



The Facts about Category 6 Cabling

Why do I need a different category of cable?

Not too long ago, when local area networks were being designed, each work area outlet typically consisted of one Category 3 circuit for voice and one Category 5e circuit for data. Category 3 cables consisted of four loosely twisted pairs under an overall jacket and were tested to 16 megahertz. Category 5e cables, on the other hand, had its four pairs more tightly twisted than the Category 3 and were tested up to 100 megahertz. The design allowed for voice on one circuit and data on the other. As network equipment data rates increased and more network devices were finding their way onto the network, this design quickly became obsolete. Companies wisely began installing all Category 5e circuits with often three or more circuits per work area outlet. Often, all circuits, including voice, were fed off of patch panels. This design allowed information technology managers to use any circuit as either a voice or a data circuit. Overbuilding the system upfront, though it added costs to the original project, ultimately saved money since future cable additions or cable upgrades would cost significantly more after construction than during original construction phase. By installing all Category 5e cables, they knew their infrastructure would accommodate all their network needs for a number of years and that they would be ready for the next generation of network technology coming down the road. Though a Category 5e cable infrastructure will safely accommodate the widely used 10 and 100 megabit-per-second (Mbps/sec) Ethernet protocols, 10Base-T and 100Base-T respectively, it may not satisfy the needs of the next Ethernet protocol, gigabit Ethernet (1000 Mbps/sec), also referred to as 1000Base-T. Thus, those IT managers looking to increase their network's speed may be limited by the cable that was installed in their facility. Though testing of the Category 5e infrastructure could determine its efficacy, the quality of both the cable and its installation could play a role in whether or not 1000Base-T will operate properly over the cable. Category 6 Cable was developed to ensure 1000Base-T performance as well as accommodate other protocols.

Why do I need Category 6 cabling?

10Base-T and 100Base-T operated over only two of the four pairs in the cable. One pair is dedicated to sending data while the other is dedicated to receiving data. Two pairs go unused. 1000Base-T, however, operates over all four pairs. There are two gigabit Ethernet protocols currently in use, 1000Base-T and

1000Base-TX. 1000Base-T transmits and receives data at 250 Mbits/sec on each of the four pairs, for a total transfer rate of 1000 Mbits/sec. The transfer of data is bi-directional on each of the four pairs. 1000Base-TX transmits data at 500 Mbits/sec on two pairs and receives data on the remaining two pairs at the same data rate. Well, Category 5e cable has four pairs. Why won't it work? Well, it may and it may not.

As the transfer speeds increase, so do the performance requirements of the cable being used. Delay skew, which is the difference between the slowest and fastest pairs within a cable, becomes increasingly important as data rates increase. In the past, shortages of some materials, including those used in making plenum rated cables, forced manufacturers to find alternative compounds and alternative construction methods that would allow them to continue manufacturing and to pass the appropriate UL burn tests required for plenum rated cables. Many manufacturers chose alternative compounds for use as insulation on two of the four pairs. These compounds have a direct impact on the speed at which a signal will travel down the conductor. The nominal velocity of propagation, NVP, is the speed of a signal down a conductor measured as a percentage of the speed of light. Though not an issue with protocols that utilize only two pairs, such as 10Base-T and 100Base-T, a cable that has different NVP values for two of its four pairs would have a negative impact on protocols that utilize all four pairs, such as gigabit Ethernet. 1000Base-T and 1000Bas-TX may not work properly over these cables. For end users with these cables installed, new cabling will have to be installed if protocols requiring all four pairs are desired.

Though they may be capable of carry gigabit Ethernet, Category 5e cables also limit the future uses of the infrastructure. Streaming media applications such as video and multi-media have created an ever-growing demand for bandwidth that shows no sign of slowing down. Today's data requirements have made Category 3 virtually obsolete. With the speed at which electronics have advanced, it is quite likely that the bandwidth provided by Category 5e will be exceeded in the very near future, making it for all intents and purposes, obsolete as well. Bandwidth is the highest frequency to which a cable will perform. As frequency injected onto a conductor increases, so does the likelihood of noise on adjacent conductor. Once noise overcomes the signal, the cable will no longer function properly. This is important to keep in mind since the cabling infrastructure should be designed to last at least 10 years and accommodate three to four generations of electronics.

While Category 5e is tested to 100 MHz, Category 6 cabling is tested to 250 MHz. Test parameters such as near end crosstalk (NEXT), return loss, and insertion loss are elevated for Category 6 and as result, ensure better performance over Category 5e cables. Category 6 cabling is also physically different from Category 5e. A center filler or star filler is used to separate the pairs from each other and the insulation on the individual conductors is thicker than that of Category 5e cable. These features allow it to accommodate higher frequencies as

well as provide better immunity from external noise. As frequencies increase, the likely hood of alien crosstalk (crosstalk from adjacent cables) becomes more likely. Category 6 is more immune from alien crosstalk than Category 5e.

Why are there different grades of Category 6 Cables?

The Honda Accord, one of the highest rated automotives on the road, is available in three levels of trim, DX, LX and EX. All are Accords, yet all offer slightly different features. The EX, the most luxurious, offers features the others do not and comes equipped with a large V-6 engine that will get you there faster. Just like the auto manufacturers, cable manufacturers offer various levels of performance in their category cables. And just like the Accord EX, some will get you there faster.

Hitachi Cable Manchester, the first cable manufacturer to incorporate a center filler in a Category 6 cable, through constant development, has found ways to improve and otherwise modify Category 6 performance. As a result, HCM manufactures three grades of Category 6 cables. They are *Plus*, *Premium* and *Supra*. The *Plus* cable offers 1dB of guaranteed NEXT (near-end crosstalk) and 6.5dB of ACR (attenuation to crosstalk ratio) headroom at 250MHz. In contrast, the *Supra* guarantees 8dB of NEXT and 14.5dB of ACR headroom at the same frequency. The *Premium* offers performance characteristics in between the *Plus* and the *Supra*. *Supra*, due to its high level of performance, is considered an *enhanced* Category 6 cable. Each cable, however, is engineered to provide a specific level of performance. The purpose behind offering three levels of performance is to ensure that a product is available to meet the needs of every potential customer. A customer's likely use of their cable infrastructure will help determine which level of performance they may want to select. End users who want to ensure that their networks perform to the best of their ability often opt for the cable that offers the highest performance. This high performance, as we described early, is measured in headroom above the Category 6 standards' requirements. The HCM *Supra*, for example, guarantees a delay skew of 20 nanoseconds. The Category 6 standard requires a delay skew of 45 nanoseconds. *Supra*, because it is an enhanced Category 6 cable, gives its user greater assurances that data will not be lost or corrupted during exchanges. Unlike the electronics used in the network that are likely to change in only a couple years, the cable infrastructure you choose is likely to remain for ten or more years. When permissible, end users should always opt for the best possible cable.

Do I need an enhanced Category 6 Cable?

Though a number of factors influence which grade of Category 6 cable a building owner or IT professional may choose, performance is typically the driving factor. Category 6 *Supra*, HCM's highest performing Cat 6 cable, has a slightly larger

diameter copper conductor and thicker insulation than other Category 6 cables. These features and others enable the *Supra* to provide a Zero Bit Error Rate. A zero bit error rate ensures all data packets reach their destination complete. As frequencies increase to accommodate the faster protocols, opportunities for dropped data packets increase. In TCP/IP, (Transmission Control Protocol/Internet Protocol) the basic communications language, if packets are dropped during communication, TCP/IP simply resends the packets until they all arrive. Voice-Over-Internet Protocol (VOIP), a growing technology that utilizes Ethernet technology to send voice signals, operates using UDP (User Datagram Protocol). While TCP/IP retransmits lost or corrupted packets, UDP does not. Due to the nature of voice communication, if packets of data are dropped, they are not retransmitted. Dropped packets in VOIP result in an inferior audio signal. For those end-users who anticipate using a VOIP telephone system, the performance of the cable will have a direct impact on the performance of the VOIP system. To ensure the best possible performance from the system, use of an enhanced Category 6 cable such as HCM's *Supra* would be appropriate.

An enhanced Category 6 cable can also be used for 10G Base-T, or 10 gigabit Ethernet (10,000 Mbits/sec). The standard for 10G Base-T, also known as IEEE 802.3an, is expected to be released in July 2006. The cabling standard addressing cable performance for 10G Base-T, TIA 568-B.2-10, will also soon be released. TSB-155 permits the use of existing Category 6 cable for 10G Base-T up to a distance of 37 meters. This is due to the high frequencies at which 10G Base-T will operate. Tested to 500MHz, Category 6 cables used for 10G Base-T must be capable of exceptional performance in regards to both individual cable performance and cable performance in a bundle. The higher frequencies of 10G Base-T will induce alien crosstalk in adjacent cables and challenge the performance of a standard Category 6 cable. Just like 1000Base-T pushes the performance levels of Category 5e cabling, 10G Base-T will push the limits of standard Category 6 cabling. HCM *Supra*, however, is designed with high performance in mind. Tested to 660MHz, *Supra*, with its Zero Bit Error Rate will provide superior 10G Base-T performance to the full 37 meters. By installing an enhanced Category 6 infrastructure, you can be confident that the infrastructure will support all current applications and most future applications as well.