Paper # **2007**
Your Network is Hanging by a Wire
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Your spending thousands (and sometimes millions) of dollars on your network equipment. If you need a network, you get it installed with the objective that it will be there, **operational,** when you need it. After all, if you did not need a network to start with, you would not spend all that money.

All the components used to create your network are vital to a certain extent. Of course, if a failure deletes a single workstation from your network, it is not as detrimental as if your whole network fails.

The components that are usually identified as vital are: the server, the hubs, the routers, the bridges, the repeaters and to a lesser degree, the cards in the workstations, except if a card upsets the whole network.

What is **missing from this list is "the cabling"**. This component, although passive in nature, should be considered as one of the **most vital** parts of your network. The reason is very simple. **Your cabling could take down your whole network.**

Since cabling is made up of many components, serious consideration should be given to the selection of **all** the components assembled as part of your cabling. The chain is no stronger than its weakest link. If any component in your cabling system is not performing right, the whole cabling system will fail, no matter how good the other parts are. The cabling has to be **seen as a system that has to perform as a complete entity. It is an integral part of your network.**

Often, cabling is not given appropriate consideration at the time of planning the installation of a network. The selection of your cabling is typically left to the decision of the installer and done at the last minute to meet the deadline for the system to be operational.

Is the installer the right person to decide, for you of what your network should use? This is what happens when cabling is not viewed as a major part of your network. **Would you let the cable installer decide your server for you?**

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At the last minute, **someone with little networking knowledge will dictate what will be used to connect your valuable network components.** For all you know, your installation company could have sent you their least experienced person. Someone with absolutely no interest in having a viable network. His responsibility is limited to connecting the items in a fashion that it will work on day one, and that's it. You pay and you are on your own.

You are basically left holding the bag when something goes wrong. **Yes you!**

Since your installer leaves after the installation and the network usually works at that time, you assume that it will work forever. Your cabling may never fail while you are using the network that it was installed for, which was often just Ethernet 10BASE-T. **Will your cabling be able to support your future networks like 100BASE-T or ATM-155 Mbps, how about other technologies that will be developed to work over Cat.5 cabling?**

Are you willing to take the chance that you will have to rewire, when the time comes to upgrade your network? If you do not consider this at the planning stages of networking, you are throwing good money out the window and you will keep doing so forever.

I know, people say **"we will never need to go to higher speeds",** we are not even using the full capacity of our existing network!

How many XTs do you have left on your network? After all, the XT technology is barely 10 years old. Do you remember hearing "8 Meg. hard disk, we will never exceed that!" Today, the "off the shelf" machines (not super office workstations) come with a 1 Gig. hard disk and more.

Software companies include all the latest functions that users expect from the applications. This results in programs that are quite larger than the ones they replace. Look at the size of the latest word processor software (like Word for Windows) and see if that is the same size as its predecessor. Windows 95 requires more power that Windows 3.1.

Will today's applications be sufficient for your operation, when **your competitor responds faster than you do?** We will let the market decide; but I bet that your present network is only a "**now**" **solution** that will be looking for a new solution within a few years. How long did the **386** remain **the** technology? How about the **486**? Now, how long will the **Pentium** last? Oh! Did you say **Pentium Pro?** Ten years eh! It has been a short ten years, don't you think?

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Will the cabling that you are considering installing last ten years and support all the new technology networks that you will install within those ten years? It should, if you plan it right and select the right cabling system.

A revised TIA/EIA Commercial Building Cabling Standard was issued in November 1995. It is called TIA/EIA 568A. It is available from Global Engineering Documents, 15 Inverness Way East, Englewood Colorado, 80112-5704. They can be reached by telephone on: 800-854-7179 or by Fax on: 303-397-2740.

What is so special about that standard?

In order to attempt to explain what you can expect from a standard, I would have to review the whole standard with you. Since this is not possible, I will try to point out some of the aspects that require real consideration.

First, let me try to convince you that standards are important. Standards are everywhere. Just think that if there were no standards for tire sizes, you would be forced to go back to the dealer to purchase a tire that fits the rim on you car. That could be upsetting, if you were 1000 miles from the dealer. Therefore, I suggest that you should not allow anything installed, as part of your cabling system, that does not meet the standard.

Are standards the ultimate? No, as a participant in developing standards, I can tell you that **standards do not specify the best**; but what is the **minimum acceptable level of performance.**

It is normal that the minimum level be specified. Otherwise, the standards would only be met, if the very best **and only the very best** were specified. This would most likely result in only one product meeting the standard and excluding everyone else. This would not be acceptable.

Standards, like TIA/EIA 568A are developed by committees that are staffed in majority by manufacturers of products. Some government and end-user representatives also participate in the development of standards; but they are a minority.

The contents of the standards are developed by consensus. That is not "UNANIMITY", often far from it. Consensus can best be described by: "When everybody around the table is just as dissatisfied as everybody else". You have to understand that each manufacturer wants his products to meet the standards; or shall we say, that the standards allow his products performance limitations. He does not want to be excluded from the market.

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Now to 568A. It is the second edition of the Cabling standard. The first was issued in July 1991.

Since then, many performance enhancements were identified in cabling components. To keep the designers informed of the latest technology improvements, TIA/EIA issued interim "Technical System Bulletins" (TSB).

These TSBs are not part of the standard, they are only informational documents and are not sent out for ballot to the same extent that standards are.

The first one of these, relating to Commercial Building Cabling, was issued as **TSB 36** in November 1991. **It was the first document that talks about Categories of "CABLES".** These are Cat. 3, usually used for voice, Cat. 4, which is a better performance cable and of course **Cat. 5, that everyone is presently installing for Data. This is the highest category of cable that is specified in standards.** Do not let anyone tell you otherwise.

Many people in the industry thought that Cat. 5 was part of the initial EIA/TIA 568, the first standard issued in July 1991. It was not! As a matter of fact it only became part of the newly issued standard TIA/EIA 568A in November 1995.

After November 1991, people started installing Cat. 5 cables and **thought that they had a Cat. 5 System that would perform "End to End".** Good luck!

In September 1992, EIA/TIA issued a second TSB called **TSB 40.** This one describes the **performance required to be met by connecting hardware** to meet the various categories Cat. 3 to Cat. 5, such as punch-down blocks, jacks and patch-panels.

People then realized that **for a Cat. 5 performance, they needed more than Cat. 5 cables**. With cables and connecting hardware, they thought "now we are in business with Cat. 5". Oh yes!

The next step was for TIA/EIA to include these two TSBs in a revised standard. Then, people would ask for components that meet or exceed the requirements of the standard. TIA/EIA wrote a revised standard proposal that included the specifications identified in TSBs 36 and 40. In the Appendix "E" of the same proposal, they included a specification for "**End to End"** performance. By the way, the **Appendix "E" is informational and not part of the standard.**

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What you want is "End to End" performance. Then, why is it that the Appendix "E" is not a requirement to be met as part of the standard? It is a question of **consensus.** The Committee could not get consensus because many of the **manufacturers could not guarantee "End to End"** because they only manufacture some, but not all the components to assure the "End to End performance.

The proposed new issue of the standard went out for ballot in July 1993. The results of the vote were compiled in Dec. 93. There were several negative votes and a multitude of comments. Most of the negative votes related to manufacturers that attempted to connect components meeting the performance set fort in Appendix E of the standard and could not get Cat. 5 "End to End" performance. Now, many manufacturers of components are making alliances with suppliers of the products they do not manufacture to attempt to provide and "End to End" solution.

Since all negative votes have to be resolved before issuing a standard, an investigation took place to find out why **"Cat. 5 components, when connected together, do not perform as Cat. 5 End to End".** Following extensive testing by many manufacturers, it was found that the test plugs used to test connecting hardware were a point of contention. **In January 1994, TIA/EIA issued another TSB called TSB 40A that replaces TSB 40.** This TSB describes how a test plug has to be fabricated to consistently verify the performance of Cat. 5 products, as well as for attempting to test "End to End" cabling.

A second ballot took place in March 1994. **This resulted in some negative votes. Two of which were from manufacturers whose components did not meet Cat. 5 anymore.** And guess what! They wanted their components to be granfathered. They tested as Cat. 5 before, therefore **they should be considered as Cat. 5** forever. Yes! TIA/EIA said sorry, but you have to meet the specs using TSB 40A. **How many of these components ended up on your network?**

Comments from many end users were **"I am not worried, because my installer tested each lobe for Cat. 5 performance after installation".** Well, it turns out that there were **no specifications for test sets to meet.** Anybody could claim that his test set could test Cat. 5 performance.

Fully **realize that this is January 1994** before the plug problem was identified. This means that many Cat. 5 jobs, installed prior to January 1994, may not perform as Cat. 5 at all. **You will not find out about it until you change your network to higher speeds.**

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Then and only then, will you be facing this problem. Most likely, your present network does not need the performance of Cat. 5.

The new TIA/EIA standard 568A was finally issued in November 1995. The Committee concurrently worked on the development of a TSB to cover the specifications to be met by portable test equipment.

In November 1995, TSB 67 was issued. It covers "hand held test set specifications". **We are slowly getting there.**

This TSB covers performance requirements for two grades of test sets. Level 1 and Level 2. Level one is for the first version of the test sets. Their accuracy can be up to 30.6% out, if the lobe tests within 1 dB from the test specifications. Level 2 is a major improvement over Level 1. Its accuracy is up to 15 % off when readings are within 1 dB from the specifications.

Now with all this, **can you assume that you will get Cat. 5 performance "End to End".** That is close to the $64,000 question. If the past is an indication of the future, **the standard is far from complete**. There are many electrical specifications that are still not covered in the standard. **It is much better than the first issue**, but still needs work. For example, the committee is studying the performance of patch-cords. **No there are no specifications for patch-cords.** Please do not accept patch-cords made locally by the installer.

When failures on the network are identified as part of the cabling, **70% of those are due to patch-cords.** And to add insult to injury, **the failures are intermittent.** Give me a cut cable and your problem will be fixed very fast, but intermittent, who can stand that. After many repair visits and the frustration of a non-performing network, if you are lucky, someone will find the culprit. **Welcome to reality.**

Oh, by the way, there are a few other electrical specifications that the Committee is developing. **Balance** is one of them. Presently, there are no specs for balance. This parameter is becoming critical at some frequencies and some components will fail when these frequencies are used with higher speed systems.

Short lobes exhibit problems that will make the cabling fail. It is partly due to resonance. The Committee is trying to find solutions for this problem. It is not an easy problem to resolve and a lot of effort is being deployed to correct the situation.

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Propagation delay is presently a hot subject, but it is not covered in the TIA/EIA standard. There is also a requirement to be met for skew. This is the difference in propagation time between the different pairs of a cable and components of cabling. It is 50 nano-seconds for 100Base-T. It was identified as a requirement when the new IEEE 100BASE-T4 standard was developed. Problems can result from using components that do not meet the IEEE specified propagation delay limits.

 With the advent of the **shortage of** a favored insulation material (referred to as Teflon) on the market, cable manufacturers are attempting to manufacture cables using different insulation material for the different pairs and at the same time, maintain the flame propagation and smoke density requirements. Since the insulation material is a major contributor in propagation delay, problems are being identified for which solutions will have to be found. TIA/EIA issued a press release identifying the problem. They found that the problem is severe enough that a TSB covering the requirements will be issued as soon as possible.

But, any manufacturer can claim Cat. 5 performance without consideration to propagation delay, since there are no specifications for that parameter in the standard yet.

Now your are just about ready to ask me **"are standards really good"?** The answer is a very serious and sincere "**yes, but".** They are not complete and they will forever be modified as we progress with faster operating networks. Your networks are dynamic and the standards to accommodate them are also dynamic. It would be impossible to state that nothing will change.

So, how can you be assured that what you install today will work with your future networks?

There are a number of warranties that manufacturers provide as assurance of performance. You have to be able to differentiate between all of them and select the one that will provide you with performance of your future networks.

Some people will say **"it's just cable, I do not need a warranty"**. It is interesting to see people purchasing a $12 pressing iron and mail in the warranty papers. What do they expect for $12? The same people will get a $100,000 cabling system installed and will not ask for a warranty. Eh!

What do you want warranted? That is a major consideration. The **products**, the **installation**, the system **Link performance "End to End"**, the **applications** or the **support** after the installation?

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I suggest that you want all of the above. The most important one, in my view, is the assurance that future applications will work. Should you care if the components are rated Cat. 5, if the network does not work? The important item is a performing network present and future.

Let us look at some of the warranties in the industry. The most common one is what I call **"The Bucket of Paint" warranty**. It reads as follows:
"...15 year warranty that horizontal cable links composed of Cat. 5 products will meet certain **Attenuation, NEXT and ACR values...**"

Two of these parameters are included in the standard. ACR is not covered in the standard. So, how can someone claim to meet ACR values, if there are no specs to meet?

This warranty is like going to the paint store and purchasing a gallon of paint for your living room ceiling. Two weeks after you have finished, the paint starts peeling off. What do you do? You go back to the store and tell the owner about your problem. His answer is simple: "No problem, here is another gallon of paint". That type of warranty and two dollars and fifty cents will get you on the cable car in San Francisco.

If you ask the provider of this warranty: What happens if it fails? The answer is: "... limited to the repair and replacement or refund of cable, connectors and /or connecting hardware". That's it. **After the failure, the very next day, there will be a FEDEX truck at your front door with a box on connectors, period.**

Is that what you are looking for?

Here is another one I call: **"More of the Same"**:

"... guaranteed to perform to the category 5 standard per EIA/TIA TSB36 (dated 12/91) & TSB 40-A (dated 1/94)...for 20 years"
"Our category 5 products are guaranteed to support these networks:

       16 Mbps Token Ring
       TP-PMD (Proposed)
       ATM (Proposed)"

"... if product fails to perform as stated above, [*company*] will provide new components at no charge"

If this is what you are looking for, stop looking and get it installed by Joe Six-Pack and his trained seals while you are at it. The results will complement the material.

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Here is another that I refer to as **"The Newlywed Game":**

"Both [*company A*] and [*company B*] manufacture products to higher specifications than required by TIA 568A giving the installed link an improved Attenuation to Crosstalk ratio for higher network performance."

"when installed by a [*company B*] installer the performance of the cabling system is warranted for a period of 16 years"

I hope that the association will last 16 years!

Wait till they find out the finger pointing that will go on, when the network fails. Who will test to find out which component failed? What if the manufacturer of each component can prove that his components meet Cat. 5? Who do you claim from? Which one will get your network up and running? Or do you just forget about it and pay someone else to come in and resolve the problem? **Will you have to replace the cabling again?**

The costs associated with cabling failures are: 1) the repairman, 2) employees time lost on the job, and 3) the **revenue loss for your corporation.** This last one could be the highest cost to you. It is impossible to evaluate that part of your losses, but many surveys indicate that this could be the highest of all costs.

Will your customers be inclined to work with another corporation that is not delayed due to network problems? It could be loss of revenue, loss of information and non accessibility of the information.

Visualize a hospital where doctors need access to medical records. **Who will tell the doctor that he cannot get access to "YOUR" medical record, because the network failed. What we are talking about here is your very own health.** Is it not enough to go to the bank and be told, by the teller, that

you cannot get your money because the computer is down? This is not acceptable with today's technology.

What you want is "network reliability"! That sounds nice; but what does it mean? Let's look at networking and what it will involve. Your network performs today. What type of network is it? 10BASE-T, Token Ring 4 or 16 Mbps? What will your next change be? 100BASE-T, 155 Mpbs ATM, 622 Mbps ATM or what? That is the question you must ask yourself. That decision could have grave consequences for your Corporation.

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I can basically say that most people do not know what their next network will be. And, there is nothing wrong with that. Technology changes so rapidly that by the time you decide to change to an improved network, there may be many new options to choose from. I would not be any better than you at risking a choice for your future network. By the way, **I do not expect that your next network will be your last network,** and neither should you.

Presently, the IEEE people are looking at networks in the 1000 Mbps. Will this materialize in time for your next move? Will it be what you will be looking for? Nobody can answer that now.

Then, what should you do when planning cabling for the **present and future networks?**

One thing for sure, **you will want your new networks to perform.** You will want your new equipment "**to plug and play**" without having to change your cabling. How can you assure that? Will the above listed warranties provide that assurance? I doubt it.

What you should be looking for is an assurance that your applications present and future will perform as expected.

Here is the type of warranty that you should be looking for: "**Assurance that present and future networks, that require Cat. 5 cabling, will work for the lifetime of your networks".**

What happens if it fails, the cabler **and the manufacturer** will work together to resolve the problems. This is quite different than shipping you parts by FEDEX. **Such a warranty is available from NORDX/CDT.**

Happy Networks

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