The Future of Copper Cabling
Hang on...
Agenda...

• Cabling History
• The unwanted kid on the block
• Next generation cabling
• The growth of the converged market
Agenda...

- Cabling History
  - The unwanted kid on the block
  - Next generation cabling
  - The growth of the converged market
Modern Cabling History...
Copper

Cat 5
1994

1995: Ratification of 100Base-T
Modern Cabling History...

Copper

- **Cat 5**: 1994
- **Cat 5e**: 1998

- **1995**: Ratification of 100Base-T
- **1999**: Ratification of 1000Base-T
Modern Cabling History...
Copper

1994: Cat 5
1998: Cat 5e
1998: Cat 6
1999: Cat 7
1999: Ratification of 100Base-T
2002: Category 6 & 7 Standard

1995: Ratification of 1000Base-T
Modern Cabling History...

Copper

Cat 5 1994
Cat 5e 1998
Cat 6 1998
Cat 5e 1998
Cat 6A 2008
Cat 7 2008
Cat 7A 2008

1995: Ratification of 100Base-T
1999: Ratification of 1000Base-T
2002: Category 6 & 7 Standard
2006: Ratification of 10GBase-T
2008: Category 6A & Cat 7A Standard
Modern Cabling History...

Copper

ISO 24764, EN 50173-5 and the new draft of ANSI/TIA 942 all state that Cat 6A shall be installed as the minimum copper solution for the data centre

OM3 for fibre
Agenda...

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Unwanted Kid on the Block...
Copper Coated Aluminum

CCA Cables are appearing onto the global market, many being released as own brands but some as counterfeit solutions to market originals.

• Fail basic transmission performance tests during commissioning acceptance tests

• Exhibit poor flexibility leading to failed connections during both installation and operation

• Produce higher than expected temperature rises when used to provide power using applications such as Power over Ethernet (PoE and PoE+)

• Exhibit oxidation of exposed aluminium at points of connection which may reduce lifetime of those connections, particularly when they are subject to vibration or other movement.

Reference: TIA-B: IAN 002 Draft
Do the Standards support the use of CCA cables?

- EN 50288 standards state that “the conductor shall be solid copper and comply with the requirements of EN50288-1:2003”

- IEC 61156 standards state that “the conductor shall be a solid annealed copper conductor”

- ANSI/TIA-568-C.2 by reference to ANSI/ICEA S-90-661-2006 for Category 5e states that “solid conductors shall consist of commercial pure, annealed, bare copper …” and that, where used “tin coated conductors shall consist of commercially pure, solid annealed copper, tin coated …”

Reference: TIA-B: IAN 002 Draft
Category 5e CCA Test Results

Insertion Loss **FAIL** by 9.9 dB!

<table>
<thead>
<tr>
<th>Length (m), Limit: 90.0</th>
<th>[Pair 12] 87.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prop. Delay (ns), Limit: 498</td>
<td>[Pair 45] 423</td>
</tr>
<tr>
<td>Delay Skew (ns), Limit: 44</td>
<td>1</td>
</tr>
<tr>
<td>Resistance (ohms)</td>
<td>[Pair 78] 43.5</td>
</tr>
<tr>
<td>Insertion Loss Margin (dB)</td>
<td>[Pair 45] -9.9 F</td>
</tr>
<tr>
<td>Frequency (MHz)</td>
<td>[Pair 45] 72.8</td>
</tr>
<tr>
<td>Limit (dB)</td>
<td>[Pair 45] 17.6</td>
</tr>
</tbody>
</table>

Cable sheath length 90m
Electrical length 87m (NVP)

Source: John Kellow Consulting
Category 5e CCA Test Results

Note the DC Loop Resistance!

The relevant TIA standard requires the DC resistance not 9.38 ohms/100m
Result should not have exceeded 9.38 ohms

Source: John Kellow Consulting
Category 5e CCA Test Results

Return Loss **FAIL** by 6.8dB!

<table>
<thead>
<tr>
<th>FAIL</th>
<th>MAIN</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worst Pair</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>RL (dB)</td>
<td>-6.8 F</td>
<td>-4.1 F</td>
</tr>
<tr>
<td>Freq. (MHz)</td>
<td>73.0</td>
<td>75.0</td>
</tr>
<tr>
<td>Limit (dB)</td>
<td>13.4</td>
<td>13.3</td>
</tr>
</tbody>
</table>

The Return Loss failure was across all four pairs.

Source: John Kellow Consulting
Category 5e CCA Test Results

Re-certifying the results to ISO/IEC 11801 Class F shows additional **FAIL** on ACR

<table>
<thead>
<tr>
<th></th>
<th>MAIN</th>
<th>SR</th>
<th></th>
<th>MAIN</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worst Pair</td>
<td>36.78</td>
<td>12.45</td>
<td></td>
<td>36.78</td>
<td>12.45</td>
</tr>
<tr>
<td>ACR-N (dB)</td>
<td>-0.8 F</td>
<td>-4.4 F</td>
<td></td>
<td>-0.8</td>
<td>-4.4</td>
</tr>
<tr>
<td>Freq. (MHz)</td>
<td>82.5</td>
<td>73.5</td>
<td></td>
<td>82.5</td>
<td>73.5</td>
</tr>
<tr>
<td>Limit (dB)</td>
<td>15.3</td>
<td>17.2</td>
<td></td>
<td>15.3</td>
<td>17.2</td>
</tr>
<tr>
<td>Worst Pair</td>
<td>45</td>
<td>45</td>
<td></td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>PS ACR-N (dB)</td>
<td>-0.1 F</td>
<td>-2.1 F</td>
<td></td>
<td>2.2</td>
<td>2.3</td>
</tr>
<tr>
<td>Freq. (MHz)</td>
<td>72.5</td>
<td>73.5</td>
<td></td>
<td>93.0</td>
<td>98.8</td>
</tr>
<tr>
<td>Limit (dB)</td>
<td>14.5</td>
<td>14.2</td>
<td></td>
<td>10.2</td>
<td>9.1</td>
</tr>
</tbody>
</table>

Source: John Kellow Consulting
Category 5e Copper Test Results

Note the DC Loop Resistance!

<table>
<thead>
<tr>
<th></th>
<th>[Pair 45]</th>
<th>[Pair 12]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (m), Limit 90.0</td>
<td>90.2</td>
<td>16.8</td>
</tr>
<tr>
<td>Prop. Delay (ns), Limit 498</td>
<td>446</td>
<td></td>
</tr>
<tr>
<td>Delay Skew (ns), Limit 44</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Resistance (ohms)</td>
<td></td>
<td>16.8</td>
</tr>
<tr>
<td>Insertion Loss Margin (dB)</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td>Frequency (MHz)</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Limit (dB)</td>
<td>21.0</td>
<td></td>
</tr>
</tbody>
</table>

Note also that the DC loop resistance of 16.8 ohms is just within the TIA limit for a 90 metre loop of 16.88 ohms.

Source: John Kellow Consulting
Unwanted Kid on the Block...
Copper Coated Aluminum

Not only affecting Cat 5e, but also now being seen entering the Cat 6 arena.
Agenda...

- Cabling History
- The unwanted kid on the block
- Next Generation Cabling
- The growth of the converged network
40GBase-T...

August 1998: Penn State University successfully transmitted 50 Gigabits per second over 100m of Cat 7A/Class F_A cable

• There is a twisted pair cable that is suitable for 40GBaseT

• That there is a suitable connector

Some manufacturers openly made public statements declaring that there systems could support 40GBaseT – Clever Marketing

One manufacturer employed the services of a technical author to produce a document stating why 40GBaseT was needed and that the Standard would be written and completed by shortly after 2009.

There is currently no standard supporting Cat 7A for 40GBase-T
So what is Next Generation Cabling..?

QTR 2 2011: TIA Standards committee discussed US ratification and final acceptance of Cat 7/Cat 7A
The proposal was only marginally rejected

It was agreed to create a new working party looking at 40GBaseT and 100GBaseT

The committee met last week for the first time:

- Group for connectivity
- Group for cable
- Group for applications
- Improved liaison with IEEE

Initial suggested ideas:

- 1600MHz
- 2000MHz
- 3000MHz
But do we need another generation..?

THERE ARE NO IMMINENT DEMANDS FOR NEW CATEGORIES

<table>
<thead>
<tr>
<th>Insertion loss - the killer</th>
<th>100 MHz</th>
<th>250 MHz</th>
<th>500 MHz</th>
<th>600 MHz</th>
<th>1000 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 5</td>
<td>21,3 dB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 6</td>
<td>19,9 dB</td>
<td>33,0 dB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 6 A</td>
<td>19,1 dB</td>
<td>31,1 dB</td>
<td>45,3 dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 7</td>
<td>19,0 dB</td>
<td>31,0 dB</td>
<td>45,3 dB</td>
<td>50,1 dB</td>
<td></td>
</tr>
<tr>
<td>Category 7 A</td>
<td>18,7 dB</td>
<td>30,0 dB</td>
<td>43,2 dB</td>
<td>47,6 dB</td>
<td>62,6 dB</td>
</tr>
</tbody>
</table>

100 m of cable

All of these cables have good insertion loss (attenuation) figures.

Remember Penn State successfully proved (via a theoretical model) that Cat 7 will support 40Gbe

Reference: The Cabling Partnership 2010
But do we need another generation..?

**WHAT MORE CAN WE DO WITH THE ONES WE HAVE GOT?**

<table>
<thead>
<tr>
<th>Category 7a</th>
<th></th>
</tr>
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<td>PIMF - S/FTP</td>
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- **S/FTP** Typical CA: Type III

- Improved latency
- Energy efficiency - Applications
- New applications
- New dimensions
  - New channel Classes?

To provide 40 & 100GBase-T links in the data centre

Reference: The Cabling Partnership 2010
But do we need another generation..?

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- **S/FTP** Typical CA: Type III

- **Improved latency**
- **Energy efficiency - Applications**
- **New applications**
  - New dimensions
  - New channel Classes?
  - Application sharing
  - AV as the driver

Audio visual demands are growing fast beyond 1000Base-T for the home user

Reference: The Cabling Partnership 2010
Cave Technology...

Virtual reality is coming...
Next Generation Timescales..?

To early to tell at this stage

However, it must be noted at once that there is a considerable difference between the standardisation of 10GBASE-T and those proposed for Next Generation cabling.

With 10 GbE a lot of time was wasted developing a standard for unscreened UTP cable.

This will not happen for 40GBaseT and 100GBaseT as all manufacturers will focus on shielded solutions only.
Agenda...

• Cabling History
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• Next generation cabling

• The Growth of the Converged Market
Convergence…

If the focus of Next Generation Cabling is focused on the DC
Where and what is happening to traditional cabling?
The Growth is Convergence...

Convergence is the bringing together of autonomous systems onto a common communication platform within a building or business to create a single unified solution.

Ethernet Network Communication: Copper or Fibre

BMS Structure

ICT Network
Traditional Infrastructures

• Traditional systems supply multiple building management systems over multiple cabling topologies and types of cable. Some are proprietary systems.

• These systems can include:
  – voice/data
  – video surveillance
  – access control
  – audio/video
  – fire alarms
  – energy management.
  – HVAC

Traditional – Multiple systems, multiple proprietary cabling types
Intelligence to ConvergeIT

- ConvergeIT is an intelligent building cabling solution
- Multiple building systems run over a single IT cabling infrastructure
- These systems can include:
  - voice/data
  - video surveillance
  - access control
  - audio/video
  - fire alarms
  - energy management.
  - HVAC
Why Converged IT

Environmental (HVAC) Building Controls
• The market will compete in applying BAS to tackle climate change issues
• Companies need to obtain and disseminate both controls and IT knowledge

Lighting Controls
• Huge savings and market potential
• Consolidation to provide total lighting solutions and more integration
• LED lighting is a growing market but controls required for better efficiency

Security Systems
• CCTV / Video surveillance setting the pace, followed by access control
• Strong movement towards IP systems and integration of security systems

Fire Detection and Alarm
• Robust, growing market, driven (and constrained) by codes & regulations.
• Demand for better evacuation solutions will drive integration of nascent mass notification / voice evacuation market
Who is Pushing Convergence...

• Large projects 90%-100% converged at management level (Ethernet)
• IT convergence not perceived to be a benefit by many BMS suppliers
• IT suppliers keen to drive IT convergence
  - Cisco, HP etc
  - IBM: software, consultancy and outsourcing providers, etc
    - Oracle & software applications
• Integrated into BMS offering by designers
• Driven by IT (cabling manufacturers such as Siemon, Systimax, etc).
• Security SI/installers high end drive it
US Building Infrastructure Market 2009...

- BMS: 29%
- CCTV/Video: 28%
- Fire Detection & Alarm: 14%
- Access Control: 13%
- Intruder Alarm: 11%
- Lighting Control: 5%
Structured Cabling’s Position

• The structured cabling network is the core element - the backbone on which all intelligent building systems rely
  – Structured cabling provides the quality, performance and reliability to support critical building systems today and into the future
  – Design and installation should be supported by a structured cabling expert

• Intelligent buildings employing an IP-based network and devices deliver:
  – Reduced Capital Expenses (CAPEX).
  – Reduced Operating Expenses (OPEX)
Converged CCTV...

IPCCTV

- Largest area of growth in the converged marketplace:
Building The System…

RJ45 Connectivity & Some Math

- Building with 5 external doors (5 x lock, 5 x IPCCTV, 5 x Motion detection)
- Building with 2 internal security doors (2 x lock, 2 x IPCCTV, 2 x Motion detection)
- With RJ45 connectivity: 21 connections are required

TERA Connectivity & Some Math

- Building with 5 external doors (5 x IPCCTV, 5 x supporting other services)
- Building with 2 internal security doors (2 x IPCCTV, 2 x supporting other services).
- With TERA connectivity only 14 connections are required
BMS – Lighting Controls...

Equipment rack/ LAN switch

Cross-connect

Lighting Control

Motion Detector

Emergency Lights (Battery-Powered)

Incandescent Lights

Exit Sign

Outdoor Floodlights

Equipment rack/ LAN switch

Cross-connect

Lighting Control

Motion Detector

Emergency Lights

Fluorescent Lights

Exit Sign

Administration PC
Building The System...

Connectivity & PoE

- All copper Categories above Cat 5e will all support PoE
- Shielded cables offer better electrical dissipation than UTP
- Low cost LED now looking towards PoE as the primary electrical source.
- Shielded cables are recommended by most manufacturers
The BMS Connector Marketplace...
The BMS Market Challenge...

Protocols

• Still a very strong ‘stand alone’ infrastructure/own cabling systems

• Dedicated open systems protocols for BMS such as:
  1-Wire, BACnet, DALI, DSI, Konnex, LonTalk, Modbus, oBIX, ZigBee*, xAP

• Dedicated open systems protocols for Building Automation such as:
  DF-1, FOUNDATION fieldbus (H1, HSE), Profibus, PROFINET IO, CC-Link Industrial Networks, CIP, Controller area network, ControlNet, DeviceNet, DirectNET, EtherNet/IP, Ethernet Powerlink, EtherCAT, Interbus, HART Protocol, Modbus, Ethernet Global Data (EGD), FINS, HostLink, MECHATROLINK, MelsecNet, Optomux, Honeywell SDS, GE SRTP, SERCOS interface, SERCOS III, Sinec H1, SynqNet, TTEthernet, PieP, BSAP
Summary...

The focus of copper cabling (standards) is now data centre focussed
The future of copper is changing and convergence for green is growing as the new market trend
There will be a new next generation of copper cabling – But we will have to wait and see what it is.

Thank You