

# 802.11n gear 10 times faster than current Wi-Fi offerings

Throughput tops 250Mbps in groundbreaking test; BlueSocket wins

**BY DAVID NEWMAN, NETWORK WORLD TEST ALLIANCE**

Testing 802.11n wireless-LAN gear for enterprises means thinking big. With the latest version of Wi-Fi promising vastly higher data rates compared with previous incarnations, testing it with a couple of laptops running a few FTP sessions through a single access point won't do.

Instead, *Network World* set up the largest public 802.11n test ever conducted. We invited all enterprise Wi-Fi vendors to supply not one but eight 802.11n access points, along with controllers if needed. Working with test instrument vendor VeriWave, we crafted test traffic from hundreds (in some cases, thousands) of virtual clients to see how high the new 802.11n systems would scale, in pure 802.11n settings and with a mix of 802.11n and legacy clients. In all these tests, the goal was to determine 802.11n performance in an enterprise context.

Four vendors took us up on the challenge: Aerohive Networks, Bluesocket, Motorola and Siemens. Some big names declined to take part, leaving us to wonder how ready their 802.11n offerings actually are (see "Big players missing in action," page 42). We stand at the ready to test these products against our existing methodology, should they decide to place their gear in a public test.

The vendors that did participate proved the adage that 90% of life is about showing up. Multiple vendors cracked the 2Gbps mark in pure 802.11n throughput tests, pushing data rates of 250Mbps or more per access point. That's around a 10-fold improvement in throughput over existing 802.11g and 802.11a access points — a compelling case for considering 802.11n as an alternative to wired connectivity in the enterprise.

Power is a big concern with the new systems, especially because some may need more juice than standards-based, power-over-Ethernet (PoE) switches can supply. Some systems stayed within the limits of current PoE specs, while others may require upgrades to larger power supplies.

The new systems showed rough spots in a few places. We couldn't complete throughput tests in some cases because access points became unresponsive or even rebooted. That's interesting given that all systems tested are built around the same Atheros Communications radio module. The very different results speak to the different optimizations each vendor has done in working with the Atheros radios.

Bluesocket's BlueSecure AP-1800 access points offer the best combination of performance, power efficiency and features. Bluesocket's sys-

**See Wireless, page 36**

## NETRESULTS

Product	BlueSecure AP-1800; BSC-2200 controller	HiPath Wireless AP-3620; HiPath C2400 controller	Aerohive HiveAP 340; Aerohive Manager	AP-7131 Tri Radio 802.11n Adaptive Access Point
Vendor	Bluesocket www.bluesocket.com	Siemens www.enterprise-communications.siemens.com	Aerohive Networks www.aerohive.com	Motorola www.motorola.com/us/products.jsp
Price	\$23,400	\$35,800	\$15,000	\$10,000
Pros	Good overall performer; relatively efficient power usage; most robust system tested.	Most efficient at power consumption; good overall performer.	Strong performer with highest 802.11n throughput; no controller needed; good security features.	Novel design will accommodate as many as three radios, including forthcoming WiMAX module.
Cons	Significantly slower with bidirectional compared with unidirectional traffic.	Software glitches created hangs or reboots in a few stress tests.	High latency in some tests; high power consumption.	Software glitches prevented completion of some tests; relatively high power consumption.
Score	<b>4.05</b>	<b>3.70</b>	<b>3.65</b>	<b>2.85</b>

\*Includes eight 802.11n access points, each with 2.4- and 5GHz radios, and controller if needed

## SCORECARD

Action	Weight	Bluesocket	Siemens	Aerohive	Motorola
802.11n performance	20%	<b>4</b>	<b>2.75</b>	<b>4.75</b>	<b>2.5</b>
Mixed-mode performance	20%	<b>3.75</b>	<b>2.75</b>	<b>3</b>	<b>2.5</b>
WiMix performance	20%	<b>4</b>	<b>4</b>	<b>4</b>	<b>2.5</b>
Power efficiency	20%	<b>4.5</b>	<b>5</b>	<b>2.5</b>	<b>2.75</b>
Features	20%	<b>4</b>	<b>4</b>	<b>4</b>	<b>4</b>
<b>Total score</b>		<b>4.05</b>	<b>3.70</b>	<b>3.65</b>	<b>2.85</b>

Scoring key: **5:** Exceptional; **4:** Very good; **3:** Average; **2:** Below average; **1:** Subpar or not available.

# CLEAR CHOICE TEST WLAN ACCESS POINTS

## 802.11n throughput

In this test, we sought to answer the primary question in assessing 802.11n performance: How fast will it go? To find out, we associated 20 802.11n clients to each of eight access points and offered traffic downstream (the most common direction for enterprise WLANs), upstream and bidirectionally.

MEASURED ACROSS EIGHT ACCESS POINTS, EACH WITH ONE 5GHZ RADIO ACTIVE

Direction	88-byte frames (Mbps)	512-byte frames (Mbps)	1518-byte frames (Mbps)	88-byte frames (fps)	512-byte frames (fps)	1518-byte frames (fps)
Aerohive downstream	<b>260.8</b>	<b>1,463.2</b>	1,948.4	<b>370,432</b>	<b>357,237</b>	160,440
Bluesocket downstream	176.1	1,023.0	1,937.1	250,085	249,766	159,511
Motorola downstream	156.8	911.4	1,893.9	222,714	222,513	155,941
Siemens downstream	227.4	1,297.4	<b>2,070.9</b>	322,983	316,751	<b>170,525</b>
Aerohive upstream	<b>460.1</b>	<b>1,871.2</b>	<b>2,109.7</b>	<b>653,585</b>	<b>456,841</b>	<b>173,725</b>
Bluesocket upstream	227.6	1,313.5	2,005.5	323,330	320,669	165,144
Motorola upstream	No valid result	1,055.2	2,050.2	No valid result	257,625	168,826
Siemens upstream	No valid result	No valid result	2,042.2	No valid result	No valid result	168,162
Aerohive bidirectionally	<b>112.7</b>	<b>904.5</b>	<b>1,550.3</b>	<b>160,149</b>	<b>220,831</b>	<b>127,663</b>
Bluesocket bidirectionally	74.7	314.8	682.5	106,121	76,857	56,197
Motorola bidirectionally	No valid result	387.1	883.2	No valid result	94,511	72,726
Siemens bidirectionally	No valid result	No valid result	583.1	No valid result	No valid result	48,014

"No valid result" indicate hardware or software issues with the system under test prevented us from obtaining a valid measurement for this test case.

### Wireless

continued from page 34

tem wasn't the fastest we tested, but it exhibited consistently low latency and jitter, and it didn't suffer from some of the software bugs that hampered our testing of the other systems.

Each of the other systems had its own merits: Siemens' HiPath Wireless AP-3620 access points are efficient with power, while Aerohive's HiveAP 340 offers an innovative alternative to controller-based designs and very high throughput. Motorola's new AP-7131 is still a work in progress and needs further software tweaks, but it too offers a unique design that soon will support as many as three radios on the same access point; that will enable enterprises to use Wi-Fi and WiMAX on the same access point.

### 802.11n throughput and latency

We assessed all systems in terms of pure 802.11n performance; mixed-mode performance in handling both 802.11n and legacy 11a and 11g clients; performance with a mix of common enterprise applications (for our "WiMix" test, in which wireless clients handle a mixture of frame sizes, see [www.nwdocfinder.com/7132](http://www.nwdocfinder.com/7132)); power consumption; and system features.

The first question when it comes to assessing 802.11n technology is: How fast will it go? We answered that by measuring throughput across eight access points, each moving traffic between 20 wired and 20 802.11n wireless clients (see "How we did it," [www.nwdocfinder.com/7134](http://www.nwdocfinder.com/7134)).

In these tests, access points used only 5GHz radios; in later tests, we turned on both 2.4GHz and 5GHz radios and used a mix of 802.11n and non-802.11n clients. For now, however, the focus was on pure 802.11n throughput and latency.

Using the VeriWave WaveTest WT-90 traffic generator/analyzer, we pounded each set of devices with short, midsize and large frames (in separate tests) to find the highest rate where the access points forwarded all traffic without loss — the throughput rate.

One significant finding is that traffic direction matters. In separate tests

with frames moving downstream (from Gigabit Ethernet to wireless clients), upstream and bidirectionally, throughput rates varied widely.

In the downstream tests, Siemens' access points moved large frames the fastest among all systems (see graphic, above). Overall system throughput was greater than 2Gbps, or nearly 259Mbps on each of eight access points. Overall system throughput for the other three vendors' access points when handling large frames was between 1.89G and 1.94Gbps.

Upstream traffic generally achieved the highest rates. The Aerohive access points came out tops in the 802.11n upstream tests, moving traffic fastest for all three frame sizes. The HiveAP 340's throughput for large frames headed upstream — 2.110Gbps, or nearly 264Mbps per access point — was the fastest data rate we recorded in the entire test.

These results are good news for all vendors: Even the slowest result is dramatically higher than the roughly 25Mbps per access point available from current 802.11g or 802.11a products. In the best case, throughput is better than 10 times higher with enterprise-grade 802.11n gear.

While access points generally moved large frames close to the theoretical maximum rates in the downstream and upstream tests, it was a different story with bidirectional traffic. Aerohive's access points were fastest by far, moving large frames bidirectionally around 2.7 times faster than the slowest access points (which were from Siemens).

The top rate bidirectionally, even for the Aerohive access points, was around 70% as fast as its upstream-only rate. Limitations in internal bus capacity, direct memory access transfer capacity and memory optimization may explain the difference in rates.

So far, we've concentrated on large-frame testing, which generally produces the highest rates. Throughput differences for short and midsize frames were more pronounced than differences for large frames; in some cases we even weren't able to complete throughput testing.

Packet-processing horsepower is the key determinant of throughput, and that in turn depends on the access point's CPU and the firmware that shuttles frames to and from the CPU. Given a heavy-enough load, an access point may degrade VoIP or video responsiveness, slow TCP con-

See Wireless, page 38

# CLEAR CHOICE TEST WLAN ACCESS POINTS

## Wireless

continued from page 36

nections or become unresponsive in testing.

We're presenting throughput in both bits and frames per second (fps), making obvious the effect of packet-processing limits. With short frames—which are the most common type on enterprise networks, mostly because of TCP acknowledgements—frame rates varied widely.

The Aerohive access points were fastest at moving short and midsize frames downstream, in both cases by a wider margin over other vendors than in the large-frame tests. However, no system came close to the theoretical limit of around 1.5 million fps in the short-frame tests. Because many applications use short frames—including VoIP and anything running over TCP (for acknowledgements)—lower throughput with shorter frames can have adverse effect on application performance.

We were unable to complete upstream testing with the Motorola and Siemens access points. Two issues with the software Motorola supplied for its AP-7131 made it impossible for us to obtain throughput results in testing with 88-byte frames. Motorola says it has fixed these problems and has obtained significantly improved results with a new software version now available to customers. We did not verify this assertion. We were unable to obtain throughput results with the software version Siemens supplied with its HiPath Wireless AP 3620, not only with 88-byte frames but also with 512-byte frames in both upstream and bidirectional tests.

It's an industry-standard practice to find the throughput rate using a binary search, offering varying loads in successive iterations. The Siemens access point would become unresponsive after receiving heavy loads from the VeriWave test instrument, making results from all subsequent test iterations invalid. In tests with 88-byte frames, the Siemens access points rebooted in some cases.

Siemens says this problem does not occur on customer networks, and that its access points wouldn't have reset if we had disabled a watchdog timer in the access-point software. Throughput tests are by definition

stress tests, and aren't intended to represent the "real world," the "WiMix" tests (see [www.nwdocfinder.com/7132](http://www.nwdocfinder.com/7132)) are a better representation of the traffic enterprises actually handle. Also, the fact that access points became unresponsive or rebooted troubles us; this shouldn't happen no matter how heavy a load users throw at them.

We also measured latency and jitter (latency variation) for 802.11n access points (see graphic, this page). Minimizing delay obviously matters for such time-sensitive applications as VoIP and video, but it also affects anything running over TCP—and that's almost all traffic in enterprise networks. Delay a packet too long, and TCP stacks can respond with rate throttling, retransmissions and even connection timeouts.

Latency and jitter were highest when packets were moving downstream from Ethernet to wireless clients. This is to be expected, given that frames move from a faster medium to a slower one in this direction.

Bluesocket's access points delayed packets the shortest amount of time in most of the downlink and uplink tests, often by wide margins over other access points for downstream traffic. Also, the difference between average and maximum delay was generally lower for Bluesocket access points compared with those from the other vendors.

That said, average latencies for all access points were on the high side. Real-time application performance begins to suffer from delays of 10 to 20 millisecond or more, and we measured many instances of much larger delays. Aerohive noted that we measured latency only at the throughput rate (as RFC 2544 requires us to do) but not with lower loads, in which latency and jitter can be far lower. This also may have reduced the sizeable differences between average and maximum latencies.

Regarding those differences, the Aerohive and Siemens access points exhibited very large maximum delays in some tests involving 512- and 1,518-byte frames. In one case, the Aerohive access point delayed a few packets for 18 seconds, easily long enough to disrupt virtually any application. In this case, an issue with firmware caused the access point to buffer some packets from a previous test run until we offered new traf-

See Wireless, page 40

## 802.11n latency and jitter

For such real-time applications as voice and video, latency and jitter (latency variation) are even more important than throughput in ensuring adequate application performance. For these measurements, conducted concurrently with the 802.11n throughput measurements, lower numbers are better.

MEASURED ACROSS EIGHT ACCESS POINTS, EACH WITH ONE 5GHZ RADIO ACTIVE

Direction	88-byte average latency (microsec)	88-byte maximum latency (microsec)	88-byte jitter (microsec)	512-byte average latency (microsec)	512-byte maximum latency (microsec)	512-byte jitter (microsec)	1518-byte average latency (microsec)	1518-byte maximum latency (microsec)	1518-byte jitter (microsec)
Aerohive downstream	23,540	83,720	3,723	61,750	18,400,000	3,382	144,500	18,100,000	10,130
Bluesocket downstream	<b>7,658</b>	<b>50,460</b>	<b>755</b>	<b>12,260</b>	<b>59,980</b>	<b>736</b>	<b>39,390</b>	<b>137,800</b>	<b>1,540</b>
Motorola downstream	23,830	159,000	3,552	30,670	298,300	4,938	42,250	318,100	4,989
Siemens downstream	25,460	144,300	1,275	35,160	256,300	1,433	64,850	316,400	2,090
Aerohive upstream	9,384	49,050	20	1,637	65,470	75	<b>975</b>	<b>80,180</b>	<b>130</b>
Bluesocket upstream	261	<b>32,060</b>	<b>14</b>	638	<b>64,150</b>	43	2,723	159,200	567
Motorola upstream	No valid result	No valid result	No valid result	350	80,580	39	1,821	111,900	282
Siemens upstream	<b>237</b>	42,630	28	<b>268</b>	72,350	<b>32</b>	3,101	111,200	528
Aerohive bidirectionally	<b>4,080</b>	<b>68,930</b>	<b>645</b>	<b>6,680</b>	<b>80,390</b>	<b>944</b>	13,980	116,800	2,049
Bluesocket bidirectionally	23,800	254,000	4,166	26,860	370,100	2,844	27,750	636,700	8,987
Motorola bidirectionally	No valid result	No valid result	No valid result	65,720	1,370,000	11,130	108,600	1,110,000	16,650
Siemens bidirectionally	No valid result	No valid result	No valid result	No valid result	No valid result	No valid result	<b>992</b>	<b>36,630</b>	<b>108</b>

"No valid result" indicate hardware or software issues with the system under test prevented us from obtaining a valid measurement for this test case.

# CLEAR CHOICE TEST WLAN ACCESS POINTS

## Wireless

continued from page 38

fic. During our tests, Aerohive supplied a new firmware version that corrected most, but not all, instances of this behavior. Again, latency and jitter may be lower with lower loads.

Maximum latency for the Siemens access point was greater than one second in some cases. Siemens again noted that this was a stress test.

### Mixed-mode throughput and latency

These tests offer a thorough picture of 802.11n performance, but few if any enterprises will deploy 802.11n-only networks on day one; instead, they're likely to deploy a mix of 802.11n and legacy wireless clients.

To get a sense of how access points would handle multiple client types, we asked vendors to enable both 2.4GHz and 5GHz radios in their access points. Then we associated 16 802.11n clients to each radio, plus four 802.11g clients to the 2.4GHz radio and four 802.11a clients to the 5GHz radio. We did not use legacy 802.11b clients because they're becoming scarce and they would have dragged down rates for all clients.

CPU processing power and bus bottlenecks were even bigger factors in these mixed-mode tests than in the 802.11n-only setups. That's because access points must service frames headed to and from two radios rather than one. And because legacy clients run at slower rates (thus keeping 802.11n clients off the air at least part of the time), throughput was generally lower in these tests (see graphic, below). In fact, when averaging all bit rates for all vendors, throughput in the mixed-mode tests was only 24% that of the average of all results from the 802.11n-only throughput tests.

One thing that did carry over from the 802.11n-only tests was the top performance of Aerohive's access points, at least with midsize and large frames. The Aerohive access points generally were fastest in downstream, upstream and bidirectional tests. A glitch with the software image we tested, however, prevented us from testing the Aerohive access points

with 88-byte frames in the mixed-mode configuration. Aerohive says it has since fixed the software issue, but we did not verify this. The same is true for Motorola: The vendor says it corrected software issues after our test window, but we did not verify this.

Rates were generally highest for upstream traffic, as in the 802.11n tests. However, unlike the 802.11n tests, rates trailed off dramatically for bidirectional and downstream traffic. Further, even the very highest upstream result was nearly 30% lower than in the tests with only 802.11n clients, despite two radios being active and thus twice as much capacity theoretically being available.

Because few applications involve traffic in one direction only, and because few enterprises will run 802.11n alone on day one, our results suggest that network managers shouldn't expect the same high rates from mixed-mode deployments as they should with 802.11n-only setups. Rates in these tests are far higher than would be possible with 802.11a/g access points; but they're not as fast as in the 802.11n-only tests.

One possible counterargument is that network designers should deploy only 802.11n clients on the 5GHz radio and dedicate the 2.4GHz radio to legacy 802.11b/g clients. This may be a sound network-design practice, but a quick look at frame rates belies the argument that overall performance would improve. None of the systems came close to meeting theoretical limits of around 1.5 million fps with short frames or 178,000 fps with long frames (measured across eight access points). The big gap between theoretical and observed frame rates suggests that access points' CPUs and buses will be limiting factors well before the systems hit any bandwidth bottlenecks.

We measured latency and jitter for mixed-mode traffic. Average latency was slightly lower than in the 802.11n tests, not surprising considering the lower loads involved. Once again there were big differences between average and maximum latencies, with the latter jumping well above one second in three cases involving the Aerohive and Siemens access points.

Certainly these high maximum delays can affect applications adverse-

See Wireless, page 42

### Mixed-mode (802.11a/g/n) throughput

Because few enterprises will run 802.11n-only networks on day one, we measured performance with a mix of 802.11a/g/n clients. In these tests, we used four access points with both 2.4GHz and 5GHz radios active. Frame rates were much lower in these tests than in the 802.11n-only tests, not only because of the presence of non-802.11n clients but also because using two radios put a much heavier load on each access point's CPU and internal bus.

MEASURED ACROSS FOUR ACCESS POINTS, EACH WITH 2.4GHZ AND 5GHZ RADIOS ACTIVE

Direction	88-byte frames (Mbps)	512-byte frames (Mbps)	1518-byte frames (Mbps)	88-byte frames (fps)	512-byte frames (fps)	1518-byte frames (fps)
Aerohive downstream	<b>120.5</b>	<b>691.0</b>	<b>812.0</b>	<b>171,232</b>	<b>168,698</b>	<b>66,862</b>
Bluesocket downstream	75.6	431.2	802.3	107,376	105,267	66,068
Motorola downstream	28.1	157.4	358.1	39,953	38,422	29,490
Siemens downstream	103.8	589.9	758.1	147,506	144,009	62,424
Aerohive upstream	No valid result	<b>1,093.2</b>	<b>1,491.3</b>	No valid result	<b>266,884</b>	<b>122,801</b>
Bluesocket upstream	<b>103.4</b>	431.2	1,407.0	<b>146,818</b>	105,274	115,858
Motorola upstream	No valid result	383.7	1,441.7	No valid result	93,672	118,720
Siemens upstream	91.7	515.9	856.9	130,273	125,953	70,560
Aerohive bidirectionally	No valid result	<b>660.4</b>	<b>739.3</b>	No valid result	<b>161,226</b>	<b>60,881</b>
Bluesocket bidirectionally	53.2	233.4	431.7	75,594	56,994	35,552
Motorola bidirectionally	No valid result	170.5	371.4	No valid result	41,637	30,579
Siemens bidirectionally	<b>97.7</b>	407.6	377.0	<b>99,510</b>	138,724	31,046

"No valid result" indicate hardware or software issues with the system under test prevented us from obtaining a valid measurement for this test case.

# CLEAR CHOICE TEST WLAN ACCESS POINTS

## Wireless

continued from page 40

ly. Because jitter remained relatively low across the board, however, it's likely that the high maximum latencies were caused by only a few stray frames (something we verified in the case of Aerohive's access points by examining capture files).

### Power grabs

Power consumption is a key concern with 802.11n. The central question is whether the new 802.11n access points will draw more than the 12.95-watt maximum permitted in the existing 802.3af specification for PoE. Some of the more powerhungry access points may need even more juice than the 15.4-watt maximum that today's PoE power sources provide. (The 2.45-watt difference between device and powersource limits accounts for power dissipation in cables and voltage fluctuations; in practice, dissipation is much smaller, even over maximum-length cables, typically a few hundred milliwatts.)

Power use is a major issue for some enterprises, especially those that only recently put PoE switches or injectors in place. For network designers, the question is whether it's necessary to trade off some performance to stay within the power budget. The IEEE is working on a higher-wattage version of the PoE spec.

To determine maximum power draw, we enabled both radios on one access point from each vendor and associated 20 802.11n clients to each radio. We configured the access points to use channel bonding, ensuring maximum bandwidth and thus the highest possible power draw.

Working with a Fluke Corp. multimeter and probe, we took three measurements: Once with no traffic, to determine power usage when idle, and again with downstream flows of 88- and 1,518-byte frames, each offered at the throughput rate. The Fluke multimeter recorded the maximum power used in each test.

Clearly, the greenest of all the access points came from Siemens (see graphic, below). When idle, Siemens' AP-3620 used only 6.3 watts, less than half the limit for the existing PoE spec. Even under the heaviest load, the Siemens access point drew less than 11 watts, again well under the 12.95-watt limit. These results validate Siemens' claim that its 802.11n gear does not require a forklift upgrade of existing PoE infrastructure.

At the other end of the spectrum, Aerohive's HiveAP 340 was over the 12.95-watt line in all three tests, drawing as much as 18 watts when forwarding 1518-byte frames. Aerohive APs have a SmartPoE feature that can adjust power consumption dynamically to match that available from an 802.3af-compatible power source, but we did not test this. After reviewing its PoE test results, Aerohive said SmartPoE would have resulted in significantly less power draw, roughly equivalent forwarding rates and a smaller coverage area, but again we did not verify this.

Motorola's AP-7131 also exceeded the current PoE limit, but only when

See **Wireless**, page 44

## Big players missing in action

Almost as notable as the remarkable results in this test are some of the big names that didn't show up: Major wireless-LAN vendors Aruba Networks, Cisco and Trapeze Networks all declined to participate in this project.

Aruba's absence came as a surprise. The vendor has fared very well in previous *Network World* tests, and offered constructive input when we put together the test methodology.

When the company said it wouldn't play this time, citing a desire to devote resources elsewhere, *Network World's* editors appealed the decision all the way to the company's founders. But Aruba Networks still declined, saying it's determined to focus more on customer support than on public testing.

Cisco never really got involved in the test process. It did not provide direct input into the test plan, and it cited unspecified concerns with the testing tools as a reason for not participating. We pressed Cisco for specifics, but did not receive a response.

Trapeze offered input when we put this project together, agreed to participate and reserved lab time. Two days before its test slot, however, the company announced it wouldn't participate. A long but ultimately fruitless conference call failed to nail down a specific reason for Trapeze's abrupt about-face. At some points on the call, Trapeze cited resource constraints and/or issues with the test plan, but at other points it emphatically said these were not reasons for pulling out. We're still unclear on why Trapeze got cold feet.

We stand ready to include these vendors in future tests. For now, however, the only thing we can say is that some vendors were willing to have enterprise 802.11n performance compared in a neutral third-party setting and others weren't. When they're assessing gear from vendors that didn't participate, we believe it's reasonable for enterprises to ask about that unwillingness.

— DAVID NEWMAN

## Maximum power consumption

Higher rates bring potentially higher power usage — so much so that in some cases existing power-over-Ethernet infrastructure may need to be replaced to support 802.11n. The magic number in this test is 12.95 watts, which is the maximum amount of power a standards-compliant PoE device should consume. Any device drawing more (indicated in red) might be able to work with existing PoE switches, but for best results, larger power supplies may be needed.

MEASURED ON ONE ACCESS POINT WITH 2.4- AND 5GHZ RADIOS ACTIVE

Direction	Idle (watts)	88-byte frames (watts)	1518-byte frames (watts)	Forwarding rate, 88-byte frames (fps)	Forwarding rate, 1518-byte frames (fps)
Aerohive downstream	13.77	15.26	18.01	43,166	39,430
Bluesocket downstream	9.90	10.05	11.47	27,708	27,327
Motorola downstream	11.99	12.69	13.59	22,488	24,626
Siemens downstream	6.34	8.06	10.88	36,500	34,998

# CLEAR CHOICE TEST WLAN ACCESS POINTS

## Wireless

continued from page 42

handling 1,518-byte frames. While it's probably possible to run the Motorola access points with existing PoE gear (because of the 2.45 extra watts of headroom between devices and power supplies), it's safest to use new "PoE-plus" power sources with either the Aerohive or Motorola access points to supply power at levels above 15.4 watts.

As noted, there are power/performance tradeoffs involved in assessing PoE. Traffic rates for Aerohive's access points were much higher than those of the others in this event, but so was power usage. For enterprises looking for the fastest system, adding new power supplies may be worthwhile. On the other hand, enterprises planning on using existing PoE infrastructure are safe with either the Bluesocket or Siemens access points, because both stayed under the 12.95-watt limit in our tests.

The Siemens access points offered the best combination of power and performance: They delivered more traffic faster per watt used than any other system tested, while staying well under the power budgets of existing PoE gear.

Although this was mainly a performance test, we also compared products in terms of their feature sets (see "Features table" at [www.nw.docfinder.com/7156](http://www.nw.docfinder.com/7156)). We should note that vendors responded to a features questionnaire, and we did not verify every answer.

Architecturally, we saw multiple approaches to WLAN design. The Bluesocket and Siemens systems are controller based, with the controller pushing out configurations and performing dynamic radio frequency management. Both vendors say they can manage other vendors' access points, providing captive portal and access control functions. Motorola also offers controller-based systems, but it supplied its new stand-alone AP-7131s for this project. The Aerohive system's design is unique: Instead of a central controller, multiple access points acting as a "hive" collectively perform that function. The vendor also supplied a central management system, but it's not required for access points to operate.

In terms of RF features, these access points are more alike than different. As noted previously, all use Atheros 802.11a/b/g/n radio modules. All use two transmit antennas, although all have at least three transmit antennas to use 3x3 multiple-in, multiple-out (MIMO) radios once these are available. Data rates are likely to rise once 3x3 radios start appearing either later this year or in 2009.

The Siemens AP-3620 offers three antennas that carry signals from both its 2.4GHz and 5GHz radios, while all other access points offer six antennas — three apiece for each radio. Siemens' access points also differed in supporting 2x3 MIMO operation (two transmit antennas, three receivers), while all other access points used 2x2 MIMO.

All systems except Motorola's supported dynamic RF control, adjusting signal strength in response to changes in the radio environment. All systems supported multiple extended service-set IDs per access point, a key feature when supporting multiple workgroups.

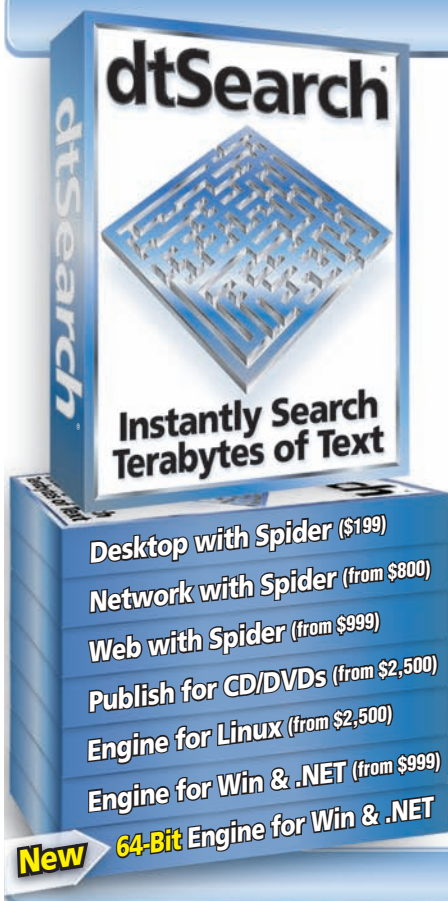
In the QoS arena, all systems support 802.11e/WMM (wireless multimedia) prioritization mechanisms to reduce latency and jitter for voice and video. All systems except Motorola's also prioritize traffic from Polycom Spectralink phones, which use a proprietary protocol.

All systems support the 802.11i/WPA2 suite of security mechanisms to provide authentication, confidentiality and message integrity. We used WPA2 personal mode to secure all test traffic. Also in the security arena, all systems have intrusion-detection and -prevention features; and all except the Siemens system provide a stateful firewall. Bluesocket's security feature set is especially extensive.

Even though all systems implement the same 802.11n protocol, and use the same chipset, we saw very different results. The new 802.11n systems offer vastly higher performance than their predecessors, and with further refinement of their software could represent a real step toward making wireless the default for enterprise connectivity.

*Newman is president of Network Test, an independent test lab in Westlake Village, Calif. He can be reached at [dnewman@networktest.com](mailto:dnewman@networktest.com).*

## Instantly Search Terabytes of Text



- ◆ over two dozen indexed, unindexed, fielded data and full-text search options
- ◆ supports hundreds of international languages
- ◆ file parsers / converters for **hit-highlighted** display of all popular file types
- ◆ Spider supports static and dynamic web data; **highlights hits** while displaying links, formatting and images intact
- ◆ API supports .NET, C++, Java, SQL, etc. New .NET Spider API

### The Smart Choice for Text Retrieval® since 1991

- ◆ "Bottom line: dtSearch manages a terabyte of text in a single index and returns results in less than a second" — *InfoWorld*
- ◆ "For combing through large amounts of data," dtSearch "leads the market" — *Network Computing*
- ◆ dtSearch "covers all data sources ... powerful Web-based engines" — *eWEEK*
- ◆ dtSearch "searches at blazing speeds" — *Computer Reseller News Test Center*

See [www.dtsearch.com](http://www.dtsearch.com) for hundreds more reviews, and hundreds of developer case studies

Contact dtSearch for fully-functional evaluations

1-800-IT-FINDS • [www.dtsearch.com](http://www.dtsearch.com)