100Gb/s per Lane for Electrical Interfaces and Electrical PHYs Study Group: Status and Work

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OUTLINE

- CFI recap
- Study group goals
- Timeline
- Proposed text
- Steps forward

CFI RECAP

- 146 gathered on Tuesday. Nov 7th for Consensus building
- Panel and Contributors:
  - John D'Ambrosia, Futurewei
  - David Ofelt, Juniper
  - Kent Lusted, Intel
  - Adam Healey, Broadcom
  - Beth Kochuparambil, Cisco
- Presentation given discussing market need, technical feasibility, and why now topics for 100Gb/s per lane for electrical interfaces and electrical PHYs.
  - http://www.ieee802.org/3/cfi/1117_3/CFI_03_1117.pdf
  - No questions brought forward on the floor.
- Study group, or even Task Force, -like material presented already back in May 2017

Thank you!

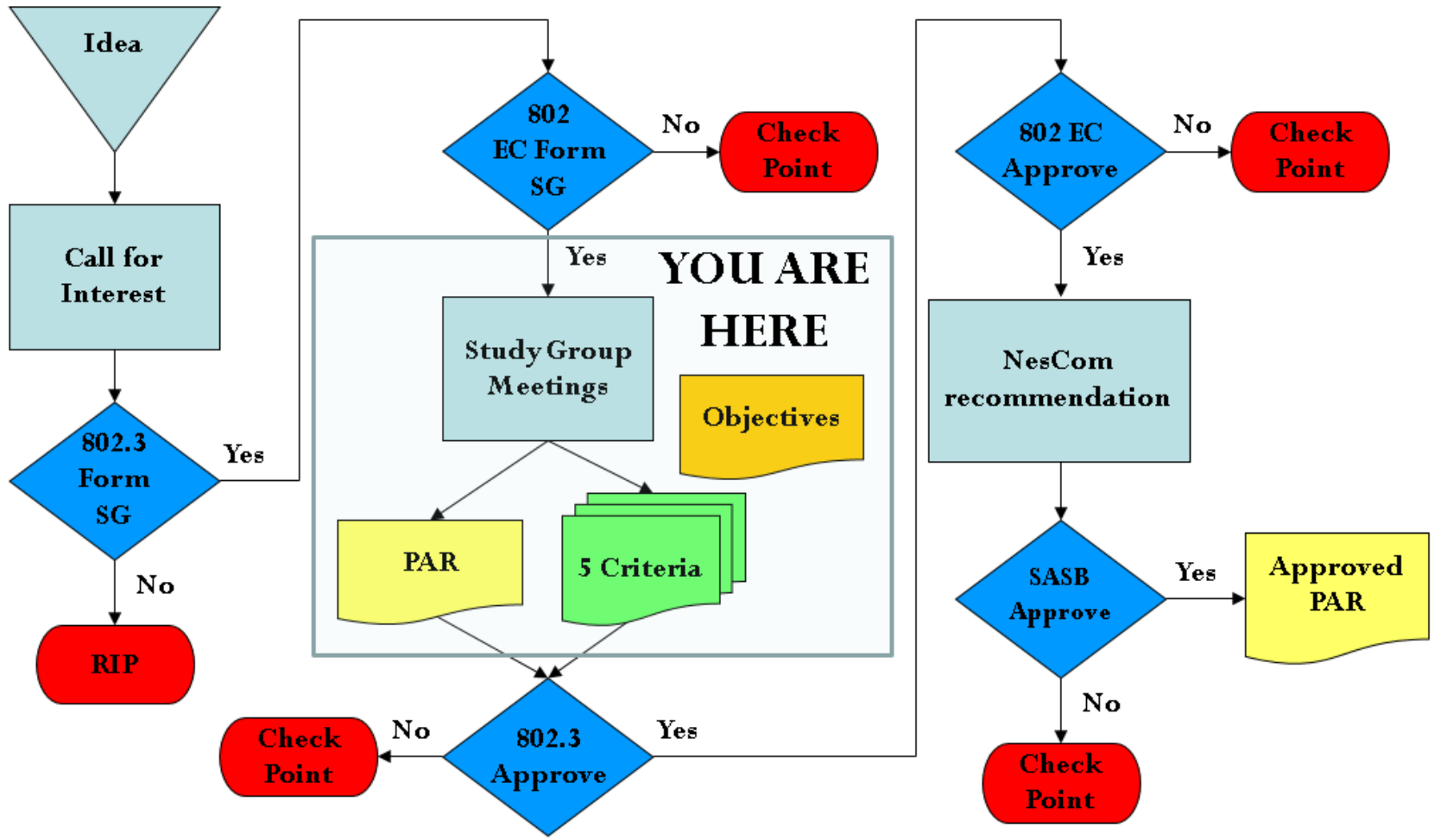
CFI RECAP – STRAW POLLS AND MOTION

- **Should a study group be formed** for "100Gb/s per Lane for Electrical Interfaces and PHYs"? **Yes: 137 No: 0 Abstain: 7**
- **I would participate** in a "100Gb/s per lane for Electrical Interfaces and PHYs" study group in IEEE 802.3. **Tally: 80**
- **My company would support participation** in a "100Gb/s per lane for Electrical Interfaces and PHYs" study group. **Tally: 45**
- Move that the IEEE 802.3 Working Group request the **formation of a Study Group** to develop a Project Authorization Request (PAR) and Criteria for Standards Development (CSD) responses for "100Gb/s per Lane for Electrical Interfaces and Electrical PHYs". **Yes: 93 No: 0 Abstain: 5**

STUDY GROUP

- 100Gb/s per Lane for Electrical Interfaces and Electrical PHYs Study Group - AKA 100G Electrical Lane SG (or "100GEL"), for short.
- Website: http://www.ieee802.org/3/100GEL/index.html
- Goal of Study Group is to study the problem and develop the following:
  - Objectives
  - Responses to The Criteria for Standard Development (CSD) – aka 5 Criteria
  - PAR
- Solving the problem, developing solutions, writing specifications are all Task Force activities

Overview of IEEE 802.3 Standards Process (1/5)- Study Group Phase



Note: At "Check Point", either the activity is ended, or there may be various options that would allow reconsideration of the approval.

TIMELINE

Option 1

PAR, CSD, and Objectives in January

March Plenary

March 9th (Plenary)

May Interim

(starts May 21st)

Approval Steps

Study Group

Working Group

WG Executive Committee

NesCom recommendation

Standards Board

First Task Force Meeting

Option 2

PAR, CSD, and Objectives in March or May

July Plenary

July 13th (Plenary)

Nov Plenary

(misses Sept interim, 10-14th)

TIMELINE

Option 1

PAR, CSD, and Objectives in January

May Interim Task Force

- Make educated start for Objectives/CSD/PAR.
- May need further study and modification to objectives in Task Force,
- Allows us to move into baseline proposals when ready
- Will need to drive to high level consensus quickly

Option 2

PAR, CSD, and Objectives in March or May

Nov Plenary Task Force

- Do deeper study prior to Objectives/CSD/PAR
- Have more firm Objectives
- Head straight into baseline proposals once a Task Force.
- May need to wait a meeting cycle or two after consensus is formed due to scheduling/process

FOUNDATIONAL OBJECTIVES

- Support a MAC data rates of 100, 200, and 400 Gb/s
- Support full-duplex operation only
- Preserve the Ethernet frame format utilizing the Ethernet MAC
- Preserve minimum and maximum Frame Size of current IEEE 802.3 standard
- Support a BER of better than or equal to 10-12 at the MAC/PLS service interface (or the frame loss ratio equivalent) for single-lane 100Gb/s operation
- Support a BER of better than or equal to 10-13 at the MAC/PLS service interface (or the frame loss ratio equivalent) for single-lane 100Gb/s operation
- Support optional Energy-Efficient Ethernet operation

PROPOSED LANGUAGE FOR 100G OBJECTIVES

- Define a single-lane 100 Gb/s Attachment User interface (AUI) for C2M electrical operation with a total channel insertion loss of <= “x” dB at “y” GHz.
- Define a single-lane 100 Gb/s Attachment User interface (AUI) for C2C electrical operation with a total channel insertion loss of <= “x” dB at “y” GHz.
- Define a single-lane 100Gb/s PHY for operation over electrical backplanes with a total insertion loss of ≤“z” dB at 28GHz.
- Define a single-lane 100Gb/s PHY for operation over twin-axial copper cable with lengths up to at least “w” m.

ASSUMTIONS FOR CREATING 200G & 400G OBJECTIVE LANGUAGE

- Modify the above objectives with appropriate language for "two-lanes" or "four-lanes" interfaces.
- Any interface we define for single lane would have similar BMP for multiple lanes.
- Desire to keep same targets for loss/reach for single-lane, two-lane, four-lane

CSD TEXT

- MANAGED OBJECTS
- CO-EXISTENCE
- BROAD MARKET POTENTIAL
- COMPATIBILITY
- DISTINCT IDENTITY
- TECHNICAL FEASIBILITY
- ECONOMIC FEASIBILITY

- KENT IS WORKING ON FIRST DRAFT

PROPOSED PAR - SCOPE

- STILL TO COME.

NEXT STEPS

- Review contributions aimed at locking down objectives
- Prepare content and contributions to substantiate:
  - Technical feasibility
  - Economic Feasibility
  - Broad Market Potential
  - Distinct Identity
  - Compatibility
- January Ad Hocs – 9:05-11am PST – January 3rd , 10th , 17th
- January Plenary – January 22-26
  - Thursday: 1pm-5:30pm & Friday: 8am-6pm

THANK YOU!

BACKUP SLIDES: PREVIOUS PROJECT OBJECTIVES

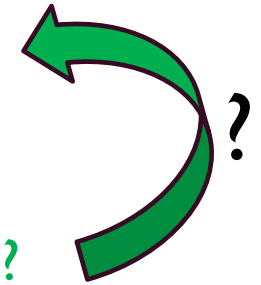
POINTS OF CONVERGENCE AND CONTENTION

- AUI Convergence:
  - Compatibility with defined 100G/lane Optics – re-use of FEC and PCS
  - Power is critical
- AUI Contention:
  - Chip-to-chip inclusion

- Proposed Objective:
  - Define a single-lane 100 Gb/s Attachment User interface (AUI) for electrical operation with a total channel insertion loss of <= “x” dB at “y” GHz.
  - Define a two-lane 200 Gb/s… total channel insertion loss of <= “x” dB at “y” GHz.
  - Define a four-lane 400 Gb/s… total channel insertion loss of <= “x” dB at “y” GHz.

POINTS OF CONVERGENCE AND CONTENTION

- Backplane Convergence:
  - More freedom for PHY definition
- Backplane Contention:
  - Loss target: approx. 25dB or approx. 30dB – Do we agree on die-to-die loss?
  - Timeframe for convergence



- Proposed Objective:
  - Define a single-lane 100Gb/s PHY for operation over electrical backplanes with a total insertion loss of ≤"z" dB at 28GHz.
  - Define a two-lane 200Gb/s PHY… total insertion loss of ≤"z" dB at 28GHz.
  - Define a four-lane 400Gb/s PHY… total insertion loss of ≤"z" dB at 28GHz.

POINTS OF CONVERGENCE AND CONTENTION

- Front-end Cable Convergence:
  - Passive Copper cable is most economic for previous loss budgets
- Front-end Cable Contention:
  - Usefulness of plausible reach: 3m→2m
  - Co-operation with defined PHYs, including FEC and PCS

- Proposed Objective:
  - Define a single-lane 100Gb/s PHY for operation over twin-axial copper cable with lengths up to at least "w" m.
  - Define a two-lane 100Gb/s PHY… up to at least "w" m.
  - Define a four-lane 100Gb/s PHY… up to at least "w" m.

802.3ap initial objectives

- Preserve the 802.3/Ethernet frame format at the MAC Client service interface.
- Preserve min. and max. frame size of current 802.3 Std.
- Support existing media independent interfaces.
- Support operation over a single lane across 2 connectors over copper traces on improved FR-4 for links consistent with lengths up to at least 1m.
  - Define a 1 Gb/s PHY
  - Define a 10 Gb/s PHY
- Consider auto-negotiation.
- Support BER of 10^-12 or better.
- Meet CISPR/FCC Class A.

802.3ap objectives

- Preserve the 802.3/Ethernet frame format at the MAC Client service interface.
- Preserve min. and max. frame size of current 802.3 Std.
- Support existing media independent interfaces.
- Support operation over a single lane across 2 connectors over copper traces on improved FR-4 for links consistent with lengths up to at least 1m.
  - Define a 1 Gb/s PHY
  - Define a 10 Gb/s PHY
- Define a 4-lane 10Gb/s PHY for operation over the 802.3ap channel model.
- Consider auto-negotiation.
- Support BER of 10^-12 or better.
- Meet CISPR/FCC Class A.

802.3bj initial objectives

- Support full-duplex operation only
- Preserve the 802.3 / Ethernet frame format utilizing the 802.3 MAC
- Preserve minimum and maximum FrameSize of current 802.3 standard
- Support a BER of better than or equal to 10^{-12} at the MAC/PLS service interface
- Define a 4-lane 100 Gb/s backplane PHY for operation over links consistent with copper traces on “improved FR-4” (as defined by IEEE P802.3ap or better materials to be defined by the Task Force) with lengths up to at least 1m.
- Define a 4-lane 100 Gb/s PHY for operation over links consistent with copper twin-axial cables with lengths up to at least 5m.

802.3bj objectives

- Support full-duplex operation only
- Preserve the 802.3 / Ethernet frame format utilizing the 802.3 MAC
- Preserve minimum and maximum FrameSize of current 802.3 standard
- Support a BER of better than or equal to 10^{-12} at the MAC/PLS service interface
- Define a 4 lane PHY for operation over a printed circuit board backplane with a total channel insertion loss of <= 35 dB at 12.9 GHz**
- Define a 4 lane PHY for operation over a printed circuit board backplane with a total channel insertion loss of <= 33 dB at 7.0 GHz**
- Define a 4-lane 100 Gb/s PHY for operation over links consistent with copper twin-axial cables with lengths up to at least 5m.
- To define optional Energy-Efficient Ethernet operation for 100G Backplane and Twinaxial cable PHYs specified in P802.3bj*
- To define optional Energy-Efficient Ethernet operation for 100GBASE-CR10***
- To define optional Energy-Efficient Ethernet operation for 40GBASE-CR4 and 40GBASE-KR4***

Objectives approved by IEEE 802.3 WG July 2011 IEEE 802 Plenary
* Objective approved by IEEE 802.3 WG Nov 2011 IEEE 802 Plenary
** Objectives approved by IEEE 802.3 WG Mar 2012 IEEE 802 Plenary
*** Objectives approve by IEEE 802.3 WG July 2012 IEEE 802 Plenary

802.3cd objectives

Objectives 1 of 2

- Support full-duplex operation only
- Preserve the Ethernet frame format utilizing the Ethernet MAC
- Preserve minimum and maximum FrameSize of current IEEE 802.3 standard
- Support optional Energy-Efficient Ethernet operation
- Provide appropriate support for OTN
- Support a MAC data rate of 50 Gb/s and 100 Gb/s
- Support a BER of better than or equal to 10^{-12} at the MAC/PLS service interface (or the frame loss ratio equivalent) for 50 Gb/s and 100 Gb/s operation
- Support a MAC data rate of 200 Gb/s
- Support a BER of better than or equal to 10^{-13} at the MAC/PLS service interface (or the frame loss ratio equivalent) for 200 Gb/s operation

802.3cd objectives

Objectives 2 of 2

50 Gb/s Ethernet PHYs

- Define single-lane 50 Gb/s PHYs for operation over
  - copper twin-axial cables with lengths up to at least 3m.
  - printed circuit board backplane with a total channel insertion loss of <= 30dB at 13.28125 GHz.
  - MMF with lengths up to at least 100m
  - SMF with lengths up to at least 2km
  - SMF with lengths up to at least 10km

100 Gb/s Ethernet PHYs

- Define a two-lane 100 Gb/s PHY for operation over
  - copper twin-axial cables with lengths up to at least 3m.
  - printed circuit board backplane with a total channel insertion loss of <= 30dB at 13.28125 GHz.
  - MMF with lengths up to at least 100m
- Define a single lane 100 Gb/s PHY for operation over duplex SMF with lengths up to at least 500 m, consistent with IEEE P802.3bs Clause 124

200 Gb/s Ethernet PHYs

- Define four-lane 200 Gb/s PHYs for operation over
  - copper twin-axial cables with lengths up to at least 3m.
  - printed circuit board backplane with a total channel insertion loss of <= 30dB at 13.28125 GHz.
- Define 200 Gb/s PHYs for operation over MMF with lengths up to at least 100m

802.3bs objectives

- Support a MAC data rate of 200 Gb/s
- Support a MAC data rate of 400 Gb/s
- Support a BER of better than or equal to 10^{-13} at the MAC/PLS service interface (or the frame loss ratio equivalent)
- Support full-duplex operation only
- Preserve the Ethernet frame format utilizing the Ethernet MAC
- Preserve minimum and maximum FrameSize of current Ethernet standard
- Provide appropriate support for OTN
- Provide physical layer specifications which support 200 Gb/s operation over:
  - At least 500 m of 4-lane parallel SMF
  - At least 2 km of SMF
  - At least 10 km of SMF
- Provide physical layer specifications which support 400 Gb/s operation over:
  - At least 100 m of MMF
  - At least 500 m of SMF
  - At least 2 km of SMF
  - At least 10 km of SMF
- Specify optional Energy Efficient Ethernet (EEE) capability
- Support optional Attachment Unit Interfaces for chip-to-chip and chip-to-module applications