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Advanced MMF Standardization

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MMF Specification Standards Activities

- **TIA FO4.1 in October published TSB-172**
  - ***High Data Rate Multimode Fiber Transmission Techniques***
- **ISO/IEC JTC1/SC25/WG3 in September received proposal to standardize a 50µm fiber with higher 850nm bandwidth than OM3**
- **Both share common thread of higher performance 50µm fiber**

TSB-172 MM Transmission Techniques

- Purpose: Show MM potential; Float possible specs
- Reviews high-speed transmission techniques and relates to existing usage in standard applications
  - Serial Transmission
  - Dispersion compensation: pre-emphasis, DCF, EDC
  - Inverse-muxing: parallel fibers, WDM
  - Line coding: binary, multi-level
  - Forward error correction
- Summarizes by tabulating all, showing untapped potential
- Contains two informative tables of fiber specs
  - OM3+ (a.k.a OM4) (4700 MHz-km EMB @ 850 nm)
  - Wider spectrum OM3 (2000 MHz-km @ 780 – 920 nm)

Summarizing TSB-172

Technique	Advantage	Disadvantage	Comment
Serial Transmission	Overall simplicity	Requires highest performance components	Most commonly deployed approach through 10 Gb/s. Untapped potential in higher bandwidth multimode fibers.
Pre-emphasis	Electronic implementation	No existing standard MMF application	Untapped potential
Dispersion Comp. Fiber	Double duty fiber	Impractical for legacy MMF	Popular for singlemode but not multimode systems
EDC	Electronic implementation	Increases power consump. & heat dissipation	Evolving technology
Parallel	Simplest inverse-mux	Increases number of fibers	Available and easily scalable to > 100 Gb/s
WDM	Maximizes fiber capacity	Increases optical complexity	Untapped potential in wider-spectrum multimode fibers
Binary code	Simplifies TRX electronics	Lowers bandwidth efficiency	Used in all standardized MMF applications to date
Multi-level code	Increases bandwidth efficiency	Increases TRX complexity	Not a compelling alternative to binary code to date; untapped potential
Forward Error Correction	Electronic implementation	Increases power & heat dissipation, adds latency	Untapped potential for multimode fiber systems

Focus on Two Advanced Fiber Items

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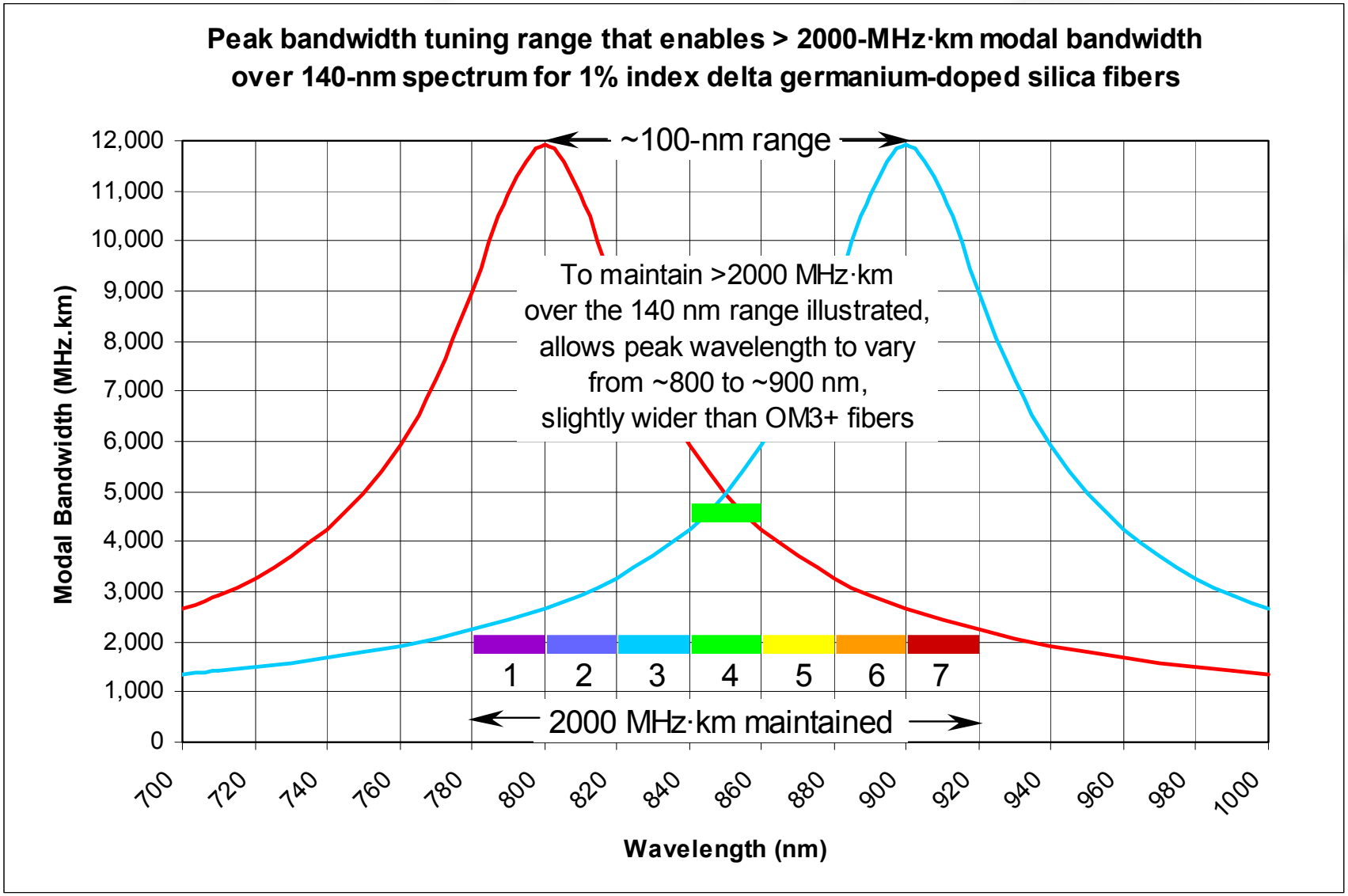
Key Specs: 50µm Fiber w/ Higher Peak Bandwidth

Attribute	Measured per FOTP	Value	Units
Effective modal bandwidth-length product at 850 nm Ensured by adherence to: annexes C.1 and C.2 scaled per annex F.2 of TIA-492-AAAC; or annexes C.1 and C.3 of TIA-492-AAAC.	220	≥ 4700	MHz·km
Overfilled modal bandwidth-length product at 850 nm	204	≥ 3500	MHz·km
Overfilled modal bandwidth-length product at 1300 nm	204	≥ 500	MHz·km

Key Specs: 50µm Fiber w/ Wider Spectrum

Attribute	Measured per FOTP	Value	Units
Effective modal bandwidth-length product from 780 to 920 nm Ensured by adherence to: annexes C.1 and C.2 of TIA-492-AAAC from 780 to 920 nm; or annexes C.1 and C.3 of TIA-492-AAAC from 780 to 920 nm.	220	≥ 2000	MHz·km
Overfilled modal bandwidth-length product from 780 to 920 nm	204	≥ 1500	MHz·km
Overfilled modal bandwidth-length product at 1300 nm	204	≥ 500	MHz·km
Attenuation coefficient at 780 nm	78	≤ 3.4	dB/km
Attenuation coefficient at 850 nm	78	≤ 2.5	dB/km
Attenuation coefficient at 920 nm	78	≤ 2.0	dB/km
Attenuation coefficient at 1300 nm	78	≤ 0.8	dB/km

A Closer Look at Spectral Bandwidth



ISO Proposal

- Tyco proposed BW specs for next generation 50µm
  - Similar to higher peak bandwidth specs of TSB-172
  - Referring to it as OM4
- Agreement of WG3 to send liaison letters to applications standards committees
  - IEEE 802.3 (Ethernet)
  - INCITS T11.2 (Fibre Channel)
- Letter to request feedback on proposed specs
  - Utility and/or adjustments for present and future applications

Bandwidth Spec Comparison

Parameter	TIA TSB-172	ISO Proposal
850nm laser BW	4700	4500
850nm OFL BW	3500	3500
1300nm OFL BW	500	500

- Specs are very similar
- Cabling industry appears fairly well harmonized

What Can These Fibers Do for 802.3 HSSG?

- **Using specs proposed in aronson_01_0907**

Supportable Distance at 0 dB Margin		
Fiber Type	**BW (MHz.km)**	**Distance (m)**
OM3	2000	230
ISO	4500	280
TSB-172	4700	280

- **Link becomes constrained by chromatic dispersion impairments (i.e. MPN) due to spectral width relaxation and by increased jitter allowance (i.e. Pcross)**

Concluding Thoughts

- Higher peak BW fibers of the type shown have been in the market for more than four years
  - used to extend link distances and margin
  - supplied by the three major MMF manufacturers
- Utility for HSSG looks muted by relaxation proposals
- While no HSSG objective exists to specify this fiber, it is a subset of OM3 and would enhance the 40G and 100G specs if included
  - Create a more forward looking specification
- Recommend considering impact of relaxations on the ability of this fiber to provide useful solutions to the customer
  - Helps to support migration from data center to LAN