Review of Decisions in P802.3ct related to P802.3cw

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Introduction

- **A number of decisions related to 400 GbE over DWDM Systems was made whileng the 400 GbE objective was part of the IEEE P802.3ct Task Force**
- **The IEEE P802.3cw PAR was approved this month**
- **Decisions made in IEEE P802.3ct related to the 400 GbE over DWDM Systems Objective need to be approved by the IEEE P802.3cw Task Force**

Summary of .3cw Related Approved Motions Adopted in .3ct

	Motion #	Meeting	Motion
IEEE P802.3cn	4	Nov 18	Move to adopt the following nomenclature • ~~50GBASE-ER 50 Gb/s operation over at least 40 km of SMF~~ • ~~200GBASE-ER4 200 Gb/s operation over four wavelengths capable of at least 40 km of SMF~~ • ~~400GBASE-ER8 400 Gb/s operation over eight wavelengths capable of at least 40 km of SMF~~ • ~~100GBASE-ZR -100 Gb/s operation on a single wavelength capable of at least 80 km over a DWDM system~~ • 400GBASE-ZR -400 Gb/s operation on a single wavelength capable of at least 80 km over a DWDM system
	8	Nov 18	I support adopting DP-16QAM modulation format for the 400 GbE 80km objective
	9	Nov 18	I support adopting the FEC proposal made in lyubomirsky_3cn_02a_1118 (CFEC) for 400 GbE 80km Objective
	6	Jan 19	Move to adopt the baseline proposal for 400GBASE-ZR PCS/PMA described in lyubomirsky_3cn_01b_0119
IEEE P802.3ct	4	Mar 19	Move to approve all motions noted on Slide #3 of motions_3ct_0319 (included motions related to 400 GbE: #4, #8, #9, #6 noted above)
	~~6~~	~~Mar 19~~	~~Move to adopt 100 GHz channel spacing for 100 GbE and 400 GbE 80 km objectives~~
	5	Jul 19	Move to adopt the parameter list on slides 4 to 6 of stassar_3ct_02_0719 for the 400GBASE-ZR PMD specification.
	3	Jan 20	Move to replace 100 GHz channel spacing for 400 GbE 80 km objective with 75 GHz channel spacing.
	4	Jan 20	Move to adopt the 191.375 to 196.1 THz frequency range for the 400 GbE Objective (based on 75 GHz spacing, 64 channels)
	5	Jan 20	Move to adopt the EVM measurement methodology defined by Slides 5 -9 of pittala_3ct_01a_0120.pdf to enable correlation for the definition of a transmitter metric

Slide #4 – stassar 3ct 02 0719

Parameters for x00GBASE-ZR transmit characteristics

Parameter Name	Units
Maximum mean channel output power	dBm
Minimum mean channel output power	dBm
Minimum central frequency	THz
Maximum central frequency	THz
Maximum spectral excursion	GHz
Minimum side mode suppression ratio	dB
Maximum laser linewidth	kHz
Maximum offset between the carrier and the nominal central frequency	GHz
Maximum power difference between polarizations	dB
Maximum skew between the two polarizations	ps
Maximum error vector magnitude	%
Maximum I-Q offset	dB
Minimum Transmitter OSNR(193.6)	dB

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Slide #5 – stassar_3ct_02_0719

Parameters for x00GBASE-ZR receive characteristics

Parameter Name	Units
Maximum mean input power	dBm
Minimum mean input power [amplified]	dBm
Minimum mean input power [unamplified]	dBm
Minimum OSNR(193.6) [amplified]	dB (0.1 nm)
Minimum OSNR(193.6) [unamplified]	dB (0.1 nm)
Receiver OSNR tolerance(193.6)	dB (0.1 nm)
Maximum reflectance of receiver	dB

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Slide #6 – stassar_3ct_02_0719

Parameters for x00GBASE-ZR black link characteristics

Parameter Name	Units
Maximum ripple	dB
Maximum (residual) chromatic dispersion	ps/nm
Minimum (residual) chromatic dispersion	ps/nm
Minimum optical return loss at TP2	dB
Maximum discrete reflectance between TP2 and TP3	dB
Maximum differential group delay	ps
Maximum polarization dependent loss	dB
Maximum polarization rotation speed	krad/s
Maximum inter-channel crosstalk at TP3	dB
Maximum interferometric crosstalk at TP3	dB
Maximum optical path OSNR penalty	dB

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Slide #5 - pittala_3ct_01a_0120

Proposed Test Plan for 400GBASE-ZR Standardization Work

Measurements setups

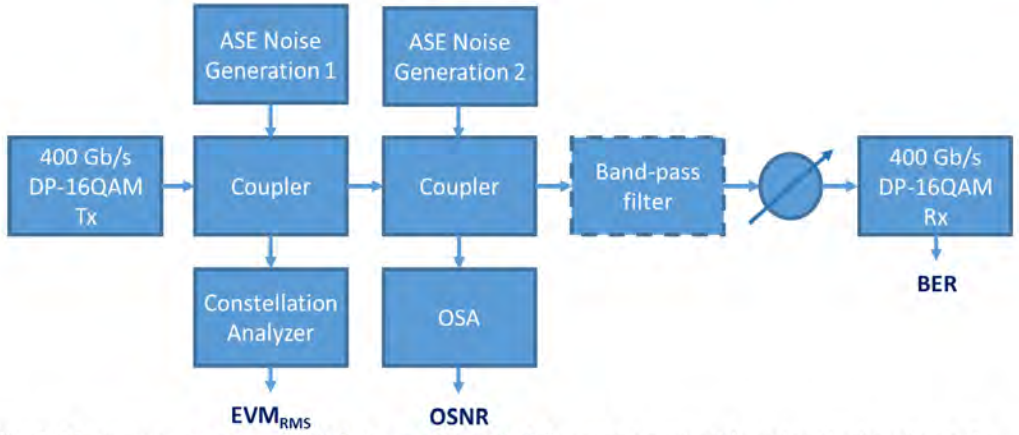

Fig. 1 Measurement setup for OSNR penalty vs EVM for non-equalizable noise like impairment.

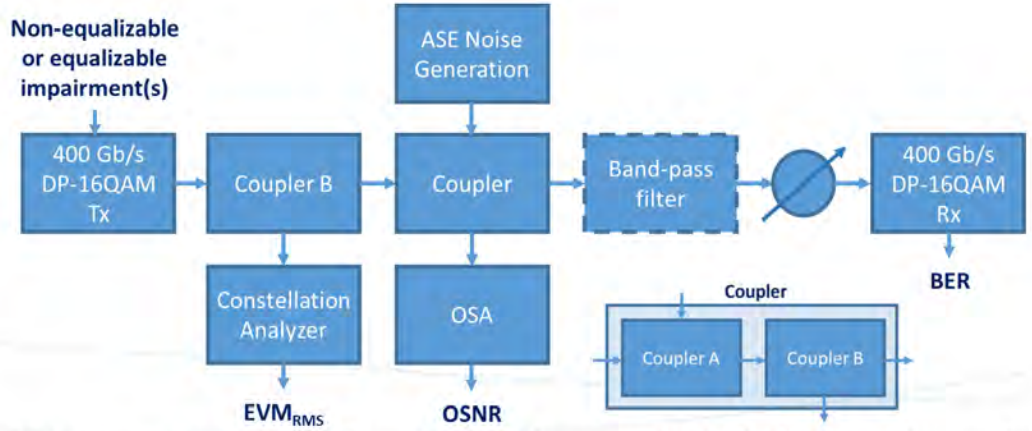

Fig. 2 Measurement setup for OSNR penalty vs EVM for non-equalizable (circle-like noise) or equalizable impairment(s).

The measurement setup in Fig. 1 (for noise like impairment) and the one in Fig. 2 (for non-equalizable or equalizable impairments) should be used to determine following parameters:

- I-Q offset (IEEE Draft P802.3ct/D1.1 - 154.8.10);
- Quadrature error;
- I-Q imbalance;
- I-Q skew (IEEE Draft P802.3ct/D1.1 - 154.8.4);
- non-equalizable impairment like circle-like noise (zero mean noise with fix magnitude and incremental phase) as shown in *anslow_3cn_01_181025;*
- non-equalizable noise like impairment.

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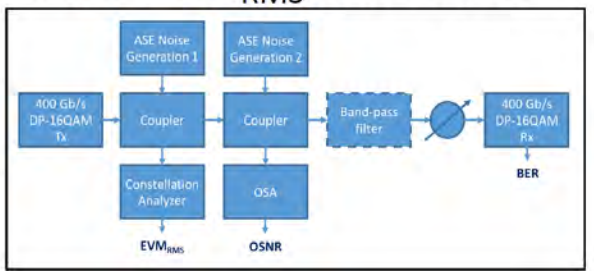
Slide #6 - pittala_3ct_01a_0120

Proposed Test Plan for 400GBASE-ZR Standardization Work

Measurements based on setup in Fig. 1

If measuring non-equalizable noise-like impairment using the setup in Fig. 1 the following steps are used:

1) Without ASE noise generation 1, adjust the ASE noise generation 2, to get the considered pre-FEC BER of 1.25e-2; then first EVM_{RMS} and OSNR values are measured (EVM_0, $OSNR_0$).
2) a) Introducing ASE noise generation 1 and measure EVM_{RMS} (EVM_1), the pre-FEC BER is changed (not 1.25e-2 anymore), b) then adjust the ASE noise generation 2, to set pre-FEC BER at 1.25e-2 again, then turn-off ASE noise generation 1 and then the second OSNR value is measured ($OSNR_1$), the OSNR penalty is ($OSNR_1$-$OSNR_0$).
3) Change the ASE noise generation 1, and repeat the step 2), more EVM_{RMS} and OSNR values are measured.
4) The curve of OSNR penalty versus EVM_{RMS} is obtained.



Slide #7 - pittala_3ct_01a_0120

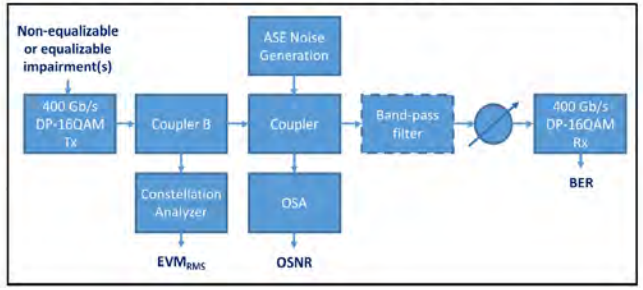
Proposed Test Plan for 400GBASE-ZR Standardization Work

Measurements based on setup in Fig. 2

It is preferred that measurements are obtained independently for each parameter, i.e as the effect of varying one parameter is being measured the other parameters remain unchanged.

Using IQ offset as an example the procedure is:

1) Adjust the ASE noise generation, to get the considered pre-FEC BER of 1.25e-2; then first EVM_{RMS} and OSNR values are measured (EVM_0, $OSNR_0$).
2) a) Modify the transmitter to give a certain value of IQ offset and b) measure EVM_{RMS} (EVM_1), the pre-FEC BER is changed (not 1.25e-2 anymore), then adjust the ASE noise generation, to set pre-FEC BER at 1.25e-2 again, then the second OSNR value is measured ($OSNR_1$), the OSNR penalty is ($OSNR_1$-$OSNR_0$).
3) Modify the transmitter to give a certain value of IQ offset and repeat the b) part of step 2), more EVM_{RMS} and OSNR values are measured.
4) The curve of OSNR penalty versus EVM_{RMS} is obtained.



Slide #8 - pittala_3ct_01a_0120

Proposed Test Plan for 400GBASE-ZR Standardization Work

Evaluate Suitability of EVM_{RMS} metric for DP-16QAM

Step 1:

1) Generate OSNR penalty versus EVM_{RMS} plots containing noise like impairments and deterministic impairments (as example circular impairment) using the setups as shown in Fig. 1 and Fig. 2. The two plots should lie on top of each other.
2) Introduce a 3rd line for an individual impairment like IQ offset, quadrature error, IQ imbalance (just one impairment at the time) which shows OSNR penalty vs uncompensated EVM_{RMS}.
3) Then check if the 3rd line for the particular impairment is very close to the other two lines. If this is the case we do not need to treat it as separate impairment and we would not need to compensate for it in the EVM calculation.
4) In case the 3rd line is sufficiently different to the other two lines then we will need to compensate for it (as it has happened for IQ-offset for 100 Gb/s DP-DQPSK transmitters).

Slide #9 - pittala_3ct_01a_0120

Proposed Test Plan for 400GBASE-ZR Standardization Work

Evaluate Suitability of EVM_{RMS} metric for DP-16QAM

Step 2 (to be addressed after step 1 is completed).

Check the OSNR penalty for combination of impairments that remain compensated by the compensated EVM metric after step 1:

1) Generate OSNR penalty versus "compensated impairment(s)" plot(s) and define a suitable limit for the individual impairment. P802.3cw would need to discuss how to define those limits based on what the performance impact and current transmitter capability is.
2) Apply the combination of individual impairments with the limit defined in 1) and measure the associated OSNR penalty.
3) Establish whether the measured OSNR penalty is acceptable. In case it is not acceptable we need to re-define the limit for the individual impairment (back to 1)).