

Calculated 62 MMF connector loss (OFL) versus lateral offset and suggested link configurations for worst-case modal noise and time variation of channel measurements for 10GBASE-LRM.

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# Outline

- Calculated loss versus offset for 62 MMF connections
- Gigabit Ethernet legacy cable model
- Suggested test configurations based on Gigabit Ethernet legacy cable models

# Loss versus transverse offset for 62 MMF connections.

## Comments on legacy links:

- The ISO 11801-1995 cabling standard specified a worst case, individual connector loss (OFL) of 0.75 dB for MMF links.

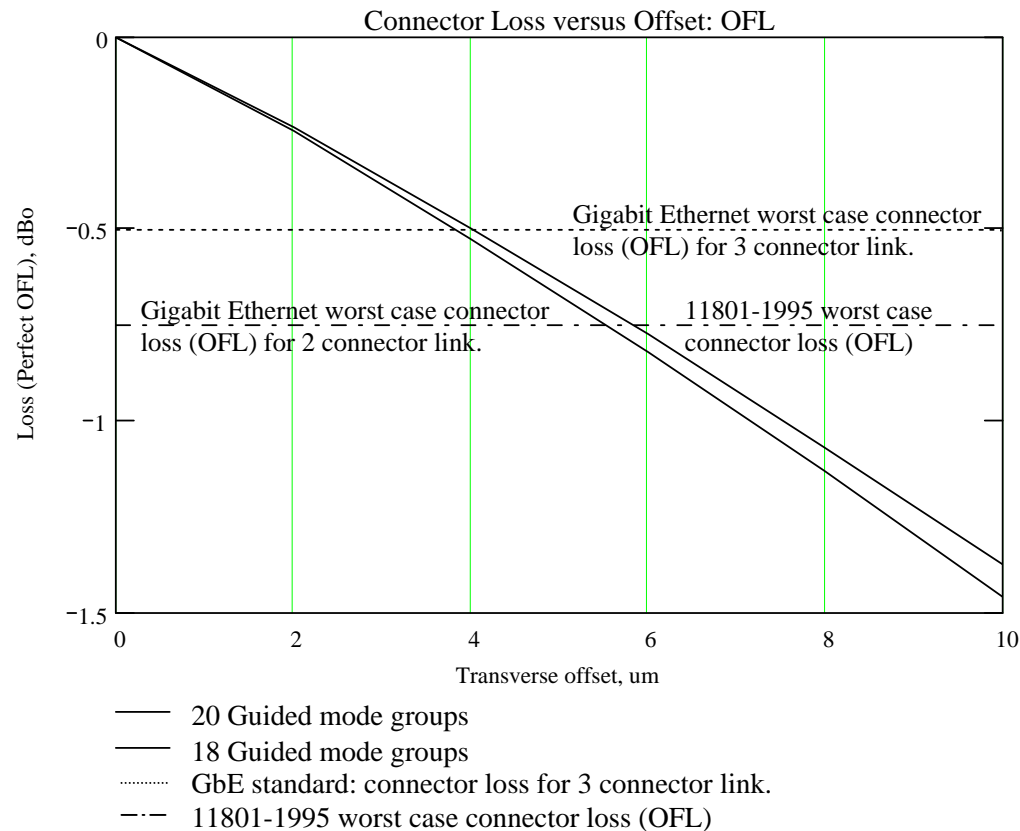
- According to the graph this is approximately equivalent to a 6  $\mu\text{m}$  lateral offset.

- The connector loss specifications of ISO 11801-1995 are consistent with earlier standards.

- Total connector loss allocation for Gigabit Ethernet was 1.5 dB

- Gigabit Ethernet assumed two 0.75 dB connectors for its worst-case cable model.

- The Gigabit Ethernet standard also stated that if the link contained three connectors then the worst case loss must be reduced to 0.5 dB per connector.

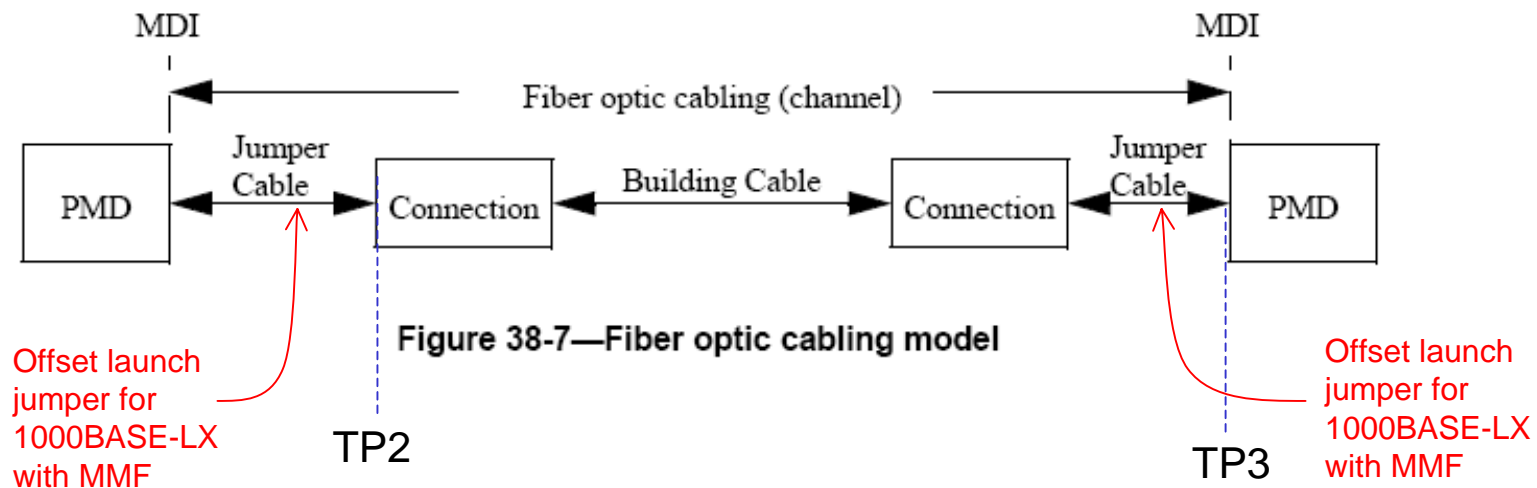


- The loss graph was calculated using overlap integrals between the modes of nominal 62.5/125 multimode fibre. Connectors are assumed to be physical contact therefore no reflection loss.

# Legacy MMF installations and standards: the Gigabit Ethernet cable model (taken from the standard)

## 38.10 Fiber optic cabling model

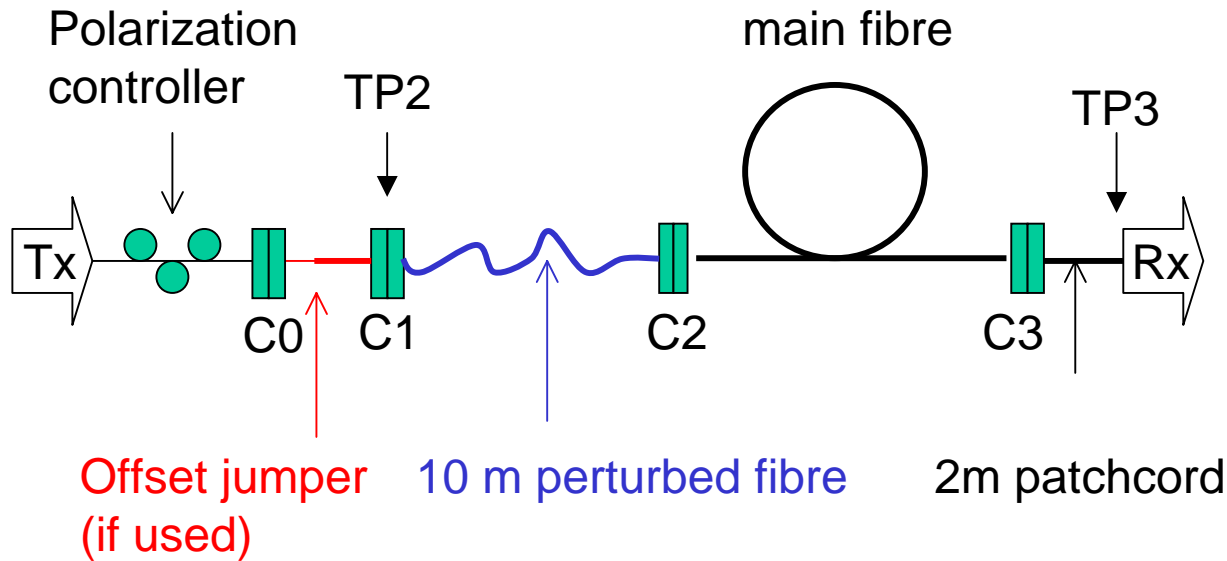
The fiber optic cabling model is shown in Figure 38-7.



### 38.11.2.1 Connection insertion loss

The insertion loss is specified for a connection, which consists of a mated pair of optical connectors. The maximum link distances for multimode fiber are calculated based on an allocation of 1.5 dB total connection and splice loss. For example, this allocation supports three connections with an average insertion loss equal to 0.5 dB (or less) per connection, or two connections (as shown in Figure 38-7) with a maximum insertion loss of 0.75 dB. Connections with different loss characteristics may be used provided the requirements of Table 38-11 and Table 38-12 are met.

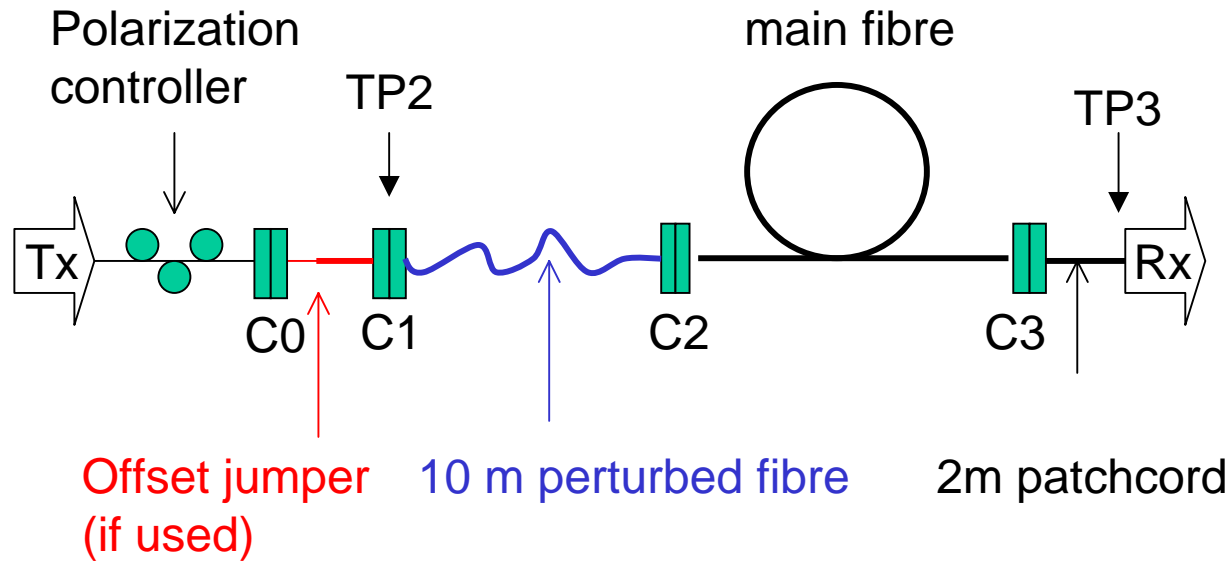
# Case 1: Worst case Gigabit Ethernet test configuration: two 0.75 dB connector case.



- Attempts to emulate the Gigabit Ethernet two connector worst case link.
- Two connectors in link will have 0.75 dB loss.
- C1 or C3 must be confirmed to be low loss to stay within loss budget.

Connectors	Offset, $\mu\text{m}$	Notes
C0	N/A	SMF
C1	0 or 6	Worst case (C3 must be opposite offset)
C2	6	Worst case
C3	6 or 0	Worst case (C1 must be opposite offset)
main fibre	length, m	
62.5 $\mu\text{m}$	220/300	tbd
50 $\mu\text{m}$	220/300	tbd

## Case 2: Worst case Gigabit Ethernet test configuration: three 0.5 dB connector case.



- Attempts to emulate the Gigabit Ethernet three connector worst case link.
- All three connectors in link will have 0.5 dB loss.

Connectors	Offset, $\mu\text{m}$	Notes
C0	N/A	SMF
C1	4	0.5 dB loss for OFL
C2	4	0.5 dB loss for OFL
C3	4	0.5 dB loss for OFL
main fibre	length, m	
62.5 $\mu\text{m}$	220/300	tbd
50 $\mu\text{m}$	220/300	tbd

# Observations

- The worst case link configuration for modal noise and time variation testing is likely to be case 1. This is because a small number of high loss connectors is worse than a large number of low loss connectors.
- Three MMF connectors are sufficient for this type of testing.
- Distributing the loss and offset amongst more connectors would decrease the modal noise and time variance because the loss and offset per connector quickly gets very small.
- The configuration with two 0.75 dB connectors would be very defensible later in standards process as this is the worst case configuration of Gigabit Ethernet and cabling experts tend to prefer configurations that use 0.75 dB (OFL) per connection.
- For practical reasons more than three connectors may be needed in the link if additional connectors are added they should be confirmed to be very low loss ( $< 0.2$  dB) with OFL.