While increasing the bit rate from 10 Gb/s to 25 Gb/s reduces the CD tolerance by a factor of 6, and to 40 Gb/s by a factor of 16, duobinary encoding provides partial mitigation by increasing the dispersion tolerance to CD by a factor of approximately 2 compared to NRZ. There are multiple paths to gaining the further required reductions in CD.

~~The (estimated)~~ Based on simulation, the usable spectrum for a 20 km G.652 standard single-mode fiber (SSMF) ~~fiber~~ that can be used without DC for the considered bit rates, laser sources and encoding are summarized in Figure 41 (assuming 1 dB optical dispersion penalty).

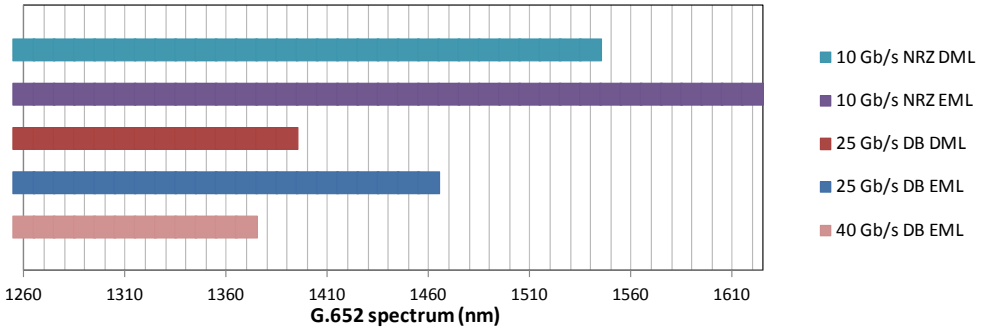

Figure 41: Estimated usable SSMF spectrum (20 km) without DC

- If both upstream and downstream transmission is in the O-band, no DC is required. Duobinary transmission up to 25 Gb/s can be achieved with DML lasers, and 40 Gb/s with EML lasers. Co-existence with 10G-EPON, GPON and 1G-EPON simultaneously is possible, if 1G-EPON upstream transmission is constrained to the same 1310 ± 20 nm window as GPON, using a DFB laser.
- ~~If the O-band is not available, then transmission needs to be placed in the E, S, C, or L bands. No is required for up to 10 Gb/s duobinary with DMLs, and up to 25 Gb/s duobinary with EMLs.~~
- 25 Gb/s duobinary transmission in the S, C, and L-bands: Allowing for a 2 dB optical penalty (instead of 1 dB), the following can be achieved without DC: (1) 20 km up to 1560 nm, and (2) at 1600 nm, up to 18 km.
- 40 Gb/s duobinary transmission in the S, C, and L-bands:~~above the O-band requires DC.~~ For ODNs longer than 5 km, DC will be required for wavelengths up to 1600 nm.

For S, C, or L-bands, DC would only need to be implemented on those longer length ODNs. Available DC technologies include:

- DC fiber, which is low-loss (<3 dB) and low cost, although bulky.
- Fiber Bragg grating dispersion compensators for PON applications might be possible; they would be smaller but possibly more expensive.
- Electronic DC may be possible, but the improvement in dispersion tolerance for duobinary modulation has not yet been determined.

Comment [e1]: These changes proposed to section 6.3.2, starting p. 66, line 24.

Comment [e2]: Makes more sense to move this text and the figure to precede the discussion.

Comment [e3]: Updated version of Figure 41.

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