

What's Up With 3G These Days?

THIRD-GENERATION TECHNOLOGY PROMISES AMPLE BENEFITS. UNFORTUNATELY, IT ALSO POSES MANY CHALLENGES. LEARN WHICH NEW DEVELOPMENTS WILL HELP EASE THIS GROWING DESIGN BURDEN.

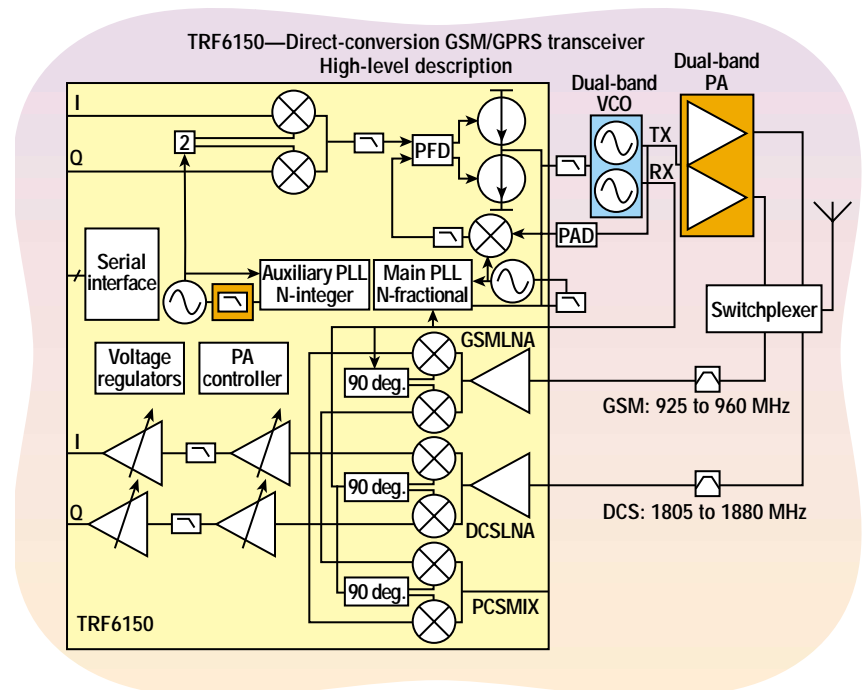
BY CHERYL AJLUNI

MENTION the term third generation (3G) these days and most engineers—let alone most consumers—generally have a fairly good understanding of what you mean. It refers to the convergence of voice, video, and data and it promises to impact virtually every wireless mobile device you develop and/or own. This common understanding of just what it is that makes 3G important has, in a sense, served to create the misconception that migrating to 3G is an easy task. After all, looking at it from a narrow perspective, the migration from 2G to 3G is really just the addition of increased bandwidth—right?

In truth, 3G does mean increased bandwidth for data transport. For a stationary device or one moving at pedestrian user speeds, that increase translates to 384 kb/s. In a car, 3G networks must be able to transmit wireless data at 128 kb/s, while in fixed applications that number is 2 Mb/s. But, 3G networks mean much more than just increased bandwidth.

As defined by the International Telecommunication Union (ITU) in its International Mobile Telecommunications (IMT) 2000 specification, 3G is a mobile-communications technology which includes support for packet-switched (PS) and circuit-switched (CS) data transmission as well as high spectrum efficiency. Third-generation networks have 230 MHz of spectrum at 2 GHz and will work over a number of wireless air interfaces including wideband code-division multiple access (WCDMA), cdma2000, and time-division multiple access (TDMA). WCDMA is a 3G standard widely perceived as the successor to Global System for Mobile Communications (GSM). cdma2000 is a 3G wireless technology based on the IS-95, or cdmaOne, standard.

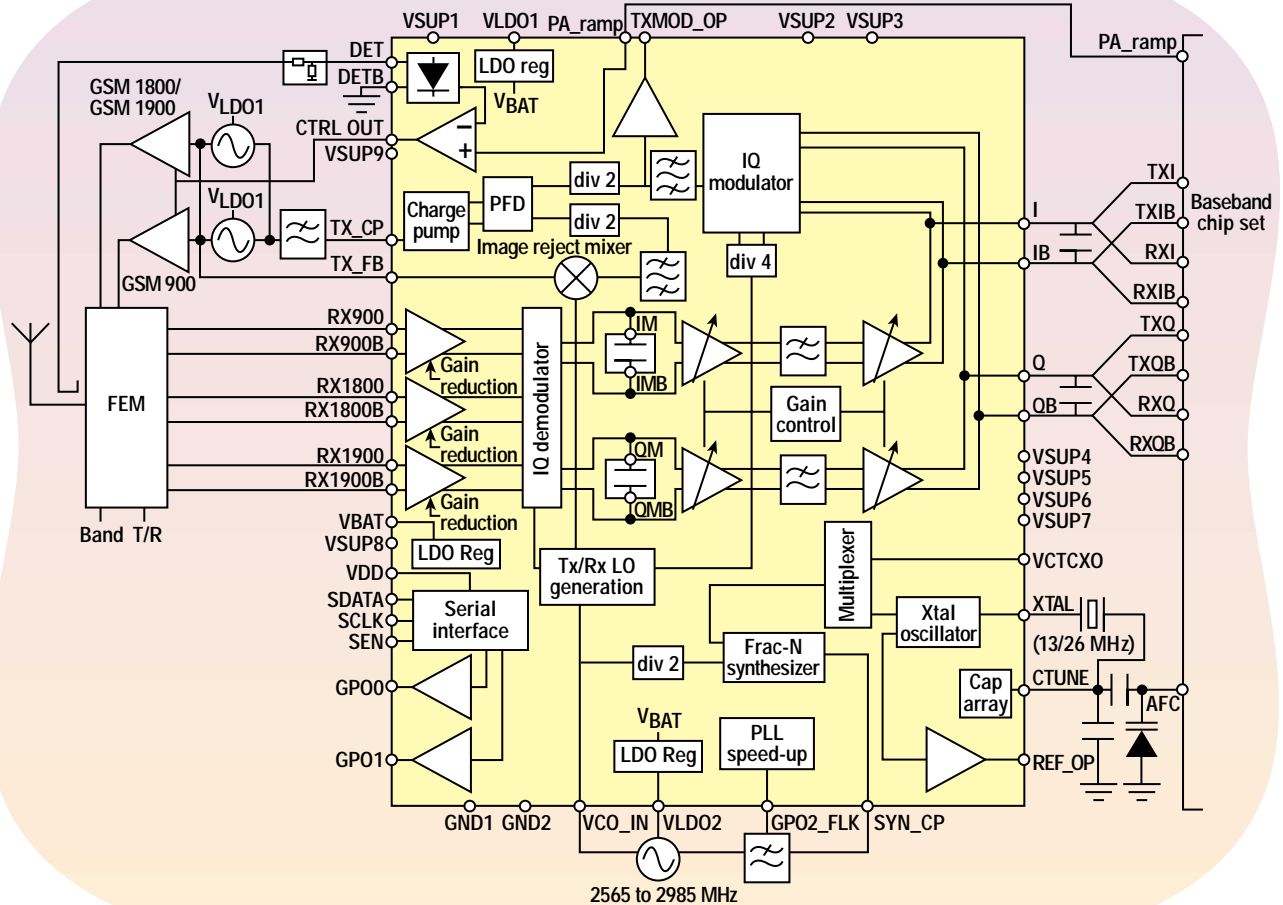
Another standard, Universal Mobile Telecommunications System (UMTS), is of special interest as it provides a vital link between today's multiple GSM systems and IMT-2000. It also addresses the growing demand by mobile and Internet applications for new capacity.



1. The single-chip direct conversion RF solution pictured here is said to provide enhanced functionality over competing devices. According to the company, it has demonstrated signal quality better or equivalent to today's RF solutions.

UMTS is being developed by Third-Generation Partnership Project (3GPP), an organization consisting of a number of telecommunications-standards bodies. These include the European Telecommunications Standards Institute (ETSI) in Europe, the Association of Radio Industries and Business/Telecommunication Technology Committee (ARIB/TTC) in Japan, the American National Standards Institute (ANSI) T-1 in the US, the Telecommunications Technology Association (TTA) in South Korea, and the Chinese Wireless Telecommunication Standard (CWTS).

3G technology and associated standards are of interest to many companies and industry organizations. That's because, in addition to overcoming network-capacity limitations, it brings with it a host of new features. The problem, of course, is that the migration to 3G also brings with it tighter requirements for lower power and higher performance, as well as the need for things like 3G-based test and



2. This schematic provides a detailed look at the Othello One chip from Analog Devices.

measurement equipment. And that's just for starters! Luckily for today's wireless systems developer, help is in the offing. It comes in the form of enhanced standards and product development targeted at 3G applications.

CHIP-LEVEL 3G

An interesting development in the area of standards hails from Qualcomm, Inc. (San Diego, CA). The company played an essential part in the recent publication of the 3G CDMA 1xEV enhancement to the cdma2000 standard. The 1xEV specification was developed by the third-generation partnership project 2 (3GPP2) and is known as TIA/EIA/IS-856 "CDMA2000 High Rate Packet Data Air Interface Specification." Based on Qualcomm's high-data-rate (HDR) technology, this high-speed packet-data specification provides high spectral efficiency for mobile, wireless wide-area networks (WANs), supporting peak data rates up to 2.4 Mb/s in a standard 1.25-MHz frequency channel. Optimized for the Internet, the 1xEV specification incorporates a flexi-

ble architecture based on standard Internet protocols that extend fast, always-on Internet access to untethered users. It is compatible with cdmaOne and cdma2000 networks.

In support of the 1xEV specification, Qualcomm will offer chip-set and system-software solutions for device and infrastructure equipment. Samples are expected to be available in the second quarter of 2001.

In addition to work in the standards arena, a number of companies are now banding together to meet the challenges of 3G head on. A perfect example of this is the recent partnership between Tivoli (Austin, TX), an IBM company, and Ericsson (Stockholm, Sweden). The two will work together to develop a comprehensive set of mobile-device-management solutions. The solutions will enable General Packet Radio Service (GPRS) and UMTS or 3G mobile-communication devices to be manageable out of the box as well as to be supported and updated remotely. The alliance will also focus on support and helpdesk ser-

vices, which will enable remote monitoring and configuration of devices as well as software and program updates.

Ericsson and Tivoli will also propose a set of international standards for managing the next generation of mobile devices. A standard proposal is expected during the first half of 2001.

Consider for a moment that the migration to 3G high-speed technology is expected to create a booming market for wireless transceiver base-station (BST) semiconductors. Wireless carriers will be faced with difficult choices concerning whether or not to move to 3G and which migration path to take. Despite these concerns, the demand for BTS semiconductors will increase. Power amplifiers (PAs), radio front-end, modulation, demodulation, and signal processing are expected to show the most growth. This trend makes the recent announcements from companies like RF Micro Devices (Greensboro, NC), Texas Instruments (Dallas, TX), and Analog Devices (Norwood, MA) all the more important.

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The RF Micro Devices product is a high-power, high-efficiency linear amplifier for 3G applications. This gallium-arsenide (GaAs) heterojunction-bipolar-transistor (HBT) amplifier, RF2186, is designed for use as the final RF amplifier in +3-VDC cdma2000 and WCDMA-/UMTS handsets, spread-spectrum systems, and other applications in the 1920-MHz-to-1980-MHz band. In addition to its compliance with 3G standards, RF2186 is backward compatible with existing 2G and next-generation 2.5G systems.

This self-contained device delivers 27-dBm linear output power, 31-dB linear gain, and 35-percent linear efficiency. Offered in an MLF-16 package, the component is now available.

Texas Instruments recently introduced a single-chip solution for the UMTS, GPRS class 12, and GSM-based wireless-telephone handsets. This highly integrated transceiver enables wireless-handset original equipment manufacturers (OEMs) to build smaller systems with fewer components, and at a cost-effective price (**Fig. 1**).

Texas Instruments' TRF6150 integrates a PA controller and on-chip low-dropout (LDO) regulators, while requiring only two external filters with a single external voltage-control oscillator (VCO). This move not only slashes one-third of the bill-of-materials (BOM) cost, but enables a 15-percent reduction in required board space as well. Direct-conversion RF reception eliminates the bulky and expensive filtering associated with intermediate frequencies (IFs) in traditional schemes. The result is a dual-band GSM RF section with an area below 10 square centimeters on a single-sided printed-circuit board (PCB).

The TRF6150 is packaged in a 64-lead thin quad flatpack (TQFP). Mass production of the solution will begin in the second quarter of 2001. Samples are now available.

In a related announcement, Analog Devices has now introduced its version of a single-chip GSM/GPRS radio. Known as Othello One, this offering builds on the company's original Othello chip set which featured a direct-conversion receiver, a translational loop "Virtual-IF" transmit architecture, and a fractional-N synthesizer (**Fig. 2**). The Othello One offering takes these features one step further by incorporating a higher level of integration and reduced component count.

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In particular, the functions integrated on the Othello One chip include low-noise amplifiers (LNAs) for all three bands, a fractional-N phase-locked loop (PLL), three LDO regulators for full radio power management, three general-purpose outputs for radio control, and RF power control. An edge-transmit capability can be easily added to the mix. Additional features of the solution include a target sensitivity of -109 dBm, support for an external polar modulator for 8-PSK, and full enhanced-data-rates-for-global-evolution (EDGE) support on the receiver (down-link). An Integral Balun for single-ended VCO operation is also included. The solution is now available and comes in a LFCSP 48-pin chip-scale package with dimensions of 7×7 mm.

It's impossible to talk about recent chip-level 3G announcements without mentioning test and measurement. The reality today is that 3G systems are simply more complex than 2G systems. That fact alone makes test-and-measurement equipment with increased performance and functionality a must. Developers must have tools that are flexible enough to handle evolving standards, while at the same time be full-featured enough to handle the measurement challenges of WCDMA and cdma2000.

With this in mind, Agilent Technologies (Palo Alto, CA) has recently come to the market with an option to its ESG-D series RF signal generator. This solution is aimed at base-station manufacturers who need selectivity and sensitivity testing to ensure that base stations are ETSI compliant and operate at the highest quality. Option 300 provides manufacturers of GSM/EDGE base stations with a fast, flexible, and high-performance base-station test solution for more accurate testing. It tests both transceiver modules and base transceiver stations and provides basic measurement modes for GSM base-station test, such as BER and sensitivity search. Option 300 also provides basic measurement modes for EDGE/EGPRS base-station test, such as BER/BLER and sensitivity measurements. These tests are all compliant to the ETSI GSM 11.21 standard.

With a continued move to proliferate 3G technology, chances are these announcements are just the beginning. Expect to see more in the coming year, along with news on evolving standards and new multimedia-type applications. **WSD**