VIAVI Solutions

Brochure

The Essentials of Ethernet Service Activation

2. Single-Service Enhanced RFC 2544

What is RFC 2544?

RFC 2544 is the Industry-standard service activation test for single-service Ethernet and IP (i.e. "pipe test"). The test measures key performance indicators and bandwidth profile such as: throughput, latency, packet Jitter, frame loss, and committed burst size (CBS).

Click to browse Bit Error Rate Testers from VIAVI

Global growth in communications and data services is driving increasing demand for Ethernet. As businesses and consumers demand more and more data, the pressure is on service providers (SP) to supply reliable Ethernet that scales for growth – and do it quickly. To capitalize on demand and manage operational costs, service providers will rely on testing tools that help them turn up and monitor Ethernet connections quickly, safely, and cost-effectively with minimal complications.

Key Advantage:

VIAVI Solutions enhanced RFC 2544 runs tests concurrently which reduces test time by two-thirds. A standard RFC 2544 test usually lasts 30 minutes or more, but takes just ten minutes with the enhanced version.

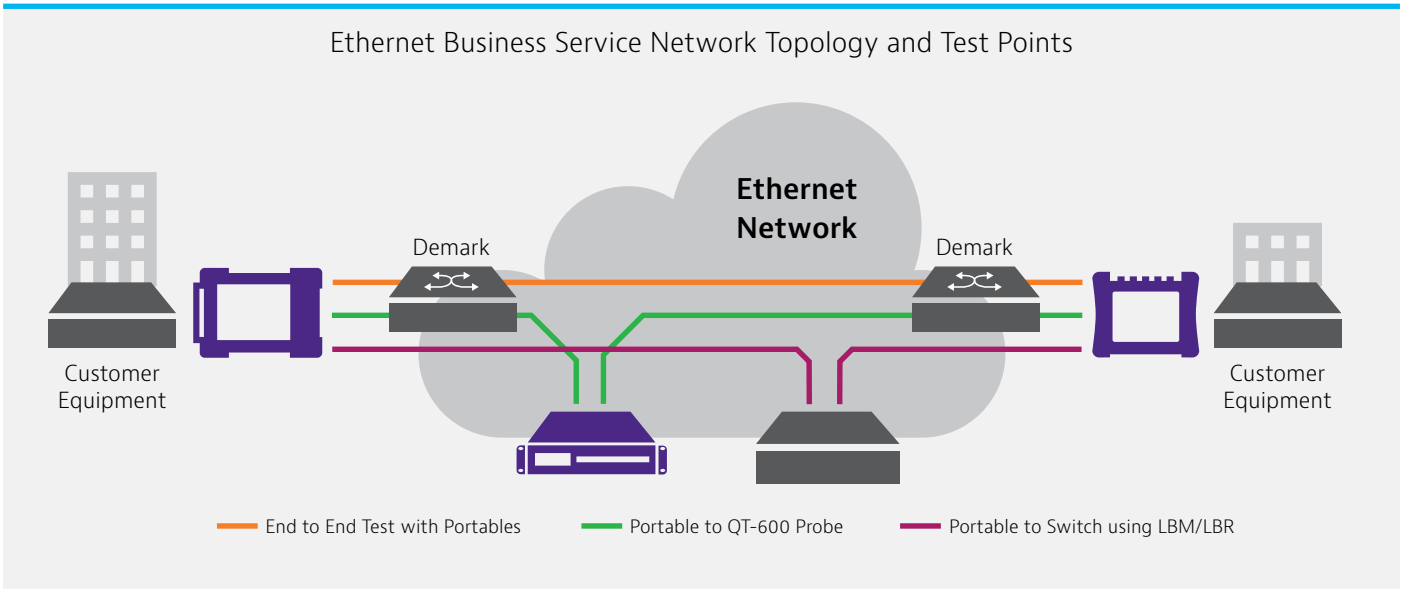
Optimized Implementation

There are two primary tests for Ethernet service activation; RFC 2544 and Y.1564. This brief will focus on RFC 2544, the most common service activation test for single-service Ethernet and IP (i.e. "pipe test"). The test measures key performance indicators and bandwidth profile such as: throughput, latency, packet Jitter, frame loss, and committed burst size (CBS).

Best Practice Workflow (Single and Multiple Services):

1. **J-QuickCheck:** Basic Connectivity and Throughput Test
2. Single-Service: **Enhanced RFC 2544**
3. Multi-Service: **Y.1564 SAMComplete** For Ethernet KPI Verification
4. **J-Proof** Layer 2 Control Plane Transparency Test
5. **RFC 6349 Fusion TrueSpeed VNF**: Layer 4 TCP Throughput

This test workflow is applicable to Ethernet Business Services and Wireless Backhaul network topologies; a typical Ethernet business service network topology is shown in the following diagram.



In the diagram above, the "local" T-BERD/MTS is represented on the left side and the "remote" T-BERD/MTS is on the right side. The most common service activation use case is a loop-back of the remote device and in this case, the device will be the remote T-BERD/MTS. Please note that even though loop back is the most common test mode, the enhanced RFC 2544 can test both directions independent and concurrently (independent transmission from each end). Bi-directional testing is critical to determine which direction is not meeting the service level agreement (SLA) and cannot be isolated when testing in loopback mode.

Enhanced RFC 2544 Test Components and Benefits

The following table describes the distinct role of Enhanced RFC 2544 as well as the VIAVI enhancements that provide unique, valuable advantages:

Service Activation Test	Description	VIAVI Advantage
Enhanced RFC 2544	· Industry-standard service activation test for single-service Ethernet and IP (i.e. "pipe" test) · Measures key performance indicators and bandwidth profile such as: throughput, latency, packet Jitter, frame loss, and committed burst size (CBS)	· The enhanced RFC 2544 runs tests concurrently which reduces test time by ~66%. · A standard RFC 2544 would take approximately 10 minutes with this enhanced technique versus 30 minutes. · Wide variety of loop backs including OAM and JMEP (VIAVI SFP-based technology) · Committed burst size (CBS) testing to ensure proper network policer and shaper configuration, as well as the MEF 34 policer test · Wizard-like UI and test profiles simplify test configuration and results interpretation · The only available long-term test, a.k.a "soak test," lasting up to 24 hours · Concurrent end-to-end, bi-directional testing which reduces test time by 50% and can reveal hidden issues in a sequential "up then down" test · "Zeroing in" throughput algorithm can dramatically reduce troubleshooting time (e.g., over ten minutes for a standard RFC 2544, just seven seconds for the enhanced RFC 2544)
Integrated with J-QuickCheck	· "Pre" test, which conducts basic connectivity and throughput tests before wasting time running the more extensive RFC 2544 test	· Currently the only vendor on the market to offer this test. The time savings for service activation can be quite substantial, potentially reducing total test time by 75% or more.
Simultaneous Key Performance Indicator (KPI) measurements	· The ability to measure all KPIs simultaneously versus sequential tests (e.g. throughput, delay, jitter)	· VIAVI runs these tests concurrently which reduces test time by ~66%. A standard RFC 2544 might take 30 minutes to complete, but would take ~10 minutes with the enhanced technique.
Committed burst size (CBS) testing	· CBS test verifies that the actual performance of traffic policers and shapers match the configured settings	· Network traffic policers and shapers must be properly configured or user performance will suffer. Standard RFC 2544 tests do not address this test need, but VIAVI added CBS as part of its enhanced RFC 2544 test. VIAVI also provides a burst "hunt" mode which automatically determines the CBS that a network can handle end-to-end (quite complex to determine without the automatic hunt mode).

Service Activation Test	Description	VIAVI Advantage
Automated Long-term Testing	· Longer term test or "soak test" which can be run up to 24 hours	· For high profile services (i.e. 10G/100G), 100% confidence is essential. The enhanced RFC 2544 can automatically execute this "soak test" after the standard RFC 2544 test.
Concurrent, bi-directional test	· With two VIAVI devices end-end, the service can be tested independently in each direction which is the only way to isolate the network path when an SLA is not met.	· Many other vendors support sequential (upstream then downstream) end-end tests which requires more test time and may mask problems that only a concurrent end-end test will discover.
"Zeroing in" throughput algorithm	· When a network problem exists or a test is misconfigured (in both cases, tested throughput exceeds capacity), the throughput "hunt" time of the traditional RFC 2544 can take a very long time.	· The enhanced RFC 2544 can dramatically reduce troubleshooting time when tested throughput exceeds network capacity (e.g., 700 seconds for standard RFC 2544 and just 7 seconds for VIAVI enhanced).

Increase Accuracy and Speed

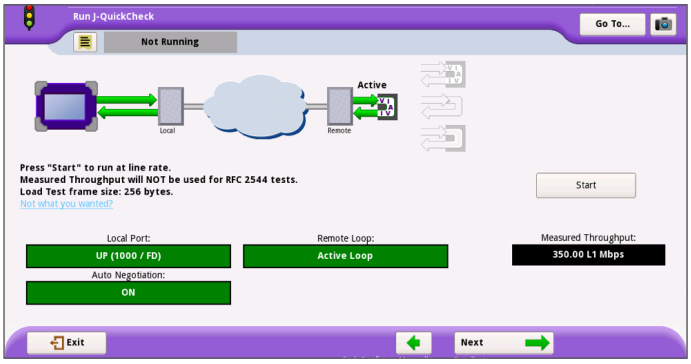
Integrated J-Quick Check

The J-QuickCheck test is somewhat of a "pre-test" that verifies basic connectivity of the network very quickly before significant time is wasted trying to run and the RFC 2544 test. Important configuration checks include:

- **Auto-negotiation Issues** – When a local test unit is connected to the network, the test unit and network equipment (i.e. Ethernet switch), must negotiate to the proper full-duplex link speed or the interface will default to half-duplex. If the interface cannot negotiate properly and enters half-duplex state, then an RFC 2544 test will falsely report a very low throughput for a given Committed Information Rate (CIR). As an example, a CIR of 100 Mbps may only achieve 10 Mbps (or less) if the link is set for half-duplex.
- **Mis-configured VLAN** – Traditionally, the technician must enter the correct VLAN on the local test set. Many times, this VLAN is incorrect or the technician is not even aware that the network is using VLAN tags. An example would be that the network is configured to use VLAN 202 between the local and remote test device. If the technician does not enter a VLAN or enters the incorrect VLAN, the remote device will never see the loopback commands. This can waste significant amounts of time since the technician must contact advanced engineering or the Network Operations Center (NOC). The situation can be even more problematic when the network is not well documented.

  The J-QuickCheck VLAN scan test automatically sends loop "hello" commands to all 4096 VLANs and provides a list of remote devices which reply on a VLAN (with the VIAVI device ID). This scan takes about 10 seconds to complete. The time savings is significant as VLAN misconfiguration is one of the most common test configuration errors.
- **Incorrect Throughput Parameters** – When running a conventional RFC 2544 test, the primary purpose is to establish the ability of the network to transmit and receive network traffic at the service CIR. RFC 2544 specifies a basic "hunt" algorithm to identify the maximum throughput achievable within the SLA. This "hunt" can take considerable time, especially if there is a configuration mismatch between the tested CIR versus actual network CIR. J-QuickCheck eliminates this misconfiguration problem altogether by running a very short throughput test

and providing immediate feedback (within seconds) if a configuration error is causing a wide discrepancy in results. By determining in seconds that a policer (etc.) is in the network versus many minutes (or hours), J-QuickCheck can reduce overall RFC 2544 test dramatically, allowing the hunt algorithm to run efficiently.

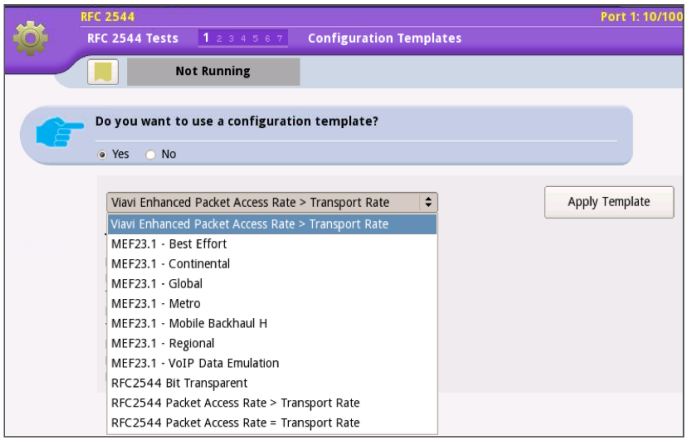


J-QuickCheck configuration page and results

Simultaneous KPI Measurements

The standard RFC 2544 test specifies that throughput, delay and jitter tests are be to be run sequentially (one test at a time and three different frame sizes). The enhanced RFC 2544 runs these tests concurrently which reduces test time by ~66%.* So a standard RFC 2544 which might take 30 minutes to complete would take about ten minutes with this enhanced technique.

Another advantage is that the enhanced RFC 2544 test's default settings are optimized for Metro Ethernet services. Specifically, the test defaults to 1 x 30 second trial per frame size for most KPIs. The RFC 2544 specification and many vendors' implementations have extremely long defaults for the frame loss test (example: 20 x 2-minute trials per frame size). This wastes an inordinate amount of technician test time.



Enhanced RFC 2544 includes MEF and RFC 2544 KPI Templates

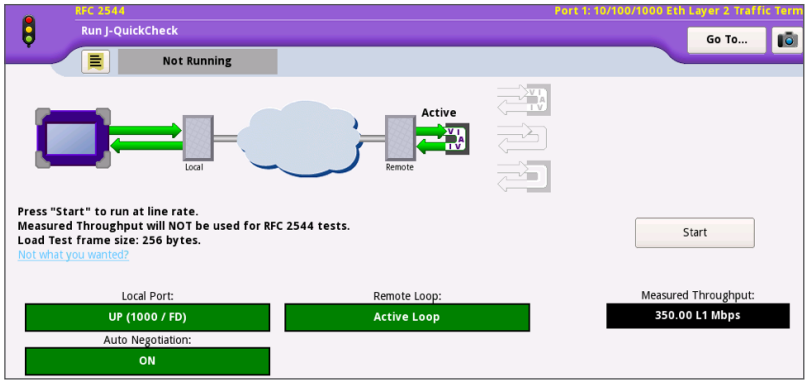
Also, VIAVI supports KPI-configuration templates based upon RFC 2544 and Metro Ethernet Forum (MEF) recommendations for a variety of services. A KPI configuration template specifies the proper thresholds for loss, delay, and jitter metrics for various classes of service. The following are examples of standards-based configuration templates:

- MEF23.1 – Best Effort, Continental, Global, Metro, Mobile Backhaul, VoIP Data Emulation
- RFC 2544 Bit Transparent, Packet Access Rate > Transport Rate, Packet Access Rate = Transport Rate

Additionally, the enhanced RFC 2544 can run end-end bi-directionally versus just a loop-back mode. These KPIs are then measured independently in each direction (upstream traffic and downstream) so that when an SLA failure occurs, the network path (upstream and / or downstream) can be determined.

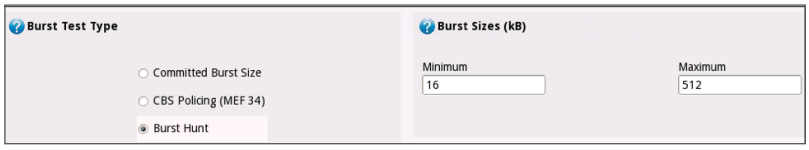
Committed burst size (CBS) testing

Traditional Ethernet service-activation test methodologies such as RFC 2544 focus on testing with constant bit rate traffic. While testing with constant bit-rate traffic can validate important KPIs, it does not validate how well the network will perform when transporting a real-world traffic mix of constant bit-rate voice, video and bursty data traffic. The two goals of burst testing are ensuring that bursty data traffic can pass through the network without frame loss and without impacting other services.



The Enhanced RFC 2544 CBS Test Results

Configuring a burst test in the enhanced RFC 2544 workflow is very easy. The user must simply enable CBS test and specify the CBS size (which is part of the network provider's SLA). The following screen illustrates the results after an enhanced RFC 2544 is conducted with CBS. Please note the simple, dashboard-style PASS/FAIL results.



Burst Hunt Selection in the Enhanced RFC 2544 Test

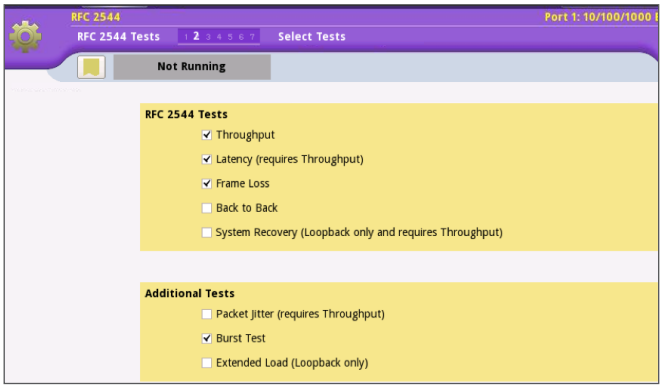
Many times, the CBS value of a network is unknown or misconfigured, especially when dealing with multiple carrier network spans (i.e. mobile back-haul). There can be a lot of finger pointing and wasted time trying to manually determine the CBS of the network.

To address this issue, VIAVI provides a burst "hunt" mode which automatically determines the CBS that an end-to-end network can handle. This can be quite complex to determine without the automatic hunt mode. As illustrated below, the user merely selects the Burst Hunt mode, defines the lower and upper limit, and the instrument automatically finds the end-to-endburst value.

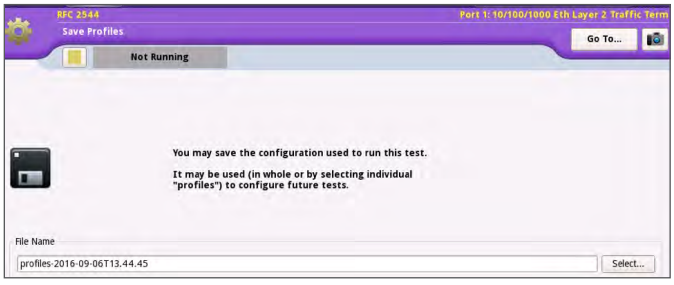
In addition to CBS-type tests, VIAVI also supports the MEF 34 policing test. The MEF 34 policing tests are helpful for Ethernet backhaul carriers or Ethernet business services providers to ensure that policer settings are configured correctly to prevent customers from using more bandwidth than should be allowed.

Wizard-like UI and Test Configurations

Configuration of an RFC 2544 test can be complicated and there are many options that a user must consider. The enhanced RFC 2544 greatly simplifies the test process and provides a wizard-like UI, which guides the user 'step-by-step' though the configuration process. Additionally, test configurations can be saved and loaded. The following are examples of two configuration screens.

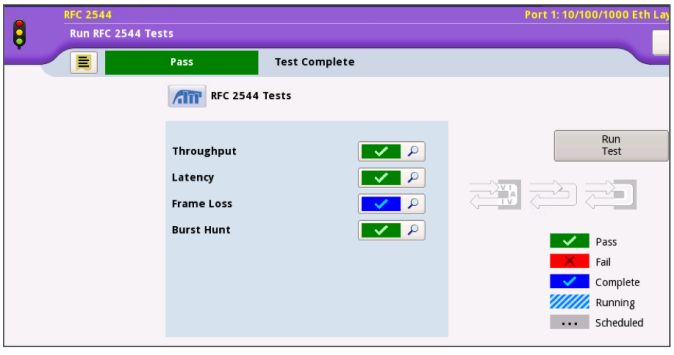


The Enhanced RFC 2544 CBS Test Results



The Enhanced RFC 2544 Load Saved Test Configurations

After the RFC 2544 test is complete, the user is presented with a simple Pass/Fail dashboard (right) making it easy to understand which tests were successful. For the tests that failed, more detailed information is available by clicking on the dashboard icons.



The Enhanced RFC 2544 Test Results Dashboard

"Zeroing In" Throughput Algorithm

Central to RFC 2544 is the concept of throughput testing and the user must enter the target throughput that the network can sustain. Measured throughput may be less than the target throughput when there are conditions such as:

- Network anomalies such as "bad" links, network elements ports, etc. which cause packet loss
- Network topology may have policer or network links that are lower speed than the test target throughput (i.e. target throughput = 1 Gbps but there is a network policer at 300 Mbps)

In cases where the standard RFC 2544 test does not achieve the target throughput, the test set enacts a "hunt" algorithm and will incrementally reduce and then increase the tested bandwidth until the true network sustained throughput can be achieved (within the SLA parameters of loss, latency, and jitter).

This standard hunt algorithm can take a lot of time, so VIAVI addressed this problem with an enhanced algorithm which can dramatically reduce overall execution time. The following table provides several test scenarios and the difference in test time between standard RFC and the enhanced RFC 2544.

Standard RFC 2544 versus VIAVI Enhanced RFC 2544 Test Time for Hunt Scenarios

Network Scenario	Standard RFC 2544 Test Time	VIAVI Enhanced RFC 2544 Test Time
CIR 500Mbps/CBS 64KB Loopback Test: Throughput, Latency, Frame Loss, Back-to-Back; 30 seconds	104 minutes	33 minutes
CIR 250Mbps/CBS 64KB Loopback Test: Throughput, Latency, CBS Policing	30 minutes	20 minutes
CIR 250Mbps/CBS 64KB End-to-End Test: Throughput, Latency, CBS Policing	35 minutes	24 minutes

Note: All test scenarios reflect a GigE (1000 Mbps) WAN using 10 Mbps for the hunt criterion

Conclusion

Ethernet service activation is your first step to ensure customer satisfaction. Service providers need to conduct service activation set-up in a cost-effective manner. The enhanced RFC 2544 test provides an advantage in time, efficiency and accuracy to make your service activation workflow as smooth and easy as possible.

Click to browse Bit Error Rate Testers from VIAVI

For more details on VIAVI test and measurement solutions, please go to VIAVIsolutions.com

VIAVI Solutions

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

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

ethernetsas-rfc2544-br-tfs-nse-ae
30186061 901 0321