Dual core high-performance architecture with integrated high-speed connectivity

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Imagine an embedded processor that's designed to deliver a quantum leap in performance and system bandwidth while keeping power in check. Freescale Semiconductor, Inc. today is unveiling such a solution, providing architectural details of its most powerful processor to date: the MPC8641D Dual Core processor. Based on the e600 PowerPC system-on-chip (SoC) platform, Freescale's new MPC8641D Dual Core processor is engineered to deliver exceptional performance, connectivity and integration for networking, telecom, military, storage and pervasive computing applications.

Freescale's high-performance MPC8641D device integrates two e600 cores and high-speed interfaces to achieve significant performance gains and system-level cost savings. Each e600 PowerPC core is designed to deliver greater than 1.5 GHz performance, doubling instruction throughput when combined. Two 1MB L2 caches (four times more L2 cache than available from the current generation of single-core MPC74xx PowerPC processors) and dual AltiVec™ vector processing engines provide additional performance acceleration. The MPC8641D device is designed to offer all this performance within a power range that is expected to be 15-25 Watts (typical).

"Freescale's dual core processor design is a smart, elegant solution for high-performance embedded processing," said David Perkins, senior vice president of Freescale and general manager of Freescale's Networking and Computing Systems Group. "Our customers want higher performance, without the power associated with higher frequencies. We listened to their needs and responded with an innovative system-on-chip platform that not only combines two e600 processor cores but also integrates the right mix of high-speed interfaces, memory controllers and buses for next-generation embedded designs."

"In designing the MPC8641D processor, Freescale has made significant strides in eliminating traditional system-level bottlenecks that can restrict processing bandwidth," said Linley Gwennap, president and principal analyst of The Linley Group. "Not only can the processor's integrated MPX bus deliver more than three times the performance of an external bus, but the integrated high-speed interconnects can help ensure that the cores will be efficiently utilized. System developers should be pleased with the performance gains."

To minimize chip-level bottlenecks, the MPC8641D processor offers low-latency access to its dual e600 cores through a high-bandwidth integrated MPX bus that is designed to scale to 667 MHz. In addition, the MPC8641D features an integrated dual memory controller that enables low-latency, high-bandwidth access to DDR and DDR2 memories.

The MPC8641D processor design provides best-in-class, high-speed interfaces that address the bandwidth-intensive requirements of next-generation wireless infrastructure, access/aggregation, enterprise routing and pervasive computing applications. Overall system latency remains low because no system controller or bridge is required to access the native interconnects.

The dual core processor includes a RapidIO® serial fabric interface for system connectivity-ideal for connecting MPC8641D processors and peripherals in high-performance distributed systems. Examples include control plane processing, protocol processing and other compute-intensive applications requiring high-speed, peer-level communications with a low pin count, such as those found in AdvancedTCA platforms. The RapidIO ecosystem is more than 50 members strong and includes industry-leading embedded vendors who provide host processors, DSPs, communications processors, backplane interfaces, switches, systems, tools, operating systems and services. Freescale is a major proponent of the

RapidIO architecture and has a significant development pipeline of products enabled by RapidIO technology, including a serial RapidIO switch and several processor products.

The MPC8641D processor embeds four Ethernet media access controllers (MACs) that support 10/100Mbps and 1Gbps Ethernet, accelerating the identification and retrieval of protocols carried over Ethernet, including IPv4, IPv6, Transmission Control Protocol (TCP), User Datagram Protocol (UDP) and Virtual Local Area Network (VLAN). The MPC8641D also enables local legacy peripheral-to-host connectivity with support for PCI Express interfaces.

In addition to unveiling the MPC8641D processor, Freescale is disclosing development of two additional processors based on the e600 PowerPC core: the highly integrated MPC8641 processor, a pin-for-pin compatible single core implementation of the dual core device; and the MPC7448 discrete processor, a higher-performance, lower-power successor to the popular MPC7447A PowerPC device, announced in February 2004. Pin-for-pin compatible with the MPC7447A, the MPC7448 processor offers 1MB of L2 cache and is expected to exceed 1.5 GHz.

Each of these PowerPC products is designed to be manufactured on Freescale's advanced 90 nanometer (nm) silicon-on-insulator (SOI) copper interconnect technology. The advent of these three devices-the dual core MPC8641D, the single core MPC8641, and the MPC7448-will provide system developers with flexible options for their high-performance processing needs while offering easy, software-compatible upgrades from existing Freescale processors containing PowerPC cores.

Applying Integrated Dual Core Technology

By integrating the functionality of two single core devices into a single device, system designers can leverage the MPC8641D processor to optimize application performance. The single-chip integration of cores, buses, controllers and interconnects helps developers reduce chip count and board-level cost, and it helps to streamline system design, development, testing and validation.

In lower bandwidth applications, system developers can leverage one core of the MPC8641D to manage the data plane and the other core to manage the control plane-or one core to manage the transmit direction of the data plane and the other to manage the receive direction. For higher bandwidth applications, both cores can work in concert with a network processor or an ASIC, with one core off-loading tasks, such as classification, security and quality of service (QoS). Developers can also choose to have both cores running the same operating system, simplifying the software transition to dual core devices while enjoying a significant performance gain.

Using an integrated dual core solution in any of these scenarios offers several benefits. First, a dual core device reduces board space and overall power consumption by replacing two separate processors and a system controller device with one processor. Second, it supports high-bandwidth communications between the two cores; messages and semaphores can be exchanged on a high-speed internal bus rather than over a slower PCI bus. Third, bandwidth to memory grows and latency is reduced. Finally, dual core architectures support high-performance coherency; one core can directly supply the most recent copy of data in its cache to the other core, without accessing main memory.

Recognizing the benefits of Freescale's MPC8641D dual core processor in system designs, many of the most popular operating system and platform vendors, including Enea Embedded Technology, Green Hills Software, Metrowerks, QNX and Wind River, have committed their support for the architecture.

Freescale will disclose additional architectural details of the MPC8641D processor at the Fall Processor Forum on October 5 and at the Network Systems Design Conference on October 21. Both events will be held in San Jose, California.