



The Springboard™ Platform

White Paper
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Introduction

Expansion today is a key focus in the handheld computing industry. Spurred largely by Handspring's introduction of the Springboard expansion platform in September 1999, handheld computing vendors are now competing to provide methods for adding additional hardware and software capabilities to their handheld computing products. Early attempts to market expansion products based on existing storage technologies such as Compact Flash were met with inadequate success. However, the recent momentum of the Springboard expansion platform in the mobile computing developer community catalyzed a movement among handheld vendors to make expandability part of their core offerings.

For instance, in the summer of 2000 Palm Computing and Sony each announced they would eventually bring to market handhelds that support different methods of expansion – Secure Digital Card and Memory Stick, respectively. These announcements, in addition to other vendors promoting Compact Flash as a standard means of expansion, prompted a considerable amount of debate in the industry and in the media over which platform brought the best solutions to handheld vendors, developers and consumers.

This white paper explains in greater detail the need for expansion and the many reasons it was important for Handspring to design an open expansion platform from a customer's point of view, as opposed to compromising user needs by adhering to existing standards intended for completely different purposes.

In short, Springboard can be described as an open-faced slot designed to accept a wide variety of plug-and-play attachments or "modules" that add a specific functionality, such as picture-taking or digital

music playback, to a handheld computer. Today the Springboard slot can be found in all of Handspring's Visor handheld computers. Over time Handspring will consider licensing opportunities so that other companies can build and sell Springboard-enabled products. Today Handspring has one such licensing partner, Symbol Technologies, which will build the Springboard slot into future generations of its handhelds, which are designed for more industrial and vertical-market applications.

Most importantly, Springboard was built from the ground up for handheld computer expansion – it is not a memory storage format that has been re-purposed for other uses and as such is not limited by the physical, mechanical and electrical constraints that hamper the true expansion capabilities of other technologies such as Secure Digital Cards, Compact Flash, Memory Stick and PCMCIA (PC Card).

While the remainder of the white paper will explore the nature of Springboard in greater detail, its advantages can be summed up by pointing out three key differentiators: true plug-and-play functionality, flexible power management, and an open-faced design.

The Three Key Differentiators:

1. **Plug-and-Play** – all software required to use a Springboard expansion product (“module”) is contained in the module itself. Any necessary software automatically loads itself onto the handheld upon insertion and launches as needed. No additional software or drivers must be installed – the user simply plugs in a module and can use it immediately. And because the Springboard slot provides a direct connection to the handheld system bus, software and services can “run in place” from the module with no need to transfer applications into system memory, providing a fast and seamless user experience. Springboard is the only expansion platform that provides this level of functionality.
2. **Flexible power management** – Springboard is the only platform that provides a means of flexible power management. The Springboard slot can provide power for modules that don't contain their own power source if needed, and is also capable of power-charging modules while the Visor is in its cradle. This is especially important for products that require enhanced power such as cellular radios for voice and data communications.
3. **Open-faced design** – the Springboard slot is physically open so that expansion products can elegantly go beyond the size of the slot itself. This allows developers to easily provide for requirements such as antennae, batteries, earpieces or earphone jacks and function buttons without sacrificing design standards or limiting the capabilities of the module. Springboard is the only open-faced expansion platform in the industry.

There are several other advantages, most of which are described later in the white paper in more detail, including royalty- and cost-free development tools and support, compatibility with other expansion platforms, low-cost, readily-available components and built-in microphone on Springboard-enabled products for use with voice-enabled modules.

There will likely be many different methods of expansion over time, but few, if any, will be like the Springboard slot, which is designed from the ground up for enabling a very broad selection of plug-and-play capabilities. Because of its unique benefits described here, Handspring believes that the Springboard platform provides the very best possible solution for expansion. Today more than 5,000 developers have downloaded the Springboard development kit, and approximately 100 companies are already preparing to bring Springboard products to market. Handspring expects this momentum to grow steadily over the years as it broadens its own product line to bring even greater opportunities to developers and an extensive range innovative, useful and fun expansion possibilities to consumers.

The Need for Expansion

Computers, by their very nature, are expandable and re-configurable devices. Unfortunately, expanding the use of personal computers is seldom easy. New software often conflicts with existing software causing computers to crash or misbehave. Adding hardware accessories often means disassembling your computer, handling circuit boards, or taking on other complex tasks only to find the accessory doesn't work. Even external interfaces such as serial ports and parallel ports often require a call to a technician to configure properly. When people complain that computers are difficult to use they are usually referring to problems with added software and attached peripherals.

Over the years the computer industry has attempted to improve this situation. One radical approach taken with the original Macintosh was to prevent the installation of any expansion cards in the computer, a position that hurt early sales. For the most part, the computer industry has approached this issue by designing new interface standards -- each one promising to be "easy to use" or "plug and play." Software vendors early on created sophisticated installation programs, and then later, sophisticated "de-installation" programs. Despite many attempts at creating easy-to-use expansion capabilities, any user of a desktop personal computer can tell you that it is still difficult and frustrating.

For handheld computer users, the benefits of hardware and software expansion become even more important. There is a need to attach all manner of peripherals to handheld computers, ranging from pagers to cell phones to GPS receivers. Wireless Internet access is also increasingly important for handheld computers. Unfortunately, no single global standard exists for wireless data transmission, so handheld computers need to accommodate many different types of radios.

Today, there is a large software developer community established around the Palm Computing platform. Almost all of the software created by these developers is delivered electronically over the Internet in compressed files. This method of distribution is efficient but unfortunately difficult for handheld computer users. For the handheld industry to continue to grow, an elegant and robust method for adding hardware and software to handheld devices is needed.

Why Springboard?

Handspring™ Inc. decided to create a family of handheld computers designed from the ground up for hardware and software expansion. These expandable handheld computers would be built upon the most successful handheld computing platform, the Palm OS. The goal was to create the easiest and most robust expansion system on any personal computer, desktop or handheld.

As the original creators of the Palm OS and the PalmPilot, the designers at Handspring pioneered the concept of simple, "one button" computing appliances. They wanted to bring the same level of simplicity to the task of hardware expansion. Adding a pager, wireless LAN card, or other accessory to a handheld computer should be as simple as possible. No tools, no switches, no disks with software should be required.

The two leading expansion methods for portable devices, PCMCIA (PC Card) and Compact Flash were considered. Both of these standards are deficient on several accounts. First, they were designed specifically as storage cards. Little thought was given to accommodating cards with varying physical requirements. Hence there are now type 1, 2, and 3 PC cards, each with different physical dimensions. PC Card and Compact Flash cards don't easily accommodate batteries, connectors and antennas. As storage and memory cards they offer no standard for what type of software is contained on the cards, much like a floppy disk. For example, although all Windows CE palm-sized computers

have Compact Flash slots, there is little interoperability between these devices. Compact Flash-based software that runs on one CE device will crash when inserted into another CE device because they use different microprocessors. Other problems with PC Card and Compact Flash involve inconsistent power management and no provision for installing and de-installing software.

More recently, Secure Digital Card and Sony's Memory Stick technology have been touted as new standards for handheld expansion, however, these technologies -- both initially intended as memory storage platforms -- are affected by same limitations that prevent PC Card and Compact Flash from reaching critical mass as robust expansion methods.

The vision of creating a much easier, elegant and even fun way of adding new hardware and software to handheld computers would require a new expansion design. This unavoidable fact led Handspring to create the Springboard expansion slot, an open-faced, communication-ready slot designed to easily fit together with a broad range of new accessories called Springboard expansion modules.



Figure A: Inserting a module into the Springboard expansion slot

The Springboard Design Philosophy

There are five core tenets of the Springboard design philosophy:

- The Springboard expansion slot had to be designed from a user's perspective, not an engineer's perspective.
- A user wishing to add a hardware accessory to a handheld computer wants an obvious, simple, and robust attachment mechanism. No tools or special skills should be required to attach a modem, radio, or MP3 player. Once attached, the combined handheld and accessory should be cosmetically and physically integrated.
- Adding or removing an accessory should never require rebooting or resetting the computer. The computer shouldn't need to be in a special state or mode to add or remove an accessory. You should be able to attach and detach an accessory at any time, even while it is in use, without crashing or compromising the system.
- All the software required to use the accessory should be included in the accessory itself. There should be no need to copy software from a disk or PC onto the handheld to use the accessory.
- Springboard expansion modules should be self-installing and de-installing. Attaching and detaching the module should be the extent of user involvement.

Springboard Features

Below are the key technical features of the Springboard expansion slot designed to meet the user needs listed above. Full technical description of the Springboard interface can be found in the Springboard Development Kit available on Handspring's web site.

Open-Faced Slot

Hardware peripherals for handheld computers come in all shapes and sizes. Some have antennas. Some need removable batteries. Some need to expose additional connectors. Some need only a few electrical components, others multiple circuit boards. Some need to present additional buttons, speakers, or display information to the user.

The Springboard expansion slot therefore had to accommodate a large number of peripherals now and into the future. It is undesirable to have multiple versions of something that is a "standard". To accomplish this, Springboard is designed with an "open face" slot on both the back and top (see figure B). It can accommodate peripherals that extend out the back and beyond the top of the handheld computer. Unlike PC Card and Compact Flash, the Springboard standard will not need multiple revisions to handle expanding and contracting peripherals. Springboard peripherals have a simple way of presenting additional buttons and other interfaces to the user by extending over the top of the computer. The Springboard specification defines available areas for expansion as well as "keep out" zones so end users are guaranteed that any Springboard module will fit in any Springboard expansion slot now and in the future.

The Springboard slot is mechanically robust. Because the slot is open, rails are provided along both sides to guarantee that Springboard modules can slide in easily but won't accidentally fall out if the unit is dropped.



Figures B1 and B2: the Springboard slot with modules

Springboard Modules Include All Necessary Software

The goal for Springboard modules is that they never come with a floppy disk or CD-ROM. All software required for any Springboard module is included in the module itself. For example, a Springboard compatible MP3 music player would contain a playlist manager application on a memory chip in the hardware. When the music player is inserted in the Springboard slot, the playlist manager runs automatically and appears in the launcher like any other application. For another example consider a two-way pager. Perhaps the pager requires modified behavior of the address book application to create messages from within the address book. The pager peripheral would contain the

modified address book. When the pager is inserted in the Springboard slot, the address book exhibits the new functionality. When the pager is removed the address book behaves as before.

Although applications can copy themselves into system RAM, most often they are executed directly on the Springboard module. The Springboard interface permits this because it is an extension of the local address and data bus of the CPU. Most existing Palm OS applications will run unaltered on a Springboard module.

Springboard Modules Automatically Install and De-Install System Software

The bane of the desktop computer user is incompatible .DLL files, corrupted .INI files, and improper registries. Installing software often leads to problems with these system files that only an expert can resolve. Furthermore, many installation procedures leave remnant files on your computer long after you have removed the software. These remnants can cause unexpected behavior in the future.

Springboard modules are always self-installing and self de-installing. The process is automatic, fast, and invisible to the user. To install a Springboard module the user simply inserts the module in the Springboard slot. To de-install a Springboard module the user removes the module from the Springboard slot. The handheld computer can be in any state. It can be on or off. It can even be running an application on the Springboard module when the module is removed and no harm will be done. There are no switches or resets required to install or remove a Springboard module.

Hidden from the user, each and every Springboard module has a “setup” application. When the handheld computer detects a Springboard module has been inserted it copies the setup application into system memory. The operating system then runs the setup application that handles all installation requirements such as installing interrupt handlers, OS patches, and new applications. When the operating system detects that a Springboard module has been removed, the setup application is run again. This time it de-installs everything related to the module. The setup application then deletes itself. All this happens very fast with no intervention by the user. If necessary the setup application can interact with the user, e.g. to enter a user name and password, but in general setup applications run invisibly to the user.

Flexible Power

It is important that a module expansion slot have a well-defined and flexible electrical power structure. Springboard module designers need to know exactly how much power is available for their use. This was a problem that has plagued some PCMCIA devices. They would work in some computers and not in others because of different power availability.

All Springboard modules can count on 100ma of current at 3.3v. If they require more current they can easily incorporate their own battery due to the open back nature of the Springboard slot.

The Springboard slot provides a standard way of charging batteries on a Springboard module should it have a rechargeable battery. A charging pin is provided on the handheld computer’s cradle connector so that Springboard modules can be charged if dropped in a cradle designed for charging or alternately by attaching the handheld computer to a travel charger. This frees the Springboard module designer from needing to incorporate charging contacts and a separate wall adapter and gives the user a common charging experience, similar to a cell phone, regardless of what module is being used.

A Springboard module can continue to draw power from the handheld computer even if the computer is off. It can also use the CPU of the handheld without turning the display on. These and other power

related features provide a flexible yet consistent power structure to the designer of Springboard modules.

Low Cost

Springboard modules will range from very low cost game cartridges to more expensive cellular radios. It is expected that many low cost software-only Springboard modules will become available. Expensive manufacturing processes, materials or components need to be avoided to guarantee a low cost of manufacture.

Springboard uses the exact same 68-pin connector block as used in PCMCIA cards. These are available from many manufacturers at low cost. It is a reliable and proven design. Similarly the Springboard physical envelope allows the use of all plastic housings and low cost ultrasonically welded assembly. (Springboard modules are keyed differently to prevent the insertion of a PCMCIA card.) A ROM-only Springboard card can be manufactured for a few dollars.

It is common practice in the game industry to charge royalties and manufacturing fees for a developer who creates a game cartridge. For example, Nintendo charges hefty fees to anyone selling a Gameboy cartridge. Springboard developers are free to develop what they want and sell it how they want. Handspring imposes no fees or royalties on Springboard developers. They only need to pass a basic, self-administered compatibility test before using the Springboard compatibility mark.

Cellular Radio Springboard Modules

Springboard modules can contain cellular radios. This type of Springboard module could provide both voice and data capabilities over cellular telephone networks. This particular application was considered thoroughly in the design of the Springboard specification. One special need of this Springboard application is a microphone. A Springboard module containing a cellular radio, rechargeable battery, and antenna can expose a speaker, but a microphone is needed to capture voice input. Therefore all Springboard enabled computers contain a suitably located microphone, which is connected to the Springboard expansion slot. Of course the microphone can be used for other applications such as voice recording and voice recognition.

Visor Edge and expansion

Even with the super-thin Visor Edge product, expansion is not compromised. However, the method for adding Springboard expansion modules had to be carefully considered to maintain a slim form-factor. Handspring achieved expansion in Visor Edge through an easily attachable and detachable Springboard slot that slides onto the back of Visor Edge. This simple method of expansion provides full Springboard compatibility while allowing Visor Edge to maintain a sleek industrial design.

The detachable Springboard slot for Visor Edge fits into the Edge connector, a small pin connector on the back of the handheld. This connector provides an attachment point for Springboard modules as well as other expansion products that can be built specifically to fit the design of Visor Edge by connecting directly into the Edge connector and not the detachable Springboard slot. When expansion products are not in use, the Edge connector is protected by a small metal hinged door on Visor Edge's metal flip cover.

A select number of third party developers are working with Handspring to produce expansion products that fit directly into the Edge connector. Expansion products under development for the Edge connector today are designed specifically for use with Visor Edge. More information about the Edge connector and free developer materials are available at www.handspring.com/developers.

An Open Standard

The Springboard specification is very open. However, since “open” is a much abused term we should be explicit in describing how it is open.

Handspring’s web site contains technical details about the Springboard expansion slot. The developer’s kit includes all mechanical, electrical, and software specifications needed to design Springboard modules. Anyone can download this material and use it to build Springboard modules.

There is no Springboard association nor are there user fees or royalties. Springboard modules contain no proprietary parts or processes so developers are free to manufacture and distribute Springboard modules as they see fit. Handspring is interested in working closely with developers of Springboard modules and supporting them in design and distribution, but this is optional.

Handspring intends to license other manufacturers of handheld computers to build Springboard compatible handhelds. For instance, Symbol Technologies licensed Springboard in June of 2000 and will build the Springboard slot into future generations of their handheld computers intended for more industrial and vertical-market applications.

The Future of the Springboard Expansion Slot

The Springboard expansion slot was carefully designed to last for many years. Of course Handspring can’t guarantee that all of its future products will contain Springboard expansion slots, or that the Springboard specification won’t undergo revision. However, we believe the Springboard expansion slot design is robust, highly flexible, and will provide reliable expansion options on handheld computers for many years to come.



Figure C: The Springboard expansion slot