Understanding the Difference between Cat5e and Cat6 Ethernet Cabling

Introduction

Since August 2009, when ANSI/TIA-568-C.2 (Balanced Twisted-Pair Telecommunications Cabling and Components Standard) was published, category 5 has been superseded by category 5e and is no longer recognized by this standard. The use of Cat5e or better cabling is recommended for all new installations. Currently there is a great deal of confusion among Ethernet cable users concerning whether to Cat5e or Cat6 cable. This short article serves as a reference paper for technical people and a buying guide for cable users.

Cat5e vs Cat6 Ethernet Cabling

Cat5e cabling requirements were first published in 2000 in order to address the additional transmission performance characterization required by applications such as 1000BASE-T that use bidirectional and full four-pair transmission schemes. The 568 standard added performance headroom to Cat5 performance limits and characterized several new transmission criteria that were required to support Gigabit Ethernet over a worst case four-connector channel.

Cat6 cabling delivers double the signal-to-noise margin of Cat5e cabling and provides the performance headroom desired by end-users to ensure that their cabling plant can withstand the rigors of the cabling environment and still support 1000BASE-T when it comes time for an application upgrade. The Cat6 cabling specification development process also brought to light the need to limit the conversion of differential mode signals to common mode signals and vice versa through the characterization of component balance, resulting in cabling systems with improved electromagnetic compatibility (EMC) performance.

The TIA (Telecommunications Industry Association) is the leader in the development of structured cabling standards. By comparing the requirements in the TIA standard, one can easily see difference of the electrical

performance requirements between Cat5e and Cat6 cables. Table 1 provides comparative horizontal cable performance data for Cat5e and Cat6, using a UTP cable as an example. Frequency-dependent values are given for 100 MHz.

	Cat5e	Cat6
Frequency Bandwidth	1-100 MHz	1-250 MHz
Insertion Loss (Min.)	22 dB	19.8 dB
Characteristic Impedance	100 ohms ± 15%	100 ohms ± 15%
NEXT (Min.)	35.3 dB	44.3 dB
PSNEXT (Min.)	32.3 dB	42.3 dB
ACRF (Min.)	23.8 dB	27.8 dB
PSACRF (Min.)	20.8 dB	24.8 dB
TCL (Min.)	n/s	30.0 dB
Return Loss (Min.)	20.1 dB	20.1 dB
Propagation Delay TCL (Max.)	538 ns	538 ns
Delay Skew (Max. per 100 m)	45 ns	45 ns

Table 1. Cat5e and Cat6 UTP Solid Horizontal Cable Specifications Comparison

Generally speaking, Cat6 cable has wider frequency bandwidth and tighter requirements on electrical performance. Although the signal transmission speed and skew of delay on all pairs are the same, Cat6 cable can still deliver more data and keep better signal integrity due to the bandwidth and headroom.

To ensure the cable is Cat6 compliant, cable manufacturer may use slightly larger conductor to meet the insertion loss requirement, higher grade of insulation material to meet the impedance and propagation delay requirements. Insulation material selection also depends on the UL flame ratings. For example, using polypropylene or polyethylene for riser-rated cable and FEP for plenum-rated cable. Besides the raw material, cable construction also plays an important role in Cat6 cable design. Various shorter pair lay lengths usually give better crosstalk performance. To further eliminate the crosstalk, a web or other shape of filler may be applied to separate the pairs from touching each other. The cable jacket and shield (for screened cable only) protect the cable core and keep the structure stable.

On the other hand, well established and qualified manufacturing process will assure the cable balanced which helps other electrical parameters such as return loss, TCL, and ELTCTL for Cat6 cables.

Ethernet Cable for Industrial Use

If the cable is designed for industrial environment, other factors should be considered as well when select the right cable for the applications. Cables used in industrial environments must be designed to work in harsh environments of temperature extremes, humidity and moisture, dust and mud, oil and solvents, corrosive chemicals, mechanical vibration, EMI interference, etc. Typical applications include oil, gas and petrochemical plants, water and wastewater facilities, wind farms, and mining. To make an Ethernet cable suitable for industrial environment, cable manufacturers use premium-grade of insulation and jacket materials for the higher temperature rating and to withstand mechanical and environmental abuse. Besides the material changes, other components such as strength member and braid can also be used to help the robustness and improve the performance.

As for selecting the right cable for customer applications, use Table 2 as a starting point, then consider other factors such as cost and future expansion plan of the existing network. Table 2 summarizes cabling types capable of supporting commonly specified applications over 100-meter, four-connector topologies. It should be mentioned that many of current available Cat5e cable of good quality can run near or at gigabit speeds, but it just cannot be "certified" for this use. On the other hand, Cat6 is designed especially for gigabit use, and is certified to operate at said speed.

Based on the information above, the able buyer should make purchasing decision based not only on the engineering specification (bandwidth, speed, existing hardware, etc.), but also on non-engineering considerations such as cost, future expansion need, etcetera.

	Cat5e	Cat6
10BASE-T	✓	✓
100BASE-T4	✓	✓
155 Mb/s ATM	✓	✓
1000BASE-T	✓	✓
1000BASE-TX (TIA/EAI-854)	✗	✓

Table 2. Cat5e and Cat6 Supported Applications Comparison