

White Paper

MAXIMIZING YOUR 802.11G INVESTMENT

Executive Summary

IEEE 802.11g has been touted as the next high speed standard for wireless LAN communications. With data rates up to 54 Mbps and backwards compatibility with legacy 802.11b equipment, it sounds like the perfect marriage of next generation advanced technology with investment protection.

However, as with most things that sound too good to be true, there are some caveats. Much has been written recently about the actual speeds that can be achieved in a mixed 802.11b and 802.11g environment. This short paper will discuss the actual achievable throughputs in two real life deployment scenarios and Proxim solutions to maximize your 802.11g investment.

Why 54 Mbps Isn't Really 54 Mbps

IEEE 802.11g is described as a 54 Mbps wireless LAN standard. Yet, the actual achievable throughputs are well below 54 Mbps. (This is also the case for the IEEE 802.11b and 802.11a standards.) To understand why that is, let's look at how a wireless LAN differs from its wired LAN counterpart.

Unlike devices on a wired LAN, wireless LAN clients are unaware of each other's presence. To avoid 'talking' over each other, a protocol has been developed to avoid collisions. This protocol results in data being transmitted for the network to operate properly, but is not part of the end user's data. So, from an end user application perspective, it results in lower overall throughput.

This protocol is called Carrier Sense Multiple Access/Collision Avoidance, or CSMA/CA. In layman's terms what this means is that each client 'asks' to talk before sending its data out. This protocol creates inefficiencies that reduce the theoretical maximum throughput of 54 Mbps. In addition, the distance of the client from the access point and the building materials that the signal travels through can also reduce the actual speeds at which the client speaks to the access point.

In a 'clean' environment - defined as one in which there is no other radio equipment operating and the client is close to the access point, actual achievable throughputs average approximately 50% of the maximum data rate. So, in the case of 802.11g this results in a best case situation of approximately 27 Mbps.¹

You may be thinking that's low, but remember that this is 20 times Internet connection speeds from a DSL or cable modem connection!

¹ All throughput numbers quoted in this paper are approximate and may not reflect specific test results.

The Impact of 802.11b Backwards Compatibility on 802.11g Throughput (or a Little Math)

As described above, the maximum achievable throughput of 802.11g is approximately 27 Mbps. However, in order for 802.11g access points to 'hear' 802.11b clients, the protocol parameters must be modified, resulting in increased overhead. While this paper does not go into detail², the specific protocol parameters that need to be addressed in mixed mode 802.11b/802.11g networks are:

- Long and short preambles
- Different slot times
- RTS and CTS protection mechanisms

Taking into account the above protocol differences, an 802.11g access point operating in a mode that allows it to hear 802.11b clients has a maximum throughput of 18 Mbps. It is important to note that this throughput is WITHOUT any 802.11b clients in the presence of the AP. Modifying the protocol to allow an 802.11g access point to hear 802.11b clients lowers the maximum achievable throughput.

What happens when I add 802.11b clients to this picture?

Simple math let's us calculate the actual throughput. An 802.11b client operates at 6 Mbps, while an 802.11g client operates at 18 Mbps. So, it takes three times as long for an 802.11b client to transmit the same data as an 802.11g client. This is illustrated in the Figure 1 below.

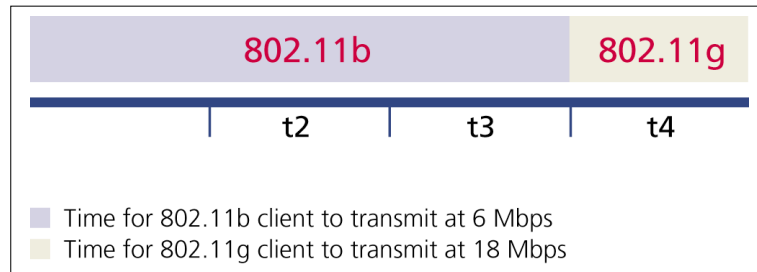


Figure 1

802.11b client traffic takes approximately three times as long to transmit as 802.11g clients operating in a mode that allows them to 'hear' 802.11b clients.

With the resulting timesharing done by a single radio access point supporting both 802.11b and 802.11g clients, average throughput for that access point is:

$$(3*6 \text{ Mbps} + 1*18 \text{ Mbps}) / 4 = 9 \text{ Mbps}$$

² For a detailed discussion of the protocol parameters and their impact on 802.11g performance, please see the Proxim technical white paper "A Detailed Examination of the Environmental and Protocol Parameters that Affect 802.11g Network Performance" at www.proxim.com/learn/library/index.html.

ORiNOCO Simplifies 802.11g Deployment

As described above, modifying protocol parameters allows 802.11g to operate either in a 'g-only' mode or a 'mixed b and g mode' allowing backwards compatibility to 802.11b with different performance results. As it will be difficult for many system managers to know how to configure these parameters to achieve the best performance for their network, Proxim provides three easy-to-understand set-up configurations for ORiNOCO 802.11b/g Access Points:

Mode Type	Clients Supported	Performance
802.11b only	802.11b	Maximum throughput of 6 Mbps for 802.11b clients in optimum environments.
802.11g only	802.11g	No backwards compatibility for 802.11b clients. Maximum throughput of 27 Mbps for 802.11g clients in optimum environments.
Mixed 802.11b and 802.11g	802.11g and 802.11b	Support for legacy 802.11b clients on a single 802.11g radio. Maximum throughput with .11g clients on radio - 18 Mbps. Maximum throughput with both .11g and .11b clients on radio – 9 Mbps.

Choosing the mode automatically configures the appropriate parameters for the best possible performance. The next section discusses how ORiNOCO provides two solutions for maximizing performance in a mixed 802.11b and 802.11g environment.

Maximizing 802.11g Performance in a Mixed 802.11b and 802.11g Environment with ORiNOCO Access Points

For situations where maximizing throughput is the utmost priority, the ORiNOCO AP-2000 is the best solution. The ORiNOCO AP-2000 dual slot architecture allows for maximum 802.11g throughput, while supporting legacy 802.11b clients.

The power of the dual-slot access point architecture can truly be seen when examining the enhanced performance of the 802.11g devices. With a single radio access point, the 802.11g devices share 9 Mbps. However, the maximum data rate for an 802.11g device in g-only mode is 27 Mbps, so if one slot is operated in b-only mode, and the other slot is operated in g-only mode as shown in Figure 2, the total throughput for g clients is maximized.

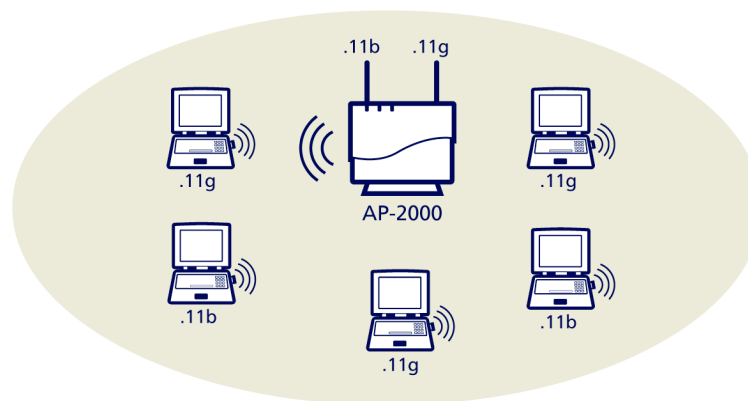


Figure 2

In a mixed 802.11b and 802.11g client environment, a dual slot access point increases 802.11g performance by three times over a single integrated radio access point.

In this scenario, 802.11b clients are only permitted to associate with the 802.11b side of the AP, and similarly for the 802.11g clients. With a dual-slot access point implementation, the 802.11g devices share 27 Mbps, which means that they see their data rate increased by 3 times! The ORiNOCO AP-2000 dual slot architecture allows users to take full advantage of the new technology, while still supporting legacy users as well.

For environments where the utmost throughput is not required, the single radio ORiNOCO AP-600b/g in mixed b and g mode provides the optimal functionality for situations in which both types of wireless devices are present at any given time. Not only are the parameters optimally configured, but in addition ORiNOCO access points dynamically adjust the three protocol parameters, (protection mechanisms, slot time and preamble) by intelligently determining if there are any 802.11b devices present. If there are no 802.11b clients present, the AP minimizes overhead to maximize throughput for the 802.11g clients. By optimizing the three protocol parameters, ORiNOCO access points deliver up to 50% better throughput than existing 802.11g solutions as shown in Figure 3.

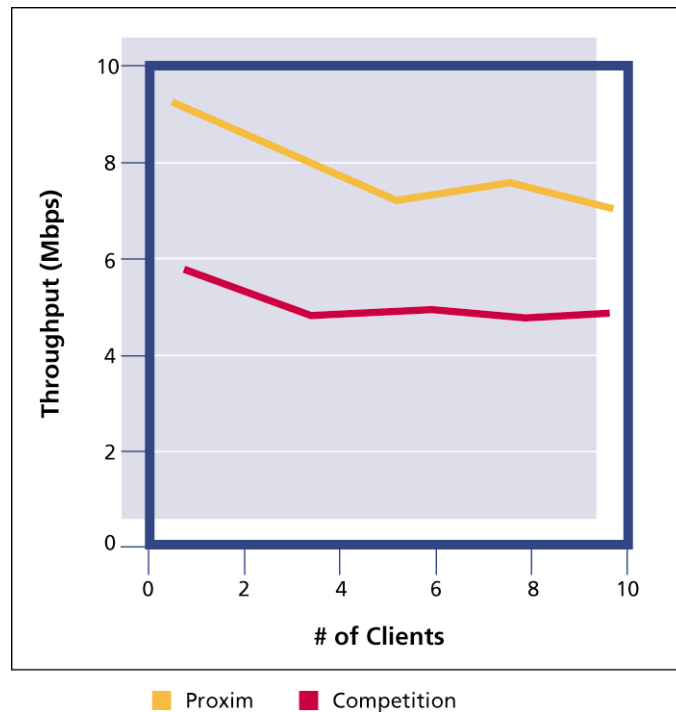


Figure 3

Optimization of the 802.11 protocol parameters allows Proxim products to deliver up to 50% better performance than competitive products in a mixed .11b and .11g environment.

Summary

802.11g offers both higher speeds and backwards compatibility to legacy 802.11b clients. Proxim recommends the following to optimize the performance of your 802.11g deployment.

- In controlled networks in which it is not necessary to support legacy 802.11b devices, access points should be configured to run in ORiNOCO 802.11g-only mode. This mode will offer the highest throughput.
- In uncontrolled networks, or networks in which legacy devices need to be supported, two operational modes are possible.
 - If the best performing, least expensive solution is desired, the ORiNOCO AP-600b/g access point should be used in the mixed b/g mode. This solution supports both 802.11g and 802.11b devices, and will automatically dynamically adjust the protocol parameters to achieve the best performance depending on the client population it is supporting.

When throughput is the overriding concern, the ORiNOCO AP-2000b/g dual-slot access point should be used to segregate the 802.11b traffic from the 802.11g traffic. This configuration supports both new and legacy users, and offers as much as a three times improvement in system throughput over a mixed-mode AP configuration