
Anticipating
CAT 8
Plan for
25/40GBASE-T
networks today
LEVITON
with
FLUKE networks
2018 BICSI WINTER
CONFERENCE & EXHIBITION
Orlando, FL | February 4-8

Anticipating Cat 8 - Agenda

- Cat 8 Overview
- Cat 8 Customer
- Design Considerations
- Testing Procedures and Standards

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What is Cat 8?

- Next Generation Copper Cabling
- 25G and 40G data rates over twisted-pair copper cabling
- Switch to server connections at data center edge

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Category 8 Standards

IEEE 802.3bq
25G/40GBASE-T

ANSI/TIA-568-C.2-1 Category 8 Cabling
Soon to be part of ANSI/TIA-568.2-D

ISO International Organization for Standardization

ISO/IEC 11803-1 Generic Cabling
Including Class I & II Channels

How is Cat 8 Different from Lower Categories?

- Frequency
- Channel Length
- Number of Connections
- Cable Construction
- Connector Options

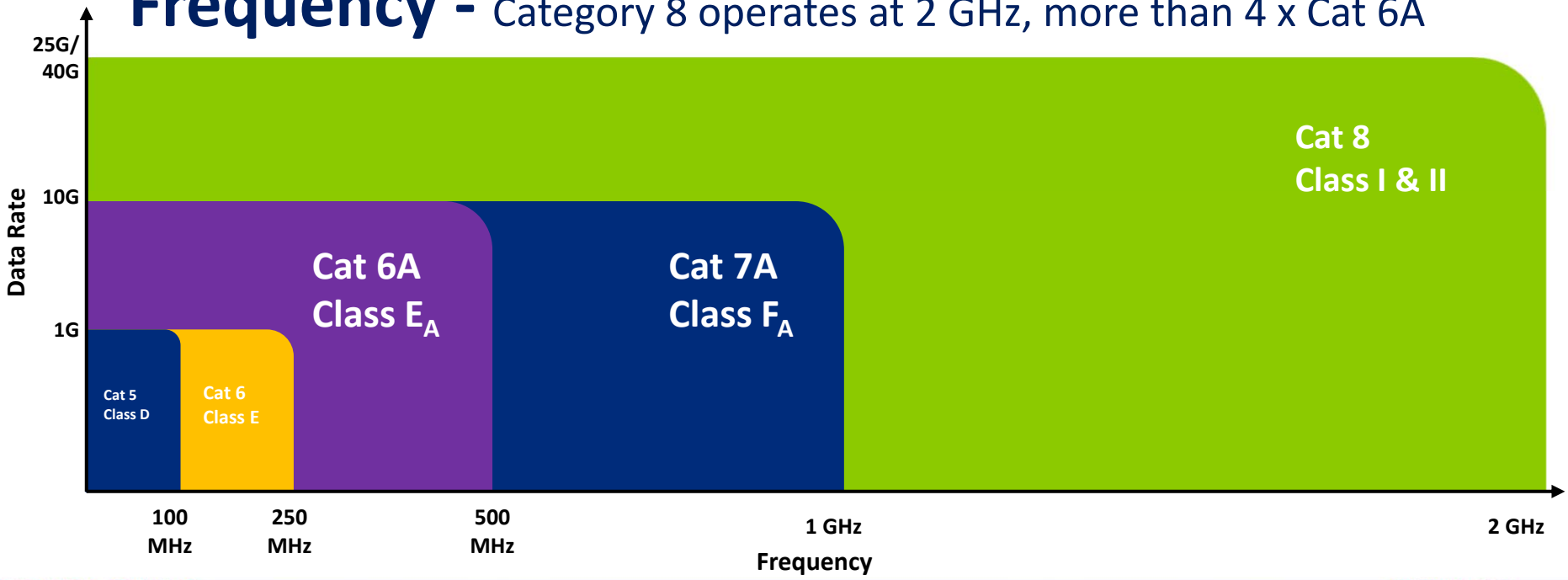
Cat 8

Class I & II

Cat 5e, 6, 6A

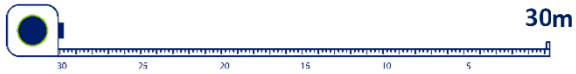
Class D, E, E_A, F_A

Frequency - Category 8 operates at 2 GHz, more than 4 x Cat 6A

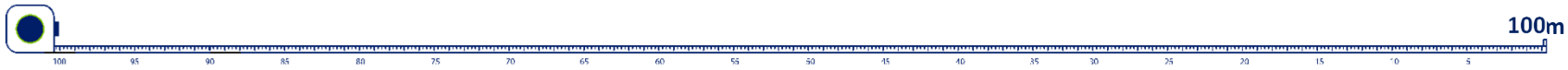


Channel Length - Category 8 channels are limited to 30 meters

Category 8 | Class I & II



Category 5e,6,6A,7A | Class D, E, E_A, F_A

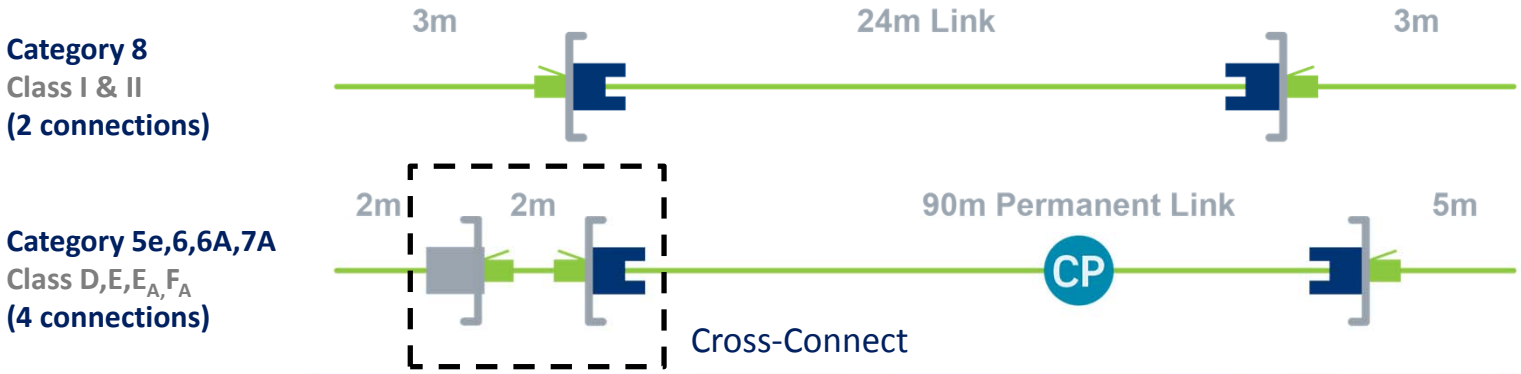


- Previous twisted-pair horizontal cabling = 100 meter limit
- Cat 8 = 30 meter limit
- New limit due to optimizing distance and power for active equipment
- Short for many building applications, but works well for data center rows
- 30 meter limit for Cat 8 applies whether inside or outside data center

Cat 8 Channels - Limited to 2 connections

Why is the connector limit important?

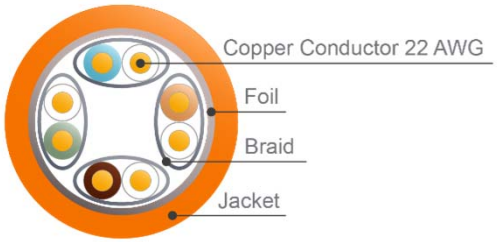
- Cat 8 **requires** interconnect topologies,
- Cat 8 **does not support** cross connect topologies

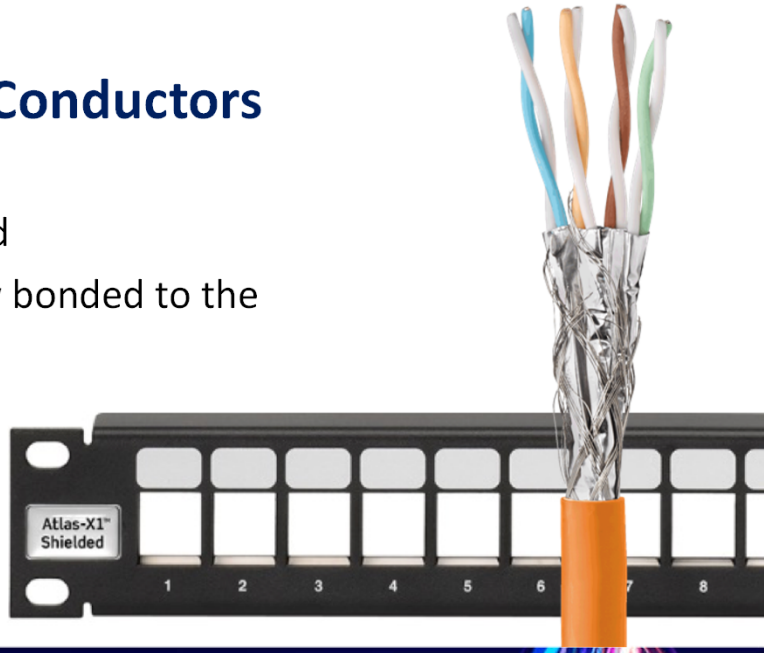


Cable Construction

Category 8 Cable is Shielded with 22 AWG Conductors

- 2 GHz frequency requires high level of shielding
- S/FTP Construction – Pairs in metal foil with overall braid
- Cat 8 solutions require shielded panels that are properly bonded to the telecommunications bonding network





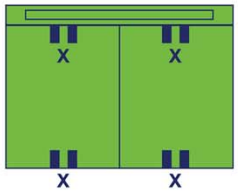
Connector Options

Four Possible Cat 8 Connectors

Cat 8.1 / Class I

RJ-45

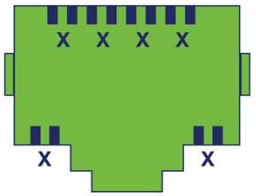
TIA 568-C.2-1
ISO/IEC 11801-1



Tera®

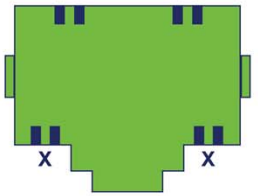
IEC 61076-3-104

Cat 8.2 / Class II (Cat 7A interface)



GG45

IEC 60603-7-71

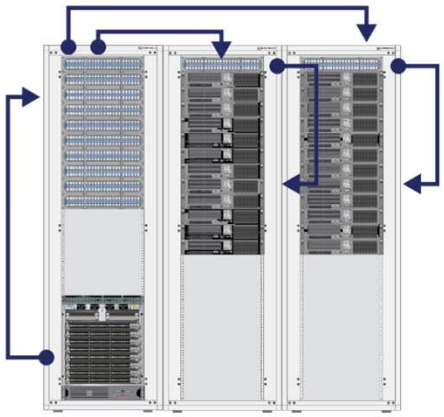


ARJ

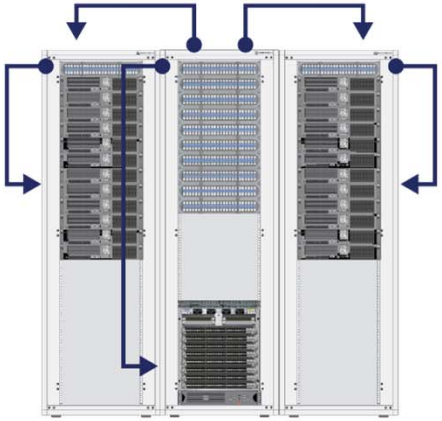
IEC 61076-3-110

Cat 8 Architecture Options

End-of-Row | Middle-of-Row

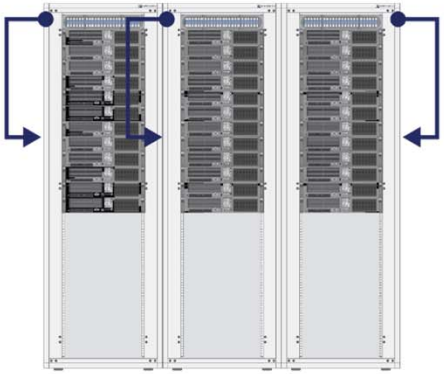


EoR



MoR

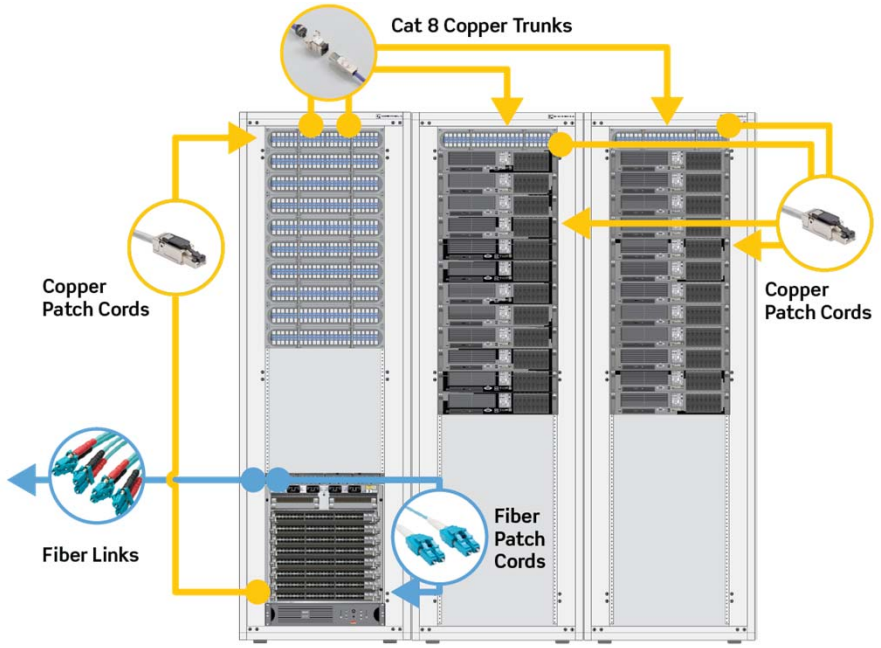
Top-of-Rack



ToR

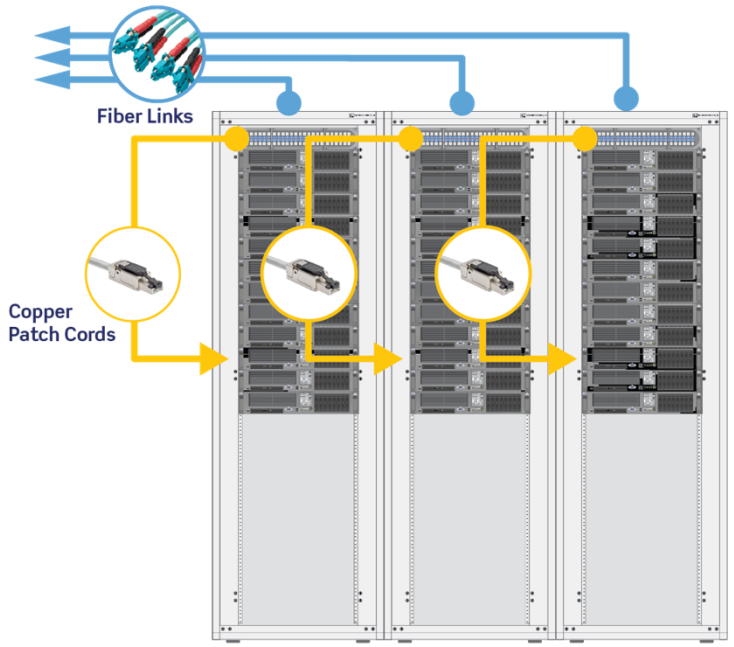
End-of-Row | Middle-of-Row Architecture

- Structured cabling approach
- Patch cords connect active equipment to panels
- Jack-Jack links with patch cord on each end
- Fiber uplinks to core / aggregate switches



Top-of-Rack Architecture

- Not structured cabling, but common in data centers
- Connects equipment within same or adjacent cabinet
- Fiber uplinks to core /aggregate switches
- Active equipment connected directly with single cable
  - DAC = Direct Attached Copper



Category 8 Application Advantages

Compared to OM3 Multimode Optical Fiber

- Lower cost alternative for channels less than 30m
- Backwards compatibility with Cat 6A and Cat 6
- Supports auto-negotiation
- Enables mixed data rates on the same switch

Category 8 Application Advantages

Compared to Twin-Axial Copper

- Lower cost alternative for Direct Attached Copper (DAC) applications of 5 meters or less
- Supports connections within same or adjacent cabinets
- Backwards compatibility with RJ-45 equipment
- Supports auto-negotiation
- Enables mixed data rates on the same switch

Who Is The Cat 8 Customer?

Anticipating Cat 8

Cat 8 is Ideal for Small/Medium Data Centers

- Data centers under 20K m^2 (~ 140m x 140m)
- On-site or Co-location
  - Essentially a collection of small/med data centers housed together
- Rows of 30 cabinets or less
- Seeking 25G upgrade from 10G or 1G at the edge

Cat 8 May Not Support Large Data Center Needs

- Longer rows with 30 to 100 cabinets
- Data rates already at 40G
- Looking for migration to 100G and higher
- OM3 or OM4 optical fiber likely to be deployed

Cat 8 Will Not Support Hyperscale Data Centers

- Hyperscale data centers require single-mode fiber
- Very long rows with cabling distances over 100 meters
- Data rates of 100G now with upgrade paths to 200G / 400G

Increased Traffic Throughout Network Driving Bandwidth Needs in Data Center

- High bandwidth applications
  - Big increase in connected devices (IoT, BYOD, etc.)
  - Cloud applications
  - Increased use of 802.11ac WAPs
    - 7GB per link vs. less than 1GB
- Fiber uplinks migrating from 40G to 100G or higher
- Access layer requires more than 10G to avoid becoming the bottleneck

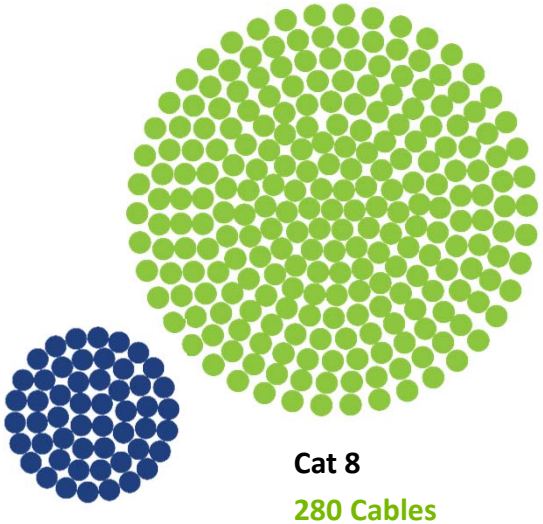
Cat 8 Outside the Data Center

- 30-meter, 2-connection channel limits still apply
- Cat 8 can support 10G in 100-meter channels
- ISO/IEC standards limit Cat 8 to the data center
- TIA includes Cat 8 in most premise cabling standards, though **Cat 6A is still recommended**
  - ANSI/TIA-568.0-D----------Generic Cabling Systems
  - ANSI/ITA-568.1-D----------Commercial Buildings
  - ANSI/TIA-862-B----------Intelligent Building Systems
  - ANSI/TIA-4966----------Education
  - ANSI/TIA-942-B----------Data Centers

Cat 8 PoE Benefits

Larger Conductors Transmit Power More Efficiently

- POE Advantages of Cat 8 Cable
  - More cables can be bundled for extended distances
  - Ambient temperature can exceed 20 °C
  - Support future applications where all cables to support 100 W
- 10 Gb/s is still the maximum data rate when
  - Distances exceed 30 meters
  - More than 2 connections used
  - Cat 6A jacks or patch cords used



Cat 8

280 Cables

Cat 6A

101 Cables

TIA-TSB-184-A

Maximum bundle size in air for 15 °C temperature rise at 20 °C ambient for 100W (1000 mA per pair)

Design Considerations for 25G

Anticipating Cat 8

Selecting the Right Media for 25G

Design Considerations

- New construction or existing facility
- Distance requirements
- Architecture type
- Sequence and timing of installation
- Future-proofing Cat 6A designs

Design Considerations for 25G

New Construction or Existing Facility

- All new equipment ➔ **Cat 8** | OM3 fiber | Twin-axial
- Must match current architecture
- New equipment must co-exist with current equipment
  - 10GBASE-T (Cat 6A) → 25GBASE-T (**Cat 8** Class I)
  - 1GBASE-T (Cat 6) → 25GBASE-T (**Cat 8** Class I)
  - 10GBASE-CR (Twin-axial) → 25GBASE-CR (Twin-axial)
  - 10GBASE-SR (OM3 fiber) → 25GBASE-SR (OM3 fiber)

Design Considerations for 25G

Distance Requirements

Distance	OM3 Fiber	Cat 8	Twin-Axial
Less than 5m	✓	✓	✓
5m to 30m	✓	✓	
30m to 100m	✓		

Design Considerations for 25G

Architecture Type

- End-of-Row | Middle-of-Row Architecture
  - Less than 30m
    - **Cat 8** | OM3 Fiber
  - Greater than 30m
    - OM3 Fiber
- Top-of-Rack
  - RJ-45 → **Cat 8**
  - SFP28 Connector → Twin-axial
  - Greater than 5m → Cannot use ToR architecture

Design Considerations for 25G

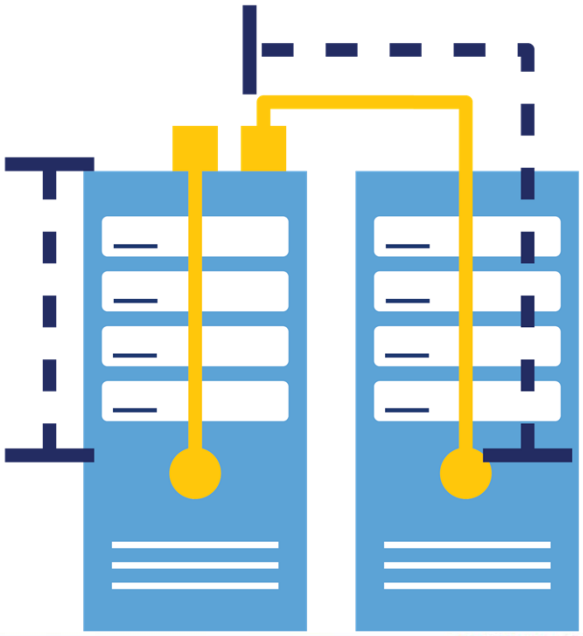
Sequence and Timing of Installation

- Concurrent Installation
  - All equipment, cabling installed together → **Cat 8** | OM3 fiber | Twin-axial
- Staggered Installation
  - Upgrade switches first, then servers over time
  - Match existing cabling type
    - Cat 6A or 6 (RJ-45) → **Cat 8 Class I (RJ-45)**
    - OM3 fiber (SFP+ & LC) → Keep OM3 cabling | upgrade transceiver
    - Twin-axial (SFP+) → Twin-axial (SPF28)

Future-Proofing Cat 6A Designs

Cabling Architectures

- Top-of-Rack Architecture
  - Connections should be supported by cords 5 meters or shorter
  - Connections within same or adjacent cabinets



Future-Proofing Cat 6A Designs

Cabling Architectures

- Middle-of-Row Architecture
  - End-of-Row may place server too far away from switch
  - Middle-of-Row provides 60m of distance with 30 meters in each direction

Future-Proofing Cat 6A Designs

Install a Shielded Solution

- Shielded panels accept both Cat 6A and Cat 8 jacks
- If Cat 6A unshielded cabling is installed, consider using shielded panels
- Panels will be bonded to cabinets as part of telecommunication bonding network

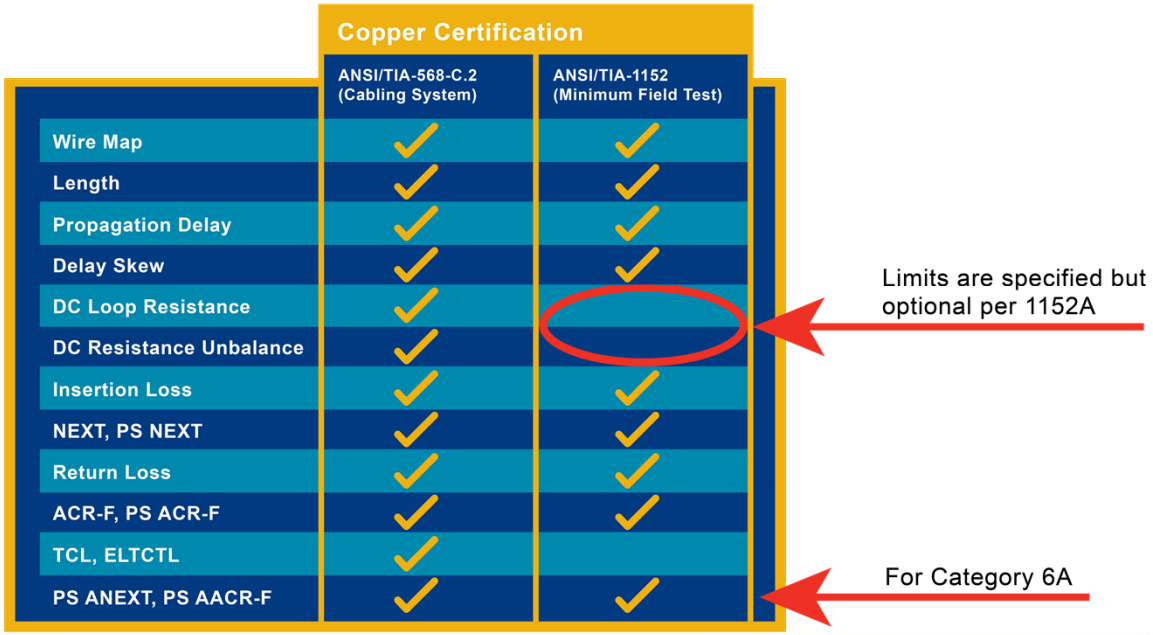
Cat 8 Testing Procedures and Standards

Anticipating Cat 8

Field Test Standard ANSI/TIA-1152-A

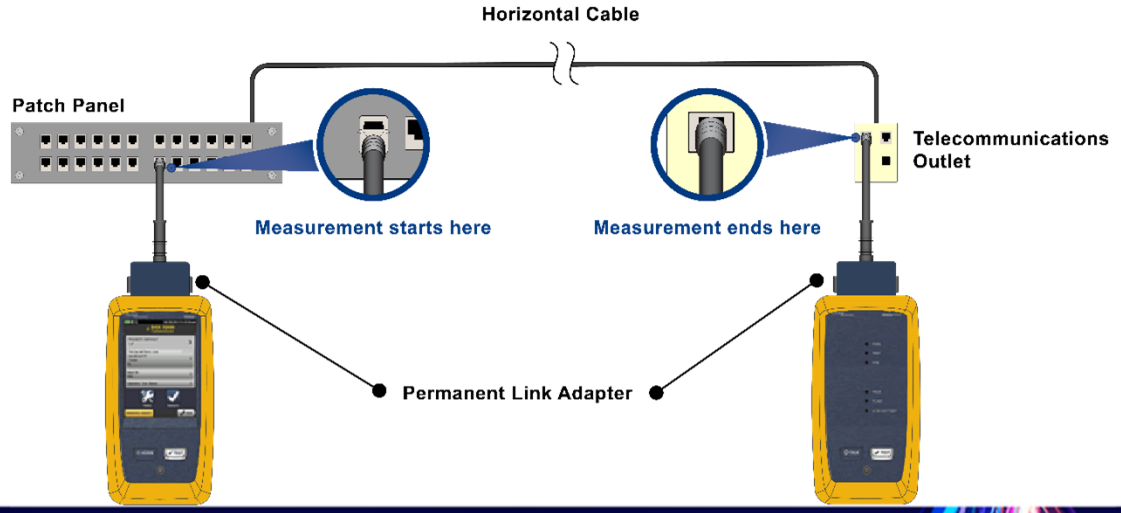
- References related standards – such as ANSI/TIA-568-C.2
- What Tests Shall be run in the field
  - And Optional Tests
- How to run the tests
- What the accuracy requirements are for the tests
  - Comparing the field test equipment results with a Lab equipment (VNA)
  - Specification of Level 2G accuracy
- Field Test Standard ANSI/TIA-1152-A

It's Not Just About 2 GHz



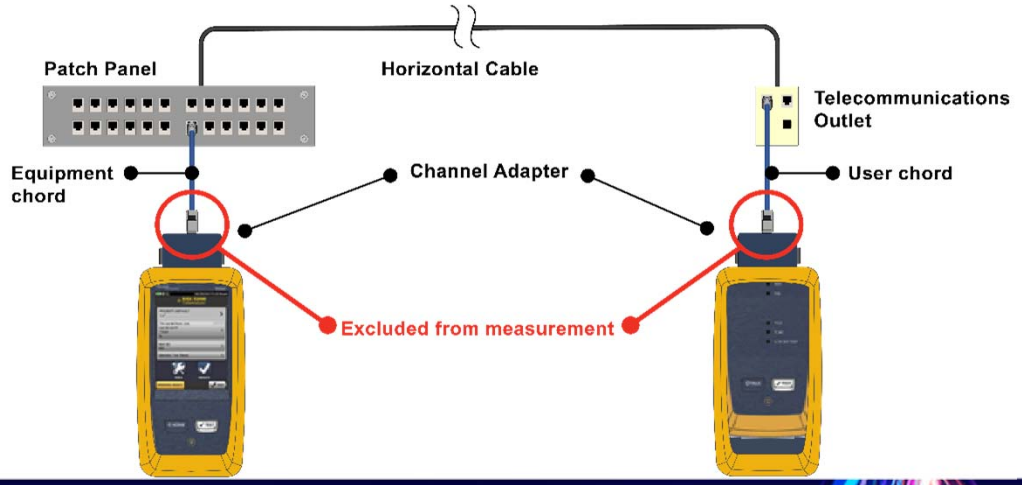
Permanent Link

- Typically used by installers – required for cabling warranties
- Max. 24 m (78 ft.)



Inter-Connect Channel

- Only two Connection Points permitted
- Equipment and user cords must remain with link
- No cross-connect or consolidation point, max. 30 m (98 ft.)

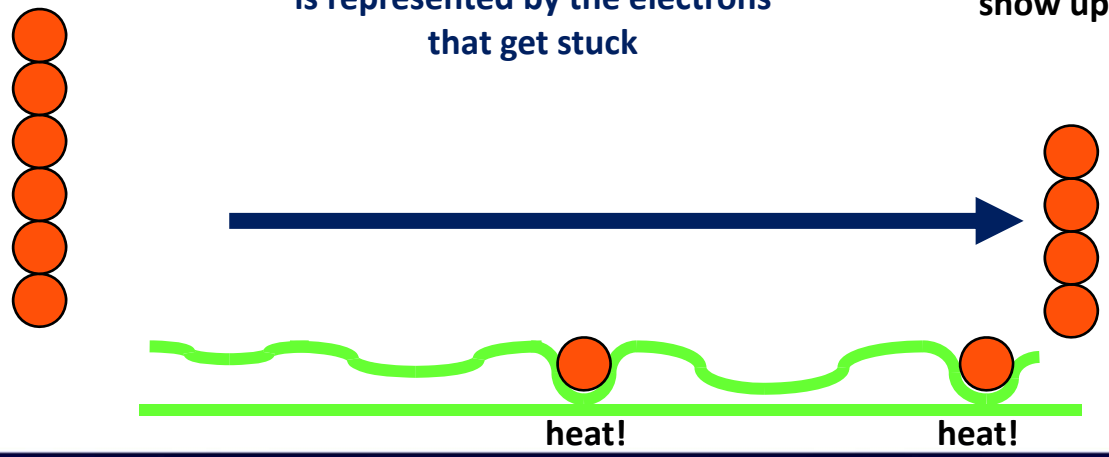


Why ‘Only’ 30 Meters…

Attenuation

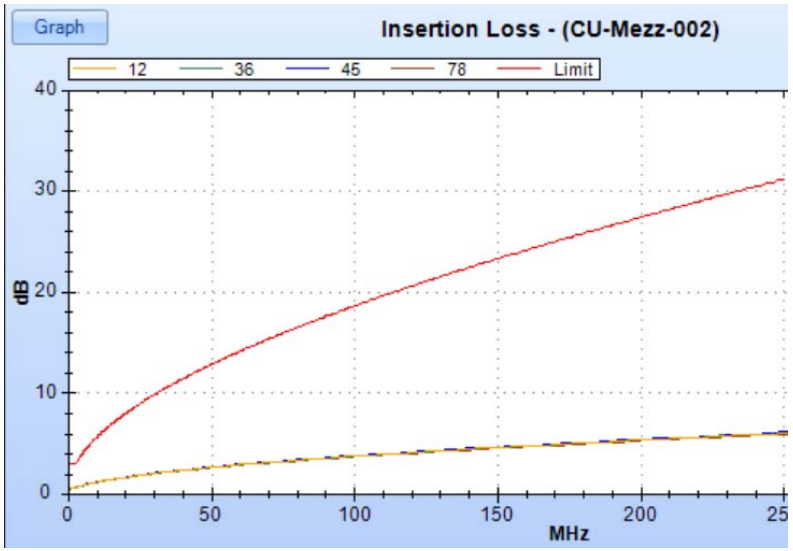
is represented by the electrons that get stuck

Fewer electrons show up!



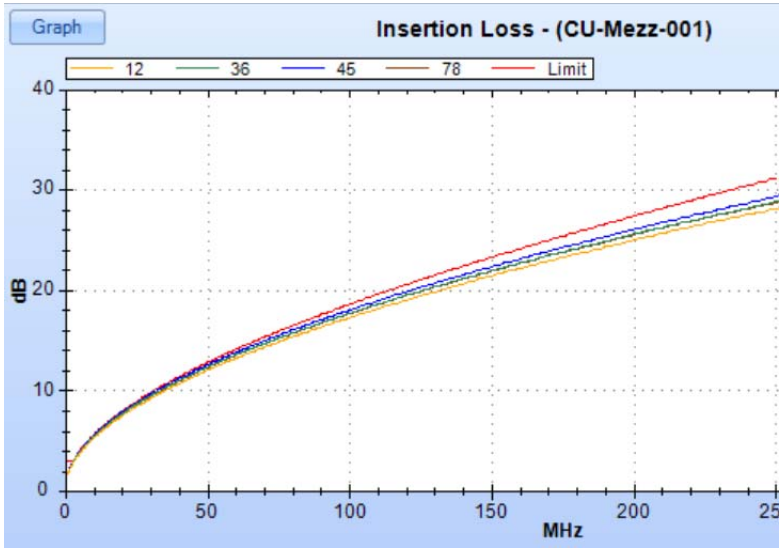
Attenuation/Insertion Loss Increases with Distance and Frequency

Attenuation on a shorter (20 meter) link



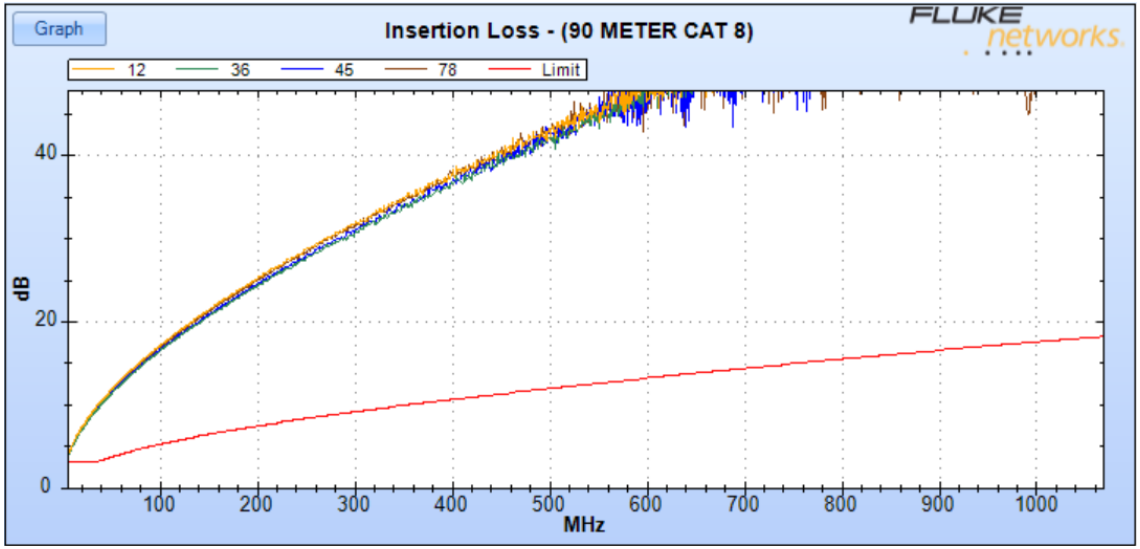
Attenuation/Insertion Loss Increases with Distance and Frequency

Attenuation on a longer (90 meter) link

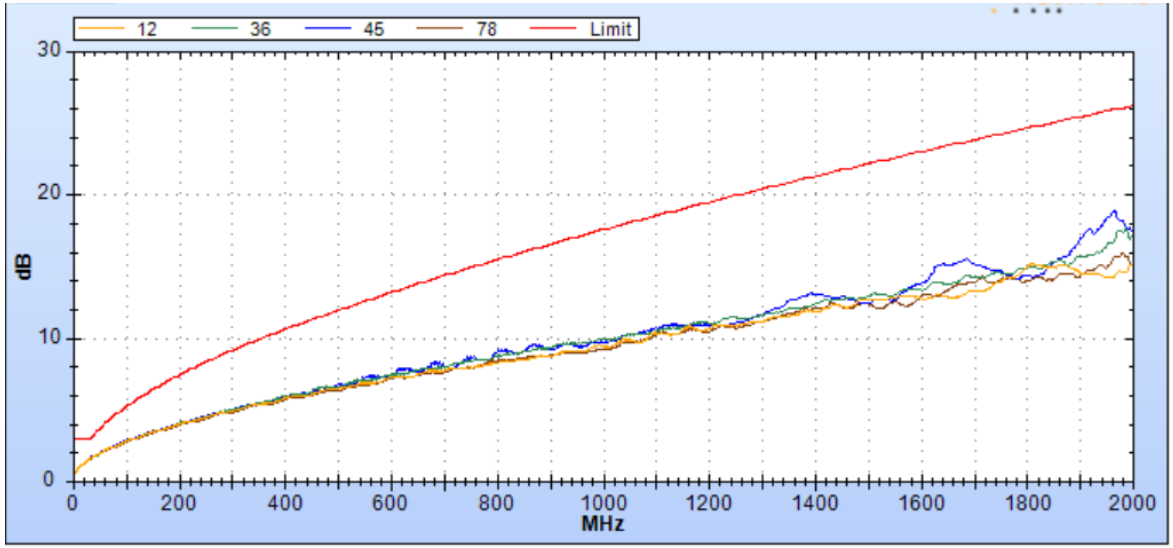


Cat 8 Attenuation Example of a 90 Meter Channel

Results should be below the limit line

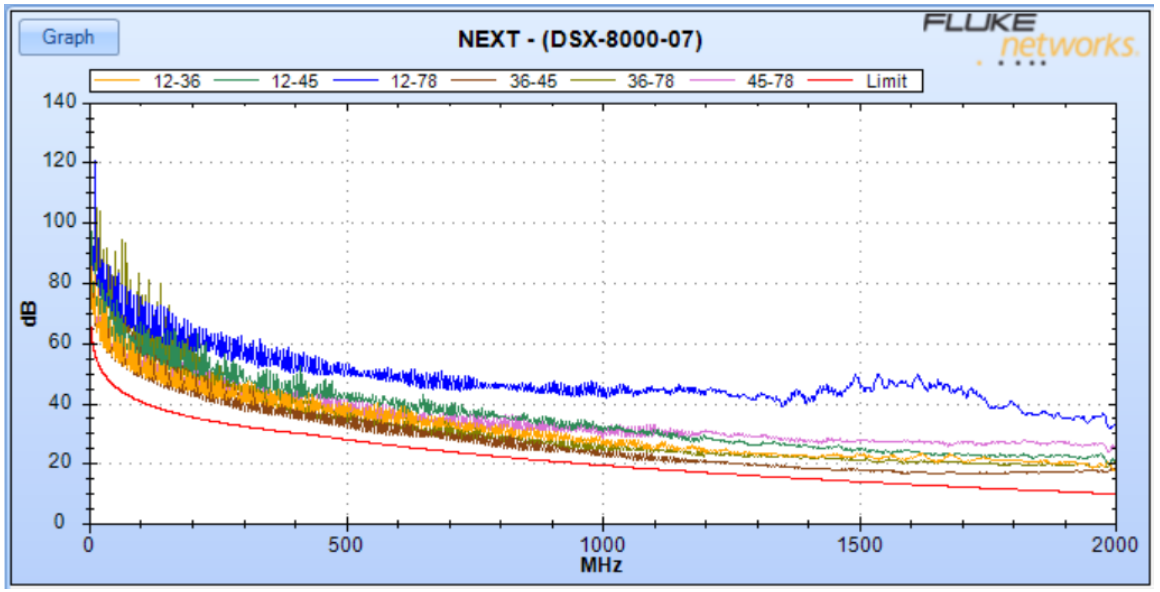


Cat 8 Attenuation Example of a 30 Meter Channel



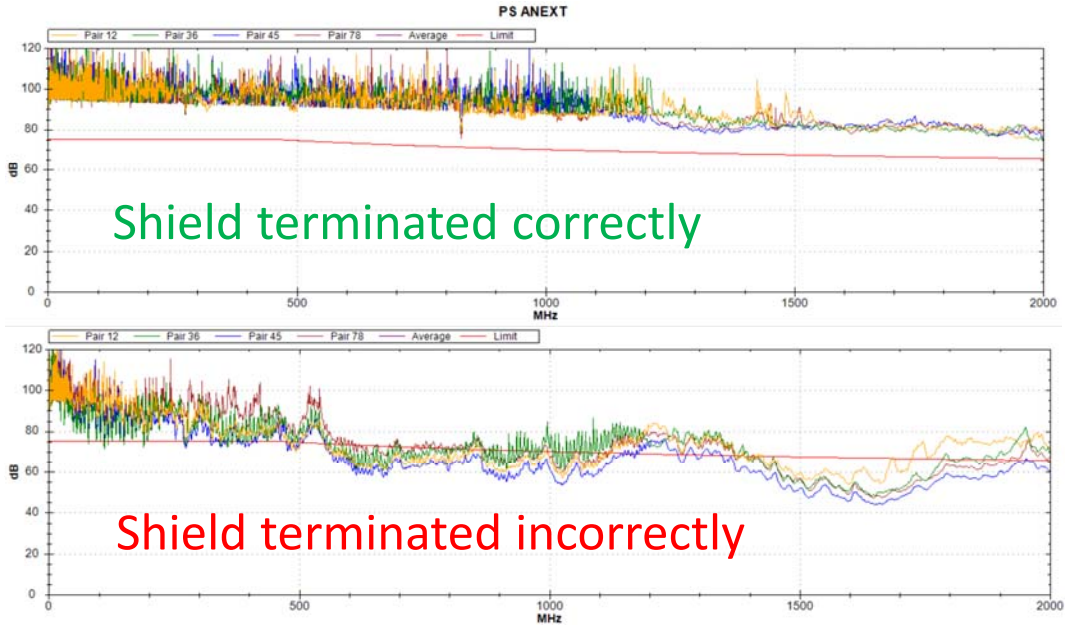
Cat 8 Limits are Similar to Cat 6A

Extended out to 2 GHz



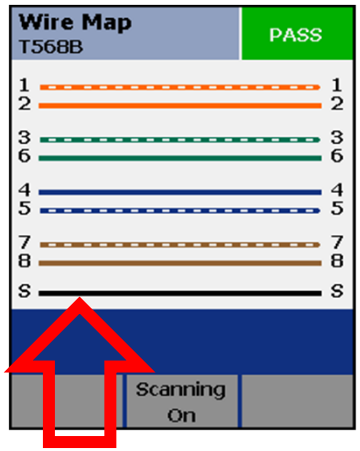
Shield Integrity Testing

Proper Shield Termination is Critical to Cat 8 Performance

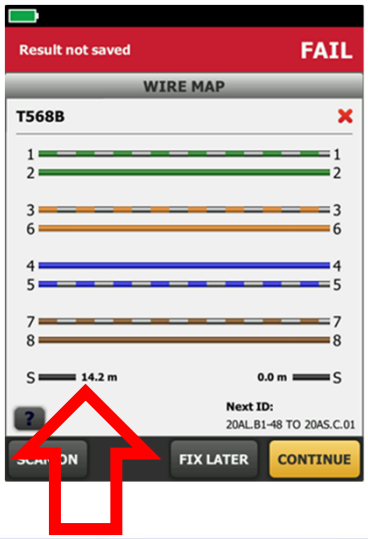


New Technology Required for Path Testing

Older Testers' Simple Resistance Test

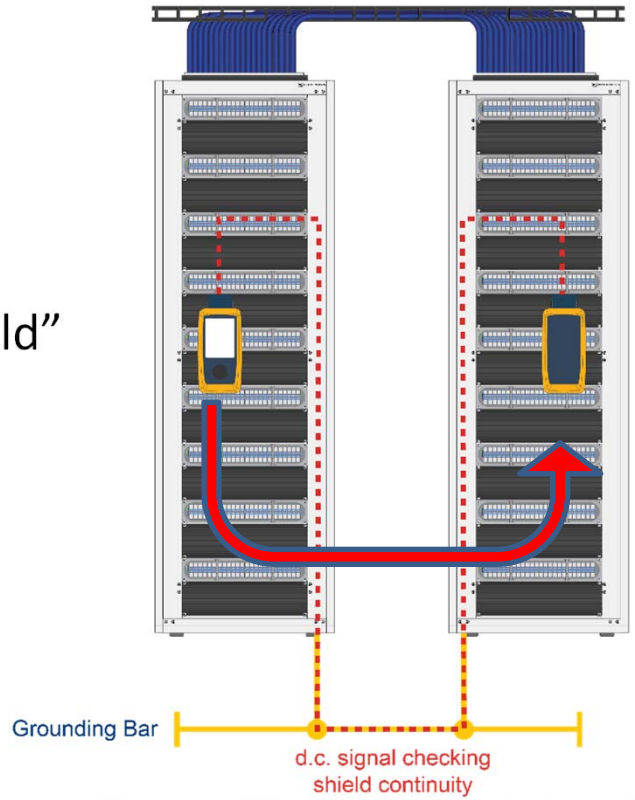


Test of Shield Path And simple resistance

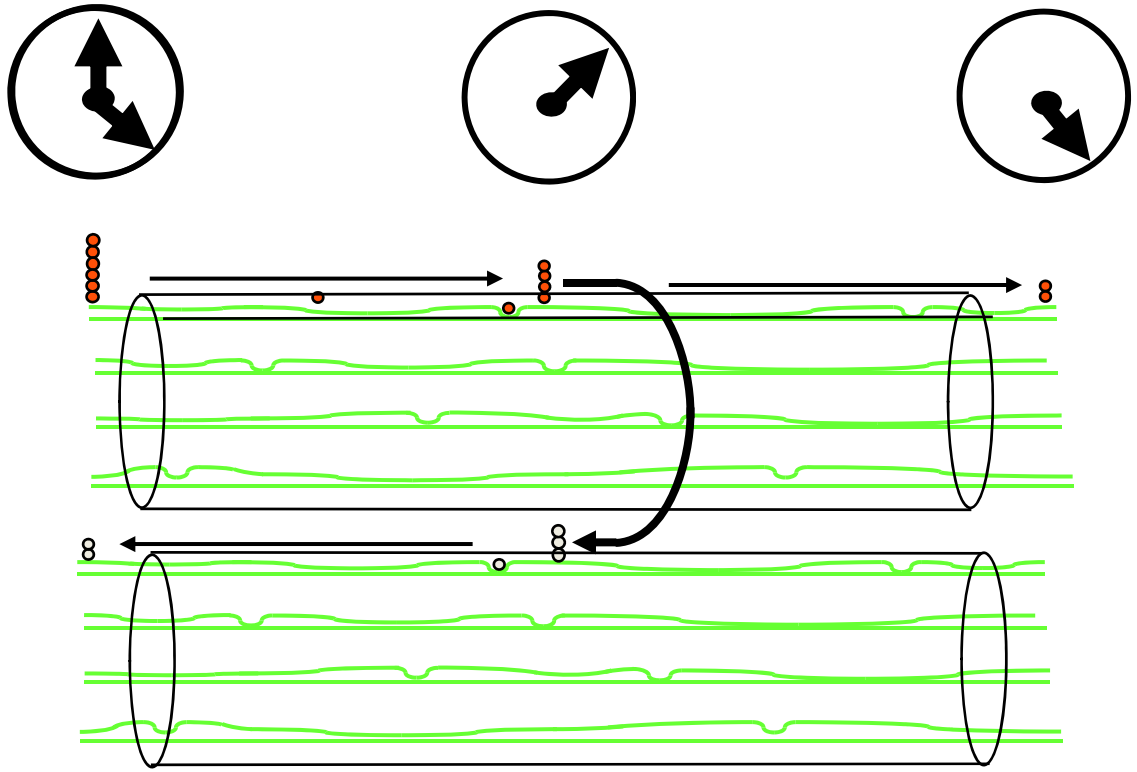


Shield Integrity Testing

- Common Ground Can “Fool” Tester
- Tester Must Verify “Along the Path of the Shield”



Alien Crosstalk Occurs Between Cables



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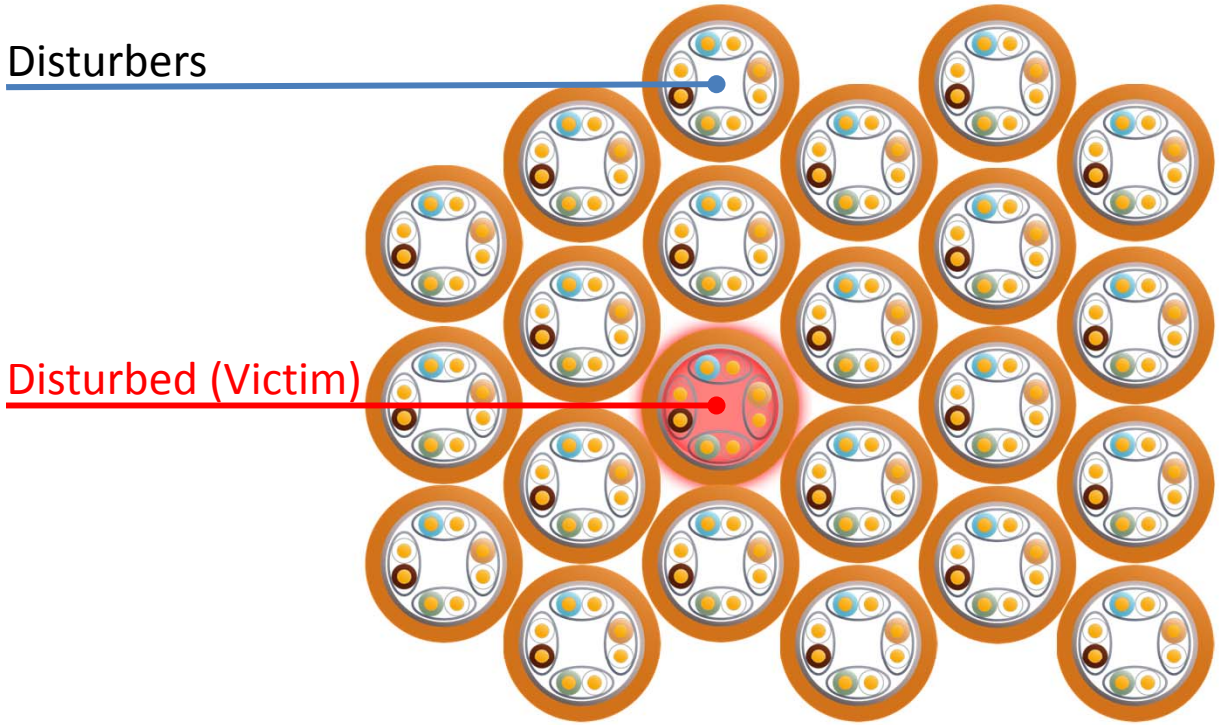
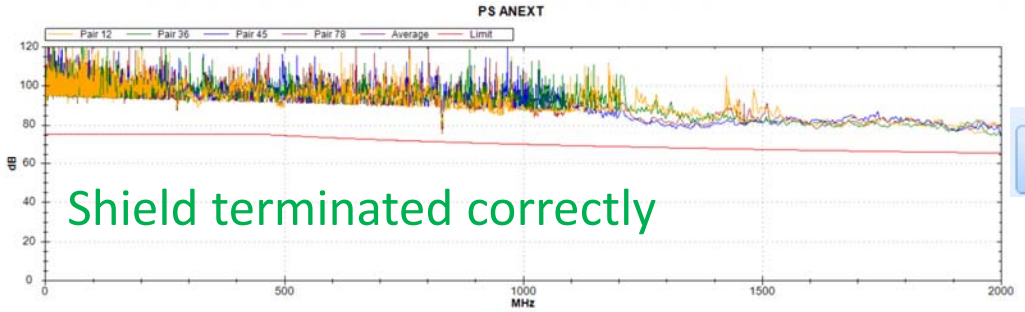
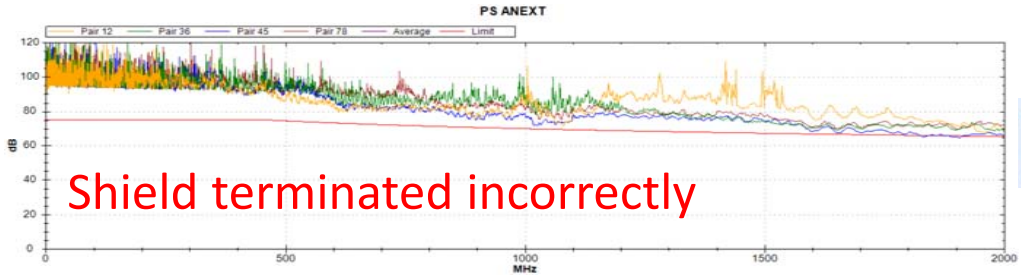


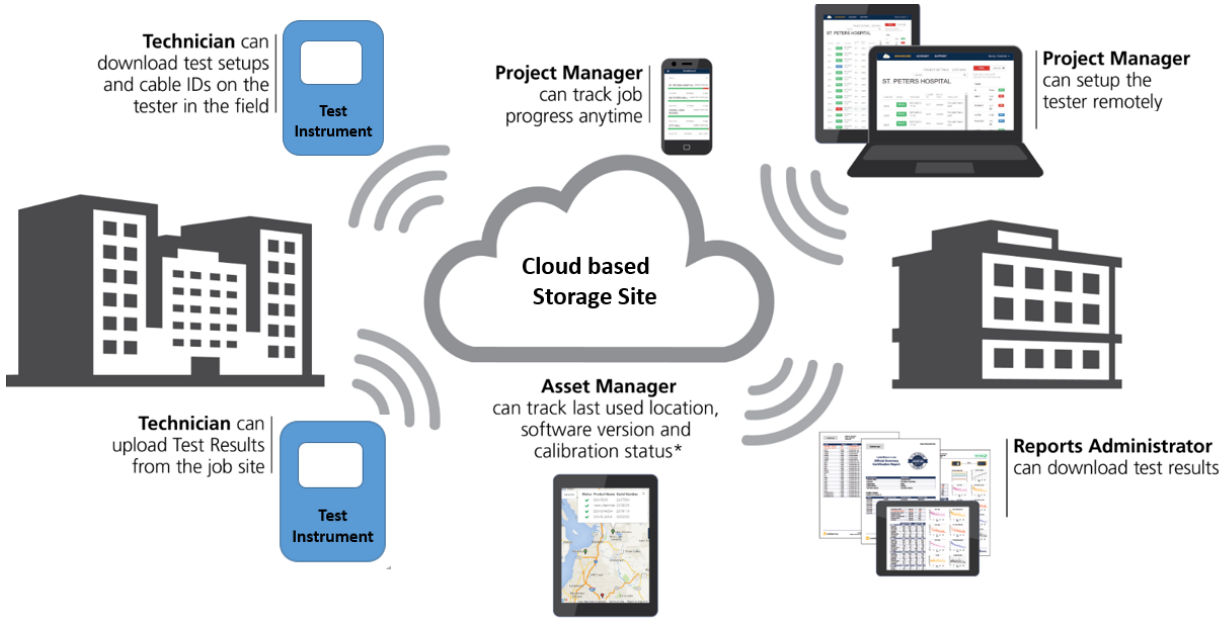
Results of Poor Shield Termination

It is important to check that the shield has continuity along the path of the cable – here the Disturbed cable has its shield open on one end





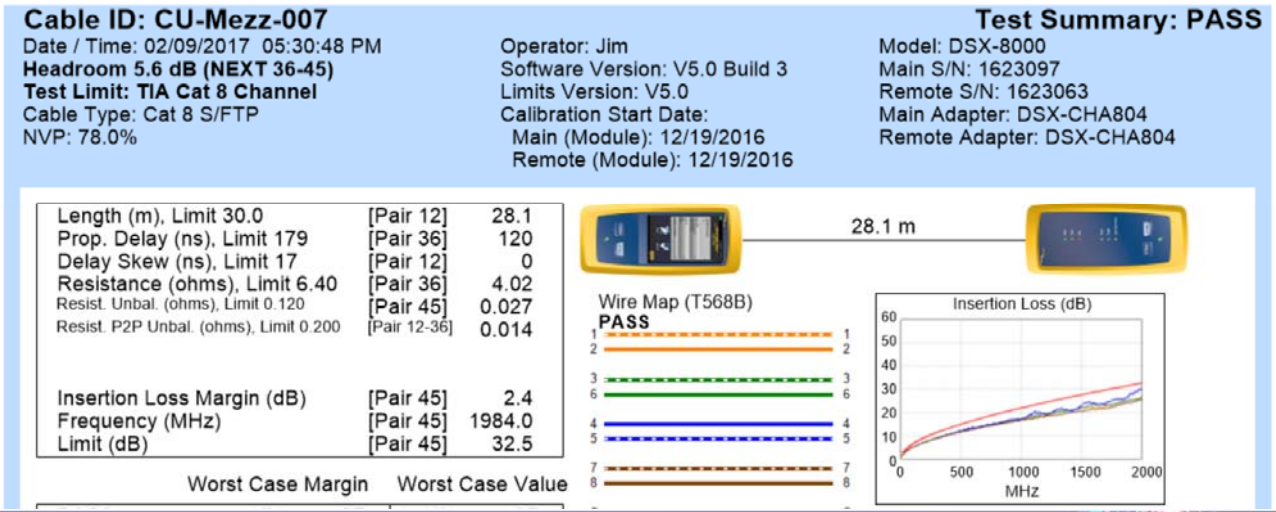
Cloud Based/SaaS Results Management



And if You've Done Everything Right –

Ready for 25/40G

LEVITON



Closing

What you need to know about Cat 8

- Great choice for extending copper cabling in your data center
- Significant differences from lower categories
- Design considerations – take steps now to ensure migration path
- Ensure proper testing

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Thank You!


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