Extended Reach on MMF: Proposals for Clause 86 and Informative Annex

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Outline

- Purpose
- Key concepts
- Test fixture
- Parametric tabulation of scenarios
- MMF chromatic dispersion element
- Advantages of approach
- Addressing prior system vendor contributions
- Examining informative annex precedents
- Content for clause 86.7.5.4
- Content for new informative annex 86A

Purpose

- Describe improved Transmitter and Dispersion Penalty (TDP) test proposal
- Describe measurement-based methodology for screening extended-reach capability of 40GBASE-SR4 and 100GBASE-SR10
- Support proposed modifications to IEEE P802.3ba draft 2.0 submitted by comments
  - Comment numbers: C1, C2, …

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)
    - of length tailored to targeted extended reach
- 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

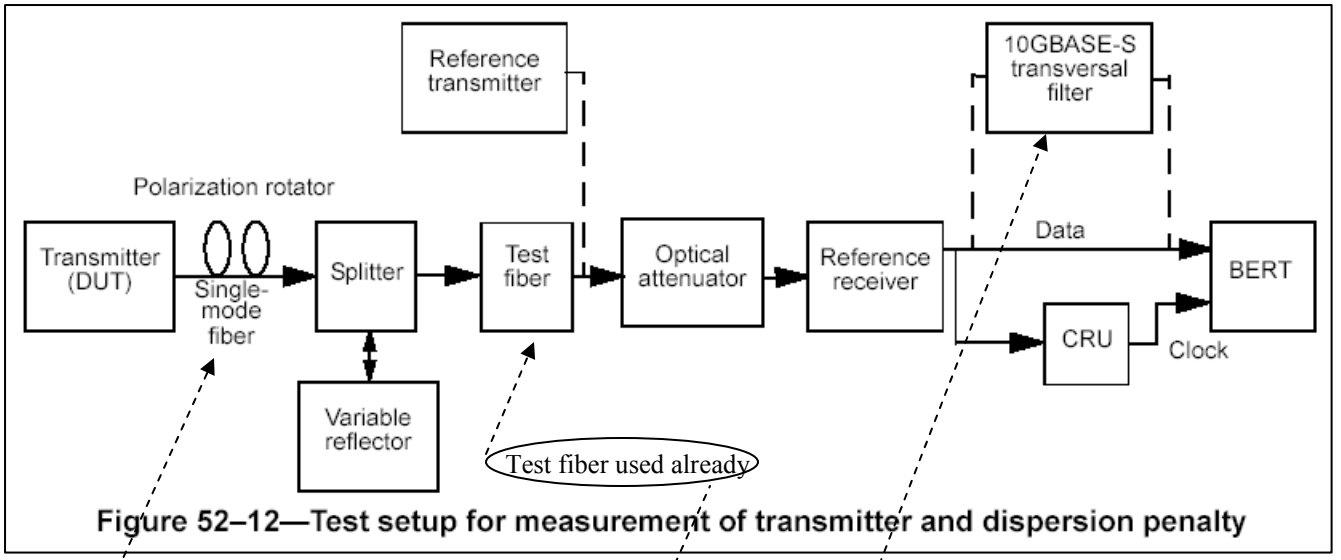
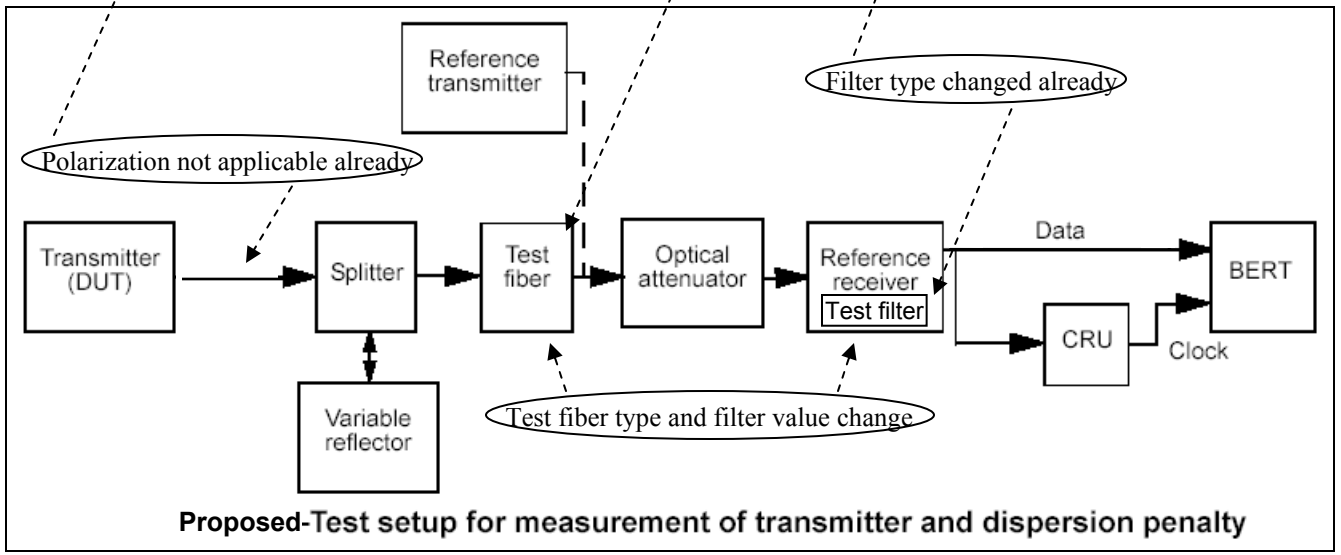


Figure 52–12—Test setup for measurement of transmitter and dispersion penalty

Clause 86.7.5.4 and XR Annex



Proposed-Test setup for measurement of transmitter and dispersion penalty

Parametric Tabulation of Scenarios

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	test filter unit	test filter 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	64.5	6.59	0.52
XR annex	0.200	OM4	4030 *	14.2	n.a.	7.5	6.64	GHz	4th ord BT	0.219	32.3	6.50	2.05
XR annex	0.250	OM4	4030	11.4	n.a.	7.5	6.27	GHz	4th ord BT	0.274	25.8	6.09	2.82

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 nm.

Test Fiber as Chromatic Dispersion Element

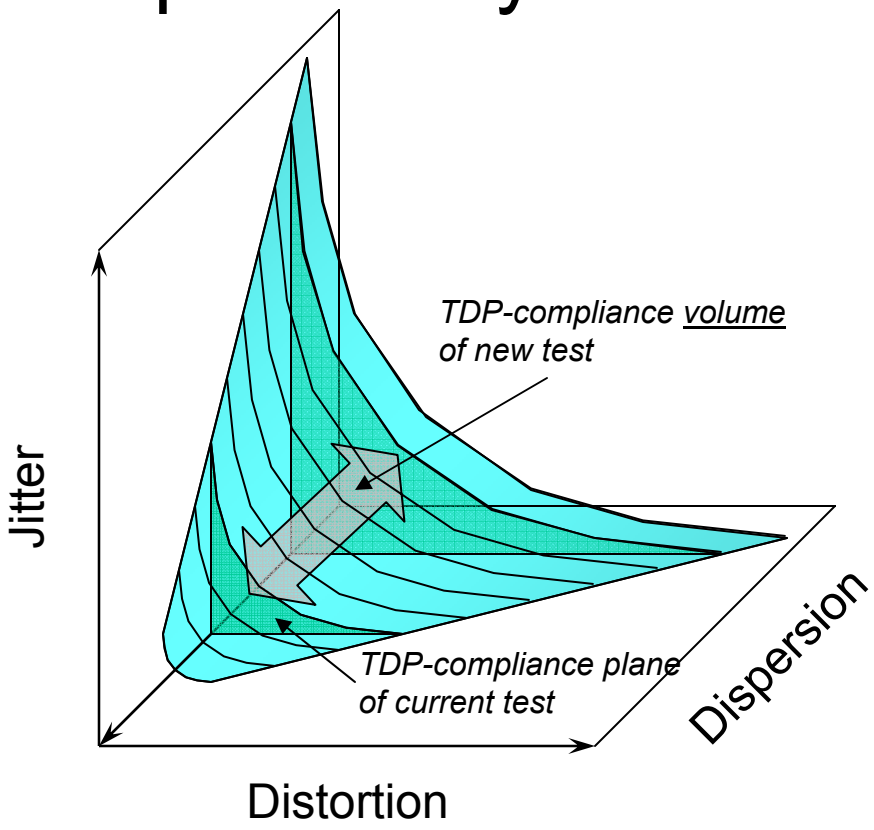
- 50 μm fiber with:
  - negligible modal dispersion at 850 nm
    - DMD (0 – 23) ≤ 0.066 ps/m
    - EMB ≥ 10,000 MHz*km
  - measured chromatic dispersion
    - known Zero Dispersion Wavelength
    - known Zero Dispersion Slope
- 100 km of such fiber is presently available
  - CD properties of all spools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

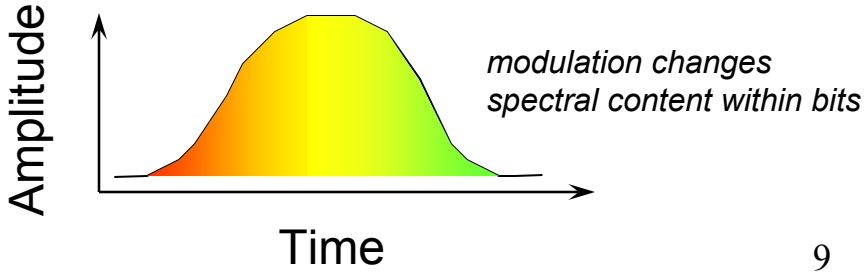
Advantages Of Approach

- Uses existing TDP fixture with minor mods
  - Small incremental cost for filter and 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
  - Rise / fall time reduction
- Dovetails with existing clause 86 specs
  - No change to PMD specs
  - Same PMD sorted by performance

New Test Adds Compliance Dimension and Captures Effects of Spectral Dynamics

- Including actual dispersion in TDP
  - removes artificial restriction fixed at surrogate worst-case dispersion value
  - opens compliance space from plane to volume that expands in all dimensions
  - maximizes trade-off of waveform fidelity components
  - captures dispersion effects of dynamically modulated spectrum





Addressing Prior System Vendor Contributions and Examining Informative Annex Precedents

Addressing prior contributions (1 of 3)

- Gustlin_xr_01_0508 (Cisco)
  - interest in 200 – 250 m on OM4
  - preferably one PMD, but open to two
  - no long table of options

- Proposal achieves:
  - 200 m on OM4
  - single PMD design
  - no table of options

Addressing prior contributions (2 of 3)

- Maki_xr_01_0708 (Juniper)
  - single PMD desirable, but not paramount
  - not acceptable:
    - cost increase of baseline PMD
    - EDC or CDR on host or in baseline PMD
  - acceptable:
    - use of OM4
    - use of better than minimally compliant PMDs
- Proposal achieves:
  - single PMD design
  - no:
    - cost increase of baseline PMD (sorting only)
    - EDC or CDR required anywhere
  - use of:
    - OM4
    - better than minimally compliant PMDs

Addressing prior contributions (3 of 3)

- Kipp_xr_01_0908 (Brocade)
  - recommended informative annex
  - 200 m on OM3

- Proposal achieves:
  - placement in informative annex
  - 200 m on OM4

Informative Annex Precedents

- Annex D
  - operation over alternate fiber types (e.g. 50 μm) and copper types (120 ohm and 150 ohm)
- Annex E
  - alternative spec for FOIRL PMD wavelength range
- Annex 23C
  - guidelines for use of 120 ohm cable
- Annex 32A
  - guidelines for use of 120 ohm or 150 ohm cable

Precedents exist for both alternative PMD specs and alternative media

Content for clause 86.7.5.4
Transmitter and dispersion penalty (TDP) test

- See file kolesar_02draft1_0509

Content for new informative annex 86A
Transmitter and dispersion penalty (TDP) test for extended-reach capability

- See file kolesar_03draft2_0509 if proposal above accepted
- See file kolesar_04draft1_0509 otherwise