

# **Expanding the PDA's Potential**

## **A Review of Expansion Memory Card Support in Palm-Powered PDA's**

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### **Introduction**

Just as a CDROM drive on desktop computers has gone from being an expensive add-on to a required component, expansion memory card slots are now a pervasive feature on just about all Palm OS-based PDAs, including models from Palm, Sony, Handspring and Handera. Yet this feature remains one of the most confusing and widely misunderstood aspects of mobile computing today. The reasons for this confusion are many, and after considering the history of expansion memory cards on Palm-powered devices it is not surprising that the PDA-buying public has appeared to be largely unaware of the benefits of the tiny slot at the front of their new handheld device.

This paper attempts to clear away the confusion by:

- Reviewing the history of memory storage and expansion memory on the Palm OS platform
- Explaining the reasons why expansion memory is an attractive feature
- Enumerating the various devices and standards offered by PDA manufacturers
- A close examination of the Palm OS Virtual File System (VFS), on which most of the expansion memory support that is available today is based.

### **A Brief History of Memory Storage on Palm-Powered Handhelds**

There is an age-old adage in computing that says "Data will always expand to fit available memory". Indeed, it is hard to imagine how we ever used personal computers that came with a 10 megabyte hard drive, but once upon a time, that was considered more memory than anyone could ever dream of using. In fact the lowliest PC available today comes equipped with a thousand times more storage than those early computers, and in the brave new world of MP3 digital music, digital photos and full motion video there seems to be no end in sight for the growth of memory capacity. Given more memory, we inevitably find more ways to make use of that capacity, our voracious data appetite never seems to be quelled.

Predictably, memory capacity on handheld computers has also followed a similar growth path. Earlier devices ran on 512KB of memory or less, but soon enough there appeared models that offered a standard 1 MB, 2MB, 4MB or 8MB. As I write this, many of the newer models are coming standard with 16MB of memory storage. Is the day far off when we will go to the store and buy a PDA that comes with a gigabyte of storage? If history tells us anything, the answer is obvious. Our increasing consumption of memory will dictate that we will ultimately require large and larger storage capacities.

So with PDAs seemingly following in the footsteps of the personal computer, offering an ever-increasing standard amount of data storage, why the need for expansion memory cards? For one, without an expansion slot your PDA would not be upgradeable, meaning that if your memory storage needs grew to be more than the available space on your PDA, you would need to go out and purchase a whole new device with more memory. Aside from adding what amounts to a “second hard drive” to your PDA, expansion cards offer other interesting uses, such as the ability to share information (such as photos) with other types of electronic devices, including cameras, music and video players, and printers. Also, expansion cards are perfect for storing large files that you use less frequently than your main applications, for example a large dictionary, travel maps, or a medical database.

Given these interesting applications, it is not surprising that handheld manufacturers have sought to bring to market new devices that offer expansion memory to their customers. Handspring was the earliest with their Visor line, offering a proprietary expansion slot called “Springboard” as a standard component for all of their devices. Beyond expansion memory cards, the Springboard slot has become famous for supporting miniature cameras, barcode scanners, and modems. TRG (now Handera) offered an expandable model called the TRGPro, which was unique in that it embraced two industry standards, Compact Flash (CF) and Secure Digital (SD). Sony soon followed with their first Palm OS-based PDA, the Clie (pronounced CLEE-ay), which came standard with a slot that supported their Memory Stick technology, making their PDA compatible with Sony’s other consumer electronics products that (naturally) supported Memory Stick.

By the year 2001 Palm was in fact the only major device manufacturer that did not offer a built-in expansion memory card slot on their devices. But they soon rectified this situation with the introduction of the m500 and m505 (followed by the m125), which came standard with a single slot for handling the SD and MMC standard. It now appears that most (if not all) of Palm’s line of products will embrace expansion card support, as will most of the devices offered by Palm’s OS licensees. At the same time, card manufacturers are offering cards with capacities ranging from 2 MB all the way up to 512 MB, and it won’t be long before we see a card that holds more than 1 GB of data. What’s more, the price per megabyte of storage is also dropping, making these cards more affordable than ever.

## **So Much for Standards**

Perhaps one of the most confusing aspects of expansion memory storage on PDAs is the dizzying array of formats supported. As opposed to the original floppy disk on the personal computer, which quickly became a de facto standard that all PC makers rallied around, it seems that handheld manufacturers cannot agree on single standard format for their collective customers. Compact Flash, SD/MMC, Springboard and Memory Stick all represent different technologies and form factors, and they are incompatible with each other, which means that you cannot insert a card from one format into a slot designed for another. Why is this?

Although it would seem obvious that these vendors should, for the customers' sake, get together and decide on a single standard, for many reasons this is not likely to happen. For one, each of the device manufacturers has a vested interest in differentiating their devices from those offered by a competitor. An example of this is Handspring's Springboard. Although one could argue there are technical reasons why existing standards were unsuitable for Handspring's requirements, it is also clear that Handspring has sought to establish a unique brand for their Visor line, and the Springboard is one of the important hallmarks that ties together the Handspring device lineup.

Another reason for the diversity of formats goes back to the history behind removable media. Before PDAs got into the game, one of the primary uses of expansion cards was in digital cameras. And in the digital camera world, the same situation exists, with CF, SD, MMC and Memory Stick all being used in different models. For a company like Sony, with an investment in Memory Stick technology across its entire product line, it would be natural to expect that they would value compatibility across all Sony consumer electronics devices over compatibility with other manufacturers' PDAs.

Finally, the device manufacturer has to keep its target audience in mind. For some types of applications, certain media formats were already prevalent. Handera's CF and SD slots are in part a tribute the established presence these formats already enjoy in some segments of their enterprise customers.

The following is a table that attempts to lay out the various device manufacturers and their supported expansion memory formats:

<b>PDA Vendor</b>	<b>Model(s)</b>	<b>Formats Supported</b>	<b>Pros</b>	<b>Cons</b>
<b>Palm</b>	m500, m505, m125, i705	SD/MMC	Embraced open standards, scalable capacities	Poor introduction, lack of bundled software to highlight solution
<b>Handspring</b>	Visor	Springboard	Numerous 3 <sup>rd</sup> party modules on market	Proprietary standard not supported by other device manufacturers. Limited capacities. Bulky. Does not support Palm OS VFS interface.
<b>Sony</b>	Clie	Memory Stick	Large capacities, compatibility with other Sony products. Bundled software for mp3, photo/video.	Not supported by other device manufacturers.
<b>TRG/Handera</b>	Pro, 330	CF, SD	Embraced open standards, scalable capacities	Relatively few customers, lack of bundled software to highlight expansion card

				benefits
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## **Palm's Initial Rollout: A Closer Look**

As you can see Palm was the last of the major device manufacturers to offer a handheld with an expansion card slot, but owing to the huge popularity of Palm's devices, as well as their position as the "standard-bearer" for the Palm OS and its licensees, Palm's implementation of this technology has a large impact on customers and the industry overall.

Unfortunately, the initial rollout of Palm's expansion slot-enabled devices may not have communicated the value of the memory slot as well as it might have. This was in part responsible for the current mystery and confusion surrounding how expansion slots work on PDAs. The first units, the m500 and m505, did indeed ship with a single SD/MMC slot. However, the device packaging told the customer almost nothing about the slot, offering no explanation of what it could be used for or indeed how to use it even if they were able to figure out a use on their own. The device did not come with a blank card, nor was it clear where to obtain one. Although expansion-aware applications were made available on a companion CD, many customers never installed the CD, and none of the built-in Palm software applications (Address Book or MemoPad, for example) had been modified to make use of expansion media. Palm's choice of how to give the user access to the expansion slot was also obscure, requiring the user to choose a category named "Card" in order to see any applications stored on the card.

Third party software developers were also slow to enhance their applications to support Palm's expansion technology, leaving puzzled customers to figure it out for themselves. A slew of enhanced expansion-aware launchers, shells and file managers did appear on the scene to try to bring order to the chaos, but the damage was done. A relatively small but enthusiastic community of adventurous early adopters took the plunge and made the effort to put the pieces together and spread the word on how to make use of the new slot.

After a slow start, we are finally starting to see a critical mass of expansion memory-aware third party applications, but there is still a ways to go before one can say that expansion card support is universal in the sense that floppy drive support was universal on desktop PC's. It is still a relatively obscure operation for an individual to migrate files and applications from their PC to their PDA's memory card, and the problem grows exponentially if you are an IT manager responsible for the rollout of PDAs to hundreds or thousands of mobile employees. Better tools are appearing to help manage these problems, but at present it requires some research to find 3<sup>rd</sup> party solutions that bridge the gap.

## **Palm OS 4.0 and VFS, the Virtual File System**

Coinciding with the availability of Palm's m-series devices was the introduction of a new version of the Palm operating system, version 4.0. Among other things, one of the more

significant enhancements was the arrival of expansion card support built-in to the operating system, with documentation for third party developers on how to make use of the new cards. For non-programmers, the only visible signs that things had changed was the addition of a new “Card” category in the standard application launcher, as well as a new menu command for copying a file to or from a card. Palm referred to the new built-in OS support as the “Virtual File System” or VFS for short.

One of the biggest areas of confusion for customers and developers alike that are new to VFS is the assumption that an expansion card is treated like a “second hard drive” on your PDA. In the desktop world, you can add more hard drive storage to your PC in about a half an hour with a screwdriver, and after you are done you can work fairly transparently with your new drive. You can run applications off of the second drive just as easily as you would from the original, and you can even store your application data on a different drive than the application itself. In general it doesn’t matter, it all just works.

With VFS, Palm significantly changed the way that applications load and store their data, creating a situation where applications would need to work with files one way if the files were on the original PDA’s memory (which I will refer to as “RAM”), and work with files another way if the files were on a VFS-mounted expansion card. This really slowed down the rollout of new VFS-aware versions of Palm applications. Further, Palm’s VFS implementation did not allow for the ability to run applications directly from card storage. Palm’s launcher did allow you to store an application (such as a game or word processor) on the card, but when you tapped on the application icon, Palm OS would work behind the scenes to temporarily copy the application to RAM first, then run it. Depending on the size of the application, a noticeable but not unreasonable delay would occur while the application was being copied over. And Palm’s built-in “Core Four” (Address Book, Datebook, ToDo, and MemoPad) remained blissfully unaware of the existence of VFS, and in fact could not be moved to card storage or store their data on a card.

A problem with this scenario is that even if you store a large application on a VFS-mounted card, that application will not be able to recognize and use its own databases if you choose to store them on the card as well. For example, if you take a VFS-unaware dictionary application and put it as well as the dictionary database on an expansion card, when the dictionary application is run it will naturally be copied first to RAM, but then will be unable to find its dictionary database. To help solve this problem, Palm introduced the concept of “bundled components”, in which a developer could tag the various databases and other components of their application, so that Palm OS would be obligated to move **all** of the application components from the card to RAM upon launching. Still, not every application vendor took this step, and as a result the end-user must determine on a case-by-case basis whether or not his or her applications can be run from an expansion card.

These issues stem from a design decision Palm made when it contemplated how to support expansion cards. One can sympathize somewhat with their dilemma: the core operating system’s file system is very minimal, would not scale well to support

removable media that is expected to grow to very large sizes. Also, one gets the impression that Palm imagined most of the utility of expansion media being in terms of reference materials, e-books, and other read-only data. In my experience, this is counter to customers' expectations, which usually assume they are expanding their 8 MB device to become a 72 MB device with the addition of a 64MB card.

Expectations notwithstanding, overall VFS is a good addition to the Palm OS, and even though it requires some commitment on the part of the developer community in order to fully utilize it, the system is built to handle a variety of uses, and appears to scale well to large denominations of expansion cards. To their credit, Palm has also been very successful in getting their OS licensees to migrate to the 4.0 version, so applications that are VFS-aware in general will run on any modern PDA (a notable exception to this is Handspring – Visors still run OS 3.5, and thus are not VFS-aware, although 3<sup>rd</sup> party vendors are working to resolve this with add-on utilities).

## **The Road Ahead**

I am pleased to report that the end result of all this is that it is now becoming possible to explore an increasingly rich variety of applications for expansion cards and PDAs in general. My current device is a Sony Clie 760C, and it is equipped with a 128 MB memory stick. I have about an hour's worth of music in the form of mp3 files on it, which I use when I go for a jog. I have moved 10 or so large 3<sup>rd</sup> party applications to the card, freeing up four or five megabytes on my Clie's built in RAM, and these applications launch just fine from the card. If I wanted to, I could store beautiful color pictures of friends and family on the card, making my PDA almost a virtual wallet. These capabilities would have been unheard of just a year ago, but now they are all possible, and my PDA has become more indispensable than ever.

Beyond my own personal usage, some of the more exciting possibilities lie in the adoption of expansion media as an efficient distribution mechanism for company documents, reports, product data sheets and applications. This scenario brings significant convenience to the mobile workforce, making it very cost-effective to distribute large volumes of timely data in a lightweight format. And all without requiring wireless connectivity or expensive laptops. Complete patient medical histories, large reference materials, product catalogs, real estate home listings, telephone books, maps and other navigation aids, all these provide but a small peek at the applications that are possible.

In the coming months and years we can look forward to higher and higher storage capacities, to 1GB and beyond, at unprecedented low prices. Creative people in our industry will dream up new applications and tools, and in time, just as with our old friend the PC, it will become hard for us to remember how we ever got by with a PDA that came without one of those curious little expansion slots.