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The ExpressCard Standard

Next-generation PC card technology

By Brad Saunders

In 2005, the computer industry will see a new generation of PC platforms that takes advantage of the high-performance, scalable PCI Express standard. To address this new technology, PCMCIA developed a new standard for hot swappable systems and modules that dramatically improves the I/O performance of both desktop and notebook computers by supporting both the PCI Express and Universal Serial Bus (USB) 2.0 standard.

The ExpressCard Standard is designed to deliver high-performance, modular expansion to both desktop and notebook computers at a lower cost and in a smaller form factor. Users are able to add memory, wired and wireless communications, multimedia and security features by inserting ExpressCard modules into compliant systems. At roughly half the size and lighter than today's PC Card, ExpressCard products also leverage the proven advantages of PC Card technology, including reliability, durability and expansion flexibility while offering improved performance.

Relationship to the PC Card Standard

The ExpressCard Standard is the next generation of PC Card technology used in more than 95% of all notebook computers for adding new hardware capabilities. The ExpressCard Standard was created by a broad coalition of PCMCIA member companies including Dell, Hewlett Packard, IBM, Intel,

Lexar Media, Microsoft, SCM Microsystems and Texas Instruments. PCMCIA developed the new standard with assistance from the USB Implementers Forum (USB-IF) and the PCI-SIG (Peripheral Component Interconnect-Special Interest Group). PCMCIA is a non-profit trade association founded in 1989 to establish technical standards for PC Card technology and to promote interchangeability among computer systems.

The ExpressCard standard builds on the success of the PC Card Standard, including the 16-bit PC Card and the popular CardBus PC Card. Over time, ExpressCard technology is expected to replace CardBus as the preferred solution for hot-pluggable internal I/O expansion for notebook and desktop computers, especially in smaller form factor 'sealed box' designs. ExpressCard technology uses a simpler connector and eliminates the CardBus controller by using direct connections to PCI-Express and USB ports in the host. This lowers the cost of slot implementations in host systems.

Module Form Factors

There are two standard formats of ExpressCard modules: the ExpressCard/34 module (34mm x 75mm) and the Express-Card/54 module (54mm x 75mm). Both formats are 5mm thick, the same as the Type II PC Card. The standard module length is 75mm, which is 10.6mm shorter than a standard PC Card. Both module formats use the same connector interface.

The two ExpressCard module sizes give system manufacturers greater flexibility than in the past. While the ExpressCard/34 device is better suited to smaller systems, the wider ExpressCard/54 module can accommodate applications that do not physically fit into the narrower ExpressCard/34 form factor. Examples include SmartCard readers, Compact Flash readers, and 1.8-inch disk drives. In addition to extra space for components, ExpressCard/54 modules can dissipate more thermal energy than the smaller module, making it a natural choice for higher performance and first generation applications.

The slot for the ExpressCard/54 module also supports an Express-Card/34 device. The wide slot features a novel guidance mechanism that steers ExpressCard/34 modules into the connector socket. The ExpressCard Standard also allows extended module formats to integrate features such as LAN and phone line connectors, or antennas for wireless cards into their products. Although CardBus PC Cards and ExpressCard modules are not designed to function in the same slot, inserting a CardBus card into an ExpressCard slot or vice versa will not cause any damage to either part.

Modular and Extensible Architecture

ExpressCard technology replaces conventional parallel buses for I/O devices with scalable, high-speed serial interfaces. It allows developers to create modules

using PCI Express for their highest performance applications, or to use USB to take advantage of the wide range of USB silicon already available. The end-user experience is the same.

In multi-slot host implementation, all slots provide equivalent I/O interface functionality. Both module formats offer access to the same I/O interface performance and source power. The larger ExpressCard/54 module provides the application with approximately 140% of the internal volume capacity of the ExpressCard/34 module.

ExpressCard Interface

The ExpressCard technology improves the data transfer speed by using higher performance serial data interfaces rather than parallel buses. ExpressCard-compliant host platforms must support both the PCI Express and USB interfaces. This includes a single PCI Express lane (x1) operating at the baseline 2.5Gbps data rate, in each direction, as defined in the PCI Express Base Specification 1.0a by the PCI-SIG. The host interface must also support the low-, full- and high-speed USB data rates as defined by the USB 2.0 Specification of the USB Implementers Forum. An ExpressCard module may use one or both of the standard interfaces depending on the application requirements.

To assist in applications that require special sideband system management features, ExpressCard host systems may also connect a two-wire SMBus interface to the slot. If available,

modules may provide support for such features as remote alerting and sideband radio control.

Connector

A common, 26-pin, beam-on-blade style connector is used for both modules and the corresponding host connector accommodates the insertion of either module. This roughly halves the number of pins used in CardBus products. The blade contacts are located on the ExpressCard module and are designed for high durability and reliability. The connectors are designed to be capable of 10,000 card insertion and removal cycles.

Hot Plug Functionality and Power Management

ExpressCard technology is designed to allow users to install and remove modules at any time, without having to switch off their systems. This hot-plug functionality is a well-established part of the CardBus and USB specification and is also supported by PCI Express. By relying on the auto-detection and configuration of the native I/O buses (PCI Express and USB 2.0), ExpressCard technology can be implemented on a host system without an external slot controller. A device to control power to the slot is required, based on a simple, wired, module presence detection scheme.

Both PCI Express and USB natively support features that enable module applications to be placed in very low power states while maintaining the ability to

detect and respond to wakeup requests. For example, an ExpressCard application can receive network messages via a wireless communications module even while the PC is in a sleep state. Effective use of these features is the key to creating high-performance applications, which are both power and thermally efficient.

ExpressCard technology will typically require less electrical power than products built on previous PC Card standards although the slot power specification does provide adequate peak current to meet the needs of applications such as wireless transmitters. Independent of the amount of power drawn from the host system, the ExpressCard Standard also specifies thermal power dissipation at a maximum of 2.1W for ExpressCard/54 modules. Thermal dissipation limits are specific to the heat released within the slot discounting that energy which is dissipated in module extensions outside the confines of the slot. These limits were established based on an assumption of a uniformly heated module with a maximum case temperature of 90°C in a host environment of 65°C.

Compliance Requirements

PCMCIA offers a two-step compliance process intended to assure interoperability between ExpressCard modules and systems. A compliance process is also available for key components.

The first step features self-

compliance testing, where manufacturers verify their products against a comprehensive requirements checklist and submit the list to PCMCIA for review. To aid in electrical compliance testing, the PCMCIA is making available a series of test cards. As part of the second step, system and module manufacturers attend a compliance workshop for formal interoperability testing where tests are run to verify their products are interoperable with a range of ExpressCard modules or systems. Optionally, both of these steps may be accomplished with the assistance of a qualified third-party test house.

With the successful completion of these steps and the execution of a license with the PCMCIA, compliant products have the right to display the ExpressCard logo—an energetic rabbit signifying mobility, fast performance and ease-of-use. All compliant products are listed in ExpressCard Compliant Products Directory. Program participation is available to PCMCIA members only.

User Benefits

By supporting both PCI Express and USB in both desktop and notebook systems, ExpressCard technology brings new functionality to computer users not found in today's PC Card. The technology delivers a consistent, easy, reliable and non-threatening way to connect devices into their systems. ExpressCard modules can be plugged in or removed at almost any time. By enabling 'all modules

in all slots,' users can easily move modules between systems without worry. More importantly, ExpressCard products also support sealed-box expandability in desktop systems, eliminating the need for users to open their computer chassis to add flash memory, networking, multimedia, security or other hardware.

The ExpressCard standard offers a friendly, easy to use technology. OEMs benefit from a lower implementation cost due to its system and mechanical design, which is less complex to implement than CardBus. The standard crosses the broader market of desktop and notebook computers and assures interoperability through the compliance program.

At roughly half the size and lighter than today's PC Card, ExpressCard products also leverage the proven advantages of PC Card technology, including reliability and durability, hot plug-n-play and auto-configuration. Users benefit from expansion flexibility in less space with higher performance. Plus, they gain future access to high-performance technology innovations, such as High-Definition TV and Gigabit Ethernet.

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