Preserving Data Integrity in the Telecommunications Pipeline

Our thanks to Pomona Electronics for allowing us to reprint the following article.

Rapid advancements in telecommunications technology pose increased challenges in providing customers with broad bandwidth transmissions at the speeds they expect within the local loop. With the development of new technologies such as xDSL, more data is being transmitted at faster speeds. Thus, ensuring the integrity of that data has become increasingly important. Considering that twisted pair copper, which was originally designed for only analog (voice) transmission, is still being used as the media for these faster and more voluminous data transmissions, several key issues arise.

Twisted pair is not the best medium for the volume and speed demands being experienced in the pipeline today, let alone the limitations it will place on emerging data transmission network architecture. However, the cost for complete replacement of twisted pair in the pipeline by other media such as coax or fiber isn't feasible in many installations. The true challenge becomes developing new transmission data formats that will work faster with either twisted pair or fiber. These new data formats would provide for the continued use of existing twisted pair installations, which are prevalent in commercial and residential facilities, and allow for the flexibility of future conversion to fiber. Until then, testing of twisted pair copper is still a primary concern.

Telecommunications Testing

To ensure the integrity of the data speeding across the phone line, proper installation, qualification and maintenance of the network, from the backbone to the home or business is critical. Periodic testing of the line is required to assure continued transmission accuracy. Essential tests include cable and transmission testing of the physical layer to verify its capability to transmit analog or digital signals; protocol analyzer testing to monitor the traffic on a network and to determine that it conforms to the expected protocols; and wireless communications testing of mobile/cellular base stations and mobile phones.

A variety of general purpose and specialized test instruments and accessories have been developed for cable, transmission, protocol, and wireless testing. From general purpose analog meters for POTS (Plain Old Telephone Service) testing to specialized instruments such as DSL, ISDN and SONET testers, a variety of equipment exists to provide the technician with the tools to perform comprehensive testing of the various layers in the network.

Test Challenges

The biggest challenge facing the technician is to develop the necessary skills to hook up to the system, locate the problem, and fix it as quickly as possible. Additionally, it is critical to fix each problem on the initial visit. Repeat calls for the same problem are both costly and inconvenient to the customer. Choosing appropriate equipment and accessories will help the technician isolate the problem correctly on the first visit, and ensure the problem is fixed quickly and accurately. Technicians must also develop the skills needed to perform line qualification and fault isolation tests encompassing a variety of analog and digital transmission formats. Examples include high-bandwidth xDSL (Digital Subscriber Lines), ISDN (Integrated Services Digital Networks), SONET (Synchronous Optical Network) and ATM (Asynchronous Transfer Mode). The tremendous number of combinations of potential physical faults, data transmission errors, and non-conforming protocols all add to the complexity of fault isolation and emphasize the need for having the proper equipment and accessories readily available.

Optimizing Test Results

A broad assortment of cable and connector types have been designed to interface the instrument to the physical media. Examples of copper-based connections include RJ11¸ RJ45, RJ48, Bantam, WE310, 5-Pin Protector, BNC, Mini WECO, Standard WECO, and 66/110 Block adapters/interfaces. There is also a wide variety of multi-pair cable assemblies, such as Front Tap Shoes with Bendix or Cinch-Jones connectors, for testing a large number of twisted pair lines. Each of these is designed to provide easier access to the test signal.

Choosing the appropriate test accessory can make the difference in how easily and efficiently the technician can complete the task at hand. For example, Pomona provides a wide selection of test accessories designed for use in both the Central Office and OSP (OutSide Plant). Some of these include patch cords and adapters with Bantam (DS1), WECO 310 (DS0), and coaxial 75-ohm BNC/Mini WECO/Standard WECO connectors.
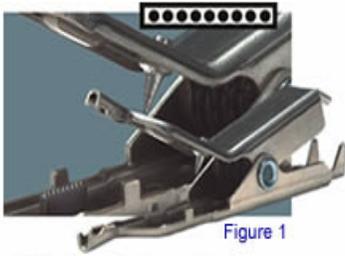
Figure 1

With fewer piercing points, the row-of-points style clip minimizes wire penetration and reduces the likelihood of breakage.
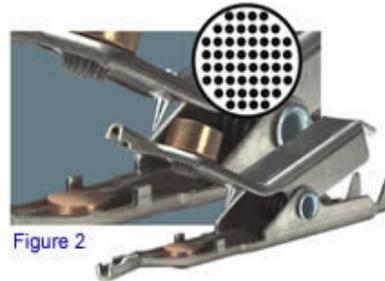

Figure 2

The bed-of-nails/single-needle style clip is for small wire penetration and single penetration of heavier wire.

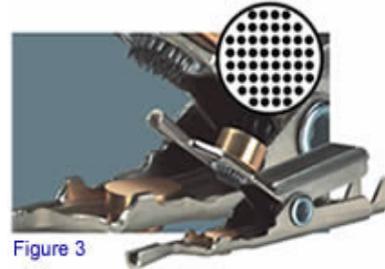
Figure 3

The bed-of-nails style clip is for small wire penetration.

Figure 4

The single-needle style clip is for single penetration of heavier wire.

A complete family of piercing alligator test clips, primarily for use in the field, allows the technician to quickly access twisted pair lines with minimal risk of wire damage. Pomona's offering includes eight piercing Alligator Test Clip model configurations to meet a variety of multi-purpose test requirements, including piercing wire sizes from 14 to 26 AWG (Figure 1). One of the newest piercing clip styles features a "row of points" configuration that is attached to a banana or bantam plug. With fewer piercing points, the "Row of Points" clip minimizes wire penetration and reduces the likelihood of breakage (Figure 1). Other types include a "bed-of-nails" style for small wire penetration (Figures 2 and 3), and single-needle style for penetration of wires with heavier insulation (Figure 4). All styles, with their wire piercing capability, eliminate the need for insulation stripping and splicing, significantly reducing test time for the technician.

Other accessories like the Mini WECO, Standard WECO, 75 Ohm BNC (DSX-3) coaxial cables and adapters, Tel-Line Tester, and Universal DSX-3 kit, are used primarily for testing in the Central Office and OSP. Again, choosing the best tool for the job at hand can make the difference. For example, the technician can use the DSX-3 test kit to test, monitor, patch and cross-connect circuits while eliminating the need for multiple cables, optimizing testing efficiency.

Another example is the Tel-Line Tester, which plugs into 5-pin protectors and eliminates the need to strip or splice wire. To troubleshoot, the technician simply clips a butt set or voltmeter to the appropriate metal tabs and checks the switch to determine whether the problem is located in the field or at the Central Office without having to cut and strip wires to isolate the problem, providing significant time-savings. A wide assortment of patch cords and cables with various breakout terminations such as alligator and Minigrabber® test clips, and RJ48 plugs, are also available to meet a variety of testing needs.
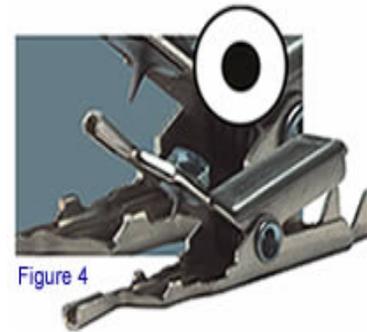
Other factors figuring into the equation for improving test accuracy include the type of test accessory itself. Nickel-plated Bantam and WE310 test plugs reduce oxide build-up that could affect signal integrity. Accessories manufactured from molded plastic housings provide strain relief for durability and shielded cables protect signal integrity.

While agreement on the importance of proper testing to ensure data integrity is probably not the issue, how this is accomplished can mean the difference between a difficult or simple test job and the degree of accuracy achieved. The biggest advantage to choosing proper test accessories is that it makes the technician's job easier and faster, with more accurate results.

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