

INDUSTRY TRANSITION FROM PC CARD TO EXPRESSCARD TECHNOLOGY

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ExpressCard technology is a small, modular add-in card designed to replace the larger PC Card over the next few years. The ExpressCard specification was released in September 2003. Developed by the

Personal Computer Memory Card International Association (PCMCIA), the technology takes advantage of the scalable, high-bandwidth serial PCI Express and USB 2.0 interfaces. Systems with ExpressCard slots are expected to ship starting with the introduction of PCI Express in 2004.

ExpressCard technology enables externally accessible slots that can be used for upgrades, new peripherals, and new classes of add-in cards (referred to as ExpressCard "modules"). ExpressCard technology leverages the operating system and device-driver support associated with the industry-standard USB and PCI Express interfaces. The technology also addresses system design and cost issues by removing the specialized silicon required for the custom interface of the PC Card and by using smaller connectors with fewer pins. ExpressCard technology can deliver nearly four times the data transfer rate of the PC Card interface by using some of the latest I/O interconnect technologies. Finally, an ExpressCard slot is a more cost-effective expansion solution than a PC Card slot. This cost advantage will encourage PC companies to expand the use of ExpressCard slots in portable computers and a wide range of other host systems, including small form-factor desktop platforms and handheld devices. ExpressCard technology can also be used in nontraditional personal electronics and automotive applications.

Dell is a strong proponent and supporter of ExpressCard technology. In this white paper, we explain why the PC Card is nearing its end of life and we describe ExpressCard technology. We conclude by describing how the industry and customers can transition smoothly from legacy PC Card to ExpressCard technology.

Limits of the PC Card

The PCMCIA was founded in 1989 as an industry trade association and standards body to develop, maintain, and promote a standard for modular cards that are interchangeable among portable computers. PCMCIA membership includes module vendors, system vendors, silicon providers, software providers, and representatives from associated special interest groups (SIGs).

The original PC Card standard addressed the need for memory cards, followed by a standard that addressed I/O module requirements. The PC Card standard has further evolved to accommodate higher-speed applications such as networking and multimedia. The latest version (v. 8.1) addresses the need for lower-cost cards by allowing dedicated interfaces to some of the newer, lower-pin-count devices. The latest PC Card controllers allow a direct connection to USB devices, consumer flash devices, smart cards, and specialized I/O devices. The form factor and connector have remained the same to ensure compatibility with existing modules. Despite these advances, the limit of the PC Card connector design was reached with version 8.1. The connector is a 68-pin-in-socket connector originally designed for transfer rates of 10 megabytes per second (MB/sec). With version 8.1, the practical limit of the interface has been reached. Its bandwidth is insufficient for high-performance upcoming requirements such as Gigabit Ethernet network adapters and 1394b cards.

ExpressCard Technology

The new ExpressCard interface is smaller, faster, and less expensive than the PC Card interface. The ExpressCard connector has just 26 pins and the interface has a potential transfer rate of up to 500 MB/sec (or 250 MB/sec in each direction) using a single-lane (or x1) PCI Express link. In addition, its form factor is up to 40 percent smaller than a PC Card, which allows ExpressCard modules to be included in smaller host systems.

The PCMCIA developed the specification with support from the PCI-SIG and the USB Implementers Forum (USB-IF). The ExpressCard specification uses the PCI Express and USB I/O interconnect standards of the PCI-SIG and USB-IF. During its development, the PCI-SIG and USB-IF provided guidance and feedback to the PCMCIA. The resulting ExpressCard form factor leverages the knowledge base of these organizations and many of their member companies. The PCMCIA, PCI-SIG, and USB-IF will also cooperate on ExpressCard certification. Each ExpressCard module will require certification, and current plans are to leverage the PCI-SIG and USB-IF certification programs. Leveraging the PCI Express and USB specifications reduces the software and silicon development effort required to implement the technology. It also allowed the PCMCIA to concentrate on developing the new form factor.

An ExpressCard module can be implemented using either PCI Express or USB, depending on the bandwidth required. A USB ExpressCard module is suitable for lower-speed devices such as a Bluetooth™ wireless card or a consumer flash memory card. A PCI Express ExpressCard module is suitable for higher-bandwidth devices such as 1394b and Gigabit Ethernet cards. To accommodate both types of cards, all ExpressCard slots are required to support both the USB 2.0 and PCI Express (x1 link) I/O interconnects.

ExpressCard Modules and Slots

There are two different ExpressCard module widths: 34 mm and 54 mm. These will be denoted on the module with the name ExpressCard/54 for the wider modules and either ExpressCard or ExpressCard/34 for the narrow module. Figure 1 compares ExpressCard modules to PC Cards.

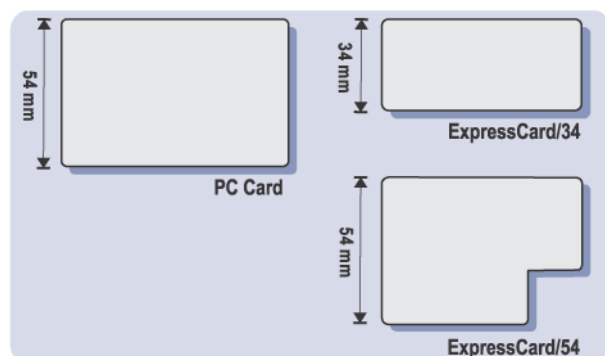


Figure 1. ExpressCard Module Sizes

There are three basic ways that ExpressCard slots can be implemented in a platform to accommodate these card sizes.

- **One 34-mm slot** — The 34-mm slot is the simplest host solution. Shown in Figure 2, this type of host slot will only support ExpressCard/34 modules. The advantage of this configuration is its compact size, and it will be common on small portable and hand-held devices.

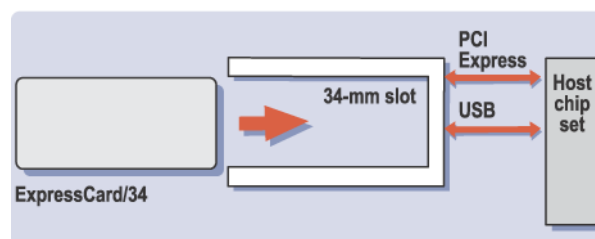


Figure 2. 34-mm ExpressCard Slot

- **One 54-mm slot** — The 54-mm slot shown in Figure 3 accommodates both ExpressCard/34 and ExpressCard/54 modules. The mechanical design requirements for an ExpressCard/54 implementation are more expensive. Its larger size and higher cost have a greater impact on smaller, low-cost platforms where the benefit derived from supporting both card sizes must be weighed against form-factor and cost penalties.

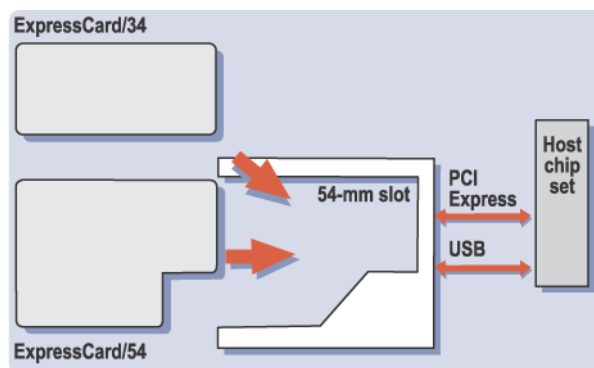


Figure 3. 54-mm ExpressCard Slot

- **One 68-mm slot** — The third slot size is a dual 34-mm slot in which two 34-mm slots are installed side-by-side. As shown in Figures 4 and 5, the resulting 68-mm slot can accommodate one ExpressCard/54 module or two ExpressCard/34 modules.

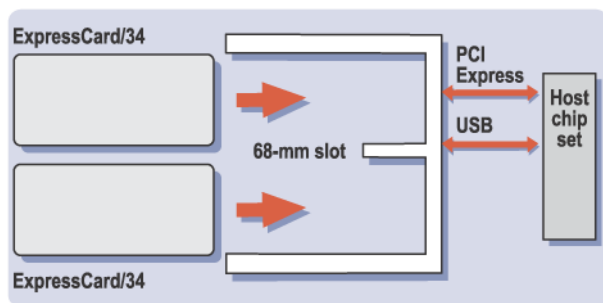


Figure 4. 68-mm ExpressCard Slot With Two ExpressCard/34 Modules

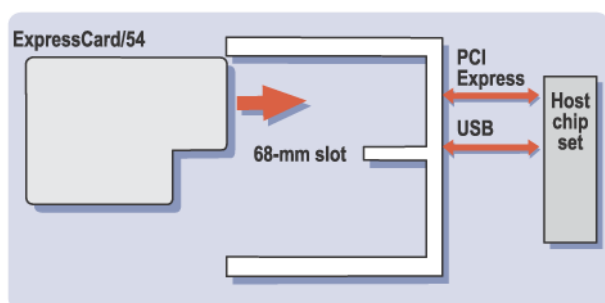


Figure 5. 68-mm ExpressCard Slot With One ExpressCard/54 Module

Advantages of ExpressCard Technology

ExpressCard technology has the following advantages over the PC Card:

- Complements PCI Express and USB devices
- Low cost and small size
- High speed

Complements PCI Express and USB Devices

ExpressCard modules provide an alternate PCI Express or USB form factor that complements PCI Express cards, which must be plugged into the system board, and USB solutions, which are connected via a USB cable. In contrast, ExpressCard modules are simply plugged into the external ExpressCard slot, just as PC Cards are installed today.

Low Cost and Small Size

The smaller size and lower cost of ExpressCard technology enables compelling enhancements for all

platforms, including servers, desktops, portables, tablet PCs, and handheld and consumer electronics devices. Portable computers can get smaller or add more slots. Desktops can add external low-cost upgrade slots. Handheld devices can leverage the same modules as portables and desktops. The same ExpressCard module can be used in all classes of computer as well as noncomputer applications.

High Speed

Its higher speed enables ExpressCard technology to be used for higher-bandwidth consumer applications. For example, ExpressCard modules may include high-definition TV tuners, new LAN solutions, and faster wireless solutions. Users can install these modules by simply inserting an ExpressCard module into the ExpressCard slot in the same way that a PC Card is inserted into a PC Card slot today.

Transition Scenarios

The PCMCIA has enabled a transition path from the PC Card to ExpressCard technology. The foundation for this transition is laid in the PC Card version 8.1 specification, which allows for PC Card form factors that use USB as their native bus. A low-cost USB PC Card can be used as a "carrier card" for an ExpressCard/34 module. In this way, an ExpressCard/34 module can be used in a USB PC Card slot or an ExpressCard slot. Figure 6 illustrates this concept. Beginning in 2004, new host platforms will implement CardBus/USB controllers that can accommodate these USB PC Cards, as well as existing non-USB PC Cards. This approach enables a transition period during which organizations can migrate to ExpressCard modules while maintaining support for legacy PC Cards.

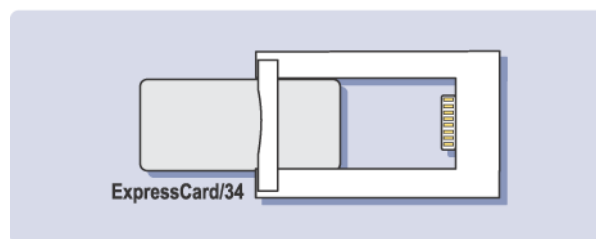


Figure 6. USB PC Card as Carrier for ExpressCard/34

Native ExpressCard slots may start to appear in 2004 when PCI Express systems are introduced. A small form-factor desktop platform that does not currently support an external expansion slot is a good candidate for a low-cost native ExpressCard slot. However, in the initial stages of the industry transition, ExpressCard modules will not be as widely available as PC Cards. During this period, a special ExpressCard module can be used that connects to an external PC Card reader. This approach enables a low-cost expansion solution that can accommodate both ExpressCard modules and legacy PC Cards.

During the transition period, some host platforms will have a PC Card slot and an ExpressCard slot. This configuration is suitable for large portable computer platforms that have the mechanical volume to accommodate both slots. The PC Card and ExpressCard slots can be stacked or, on very large platforms, placed side by side.

As the industry transition continues, the small size of ExpressCard slots enables more creative placement. On current portable computers, two PC Card slots must be stacked because their large size limits their location. In contrast, a 34-mm ExpressCard slot can fit on either side, the back, or on the display of the portable computer. The slot can also be located in the docking station.

This design flexibility is not limited to portable platforms. An ExpressCard slot can be added to a desktop platform by installing a low-cost connector to the system board. This allows ExpressCard solutions consisting of a cable and daughter board to be easily added to a system. ExpressCard slots can be placed on the top, front, back, or side of a desktop system. ExpressCard slots can also be located in displays or small external appliances that sit on a desk next to the display.

Conclusion

Dell has taken an active role in developing, promoting, and supporting the ExpressCard specification. This includes encouraging current PC Card solution suppliers and application developers to move to ExpressCard modules.

Dell customers should prepare for the transition to ExpressCard technology, which will begin in late 2004. Customers should require that new portable computer platforms have CardBus/USB PC Card slots. This capability will enable the new portables to read legacy PC Cards, as well as ExpressCard modules that are inserted into low-cost carrier cards. Customers should also plan to procure these carrier cards, which are USB PC Card solutions.

As more ExpressCard modules become available, their smaller size and increased bandwidth will accelerate the transition. PC Card slots may persist longer in the largest portable platforms, which have the mechanical volume to support ExpressCard and PC Card slots. The timing of the final removal of PC Card will depend on the variety of solutions available in ExpressCard modules.

For More Information

- ExpressCard technology: www.expresscard.org
- PCMCIA: www.pcmcia.org
- PCI-SIG: www.pcisig.com
- USB-IF: www.usb.org

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