Key Performance Benefits of 802.11n

As the first company to introduce a Wi-Fi certified, enterprise-class 802.11n access point, Cisco conducted extensive performance testing to help ensure that its 802.11n solution lived up to the promise of the specification.

Cisco has led the transition to next-generation wireless. Cisco's 802.11n solution, including the Cisco® Aironet® 1250 AG Access Point and the Cisco® Aironet® 1140 Series Access Point, has been the most rapidly adopted to date. This broad deployment base has enabled Cisco to work closely with multiple customers both in measuring and in optimizing next-generation wireless network performance.

Armed with an extensive stream of performance data, Cisco's Wireless Networking business unit has been able to compare lab testing results to real-life deployment scenarios. The results have been more than encouraging, both with regard to the impact 802.11n technology is having on network performance and also because of the business benefits this enhanced performance brings.

It is well documented that wireless performance varies based on a variety of factors such as the type of applications delivered over Wi-Fi or the physical challenges presented by building materials or architectural configurations. Cisco's lab testing engineers have consistently reached connection data rates of 300 Mbps per 802.11n radio. This data rate typically translates to a throughput rate of 185 Mbps for sustained periods of time.

This white paper provides more details about the 802.11n performance metrics we have been experiencing.

7x More Video

Video is having a profound effect on the way we consume information. It is estimated that video is now approximately one-quarter of all consumer Internet traffic. Thirteen hours of video are uploaded each minute on YouTube alone. In ways that are analogous to the transformation of social interactions by social networking video, corporate video is enhancing the collaborative experience. Cisco employees alone stream more than 73,000 videos a month, while they produce and upload more than 1,600 internal and external-facing videos a month.

Before the introduction of 802.11n, a healthcare organization that needed to stream high-definition (HD) video for mobile diagnostic services would be limited to only two HD streams at a time over a wireless network. Even then, an 802.11g network would not be a reliable transport medium for HD streaming video. Previous standards, such as 802.11b, did not have the necessary throughput capacity for any HD video streams.

802.11n allows for the distribution of seven times more video streams than 802.11g networks (Table 1). Such an increase in the throughput rate can truly mobilize applications such as bandwidth-intensive, video-streaming applications. With 802.11n, organizations like the healthcare provider mentioned earlier can dramatically increase the number of simultaneous mobile diagnostics that can be performed. The result is a significant improvement in medical staff

productivity, resource utilization, and patient satisfaction (due to shorter wait times), all of which leads to greater profitability.

Table 1. Number of Video Streams per Wireless Technology

Video Stream Types (throughput required)	802.11g (22 Mbps)	802.11n (140 Mbps)*	Improvement Factor
HD (10 Mbps)*	2	14	7X
DVD (5 Mbps)**	4	28	7X

* In real-life network deployments, Cisco 802.11n solutions have maintained a consistent throughput peak of 185 Mbps. Unfortunately, when it comes to video streaming over Wi-Fi, contention reduces the available throughput per 802.11n radio to roughly 140 Mbps.
** A typical DVD-quality video stream requires about 5 Mbps of throughput. A high-definition video stream requires double the throughput—that is, about 10 Mbps.

8x More Users

The transformative nature of wireless networking drives—and also feeds—an insatiable appetite for network-connected devices. Most of us today have at least one Wi-Fi-enabled device, but many of us are starting to carry more than one—for example, a dual-mode phone, a laptop computer, a digital camera, a gaming console, or a music device. We are also becoming accustomed to finding an available network that we can connect those devices to while at home, at work, or on the go, which in turn drives the need for ubiquitous network connectivity.

The proliferation of these network-connected devices is creating an undeniable need for high-density deployments as more and more users connect to the same network with multiple devices for different reasons. This need is only exacerbated in areas where people tend to congregate in large numbers for business, education, entertainment, or other reasons.

The Cisco 802.11n solution has been particularly successful in higher education environments for that same reason. Consider a large lecture hall where many students congregate during class and are connecting to the wireless network with their laptop computers in order to download the instructor's presentation slides and notes or conduct parallel, online research on the discussion topic of the day.

If we assume that this large lecture hall is equipped with three 802.11g access points today, the students in the classroom and their connected devices would be sharing an available bandwidth of 22 Mbps by load balancing these users and devices across the three available access points. Now suppose that all these students were required by the instructor to use a "blackboard" type of application to download presentation notes transcribed onto slides in real time. The application would require a consistent bandwidth of 5 Mbps in order to provide a good user experience, and the result would be that only 12 students (four students per access point) would be able to use the application effectively in the classroom.

Suppose we were to replace these three 802.11g access points with three next-generation, 802.11n access points. The system-level bandwidth in the classroom would increase substantially and more than 96 students (32 users per access point) would be able to connect to their wireless network and expect to have a consistent application experience.

In fact, a one-to-one replacement of access points is the most prevalent migration scenario to 802.11n for organizations that want to increase their deployment density. User density becomes an even more complex problem to solve when network users are demanding different bandwidths to run their specific applications. It is not hard to imagine how airport terminal or conference room

hotspots, where users run a variety of mobility applications, would benefit from next-generation wireless. Not only would it allow more users on the network, but it could also improve their individual user experience.

Cisco testing has shown that on a systemwide basis, adding devices (users) onto the network may at some point create some throughput loss, up to 5 percent, which will result in slightly fewer additional users being able to use the network. That is why the number of users is not entirely aligned with the expected performance improvement we see from migrating to 802.11n.

9x Faster

Even though Internet or Intranet video streaming and higher user density are both compelling reasons to migrate to 802.11n, the vast majority of companies migrating to next-generation wireless will do so because of the raw performance improvement their users will experience daily. Extensive field testing has shown that sustained throughput performance of 802.11n wireless networks is 185 Mbps. However, in many cases during those field trials, a sustained upper limit of 198 Mbps has been observed.

Companies migrating to a next-generation 802.11n wireless network can expect to experience an improvement in performance that is up to nine times faster than 802.11g technology for the mobile applications used today. Furthermore, many applications, such as scheduled data backups and large file transfers that were previously performed over the wired network, will now be mobilized. These performance improvements increase overall employee effectiveness and productivity and in turn shorten the 802.11n investment payback period, while increasing the return on investment.

There is no doubt that the emergence of 802.11n will also bring about an influx of bandwidth-hungry mobile applications that could not be enabled wirelessly until now. Companies that have refreshed their wireless infrastructure will be in a position to take full advantage of those mobility applications and empower their users with an increasing number of productivity-enhancing tools.

This is truly the right time to migrate to an 802.11n wireless network.

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