The Essentials of Ethernet Service Activation

Webinar #1
Y.1564, RFC 2544 and J-QuickCheck
Ethernet Service Activation Webinar Series

3 Webinars covering five Ethernet tests:

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 TrueSpeed**: Layer 4 TCP Throughput
The Essentials of Ethernet Service Activation Series

JUNE 14 2:00 PM EST
Y.1564, RFC 2544, and QuickCheck

JUNE 28 2:00 PM EST
Layer 2 Control Plane J-Proof

JULY 12 2:00 PM EST
RFC 6349 TrueSpeed Testing
Agenda for Today’s Webinar

• Carrier Ethernet SLA’s and KPI’s
• Y.1564 and RFC 2544
• Where to test
• Demo of Y.1564
• QuickCheck and non-SLA services
• Demo QuickCheck
• Additional Resources and Q&A
Business Class Ethernet Services
Business Class Ethernet Services What they Are

The Metro Ethernet Forum defines 5 types of carrier Ethernet services

<table>
<thead>
<tr>
<th>Retail Service Types</th>
<th>Wholesale Service Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-Line</td>
<td>E-Access</td>
</tr>
<tr>
<td>E-LAN</td>
<td>E-Transit</td>
</tr>
<tr>
<td>E-Tree</td>
<td></td>
</tr>
</tbody>
</table>

**E-Access**
- Multipoint to Multipoint (EVPN)
- E-Line Virtual Private LAN (E-LVPL)
- E-Tree Virtual Private LAN (E-TVPL)

Source: Metro Ethernet Forum
Service Level Agreements - SLAs

SLA Example

<table>
<thead>
<tr>
<th>CIR (Mbps)</th>
<th>CBS (Kbytes)</th>
<th>One-Way Delay (msec)</th>
<th>One-Way Jitter (msec)</th>
<th>Frame Loss Ratio</th>
<th>MTTR (hours) for services</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>128</td>
<td>&lt;25</td>
<td>&lt;1.5</td>
<td>&lt;10^{-6}</td>
<td>&lt;3</td>
<td>&gt;99.999%</td>
</tr>
</tbody>
</table>
## Sample SLA Values for Ethernet – MEF 23.1

<table>
<thead>
<tr>
<th>Characteristics (one way)</th>
<th>Mobile Backhaul services</th>
<th>EPL/EVP</th>
<th>Voice Trunking Services</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bandwidth (CIR)</strong></td>
<td>1 Mbps to 10 Gbps</td>
<td>1 Mbps to 10 Gbps</td>
<td>80 Kbps per call (2 Mbps per PRI)</td>
</tr>
<tr>
<td><strong>Committed Burst Size</strong></td>
<td>256 KBytes</td>
<td>64 KBytes</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Frame Delay</strong></td>
<td>&lt; 10 ms</td>
<td>&lt; 25 ms</td>
<td>&lt; 40 ms</td>
</tr>
<tr>
<td><strong>Frame Delay Variation (Jitter)</strong></td>
<td>&lt; 2 ms</td>
<td>&lt; 25 ms</td>
<td>&lt; 20 ms</td>
</tr>
<tr>
<td><strong>Frame Loss</strong></td>
<td>&lt; .001 %</td>
<td>&lt; .01%</td>
<td>&lt; 1 %</td>
</tr>
<tr>
<td><strong>Throughput</strong></td>
<td>99.995 %</td>
<td>99.99 %</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Availability</strong></td>
<td>99.999 %</td>
<td>99.99 %</td>
<td>99.99 %</td>
</tr>
<tr>
<td><strong>Mean-time to repair</strong></td>
<td>2 hours</td>
<td>4 hours</td>
<td>4 hours</td>
</tr>
</tbody>
</table>
Generic Key Performance Indicators (KPIs)

**Latency – Round Trip Delay**
- Voice: over-talk, echo, dropped calls
- Video: choppiness and delays
- Data: long download times

**Packet Jitter – Delay Variation**
- Voice: clicking and popping noises
- Video: pixelization or blue screens
- Data: minimal affect

**Frame Loss**
- Voice: clicks/fuzziness, dropped calls
- Video: pixelization or blue screens
- Data: long download times
What to do when things go wrong?

120 - Passed - 1st test
7 - Failed - revisit
91 - passed after work wth carrier

Failed – requires retest 1
Passed – after work with the carrier 2
Passed 3

45% of all tests fail the first time

Top problems:
• Auto-Negotiation set incorrectly
• 802.3 versus DIX framing
• Misconfigured CIR
• VLAN configuration problems
• Jitter
• Fail-Over Failures
Quick Survey

What service activation test methods do you use today?

- No Testing or Testing with Ping
- RFC 2544
- Y.1564
- RFC 6349
- Layer 2 Control Plane
Reduce OpEx with Ethernet Service Activation Testing

- TrueSAM
- RFC-6349
- TrueSpeed
  Validates TCP Throughput and User Experience
- J-Proof
  Validates Layer 2 Control plane Transparency – CDP, SDP, etc.
- RFC-2544
  Validates KPI for single stream
  No control-plane or user experience validation
- Y.1564 SAMCompete
  Validates KPI for multiple Class of Service (COS) applications
  No CP or user experience validation
- Not Testing Ethernet or Testing with L1 or Ethernet BERT
  No way to validate KPI or auto-negotiation settings
- Testing with Just a Ping
  No way to validate KPI or auto-negotiation settings

More thorough testing now → fewer truck rolls later
Key Measurements and the Benefits of Service Activation Testing
Y.1564
Summary
Y.1564 SAMComplete

• Newer industry standard for single and **multiple service** Ethernet and IP service activation test
• Measure Key Performance Indicators and Bandwidth Profile
  • CIR, EIR (Throughput)
  • Frame Delay – FD (Latency)
  • Frame Delay Variation – FDV (Jitter)
  • Frame Loss Rate - FLR
  • Committed Burst Size – CBS
  • Policing
• Fully automated with report generation
Y.1564 Part 1: Service Configuration Test (Ramp Test)

- Validates network traffic profile configuration – one service (stream) at a time
  - First stage, X steps to CIR, 1 to 60 seconds each
  - Verifies SLA parameters are met for rates lower and equal to CIR
  - SLA parameters: Throughput, Delay (FD), Jitter (FDV) and Frame Loss (FL)
  - Then step to EIR and MIR line rate
  - Verifies throughput – errors allowed in excess of CIR
  - Verifies Max Throughput does not go over the maximum allowed

![Diagram showing network traffic profile configuration](image-url)
Y.1564 Part 2: Service Performance Test (Multi-Service)

- Part 2 validates quality of service for each service and proves SLA conformance
  - All services generated **simultaneously** at their CIR and KPIs measured for each
  - This phase is a single measurement done over a mid to long-term time period
  - This procedure allows the characterization of each service and its influence on others and ensures that they all comply to their respective SLA
RFC 2544
Summary
Enhanced RFC 2544

- Widely used service activation test for Ethernet and IP services
- **Single service** test
- Measure Key Performance Indicators and Bandwidth Profile
  - Throughput
  - Latency
  - Frame Loss
  - Packet Jitter
  - Committed Burst Size - CBS
- Fully automated with report generation

![RFC 2544 Test](image)
# Comparison of Measurements in RFC 2544 vs. Y.1564

<table>
<thead>
<tr>
<th>RFC 2544</th>
<th>Y.1564</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throughput</td>
<td>Committed Information Rate (CIR)</td>
<td>The speed in Mbps of traffic that can be transmitted</td>
</tr>
<tr>
<td>Latency</td>
<td>Frame Delay (FD)</td>
<td>The time in ms or µs it takes traffic to be transmitted</td>
</tr>
<tr>
<td>Frame Loss</td>
<td>Frame Loss Ratio (FLR)</td>
<td>The rate that frames are lost as they are transmitted</td>
</tr>
<tr>
<td>Jitter*</td>
<td>Frame Delay Variation (FDV)</td>
<td>The difference in latency from one packet to the next</td>
</tr>
<tr>
<td>Burst*</td>
<td>Committed Burst Size (CBS)</td>
<td>The number of bytes that can be transmitted at line rate without losing packets</td>
</tr>
<tr>
<td>N/A</td>
<td>Policing</td>
<td>Tests that policers are configured properly so that customers cannot get more than they paid for</td>
</tr>
</tbody>
</table>

*added to Viavi Enhanced RFC 2544
Testing Scenarios and Demos
Logical Ethernet Business Service Topology
Network is Gigabit end-end, but policed to 100 Mbps in the direction of the Local to Remote TBERD
Non-SLA services

• Sometimes techs need to test Ethernet services and circuits without an SLA

• Examples:
  - Internal network connections such as transport circuits
  - Installation of network equipment or replacement of line cards
  - Low cost “Best Efforts” internet access services

• A simpler test is often the right solution
QuickCheck

- Pre-test in RFC 2544 or Y.1564
- Standalone test for non-sla services
- Checks
  - Near-end connectivity and auto negotiation
  - Connectivity to far end and loopback detection
- Measures
  - Throughput
  - Frame loss
QuickCheck Demo

Provider Edge Router

Emulated Network (40 ms RT delay)

Operator Network

T-BERD 5800

Cisco ME-3400

Network is Gigabit end-end, with no policing
Wrap-up and Q&A

Stay tuned for a follow-up email with links to a whitepaper series with more details on the topics covered today.

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Barry Constantine: barry.constantine@viavisolutions.com
Head to Head versus Loopback Testing

- Traffic can either be generated **Head to Head** between two test sets or to a **Loopback Device**.

- Testing to a **Loopback Device** offers the following advantages:
  - Less experienced technician can set up the loopback device.
  - Round Trip Delay measurement.
  - Faster initiation of automated tests (QuickCheck, Enhanced RFC-2544, etc.)
  - Single report containing bidirectional test results.
**Loopback Devices**

- Viavi Test equipment and some NIDs support Viavi proprietary loopbacks that swap Source and Destination MAC addresses and IP addresses.

- Some Carrier Ethernet switches and NIDs support **IEEE 802.11ag Loopback Messages**.

- Other switches and non-Viavi Test Sets may support “software” loopbacks that swap Source and Destination MAC addresses and IP addresses.

*Hard loops generally cannot be used across Switches and Routers, but may be used across a “Layer 1” circuit, such as fiber link.*
Viavi Recommended Best Practice Workflows

**Single Service: Enhanced RFC 2544 Multi-Service Y.1564 SAMComplete**
For Ethernet KPI Verification

**J-Proof Layer 2 Control Plane Transparency Test:**

**RFC 6349 TrueSpeed Layer 4 TCP Throughput**

Best Practice Workflow (Single and Multiple Services)

**Multiple Class of Service (COS) Workflow**

**J-QuickCheck Basic Connectivity and Throughput Test**

**Y.1564 SAMComplete Ethernet KPI Verification for Multiple Services**

**J-Proof Layer 2 Control Plane Transparency Test:**

**RFC 6349 TrueSpeed Layer 4 TCP Throughput**
## Summary of the Various Standards Based Tests and Problem Solved

<table>
<thead>
<tr>
<th>Turn-up Related Problem</th>
<th>RFC2544</th>
<th>Y.1564</th>
<th>RFC 6349</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Service, Layer 2/3 SLA Issues (loss, jitter, etc.)</td>
<td>![Check Mark]</td>
<td>![Check Mark]</td>
<td>N/A</td>
</tr>
<tr>
<td>Multi-service, Layer 2/3 SLA Issues (service prioritization, loss, jitter, etc.)</td>
<td>![X Mark]</td>
<td>![Check Mark]</td>
<td>N/A</td>
</tr>
<tr>
<td>Demonstrate the effect of End customer TCP Window size on throughput (CPE issue).</td>
<td>![X Mark]</td>
<td>![X Mark]</td>
<td>![Check Mark]</td>
</tr>
<tr>
<td>Inadequate device buffers to handle bursty applications.</td>
<td>![X Mark]</td>
<td>![X Mark]</td>
<td>![Check Mark]</td>
</tr>
<tr>
<td>Policing effects to TCP performance.</td>
<td>![X Mark]</td>
<td>![X Mark]</td>
<td>![Check Mark]</td>
</tr>
</tbody>
</table>
JDSU RFC 2544 Test Parameters

- Configurable test times
  - 5 min – 6 hours
- Configurable frame sizes
  - Including Jumbo
- Packet Jitter included
  - Real-time services – voice and video
- Maximum Bandwidth
  - Committed throughput guaranteeing Key Performance Indicators (KPIs)
- Concurrent tests reduce test time by half
  - Measure Throughput, Delay, and Jitter simultaneously
J-QuickCheck

The Problems

• It takes too long to get the test set-up correctly before actually starting

• Users mis-configure the test set auto-negotiation and loopback settings

• It’s a waste of time to run the full test if throughput is way off from expected

The Solution

• Saves valuable time by performing quick end-to-end connectivity and configuration test

• Verifies test set auto-negotiation settings and connectivity to far end with proper loopback

• Quickly verifies end-to-end throughput
J-QuickCheck

*Save test time if a major configuration problem exists*

- Save time by automating the first few steps of the M&P
- Available as a standalone test or…
- Integrated into both RFC 2544 and Y.1564 tests
- One screen test setup determines:
  - Correct auto-negotiation settings
  - Connectivity and loopback with the far end and
  - Performs a quick throughput test

**Feature** | **Description** | **Benefit**
---|---|---
Identifies auto-negotiation settings | Automatically configures auto-negotiation settings to match local network | User error of auto-negotiation settings is eliminated
Verifies connectivity to the far end | Only need to configure far end IP address to connect | Users don’t need to know all the low level details of setup and configuration
Quick throughput test | Rapid throughput test to ensure that circuit is active | Saves valuable test time if some major configuration problem exists in the network or with the test sets