WLAN Testing with IxChariot

Sample Test Plans

Contents

Ixia
26601 W. Agoura Road
Calabasas, CA 91302

Phone:	(818) 871-1800
Fax:	(818) 871-1805
Email:	info@ixiacom.com
Internet:	www.ixiacom.com

1. Test Overview

A number of key questions need to be answered when architecting an 802.11 network that relies on IxChariot for testing. These are:

- location of the Console, E1 and E2, both with regards to the WLAN system and for any planned attenuation testing
- the 802.11 standard supported by the WLAN access points (AP) and clients (STA) equipped with 802.11 cards (i.e. the infrastructure Basic Service Set - BSS)
- the protocols supported by the BSS (e.g. IPv6, multicast support on APs and STAs)

The following topology presents a framework for WLAN test. The BSS is a generic 802.11 b/g network (Figure 1).

IxChariot now natively supports RSSI measurements and these can be viewed

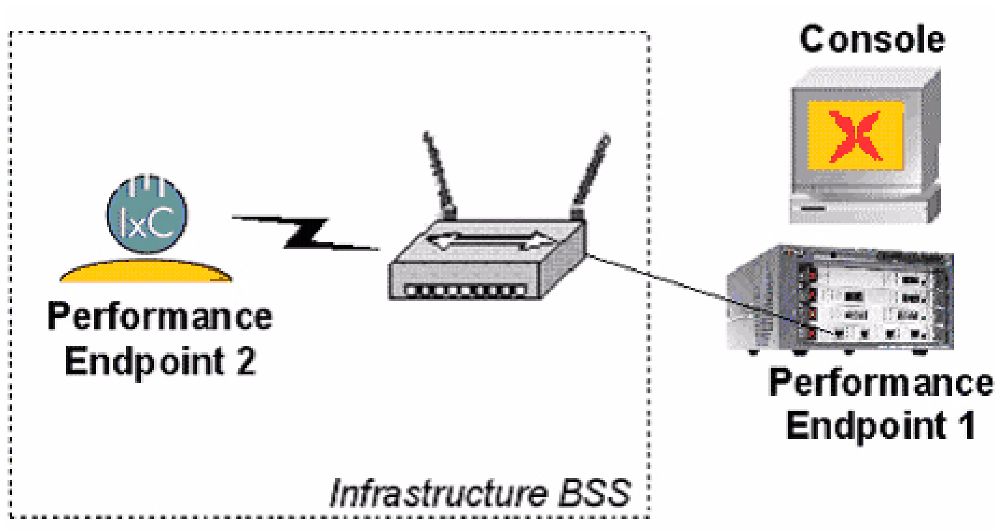


Figure 1. WLAN test topology.

2. Test results – Managing Expectations

One of the principal data points in IxChariot testing is throughput. In an 802.11 radio environment, there are a large number of factors (e.g. antenna design, scattering, interference) that need to be kept in mind when benchmarking different devices and networks. In addition, the IEEE 802.11 standard defines various physical layer rates (e.g. 802.11b = 11Mbit/s) that are important when comparing results. Due to the characteristics of 802.11 (e.g. additional data in packets such as preambles, headers), the maximum STA-level performance is always less than link-layer throughput.

	Maximum Link Rate	Maximum TCP Rate	Maximum UDP Rate
802.11b	11Mbit/s	5.9 Mbit/s	7.1 Mbit/s
802.11g (with b)	54 Mbit/s	14.4 Mbit/s	19.5 Mbit/s
802.11g (only)	54 Mbit/s	24.4 Mbit/s	30.5 Mbit/s
802.11a	54 Mbit/s	24.4 Mbit/s	30.5 Mbit/s
802.11a (TURBO)	108 Mbit/s	42.9 Mbit/s	54.8 Mbit/s

Figure 2.

3. Determine Performance of 802.11 Networks in Different Environments

Objective and Setup: A defining criterion of an infrastructure BSS is the distance from the clients to the access point. In addition, as shown above, the specific 802.11 standard that is being used in the network will influence key performance measurement criteria such as Throughput and Response Time. Any changes in the network performance parameters (throughput, response time etc.) that are suspected to be due to a change in signal strength can thus be tracked directly. This provides network designers a means to test wireless network performance as a function of the signal strength, all from a single application. Depending on the network, designers can thus decide whether particular signal strength is sufficient to run all applications the network is designed to handle.

Test Methodology:

- Place STAs in close range of 802.11b/g WLAN AP that has b only mode (Figure 1 test used .5 meters).
- Create one 802.11b pair (use 802.11b NIC) and run Filesndl application script.
- Create one 802.11g pair, change the AP to 'g only' mode and run Filesndl application script.
- Move the STAs to track RSSI vs network performance parameters from AP.
- Use Compare Test function in IxChariot. (See Figure 3a)

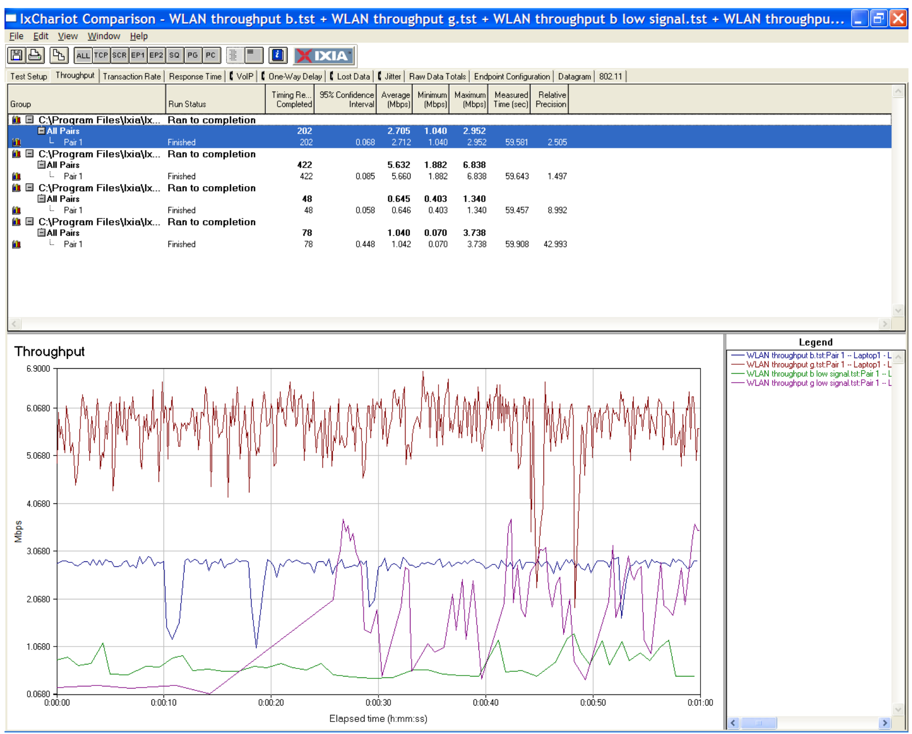


Figure 3a. Compares the performance of 802.11b and 802.11g (only) test using standard IxChariot long connection script Filesndl

Figure 3b, 3c and 3d show the relation between the RSSI and the throughput/ response time. (These are outputs takes directly as .gif files after the results were exported to an html file)
As the signal strength drops (as indicated by the dropping RSSI), the throughput is seen dropping and the response time of the wireless network increases. The timelines from left to right indicate the drop in strength and the corresponding changes in network performance parameters.

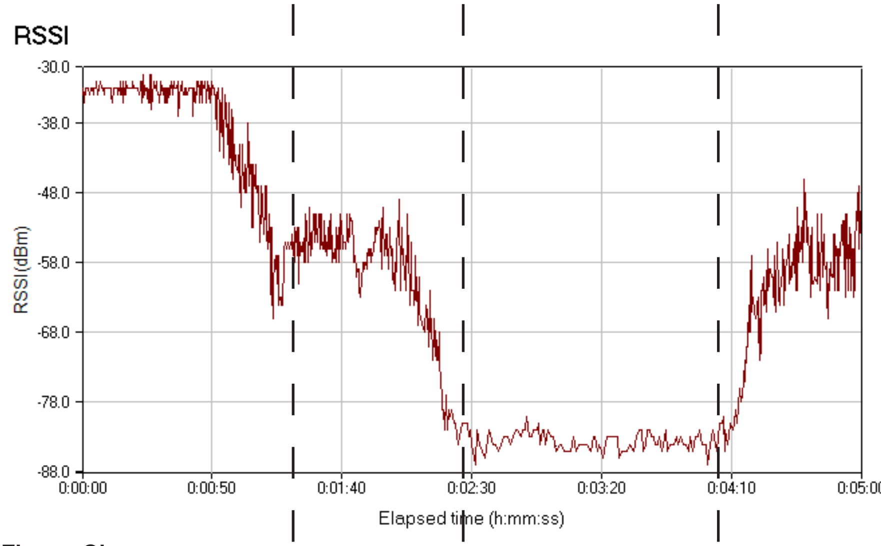


Figure 3b

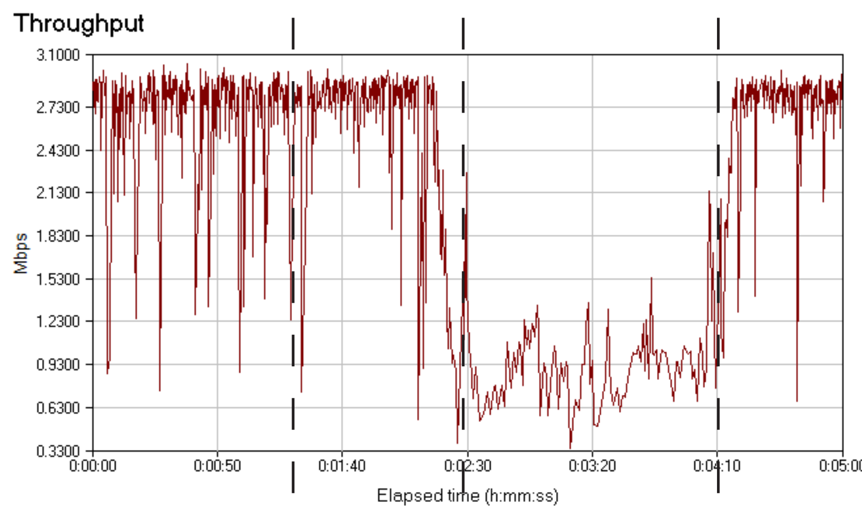


Figure 3c

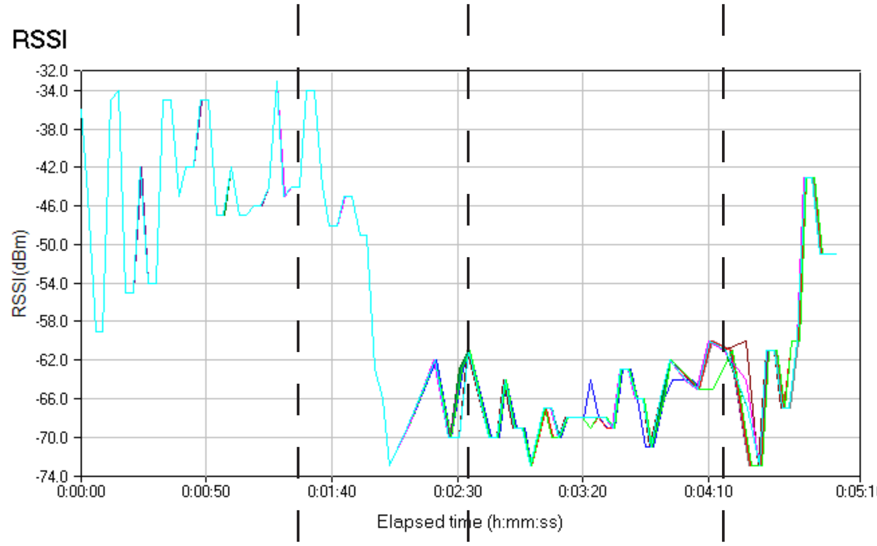


Figure 3d

4. VoWLAN Test

Objective and Setup: Regarded by many as a “killer application” for WLAN networks, VoWLAN is challenged by the mobility aspects of a wireless network and the QoS sensitivity of packetized voice. Extending the proven VoIP test functionality of IxChariot to the WLAN space is easy. As in wired networks, a key data point to measure voice quality is the MOS estimate.

Using IxChariot, the MOS score can be correlated to the signal strength of the wireless connection. In addition, the carriage capacity in terms of the mixture of application traffic may also be determined.

Test A:

- Setup series of VOIP pairs with showing acceptable MOS (e.g. 3 pairs with MOS higher than 4.).
- Setup additional pairs running Application scripts (e.g. SAP, HTTP) and show MOS score deterioration.

Figure 4a shows the average MOS estimate of 3 bi-directional VoIP pairs running across an 802.11b BSS.

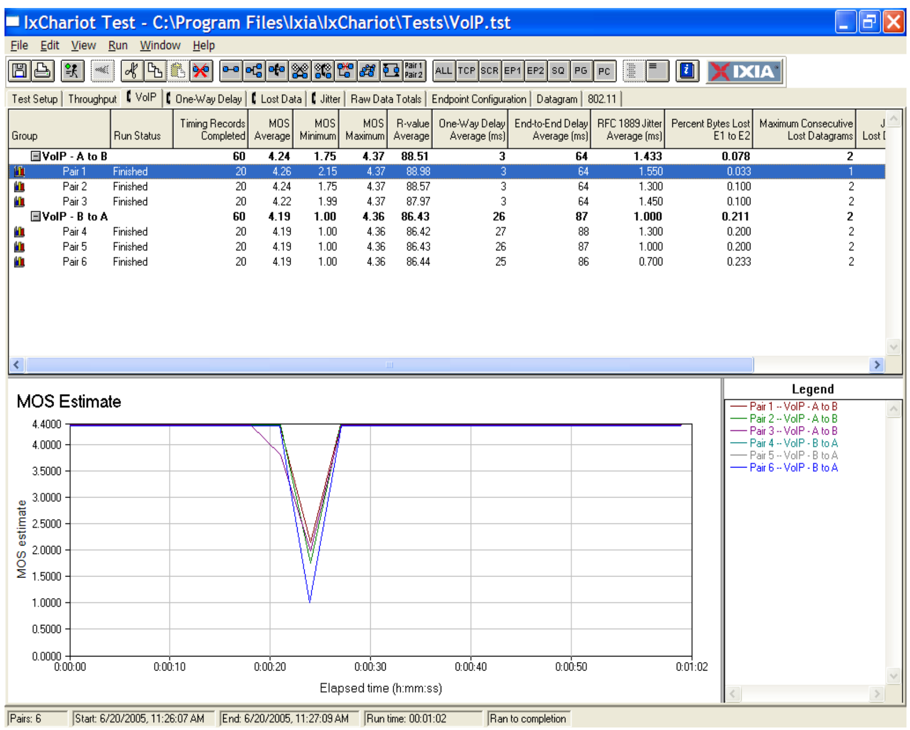
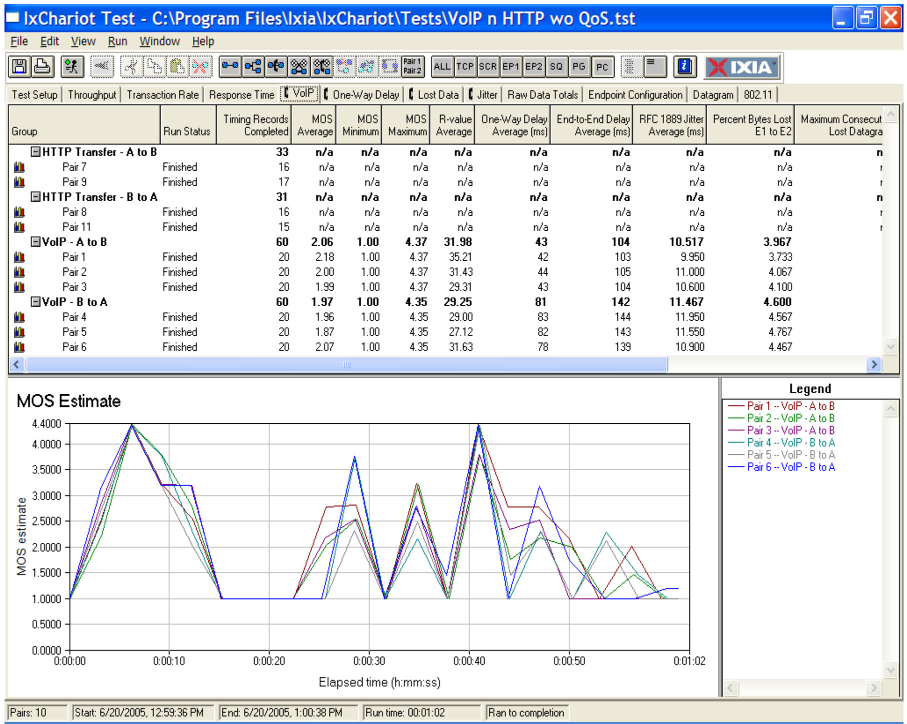


Figure 4a. Average MOS score of 4.24 for 3 bi-directional VoIP pairs

Figure 4b adds data traffic (HTTP transactions) to the VoIP traffic above and we can see the result on the MOS score (i.e 2.6).



Group	Run Status	Timing Records Completed	MOS Average	MOS Minimum	MOS Maximum	R-value Average	One-Way Delay Average (ms)	End-to-End Delay Average (ms)	RFC 1889 Jitter Average (ms)	Percent Bytes Lost E1 to E2	Maximum Consecut Lost Datagra
HTTP Transfer - A to B		**33**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n**
Pair 7	Finished	16	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	r
Pair 9	Finished	17	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	r
HTTP Transfer - B to A		**31**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n**
Pair 8	Finished	16	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	r
Pair 11	Finished	15	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	r
VoIP - A to B		**60**	**2.06**	**1.00**	**4.37**	**31.98**	**43**	**104**	**10.517**	**3.967**	
Pair 1	Finished	20	2.18	1.00	4.37	35.21	42	103	9.950	3.733	
Pair 2	Finished	20	2.00	1.00	4.37	31.43	44	105	11.000	4.067	
Pair 3	Finished	20	1.99	1.00	4.37	29.31	43	104	10.600	4.100	
VoIP - B to A		**60**	**1.97**	**1.00**	**4.35**	**29.25**	**81**	**142**	**11.467**	**4.600**	
Pair 4	Finished	20	1.96	1.00	4.35	29.00	83	144	11.950	4.567	
Pair 5	Finished	20	1.87	1.00	4.35	27.12	82	143	11.550	4.767	
Pair 6	Finished	20	2.07	1.00	4.35	31.63	78	139	10.900	4.467	

Figure 4b. MOS score drops to 2.06 with the addition of data traffic

Test B:

- Setup series of VOIP pairs with different codecs (eg. 1 bi-directional pairs per codec)
- Run test and check for MOS score variation with respect to the RSSI by increasing the distance successively.

Figure 4c shows voice pairs with different codecs (G.711u, G.729, G.723) and their effect in a WLAN environment. Some codecs may be better suited to be used at particular signal strengths than others.

We can check if a codec is acceptable at a signal strength level with its average MOS score. As the MOS score also depends on the codec used due to the delay in compression time and the dependency of the codec algorithm on packet loss, various codecs have a varying performance at the same signal strength.

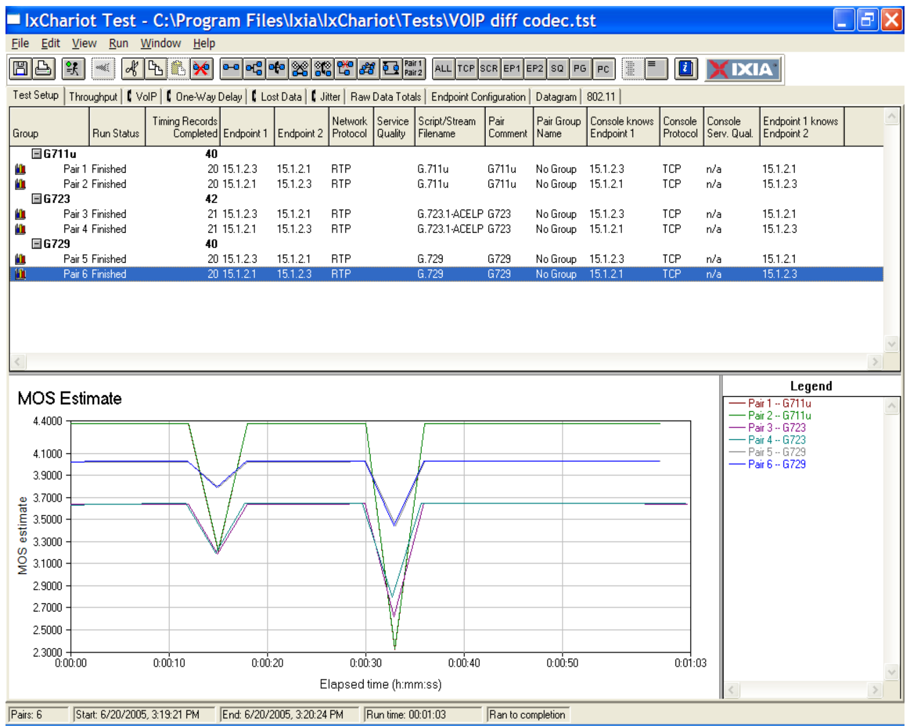


Figure 4c. MOS measurement for VoIP traffic with different codecs

Figure 4d and 4e show the relation between the RSSI and MOS score. As with the "data only" tests, the signal strength may be tied to the MOS score. A drop in signal strength may result in packet loss, increased one-way delay and hence may result in a degraded quality of voice reflected in the MOS score.

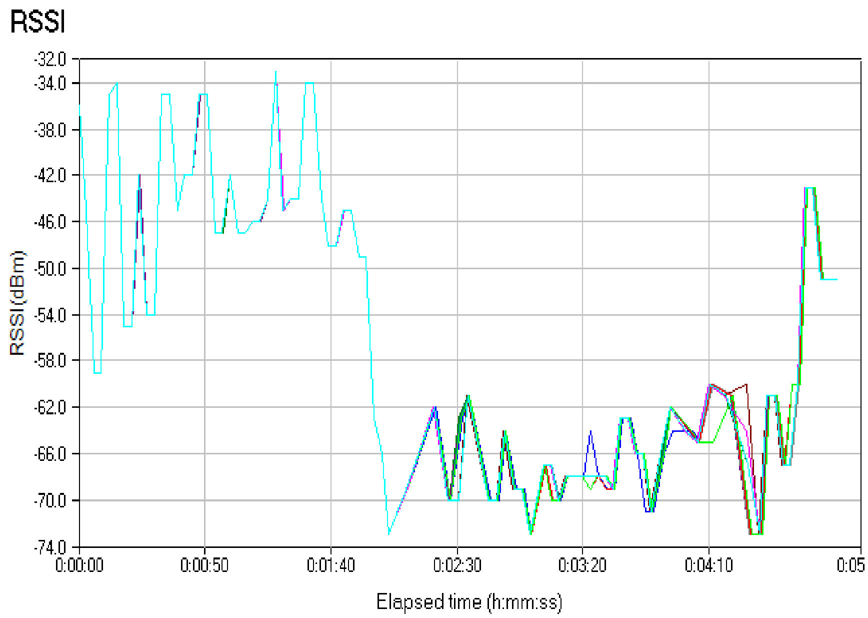


Figure 4d. RSSI measurements

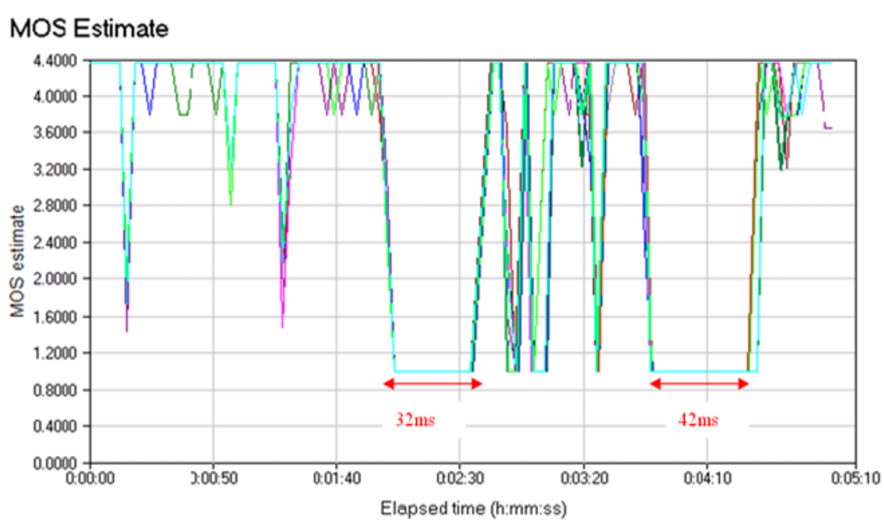


Figure 4e. MOS measurements

Test C:

- Setup series of VOIP pairs with different codecs and see the throughput of the VOIP traffic

Figure 4f shows the bandwidth consumption for each VoIP pair using multiple codecs.

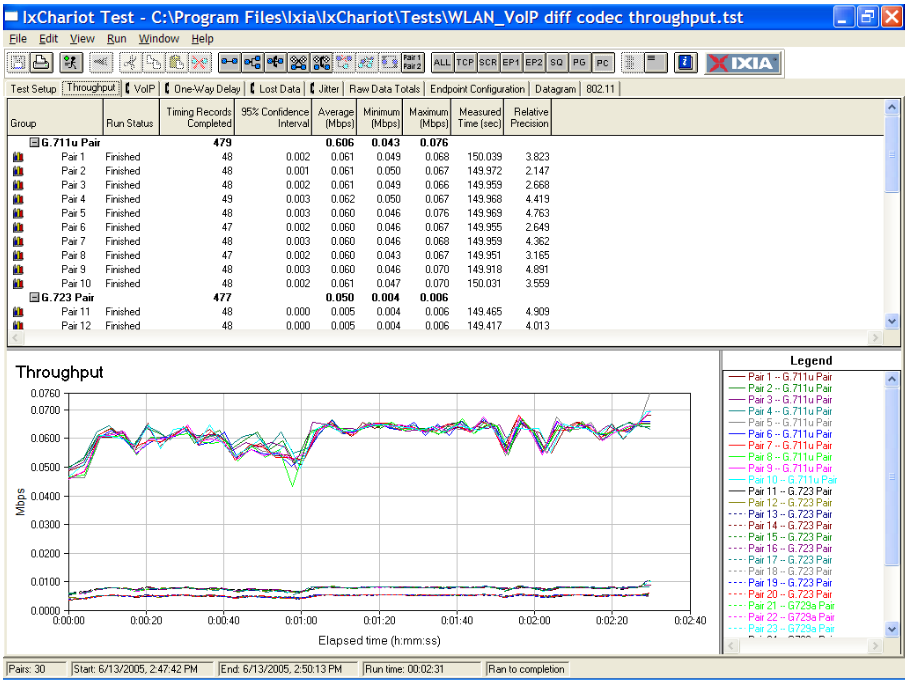


Figure 4fc.

5. Dual Stack Test

Objective and Setup: Many higher-end networking devices now simultaneously support IPv4 and IPv6 to respond to customer requirements to be future-proof for pure IPv6 networks. From a link-layer perspective, the 802.11 framing conventions used in a BSS should seamlessly support both IPv4 and IPv6 encapsulation. As shown in Figure 5, IxChariot allows you to simultaneously run both IPv4 and IPv6 traffic through the WLAN to the client, thus testing the dual stack capabilities of both the AP and the STA.

Test Methodology

- Setup one IPv6 pair. Run test.
- Setup additional IPv4 pair. Run test.

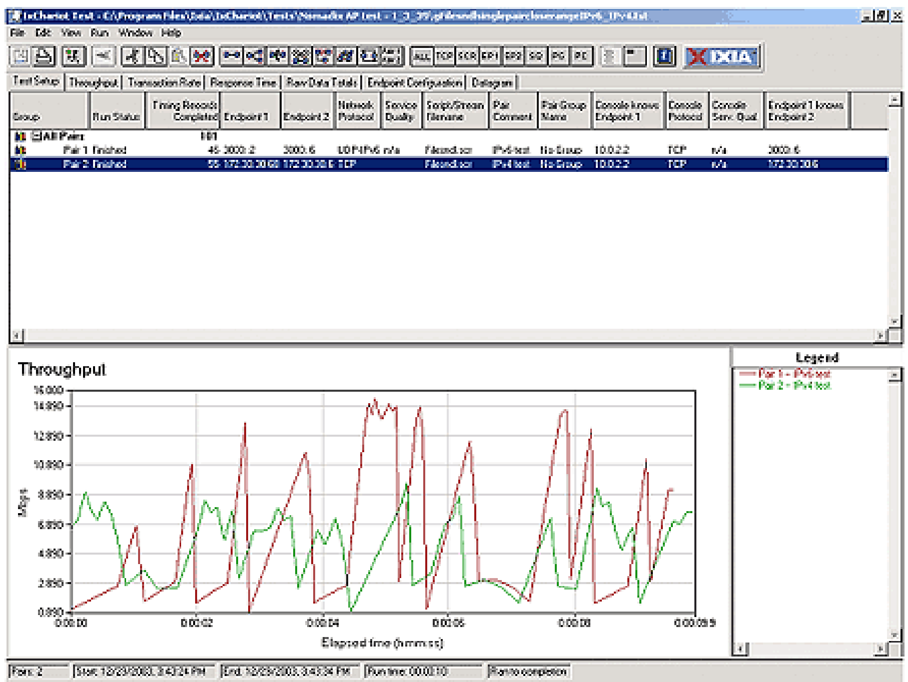


Figure 5