

Combo Chip Set Dials In Much-Needed Functionality

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With Support For 802.11a, 802.11b, And 802.11g,
This Solution Puts WLAN Technology On The Fast Track
For Wide-Scale Deployment.

AS a competitor in the personal-area-networking (PAN) space, wireless-local-area-network (WLAN) technology boasts strengths in both maturity and price. These characteristics make WLAN enviable to today's enterprises, small networking environments, residential gateways, and advanced TV products. To date, most commercial products have been based on the 802.11b version of the WLAN specification. Those who favor a higher-bandwidth and higher-performance version have turned to 802.11a.

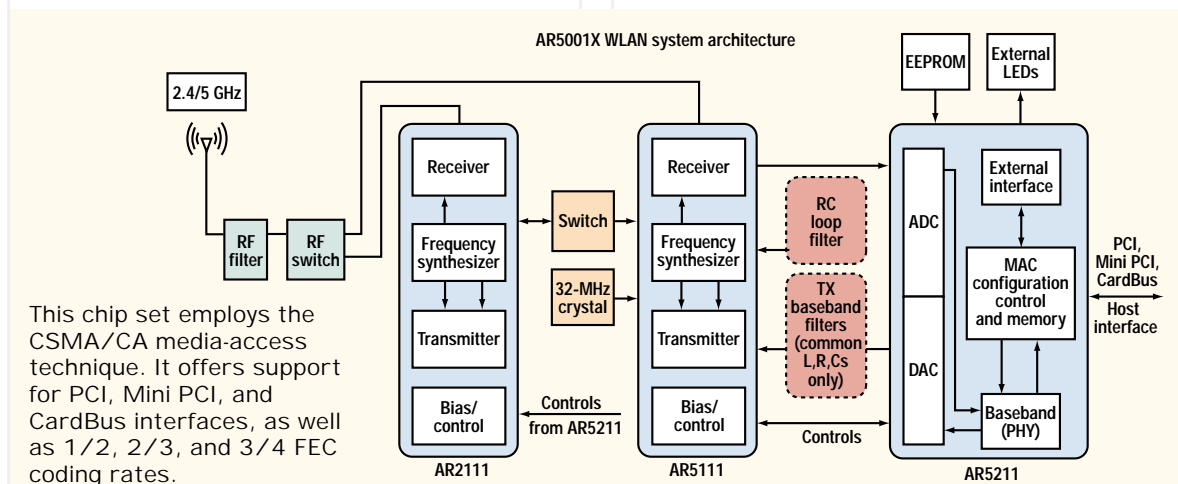
Unfortunately, the existence of two such WLAN standards has left many people wondering which option to choose. To add to this confusion, the draft 802.11g standard promises to retrofit some of the performance advantages of 802.11a into the 2.4-GHz band used by 802.11b. Many vendors have announced intentions to introduce an 802.11a/b chip. No vendor has successfully brought one to market, though. With the 802.11g specification not yet fully approved, vendors also have remained silent on this front.

That's all about to change, thanks to Atheros Communications (www.atheros.com). This month, its AR5001X chip set hits the street amid great fanfare. What exactly makes this chip set so innovative? For starters, it supports all three IEEE wireless-LAN standards: the 5-

GHz 802.11a, the OFDM enhancement for 2.4 GHz in the 802.11g draft, and the legacy 2.4-GHz 802.11b.

As if that weren't enough, the chip set flaunts a handful of new enterprise-class security features, as well as support for the draft extensions being developed for the IEEE 802.11 standard. Among these extensions are 802.11f Interaccess Point Communications, 802.11i Enhanced Security, 802.11e Quality of Service (QoS), and 802.11h Spectrum Management for European regulatory requirements. The culmination of such capabilities is a chip set packed with enhanced performance and functionality, yet with a price tag that reflects only about a 25% premium over 802.11a- or 802.11b-only solutions.

Atheros' Combo 802.11a/g/b chip set for dual-band WLAN support is fabricated on the 0.25- μ m digital CMOS process from TSMC. It supports up to 16 separate channels of 54-Mbps connectivity in the 2.4-GHz and 5-GHz unlicensed frequencies available in North America and Asia. In European countries, where additional spectrum is available, it supports up to 22 separate channels. As a result, the chip set can handle up to 864 Mbps of network system capacity in the U.S. before reusing a channel, or more than 1 Gbps in parts of Europe.



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The AR5001X solution supports orthogonal frequency division multiplexing (OFDM), CCK and DSSS modulation schemes, and the BPSK, QPSK, 16-QAM, and 64-QAM modulation techniques. It's comprised of three low-power chips: the AR5111 5-GHz radio-on-a-chip (RoC), which boasts a tuning range of 5.150 to 5.850 GHz; the AR2111 2.4-GHz RoC; and the AR5211 multiprotocol MAC and baseband processor (SEE FIGURE).

The AR5111 RoC has an operating voltage of 2.5 V ($\pm 5\%$) and 3.3 V ($\pm 10\%$). It comes packaged in a 64-LPCC format with a package dimension of 9 by 9 mm. This chip integrates both a second-generation power amplifier (PA) and low-noise amplifier (LNA) with all radio circuitry.

An integrated sliding IF dual-conversion architecture for both the transmitter and receiver helps minimize the need

for other external components. The RoC can therefore eliminate external Flash, SRAM, voltage-controlled oscillators (VCOs), and surface-acoustic-wave (SAW) or intermediate-frequency (IF) filters. The on-chip power amplifier controls all 52 subcarriers with the same gain and linearity for the supported modulation techniques.

The AR2111 chip also has an operating voltage of 2.5 V ($\pm 5\%$) and 3.3 V ($\pm 10\%$). It comes packaged in a 48-pin LPCC format, with dimensions of 7 by 7 mm. The chip operates in the 2.412- to 2.472-GHz US frequency bands, as well as the 2.484-GHz Japanese band.

The AR5211 MAC and baseband processor operate at 2.5 V ($\pm 10\%$) and 3.3 V ($\pm 10\%$). They come in a 196-pin PBGA format that's 15 by 15 mm in size. Other features include a PCI 2.2 and PC Card 7.1 host interface, analog-to-digital/digital-to-analog converters, and Serial EEPROM, LED, and GPIO peripheral interfaces. AR5211 also has a low-power sleep-mode capability. It supports both the AR5111 and AR2111 RF front ends.

At the heart of the AR5001X solution is Atheros' second-generation, 5-GHz, 802.11a radio technology. This technology includes enhancements for security and a second-generation implementation of the OFDM modulation scheme with 15 advances in OFDM radio design. Among these advances are increased integration, which results in a 20% drop in component count over current 802.11a and b solutions. A Turbo Mode increases wireless data rates to 108 Mbps. It's also backward compatible to Atheros' first-generation, 72-Mbps mode.

In Turbo Mode, a sophisticated software-based rate-adaptation algorithm continuously seeks to optimize a connection's data rate and error-correction codes for any application. Meanwhile, the Power-Trickle Architecture increases a laptop's battery life by up to 35% over current 802.11b designs. To support European operation, the chip set includes Dynamic Frequency Selection (DFS) and Transmit Power Control (TPC) features.

The chip set's OFDM capability is crucial, as the IEEE recently endorsed the broad adoption of OFDM for WLANs. OFDM mitigates multipath intersymbol interference at high data rates by simultaneously transmitting

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multiple subcarriers on orthogonal-frequency channels. Each subcarrier is modulated at a low symbol rate. The OFDM approach is tolerant of many common channel impairments, leading to improvements in range and reliability. In particular, the AR5001X chip set supports applications across all 5-GHz unlicensed bands: the 5.150 to 5.350 U-NII, 5.470 to 5.725 ERC (Europe), 5.725 to 5.825 U-NII, and 5.825 to 5.850 ISM.

With recent security flaws in WLAN technology revealed, the security features of the AR5001X chip set take on ever-increasing importance. Four areas of security are addressed in this release: Advanced Encryption Standard (AES) encryption and integrity-checking technology, 802.1x authentication, virtual private networks (VPNs), and virtual LANs (VLANs). The chip set also supports Temporal Key Integrity Protocol (TKIP) and Wired Equivalent Privacy (WEP) functionality for legacy systems that don't support AES.

So how exactly does the AR5001X chip set function? Essentially, its SmartSelect technology works to transparently connect to 802.11a, 802.11b, or 802.11g networks. It automatically chooses the RF technology (a/g/b), data rate, error-correction mode, radio channel, power-management mode, and security protocol best suited to the situation at hand. These decisions may depend, for example, on the frequency running, signal strength, or type of protocol(s) running.

Once the appropriate choices have been made, SmartSelect negotiates a setup with the network. It even dynamically adapts to changing conditions as the user roams within that network. Because both the 802.11a and 802.11b networks occupy different frequency bands, they can be deployed alongside one another. This aspect creates an easy upgrade path for expanding available bandwidth.

According to Sheung Li, Atheros' Hardware Product Line Manager, "From the end user's perspective, this is good news. The end users simply want to gain access to a network. They don't want to have to worry about which network. SmartSelect technology literally takes that worry out of the hands of the user."

The AR5001X chip set offers a number of key benefits. The combination of OFDM performance and broad spectrum support, for example, improves

network scalability. Its broad spectrum also increases the number of available channels, thereby reducing or eliminating co-channel interference. System developers can use the AR5001X to create products that work with any of these networks (a, b, or g).

Having access to 802.11g this early in the game also has its rewards. The user gains the widespread interoperability of 802.11g to talk to 802.11b. And while the range and performance gains of 802.11g

are outperformed by what is currently available in 802.11a, having access to 802.11g does add to the overall available functionality of the AR5001X chip set.

The Atheros Combo AR5001X WLAN chip set is sampling now. Volume shipment is expected in the second quarter of this year. ■

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