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Objectives for NG 200G and 400G PHYs

NG 200G & 400G PHYs over fewer MMF Pairs Study Group

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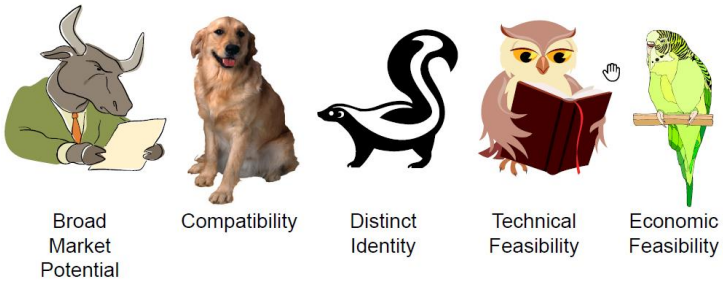
Developing our Objectives

- A key task of the Study Group is to develop a set of objectives for NG 200G & 400G PHYs over fewer MMF pairs
  - It is important to get the objectives right
  - We need 75% support to adopt
  - Objectives must support 5 Criteria



- IEEE has always preferred a minimum set of PMDs
- As experts, we need to make the tough choices
- We should avoid a “let the market decide” mentality
- This contribution suggests some possible wording for the objectives and what questions need to be answered by the Study Group before a suitable set of objectives can be agreed

A look back at previous projects

- Objective
  - 802.3bm NG 40G and 100G
    - Define a 100 Gb/s PHY for operation up to at least 100 m of MMF
  - 802.3bs 200G and 400G
    - Provide physical layer specifications which support 400 Gb/s operation over at least 100 m of MMF
  - 802.3by 25G
    - Define a single-lane 25 Gb/s PHY for operation over MMF consistent with IEEE P802.3bm Clause 95
  - 802.3cd 50 Gb/s, 100 Gb/s, and 200 Gb/s
    - Define a single-lane 50 Gb/s PHY for operation over MMF with lengths up to at least 100m MMF
    - Define a two-lane 100 Gb/s PHY for operation over MMF with lengths up to at least 100m MMF
    - Define a four-lane 200 Gb/s PHY for operation over MMF with lengths up to at least 100m MMF

- Resulting Standard
  - The required operating range was consistent for each project*
    - 0.5m to 70m for OM3
    - 0.5m to 100m for OM4
  - **The reach objective(s) for NG 200G and 400G must support the same reaches as previous projects**
    - **Supports upgrade path for installed base**
    - **Ensures application coverage is maintained**
      - **Going below 100m limits broad market potential**

*Note: 802.3bs and 802.3cd added a reach objective of 0.5m to 100m for OM5

We should develop a minimum set of PMD objectives

- Manufacturers want a return on their investment
  - Multiple PMDs fragment development efforts
  - Multiple PMDs fragment the market
- Customers don’t care about the technology
  - Customers want cost effective solutions
  - Customers want to minimize uncertainty
    - Our objectives should provide clear guidance to the market
- Our choice(s) for objectives should consider
  - Broad market potential as well as technical and economic feasibility
  - Lowest overall interconnect cost including fiber, interfaces and power consumption
  - Future proofing the fiber infrastructure

Technology Options – The Swanson Selector

- Goal is to evaluate 200G and 400G over fewer MMF pairs

Technology (per fiber)	1 fiber pair	2 fiber pairs	4 fiber pairs	8 fiber pairs	16 fiber pairs
25G-λ NRZ	25G-SR		100G-SR4		400G-SR16
50G-λ PAM4	50G-SR	100G-SR2	200G-SR4	400G-SR8	
2x50G-λ PAM4	100G-SR1.2	200G-SR2.2	400G-SR4.2		
4x25G-λ NRZ	100G-SR1.4	200G-SR2.4	400G-SR4.4		
4x50G-λ PAM4	200G-SR1.4	400G-SR2.4	800G-SR4.4		

Examples of technologies for 200 & 400 Gb/s links over fewer MMF fiber pairs

Existing IEEE standard
In progress in 802.3cd

Multi-Wavelength Nomenclature
SRm.n m = # fiber pairs
n = # wavelengths

Recommended SG Focus

- Objectives can be considered by the SG for all options shown below but the 3 circled options have garnered the most interest thus far

Technology (per fiber)	1 fiber pair	2 fiber pairs	4 fiber pairs	8 fiber pairs	16 fiber pairs
25G-λ NRZ	25G-SR		100G-SR4		400G-SR16
50G-λ PAM4	50G-SR	100G-SR2	200G-SR4	**400G-SR8**	
2x50G-λ PAM4	100G-SR1.2	**200G-SR2.2**	**400G-SR4.2**		
4x25G-λ NRZ	100G-SR1.4	**200G-SR2.4**	**400G-SR4.4**		
4x50G-λ PAM4	**200G-SR1.4**	**400G-SR2.4**	800G-SR4.4		

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Example Objectives

- Two sets of objectives may be required for some variants
  - One part of the objective needs to address the installed base of MMF
  - One part of the objective needs to address new fiber
  - Or we could go with just the first part

- Example objectives include the following (we could do 1, 2 or all 3 of the options)

1. "Define a 200 Gb/s PHY for operation over
- **1 pair of installed MMF with lengths up to at least 100m**
- **1 pair of MMF with lengths at least 100m"**

2. "Define a 400 Gb/s PHY for operation over
- **4 pairs of installed MMF with lengths up to at least 100m**
- **4 pairs of MMF with lengths at least 100m**

3."Define a 400 Gb/s PHY for operation over
- **8 pairs of MMF with lengths up to at least 100m**

Questions for the SG to answer

- Technical feasibility of PMD
  - For 400G, confirm that 2λ SWDM can support 70m on OM3 and 100m on OM4
    - Determine capability of OM5
  - For 200G, confirm that 4λ SWDM can support 70m on OM3 and 100m on OM4
    - Determine capability of OM5
  - For both 200G and 400G, characterize installed base of MMF for performance at wavelengths longer than 850nm
    - Recommend TIA study this
  - How will we verify technical feasibility?
    - Recommend development of publicly available model

- Economic feasibility of PMD
  - Confirm that the new PMDs provide significant value over the existing PMDs
    - For 400G, compare the relative costs of 400G-SR8 and 400G-SR4.2 to 400G-SR16
    - For 200G, compare the relative costs of 200G-SR1.4 to 200G-SR4

- Evaluate the importance of supporting breakout capability


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