CORRELATIVE Incorporated

Executive Briefing: Introduction to 802.11x Wireless Networking

NETWORKING	
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Purpose of this Document

Wireless networking technology has evolved over the years to a point where it is now accessible, reliable and cost-effective to consider in the corporate infrastructure. However, wireless networking is not best suited for every environment. The purpose of this document is to provide an overview of the various wireless networking technologies and provide assistance in evaluating these technologies for your organization.

Key Vendors Offering Wireless Networking Products

The majority of networking vendors offer wireless networking products and solutions. Some of the key wireless network equipment vendors are:

3Com	Wireless LAN product line.
Apple	AirPort and AirPort Extreme product line.
Cisco Systems	Aironet Wireless Series product line.
HP/Compaq	WL Series and Procurve Wireless product lines.
Enterasys Networks	RoamAbout product line.
Linksys	Linksys Wireless product line.
Proxim	Orinoco Wireless Networks product line.

802.11b Technology Overview

What Wireless Networking Specifications Currently Exist?

As of this writing, three competing wireless specifications exist: ***802.11b***, ***802.11a*** and ***802.11g***. 802.11b is the original and most dominant standard. More recently, both 802.11a and 802.11g standards have emerged as competing successors to the 802.11b standard.

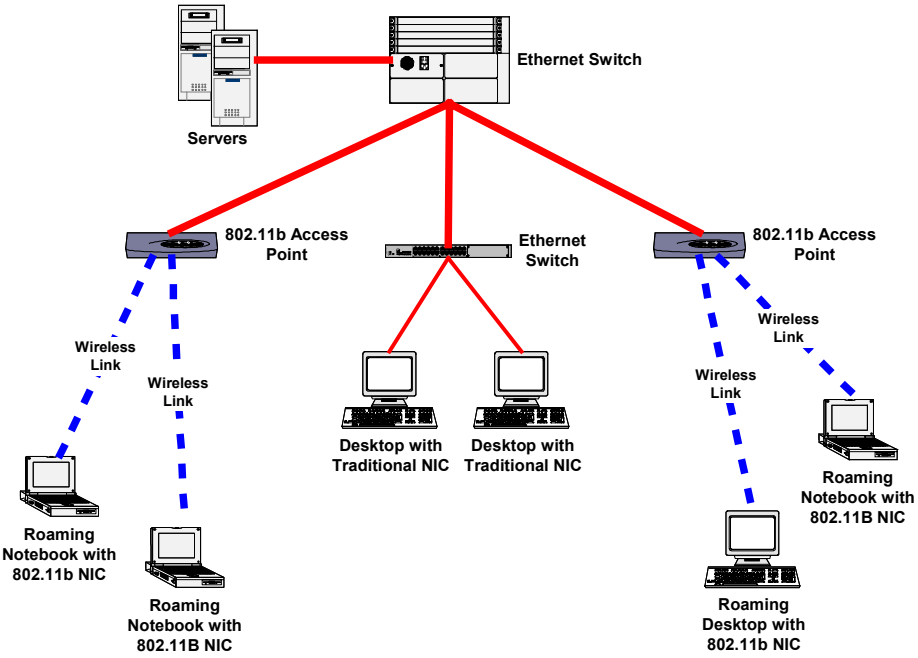
What is the 802.11b Specification?

The IEEE 802.11b wireless networking specification is an IEEE-backed standard for ensuring interoperability between vendor's wireless networking products. This specification was the original specification. Furthermore, the manufacturing consortium, Wi-Fi Alliance, formed to guarantee interoperability between wireless products. Wi-Fi's members include 3COM, Cisco, D-Link, HP, IBM, Intel and Proxim.

802.11b products were originally designed for private network connectivity. The 802.11b specification was not positioned as a replacement to cellular or PCS public network infrastructures. However, a number of efforts are currently underway to leverage the success of 802.11b to provide public "hotspots." These hotspots provide wireless Internet access in public locations such as airports, train stations, coffee shops, malls, etc.

How 802.11b Wireless Networking Works

802.11b is a wireless ethernet technology operating at 11MB. 802.11b devices use Direct Sequence Spread Spectrum (DSSS) radio technology operating in the 2.4GHz frequency band. This band is also used by devices including: cordless phones, microwave ovens and Bluetooth-enabled equipment. An 802.11b wireless network consists of wireless NICs and access points. NICs come in different models including PC Card, PCI, USB, etc. Access points act as wireless hubs to link multiple wireless NICs into a single subnet. Access points also have at least one fixed ethernet port to allow the wireless network to be bridged to a traditional wired ethernet network (such as the organization's network infrastructure). Wireless and wired devices can coexist perfectly on the same network.



Typical 802.11b Wireless and Wired Mixed Network

Operating Modes

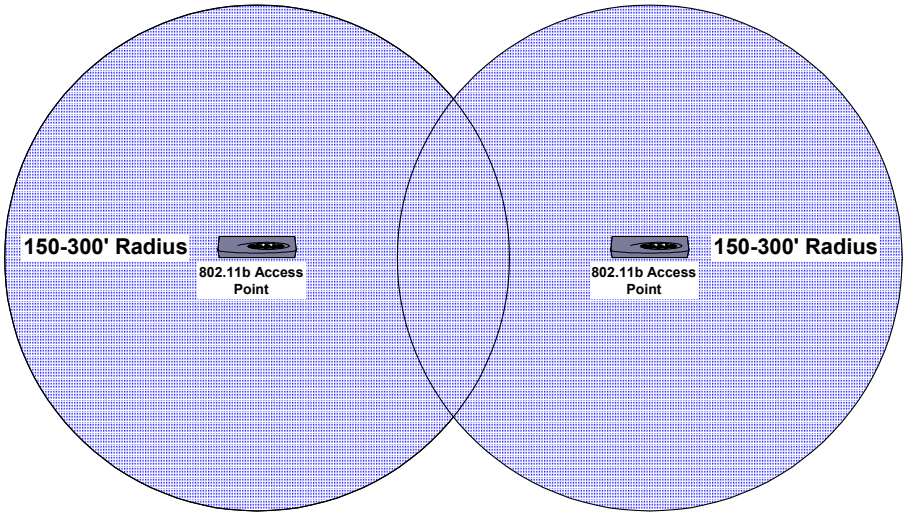
IEEE 802.11b wireless NICs can be configured to operate in one of two modes: ***Ad-Hoc Mode*** (also know as Demo mode) and ***Infrastructure Mode***.

Ad-Hoc Mode: This is the simplest mode of operation. This mode is also the most limited in functionality. In Ad-Hoc Mode, 802.11b NICs ignores all access points and join together with other Ad-Hoc Mode 802.11b NICs to form a peer-to-peer network. When operating in this mode, 802.11 NICs also ignore any specified ***Network Name*** defined for the card.

Infrastructure Mode: This is the mode of operation most organizations will use. In this mode, one or more access points must be present and configured to hub the 802.11b NICs configured for Infrastructure Mode. NICs running in this mode specify a ***Network Name***. The same Network Name is specified for all other NICs and access point that should link together and form a common subnet. Generally, 802.11b NICs can also specify a Network Name of ***ANY*** which instructs the NIC to connect to the closest 802.11b network regardless of its Network Name. The Network Name of ***ANY*** can be used for roaming 802.11b users that travel between different sites or organizations where the Network Name varies.

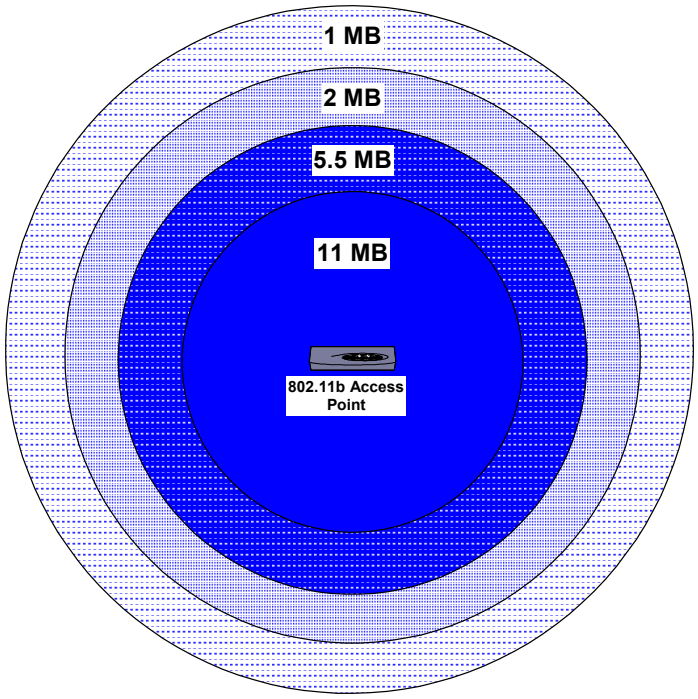
Range of Operation

802.11b devices can communicate across a maximum range of 150-300 feet from each other. Since most network configurations will operate in Infrastructure Mode (implement access points for connectivity), this means that 802.11b devices can operate in a 150-300 feet radius of an access point. Multiple access points can be installed across an organization's office or campus to further extend these distances.



Extending Wireless Range with Multiple Access Points

Another feature of 802.11b technology is the ability to automatically compensate for extended distances and materials that limit the transmission of radio waves (such as walls, floors, trees, etc.) 802.11b devices can step down their transmission speed in these situations to compensate for poor signal strength to the target device (such as an access point). 802.11b NICs and access points are capable of operating at 11MB, 5.5MB, 2MB and 1MB. Of course, if a card's signal strength cannot support 1MB (the minimum speed supported), the card will lose connection to the network.



How Transmission Speed Steps Down over Distance

802.11a and 802.11g Technology Overview

As the popularity of 802.11b networking grew, it was inevitable that the demand for bandwidths greater than 802.11b's 11Mbps limit would be on the short list of enhancements. Enter the 802.11a and 802.11g standards—both technologies are based on the same principles of 802.11b, but achieve 54Mbps bandwidth.

What is the 802.11a Specification?

The first specification to deliver 54Mbps wireless bandwidth was 802.11a. Although 802.11a does provide 5 times the bandwidth of 802.11b, its maximum transmission range is only half of 802.11b (roughly 75 –150 feet).

One of the original concerns with 802.11b was its use of the 2.4GHz band that is also shared by the Bluetooth specification, some cordless phones and microwave ovens. This opens 802.11b devices up to possible conflicts and transmission issues with other devices operating in the 2.4GHz band. 802.11a eliminated this issue by operating in the uncrowded 5GHz range. In a mixed 802.11b and 802.11a environment, both specifications can coexist without conflict. However 802.11a devices are unable to directly interoperate with 802.11b devices. For example, a device with an 802.11a NIC cannot communicate with an 802.11b access point. In an infrastructure required to support both 802.11b and 802.11a devices, the potential exists for having to deploy twice the access point infrastructure (one infrastructure for 802.11b and a second for 802.11a).

How about the 802.11g Specification?

The latest specification that has emerged in the wireless networking world is 802.11g. Although this specification is still considered in draft (as of this writing), many wireless vendors have adopted the standard and are delivering products based on the standard. It is being positioned as a better alternative than 802.11a. 802.11g also provides 54Mbps of bandwidth (same as 802.11a), offers a maximum transmission range between 150 – 300 feet (same as 802.11b / twice the range of 802.11a) and is compatible with 802.11b devices.

The 802.11g standard was developed to be more of an enhanced version of the 802.11b standard as opposed to 802.11a's approach as a replacement technology. 802.11g operates in the 2.4GHz band (same as 802.11b). When an 802.11g device needs to communicate with an 802.11b device, it steps down its bandwidth and signaling to the 802.11b standard. So, in order for an infrastructure to support both 802.11g and 802.11b devices, only one infrastructure (802.11g-capable) would need to be deployed.

Evaluating the Technology for Your Organization

Scenarios where Wireless Technology will Benefit

Corporate Environments with Highly-Mobile Users: Staff with notebooks or PDAs can roam within the company's office space or conference rooms and remain connected without requiring a network jack.

Warehouse Environments: Workers can perform inventorying of stock using PDAs or sub-notebooks equipped with wireless NICs. Changes can be transmitted back to a central server and database.

Hotel Internet Access: Hotels and serviced apartments can offer Internet access to guests and tenants that is accessible from anywhere in the building.

Environments where Premise Wiring is Cost-Prohibitive: Older building may have stone or concrete walls or lack raised ceilings/floors that make network cabling an expensive proposition. In this scenario, wireless network could provide much more flexibility in workstation placement and be more cost-effective.

Public Hotspots: Public Internet access can be offered in locations such as airports, courtesy lounges, Internet cafés, etc.

Scenarios where Wireless Technology will not Benefit

Mobile Users Traveling to Sites with Wired Networks: Network devices which are required to connect at both sites with wireless and traditional wired network will require the purchase of two NICs (wireless and standard ethernet NIC). Unless the additional cost of a second NIC can be justified, a wireless NIC is not the best choice.

Nodes Requiring Network Bandwidth Greater than 11 or 54Mbps: Network nodes that require high-speed network bandwidth will require a high-speed wired NIC such as Fast (100MB) or Gigabit (1000MB) Ethernet.

Nodes that Do Not Require Mobility: Network nodes that will not frequently move (such as servers, desktops) will generally benefit from a traditional wired NIC and network connection. Per node, wired nodes are more secure and can scale to bandwidths above 11MB.

Networks Requiring a High Degree of Security: Unless high encryption, firewalls or access point access lists are implemented, wireless networks are easier to hack than traditional wired networks. Hackers with wireless NICs and in close proximity can easily connect to your network. Tools such as a protocol analyzer can snoop your private network traffic or use other hacking tools to compromise the network. It is important to consider that your wireless network may be broadcasting past your office's boundaries and into neighboring office space, halls or outside the building.

Cost of Ownership

The cost in deploying wireless technology is becoming less costly than deploying traditional wired ethernet technology. Wireless NICs currently can cost from 60% - 100% more than traditional ethernet NICs. Access points cost approximately 25% more than a standard 10/100MB 24 port ethernet switch. However, if you factor in the cost of wiring new ethernet runs for each traditional wired ethernet node, a comparable wireless network configuration can cost less.

For example, in a 24 port configuration of both an wireless and wired ethernet network, the approximate costs would be:

	802.11b/g Combo Wireless	10/100Base-T Switched
24 NICs (PC Card)	$2,880 (24 x $120)	$1,440 (24 x $60)
24 Wiring Runs	N/A	$3,000 (24 x $125)
1 Access Point/Switch	$800	$ 750
Total	$3,680	$5,190

In this scenario, the wireless configuration actually is less expensive. However, the 10/100 switched ethernet configuration would allow a maximum bandwidth of 100Mbps where the 802.11b/g network would only provide 54Mbps. Also, this scenario does not account for the additional security components possibly required to achieve the same intruder protection as available in the wired configuration.

About Correlative and the Author

Correlative is an international consulting and outsourcing company. Correlative specializes in providing cutting-edge networking, directory services, e-commerce, groupware, and training solutions.

Christopher Leone is Correlative's President and Senior Project Manager. Christopher brings 18 years of IT and 13 years of management experience to the company. Christopher has extensive professional experience in the legal, corporate consulting, government contracting, and technical education industries. Christopher resides in both the United States and Asia and is very knowledgeable in Asian cultures. He has also served as an active member of a number of technological professional organizations and advisory boards. Christopher can be reached via e-mail at ***cleone@correlative.com***.

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