

White Paper

2.5 & 5Gb -A step too far? – You decide.



Overview

In the last few weeks we have seen a major announcement coming out from the IEEE, followed by the supporting marketing hype from certain switch technology vendors, making several very bold claims which border on the irresponsible.

Back in 2013 the IEEE set up a task force under the designation of NGBase-T which set out to investigate getting higher and higher speeds over copper twisted pair cables. The first task was to try and get 40Gb Ethernet over what has become Category 8 cabling. This was given the designation 802.3bq, the background of which was more about the economics of copper vs fibre interfaces in the switch, rather than anything around a performance upgrade.

The second task, driven by the Ethernet Alliance, came along more recently which saw some additional requirements under the banner of 802.3bz. Its members had realised that there was a potential hurdle in the deployment of Wave 2 802.11ac wireless. This has a theoretical bandwidth limit that far outstrips what can be delivered by existing 1Gb Ethernet provided by Category 5e and Category 6 cabling. Therefore anyone wanting to upgrade their systems and deploy this new technology would also have to re-cable their building.

This has made some companies think twice, due to the additional cost as well as the major disruption it would cause to upgrade the cabling. Not a good result for the equipment vendors.

So, in October 2016 we have seen one of the fastest developed standards being published, which states that 2.5 and 5Gb can be deployed over legacy Category 5e and Category 6 twisted pair cabling. A significant development you might think, unfortunately whilst it may be well intentioned, it is poorly thought out.

The reason for this statement is based on the premise that these Categories of cabling are now going to be asked to support parameters they were never designed for. When the standards were developed the Category 6 standard improved various values including Next and Return Loss values and introduced ACR-F (attenuation to crosstalk ratio – far end) as can be seen below. When Category 6A, was introduced, this further introduced AXT (alien crosstalk), so we are now asking the cable to do more than it was intended for. Furthermore the Category 5e cable we installed 10 years ago, as well as the way it was installed, is not the same as what we have and do today, purely because we have had 10 years to learn and make improvements in both aspects.

Channel Performance Comparison

Parameter	Category 5e	Category 6	Category 6A
Propagation Delay	548ns	546ns	546ns
Delay Skew	50ns	50ns	50ns
Insertion Loss	24dB	21,7dB @100MHz 35,9dB @250MHz	12dB @100MHz 8dB @250MHz 6dB @500MHz
Next	30,1dB	39,9dB @100MHz 33,1dB @250MHz	39,9dB @100MHz 33,1dB @250MHz 27,9dB @500MHz
PSNext	27,1dB	37,1dB @100MHz 30,2dB @250MHz	37,1dB @100MHz 30,2dB @250MHz 24,8dB @500MHz
Return Loss	10dB	12dB @100MHz 8dB @250MHz	12dB @100MHz 8dB @250MHz 6dB @500MHz
1PSACR-F	14.4dB	20,3dB @100MHz 12,3dB @250MHz	20,3dB @100MHz 12,3dB @250MHz 6,3dB @500MHz

Above values taken from BS EN 50173-1

Also, note there is no mention in the above table above regarding anything to do with ANEXT as this only appears as a parameter for Category 6A and above.

What has been the reaction of the cabling groups?

Whilst not with the same fanfare, the cabling standards groups have not been sat on their hands either, work has been progressing both within the TIA and ISO/IEC, the former being slightly ahead of the latter.

TIA TR42.7 has been developing TSB 5021

Guidelines for the Assessment and Mitigation of Installed cabling to support 2.5GBASE-T and 5GBASE-T

ISO/IEC TR 11801-9904 is also underway.

Guidelines for Installed Cabling to Support 2.5G/5GBASE-T

Please understand the titles of both the TIA and ISO/IEC documents, they are Technical Reports or Technical Service Bulletins, are not standards, they are used for mitigation and assessment NOT design, you cannot use them to design a new installation, as explained further in this document.

These documents lay out how to test and assess the existing installation to see if it is possible to support either 2.5 or 5Gb Ethernet on any of the links. TSB 5021 provides details for this testing and if we thought AXT (Alien Crosstalk) testing for 10Gb over unscreened Category 6A was complex, it has nothing on this latest development.

The basis of the calculations is as follows. You create a 6 around 1 bundle in the same manner as AXT testing and test all victim/disturber combinations, however this should now also be done for 10Mb, 100Mb, 1Gb, 2.5Gb and 5Gb. In total there are 4096 calculations, you then take your worst value which cannot have a value less than 28dB.

5GBps Cat 5e Structured Cabling		Bundling Distance (Metres)											
		5	50	45	40	35	30	25	20	15	10	5	0
Victim and Disturber Lengths (Metres)	100	v	v	v	v	v	v	v	v	v	v	v	Y
	95	v	v	v	v	v	v	v	v	v	v	v	Y
	90	v	v	v	v	v	v	v	v	v	v	v	Y
	85	v	v	v	v	v	v	v	v	v	v	v	Y
	80	v	v	v	v	v	v	v	v	v	v	v	Y
	75	v	v	v	v	v	v	v	v	v	v	v	Y
	70	v	v	v	v	v	v	v	v	v	v	v	Y
	65	v	v	v	v	v	v	v	v	v	v	v	Y
	60	v	v	v	v	v	v	v	v	v	v	v	Y
	55	N/A	v	v	v	v	v	v	v	v	v	v	Y
	50	N/A	N/A	v	v	v	v	v	v	v	v	v	Y
	45	N/A	N/A	N/A	v	v	v	v	v	v	v	v	Y
	40	N/A	N/A	N/A	N/A	v	v	v	v	v	v	v	Y
	35	N/A	N/A	N/A	N/A	N/A	v	v	v	v	v	v	Y
	30	N/A	N/A	N/A	N/A	N/A	N/A	v	v	v	v	v	Y
	25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	v	v	v	v	Y
	20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Y	Y	Y
15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Y	Y	
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Y	

= Application Assured, N= Application Not Assured, V=Validate Application with Testing

Table Courtesy of TIA TSB 5021

28dB of what?

Because the IEEE would not agree to it being called AXT we have a new parameter to contend with - Alien Limited Noise to Signal Ratio (ALSNR), in simple terms it is the ratio between Insertion Loss and Alien Crosstalk.

This calculation is also length dependent, both the length of the link as well as the length the cables are bundled together. Within TIA TSB 5021 they do try to provide some form of guidance regarding whether the cable might work or not, unfortunately in the table above these are only single cables or very short links that are only bundled for a very short distance.

For clarification, every combination in Green requires the calculations to be run and only the Grey are said to work.

Unfortunately, there is no simple fix for testing, whilst Fluke have got 2.5 and 5 Gb application tests in the latest DSX, it's only an application based test on the single cable. ALSNR is looking at the impact of the noise coming from the cables around the victim cable, so will require an extension to the existing AXT testing to be able to do that.

Another consideration we must look at is the fact that whilst we have the 'get out of jail card' for Screened Cables when it comes to Category 6A & AXT the problem is that the vast majority of the Category 5e and Category 6 cable installed,

especially in the UK, is unscreened so susceptible to external noise.

The scale of the potential problem could be huge with customers complaining that their wireless networks are failing to provide the bandwidth their equipment vendor has promised. The blame is likely to be placed on the cabling infrastructure, however the cabling system they installed 5-7 years ago was never intended to support these new parameters.

Conclusion

One saving grace for the cabling community will be the 'Standards' there will be no retrospective action by any of the standards committees to include 2.5Gb and 5Gb Ethernet as supported applications in the Category 5e and Category 6 sections of ISO 11801 or BS EN 50173. Only under Category 6A will they be listed.

Furthermore, there is a clear move within the cabling standards to recommend that all new installations should be of a minimum category to support the latest technology, therefore it should be Category 6A. So the simple answer for anyone considering upgrading their wireless infrastructure to support a higher bandwidth should be, to ignore the marketing hype and factor in the cost of re-cabling if they want guaranteed performance.

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