
# Category 5e vs. 6

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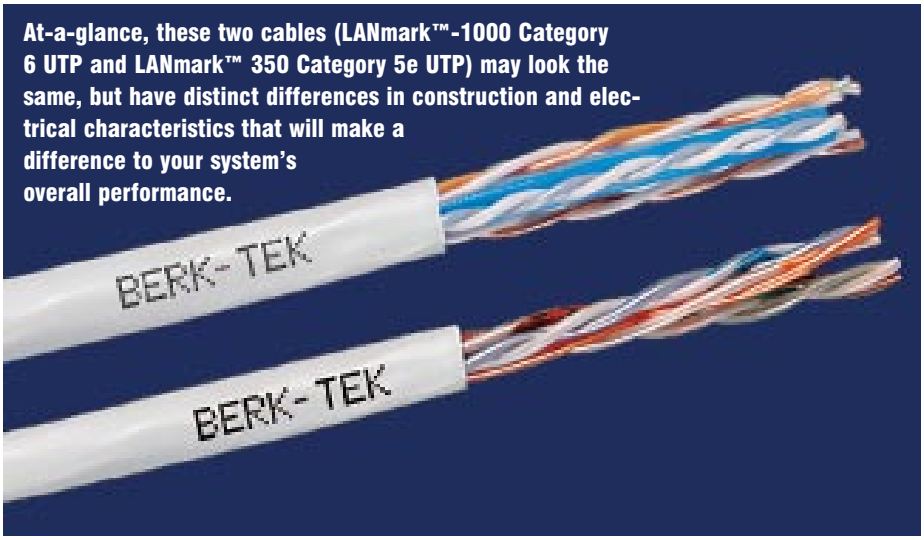
Category 5e still accounts for the majority of installed base of horizontal cable for voice and data applications in the LAN and enterprise market. But according to the latest study by FTM Consulting, Category 6 is gaining significant ground with new installations and will outpace Category 5e by next year. Category 5e is expected to fall off significantly in two years, primarily being used in existing and lower-end installations. So, why does this question continue to arise over and over, "Why should I choose Category 6 over Category 5e?"

Today's data and voice applications, such as one Gigabit to the desktop, have been designed to run over Category 5e. After all, Category 5e is the minimum performing solution that meets the TIA 568-B specifications. But, Category 6 allows better signal integrity at higher bandwidth, which will become critical for the cabling plant to support some future applications. Category 5e is defined at 100 MHz bandwidth capacity with Category 6 over twice that at 250 MHz. In addition, significant improvements in the design and manufacture of Category 6 provides improvements over simple bandwidth. Following the history of increasing needs for higher bandwidths which, according to Moore's law, doubles every 18 months, the need for speed and capacity may obsolete your cabling plant, depending on your requirements.

Category 6 uses a larger conductor size and tighter twist ratio to improve basic electrical characteristics, such as crosstalk. Some Category 6 cables include a spline to further separate the pairs. The reduced attenuation and larger gauge size makes Category 6 a more robust cable, which is necessary in higher bandwidth applications and also in temperature fluctuations. In addition, some Category 6 cables are designed and manufactured to have exceptional balance. Cable balance enables the cable to resist interference from noise, both internal and external to the cable.

But let's take a closer look at how the physical differences affect overall network performance. The Nexans Data Communications Competence Center (DCCC) lab in New Holland, PA, conducted several comparative tests on signal integrity in Category 5e and Category 6 cabling systems from various manufacturers. You can be the judge on whether these are important when making your cable selection.




**At-a-glance, these two cables (LANmark™-1000 Category 6 UTP and LANmark™ 350 Category 5e UTP) may look the same, but have distinct differences in construction and electrical characteristics that will make a difference to your system's overall performance.**

## REDUCED ERRORS

One study showed that Category 6 was less prone to errors than Category 5e with a range of transceiver performance levels. Tests performed in the DCCC lab compared the number of Cyclic Redundancy Check (CRC) errors over Category 5e and Category 6 when using a Gigabit Ethernet transceiver. It is a misconception that all Gigabit transceivers are the same. There is actually variability in transceivers, even by the same manufacturer. In the lab, three transceivers were used and Gigabit Ethernet packets were transmitted over a 100-meter, 3-connector channel, first over Category 5e and then Category 6.

The test results showed a 13x reduction of CRC errors when using Category 6. Changing the cabling system to Category 6 improves the signal-to-noise ratio of the entire transmission system, allowing the transceivers to more consistently and accurately receive the Ethernet packets. The improved performance of Category 6 cabling affects the overall reliability for the network. This additional headroom allows the use of network components that might otherwise cause significant network downtime and expense.

## CATEGORY 6 TAKES THE HEAT – INSIDE AND OUT

Structured cabling is often installed in hot areas – such as above the ceilings in plenum spaces. In fact, it is not uncommon over the course of a day for the temperature in some settings to rise and fall as much as 25°C (45°F). These fluctuations affect

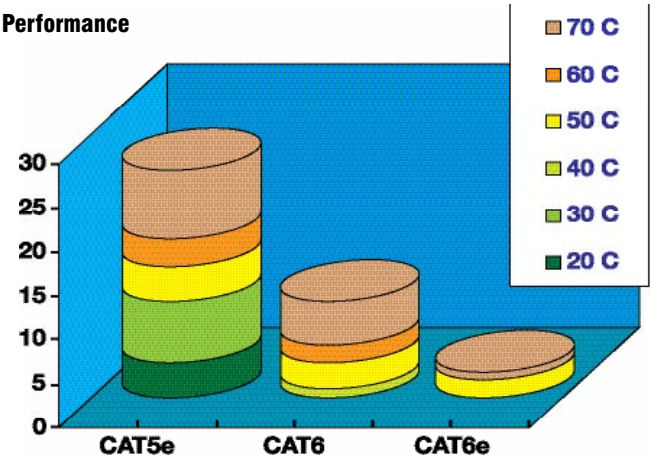
cable performance. The DCCC conducted a series of tests where 1000BASE-T signals were transmitted over 90-meters of Category 5e, 6 and enhanced Category 6 cabling systems. At different stages, increased temperatures were introduced in a controlled oven, from 20°C to 70°C in 10 degree increments.

The results of the tests showed that there was a significantly higher occurrence of CRC errors at higher temperatures using Category 5e cabling as compared to Category 6 (See Table 1). There was a further significant reduction in the number of errors when an enhanced Category 6 cabling system was tested.

In addition to cable being affected by outer heat sources, the cable is also affected by applications, such as in PoE (Power over Ethernet). To integrate running power over the structured cabling system, industry standards have been formulated to govern both the electrical and physical characteristics for PoE applications. IEEE developed 802.3af in 2003 to define the methodology for the provision of power via balanced cabling to connected Data Terminal Equipment (DTE) with 802.3 Ethernet interfaces. The amount of power is limited by cabling physics and regulatory considerations. Because the 802.af standards specified compatibility with existing equipment, the transmission guidelines honed in on delivering power over Category 5e as most networks were running on 10BASE-TX or 100BASE-TX.

Applications designed to send power and data through the same twisted pair cable, such as Voice over IP phones and security cameras, will eventually need to push more power over the cable. Two years on the docket, but soon to be ratified is the IEEE 802.3 at specification, also known as PoE Plus. This will increase the allowable wattage running through a twisted pair from 13W up to 60W. As seen in previous testing, cable performance tends to degrade at higher temperatures due to greater insertion loss. Therefore, the maximum transmission distance for a link or channel may be affected. The industry trend to install higher-grade cables, such as Category 6, which utilize larger conductors, minimizes insertion loss while increasing current carrying capacity.

**Table 1 – Gigabit Ethernet Performance at Elevated Temperatures**

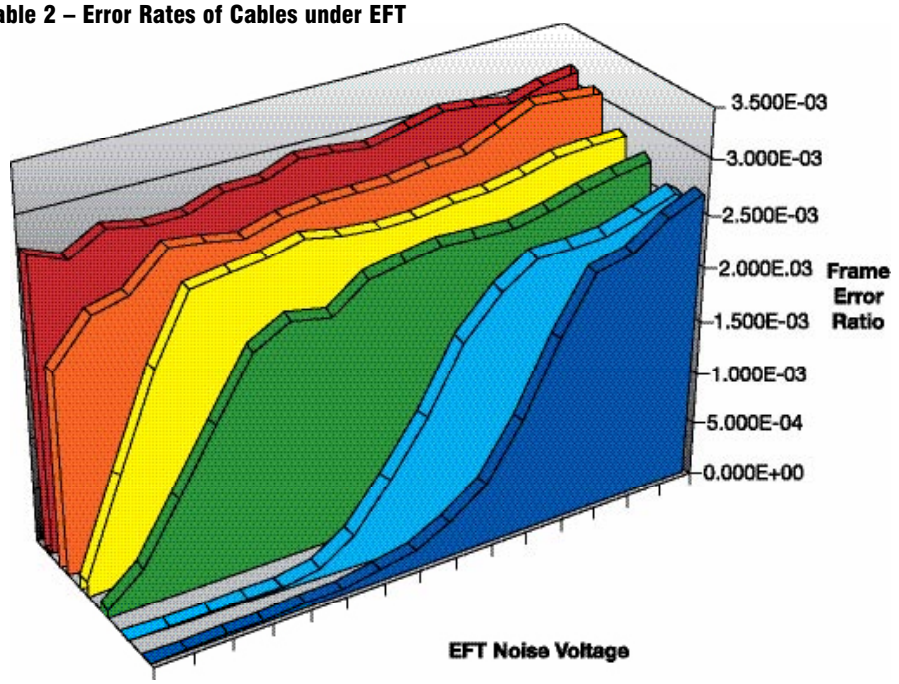



## WITHSTANDS NOISY ENVIRONMENTS

Increased susceptibility to external noise becomes critical with increased data rates, which require higher signaling speeds and more complex encoding. External noise sources such as power lines, air conditioning units, elevators, electrical equipment and interference from adjacent cables generate spikes of voltage, also referred to as electrical fast transients (EFT). EFT can drastically affect the operation of copper cables and create errors. There is a direct relationship between balance and noise immunity. Balanced cable, such as Category 6, results in better noise immunity – up to 50 percent better than Category 5e.

Tests performed at DCCC included exposing Category 5e, 6 and enhanced Category 6 cables to varying levels of EFT while transmitting Gigabit Ethernet packets. The ratio relationship between errors and noise pulses were calculated and graphed. Significant differences in performance exist between balanced and unbalanced, and Category 5e and Category 6 cables. (See Table 2)

**Table 2 – Error Rates of Cables under EFT**



## JUSTIFYING THE INVESTMENT

One of the main reasons for choosing Category 5e over 6 often comes down to budgetary decisions. The larger conductor size, tighter lay lengths, and a more complex manufacturing process adds to the cost of a Category 6 cable. But, everything is relative.

True, Category 6 can be 35-50 percent more expensive than Category 5e in materials alone. But, taking into account the total cost of the network system, this percentage actually becomes minimal. When designing a network system, costs are usually broken down by the following elements:

- software – 51 percent,
- hardware – 22 percent,
- network infrastructure – 20 percent,
- training and documentation – seven percent.

Take the 20 percent network infrastructure and break it down even more between passive and active components, as well as design management. Of those items, less than half go towards cabling. And of that ratio, the cable itself totals 35 percent. The end result is that LAN cable cost is actually less than three percent of the total network cost. The cost to upgrade from Category 6 from Category 5e is actually less than one percent of the total network cost, which is relatively low.

Studies show that telecommunications cabling life cycle supports at least two generations of network equipment. This should lead cabling system designers and installers to select the most advanced infrastructure. If you want your cabling plant to support existing and future applications, the investment in Category 6 is minimal considering the benefits. And, if heat, noise, increasing bandwidth and speeds are not major concerns, then Category 5e is fine for now. The choice is yours. ■

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