Testing Residential Cabling Systems

A hundred years ago, it was unheard of to run wires through the walls of your home for telephones. 50 years later, telephone wiring was commonplace, but people would scoff at the idea of television wiring in the home. Today, all homes come standard with both telephone and TV cabling pre-installed. What about the future? The next anticipated trend is structured communications cabling for home computer networks. In the near future, homes will have multiple computers, printers, scanner, and fax – all connected to the Internet via a single high-speed connection. Homeowners will expect pre-wired jacks for computer networks alongside telephone and cable TV outlets.

Already, much work is being done to standardize requirements for home cabling, often called SOHO (Small Office Home Office) cabling. In the U.S., this is covered in TIA 570A, the Residential and Light Commercial Telecommunications Wiring Standard.

Installers and contractors who will install this new cabling need to learn new skills and information because data cabling installation is similar, but markedly different from the practices used to install telephone wiring. In fact, even telephony wiring is changing. Many newer systems employ the same 4-pair UTP cabling used in data networks.

Residential data communications cabling is typically 4-pair, 100-ohm twisted pair cabling rated at Category 5 or 5E. It runs from the Network Interface Device (or NID, a wiring distribution panel, located near the outside data access connection) to outlets positioned in rooms throughout the home. The homeowner may choose to connect a hub at the NID, or simply connect directly to the outside Internet access service, depending upon the desired complexity of the home network.

When installing residential cabling, care must be taken to preserve proper twist ratios in the cable when attaching data jacks, in order to minimize crosstalk concerns. To avoid deformation, the cable also should not be stretched or pulled around sharp corners, which could lead to performance degradation. When possible, data cabling should be routed away from cables carrying AC power to avoid noise coupling.

Certification and verification

In commercial cabling, standards are well established for the testing and certification of structured wiring systems. Business systems are expected to place high demands on installed cabling and a myriad of standards define installation and test requirements. Such networks are "certified" to meet standards. What does this mean?

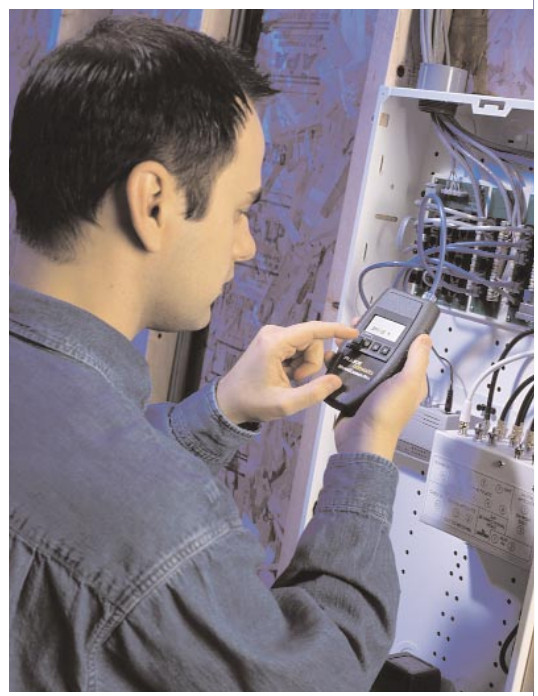


Figure 1: Installer uses MicroScanner Pro to test and verify a structured cabling home network.

Certification refers to the process of making measurements and then comparing the results obtained to pre-defined standards, so that a pass/fail determination can be made. In the case of a Category 5E link, for example, a tool such as the Fluke Networks OMNIScanner2® makes thousands of measurements across a bandwidth of 100 MHz, and compares them to complicated formula from agreed-upon standards before an answer can be obtained.

Application Note

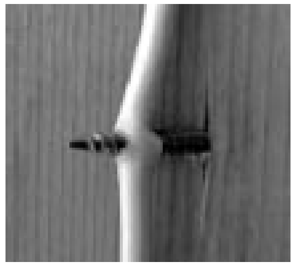
Network SuperVision Solutions™ for residential network testing.

In contrast, most home wiring systems are "verified." Verification ensures that basic continuity and correct terminations have been applied, but does not attempt to measure the information-carrying capacity of the link. This is a reasonable simplification to make, because home networking links are considerably shorter than commercial wiring links.

Because the links are shorter, they do not suffer nearly as much from attenuation losses. Since the signal is typically much stronger, impairments such as near end crosstalk (NEXT), far end crosstalk (FEXT), or return loss are much less of a concern.

Wiremap

In verifying residential wiring, the most important measurement or diagnostic is wiremap. Wiremap ensures proper pin-to-pin connectivity between both ends of the link **(see Figure 2)**. In the home, a cable could be cut or shorted by a nail or staple. It could be incorrectly terminated or miswired. It could be damaged by other construction processes. A good wiremap tester will quickly find any breaks, shorts, or miswires. Correct wiring and common errors are shown in **Figure 2**, while a typical fault displayed in a field tester is shown in **Figure 3**.



Diagnostics

What happens when a fault is detected? First, you want to correctly identify it in order to fix the problem quickly. This means diagnostic functions in your tester are useful. For example, let's say your wiremap tester tells you pin 2 is open or missing. Where is it open? At the local connection? 10 feet away? 30 feet away? 50 feet away? At the far end connector? You could waste a lot of time trying to find the source of the problem with visual inspection. And what if much of the cable is hidden in the wall? This is why TDR (Time Domain Reflectometry) functions are extremely handy in a field tester. TDR is like "cable radar," and it

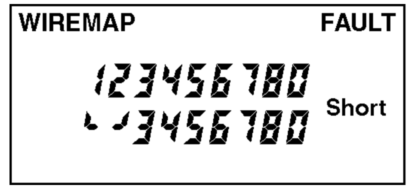


Figure 3: Wiring Fault and Field Tester Wiremap Display

allows you to see how far away an open or shorted event is. In the preceding example, a TDR function (usually called length measurement) might tell you pin 2 is open at 33 feet; whereas the cable itself is 58 feet long.

And what is at the far end of the cable? It is open? Shorted? Connected to a hub? The ability of the tester to identify what is happening at the far end also saves time when troubleshooting. **Figure 4** indicates a field tester screen identifying the length of the cable and the nature of the far end termination. The connection is to an inactive network hub. If the hub was active, the speed (10/100) of the connection would be indicated.

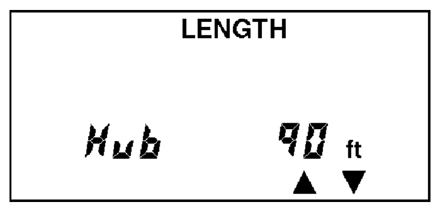


Figure 4: Field Tester Identifying Length and Termination of an Unknown Cable

UTP and Coax

In residential applications, it is useful to have this length function be supported for both twisted pair and coaxial copper cable. Then you can troubleshoot telephone, data, and CATV cabling problems with a single tester. Length is also useful because it allows you to measure and record the total length of installed cabling for documentation and billing purposes.

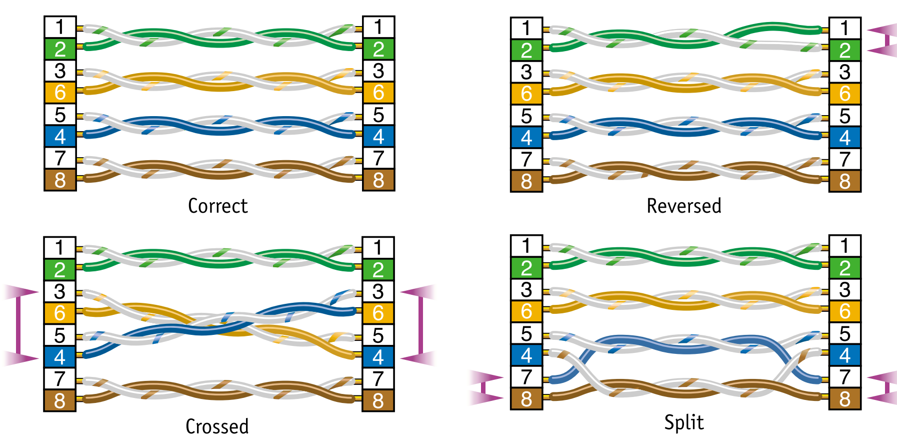


Figure 2: Common Wiring Errors

Another popular troubleshooting tool is the toner/probe. This is actually a pair of tools used together. The toner generates a special signal on an attached cable. The probe “listens” for the signal, and when its tip is in close proximity to the cable, sounds an audible musical tone. The closer the tip is to the cable, the louder the sound. This is useful when you need to identify one cable from a group clustered together, or find a cable that might be hidden behind a wall. You attach the toner to the known end and set it to generate the signal. Then you sweep the probe across all the potential far ends or cabled areas, and listen for the distinctive tone.

Home networks are being installed at an ever increasing rate. Within five to ten years, they will be commonplace. They represent a great opportunity for residential cabling installers to provide a useful service with good profit margins. However, data cabling requires a bit more than the “install and forget” methodology. Simple tests to verify your residential cabling is installed correctly and professionally will lead to increased customer satisfaction and repeat business.

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