Testing and Certification:
Ethernet Performance and TIA with the Latest in Testing & Troubleshooting Cable and Networks
Presented by Wendy Thomas
IDEAL Networks
A Division of Ideal Industries Inc.
Agenda

- Introduction: What Does Testing Mean Today and What Options Are Available?
- Verification Testing: Test As You Go
- Prove That It Works: Performance Testing
- Reporting: What's Required for Your Customer and Your Own Documentation
- Troubleshooting? Cable, Network or Poe?
- TIA Certification: When and Why
- Summary: Choosing the Right Tester
It’s not enough to install the cable. Today’s cable supports mostly Ethernet devices. Devices make up a Network. Speed and performance matter!

NETWORKS 101
Where are networks used?

- Markets with rapid growth in network construction:
  - Financial
  - Healthcare
  - Education
  - Manufacturing
  - Retail
  - Government
  - Transportation
  - Data Centers
  - Industrial

How much do you need to know to work and grow effectively?
First, some basics. What is this?

- A Cat 5 cable?
- How do you know what category it is?
- Because it’s a blue cable?
- A patch cord?
  - Yes
- A Network cable? An Ethernet cable?
  - Yes
- What is Ethernet? What is Cat 5? Let’s discuss.
### Terms and Definitions

<table>
<thead>
<tr>
<th><strong>STP</strong></th>
<th>Shielded Twisted Pair - cable with a shield around the inner pairs to prevent interference. Rarely used in US except for Cat 6A.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bits</strong></td>
<td>Small pieces of information that are grouped into frames or packets before being sent onto the network.</td>
</tr>
<tr>
<td><strong>Cat 5e</strong></td>
<td>Cable rating that supports up to 1,000 Mb/s (1Gb/s) data rate. Certified to 100MHz. Accounts for 45% of sales.</td>
</tr>
<tr>
<td><strong>Cat 6</strong></td>
<td>Cable rating that supports up to 1,000 Mb/s (1Gb/s) data rate. Certified to 2500MHz. Accounts for 29% of sales.</td>
</tr>
<tr>
<td><strong>Cat 6A</strong></td>
<td>Cable rating that supports 10 Gb/s (10,000 Mb/s) data rate. Certified to 500 MHz. Accounts for &lt;25% of sales.</td>
</tr>
<tr>
<td><strong>Cat 7</strong></td>
<td>STP Cable that supports 10 Gb/s (10,000 Mb/s) data rate. Certified to 600 MHz. Accounts for &lt;5% of sales.</td>
</tr>
<tr>
<td><strong>Cat 8</strong></td>
<td>Future cable rating that supports 40 Gb/s data rate. Will be certified to 2,000MHz. Will use UTP or STP.</td>
</tr>
<tr>
<td><strong>Cable/Connector Categories</strong></td>
<td>Performance ratings for network cable and jacks. Common categories are Cat 5e, Cat 6, Cat 6A, Cat 7. Defined by TIA-568-C standard.</td>
</tr>
<tr>
<td><strong>Certifier</strong></td>
<td>An advanced cable tester that is used to determine cabling meets the performance requirements of TIA-568-C standard for Cat 5E, 6, or 6A.</td>
</tr>
<tr>
<td><strong>Ethernet</strong></td>
<td>Communication protocol &quot;language&quot; networked devices use to communicate. There are different speeds from 10Mb/s to 10Gb/s. Standard defined by IEEE.</td>
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<tr>
<td><strong>Frame</strong></td>
<td>A cluster of information that is sent from one device on the network to another. Think of it as a bus full of information on the highway. Frames come in different sizes.</td>
</tr>
<tr>
<td><strong>IEEE 802.3ab</strong></td>
<td>IEEE Standard that defines performance requirements for gigabit Ethernet.</td>
</tr>
<tr>
<td><strong>IP Address</strong></td>
<td>A temporary ID assigned to a device on a network. Used as a source &amp; destination address for data frames. Think of it as a mailing address, they change over time.</td>
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<tr>
<td><strong>LAN</strong></td>
<td>Local Area Network - a group of Ethernet devices that communicate in a geographical area typically as large as a campus.</td>
</tr>
<tr>
<td><strong>MAC Address</strong></td>
<td>Media Access Controller Address - The permanent hardware ID of a device. Every Ethernet device in the world has a unique MAC. Think of it as a social security number.</td>
</tr>
<tr>
<td><strong>Mb/s</strong></td>
<td>Mega bits per second – the data rate at which devices are communicating on the network.</td>
</tr>
<tr>
<td><strong>MHz</strong></td>
<td>Millions of cycles per second (frequency). Used to describe the different performance ratings of cable systems.</td>
</tr>
<tr>
<td><strong>Packet</strong></td>
<td>A cluster of information that is sent from one device on the network to another. The term is used interchangeably with Frame.</td>
</tr>
<tr>
<td><strong>PoE</strong></td>
<td>Power over Ethernet - a way of sending DC power through a network cable to power small devices like phones, wireless access points and cameras. 48V typical.</td>
</tr>
<tr>
<td><strong>Qualifier</strong></td>
<td>A basic tester that is supposed to provide information about the quality of network cabling. Currently available products do not explain their measurements nor pass/fail criteria.</td>
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<tr>
<td><strong>Router</strong></td>
<td>A devices that manages the passing of data between different LANs or between a LAN and a WAN. When connecting a LAN to the internet it is called a Gateway. Network testers identify the Gateway IP address when connecting to the network.</td>
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<tr>
<td><strong>Switch</strong></td>
<td>The central component on a LAN that interconnects all of the individual devices to the network. Switches are rated at 100/1000 Mb/s.</td>
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<td><strong>TDR</strong></td>
<td>Time Domain Reflectometer - a method of measuring the distance to opens, shorts or other anomalies on a cable.</td>
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<tr>
<td><strong>TIA 568-C / TIA 1152-A</strong></td>
<td>TIA Standard that defines performance requirements for Cat 5e/6/6A cable &amp; connectors.</td>
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<tr>
<td><strong>Transmission Tester</strong></td>
<td>An advanced tester that is used to determine whether cabling or an active network meets the performance requirements of the IEEE 802.3ab gigabit Ethernet standard.</td>
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<tr>
<td><strong>Verifier</strong></td>
<td>A basic tester that checks the continuity of network cables. Used to make sure connectors are properly terminated. Sometimes measure length.</td>
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<tr>
<td><strong>WAN</strong></td>
<td>Wide Area Network - a group of LANs that are connected together. The LANs can be near or far from one another.</td>
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<tr>
<td><strong>WAP</strong></td>
<td>Wireless Access Point - a device that allows wireless devices like laptops and tablets to connected to the wired LAN. They are spread throughout a LAN and cabled back to a switch.</td>
</tr>
<tr>
<td><strong>Wire map</strong></td>
<td>Basic continuity test of connectors onto a cable. Checks for opens, shorts, miswires and split-pairs.</td>
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</tbody>
</table>
More and More Acronyms

- IoT
- BAS
- DAS

Above are commonly used. What are they?
More and More Acronyms

- **IoT** Internet of Things
  - Network of physical objects that collect and exchange data

- **BAS** Building Automation System
  - Management of a building's HVAC, lighting, and other systems

- **DAS** Distributed Antenna System
  - Network of Antennas for wireless service

New terms because there is constantly new stuff.
Back to Basics: Components

Typical Ethernet Link

- **Cable** - 295 ft. maximum length.
- **Modular Jacks (RJ45)** – Terminated to the cable at each Work Area.
- **Patch Panel** – Termination point in the Telecom Room where all the cabling comes together.
Categories and Data Rates

- Cable & connector performance is specified by a Category rating.
- What is the network owner paying for?
  1. The ability to transmit data from one place to another.
  2. A data rate that meets their needs.
- 1 gigabit (1000 Mb) is more than enough for most users.
- What category of cabling is needed to support 1 Gb/s?

<table>
<thead>
<tr>
<th>Data Rate</th>
<th>Cable Rating</th>
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<tbody>
<tr>
<td>10 Mb/s</td>
<td>Cat 3</td>
</tr>
<tr>
<td>100 Mb/s</td>
<td>Cat 5</td>
</tr>
<tr>
<td>1 Gb/s</td>
<td>Cat 5e, Cat 6</td>
</tr>
<tr>
<td>10 Gb/s</td>
<td>Cat 6A</td>
</tr>
</tbody>
</table>

Cat 7A is for 4 pair Shielded—not common.
Cat 8 isn’t ratified, data center/short distance application, not mainstream.
Most Basic Test is Wire Map Test

• Wire Map Test is used to detect shorts, opens, and miswires.
• Minimum test that should be performed
• What specifically does the Wire Map Test do?
  – Detects any wiring errors
  – Identify combinations of up to three: opens, shorts, and/or cross-connections
  – Indicates Opens and/or Shorts (Continuity)
  – Identifies Split Pairs
• NOT a performance test.
Reversal

- Conductors on one end are reversed from the order at the other end
- Can be 1\textsuperscript{st} conductor wired to 2\textsuperscript{nd} slot
- Can be all 8:
  1-8
  2-7
  3-6
  4-5
  etc.
Open

- Usually an open signifies a poor termination, not making contact
- Can also be a cleanly cut conductor
- Or an over-punched conductor
Short

• Can be a nick exposing bare conductors
• Can be 2 conductors in 1 IDC slot on a modular jack
• Nail, screw or staple through a cable
Miswire

- Conductors are not in the same order at both ends of the cable
Split Pair

- Conductors are in the same “wrong” order at both ends of the cable.
- 2 pairs of conductors are split from each other and mated with conductors from an adjoining pair.
- Passes continuity but introduces excessive crosstalk causing slow data rates.
You could be testing Horizontal Cabling.

Horizontal Cable <295 ft
Patch Panel
Telecom Room
Work Area Outlet
Outlet
Must all be same minimum rating
Or Backbone Cabling

- Backbone cabling is used to connect multiple TRs to a central location.
- Three typical types of backbones.
  - Multi-floor buildings
  - Extending the reach in large buildings (factories, distribution centers)
  - Connecting multiple buildings together (campuses)
- Copper backbone runs are limited to 295 ft.
- Fiber optic backbone runs can be 2000 ft. or more.
Why does testing length matter?

• 295’ is the limit for performance rating of cable
• How much cable is behind the wall, left in the box or coiled up in the back of your truck, closet or warehouse?
• Where is the break or short?
• Has the cable exceeded the recommended allowed distance for maximum performance?
• How far are you from the closet or termination?
• How much cable do you need for additional runs?
Attached to the Cable are Networking Devices

- Any number of devices can be connected to a network.
- Most are IP addressable
- Many devices now require PoE.
- Multiple switches can be connected together to extend the reach beyond 295 ft.
- Ethernet is not limited to computer networks – there are multiple other uses
What has an IP address?
Lots of stuff!

- Computers, tablets, smartphones, printers
- Voice over IP Phones
- Wireless Access Points
- Lighting
- PLC and Automation
- Access Control
- Cameras
- Websites (i.e. the internet)
- Electronic Signs
- A/V
- Smart Boards
- Appliances
- HVAC, Thermostats
- Vending machines
- Cash Registers/ATMs
- Fuel Pumps
- Kiosks
Why do you care?

What are all these things connected to? **Cable.** And the Network. **Ethernet!**

What and who gets blamed first if something’s **not** connected to the network, can’t reach the internet or has a network issue?
Devices needing PoE-What is it?

- Per Wikipedia: Power over Ethernet refers to a system or standard that allows a single cable to provide both data connection and electrical power to devices such as wireless access points or IP cameras.

- Voice over IP Phones
- Network or IP Cameras
- Access Control Points

Again, why do you care? It’s your cable that transmits the power from the switch to the device. What gets blamed first?
What Level of Testing do you need?

If you want to test beyond the cable, what do you need?

A cable that passes wire map SHOULD work.

Do you need to prove that it DOES work?
CLASSES OF TESTERS

Application, Use and Function
Summary of Tester Types

- IDEAL Networks breaks out 4 types of testers on our Selection Chart:
  - Verification
  - Network
  - Transmission
  - Certification

- Verification doesn’t provide performance data.
- Certifiers and Transmission Testers are performance testers, measuring to recognized industry standards.
Examples and Comparisons of What Each Test Provides

VERIFICATION VS TRANSMISSION TESTING
Verification

Most basic, test as you go, every cable should be verified.

Verifiers test continuity, wire map and possibly length which does not guarantee the cable will support data transmission.

*It should work but no proof it actually does.*
Transmission Test Example

• Data is transmitted bi-directionally across the cable.
• The tester counts any dropped frames and compares to the IEEE 802.3ab standard to make a Pass/Fail determination.
• This type of test ensures that the cable actually performs as expected.
SignalTEK Guarantees Performance

- The IEEE Ethernet standard has specific performance requirements
- Some testers are “qualifiers” and make claims about performance but are not actually transmitting data or testing to a standard
- SignalTEK is the only tester in its class that proves cabling meets the IEEE data drop limit by measuring actual data on the cable

*Some local jurisdictions may have code requirements for voltage drop*
Simplicity in Operation

• Easy to use, easy to report
  – If you can use a VDV II, you can use SignalTEK

• Simple configuration

• The NT model also performs tests fiber and has network/PoE functions.
It’s good to prove the cable works: 
by a documented cable performance test
But what about the call that comes in after you’ve left 
the job, saying something doesn’t work?
How do you know what’s wrong?

• Is it the cable?
• Is it a connectivity issue?
• Is it a PoE issue?
• Is it a Bandwidth issue?
SignalTEK CT and SignalTEK NT will check the physical cable

- IEEE Ethernet Performance Test on copper 4 pair cable
- Wire Map
  - Advanced Fault Finding
  - Which Pin
  - Which End
- Tone
- Length
  - Distance to break
  - Distance to short

To check more than the cable, SignalTEK NT is needed
SignalTEK NT also checks and troubleshoots the active Network

- Is the port active?
- What is the IP address?
- Is there PoE?
- Does the network have enough bandwidth?
- Do I need to test fiber or check an active fiber port?

Just by plugging SignalTEK NT into a network port, it tells you lots of stuff.
Remember the call we got?

Something doesn’t work?

• Is it the cable?
• Is it a connectivity issue?
• Is it a PoE issue?
• Is it a Bandwidth issue?
Server can’t connect to camera

✓ Does the drop have access to the network?

• Assuming you’ve tested the cabling...
  - Check network connectivity – verify link speed and that an IP address was obtained
  - Run a ping test to the Server’s IP address. No response means the Server isn’t accessible.
  - You can also ping the camera itself to see if it’s online
Back to our call

Something doesn’t work?

• Is it the cable?
• Is it a connectivity issue?
• Is it a PoE issue?
• Is it a Bandwidth issue?
Detecting PoE is great, but troubleshooting requires a PoE load test

The tester acts as a PoE PD (powered device) and requests power from the network, measuring the voltage and current provided. Compare available power to the requirements of your devices.
Final thing to check

Something doesn’t work?

• Is it the cable?
• Is it a connectivity issue?
• Is it a PoE issue?
• Is it a Bandwidth issue?
Checking the active Network

– Run a stress test on the network itself
– Create traffic by application or amount
– Run that traffic through switches
– *Does the network have enough bandwidth?*

SignalTEK NT has the unique ability to stress test an active network based on amount of traffic calculated using the “Bandwidth Calculator.” Make sure it works while everything’s up and running and before adding more devices:

- the network isn’t too slow
- dropping packets
- crashing.

All of which the cable gets blamed for.
SignalTEK NT #R156004 automatically generates test reports in PDF or CSV format. The summary page of each report can be customised to include logo, company and operator details.

Choose between 3 different reports that can show either passed, failed or all test reports in each report:

1. Summary
2. Brief
3. Full
Brief report

Full report
Even a new IDEAL App for Wireless Reporting!

Get tests from the job site to your Office or customer fast!
Cable installers and IT technicians can share difficult problems and test results with colleagues not located onsite to help with troubleshooting, improve productivity and minimise downtime.

Please note tests can also be transferred using USB thumb drive, just like SignalTEK CT.
Who Tests & Why

NETWORK CABLE TESTING
Drivers of Cable Testing

1. Good practice, company policy
2. Job requires installation documentation
   - Requirements may or may not be specific
     • What tests and reports are needed to fulfill contract requirements?
3. Contractor/Installation company wants protection
   - Proof of proper installation for callbacks/trouble calls
   - In recent focus groups we found nearly all test for this reason at a minimum
   - We also found that majority don’t understand what is being tested, know difference between types of testers, or fall for deceptive marketing & advertising
Jobs Requiring Documentation

What type of test and report is required to meet the job requirements?

Job specification requires:
TIA-568-B.x, 568-C.x standards
Warranty or
NEXT, Return Loss, Insertion Loss, ACR, Alien Crosstalk, etc.

**No**
Contractor can use anything that generates report.
IDEAL Products
SignalTEK CT, SignalTEK NT, LanTEK

**Yes**
Requires a **true** Certifier that performs a complete Certification test as defined by the TIA standards.
IDEAL LanTEK III

Focus Group Video
Why Certification?

- New construction, commercial, data, government and education, large projects
- Frequency based testing to TIA or ISO standards
- Comprehensive performance test per cable rating and standard
- Thousands of measurements on each cable
- Data plotted into numerical and graphical display
- Necessary for payment and warranty
TIA Certification requires LanTEK III

- Copper Certification to TIA Category Standard
- Warranty submissible
- IDEAL DataCenter software for professional reports
- FiberTEK III for Tier 1 Fiber Certification
PRODUCT RANGE AND APPLICATIONS
What is the **right** tester for you? Features and cost-both matter

The right choice might be an inexpensive wire map tester.

But if you want to do more, there are options.
## Cable Installation & Troubleshooting

### Cable Installation Testing & Troubleshooting

<table>
<thead>
<tr>
<th>Cable Verification</th>
<th>VDV II</th>
<th>VDV II</th>
<th>SignalTEK CT</th>
<th>NaviTEK NT</th>
<th>SignalTEK NT</th>
<th>LanXPLORER</th>
<th>LanTEK III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced wiremap Test</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Length to Open</td>
<td>Plus</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>TDR Length to Short</td>
<td>Pro</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Fiber Optic Ready</td>
<td>•</td>
<td>Pro</td>
<td>FO Version</td>
<td>Plus &amp; Pro</td>
<td>●</td>
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<table>
<thead>
<tr>
<th>Performance Testing to Standards</th>
<th>VDV II</th>
<th>VDV II</th>
<th>SignalTEK CT</th>
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<th>SignalTEK NT</th>
<th>LanXPLORER</th>
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<tbody>
<tr>
<td>IEEE Cable Transmission Test</td>
<td>●</td>
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<td>IEEE Active LAN Transmission Test</td>
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<td>●</td>
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<tr>
<td>TIA 568-C Cable Certification</td>
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<td>Fiber Optic Performance Test</td>
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<td>FO Version</td>
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<td>Generates Test Report</td>
<td>●</td>
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<td>Plus &amp; Pro</td>
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<thead>
<tr>
<th>Tracing &amp; Connectivity</th>
<th>VDV II</th>
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<th>SignalTEK CT</th>
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<th>SignalTEK NT</th>
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<th>LanTEK III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tone Generator (audible trace)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Flash Switch Link LED (visual trace)</td>
<td>Pro</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Ethernet Service Detection</td>
<td>Pro</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<td>●</td>
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<tr>
<td>PoE Detection</td>
<td>Pro</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Available PoE Watts</td>
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Questions?
IDEAL Networks can help.

Contact IDEAL Networks for additional information

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Wendy.Thomas@idealnetworks.net
Thank you!