



WHITE PAPER

SANDISK MINISD CARD FLASH CARD FOR MOBILE PHONES

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OVERVIEW

Mobile phones—based on 2.5G and 3.0G technology—with their increased data rates are expected to offer consumers a wide range of enhanced data services throughout the upcoming years. The ultimate goal for service providers is to increase the use of mobile phones thereby increasing the average revenue per user.

If the trends prevalent in Japan and Europe are any indicator, the U.S. market will soon see the explosion of uses for cell phones beyond voice services. According to IDC (2002) the smart phone market is predicted to grow from 4 million units in 2002 to 47 million units by 2005 and the camera phone market is expected to grow from 19 million units in 2002 to 147 million units in 2005.

Consumers will soon have the ultimate in convenience and enhanced features such as digital images, compressed audio (MP3 files), MS PowerPoint presentations, maps, spreadsheets and more in one small device.

► new technologies

Various technologies—high speed CPUs, power management ICs, LCD color displays, and Systems on a Chip (SOC)—are enabling a new class of cell phone designs:

System designers are taking advantage of all of these technology trends to build multifunctional portable products for consumers. With digital images easily reaching 500 Kbytes for a 1 megapixel image and an MP3 file at 1 Mbyte per minute of audio, having these features can easily swamp the storage capability of traditional cell phones. The ability to capture, store, manipulate, send and receive massive amounts of data also puts a burden on the mass storage system of the mobile device.

► SanDisk miniSD card

High-capacity removable storage to these form factor-constrained devices is now possible using a breakthrough product: the thumbnail-sized SanDisk miniSD Card, recently introduced by SanDisk.

INTRODUCING THE MINISD CARD

The miniSD, the world's smallest flash storage card has indeed arrived at an opportune time for mobile phone designers, as multimedia applications in cell phone that are enabled by the new technologies mentioned above are requiring capacities that go well beyond existing onboard embedded storage. miniSD, the world's smallest flash storage card, was developed to specifically meet the storage needs of emerging cell phone designs. In addition, Moreover, the miniSD card provides a much-needed mechanism for exchanging data with other platforms.

miniSD is a smaller version of the very popular SD memory card which is promoted by the SD Association. The card was originally developed by Panasonic, Toshiba and SanDisk, collectively, the 3C. By using a passive adapter, the miniSD can be used in any of the hundreds of devices that support SD.



With the miniSD card, up to 64MB of removable flash memory storage (128MB and 256MB available by year's end) can be readily integrated into mobile phone designs, by taking advantage of its full compatibility with the widely supported, industry standard SD card.

TRENDS IN FUNCTIONALITY

Mobile phone manufacturers have been attempting to accelerate the product replacement cycle by providing consumers with compelling reasons to upgrade beyond existing technology. As a result, 2.5G and 3.0G mobile phones are becoming Swiss Army knife-like with a multiplicity of features housed within the same sleek form factors as their voice-only predecessors. Among these are games, personal information management (PIM) applications, MP3 players, MPEG-4 video capture, email, and digital cameras.

The ability to conveniently snap digital photographs and wirelessly share them via email and messaging is fueling demand for these products. As a result, sales of these units has been brisk: Over 18 million camera phones were shipped in 2002 and approximately 37 million more are expected to ship this year. And by 2005 it is anticipated that sales of these integrated camera phones will eclipse those of stand-alone digital cameras. Currently, the resolutions of the cameras built into these handsets are much less than can be achieved with existing digital cameras; however, advances are being made: 1.3-megapixel camera phones, such as models in the NTT DoCoMo 505i series, are have been announced; and 2 megapixel units are expected by year's end.

PHYSICAL CONSTRAINTS

Accommodating such functionality within the available real estate of a 4-ounce mobile phone is a challenge that doesn't stop with the video aspects of the design: a flexible storage solution in particular, has been one of the biggest hurdles. Audio and video applications are capacity-hungry, yet space has not permitted a card slot for removable storage. Thus, early designs have been based on embedding flash memory chips directly within the units, which has meant capacities haven't been expandable and no mechanism has existed for physically moving data between platforms.

With 1.3-megapixel camera pictures each requiring about 0.5MB (based on least compression JPEG format) and the typical MP3 song file consuming 3-5 MB, this limitation becomes all the more glaring. The miniSD card changes this by scaling down to a whole new level of miniaturization – even less than its postage stamp-sized SD card counterpart. At just 21.5 millimeters (mm) long, 11 mm wide and 1.4 mm thick, miniSD consumes 40% less printed circuit board area and 60% of the volume required to support the SD card in a portable device. Yet its internal workings and external interface are fully backward compatible.

HARDWARE INTERFACE

True to its SD card roots, the miniSD card provides the same simple high performance serial interface. As with SD, four non-bussed data lines support a transfer rate of up to 10 MB per second. And, going back yet another generation in compatibility, miniSD also supports the same 1-bit data path SPI interface found in the MultiMediaCard (the ancestor of SD). Those familiar with the SD card's 9-pin interface, however, will discover two additional pins (labeled as NC). These are slated for future applications that may include intriguing things such as e-commerce (imagine the convenience of pointing your phone at a toll booth or vending machine and having payment automatically occur).

Although the pin count differs, the miniSD card can be used within SD card slots via a passive adapter. This provides powerful interoperability, as SD is supported in over 900 PDAs, digital cameras, audio players, and computer systems. Digital pictures, video clips, audio files, and application programs are easily shared across these platforms.

Internally, miniSD contains an SD flash memory controller technology that manages all aspects of the flash (including defect management and ECC), while furnishing disk-like, sector-oriented addressing. The miniSD card also contains SD's built-in encryption that supports digital rights management of copyrighted materials and the secure storage of confidential data.

The miniSD card passive adapter supports SD card slots.

MINI SD AND WIRELESS CHIPSETS

Integrating miniSD into mobile phone designs has become a simple task thanks to increasingly integrated off-the-shelf wireless chipsets. The SD interface is directly supported along with just about every other imaginable mobile phone feature. This may be surprising, as not long ago, the number of specialized chips (not to mention the number of specialized engineering resources) required to handle the radio frequency interface, baseband with DSP, and application processing was relatively large. Today, chipsets from companies such as Intel, Qualcomm, and TI, integrate all of this functionality and directly support the SD interface, as well as many advanced multimedia functions.

Reference designs based on these chipsets are essentially complete manufacturing-ready, miniSD-enabled, mobile phones; as a result, product development efforts have almost been reduced to an exercise in mechanical engineering.

SOFTWARE SUPPORT

On the software side, existing components ease the support of the miniSD card as well. Similar to a disk drive, miniSD requires a device driver to carry out read and write requests. And, at a layer further up in the storage subsystem, support for miniSD must also include a FAT file system for managing directories and files. Applications such as audio players and cameras make use of operating system application program interface (API) services that filter down into the file system, and then on to the device driver that communicates with the miniSD card.

Again, there is good news here for developers, as mobile phone software such as Symbian's operating system and Microsoft's Windows CE include all of this functionality. For platforms running proprietary operating systems or other specialized code, it's also still possible to get a pre-built solution. SanDisk offers a Host Developer's Toolkit software package, which furnishes the API, FAT file system, and device driver required to fully support the miniSD card. The toolkit supplies complete ANSI C source code for all modules, including an abstraction layer that facilitates porting to any CPU environment.

CONCLUSION

Mobile phones based on 2.5G and 3.0G technology are poised for phenomenal growth as multimedia features such as integrated digital cameras and audio players are beginning to strike a how-did-we-ever-live-without-it chord among millions of consumers. The miniSD card should serve to even further proliferate the success of these devices by providing an expandable and interoperable storage solution that melds miniscule size with high capacity.

For more information, please visit the SanDisk Web site at: www.sandisk.com

SanDisk Corporation
Corporate Headquarters
140 Caspian Court
Sunnyvale, CA 94089
408-542-0500 FAX: 408-542-0503
www.sandisk.com