VIAVI Solutions

White Paper

VIAVI TrueSpeed Meets the Needs of Carrier Grade TCP Throughput Testing

Introduction

Accurate TCP throughput testing is paramount to a network operator's ability to sell business class Ethernet services to enterprise customers. Compliant with IETF RFC 6349, VIAVI TrueSpeed test is a carrier-grade TCP throughput test which provides accurate and indisputable test results. In contrast, non-standards based tests found on the Internet are directional casual consumer throughput tests that not only provide inaccurate results, but in many cases, can actually conceal network or client/server performance issues.

The following table highlights the key differences between VIAVI TrueSpeed test and free commodity speed tests.

Test Attribute	TrueSpeed	Generic Speed Test	So What?
Traffic Transmission Rate	Sent according to the capacity of the network (calculated per RFC 6349) to consistently reveal its "true bandwidth"	Floods the network over its capacity to achieve the "highest bandwidth," an inflated number with high variability	TrueSpeed traffic generation accurately emulates customer applications while generic test processes often conceal network issues. Further, generic tests do not produce repeatable results like TrueSpeed.
Client computer and server resources effect on the test result	Low client PC overhead and server-side resource management	Very high client PC overhead and "best effort" server resources	A poor network throughput result has a higher chance of being caused by PC hardware or server saturation when running an generic speed test than with TrueSpeed.
Diagnosing throughput issues	Uses a combination of RFC 6349 metrics and PC client monitoring to provide root cause diagnosis	No diagnostic capability	A carrier grade TCP throughput test must provide the ability to diagnose root cause - only TrueSpeed can
Appropriate Test Geography	Tests throughput between your end-user customer and a centralized test head in your network.	Tests throughput between your end-user customer and wherever the test server is located, which could be off-net.	TrueSpeed only tests the part of the network that is relevant, the part that is under your control

Table 1: Overview of VIAVI TrueSpeed versus generic speed test

In short, because of its simple methodology and lack of diagnostics, a free Internet throughput test can return poor results but not reveal why, or it can return positive results even when user applications are performing poorly, neither of which are good when delivering business-class services. The following sections will expand upon each of the key test attributes and provide real-world case studies to highlight the benefit/cost savings of TrueSpeed.

Traffic Transmission Rate

A good TCP throughput test uses parallel TCP connections to achieve the full network bandwidth. Parallel connections are more representative of how a consumer uses bandwidth; i.e. multiple video streams, web browsing sessions, Facebook, etc. occurring at the same time.

The key question becomes, "how many connections and what window size should be used to achieve full bandwidth?" According to RFC 6349, the Bandwidth Delay Product (BDP) is the product of a data link's capacity (in bits per second) and its end-to-end delay (in seconds).

Bandwidth Delay Product (BDP) BDP = Round Trip Time (RTT) * Bandwidth / 8

Using an example network bandwidth of GigE (1000Mbps) with 20 ms RTT),

- BDP = 20 ms * 1000 Mbps / 8 = ~2.5 MBytes

In the simplest terms, the BDP can be thought of the number of bytes that a sender can send to achieve a specified bandwidth.

Commodity speed tests do not consider the network's BDP and provides rudimentary configuration settings to control the amount of data that is "shoved" into the pipe. In many cases this causes a generic test to over subscribe a network resulting in excessive packet loss, BUT the oversubscription can provide high throughput numbers and mask potential issues in queues, shapers, policers, etc.

As a simple analogy, think of the BDP as a 25mm in diameter water hose and TCP traffic as water released into the hose from a water faucet. Referencing Figure 1, assume that a bucket on the end of the hose is 5 liters and at a water faucet rate of 1 liter per minute, the bucket should be filled in 5 minutes.

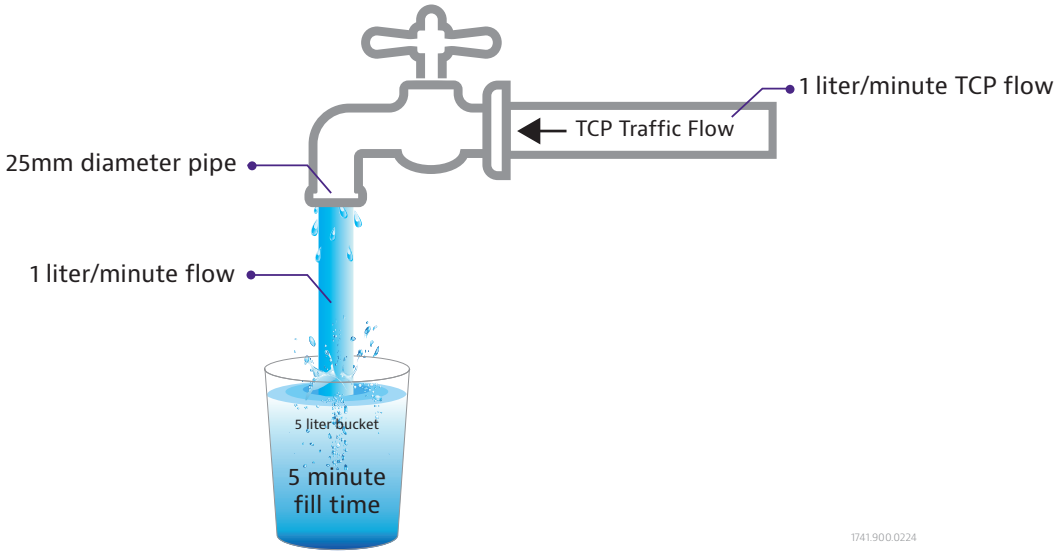

Figure 1: Simple Illustration of TCP "Water" Flow

If there are no holes or leaks in the hose, then simply turning the faucet on to 1 liter per minute (consider this the "BDP") will fill the bucket in 5 minutes. But if there are holes in the hose, leaks will occur, and the bucket will take longer to fill *if* the water flow remains fixed at 1 liter per minute (figure 2).

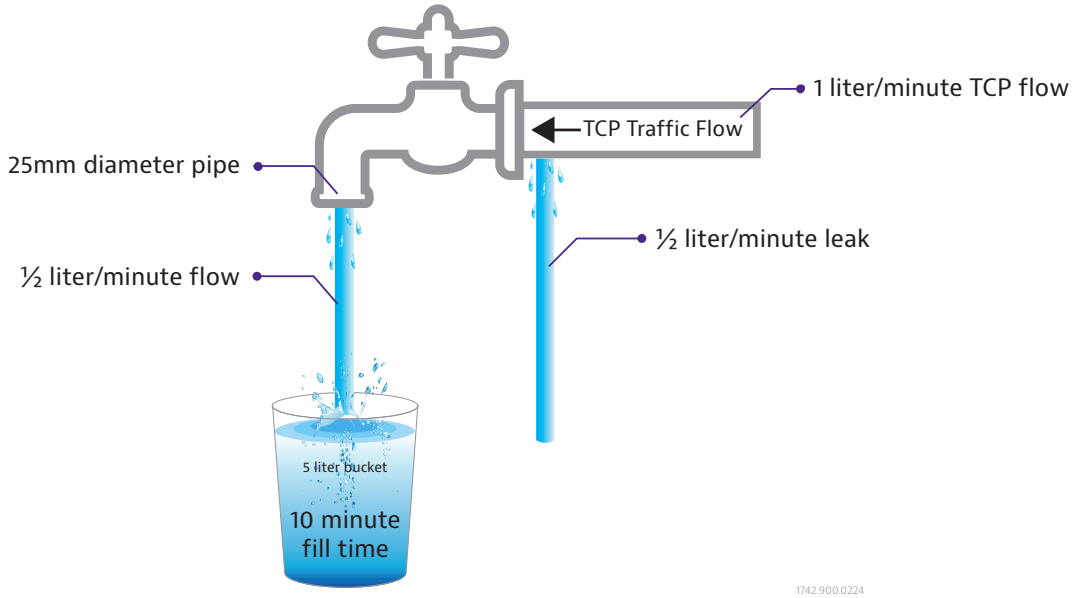

Figure 2: "Network Problem" scenario

Using a commodity speed test however, the test increases the water flow rate by some amount, let's say 50% (1.5 liters per minute), and the bucket still fills in 5 minutes (despite 50% of the water wasted and leaking (figure 3)).

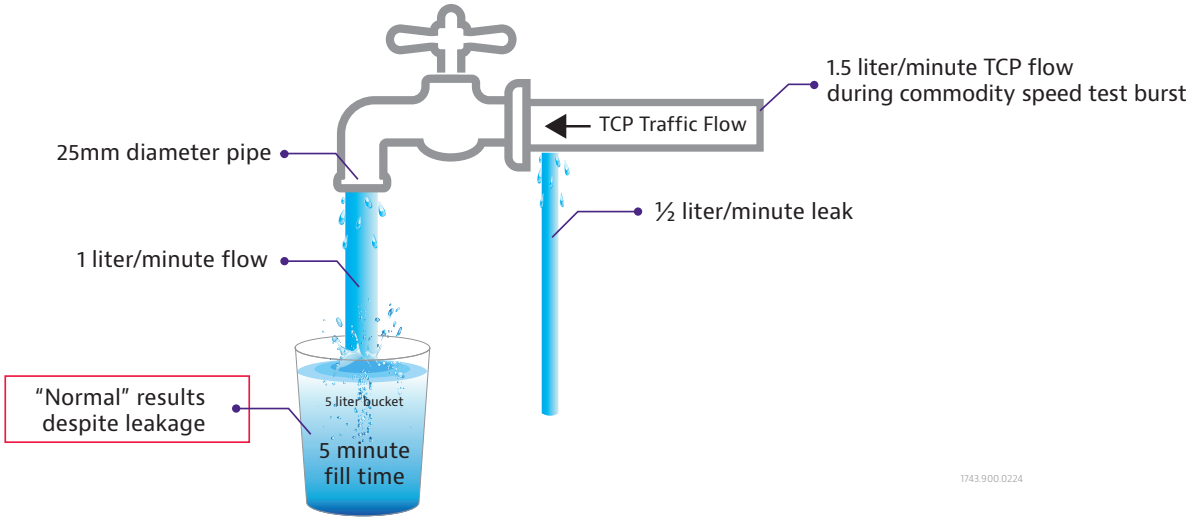

Figure 3: Generic speed test during network problem

Meanwhile, a TrueSpeed test never tries to conceal leaks and only releases water at the 1 liter per minute rate. The bucket takes 10 minutes to fill!

While this may seem like an overly simplistic example, it is remarkably similar to how a free Internet speed test measures network throughput (with a high rate of packet drops) versus TrueSpeed. In several case studies, an end customer reported a perfect throughput result with a commodity test and yet when doing an FTP (etc.), the throughput is much lower. Meanwhile in the same case studies, TrueSpeed accurately detects the network issue and demonstrates throughput consistent with the end customer applications (FTP in this example).

Getting into the technical details of the case study, let's look at the TCP performance of a generic test versus TrueSpeed for this customer. Figures 3 and 4 show the results of a generic test and VIAVI TrueSpeed TCP throughput test. Note that the test was conducted for a 100 Mbps business services customer.

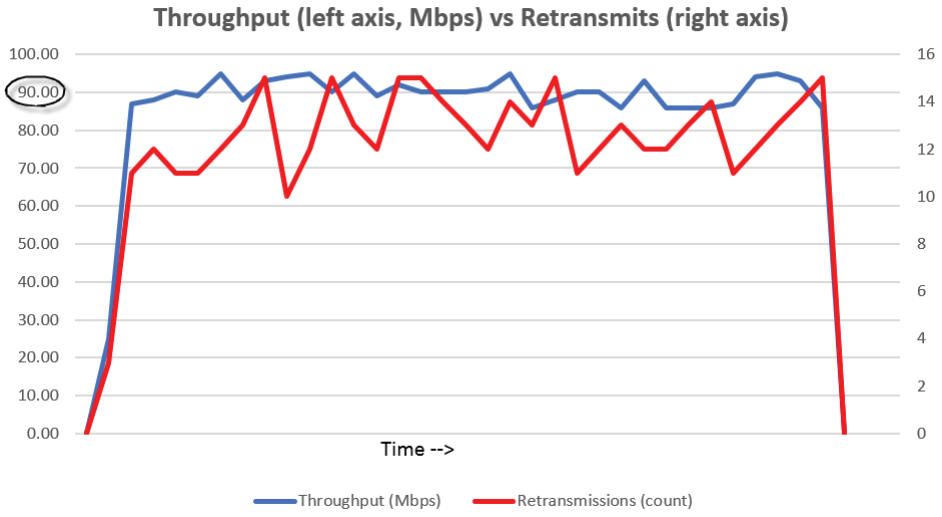

Figure 4: Generic Test Results for 100 Mbps Business Service

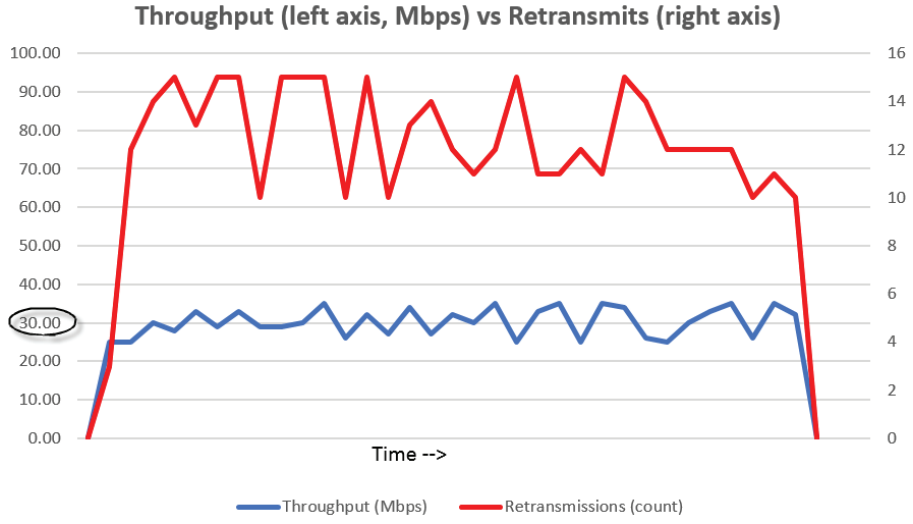

Figure 5: VIAVI TrueSpeed Test Results for 100 Mbps Business Service

The generic test result achieved full TCP layer throughput (~94 Mbps) even in the midst of severe TCP retransmissions (packet loss). Meanwhile, TrueSpeed correctly showed that the end customer would experience only ~30 Mbps (!!) which was in line with the complaint filed by the customer (FTPs only achieving 30 Mbps).

Client and Server Resource Effects

To achieve an accurate TCP throughput test, client or server resource issues must not impact the results. Otherwise, compute resource issues may mislead one to believe that the network is the problem when it isn't. Client processor demands for commodity throughput tests are very high compared to TrueSpeed's, and may impact test results.

To illustrate the CPU consumption difference, the ability of various performance laptops to achieve full Gigabit TCP throughput was compared. Note that TCP maximum throughput under this condition is ~949 Mbps. In all cases, the laptops were Microsoft Windows 7 OS with all patches applied. No other applications were run on the laptops and they were connected directly to the customer router.

Client Laptop Specification	Commodity Speed Test TCP Throughput	VIAVI TrueSpeed
Intel Core i3, 1.3 GHz, 4GB, Laptop	242 Mbps	902 Mbps
Intel Core Duo E8500 3.16 GHz, 4GB, Desktop	339 Mbps	942 Mbps
Intel Core i5 2.5 GHz, 4GB, Laptop	754 Mbps	949 Mbps

Table 2: Commodity speed test versus VIAVI TrueSpeed Performance on Different Client Hardware Platforms

Because the free Internet speed test selected for the comparison is a Java application (standard among the free tests) while TrueSpeed is a "tuned thick client," TrueSpeed outperformed the commodity test. Speedtest. This is obviously very important because when application performance dips, customers almost always assume it's the network and start opening trouble tickets. Without diagnostics, call center technicians are forced to prove it is not a network problem and dispatch a technician to investigate. However, as we see above, many times the problem is a limit of the hardware platform and not the network, which results in wasted technician time. TrueSpeed reduces truck-rolls by providing call center technicians CPU utilization charts as part of its extensive reporting capability (more on this in the next section), letting technicians know quickly whether the problem is the network or something else.

Another difference between a commodity test and VIAVI TrueSpeed involves the server-side congestion management. With the generic tests, if too many customer tests are run concurrently, the server does not limit the number of tests to the capacity of the server. This causes poor test performance (and reduced predictability) which may lead to incorrect conclusions.

In contrast, the VIAVI TrueSpeed solution actively limits the number of concurrent tests based on the available test capacity of the server, which equates to the overall throughput and number of concurrent tests permitted to consume this throughput. Additionally, the network operator is also provided with detailed report charts of server CPU utilization during the test so that the network technician/engineer can determine if a server upgrade is merited (there may be other applications running on the same server). Even when no test capacity is available, no test request is dropped since every outstanding TrueSpeed test is automatically placed into a queue to be executed once resources become available again.

Diagnosis of Throughput Issues

Running a casual bandwidth test can only determine "what is my bandwidth", but the important questions remain unanswered:

1. *Why* is my bandwidth lower than expected?
2. *How* do I fix the issue?

Proper diagnostic tools highlight many possible conditions that may degrade performance including:

- Under powered laptop running the bandwidth test
- Inadequate traffic shaper settings that cannot handle bursty TCP traffic
- Laptop running the test overloaded with other applications such as virus scanning software, etc. Layer 4 (TCP) proxy devices such as stateful firewalls, virus scanners, intrusion detection systems (IDS) that are "in the middle" of a bandwidth test and can adversely affect performance
- Duplex mismatches
- Inadvertent use of WiFi connection when testing a GigE service

The following are a representative examples which highlight key client and network conditions that VIAVI TrueSpeed can diagnose while a commodity speed test pulled from the Internet cannot.

In some cases, performance issues may involve the client host computer. Section 4.1 showed the significant client-side resource requirements of a generic test versus TrueSpeed VNF, but what if the client laptop has enough "horsepower" but there are other applications consuming resources during the throughput test?

The VIAVI solution reports client side CPU utilization AND provides a list of processes that were detected during the throughput test. Figure 6 shows an example of an overloaded client computer and the process which caused the overload.

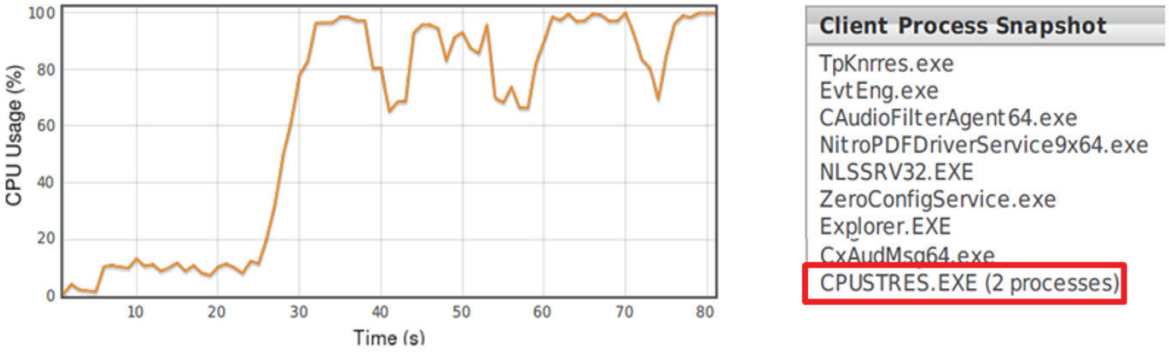

Figure 6: High Client CPU Utilization and List of Possible Client Processes

There are also times when a customer may inadvertently have used WiFi for the test instead of using the dedicated wired interface. The VIAVI TrueSpeed report provides a list of network interface cards that were active during the test, providing the network provider the ability to diagnose problems that would otherwise require a technician to be dispatched to the customer premises. (Figure 8).

In this example, the download CIR was 70 Mbps and the throughput achieved by the client PC was only 22 Mbps.

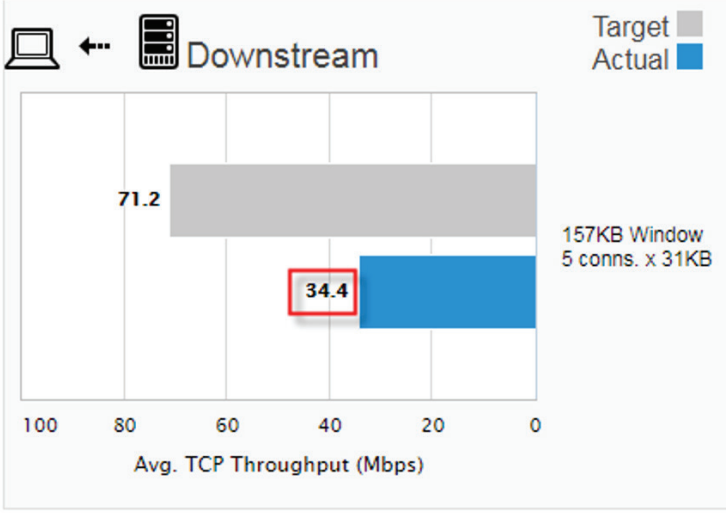

Figure 7: Download Test Result

TrueSpeed provides the call center technician with the information to show that the client PC was using WiFi adapter instead of wired adapter which is a common mistake.

Client configuration	
CPU Vendor	Intel
CPU Model	Core(TM) i3-2357M CPU @ 1.30GHz
CPU Number	4
Memory	4008 MB
OS Version	Windows 7
Max CPU Utilization	52.37%
Interface<IP Address>	Intel(R) Centrino(R) Wireless-N 130<192.168.1.167>

Figure 8: TrueSpeed Report of Client Side NIC Settings

In many cases, the proxy device is "in the middle" of the network segment to be tested and can have very adverse effects on TCP throughput (firewall, virus scanner, Internet content filter, etc.). Unlike a casual throughput test, VIAVI TrueSpeed detects many proxy conditions as part of its broader TCP diagnostics reporting. When a network proxy is detected during a TrueSpeed VNF test, the backend server report would provide the following diagnosis:

"Warning: Inconsistent RTT values detected. This usually means a TCP proxy intercepted the connection and might have skewed the test results. There may be a Firewall, virus scanner, VPN concentrator, or other network appliance in the path whose processing imposes an additional constraint on the packet switching rate."

Test What Matters

The purpose of a throughput test is to understand how your customer is experiencing your network. To do that, the test endpoints must lie within your network. How a network adjacent to yours is performing is irrelevant to you and your customer. Yet, that is exactly what generic throughput tests often measure. It's possible that your customer, running a generic speed test on a PC you don't control, is testing to another device you don't control that, even worse, is sitting outside your network footprint! In extreme cases, we have seen traceroutes on generic speed tests where one endpoint is in Alaska, and the other is in the mainland United States. The customer doesn't care. If they get a poor result on their speed test, they're angry and they want the service provider to fix it, even though half the route might be out of the service provider's footprint.

Users of TrueSpeed test between two test points within the service provider's network. Many TrueSpeed customers deploy a centralized, rack-mounted test head against which technicians and customers can run TrueSpeed tests. In this way, the whole route under test lies within the service provider's network, where transmission variables are managed by your own network administrators.

Conclusions

In today's digital world, everyone wants high-performance connectivity, and they want their network service provider to give them what they're paying for. Regarding the second of those, commodity throughput tests give consumers a general indication of the throughput performance they're receiving. However, for more demanding business customers with revenue in the balance and SLAs that must be met, those generic tests are woefully inadequate.

The generic tests deliver inconsistent results at best, and mask problems at worst. Due to faulty methodology and poor diagnostics, a provider may determine from information from one of those generic tests that the network is OK when it isn't, or that the network has a problem when it doesn't. Neither of those false diagnoses are good for the experience of valuable business customers or for operating efficiency.

Built on industry standards, VIAVI TrueSpeed runs rigorous throughput tests that yield accurate, consistent results. TrueSpeed can be run from multiple VIAVI instruments including the NSC-100/200, T-BERD/MTS 5800, MAP-2100, and our virtual test system, Fusion. TrueSpeed produces valuable diagnostic information that you control, not the third-party test provider, which is critical to identifying and solving problems quickly.

VIAVI Solutions

Contact Us **+1 844 GO VIAVI**
(+1 844 468 4284)

To reach the VIAVI office nearest you,
visit viavisolutions.com/contact

truespeed-wp-cab-nse-ae
30187646 902 0324