# Atheros Wireless LAN

Atheros' Super G™ and Super AG™ (Turbo WLAN) technology provides dramatically increased bandwidth over existing 802.11 implementations, delivering effective data rates of 60 Mbps or more (see chart below for more detail).

| Wireless Standard | Theoretical throughput | Effective throughput |
|---|---|---|
| 802.11b | 11 Mbps | ~4 Mbps |
| 802.11a/g | 54 Mbps | ~24 Mbps |
| Atheros Super G™ and Super AG™ system | 108 Mbps | up to ~60 Mbps |

*__Note__ the effective throughput rates vary depending upon a number of factors: the station's distance from the access point; frequency interference; the use of data ciphering for security; and other factors

Improved networking performance is the most notable benefit. For current and anticipated Wi-Fi applications, particularly for those with time-sensitive throughput needs, such as video and audio streaming, Voice over IP data, playing video games with others over the Internet, this means enhanced mobile computing.

## How does Atheros Wireless LAN technology work?

Super G™ and Super AG™ WiFi technology provides four key extensions to traditional 802.11 networking. Operating independently or in concert, these four features greatly extend the real, end-user bandwidth of the connection between wireless station and access point.

### 1. Frame bursting – greater bandwidth

During normal 802.11 network operations, a station sending a packet along to an access point (AP) first contends for the airtime on the channel with all the other stations using the AP. Upon winning the airtime, the station sends a single data frame; then it backs off and must contend for airtime again in order to send a subsequent data frame. This mechanism gives each station connected to the AP a turn to use the link in quick succession.

By contrast, when using frame bursting, capable stations first negotiate for airtime with the AP and then send a series of data frames before backing off to renegotiate. This technique lets the station transmit (or receive) more data frames within the same time period (because of less need for network overhead), increasing the effective bandwidth.

### 2. Frame compression – increase data throughput

The Super G™ and Super AG™ system can compress the data sent along a link. Therefore, sending the same amount of data takes fewer frames. For example, if the station has data to send to the AP, it first compresses the data, then it forms the compressed data into frames. On the receiving end, the AP de-compresses the received data back into original form.

The Super G™ and Super AG™ system uses standard Lempel-Ziv (Zip) compression, and because the compression is handled in the network hardware, it's fast and completely transparent to the user. Since the compression happens on a link-by-link basis, it has no negative impact on other, standard stations connected to the access point. Both the station and the AP must support this technique.

### 3. Fast frames – eliminate overhead, get more data

The Super G™ and Super AG™ system can increase the amount of data in a frame (bundling two frame's worth of data in one frame) to transmit more data in the same amount of time. To achieve this, it uses the overhead to handle a single frame to cover twice the amount of data. Both station and AP hardware must be compatible and able to support the Fast Frame improvement.

## 4. Multiple channels - dynamic turbo for faster speeds

The Super G™ and Super AG™ system can dynamically employ two wireless channels to transmit data frames in parallel, thereby doubling the effective data throughput. This also serves to increase the effective broadcast range of an AP with compatible stations. A station far away from an AP might only be able to use a link at 18 Mbps, but by using two channels for data it can achieve a throughput of up to 36 Mbps. Normal stations would need to be closer to the AP to achieve this rate.

Naturally, both station and AP must support this technique. Since two channels are employed, this technique works best in environments where Wi-Fi channels are not heavily used by a variety of devices. The Atheros system is specifically designed to adapt to the existing wireless environment, to use the extra channel only when required and appropriate.

## Atheros Wireless LAN Technology - Summary

| Extension | Characteristics | Benefits | Speed Increase |
|---|---|---|---|
| **Frame Bursting** | • More data frames per given time period<br>• Standards based | • Increase throughput via overhead reduction<br>• Works within subset of proposed 802.11e standard<br>• Advantage applies to any AP | Up to ~40 Mbps from base ~22 Mbps |
| **Frame Compression** | • Station and AP provide in-hardware compression of data before network transmission<br>• Compression uses standard Zip (Lempel Ziv) format | • Increased data throughput using compressed frames<br>• Compression happens in network hardware, so no impact on host CPU<br>• No impact on other standard stations using the same AP | Up to ~40 Mbps from base ~22 Mbps |
| **Fast Frames** | • Send twice as much data within a single frame<br>• Adjusts frame timing to fit within timings for existing 802.11 standards | • Increases throughput by transmitting more data per frame<br>• No impact on other standard stations using the same AP | Up to ~40 Mbps from base ~22 Mbps |
| **Multiple Channels** | • Similar to trunking technique used in Fast Ethernet networks, utilizes dual channels to “double” transmission rates<br>• Analyzes environment and adjusts bandwidth accordingly | • Extends effective network range as well as increase in throughput<br>• Environment aware, so engaged only when appropriate | Doubling of effective existing throughput, >60 Mbps |

## Atheros Wireless LAN– boosting performance today and tomorrow

All of the Atheros techniques are either transparent to the existing Wi-Fi traffic, or implemented within the existing 802.11 standards framework. As such, the Super G™ and Super AG™ system can easily co-exist with existing Wi-Fi implementations. Atheros' systems are constructed to dynamically react to the surrounding wireless environment, using the Super G™ and Super AG™ techniques when appropriate to minimize the impact on surrounding standard systems. Finally, Atheros' Super G™ and Super AG™ system is forward-looking: it helps lay a foundation for systems described by the emerging 802.11e and 802.11n standards, and so will be compatible into the future.


## To learn more

You can find out more about Atheros' Super G™ and Super AG™ system and 802.11 networking at these URLs:

Atheros' white paper on the Super G™ and Super AG™ system

IEEE working group for 802.11 standards

# Glossary – Basic Wireless Network Terminology

## 802.11a

An 802.11 specification for high-speed wireless networking, 802.11a networks operate in the 5 GHz band utilizing 8 separate channels and offer theoretical bandwidth of up to 54 Mbps with average throughput of about 27 Mbps. This specification is mature and well established and provides performance sufficient for all types of computer data and most types of rich-media data (such as streaming video and audio).

## 802.11b

An IEEE specification for low- to medium-speed wireless networking, 802.11b networks operate in the 2.4 GHz band utilizing 3 separate channels and offer theoretical bandwidth of up to 11 Mbps with average throughput of about 4.5 Mbps. This specification is mature and well established and provides performance sufficient for most types of computer data (standard file transfers, network application data transfers, most HTTP data traffic).

## 802.11e

An IEEE specification for enhancing existing 802.11 wireless networking standards to provide support for Quality of Service systems for asynchronous data (voice, rich media). Access points and stations supporting 802.11e will be able to adjust their use of the spectrum to account for interference, existing wireless traffic, and so forth, to make the most efficient use of the existing wireless resources. Notice that this standard has yet to be ratified; it is expected to be some time in 2005.

## 802.11g

An 802.11 specification for high-speed wireless networking, 802.11g networks operate in the 2.4 GHz band utilizing 3 separate channels and offering theoretical bandwidth of up to 54 Mbps with average throughput of about 22 Mbps. Since this specification uses the same part of the radio spectrum as 802.11b it is interoperable with 802.11b equipment.

## 802.11n

An 802.11 specification for next-generation high-speed wireless networking, 802.11n networks will support bandwidth in excess of 200 Mbps with expected effective throughput in excess of 100 Mbps.

## Atheros Super G™ and Super AG™

The Atheros Super G™ and Super AG™ systems describe a set of proprietary extensions to the existing 802.11a, 802.11b and 802.11g standards designed for more efficient use of the existing radio spectrum. Through a group of four techniques (frame bursting, frame data compression, “fast frames”, channel bonding), the Super G™ and Super AG™ systems can afford effective bandwidths in excess of double the underlying standard (the exact increase above the doubling depends on the extent of compression effected on the transported data), and similar increases of throughput within that bandwidth.

## Bandwidth

Bandwidth describes the size of a network connection in terms of the rate of data flow the connection can theoretically support; thus it defines the maximum possible data transfer rate (throughput) for a connection. Most computer network bandwidths are expressed in mega-bits per second, or Mbps.

## Throughput

Throughput describes the actual rate of data transfer through a network connection; thus it is never more than the bandwidth for that connection and nearly always less. Most computer network throughputs are expressed in mega-bits per second, or Mbps.

## Wi-Fi Alliance

The Wi-Fi Alliance is a non-profit association with the aim of certifying interoperability amongst wireless LAN (WLAN) products based on IEEE’s 802.11 family of standards.