WHITE PAPER

Ethernet Speed Certification

Net Chaser™

PLATINUM TOOLS®

TRUE Gigabit Speed Certification Testing

Ethernet certification is nothing new. For as long as computers have been networked, there has always been a way to test connection speeds. However, there is a significant variation between the certification tools used today and the ones used back then.
The Net Chaser is a modern Ethernet certification tool.

What makes Net Chaser a valid certification tool?

Most modern Ethernet speed testing tools run the network cable against a TIA568 Interconnect Standards to measure TIA568 noise and Delay. The Net Chaser works in a similar way but performs several other beneficial tests including;

- **SNR TESTS**
- **BER TESTS**
- **DELAY SKEW**
- **CONTINUITY TESTS**

BER TESTS

Bit Error Rate (BER) first became popular during the transition from 10Base-T Ethernet to 100Base-T Ethernet – also known as Fast Ethernet. 10Base-T Ethernet is designed to run over Cat3 twisted pairs and initially gained a reputation for being robust and very reliable. 100Base-T Ethernet runs over a minimum Category 5. It is also potentially more susceptible to errors belonging to the higher frequencies and multiple voltage level encoding scheme.

BER is the number of bit errors being transmitted. Fast Ethernet originally targeted a BER of 1 error for every 10 billion bits of information passing through the cable. For a data transfer rate of 100Mbps, this translates to one error every 100 seconds which is acceptable.

Keep in mind that within the network protocol, information is packaged into frames and that if an error is detected in a frame, that frame is normally retransmitted. A higher BER rate may therefore adversely affect data throughput and may start to slow down network performance.

The Net Chaser conducts Bit Error Rate (BER) tests using an Active Remote where data packets are sent down specific cable lines at defined data rates, approaching maximum throughput. Throughput refers to the amount of data carried from one point to another on the cable and is determined by both the data carrying capacity of a network (bandwidth) and the routing information overhead.

SNR TESTS

Signal-to-Noise Ratio (SNR) is a critical factor in the performance of a network. It is a measure of a network's immunity to noise. Expressed in Decibels (dB), SNR represents the additional noise the cabling can accommodate before violating BER.

For example, a signal to noise ratio margin of 3dB would be interpreted to mean that if the noise level in the cabling was increased by 3 decibels, then the network would be subjected to excessive errors.

The signal to noise ratio is more critical for Gigabit Ethernet because logic levels are increased from 3 to 5 while maintaining a 2V overall envelope. This effectively reduces the distance between levels by up to 50%, resulting in the need for a larger SNR margin.

The Net Chaser is effective in measuring SNR in both and 100 Megabit and 1 Gigabit cables allowing you to determine quality issues in the network that might impact high-speed data transmission.

Delay Skew

Propagation Delay and Delay Skew are terms that were first introduced to the industry around 1997 in the revised TIA568-A Standards when the need for additional protection of the unshielded twisted pair became apparent.

Propagation Delay is the time a signal is delayed when traveling through a piece of wire. It is measured in nanoseconds per meter of the cabling. Propagation delay is affected by both the materials and geometry of an insulated conductor.

Delay Skew is when multiple pairs in the same cable exhibit different delay performance, the result is delay skew. Delay skew is determined by measuring the difference between the pair with the least delay and the pair with the most delay.

TIA568-A recommends that the delay skew between the fastest and slowest pair in a cabling system should not exceed a maximum of 45 nanoseconds on a 100 meter cable.

The Net Chaser allows you to measure total Delay Skew that can affect 1 Gigabit data transmissions.

Continuity Tests

Wiremapping basically involves correctly hooking up each wire so that there are no shorts or opens. Each pair must also be connected to the right pins at the jacks and plugs. Finally, the contacts in the terminations must be in working condition.

However, mistakes happen and sometimes cables end up with reversed wires, crossed pairs, and one or more opens and shorts.

The Net Chaser allows you to test for any opens, shorts, split pairs, miswires, reversals, and high resistance faults. You can even determine distance to faults and total cable length.

The Net Chaser can be used in testing CAT 3, CAT 3_2P, CAT 3_4P, RG-6, RG-58, CAT 5, CAT 5_2P, CAT5STP, CAT5ESTP, CAT 6, and CAT6STP networks.

Challenges in frequency testing

When the TIA568 standard was originally formulated, 1Gbit Ethernet was not yet defined by the IEEE802.3 standard. TIA568 defined the cable by parametric attributes using frequency sweeps. CAT 5 was intended to support 1Gbit Ethernet, but a key parameter, Power Sum near end and far end crosstalk or PSNEXT and FPSFEXT were not measured or contemplated by the TIA568 standard. The use of all four pairs simultaneously had not been envisioned by the standard. CAT5E became the standard to support 1Gbit Ethernet and added these key parameters.

The TIA568 standards have generally failed to adequately predict the cable requirements of future data standards. CAT6 was intended to adequately define the cable needs of 10Gbit Ethernet, but now CAT6E and CAT6A have emerged to describe the cable requirements in terms of frequency sweeps for 10Gbit Ethernet.

The TIA568 have not succeeded in “future proofing” cabling systems for use with yet to be defined data standards as evidenced by the 1Gbit and 10Gbit experiances.

Why choose the Net Chaser over frequency tests

One reason why technicians are choosing the Net Chaser over frequency testers is because frequency testing will only uncover LIKELY conditions for failure, and the results obtained are measured against pre-determined TIA568 standards.

The Net Chaser on the other hand sends digital signals along the cable to measure ACTUAL noise levels, SNR, and BER. Furthermore, BER tests have proved to be far more accurate and insightful compared to both PSFENEXT and PSNEXT because BERT results are TRUE measurements of actual data flowing inside a cable, not simulations.

Picking the right tool for the job

The right tool for the project at hand can only be determined by assessing the project requirements and the capabilities of the individual tool. Although traditional cable testers were capable of performing an astounding range of network tests, often providing pages and pages of data, the question remains the same; are they the best alternative?

The answer is No. Even without going into detail, in a world where time is money, if the extra tests performed in frequency certification serve little function, it’s a waste of resources. The industry has seen the development of simpler, cheaper testers that are able to deliver more insightful results at a fraction of the cost. Moreover, this new set of testers are streamlined to focus on what is most important - Ethernet testing.

How it all started

A brief history of field testing communications should help us understand why the shift to digital testers is the way to go.

Field testing first became necessary as offices expanded to accommodate new servers. So, the existing infrastructure had to accommodate additional networks servers and terminals. At that time, networkers could only count on 3 networking tools.

- The Break-out-Box (BoB),
- A Time Domain Reflectometer (TDR), and
- The Volt-Ohm Meter (VOM)

The BoB allowed networkers to re-map connectors with jumper wires. This way it was possible to route signals to get the network up and running. Once a system was running, they would make a permanent connector to duplicate the crossover pattern originally created with the BoB. The VOM basically helped in measuring voltages and in checking for opens on custom wired connectors. The TDR was used to determine the length of a cable for open, short, or load terminations and to find out if mid-span connectors were causing significant impedance mismatches. TDRs were a bit expensive and were only used occasionally.

There is no doubt that these tools accomplished the task at hand. Indeed, they were very effective back then. However, as helpful as they were, could they provide information about the ability of a network cable to faultlessly support data transmission? No.

Since this had always been the objective, the tools are no longer used in network testing.

Frequency testing - benefits and shortcomings

Increasing efforts to define better testing tools and certification standards culminated in the adoption of the (Telecommunication Industry Association) TIA568-A Standards. The TIA568-A Code defines common practices in design, installation, and certification of communication cables in commercial buildings.

Basically, the industry was adopting a set of standards against which field tests would be compared. A cabling technician would test your cabling to ensure that it provided performance to the standards of the hardware in question.

The TIA568-A Standard required cable installers to measure attenuation and near-end crosstalk (NEXT). You immediately realize that both of these parameters are frequency specific. It followed then that the technician had to sweep a cable across a given frequency range. Not only that, but he had to gather results for all the pairs and all their unique combinations.

From then on, every network testing company went down to work to try to develop simpler testers. Soon, there were a dozen new testers in the market most of which were able to sweep higher frequencies than the TIA568-A standards required.

Today, in parts of the world where TIA is still used, Category 6Ais considered superior. 6A requires several tests to be run from 0Hz to 500MHz. The tests include; delay, wire map, skew, attenuation, NEXT, Equal Level Far End Cross-Talk (ELFEXT), Power Sum NEXT (PSNEXT), Power Sum ELFEXT (PSELFEXT), Return Loss,

Frequency testing - benefits and shortcomings (cont'd)

Attenuation-to-Crosstalk Ratio (ACR), and the Sum ACR.

Again, these standards were effective at the job but came with several limitations. For instance, the circuitry required to perform the listed tests were very complex. Moreover, ready-made circuits weren't available in the market. So, an engineer had to device very sophisticated test equipment. But as you would expect, this also comes at a cost. The equipment designed must be;

- Affordable,
- Durable enough to stand the rigors of the field, and
- Versatile enough to perform all the tests - as quickly as possible.

Some reference equipment used in labs to test network cables weighed a few dozen pounds and cost in excess of $8,000-$10,000. Yet, they would still take up to an hour to test just one cable.

Unnecessarily costly

Aside from higher frequencies, Ethernet testers should be able to test a defined number of frequency steps/ points. What many fail to appreciate is the fact that the TIA568-A Standard was simply developed to act as a Guide. You always need a standard against which you compare performance; but again, most of the thriving industries have a host of competitive standards to choose from.

The current economy is 90% concerned with Ethernet. From smart TVs to IP calls, they use Ethernet cables. Interestingly, the TIA568-A/B still requires testers to test across a broad range of frequencies. What for? To support a legacy? Testing over such a broad range of frequencies is not only time-wasting but also very expensive. If one wanted to exclusively test 1 Gigabit Ethernet (GbE), won't it be more cost effective to build a device that tested a smaller range frequencies concentrated around GbE?

It is also important to highlight how accuracy issues in frequency tests may drive up costs. The required thoroughness and accuracy in tests often means that cable manufacturers are willing to extend lengthy warranties to consumers. However, they will only pick installers with appropriate standards. Considering that professional installers rely on third-party testing agencies such as Underwriters Laboratories to verify accuracy claims, you would expect cable manufacturers to be satisfied with the services of these installers. However, that is never the case. Most manufacturers still have internal audit departments tasked with reviewing the accuracy of and approving field testers to be used in certifying cabling systems. This is a double-cost.

Enter digital testers

Inspired by the IP industry where engineers have a huge resource of off-shelve tools and materials that they can call on to inspire new designs and easily create software to make things work, the Ethernet testing industry is quickly adopting an approach where testers are specifically designed to certify Ethernet. This approach eliminates most design bottlenecks by limiting the scope of field-testing to just one application, effectively removing much of the cost and complexity.

The biggest challenge facing this shift is that the consumer base has been made to believe that certification involves a number frequency sweep tests on a cable to test whether it complies with TIA568 Standards. Most application based certifi ers do not test against these standards with most of them choosing to follow the IEEE802.3 Standards. One reason why application-based tests favor the IEEE802.3 Standard is because you can determine if the cable link has “passed” or “failed” a test.

So, are application tests worth the salt?

If it comes down to determining whether or not an Ethernet cable can transmit data, which is what most residential consumers and small businesses want to know, then the answer is a big Yes. Digital testers can actually deliver almost everything that you can get from frequency testing, plus so much more.

Let’s find out how the Net chaser which is an excellent example of application-based testers accomplishes all the necessary tests.

The Net Chaser™

The Net Chaser™ is a one-of-a-kind testing device. At its most basic, it allows you to test and speed certify Ethernet network cables up to 1Gbps. You can test for noise in a network, detect faults in the cable itself, and determine whether cables support speed capabilities of the active equipment.

While many application-based tester manufacturers completely ignore the TIA568 Standards, the Net Chaser supports the standard. Consequently, you can test cables to TIA568A/B Standards. Speed certifi cations are tested to IEEE 802.3 Standards. Moreover, the tester provided a clear vision of network layout. And you get an unobstructed view of interfaces between active components such as routers and switches.

Cable testing capabilities

The Net Chaser performs BER test down specific cable runs at specified data rates and instantly reports on signal quality that can impact the speed of transmission by measuring SNR. Added advantages of the cable tests include among others;

- You can measure and display length of individual pairs in meters or feet
- Improper terminations are clearly displayed on a graphical interface
- You can determine shorts and opens
- It verifies continuity for coaxial cables and RJ45s

Network configuration tests

This feature allows you to test active network capabilities. For instance, you can measure Power over Ethernet (PoE) to determine whether or not you have enough power at the correct pins. You can also use Port Discovery to determine whether duplex capability is available.

Additional benefi ts of network confi guration tests include among others;

- Port Discovery
- Detects PoE per IEEE 802.3af/at with load test for voltage drop and which pairs the PoE is located on (class)
- IPV4 Support
- Ping to a specific IP or URL address
- Ping up to 8 IP targets at a time
- Link light to identify location on a hub/switch/router port
- Verifies DHCP connectivity and DNS
- Discovers CDP and LLDP Protocols
- VLAN Discovery
- Traceroute

Endless Benefits

There are several other obvious advantages of application-based testers such as the Net Chaser. For instance, the Net Chaser can be affected by electromagnetic/radio frequency interference (EMI/RFI) whereas frequency sweep testers cannot. Frequency sweep testers are designed to have high common mode rejection (CMR) performance meaning that they cannot “see” effects of external noise on cables. The circuitry receivers of these testers can only measure signals sent by the tester’s transmitters to the cable under test. This is perfectly understandable considering that traditional testers were originally designed to determine the performance of a network regardless of the environment.

Yet sometimes EMI/RFI influence can be strong enough to affect flow of packets across a link. This is the reason why application testers don’t ignore such interferences.

Also, because consumers are always expanding their networks to accommodate new devices, there is always a need to ensure that the cabling can continue performing to expectations when such expansions are made. Application-based testers are the perfect low-cost alternative when preparing networks for such changes.

A good example is the rollout of GbE. Most commercial buildings were built with the Category 5 and 5e cabling in mind. The expectation was that someday, GbE would be introduced to all users of Category 5 networks. Although GbE runs over Category 5, it doesn't require 5e cabling. Today, according to TIA, Category 5e is obsolete and no longer acceptable for new installations. What follows it is that most traditional LAN certifiers no longer have it in their firmware. This will in the near future result in problems in testing Category 5 cables to current category 5e test limits. This is a good area where application-based testers can be used.

Summary

Sooner rather than later, consumers and the network testing industry at large will have to accept that it's a new dawn. People will realize that just like VOMs, TDRs, and BoBs, the TIA568 has done its job. It has shown us how to install and test cables for networks. However, as technology advances, there is growing need to adopt simpler, cost effective, and more efficient digital tests.

And when that time comes, the Net Chaser will find its way around the market and may as well be crowned the new Ethernet testing standard!

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