Cat 6 Cable:
Copper's Last Stand?

Cat 6 Cable is craft intensive!
Advanced Installation & service skills are a MUST.

Cat6 Cable: Copper's Last Stand?
Nope, Not yet! 10Gig IP to the rescue!

What is Category 6?

Unlike earlier cabling standards Category 6 is a 200MHz classification. The Category 6 standard is an integral part of the 2nd editions of the ISO 11801, TIA 568A and En5017. Initially there were only two parameters proposed for Category 6. These were that any Category 6 solution must use the existing RJ45 plug and jack format. The second was that the Powersum ACR must be positive to 200 MHz. As the standards have developed, additional parameters have been added. These standards continue to be developed and represent the pinnacle of performance for structured cabling systems.

The intention behind the Category 6 standard is to provide the state-of-the-art 4-pair cabling system. The different and more stringent handling requirements for Category 6 components demand additional training, even for installers well used to the demands of Category 5e installation practices. Time, care and a high level of technical expertise are essential when installing Category 6. Even slight variations in the termination of links can have a massive effect on the overall performance of the system. It is for these reasons, that it is essential to select an installer who has an existing track record of successfully installing Category 6. With the comprehensive backing of Molex, under the Certified Installer (CI) program, SMT has the experience and track record you need to be sure that your Category 6 solution will perform for you now and in the future.

www.category6cabling.com

http://www.smtnet.co.uk/cabling/whatis.htm

The State of the Cabling Industry
By John Siemon, VP of Siemon Global Operations,
as told to Connection Magazine, Australia
The Siemon Company
1903-2003
100 Years of Quality, Service, Innovation, and Value
http://www.siemon.com/us/literature/otherpdf/cablingforthefuture.pdf

Ten years is a long time in this industry. Just over ten years ago, category 5 was first introduced. That was in 1991-92, when the original Technical Bulletins were issued by the Telecommunications Industries Association. Also in the early 80s, the Internet was just coming into focus, with seemingly far-fetched predictions as to its impact on global communication, commerce and entertainment that today have become a reality.

Cabling standards and category 5 led to an explosion of structured cabling solutions in the 1990s, and as a result, the term "category 5" is now known by millions of people throughout the world. The development of reliable, high-performance infrastructure for all kinds of telecommunications applications on a global basis has been a huge accomplishment.

TWISTED-PAIR COPPER VS. FIBER

Over the past twenty years, industry experts have predicted that twisted-pair would be replaced with something else. Yet over time, its replacement by fiber for long haul public network connections has been more than offset by its use as the pre-eminent media for IP connections to end-point devices. Twisted-pair cabling owes its staying power to many factors, not least of which is the continuing collaboration between manufacturers that have continued to push performance, reliability and value of this media and associated network equipment to new heights.

Copper or fiber? The fact is that they both have specific advantages and provide unique solutions for today's cabling infrastructure needs. Clearly, optical fiber has a bandwidth advantage, especially for public networks, backbone cabling and data centers. In these places, optical fiber is dominant and will continue to be so because of its ability to provide reach and throughput for applications that are increasingly bandwidth hungry at the core of the network.

For IP connections, copper has been tracking with fiber in terms of throughput, and has been able to retain its cost advantage but with greater restrictions on length. Industry standards have locked-in an implementation model for copper that is widely accepted and applicable to the great majority of installations. The 100-meter channel for horizontal cabling has been an important anchor point in a rapidly evolving industry. It has provided a solid foundation on which to build technological advancements for twisted-pair cabling and the equipment to which it connects.

10 GIGABIT BANDWIDTH

In August 2002, IEEE 802.3ae was published, providing requirements for 10 Gb/s over fiber. This standard, which specifies an operating distance of 300-meters using laser optimized multimode fiber, is a major industry milestone and gives fiber a decisive lead in the bandwidth race. However, there is also work being done now for standardization of 10 gigabit transmission over copper. In an IEEE study group the planned completion date of the standard is 2006. Will that be time enough for future 10G copper systems to be cost competitive with a future fiber solution? Many companies are betting a good portion of their R&D budget that the answer is “yes”.

The 10 gigabit over copper study group has also confirmed that the medium is Category 6. Their work includes mitigation techniques to address 10G performance over UTP. Cat 7/classF has already been proven to provide the bandwidth necessary for this performance. Based on the noise immunity required for 10G – less than one-fifth that of 1000BASE-T – and the need to achieve predictable channel performance as high as 625 MHz, category 6 is well positioned as the primary cabling solution for this application. The inherently better balance of category 6/class E also gives it an advantage with respect to alien crosstalk. The question of what implementation lengths will be supported over UTP versus ScTP (FTP) is still under consideration within the 10GBASE-T study group. In terms of its ability to support leading edge networking applications, however, copper is still several beats behind fiber and remains constrained to operating distances of 100 meters or less. Copper remains an attractive alternative for use in data centers and server farms. As standards development evolves on the use of balanced cabling for 10 Gb/s transmission it will be interesting to see what new implementation models emerge.

POWER TO THE PAIRS

Another rediscovery with copper is its ability to deliver electrical power to IP devices while simultaneously carrying network traffic. The RJ45 connector is the first globally accepted low voltage power over ethernet interface. This capability allows equipment to operate entirely without connections to power outlets as the power is delivered via a specially equipped switch. With the installed cost of a twisted-pair cabling channel much less than that of a power outlet, and with IP devices increasingly installed in places where power is not readily accessible, the range of IT solutions provided by twisted-pair has just expanded.

802.3af has been approved by IEEE and work on this amendment is complete. This amendment specifies methods for providing limited power over twisted-pair cabling while simultaneously supporting signal transmission that is compatible with the full range of Ethernet standards. For example, if you have VoIP Phone it is now possible to deliver power to that device and provide the telecommunications channel through the same cable. Networking devices with power provisioning functionality are shipping today.

WIRELESS CABLING – AN OXYMORON?

Wireless is enjoying a high rate of adoption in home cabling where people are reluctant to invest in cabling and where a single wireless access point can provide voice and data service.

Just as we have learned that the unique capabilities of copper and fiber have prevented IT professionals and consultants from installing all of one or the other, it would be wrong to predict an all-wireless network somewhere over the horizon. Future solutions will most likely consist of an infrastructure consisting of multiple media types, configured to provide seamless access to the network by the broadest possible range of devices.

At the February 2003 meeting of ISO/IEC in Wellington, New Zealand, a draft technical report on cabling for wireless access points (WAPs) was created. Although you might think of wireless as 'without wire', in most cases it requires connections to wired devices. In this way, a wireless access point serves as a bridge between two network protocols – typically between "cabled" 802.3x compatible switches and wireless 802.11x data terminal equipment. This technical report provides a structured approach to configuring cabling to and from wireless access points in enterprises, in addition to the structured cabling specified in ISO/IEC 11801.

WIRELESS CABLING (CONT.)

Rather than causing a contraction in cabling demand, there is a potential expansion of 5% or more in the number of cabling channels required for wireless access points. This is just one of many potential uses for Internet Protocol (IP) devices in premises that extend beyond traditional desktop connections.

BAS (BUILDING AUTOMATION SYSTEMS)

In recognition of the growing trend of using IP chips to control and monitor a wide range of equipment, TIA has developed a standard on building automation systems (BAS). Even though Internet razors will probably not come to pass in the near future, there is a high rate of adoption of IP devices beyond the desktop for building automation applications. Life-safety, environmental control and security are among the types of services that are readily connected using the types of cabling specified in the latest editions of today's standards.

DATA CENTERS

TIA TR42.1.1 has released the second draft PN-3-0092, Telecommunications Infrastructure for Data Centers. This standard addresses copper and fiber structured cabling and it is intended for architectural, facilities and IT personnel to plan for the design and install of cabling to support the mission critical nature of data centers and computer and server rooms. More than 50% of the technical content addresses facility specifications which have been traditionally undefined and specific to the many considerations that make each data entry unique subject to personnel preference. Sizing, power distribution, pathways and spaces, building control (HVAC, security, operation and administration), scalability and reliability are examples of the design guidelines presented. The standard defines the optimal location of space and equipment to maximize the efficiency of the data center's initial loading and planning future growth.

An Annex is also included to define a data center tier system to allow for a common understanding of the varying levels of data center implementations. There are

recommendations for architectural, security, electrical mechanical and telecommunication for each of the four tiers. These recommendations provide a uniform way to understand your data center needs and are a starting point for establishing design requirements. The standard is expected to be published during 2004 as standard ANSI/TIA/EIA-942.

REAL-TIME TRANSMISSION

Applications that are driving bandwidth demand are transmission of video and audio content through the network. Examples include streaming video, video conferencing and Voice over IP (VoIP). These applications require high performance cabling systems.

Collisions do not exist in a full duplex network by definition. In a heavily used network, retransmissions increase exponentially – especially when caused by limitations of the cabling channel or marginally performing network equipment or multiple network protocols. When a bit error occurs, the entire packet must be retransmitted, placing an increased load on the network and thereby lowering performance and increasing latency. Because the process is "self correcting", the only evidence of retransmission would be provided through a network monitoring tool, or a noticeable delay in file transfer. But in the case of live voice and video traffic, the rules for re-transmission change, resulting in lost content that degrades signal quality. These transmission errors are evident by lost video frames, audio skips and a “snowy” picture where corrupted pixels appear as white dots. The increased use of IP-based video and audio transmission will continue to increase network bandwidth requirements and decrease the tolerance for latency and bit errors. These types of artifacts are evident even with standard compliant cabling and are sometimes used to demonstrate the benefits of premium system offerings. To support real-time transmission over LANs and WANs there will be an increased demand and reliance on high performance cabling.

INDUSTRIAL CABLING

Beyond enterprise cabling there is a high rate of adoption of IP for equipment on the factory floor. Developing structured cabling solutions for those unique environmental applications is a challenge to which the Standards community has started to dedicate resources. Two of the four days at the September ISO/IEC meeting in Zürich are devoted to industrial cabling. In this context, the term IP refers to a degree of environmental protection from solid and liquid contaminants. A growing number of cabling solutions that provide varying degrees of protection are available from multiple suppliers. Although several variants of an environmentally hardened “RJ” interface are pending standardization within IEC, the final selection of allowed variants for the cabling has yet to be determined by ISO/IEC. In the meantime The Siemon Company’s Industrial MAX® connector interface which offers an IP-67 rating, has been recognized by the Open DeviceNet Vendor Association (ODVA), and IEC PAS 61076-3-111 and Industrial Automation Open Networking Alliance (IAONA).

OVERDOING THE FUTURE-PROOFING

In the 1990s IT professionals were trying to future-proof to the greatest extent possible. The result was that they sometimes over-saturated the horizontal cabling. For example,

six outlets per faceplate and multiple faceplates per work area were the norm. What we are seeing now is that IT professionals are more discriminating when it comes to the number and quality of the cabling channels used in both the horizontal and backbone subsystems. Just as people are becoming more conscious of what they put in their bodies, we see an increasing care in the decisions about what IT professionals are putting into their buildings. Applications like VoIP and the convergence trend toward fewer, more feature-rich desktop and handheld devices that connect to one another in the work area make it possible to be more selective about the quantity and quality of cabling assets to be installed.

The original Standards requirement of two outlets per work area with provisions for furniture placement is the right starting point. This practice provides a level of redundancy, bandwidth and flexibility required by the vast majority of office occupants. There will always be special use spaces like call centers, IT labs and trading desks that require a higher density of outlets, but the needs of these types of specialized work spaces can usually be planned for in advance.

There is an abundance of information available to make educated choices on how to cable an enterprise for existing and future IP applications. The good news for IT professionals and their clients is that there are a number of high performance/high value solutions to choose from that will satisfy even the most unique applications and environments.

THE FUTURE: CABLING IS HERE TO STAY

Think of the IT industry as a rocket. Lift-off and stage one have taken us this far. Stage two is just kicking in and will be fueled by increasing penetration of interconnected IP devices in the places we live, work and travel. Telecommunications infrastructure is about reliable, high-performance access – anytime, anywhere. As long as suppliers to the IT industry stay focused on the fundamental needs of the market and continue to leverage their respective resources to foster technical advancement and market growth, there will be continued innovation that translates to tangible benefits. As a result, network professionals and the end-user communities they serve can enjoy peace of mind through increased network up-time, transmission quality and productivity.

The Siemon Company manufactures the products and provides the services you need to design and build an IT infrastructure that will serve your strategic business needs. Siemon's heritage is providing the highest quality; best performing structured cabling systems available.
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What does the ever-changing future have in store for us as far as Information Technology for the cabling community and related areas? We can only make educated hypotheses about what the future holds and the speeds we will reach. As technology evolves the speed of processors become faster and more efficient. Within the past year the Category 6 cables became more favorable over Category 5e for networks and network expansions where copper is needed. The true question is will copper cable withstand the changes of faster and better?

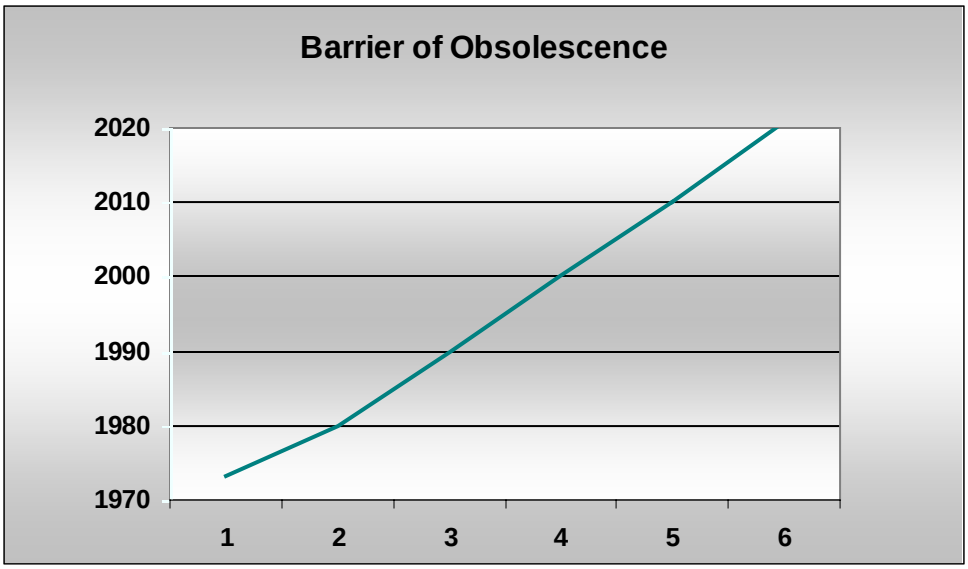
The computer industry continues to move ahead by building processors with more Gigabit capabilities and more speed. Gigabit Ethernet demand is growing, and the march towards mainstream 10 Gig is on. More high-speed, high-capacity backbone links are being designed and implemented on single mode fiber.

There is a rise towards Category 6 cabling and more single fiber into the backbone. Zone-style cabling can mean big flexibility for your customers, and as the trend towards adaptable environments continues, it can also mean revenue for those who are savvy enough to know what solutions are available and how to design effective topologies.

Category 6 Consortium Participant's Product Information

* TIA Engineering Committee Participant Only
** TIA Member and Engineering Committee Participant

Avaya**
KRONE, Inc.**
Berk-Tek**
Leviton Voice & Data Div.**
Commscope**
Mohawk/CDT*
Suttle
Molex, Inc.*
Draka Comteq*
Nordx/CDT*
Fluke Networks**
Ortronics**
General Cable**
Panduit**
Graybar**
RiT Technologies**
Hellermann Tyton**
The Siemon Company**
Hitachi Cable Manchester Inc.*
Superior Modular Products*
Hubbell Premise Wiring*
Superior TelecommuniCations, Inc.
Ideal Industries**
Tyco Electronics/AMP
NETCONNECT**
Intertek Testing Service**
UL, Underwriters Laboratories, Inc.*



The barrier of obsolescence is the point where the functionality of copper based communications cabling can no longer deliver the required speeds of the network.

For many years the communications industry has "guessed" at the maximum effective speed of copper (UTP) cabling. Today many experts are in agreement that the need for speed is approaching copper's max. We must begin to look at hybrid designs that incorporate new technologies mixed with the traditional copper UTP.

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Why do I need all the bandwidth of category 6? As far as I know, there is no application today that requires 200 MHz of bandwidth.

Bandwidth precedes data rates just as highways come before traffic. Doubling the bandwidth is like adding twice the number of lanes on a highway. The trends of the past and the predictions for the future indicate that data rates have been doubling every 18 months. Current applications running at 1 Gb/s are really pushing the limits of Category 5e cabling. As streaming media applications such as video and multi-media become commonplace, the demands for faster data rates will increase and spawn new applications that will benefit from the higher bandwidth offered by Category 6. This is exactly what happened in the early ’90s when the higher bandwidth of Category 5 cabling compared to Category 3 caused most local area network (LAN) applications to choose the better media to allow simpler, cost effective, higher speed LAN applications, such as 100BASE-TX. It is also important to note that cabling infrastructure is generally considered a 10 year investment as opposed to two or three years for electronics. Work has already started on 10G BASE-T, and Category 5e cabling is not being

considered. With additional throughput requirements right around the corner, it makes sense to plan ahead. *Note: Bandwidth is defined as the highest frequency up to which positive power sum ACR (attenuation-to-crosstalk ratio) is greater than zero.*

FAQ

Q: What is the difference between Cat3, Cat5, Cat5e, Cat6, etc.?
A: This is actually a somewhat complex question to answer as it involves a number of technical details. The most basic answer is that each Category of cable is supposed to meet (or exceed) a specific set of standards, the most significant of which, is the ability to pass all signals up to a particular carrier frequency (or signaling rate). Additional standards have to be met include values for attenuation, near end cross talk (NEXT), ACR, etc.

Below is a table of the types of Category Cable we install. The table shows the Maximum Carrier Frequencies required by the EIA/TIA 568 Standards for each category of cable and the Maximum Frequencies the manufacturer actually tests the cable to.

Category	Typical Applications	Frequency Required	Tested to	EIA/TIA Ratified Standard?
Cat 3	**Voice**	**16 MHz**	**16 MHz**	**Yes**
Cat 5	**Voice, Data (10/100 Mbps Ethernet)**	**100 MHz**	**100 MHz**	**Yes**
Cat 5e	**Voice, Data (10/100 Mbps/ Gigabit Ethernet)**	**100 MHz**	**200 MHz**	**Yes**
Cat 5 ENH[1]	**Voice, Data (10/100 Mbps/ Gigabit Ethernet)**	*****	**350 MHz**	**See note 1.**
Cat 6[2]	**Voice, Data (10/100 Mbps/ Gigabit Ethernet)**	**200(250?) MHz**	**500 MHz**	**Draft**

[1] Cat 5 ENH is another version of Cat 5e offered by the manufacturer we use that further exceeds the Cat 5e EIA/TIA Standard.
[2] The Cat 6 Standard has not yet been officially ratified by the EIA/TIA so the specs used by the manufacturer to claim the cable is Cat 6 are based on the current draft of the Standard.

Network Cable

- **Category 5 Cable** (UTP) (Unshielded Twisted Pair) A multipair (usually 4 pair) high performance cable that consists of twisted pair conductors, used mainly for data transmission. Note: The twisting of the pairs gives the cable a certain amount of immunity from the infiltration of unwanted interference. category-5 UTP cabling systems are by far, the most

common (compared to SCTP) in the United States. Basic cat 5 cable was designed for characteristics of up to 100 MHz. Category 5 cable is typically used for Ethernet networks running at 10 or 100 Mbps.

- **Category 5 E Cable** (enhanced) Same as Category 5, except that it is made to somewhat more stringent standards (see comparison chart below). The Category 5 E standard is now officially part of the 568A standard. Category 5 E is recommended for all new installations, and was designed for transmission speeds of up to 1 gigabit per second (Gigabit Ethernet).
- **Category 6 Cable** Same as Category 5 E, except that it is made to a higher standard (see comparison chart on next slide). The Category 6 standard is now officially part of the 568A standard.

Category 7 Same as Category 6, except that it is made to a higher standard (see comparison chart below). The Category 7 standard is still in the works (as of this writing) and is not yet part of the 568A standard. One major difference with category 7's construction (as compared with category 5, 5 E, and 6) is that all 4 pairs are individually shielded, and an overall shield enwraps all four pairs. Category 7 will use an entirely new connector (other than the familiar RJ-45). Category 5 Cable (SCTP) (Screened Twisted Pair) Same as above, except that the twisted pairs are given additional protection from unwanted interference by an overall shield. There is some controversy concerning which is the better system (UTP or SCTP). Category 5 SCTP cabling systems require all components to maintain the shield, and are used almost exclusively in European countries.

Category 5E, RJ45 jack (Work Area Outlet) An 8 conductor, compact, modular, female jack that is used to terminate category-5E cable at the user (or other) location. The jack is specifically engineered to maintain the performance of cat 5E cabling.

Category 5E Patch Panel A Category 5E Patch Panel is basically just a series of many category-5E jacks, condensed onto a single panel. Common panel configurations are 12, 24, 48, and 96 ports. Patch panels are typically used where all of the horizontal cable sections meet, and are used to connect the segments to the Network Hub.

Category 5E Patch Cable A Category 5E Patch Cable consists a length of cat 5E cable with an RJ-45 male connector, crimped onto each end. The cable assembly is used to provide connectivity between any two category-5E female outlets (jacks). The two most common are from network hub to patch panel, and work area outlet (jack) to the computer.

EIA/TIA 568A Standard This standard was published in July of 1991. The purpose of EIA/TIA 568A, was to create a multiproduct, multivendor, standard for connectivity. Prior to the adoption of this standard, many "proprietary" cabling

systems existed. This was very bad for the consumer. Among other things, the standard set the minimum requirements for category 5E cable and hardware. The 568 "standard" is not to be confused with 568A or 568B wiring schemes, which are themselves, part of the "568A standard".

568A and 568B Wiring Schemes When we refer to a jack or a patch panel's wiring connection, we refer to either the 568A, or 568B wiring scheme, which dictates the pin assignments to the pairs of cat 5E cable. It is very important to note that there is no difference, whatsoever, between the two wiring schemes, in connectivity or performance when connected form one modular device to another (jack to Patch panel, RJ-45 to RJ-45, etc.), so long as they (the two devices) are wired for the same scheme (A or B). The only time when one scheme has an advantage over the other, is when one end of a segment is connected to a modular device, and the other end to a punch block. In which case, the 568A has the advantage of having a more natural progression of pairs at the punch block side. More on 568 A&B later on.

What is the difference between enhanced category 5e cable rated for 400 MHz and category 6 cable rated for 250 MHz?

Category 5e requirements are specified up to 100 MHz. Cables can be tested up to any frequency that is supported by the test equipment, but such measurements are meaningless without the context of applications and cabling standards. The Category 6 standard sets minimum requirements up to 250 MHz for cables, connecting hardware, patch cords, channels and permanent links, and therefore guarantees reasonable performance that can be utilized by applications.

What is the difference between CAT5, CAT5e, & CAT6

- The Simple Answer:
  CAT5 is rated to 100M
  CAT5e is rated to 350M
  CAT6 and CAT6e is rated to 550M or 1000M depending on your source
  CAT7 is supposedly rated to 700M or presumably 1000M
- Today there is no approved CAT6 or CAT7. While some folks are selling products they call Level 6 or 7, there aren't even specs for them, making CAT5e the best available option. CAT6 cable is being made with 23-gauge conductor wire as opposed to the slightly smaller 24 gauge for CAT5e and also has a separator to handle crosstalk better.
- Both CAT5 and CAT5e have 100 ohm impedance and electrical characteristics supporting transmissions up to 100 MHz. The differences between CAT5 and CAT5e show in all aspects of performance: capacitance, frequency, resistance, attenuation, and NEXT. CAT5e components were designed with high-speed gigabit Ethernet in mind.

While CAT5 components may function to some degree in a gigabit Ethernet, they perform below standard during high-data transfer scenarios. CAT5e cables work with ATM and gigabit speed products. Simply, if you are using a 100Mbps switch, get CAT5e cable instead of CAT5.

- CAT5e is formally called ANSI/TIA/EIA 568A-5 or simply Category 5e (the e stands for 'enhanced'). CAT5e is completely backward compatible with current CAT5 equipment. The enhanced electrical performance of CAT5e ensures that the cable will support applications that require additional bandwidth, such as gigabit Ethernet or analog video.

What is the general difference between category 5e and category 6?

The general difference between Category 5e and Category 6 is in the transmission performance and extension of the available bandwidth from 100 MHz for Category 5e to 200 MHz for Category 6. This includes better insertion loss, near end crosstalk (NEXT), return loss and equal level far end crosstalk (ELFEXT). These improvements provide a higher signal-to-noise ratio, allowing higher reliability for current applications and higher data rates for future applications. The additional performance parameters provide a sort of "forgiveness factor" for things that happen within a cabling infrastructure over its lifetime assuring that bandwidth remains available for applications. Please note that the bandwidth referred to above is the bandwidth to achieve a positive signal to noise ratio between insertion loss and power sum near end crosstalk (PSACR is greater than 0). Cat 6 cabling performance is specified to 250 MHz, or 25 percent beyond the 0 dB PSACR frequency of 200 MHz.

If we use a Cat 5e RJ45 connector and connect it to a Cat 6 UTP cable, will the installation be Cat5e or Cat 6?

By definition (of the standard), it will be a Cat 5e channel. The actual performance will probably be somewhat better, but nowhere near Cat 6 requirements. Of course, you can set up a channel using any components and measure it using a Cat 6 (level III) compliant tester, and if it passes, it is Cat 6 performance compliant. It would not be standards compliant however, because the components have requirements in and of themselves to assure interoperability with other Cat 6 components.

Category 6 cabling recognizes advances in cabling technology and is designed to be backward compatible with Categories 3, 5 and 5e. This ensures that any applications that operate on lower category cabling will be fully supported by Category 6 cabling. When different category components are mixed with Category 6 components, the resultant cabling will satisfy the category transmission requirements of the lower performing component. To ensure generic cabling system performance, Cat 6 component requirements are specified to be interoperable when products from different manufacturers are mated. http://pulse.tiaonline.org/article.cfm?id=849

Is there a limitation on the size of bundles one can have with category 6? Can you have 200-300 and still pass category 6?

There is no limit imposed by the standards on the maximum number of Category 6 cables in a bundle. This is a matter for the market and the industry to determine based on practical considerations. It should be pointed out that after six or eight cables, the performance in any cable will not change significantly since the cables will be too far away to add any additional external (or alien) NEXT.

Will category 6 supersede category 5e?

Yes, analyst predictions and independent polls indicate that 80 to 90 percent of all new installations will be cabled with Category 6. The fact that Category 6 link and channel requirements are backward compatible to Category 5e makes it very easy for customers to choose Category 6 and supersede Category 5e in their networks. Applications that worked over Category 5e will work over Category 6.

Are the connectors for category 5e and category 6 different? Why are they more expensive?

Although Category 6 and Category 5e connectors may look alike, Category 6 connectors have much better transmission performance. For example, at 100 MHz, NEXT of a Category 5e connector is 43 decibels (dB), while NEXT of a Category 6 connector is 54 dB. This means that a Category 6 connector couples about 1/12 of the power that a Category 5e connector couples from one pair to another pair. Conversely, one can say that a Category 6 connector is 12 times less "noisy" compared to a Category 5e connector. This vast improvement in performance was achieved with new technology, new processes, better materials and significant R&D resources, leading to higher costs for manufacturers.

Warranty
1000Base-T and Beyond- Leviton
http://www.controlcable.com/products/leviton_cat_6_extreme_cabling_system.html
Our most powerful system to date is designed for those applications that are expected to require speed and accuracy above and beyond anything known in the 20th Century. The Extreme cabling System surpasses the proposed CAT 6/Class E channel specifications when installed with a full line of Extreme components - including QuickPort Modules, CAT 6 cables and Extreme patch blocks and patch panels - to make this system exceed 1000Base-T requirements. A lifetime warranty on parts and performance is also included with every certified installation, naturally.

Will contractors be able to make their own patch cords?

Category 6 patch cords are precision products, just like the cables and the connectors. They are best manufactured and tested in a controlled environment to ensure consistent, reliable performance. This will ensure interoperability and

backward compatibility. All this supports patch cords as a factory-assembled product rather than a field-assembled product.

Patch panel

Obviously, all the points we made about termination problems apply here—the other point is how to best dress the cables into the cabinet/frame. Use as many ties (Velcro type) as you need to install vertical runs. Then, when all the cables are in place, remove any that are not absolutely necessary to support the Cat 6 cables. And on the horizontal runs keep them to a bare minimum and don't tighten them.

Outlets

Finally, we've found quite a few failures on links that worked fine before the cable was shoved back into the wall box or floor-box. Think what's going to happen to the cables as you push back. If they are going to kink, crush or over-bend you're going to have problems. The author is Technical & Product Manager - PremisNET, Krone Communications.

What will happen if I mix and match different manufacturers' hardware?

If the components are Category 6 compliant, then you will be assured of Category 6 performance. Consult the manufacturer for specific warranty provisions that may be applicable.

Why wouldn't I skip category 6 and go straight to optical fiber?

You can certainly do that, but you will find that a fiber system is still very expensive. Ultimately, economics drive customer decisions, and today optical fiber together with optical transceivers is about twice as expensive as an equivalent system built using Category 6 and associated copper electronics. Installation of copper cabling is more craft-friendly and can be accomplished with simple tools and techniques. Additionally, copper cabling supports the data terminal equipment (DTE) power standard developed by IEEE (802.3af). PCs ship with copper network interfaces included, in fact, recent announcements indicate that the major PC vendors are shipping 10/100/1000 with all new systems. Moving to fiber would mean buying a fiber-based network card to replace equipment already included in the PC.

When should I recommend or install category 6 vs. category 5e?

From a future proofing perspective, it is always better to install the best cabling available. This is because it is so difficult to replace cabling inside walls, in ducts under floors and other difficult places to access. The rationale is that cabling will

last at least 10 years and will support at least four to five generations of equipment during that time. If future equipment running at much higher data rates requires better cabling, it will be very expensive to pull out Category 5e cabling at a later time to install Category 6 cabling. So why not do it for a premium of about 20 percent over Category 5e on an installed basis?

We strongly recommend that you lay-in Cat 6 cable in preference to pulling it in. If you're forced to pull-in, be very careful around corners. It's a pain at the time, but it's even worse if you have to go back and replace the cables to get the installation through test.

If you've never done Cat 6 before you can avoid high failure rates by seeking the manufacturer's advice. You not only need generic Cat 6 training, you need manufacturer-specific training on the termination techniques for the particular cable/connector combination. Be incredibly kind to the cable. Above all, read the instructions. It could save you thousands of rupees on a job.

Which standard addresses the combination of electrical cable and Cat 6 regarding performance or sensitivity?

I'm an ICT Consultant for a university and in process of designing the infrastructure for them. They are using Cat 6 cable as horizontal cabling and fiber optic as backbone. We are facing a problem with M & E consultant on the trunking design. They are proposing the use of a 4-way service box which contains cables for electrical and Cat 6. We cannot find in the standard about the combination of electrical cable and Cat 6 cabling either of performance or sensitivity.

TIA/EIA-569 (click here for the series) "Commercial Building Standard for Telecommunications Pathways and Spaces" includes all necessary provisions for service boxes and enclosures. There are no special considerations associated with Cat 6 cabling.

What is the shortest link that the standard will allow?

There is no short length limit. The standard is intended to work for all lengths up to 100 meters. There is a guideline in ANSI/TIA/EIA-568-B.1 that says the consolidation point should be located at least 15 meters away from the telecommunications room to reduce the effect of connectors in close proximity. This recommendation is based upon worst-case performance calculations for short links with four mated connections in the channel.

Are there any issues with a scenario of Category 6 horizontal run, but a user with a Category 5 office patch cable?

The main issue with using Category 5 patch cords with Category 6 horizontal cabling is transmission performance and Category designation by TIA standards. TIA-568-B standards series require that all components of a link or channel be Category 6 for a horizontal run to be classified as Category 6. Testing installed cabling is additional and optional in TIA and if used there are additional requirements for links and channels for Category 5e and Category 6. The horizontal run containing Category 6 cable and Category 5 patch cords will be designated by the lowest Category component, i.e., Category 5.
Transmission performance of Category 6 is significantly improved over Category 5, especially in the areas of NEXT, ELFEXT and Return Loss. Hence using poor patch cords could easily degrade the performance of the horizontal run, especially since these cords are so close to the equipment where cross-talk coupling is very strong. So depending on the application, this may potentially translate into increased frame errors, or CRC errors.
These days, with more and more data network users talking about Gigabit Ethernet and other high-speed applications, there's clearly a need for copper cabling systems that go beyond Category 5. And, indeed, the industry is now working to define and develop cables and components capable of handling faster bandwidths.
Spearheading this effort is Anixter, the giant distributor of cabling and associated components, which is working with structured cabling and component manufacturers to define two new performance categories, referred to as Level 6 and Level 7.

Level 6 is, in effect, "extended performance" power sum rated Category 5 cable. Defining its performance characteristics should pave the way for manufacturers to develop power sum outlets and other hardware needed to install complete *Level 6-rated networks* and prepare for the base requirements of Gigabit Ethernet.

Level 7 represents a new generation of products being launched especially for bandwidth-hungry networking applications like Gigabit Ethernet and ATM. *Level 7 systems* must be able to transmit data at speeds of at least one Gigabit (billion bits per second), plus be capable of supporting multiple applications at different frequencies over the same cable.
Only a limited number of manufacturers are now actually making such components, but Anixter evaluates various combinations of all kinds of existing cables, outlets, patch panels, cross-connects, and other hardware in its testing labs. Those combinations of products that meet performance goals-and only those systems-may use the Anixter Levels Channels designation (ALC 6 or ALC 7).
But considering Anixter's history in defining performance standards, it may not be long before ALC 6 and ALC 7 systems become Cat 6 and Cat 7 products. In the late 1970s-a time when communications cable construction and electrical performance varied widely among different manufacturers, and no uniform standard of measurement existed to compare one brand to another - the company developed a series of five cable performance levels designed to allow users and specifiers to select the most cost-effective product for their

applications. These ranged from Level 1 for conventional four-conductor telephone wiring (POTS) up to Levels 3, 4, and 5 for high- frequency computer networks. Anixter's levels were so well received in the marketplace that EIA/TIA adopted them as the five "categories" defined in the first edition of the 568 standard, published in 1986.
And, in fact, U.S. and international standards organizations are already working to add new Category 6 and 7 requirements to the industry telecommunications standards. Thus, by the millennium, Cat 6 and Cat 7 cabling and their associated components may be as common and widely available as Cat 5 systems are today.- *This article was written by Brooke Stauffer* - NECA.http://www.elec-toolbox.com/communications/classifications/cat6-7/cat6-7.htm

TESTING

Can you tell me where I can find a list of test facilities that can certify that a Cat 6 cable tester complies with TIA-568?
Testing facilities such as UL and Intertek/ETL SEMKO provide assessment services for various products. Typically the tester manufacturer participates in a program with one or more of these facilities. These services are much wider in scope than simply verifying the accuracy and calibration of a particular testing device. For more information on calibration services you should refer to the technical documentation accompanying your tester.
When Category 6 systems are being installed, do the standards encourage both channel and permanent testing? I have heard that channel testing has been taken out of the Cat 6 standard. Is this true?
No, Cat 6 channel testing is still in the standard. There is nothing to preclude you from doing this in the standards. There may be issues relating to the installation, bend radius of the cable, etc., but these can be overcome with the correct design of back box, etc. Would you get passing test results if you used a link adapter not recommended by a manufacturer?
You should expect to get passing results if both the link adapter interface and the mating jack that is part of the link are both compliant to Category 6 requirements. Consult the manufacturer for specific warranty provisions that may be applicable.
Just installed a Category 6 system and tried to certify the channel with "field tester A" and it failed. Then my other technician brought our "field tester B" to the site and the channel passed. Why am I getting such different results between testers?
This is a difficult question to answer from a general standpoint. There may be a calibration problem or adapter problem with field tester A for example. It may be also instructive to look at the detailed results for the test. It may be that the channel configuration is just barely passing with tester B and just barely failing with tester A. All test equipment has a finite level of accuracy and repeatability. These levels are stated in the tester documentation. Also with Cat 6 cabling, the magnitude of many parameters being measured is much lower than that of Cat 5e. The measurement frequency range is also much wider. So while it may

appear that two testers have greatly different results (in dB), the total difference may be less than the Level III accuracy requirements. To cover this issue in detail is beyond the scope of this document and requires a working understanding of measurement scales (dB vs mV/V).

Conclusion:

Copper is not dead, not by a long shot. The communications industry has wrongly predicted copper's barrier of obsolescence for more than 30 years. Each time we drew a line in the sand and said this is the maximum; we were swept aside by the awesome technical developments of the communications cabling industry and all of its related infrastructure providers. The motto of the cabling industry continues to be: **"the improbable we do right away. The impossible takes a little longer."**

THE COMMUNICATIONS CABLING INFRASTRUCTURE IS STILL ONE OF THE "BEST VALUE" BUYS IN THE INFORMATION AGE.

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