AC/DC Front-end Technology within Wireless Datacom Applications

With the widespread utilization of WiFi/WiMAX systems, the need for more operating power in a smaller, environmentally-friendly package continues to increase.

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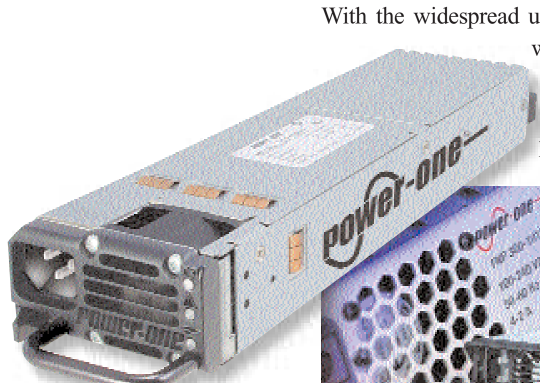
Over the past few years, today's data-communication and telecommunication markets have been rapidly deploying AC front ends as the primary means of converting AC mains voltage to the more usable voltages preferred by logic devices, auxiliary/peripheral devices and/or alternate point-of-load regulators and DC-DC converters. The advantages of using these AC front ends have been influencing the overall architecture of global wireless networks, and therefore, the operating philosophy of these wireless networks.

As seen in Table 1, there are several key advantages in deploying ACFE's within wireless networking equipment. With the drive in today's society towards a 'green' friendly environment, the most important advantage is the greater efficiency offered by front ends, in a much smaller package than traditional AC/DC solutions. Today's AC front ends are pushing densities greater than 30 W/in^3, in a box height no larger than 1.60″ (to accommodate placement within a 1U high chassis).

Indeed, many system designers have started architecture layout schemes keeping in mind the 'power advantages' seen in Table 1. With the widespread utilization of WiFi / WiMax systems, and wireless datacom equipment as a key component of next generation telecom equipment, the drive towards more operating power in a smaller, environmentally-friendly box, is greater now than ever before.



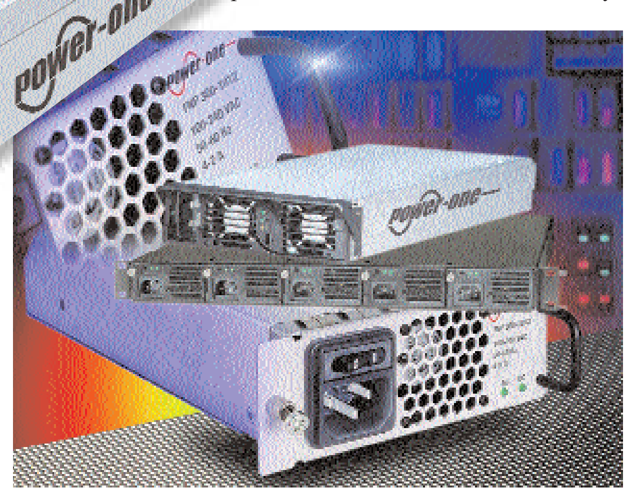


Figure 1.The SFP450-650-1050 Series offers both wide range AC and wide range DC input options. Figure 2. Power-One's FNP series provide both front and rear input voltage options, AC and DC input options, and high power density.

Table 1

ACFE Feature	Wireless Network Benefit
Low Profile/High Density	Smaller overall system; More efficient use of space
High Efficiency	Cooler operation; Lower overall power consumption
Two outputs: High power main; Low power standby	
Redundant Operation	Failsafe operation; Greater 'uptime'
NEBS Compliance	Rugged system performance
Communications Interface(I^2C)	Provides communications interface to the PCB level

A quick review of the predominant wireless system components available today, reveals a striking trend which confirms what power designers have been seeing for years: Greater power density is directly proportional to increased revenue generating capacity. Consider the following major components: Routers & data switches, wireless network servers, WiFi/WiMax transmitters/receivers.

Routers and data switches are the primary backbone of data networks, whether wireless or wireline. In the case of wireless routing equipment, the available space allocated to simply redirecting or routing data throughout a building or server has dramatically decreased in the past 2 to 3 years. This hardware is generally less than 1U high, is highly multi-functional, and is generally fully parallelable. All of this increased multi-tasking and load sharing requires approximately 50 to 75% more power and expanded communications with the host system via I^2C.

When dealing with the actual server itself, as a bulk device or as a blade-type, or when dealing with WiFi and WiMax equipment, higher bandwidth transmission rates are of primary importance. Handling more data and storing more data requires increased power. Additionally, in order to maximize the $ per square foot earned in a typical data center or network equipment rack, such servers and transmission equipment are radically shrinking in size often being less than 1.65″ in height. Greater power densities and a cool thermal profile are of keen importance to the system architect.

For broader appeal, today's AC front ends are also optimized for maximum efficiency and minimal power loss at 40 to 75% loading. As most AC front ends are employed in a redundant, parallel orientation, 100% loading on a single AC/DC power source is never realized. Active current sharing provides for near 50% load balancing, except when the load increases or decreases at a very high slew rate. Therefore, power designers today look to a 40 to 75% load rating at ambient temperatures to optimize performance. In some cases, an adaptive power or intelligent feedback, allows the AC front end to adjust internal operating and performance characteristics to maximize efficiency. In effect, a true closed loop system.

Today's AC front ends provide all of these features and benefits, in a wide variety of form factors. However, certain ideal form factors appeal greatly to the broad base of system designers. Consider the SFP series (Figure 1), which also offers both wide range AC and wide range DC input options. The SFP series measures 1.6″(H) × 3.3″(W) × 11″ deep and provides from 450 to 1,050W in the same package size with a typical efficiency of 91.5%. Ideally suited to wireless and wireline server applications, these types of AC front ends are deeper, but more narrow, effectively taking advantage of rack depth, while maximizing placement of two front end supplies within a 7.0″ width. Typical applications for this type of front end include data switches, wireless servers, data storage equipment and networking equipment demanding a high level of reliability through redundancy.

Certain systems prefer a combination of shortest possible depth/length, with a very low height (<1U), but can afford a slightly wider form factor to 5.50″. Consider certain front ends like Power-One's FNP series (see Figure 2), which provide both front and rear input voltage options, AC and DC input options, and high power density. A broad power offering can be key to application viability, so as to support power growth in the future. Offerings from 300 to 2000W can truly service the varied needs of wireless data communication equipment. As witnessed by Power-One's successes in the overall networking marketplace, typical sweet spots exist in the 300, 850 and 1500 to 1800W range. The FNP300, FNP850 and FNP1500/1800 address the needs of system designers.

Additionally, consideration must be given to the power architecture to be deployed within the system While traditional distributed power architectures (DPA) utilize DC-DC bricks to convert from a bulk 48V feed (courtesy of the AC/DC front end), the more common intermediate bus architecture (IBA) is based on the very widely accepted 12v bus where the 12V is supplied directly to the Point of Load (POL) converters. Without exception, in order to support legacy equipment and new system designs, both high power 12 and 48V must be supported by the AC front end line.

Pricing is an equal consideration, but only when it maximizes total ownership cost. The days of using the 'cheapest', least expensive supply on the market have long gone. Reliability, for a fair price, can be had. Leveraging the tradeoffs of high performance for an affordable price is best determined by the combined efforts of the system designer and power supply provider.

As a rule of thumb, involve the power supply specialists as soon as possible so as to maximize overall system performance. Use of Field Application Engineers, similar to those regionally based by Power-One, can aid in the proper selection and design of power systems for datacom applications.

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About the Author
John Carroll is the global director of marketing for Power-One's full line of AC/DC products. He has over 17 years of experience in the power supply industry and has held various positions beginning as a design engineer, sales/applications engineer, and multiple marketing and divisional management positions. He can be reached at john.carroll@power-one.com.