Product Bulletin

OMAP1510
Application Processor for 2.5 and 3G Wireless Devices

The OMAP1510 processor is a unique dual-core architecture that combines the command and control capabilities of the TI-enhanced ARM™ 925 processor with the high-performance and low power capabilities of the TMS320C55x™ DSP core.

Key Features
- Dual-core architecture optimized for efficient operating system and multimedia code execution
- TMS320C55x™ DSP core provides superior multimedia performance while delivering the lowest system-level power consumption
- TI-enhanced ARM™ 925 core with an added LCD frame buffer to run command and control functions and user interface applications
- Rich set of peripherals including USB Client; USB Host; and camera, audio and memory interfaces allow developers to customize their products to their customers' needs
- Small, 289-pin MicroStar™ BGA package (12 x 12 mm) eases design in space-constrained devices
- DSP/BIOS™ Bridge allows easy-to-integrate DSP multimedia algorithms
- Open platform enables a large network of independent developers providing a broad range of OMAP™ architecture compatible software solutions
- Code Composer Studio™ Integrated Development Environment (IDE) is part of TI's award winning eXpressDSP™ Real-Time Software Technology that slashes development and integration time by up to 50%

As the wireless market continues to grow, the OMAP™ platform from Texas Instruments (TI) will help meet wireless devices increasing consumer expectations. Next-generation wireless multimedia appliances will include more than just voice communications. As full-motion video, video conferencing, voice recognition, real-time Internet and high-fidelity audio are integrated into these wireless appliances, a general-purpose processor alone will not be able to handle the processing performance needed while meeting battery life expectations. The consumer expects this rich functionality while continuing to demand longer battery life and smaller, sleeker products. The OMAP architecture features open hardware and software that drives the quick introduction of differentiated products for next-generation wireless appliances. The OMAP architecture has a high-performance, ultra-low-power TMS320C55x™ digital signal processor (DSP) core for efficient execution of real-time multimedia applications as well as a TI-enhanced ARM™ 925 processor to run command and control function and user interface applications.

The OMAP processor is the ideal engine for wireless multimedia applications processing. TI DSP technology is the key to providing both the high performance and low-power consumption required in these next generation mobile products. In addition, OMAP architecture is open, providing flexibility and a programmable platform for developers. The OMAP processor supports advanced operating systems (OS) such as Microsoft Windows® CE and Symbian EPOC™ as well as standard multimedia application programming interfaces (APIs). Developers can

leverage a wide range of software developer's networks, including TI DSP third parties, ARM third parties, TI OMAP developers and OS third parties. The OMAP processor enables real-time communications with the extended battery life that consumers demand.

The OMAP1510 is the first applications processor specifically targeted for 2.5 and 3G wireless devices. The OMAP1510 processor combines a TI-enhanced ARM 925 core with a C55x™ DSP core along with a wide range of general-purpose peripherals and dedicated multimedia application peripherals. The OMAP1510 has been optimized for power efficient execution of the key multimedia applications including MPEG-4
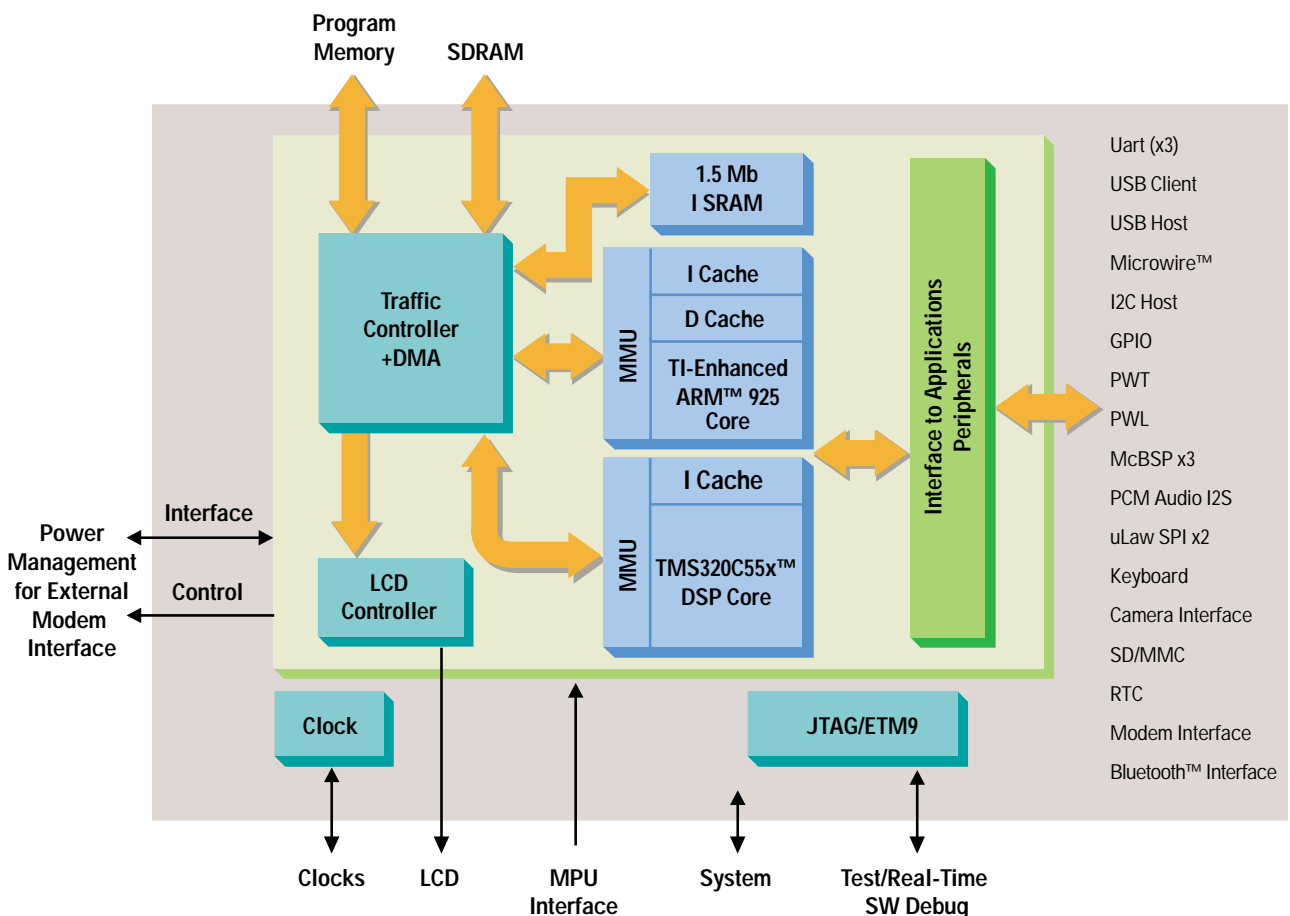
decode and encode, MP3 decode and encode, JPEG decode and encode and advanced speech applications such as text-to-speech, speech recognition and Adaptive Multi-Rate (AMR). This combination of cores and peripherals provides the best-in-class power and performance ratio for both standard and custom processors for wireless devices. As an example, the OMAP1510 provides the same processing power of a standalone RISC processor but uses just 1/4th the power.

The OMAP1510 is initially targeted at PDA and smart phone applications although it is scheduled to be offered for a wider range of applications in the second half of 2001.

OMAP Architecture

The OMAP1510 processor is based on the unique dual-core architecture that combines the command and control capabilities of the TI-enhanced ARM 925 core with the benchmark performance/power capabilities of the C55x DSP engine. The TI-enhanced ARM 925 core is an industry leading implementation of the ARM RISC architecture that operates up to 175 MHz. The TI-enhanced ARM 925 includes a memory management unit (MMU) for virtual-to-physical memory translation and task-to-task memory protection as well as a 16KB instruction cache, an 8KB data cache and a 17 word write buffer. There is 1.5 Mb of internal SRAM provid-

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ing a large memory space for power efficient on-chip data and code storage for applications such as liquid crystal display (LCD) frame buffering. A two level interrupt handler provides 32 interrupt lines including 13 internal and 19 external interrupts. Also included in the core is the ARM CP15 coprocessor and protection module.

DSP Advantage

The 200 MHz C55x DSP core sets the DSP industry's benchmark power and performance ratio. Three key innovations enable this: increased idle domains, variable length instructions and increased parallelism. The C55x DSP core has a highly optimized architecture for multimedia applications, including core level extensions that facilitate the demands of the multimedia market for real-time, low-power processing of streaming video and audio. The C55x DSP core contains three multimedia extensions to further improve the power efficiency. These are motion estimation, discrete cosine transform (DCT), inverse discrete cosine transform (IDCT) and 1/2- pixel interpolation. The addition of this hardware accelerator enables video applications to run up to twice as fast while also reducing the power consumption.

The C55x DSP core includes 32 kwords of internal dual-access SRAM, 48 kwords of internal single access SRAM and a 12 kword instruction cache. The C55x DSP core also includes an MMU as well as a dual layer interrupt handler and a direct memory access (DMA) unit. The DMA allows the transfer of data between points in the memory space as well as between peripherals without Microprocessor Unit (MPU) intervention.

LCD Controller

The LCD controller allows a direct connection to a black and white or color LCD panel, either super twist nematic (STN) or thin film transistor (TFT), reducing the system component count and power consumption. The frame buffer can be allocated in external SDRAM or internal 1.5Mb SRAM for improved power efficiency. A dedicated channel on the DMA unit is used to transfer data from the frame buffer to the LCD controller. The LCD controller can support 2/4/8/12/16-bits per pixel and a 1024x1024 display.

Memory Interfaces

The OMAP1510 processor contains three memory interfaces– two external and one internal. The external memory interfaces support direct connection to 64MB of addressable SDRAM up to 100 MHz and to 32MB of addressable Flash (asynchronous or burst), random access memory (RAM) or read only memory (ROM) devices. Both of these external memory interfaces are 16-bits data wide and support external devices having 2.75-V or 1.8-V (typical) interfaces. The internal memory port connects to the 1.5 Mb of on-chip SRAM. All three memory interfaces are accessible and can be shared by the TI-enhanced ARM 925 MPU, C55x DSP core and system DMA. The system DMA is included to allow transfers of data between points in the memory space without MPU intervention. Data movements to and from internal memory, external memory and peripherals can occur in the background of MPU operation.
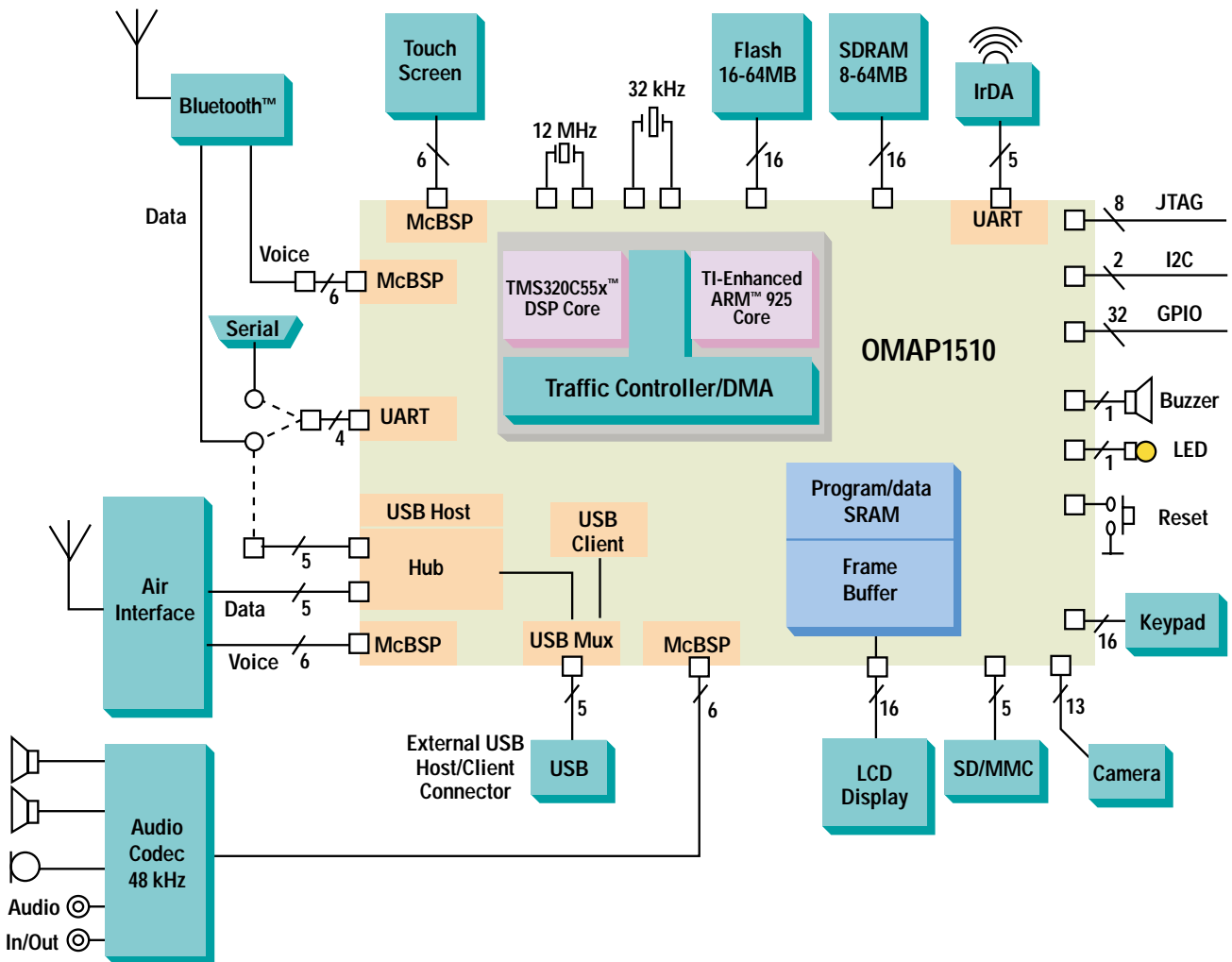
Camera Interface

Video applications will be an important part of next-generation wireless appliances. A camera interface allows the OMAP1510 to connect directly with a camera module for video conferencing and other video applications. The interface uses 8-bit parallel image data, pixel clock and horizontal/vertical sync signals for the interface. Additionally, a clock can be provided to the external camera at various configurable frequencies. The pixel clock can be synchronous or asynchronous depending on the requirements of the external camera module. A DMA port allows camera data to be transferred without the need for MPU intervention.

Air Interface

An external modem device can be connected directly to the OMAP1510 through a modem interface, allowing both data and voice communications. The interface has been designed to work with any air interface standard, making it easy to use in any system. The data is transferred on the TI standard Multi-channel Buffered Serial Port (McBSP) at configurable rates up to 6 Mbps while the control is done through a UART along with control signal lines for the clock and power. The 8-kHz voice data can be transferred by the Multi-Channel Serial Interface (MCSI). The McBSP and universal asynchronous receiver transmitter (UART) have DMA support, reducing the MPU loading.

Bluetooth™ Interface

The Bluetooth™ standard will allow short distance wireless connectivity so that wireless multimedia appliances can be connected with other appliances, a home computer or local area network. A Bluetooth interface, provided by a high-speed UART and MCSI serial port on the OMAP1510 processor allows developers to easily incorporate this feature in their next-generation wireless devices. The Host Control Interface is done through a standard UART with extended baud rate options up to 1.625 Mbps by using an externally supplied baud clock. The MCSI

can be used for 8-kHz voice data and has a four-wire interface with bi-directional data, a serial clock and frame sync.

Universal Asynchronous Receiver Transmitter (UART)

Three 16C750 compatible UARTs are included in the OMAP1510. All are controllable through a software interface or through hardware flow control signals. Two of the UARTs, as mentioned above, are intended for modem and Bluetooth interfaces but are not limited to those applications. The third UART includes optional infrared data adapter (IrDA) 1.0 serial infrared (SIR) support for

serial communication up to 115.2 kbps. The three UARTs have 64 word receive and transmit FIFOs with programmable trigger levels and offer even, odd or none transmit parity along with 1, 1.5 or 2 stop bits.

I2C Host

The OMAP1510 includes an I2C host port compliant with Philips I2C standard. The interface is a single master only, half-duplex serial port using two lines (data and clock) for data transmit with software addressable external devices. Both standard 100-kHz and fast 400-kHz transmit modes are supported. Burst write, single

read and combined read modes are all supported. A transmit burst buffer of 16 words allows for continuous transmission of data.

PWT Generator

A pulse width tone (PWT) generator generates a modulated frequency signal for the external buzzer. The frequency is programmable between 349 Hz and 5276 Hz with 12 half-tone frequencies per octave. In addition, the PWT is volume programmable, allowing the user to select how loud their phone rings. To control the backlight of the LCD and keypad, a pseudo-noise pulse width light (PWL) modulator is also included.

Serial Ports

The OMAP1510 processor includes many different types of serial ports. Two McBSPs can be used for interface to an audio codec for digital audio input and output (using I2S interface protocol for example) or can be configured to connect to an external optical audio interface device. A Microwire™ standard compatible interface is included for connecting external devices such as a serial EEPROM or LCD. The 14-bit general-purpose input/output (GPIO) can be dedicated to either the DSP or the microcontroller unit (MCU). A 5-bit GPIO dedicated to the MCU is also provided. A general serial port interface (SPI) is included and can be used as a voice communication interface.

USB Client and Host

The OMAP1510 processor includes a universal serial bus (USB) client controller for high-speed plug-and-play synchronization with a personal computer or other master device. The OMAP1510 also has a USB host controller, with up to three down stream ports, allowing connection to high-speed modem devices or USB peripherals such as a mouse, keyboard or camera. Both the host and client controllers are compliant with the USB specification version 1.1.

SD/MMC Interface

A Secure Digital (SD)/MultiMedia Card Controller (MMC) interface allows connection of industry standard flash storage cards and I/O peripherals for storage of large multimedia data like digital audio, digital video, maps and digital still photos. The I/O peripheral mode allows for the addition of future peripherals. The SD/MMC interface is compliant with the MMC standard specification version 2.2 and the SD Physical Layer specification version 1.0.

Additional Features

The OMAP1510 processor also offers support for licensees of MemoryStick™ or OpenMG™ technology. This allows the consumer to add flash cards to their wireless appliance that contain programs, games, personal information, music or other data important to them.

A real-time clock (RTC) keeps track of the current time in seconds, minutes and hours and allows for devices to include alarm clock functionality. Calendar information like day, month, year and day of the week up to the year 2099 is also provided.

Other features of the OMAP1510 include a keyboard interface that allows a direct connection of a 6x5 or 8x8 matrix keyboard, a JTAG and emulation interface, a clock generator with Phase Lock Loop (PLL) and power management. The MPU and DSP each have three 32-bit timers and a watchdog timer.
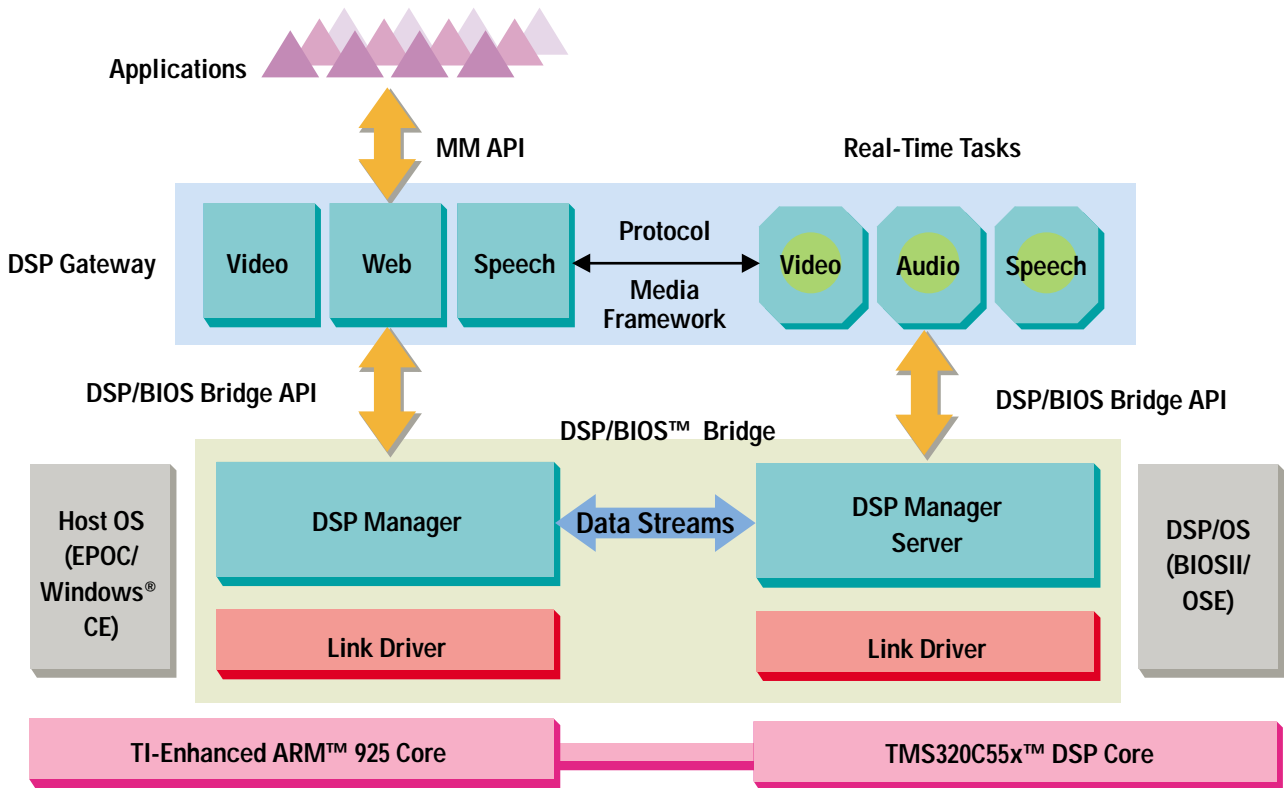
Space Saving Package

The OMAP1510 comes in a space-saving 289-pin MicroStar™ ball-grid array (BGA) package with 0.5-mm ball pitch. The 12 x 12-mm package is ideal for ultra-small, ultra-light designs.

Tools and Support

TI will offer a wide range of support for OMAP platform products including PC-based application development tools and an evaluation module (EVM) with a User's Guide and Technical Reference Manual to help speed designs to market.

Application software developers can use the same PC-based emulation tools currently provided by the OS manufacturers with added TI OMAP extensions. This allows application developers to develop in the same environment they are used to and tap into the OMAP processor capabilities by simply calling into the software extensions that represent the extensive base of DSP algorithms. The application developers can quickly develop software, using available DSP algorithms, without having to use either the EVM hardware or learn the internal complexities of the DSP algorithm.

For development of DSP algorithms and the DSP gateway components on the TI-enhanced ARM 925, the programmer can use the TI Code Composer Studio™ Integrated Development Environment (IDE), a component of TI's award winning eXpressDSP™ Real-Time Software Technology, and EVM. Code Composer Studio is a fully integrated development environment that improves time-

to-market and covers all phases of development, from editing and building to debugging, code profiling and project management. Code Composer Studio includes a full compiler, simulator and debugger for the OMAP1510. The Visual Project Management system allows visualization, access and manipulation of all project files from the same window. Code Composer Studio also supports the development of systems with multiple processors using the Parallel Debug Manager (PDM). DSP/BIOS™, also part of eXpressDSP, is a scalable, real-time kernel for the C55x DSP core that provides a standard software base that reduces cost, risk and development time. Common run-time objects and utilities such as I/O modules, a fast preemptive scheduler and APIs for capturing real-time infor-

mation are included to get products to the market faster. OMAP supports multiple OSs on the DSP including TI's DSP/BIOS and OSE™, from Enea OSE systems.

OMAP1510 Software Applications Platform

The OMAP1510 includes an open software architecture that supports fast application development and provides the ability to dynamically download applications and application upgrades. The DSP/BIOS™ Bridge provides the communications between the applications on the TI-enhanced ARM 925 and algorithms on the C55x DSP core. The DSP/BIOS Bridge API allows developers to initiate and control tasks on the DSP, exchange messages with the DSP, stream data to and from the DSP and perform status queries. In this environment, the applica-

tion developer calls localized DSP gateway components to perform different functions like video, audio and speech. Thus, high-level application developers do not need to be knowledgeable about using the DSP or DSP/BIOS Bridge API to successfully introduce new applications. Once an application has been developed using this standard API, it will be compatible with future wireless appliances based on the OMAP platform.

The OMAP platform currently supports Microsoft Windows CE and Symbian EPOC operating systems. Other operating systems are planned for the OMAP platform in the near future. TI is also investing in technologies, such as JAVA™, which will allow a larger software developer base.

OMAP Developers Network

The OMAP software infrastructure is optimized for use by software developers. Software developed using the standard DSP/BIOS will be OMAP processor compatible. TI is working with software developers to develop application software, DSP algorithms, and gateway components for the OMAP platform.

There are a number of application areas for OMAP developers to focus on for 2.5 and 3G wireless appliances. Some promising areas include:

- *Multimedia:* streaming audio/video, broadcast, players
- *Games:* 2D, 3D
- *Location-based services:* GPS, network-assisted solutions
- *Security (user interface):* biometrics, user authentication
- *Security (infrastructure):* encryption/decryption, firewall, user verification, anti-virus
- *Business applications:* database management, spreadsheet, synchronization, application navigation via speech

The OMAP Developer Network will benefit the wireless device manufacturer in many different ways. The manufacturer can now rely on expert outside developers to deliver specialized programming specifically for their platform. Since the software developers have already invested the time and resources building expertise in their particular area, these applications will add value to any platform. To provide the highest performance possible, the software developer has already optimized their code between the DSP and microprocessor, this allows faster time-to-market for manufacturers.

TI has an existing DSP Third Party Program with the most extensive collection of DSP development support in the industry. With access to TI's DSP Third Party Network, the list of potential applications leveraging the performance of the DSP is ever-expanding. Given the wide variety of application software being developed, a hardware manufacturer can put together software from many different developers to get the right mix for their customers.

Availability

The OMAP1510 processor is initially targeted at PDAs and smart phone manufacturers. TI is shipping production samples of the OMAP processor today, and the OMAP1510 is scheduled to be available in volume production quantities in third quarter 2001.

For More Information

To find out more about how the OMAP1510 processor is the ideal engine for 2.5 and 3G wireless devices, call your local sales office or visit the TI web site. Find out how TI products can help make your next-generation systems easier to design with higher performance and lower power consumption.
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www.omap.com

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Indonesia	001-801-10	-800-800-1450
Korea	080-551-2804	–
Malaysia	1-800-800-011	-800-800-1450
New Zealand	000-911	-800-800-1450
Philippines	105-11	-800-800-1450
Singapore	800-0111-111	-800-800-1450
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