

## Belkin N150/N300/N600 DB Wireless N Routers

### 802.11n Rate/Range Performance vs. Comparable Routers

#### EXECUTIVE SUMMARY

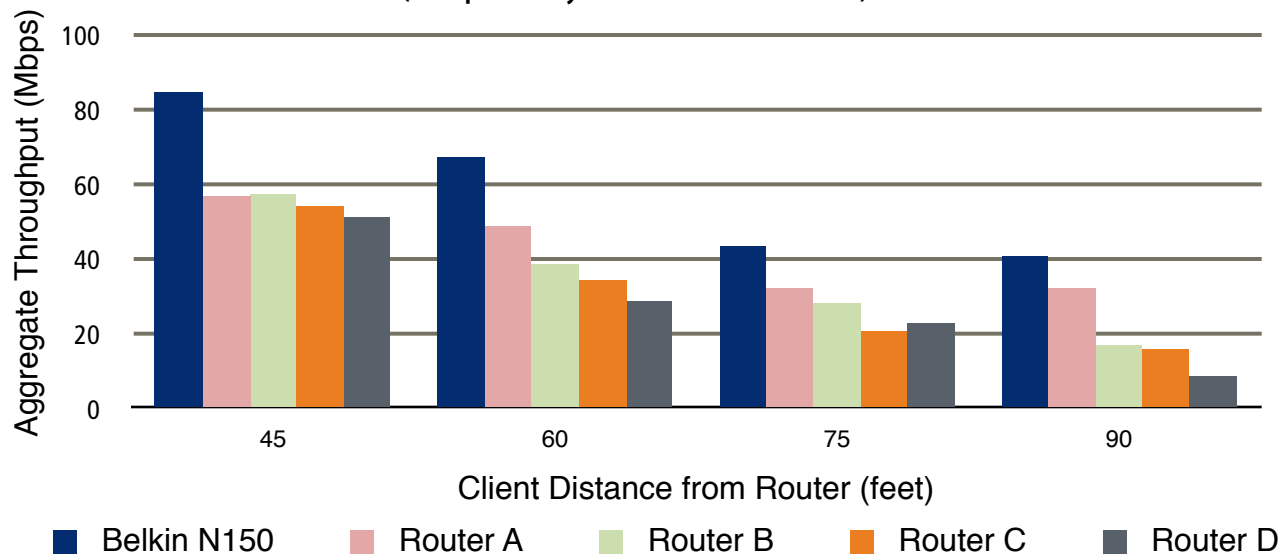
As the number of Wi-Fi devices in the home grows, new applications on those devices are driving the demand for Wi-Fi bandwidth ever higher. Belkin's new line of Wi-Fi routers are focused on maximizing the bandwidth available for user applications and delivering a superior user experience from any point in the house.

Belkin commissioned Tolly to benchmark the performance of its wireless LAN (WLAN) routers in an actual residence and compare that performance against comparable products from other leading home networking vendors. All tests for a given benchmark were run on the same day to minimize variability from environmental factors. The testing consisted of multiple locations, averaging the results of the four router orientations at each point to arrive at the reported metrics.

#### THE BOTTOM LINE

- 1 Belkin's N150, N300 and N600 DB routers provide higher throughput than comparable routers at long range
- 2 At 60ft, the Belkin N150 provides 38% to 135% greater throughput than comparable routers
- 3 At 60ft, the Belkin N300 provides 46% to 94% greater throughput than comparable routers
- 4 At distances greater than 30 feet, the Belkin N600 DB delivers greater Wi-Fi throughput than comparable routers
- 5 Under heavy simulated download traffic, the Belkin N600 DB provides 39% to 331% greater Wi-Fi throughput at 60ft than comparable routers

**Belkin N150 WLAN Router 802.11n 2.4GHz Band Rate/Range Performance vs. Comparable Routers**  
**Bidirectional Throughput**  
 (as reported by Ixia IxChariot v7.10 SP3)



Source: Tolly, May 2011

Figure 1



### Test Results

#### Belkin N150

The Belkin N150 is a 2.4GHz single-band 802.11n wireless LAN router and was tested along with five comparable routers with the WLAN client station positioned from 45 to 90 feet from the router with one interior wall in the signal path.

The Belkin N150 delivered the highest average aggregate throughput at all four test points. See Figure 1 and Table 1.

At 45 feet, the Belkin N150 delivered aggregate bidirectional throughput in excess of 84 Mbps. This was nearly 1.5 times the throughput of the nearest competitor and nearly 1.7 times the throughput of the trailing router.

At 90 feet, the Belkin N150 delivered throughput that exceeded 40 Mbps. This was more than 1.25 times the throughput of the nearest competitor and more than 4.5 times the throughput of the trailing router.


#### Belkin N300

The Belkin N300 is a 2.4GHz single-band 802.11n wireless LAN router and was tested along with four comparable routers using the same test scenarios outlined above.

The Belkin N300 delivered the highest average aggregate throughput at all four test points. See Figure 2 and Table 1.

At 45 feet, the Belkin N300 delivered aggregate bidirectional throughput in excess of 75 Mbps. This was over 7 Mbps greater throughput than the

**Belkin International, Inc.**



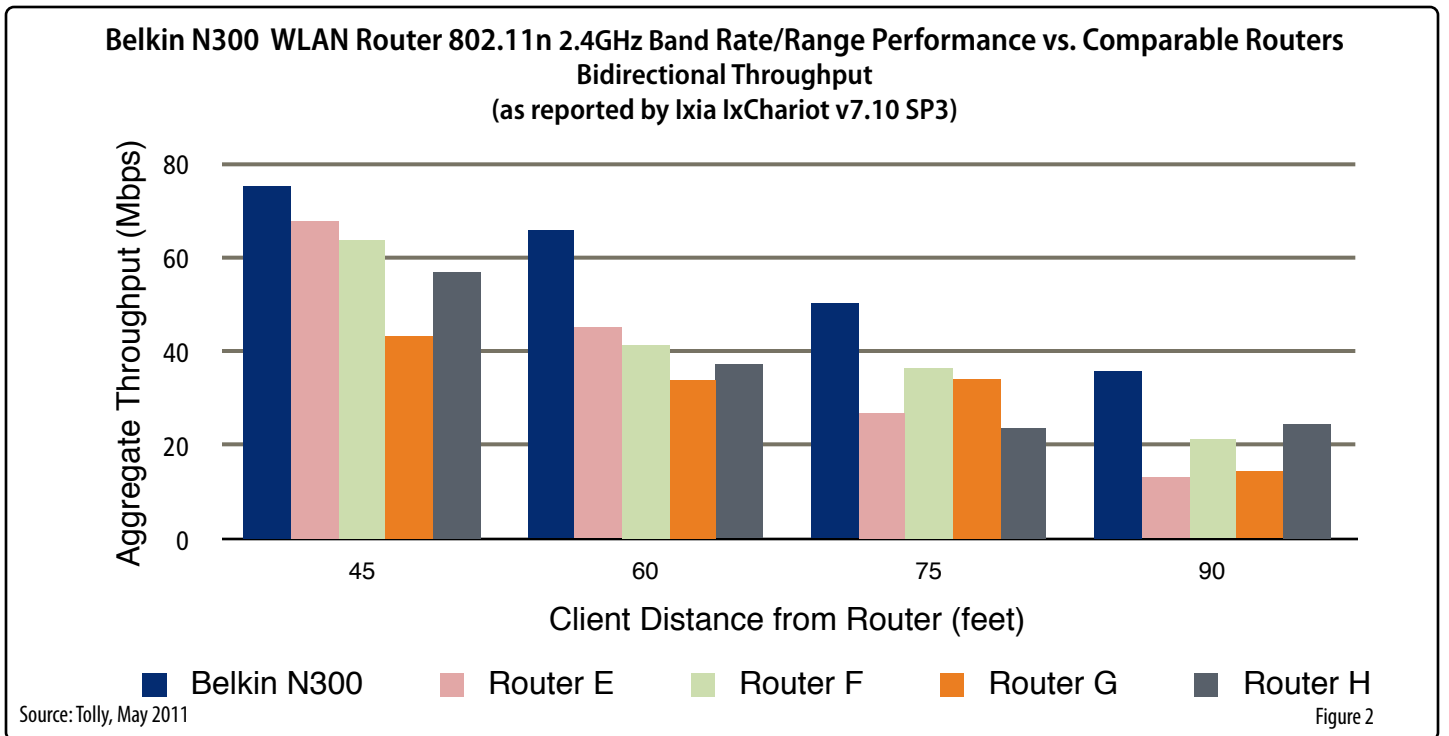
**Belkin N150/N300/N600 DB**

**802.11n WLAN Performance**

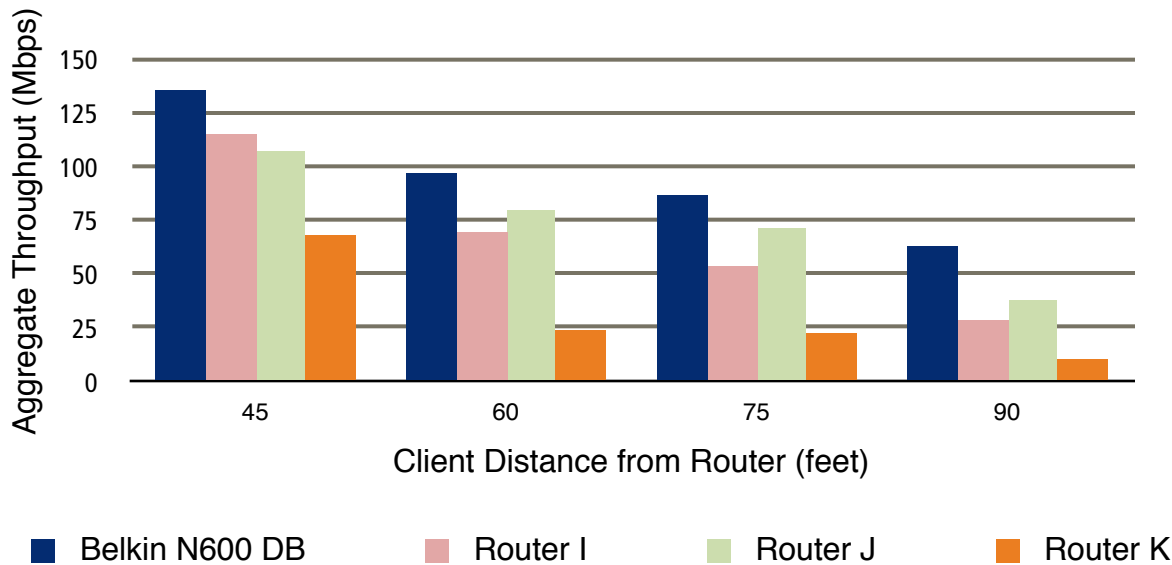
*Tested May 2011*

nearest competitor and more than 1.7 times the throughput of the trailing router.

At 90 feet, the Belkin N300 delivered throughput that exceeded 35 Mbps. This was almost 1.5 times the throughput of the nearest competitor.



**Belkin N600 DB WLAN Router 802.11n Rate/Range Performance vs. Comparable Routers**  
**Simultaneous Bidirectional Throughput of 2.4GHz and 5GHz Bands**  
 (as reported by Ixia IxChariot v7.10 SP3)



Source: Tolly, May 2011

Figure 3

and more than 2.7 the throughput of the trailing router.

### Belkin N600 DB

The Belkin N600 DB is a 2.4GHz/5GHz dual-band 802.11n wireless LAN router and was tested along with three comparable routers using the same test scenarios outlined above with test clients running on both bands simultaneously.

The Belkin N600 DB delivered the highest average aggregate throughput at all four test points. See Figure 3 and Table 1.

At 45 feet, the Belkin N600 DB delivered aggregate bidirectional throughput in excess of 135 Mbps. This was over 20

Mbps greater throughput than the nearest competitor and nearly 2 times the throughput of the trailing router.

At 90 feet, the Belkin N600 DB delivered throughput that exceeded 62 Mbps. This was more than 1.6 times the throughput than the nearest competitor and more than 6.3 times the throughput of the trailing router.

### Belkin N600 DB With WAN Traffic

For this class of router, an additional test scenario was run where traffic was generated across the Ethernet port that directs traffic to the Internet<sup>1</sup>.

The Belkin N600 DB delivered the highest average aggregate WLAN

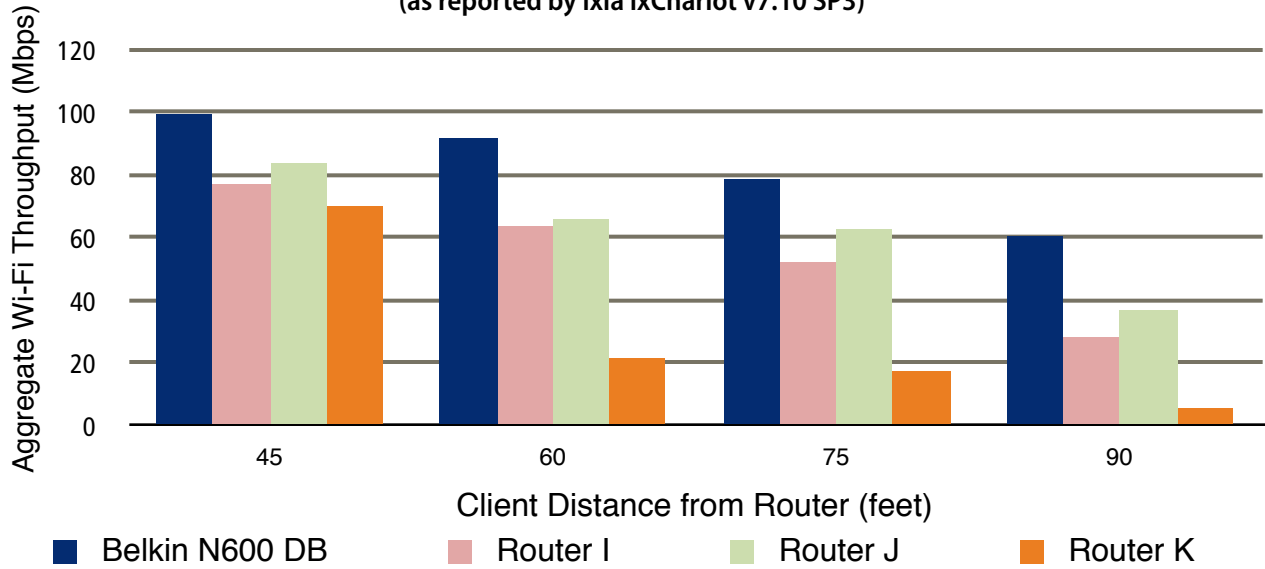
throughput at all four test points. See Figure 4 and Table 1.

At 45 feet, the Belkin N600 DB delivered aggregate bidirectional throughput in excess of 99 Mbps. This was over 15 Mbps greater throughput than the nearest competitor and nearly 30 Mbps greater throughput than the trailing router.

At 90 feet, the Belkin N600 DB delivered throughput that exceeded 60 Mbps. This was more than 1.6 times the throughput than the nearest competitor and more than 11 times the throughput of the trailing router.

<sup>1</sup> Even though this port is a standard Fast Ethernet/Gigabit Ethernet port it is referred to as a WAN port since it serves as the conduit for traffic between the Internet wide area network and the local LAN.

**Belkin N600 DB WLAN Router 802.11n Rate/Range Performance vs. Comparable Routers**  
**Simultaneous Bidirectional Throughput of 2.4GHz and 5GHz Bands with WAN Port Download Traffic**  
 (as reported by Ixia IxChariot v7.10 SP3)

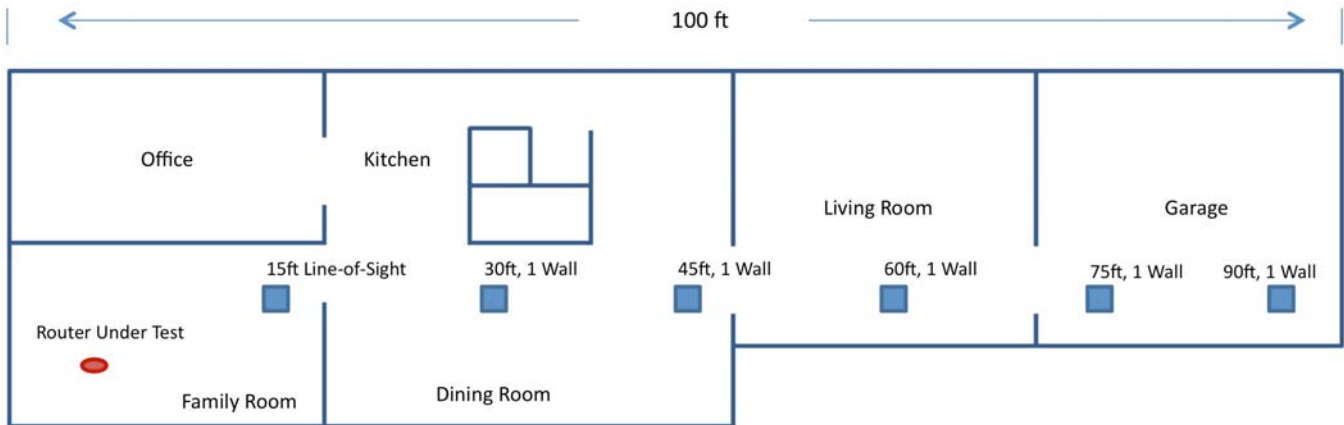


Source: Tolly, May 2011

Note: WAN port was Fast Ethernet. Results do NOT include traffic processed over WAN port.

Figure 4

**Test Environment Diagram**



Note: Test environment was an actual, active residence. Interference from neighboring routers was never stronger than -80 dbm RSSI at any test location.

Source: Tolly, May 2011

Figure 5



**WLAN Router 802.11n Rate/Range Performance  
Test Results Summary  
(as reported by Ixia IxChariot v7.10 SP3)**

Belkin Product	Device Under Test	Distance Between Client and Router (feet) Results (Mbps) Average of Four Runs			
		45	60	75	90
N150	Belkin N150	84.67	67.12	43.31	40.58
	Router A	56.72	48.67	31.97	32.01
	Router B	57.30	38.62	28.06	16.93
	Router C	54.05	34.29	20.58	15.66
	Router D	51.16	28.57	22.60	8.65
N300	Belkin N300	75.24	65.75	50.23	35.83
	Router E	67.86	45.16	26.98	13.22
	Router F	63.74	41.41	36.52	21.32
	Router G	43.27	33.91	34.17	14.53
	Router H	56.99	37.25	23.79	24.60
N600 DB	Belkin N600 DB	135.37	96.59	86.32	62.53
	Router I	114.98	68.97	53.61	28.31
	Router J	107.06	79.19	71.17	37.59
	Router K	68.02	23.40	22.14	9.96
N600 DB/With WAN Traffic	Belkin N600 DB	99.15	91.55	78.46	60.34
	Router I	76.91	63.57	51.82	27.93
	Router J	83.42	65.66	62.43	36.50
	Router K	69.80	21.25	17.09	5.36

Note: N600 DB WAN scenario results do not include WAN throughput.

Source: Tolly, May 2011

Table 1



# Test Setup & Methodology

## Test Setup

The testing effort evaluated the performance and coverage of three classes of 802.11n routers. The N150 and N300 classes both utilize 2 antennas on the 2.4GHz spectrum to attain a maximum theoretical throughput of 150 Mbps and 300 Mbps, respectively. The Dual Band N600 class utilizes two antennas in each the 2.4GHz and 5GHz spectrums, providing a maximum theoretical throughput of 600 Mbps (300 Mbps in 2.4GHz, 300 Mbps in 5GHz).

The Belkin N150 and N300 were both running firmware version 1.00.05, and the Belkin N600 DB was running firmware version 1.00.06. All comparable devices under test were categorized into one of these classes based on the manufacturer specifications and were running the latest publicly available firmware supplied by the vendors as of May 19, 2011.

All devices were configured to have the same SSID, such that clients would automatically connect when brought online, but otherwise in their default configurations. Engineers separately configured each client to have a static IP address, though the router DHCP server remained active.

The testing consisted of taking throughput measurements of connected clients from a total of four

incremental distances (45, 60, 75, and 90 feet from the router,) separated from the router by a single, two foot thick wall. See Figure 5.

Prior to the commencement of the performance testing, engineers performed a survey of the wireless spectrum at each test location to ensure there was not significant interference.

In the 2.4GHz spectrum, the highest signal level detected at any location was an RSSI of -80 dbm, on a different channel than the configured routers. In the 5GHz band, there was no source of interference to any extent, and the background noise was measured at approximately -120 dbm.

Results were reported using Ixia's IxChariot 7.10 SP3 console and three performance endpoints. The 5GHz client was equipped with the Intel Centrino Ultimate-N 6300 wireless chipset (Capable of three spatial streams), running driver version 13.3.0.24, and the 2.4GHz client was equipped with the Intel WiFi Link 5100 AGN adapter (Capable of two spatial streams) running firmware 13.5.0.

The wired console was connected to the device under test using a 100 Mbps LAN connection. IxChariot was configured to generate two bidirectional traffic streams per radio, the reported throughput being the sum across both radios.

## Test Methodology

For each one of the fourteen WiFi routers evaluated, engineers connected the LAN port to the IxChariot console, and placed the applicable client laptop at the designated location, facing the router.

Engineers configured the tests to run for one minute, and at the conclusion of each run, the router would be rotated 90 degrees clockwise, and the test was re-run. Engineers averaged the four readings to obtain the reported throughput for that location. For the Dual Band N600 class, both the 2.4GHz and 5GHz client laptops were utilized, placed two feet apart at each distance.

To generate the heavy WAN download traffic, engineers connected a wired client to the Fast Ethernet WAN port of the N600 DB routers, configuring each router's default gateway to correspond with the IP of the additional wired client. Engineers repeated the location testing with the addition of the WAN to LAN traffic, and recorded the WiFi throughput.



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### Test Equipment

The Tolly Group gratefully acknowledges the provider of the benchmarking solution used in this project.

Vendor	Product	Web
Ixia	IxChariot 7.10	 <a href="http://www.ixiacom.com">http://www.ixiacom.com</a>

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