of an objective for 200G over duplex MMF. General discussion followed. Updated presentation (link above) includes Supporters list.

Break at 10:20 am. Resumed at 10:40 am.

Presentation #17:
Title: "Technical feasibility of a 400 Gb/s optical PMD supporting four MMF pairs"
Presenter: Jonathan Ingham
http://www.ieee802.org/3/NGMMF/public/ingham_NGMMF_01_jan18.pdf
Contribution argued for TF for 400GBASE-SR4.2 in support of a 100m objective. General discussion followed.

Presentation #18:
Title: "The Need for 100Gb/s/lane MMF PMDs"
Presenter: Ali Ghiasi

http://www.ieee802.org/3/NGMMF/public/ghiasi_NGMMF_01_jan18.pdf
Benefits of shorter reach, <30m. Depopulating switches for ToR. Need more centralized switches. Cannot handle with DAC or AOC.
Contribution viewed as important in rethinking use of MMF links – more as very short reach <30m solution to replace DAC and AOC as data rates increase and market and customer needs evolve. However, the time frame in terms of achieving Technical Feasibility within project timeline was questioned. Possibility of adding objective during Task Force was discussed.

Break at 12:00 pm. Resumed at 1:00 pm.

Motion #3:

- Move that the NGMMF Study Group adopt the following objectives:
    1. Support full-duplex operation only
    2. Preserve the Ethernet frame format utilizing the Ethernet MAC
    3. Preserve the minimum and Maximum FrameSize of current Ethernet standard
    4. Provide appropriate support for OTN
    5. Specify optional Energy Efficient Ethernet (EEE) capability
    6. Support a BER of better than or equal to 10-13 at the MAC/PLS service interface (or the frame loss ratio equivalent)
- Moved by Earl Parsons
- Seconded by Paul Kolesar
- Y: 24 N: 0 A: 0 (Technical, >= 75%)
- Room Count: 25
- Motion Passes!

Presentation #19:
Title: "Lower fibre count 200 Gb/s and 400 Gb/s PMDs"
Presenter: Vipul Bhatt (for Jonathan King)
http://www.ieee802.org/3/NGMMF/public/king_NGMMF_01_jan18.pdf
Contribution argued for the TF of both 200GBASE-SR1.4 and 400GBASE-SR4.2 in support of 100m objectives for both. General discussion followed.

Straw Poll #1:
Straw Poll for 400G parallel PMDs:

- Vote for all options you could support (Chicago Rules):
    A. I support an objective for 4 fiber pairs
    B. I support an objective for 8 fiber pairs
    C. I would support both in this project
    D. I would oppose doing both in this project
    E. I plan to abstain from voting on 400G PMDs
- A)18 B)21 C)18 D)1 E)3
- Room Count: 24

Straw Poll # 2:
Straw Poll for 200Gb/s (Chicago rules):

- I support a 200 Gb/s objective for operation over:
    A. 1 pair, up to at least 100m over MMF

B. 1 pair, up to at least 100m over OM4 MMF

- Chicago rules – vote for as many as you would support
  - A) 10 B) 16

Straw Poll # 3:
Straw Poll for 200Gb/s (Chicago rules):

- I oppose a 200 Gb/s objective for operation over:
  A. 1 pair, up to at least 100m over MMF
  B. 1 pair, up to at least 100m over OM4 MMF
- Chicago rules – vote for as many as you would oppose
  - A) 7 B) 0

SG broke for 30 minutes so three motions could be crafted for likely passage based on straw poll results.

Motion #4:
Move that the NGMMF Study Group adopt the following objective:

- Define a physical layer specification that supports 200 Gb/s operation over 1 pair of OM4 MMF with lengths up to at least 100m
  - Moved by: Paul Kolesar
  - Seconded by: Adrian Amezcua
  - Technical : >= 75%
  - Y: 13 N: 8 A: 7
  - Motion Fails

Motion #5:
Move that the NGMMF Study Group adopt the following objective:

- Define a physical layer specification that supports 400 Gb/s operation over 8 pairs of MMF with lengths up to at least 100m
  - Moved by: Zuowei Shen
  - Seconded by: Chris Cole
  - Technical : >= 75%
  - Y: 22 N: 3 A: 2
  - Results: Yes 22 No 3 Abstain 2
  - Motion passes!
  - Room Count: 27

Motion #6:
Move that the NGMMF Study Group adopt the following objective:

- Define a physical layer specification that supports 400 Gb/s operation over 4 pairs of MMF with lengths up to at least 100m
  - Moved by: Jonathan Ingham
  - Seconded by: Vipul Bhatt
  - Technical : >= 75%
  - Y: 21 N: 0 A: 5
  - Motion Passes!

Motion #7:

Move that the NGMMF PHY Study Group adopt the following objective:

- Support a MAC data rate of 400 Gb/s
    - Moved by: John Abbott
    - Seconded by: James Young
    - Technical : >= 75%
    - Y: 21 N: 0 A: 0
    - Motion Passes!

Based on the outcome of the motions for the objectives for this SG meeting, the Draft CSD and Draft PAR documents were modified to remove references to 200 Gb/s and 1 pair MMF.
The group reviewed and discussed the modified Draft PAR and Draft CSD documents to create final version of CSD document, choudhury_NGMMF_03_jan18, for this SG meeting. Expanded Distinct Identity for CSD to substantially differentiate 400 Gb/s PHY for both 8 pairs and 4 pairs.

Motion # 8:
Move that the NGMMF Study Group adopt the CSD responses in
http://www.ieee802.org/3/NGMMF/public/choudhury_NGMMF_03_jan18.pdf

- Moved by: Ken Jackson
- Seconded by: Mabud Choudhury
- Technical : >= 75%
- Y: 17 N: 0 A: 0
- Motion Passes!

The Draft PAR document was further reviewed with David Law, Working Group Chair. Some typos were caught and corrected.
The PAR form was then completed on-line in via the myProject system with Mr. Law's assistance. The completed PAR http://www.ieee802.org/3/NGMMF/public/choudhury_NGMMF_04_jan18.pdf was reviewed with the group.

Motion # 9:
Move that the NGMMF Study Group adopt the PAR in
http://www.ieee802.org/3/NGMMF/public/choudhury_NGMMF_04_jan18.pdf

- Moved by: James Young
- Seconded by: Steve Swanson
- Technical : >= 75%
- Y: 17 N: 0 A: 0
- Motion Passes!

Motion #10:
Move to Adjourn:

- Moved by: Steve Swanson
- Seconded by: Adrian Amezcua
- Approved by voice vote without objection (Procedural > 50%)

The Meeting was adjourned at 5:45 pm, Central European Time (Geneva, Switzerland), Tuesday, January 23, 2018.

Appendix A: Attendees at the IEEE 802.3 Next-generation 200 Gb/s and 400 Gb/s MMF PHYs Study Group, 22-23 January 12-13, 2018

	Last Name	First Name	Employer	Affiliation	22-Jan-18	23-Jan-18
1	Abbott	John	Corning	Corning	x	x
2	Alasad	Amr	KACST	KACST		x
3	Amezcua	Adrian	Prysmian	Prysmian	x	x
4	Baldwin	Thananya	Ixia/Keysight	Keysight		x
5	Bhatt	Vipul	Finisar	Finisar	x	x
6	Booth	Brad	Microsoft	Microsoft	x	x
7	Chang	Ayla	Huawei	Huawei	x	x
8	Chang	Frank	Inphi	Inphi		x
9	Choudhury	Mabud	OFS	OFS	x	x
10	D'Ambrosia	John	Futurewei	Futurewei	x	
11	Estes	David	Spirent	Spirent	x	x
12	Flatman	Alan	LAN Technologies	LAN Technologies	x	x
13	Ghiasi	Ali	Ghiasi Quantum	Ghiasi Quantum / Huawei	x	x
14	Gong	Zhigang	O-Net	O-Net	x	x
15	Grillaert	Joost	Nexans	Nexans	x	x
16	Gustlin	Mark	Xilinx	Xilinx	x	x
17	Ingham	Jonathan	Foxconn Interconnect Technology	Foxconn Interconnect Technology	x	x
18	Jackson	Ken	Sumitomo	Sumitomo		x
19	Kolesar	Paul	CommScope	CommScope	x	x
20	Lingle	Robert	OFS	OFS	x	x
21	Nicholl	Gary	Cisco	Cisco	x	
22	Ofelt	David	Juniper Networks	Juniper Networks	x	x
23	Parsons	Earl	CommScope	CommScope	x	x
24	Pepper	Jerry	Ixia/Keysight	Keysight		x
25	Pham	Phong	US Conec	US Conec	x	x
26	Pimpinella	Rick	Panduit	Panduit	x	x
27	Shen	Zuowei	Google	Google	x	x
28	Sprague	Ted	Infinera	Infinera		x
29	Swanson	Steve	Corning	Corning	x	x
30	Wang	Haifei	Huawei	Huawei	x	
31	Wang	Xinyuan	Huawei	Huawei	x	
32	Wang	Roy	Hewlett Packard Enterprise	Hewlett Packard Enterprise		x
33	Xu	Yu	Huawei	Huawei	x	x
34	Young	Jim	CommScope	CommScope	x	x
35	Zhuang	Yan	Huawei	Huawei	x	x