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CABLE sharing

A UNIQUE, INNOVATIVE CATEGORY 7_A APPLICATION

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BY ROBERT CARLSON

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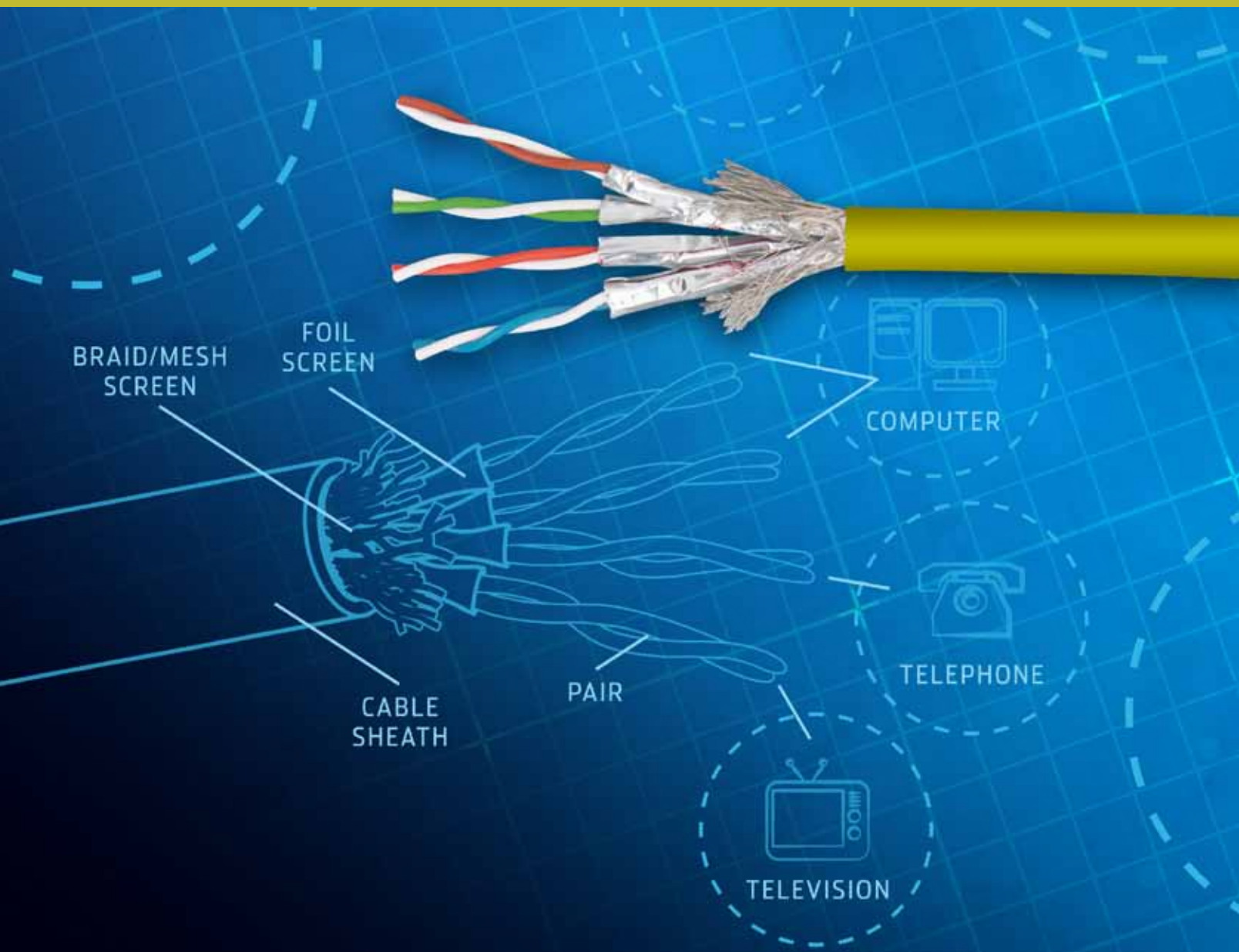

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When using the IEC 61076-3-104 category 7_A non- RJ-style connector, up to four applications can be shared over a single cable.

After much debate, the Telecommunications Industry Association (TIA) TR-42.7 Copper Cabling Subcommittee adopted "category 8" as the nomenclature of their next generation balanced twisted-pair cabling system to eventually support 40 gigabits per second (Gb/s) over a 2-connector channel up to at least 30 meters (m [98 feet (ft)]). TIA moving consecutively from category 6A to category 8 has the potential to cause some confusion in the industry, and some may be asking, "What about category 7?"

IT managers and end users can rest assured that there is indeed an existing standards-based category 7 and category 7_A. Moreover, category $7/7_A$ offers the benefit of interference-free cable sharing—the practice of running more than one application over different pairs of a twisted-pair copper channel as a means to reduce cost, simplify cable management and converge applications onto a single media type.

A Standards-Based Concept

Category 7_A is the highest grade of twisted-pair copper cabling supported by a published performance standard. It is a popular choice for the European market, and it has been gaining significant ground in the U.S. and other regions such as Latin America. Ratified in 2010 by the International Organization for Standardization (ISO) under Amendment 2 of ISO/IEC, 11801, 2nd edition, category 7_A (class F_A) is a fully-shielded system characterized up to a bandwidth of 1000 megahertz (MHz). It was preceded by category 7 (class F) cabling, which was ratified by ISO/IEC in 2002 and characterized up to a bandwidth of 600 MHz. For the purpose of this article, we will refer to category 7_A, as it is the latest category 7 standard.

ISO/IEC specifies two connector options for category 7_A—an RJ-style connector as defined by IEC 60603-7-7 and a non-RJ-style connector as defined by IEC 61073-3-104. The RJ-style connector features internal category 6A and 7_A circuits. Its category 6A circuit is backwards compatible in that it accepts the 8-position, 8-contact (8p8c) RJ-style modular plug interface used in category 6A and lower category cabling. Its category 7_A circuit is activated by the insertion of a special non-RJ-style plug that engages with contacts located in the four outside corners of the jack (see Figure 1).

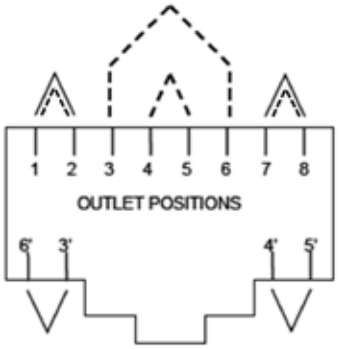

Figure 1: RJ-style (IEC 60603-7-7) interface outlet contact positions (category 6A and lower uses dashed-line positions; category $7/7_A$ uses solid-line positions)

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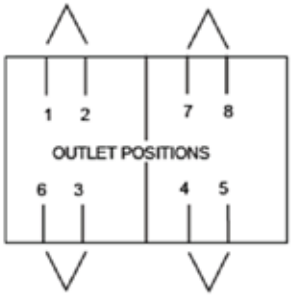


Figure 2: Non-RJ-style (IEC 61073-3-104) interface contact positions

Figure 3: The non-RJ-style connector interface (IEC 61073-3-104) specified by ISO/IEC for category 7 and 7_A features an isolated quadrant design that better accommodates cable sharing.

The non-RJ-style connector features an isolated quadrant contact design (see Figure 2). It fits into a standard RJ-45-sized modular jack opening and is backwards compatible with category 6A and lower category cabling via hybrid patch cords. The non-RJ-style design offers a standardized interface that provides innovative cable sharing capabilities.

Cable sharing is the practice of running more than one application over different pairs of a twisted-pair copper cable. Common legacy examples of cable sharing include running twelve 10 megabits-per-second (Mb/s) channels over one 25-pair cable or using y-adapters (splitters) to break out pairs for creating separate voice and fax lines over a single cable.

Although the practice of cable sharing has been accepted by telecommunications professionals for more than two decades and was recognized in TIA and ISO standards as early as 1991, cable sharing did not start gaining popularity until the adoption of fully-shielded cabling systems like category 7_A. This is because the amount of internal crosstalk coupling (both near-end and far-end) in unshielded twisted-pair (UTP) cabling systems makes it difficult for users to predict whether multiple applications can coexist in one cable. In fact, standards caution that, when deciding which applications can share a UTP cable, users should be aware that crosstalk from applications operating in similar frequency bands can potentially interfere with one another. On the other hand, fully-shielded category 7_A cabling guarantees that there is sufficient noise isolation between pairs to support multiple applications, or the multiple appearance of any one application, over a four-pair channel.

Some standards, such as ISO/IEC 15018, specifically recommend that cable sharing be considered when pathway space is limited and identify the non-RJ-style category 7_A interface (IEC 61073-3-104) as the preferred connector style for this application. The interface features an isolated quadrant design that allows easy access to one or two pairs of a channel to better accommodate cable sharing (see Figure 3).

Share and Share Alike

When using the IEC 61076-3-104 category 7_A non-RJ-style connector, up to four applications can be shared over a single cable. This ability is uniquely enabled by both the cable and connector construction. As with any category 7_A cabling channel, all four shielded pairs are terminated to a single outlet. However, in addition to accepting a 4-pair cord, the non-RJ-style outlet can also accept four 1-pair cords, two 2-pair cords, or a combination of the two—without the need for splitters or adapters. This flexibility allows various applications to be converged onto a single cable, decreasing the amount of cabling and required pathway space associated with multiple runs that use lesser grade cabling.

Modular cords supporting cable sharing are terminated on one end with either a 1-, 2- or 4-pair non-RJ-style connector that fits into one, two or all four quadrants of the IEC 61076-3-104 category 7_A connector. The other end of the modular cord is terminated to an appropriately wired interface connector, such as an RJ-11 plug for voice or an RJ-45 plug for Ethernet (see Figure 4). Cords with integrated baluns or modular connections to

Figure 4: Modular cords supporting cable sharing can be terminated with 4-, 2- and 1-pair non-RJ-style connectors.

APPLICATION	NUMBER OF PAIRS
Analog Voice	1
Voice over IP	2
Video over IP	2
CATV	1 w/balun
CCTV	1 w/balun
10/100BASE-T	2

Table 1: Typical cable sharing applications in high-density work area environments

F-type balun adapters can be used for 1-pair video applications like cable TV (CATV). In fact, class F_A is the appropriate grade of cabling for supporting all channels of digital CATV (up to approximately 700 MHz) because of its extended frequency characterization. As with coaxial implementations, depending upon the incoming signal strength, length of the cabling run and the highest and lowest channel being distributed, amplification may be required to support some CATV deployments over twisted-pair cabling. BNC-type balun adapters are also available to facilitate closed-circuit TV (CCTV) applications.

While most commercial environments provide a minimum of two outlets at each work area per industry standards, there are some environments that need to support more than two applications at a work area. For example, in health care facilities, some patient recovery rooms require more than 15 applications at a single work area. Many of these high-density work areas only need to support low-speed applications. With the cable sharing capabilities of category 7_A and the IEC 61076-3-104 non-RJ-style connector, a single outlet can support multiple 1- and 2-pair low-speed applications or one 4-pair high-speed data application like 1000 Mb/s (1000BASE-T) or 10 Gb/s Ethernet (10GBASE-T).

A two-outlet work area using two category 7_A non-RJ-style connectors can support several more applications than a typical two-outlet work area supported by lower category cabling and can do so in a less wasteful manner. Specifically, the unused pairs that would be present if a 4-pair channel was dedicated to an application transmitting over just one, two, or three pairs are eliminated, significantly decreasing the number of cables required and subsequently reducing pathway costs and cable management complexity. Table 1 shows some typical 1- and 2-pair applications that can easily be supported with cable sharing.

Cable sharing implementation practices are extremely flexible and support a wide range of configurations. For example, consider a call center where four agents arranged in a work group each need an analog phone and an Internet connection. The work area outlet for this group could contain one category 7_A non-RJ-style connector to support four 1-pair analog phones and four additional outlets for high-speed data. In other words, five outlets at the work area could serve all four agents versus eight individual outlets. In this scenario, a call center can typically realize a cost savings in excess of 10 percent for materials and a 39 percent reduction in the total number of outlets.

When designing cable sharing solutions, it is critical to plan for the types of applications to be supported and understand their equipment lifecycles. It is important to ensure that the cabling infrastructure can support future applications and upgrades. As a result, the recommended practice for all cable sharing solutions is to provide a minimum of one dedicated outlet for data and one outlet for other low-speed 1- and 2-pair applications. This helps to ease migration to high speed data applications that require all four pairs for transmission.

Putting Cable Sharing to Work

Located in the north-central area of South Carolina, the City of Rock Hill is a growing community of 67,000 residents that encompasses more than 36 square miles. The city is a business-savvy blend of historic charm and responsibly implemented expansion, and it is the only major South Carolina city in the Charlotte area. When the municipally-owned Rock Hill Utilities Department decided to construct a new three-building campus to house administration offices, a shop and a warehouse, they needed a versatile network to support everything from video, voice over Internet protocol (VoIP) and analog telephony, to CATV, video surveillance, IP radio and data.

"We typically would put four outlets at each work area to support

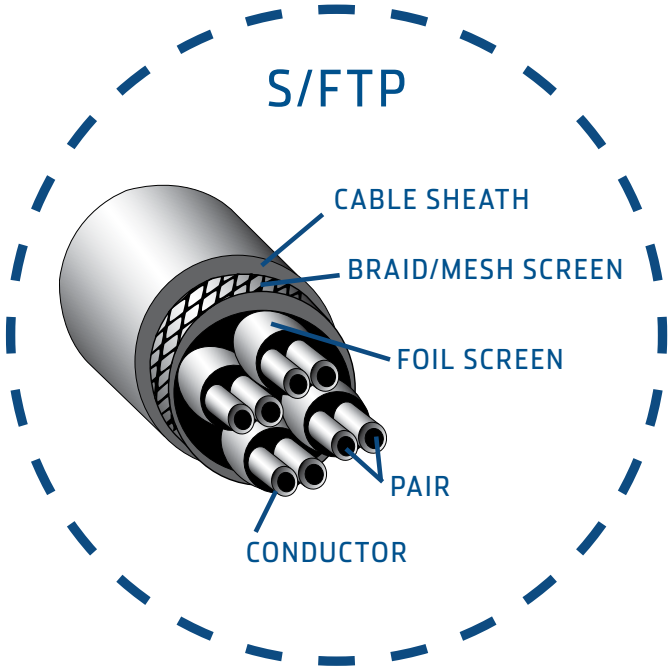
City of Rock Hill Utilities Department in South Carolina deployed cable sharing to support everything from video, VoIP and analog telephony, to CATV, video surveillance, IP radio and data.

a variety of applications, including a coaxial outlet for video. We need to keep track of the weather and other important emergency information via CATV, while also supporting video for training and digital signage," said Brenda Roof, with the City's information technology systems (ITS) department. "Although we had budgeted for a category 6A system, when I came across the concept of cable sharing using category 7_A with the non-RJ-style connector, it looked extremely versatile."

After conducting thorough research on category 7_A and cable sharing, including meeting with technical experts, Roof was able to convince her superiors that the solution was ideal to support their needs. "It wasn't an easy decision," she said. "When we first went out for bid, I was the odd one out. Most of the cabling contractors were pushing us towards category 6A." Roof stuck to her guns and ultimately found a manufacturer able to support her decision to deploy category 7_A and cable sharing, including providing onsite training and certification for the installers and the City's ITS and Utility staff.

By deploying the non-RJ-style category 7_A connectors and implementing cable sharing, the Rock Hill Utilities Department was able to significantly cut down on the amount of cabling, outlets and labor required. Through the use of hybrid cords terminated to an F-type connector and featuring an integrated balun, they were also able to eliminate the use of coax to support CATV, surveillance and other video applications on runs of less than 175 feet.

"Rather than having four outlets at each work area, we were able to go down to just two," says Larry Williams of the City's ITS department. "For most of our users, one outlet provides two pairs for a



10/100BASE-T connection to the computer and two pairs for a VoIP phone. We then have the additional four pairs in the second outlet to support a variety of other devices like printers, analog phones and fax machines or for migrating to a 4-pair 1000BASE-T connection."

For CATV and other video applications, the Rock Hill Utilities Department is able to support up to four TVs from a single outlet. "By eliminating the extra outlets and much of the coaxial cabling for video, we were able to cut labor costs in half," says Roof. "With the category 7_A outlets, we also don't have to worry when we need to move people around. It's as simple as using different patch cords." With custom-made cords, they were even able to support their existing digital phone system that required a crossover cable.

Rock Hill Utilities Department ultimately ended up installing 480 category 7_A outlets in the administration building, 203 in the shop and 42 in the warehouse. "The system is now up and running, and if I had the chance to do it over again, I would pick the same system and use cable sharing," says Roof.

Even More to Share

Category 7_A provides additional benefits besides cable sharing capabilities. Due to its fully shielded design, category 7_A cable provides higher performance than unshielded twisted-pair (UTP) lower category cabling. At higher frequencies, the use of individually shielded pairs virtually eliminates internal crosstalk between pairs and external cable-to-cable alien crosstalk, both along the cable run and between connectors at the work area and in the telecommunications closet. It is therefore able to support 10 Gb/s applications without any additional mitigation practices like those often required when using UTP cabling.

The cable's outer overall braid shield provides additional strength and a low impedance path to ground. The outer shield picks up low-frequency noise from external sources and effectively conducts it to ground, providing superior resistance to electromagnetic interference and radio frequency interference (EMI/RFI) common in a variety of environments like health care and industrial facilities.

While category 8 may now be on the horizon, category 7_A is an existing standards-based system that provides the benefits of cable sharing, higher bandwidth capacity and EMI/RFI immunity over 100 meters. Up to 1000 MHz, proposed performance limits for category 8 do not currently meet those specified for category 7_A. ISO/IEC is already looking toward the future of fully-shielded cabling. The nearly finalized IEC 61076-3-104, 3rd edition, will extend the performance of the IEC 61073-3-104 category 7_A non-RJ-style connector out to 2 GHz—the same frequency tentatively proposed for category 8.

Until the signal processing capabilities of a 40 Gb/s Ethernet (40GBASE-T) application are finalized and more advanced and representative real-life analysis can be conducted, it is too early to guarantee 40GBASE-T application support distance for any media. However, it does look as if a fully-shielded system with the non-RJ-style connector and its unique isolated quadrant design will ultimately provide some support for next generation speeds of 40 Gb/s while offering the innovative capability of cable sharing. Standards-based category 7_A is here today and here to stay. ■