BASELINE PROPOSAL FOR 100G/80KM OBJECTIVE

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CABLELABS 100G P2P COHERENT OPTICS SPEC

- CableLabs publicly released a 100G P2P Coherent Optics specification June, 2018 to enable interoperable transceivers
  - P2P Coherent Optics Physical Layer 1.0 Specification (P2PCO-SP-PHYv1.0)
  - Available at https://specification-search.cablelabs.com/P2PCO-SP-PHYv1.0
- CableLabs specification defines line-side (optical) physical layer interfaces between two transceivers operating at 100G including:
  - FEC and Framing
  - Modulation and symbol mapping
  - Optical parameters and requirements
  - Line-side (optical) interface only; generally no requirements on client-side (electrical) interface
- CableLabs specification coverage roughly aligns to optical PCS/PMA/PMD in 802.3 terminology

CABLELABS P2PCO SPECIFICATION OBJECTIVES

- Ensure protocol interoperability between compliant 100G coherent optics transceivers
- Support P2P optical links with Wavelength Division Multiplexing at the following distances:
  - At least 40km unamplified
  - At least 80km amplified on hub side
- Optimize parameters to enable low cost solutions
- Leverage existing technology to enable scale
- Aligns with 100G/80km WDM objective for 802.3cn

CL SPEC: FEC AND FRAMING

- FEC
  - Adopted Staircase Hard Decision FEC from ITU-T G.709.2
  - Well known FEC, already used for other 100G coherent optics applications
  - Supported objectives
- Framing
  - Adopted line-side framing based on OTN from ITU-T G.709
  - Already adapted to Staircase HD FEC
  - Readily available technology

CL SPEC: MODULATION AND SYMBOL RATE

- Modulation
  - Adopted Dual Polarization Differential Quadrature Phase Shift Keying (DP-DQPSK) from ITU G.698.2
  - Provided good balance between capacity and robustness
  - Well understood and readily implemented
  - Differential QPSK removes need for precise measurement of absolute phase at receiver
- Symbol Rate
  - Adopted 27.95 Gbaud
  - Allows 100 Gbps transmission of data after consideration of FEC, Framing, Modulation, etc.
  - ~30 Gbaud optics are well established technology

CL SPEC: KEY TRANSMITTER OPTICAL PARAMETERS

Parameter	Value
Frequency Grid	100 GHz channel spacing
Minimum Tx output power	-6 dBm
Center frequency accuracy	1.8 GHz
Laser linewidth	1000 kHz
OSNR (min)	35 dB
Quadrature (I and Q) Skew (max)	1.5 ps
Polarization (X and Y) Skew (max)	6 ps

- Defined via individual parameters, in part because error vector magnitude (EVM) was not considered well defined at the time of CableLabs spec publication
- Parameters selected to enable low cost solutions that meet objectives
- Defined as “Beginning of Life” (BoL), since that is when a device would normally get evaluated for compliance (vs. ”End of Life” or EoL)

CL SPEC: KEY RECEIVER OPTICAL PARAMETERS

Parameter	Value
Received Optical Power Baseline	≥ -31 dBm when OSNR is ≥ 35 dB
Received OSNR Baseline	≥ 14.5 dB when received power is ≥ -10 dBm
Chromatic Dispersion Compensation (min)	2400 ps/nm
Polarization Mode Dispersion Compensation (min)	10 ps
State of Polarization tracking rate (min)	50 krad/sec
Polarization Imbalance Tolerance (min)	2.0 dB
Received Frequency Accuracy	+/- 1.8 GHz
Quadrature (I and Q) Skew Tolerance (min)	3.5 ps
Polarization (X and Y) Skew Tolerance (min)	30 ps

- As with transmitter, parameters selected to enable low cost solutions that meet objectives

DIFFERENCES BETWEEN CL AND ITU SPECIFICATIONS

Parameter	CableLabs Specification	ITU-T G.698.2 Table 8-8
Min Tx Output Power	-6 dBm	-8 dBm
Max Laser Linewidth	1000 kHz	500 kHz
Max EVM	Not used	23%
Tx OSNR (min)	35 dB	Included in EVM
Quadrature (I and Q) Skew (max)	1.5 ps	Included in EVM
Polarization (X and Y) Skew (max)	6 ps	10 ps
Rx OSNR tolerance	14.5 dB	19.0 dB

- Key difference is use of individual parameters vs. EVM
- Open to harmonizing on other parameters; differences may in part be due to use of "BoL" vs. "EoL"

SUMMARY

- CableLabs specification designed to enable low cost, interoperable 100G transceivers that meet MSO requirements at low cost
  - Aligns well with 802.3cn 100G/80km objective
- CableLabs P2PCO-SP-PHYv1.0 specification document provides much of what is needed to create a draft for the 803.3cn 100G/80km objective, but not everything
  - Does not include client-side (electrical) requirements
  - Not explicitly divided into PCS/PMA/PMD
  - Does not include testing methodology for optical parameters
- CableLabs specification document could provide a good start for our work in 802.3cn

PROPOSAL

- Propose adopting CableLabs P2P Coherent Optics Physical Layer 1.0 specification document as a baseline for the 802.3cn 100G/80km objective
  - Specification text can serve as initial starting point that covers much of what is needed
  - Other contributions can be adopted to supplement or alter as needed
  - Also open to adopting portions of the document if preferred by Task Force
- CableLabs has granted copyright permission to 802.3cn/ct to use the P2PCO-SP-PHYv1.0 specification document for this purpose
  - Specification available publicly on the CableLabs website and posted on TF page
  - Available at https://specification-search.cablelabs.com/P2PCO-SP-PHYv1.0
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