veriwave™

WaveTest™ 90 / WaveTest™ 20
Multi-Client Traffic Generator / Performance Analyzer

WaveTest is a powerful Traffic Generator / Analyzer capable of generating thousands of independent client sessions, each representing a unique user of the network. It offers native IEEE 802.11 a/b/g/n interfaces as well as 10/100/1000 Mbps Ethernet interfaces. Using WaveTest, network traffic can be accurately, repeatedly and precisely created. WaveTest offers unique insight into the functionality, quality and performance of the network, or network component, under test.

Minimize Cost of Ownership
- Reduce test time from days to minutes
- Increase test coverage
- Reveal bugs early in QA cycle

Automation – 10x More Efficient
- Run hundreds of tests unattended
- Uninterrupted operation for extended periods of time
- Complete control over large scale deployment scenarios

Repeatability = Confidence
- Get to root cause & solve problems faster
- Avoid pitfalls when testing with off-the-shelf clients

Go Beyond Conformance & Interoperability
- Scale to thousands of stateful and independent clients
- Quantify real world deployment scenarios
- Stress test a complete WLAN network

WaveTest 90

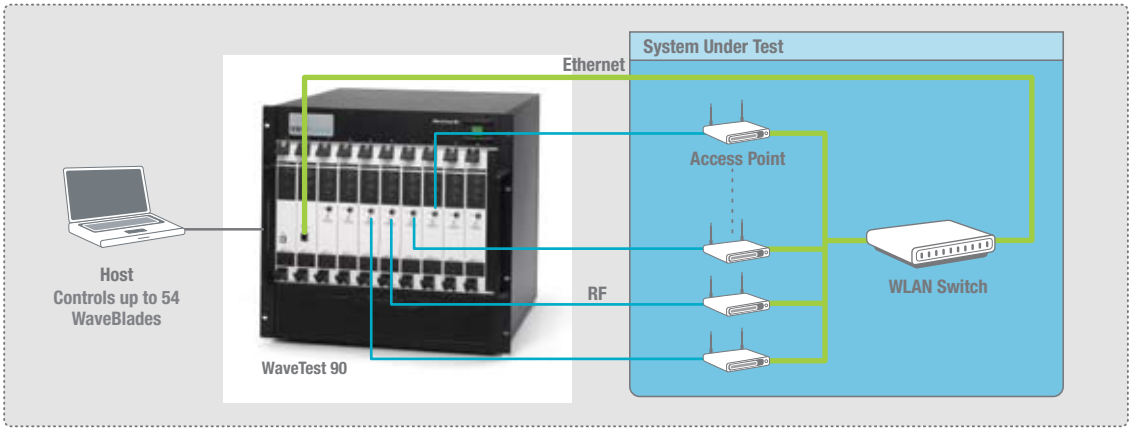
WaveTest 20

Large Scale Testing

WaveTest is a chassis-based test system which utilizes individual WaveBlades for traffic generation and analysis:

- Each WaveBlade supports up to four independent traffic generator / performance analyzers depending upon the WaveBlade model
- Each traffic generator / performance analyzer emulates up to 500 WLAN or 1000 Ethernet clients across single or multiple subnets
- Each WaveTest 90 supports up to 9 WaveBlades with a combined capacity of 18,000 individual WLAN clients (STAs)
- Unprecedented network scale can be achieved by daisy-chaining WaveTest 90 chassis to generate traffic from tens of thousands of clients
- Generate and analyze traffic between WLAN clients and Ethernet clients / servers or mobile WLAN clients
- Gigabit Ethernet traffic generation and analysis at full wire-speed
- Multiple traffic flows per client are supported with each flow offering stateful traffic at layers 2 through 7
- Real-time port statistics, per flow statistics, packet filters, triggers and capture capabilities for precise analysis
- Built-in client mobility allows precise roaming of each and every client between any Access Points, at pre-determined time or power settings

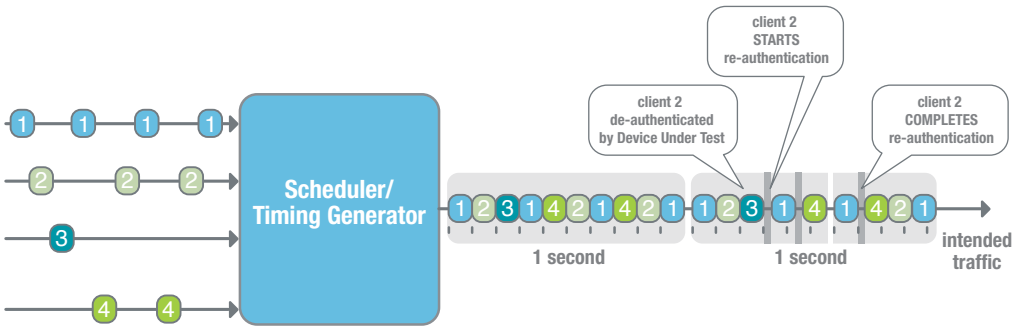
Typical setup supports testing of tens of Access Points and multiple WLAN switches



Real-World Stateful WLAN Client Traffic Generation

- The WaveBlade traffic scheduler offers fully interleaved traffic flows, creating real mobile clients contending for the shared medium
- The traffic scheduler dynamically adjusts offered load to approximate intended load with load resolution of better than 0.5%
- Client contention can be precisely emulated, guaranteeing real-world behavior in every test iteration
- Client behavior is individually controlled providing accurate control of 802.11, 802.3, and IP characteristics, including power, medium access control, authentication and encryption, frame size and rate

Scheduler interleaves traffic flows contending for the shared medium



Anatomy of a VeriWave Stateful Client

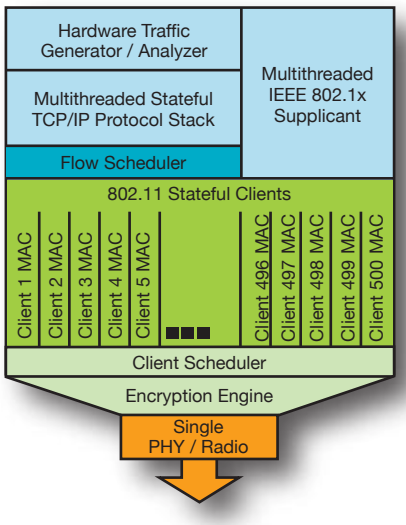
- Each client supports the full MAC per 802.11 standard
- 802.1X supplicant supports full EAP stack per client
- Upper layer protocols (e.g., DHCP and TCP) are implemented using independent protocol state machines
- All state machines for all clients run concurrently
- Every client independently updates its state based on channel conditions e.g. 802.11n clients using protected-mode when .11g is detected
- Each Stateful client implements:
  - Carrier deference
  - Collision sensing
  - Random back-off
  - Retransmission
  - Collision emulation
- Multi level scheduler enables optimum channel utilization, multiple traffic flows per client, and mixing of Constant Bit Rate voice/video traffic with Best Effort data traffic

Stateful Behavior of Every Client

- Layer 2 - 802.11
  - Fully Stateful MAC implementation as per IEEE 802.11
- Layer 4 - TCP/IP
  - Fully Stateful implementation as per IETF RFC-793, with TCP congestion control (as per IETF RFC-2581), including slow start, congestion avoidance, fast retransmit, and fast recovery
  - Line / air rate TCP traffic generation / analysis on every WaveBlade port
  - Per flow / client independent state machine
  - 1,000 Stateful TCP flows maintained, per WaveBlade port
- Comprehensive set of TCP connection stats
- WiMix - Real world vertical industries deployment scenarios provides pre-configured and easy to model real-world deployment scenarios to study end-users QoE (Quality of Experience)

Advantages

- Exercise and stress AP client state table with various client connection speeds and RSSI levels at unprecedented scales
- Verify AP's ability to handle concurrent 802.1x port authentications and 802.11i key handshakes for high client loads
- Qualify effectiveness of IDS/IPS and DoS security policies and their impact on AP performance
- Evaluate AP's 802.11e/802.1D/VLAN/SSID based QoS mechanisms to prioritize different traffic types
- Assess robustness of AP's buffer management and load balancing schemes with clients at different power management, FER levels, data rates
- Quantify AP's data plane performance using flow packets of different sizes, protocol types, encryptions and rates



Accurate and Scalable Performance Analysis

Ease of Use

- The WaveTest offers four fully-integrated use-models:
  - WaveDynamix - A user interface offering comprehensive, real-time control and results for functional testing
  - WaveApps - Fully automated tests offering rapid configuration and test result gathering for a variety of test modules including: benchmarking, QoE analysis, roaming, VoIP, and mesh network analysis
  - VCL (VeriWave Command Library) - Programmatic control, test configuration, statistics, and reporting functions are supported via this common library that is accessible via Tcl, Perl, and Python
  - WaveAutomation - Creates a complete regression test setup to run hundreds of test cases, unattended and with minimal effort
- Configuration data, test control, and results are all seamlessly transferable between all use models
- Test results are collected and displayed using an extensive set of predefined counters, user defined counters, triggers and filters, as well as a 256 MB capture buffer per WaveBlade
- Comprehensive, management level reports are created automatically in PDF format at the conclusion of each test, and include:
  - Test details: date, version numbers, etc.
  - Measured results
  - Expected results
  - Explanation of how to interpret results

Testing the Issues that Matter Most

WaveTest system applications are broadly classified into five categories:

Data Plane Test Applications

- Unicast Throughput
- Unicast Forwarding Rate
- Unicast Packet Loss
- Unicast Latency
- Multicast Forwarding Rate
- Multicast Roaming
- TCP Goodput
- Power Save Throughput

Control Plane / Security Applications

- Roaming Benchmark
- Roaming Stress
- Client Association Database Capacity
- AP Load Balancing
- Connection Stress Test
- Concurrent Connections Test
- Thin AP Failover Test
- 802.11 Frame Generator / Attack Generator
- AAA Server / RADIUS Authentication Capacity
- Multicast Roaming
- TCP Goodput
- Power Save Throughput

End-User QoE (Quality of Experience) Including Voice & Video

- WiMix – Real world deployment scenarios & measurement of end-user QoE
- VoIP Call Capacity
- VoIP Service Assurance
- QoS Service Differentiation
- Roaming Service Quality (VoIP Roaming)

Muni Wi-Fi Mesh Application

- Mesh client capacity
- Mesh VoIP Call Capacity
- Mesh Throughput Per Hop
- Mesh Forwarding Rate Per Hop
- Mesh Latency Per Hop
- Mesh Backhaul Failover (self-healing)
- Mesh Backhaul Impairment Performance: Throughput
- Mesh Backhaul Impairment Performance: Latency

Hybrid Application

- Hybrid testing facilitates interoperability testing with WLAN 802.11 client devices
- Hybrid testing provides a controlled environment that allows the user to define a traffic model
- Key Focus Areas:
  - VoWLAN handsets
  - RFID tags
  - Laptop / PC clients
  - Mixed residential scenarios
  - Healthcare environments

VeriWave Master Test Plan

The VeriWave Master Test Plan for Wireless LANs establishes guidelines, best practices and baseline evaluation criteria for testing the performance and scalability of wireless equipment. The plan outlines the goals, procedures, and expected results for thousands of unique test cases while offering insight into the behavior and performance of Wireless LANs. The Master Test Plan offers the flexibility of selectively choosing the most appropriate individual tests needed to verify the functionality and performance of each unique system under test. The guide addresses every aspect of required network testing, from functional verification, performance measurement and network capacity assessment, to system testing, and stress testing

Ordering Information

WT90	WaveTest 90 - 9 slot chassis, 19”rack-mountable
WT20	WaveTest 20 - 2 slot chassis, portable
WBW2000	WaveBlade WiFi 802.11n - 3x3 MIMO multi-client traffic generator / performance Analyzer with on-board channel emulator
WBW1104N	4-port WaveBlade WiFi 802.11 a/b/g and 802.11n SISO - multi-client Traffic Generator / Performance Analyzer for WiFi networks
WBW1104	4-port WaveBlade WiFi 802.11 a/b/g - multi-client Traffic Generator / Performance Analyzer for WiFi networks
WBW1101	1-port WaveBlade WiFi 802.11 a/b/g - multi-client Traffic Generator / Performance Analyzer for WiFi networks
WBW1101P	1-port High-Power WaveBlade WiFi 802.11 a/b/g - multi-client Traffic Generator / Performance Analyzer for WiFi networks
WBE1104	4-port WaveBlade Ethernet - multi-client Traffic Generator / Performance Analyzer for 10/100/1000 Mbps Ethernet networks
WBE1101	1-port WaveBlade Ethernet - multi-client Traffic Generator / Performance Analyzer for 10/100/1000 Mbps Ethernet networks
WB1000	WaveBlade Management
WaveDynamix	Graphical user-interface - provides functional and behavioral test capabilities
WaveApps	Automated testing packages include: IEEE Benchmarking, VoIP QoS Service Assurance, WaveQoE, Roaming, WaveClient
VCL Library	Control the WaveTest system using popular programming languages through this API
WaveAutomation	Provides a framework for comprehensive user control and programmability of the WaveTest system and the system under test
WCH1000, WCH1100, WCH2000, WCH2100, WCH3000, WCH3100, WCH3600	RF Isolation Chambers

WT90

WT20

WBW2000

WBW1104N

WBW1104

WBW1101

WBW1101P

WBE1104

WBE1101

WB1000

WCH1000

WCH1100

WCH2000

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