

IBM Introduces Chip Morphing Technology: Self-Managing Semiconductors System

August 2 2004

[IBM](#) today revealed a breakthrough chip morphing technology, enabling a new class of [semiconductor](#) products that can monitor and adjust their functions to improve their quality, performance and power consumption without human intervention. The patented technology, called "eFUSE," combines unique software algorithms and microscopic electrical fuses to produce chips that can regulate and adapt their own actions in response to changing conditions and system demands.

By dynamically sensing that a chip needs a "tune-up," eFUSE can alter the configuration and efficiency of circuitry to enhance performance or avoid a potential problem. This autonomic capability is expected to change the way chips are designed, manufactured and integrated into computers, cell phones, consumer electronics and other products.

"eFUSE reroutes chip logic, much the way highway traffic patterns can be altered by opening and closing new lanes," said Dr. Bernard Meyerson, IBM Fellow, vice president and chief technologist, IBM Systems and Technology Group. "Our work with innovative technologies like eFUSE is a result of IBM's commitment to investing in fundamental research and development, as well as to creating an environment that values and stimulates innovation."

eFUSE Enables Better Chips

eFUSE is part of a built-in self-repair system that constantly monitors a chip's functionality. If an imperfection is detected, this innovative technology "instinctively" initiates corrective actions by tripping

inexpensive, simple electrical fuses that are designed into the chip at no additional cost. The activated fuses help the chip control individual circuit speed to manage power consumption and repair unexpected, and potentially costly flaws. If the technology detects that the chip is malfunctioning because individual circuits are running too fast or too slow, it can 'throttle down' these circuits or speed them up by controlling the appropriate local voltage.

The morphing technology also will optimize and tailor the performance and capabilities of a chip to meet an individual customer's product needs in response to changing end-user or software demand. Customers further benefit from the versatility of eFUSE as the morphing can be repeated several times -- even after the chip has been packaged and shipped in a product.

Invented and refined by IBM scientists and engineers, eFUSE achieves a goal pursued by chip designers for many years by putting to positive use the phenomena of "electromigration." This phenomena has traditionally been detrimental to chip performance and was avoided -- even at significant cost and effort. IBM has perfected a technique that harnesses electromigration and uses it to program a fuse without damaging other parts of the chip. Previous implementations of on-chip fuse technology in the industry often involved rupturing fuses, which had resulted in unwanted performance and reliability problems.

Both versatile and adaptable, eFUSE is being implemented to support a variety of applications, such as high-performance microprocessors based on IBM's Power Architecture, including POWER5 and other chips used in IBM eServer systems, as well as low-power IBM silicon germanium (SiGe) chips. eFUSE-enabled chips also are available to IBM foundry customers.

As the leading ASIC (application specific integrated circuit) supplier,

IBM also is leveraging the self-managing function of eFUSE in all 90 nanometer custom chips, including those designed with IBM's advanced embedded DRAM technology. The combination of eFUSE and embedded DRAM helped the company achieve Frost & Sullivan's 2004 Award for Excellence in Technology, which is bestowed in recognition of the development and introduction of an innovative technology that has either impacted or has the potential to impact several market sectors.

eFUSE is technology independent, does not require introduction of new materials, tools or processes, and is in production today at IBM's 300 millimeter (mm) facility in East Fishkill, N.Y. and 200mm plant in Burlington, Vt.

IBM engineers hold dozens of fundamental eFUSE technology patents that led to this innovation.

Citation: IBM Introduces Chip Morphing Technology: Self-Managing Semiconductors System (2004, August 2) retrieved 26 April 2024 from <https://phys.org/news/2004-08-ibm-chip-morphing-technology-self-managing.html>

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