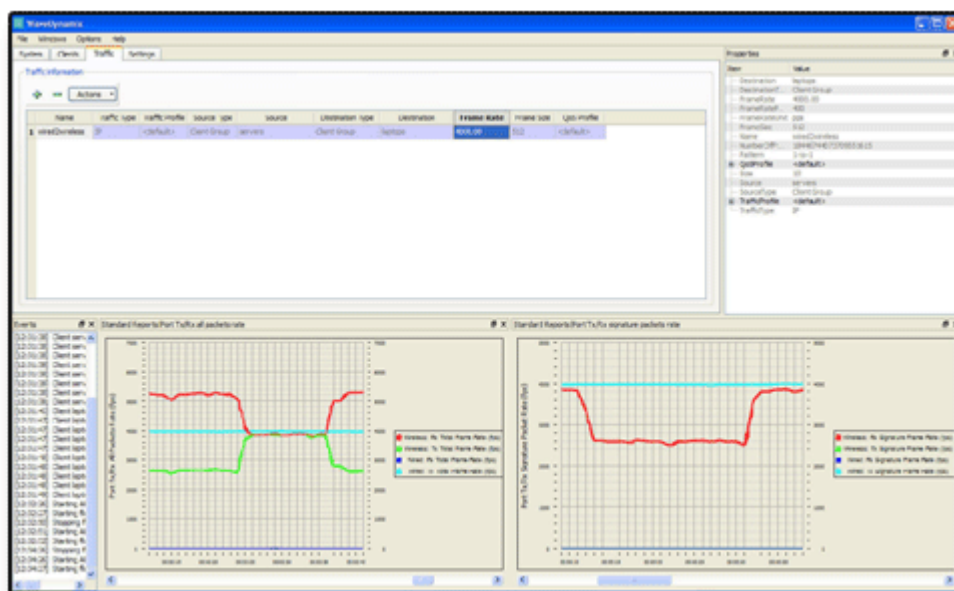


**WaveDynamix** - is an application that works with the WaveTest system to help development and test engineers at network equipment manufacturers and service providers quickly create a broad range of functional and scalability tests for 802.11 and Ethernet devices. The base 802.11 and 802.11n standards, at over 1500 pages in combined length, encompass a great deal of complexity, demanding that any quality product must be thoroughly tested to verify performance and stability. WaveDynamix™ greatly simplifies this process by allowing functional components to be easily tested in isolation and then integrated and tested as part of the complete system.



## Benefits

- **Exploratory Testing:** It is often clear that a device under test is not producing the expected results, but the cause of the unexpected behavior can be difficult to isolate. Some experimentation is necessary to identify the source of the problem before a fix can be created or a more formal regression suite can be introduced. WaveDynamix provides customers with a flexible and efficient tool to trial different test conditions and examine responses both in the test equipment and in their device.
- **Over-time Results:** Many problems in wireless networks can be traced to the stateful interaction between clients and servers, and show up as system instabilities. WaveDynamix provides the user the ability to create these dynamic interactions and to view the device's response over time. The network's ability to gracefully handle these various conditions is critical to delivering a high quality system.
- **Functional Testing:** The granular control of WaveDynamix makes it very easy to support a variety of functional and negative testing. The interactive control of WaveDynamix allows the user to halt the state changes in the test bed and to verify that the DUT is in the proper state during each step of the test. In addition to identifying functional failures, this capability of WaveDynamix also facilitates rapid identification of the cause of any functional failures.
- **802.11n Testing:** For 802.11n networks to approach the advertised rates of the technology, it is necessary to understand how well each acceleration mechanism works independently and as part of a standard configuration. WaveDynamix enables users to quickly assess the static and dynamic performance of 802.11n networks with a variety of client types, traffic flows, QoS configurations, and physical layer conditions in all stages of product development.

## Key Features

- **Decoupled Management and Data Planes:** WaveDynamix is the first 802.11 test tool that allows the tester to control the management plane and the data plane independently providing unprecedented control. This capability can be particularly useful for hardware engineers who can send and receive frames without first having to form an association between a client and an access point.
- **Highly Interactive Interface:** Networks are highly dynamic and intelligently respond to changes in the network conditions. Testers can easily change network conditions on the fly, by adding new clients or changing flow rates, and immediately view the results in real-time charts and graphs.
- **Generate Normal and Custom Traffic:** Users can generate either fully compliant UDP or stateful TCP traffic, or create fully customized packets independently or concurrently. For developers, the custom frame capability can be very useful to test content-specific features such as filters and rogue AP detection. Custom frames can also be used to generate DoS attacks on a network infrastructure while simultaneously viewing the forwarding behavior of compliant traffic.
- **Integrated Troubleshooting:** A wealth of diagnostic information and troubleshooting tools are available to facilitate rapid problem identification and isolation. An integrated capture/decode capability runs on every port during the test session and allows users to view physical and logical layer information in the protocol decodes using the VeriWave radio tap header whenever there is an unexpected event.

## Port Specifications

Port Type	802.11 or Ethernet
Ethernet autonegotiation	On, forced, or manual
Ethernet speed	10,100 or 1,000 Mbps
Ethernet duplex	Half or full
802.11 channel	1-14, 21, 25, 36, 40, 44, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 149, 153, 157, 161, 165 or deferred to client configuration
802.11 contention	On or off
<b>Event and Event Rate Counters</b>	<b>All Counters Maintain an Event Count and One Second Rate Per Port Unless Otherwise Noted</b>
Addressing	Tx/Rx unicast, tx/rx multicast, and tx/rx broadcast frames
Basic	<ul style="list-style-type: none"> <li>• Tx/Rx total, tx/rx signature, tx/rx FCS errored, tx failed, tx failed ACKs, rx beacon and rx PAUSE</li> <li>• 1&gt;Tx / Rx total rate in Mbps</li> <li>• Min, max, 1 second average, and total test average latency in mS</li> </ul>
<b>Statistical Chart</b>	<b>All Charts Display Per Port Results Once Per Second</b>
Available Charts	Tx/Rx all frames rate (fps), tx/rx all frames rate (Mbps), tx/rx signature frame (fps), tx/rx average signature frame latency over the last 1 second

## Client Specifications

Client Type	802.11 or Ethernet
802.11 client PHY	802.11ag, 802.11b, or 802.11n
802.11ag or 802.11b settings	Tx Flow Bit Rate, Tx Management Bit Rate, Tx Power, Frame Error Rate
802.11n MCS index	0 - 23
802.11n bandwidth	20 or 40 MHz
802.11n guard interval	Short or standard guard interval
802.11n A-MPDU aggregation	Enabled or disabled
802.11n channel model	Bypass or IEEE models A-F
<b>802.11 MAC</b>	
CTS-to-self	Enabled or disabled
Management retries	0 - 10
Data retries	0 - 10

## Client Specifications

### 802.11 Performance

Probe before association	Unicast, broadcast or disabled
Reauthenticate if deauthenticated	Enabled or disabled
Advertise WMM support	Enabled or disabled
Power save	Enabled or disabled
Power save listen interval	1 – 65535 beacon intervals
WMM uAPSD	Enabled or disabled
WMM uAPSD service period length	Request delivery 2, 4, 6, or all buffered frames per service period

### Layer 2 General

MAC address	Fully configurable
-------------	--------------------

### Layer 2 802.11

SSID	Fully configurable
Channel	1-14, 21, 25, 36, 40, 44, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 149, 153, 157, 161 or 165
Authentication	Open, shared, WPA, WPA2, DWEP or LEAP
Encryption	None, WEP40, WEP104, TKIP, AES-CCMP
Type	PSK, EAP-TLS, EAP-TTLS, PEAP-MSCHAPv2, LEAP, EAP-FAST
Credentials	Credentials fully configurable by client, configurable parameter determined by encryption and type

### Layer 2 Ethernet

VLAN tag	Enabled or disabled
VLAN ID	0 - 4094
VLAN CFI	Enabled (1) or disabled (0)

### Layer 3

Address acquisition	DHCP or static
ARP timeout	1 – 20,000 mS, configurable to 1 mS resolution

### Static IP Addressing

IP address	Fully configurable
Subnet mask	0 to 32 bit netmask
Default gateway	Fully configurable
Authentication	Open, shared, WPA, WPA2, DWEP, or LEAP

### Event Counters

Client statistics	<ul style="list-style-type: none"> <li>• ARP handshakes: successful, failed and retries</li> <li>• DHCP handshakes: successful, failed and retries</li> <li>• Authentication handshakes: successful, failed and retries</li> <li>• Association handshakes: successful, failed and retries</li> <li>• Probe handshakes: performed and retried</li> <li>• Tx Pings, Rx Pings, Rx Deauthentication frames, and Rx Disassociation frames</li> </ul>
-------------------	---

## Traffic Specifications

### Traffic General

Traffic type	IP or custom
Intended frame rate	1 – 1,488,095

# Traffic Specifications

<b>Custom traffic</b>	
Custom frame contents	Fully specifiable except IEEE 802.11 sequence number and frame control fields and FCS fields on Ethernet and 802.11 interfaces
Custom traffic source	Any port in the test configuration
<b>IP Traffic</b>	
Frame size	64 – 1518 bytes
IP traffic source	Client or client group
IP traffic destination	Client, client group or user-specified IP address
L4 protocol	ICMP, UDP or stateful TCP
TCP source port	1 - 65535
TCP destination port	1 - 65535
TCP window size	2 - 65535
UDP source port	1 - 65535
UDP destination port	1 - 65535
ICMP type	Echo request, echo reply, destination unreachable, source quench, redirect
ICMP code	0 - 255
<b>L4 Payload Fill</b>	
Mode	Fixed or repeating
Contents	Custom, all zeroes, all ones, F0:F0:F0:F0, A0:A0:A0:A0, 70:70:70:70, or 50:50:50:50
<b>QoS</b>	
	<b>Configurable per Flow</b>
State	Enabled or disabled
WMM or VLAN user priority	0 - 7
WMM EDCA parameters	Adopt from BSS advertisements, or manually specify AIFSN, ECWmin, ECWmax, and retry limit
WMM ADDTS handshake	Enabled or disabled
TSPEC configurable parameters	TID / TSID, nominal MSDU size, minimum PHY rate, mean data rate, surplus bandwidth allowance, and flow direction
IP diffserv	Enabled or disabled
IP DSCP	0 - 63
<b>Event Counters</b>	
	<b>Counters Maintained per Flow Since the Start of the Test Session Unless Otherwise Noted</b>
Flow statistics	<ul style="list-style-type: none"> <li>• Tx/Rx counters: frames, frame rate, frame bytes, IP packets, IP bytes</li> <li>• Offered load (Mbps), forwarding rate (Mbps)</li> <li>• Instantaneous packet loss and instantaneous packet loss rate</li> <li>• Packet loss, lost n sequential frames (n=2, 3, 4, and 5)</li> <li>• Max Latency, total latency, average latency over last 1 second, latency of last rx frame (mS)</li> <li>• Rx out of sequence frames, sequence number of last rx frame</li> <li>• Rx frames with bad payload</li> <li>• Rx smoothed inter-arrival jitter (mS)</li> </ul>
Statistical tables	Multiple flow statistics are updated once per second in a tabular view
Number of flows in table	1 - 16
Data displayed per flow	Any of the flow statistics
Statistical charts	All charts display per flow results once per second
Number of flows in table	1 - 16
Flow statistics	Tx frame rate, rx frame rate, Rx smoothed inter-arrival jitter (mS), packet loss, packet loss rate, lost n sequential frames (n=2, 3, 4, and 5), offered load (Mbps), forwarding rate (Mbps)