



# Testing and deployment of direct attach and the impact of category 8

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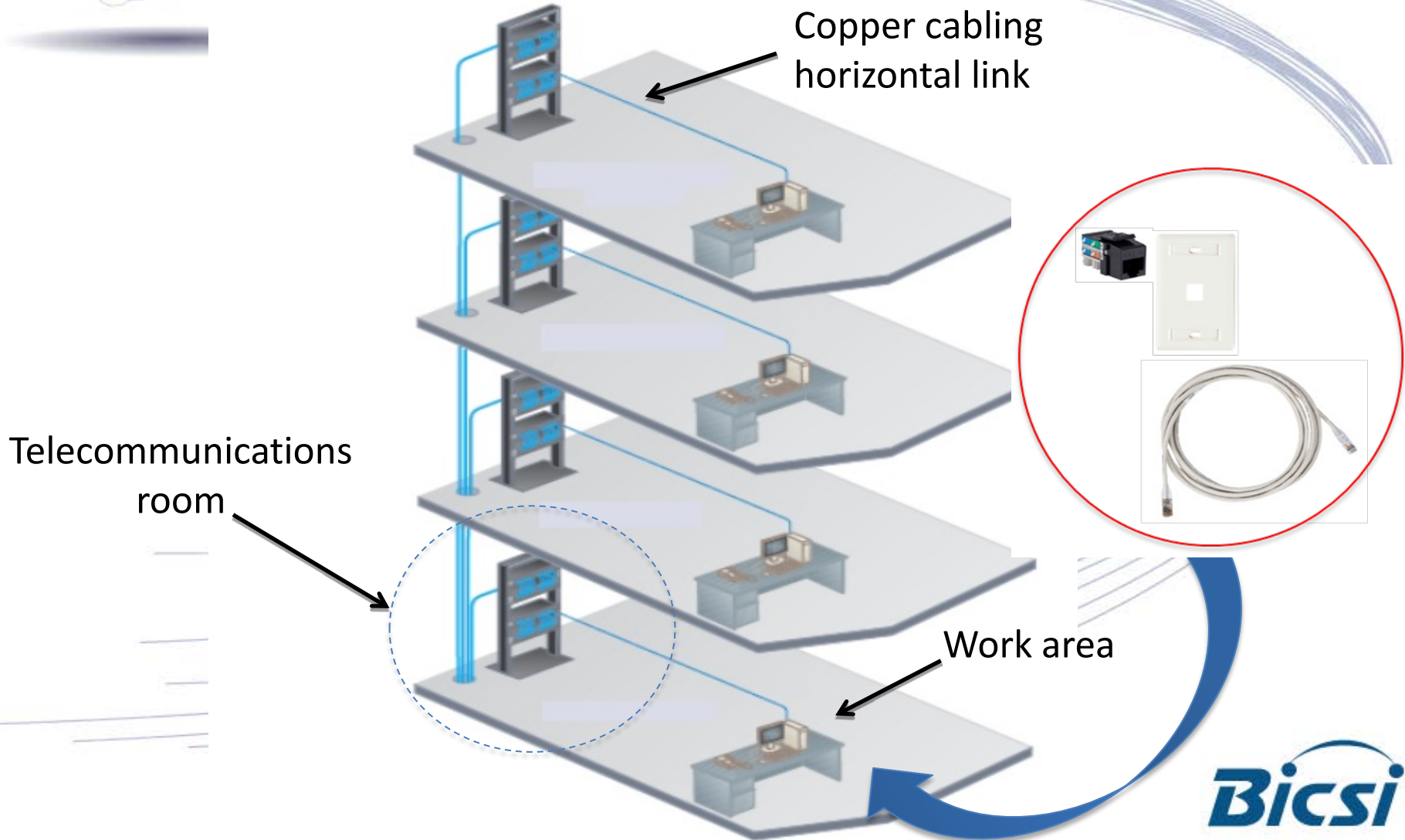


# Overview

- Traditional structured cabling
- Market drivers/applications
- Conventional link vs. direct attach
  - Plug problem/solution
  - Test problem/solution
  - Proof in performance
    - Real world test comparison
- Industry standards recognition
  - Current standards
  - Impact of Cat8 standard on direct attach
- Emerging applications/standards



# Traditional structured cabling





# Market shift: wired to wireless

- “The number of outlets per desk and number of workstations will decline”
  - ❖ Worldwide traditional PC/notebook shipments continue to decline
    - ❖ 12% decline 2016-2019 (Gartner)
- Enterprise-class Wireless LAN market sales are forecast to almost double by 2021 (Dell’Oro Group)



# Market shift: desktop to device (IoT)

## Global structured cabling market forecast continued growth

- “Growth in emerging markets as well as the use of Ethernet networks to connect and even power other devices will have a positive impact on the market.”
- “Convergence will increase and more structured cabling will be used to wire access points, IP cameras, building management systems, access controls, etc.”
- “Overall cabling in LAN is expected to grow from \$4.9 billion in 2012 to \$6.4 billion in 2020”





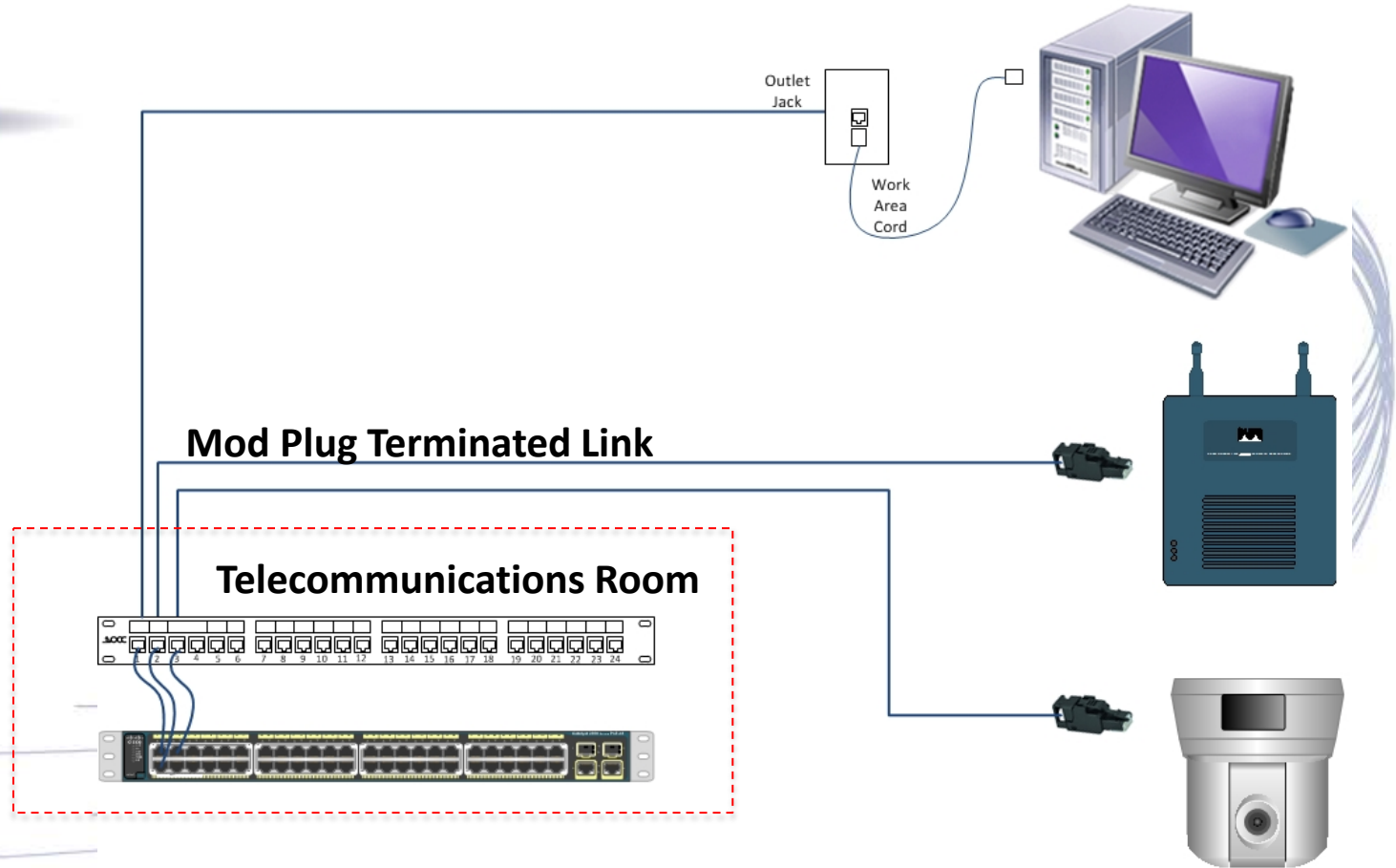
# Direct attach applications/ market drivers

- Growth of IP devices and demand for speed
  - CCTV cameras, wireless access points, building automation system (BAS) devices
  - 802.11ac wireless standard supports data rates up to 7Gbps
    - 802.11ay expected to provide 20Gbps throughput
  - Building automation system (BAS) market expected to reach \$99 Billion by 2022  
(Source: MarketsandMarkets)
- IDC forecasts that 28 billion connected things will be in use in 2020





# Conventional link vs. direct attach



TSB-162-A, Telecommunications Cabling Guidelines for Wireless Access Points, "Cabling for wireless access points should be balanced twisted-pair, category 6A or higher"



# The plug problem



- Patch cord plugs are commonly used for direct attach applications
- Termination difficulty
- Inconsistent terminations/performance
- Incompatible with large cable OD/conductors used in Cat6A cable
  - TIA TSB-162-A Telecommunications Cabling Guidelines For Wireless Access Points - recommends Cat6A cabling
- ❖ ANSI/TIA-568-C.0 Section 5.3.4: “Due to performance and testing requirements, it is recommended that modular cords be factory manufactured”





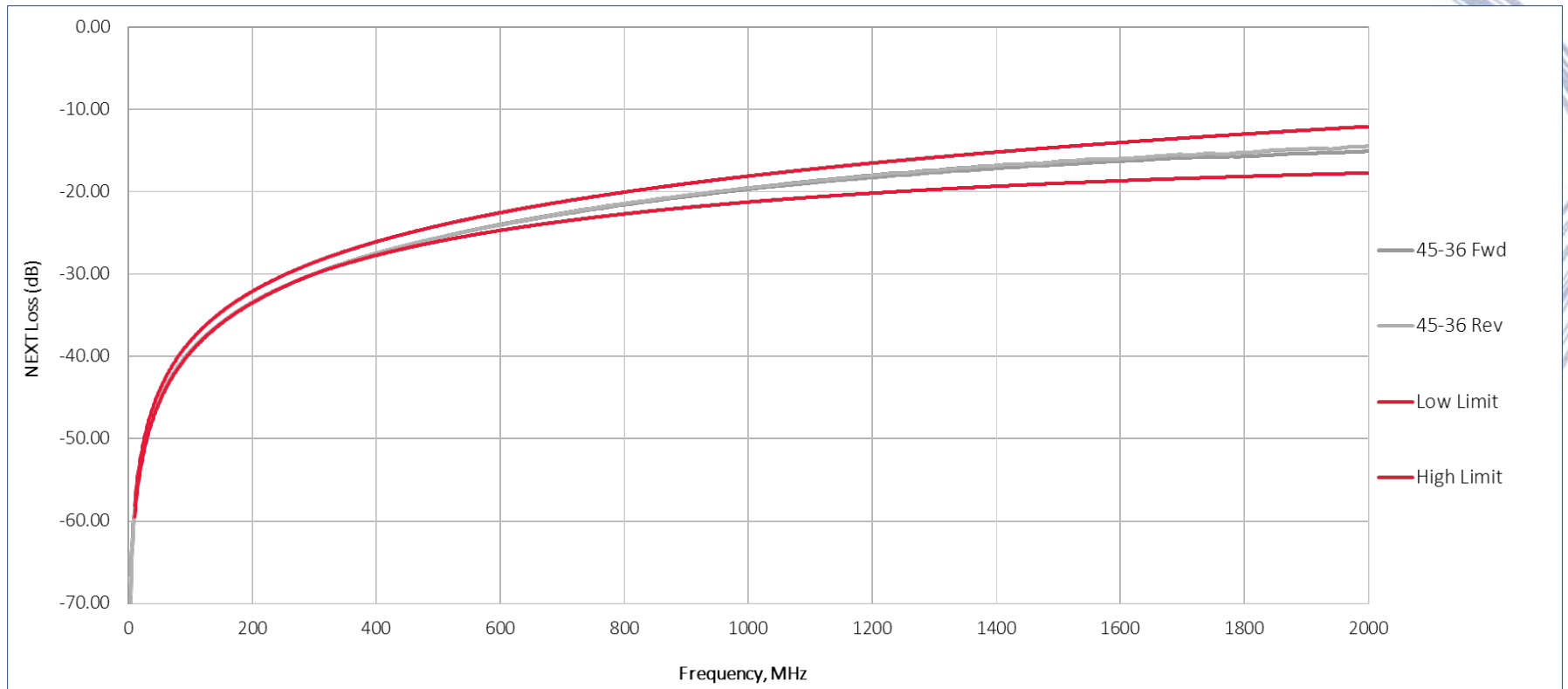
# The plug solution

- Designed for field installation
- Easy to terminate— more like a jack
- Repeatable terminations/performance
- Compatible with large conductor/large diameter cable
- Shielded and Unshielded
- Cat6A performance and beyond



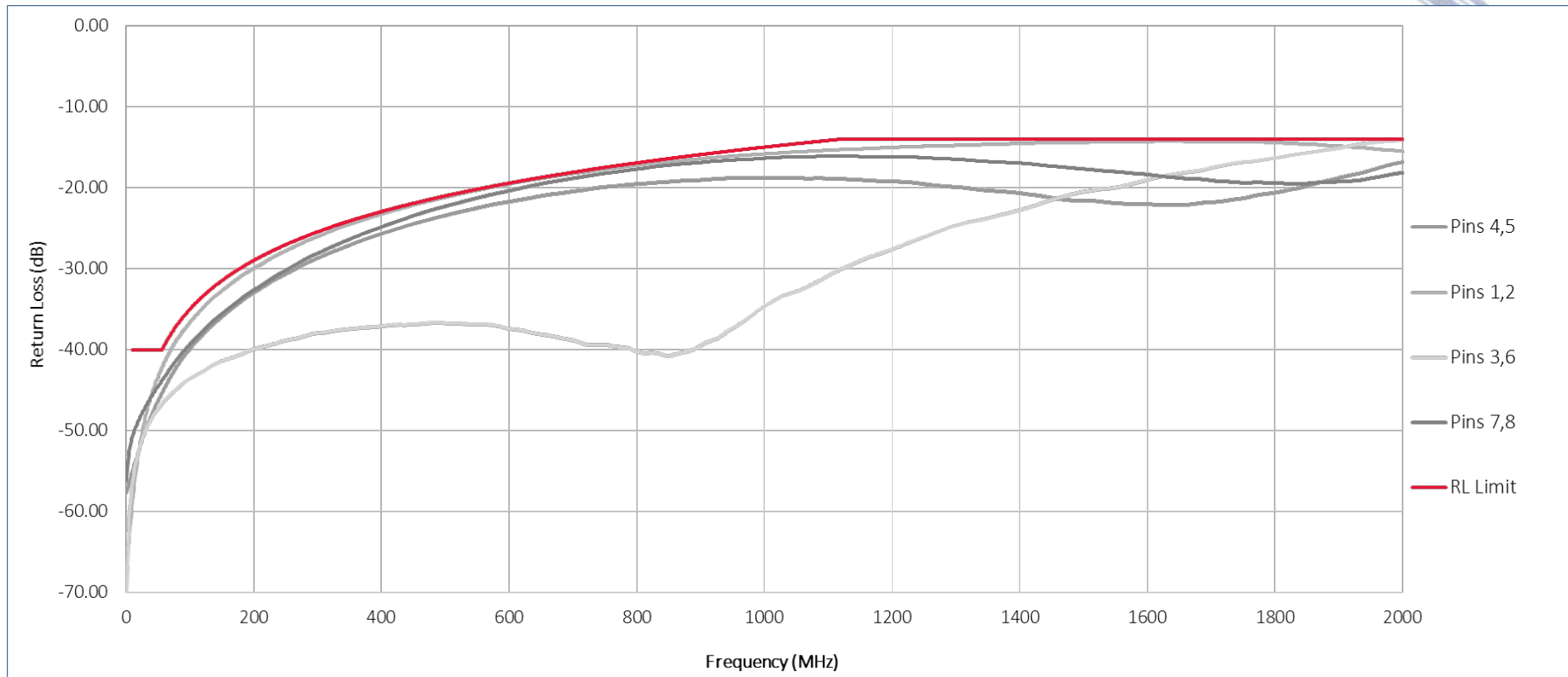


# Cat8 Field Terminable Plug Near-End Crosstalk 2GHz performance





# Cat8 Field Terminable Plug Return Loss 2GHz performance





# Designed for easy field termination

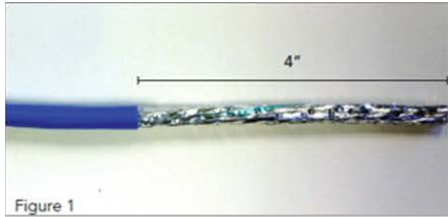


Figure 1

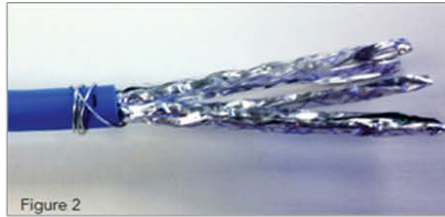


Figure 2



Figure 3

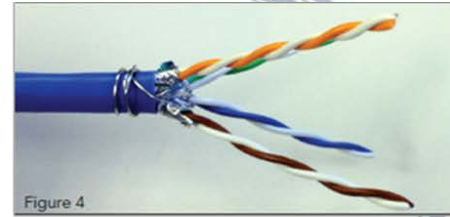


Figure 4

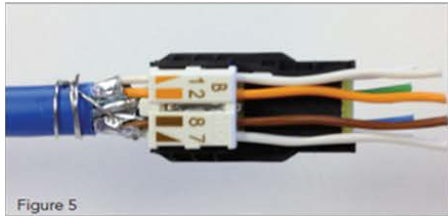


Figure 5



Figure 6



Figure 7



Figure 8

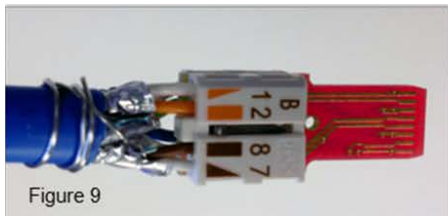


Figure 9



Figure 10



Figure 11

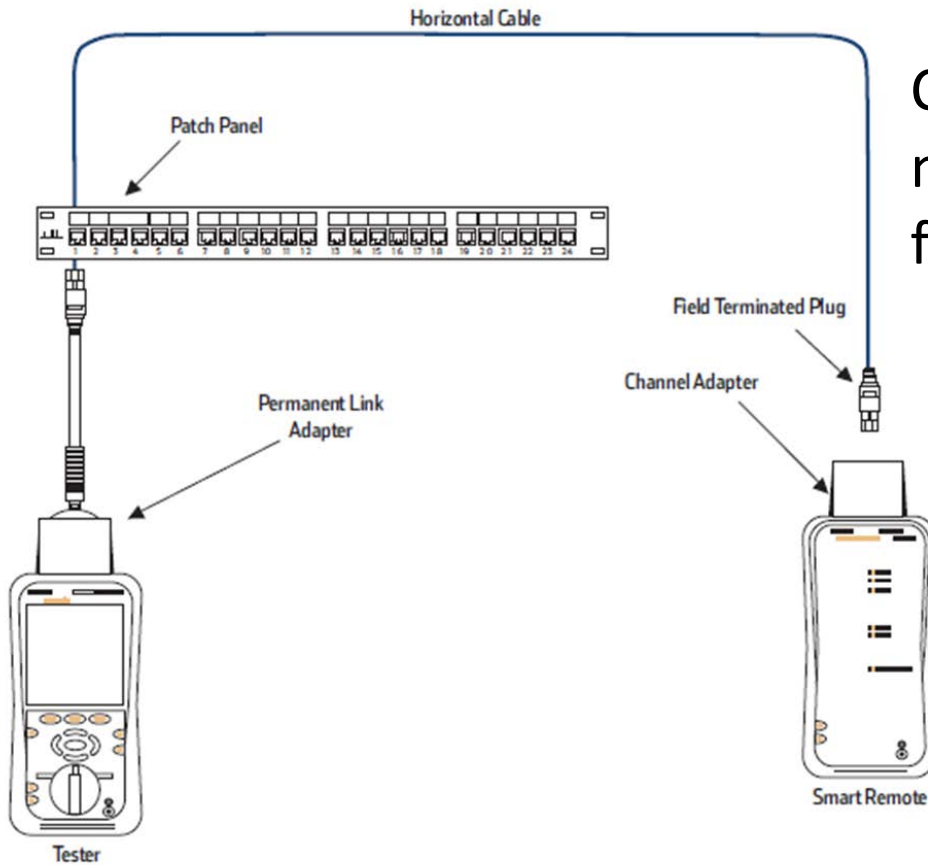


Figure 12



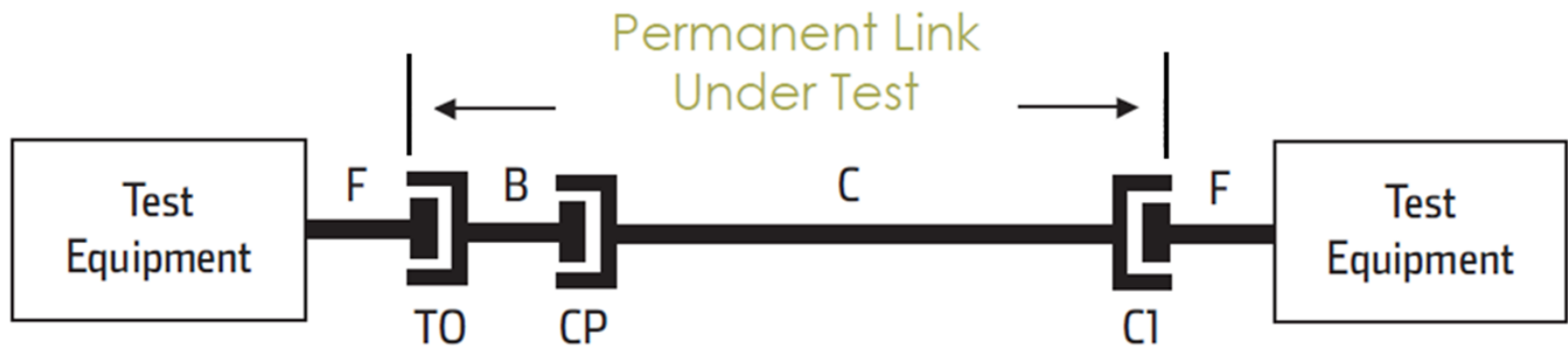
# The test problem

Current test method does not measure the performance of the field terminated plug





# ANSI/TIA-568-C Permanent link configuration



## Cables and Cords

F = Test equipment cord

B = Optional consolidation point cable

C = Horizontal cabling

## Connecting Hardware

TO = Telecommunications outlet/connector

CP = Optional consolidation point cable

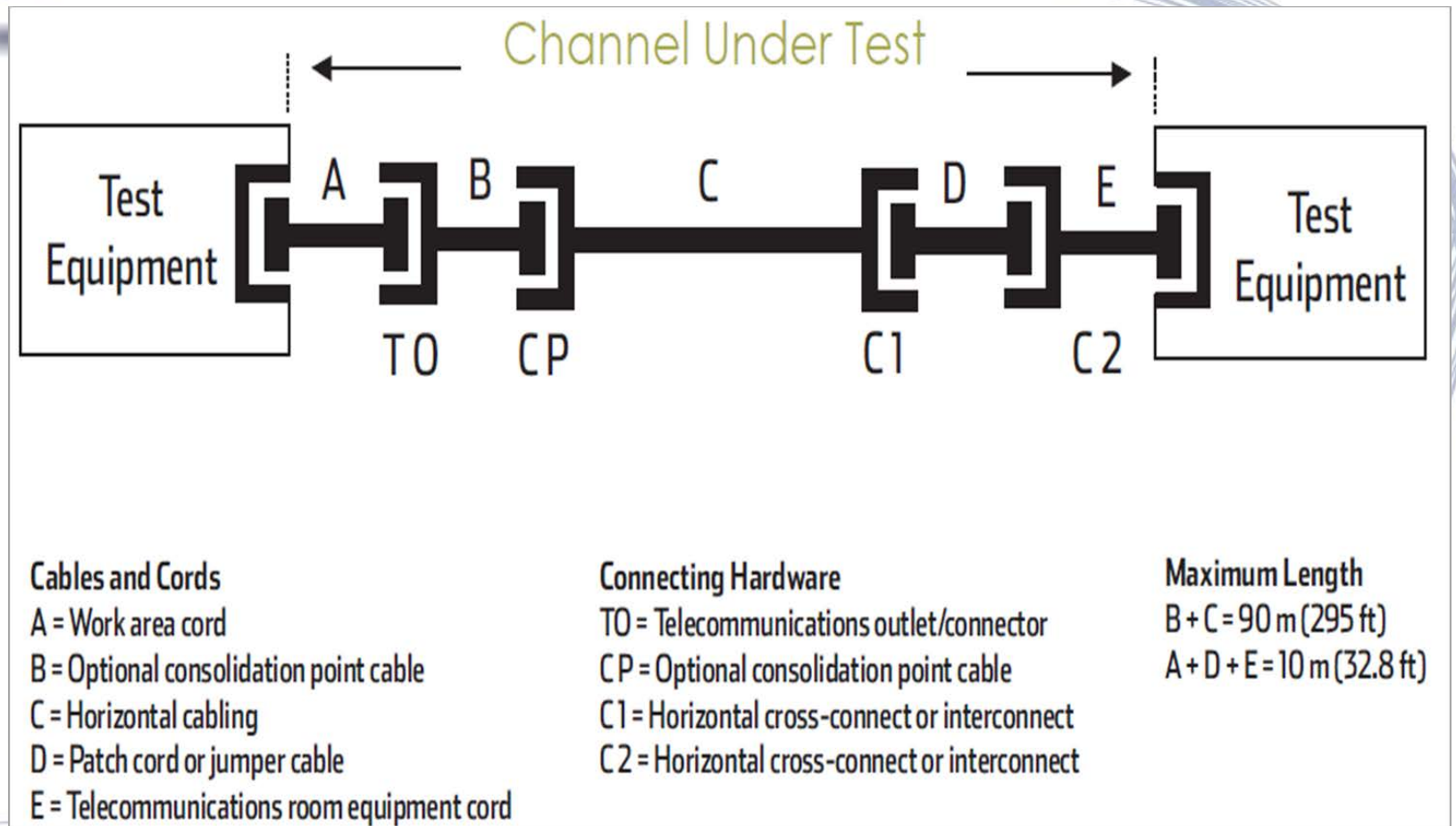
CI = Horizontal cross-connect or interconnect

## Maximum Length

$B + C = 90 \text{ m (295 ft)}$



# ANSI/TIA-568-C Channel configuration



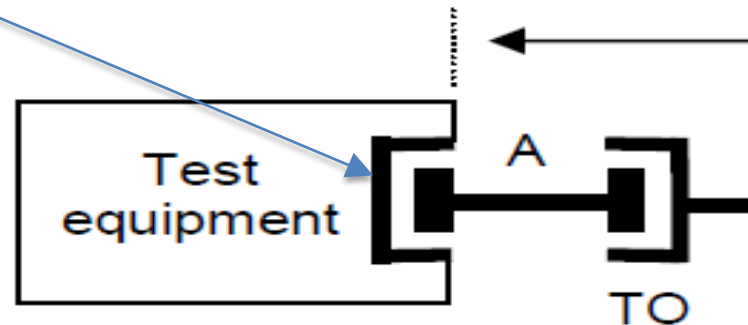


# Why is there a problem?

Commonly used method: Tester “subtracts out” the plug at the channel adapter masking the true performance of the link

- ❖ This test method does not measure the plug performance, regardless of the actual performance

Plugs connected to the test equipment channel adapter are not part of the channel under test.







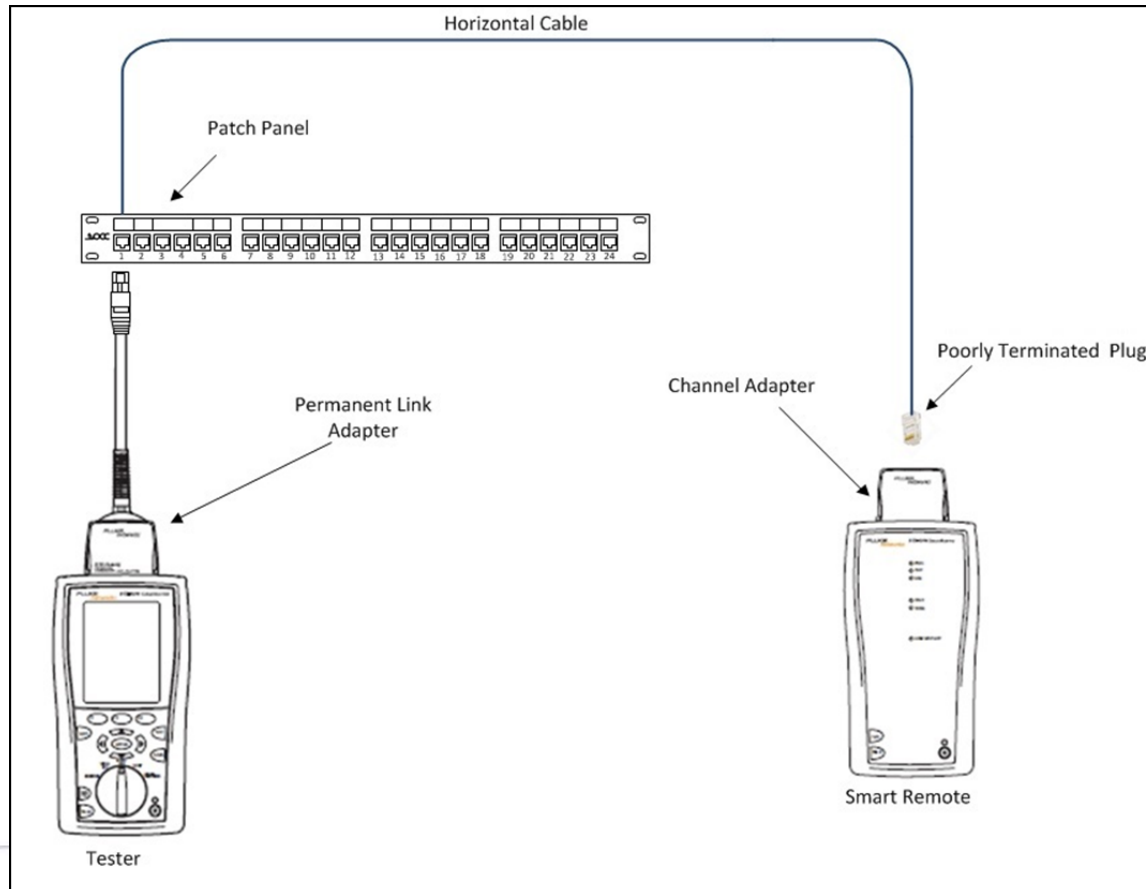
# Proof in performance

## Direct attach test and evaluation

- Poorly terminated plug: commonly used test method
- High performance field plug: commonly used test method
- Poorly terminated plug: field plug test adapter
- High performance field plug: field plug test adapter



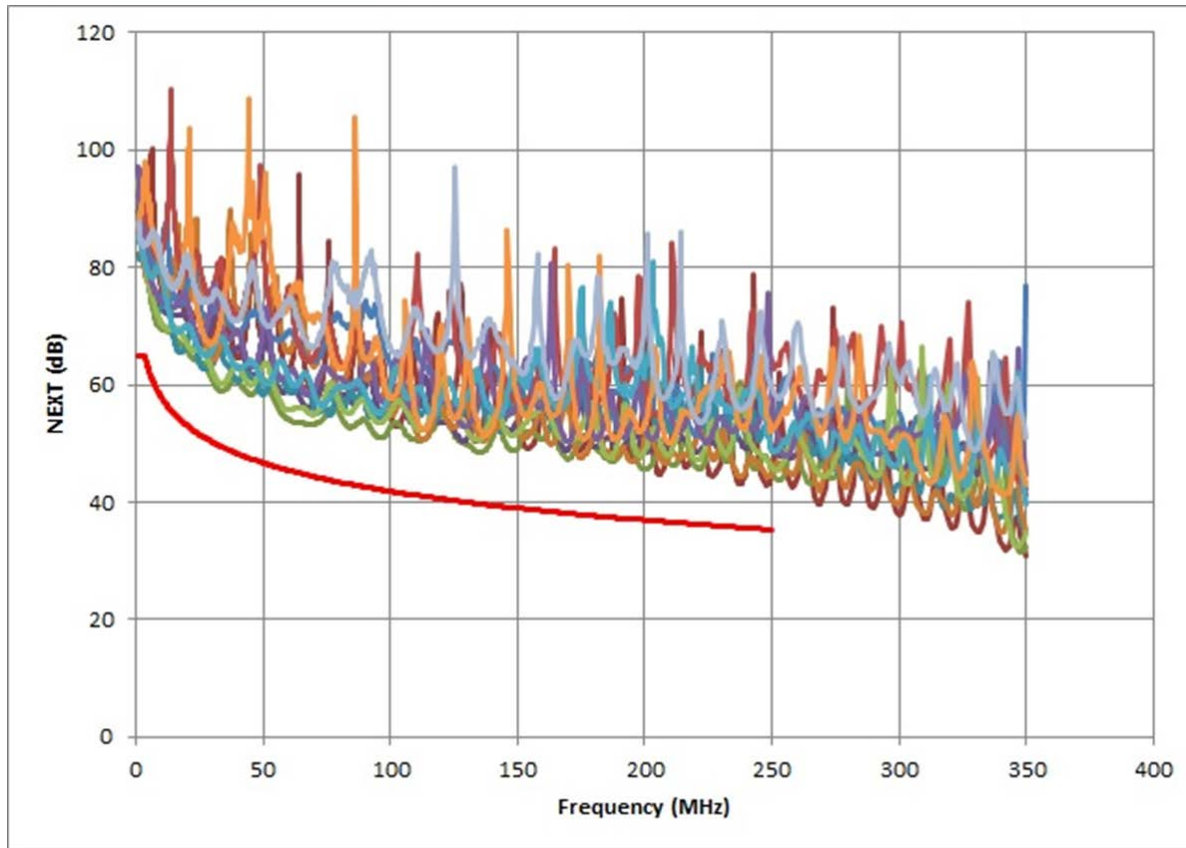
# Poorly terminated plug: commonly used test method



- Cat6 10 meter modular plug terminated link
- Poorly terminated plug
- Passed all tests: 8dB NEXT margin



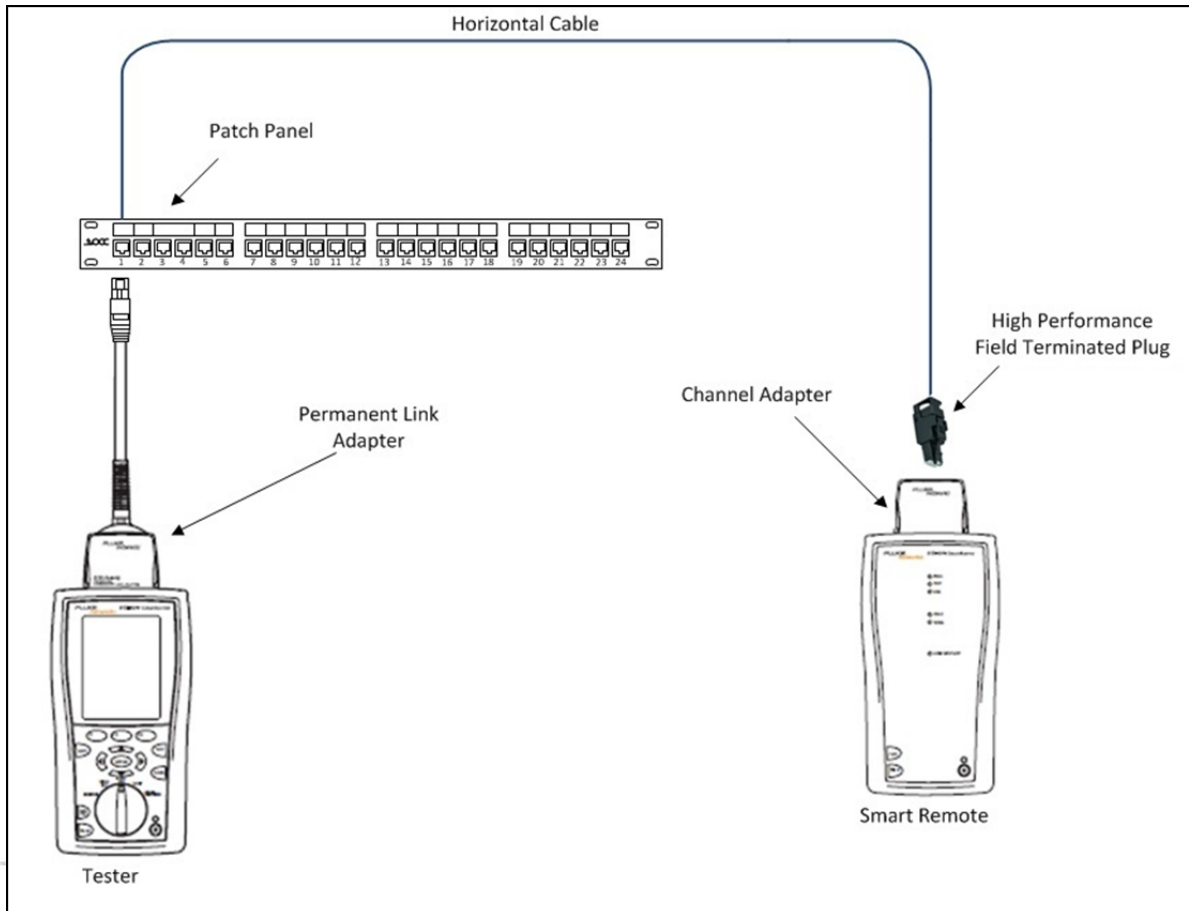
# Poorly terminated plug: commonly used test method



- Plug performance is not factored into the measurement
- Results are not representative of the true link performance



# High performance field plug: commonly used test method



- Cat6 10 meter modular plug terminated link
- High performance field plug
- Passed all tests: 8dB NEXT margin
- ❖ No difference between results of poorly terminated plug and high performance field terminable plug



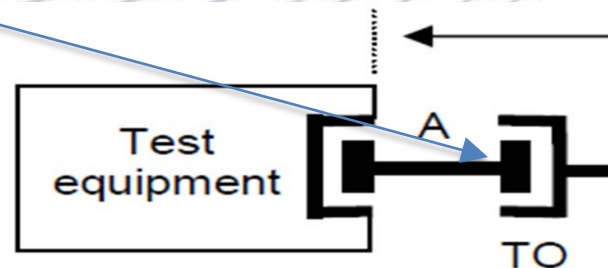
# Solving the problem

Commonly used method: Tester “subtracts out” the plug at the channel adapter masking the true performance of the link

- ❖ This test method does not accurately measure the plug, regardless of the performance

Suggested method: Utilize a field plug test adapter. The adapter plug is connected to the test equipment – not the field terminable plug under test.

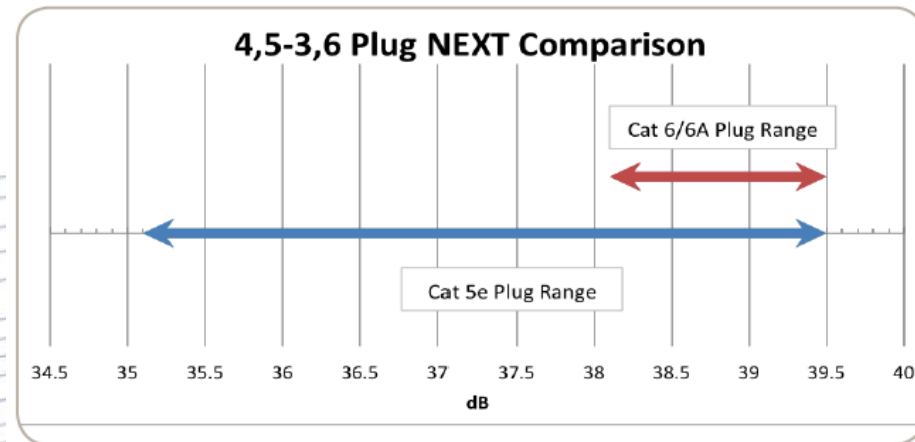
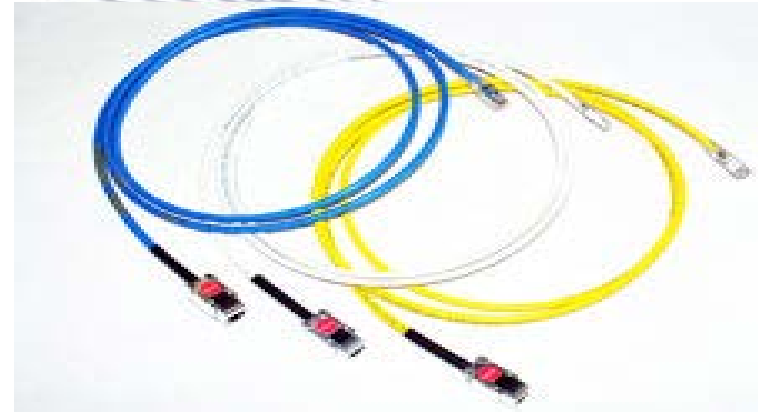
Plugs connected to the test equipment channel adapter are not part of the channel under test.





# OCC field plug test adapters

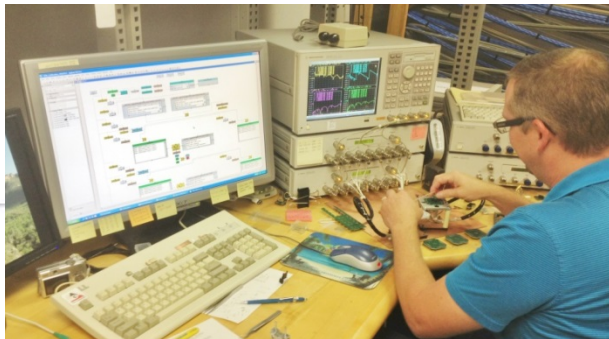
- Manufactured for a specific performance category
  - Cat5e, Cat6 and Cat6A
- Jacks are compliant with TIA-568-C.2, Clause C.5.2 Patch Cord Test Adapter requirements
  - Individually center tuned for the appropriate standard's category ensures maximum accuracy
- Can be utilized with any field terminable plug





# Field plug test adapters

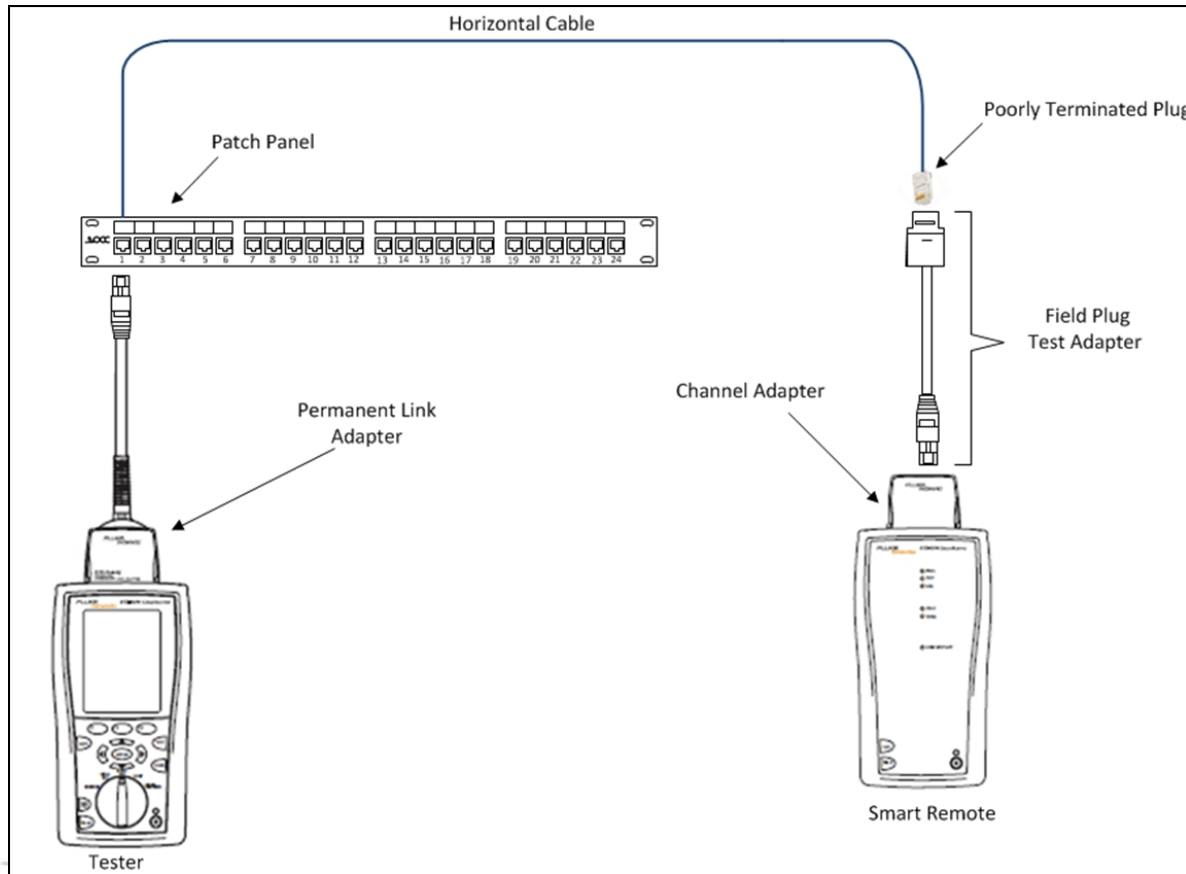
Why can't I  
build my own  
test adapter  
cord?



- ANSI/TIA-568-C.0 Section 5.3.4: “Due to performance and testing requirements, it is recommended that modular cords be factory manufactured”
- Field Plug Test Adapters utilize a modular cord test head that must be qualified per the electrical performance requirements of TIA-568-C.2 Annex C.5
- The qualification procedures requires a network analyzer, specialized test fixtures and a high level of technical expertise



# Poorly terminated plug: field plug test adapter



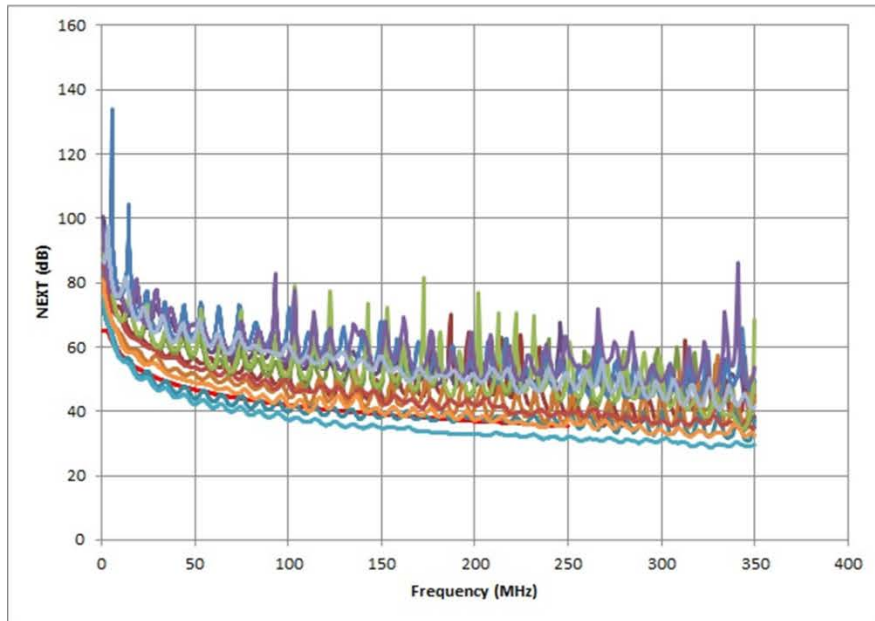
- Cat6 10 meter modular plug terminated link with field plug test adapter
- Poorly terminated plug
- Failed test: -5dB NEXT margin

**Note:** It is important to use the field plug test adapter corresponding to the category of the link to be tested.

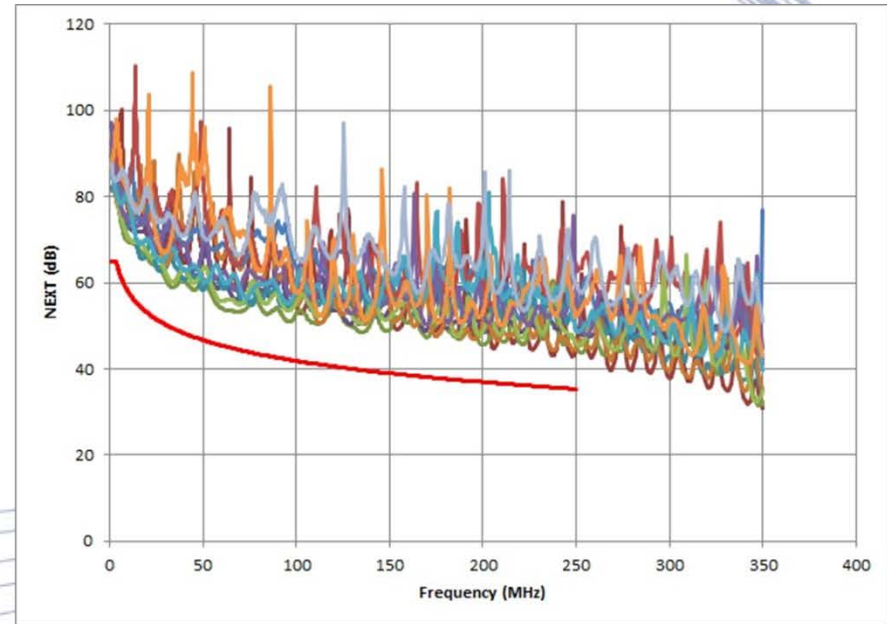




# Poorly terminated plug: field plug test adapter



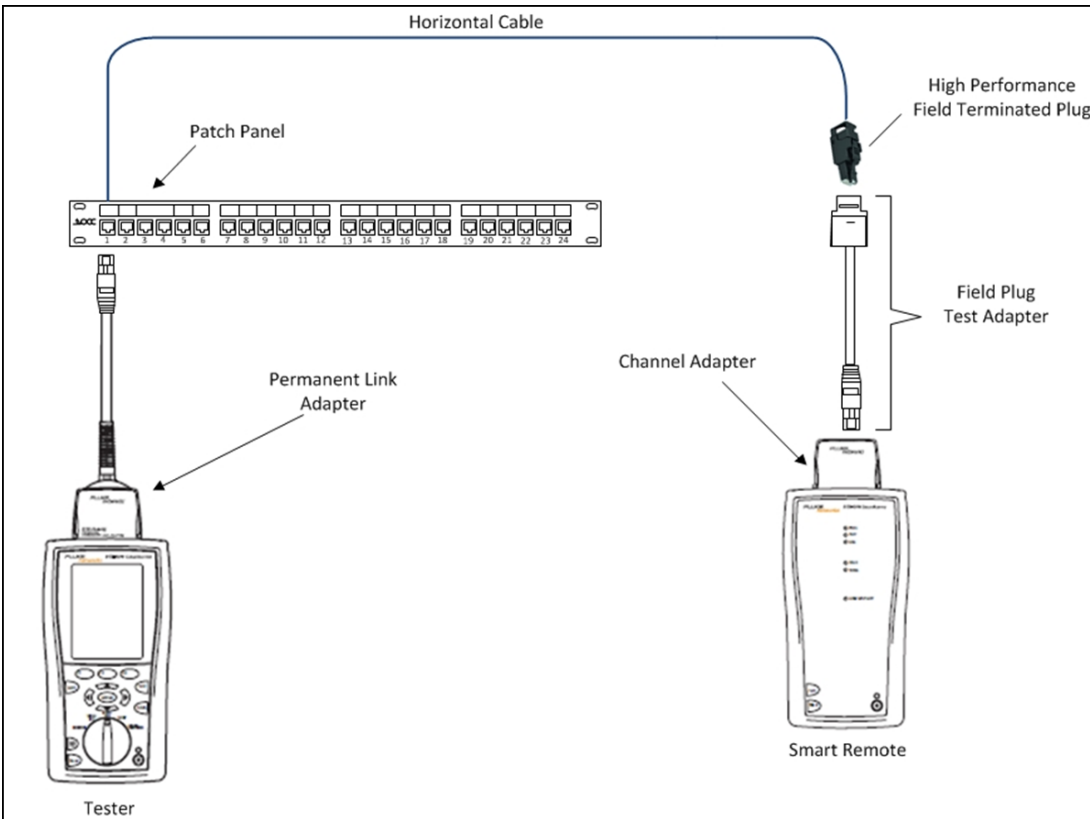
With Field Plug Test Adapter



Without Field Plug Test Adapter



# High performance field plug: field plug test adapter



- Cat6 10 meter modular plug terminated link with field plug test adapter
- High performance field plug
- Passed all tests: 7dB NEXT margin
- ❖ 12dB difference between the poorly terminated plug and the high performance field terminable plug

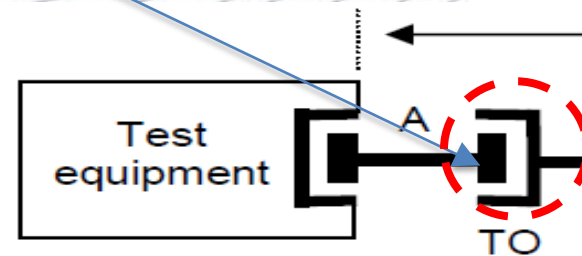


# Why the difference?

**Commonly used method:** Tester “subtracts out” the plug at the channel adapter masking the true performance of the link

**Suggested method:** Utilizing a field plug test adapter, the field terminated plug is now part of the tested link. The true performance of the link is now measured.

Plugs connected to the test equipment channel adapter are not part of the channel under test.





# Industry standard recognition

- ANSI/TIA-862-B, Structured Cabling Infrastructure Standard for Intelligent Building Systems
- ANSI/BICSI 005-2016, Electronic Safety and Security (ESS) System Design and Implementation Best Practices
- ANSI/TIA-568-C.2-1, Specifications for 100  $\Omega$  Category 8 Cabling
  - Incorporated direct attach channel
- TR-42.7 Engineering Committee (TIA-568)
  - Modular Plug Terminated Link topology and test method have been defined
    - Currently included in latest draft of ANSI/TIA-568.2-D
    - Will likely be included as annex F in final standard



# Category 8 standard: Impact on direct attach

Approved June 30, 2016

- Developed primarily to support IEEE 802.3bq 25/40GBASE-T for data center applications

Transmission characteristics are specified from 1 to 2000 MHz

- 4 times bandwidth of Cat6A (500MHz)

Max channel distance: 30 vs 100 meters

- 24 meter vs 90 meter permanent link

**Category 8 direct attach channel now recognized**



IEEE Standard for  
Information technology –  
Telecommunications and information  
exchange between systems –  
Local and metropolitan area networks –  
Specific requirements  
Part 3: Carrier Sense Multiple Access with  
Collision Detection (CSMA/CD) Access Method  
Specifications

and Management Parameters  
GBASE-T

IEEE Std 802.3aq™-2006  
Amendment to  
IEEE Std 802.3™-2008



**TIA STANDARD**

Balanced Twisted-Pair  
Telecommunications Cabling and  
Components Standard, Addendum 1:  
Specifications for 100  $\Omega$  Category 8  
Cabling

TIA-568-C.2-1  
(Addendum to TIA-568-C.2)

July 2016

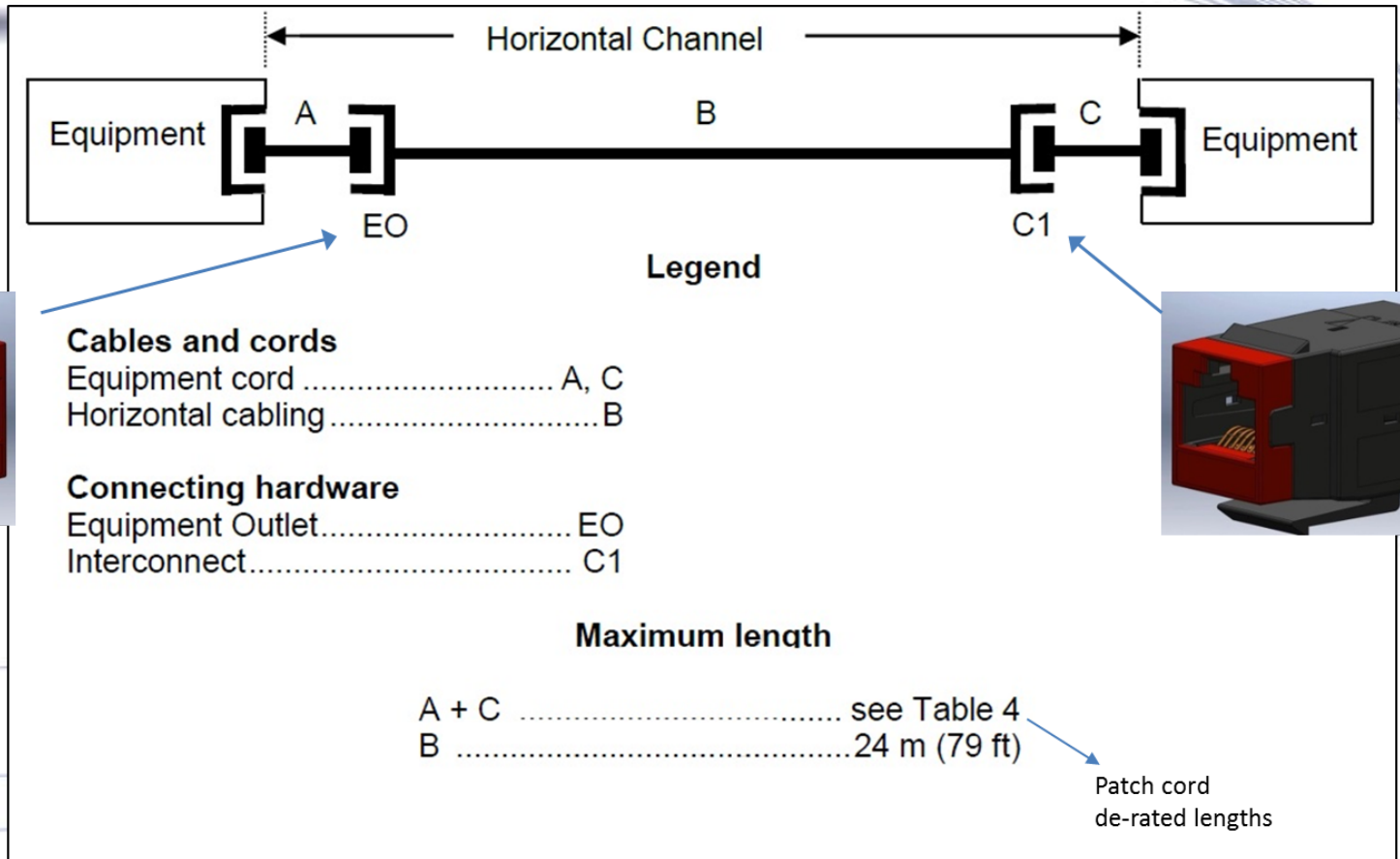
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# Cat8: 2-connector channel



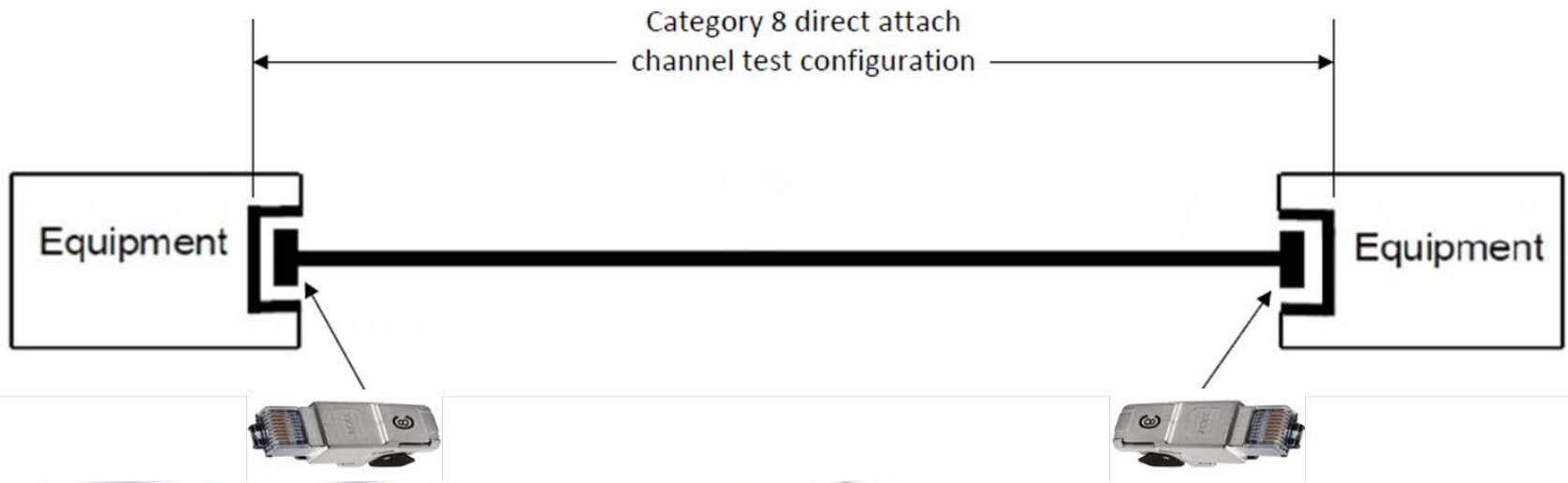


# Cat8 direct attach channel

Direct attach channels now recognized for Cat8 ONLY

Direct attach channels are composed of compliant plug connectors and flexible cable

Contains transmission performance specifications for category 8 direct attach channels with a maximum length of 5 meters





# Cat8 direct attach cable assembly

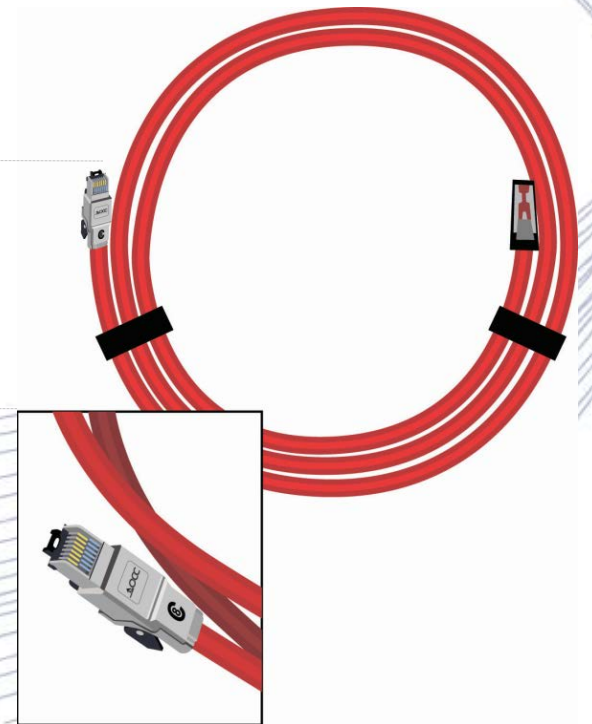
- Factory terminated, 100% tested , fully shielded

- TIA standard recognizes max direct attach channel length of 5 meters

  - Cat8 max channel length: 30m

- Supports IEEE 802.3bq 25/40GBASE-T Ethernet

  - More cost effective compared to existing 40G technology

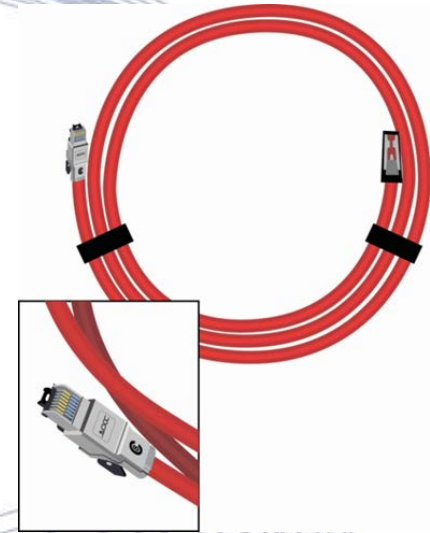






# Direct attach cable vs patch cord

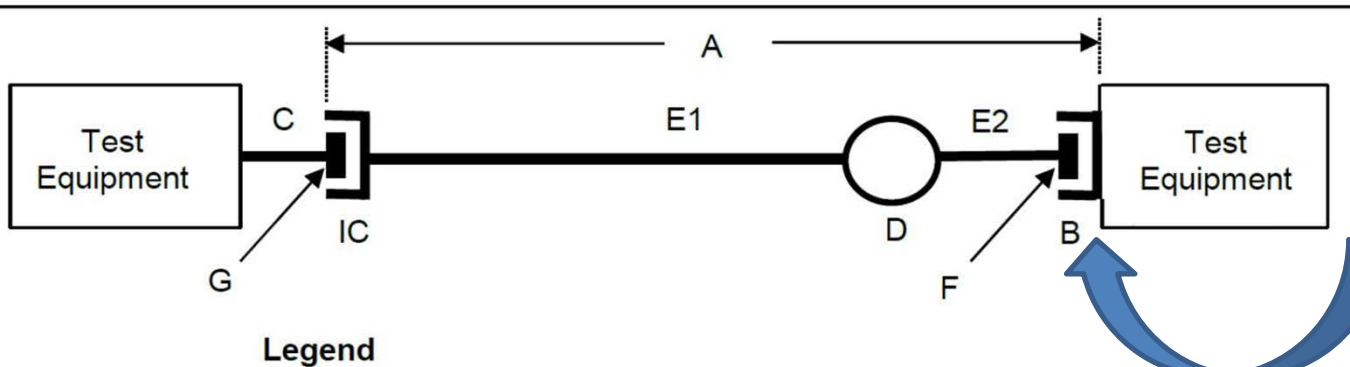
TEST PARAMETERS	PATCH CORD	DIRECT ATTACH CHANNEL
NEXT	•	•
Return loss	•	•
Insertion loss		•
PSNEXT		•
ACRF		•
PSACRF		•
Propagation delay		•
Delay skew		•



Note: Category 8 standard recognizes stranded and solid conductor cable for patch cord construction. Previous standards recognize stranded conductor only.



# Test configuration for modular plug terminated link topology



## Legend

### Cables and cords

Horizontal cabling ..... E1, E2

### Connecting hardware

Interconnect ..... IC

Optional consolidation point ..... D

### Maximum length

E1 + E2 ..... 90 m

A: MPTL Under Test (MUT)

B: Patch cord test head as qualified per annex C or D

C: Test equipment cord

F: Modular plug terminates the modular plug terminated link

G: Test plug qualified per annex C or D

\*Patch cord test head qualified per TIA-568-C.2 annex C

-Same requirements for field plug test adapter test head



# Direct attach applications



## HDMI/HDBASET

- Uncompressed HD Audio/Video
- HDBASET max supported data rate: 10.2Gbps

HDMI Data Rates	
Version	Data Rate (Gbps)
1.4a	10.2
2.0	18
2.1	48

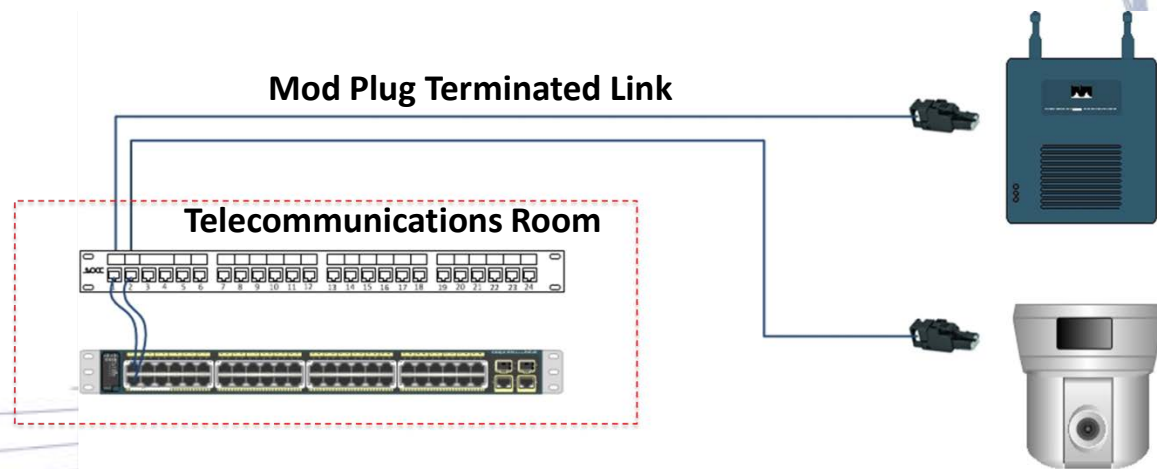


- ## Data Center
- (Top of Rack Architecture)
- Switch-to-Server



# Beyond the data center

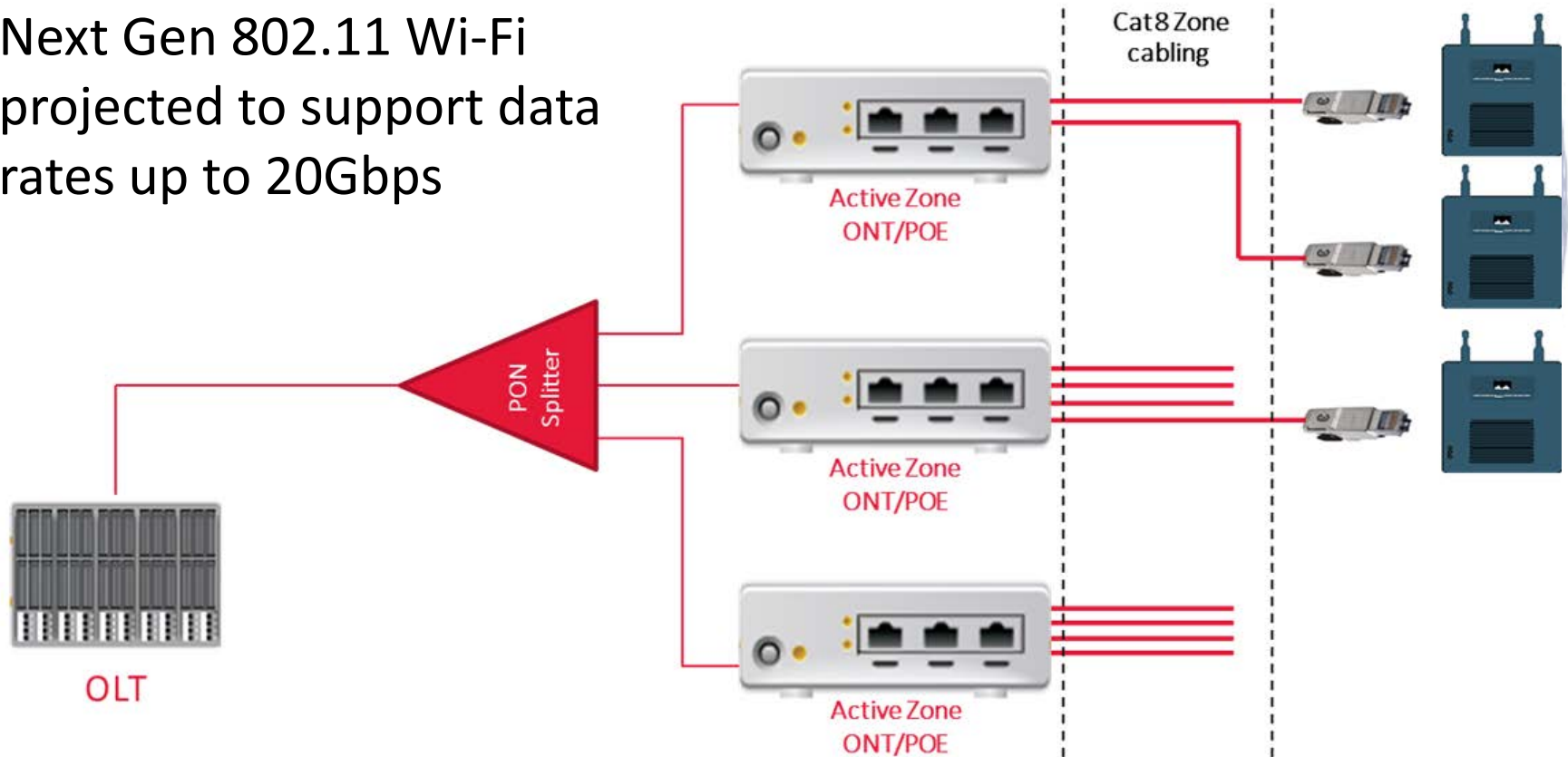
- Cabling for 802.11ac wireless access points has driven demand for Cat6A cabling beyond the data center
- Cat8 may experience similar trend as wireless speeds continue to advance/higher density deployments





# POLAN/active zone application

- ❖ Next Gen 802.11 Wi-Fi projected to support data rates up to 20Gbps





# Summary

- Commonly used test method does not accurately measure the plug, regardless of the performance
- It is impossible to tell the difference between poorly terminated and properly terminated plugs
- The formal recognition of direct attach in the Cat8 standard has provided an impetus for the inclusion of mod plug terminated links in the forthcoming ANSI/TIA-568.2-D standard
- Field terminable plugs and field plug test adapters provide the capability to reliably terminate and accurately test the performance of modular plug terminated links TODAY.



# Gracias!



Connections You Can Count On.™

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