CORNING

Objectives for NG 200G and 400G PHYs

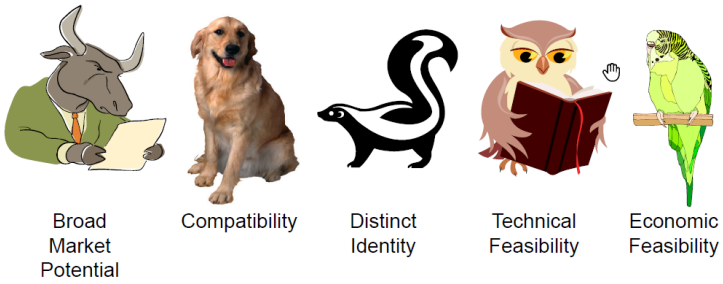
NG 200G & 400G PHYs over fewer MMF Pairs Study Group

Steve Swanson

January 22, 2018

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 need to be honest regarding the 5 criteria

- 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

Previous Project Objectives

- 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

Each project aligned on the reach objectives in the standard*

- 0.5m to 70m for OM3
- 0.5m to 100m for OM4

NG 200G and 400G reach objectives must be aligned with those established by previous projects

- **Must support upgrade path for installed base (brownfield)**
- **Ensures broad market potential for the application**

*Note: 802.3bs and 802.3cd also 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
  - Customers want longevity for their infrastructure

- Our choice(s) for objectives should consider the 5 criteria
  - The order of the 5 criteria is not random
  - Broad Market Potential and Compatibility come first
  - Develop a solution to solve a market problem, not the other way around (a technology in search of a need)

Example Objectives

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

- 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**

Technology Options

- 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 NRZ				**400G-SR8**	
50G-λ PAM4	50G-SR	100G-SR2	200G-SR4	**400G-SR8**	
100G-λ PAM4	**200G-SR1.2**	**200G-SR2**	**400G-SR4**		
2x50G-λ PAM4		**200G-SR2.2**	**400G-SR4.2**		
4x25G-λ NRZ		**200G-SR2.4**	**400G-SR4.4**		
4x50G-λ PAM4	**200G-SR1.4**	**400G-SR2.4**			
8x50G-λ PAM4	**400G-SR1.8**				

Existing or in-progress IEEE standard

Multi-Wavelength Nomenclature

SRm.n m = # fiber pairs n = # wavelengths

Technology Options

- Module types in **RED** are in scope for the SG but many lack technical feasibility and broad market potential

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 NRZ				**400G-SR8**	
50G-λ PAM4	50G-SR	100G-SR2	200G-SR4	**400G-SR8**	
100G-λ PAM4	**200G-SR1.2**	**200G-SR2**	**400G-SR4**		
2x50G-λ PAM4		**200G-SR2.2**	**400G-SR4.2**		
4x25G-λ NRZ		**200G-SR2.4**	**400G-SR4.4**		
4x50G-λ PAM4	**200G-SR1.4**	**400G-SR2.4**			
8x50G-λ PAM4	**400G-SR1.8**				

Existing or in-progress IEEE standard

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

Questions on Technology Options

- 50G-λ NRZ is likely a NG technology for MMF
  - Should we consider 400G-SR8 based on 50G NRZ?
- 100G-λ PAM4 is likely a NG technology for MMF
  - Should we consider 200G-SR1.2?
  - Should we consider 200G-SR2?
  - Should we consider 400G-SR4?
- 50G-λ PAM4 is likely a NG technology for MMF
  - Should we consider 200G-SR1.8?
- The installed base is primarily 1-pair or 4-pair fiber plants
  - Should we consider 200G-SR2?
  - Should we consider 200G-SR2.2?
  - Should we consider 200G-SR2.4?
  - Should we consider 400G-SR2.4?
- Do we need to support breakout??

Technology Options

- That leaves 4 PMDs for primary consideration for the SG
  - Must determine broad market potential and economic feasibility

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 NRZ				400G-SR8	
50G-λ PAM4	50G-SR	100G-SR2	200G-SR4	400G-SR8	
100G-λ PAM4	200G-SR1.2	200G-SR2	400G-SR4		
2x50G-λ PAM4		200G-SR2.2	400G-SR4.2		
4x25G-λ NRZ		200G-SR2.4	400G-SR4.4		
4x50G-λ PAM4	200G-SR1.4	400G-SR2.4			
8x50G-λ PAM4	400G-SR1.8				

Existing or in-progress IEEE standard

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

Summary

- It is important to get the objectives right
- Objectives must support the 5 Criteria
- Objectives must support installed base and align with previous standards
  - Need to support upgrade path for installed base
  - 70m on OM3 and 100m on OM4
  - Ensures application coverage is maintained


CORNING