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IEEE802.11T – WLAN Test Methods and Metrics

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Until now the surge of wireless networking has been largely confined to the SOHO market, where performance has taken a second place to cost. The new applications for the WLAN industry are voice and video – services that depend on performance. Formally defining performance test methods and metrics is a timely and important undertaking. Proper testing will shine the light on performance issues and will help the WLAN industry to expand into the emerging cellular and streaming video markets.

Testing of 802.11 devices and systems for performance and stability is a challenge for the industry because complexity of the 802.11 protocol brings with it complexity of test and this complexity is further compounded by the inherent mobility of the wireless devices and by the prevalence of RF interference.

In July, 2004 the IEEE802 committee has formed the IEEE 802.11T Task Group to develop a test specification document, "Recommended Practice for the Evaluation of 802.11 Wireless Performance". By forming 802.11T, the IEEE community has acknowledged the need to standardize test metrics and methods to provide the end user with an objective means of evaluating functionality and performance of 802.11 products.

The efforts of 802.11T are driven by the industry giants such as Dell, Microsoft, Intel, Broadcom and by WLAN test equipment leaders like Azimuth Systems.

802.11T document overview

The 802.11T document defines test metrics in the context of use cases. Three principal use cases are:

- Data use case
- Latency-sensitive use case
- Streaming media use case

Data use case

Data applications do not impose critical requirements on the network and include applications such as web downloads, file transfers, file sharing, e-mail, etc. Data-oriented traffic is typically transmitted using low priority. Performance test metrics important for data use case include:

- throughput vs. range
- access point capacity
- access point throughput per client

Latency-sensitive use case

The latency-sensitive applications are time-critical applications such as VoIP over WLAN. QoS requirements for these applications include limits on:

- Voice quality (latency, jitter, packet loss) vs. range
- Voice quality vs. network load
- Voice quality vs. call load
- BSS transition (roaming) time

Streaming media use case

The streaming-media applications include real-time audio/video streaming, stored content streaming and multicast high-definition television streaming. These applications require the most stringent quality of service including bandwidth and latency guarantees. Performance metrics include:

- video quality (throughput, latency, jitter) vs. range
- video quality vs. network load

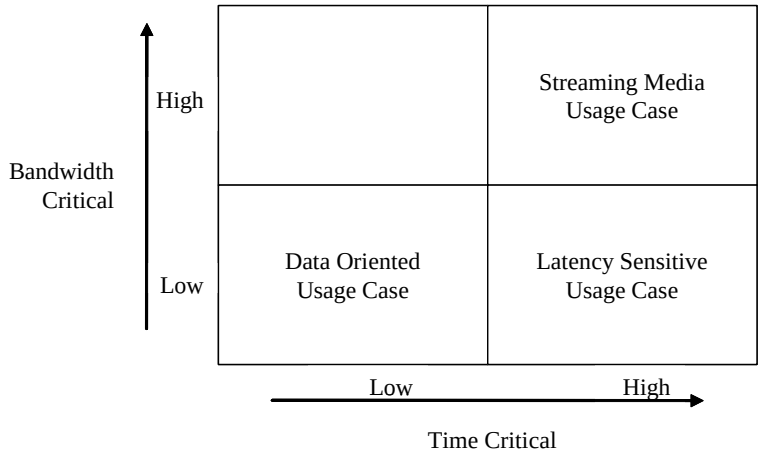

Figure 1: Use cases covered by the IEEE802.11T test metrics and methods specification

The 802.11T document specifies 802.11 performance test metrics and test methodology for each metric. The use cases reference one or more of these metrics and this enables users to determine what measurements are important for their applications and how to make these measurements.

The metrics are classified as primary and secondary. Primary metrics directly impact the user experience, as for example voice quality. Secondary metrics impact the primary metrics, as for example latency, jitter and packet loss impact voice quality.

Test environments

The 802.11T document defines conducted and over-the-air test environments. Most of the tests currently in the draft require conducted environment for emulation of motion and repeatability of measurements.

In a conducted environment each device in the test setup is placed in a shielded chamber for isolation. RF cables connect the antenna ports of each device to other devices through programmable attenuators (figure 2). The attenuators emulate distance by virtue of controlling the path loss among devices in the test setup. Shielding and filtering are

employed to protect the test setup from outside interference and to achieve device to device isolation.

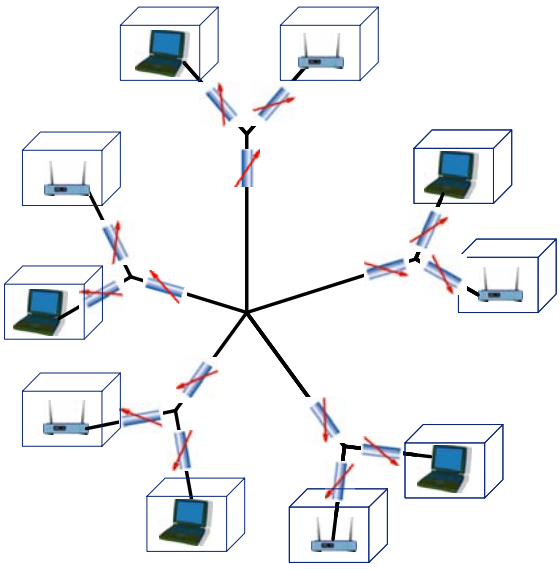

Figure 2: Devices connected in a conducted test setup through programmable RF attenuators. RF cables connect to the 50 ohm antenna ports of the devices with antennas removed. Programmable attenuators emulate physical distance among devices and motion.

Device isolation eliminates signal paths other than through the attenuators. Isolation between any two devices in a test setup must be greater than 110 dB due to the wide dynamic range of 802.11. Such isolation is difficult to achieve, particularly in the 5 GHz band.

Test metrics

Table 1: Metrics currently specified in the 802.11T draft document

	Test description	**Test environment**
Throughput vs. path loss/conducted	Measurement performed on clients, APs or systems of clients and APs to determine throughput of the DUT/SUT as a function of path loss	conducted
Throughput vs. path loss and range/over the air	Measurement performed on clients, APs or systems of clients and APs to determine throughput of the DUT/SUT as a function of path loss or distance	over the air
BSS transition	Measurement performed on clients, APs or systems of clients and APs to determine roaming time as	conducted

	client moves from one AP to another	
Fast BSS transition	Measurement performed on clients, APs or systems of clients and APs to determine roaming time as client moves from one AP to another and roams according to the emerging 802.11r fast BSS transition specification	conducted
Antenna diversity	Measurement performed on clients or APs to determine the performance of the antenna diversity algorithm used to optimize throughput	conducted
Adjacent channel interference	Measurement performed on clients, APs or a system of clients and APs to determine the throughput performance in the presence of adjacent channel interference	conducted
Receiver sensitivity	Measurement performed on clients or APs to determine frame error rate vs. signal level	conducted
AP capacity	Measurement performed on APs to determine the maximum number of clients an AP can associate	conducted
AP association performance	Measurement performed on APs to determine the maximum rate of association/authentication operations	conducted

Summary

The goal of 802.11T is to enable testing, comparison, and deployment planning of 802.11 WLAN devices based on a common and accepted set of performance metrics, measurement methodologies and test conditions. The document being developed by this group will supply test labs and IT managers with a solid set of standard benchmarks for WLAN networks and will help the 802.11 industry achieve the stringent requirements of the cellular and video applications.