

Proposal for Clause 86: Improved TDP Test

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Outline

- Purpose
- Key concepts
- Test fixture
- Parametric tabulation of scenarios
- MMF chromatic dispersion element
- Advantages of approach
- Examining impact on DJ
- Content for clause 86.7.5.4

Purpose

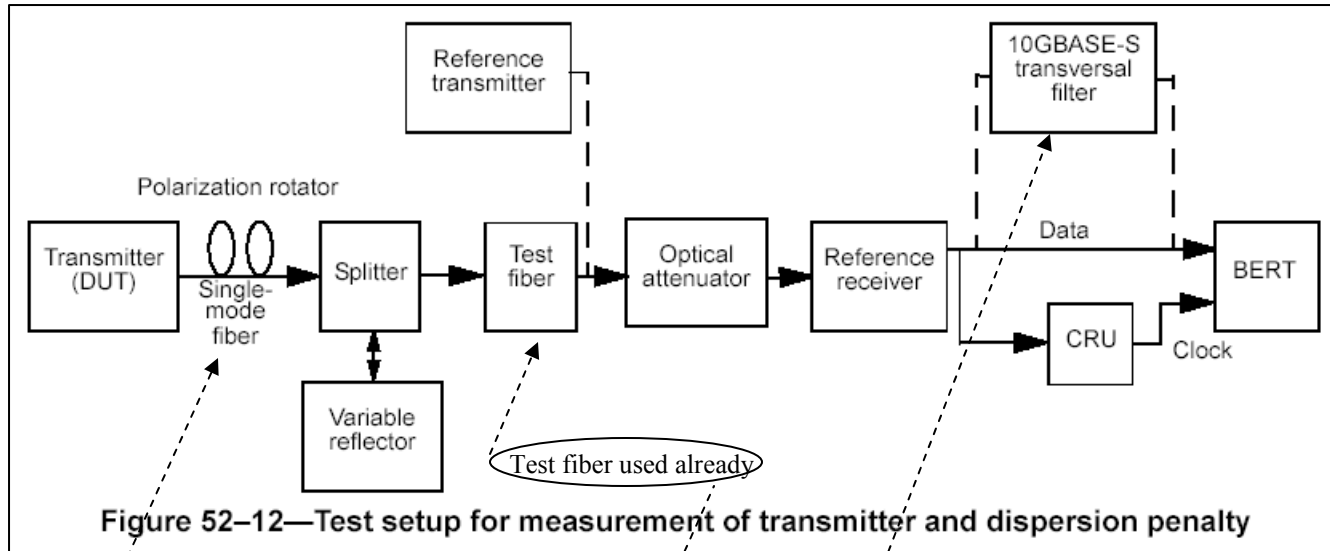
- Describe improved Transmitter and Dispersion Penalty (TDP) test proposal
- Support proposed modifications to IEEE P802.3ba draft 2.0 submitted by comments
 - Comment numbers: 276, 353

Key Concepts

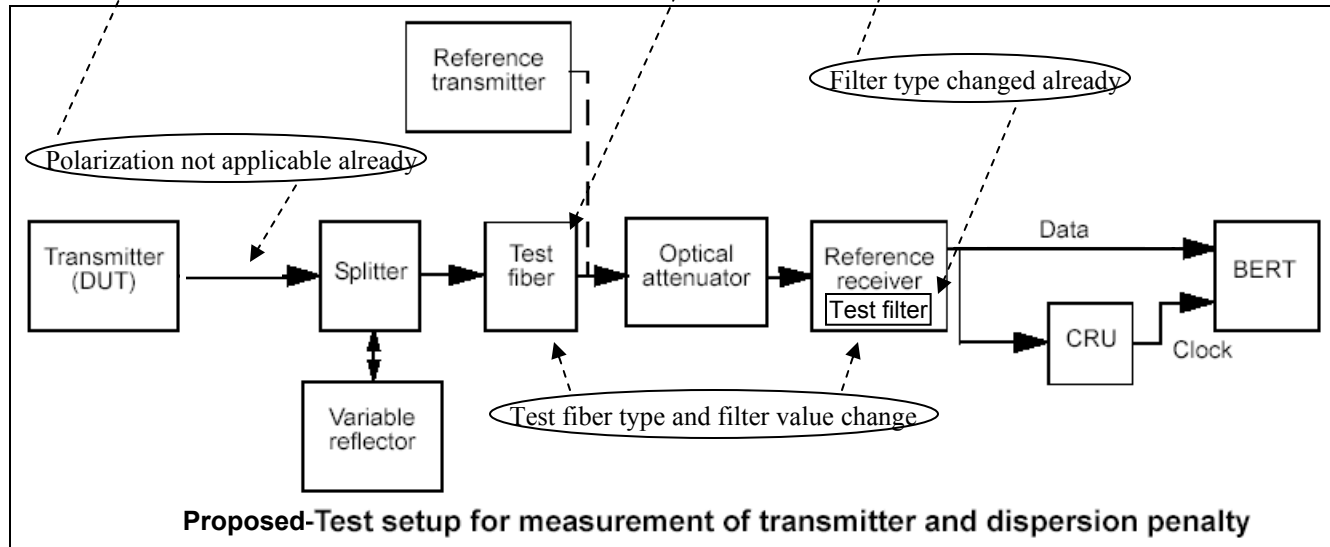
- Use existing TDP test fixture:
 - defined in clause 52.9.10 and
 - modified by clause 86.7.5.4 (ref Rx filter)
- Apply a chromatic dispersion (CD) test fiber
 - as presently done for SM tests, but
 - use selected MMF (described in detail later)
- Modify ref Rx filter to account for test fiber
 - tweak filter value of existing modification in clause 86.7.5.4
 - to remove the portion associated with modeled CD impairment

TDP Test Fixture Comparison

Clause 52



Clause 86.7.5.4 and XR Annex



Parametric Tabulation of Scenarios

| Spreadsheet model parameters | | | | | | | Test parameters | | | | | |
|------------------------------|---------------------|------------|-----------------------|---------------------------|------------------------|------------------------|-----------------------------|---------------------------|---------------------------------|---------------------------------|--|--|
| clause | target dist (km) | media code | EMB 840nm (MHz*km) | modal effBW 3dBe (GHz) | chrom BW 3dBe (GHz) | RefRx BW 3dBe (GHz) | test filter value unit type | test fiber length (km) | test fiber effBWm 3dBe (GHz) | test fixture effBW min (GHz) | fixture BW reduc. from test fiber (% of BW) | |
| 52.9.10 | 0.300 | OM3 | 2000 | 4.7 | 9.0 | 7.5 | 55.0 ps transversal | n.a. | n.a. | n.a. | n.a. | |
| 86.7.5.4 | 0.100 | OM3 | 2000 | 14.1 | 18.8 | 7.5 | 6.25 GHz 4th ord BT | n.a. | n.a. | n.a. | n.a. | |
| 86.7.5.4 mod | 0.100 | OM3 | 2000 | 14.1 | n.a. | 7.5 | 6.63 GHz 4th ord BT | 0.110 | 48.4 | 6.56 | 0.92 | |
| XR annex | 0.200 | OM4 | 4030* | 14.2 | n.a. | 7.5 | 6.64 GHz 4th ord BT | 0.219 | 24.2 | 6.40 | 3.56 | |
| XR annex | 0.250 | OM4 | 4030 | 11.4 | n.a. | 7.5 | 6.27 GHz 4th ord BT | 0.274 | 19.4 | 5.96 | 4.86 | |

100 m OM3 equates to 200 m OM4 using proposed 6.63 GHz test filter (equates to 250 m OM4 with existing 6.25 GHz test filter)

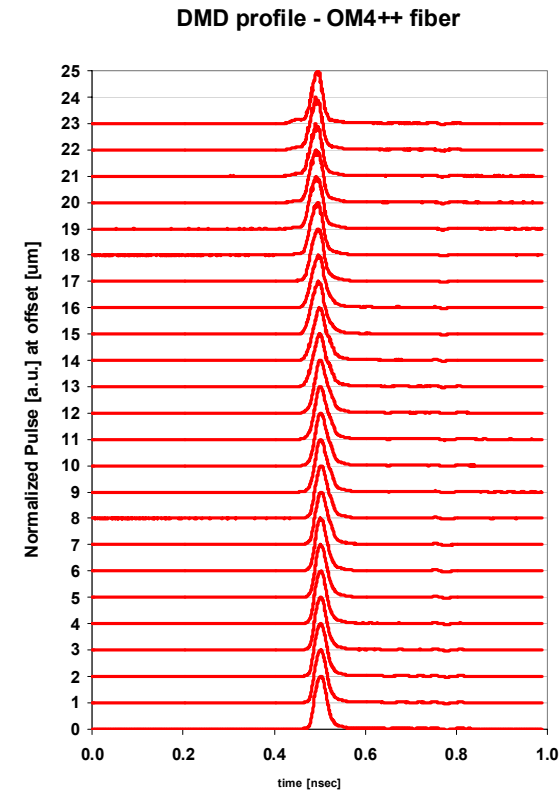
10 GHz*km test fiber inserts small reduction in test fixture bandwidth that produces a slightly more conservative test`

*Note: 4700 EMB worst-case de-rated for operation at 840 – 860 nm.

`Note: 10 GHz*km worst-case de-rated for operation at 840 – 860 nm.

Test Fiber as Chromatic Dispersion Element

- 50 μm fiber with:
 - negligible modal dispersion at 850 nm
 - $\text{DMD} (0 - 23) \leq 0.066 \text{ ps/m}$
 - $\text{EMB} \geq 10,000 \text{ MHz*km}$
 - measured chromatic dispersion
 - known Zero Dispersion Wavelength
 - known Zero Dispersion Slope
- 100 km of such fiber is presently available
 - CD properties of all spools matched to 0.5%
 - Thanks to Draka for manufacturing and selecting this inventory



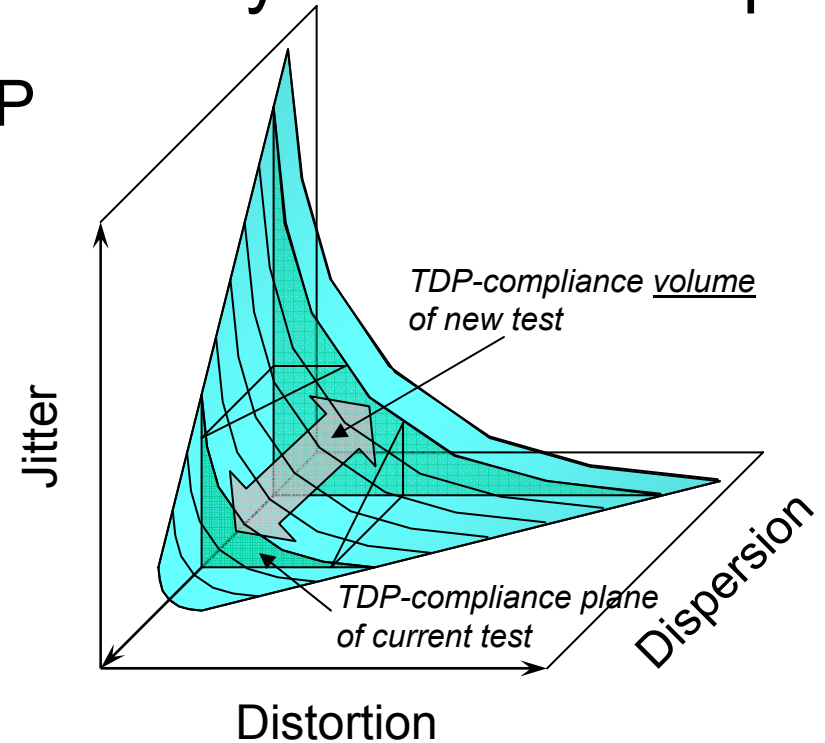
Advantages of Approach

- Uses existing TDP fixture with minor modification
 - Small incremental cost for fiber
- Allows assessment of CD impairments as composite measurement with TDP
 - Potential yield improvement due to lumped impairment test
 - Captures true dynamic impairment, not static filter surrogate
 - Propose to adopt normatively for clause 86
- Applies to any transmitter-based improvement
 - Jitter reduction
 - Spectral width reduction
 - Mode Partition Noise (MPN) reduction
 - Rise / fall time reduction
- Dovetails with existing clause 86 specs
 - No change to PMD specs
 - Same PMD sorted by performance

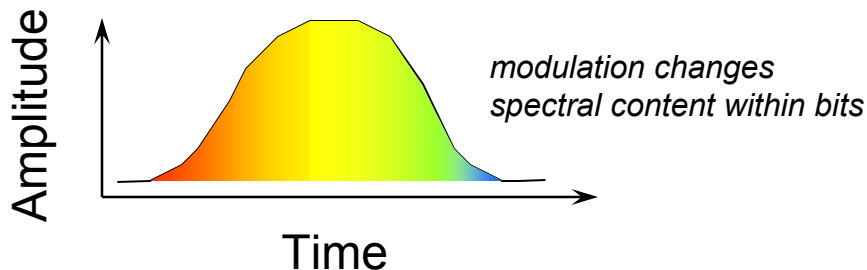
Improved TDP Test Adds Compliance Dimension and Captures Effects of Spectral Dynamics & Shape

- Including actual dispersion in TDP

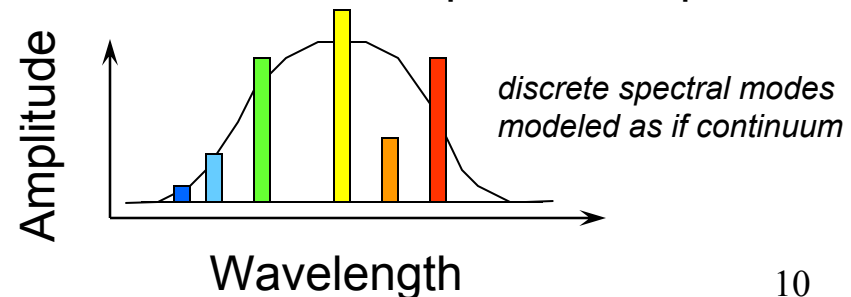
- removes artificial restriction fixed at surrogate worst-case chromatic dispersion value
- includes MPN
 - no k-factor guesswork
- opens compliance space from plane to expanding volume
- maximizes trade-off of waveform infidelity components



- captures dispersion effects of dynamically modulated spectrum



- captures dispersion effects of non-Gaussian spectral shape





Examining Impact on Deterministic Jitter

in the absence of other parametric improvements
(i.e. reduction in RIN, DCD, Rise/Fall times)

For a given TDP, tabulate the effect on required DJ (ps) compared to Draft 2.0.
Rise/fall times, DCD and RIN unchanged. MPN k-factor = 0.3 for all cases.
Positive numbers indicate an increase in allowable DJ.

| DJ change (ps) with 6.64GHz test receive bandwidth and 10GHz*km test fiber | | | | | | |
|--|---|------|-----|---|------|------|
| RMS Spectral Width (nm) | Screen for 100m OM3 Center Wavelength (nm) | | | Screen for 200m OM4 Center Wavelength (nm) | | |
| | 840 | 850 | 860 | 840 | 850 | 860 |
| 0.35 | 0.5 | 0.5 | 0.6 | -0.7 | -0.5 | -0.3 |
| 0.45 | 0.5 | 0.6 | 0.7 | -1.8 | -1.3 | -1.1 |
| 0.55 | 0.1 | 0.2 | 0.3 | -3.4 | -2.8 | -2.4 |
| 0.65 | -0.2 | -0.1 | 0.0 | -5.9 | -5.0 | -4.2 |

| Color code legend | |
|--------------------------------|---|
| Same as Draft 2.0 (within 1ps) |  |
| More than 1ps smaller |  |

Content for clause 86.7.5.4

Transmitter and dispersion penalty (TDP) test

- See file `kolesar_02_0509`