TheAmplifier

A Newsletter for Richardson Electronics

December 2008

ANADIGICS

Wireless LANs: Wi-Fi Everywhere

Wireless networking is hot, from the home to the office and at hot spots in restaurants, bookstores, and airports. Everybody with a laptop wants network access. But laptops are only part of the story. Wireless networking is moving strongly into the consumer space with a wide variety of devices that can now connect wirelessly: cameras, smart phones, MP3 players, game controllers, printers . . . you name it.

WLAN connectivity is becoming popular not only with computers but with a range of consumer electronics.

What's in a Name?

Wireless broadband networking goes under several names: 802.11a/b/g/n, Wi-Fi, and wireless Ethernet.

- **802.11** is the IEEE committee that writes the standards for wireless LAN networks. The lettered suffixes refer to different revisions or amendments to the standard.
- **Wi-Fi** is a popular consumer-oriented name for 802.11-based wireless networks. The Wi-Fi Alliance is a trade organization promoting wireless networking. **Wi-Fi** as a name is more consumer friendly than **802.11**.
- **Wireless Ethernet** is sometimes used because 802.11 networks use the same Ethernet frames as wired Ethernet. Less common today, the term **wireless Ethernet** derives from the fact that the original impetus for 802.11 was to create a wireless LAN that could co-exist with wired Ethernet.

Version	Frequency Band	Max. Data Rate
802.11a	5 GHz	54 Mb/s
802.11b	2.4 GHz	11 Mb/s
802.11g	2.4 GHz	54 Mb/s
802.11n (MIMO)	2.4/5 GHz	300 (3x3) Mb/s 600 (4x4) Mb/s

The basic flavors of wireless are distinguished by the frequency band and maximum data rates.

802.11n is a multiple-input, multiple output (MIMO) application that extends both the speed and range of wireless networking. A MIMO application uses more than one antenna and transmit/receive stream to send and receive messages. The streams are treated as a single message. While 802.11n includes changes that boost the data rate of each stream, it also boosts the rate through multiple streams. The effect of MIMO is to multiply the bandwidth by the number of streams. MIMO allows up to four streams. In most applications, a separate antenna is required for each stream. The exception is cell phones, which can use a single antenna.

In a MIMO application, each stream requires its own transmit chain with a power amplifier.

Note that maximum data rates for all flavors of 802.11 depend on transmission distance, obstructions in the path, and other factors. In the real world, actual data rates are often slower. All 802.11 flavors have built-in fall-back mechanisms that automatically adjust the connection speed up or down as required for reliable connections.

What's the Market for Wireless Broadband?

The first thing you think of is laptop computers and wireless access points. Nearly all laptops today have wireless built in to allow connection to LANs, the Internet, and so forth. You can't get to the internet without a LAN or other network connection. Adapters, most often USB devices or plug-in PCI cards, are available for desktop computers.

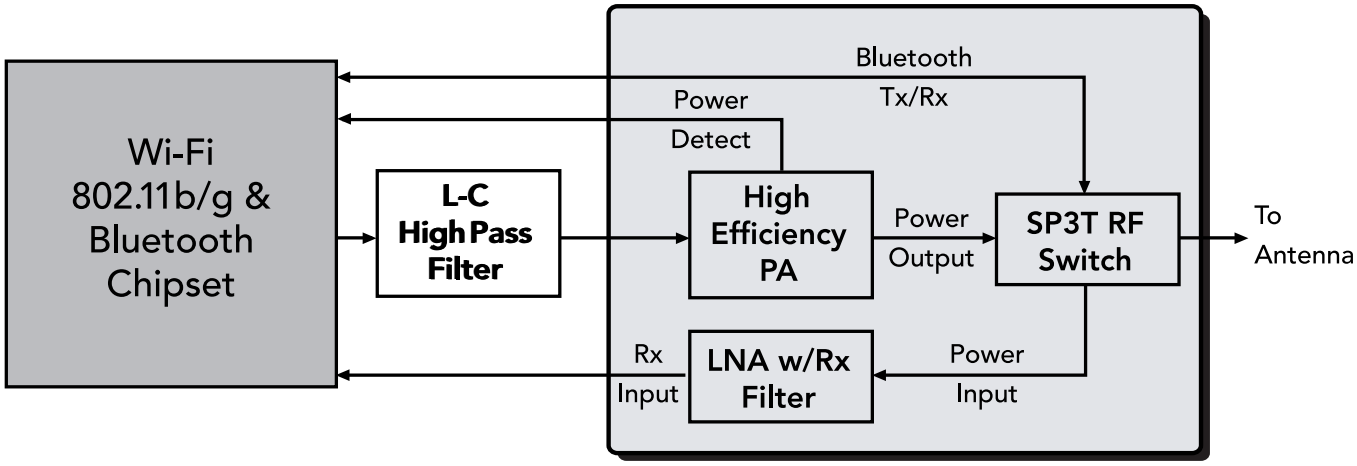
But 802.11 connectivity is quickly moving beyond computers to embrace a wide range of devices: digital camera and camcorders, smart phones, MP3 players, game controllers, and printers. The driving force is to allow devices to connect to computers without having to plug them in.

What Are the Market Drivers for Power Amplifiers?

Performance: Performance is always critical. High linearity is important to maintain signal integrity. High efficiency reduces power consumption and lengthens battery life.

Higher Integration: Putting more functions into less space simplifies design, saves real estate, and reduces the bill of materials. ANADIGICS offers front-end integrated circuits (FEICs) that integrate, into a single package, a high-performance PA for transmitting, a low-noise amplifier (LNA) for receiving, and an SPDT or SP3T switch used to switch the antenna between transmitting and receiving circuits. The SP3T switch allows both the PA and LNA to be bypassed to provide a path for Bluetooth signals.

FEICs reduce the size of the front end to enable very small form factors for handheld applications, eliminate off-chip FET switches for on/off control, and end the need for regulated voltage supply. The result is significantly reduced complexity and cost of the front-end in high volume manufacturing. The highly integrated FEICs help designers save space and reduce the bill of materials expense. Rather than a handful of external active and passive devices, the FEICs require only a decoupling capacitor, and, for high-power applications, a choke inductor. Simply put, it's easier to buy a front end than to design one.



Space Savings: With the move to include WLAN capabilities in compact devices like cell phones, PDAs, and cameras, saving space is important, both in the area of board real estate used and in the height of the device. We have steadily reduced the footprint of products—moving from 5 x 5-mm size to 3 x 3 mm. Our newer AWL6254 FEIC has a scant board-hugging 0.55-mm profile.

Output Power: Output power helps determine the range of the device: higher output means longer range. For computers and wireless handsets, range is important. For consumer devices like cameras or printers, range is not as important a factor.

What Is the Market for WLAN PAs?

The applications mentioned above suggest the market. But who are the buyers and influencers? We approach the market from both a top-down and bottom-up perspective to target different segments of the market.

Manufacturers: Companies like Intel, Motorola, and Nokia are movers and shakers in the world and having them spec our products obviously means important, high-visibility design wins. As the Wi-Fi market expands, prospects go beyond the traditional makers of computer-based WLAN devices and access points to include handset makers, computer peripherals, and others.

ODMs: Contract manufacturers and ODMs are playing a bigger role in selecting and specifying parts. While a marketing company might once have given a complete design and parts list to an ODM, today they are giving the ODM more latitude in specifying parts.

Chipset Vendors: Close development relationships with vendors of 802.11 chipsets can help us get specified in reference designs. They also allow us to optimize the new designs to work with specific chipsets.

What about Wireless Phones?

Traditionally, wireless telephony uses other protocols for data. Speeds are much lower, but transmission distances are much longer than for wireless LANs. Newer phones support both 3G and upcoming 4G telephony standards *and* Wi-Fi. With the growth of both Wi-Fi hotspots and smartphones, consumers want to have LAN-like connectivity in their mobile devices.

VoIP telephone, which uses the Internet for telephone calls, is also evolving wireless variations that use 802.11.

What about WiMax?

WiMAX grew out of the computer industry as a means of entering the wireless industry. WiMax offers a big jump in data rates over 3G data rates. Compared to Wi-Fi, it offers much longer connection distances, but does not match the speed. The big selling point for WiMax over WLAN is that it allows connectivity while moving. Wi-Fi does not. The convergence of Wi-Fi and WiMax in wireless handsets gives user the best of both worlds: mobile WiMax over long distances and high-speed Wi-Fi connectivity over shorter distances.

What about Bluetooth?

Bluetooth is a wireless standard for short-distance Personal Area Networks, operating only over distances of a few feet. A common Bluetooth application is between a wireless handset and the headset. The requirements for the Bluetooth PA function are not as rigorous as for 802.11. ANADIGICS does not offer Bluetooth amplifiers: Bluetooth does not require a separate PA, but drives the antenna directly from the Bluetooth transceiver. Our AWL6254 FEIC is compatible with Bluetooth: the internal SP3T switch allows the WLAN send and receive circuits to be bypassed, allowing Bluetooth signals to pass directly from the antenna to the chipset's transceiver.

What Does ANADIGICS Offer for WLAN?

The table shows popular ANADIGICS PAs and FEICs for WLAN applications.

We offer an industry-leading combination of linearity, power, and efficiency for WLANs. Benefits include higher power for better, wider wireless coverage, higher efficiency for longer battery life, and better linearity for high, error-free data rates. Our power amplifiers bring the same advanced technology to wireless LANs that has made us a leader in power amplifiers for wireless phones. With single or dual-band support for IEEE 802.11a/b/g/n, our products enhance the performance of WLAN chipsets, save space and reduce component count, and enable maximum wireless coverage.

The **AWL6951** offers dual-band support for 802.11a/b/g, a low current consumption of only 175 mA, and a low EVM to maintain high modulation accuracy and error-free transmissions. It works with a wide supply voltage ranging from 3.0 to 4.4 V.

The **AWL6153**, for 802.11b/g applications, can be used with either a 3.3-V or 5-V supply for easy compatibility with a wide range of designs. Its higher output power makes it suited to applications requiring strong connectivity over maximum distances, such as access points.

Also for 802.11b/g, the **AWL9224** offers a smaller 3 x 3 x 0.9 mm package, operating at 3.3 V. It is suited for those applications requiring small size and lower costs.

The **AWL6254** is our popular and proven FEIC with ultra-low current consumption of only 80 mA at 16 dBm output power. It is well suited for a wide range of applications where small size and long battery life are essential requirements. These include VoIP handsets, smart phones, ultra mobile PCs, notebook PCs, PDAs, cameras, USB adapters, and game controllers.

802.11 PA Family							
Frequency (GHz)	**Package Size (mm)**	**Gain (dBm)**	**OP1dB (dBm)**	**Current (mA) (802.11g)**	**EVM @ 54 Mbps (802.11g)**	**Supply (V)**	**Part Number**
2.4 – 2.5 4.9 – 5.9 802.11a/b/g	4 x 4 x 1.3	32 (a) 30 (b/g)	27	175 @ +20 dBm	2.9% @ +20 dBm	3.0 – 4.4	AWL6951
2.4 – 2.5 802.11b/g	4 x 4 x 1.4	29.5	28	190 @ +21 dBm	3% @ +21 dBm	3.3	AWL6153
		30.5	31	290 @ +25 dBm	3.5% @ +25 dBm	5	
	3 x 3 x 0.9	32	27	200 @ +20 dBm	3% @ +20 dBm	3.3	AWL9224
802.11 Front-End Integrated Circuit: PA, LNA, Switch							
2.4 – 2.5 802.11b/g/n MIMO	3 x 3 x 0.55	27	23	80 @ +16 dBm	4% @ +16 dBm	3.3 – 4.2	AWL6254

How Does ANADIGICS Compare with the Competition?

Overall, ANADIGICS products give designers more features and better specifications than competitive products. While space prohibits a spec by spec comparison, ANADIGICS FEICs and PAs offer higher levels of integration in a smaller package and offer compelling performance specifications (with a performance edge more times than not). For example, the AWL6254 FEIC integrates both an LNA and a 3-pole switch. With the RFMD and Epicom parts, you can have one of these, but not both. While the RFMD has slightly better EVM, it does so at a much higher current draw that makes it less attractive in battery-powered devices.

(See table on following page)

Powering the Evolution of Wi-Fi

As WLAN connectivity grows, ANADIGICS is helping to power that growth by delivering industry-leading PAs and FEICs. As the market matures, we meet diverging needs for higher integration, smaller form factors, and the specific performance needs of various segments of the market. But as our product offering grows, one thing remains constant. We continue to offer products with power levels, linearity, and integration that means higher value to our customers and to WLAN users.

	Smartphones and Computer Electronics				Computers	
	FEICs			Discrete	PAs	
	ANADIGICS AWL 6254 FEIC	RFMD RF5924 FEIC	Epicom FM2422 FEIC	RFMD 5122 PA + SKY13268 SPDT + LNA	ANADIGICS AWL6951 PA	TRIQUINT TQM7M7001 PA
Frequency Bands	802.11b/g	802.11b/g	802.11b/g	802.11b/g	802.11a 802.11b/g	802.11a 802.11b/g
Structure	PA Detector LNA SP3T switch	PA Detector Balun SP3T switch	PA Detector LNA SPDT switch	Discrete Packages	PA	PA
EVM (%)	<4.0 @80 mA at +16 dBm	<3.5 @150 mA at +16 dBm	<4 @60 mA at +14 dBm	2.5 @+16.5 dBm	3 @+20 dBm	3 @+18 dBm
Efficiency (%)	15			12		
Output Power, (dBm)	+20	+21	+18	+18	+24	+22
LNA Noise Figure (dB)	2.3	--	3.0		--	--
Switch Loss (dB)	0.8	1.6		0.4	--	--
Package Size (mm)	3 x 3 x 0.6	3.5 x 3.5 x 1.4	4 x 4 x 0.8	>20 mm^2 board space	4 x 4 x 1.3	4 x 4
On/Off Control CMOS Compatible?	Yes	No	No	--	--	--
Bluetooth Path	Yes	Yes	No	No	--	--

Your Contacts at ANADIGICS

Nikhil Krishna

Distribution Sales and Marketing Manager

nkrishna@anadigics.com

(908) 668-5000 x5247

Jennifer Palella

Senior Director Marketing and Worldwide Distribution

jpalella@anadigics.com

(908) 668-5000 x5938

141 Mount Bethel Road, Warren, NJ 07059 |
(908) 668-5000 | www.anadigics.com