EDC Coverage Results on the Cambridge MMF Model

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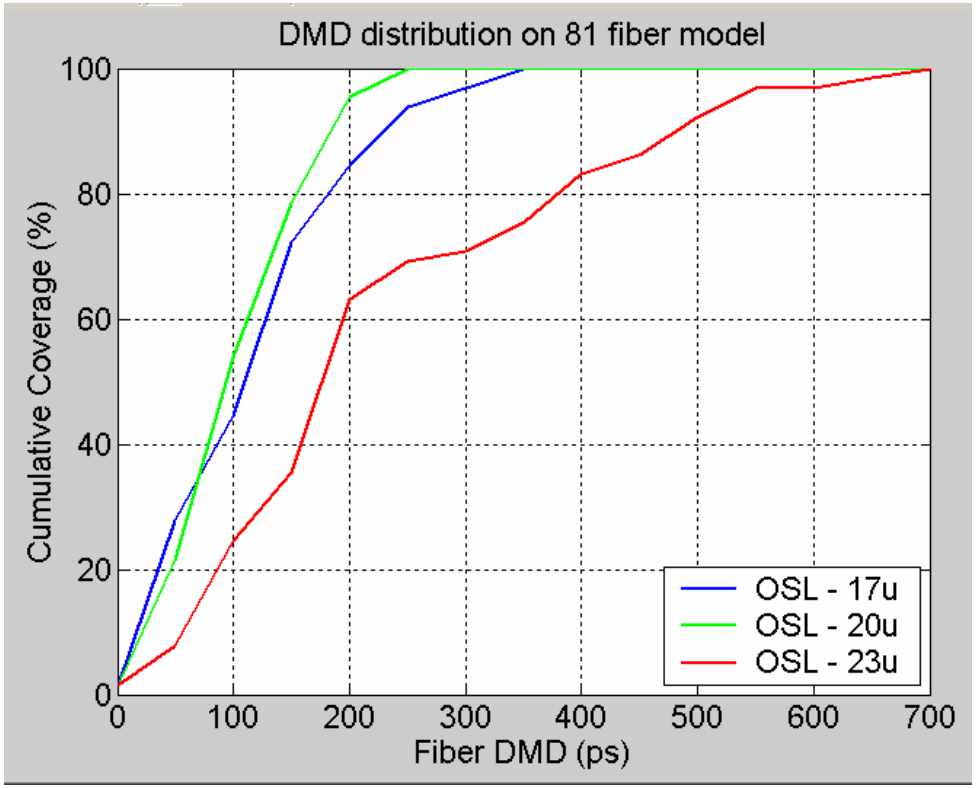
Outline

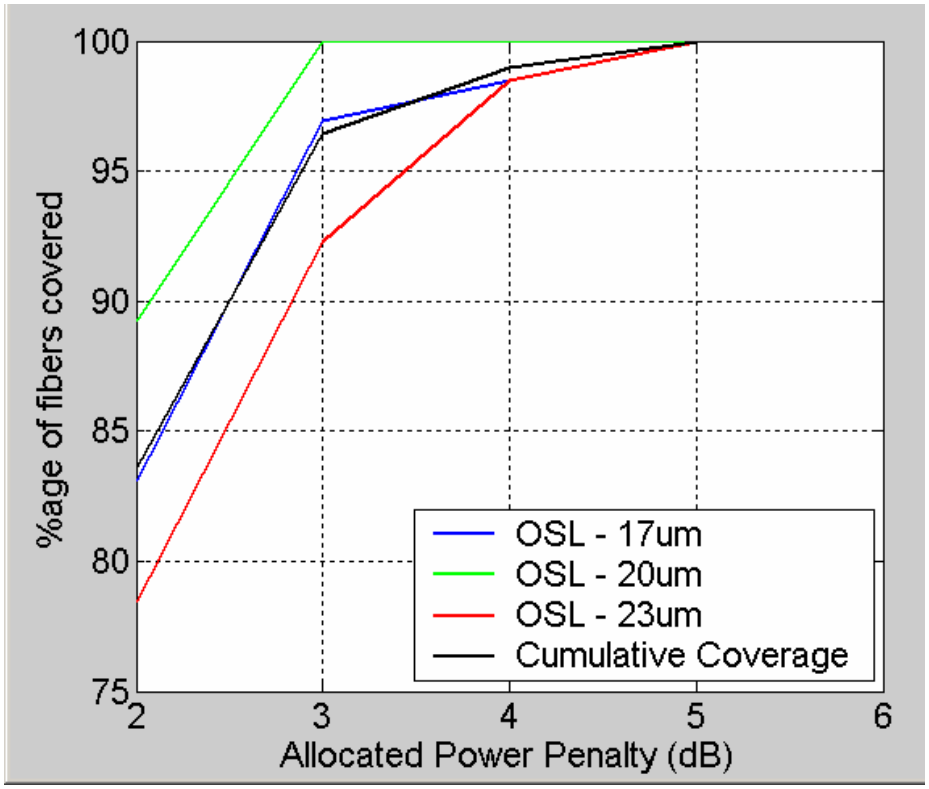
- DMD Distribution
- Equalizer Coverage Results for OSL
- Sweeps
  - Power Penalty
  - FFE & DFE Taps
  - Model Extensions
  - Rx Bandwidth
- Conclusions

DMD-metric Cumulative Distribution



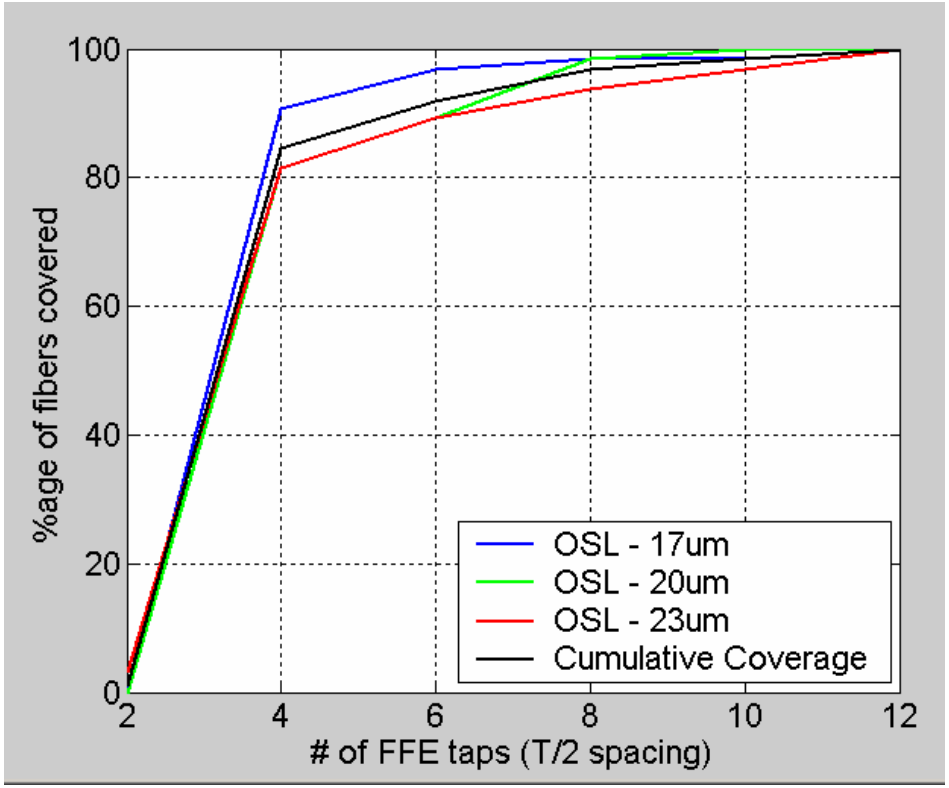
- All impulse responses are for the 300m distance
- DMD-metric computed as 5 – 95% rise time
- Offset Single-Mode Launch with 23um radial offset is the worst case

Power Penalty vs. Coverage at 300m



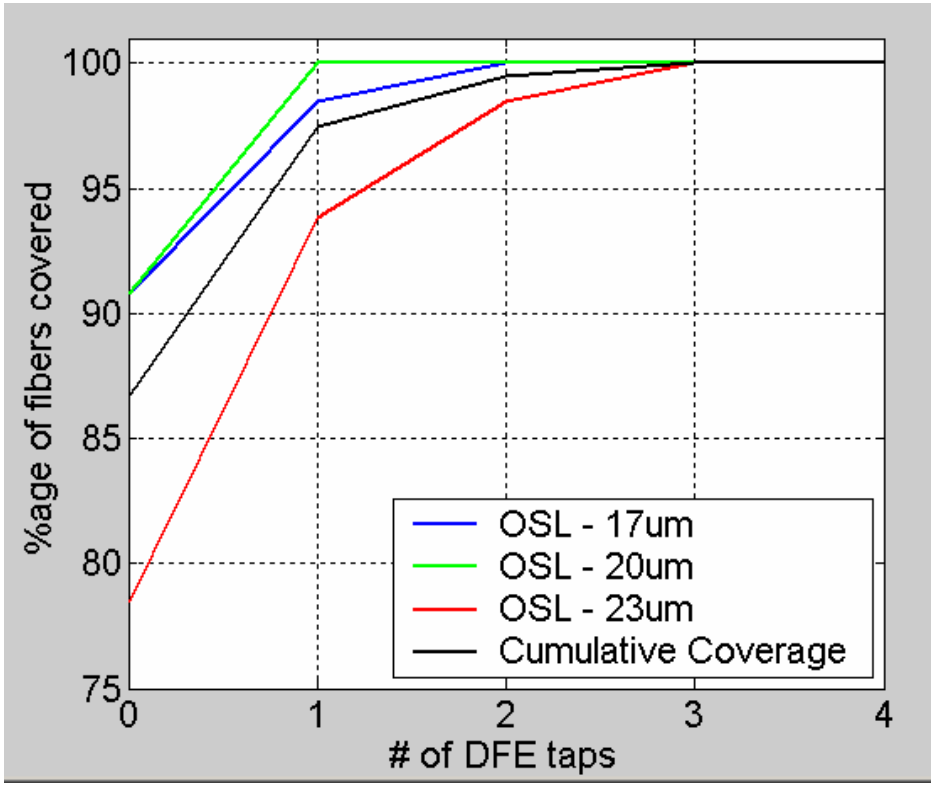
- Model:
  - Simulated Equalizer is a 20 tap FFE (T/2) and 5 DFE taps
  - 10GBASE-LR Tx & Rx
  - See bhoja_1_0104
- Cumulative Coverage is the average of the 3 OSL's
- Results:
  - 100% coverage with 5dB allocated power penalty
  - 99% coverage with 4dB allocated power penalty

Number of FFE Taps – Cumulative Coverage Results at 300m



- Assumptions:
  - 5dB optical penalty
  - # of DFE taps fixed at asymptotic limit of 10
  - # of FFE taps are swept
- Results:
  - 12 (T/2) spaced FFE taps provides 100% coverage

Number of DFE Taps – Cumulative Coverage Results at 300m

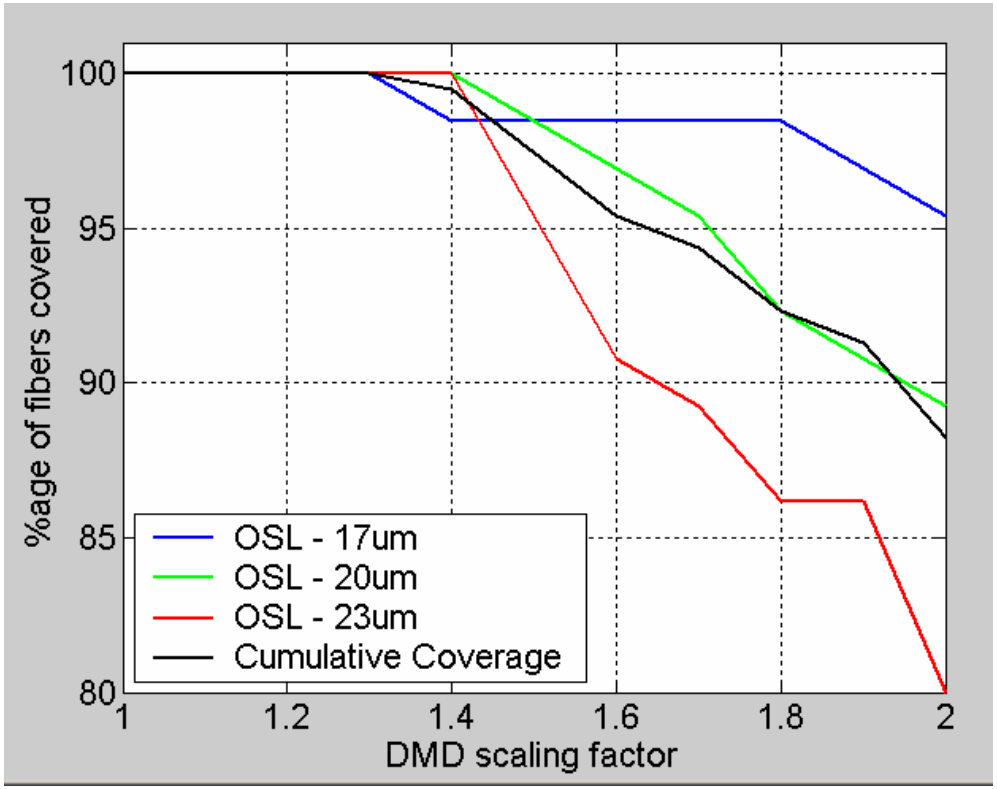


- Assumptions:
  - 5dB optical penalty
  - # of (T/2 spaced) FFE taps fixed at asymptotic limit of 12
  - # of DFE taps are swept
- Results:
  - 3 DFE taps produces 100% coverage (at 5dB penalty)
  - 12 taps (T/2) FFE only (e.g., no DFE) provides 78% coverage for 23um off-set

Power Coupling Coefficient Variation

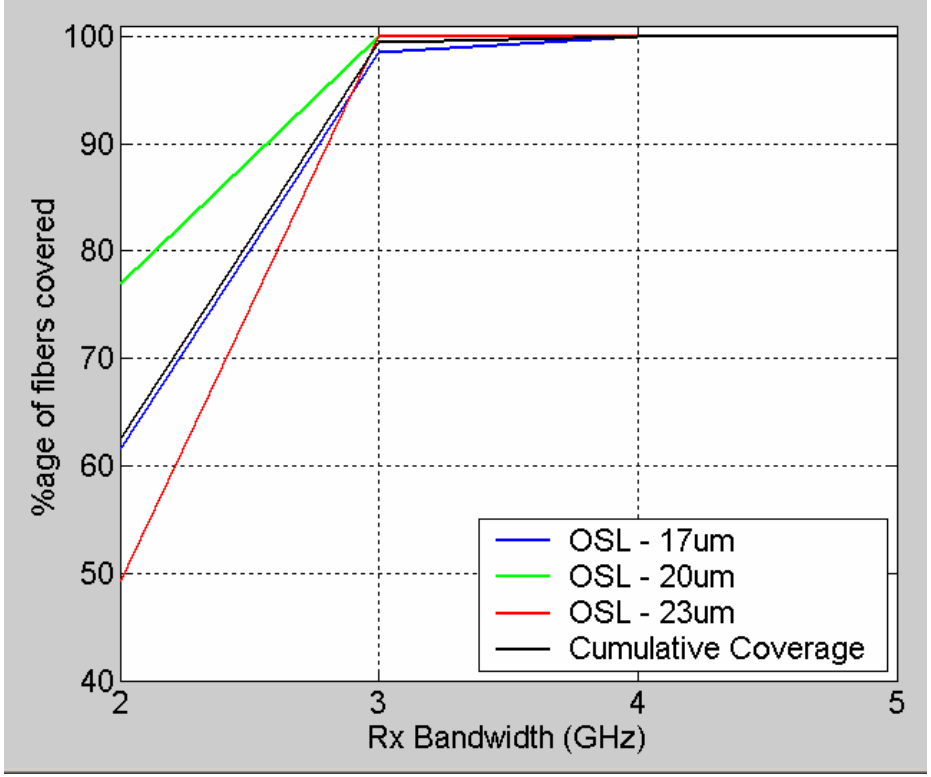
- Measurements over time and/or connector perturbation with OSL indicate small changes in the impulse response
  - ewen_1_0104, king_1_0104
- Power coupling coefficient for the modal delays are randomly perturbed by up to 25%
  - 500 trials; DC gain renormalized to unity
  - 23um OSL simulated
- 5dB penalty, 20 (T/2 spaced) FFE and 5 DFE taps
  - Results: 100% coverage at 300m

DMD Scaling



- DMD scaling
  - 300m impulse responses
  - Delays of the mode groups are scaled
- 6dB penalty, 20 (T/2 spaced) FFE taps and 5 DFE taps
- Results:
  - >99% coverage at 1.4 scale factor
  - 90% coverage at 1.95 scale factor
  - Suggests it is possible to support a higher DMD value (>2ns/km) at 300m if required

Rx Bandwidth Sweep



- 6dB penalty, 20 (T/2 spaced) FFE taps and 5 DFE taps
- Rx is 4th order Butterworth filter
- Results:
  - Optimization of Rx bandwidth with EDC possible
  - Opportunity to lower cost of ROSA

Conclusions

- Coverage results for EDC on Cambridge MMF model presented
- FFE+DFE provides 100% coverage at 300m
  - 5dB optical penalty
  - 12 tap (T/2) FFE and 3 tap DFE nominal EQ requirement
- Linear Equalizer-only provides inadequate coverage at 300m
- Depending on final optical budget allocated for the solution:
  - Simulations show that there is margin in the allowed DMD or distance to be supported
  - Potential to relax the required Rx Bandwidth or other aspects of the optical specifications