

TIA FO-2.2.1

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Chair, TIA FO-2.2.1

Task Group on Modal Dependence of Bandwidth

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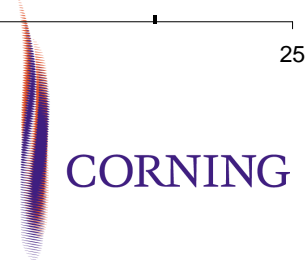
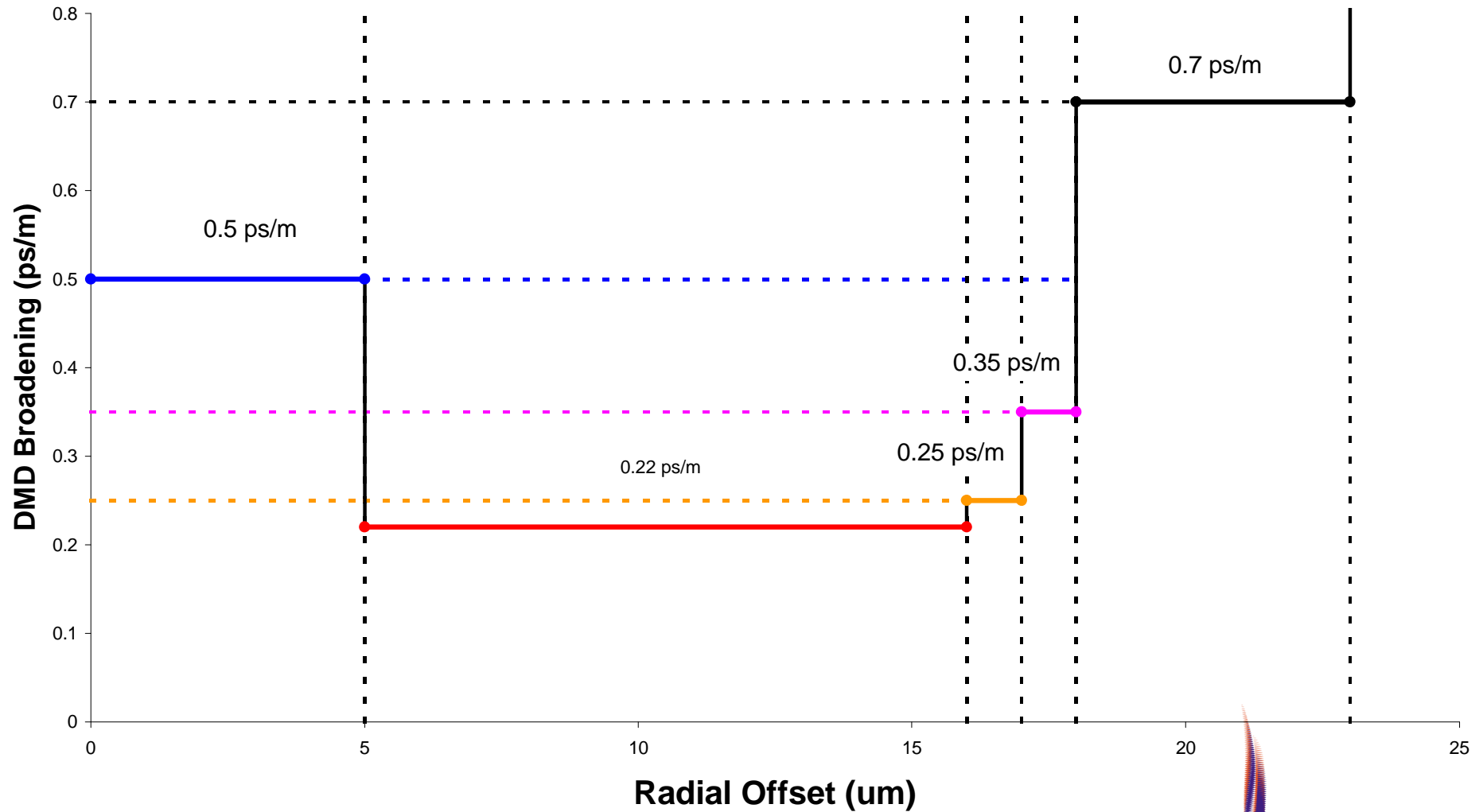
Next Generation 50 mm Fiber Recommendation Complete

- Requirements have been defined
 - * Fiber DMD (FOTP 220) and
 - * Transceiver encircled flux (FOTP 203)
- Comments submitted to P802.3ae/D2.1
 - * Swanson and Kolesar
- Formalization of recommendation initiated in appropriate standards committee
 - * FOTP 220 ballot initiated in TIA FO-2.2
 - * Specification introduced in IEC SC86A WG1
 - IEC 793-2 annex already calls out 2000 EMB

Fiber Requirement Set

- Fiber requirement defined in terms of a Differential Modal Delay (DMD)
- TIA ballot initiated for FOTP 220
 - * “Differential Mode Delay Measurement of Multimode Fiber in the Time Domain”
 - * Defines a maximum allowable broadening (ps/m) over a range of radial offsets (μm)
- Mask balances fiber DMD and transceiver launch properties
 - * Intermediate modes in the fiber are easiest to tune
 - * Typical sources using cost effective manufacturing have a limited range of launches
 - “Not too large, not too small”

300m 2000 MHz-km 50 mm Fiber 850 nm DMD Mask



Transceiver Requirement Set

- Transceiver requirement defined in terms of Encircled Flux
 - * TIA FOTP 203 - status approved
- Encircled flux requirement
 - * $\geq 86\%$ at $19\ \mu\text{m}$ radius
 - Eliminates too large
 - * $\leq 30\%$ at $4.5\ \mu\text{m}$ radius
 - Eliminates too small

Approach to 10 Gb Multimode Fiber Specification

- Target - 2000 MHz-km effective modal bandwidth (EMB)
 - * Input into the IEEE system model
- 10 Gb Demonstration Testing Objectives
 - * Demonstrate ability to select fiber and transmitters to
 - Reliably deliver 10 Gb performance at
 - 300 meters over
 - 50 μm fiber
 - * Determine optimum thresholds and specification methodologies
- 10 Gb Demonstration Testing Approach
 - * Collect EMB using characterized fibers and 10 Gb transmitters
 - * Utilize modeling and additional testing to assess risk

TIA 10 Gb 50 mm Demonstration

- Fiber selected, cabled and tested for EMB and DMD
 - * Cable contains twelve 50 μm high bandwidth fibers
 - * Fiber selected to explore limits of performance
 - Blue cable fibers chosen to work
 - Orange cable fibers “interesting”
- Lasers selected from more than 5 sources / manufacturers
 - * Spanning a range of encircled flux values
- Measurements performed by 6 labs
- Analysis used to confirm requirement achieves low risk

TIA 10 Gb 50 mm Demonstration Conclusion

- Specification consistent with observed performance

EMB Sorted by Encircled Flux and DMD

3	4	6	1	2	9	7	11	10	5	8	12
Orange	Orange	Orange	Orange	Orange	Blue	Blue	Blue	Blue	Orange	Blue	Blue
Yellow	Violet	Aqua	Red	Black	Green	Blue	Slate	Brown	Rose	Orange	White

29	02	3168	2043	2439	2520	2664	2277	2313	> 3600	> 3600	2349	> 3600	> 3600
55	01	2574	1779	2454	2394	2274	2494	2217	2732	2733	2532	2712	2811
29	04	3465	1845	3546	2808	2574	> 2961	2700	> 2970	> 2880	2880	> 2979	> 2943
56	04	2050	2480	2980	2560	2100	3400	3400	3400	3400	3200	3400	3400
56	03	2036	2015	2760	2250	2430	3400	3400	3400	3400	2860	3300	3400
29	03	3177	2061	> 2718	2808	2817	2241	2286	> 2997	> 2880	2034	> 2934	> 3000
55	03	2633	1760	2652	2295	2276	2454	2196	2811	2811	2533	2831	2930
55	04	2513	1918	2732	2454	2494	2633	2811	3003	2970	2732	2965	3003
19	03	3872	3165	4900	3450	3384	3587	3558	> 5000	5198	3322	5624	> 5000
56	02	1980	2980	2075	2200	2300	3400	3380	3350	3400	2960	3400	3400
28	02	2988	2188	2923	2124	2035	2529	2353	9640	10786	2035	6987	10000
28	01	4033	2562	4308	5000	3796	3919	2757	10000	8510	3706	7044	10000
19	04	3640	2289	> 5000	1864	5244	2150	1945	> 5000	> 5000	4625	> 5000	> 5000
19	05	2520	2175	2582	1853	2714	1974	1857	3138	2465	2322	2798	3772
19	01	4458	4947	3862	2217	3462	2383	2899	4849	3834	2504	3484	5848
19	02	3453	3323	2588	2483	3478	3100	3589	5695	4226	3634	4283	4214
29	01	> 3303	2331	> 3600	> 3105	> 3105	3069	2592	> 3117	> 3411	> 2997	> 3600	> 3600
55	02	2414	1799	2355	2375	2315	2037	2117	2494	2454	2276	2474	2633
28	04	3105	2188	2866	1893	2967	2188	2035	4421	4180	2837	4226	7306
28	03	4445	2924	4856	1760	4107	2353	2035		5042	4075	4431	7519
56	01	1500	2040	1930	1980	1850	2340	2800	3000	2640	1490	2625	2960

Modeling

- Modeling used to confirm risk assessment
 - * Includes fiber and transceiver performance / interaction
 - * Connector offset impact evaluated
- Modeling supported by
 - * 2 fiber manufacturers
 - * 1 transceiver manufacturer

Conclusion

- TIA FO-2.2.1 recommendation complete
 - * Recommendation submitted in comments by Swanson and Kolesar
 - * Achieves optimum balance between fiber and transceiver properties
 - * Includes fiber DMD and transceiver encircled flux requirement
- Follow on activities in TIA FO-2.2.1 in progress
 - * Complete final modeling
 - * “Work” the standards process
 - * Complete documentation and wrap up
 - * Prepare for the next Ethernet standard (100 Gb over MMF!)