Cabling the Data Center: Best Practices Panel

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LIGHTWAVE

Agenda

- Data Center Architectures
- Data Center Media Options
- Data Center Testing

Data Center Architectures (Rodney Casteel)

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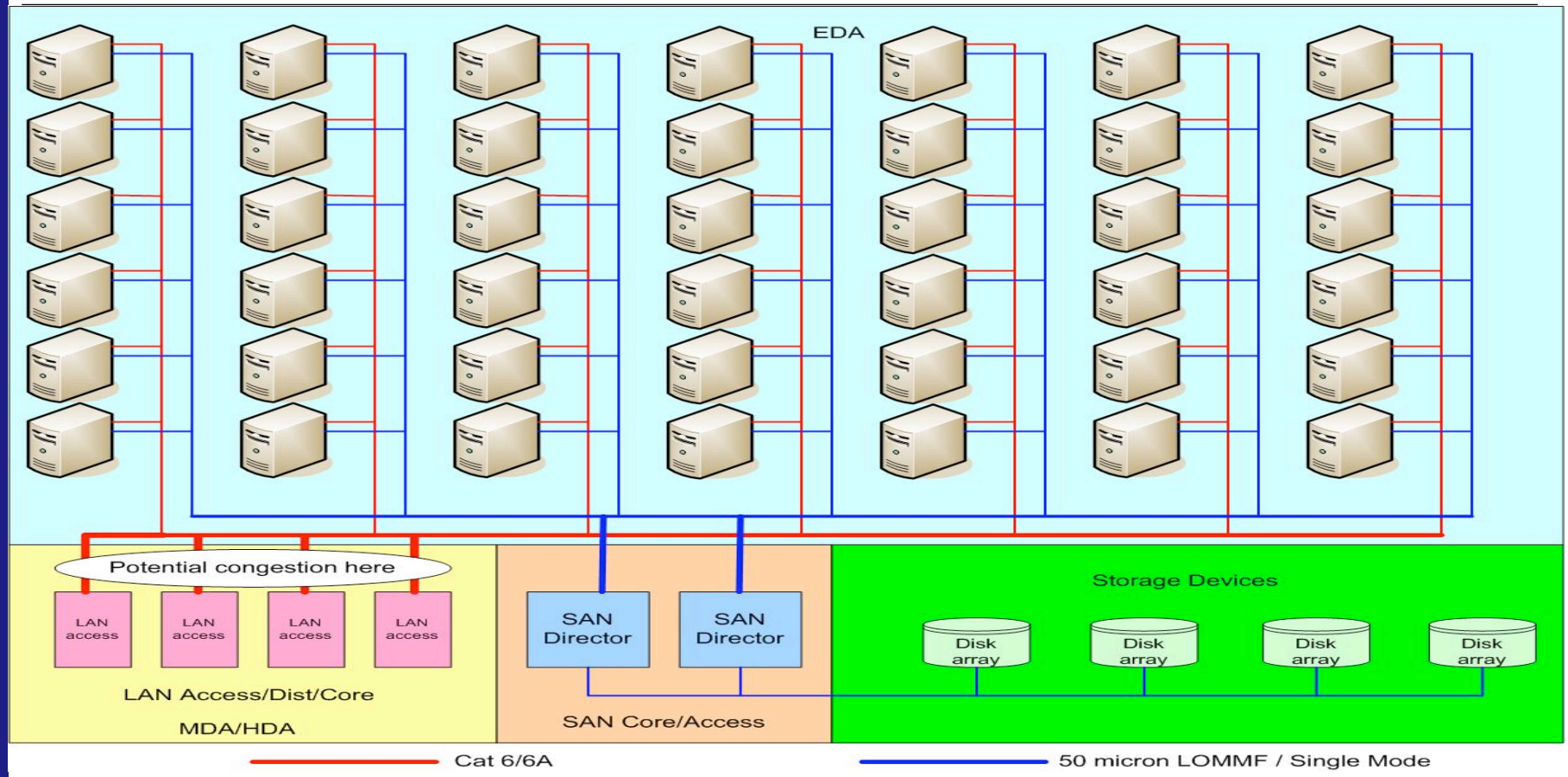
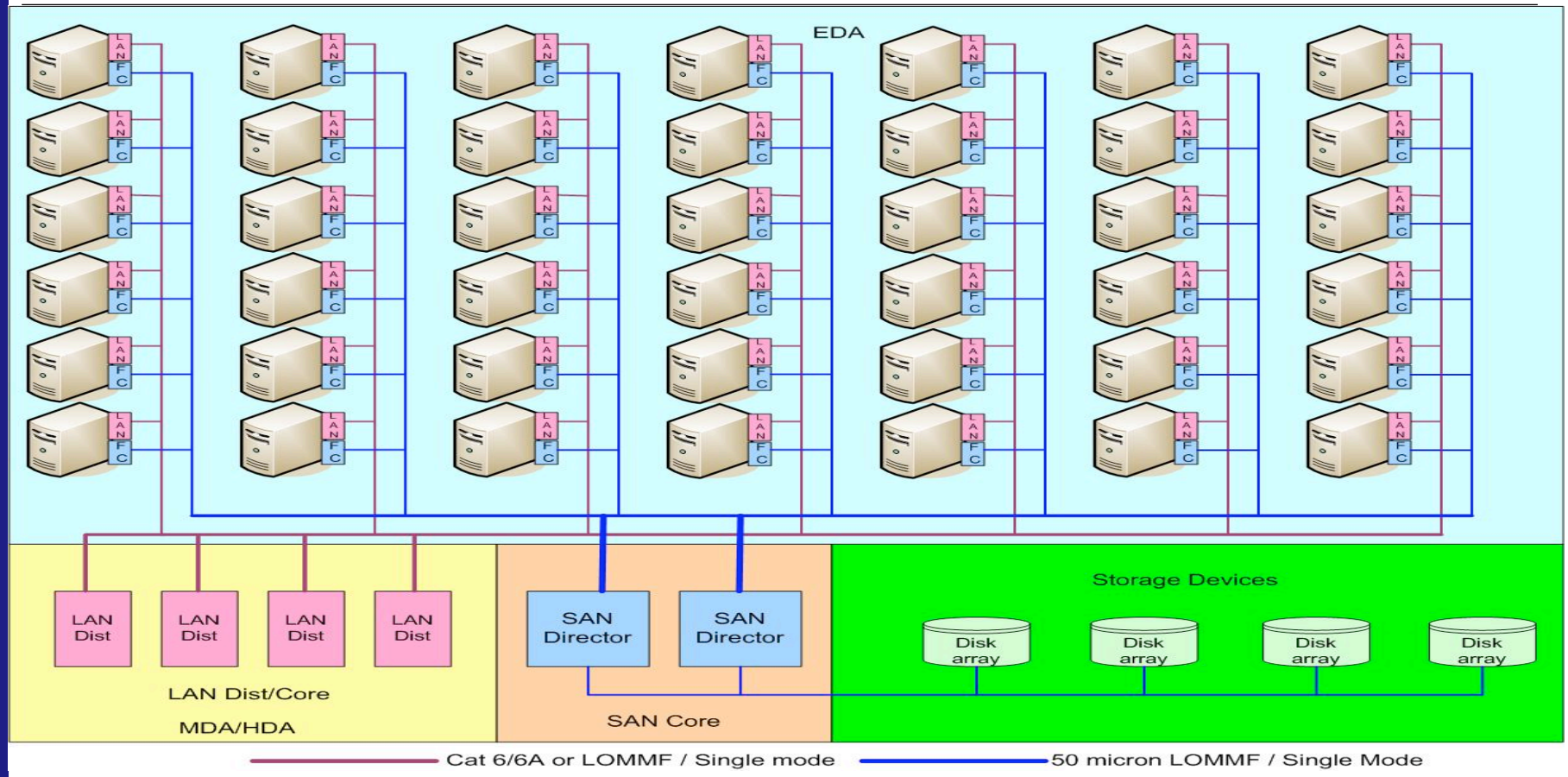
Centralized Direct Connect LAN/SAN Example



Direct Connect Pros and Cons

- Pros
  - Great flexibility
  - Most efficient use of network switch ports, LAN and SAN
  - Excellent physical control
- Cons
  - Does not scale well
    - Potential cable congestion
    - Potential length issues (longer than 100m)
  - Highest cable infrastructure expense

Distributed LAN/SAN (ToR) Example



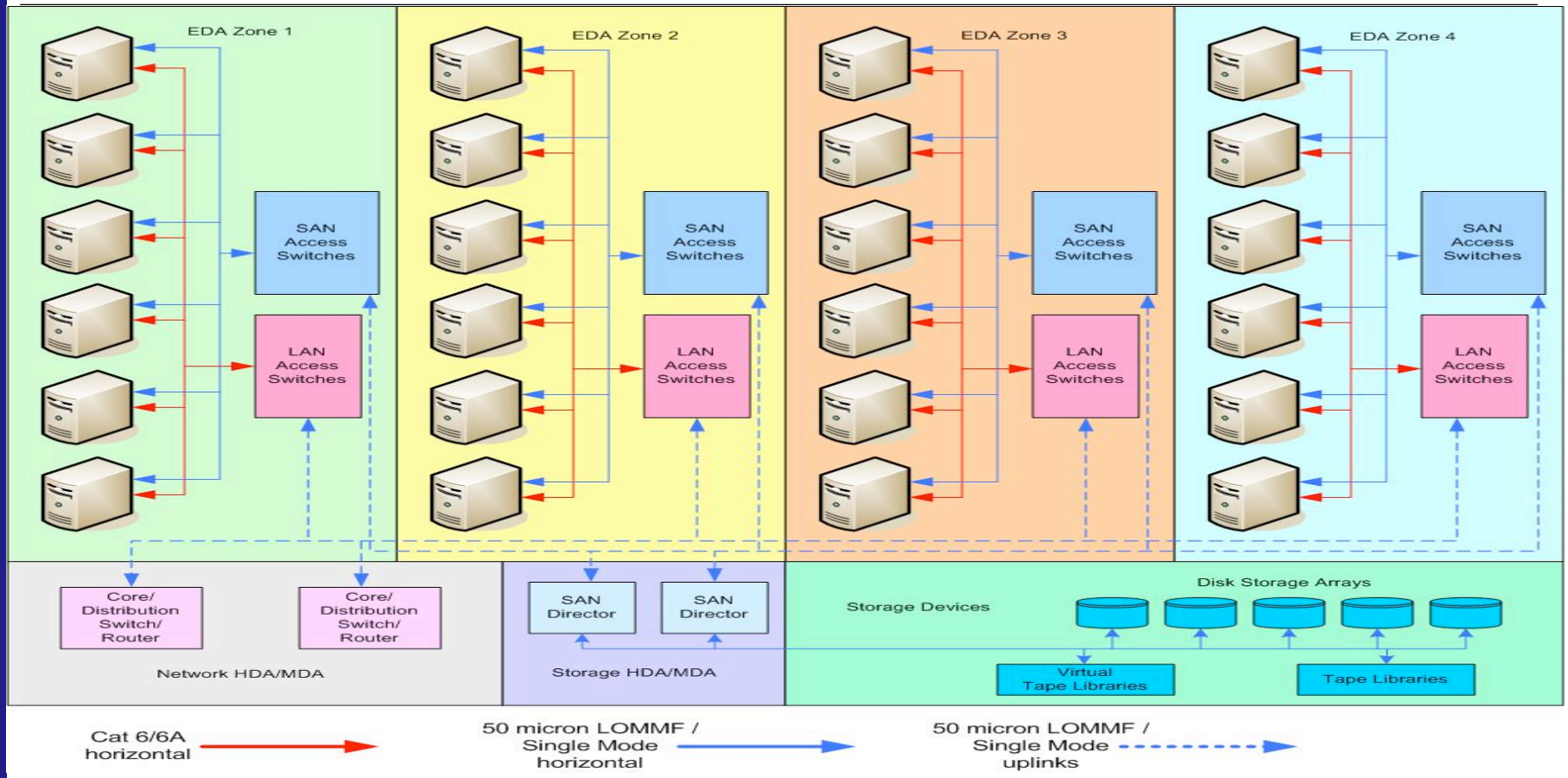
Distributed Pros/Cons

- Pros
  - Efficient use of network cabling
  - Efficient use of floor space
- Cons
  - Inefficient use of LAN/SAN switch ports
  - Difficult to manage in large deployments
  - Potential overheating of LAN/SAN switch gear in server racks

Zoned Direct Connect AKA, Zoned Distribution Architecture

- Multiple Zones in white space
- Not the ZDA of TIA 942 Data Center Standards

What does it look like? (logical view)



Why should I use it? (Pros)

- Very scalable, repeatable design
- Excellent balance of cable cost and switch port utilization
- Repeatable and predictable
- Keeps cable bundles manageable
- Allows implementation of network applications with limited cable distances
- Recommended cable architecture of TIA-942 Data Center Standards
- Lower cabling cost vs. Centralized Direct Connect

When wouldn't I use it? (Cons)

- Small data center
- Deploying Top of Rack
- When equipment ports are very expensive
  - Fibre Channel
  - Ficon
  - FCoE

Data Center Media Options (Alfred Flores)

LIGHTWAVE

Cabling Media

- 10 GbE
  - Copper Media
  - Optical Fiber
- 40/100 GbE
  - Fiber Types
  - Enabling Technologies
- Items to Consider

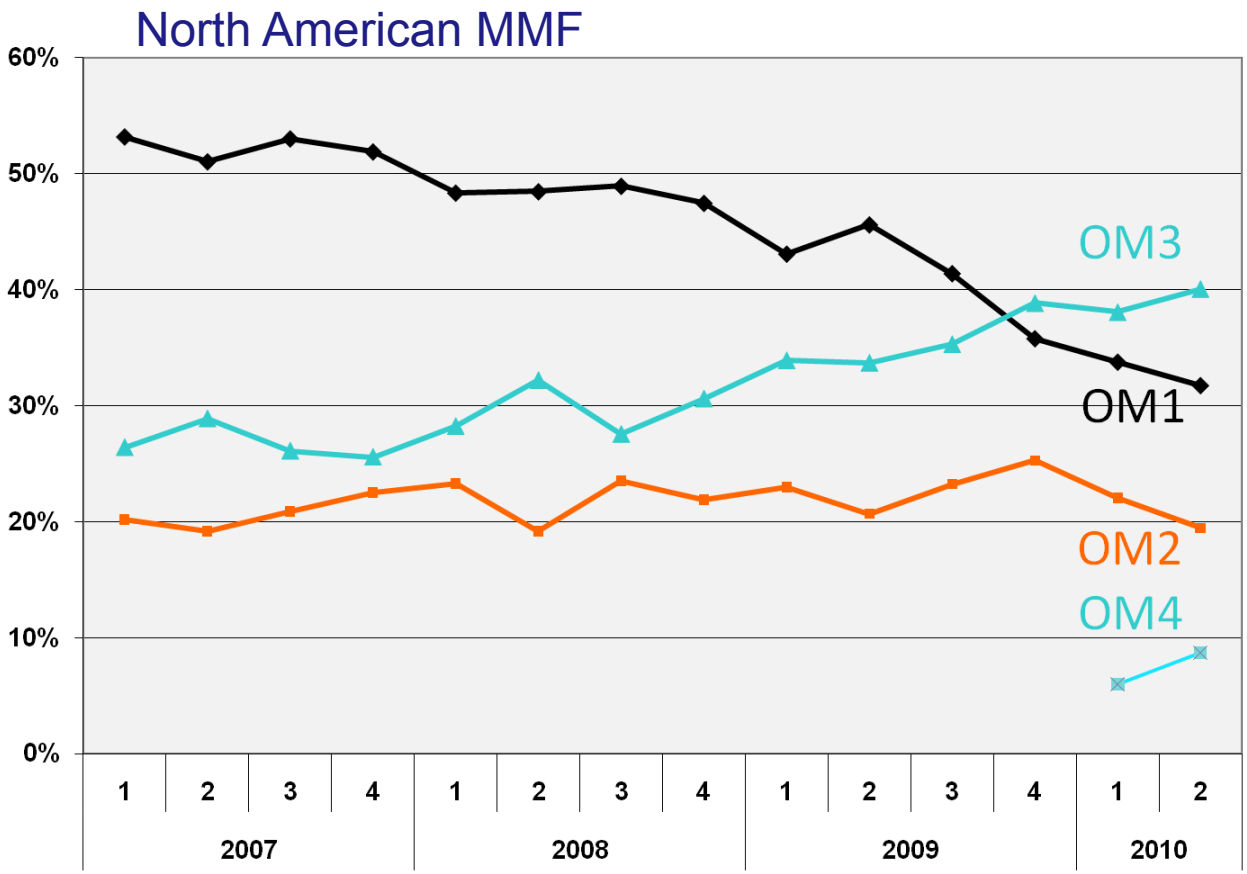
10 GbE

- Copper Cabling Media
  - IEEE 802.3an
  - 10G Twinax
    - ~10 m reach, 8-pair
    - 10G Active twinax up to 30 m
  - Category 6
    - ~ 37 m, 55 m using TIA-155-A guidelines
  - Category 6A or FTP
    - 10GBASE-T up to distances of 100 m
    - Large cable (0.3”) typical

10 GbE

- Optical Fiber
  - IEEE 802.3ae
  - OM1/2 ISO/IEC 11801
    - ≤ 82 m over 62.5 µm or lower grade 50 µm
  - OM3, TIA-492AAAC
    - 300 m reach over laser optimized 50 µm
    - Aqua jacket
  - OM4, TIA-492AAAD
    - 550 m reach over laser optimized 50 µm
    - 20%-40% premium over OM3

10 GbE

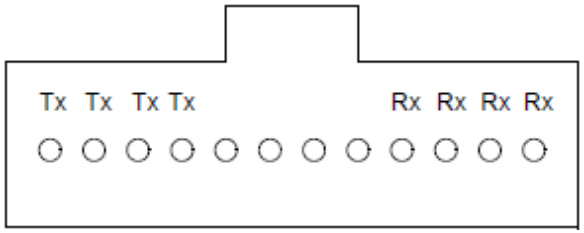

North American MMF
60%
50%
40%
30%
20%
10%
0%
OM3
OM1
OM2
OM4
1
2
3
4
1
2
3
4
1
2
3
4
1
2
2007
2008
2009
2010

10 GbE

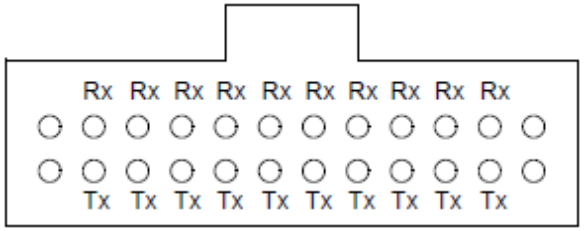
- Optical Fiber
  - Singlemode
    - Km of reach
    - Low Water Peak
    - Cabling inexpensive
  - About Bend Optimized/Tolerant/Insensitive Fibers

40/100 GbE

- Copper Cabling
  - Active Twinax to 7 m
- Optical Fiber
  - Multimode
    - Parallel optics
    - More cabling required
    - OM3 to 100 m
    - OM4 to 150 m
    - Transceiver limited



10GBASE-SR4



10GBASE-SR10

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40/100 GbE

- Optical Fiber
  - Singlemode
    - 2 Fiber (T_x/R_x), probably LC connectors
    - 40GBASE-LR4, CWDM, 2 km to 10 km
    - 100GBASE-LR4 (-ER4), CWDM, 2 km to 10 km (-ER4 up to 40 km)

Items to Consider

- Switch – Server Links
  - Massive market
  - Well within copper reach up to 100 GbE
- Preterminated Optical Assemblies
  - Common in 10 GbE applications
  - Critical in 40/100 GbE
    - Unforgiving Link Loss Budgets

Items to Consider

- 1/10/40/100 GbE Optical Infrastructure Migration Path
  - Cassette – MPO Trunk – Cassette
    - Using OM3 or better
    - Enables infrastructure re-use to 100 GbE
  - MPO to MPO Polarity
    - Methods A and B supported

Data Center Testing
(Adrian Young)

LIGHTWAVE

Agenda:

- Reflectance
- Proper Cleaning
- Proper Reference-Setting
- Encircled Flux

Reflectance – what is it?

- When light moves from a medium of a given refractive index n1 into a second medium with refractive index n2, both reflection and refraction of the light may occur.

- As soon as there is an air gap between the end-faces of the fiber, then Fresnel reflections will occur. It is these Fresnel reflections that you see when looking at a window. These are caused by the refractive index difference between air and glass.

- If the reflection is not too bad, you can still see through the glass.

Reflectance – is it required?

- ANSI/TIA-568-C.0 – No, for link testing.
- ANSI/TIA-568-C.3 – Connector specification only
  - Multimode -20 dB
  - Singlemode-26 dB
- ISO/IEC 11801:2002 – Connector specification only
  - Multimode -20 dB
  - Singlemoe -26 dB
- ISO/IEC 11801 Amd 2 – Maybe
- IEEE 802.3ae
  - The Max. discrete reflectance for 10GBASE-S shall be less than –20 dB.
  - The Max. discrete reflectance for 10GBASE-L and 10GBASE-E shall be less than –26 dB.
- IEEE 802.3ba
  - The Max. discrete reflectance for 40GBASE–SR4 or 100GBASE–SR10 shall be less than –20 dB.
  - The Max. discrete reflectance for 40GBASE-LR4 and 100GBASE-LR10 shall be less than –26 dB.

Proper Cleaning Techniques

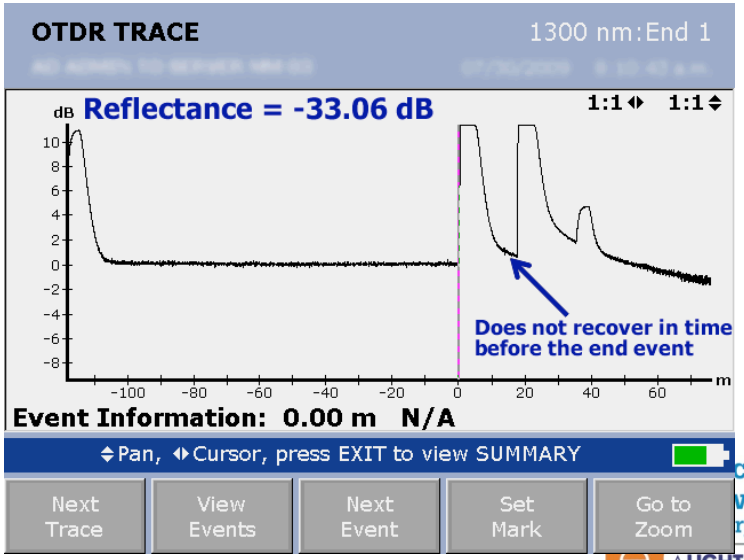
- Over 80% of fiber certification failures are due to contamination – but contamination needs to be removed properly
- Advanced fiber wipes and solvents:
  - Evaporate much quicker
  - Are more aggressive at cleaning
  - Have antistatic properties
- According to the EPA, the typical dust particle in the office is betwe 2 and 10 µm
- Having a cleaner with an antistati properties reduces the chance of dust being attracted to the end face of the connector

Using the Fiber Optic Solvent Pen, dab a small amount of solvent onto the pad.

Cleaning: IPA vs. Hybrid Cleaner

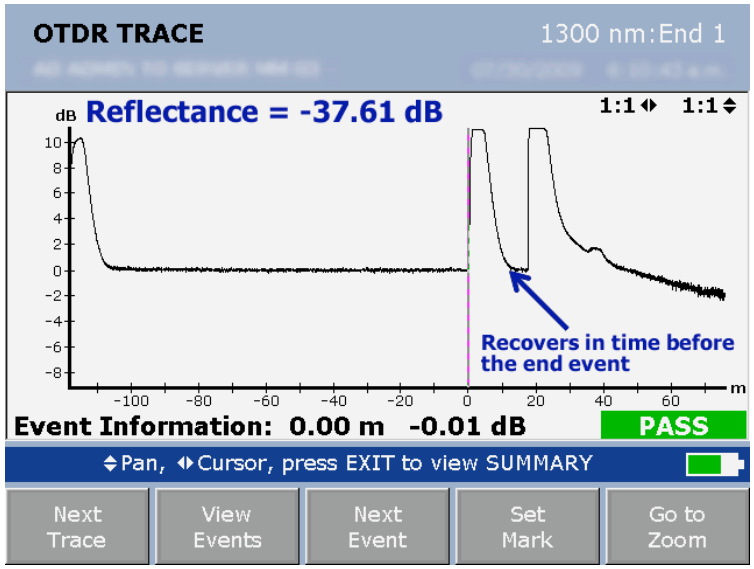
IPA

- Poor reflectance causes tailing.
- If it is really bad, as in this example, the OTDR will not be able to measure the loss (note the loss at 1300 nm is missing)
- The reflectance is below the “desired -35 dB” (3 dB is a factor of two)

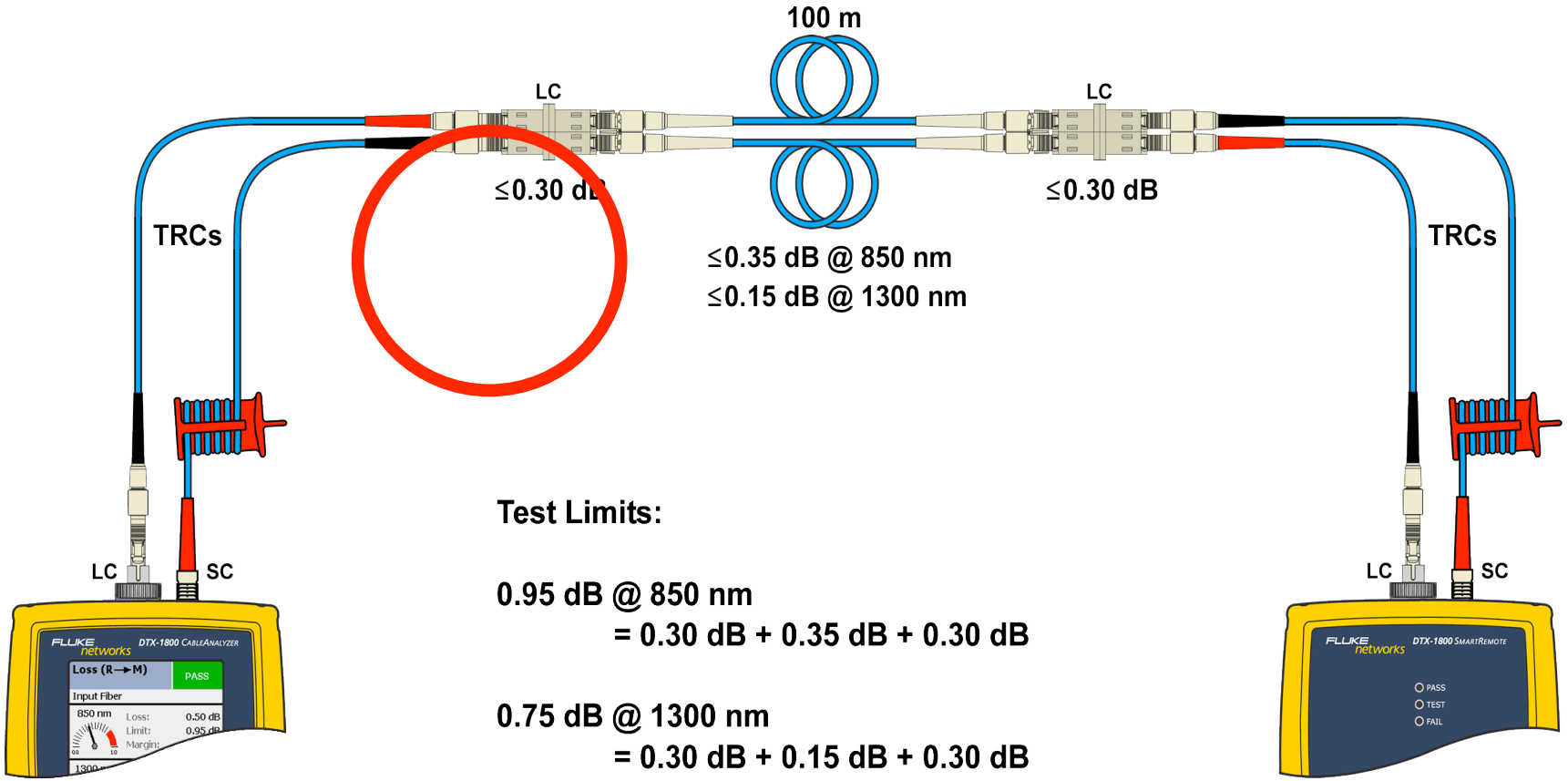


Hybrid

- The reflectance is above the “desired -35 dB” (3 dB is a factor of two)
- OTDR is able to make a measurement (-0.01 dB), perfect



One-Jumper Reference-Setting IEC 14763-3



Test Limits:

0.95 dB @ 850 nm
= 0.30 dB + 0.35 dB + 0.30 dB

0.75 dB @ 1300 nm
= 0.30 dB + 0.15 dB + 0.30 dB

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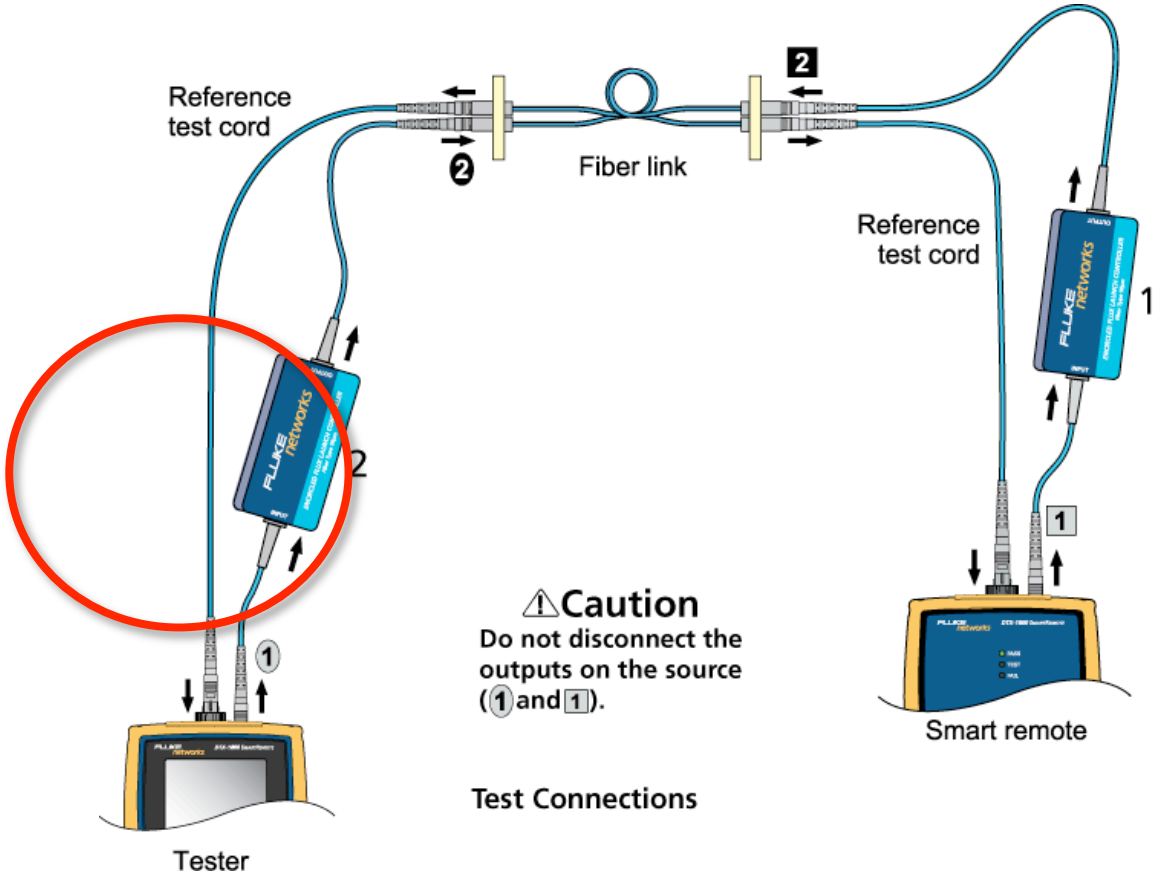
What is Encircled Flux?

EF is a new multimode launch condition metric that:

1. *Reduces link loss variation*
2. *Was developed to keep up with components used in high speed networks (850 nm VCSEL, OM3/4 fiber)*
3. *Was intended for >1GbE*
4. *Targets 850 nm and 50 um cabling*
5. *Can be used for all sources and links*
6. *Improves supplier to supplier consistency*

EF tightly controls the number of modes

Encircled Flux Testing



Test Connections

Conclusions

TIA Fiber Optics LAN Section

Providing information on the use of fiber in customer-owned networks
Current members include:

- ADC
- AFL Telecommunications/Noyes Fiber Networks
- Berk-Tek, a Nexans Company
- Corning Incorporated
- Draka Communications
- Fluke Networks
- OFS
- Ortronics/legrand
- Panduit
- Sumitomo Electric Lightwave
- Tyco Electronics

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