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Video and high-speed networks

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No longer does every cable carry a synchronous video stream.

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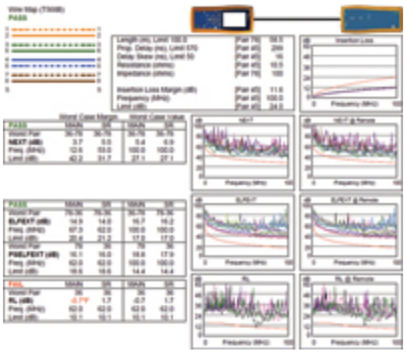

Figure 1. Measuring Cat 7 cable
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Today's engineering staff has to be aware of packetized networks and how they affect the modern facility. As the requirement to distribute very high data rate streams (either synchronous SDI or asynchronous network traffic) around film and television facilities grows, the modern engineer has to be familiar with the copper (both coaxial and twisted-pair), as well as the optical cabling standards that cover 3Gb/s video, 10GigE and new standards supporting more than 10Gb/s over fiber.

Because data rates will only increase as 50p/60p video and 4K film become commonplace, nobody involved in engineering can afford to be ignorant of such developments.

Film and TV production moving to faster networks

Is convergence really here at last? It does indeed seem so now that technical staffs have to know as much about FTP servers as they used to know about the head-drum in a VTR. Recent years have seen a sea change. For broadcasters, it's SD to HD with system integrators now selling more HD coaxial cable than SD, and commissioning editors not paying for SD programming. For film, it's the shift from 2K to 4K for workflows and less reliance on 1K proxies. GigE can be too slow, so a change to 10GigE is needed in many instances.

The trend is upwards. Moore's Law hasn't yet run out for both storage and bandwidth, and the upshot of all this is that machine rooms are starting to look more like data centers. Increasingly, system integrators are planning the Ethernet and fiber first, and video/audio are the afterthought.

Changes in storage

An illustration of how wrong technologists can get things is shown in an article published in “Practical Mechanics” magazine in the mid-1930s. It suggested that new designs for DC motors would mean the cheap availability of motive power to all households in the form of a large motor in the loft that would, via a series of belts, power the washing machine, the heating and anything else that needed the services of a motor. What they didn't realize was that motors would get so cheap that there would be dozens in every house. The same can be said of domestic computers.

How many microprocessors are there in your house? How many are you carrying at the moment? These include smart phones, iPods, etc.

The same is also true of high-performance storage; the original vision of one large facilitywide SAN is giving way to commodity hardware based on more open standards. It's now common for the NLE to be hanging off a TCP/IP-based storage system, which means the same network topology is applicable for production, post-production/transmission servers and VOD services.

Network and facility's business model

Large and small post houses' network infrastructures are becoming an essential part of their provision for the business. Flexibility and agility are the name of the game, and whereas fiber was previously an exotic extra, it is now essential to wire a building in the same way you might have done with Cat 5 a decade ago. The emerging 10Gb/s standards for copper networking are also a wise investment — less than a factor-change in cost but they give an order of magnitude improvement in network performance. All the research currently being done by the IEEE indicates that Cat 7 cable will be good for 100Gb/s Ethernet.

Since 2007, large facilities have been updating their entire production networks to 10GigE. Typically this is arranged in two phases — in traditional network terms, the horizontal and vertical segments — the departmental networking and the campus backbone. Both engineering staff and wiremen have to be trained to the new standards, and investment needs to be made in tooling and test equipment.

10Gb/s over copper — Cat 7/6a

Because there is no ratified standard for Ethernet at this data rate, different manufacturers use different terminology. The Germans refer to the cable as Cat 7 (see Figure 1 on page 8), the Americans call it Cat 6a (the “a” means augmented), and another name is XG 10gig cable. The new cable uses a 600MHz channel and QAM and OFDM signal processing techniques to send 10Gb/s down 100m of cable without violating information theory.

New cable construction

The differences in cable and termination are sufficiently different from traditional Cat 6 as to require various tools and techniques. Every parameter is specified, even down to the sub-50N force you can apply when pulling it into ducts. The IEEE has accepted that relying on common-mode rejection as the only means of noise reduction is flawed, and consequently this new cable is double-screened; the pairs are individually shielded, and there is an overall screen. The cable is also referred to as PIMF (pairs in metal foil). The reasons for differences are:

- Near-end cross talk is dramatically reduced by virtue of the new ends and termination tool. When properly terminated, the twisted-pair and shield is maintained to within a couple of millimeters of the pin on the connector. You could never achieve this with traditional punch-down methods.
- The over-shield minimizes alien crosstalk. Cat 5e and Cat 6 never really enjoyed this advantage.
- The foil shield around each of the pairs minimizes interpair crosstalk.
- There is no RJ45 plug that can be crimped on. You can only buy premade patch cords. Panel-to-panel wiring is the only termination type permitted on-site.

Testing

Testing 10Gb/s over copper isn't yet ratified, so we use a slightly ad-hoc method; 10GigE testing should be performed to ISO 11801 Class E_A channel testing using PIMF 600 patch cables. (Channel refers to the end-to-end path between the sending and receiving equipment, as opposed to the permanent link which is the fixed part of the cabling excluding patch cables and the like.) The latest draft standard for 10GigE cabling system performance is ISO Class E_A Ch 25N1255, but there is currently no permanent link standard for measurements as the link requires component performance parameters which are yet to be defined.

Fiber-optic cabling

In tight-buffered fiber, the glass fibers are lined with a nylon jacket coated in a plastic sheath. These cables are cheap to manufacture and are flexible enough for dressing within equipment bays. The problem with tight-buffered cable comes when running long lengths of it through voids and dry-risers — between the machine room and the edit suite, for example — where it will often fail. Traditional cable-working techniques tend to compromise it. The attraction to most in-house engineering departments is that you can buy the cables ready-made so you don't have to concern yourself with terminating cables that you have little familiarity with.

The better way of providing a fiber infrastructure is to run in a “loose-buffered” cable where the fibers float in a mineral oil that is contained within a plastic hose. This is wound in a Kevlar mesh — the same material used to make bullet-proof vests — and covered in a plastic sheath. The cable scores over tight-buffered cable, in that the fibers can slide within the oil as the cable is pulled around bends. Kevlar means you can step on the cable and abuse it. The bulk of the cost of the cable is in the protective construction and not in the glass fibers themselves; it's economical to run four cores where you might only need two, or 24 where you only need eight, for example. This price scalability means you can future-proof yourself. Neither of these advantages can be ascribed to tight-buffered cable. The installation cost has a marginally higher TCO, but reliability is an order of magnitude better.

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