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Making Sense of The Approved TIA Standards and Ethernet Cable Speeds

Even in modern day technology, there is still a lot of mystery surrounding the world of megahertz as it applies to category cables and Ethernet speeds. In this article we are going to clear up some of the mysteries and myths that are circulating around about Ethernet megahertz, what it is and why it matters.

What exactly are Megahertz in relation to cabling? Megahertz are the rate at which a signal can change states. In networking this would be from 1 to 0 or 0 to 1. So when you see a copper network cable labeled 100MHz that means the cable supports anything from 1MHz to 100MHz or 1,000,000 - 100,000,000 changes per second (Cat5/Cat5e). When it comes to modern networking, three cable types are at the center of marketing gimmicks: Cat5e (100 MHz), Cat6 (250MHz) and Cat6a (500MHz). The reason why Cat6 exists with its 250MHz standard is due to the fact that the original Gigabit networking standard was going to be used on two pairs, which meant that it would need to support 200MHz. It was decided that a little overhead would be nice so the committee added an extra 50MHz. After Cat6 was established at this higher MHz, it was decided that Gigabit would instead use all four pairs and thus only require 100 MHz. This extra overhead was decided upon before Gigabit was established so all Gigabit network equipment is designed with 100MHz as the standard. This means you can buy a 100MHz Cat5e cable and run Gigabit with no issue, provided that the cable meets the rest of the standards and that it gets installed correctly.

A category cable is built for carrying signals, most typically of the Ethernet variety. Category cables come with insulated copper wires that are twisted together inside the cable jacket, which is referred to as a twisted pair. Some category cables come with splines inside the cable, which are shaped like T-Pins and separate the twisted pairs inside cables. Cables are twisted for a few reasons, but mainly to cut down on crosstalk and also to make the cable itself flexible. Crosstalk is the electromagnetic interference that can run through a cable. This is an undesired effect, and is basically one signal mixing with another and causing a disruption. External interference can happen when signals get intertwined with another nearby signal. This is common in workplace settings where there are sources of electronic interference. An extra step in preventing crosstalk is shielding a cable. Shielded cables have an extra layer of protective insulation using aluminum to cover the cable's twisted pairs. This extra protective covering helps ensure that the cable's signal does not radiate and interfere with other nearby signals.

Cables manufactured in the U.S. must follow guidelines set up by an association who regulates cable specifications. Referred to as the EIA/TIA, this is the organization that decides what a category cable consists of in the U.S. TIA stands for the Telecommunications Industry Association, which is associated with the Electronics Industries Alliance (EIA). For European standards there is the Institute of Electrical and Electronics Engineers (IEEE) that regulates all category cable specifications. The EIA/TIA sets very strict regulations on what they expect from cable manufacturers. This way there is a common industry standard that all manufacturers can use as their guideline when creating cables. The EIA/TIA states that category cables do have such a thing as a maximum length. For Cat 5/6 cables, the maximum cable length is 100 meters, or 328

feet. Out of those 100 meters, ten meters is reserved for stranded patch cable between the jack and the wall plate. Any length longer than that and the cable's performance may start to be affected. Cables are also defined by their AWG (American Wire Gauge) rating, which is used to measure the thickness of a cable's conductor(s). This helps determine the carrying capacity of a cable.

Category cables are either made with pure copper or what's known as CCA. Copper clad aluminum is an aluminum conductor that is coated with copper. This is done typically to cut costs when manufacturing a cable. This makes for a weaker cable and can cause multiple problems in installation. CCA cables will also have a shorter shelf-life than all copper cables, so it's something to think about when purchasing them for an installation. Too little copper decreases a cable's efficiency. CCA is quite a bit less expensive than pure copper, depending on the copper to aluminum ratio used in the cable. You can usually tell a CCA cable by its lightness, as aluminum is lighter than copper. Official TIA specifications call for pure copper in category cables. Therefore CCA cables are not recognized by the TIA/EIA.

The first category cable ever created was labeled Category 3, and was originally manufactured for use in telephone wiring. Later it was used as an Ethernet cable carrying data up to 10 Mbit/s. This was followed by a Category 4 cable that carried 16 Mbit/s. These were then replaced by Category 5 cables which were then upgraded to the Category 5 enhanced aka Cat5e. These carried up to 100 MHz and made all previous category cables basically obsolete. The Cat 5e is still relevant today and is still widely used in many installations.

Cat 6 cables then hit the market amid some controversy. A lot of installers started picking Cat6 cables over Cat5e due to the way they were marketed instead of for their specifications. Cat6 cables are more expensive than Cat5e, and can be overkill for today's home network speeds and what installers are using them for. They have been advertised as being a much better solution than Cat 5e cables, but that is not necessarily the case. Most networks are still gigabit or less and Cat5e can handle gigabit speeds without a problem. The biggest misconception is that they are rated at a much higher megahertz than other cables, up to 250 MHz. This is not an accurate description though when it comes to the cable's actual ability to pass a signal. Another misconception is that the Cat6 will carry a signal farther than other cables. This is not true; Cat 6 cables cannot carry a signal farther than the Cat 5e although the signal itself will be stronger. There is also Cat 6a on the market, which stands for "augmented Cat 6." This cable is defined as having frequencies up to 500 MHz. Although this enhanced version of the cable will have a higher performance level, that means that it is physically bigger also. Cat 6a cables are the biggest currently on the market, which means they are heavier and need more room to bend.

Category 7 cables do exist, but they are not rated or regulated for use in the United States. There has been some debate on why Cat 7 cables were not sanctioned by the TIA for use in the U.S. The reason being that Cat 7 cables have a 600 MHz bandwidth, and Cat 6a already has a 500 MHz bandwidth. There would not be a significant enough upgrade to make a whole new cable classification. In Europe the new cable type caught on in popularity with the belief that the added bandwidth would give installers a "safety margin." Cat 7 cables are sometimes referred to as "ultrafast Ethernet." Most of the Cat7 cables you see on the market here in the U.S. don't follow the European standard, but come with a specification that was made up by an offshore factory to sell more cables.

The Cat 7 cable is outlined by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) and is formally called a "Class F" cable in Europe. All cables are defined by letters instead of digits there, but then Europeans started calling it the "Cat 7" so TIA just decided to skip

that number altogether and move on to "Cat 8" to avoid confusion.

Cat 8 cables are still in production stages, but speculation so far is that it will be physically similar to a shielded Cat 6a cable, and that they will stay with the RJ45 connectors at the ends. The Cat 8 cable has an expected release date of late 2014 or early 2015.

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