Medical And Smart-Grid Markets Beckon Designers

While new business continues to sprout in defense, automotive, and communications applications, high-frequency companies are also finding opportunities in emerging smart-grid and medical markets.

Microwave companies have largely weathered the current recession with grace, thanks to steady military requirements and evolving communications markets. Those markets have offered microwave firms new opportunities supporting fourth-generation (4G) wireless systems, unmanned aerial vehicles (UAVs), and improvised-explosive-device (IED) detection. Yet high-frequency technology also is viewed as a solution for nontraditional markets, such as the medical and smart-grid areas, as a means of supporting reliable, high-data-rate wireless connectivity. These emerging needs translate into new opportunities for the RF and microwave companies that can meet technology and price requirements.

According to the report, "Telecommunications, IT, and Healthcare: Wireless Networks, Digital Healthcare and the Transformation of US Healthcare, 2009-2014" by Insight Research Corp., spending by the US healthcare industry on telecommunications services will grow at a compound rate of 10.2 percent over the forecast period. From $7.1 billion in 2009, healthcare-industry spending on telecommunications services is predicted to reach $11.6 billion in 2014. Emerging medical opportunities range from the treatment of tumors to determining the radiation effects of ingestible wireless devices. Currently, one of the broadest opportunities lies in wireless patient monitoring. For example, the Intel Health Guide is a patient-monitoring system that allows healthcare professionals to customize care, gather timely information about the status of their patients, and collect and prioritize data. It offers patients an intuitive way to have timely interaction with healthcare providers and receive relevant self-care education.

A clinical trial between Toumaz Technology Ltd. and Imperial College London currently features Toumaz's Sensium-enabled "digital plaster" wireless body monitor. The focus of the trial will be to verify that the physiological data acquired by the digital plaster system within a clinical setting is equivalent to that acquired using the gold-standard monitors in current use (***Fig. 1***). The Sensium digital plaster is a disposable wireless device with a working lifetime of several days. It is based on Toumaz's AMx semiconductor intellectual-property (IP) platform. Powered by thin batteries, body-worn Sensium-enabled monitors vow to deliver clinical-quality data. They intelligently integrate that data into an electronic medical record via a network built on Toumaz's wireless operating and networking system, Nano Sensor Protocol (NSP).

Although such solutions offer convenience, they also can have tremendous emotional and financial impact. Last month, American Educational Telecommunications(AET) remotely diagnosed a baby's heart murmur in real time using wireless technology, eliminating the need to transport the child to another facility. The baby's pediatrician, Dr. Vasudevan, became concerned about an obvious heart murmur while performing a post-natal examination at Faith Regional Health Services in Norfolk, NE. To diagnose its severity, he requested a consultation with a pediatric cardiologist. Yet the closest pediatric cardiologist was in Omaha, NE—115 miles from Norfolk.

The doctors agreed to set up a telemedicine consultation utilizing a remote echocardiogram system connected to a mobile and wireless transmitting video-conferencing device, rather than transporting the baby (one of a set of triplets) to Omaha. Dr. Scott Fletcher, a cardiologist with the University of Nebraska Medical Center/Creighton University Medical Center, Joint Division of Pediatric Cardiology in Omaha, was able to view an ultrasound and provide immediate confirmation that it was neither life threatening nor lifestyle limiting. (A video, "Live Echocardiogram Diagnosis of Newborn's Heart Defect," can be viewed at www.aetmedical.net/Video.html.)

High-frequency innovations for military applications also find their way into medical markets. For instance, Advanced Image Enhancement (AIE) recently debuted image-enhancement technology for digital mammography in breast-cancer screening and diagnosis. The firm's image-enhancement software leverages signal-processing technology originally developed to locate undersea mines for the US Navy. In a hospital, it allows physicians to extract more information from medical images by improving the clarity of abnormalities.

Among the wireless standards efforts being applied to the medical arena is ZigBee Health Care, an open standard for the secure monitoring and management of noncritical, low-acuity healthcare and wellness services. This standard, which fully supports IEEE 11073 devices, is designed to reduce patient care costs while improving care and quality of life for patients and consumers. Although ZigBee or IEEE 802.15.4 is often associated with home and industrial control, it faces competition in those areas from the EnOcean Alliance's standard, which was formalized to provide self-powered wireless monitoring and control systems for sustainable buildings. Such applications fall under the smart-grid umbrella, which also is proving to be a profitable emerging market—largely because of recent stimulus funding.

The smart grid has several components. Paul Minton, CEO of California Eastern Laboratories, states, "We break smart grid into three chunks. The most visible chunk right now is the meter making the transition from what we call automatic meter reading (AMR)—one-way wireless from the meter to read it either to a truck or some kind of wireless backhaul—and now the transition to advanced metering infrastructure (AMI), which is two-way. That enables the second chunk we think of, which is the home-area network. Both of these require the third chunk, which is the backhaul or smart utility network (SUN)."

Minton sees energy monitoring within the home as a promising growth area for wireless technology: "We see experimentation with customers that are building the kind of wireless, battery-operated, magnetic, mount-to-your-refrigerator home-energy monitor—what we might call nodes or end points so that you would have intelligent control of a socket, say, for a lamp or the light and in the future perhaps the ability to turn on or turn off appliances." Rich Howell, Director of Business Development for CEL's 802.15.4 and ZigBee product lines, adds, "We do have a number of ZigBee Pro devices that are shipping today in thousands of units per month and sometimes tens of thousands of units per month that go into smart thermostats, in-home displays—as Paul articulated, something that attaches with a magnet to the refrigerator with an LCD on it that tells the consumer, 'You're halfway through the month and you're on par to reach a $300 electricity bill this month, which is well above normal' or 'Congratulations, you're well below your normal usage rate.'"

The ability for consumers to manage their own utility bills also is a focus of the Edison Electric Institute. The institute recently spotlighted Baltimore Gas & Electric's (BGE's) smart-energy pricing pilot program, in which customers have been able to manage electricity use in direct response to price signals. According to Lisa Wood, Executive Director of the Institute for Electric Efficiency, BGE first installed advanced interval metering for

approximately 1050 residential customers so the utility could communicate prices directly. It decided to test dynamic peak pricing (DPP) and peak-time rebate (PTR, which is between 2:00 and 7:00 pm on weekdays). By 6:00 pm the day before a critical peak pricing day, the utility sent out a notice by e-mail, telephone, or text message.

Alternatively, the utility tested two systems that automatically respond to the day-ahead price notification: a device that automatically cycles the air conditioner when the price changes and an energy orb, which is a spherical device inside the home that changes color and pulsates when the price is about to change (***Fig. 2***). The orb used a publicly available very-high-frequency (VHF) paging network. It currently only receives messages and does not have the capability to send outbound messages. In the future, BGE plans to test in-home displays that operate off more robust two-way mesh networks, such as ZigBee and other AMI technologies.

To support such capabilities, RF designers must develop secure and robust smart meters capable of wireless data transmission over short distances. According to Phillip Halford, Product Manager of Analog Devices' RF Group, "Wireless technology is becoming more pervasive as a mechanism to control and monitor energy as well as control home and business systems. Short-range RF transceivers offering robust radio performance are paramount for these applications." For examples of products that can support such applications, Halford points to ADF7022 and ADF7023 RF transceivers (***Fig. 3***). The ADF7022's integrated communications processor supports the io-homecontrol protocol, which enables homeowners to remotely control systems like roller blinds and shutters, awnings, garage doors, roof windows, and heating systems.

As solar nodes are increasingly deployed for power generation, they will become part of the smart grid as well. To make sure that solar panels are working effectively, each one requires isolation for accurate monitoring. In addition, the output level must be reported to a master control point. According to CEL's Minton, a lot of this reporting is currently done via wired control. For each individual panel, there is a clear opportunity for isolation and wireless monitoring and control.

Lighting control also plays into the smart-grid arena. Prices for light-emitting diodes (LEDs) have been dropping dramatically, which will lead to their increased usage. Howell states, "You actually need to control an LED through some type of mechanism that gets you directly into the digital control of the light itself. It's done with pulse-width modulation, which turns the LED on and off rapidly—too fast for the eye to see, but the net effect is that the light looks dimmer. Through the digital control, you can set whether it's half-dim, etc. The only practical way to do that is with a wireless control. The other option would be to string a totally separate wire to that light just for the purpose of control." CEL has a video showing LED lighting control on YouTube (www.youtube.com/watch?v=f64qCYylZJg).

A smarter energy grid may be possible through more practical use of the current infrastructure. Joe Thomas, CEO of the recently privatized M/A-COM Technology Solutions, notes, "Even with the conventional power generated by power plants, people are working on options for a smarter grid. A study was completed by NASA that said utilities generate 20 percent more energy than is needed to assure reliable service. Said a different way, 20 percent of the energy generated today is wasted. If there could be 5-percent improvement in that excess the grid has to maintain, that decrease would eliminate the need to build new infrastructure or power plants to the tune of $50 billion over the next 25 years and make the current infrastructure much more efficient. We talk about how people can become more efficient and use less power through higher Energy Star-rated

appliances, etc. But think about if you could just start getting the electricity to the right user at the right time or make it more effective to generate electricity more on demand."

Smart-grid developers also are taking into account electric and hybrid vehicles. For example, the Spain-based NAGARES Group and PREMO have formed an agreement to develop and produce smart-grid-interface EMC modules for such applications. Telematics systems are positioned for greater growth as well. According to iSuppli Corp., global shipments of such systems are set to rise to 84.4 million units in 2016—up by more than 4X from 19.3 million in 2008. By 2016, 68.4 million cars will ship with telematics systems installed by OEMs, which will translate into 84.6 percent of all cars shipped. So far, the US is the leading telematics market with 30 percent of all models available with installed systems. This trend is credited to General Motors (GM), which pioneered installed telematics in 1996 with its OnStar satellite-communications (satcom) service. OnStar was made a standard feature on all cars this year.

Ford Motor Co. recently partnered with Microsoft on a solution called SYNC, which provides the following features: ands-free calling; turn-by-turn navigation; 911 Assist; music search; vehicle health report; news, sports, and weather; business search; real-time traffic; and audible text messages. According to Thomas, "Basically, Ford and Microsoft want to make the Ford car a node on the network. So they have to know where you are and that information can't just be reliant on a connection to a GPS satellite because you can lose the link to the satellite. M/A-COM Technology Solutions has developed a product and started shipping it about halfway through this year. Next year, we'll be shipping a substantial number of units."

Many smart-grid applications will rely on mesh networking, which also is being utilized in the homeland-security and military industries for voice, video, and data networks as well as inspection and detection systems. For example, EF Johnson Technologies, Inc.'s subsidiary, 3e Technologies International (3eTI), received a $3.1 million contract from the US Defense Threat Reduction Agency (DTRA) for weapons-of-mass-destruction (WMD) sensor technology integration with the Vessel Boarding Inspection System (BVIS). 3eTI will provide engineering and technical services as an integrator of both ultra-wideband (UWB) communications and sensor technology. Also among growing defense applications are missile warning satellites, satellite and wireless communications, and unmanned aerial vehicles (UAVs).

Aerospace offers a steady flow of opportunities for microwave technology as well. One example hails from Ball Aerospace & Technologies Corp., which has been selected by NASA's Goddard Space Flight Center to build a second Global Precipitation Measurement Microwave Imager (GMI) in support of the Global Precipitation Measurement (GPM) mission. These multi-channel, conical-scanning, microwave radiometers will aid the GPM in improving climate, weather, and hydrological predictions by providing more accurate precipitation measurements from space. The GPM mission also will create a reference standard to unify measurements from satellites carrying microwave sensors.

The popularity of smartphones and the march toward LTE and other 4G technologies has created new opportunities for backhaul equipment as well as femtocells and picocells (see "'Tis The Season To Send Data"). Analog Devices' Halford notes, "The trend in the microwave backhaul market is to move to the higher-bandwidth 56-MHz signal bandwidth with a very-high-order modulation scheme of 256QAM and above. Obviously, when you push for performance and bandwidth like that, a challenge arises from the semiconductor companies' perspective: 'How are we going to deliver that performance without increasing the power consumption and delivering the optimal performance for those platforms?'"

Wireless-broadband solutions also remain viable despite the fact that WiMAX has not grown as predicted. The technology is still a good fit for last-mile solutions as well as a source of broadband for countries with little infrastructure. In fact, countries like China and India are active markets for both wired and wireless suppliers, as they are currently building out their infrastructure. With WiMAX in particular, there also is an opportunity for some technology to cross over to 4G systems. Halford notes that ADI is seeing interest in its integrated 2x2 products, which were developed for WiMAX, to be used as picocell products for LTE. Many more niches exist for microwave and RF products, making it clear that the recession has not hampered the emergence of new opportunities. If anything, it seems that microwave and RF companies are limited only by their imaginations.

http://www.mwrf.com/Articles/Index.cfm?Ad=1&Ad=1&Ad=1&ArticleID=22245

Article: Medical And Smart-Grid Markets Beckon Designers
by Nancy Friedrich
Microwave & RF – December 2009