Ten Years and Counting:
PowerQUICC™ Communications Processors Everywhere

Wherever you go in the world, the chances are good you'll find a Freescale PowerQUICC™ communications processor at work. We've sold some 185 million communications processors since introducing the first one in 1989. The PowerQUICC line alone has been chosen by more than 500 manufacturers for more than 5,000 equipment designs since its introduction in 1995. As the world's leading communications processor architecture, PowerQUICC has found its way into virtually every corner of our lives.

When you think of PowerQUICC processors, you might automatically think of networking and communications equipment. And that's a logical place to start–the top 10 networking and communications equipment providers around the world all use this leading architecture. Thanks to the popularity of the PowerQUICC architecture, Freescale is the number one supplier of integrated communications processors.

But that's just the beginning. PowerQUICC processors are virtually everywhere. The mammoth Airbus A380–the world's largest passenger aircraft–relies on PowerQUICC in its navigation system. Stop for a hamburger, and you may find PowerQUICC behind the counter, in French fry machines. Pull the lever on a pachinko machine, and there's a good chance you're putting a PowerQUICC through its paces.

Freescale Semiconductor
PowerQUICC
10 Years
2005

freescale™
semiconductor

Driven Innovation

...ned this kind of success when we pioneered the first communications processor of its kind in 1989. No flash of inspiration, it came about after long talks with two key customers, AT&T (now Lucent) and Alcatel. They needed a faster, more cost-effective solution for ISDN terminal adaptors. Freescale (then Motorola's semiconductor sector) responded with a 68K-based host processor and a WAN interface, all integrated on a single chip. The MC68302 hit the market in September 1989.

The MC68302 succeeded, and more customers, including Ericsson, Motorola and Wellfleet (now Nortel), came on board. By 1993, the device had evolved into the first QUICC (Quad Integrated Communications Controller), the MC68360, and had grown to embrace new applications, including wireless base stations, small-medium enterprise (SME) routers and small-office/home-office (SOHO) routers. The addition of multichannel HDLC support, affectionately known as QUICC Multichannel Code (QMC), enabled the MC68MH360 to become a de facto standard in wireless base station applications.

Adding Power to QUICC

In 1994, a team of Motorola semiconductor engineers began working to integrate the QUICC's communications processor module, now known as the CPM, with the PowerPC® core. The PowerPC® architecture was jointly designed by Motorola, IBM and Apple for embedded and pervasive computing applications. Its minimal silicon requirements enable high levels of integration, making it possible to pack multiple peripheral functions on a single chip with low levels of power consumption and heat generation. The first PowerQUICC processor debuted in 1995 with the introduction of the MPC860.

And so the die was cast. Now most PowerQUICC processors pair an embedded PowerPC core with a CPM. Each

succeeding generation, from PowerQUICC I, PowerQUICC II, PowerQUICC II Pro to PowerQUICC III, offers higher performance cores, higher-speed CPMs and more advanced communications peripherals and interfaces. For example, clock rates for the various PowerPC cores range from 50MHz in a PowerQUICC I processor to 1.33 GHz in a 90 nanometer (nm) PowerQUICC III device. Faster clock rates for the CPM support the faster PowerPC core clock rates, reaching a maximum of 333MHz. The result is a spectrum of processors at different price and performance points to address a wide range of applications.

PowerQUICC I processors are based on Freescale's 180nm micron process technology with CPU frequencies ranging

from 66 to 133 MHz. PowerQUICC II processors offer the PowerPC 603e core and higher-performance 130nm technology for frequencies up to 450 MHz. They're made for applications such as Fast Ethernet, ATM and PCI. The PowerQUICC II Pro family incorporates a faster e300 core that runs at up to 667 MHz and includes Gigabit Ethernet and DDR memory. The award-winning PowerQUICC III, the first communications processor with RapidIO™ interconnect technology, incorporates the more powerful e500 PowerPC core for performance up to 1.33 GHz in 90 nm Silicon on Insulator (SOI) technology and adds capabilities such as Gigabit Ethernet and DDR2 SDRAM.
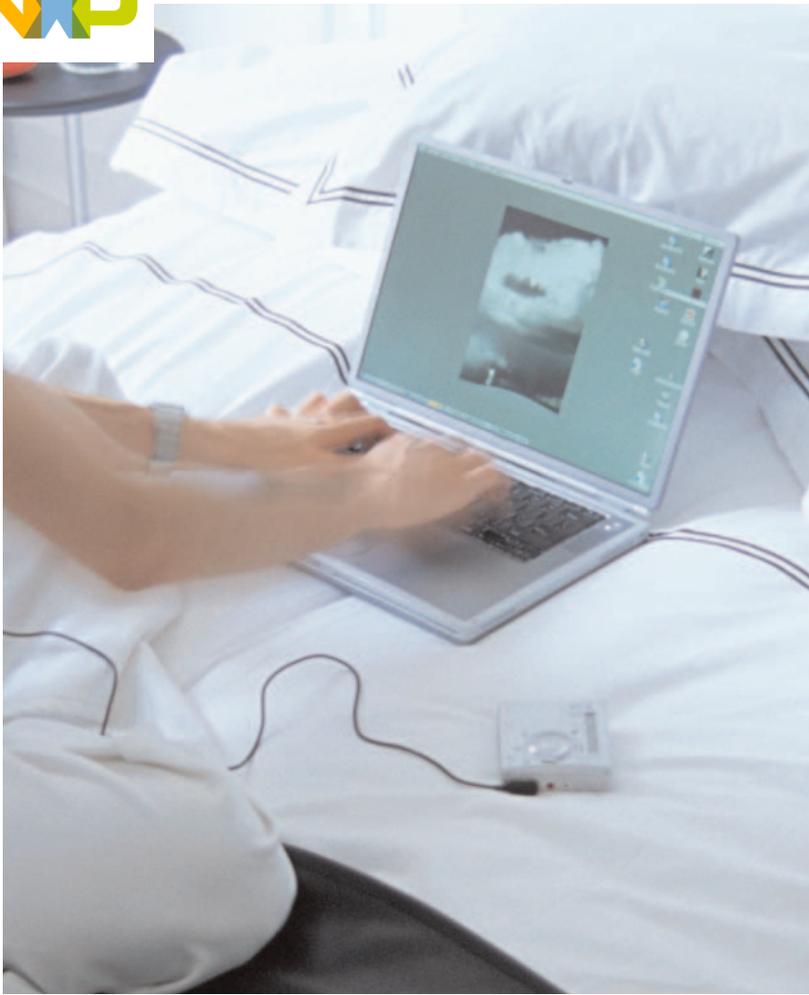
CPM Evolves Into QUICC Engine™

The CPM is an array of hard-wired serial communications controllers attached to a peripheral bus controlled by a 32-bit RISC engine. From its beginnings in the 68K-based 68360 communications processor, the CPM evolved to handle higher throughput and more Layer 2 protocols, including Fast Ethernet and ATM. Over the years, CPM has proven to be extremely flexible. For example, it can acquire new functions through firmware upgrades installed in its dual-port SRAM, allowing PowerQUICC communications processors to be upgraded to tackle new applications.

QUICC Engine technology is an evolutionary leap forward from the CPM. It features two RISC engines instead of the CPM's one, and is designed to deliver up to four times the data throughput, scales up to 500 MHz (compared to 333 MHz for CPM), and supports OC-12 and Gigabit Ethernet. While the CPM excels at Layer 2 applications, QUICC Engine technology supports Layer 3 tasks such as interworking, forwarding, switching and parsing. It provides integrated multi-protocol processing and interworking at rates of up to 1.2 Gbps. This frees the PowerPC core to focus on control-plane processing and improves the overall performance of PowerQUICC processors.

### QUICC Engine Technology at Work

The MPC8360E PowerQUICC II Pro family is the first line to feature QUICC Engine technology. Based on the e300 PowerPC SoC platform and featuring integrated security engines, the PowerQUICC II Pro family is designed for optimal price/performance and a balance of control plane and data-path capabilities for IP convergence applications. Target applications include IP DSLAMs, Multi-Service Access Nodes (MSANS), Voice-over-IP (VoIP) systems, 3G wireless infrastructure, passive optical networking (PON) equipment, multi-service access nodes (MSAN), and SME routers.

Designed to be Combined

Freescale functional blocks are designed to be easily re-used and combined. This enables rapid development of complete System-on-Chip (SoC) devices. Product development usually goes something like this: With customer requirements in mind, the development team chooses an appropriate core from Freescale's ever-advancing PowerPC product line and integrates it with a RISC-based CPM or the new QUICC Engine™ technology introduced in the MPC8360E PowerQUICC II Pro family. Reusable system blocks from Freescale's extensive intellectual property library round out the SoC designs.

United - We Build Solutions

When it comes to developing PowerQUICC solutions for our customers, Freescale often joins forces with other industry leaders. Over the years, a large and thriving product development ecosystem has evolved to support the application needs of Freescale's customers. One recent example: Freescale's MPC8360E PowerQUICC II Pro family with QUICC Engine technology is supported by software development tools, real-time operating systems (RTOSs), embedded Linux® operating systems and protocol stacks–all available from Freescale and third-party suppliers.
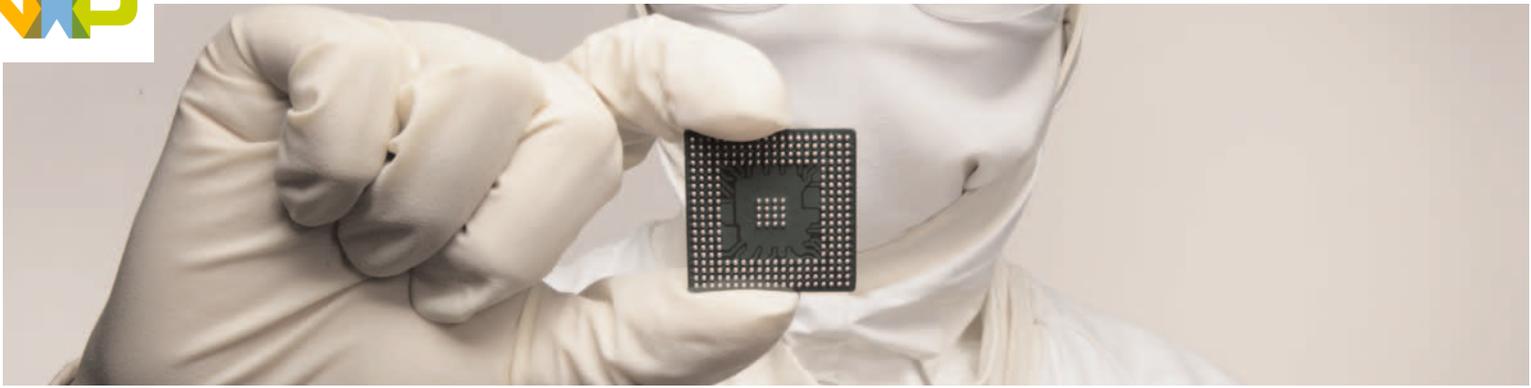
Consistency, Compatibility, Simplicity

Even after enormous leaps in technology, performance and capabilities, PowerQUICC communications processors remain consistent, compatible and well-defined from generation to generation. The architecture has been consistent throughout its evolution from the first PowerQUICC communications processors to the latest PowerQUICC III.

This continuity offers tremendous advantages to past, present and future PowerQUICC customers. They can rest assured that their investments in PowerQUICC processor-based products are both backward and forward compatible. They know their designs can work with future generations of PowerQUICC communications processor platforms without extensive new development investments.

Built-in Security

We've integrated security engines from the proven S1 family of security coprocessors across the entire PowerQUICC line. This helps equipment manufacturers reduce system-level costs and simplify board layout in developing solutions that enable trusted networks. On-chip security provides an economical means of accelerating cryptographic throughput and eliminating encryption bottlenecks in applications that support Internet Protocol Security (IPSec), Secure Sockets Layer (SSL) and other security protocols.

Sample Applications

While applications like the new Airbus A380 make headlines, more common applications featuring PowerQUICC processors include:

> Digital subscriber line (DSL) modems

> Small office-home office (SOHO) routers

> Integrated access devices (IADs)

> Remote access servers

> Digital subscriber line access multiplexers (DSLAMs)

> Central office switches and other telecom equipment

> Wireless infrastructure base stations

> Enterprise and virtual private network (VPN) routers

> Media gateways for packet telephony

> Printing, imaging and storage

Fast Facts

> World's best selling line of integrated communications processors

> Powers at least 5,000 equipment designs

> 2003 and 2004 Microprocessor and Report Analysts' Choice Award

> Voted one of EDN's Hot 100 Products of 2003

> Combines PowerPC® cores and RISC-based packet processors

> System-on-Chip design

> World-class manufacturing technology

THEN AND NOW: A COMMUNICATION PROCESSOR COMPARISON

Motorola MC68302 ICP (1989)	Freescale MPC8548 PowerQUICC III (2005)
16 MHz CPU speed	1.33 GHz CPU speed
No cache	32Kb I-cache, 512Kb D-cache
3 communication ports	4 Gigabit Ethernet ports

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