Category 6A
A Sensible Choice?

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National Technical Manager- Technology and Applications

April, 2017
Copper Cabling

- Category 5e
- Category 6
- Category 6A
- Category 8
- Category 7/7A
Convergence

2000s

• IP driven
• Brings disparate subsystems under one
• Solution looking for tangible benefits ...

2016 ...

• IoT driven
• Merges not-so-disparate subsystems into one
• Unlocks productivity, efficiency ... and business opportunities
### Convergence Uptake in the Enterprise

#### IT Converged vs Stand-Alone Systems (% Share by Value), North America

<table>
<thead>
<tr>
<th>System</th>
<th>IT Converged</th>
<th>Stand-Alone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Detection &amp; Alarms</td>
<td>20%</td>
<td>80%</td>
</tr>
<tr>
<td>Intrusion</td>
<td>20%</td>
<td>80%</td>
</tr>
<tr>
<td>Lighting</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>Access</td>
<td>30%</td>
<td>70%</td>
</tr>
<tr>
<td>CCTV</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>BACS</td>
<td>80%</td>
<td>20%</td>
</tr>
</tbody>
</table>

*BSRIA, 2015*
Power-over-Ethernet Adoption

BSRIA, 2015

- Desktop Phones
- Wireless Access Points
- Security Cameras
- BACS & Lighting

BSRIA, 2015
Evolving Usage Patterns

2000s

- 100M NIC over 1G Cabling
- 1 desktop dedicated user
- Sporadic use
- Underutilized capacity of cabling systems

2020

- 5G/10G WAP Uplink
- Multiple users per WAP
- Remote powering up to 100W
- Constant use
- More demanding applications
- Higher performance cabling required
Synergy in the LAN

Wired
- 2000: 100M
- 2020: 1G, 2.5G, 5G, 10G

Wireless
- 2000: b (11 Mbps), g (54 Mbps), n (600 Mbps), ac wave 1 (1.3 Gbps), ac wave 2 (3.5 - 7 Gbps), ax (~10 Gbps)

Power-over-Ethernet
- PoE: 15W
- PoE+: 30W
- 4PPoE: 15/30/60/100W

Structured Cabling
- Category 5e
- Category 6
- Category 6A
# New LAN on the Rise

<table>
<thead>
<tr>
<th>2000s</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecting People</td>
<td>Connecting Devices</td>
</tr>
<tr>
<td>Fixed Connections</td>
<td>Wireless Connections</td>
</tr>
<tr>
<td>Locally Powered Devices</td>
<td>Remotely Powered Devices</td>
</tr>
</tbody>
</table>
LAN Speed Migration

Wireless LAN Active Users Growth Outpacing Wired LAN

LAN Speed Increase

2.5x from 2015 to 2019

Fueled by Multi-Gigabit WiFi

Dell'Oro, 2015
More End Devices

Wireless Access Points (M Units)
- 802.11b/g/n
- 802.11ac

Surveillance Cameras (M Units)
- Analog
- IP
CommAV

- Monitors
- Signage
- Displays

Building Management

- Gateways...
  - Access controls and monitoring
  - Occupancy sensors
  - Emergency notification
  - Energy management
  - HVAC
Application Mix Shift

Enterprise Mix %

- Desktop LAN
- Wireless LAN
- Security
- Comm AV
- LED Lighting
- BAS


Infrastructure Connectivity

User Connectivity

Belden

Bicsi
Converging Enterprise Networks

**User Connectivity**
- Desktop
- Data & Voice
- WiFi

**Infrastructure Connectivity**
- Security
- AV
- Lighting & Building Management

**Digital Infrastructure**
New Deployment Strategies

Planning / Provisioning
- People and devices
- Dedicated link vs. area coverage
- From walls to ceilings

Future Proofing
- Initial deployment vs. future MACs
- Bandwidth
- Power delivery

Connectivity Options
- Field termination
- Direct-connect
- Pre-term

Universal RJ45 Connectivity
- Discrete jacks
- Field plugs
- Coupler
Cabling Performance

- Signal Power
- Noise Immunity
- Information Capacity
- Power Delivery Efficiency

Frequency

PSE Power

Efficiency

New Cabling Performance
Increased bandwidth leads to increased information capacity, or higher SNR.

Maximum Performance and Reliability

- **Signal Power**
- **Noise Immunity**
- **Information Capacity**

- **Frequency**

**Increased bandwidth**

**Better RL** leads to less reliance on the PHY echo cancellation algorithms.

**Better NEXT** leads to less reliance on the PHY digital signal processing.

Less reliance on the computational power of the PHY means a more reliable data transmission, more channel up-time, and even lower power consumption.
Power is the New LAN Signal

![Graph showing the relationship between PSE (Watts), Efficiency (%), Wire Diameter, DCR, Efficiency, and Power Delivery Cost.](image)

- **↑ Wire Diameter**
- **↓ DCR**
- **↑ Wire Diameter**
- **↑ Efficiency**
- **↑ Wire Diameter**
- **↓ Power Delivery Cost**
Why Use Higher Performance Category Cable?

Category cabling can supply the frequency spectrum required to support the internal parameters of a single channel.
2.5G/5GBASE-T Cabling Requirement

- Alien Noise limitations
  - PSANEXT and PSAFEXT from cable bundling
  - Worsened with cables of varying data rates in close proximity

- Alien Noise minimized with Category 6A cabling
Using PSANEXT to Estimate SNR

-8 -6 -4 -2 0 2 4 6 8 10 12 14

Risk of Low SNR

Bundled Length, m

Alien Limited SNR, dB

Cat 6, 5G
Cat6, 2.5G
Cat5e, 5G
Cat5e, 2.5G

100m
Channels

Victim
Surrounded by
Aggressors
Cabling for Gigabit Wireless

WAP Uplink Speed

Category 5e
Category 6
Category 6A

Multi-Gigabit Full Implementation
## TIA Cabling Infrastructure Standards

### Category 6A is the recommended cabling media for new installations

<table>
<thead>
<tr>
<th>Category</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Premises*</td>
<td>TIA-568.0-D</td>
</tr>
<tr>
<td>Educational Facilities</td>
<td>TIA-4966</td>
</tr>
<tr>
<td>Intelligent Building</td>
<td>TIA-862-B</td>
</tr>
<tr>
<td>Wireless Access Point</td>
<td>TSB-162-A</td>
</tr>
<tr>
<td>Healthcare Facilities</td>
<td>TIA-1179</td>
</tr>
<tr>
<td>Data Centers</td>
<td>TIA-942-A</td>
</tr>
</tbody>
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### Category 6A is the best suited cabling media to support emerging applications

<table>
<thead>
<tr>
<th>Emerging Applications</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE 802.11ac Wave 2</td>
<td></td>
</tr>
<tr>
<td>IEEE 802.3bt 4PPoE Type 2, 3 &amp; 4</td>
<td></td>
</tr>
<tr>
<td>IEEE 1191.2 HDBaseT 2.0</td>
<td></td>
</tr>
<tr>
<td>IEEE 802.3an 10GBASE-T</td>
<td></td>
</tr>
</tbody>
</table>

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*Intelligent Building is an emerging facility type.*
What About Category 8?

New TIA standard in development
- Shielded balanced twisted pair copper
- RJ45 connectivity
- Maximum reach of 30 meters

To support 2 new upcoming Ethernet protocols

Data Center Applications
- Switch to Server links
- ToR, MoR
BASE-T Applications

Category 6A

Desktop

Wireless Access Points

Category 8

Switch-to-Server

1G

2.5G

5G

10G

25G

40G

LAN

Horizontal Distribution

Centralized Cross-Connect

MoR

ToR

DATA CENTER

100 m

30 m

7 m
### Category Cabling Lifecycle

<table>
<thead>
<tr>
<th>Standard</th>
<th>Bandwidth</th>
<th>Max. Throughput</th>
<th>TIA Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 5e</td>
<td>100 MHz</td>
<td>1G (2.5G*)</td>
<td>Legacy</td>
</tr>
<tr>
<td>Category 6</td>
<td>250 MHz</td>
<td>1G (5G*)</td>
<td>Minimum</td>
</tr>
<tr>
<td>Category 6A</td>
<td>500 MHz</td>
<td>10G</td>
<td>Recommended</td>
</tr>
<tr>
<td>Category 8*</td>
<td>2 GHz</td>
<td>25/40G</td>
<td>Data Center Switch to Server</td>
</tr>
</tbody>
</table>

#### Footage Mix %

- **2010**: 100%
- **2015**: 100%
- **2020**: 100%

- Category 5e
- Category 6
- Category 6A
Enterprise Wireless is becoming a dominant user connectivity application.

Enterprise Infrastructure applications require LAN connectivity to unlock their full benefits.

The **Digital Infrastructure** will be the backbone of the **New Convergence in the Enterprise**.
### Applications
- Power-over-Ethernet
- Wireless
- HDBaseT
- Security

### Ubiquitous Systems
- Performance Metrics
- Deployment Strategies

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### Distribution
- **Category 6A**

### Backbone
- **OM4 / OS2**
Belden Recommendations

<table>
<thead>
<tr>
<th>Efficiencies</th>
<th>Migration Strategies</th>
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<tbody>
<tr>
<td>Optimized Integration</td>
<td>Access: 1G to 10G</td>
</tr>
<tr>
<td>Connectivity</td>
<td>Aggregation: 10G to 40G</td>
</tr>
<tr>
<td>Power Management</td>
<td></td>
</tr>
<tr>
<td>Thermal Management</td>
<td></td>
</tr>
</tbody>
</table>

Enterprise Data Center

Access Category 6A

Aggregation OM4 / OM5 / OS2
Installing Category 6A: The Future is Now
Blog Category: Data Centers
Posted by: Stéphane Bourgeois on April 09, 2015

Category 6A twisted-pair copper received much attention when it first hit the marketplace in 2005. But adoption has been slow, since the 10 gigabit per second (Gb/s) capacity of Category 6A exceeds the requirements of most LAN applications. However, times are now changing. Data rates in the enterprise continue to climb. More devices than ever are being connected. Emerging applications demand higher performance and faster speeds. And, these trends haven’t escaped the notice of industry standards bodies.

PoE Types: What They Mean and How They’re Used
Blog Category: Enterprise Networking
Posted by: on August 13, 2016

PoE can enable fast installation and deployment, fewer operating costs and maximum reliability for today’s enterprise networks. As PoE changes twist pacing technology and application requirements, it is being classified by classes. PoE devices, on the other hand, are categorized by type depending on their power requirements. The difference between PoE types and classes can sometimes cause confusion when talking about PoE applications and capabilities. In this blog, we offer a breakdown of the four PoE types – Type 1, Type 2, Type 3 and Type 4 – and where they’re used, along with other terms used to describe them.

LAN Connections On the Move: From the Wall to the Ceiling
Blog Category: Enterprise Networking
Posted by: on July 15, 2016

LAN connections are on the move. Where they once resided in the walls of our buildings, they are now residing to the ceiling. With cable and wiring located overhead, devices can connect to it there vs. at a LAN connection point on the wall.

What You Need to Know About Alien Crosstalk Today
Blog Category: Enterprise Networking
Posted by: Ron Tafelski on January 27, 2017

The industry has been predicting the growth of 10GBASE-T for years, and its finally happening. More networks are planning 10G migrations. Why? Due to demand from more advanced devices, users and applications.

The Negative Impacts of Cable Temperature Rise
Blog Category: Enterprise Networking
Posted by: on September 12, 2016

Devices designed to connect directly to networks require increased power delivery through network cables. To grow the number of devices that can be powered by PoE, available power from the current must be increased – and the amount of heat generated within the network cable must increase as well. Cable temperature rise that is too high can ultimately push cables beyond their rated temperature, reducing performance and reliability (and causing potential damage to the cable itself).

In this article, learn why cable temperature rise matters, how to reduce the heat, and where UP cables fit in.

Breaking News: TIA Recognizes Direct-Connect Termination Method
Blog Category: Enterprise Networking
Posted by: Ron Tafelski on February 10, 2017

This week, the industry received some big news: The TIA TR-42.1 sub-committee agreed to include modular plug-terminated lines (also known as “direct-connect”) in a TIA-568-C.2 normative annex. The annex provides guidance to IT professionals to ensure a proper direct-connect cabling arrangement. Several Belden staff are closely involved with the Telecommunications Industry Association (TIA), holding many leadership positions within the organization.