



Spirent Journal of Benchmark PASS Test Methodologies

A decorative graphic consisting of several overlapping, semi-transparent, light blue and grey geometric shapes that form a horizontal, multi-faceted structure. The word "PASS" is centered within the rightmost part of this structure.

PASS

Introduction

Today's Devices Under Test (DUT) represent complex, multi-protocol network elements with an emphasis on Quality of Service (QoS) and Quality of Experience (QoE) that scale to terabits of bandwidth across the switch fabric. The Spirent Catalogue of Test Methodologies represents an element of the Spirent test ecosystem that helps answer the most critical Performance, Availability, Security and Scale Tests (PASS) test cases. The Spirent Test ecosystem and Spirent Catalogue of Test Methodologies are intended to help development engineers and product verification engineers to rapidly develop and test complex test scenarios.

How to use this Journal

This provides test engineers with a battery of test cases for the Spirent Test Ecosystem. The journal is divided into sections by technology. Each test case has a unique Test Case ID (Ex. TC_MBH_001) that is universally unique across the ecosystem.

Tester Requirements

To determine the true capabilities and limitations of a DUT, the tests in this journal require a test tool that can measure router performance under realistic Internet conditions. It must be able to simultaneously generate wire-speed traffic, emulate the requisite protocols, and make real-time comparative performance measurements. High port density for cost-effective performance and stress testing is important to fully load switching fabrics and determine device and network scalability limits.

In addition to these features, some tests require more advanced capabilities, such as

- Integrated traffic, routing, and MPLS protocols (e.g., BGP, OSPF, IS-IS, RSVP-TE, LDP/CR-LDP) to advertise route topologies for large simulated networks with LSP tunnels while simultaneously sending traffic over those tunnels. Further, the tester should emulate the interrelationships between protocols through a topology.
- Emulation of service protocols (e.g., IGMPv3, PIM-SM, MP-iBGP) with diminution.
- Correct single-pass testing with measurement of 41+ metrics per pass of a packet.
- Tunneling protocol emulation (L2TP) and protocol stacking.
- True stateful layer 2-7 traffic.
- Ability to over-subscribe traffic dynamically and observe the effects.

Finally, the tester should provide conformance test suites for ensuring protocol conformance and interoperability, and automated applications for rapidly executing the test cases in this journal.

Further Resources

Additional resources are available on our website at <http://www.spirent.com>

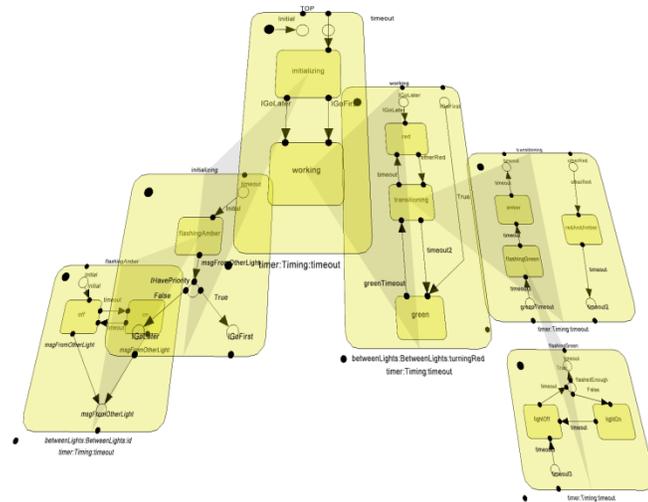
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Testing Industry Standards

To provide a stand way of measuring and evaluating a Device Under Test (DUT), the industry has created a series of benchmarks. These benchmarks establish a uniform procedure for the generation of traffic to and from the DUT with a normalized procedure of analysis and reporting. The goal of the benchmark is to generate metrics in a reproducible and unbiased fashion for comparability.

Benchmarking standards can come from any organization for potential industry wide adoption. Two key organizations, IEEE and IETF, help set standards in the industry by coordinating recommendations. Though the RFC (Request for Comment) and WG (Working Group) system, sub groups like the BMWG (Bench mark Working Group) help coordinate and refine recommendations. Key recommendations such as RFC-2544, RFC-2889, and RFC-3918 have come from this process.



In order to execute benchmarks, test and measurement equipment like Spirent TestCenter, Spirent Avalanche, and Spirent Landslide help the user systematically generate, analyze, and report based on the industry derived standards. Spirent TestCenter is especially architected to rapidly test and measure industry standards to its microkernel-architected and high-port-density design, allowing up to 32 multiple automated processes to execute in parallel per chassis.

This document describes the methodologies associated with testing key industry standards. These constructive generic frameworks help users understand and execute key standards and reduce the time associated with testing benchmarks.

Abstract

This test case determines the time it takes the DUT to start/stop forwarding multicast frames once it receives a successful IGMP group membership report/leave group message.

Description

This test is part of the RFC 3918 tests, in this case to determine the time it takes a DUT to start/stop forwarding multicast frames from the time a successful IGMP group membership report/leave group message is sent.

In this test, Spirent TestCenter ports act as both multicast clients and sources with the DUT in between. The DUT shouldn't forward multicast traffic until it receives a request from the client. It should process multicast Join/Leave requests from the client with the minimum possible latency.

This is critical for presenting the user with a good quality of experience, especially with video applications.

Target Users

All NEMs and service providers

Target Device Under Test (DUT)

Core Equipment

Reference

RFC 3918

Relevance

This test case show cases the DUT's capability to handle Join/Leave requests from the Multicast Clients.

Version

1.0

Test Category

Testing Benchmarking Standards

PASS

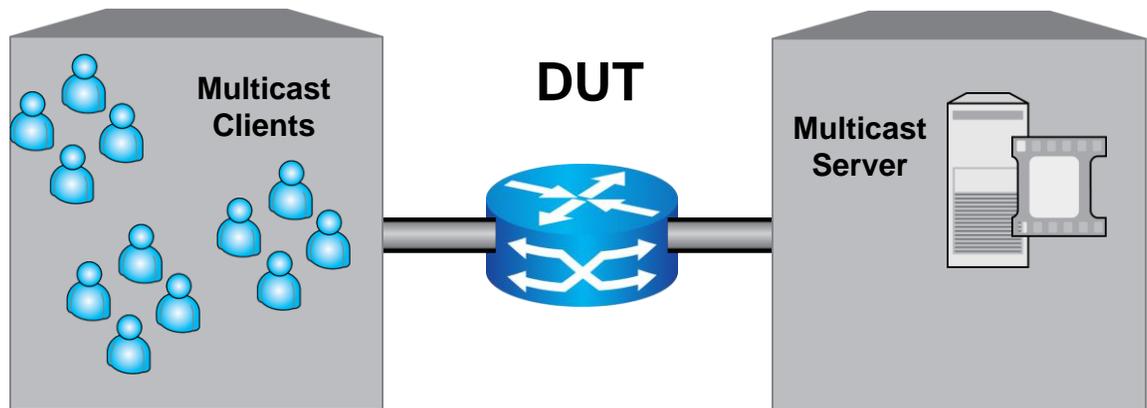
Performance Availability Security Scale

Required Tester Capabilities

The tester must support:

- RFC 3918
- Multicast protocols support – IGMP/MLD
- Results reporting capabilities in a template format with key

Topology Diagram



Test Procedure

1. Launch the RFC 3918 Wizard in the Spirent TestCenter GUI.
2. Select the Multicast Join/Leave Test.
3. Select the ports that will be used in the test.
 - a. Configure multicast hosts and the group automatically with the wizard or manually.
4. Select the endpoint mapping and multicast source and client ports.
5. Configure the following parameters
 - a. Multicast Client Version (IGMP Version).
 - b. Join Group Delay.
 - c. Leave Group Delay.
 - d. Multicast Message Tx Rate.
 - e. Multicast Group Base IP Address, Step and the how much should it Increment in each step.
 - f. Layer 4 Header – None, TCP, UDP.
 - i. If TCP/UDP is selected, give a port number range.
 - g. TOS or Class of Service.
 - h. VLAN P-bit, if any.
 - i. TTL.
 - j. Latency Type.
 - i. Selection from LIFO, FIFO, FILO or LIFO.
 - k. The Multicast Group Distribution Mode – Even or Weighed, between Client ports, if more than 1.

6. Configure the test options.
 - a. Number of Trials to be run.
 - b. Duration in seconds.
 - c. Test Start Delay – for the DUT to be able to ramp up.
 - d. Frame Size.
 - i. Option to have Fixed, Random, Step, Custom or iMIX.
 - e. ARP/Learning parameters.
 - f. Results Collection Delay – after the test has finished, the analyzer will wait this amount of time before it calculates the results.
7. Finish the wizard. It automatically creates a sequence of steps in the Command Sequencer.
8. Run the Command Sequencer and allow the Results Reporter to open up when the first iteration has finished.
9. The Results Reporter tool launches when the first iteration is complete and displays the results in a pre-defined template with all the necessary information.
10. Create a PDF, HTML or Excel report from the template if desired.
11. Run the test for IPv6/MLD if desired.
12. End of test case.

Control Variables & Relevance

Variable	Relevance	Default Value
Number of IGMP Groups	The more the number of IGMP Groups, more processing required on the DUT	1
IGMP Version	This would be normally Version 2 or 3.	2
MLD Version	This would be normally Version 2 or 3	2
Number of Multicast Hosts	This defines the number of Multicast Clients per port – usually the number of Multicast Clients and Groups are in 1:1 ratio	1
IGMP/MLD Group Addresses	The Starting Group Address – should be a Class D address. There are some Class D addresses, which are private and should not be used.	225.0.0.1
Multicast Group Address Step	Which octet to increment if we have more than 1 Groups	/8
TOS	Class of Service for the Multicast packets	0
IP TTL	Time to leave for the multicast packets	10
Multicast Group Distribution Mode	How the number of groups are distributed amongst the ports, if more than one	Even
Latency Type	The way latency is calculated	FIFO

Key Measured Metrics

Matric	Relevance	Metric Unit
Join Latency	The time it takes for the first Multicast packet to arrive on the client port from the moment a join message is sent for the particular group	Microseconds
Leave Latency	Time it takes for the DUT to stop forwarding the Multicast packets for a particular group after a Leave has been sent	Microseconds

Desired Result

The DUT should be able to process the multicast Join/Leaves as fast as possible.

Analysis

The DUT should be able to process the multicast Join/Leaves as fast as possible for multiple Joins and Leaves happening together.

Typically, a Join latency will be lower than a Leave latency but there shouldn't be too much of a gap.

A high Join/Leave latency indicates a significant issue with the DUT processing engine as well as the buffers.

Appendix A – Telecommunications

Definitions

APPLICATION LOGIC. The computational aspects of an application, including a list of instructions that tells a software application how to operate.

APPLICATION SERVICE PROVIDER (ASP). An ASP deploys hosts and manages access to a packaged application by multiple parties from a centrally managed facility. The applications are delivered over networks on a subscription basis. This delivery model speeds implementation, minimizes the expenses and risks incurred across the application life cycle, and overcomes the chronic shortage of qualified technical personnel available in-house.

APPLICATION MAINTENANCE OUTSOURCING PROVIDER. Manages a proprietary or packaged application from either the customer's or the provider's site.

ASP INFRASTRUCTURE PROVIDER (AIP). A hosting provider that offers a full set of infrastructure services for hosting online applications.

ATM. Asynchronous Transport Mode. An information transfer standard for routing high-speed, high-bandwidth traffic such as real-time voice and video, as well as general data bits.

AVAILABILITY. The portion of time that a system can be used for productive work, expressed as a percentage.

BACKBONE. A centralized high-speed network that interconnects smaller, independent networks.

BANDWIDTH. The number of bits of information that can move through a communications medium in a given amount of time; the capacity of a telecommunications circuit/network to carry voice, data, and video information. Typically measured in Kbps and Mbps. Bandwidth from public networks is typically available to business and residential end-users in increments from 56 Kbps to 45 Mbps.

BIT ERROR RATE. The number of transmitted bits expected to be corrupted per second when two computers have been communicating for a given length of time.

BURST INFORMATION RATE (BIR). The rate of information in bits per second that the customer may need over and above the CIR. A burst is typically a short duration transmission that can relieve momentary congestion in the LAN or provide additional throughput for interactive data applications.

BUSINESS ASP. Provides prepackaged application services in volume to the general business market, typically targeting small to medium size enterprises.

BUSINESS-CRITICAL APPLICATION. The vital software needed to run a business, whether custom-written or commercially packaged, such as accounting/finance, ERP, manufacturing, human resources and sales databases.

BUSINESS SERVICE PROVIDER. Provides online services aided by brick-and-mortar resources, such as payroll processing and employee benefits administration, printing, distribution or maintenance services. The category includes business process outsourcing (BPO) companies.

COMMERCE NETWORK PROVIDER. Commerce networks were traditionally proprietary value-added networks (VANs) used for electronic data interchange (EDI) between companies. Today the category includes the new generation of electronic purchasing and trading networks.

COMPETITIVE ACCESS PROVIDER (CAP). A telecommunications company that provides an alternative to a LEC for local transport and special access telecommunications services.

CAPACITY. The ability for a network to provide sufficient transmitting capabilities among its available transmission media, and respond to customer demand for communications transport, especially at peak usage times.

CLIENT/DEVICE. Hardware that retrieves information from a server.

CLUSTERING. A group of independent systems working together as a single system. Clustering technology allows groups of servers to access a single disk array containing applications and data.

COMPUTING UTILITY PROVIDER (CUP). A provider that delivers computing resources, such as storage, database or systems management, on a pay-as-you-go basis.

CSU/DSU. Channel Server Unit/Digital Server Unit. A device used to terminate a telephone company connection and prepare data for a router interface.

DATA MART. A subset of a data warehouse, intended for use by a single department or function.

DATA WAREHOUSE. A database containing copious amounts of information, organized to aid decision-making in an organization. Data warehouses receive batch updates and are configured for fast online queries to produce succinct summaries of data.

DEDICATED LINE. A point-to-point, hardwired connection between two service locations.

DEMARCATION LINE. The point at which the local operating company's responsibility for the local loop ends. Beyond the demarcation point (also known as the network interface), the customer is responsible for installing and maintaining all equipment and wiring.

DISCARD ELIGIBILITY (DE) BIT. Relevant in situations of high congestion, it indicates that the frame should be discarded in preference to frames without the DE bit set. The DE bit may be set by the network or by the user; and once set cannot be reset by the network.

DS-1 OR T-1. A data communication circuit capable of transmitting data at 1.5 Mbps. Currently in widespread use by medium and large businesses for video, voice, and data applications.

DS-3 OR T-3. A data communications circuit capable of transmitting data at 45 Mbps. The equivalent data capacity of 28 T-1s. Currently used only by businesses/institutions and carriers for high-end applications.

ELECTRONIC DATA INTERCHANGE (EDI). The electronic communication of business transactions (orders, confirmations, invoices etc.) of organizations with differing platforms. Third parties provide EDI services that enable the connection of organizations with incompatible equipment.

ENTERPRISE ASP. An ASP that delivers a select range of high-end business applications, supported by a significant degree of custom configuration and service.

ENTERPRISE RELATIONSHIP MANAGEMENT (ERM). Solutions that enable the enterprise to share comprehensive, up-to-date customer, product, competitor and market information to achieve long-term customer satisfaction, increased revenues, and higher profitability.

ENTERPRISE RESOURCE PLANNING (ERP). An information system or process integrating all manufacturing and related applications for an entire enterprise. ERP systems permit organizations to manage resources across the enterprise and completely integrate manufacturing systems.

ETHERNET. A local area network used to connect computers, printers, workstations, and other devices within the same building. Ethernet operates over twisted wire and coaxial cable.

EXTENDED SUPERFRAME FORMAT. A T1 format that provides a method for easily retrieving diagnostics information.

FAT CLIENT. A computer that includes an operating system, RAM, ROM, a powerful processor and a wide range of installed applications that can execute either on the desktop or on the server to which it is connected. Fat clients can operate in a server-based computing environment or in a stand-alone fashion.

FAULT TOLERANCE. A design method that incorporates redundant system elements to ensure continued systems operation in the event of the failure of any individual element.

FDDI. Fiber Distributed Data Interface. A standard for transmitting data on optical-fiber cables at a rate of about 100 Mbps.

FRAME. The basic logical unit in which bit-oriented data is transmitted. The frame consists of the data bits surrounded by a flag at each end that indicates the beginning and end of the frame. A primary rate can be thought of as an endless sequence of frames.

FRAME RELAY. A high-speed packet switching protocol popular in networks, including WANs, LANs, and LAN-to-LAN connections across long distances.

GBPS. Gigabits per second, a measurement of data transmission speed expressed in billions of bits per second.

HOSTED OUTSOURCING. Complete outsourcing of a company's information technology applications and associated hardware systems to an ASP.

HOSTING PROVIDER. Provider who operates data center facilities for general-purpose server hosting and collocation.

INFRASTRUCTURE ISV. An independent software vendor that develops infrastructure software to support the hosting and online delivery of applications.

INTEGRATED SERVICES DIGITAL NETWORK (ISDN). An information transfer standard for transmitting digital voice and data over telephone lines at speeds up to 128 Kbps.

INTEGRATION. Equipment, systems, or subsystem integration, assembling equipment or networks with a specific function or task. Integration is combining equipment/systems with a common objective, easy monitoring and/or executing commands. It takes three disciplines to execute integration: 1) hardware, 2) software, and 3) connectivity – transmission media (data link layer), interfacing components. All three aspects of integration have to be understood to make two or more pieces of equipment or subsystems support the common objective.

INTER-EXCHANGE CARRIER (IXC). A telecommunications company that provides telecommunication services between local exchanges on an interstate or intrastate basis.

INTERNET SERVICE PROVIDER (ISP). A company that provides access to the Internet for users and businesses.

INDEPENDENT SOFTWARE VENDOR (ISV). A company that is not a part of a computer systems manufacturer that develops software applications.

INTERNETWORKING. Sharing data and resources from one network to another.

IT SERVICE PROVIDER. Traditional IT services businesses, including IT outsourcers, systems integrators, IT consultancies and value added resellers.

KILOBITS PER SECOND (KBPS). A data transmission rate of 1,000 bits per second.

LEASED LINE. A telecommunications line dedicated to a particular customer along predetermined routers.

LOCAL ACCESS TRANSPORT AREA (LATA). One of approximately 164 geographical areas within which local operating companies connect all local calls and route all long-distance calls to the customer's inter-exchange carrier.

LOCAL EXCHANGE CARRIER (LEC). A telecommunications company that provides telecommunication services in a defined geographic area.

LOCAL LOOP. The wires that connect an individual subscriber's telephone or data connection to the telephone company central office or other local terminating point.

LOCAL/REGIONAL ASP. A company that delivers a range of application services, and often the complete computing needs, of smaller businesses in their local geographic area.

MEGABITS PER SECOND (MBPS). 1,024 kilobits per second.

METAFRAME. The world's first server-based computing software for Microsoft Windows NT 4.0 Server, Terminal Server Edition multi-user software (co-developed by Citrix).

MODEM. A device for converting digital signals to analog and vice versa, for data transmission over an analog telephone line.

MULTIPLEXING. The combining of multiple data channels onto a single transmission medium. Sharing a circuit - normally dedicated to a single user - between multiple users.

MULTI-USER. The ability for multiple concurrent users to log on and run applications on a single server.

NET-BASED ISV. An ISV whose main business is developing software for Internet-based application services. This includes vendors who deliver their own applications online, either directly to users or via other service providers.

NETWORK ACCESS POINT (NAP). A location where ISPs exchange traffic.

NETWORK COMPUTER (NC). A thin-client hardware device that executes applications locally by downloading them from the network. NCs adhere to a specification jointly developed by Sun, IBM, Oracle, Apple and Netscape. They typically run Java applets within a Java browser, or Java applications within the Java Virtual Machine.

NETWORK COMPUTING ARCHITECTURE. A computing architecture in which components are dynamically downloaded from the network onto the client device for execution by the client. The Java programming language is at the core of network computing.

ONLINE ANALYTICAL PROCESSING (OLAP). Software that enables decision support via rapid queries to large databases that store corporate data in multidimensional hierarchies and views.

OPERATIONAL RESOURCE PROVIDER. Operational resources are external business services that an ASP might use as part of its own infrastructure, such as helpdesk, technical support, financing, or billing and payment collection.

OUTSOURCING. The transfer of components or large segments of an organization's internal IT infrastructure, staff, processes or applications to an external resource such as an ASP.

PACKAGED SOFTWARE APPLICATION. A computer program developed for sale to consumers or businesses, generally designed to appeal to more than a single customer. While some tailoring of the program may be possible, it is not intended to be custom-designed for each user or organization.

PACKET. A bundle of data organized for transmission, containing control information (destination, length, origin, etc.), the data itself, and error detection and correction bits.

PACKET SWITCHING. A network in which messages are transmitted as packets over any available route rather than as sequential messages over circuit-switched or dedicated facilities.

PEERING. The commercial practice under which nationwide ISPs exchange traffic without the payment of settlement charges.

PERFORMANCE. A major factor in determining the overall productivity of a system, performance is primarily tied to availability, throughput and response time.

PERMANENT VIRTUAL CIRCUIT (PVC). A PVC connects the customer's port connections, nodes, locations, and branches. All customer ports can be connected, resembling a mesh, but PVCs usually run between the host and branch locations.

POINT OF PRESENCE (POP). A telecommunications facility through which the company provides local connectivity to its customers.

PORTAL. A company whose primary business is operating a Web destination site, hosting content and applications for access via the Web.

REMOTE ACCESS. Connection of a remote computing device via communications lines such as ordinary phone lines or wide area networks to access distant network applications and information.

REMOTE PRESENTATION SERVICES PROTOCOL. A set of rules and procedures for exchanging data between computers on a network, enabling the user interface, keystrokes, and mouse movements to be transferred between a server and client.

RESELLER/VAR. An intermediary between software and hardware producers and end users. Resellers frequently add value (thus Value-Added Reseller) by performing consulting, system integration and product enhancement.

ROUTER. A communications device between networks that determines the best path for optimal performance. Routers are used in complex networks of networks such as enterprise-wide networks and the Internet.

SCALABILITY. The ability to expand the number of users or increase the capabilities of a computing solution without making major changes to the systems or application software.

SERVER. The computer on a local area network that often acts as a data and application repository and that controls an application's access to workstations, printers and other parts of the network.

SERVER-BASED COMPUTING. A server-based approach to delivering business-critical applications to end-user devices, whereby an application's logic executes on the server and only the user interface is transmitted across a network to the client. Benefits include single-point management, universal application access, bandwidth-independent performance, and improved security for business applications.

SINGLE-POINT CONTROL. One of the benefits of the ASP model, single-point control helps reduce the total cost of application ownership by enabling widely used applications and data to be deployed, managed and supported at one location. Single-point control enables application installations, updates and additions to be made once, on the server, which are then instantly available to users anywhere.

SPECIALIST ASP. Provide applications which serve a specific professional or business activity, such as customer relationship management, human resources or Web site services.

SYSTEMS MANUFACTURER. Manufacturer of servers, networking and client devices.

TELECOMS PROVIDER. Traditional and new-age telecommunications network providers (telcos).

THIN CLIENT. A low-cost computing device that accesses applications and and/or data from a central server over a network. Categories of thin clients include Windows-Based Terminals (WBT, which comprise the largest segment), X-Terminals, and Network Computers (NC).

TOTAL COST OF OWNERSHIP (TCO). Model that helps IT professionals understand and manage the budgeted (direct) and unbudgeted (indirect) costs incurred for acquiring, maintaining and using an application or a computing system. TCO normally includes training, upgrades, and administration as well as the purchase price. Lowering TCO through single-point control is a key benefit of server-based computing.

TOTAL SECURITY ARCHITECTURE (TSA). A comprehensive, end-to-end architecture that protects the network.

TRANSMISSION CONTROL PROTOCOL/INTERNET PROTOCOL (TCP/IP). A suite of network protocols that allow computers with different architectures and operating system software to communicate over the Internet.

USER INTERFACE. The part of an application that the end user sees on the screen and works with to operate the application, such as menus, forms and buttons.

VERTICAL MARKET ASP. Provides solutions tailored to the needs of a specific industry, such as the healthcare industry.

VIRTUAL PRIVATE NETWORK (VPN). A secure, encrypted private connection across a cloud network, such as the Internet.

WEB HOSTING. Placing a consumer's or organization's web page or web site on a server that can be accessed via the Internet.

WIDE AREA NETWORK. Local area networks linked together across a large geographic area.

WINDOWS-BASED TERMINAL (WBT). Thin clients with the lowest cost of ownership, as there are no local applications running on the device. Standards are based on Microsoft's WBT specification developed in conjunction with Wyse Technology, NCD, and other thin client companies.