Backplane and Copper Cable PMD Objectives

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Agenda

- Propose objectives for backplane PHYs.
- Propose objectives for copper cable PHYs.
- Goal is to approve objectives at the January meeting with no TBD values, but with the possible intention of adding necessary details at the March meeting.

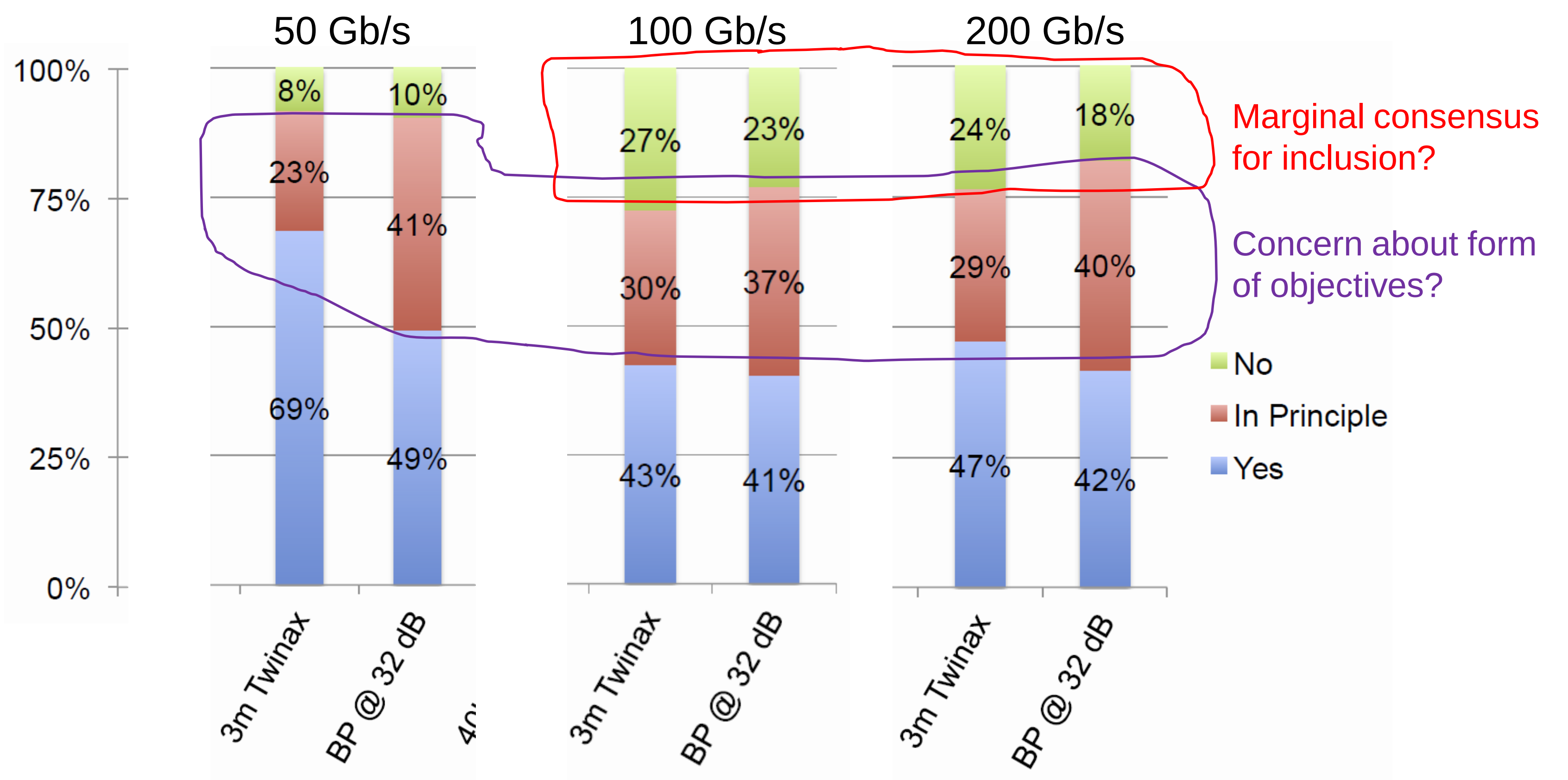
- The presentation is not intended to promote:
  - which data rates should have backplane or cable objectives
  - what particular length each objective should support

Parameters to consider in the objectives

- Medium
  - printed circuit board backplane
  - twinaxial copper cables
- Data rate
  - one-lane 50 Gb/s
  - two-lane 100 Gb/s
  - four-lane 200 Gb/s
- Reach
  - for backplane
    - reach in physical length, e.g., 1 m
    - <u>reach in insertion loss, e.g., 32 dB at Nyquist</u>
  - for twinaxial copper cable
    - reach in physical length, e.g., 3 m
  - leaving reach for task force to define is not an option

Consensus survey numbers

- Survey monkey results were published from Mark Nowell.



from: http://www.ieee802.org/3/50G/public/adhoc/archive/nowell_010616_50GE_NGOATH_adhoc.pdf

Consensus survey comments

50 Gb/s

3m Twinax → 50Gb/s no-FEC option for low-latency applications.
→ We should be open to a slightly shorter reach to ensure practicality.
→ need confirmation of technical feasibility

Backplane → The numbers 32 and 12.9 are wrong. Nyquist frequency for the likely encoding is approx. 13.3 GHz. The work done in OIF suggests that an insertion loss of 27-28 dB is the limit for reasonable PAM4 transceivers at this rate, far less than 32 dB. <snip> I intend to propose an objective for "PCB backplane consistent with a total insertion loss equivalent to 3m of Twinax cable".

→ Need technical feasibility data
→ I think an insertion loss in the range of 28 to 30dB is more realistic.
→ More detailed work on Channel loss
→ uncertain of the 32 dB limit.

100 Gb/s

3m Twinax → need BMP data
→ We should be open to a slightly shorter reach to ensure practicality.
→ Only reach should be defined. Strongly recommend to consider high performance computing applications where latency is critical and Active cable may be needed.

Backplane → Adoption of a backplane objective is fine. It is not clear what an appropriate insertion loss target should be.

→ With serial 100 Gb/s not technically feasible it does not make sense to define 2x50G Cu
→ technical feasibility and should mirror 50G objective.
→ uncertain of the 32 dB limit.

200 Gb/s

3m Twinax → I see no reason to define a 200G copper PMD at this point in time. The primary purpose for such PMDs would be to connect servers to TOR switches…
→ We should be open to a slightly shorter reach to ensure practicality.
→ Only reach should be defined. Strongly recommend to consider high performance computing applications where latency is critical and Active cable may be needed.

Backplane → The numbers 32 and 12.9 are wrong. Nyquist frequency for the likely encoding is approx. 13.3 GHz. The work done in OIF suggests that an insertion loss of 27-28 dB is the limit for reasonable PAM4 transceivers at this rate, far less than 32 dB. <snip> I intend to propose an objective for "PCB backplane consistent with a total insertion loss equivalent to 3m of Twinax cable".

→ Same reason as above. I see no need for a 200GE backplane interface at this point in time
→ I think an insertion loss in the range of 28 to 30dB is more realistic.
→ More detailed work on Channel loss
→ uncertain of the 32 dB limit.

Observation: Common theme is concern for choice of backplane insertion loss number.

from: http://www.ieee802.org/3/50G/public/adhoc/archive/nowell_010616_50GE_NGOATH_adhoc.pdf

Length considerations for objectives

- For backplane opposing views on reach have been stated
  - view #1: need 32 dB based on channels in real systems
  - view #2: 32 dB is impractical, 28 to 30 dB or less is more realistic
  - need to arrive at mutually acceptable value
- For copper cable, historically…
  - physical length of 3 m is important
  - backplane PMD specifications assumed for end to end channel

Length trade offs for objectives

- Choice of reach impacts net system cost, power, and density.
- Shorter reach backplane PHY
  - for shorter channels, impact is lower power
  - for longer channels, retimers are needed; impact is higher cost, more components
  - for copper cables, might not get the 3 m reach that is historically required
- Longer reach backplane PHY
  - for shorter channels, impact is more power
  - for longer channels, fewer channels need retimers; impact is lower net system cost and fewer components
- A trade off requires considerable analysis and discussion.

Backplane Objectives, Possible Forms

- Base template
  - Define a <rate> PHY for operation over a printed circuit board backplane with <details>.
- <rate>
  - “one-lane 50 Gb/s”
  - “two-lane 100 Gb/s”
  - “four-lane 200 Gb/s”
- <details>, common to all rates
  - “<blank>”, i.e., no reach specified, to be addressed by March
  - <u>“channel insertion loss of up to at least <IL>”</u>
- <IL>
  - “TBD dB at 13.3 GHz”, e.g., TBD is 28, 30, 32, other value?
  - other form?

Copper Cable Objectives, Possible Forms

- Base template
  - Define a <rate> PHY for operation over copper twinaxial cables <details>.
- <rate>
  - “one-lane 50 Gb/s”
  - “two-lane 100 Gb/s”
  - “four-lane 200 Gb/s”
- <details>, common to all rates
  - “<blank>”, i.e., no reach specified, to be addressed by March
  - <u>“consistent with lengths up to at least <distance>”</u>
- <distance>
  - “TBD m”, e.g., TBD = 2.5, 3, other value?
  - other from?

Proposal objective forms, final form

- For 50G
  - Define a one-lane 50 Gb/s PHY for operation over copper twinaxial cables consistent with lengths up to at least TBD m.
  - Define a one-lane 50 Gb/s PHY for operation over a printed circuit board backplane with a channel insertion loss of up to at least TBD dB at 13.3 GHz.
- For 100G
  - Define a two-lane 100 Gb/s PHY for operation over copper twinaxial cables consistent with lengths up to at least TBD m.
  - Define a two-lane 100 Gb/s PHY for operation over a printed circuit board backplane with a channel insertion loss of up to at least TBD dB at 13.3 GHz.
- For 200G
  - Define a four-lane 200 Gb/s PHY for operation over copper twinaxial cables consistent with lengths up to at least TBD m.
  - Define a four-lane 200 Gb/s PHY for operation over a printed circuit board backplane with a channel insertion loss of up to at least TBD dB at 13.3 GHz.

Proposal objective forms, remove controversial details

- For 50G
  - Define a one-lane 50 Gb/s PHY for operation over copper twinaxial cables ~~consistent with lengths up to at least TBD m~~.
  - Define a one-lane 50 Gb/s PHY for operation over a printed circuit board backplane ~~with a channel insertion loss of up to at least TBD dB at 13.3 GHz~~.
- For 100G
  - Define a two-lane 100 Gb/s PHY for operation over copper twinaxial cables ~~consistent with lengths up to at least TBD m~~.
  - Define a two-lane 100 Gb/s PHY for operation over a printed circuit board backplane ~~with a channel insertion loss of up to at least TBD dB at 13.3 GHz~~.
- For 200G
  - Define a four-lane 200 Gb/s PHY for operation over copper twinaxial cables ~~consistent with lengths up to at least TBD m~~.
  - Define a four-lane 200 Gb/s PHY for operation over a printed circuit board backplane ~~with a channel insertion loss of up to at least TBD dB at 13.3 GHz~~.

Proposal objective forms, short term compromise

- These forms would be a baseline goal for this meeting.
  - More details can be added if agreement can be reached at this meeting.
- For 50G
  - Define a one-lane 50 Gb/s PHY for operation over copper twinaxial cables.
  - Define a one-lane 50 Gb/s PHY for operation over a printed circuit board backplane.
- For 100G
  - Define a two-lane 100 Gb/s PHY for operation over copper twinaxial cables.
  - Define a two-lane 100 Gb/s PHY for operation over a printed circuit board backplane.
- For 200G
  - Define a four-lane 200 Gb/s PHY for operation over copper twinaxial cables.
  - Define a four-lane 200 Gb/s PHY for operation over a printed circuit board backplane