



Spirent TestCenter System and Application Overview

Spirent TestCenter Functions

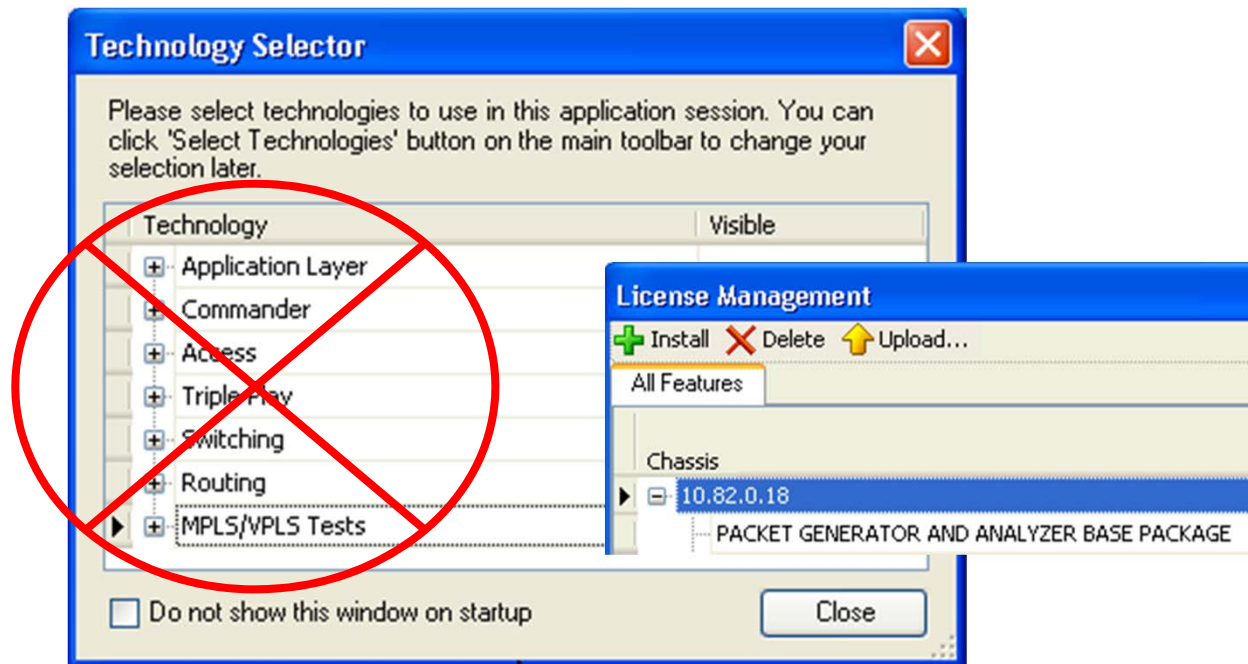
- PGA: Packet Generation/Analysis
- Emulation Protocol Support (e.g., BGP and PPP)
- ALP: Application Layer Protocols (e.g., TCP and HTTP)
- Avalanche: full TCP and application layer support
- All chassis support all functions; some modules are limited



PGA Function

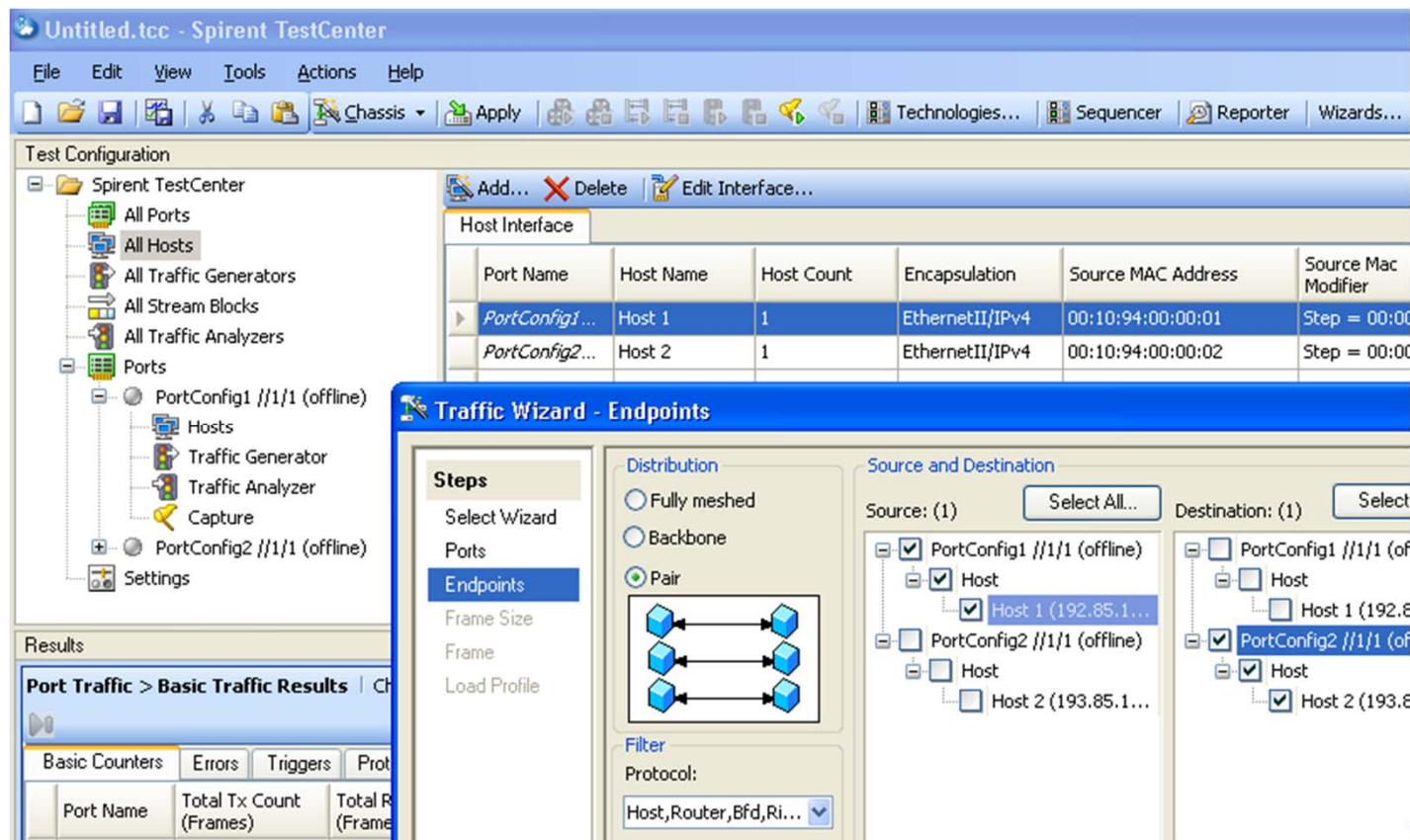
- The Packet Generator/Analyzer “Basic Package” contains all the tools and functionality required to Transmit (Tx), Receive (Rx), and Analyze traffic.
- It does not require any special “Technologies” to be active; and only requires the “PGA Base Package” license.
- The PGA functions can be used with any/all other protocols.

not required
for PGA
function



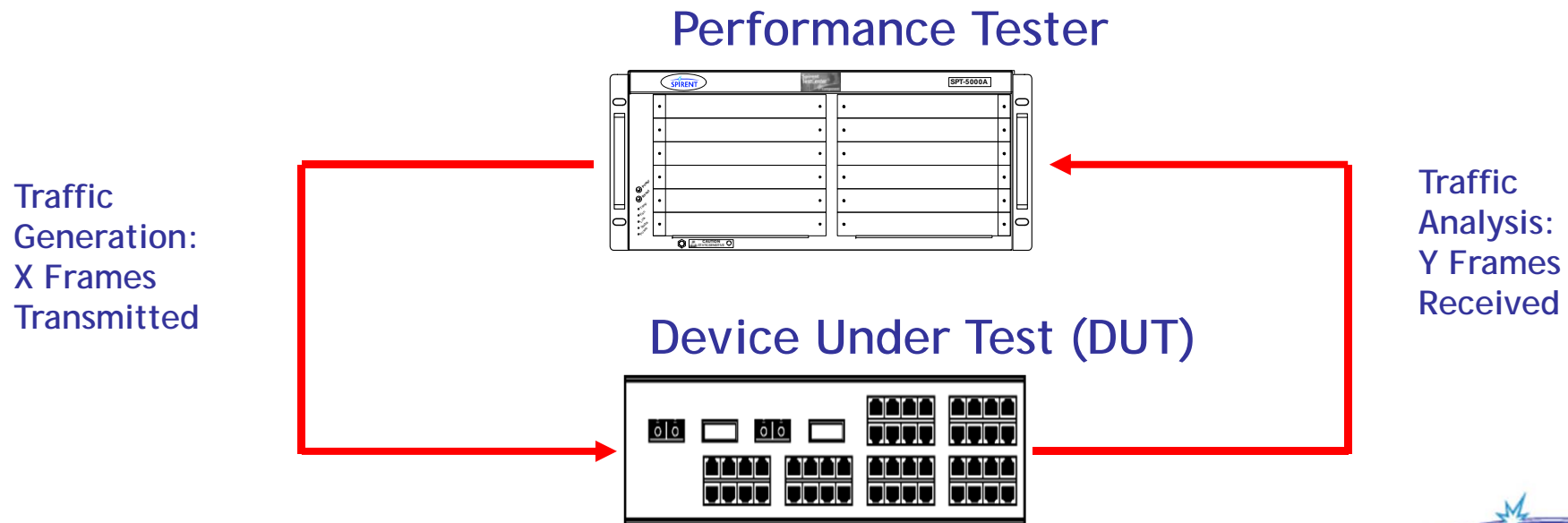
PGA Overview

- The PGA consists of the following “umbrella” tools which are covered in detail here: Traffic Wizard, Generator, Custom Test Wizard, Analyzer, and Results.
- Also incorporated in the PGA, but not covered in detail here, are the Port Settings, Hosts Blocks, Stream Blocks, Capture and their related functionality.



PGA: Packet Generation/Analysis

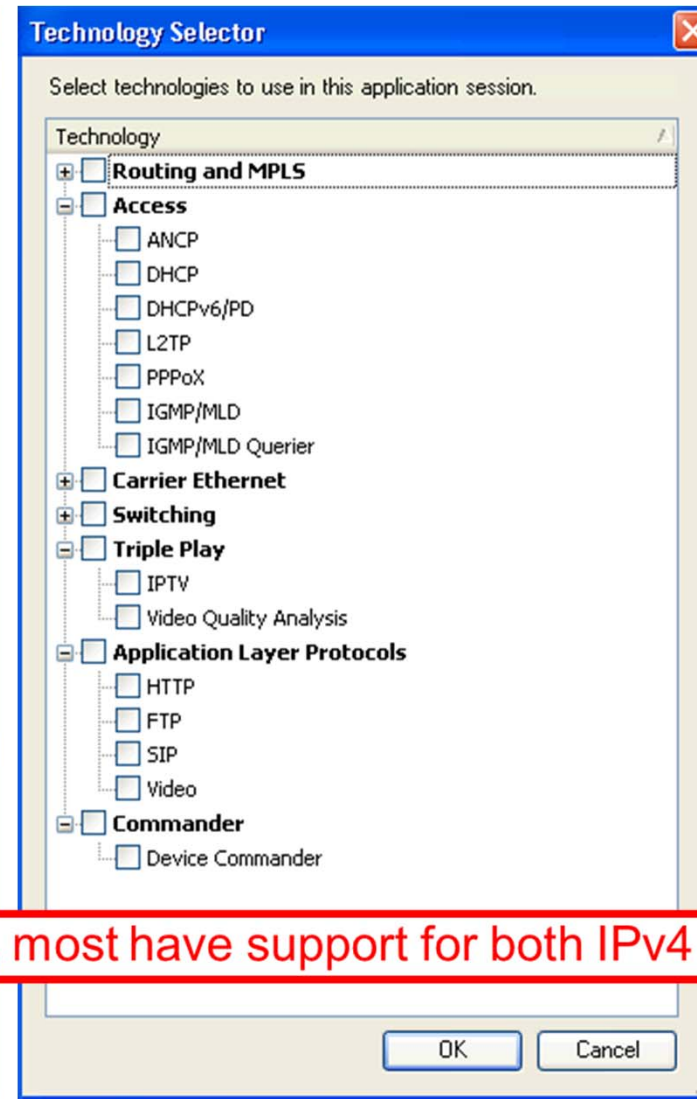
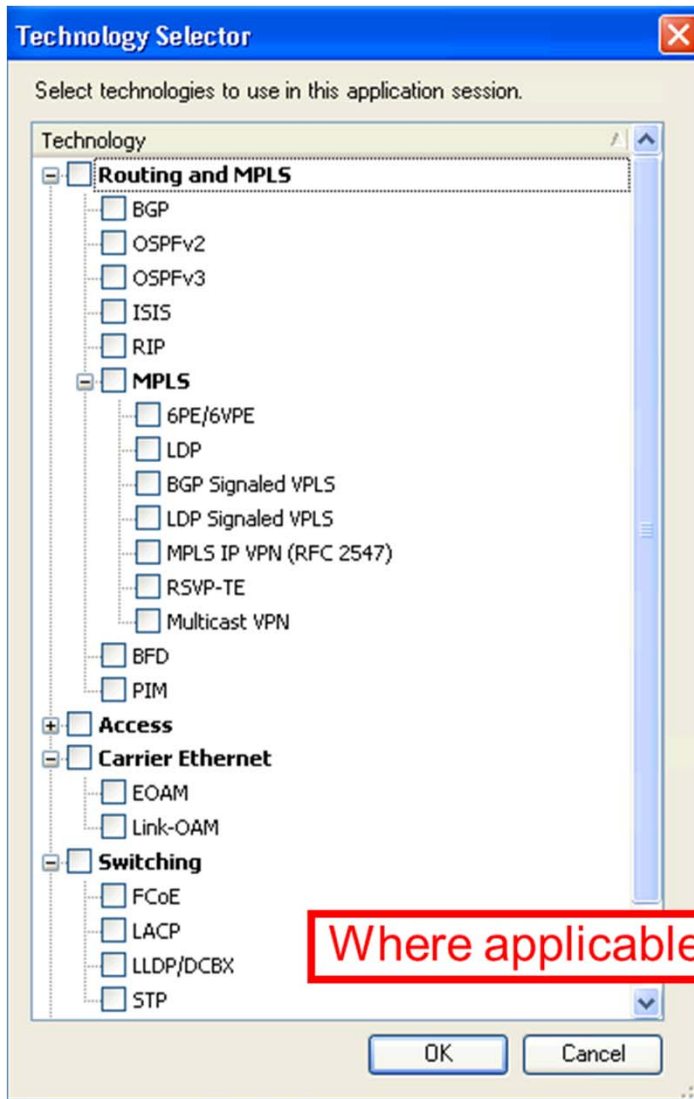
- Layer 2, 3, and Layer 4+ headers
- IP layer emulation: ARP/ND, Ping, IGMP
- Performance, Multicast, and QoS Testing
- Capture and Error Generation



Module's PGA Capabilities

- 1000 Series and HM CV generator
 - 16383 streams; billions of flows
 - 4 variable fields of 4-bytes each (6 of 4-bytes with CV)
- 2000 Series and HM CM generator
 - 32767 streams; billions of flows
 - 6 variable fields of 4 bytes
- All generators
 - transmit at up to 104% of wire rate; down to 8 byte IFG
 - 40 bytes to 16383 bytes frames sizes
 - error Generation: Ethernet FCS, IP/UDP/TCP checksums, IP/UDP total length
- All analyzers
 - 64,000 streams, 40 statistics per stream; stream/port/protocol counts and rates
 - Histograms; 10ns latency resolution
 - four 16 bit and one 32 bit Analyzer Filters
 - error counters: CRC, checksums, length, PRBS, header errors
 - Capture Buffer 16M (8M on 10G); supports real-time capture mode

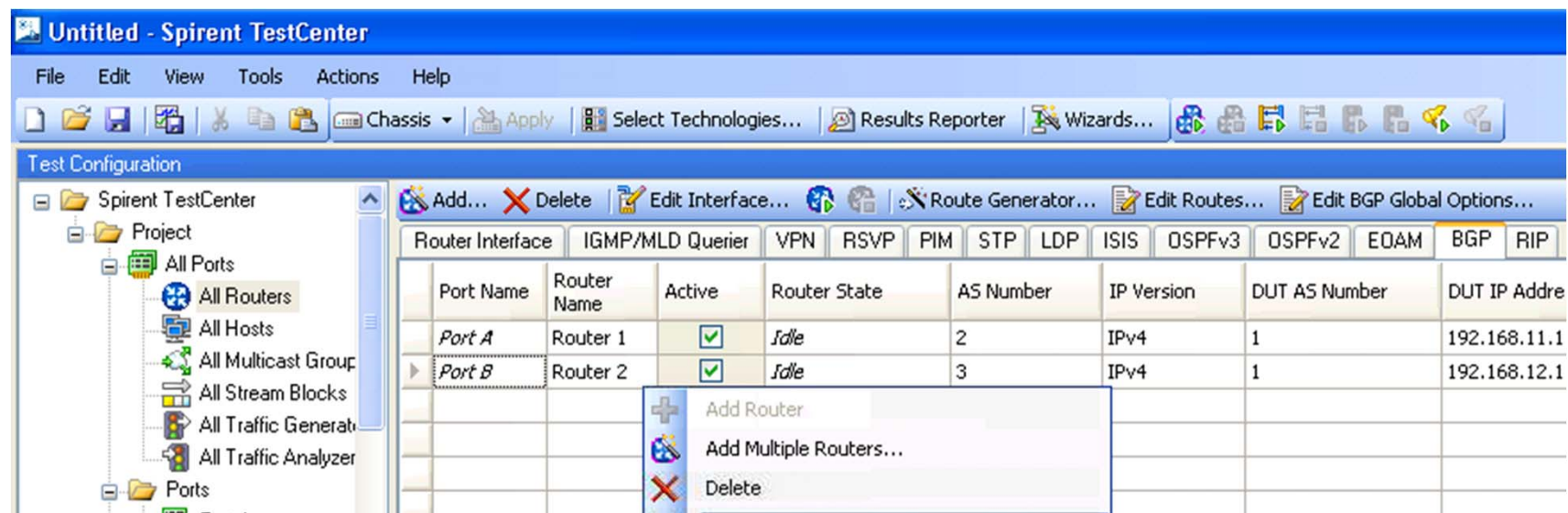
Emulation Protocol Support



Where applicable, most have support for both IPv4 and IPv6!

Spirent TestCenter Router Emulation

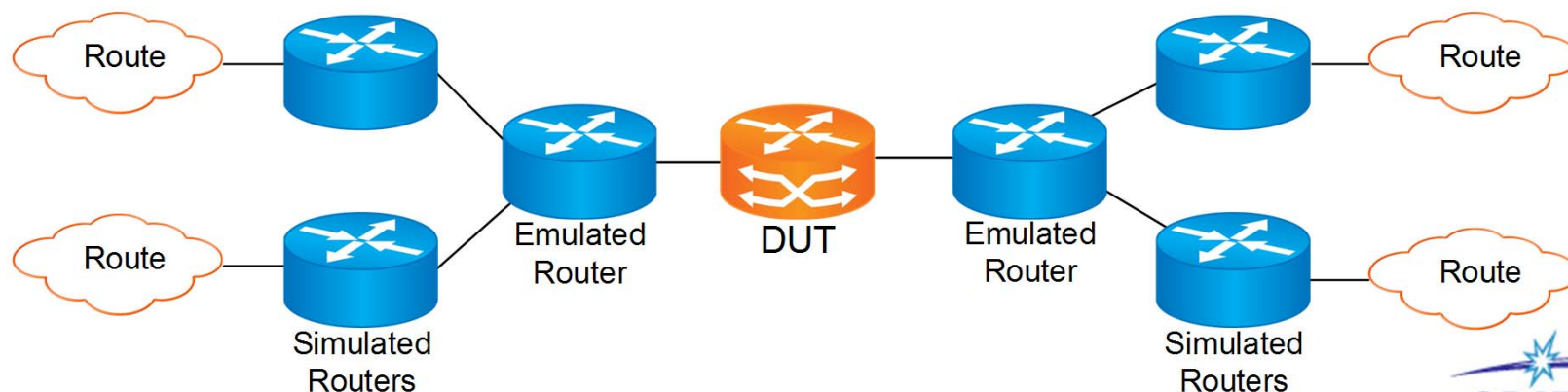
- Routing Emulation with Spirent TestCenter is router centric.
 - This is more like you would set up a real router.
 - You define a router interface(s) and multiple protocols can be bound to it/them.
- An **Emulated** Router is a “real” router in that it will form an actual session and participate in all protocol events with the DUT.
 - It can also represent a network, internet, or topology of 100s/1000s of **Simulated** routers.
 - You have direct control over all the route/router parameters (even negatively).



Simple Routing Topology Example

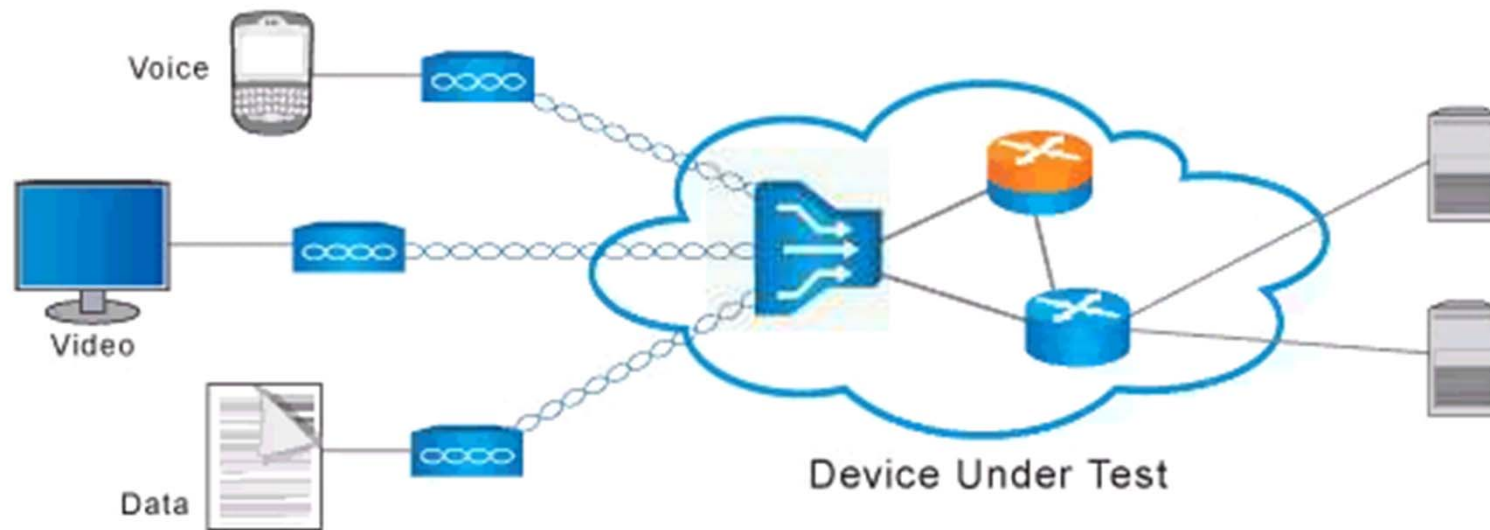
Spirent uses two terms to describe router emulation:

- **Emulated Routers** - run a routing protocol with the DUT, maintain protocol state, send routes, etc.
 - **Simulated Routers** - exist as link-state routing advertisements from OSPF or IS-IS, or additional AS Paths with BGP
- Use emulated routers to exchange routes or perform interactive testing
 - Create simulated routers to build topologies to represent an environment
 - Simulated routers are created via Route Generators, configuration grids, and test wizards
 - Create topologies that extended tens of routers deep, then simulate traffic from remote access networks across core/provider topologies

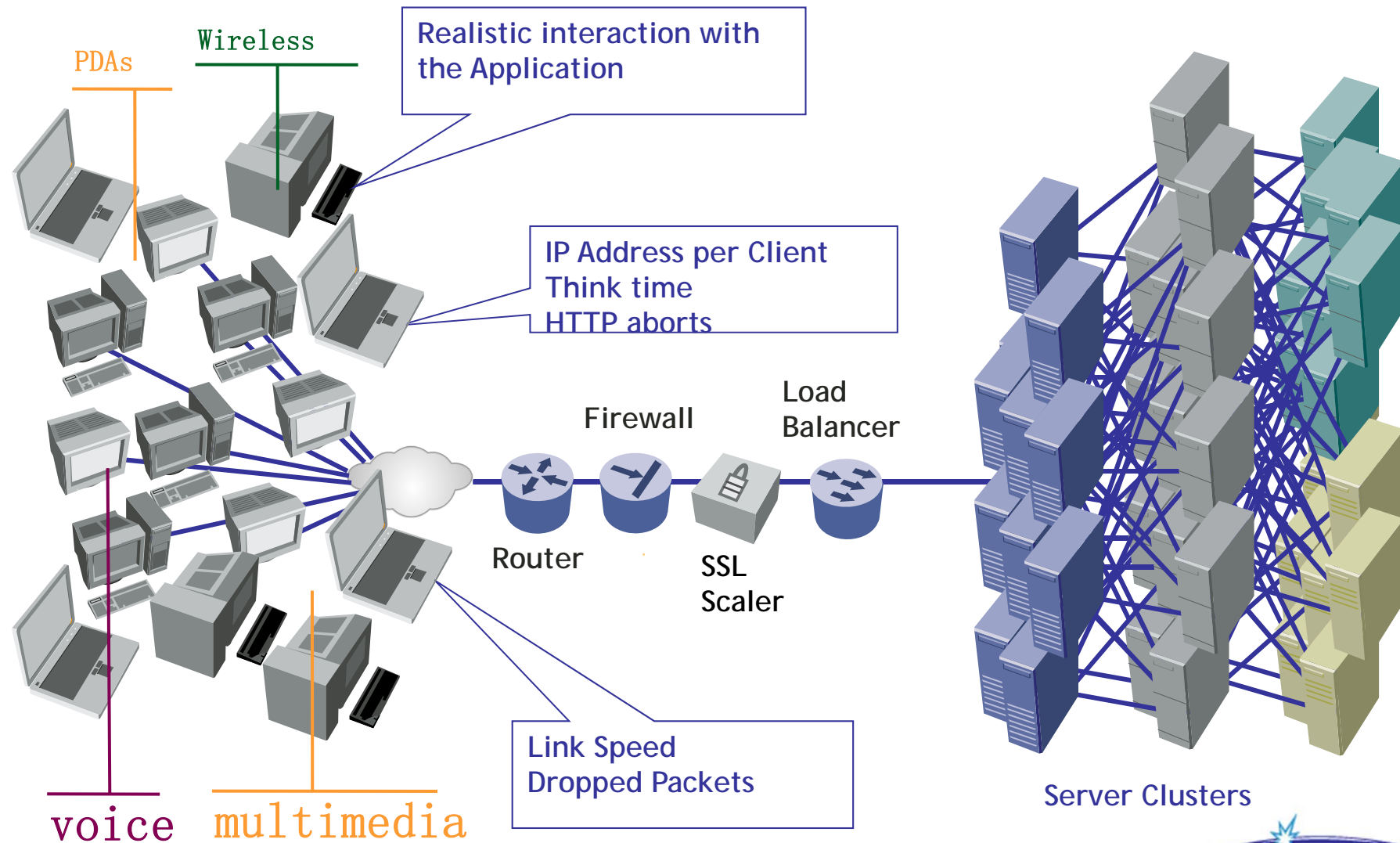


ALP: Application Layer Protocols

- Enables integrated Layer 2-7 Testing
- Supports Stateful TCP
- Limited HTTP, FTP, and SIP
- Video Quality Analysis (VQA)



Avalanche: Emulated Clients and Servers



Layer 2/3 Test Solutions Example

This is not a complete list!

Test Solutions

Software Packages

Each solution/package works with any module with the performance specified in the Package Scalability table.

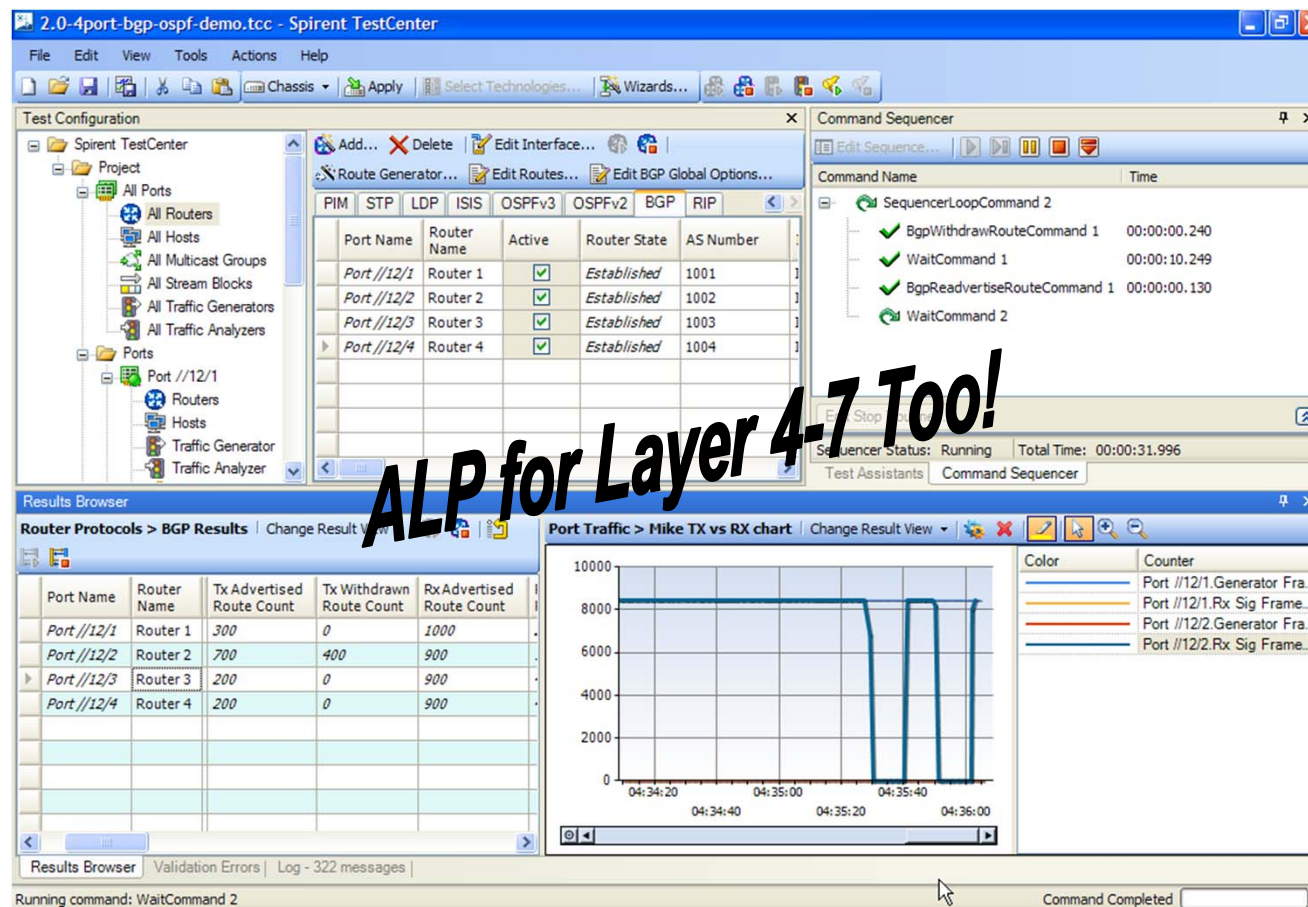
P/N	Description	SPK-0001 Ent/Metro Router TSA	SPK-0001-2U Enterprise/Metro Router Test Solution A - 2U*	SPK-0002 Ethernet Switch TSA	SPK-0003 Ethernet Access Concentrator Test Solution B	SPK-0005 Ent/Metro Router TS A	SPK-0006 IPTV Test Solution A	SPK-0007 IPTV Test Solution B		
BPK-1001A	Packet Generator and Analyzer Base Package A	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1002A	STP / RSTP Base Package A	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1003A	IGMP / MLD Host IP Multicast Base Package A	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1003B	IGMP / MLD Host IP Multicast Base Package B	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1004A	Unicast Routing Base Package A	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1004B	Unicast Routing Base Package B	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1005A	Multicast Routing Base Package A	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1005B	Multicast Routing Base Package B	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1006A	MPLS / LDP / RSVP-TE Base Package A	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1006B	MPLS / LDP / RSVP-TE Base Package B	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1007A	PPPoX Base Package A	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1007B	PPPoX Base Package B	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1008A	DHCP Base Package A	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1008B	DHCP Base Package B	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1011A	DHCP-PD Base Package A	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1014A	MSTP Base Package A	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1015A	IEEE 802.3AD Link Aggregation Base Package A	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1024A	Conformance Application Base Package A	✓	✓	✓	✓	✓	✓	✓	✓	✓
BPK-1029A	Enhanced Capture and Decode Base Package A	✓	✓	✓	✓	✓	✓	✓	✓	✓
TPK-1000	RFC-2544 w/VLAN Network Device Benchmark Test Pkg	✓	✓	✓	✓	✓	✓	✓	✓	✓
TPK-1001	RFC-2889 with VLAN Test Package	✓	✓	✓	✓	✓	✓	✓	✓	✓
TPK-1002A	IPTV Test Package A	✓	✓	✓	✓	✓	✓	✓	✓	✓
TPK-1002B	IPTV Test Package B	✓	✓	✓	✓	✓	✓	✓	✓	✓
TPK-0030	CTS IGMPv2 Test Package	✓	✓	✓	✓	✓	✓	✓	✓	✓
TPK-0031	CTS IGMPv2 Snooping Test Package	✓	✓	✓	✓	✓	✓	✓	✓	✓
TPK-0034	CTS Ethernet Link OAM (802.3ah) Test Package	✓	✓	✓	✓	✓	✓	✓	✓	✓
TPK-1006	CTS MEF 9 Test Package	✓	✓	✓	✓	✓	✓	✓	✓	✓
TPK-1007	CTS MSTP Test Package	✓	✓	✓	✓	✓	✓	✓	✓	✓
TPK-1008	CTS VLAN Test Package	✓	✓	✓	✓	✓	✓	✓	✓	✓
TPK-1009	CTS LACP/802.3AD Test Package	✓	✓	✓	✓	✓	✓	✓	✓	✓
TPK-1010	CTS STP Test Package	✓	✓	✓	✓	✓	✓	✓	✓	✓
TPK-1011	CTS RSTP Test Package	✓	✓	✓	✓	✓	✓	✓	✓	✓
TPK-1013	CTS IPV6 Test Package	✓	✓	✓	✓	✓	✓	✓	✓	✓
VPK-0001	IPTV Video Quality Module (VQM) — per Blade	✓	✓	✓	✓	✓	✓	✓	✓	✓
VPK-0002	IPTV Video Quality Module (VQM) — per Chassis	✓	✓	✓	✓	✓	✓	✓	✓	✓

*For use ONLY on a 2U chassis

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Graphical User Interface for Layer 2/3

- The Spirent TestCenter “Application”
- Common GUI Framework for all Layer 2/3 Test Solutions



The Spirent TestCenter Application

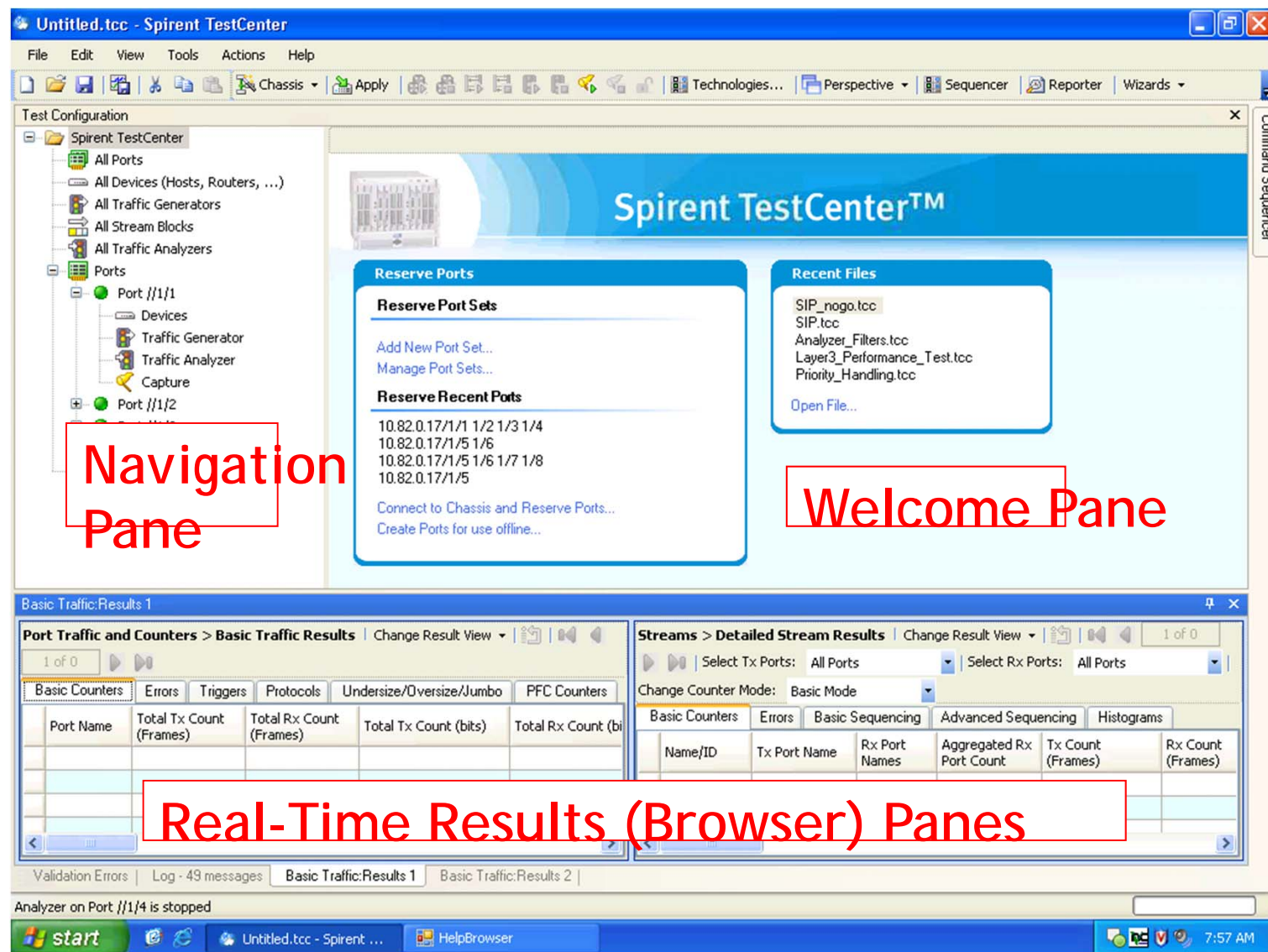
- Supports Performance and Functional Testing for Layers 2-7
 - Layers 4-7 supported with ALP
- Integrated control and data plane testing
 - For example, sending traffic to BGP advertised routes
- Provides deterministic and repeatable test environment
- Test results are available in real-time and at the end of a test
- The setup and results can be saved in different formats
- Includes many easy-to-use wizards:
 - Simplifies test set up and execution
 - Used for Device and Traffic creation
 - Used for Large Scale testing
 - For creating Access and Routing Topologies
 - For creating MPLS Layer 2/3 VPNs
 - Plus RFC 2544/2889 Test Packages



Basic GUI Features

- Multi-pane window to see and compare everything at a single glance
- Includes equipment, firmware, and license management features
- Spreadsheet configuration windows with copy down and fill functions
- Multiple Wizards for setting up and running tests
- Allows you save the setup and results in standard formats: XML&SQL
- Unique analysis capabilities aid in the interpretation of test results
- Troubleshooting tools reduce time to identify and correct problems
- GUI-to-script improves the time and effort required to automate tests
- Allows you to simultaneously view both Setup and Results
- Customizable setup and results windows
- Reporting tools quickly produce summarized and detailed test reports

Main Window



Main Window - Cont.

The screenshot displays the Spirent TestCenter Main Window, which is divided into several panes. The **Test Configuration** pane on the left shows a tree view of the test setup, including **Project**, **All Ports**, **All Routers**, **All Hosts**, **All Multicast Groups**, **All Stream Blocks**, **All Traffic Generators**, **All Traffic Analyzers**, **Ports**, **Port //2/1**, **Port //2/2**, **Port //2/3**, **Port //2/4**, and **Settings**. The **Dynamic Setup Pane** in the center shows a table of traffic generators and analyzers. The **Command Sequencer** pane on the right shows a table of commands and their status. The **Log Messages Pane** at the bottom shows a list of messages with timestamps and descriptions.

Dynamic Setup Pane

Name	Scheduling Mode	Duration Mode	Duration	Burst Size	Inter frame gap	Load
Port //2/1	Port Based	Continuous		1		Fixed
Port //2/2	Port Based	Continuous		1		Fixed
Port //2/3	Port Based	Continuous		1		Fixed
Port //2/4	Port Based	Continuous		1		Fixed

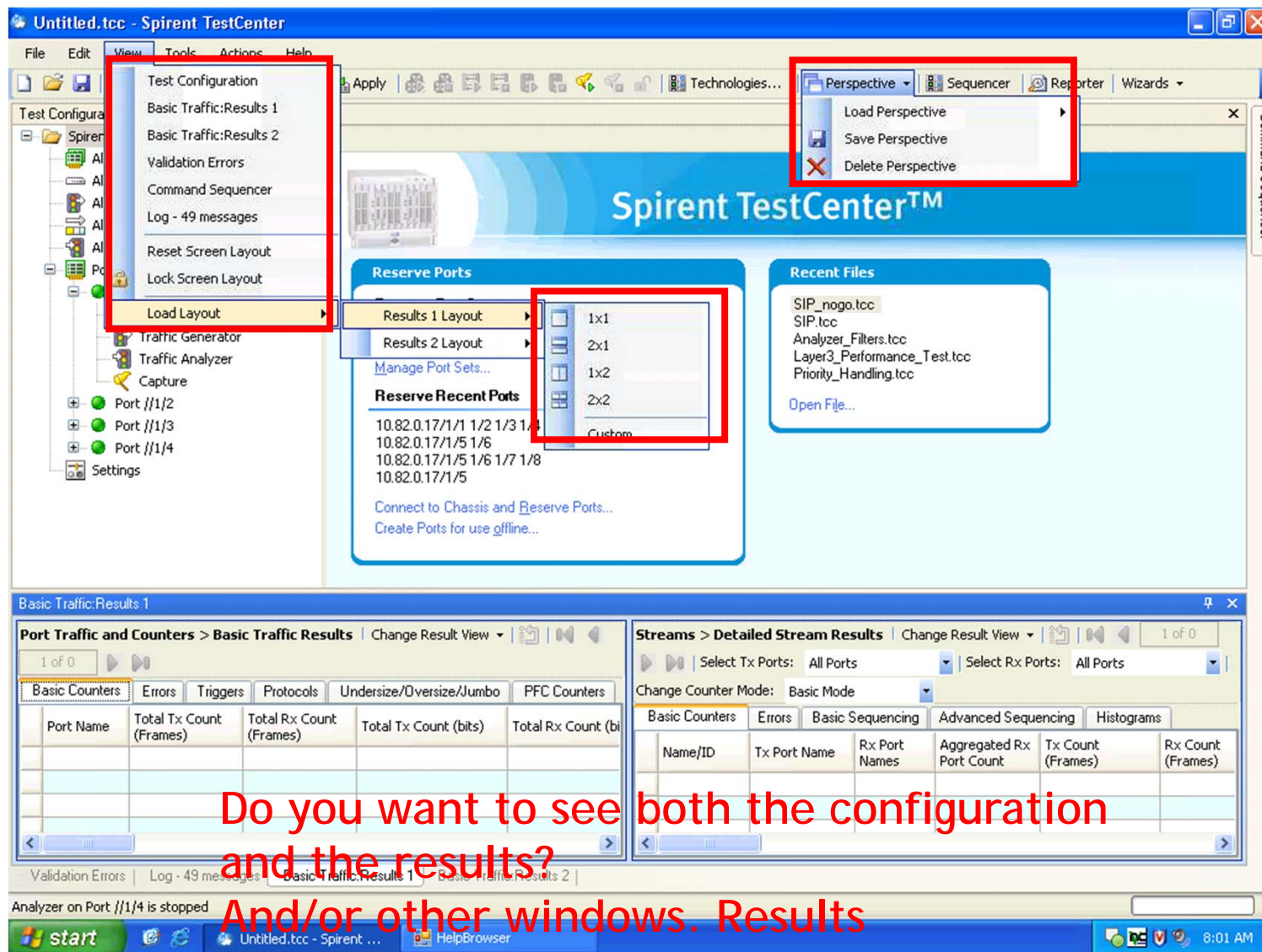
Command Sequencer

Command Name	Time
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Log Messages Pane

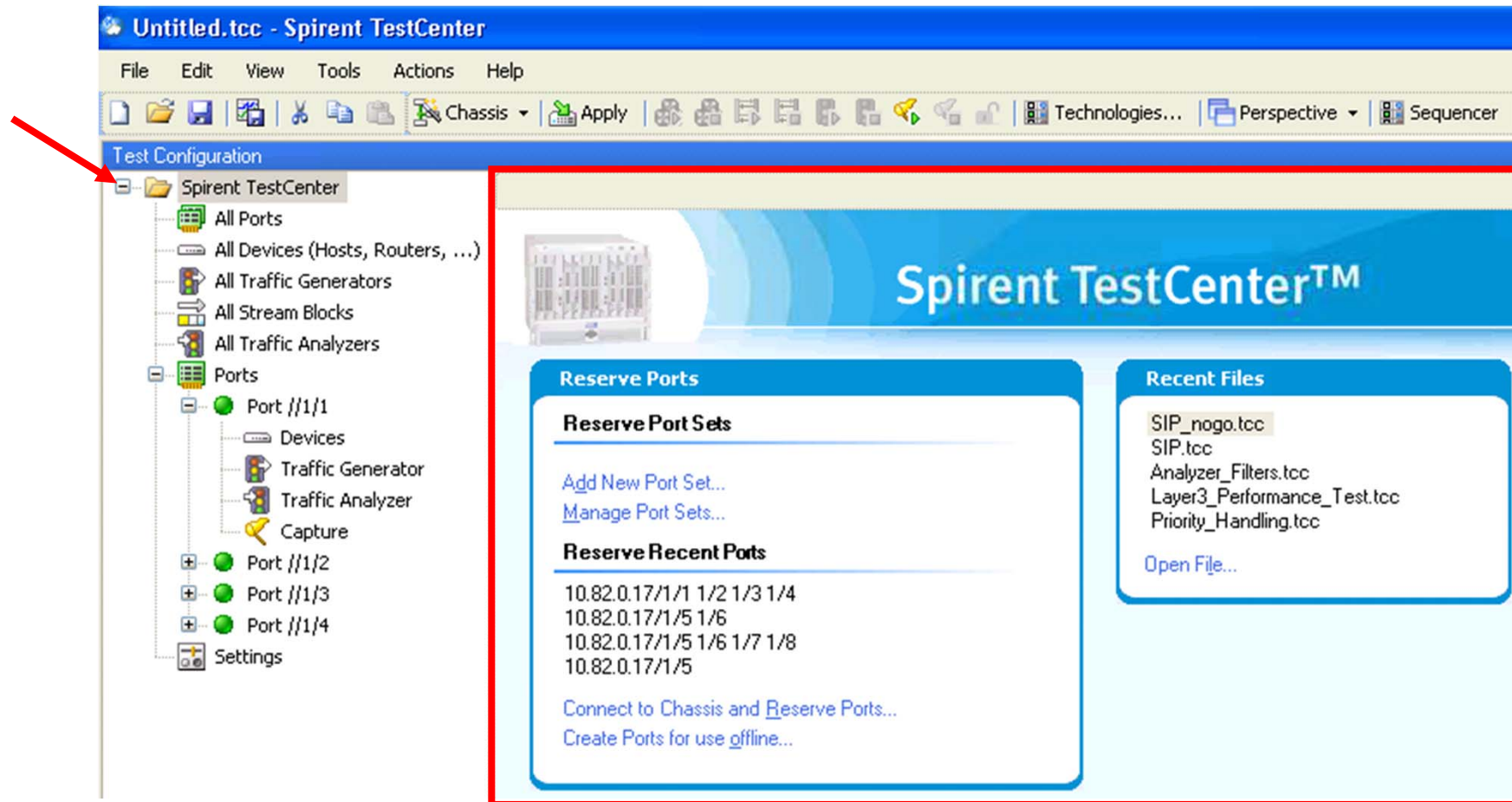
Time	Description	Category
5/16/2007 11:30:50.6	Generator on Port //2/2 (offline) is stopped	Other
5/16/2007 11:30:50.6	Analyzer on Port //2/2 (offline) is stopped	Other
5/16/2007 11:30:55.0	Successfully reserved port //63.171.237.132/2/4	Port
5/16/2007 11:30:55.0	Analyzer on Port //2/3 (offline) is stopped	Other

Change Window View by Menu



Welcome Pane

- Port Reservation, add Offline Ports, Load Files



Test Configuration Pane - Navigation Tree

- The navigation test configuration pane is always displayed on the left side of the Test Setup pane.
- When you open the application, the navigation tree is collapsed with only the top-level icons displayed.

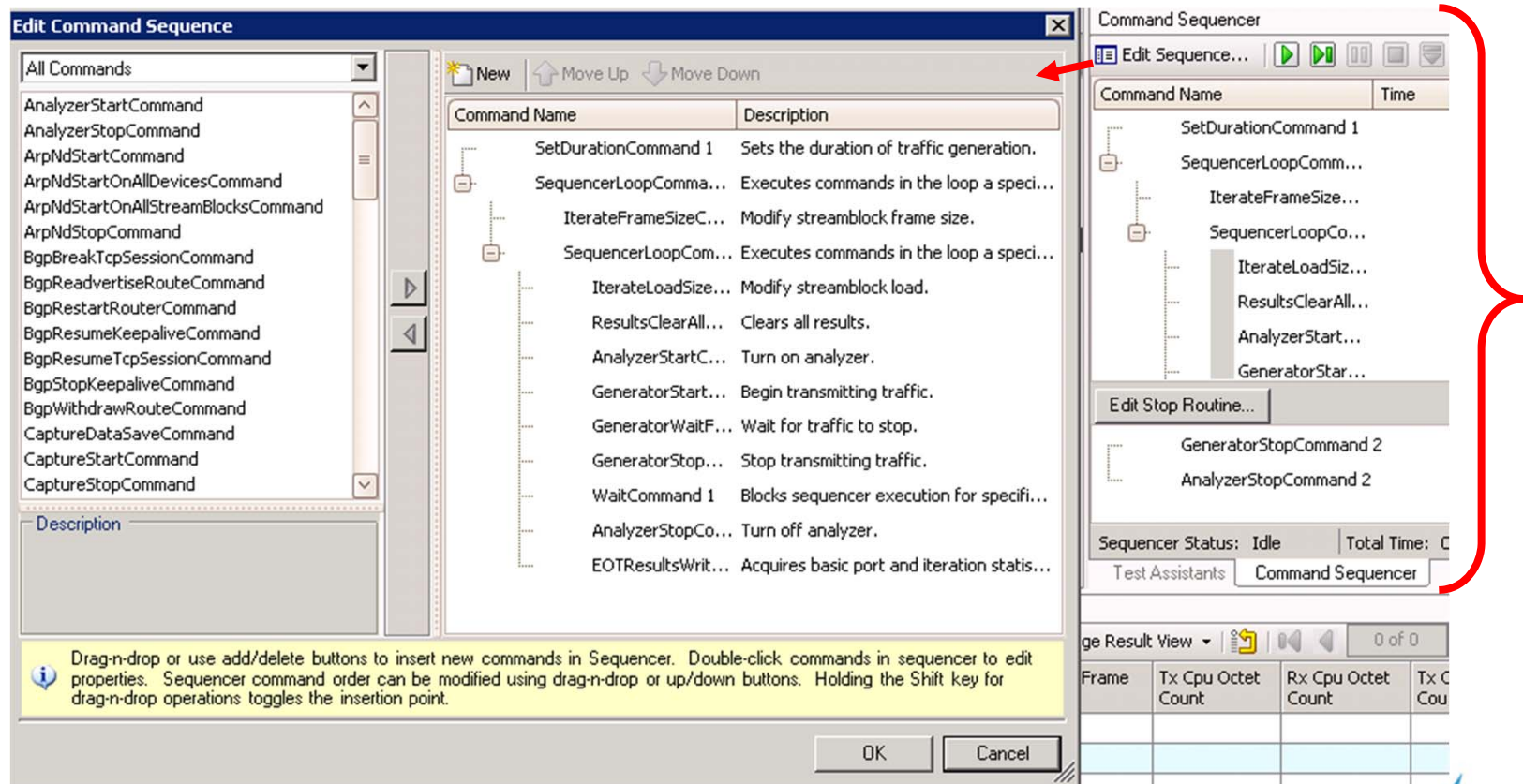
[illegible]

- Allows user to configure detail testing parameters.
- The Setup pane, located on the right side of the Navigation pane, displays the active test setup grid (spreadsheet) or form.
- Change the grid or form displayed in the Setup pane by clicking another icon in the Navigation pane.



Command Sequencer

- User customizable; used to run batch mode tests
- Sequence steps can also be created using the Wizards



Results Browser Pane

- All real-time results data is displayed in the Results Browser
- There are two Results Browser windows by default
- There are ports-based and stream-based counters
- There are events and rates
- There are dataplane and control plane (CPU) counters
- There are many, many more!

The screenshot displays the Results Browser interface with two main sections: Port Traffic and Stream Results.

Port Traffic > Basic Traffic Results

Port Name	Total Tx Frame Count	Total Rx Frame Count	Total Tx Octet Count	Total Rx Octet Count
Port //1/1	530,239	53,104	67,870,272	6,796,928
Port //1/2	52,685	531,667	6,743,360	68,052,992

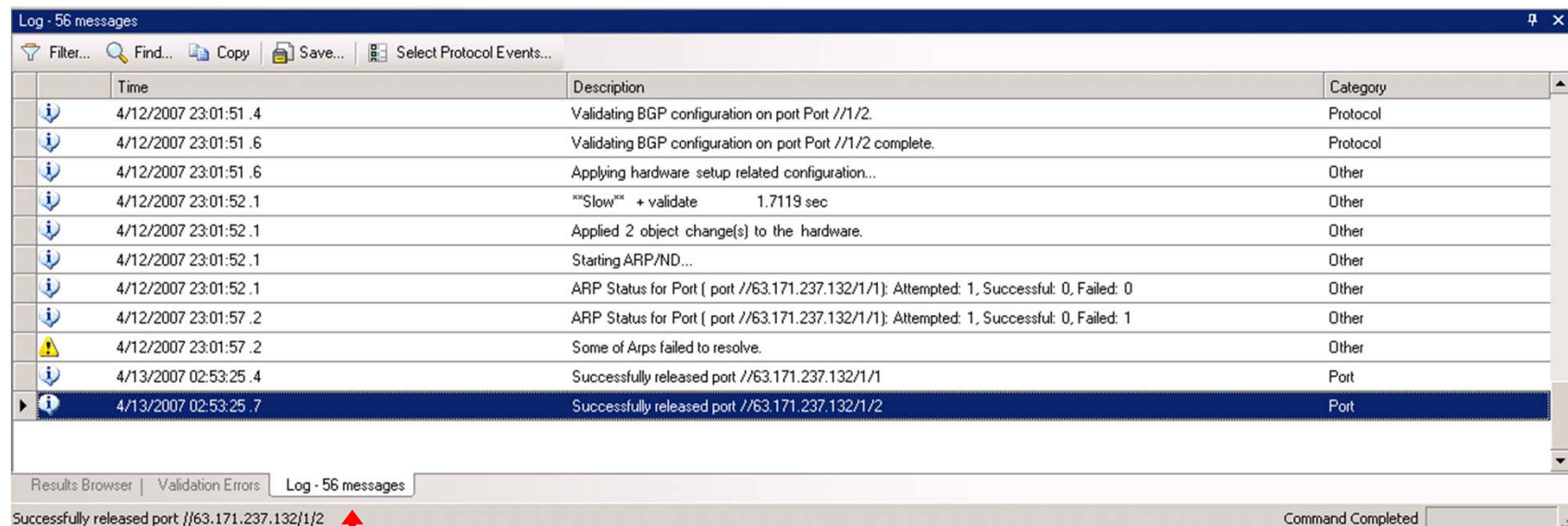
Stream Results > Filtered Stream Results

Show: Port //1/1 | Change Counter Mode: Histogram Mode

Rx Port Name	Rx Stream Id	Stream Index	Rx Frame Count	Rx Octet Count	Rx Sig Frame Count
Port //1/1	131072	0	10,554	1,350,912	10,554
Port //1/1	131073	1	10,554	1,350,912	10,554
Port //1/1	131074	2	10,554	1,350,912	10,554
Port //1/1	131075	3	10,553	1,350,784	10,553
Port //1/1	131076	4	10,553	1,350,784	10,553

Test Log Pane

- The Event Log is displayed on demand.
- It records both informational and warning messages.
- A row is appended to the Event Log each time it receives a new event.



Log - 56 messages

Time	Description	Category
4/12/2007 23:01:51 .4	Validating BGP configuration on port Port //1/2.	Protocol
4/12/2007 23:01:51 .6	Validating BGP configuration on port Port //1/2 complete.	Protocol
4/12/2007 23:01:51 .6	Applying hardware setup related configuration...	Other
4/12/2007 23:01:52 .1	""Slow"" + validate 1.7119 sec	Other
4/12/2007 23:01:52 .1	Applied 2 object change(s) to the hardware.	Other
4/12/2007 23:01:52 .1	Starting ARP/ND...	Other
4/12/2007 23:01:52 .1	ARP Status for Port { port //63.171.237.132/1/1}: Attempted: 1, Successful: 0, Failed: 0	Other
4/12/2007 23:01:57 .2	ARP Status for Port { port //63.171.237.132/1/1}: Attempted: 1, Successful: 0, Failed: 1	Other
4/12/2007 23:01:57 .2	Some of Arps failed to resolve.	Other
4/13/2007 02:53:25 .4	Successfully released port //63.171.237.132/1/1	Port
4/13/2007 02:53:25 .7	Successfully released port //63.171.237.132/1/2	Port

Results Browser | Validation Errors | Log - 56 messages

Successfully released port //63.171.237.132/1/2

Command Completed

Results Reporter Application

Spirent TestCenter Results Reporter

File Report Help

Open Result Database... Ctrl+O

Close Ctrl+W Folder of Databases...

Choose Result Database

Look in: RFC2889-Forwarding-2007-05-11_08-16-09

- RFC2889-Forwarding-Summary-2007-05-11_08-16-09.db
- RFC2889-Forwarding-Trial-1-FrameSize-64-Burst-1-Load-90.db
- RFC2889-Forwarding-Trial-1-FrameSize-64-Burst-1-Load-95.db
- RFC2889-Forwarding-Trial-1-FrameSize-64-Burst-1-Load-97.5.db
- RFC2889-Forwarding-Trial-1-FrameSize-64-Burst-1-Load-98.75.db
- RFC2889-Forwarding-Trial-1-FrameSize-64-Burst-1-Load-100.db

Spirent TestCenter Results Reporter

File Report Help

Rows: 1 to 100

Template: Title Test Summary Trial Summary FRMOL/MFR Theoretical Max

Results

- RFC2889-Forwarding-Summary-2007-05-11_08-16-09.db
- Rfc2889 Forwarding Test Result Summary
 - Trial: 1
 - Frame Size: 64
 - Burst Size: 1.000
 - Load: 90.000
 - Load: 95.000
 - Load: 97.500
 - Load: 98.750
 - Load: 99.375
 - Load: 100.000
 - Frame Size: 128
 - Burst Size: 1.000
 - Load: 90.000
 - Load: 95.000
 - Load: 97.500
 - Load: 98.750
 - Load: 99.375
 - Load: 100.000
 - Trial: 2
 - Frame Size: 64
 - Burst Size: 1.000
 - Load: 90.000
 - Load: 95.000
 - Load: 97.500
 - Load: 98.750
 - Load: 99.375
 - Load: 100.000
 - Frame Size: 128
 - Burst Size: 1.000
 - Load: 90.000
 - Load: 95.000
 - Load: 97.500
 - Load: 98.750
 - Load: 99.375
 - Load: 100.000

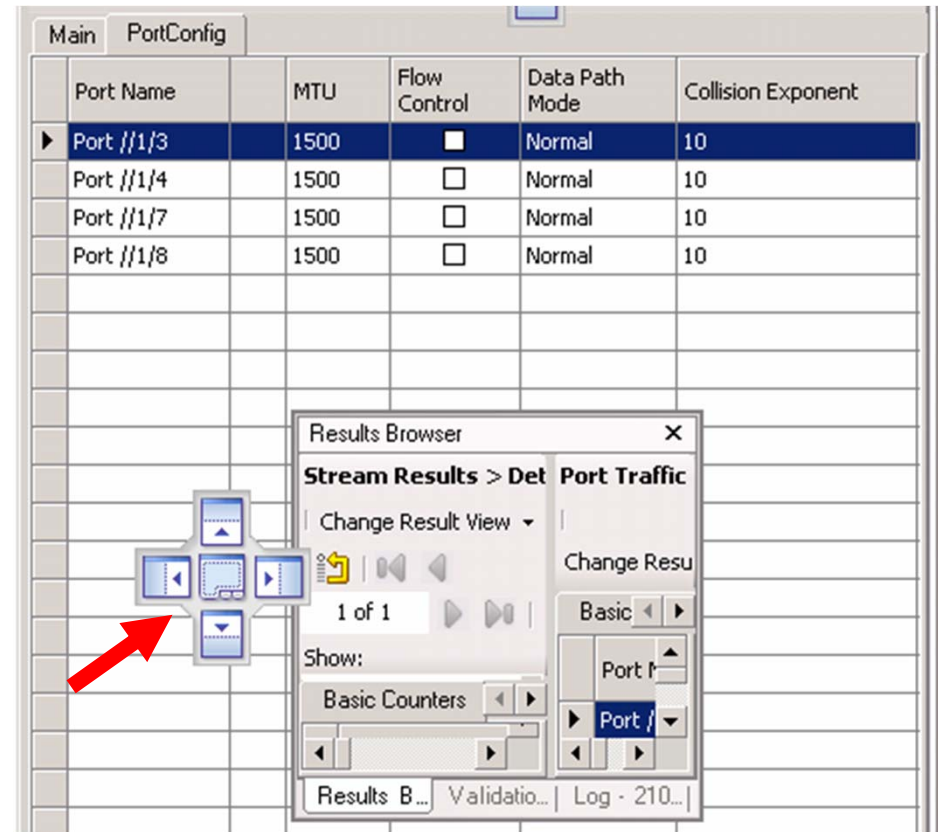
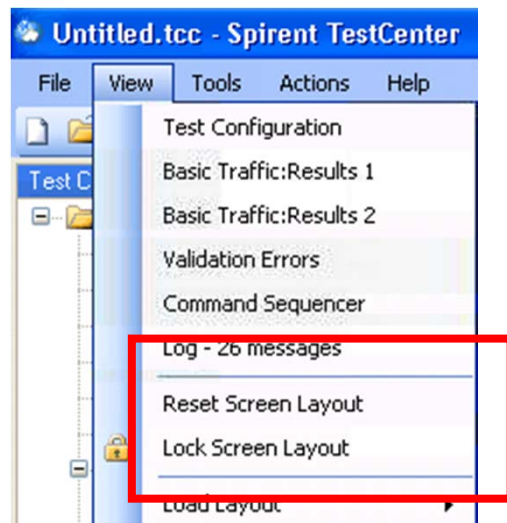
Rfc2889 Forwarding Test Result Details

Test Summary

Frame Size Bytes	Intended Load %	Offered Load (bps)	Throughput %	Forwarding Rate (fps)	Frame Loss %	Tx Frame Count	Rx Frame Count	Other Rx Frames	Flood Count
0	0	0	0	0	0	0	0	0	0
64	90	274,285,568	90	535,714	0	5,357,144	5,357,144	0	0
64	95	289,523,712	95	565,476	0	5,654,764	5,654,764	0	0
64	97.5	297,142,784	97.5	580,357	0	5,803,572	5,803,572	0	0
64	98.75	300,952,576	98.75	587,798	0	5,877,980	5,877,980	2	0
64	99.375	302,857,216	99.375	591,518	0	5,915,180	5,915,180	0	0
64	100	304,761,856	100	595,238	0	5,952,384	5,952,384	0	0
128	90	311,351,296	90	304,054	0	3,040,544	3,040,544	0	0
128	95	328,648,704	95	320,946	0	3,209,460	3,209,460	2	0
128	97.5	337,297,408	97.5	329,392	0	3,293,920	3,293,920	2	0
128	98.75	341,621,760	98.75	333,615	0	3,336,152	3,336,152	0	0
128	99.375	343,783,424	99.375	335,726	0	3,357,264	3,357,264	0	0
128	100	345,946,112	100	337,838	0	3,378,380	3,378,380	2	0

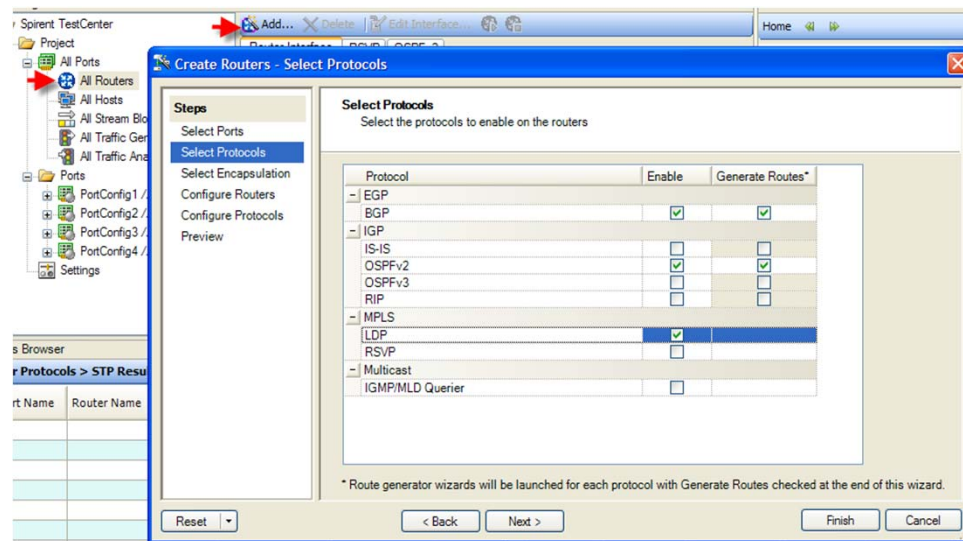
Docking Framework

- Flexible layout
 - Window panes or tabs
- Allows docked or floating views
 - Example: you can have a floating results window on a 2nd monitor
- Auto-hide pin
- Can bring back the windows using the View menu

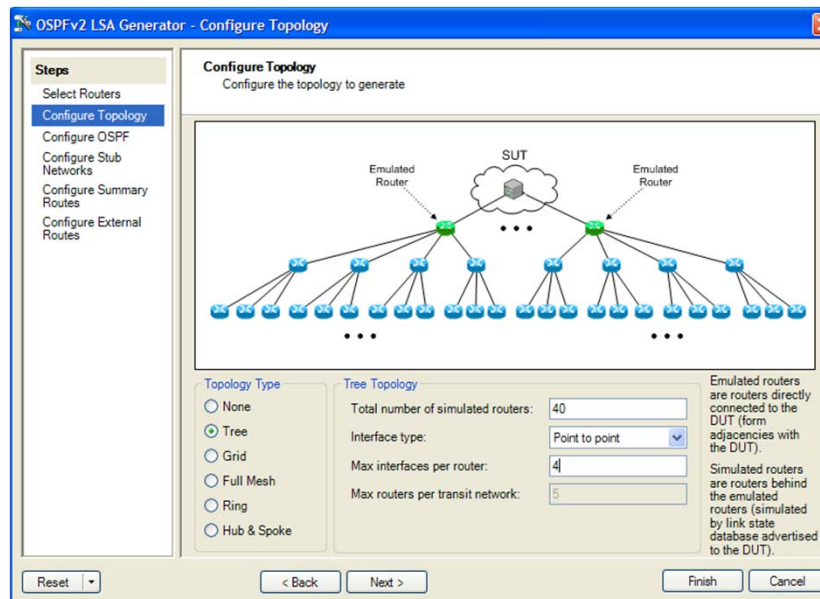


GUI Configuration Tools

Quickly build tens, hundreds or thousands of emulated routers and enable multiple protocols as well as routes to advertise:



The Route/LSA generators provide ease creation of large, realistic network topologies:



Traffic Wizard

Quickly and easily build traffic to and from routes.

Use the Select All tool to select specific protocols.

Right-click on the stream blocks created and select Preview to see all streams/flows created:

The screenshot displays the Spirent TestCenter Traffic Wizard interface. The main window is titled "Traffic Wizard" and shows the "Select source network and destination network" step. The "Distribution" section is set to "Pair". The "Filter" section shows "Protocol: Host,Router,Rip,B..." and "Encapsulation: IPv4". The "Orientation" section is set to "Unidirectional". The "Source and Destination" section shows a list of selected items: "Port //1/1", "Host 7 (10.1.1.2)", "Router 2 (10.1.1.2)", "Router 2", "Route 100.0.0.0-100.0.9...", "Ospf2", "Router 2", "External LSA 1.0.0.0/24", "External LSA 1.0.1.0/24", "External LSA 1.0.2.0/24", "External LSA 1.0.3.0/24", and "External LSA 1.0.4.0/24". The "Destination" section shows a list of selected items: "Router 3", "Route 100.0.10.0-100.0.1...", "Ospf2", "Router 3", "External LSA 1.0.10.0/24", "External LSA 1.0.11.0/24", "External LSA 1.0.12.0/24", "External LSA 1.0.13.0/24", "External LSA 1.0.14.0/24", "External LSA 1.0.15.0/24", "External LSA 1.0.16.0/24", "External LSA 1.0.17.0/24", "External LSA 1.0.18.0/24", and "External LSA 1.0.19.0/24".

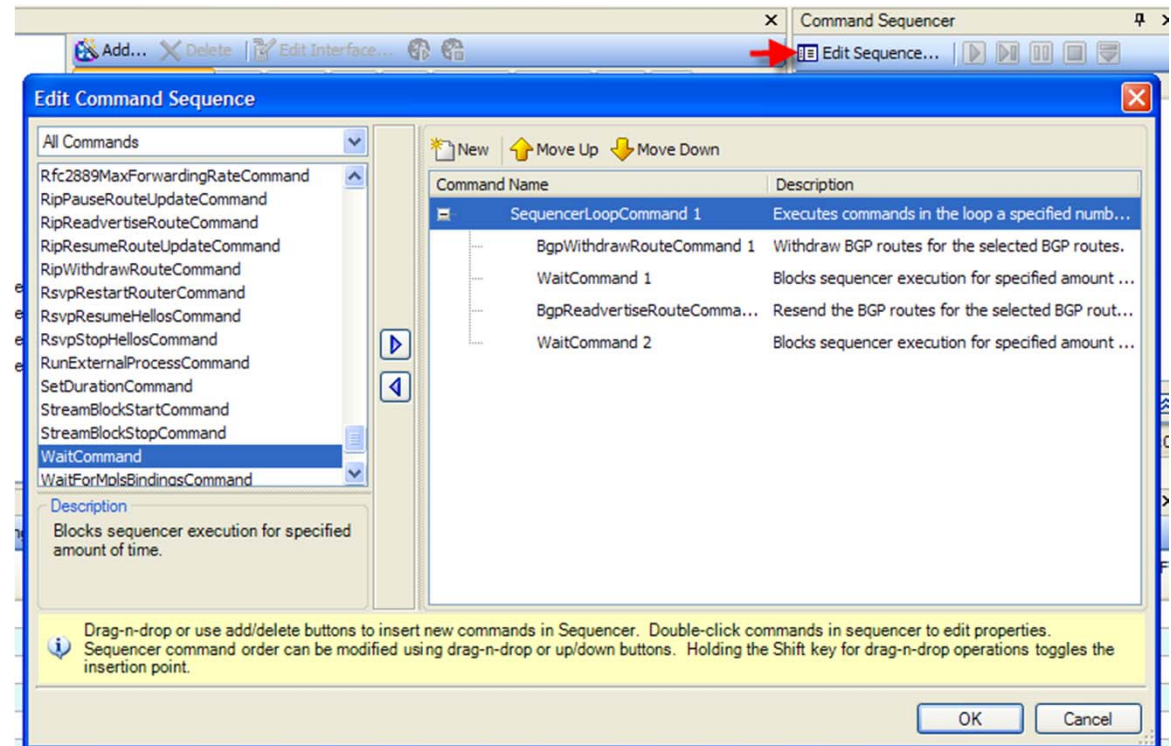
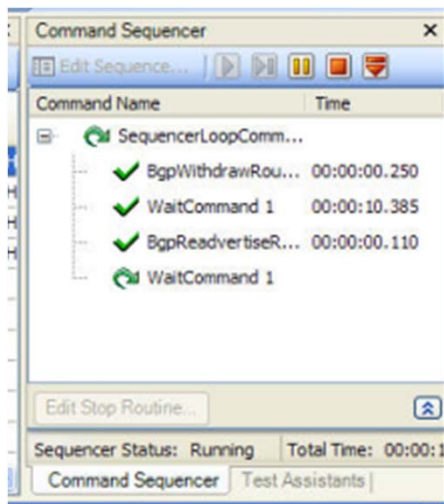
Below the main window, a "Preview" window is open, showing a table of created streams/flows. The table has columns: No., Source, Destination, Stream Count, and Flow Count. The table contains 10 rows of data, each representing a stream from an External LSA to another External LSA.

No.	Source	Destination	Stream Count	Flow Count
1	External LSA 1.0.0.0/24	External LSA 1.0.10.0/24	1	1
2	External LSA 1.0.1.0/24	External LSA 1.0.11.0/24	1	1
3	External LSA 1.0.2.0/24	External LSA 1.0.12.0/24	1	1
4	External LSA 1.0.3.0/24	External LSA 1.0.13.0/24	1	1
5	External LSA 1.0.4.0/24	External LSA 1.0.14.0/24	1	1
6	External LSA 1.0.5.0/24	External LSA 1.0.15.0/24	1	1
7	External LSA 1.0.6.0/24	External LSA 1.0.16.0/24	1	1
8	External LSA 1.0.7.0/24	External LSA 1.0.17.0/24	1	1
9	External LSA 1.0.8.0/24	External LSA 1.0.18.0/24	1	1
10	External LSA 1.0.9.0/24	External LSA 1.0.19.0/24	1	1

Command Sequencer

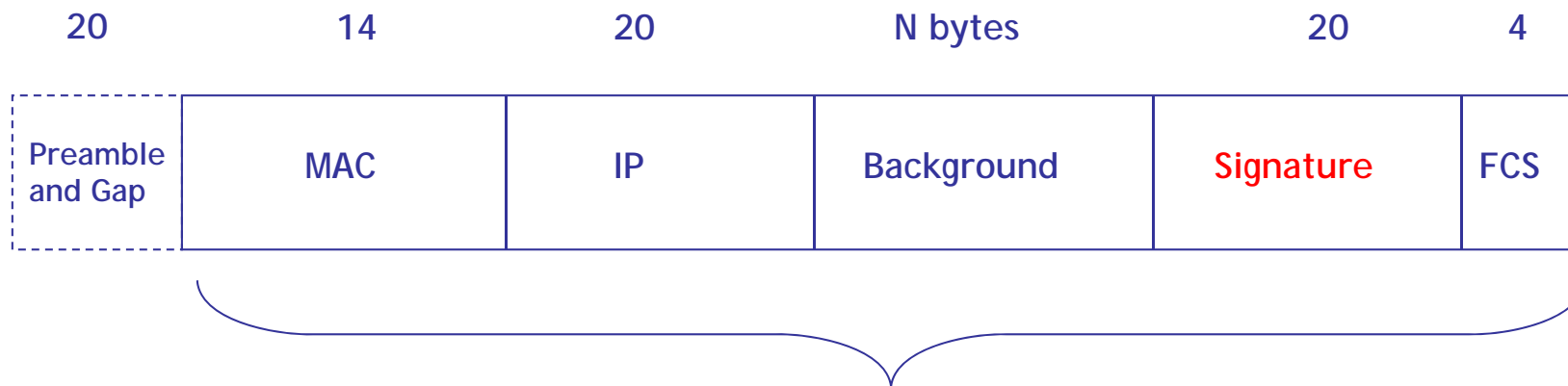
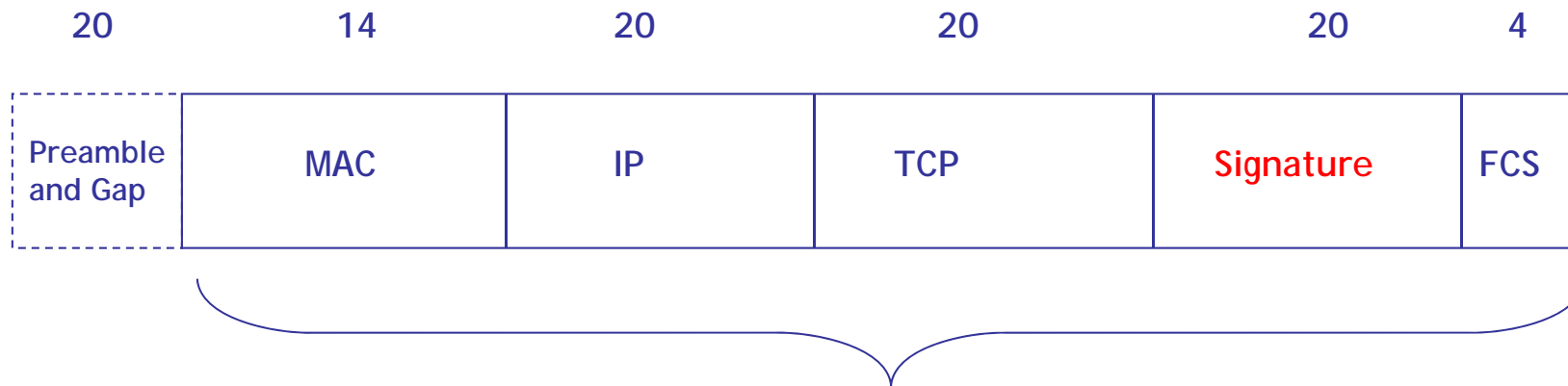
The Command Sequencer includes over 130 commands including all protocol, stream, capture and more :

It can be run at any time and shows status and time stamp for each event :

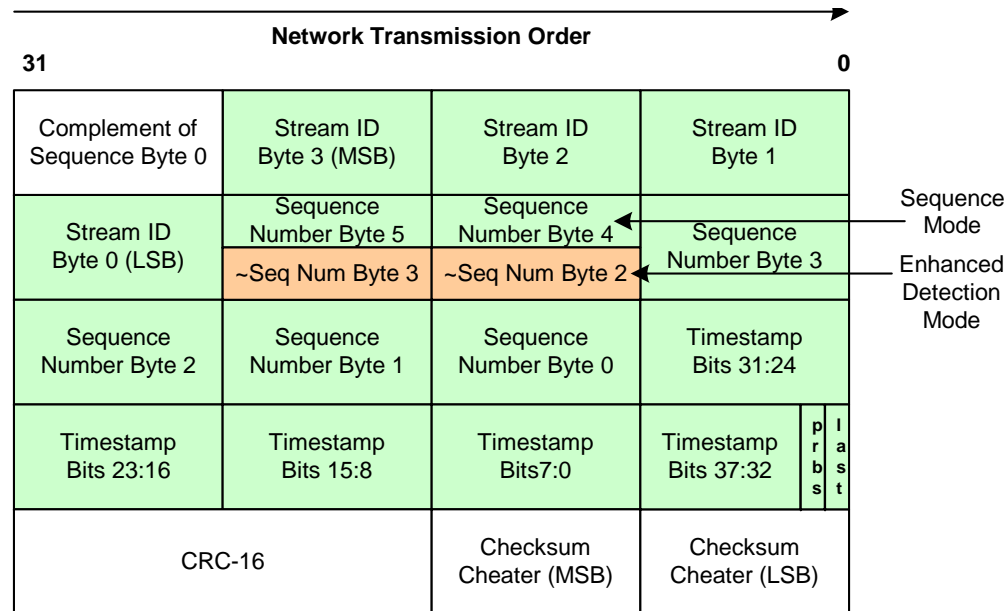


Command Sequencer also includes “Run External Event” command which enables **White Box testing** to interact with the DUT/SUT during the test.

Spirent TestCenter Test Frame



The Spirent TestCenter Signature Field



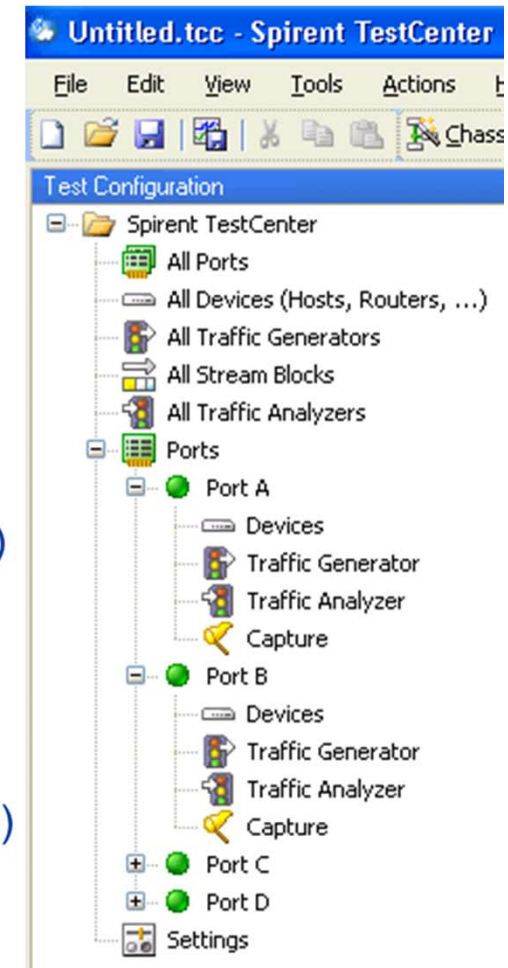
- the Signature is **Scrambled** so not to influence repetitive patterns
- it is **20 bytes** and oriented at the end of the IP Datagram
- it contains 32 bits of **Stream ID** (up to 4 billion test streams possible)
- it has a 10 nanosecond **Timestamp** resolution
- the **PRBS bit** is set when Spirent TestCenter inserts a PRBS 23 pattern in the payload
- the **Last bit** will tell the receiver which byte was time stamped
- it has a built in **UDP/TCP Checksum Cheater** field (for use when modifiers are placed in the payload)

12 Steps to Setup and Run a Test

Work your way from the top down on the Test Configuration Tree

1. Configure and connect to the Device/System Under Test (DUT/SUT)
2. Verify that you have IP connectivity to the chassis (your PC)
3. Connect and reserve the test ports (Port Reservation)
4. Configure the physical layer parameters (Ports)
5. Possibly enable network emulation (Devices: Routers)
6. Possibly define the traffic endpoints (Devices: Hosts/Routes/LSPs)
7. Create the traffic and traffic attributes (Stream Blocks: Raw or Bound)
8. Possibly modify transmit properties (Traffic Generator)
9. Possibly modify receive properties (Traffic Analyzer)
10. Possibly setup the test schedule (Command Sequencer)
11. Possibly modify other test parameters (Settings and Tools > Options)
12. Run your test; view and interpret the results (Results Browser)

Only Items 1-4, 7 & 12 are required
Underlined items are related



1. Configure and connect to the DUT/SUT



Test Port 1



Test Port 2



Test Port 3

$192.168.11.X/2$
4

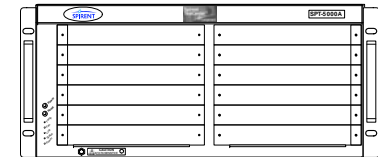
$192.168.12.X/2$
4

$192.168.13.X/2$
4

This is the Test Plan that will be demonstrated on the following slides



$192.168.14.X/2$
4



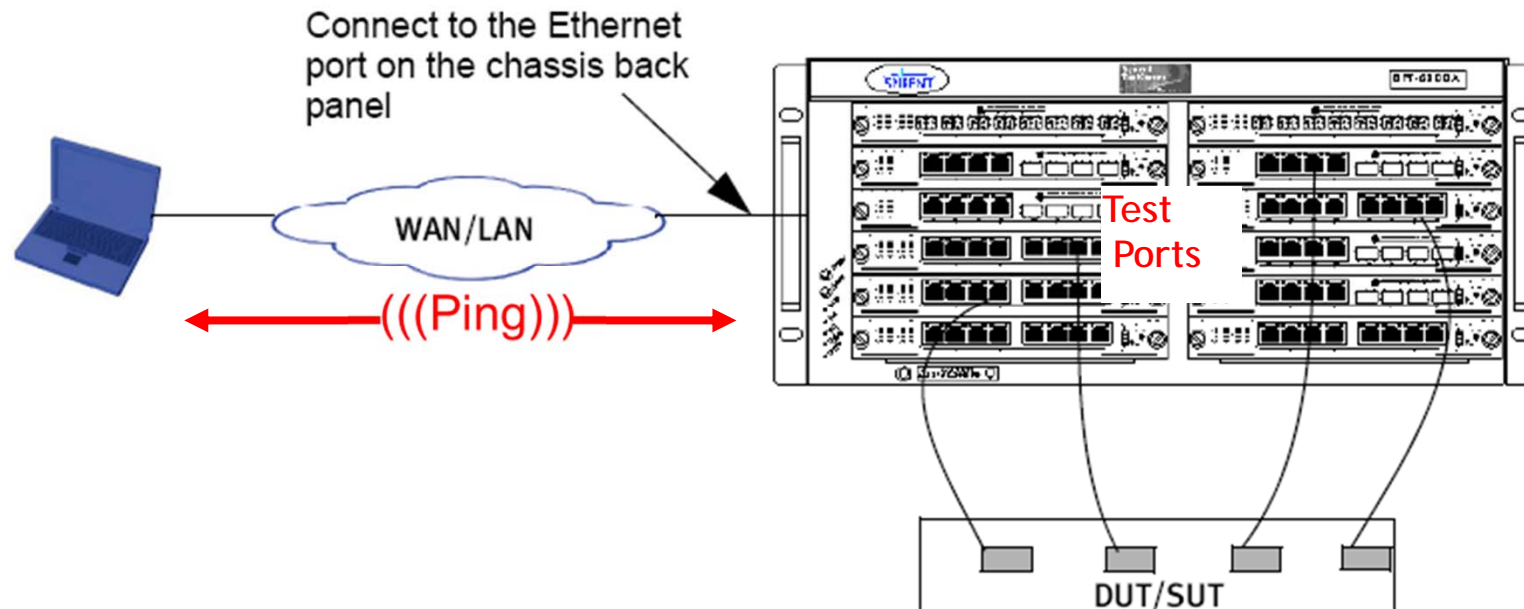
Test Port 4

Where $X = 1$ for the Gateway (DUT)
and 2 for the Spirent TestCenter Host



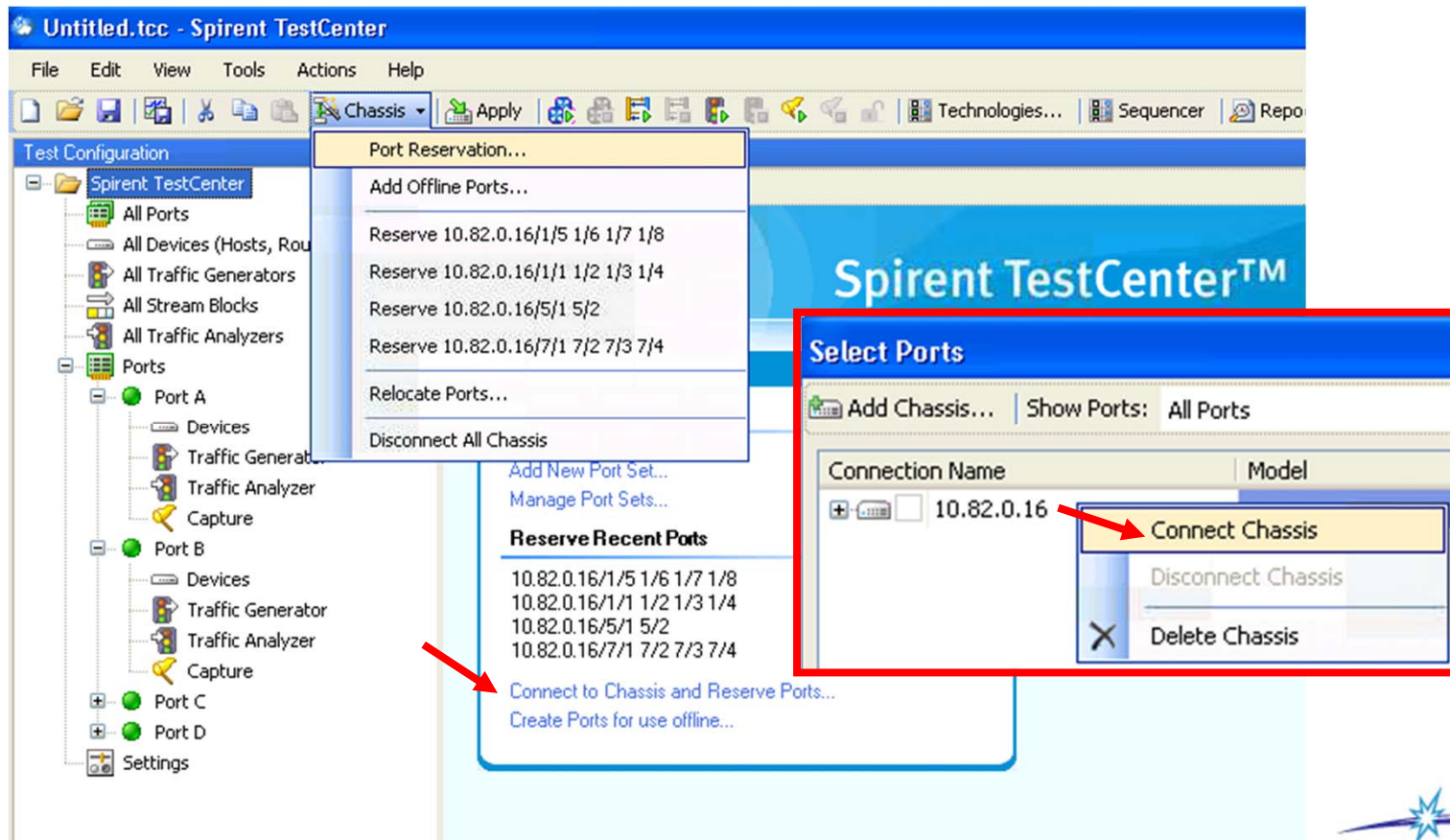
2. Verify IP Connectivity

- Your PC runs the "Spirent TestCenter Application" and connects out-of-band to the chassis' management port.

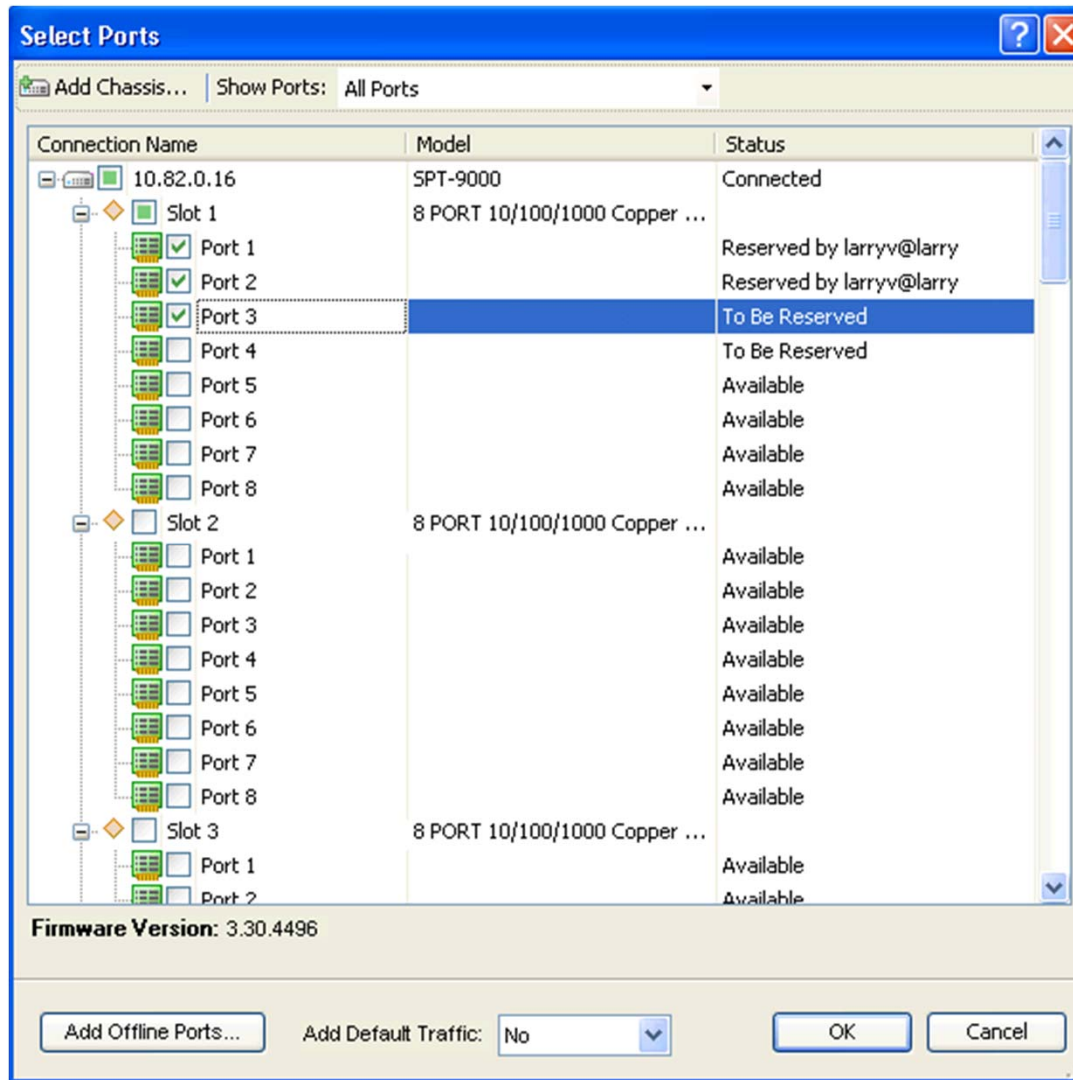


3a. Connect to the Chassis

- In the Select Ports window, right-click and select Connect Chassis
- This can also be done by expanding the + sign under Connection Name column for the corresponding IP address



3b. Reserve the Ports



- After connecting to Chassis, select the ports which are to be used.

- Ports are reserved in multiples of two unless it is a 10GigE port or a HM CM module*

*Optional with 3.40

4. Configure the Physical Layer Properties

- Example shows setting 4 ports to copper and 100M full duplex.

Test Configuration

Spirent TestCenter

All Ports

All Devices (Hosts, Routers, ...)

All Traffic Generators

All Stream Blocks

All Traffic Analyzers

Ports

Port A

Devices

Main Port Config

Port Name	Append Location to Port Name	Location	Online	Media Type	Link Status
Port A	<input type="checkbox"/>	//10.82.0.16/1/1	<input checked="" type="checkbox"/>	Ethernet Copper	Up
Port B	<input type="checkbox"/>	//10.82.0.16/1/2	<input checked="" type="checkbox"/>	Ethernet Copper	Up
Port C	<input type="checkbox"/>	//10.82.0.16/1/3	<input checked="" type="checkbox"/>	Ethernet Copper	Up
Port D	<input type="checkbox"/>	//10.82.0.16/1/4	<input checked="" type="checkbox"/>	Ethernet Copper	Up

Test Configuration

Spirent TestCenter

All Ports

All Devices (Hosts, Routers, ...)

All Traffic Generators

All Stream Blocks

All Traffic Analyzers

Ports

Port A

Devices

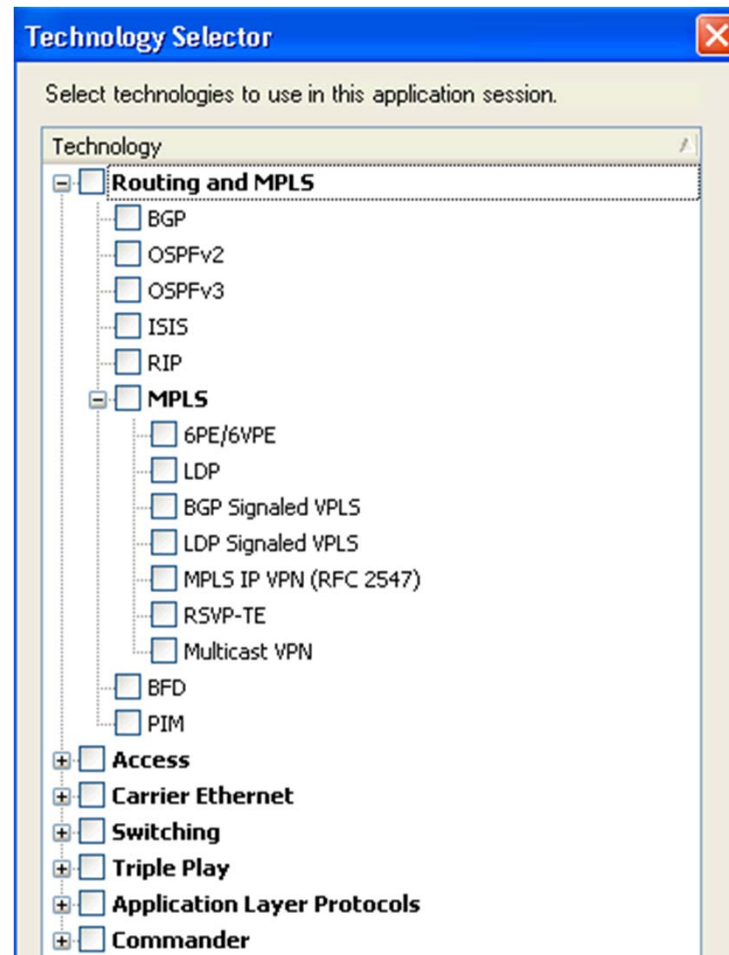
Main Port Config

Port Name	Auto Negotiation	Line Speed	Duplex	MTU	Flow Control	Data Path Mode	Collision Exponent	Link Status
Port A	<input type="checkbox"/>	100Mbps	Full	1500	<input type="checkbox"/>	Normal	10	Up
Port B	<input type="checkbox"/>	100Mbps	Full	1500	<input type="checkbox"/>	Normal	10	Up
Port C	<input type="checkbox"/>	100Mbps	Full	1500	<input type="checkbox"/>	Normal	10	Up
Port D	<input type="checkbox"/>	100Mbps	Full	1500	<input type="checkbox"/>	Normal	10	Up

5. Enable Network Emulation if Required

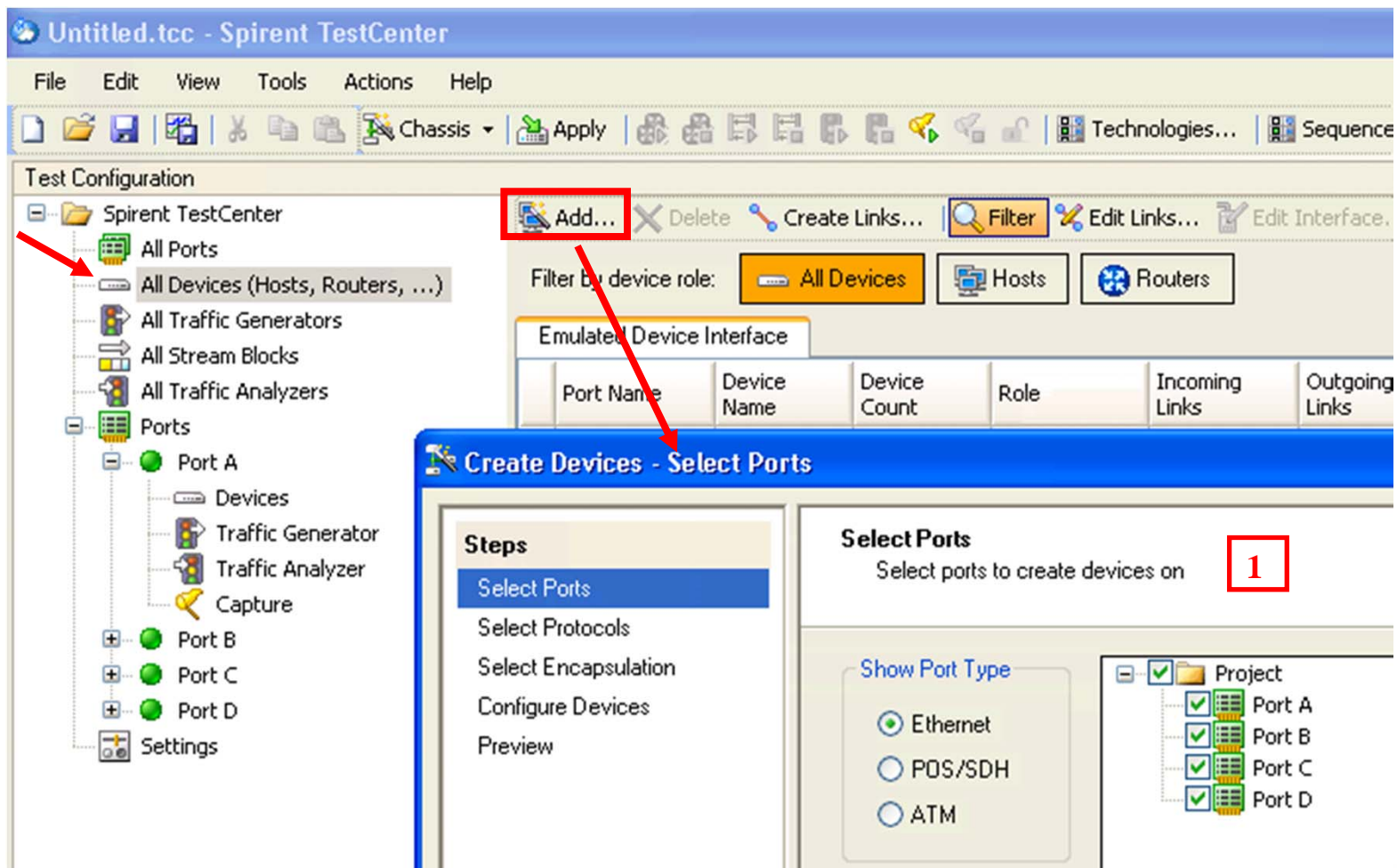
- Since we are using static addresses and directly connected interfaces for this example, no other emulation is required.

ARP/ND and Ping will still be enabled by default



6a. Define the Traffic End Points

- Add Devices using the Create Devices Wizard: Step 1



6b. Creating the Devices - Wizard Step 2 & 3

Create Devices - Select Protocols

Steps

- Select Ports
- Select Protocols**
- Select Encapsulation
- Configure Devices
- Preview

Select Protocols

Select the protocols to enable on the devices
Application protocols (e.g. HTTP, FTP, SIP and Video) are configured through the Application

Protocol Technologies

☒ None (Traffic only device) ☐ Access ☐ Routing and MPLS ☐ Switching

Protocol	IP Versions Supported
Name	Enable IPv4 IPv6 IPv4 & IPv6 (Dual Stack)

Create Devices - Select Encapsulation

Steps

- Select Ports
- Select Protocols
- Select Encapsulation**
- Configure Devices
- Preview

Select Encapsulation

Select encapsulation

Upper Layer

☐ None
☒ IPv4
☐ IPv6
☐ IPv4 and IPv6 (dual stack)

Lower Layer

☒ Ethernet ☐ Number of VLAN Headers 0
☐ PPP/Cisco HDLC ☐ GRE over IPv4
☐ ATM

Buttons: Reset, < Back, Next >

6c. Creating the Devices - Wizard Step 4

- Configure MAC and IP/Gateway addresses for the Devices.

Create Devices - Configure Devices

Steps

- Select Ports
- Select Protocols
- Select Encapsulation
- Configure Devices**
- Preview

Configure Devices
Configure device options

Devices per port: 1 Total devices: 4

Device blocks per port: 1 Total device blocks: 4

Device block mode: One network per block, multiple devices per network

Device role: <None> Name: Device \${BlockIndex}

Ethernet

☐ Enable RFC 4814 MAC addresses Random Seed: 4814

MAC address: 00:10:94:01:00:01 Step: per device=00:00:00:00:00:01

IPv4

IPv4 address: 192.168.11.2 Step: per device=0.0.0.1, per port=0.0.1.0

Prefix length: 24

IPv4 gateway: 192.168.11.1 Gateway will use the network part of the address

ToS/DiffServ (hex): C0

Reset < Back **Next >**

Address Step

Start value: 192.168.11.2

Step per device: 0.0.0.1

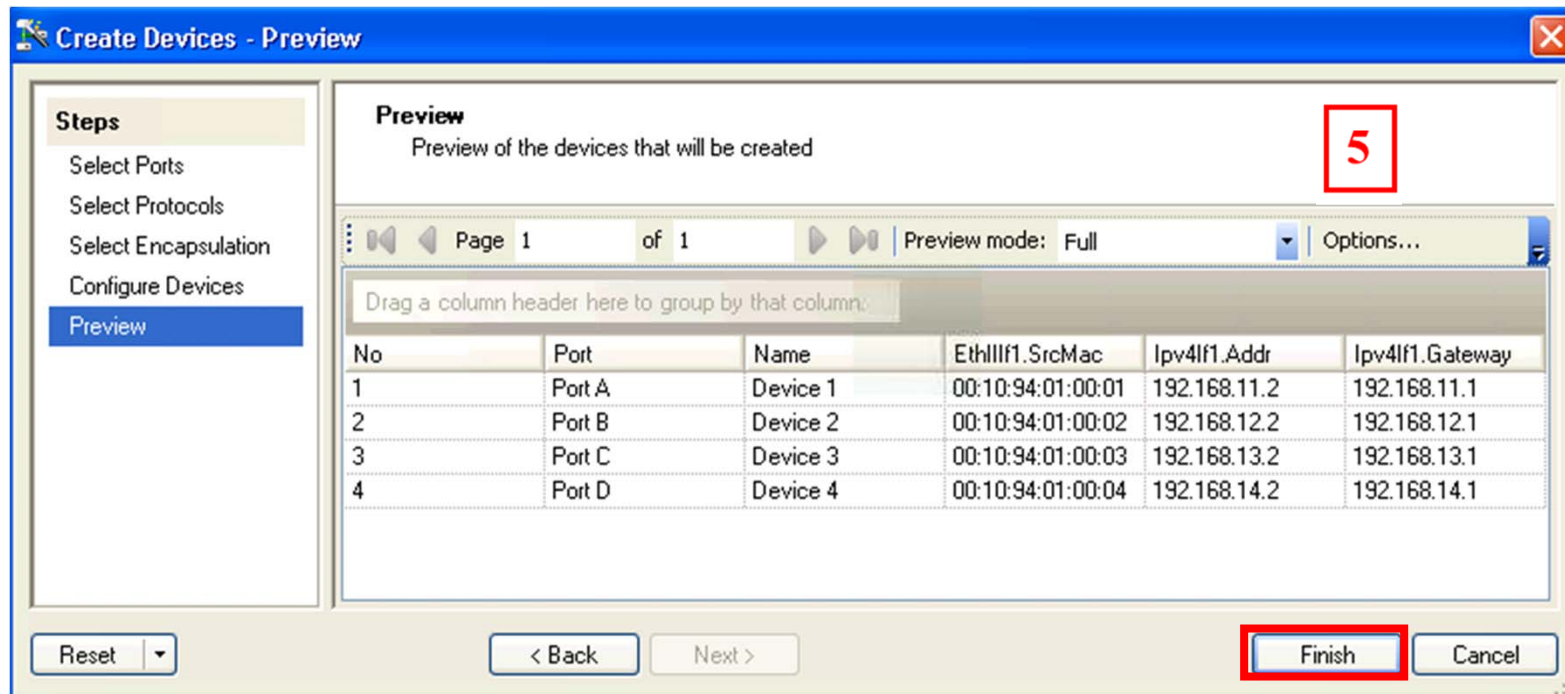
Port Step

i Determines the next value when stepping across ports. If no step is provided, the value will continue from where it left off. To repeat across ports, set the step per port to zero.

☒ Step per Port: 0.0.1.0

6d. Creating the Devices - Wizard Step 5

- Preview of the Devices that will be created.



6e. Resolve the Gateway's MAC Address

- Right-click on a Device(s) and select ARP/ND

The screenshot displays the Spirent TestCenter 'Test Configuration' window. On the left, a tree view shows the hierarchy: Spirent TestCenter > All Ports > Port A > Devices. A right-click context menu is open over 'Port A', with the 'ARP/ND' option selected. The main panel shows a table of 'Emulated Device Interface' configurations. The table has columns for Port Name, Device Name, IPv4 Gateway Modifier, Resolve IPv4 Gateway Mac Address, IPv4 Gateway Mac, and IPv4 Gateway Mac Resolve State. The first four rows show 'Unresolved' states. A red box highlights a section of the table where the MAC address has been resolved to '00:04:96:21:00:00'.

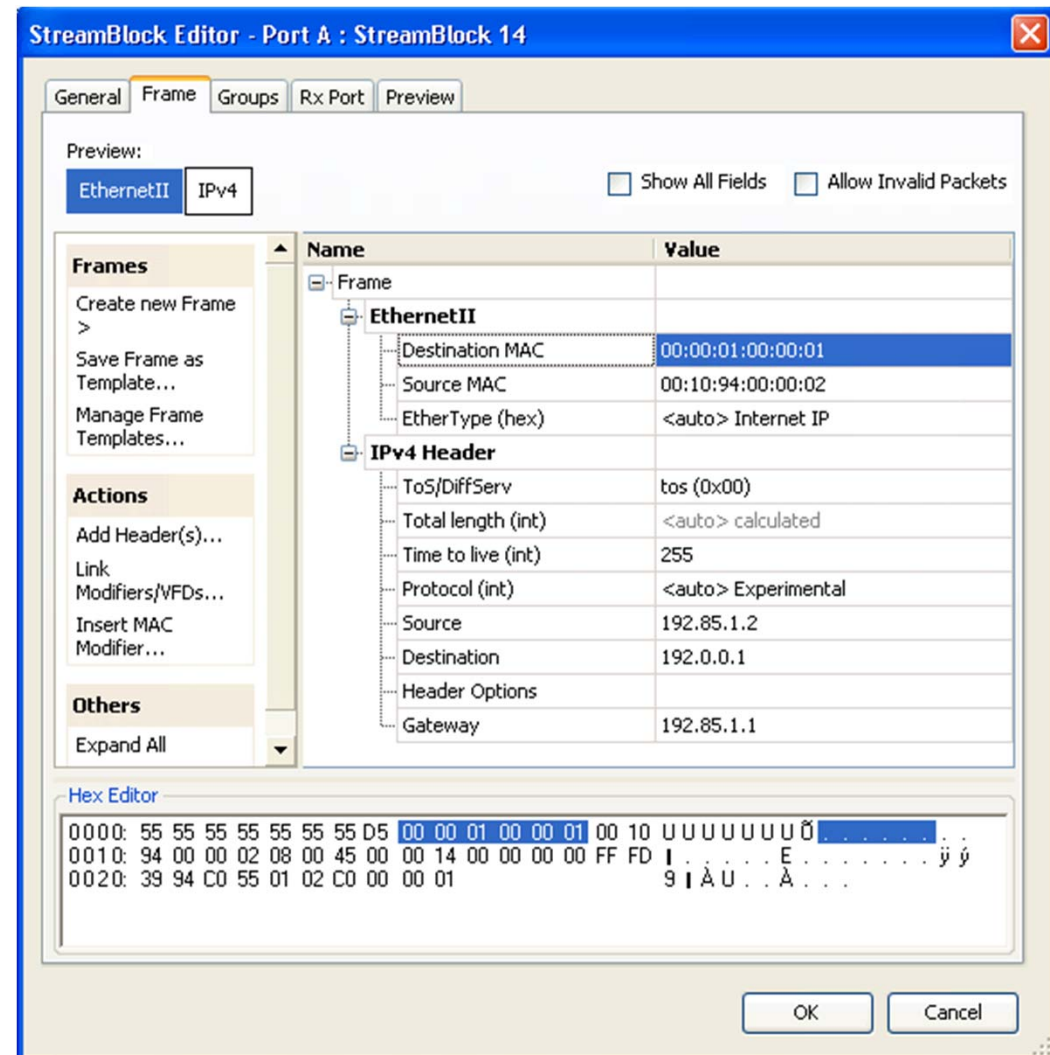
Port Name	Device Name	IPv4 Gateway Modifier	Resolve IPv4 Gateway Mac Address	IPv4 Gateway Mac	IPv4 Gateway Mac Resolve State
Port A	Device 1	10.0.0.0	<input checked="" type="checkbox"/>	00:00:01:00:00:01	Unresolved
Port B			<input checked="" type="checkbox"/>	00:00:01:00:00:01	Unresolved
Port C			<input checked="" type="checkbox"/>	00:00:01:00:00:01	Unresolved
Port D			<input checked="" type="checkbox"/>	00:00:01:00:00:01	Unresolved
Resolved Section (Highlighted)					
				00:04:96:21:00:00	Resolved
				00:04:96:21:00:00	Resolved
				00:04:96:21:00:00	Resolved
				00:04:96:21:00:00	Resolved

At the bottom, the 'Results 1' pane shows 'Port Traffic and Counters > ARPND Results' with '1 of 1' entries. A 'Start ARP/ND' button is visible in the bottom right.

7. Traffic using Raw Stream Blocks

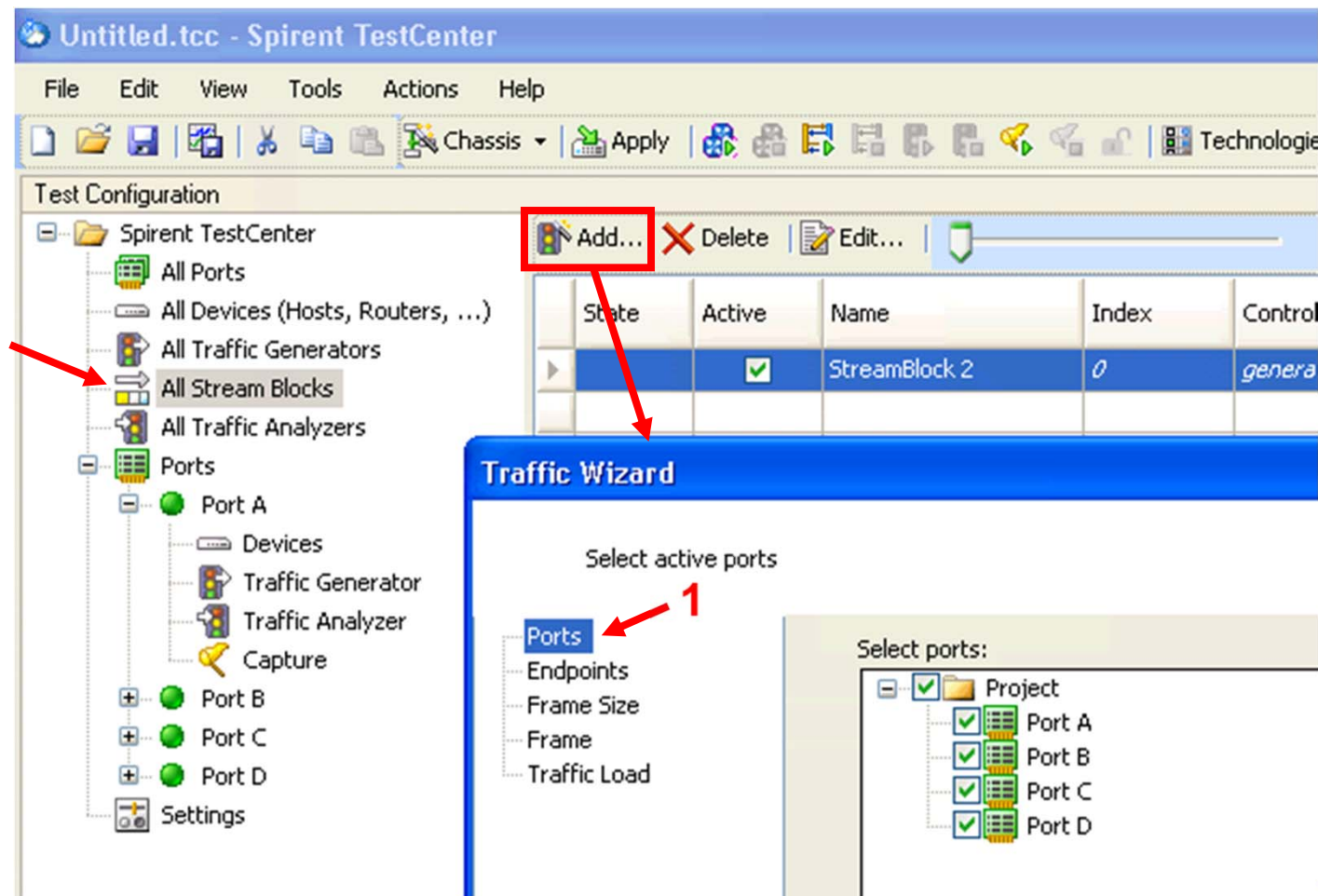
- A way to build custom traffic
- No direct concept of endpoints
- Still supports ARP
- Has other Stream Block concepts:
 - Frames Sizes*
 - Payload Definition*
 - Traffic Mode and Load*
 - Specific Receive (Rx) Port(s)

*General tab



7a. Traffic Wizard Step 1

- Or access the Traffic Wizard to create **Bound Stream Blocks**



7b. Traffic Wizard Step 2

2

Although I could have used Backbone too

Port 1, Port 2, Port 3, to Port 4 Bidirectional Traffic.

7c. Traffic Wizard Step 3

- Configure the Stream Block name, Options, and Frame Size

Traffic Wizard

Setup general traffic configuration

Spirent TestCenter™ Component

General

Stream block name prefix: ☐ Vary Protocol & QOS

Frame Size (Bytes) (With CRC and Signature Field)

☒ Fixed Size:

☐ Random Min:

☐ Increment Max:

☐ Decrement Step:

☐ Auto

☐ iMIX

Options

☐ Allow port to generate traffic to itself

☒ Expand stream blocks under ports

☒ Multiple paths per streamblock

☐ One path per streamblock

7d. Traffic Wizard Step 4

- Configure the Frame template; optional

4

The screenshot shows the 'Traffic Wizard' window in Spirent TestCenter. The left sidebar has a tree view with 'Ports', 'Endpoints', 'Frame Size', 'Frame', and 'Traffic Load'. A red arrow points to 'Frame', which is highlighted. The main area is titled 'Add and edit protocols in the frame'. It has a 'Preview' section with a 'IPv4' button. To the right of the preview are checkboxes for 'Show All Fields' and 'Allow Invalid Packets'. Below the preview is a table with 'Name' and 'Value' columns. The table shows a 'Frame' container with an 'IPv4 Header' sub-item. The 'IPv4 Header' has several fields: 'ToS/DiffServ' (tos (0xC0)), 'Total length (int)' (<auto> calculated), 'Time to live (int)' (255), 'Protocol (int)' (<auto> Experimental), 'Source' (<auto> 192.168.11.2), 'Destination' (<auto> 192.168.14.2), 'Header Options' (empty), and 'Gateway' (192.168.11.1). Below the table is a 'Hex Editor' section showing two lines of hex data: '0000: 45 C0 00 14 00 00 00 00 FF FD 1F D8 C0 A8 0B 02' and '0010: C0 A8 0E 02'. The bottom of the window has buttons for '<Previous', 'Next>', 'Finish', and 'Cancel'.

Traffic Wizard

Add and edit protocols in the frame

Spirent TestCenter™ Component

Ports
Endpoints
Frame Size
Frame
Traffic Load

Preview:
IPv4

☐ Show All Fields ☐ Allow Invalid Packets

Name	Value
Frame	
IPv4 Header	
ToS/DiffServ	tos (0xC0)
Total length (int)	<auto> calculated
Time to live (int)	255
Protocol (int)	<auto> Experimental
Source	<auto> 192.168.11.2
Destination	<auto> 192.168.14.2
Header Options	
Gateway	192.168.11.1

Frames
Create new Frame
>
Save Frame as Template...
Manage Frame Templates...

Actions
Add Header(s)...
Link Modifiers/VFDs...
Delete IPv4 Header


Hex Editor

```
0000: 45 C0 00 14 00 00 00 00 FF FD 1F D8 C0 A8 0B 02 E Ä . . . . . ü ý . 0 Ä . . .  
0010: C0 A8 0E 02 Ä - . . .
```

<Previous Next> Finish Cancel

7e. Traffic Wizard Step 5

- Configure the Traffic Load options

5 

Traffic Wizard

Setup general traffic configuration

Spirent TestCenter™ Component

Left Sidebar:

- Ports
- Endpoints
- Frame Size
- Frame
- Traffic Load**

Generator Scheduling Mode

☒ Port based
☐ Load per streamblock Rate Based

Settings

Scheduling priority: (0 is the highest) 0
Burst size: 1
Start delay (bytes): 0
Inter-frame gap(bytes): 12

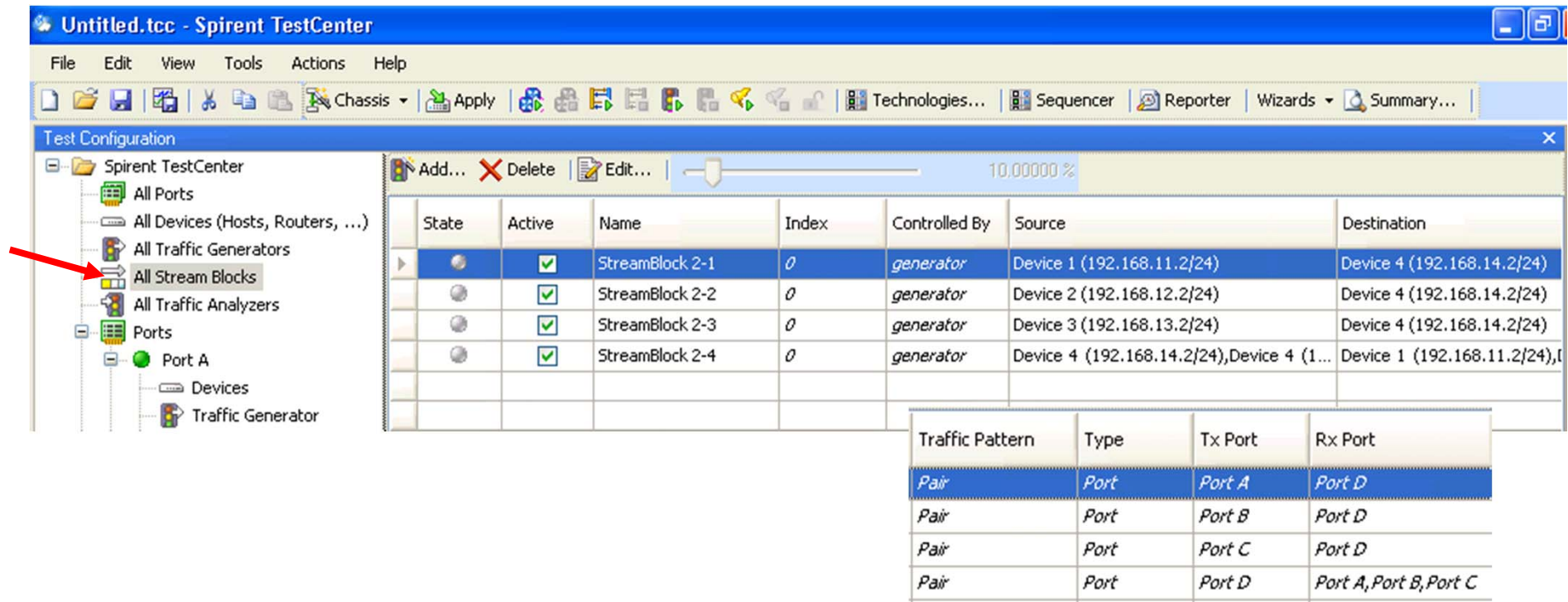
Generator Load Options

Load mode: Fixed
Load unit: Percent (%)
Load: 10
Min: 1
Max: 1
Count: 10
Repeat: 0

<Previous Next> Finish Cancel

7f. Traffic Wizard Result

- Bound Stream Blocks from the All Stream Blocks view
- See Source and Destination endpoints; and specific Tx/Rx Ports



The screenshot shows the Spirent TestCenter interface with the 'All Stream Blocks' view selected. The main table lists the following stream blocks:

State	Active	Name	Index	Controlled By	Source	Destination
	<input checked="" type="checkbox"/>	StreamBlock 2-1	0	generator	Device 1 (192.168.11.2/24)	Device 4 (192.168.14.2/24)
	<input checked="" type="checkbox"/>	StreamBlock 2-2	0	generator	Device 2 (192.168.12.2/24)	Device 4 (192.168.14.2/24)
	<input checked="" type="checkbox"/>	StreamBlock 2-3	0	generator	Device 3 (192.168.13.2/24)	Device 4 (192.168.14.2/24)
	<input checked="" type="checkbox"/>	StreamBlock 2-4	0	generator	Device 4 (192.168.14.2/24), Device 4 (1...	Device 1 (192.168.11.2/24), Device 1 (192.168.11.2/24)

Below the main table, a secondary table shows the traffic pattern and specific Tx/Rx ports:

Traffic Pattern	Type	Tx Port	Rx Port
Pair	Port	Port A	Port D
Pair	Port	Port B	Port D
Pair	Port	Port C	Port D
Pair	Port	Port D	Port A, Port B, Port C

8. Possibly Modify Transmit Properties

- Not necessary for this example

Test Configuration

Spirent TestCenter

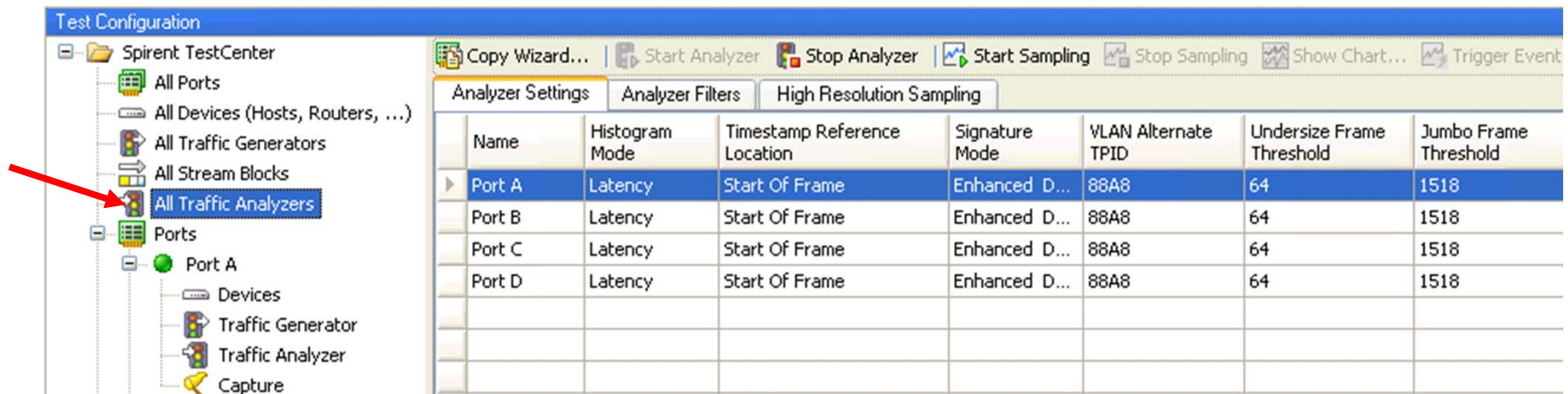
- All Ports
- All Devices (Hosts, Routers, ...)
- All Traffic Generators
- All Stream Blocks
- All Traffic Analyzers
- Ports
 - Port A
 - Devices
 - Traffic Generator
 - Traffic Analyzer

Start Traffic Stop Traffic

Tx State	Port Name	Scheduling Mode	Duration Mode	Duration	Burst Size	Inter Frame Gap	Load Mode
	Port A	Port Based	Continuous		1		Fixed
	Port B	Port Based	Continuous		1		Fixed
	Port C	Port Based	Continuous		1		Fixed
	Port D	Port Based	Continuous		1		Fixed
			Continuous				
			Bursts				
			Seconds				

9. Possibly Modify Receive Properties

- Not necessary for this example



The screenshot displays the 'Test Configuration' window in Spirent TestCenter. The left sidebar shows a tree view with the following items: Spirent TestCenter, All Ports, All Devices (Hosts, Routers, ...), All Traffic Generators, All Stream Blocks, All Traffic Analyzers (highlighted with a red arrow), Ports, Port A, Devices, Traffic Generator, Traffic Analyzer, and Capture. The main area shows the 'Analyzer Settings' tab with a table of analyzer configurations.

Name	Histogram Mode	Timestamp Reference Location	Signature Mode	VLAN Alternate TPID	Undersize Frame Threshold	Jumbo Frame Threshold
Port A	Latency	Start Of Frame	Enhanced D...	88A8	64	1518
Port B	Latency	Start Of Frame	Enhanced D...	88A8	64	1518
Port C	Latency	Start Of Frame	Enhanced D...	88A8	64	1518
Port D	Latency	Start Of Frame	Enhanced D...	88A8	64	1518

10. Possibly Setup the Test Schedule

- Not necessary for this example since we will run the test interactively.

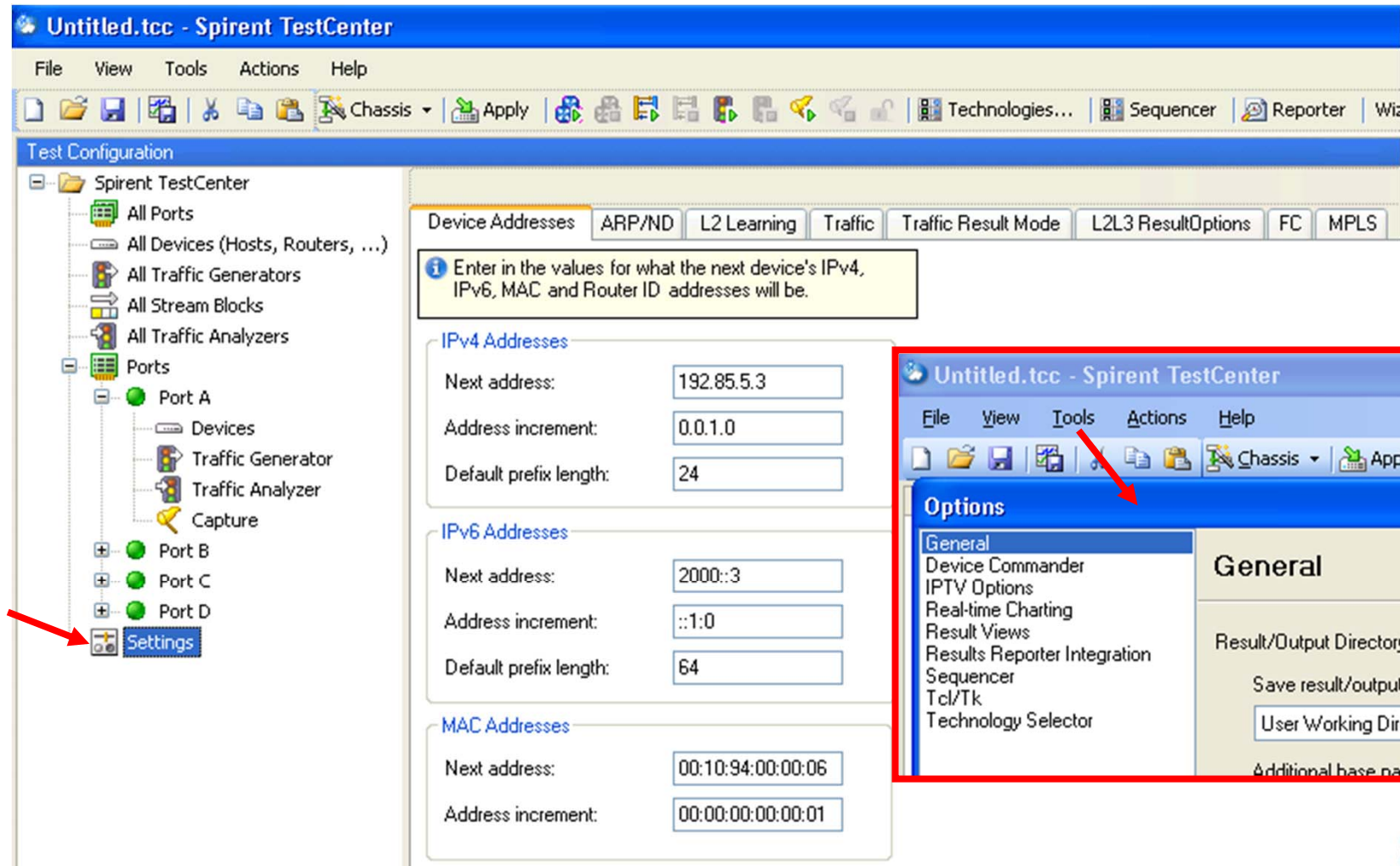
The screenshot displays the Spirent TestCenter software interface. The main window is titled "Untitled.tcc - Spirent TestCenter" and features a menu bar (File, View, Tools, Actions, Help) and a toolbar with various icons. The left sidebar shows a "Test Configuration" tree with folders for "Spirent TestCenter", "All Ports", "All Devices (Hosts, Routers, ...)", "All Traffic Generators", "All Stream Blocks", "All Traffic Analyzers", "Ports", and "Settings". The "Ports" folder is expanded, showing "Port A", "Port B", "Port C", and "Port D". The main area is divided into tabs: "Analyzer Settings", "Analyzer Filters", and "High Resolution Sampling". The "Analyzer Settings" tab is active, displaying a table with columns: "Name", "Histogram Mode", "Timestamp Reference Location", "Signature Mode", and "VLAN All TPID". The table contains four rows for "Port A", "Port B", "Port C", and "Port D", all with "Latency" in the Histogram Mode column and "Start Of Frame" in the Timestamp Reference Location column. A "Command Sequencer" window is overlaid on the right side, showing a table with columns: "Command Name", "P/F", and "Elapsed Time". The "Command Sequencer" window is highlighted with a red border.

Name	Histogram Mode	Timestamp Reference Location	Signature Mode	VLAN All TPID
Port A	Latency	Start Of Frame	Enhanced D...	88A8
Port B	Latency	Start Of Frame	Enhanced D...	88A8
Port C	Latency	Start Of Frame	Enhanced D...	88A8
Port D	Latency	Start Of Frame	Enhanced D...	88A8

Command Name	P/F	Elapsed Time
--------------	-----	--------------

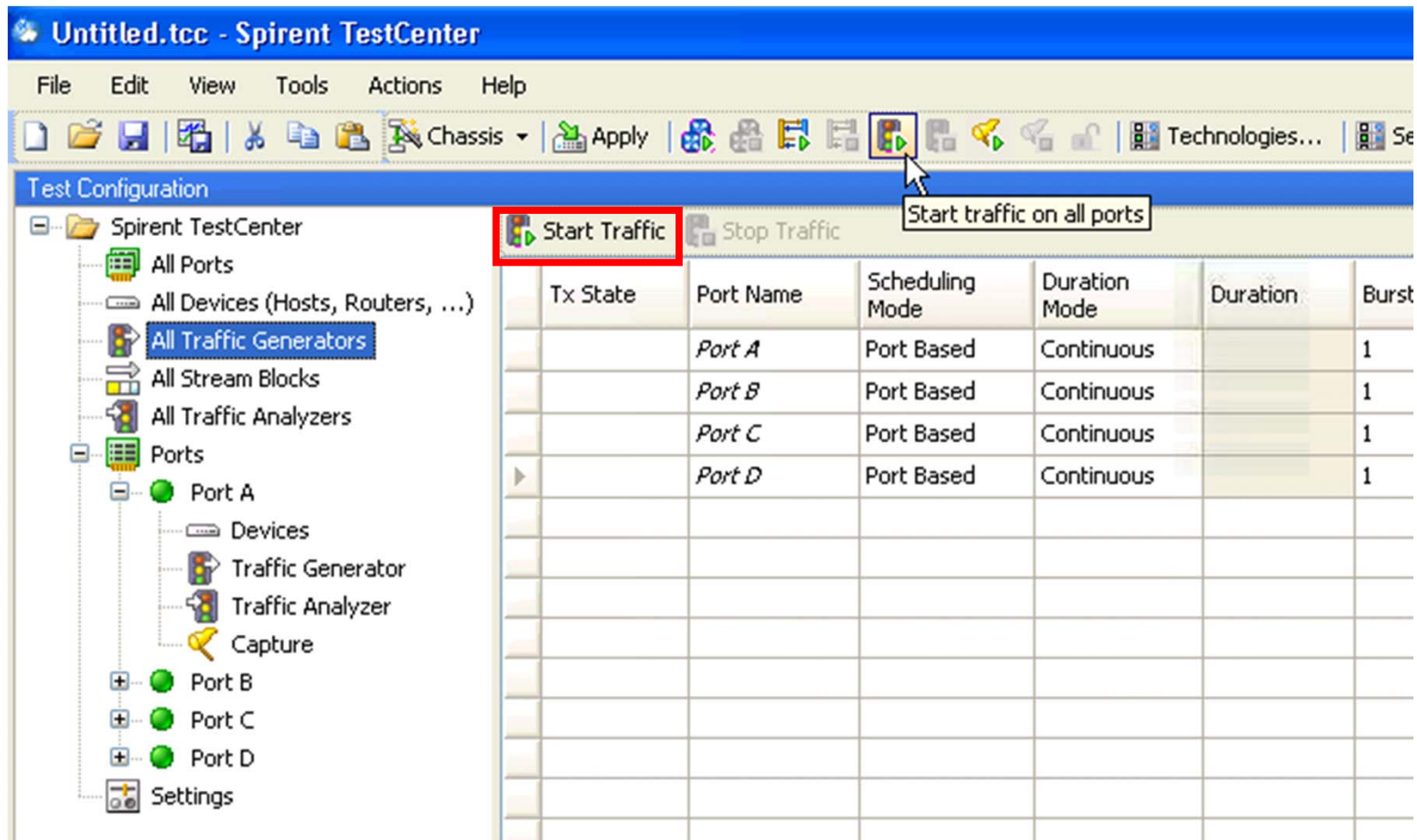
11. Possibly Modify other Test Settings

- Not necessary for this example



12a. Run the Test

- Send traffic by clicking Start Traffic button.



12b. View and Interpret the Results

- You can view the Port-based aggregate or Stream-based individual statistics; Stream-based also supports Histograms

Results 1

Port Traffic and Counters > Basic Traffic Results | Change Result View | 1 of 1

Basic Counters	Errors	Triggers	Protocols	Undersize/Oversize/Jumbo			
Port Name	Total Tx Count (Frames)	Total Rx Count (Frames)	Total Tx Count (bits)	Total Rx Count (bits)	Total Tx Rate (bps)	Total Rx Rate (bps)	Tx L1 Count (bits)
Port A	116,705	40,981	119,504,896	41,956,864	8,648,616	2,883,568	138,177,696
Port B	119,248	41,101	122,108,928	42,079,744	8,648,616	2,882,552	141,188,608
Port C	120,157	39,396	123,039,744	40,333,824	8,648,736	2,883,560	142,264,864
Port D	122,905	355,711	125,853,696	364,240,384	8,648,672	25,946,608	145,518,496

Streams > Detailed Stream Results | Change Result View | 1 of 1 | Select Tx Ports: All Ports | Select Rx Ports: All Ports

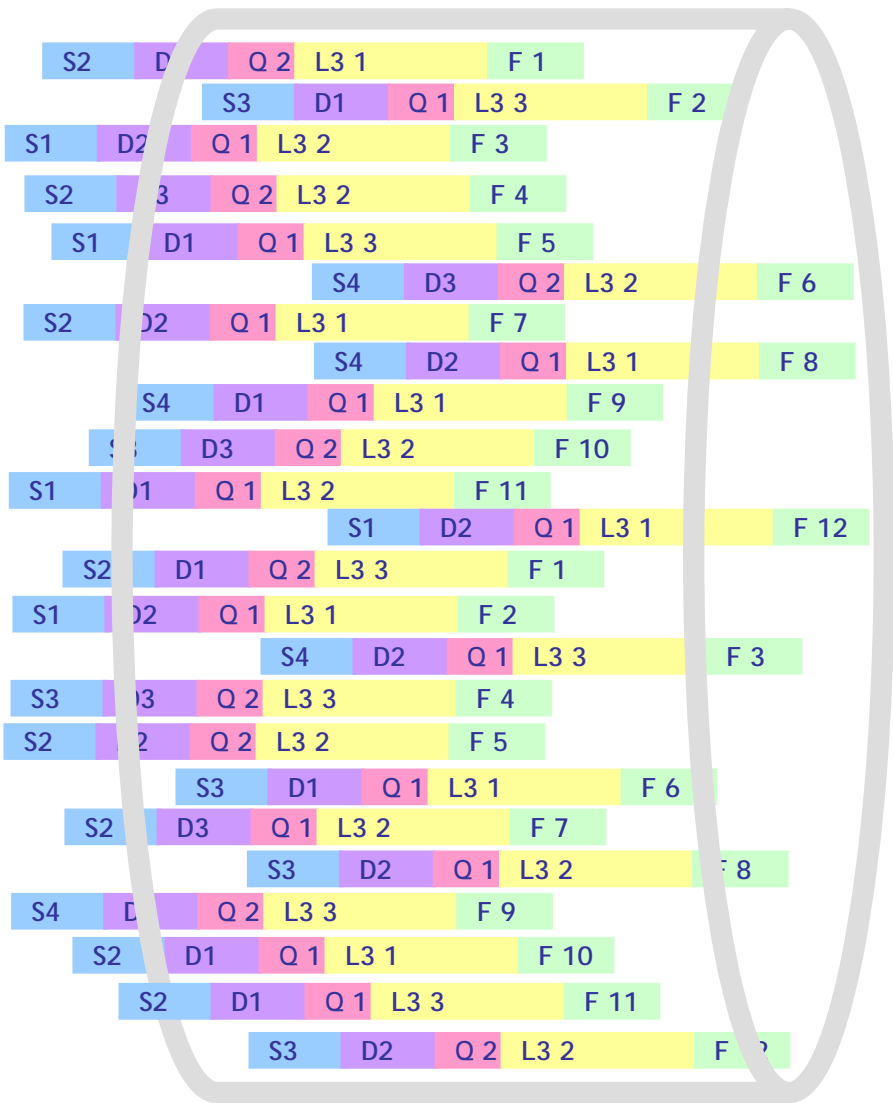
Change Counter Mode: Basic Mode

Basic Counters	Errors	Basic Sequencing	Advanced Sequencing	Histograms				
Name/ID	Tx Port Name	Rx Port Names	Tx Count (Frames)	Rx Count (Frames)	Dropped Count (Frames)	Dropped Frame Percent	In-order Count (Frames)	Reordered Count (Frames)
StreamBloc...	Port A	Port D	125,160	127,206	0	0	127,206	0
StreamBloc...	Port B	Port D	127,702	127,078	0	0	127,078	0
StreamBloc...	Port C	Port D	128,611	127,214	0	0	127,214	0
StreamBloc...	Port D	Port A	40,970	41,022	0	0	41,022	0

Analyzer Capabilities

- ◉ Flexible classification of results
 - Stream ID is the default; track only "Test" traffic
 - Customize Analyzer Filters; track anything
 - by QoS, Protocols, Addressing, VLANs, More!
- ◉ Up to 2 Million user-selectable real-time statistics per port
- ◉ Advanced measurements, concurrently, in real time
 - Jitter
 - Loss
 - Sequencing
 - Latency
 - Data Integrity

Spirent TestCenter Analyzer Filters



There are 100s of Analyzer Filter Options!

Source

S1	
S2	
S3	
S4	

Destination

D1	
D2	
D3	

QoS

Q1	
Q2	

L3

L3 1	
L3 2	
L3 3	

Source/Destination Pairs

S1	D1	
S1	D2	
S1	D3	
S2	D1	
S2	D2	
S2	D3	
S3	D1	
S3	D2	
S3	D3	
S4	D1	
S4	D2	
S4	D3	

Source & QoS

S1	Q1	
S1	Q2	
S2	Q1	
S2	Q2	
S3	Q1	
S3	Q2	
S4	Q1	
S4	Q2	

L3 Protocol & QoS

L3 1	Q1	
L3 1	Q2	
L3 2	Q1	
L3 2	Q2	
L3 3	Q1	
L3 3	Q2	

Customizing Analyzer Filters

The screenshot shows the Spirent TestCenter interface. In the left sidebar, 'Traffic Analyzer' is selected (indicated by red arrow 1). The main window has the 'Template Filter' tab active (indicated by red arrow 2). Below the tabs, it shows '16 Bit Filters Used: 4 of 4' and '32 Bit Filters Used: 0 of 1'. A table of filters is displayed with columns: Name, Filter, Mask, Min Value, and Max Value. The 'IPv4 Header' section is expanded, and the 'Destination' field is selected (indicated by red arrow 3). Below the table, a 'Filter Summary' is shown.

Name	Filter	Mask	Min Value	Max Value
EthernetII				
IPv4 Header				
ToS/DiffServ	<input type="checkbox"/>			
Total length (int)	<input type="checkbox"/>			
Time to live (int)	<input type="checkbox"/>			
Protocol (int)	<input type="checkbox"/>			
Source	<input checked="" type="checkbox"/>	255.255.255...	000.000.000...	255.255.255...
Destination	<input checked="" type="checkbox"/>	255.255.255...	000.000.000...	255.255.255...
Header Options				

Filter Summary
 IPv4 Header:Source = 255.255.255.255 Min Value = 000.000.000.000 Max Value = 255.255.255.255, IPv4 Header:Destination = 255.255.255.255 Min Value = 000.000.000.000 Max Value = 255.255.255.255

The results of customized filters are viewable in the **Filtered Stream Results:**

The screenshot shows the 'Stream Results > Filtered Stream Results' window. The 'Basic Counters' tab is selected. The table below shows the results of the filtered stream.

Rx Port Name	Source(IPv4)	Destination (IPv4)	Stream Index	Rx Frame Count	Avg Latency (us)	Min Latency (us)	Max
Port //1/1	30.1.1.2	10.1.1.2	0	160,631	129.65	83.93	505..
Port //1/1	40.1.1.2	10.1.1.2	1	160,631	131.98	74.7	896..
Port //1/1	20.1.1.2	10.1.1.2	2	160,631	122.83	76.24	623..

Traffic Analyzer Histograms

- There are a several customizable choices that display in real-time
- The following types of histograms are available:
 - Inter-arrival time*
 - Frame length distribution*
 - *available for non-test traffic too
 - Latency distribution
 - Sequence run length
 - Sequence difference check
 - Jitter as per the MEF specs
- User-defined buckets and distribution modes
- Real-time results displayed in the Results Browser
- Post-test results saved in the database and displayed via the Results Reporter

Copy to Ports...

Template Filter Custom Filters **Histograms** QoS Settings Advanced

Histogram Mode: Inter-arrival Time

Bucket Size and Limit Configuration

Select a predefined bucket size distribution mode:

Predefined Mode: Custom

Mode Size: 0

Uniform Bucket Size: 0

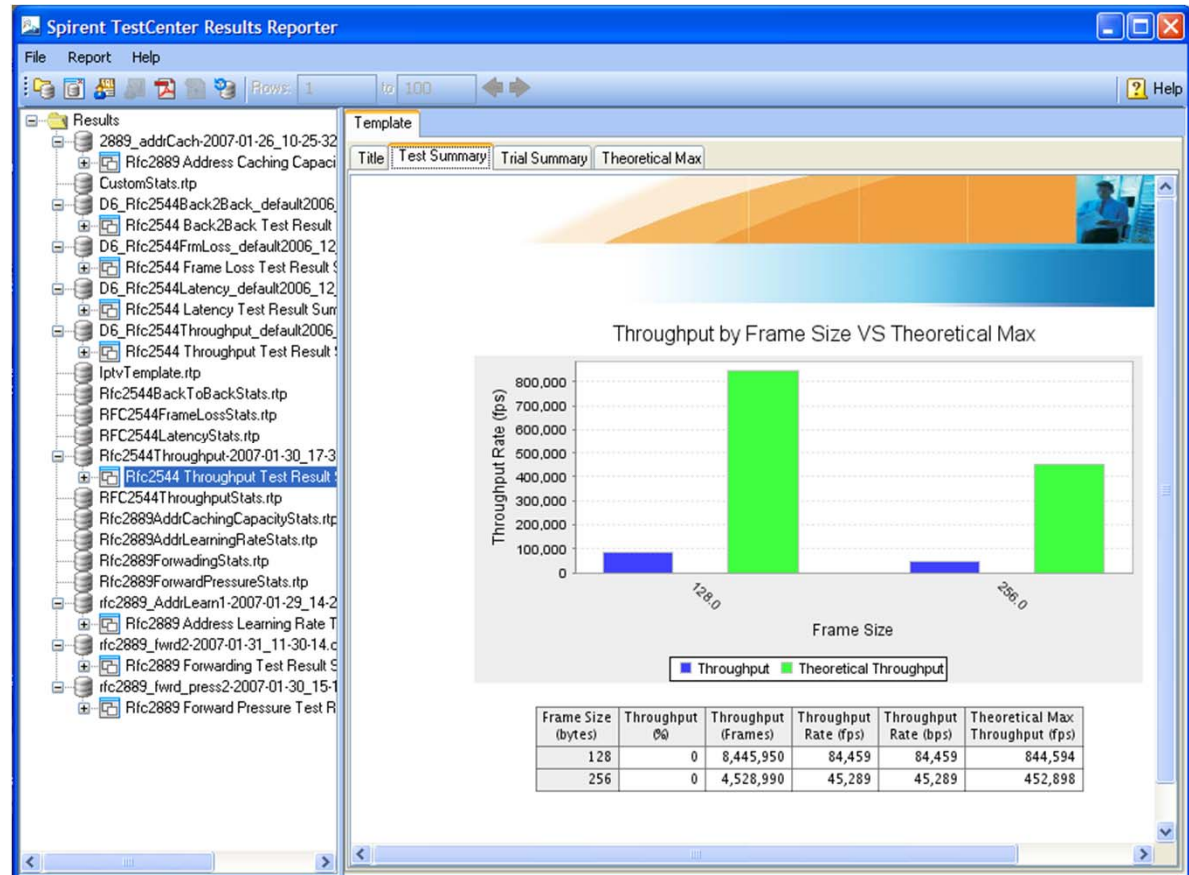
(Each unit represents 10ns time.)

Change Bucket Size: Reset

	Bucket Sizes	Limits	Description
1	2	2	$x < 2$
2	4	6	$2 \leq x < 6$
3	8	14	$6 \leq x < 14$
4	16	30	$14 \leq x < 30$
5	32	62	$30 \leq x < 62$
6	64	126	$62 \leq x < 126$
7	128	254	$126 \leq x < 254$
8	256	510	$254 \leq x < 510$
9	512	1,022	$510 \leq x < 1022$
10	1,024	2,046	$1022 \leq x < 2046$
11	2,048	4,094	$2046 \leq x < 4094$
12	4,096	8,190	$4094 \leq x < 8190$
13	8,192	16,382	$8190 \leq x < 16382$
14	16,384	32,766	$16382 \leq x < 32766$
15	32,768	65,534	$32766 \leq x < 65534$
16	4,294,901,761		$x > 65534$

Post-test Results and the Results Reporter

- Results are saved to a standard .db database format
- Then they can be viewed with Results Reporter:
 - Templates format results into test reports
 - Results reports can be exported to PDF, XLS, CSV or HTML
 - SQL queries can be used to examine specific result fields
- Alternatively they can be manipulated with SQLite



Generator Aggregate Statistics

The following statistics are available for the generator on each port (rates are available for each statistic)

- Generator Frames
- Generator Octets
- Generator Signature Frames
- Generator Signature Octets
- Generator CRC Error Frames
- Generator L3 Checksum Errors
- Generator L4 Checksum Errors
- Generator IPv4 Frames
- Generator IPv6 Frames
- Generator VLAN Frames
- Generator MPLS Frames
- Generator Undersized Frames
- Generator Oversized Frames
- Generator Jumbo Frames

Port Aggregate Statistics

The following statistics are available for each port (rates are available for each statistic)

- Tx and Rx Frames
- Tx and Rx Octets
- Rx FCS Error Frames
- Rx IPv4 Checksum Errors
- Rx TCP Checksum Errors
- Rx UDP Checksum Errors
- Rx PRBS Filled Octets
- Rx PRBS Bit Errors
- Total IPv4 Frames
- Total IPv6 Frames
- Total Tx MPLS Frames
- Rx IPv4 Frames
- Rx TCP Frames
- Rx UDP Frames
- Rx MPLS Frames
- Rx ICMP Frames
- Rx VLAN Frames
- Rx Oversized Frames
- Rx Jumbo Frames
- 8 user-defined counters/triggers

Control Plane Statistics

The following statistics are available for the CPU (“control plane” or “stack”) on each port (rates are available for each statistic)

- Tx and Rx CPU Frames
- Tx and Rx CPU Octets
- Tx and Rx CPU IPv4 Frames
- Tx and Rx CPU IPv6 Frames
- Tx and Rx CPU ARP Requests
- Tx and Rx CPU ARP Reply
- Tx and Rx CPU ICMP Echo Requests
- Tx and Rx CPU ICMP Echo Replies

Stream Analysis

The following statistics are available for each stream; it depends on the Analyzer “mode” though.

- Tx/Rx Frames (rate)
- Tx/Rx Bytes (rate)
- Packet Loss (rate)
- In Order Packets (rate)
- Reordered Packets (rate)
- Duplicate Packets (rate)
- Late Packets (rate)
- Dropped Packets (rate)
- In Sequence Packets (rate)
- Out of Sequence Packets (rate)
- First and Last Arrival Time
- Min/Max/Ave Inter-arrival Time
- Min/Max/Ave Latency
- Min/Max/Ave Jitter
- Histograms (inter-arrival time, latency, jitter, frame length, sequence run length, sequence difference check)
- Invalid FCS (rate)
- IPv4 Errors (rate)
- TCP/UDP Errors (rate)
- PRBS Errored Bits and Fill Bytes (rate)

RED = always trackable, even without the signature field; think custom analyzer filters!



Thank You

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