Anticipating CAT 8 Plan for 25/40GBASE-T networks today
Anticipating Cat 8 - Agenda

• Cat 8 Overview
• Cat 8 Customer
• Design Considerations
• Testing Procedures and Standards
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
**Category 8 Standards**

**IEEE**
IEEE 802.3bq  
25G/40GBASE-T

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

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

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How is Cat 8 Different from Lower Categories?

- Frequency
- Channel Length
- Number of Connections
- Cable Construction
- Connector Options
Frequency - Category 8 operates at 2 GHz, more than 4 x Cat 6A
**Channel Length** - Category 8 channels are limited to 30 meters

- 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

**Category 8**
Class I & II
(2 connections)

**Category 5e, 6, 6A, 7A**
Class D, E, E_A, F_A
(4 connections)
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

Cat 8.2 / Class II (Cat 7A interface)

RJ-45
TIA 568-C.2-1
ISO/IEC 11801-1

Tera®
IEC 61076-3-104

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

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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 m² (~ 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

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

<table>
<thead>
<tr>
<th>Distance</th>
<th>OM3 Fiber</th>
<th>Cat 8</th>
<th>Twin-Axial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5m</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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<tr>
<td>5m to 30m</td>
<td>✔</td>
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<td>✔</td>
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<tr>
<td>30m to 100m</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Design Considerations for 25G

Architecture Type

• End-of-Row | Middle-of-Row Architecture
  - Less than 30m
  - Greater than 30m
  - Cat 8 | OM3 Fiber
  -OM3 Fiber

• Top-of-Rack
  - RJ-45
  - SFP28 Connector
  - Greater than 5m
  - Cannot use ToR architecture
  - Twin-axial
  - Cat 8

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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+)

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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

<table>
<thead>
<tr>
<th>Copper Certification</th>
<th>ANSI/TIA-568-C.2 (Cabling System)</th>
<th>ANSI/TIA-1152 (Minimum Field Test)</th>
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</thead>
<tbody>
<tr>
<td>Wire Map</td>
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<tr>
<td>Length</td>
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<tr>
<td>Propagation Delay</td>
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<tr>
<td>Delay Skew</td>
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<td>DC Loop Resistance</td>
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<td>DC Resistance Unbalance</td>
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<td>Insertion Loss</td>
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<td>Return Loss</td>
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<td>TCL, ELTCTL</td>
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<tr>
<td>PS ANEXT, PS AACR-F</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

Limits are specified but optional per 1152A

For Category 6A
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!

heat! heat!
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

Shield terminated correctly

Shield terminated incorrectly
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
Alien
Crosstalk
Occurs
Between
Cables

Disturbers

Disturbed (Victim)
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.

Shield terminated correctly

Shield terminated incorrectly
Cloud Based/SaaS Results Management

Technician can:
- Download test setups and cable IDs on the tester in the field.
- Upload Test Results from the job site.

Project Manager can:
- Track job progress anytime.
- Setup the tester remotely.

Asset Manager can:
- Track last used location, software version and calibration status.

Reports Administrator can:
- Download test results.

Cloud based Storage Site.

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And if You’ve Done Everything Right – Ready for 25/40G

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**Cable ID:** CU-Mezz-007  
**Date / Time:** 02/09/2017 05:30:48 PM  
**Headroom:** 5.6 dB (NEXT 36-45)  
**Test Limit:** TIA Cat 8 Channel  
**Cable Type:** Cat 8 S/FTP  
**NVP:** 78.0%  

**Operator:** Jim  
**Software Version:** V5.0 Build 3  
**Limits Version:** V5.0  
**Calibration Start Date:** Main (Module): 12/19/2016  
**Remote (Module):** 12/19/2016  

**Test Summary:** PASS  
**Model:** DSX-8000  
**Main S/N:** 1623097  
**Remote S/N:** 1623063  
**Main Adapter:** DSX-CH804  
**Remote Adapter:** DSX-CH804  

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<thead>
<tr>
<th>Test Parameter</th>
<th>Limit 30.0</th>
<th>Limit 179</th>
<th>Limit 17</th>
<th>Limit 6.40</th>
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<td>0.014</td>
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<td>Resistance (ohms)</td>
<td>[Pair 36]</td>
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<td>0.014</td>
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<td>Resist. Unbal. (ohms)</td>
<td>[Pair 45]</td>
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<tr>
<td>Resist. P2P Unbal. (ohms)</td>
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<td>Insertion Loss Margin (dB)</td>
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<td>32.5</td>
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<td>Frequency (MHz)</td>
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<td>Limit (dB)</td>
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<td>1984.0</td>
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</table>

**Worst Case Margin** | **Worst Case Value**

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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
Thank You!