

Flash Memory: The New Handset Differentiator

***A White Paper by
iGillottResearch, Inc.***

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Executive Summary

An easy way to quickly date a modern movie is to look at the mobile handsets the characters use – even a five year old mobile device looks big and clunky next to today's sleek multi-media equivalent. The pace at which cell phones have changed in movies illustrates the pace of the wireless industry overall. Today's cell phones are true multimedia devices capable of taking and storing pictures, playing music, downloading and playing games, accessing the Internet, and, yes, making phone calls.

Just as the capabilities of the mobile handset have increased, so the technical design of the devices has advanced immeasurably. For example, today's mid-tier handset has more processing power and memory than a laptop PC did just five years ago. And as consumers use more multimedia services, the memory and processor requirements of the handsets will increase.

The memory available on the mobile handset is a critical component of the design, not just for the handset OEMs but also to support the business model of the mobile operators. Flash memory on the device allows the operator to offer music, picture and video services that would not otherwise be possible.

However, simply packing as much memory as is physically possible into a mobile handset is not the answer. Since the price of the handsets is subsidized by many mobile operators around the world (and in those markets where no subsidies exist, consumers are usually highly cost-conscious), the cost of the handsets is a critical issue for mobile operators. The operators carefully segment their markets and position handsets within specific price and feature tiers. Hence a low-tier handset must support not just a specific feature set but do so within a specified price band.

The market for handsets capable of supporting content and media is considerable. Consider that:

- The world's demand for mobile handsets will not diminish and that by 2009, nearly 1 billion handsets will be shipped annually.
- The majority of mobile devices will be feature phones with more than just basic voice and texting capabilities. This means that even the most inexpensive handsets will be able to play basic games, access ringtones and display simple images. Many will have cameras and be capable of recording short videos, as well as playing music. The advanced capabilities in today's handsets will be commonplace tomorrow.
- The growth markets for data and media products and services are in Asia and Latin America, areas where the sales of mobile handsets is increasing rapidly, but where disposable incomes are lower than for the more developed markets. The cost of the services and handsets is therefore critical.
- Even in the developing regions of the wireless world, ARPUs associated with wireless data and media services will be significant in 2008 and beyond. Thus, since these regions will be responsible for adding the next billion users to the subscriber base, the new users must also have a handset capable of supporting wireless data and media services and applications.

These trends indicate a strong need for increased flash memory in mobile handsets at all price points, not just for smartphones and high end feature phones. To grow the wireless market to the next billion subscribers, handsets at even the lowest price points must be capable of supporting content and media applications, including ringtones and games. For the handset OEMs, the ability to design a handset architecture that incorporates low cost, scalable flash memory is essential to increasing their business with the mobile operators. Comments from the large mobile operators around the world interviewed for this paper reinforce this need:

- All of the operators interviewed clearly saw the need for more memory on consumer handsets. There was some evidence from the point of sale that increased flash memory on the handset was a differentiator when consumers were choosing devices and that consumers believed that a device with limited flash memory would have limited ability to play games or download music.
- One international operator said that the ability to read memory quickly was as important as the ability to search for data. The current memory read time must not increase as the amount of flash memory increases.
- Operators believe that the amount of flash memory on the handset would increase over the next few years, but the total BOM for the handset would not increase significantly.
- Not all consumers want to stream video or download music, for example. The operators need to be able to define handsets with the correct memory configuration to meet their needs – flexibility and scalability are critical.

Any flash memory solution must therefore not only provide effective storage for data and code, but also be scalable, supporting the lowest tier handset up to a fully featured phone and smart phone. All of this must be done cost-effectively and without requiring extensive changes to the handset architectures.

MirrorBit™ ORNAND™, a new flash memory architecture developed by Spansion, combines the key features of NOR and NAND flash memory to provide a scalable data storage platform for mobile handset OEMs. MirrorBit ORNAND is based on Spansion's proprietary MirrorBit technology. MirrorBit ORNAND offers several benefits to the handset OEM such as: faster write speeds than NOR and faster read than NAND, supporting multimedia applications and features; higher reliability of NOR; cost advantages normally associated with NAND; and scalability on a single platform up to 3GBits, allowing handset designers to scale the flash memory required for each market segment.

To increase functionality on feature phones, MirrorBit ORNAND can be added to the MirrorBit NOR platform, allowing the use of common software and hence reducing the time and cost for developing new handsets.

Mobile Operators, Mobile Media and Content

Mobile operators around the world are rapidly changing their business models, moving away from providing simple connectivity to become fully integrated media companies. This shift has been driven by the need to generate new revenues and profits: as the wireless voice revenues decline (due to falling per-minute prices, not reduced usage), operators need to find new sources of revenue to offset the drop in average revenue per user per month (ARPU).

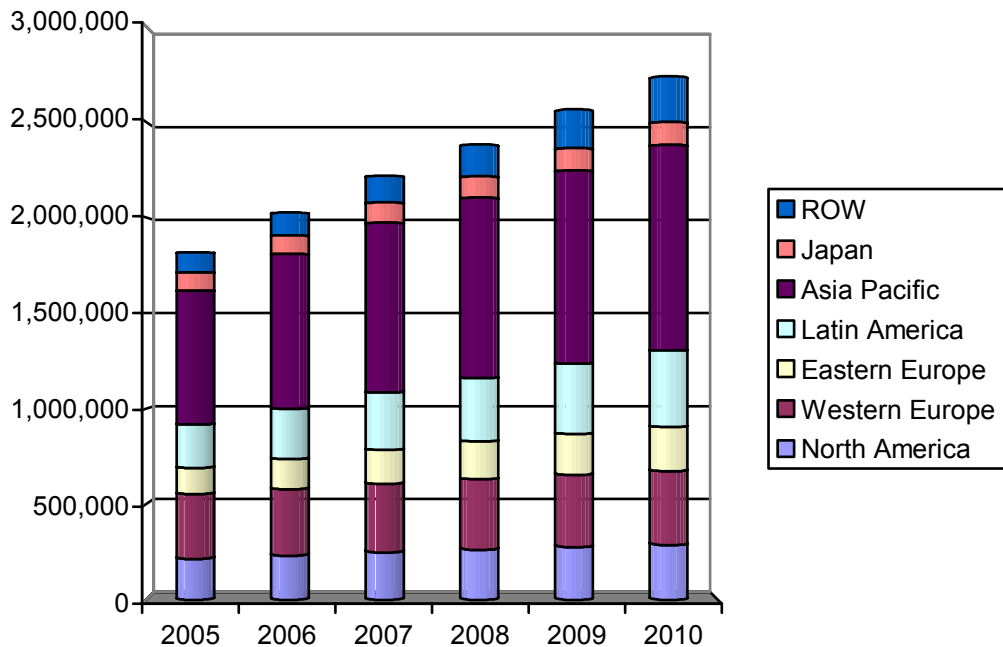
This section reviews how the operators are making this change, the opportunity for mobile media and content products and services, and how mobile media and content drives the demand for more advanced handsets and devices with increased memory capabilities.

Worldwide Wireless Subscribers

The wireless industry is expected to continue its worldwide growth – as Figure 1 shows, the worldwide wireless market will grow at a rate of 8.5 percent from 2005 to 2010. The number of users will grow from 1.8 billion to more than 2.7 billion by 2010.

The regions defined as the “Rest of the World”, Eastern Europe and Latin America will see CAGR of 17 percent, 10 percent and 12 percent, respectively. North America will see growth of 6 percent. Japan and Western Europe, both already enjoying high penetration rates, will see slow growth over the forecast period.

Figure 1: Worldwide Wireless Subscribers by Region, 2005 – 2010 (000s)



Source: iGillottResearch Inc., 2006

In 2005, the Asia Pacific region has the largest number of subscribers, and by the end of 2010, that region will have 39 percent of all wireless subscribers. Other developing regions like Eastern Europe and the Rest of the World will also see subscriber percentages increase significantly. Regions with penetration rates above 50 percent – such as North America, Western Europe and Japan will see their percentage in the overall wireless market decrease through 2010 as their markets are already saturated or quickly reach that point.

Of course, the size of the subscriber base does not indicate the complexity in a specific region. Given the breadth of data and media services available today, we must also consider the number of subscribers capable of accessing this type of data – a wireless data and media capable subscriber.

A wireless data and media capable subscriber is described as a user with a wireless data and Internet-capable handset, not just SMS functionality. These handsets range from those with basic wireless web-browser capability to those with enhancements such as a still or video camera, music player, game player or personal digital assistant. An important point to note is that the mobile operator must support a wide range of such devices, appealing to consumers looking for a heavily-subsidized handset up to a business professional requiring a smartphone. Thus, mobile media features must be enabled on scalable architectures – one size does not fit all.

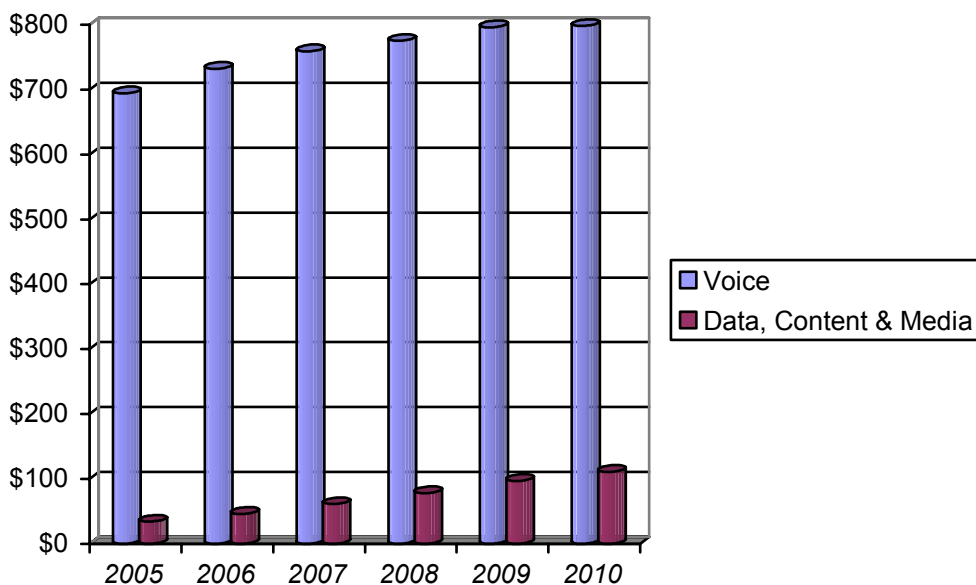
The highest numbers of data and media services users are in Japan and Asia Pacific regions: in Japan, this is due to the country's amazing number of wireless data service subscribers. In Asia Pacific, countries like South Korea and other countries with developed wireless markets, such as Singapore and Australia, are setting the trend growth of mobile data and media services.

Wireless Data and Media Revenues

The overall worldwide revenue generated by non-SMS wireless data and media services is expected to grow from \$34 billion in 2005 to close to \$111 billion by 2010 (Figure 2). The majority of this revenue comes from content, with the remainder from additional airtime charges for the data services. Note that the growth of data and content revenues worldwide grow at a compounded growth rate over 26 percent, compared to just 2.8 percent CAGR for voice revenues. While it may seem unusual that data airtime generates less revenue than content, the reason is clear – countries with developed wireless data and content markets, such as Japan and South Korea, have many more data users and many of those users pay more for content and information than data airtime. At the present time, these two countries are the only wireless data and media powerhouses in the world because they generate so much revenue that they dominate the trends in this chart.

While these numbers may seem impressive, it must be remembered that the revenues generated by voice services are much higher. But, the profitability of mobile media and content services are much higher than for traditional voice, especially if the cost of the wireless data network implementation has been leveraged against the cost of upgrading the voice network. A ringtone that sells for \$2.49 can be as profitable as a \$50-per-month consumer voice rate plan

Figure 2: Non-SMS Wireless Data and Media Associated Revenue, 2005 – 2010 (\$Billions)



Source: *iGillott*Research Inc., 2006

Looking at 2010 worldwide, approximately ten percent of the mobile operators' revenues will come from media and content, with an additional three percent from mobile data network services. Given the increased profitability of such services and content, the mobile operator must be able to deliver a wide range of mobile media to all segments of the subscriber base, no matter how small the opportunity.

The statistics for the mature markets are more pronounced, with more than twenty five percent of revenues coming from media and content. For example, consider the following examples:

- Vodafone live! Australia lists 79 games in six separate categories. The global live! operation has more than 500,000 music tracks available for download.
- Orange in the UK lists approximately 40 ringtones each day in the "latest arrivals" category. More than 300 artists are listed on their Web site with about 2,000 ringtones available for download.
- O2 Ireland offers 45 categories of wallpaper images, each category containing 15 to 70 images. The company also lists 25 categories of polyphonic ringtones, with between 5 and 80 ringtones per category.
- Verizon Wireless quotes more than 10,000 ringtones with Get It Now, although not all are available on all brands of handsets.

Mobile Music, TV and Video

The wireless and mobile industry is, of course, expanding the range of media and content offerings beyond wallpapers, ringtones, games and short music tracks. In 2005, significant new services were introduced by some of the largest operators in the world allowing subscribers to download full music tracks, download TV programming, stream satellite radio and stream video to their handsets:

- Hutchison 3G UK has teamed with BMG to launch a mobile video jukebox enabling customers to stream music videos direct to their video mobiles. Customers are able to both watch and hear music video releases four to six weeks in advance of the single launch.
- Vodafone has an agreement with Sony Music Entertainment to bring music content, including ring tones, artist images, video streaming and short video downloads, to Vodafone live! customers. Initially, subscribers in 15 countries where Vodafone operates have access to the service.
- RubberDuck Media Lab and the Norwegian Broadcasting Corporation allow consumers to watch television on their mobile handsets 24 hours a day. In addition to live streaming, consumers can select more specialized content such as a news bulletin every hour and a motoring show, along with streamed movie trailers. NRK said that in the first eight hours of launching the service, 2,000 video clips were downloaded.
- In November, 2005, Sprint Nextel, Comcast Corporation, Time Warner Cable, Cox Communications and Advance/Newhouse Communications announced the formation of a joint venture to “accelerate the convergence of video entertainment, wireline and wireless data and communications products and services” to their cable and mobile customers. The JV will develop products and services that leverage the benefits of the cable MSOs assets and the reach of the Sprint Nextel wireless network.
- On November 1, 2005, QUALCOMM and Verizon Wireless announced plans for nationwide commercial deployment of MediaFLO, Qualcomm’s mobile real-time TV delivery service. The initial deployment is expected to cover approximately half of the Verizon Wireless EV-DO markets – the exact markets have yet to be determined.

All of these mobile radio, music, TV and video services have one thing in common – the subscriber is required to have a new handset capable of supporting mobile multimedia. Older handsets, even those designed to use some of the newer network technologies, do not have sufficient processor, memory or software capabilities to support multimedia services. The situation is analogous to the PC – older models may be able to access the Internet but do not have sufficient processor power or memory to download music, process streaming video or play DVDs. Just as the technical capabilities of the PC have increased to support multimedia services on the Web, so the mobile handset has evolved to support mobile media and content.

Sufficient memory must be available on the handset to store and play songs, store and play multimedia games, cache streaming video and music, store pictures and video, and, of course, support the traditional voice and messaging features of the phone.

Demand for Media and Content

As an example of the demand seen for multimedia and content services in mobile markets around the world, consider a recent (June 2005) survey in which *iGillott*Research asked 208 consumers in North America (who in addition to a cell phone also had an MP3 player) about their current and planned use of various media services.

Forty-three percent of respondents said they had purchased a ringtone in the previous twelve months. While this is the minority, if this data is applied to the cell phone population, it equates to approximately 81 million subscribers. Furthermore, nearly 39 percent of the sample said that they planned to buy ring tones in the future. Clearly, even for a more mature media application such as ringtones, there is significant potential for growth in the market.

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A similar pattern appears when the survey respondents were asked about games. Nearly one quarter said that they had purchased games, a high number considering that the industry only began promoting cellular gaming in North America in the last two years. Interestingly, more than half of the survey respondents said that they planned to buy games in the future on their cellular handsets – this suggests that the gaming market is certain to expand in North America. The type of games consumers are interested in varies considerably, from simple puzzle games and crossword puzzles to interactive, graphic-intensive games. The processor and memory demands placed on the mobile handset will therefore also vary, but the fact remains that mobile devices must be capable of supporting increasingly technically complex games.

When these results are split by income and length of time using the mobile handset, it is clear that newer subscribers and those with lower incomes represent those who plan to buy content and media. While games have generally been purchased by those under 30 years old, there are strong indications that older subscribers are as interested in games as younger generations – however, the game genre will change with age.

One key to realizing the gaming opportunity is the availability of suitable handsets – more advanced media and data features are needed to expand the market in each region of the world.

The move to mobile media and content

As discussed, there are a number of data and media users that generate considerable additional revenues for the mobile operators, the majority of which is higher-profit than voice services. As the growth of revenues continues to slow, mobile operators increasingly rely on mobile media and content revenues and profits to maintain their financial growth and, ultimately, their share prices. As a result, many of the world's largest mobile operators now label themselves as 'media companies'.

However, the majority of mobile subscribers in the world do not yet use data and media services, even though they have mobile handsets capable of accessing such services. Mobile operators need to be successful with data and media services and products because of the potentially higher profit margins, but also because they need to move

subscribers to the newer 2.5G and 3G networks. Media and content services are also important for market segmentation, to potentially reduce churn, and to increase ARPU and profits.

The growth markets for data and media products and services are especially strong in Asia, Eastern Europe and Latin America, areas where the sales of mobile handsets is increasing rapidly, but where disposable incomes are lower than for the more developed markets. The cost of the services and handsets is therefore critical, but the handset must still support the advanced features that allow operators to offer data and media services. Even in the developing regions of the wireless world, ARPUs associated with wireless data and media services will be significant in 2008 and beyond. Thus, since these regions will be responsible for adding the next billion users to the subscriber base, the new users must also have a handset capable of supporting wireless data and media services and applications.

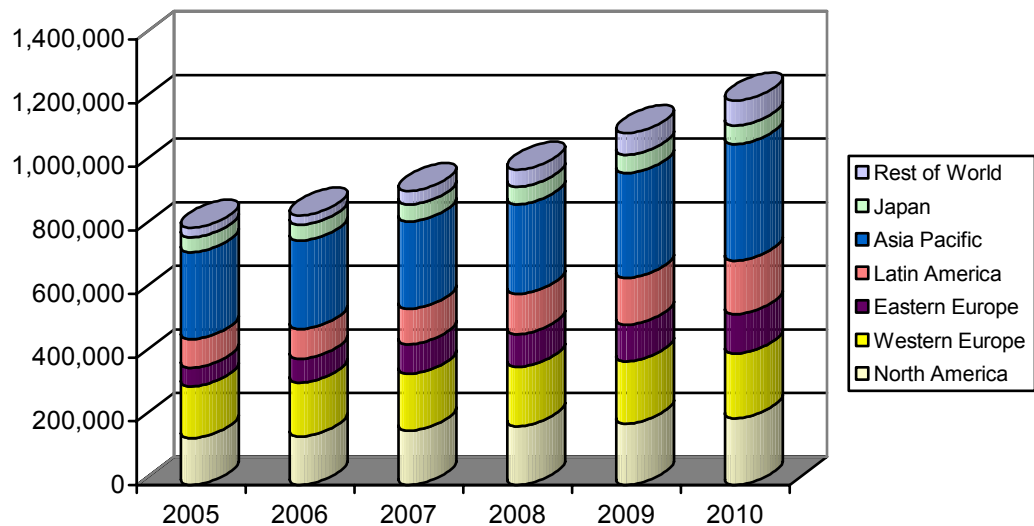
Mobile media and content revenue growth in the mature mobile markets of Western Europe, North America and Japan, is also significant. However, since the majority of consumers and business users already have mobile handsets, mobile media and content service adoption requires a new handset, which changes the economic model for both the subscriber and the mobile operator.

No matter which region of the world the subscriber is in, in order to access mobile media and content services, the handset must have sufficient memory to store and play songs, store and play multimedia games, cache streaming video and music, store pictures and video, and, of course, support the traditional voice and messaging features of the phone.

The Worldwide Mobile Handset Opportunity

Before looking at the changes in the mobile handset technology and design resulting from the increased demand for and use of mobile media and content, we must first size the market. As Figure 3 shows, the total sales of wireless and mobile handsets and devices rise from just over 808 million in 2005 to more than 1.2 billion in 2010. Given that there are just over 6 billion people in the world, this means that over thirteen percent buy a new handset every year. The current market is equivalent to every person in the U.S. and Western Europe buying a new handset each year.

Figure 3: Worldwide Wireless and Mobile Handset Shipments by Region, 2005 - 2010 (000s)



Source: iGillottResearch, Inc. 2006

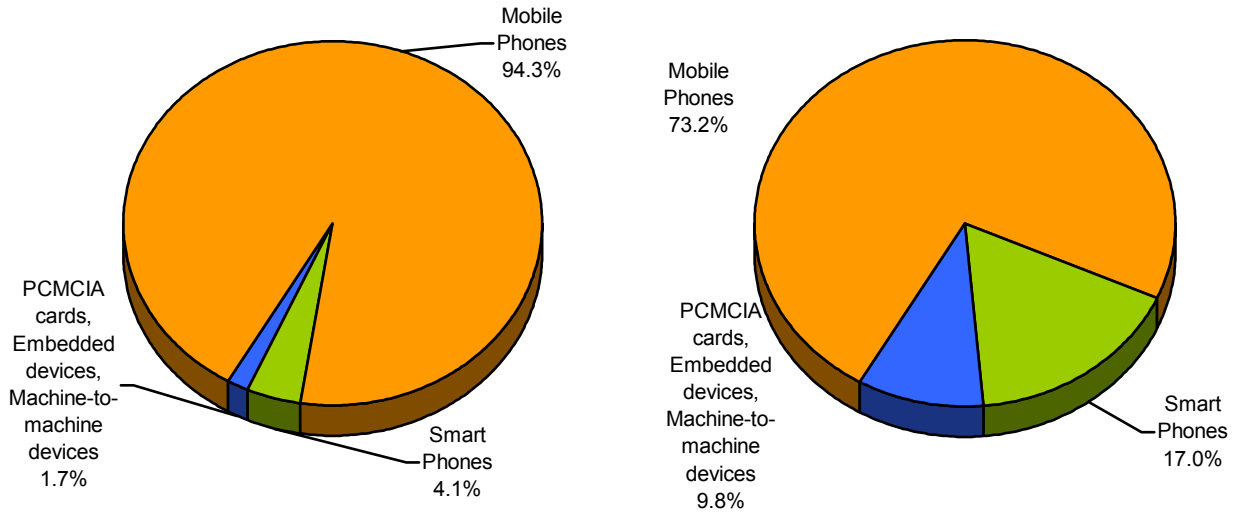
Of course, the mobile handset market is far more diverse than just the U.S. or Europe, as Figure 3 shows. Since handset shipments depend on the size of the installed base and the growth of new subscribers, it follows that the larger regions of the world, such as Asia Pacific, will have the higher shipments. When handset shipments are split by technology, GSM handsets will dominate the market throughout the forecast period. However, the fastest growth is for handsets supporting 3G technologies.

Figure 4 shows the type of devices shipped in 2005 and 2010 respectively, whether the wireless and mobile devices are traditional handsets, PDAs/smartphones or PC cards and embedded devices. Despite the widespread availability of new form factors such as PDAs with keyboards, the majority of wireless devices sold are traditional handset form factors and will remain so.

The term "smartphone" refers to devices combining some PDA functionality and in some cases advanced operating systems such as Palm OS, Microsoft or Symbian. Thus, "traditional" handsets are increasing in functionality and include features such as cameras

and MP3 players, but just because a handset includes a camera does not mean it is “smart.”

Figure 4: Worldwide Wireless and Mobile Handset Shipments by Type, 2005, 2010



Source: iGillottResearch, Inc. 2006

As Figures 3 and 4 illustrate, over the forecast period the number of feature phones and high-end handsets, those devices that have services beyond basic voice and text messaging, will grow from 439 million to more than 871million, which equals a CAGR of 14.7 percent.

This data demonstrates three main points:

- Firstly, that the world’s demand for mobile handsets will not diminish and that by 2010, nearly 1 billion handsets will be shipped annually.
- The number of “smart” devices increases significantly, from 4 percent of shipments in 2005 to 17 percent in 2010. Hence, 1 in six handsets will have an advanced processor, significant flash memory and an advanced operating system, and will likely match the computing capabilities of a laptop PC.

The majority of mobile devices will be feature phones – that is they will have more than just basic voice and texting capabilities. This means that even the most inexpensive handsets will be able to play games, access ringtones and display images.

Finally, that the majority of mobile devices will be feature phones – that is they will have more than just basic voice and texting capabilities. This means that even the most inexpensive handsets will be able to play games, access ringtones and display images. Many will have cameras and be capable to recording short videos, as well as playing music. The advanced capabilities in today’s handsets will be commonplace tomorrow.

The Need for Increased Device Memory

As discussed in this white paper, the demand for mobile handsets with wireless data and media features is increasing in all regions of the world, and media and content services are providing important new profits for the mobile operators. New subscribers are as likely to use media and content services as existing subscribers, meaning that low cost mobile handsets must also support such services. Mobile handsets need sufficient memory to store the content. The speed at which the memory on the mobile handset can be accessed is also critical.

Mobile Operator Views

As part of the research for this white paper, *iGillott*Research spoke to several large mobile operators around the world about the need for additional memory on the mobile handset. Several points were made about the operators regarding the need for memory on mobile handsets:

All of the operators interviewed clearly saw the need for more memory on consumer handsets.

- All of the operators interviewed clearly saw the need for more memory on consumer handsets, not just smart phones. There was also evidence from the point of sale that consumers wanted more flash storage on the handset, not just removable memory cards. The need for additional memory is driven by new services and applications.

There was some evidence from the point of sale that increased flash memory on the handset was a differentiator when consumers were choosing devices.

- Some operators said there was evidence from the point of sale that increased flash memory on the handset was a differentiator when consumers were choosing devices. As the popularity of MP3 players and digital cameras has increased, so consumers have been educated about how much memory they need – they may not know what a MB is, but they know how many they need to store a specific number of songs or pictures.

Some evidence indicated that consumers believed that a device with limited flash memory would have limited ability to play games or download music.

- One of the large international operators noted that there was some evidence that consumers believed that a device with limited flash memory would have limited ability to play games or download music. These comments came from the point of sale. This supports the theory that consumers are aware of the need for memory and view a handset with increased flash memory as offering higher performance.

- Operators saw two main drivers for flash memory on the device: to support the newer operating systems and to support applications and services, especially those supported by 3G. In fact, one large international operator stated that in order to take full advantage of 3G services, more flash memory is needed than on current 2.5G handsets. The same operator also saw the need for fast-write flash memory to store volatile data on the handset.
- One operator in North America stated that they see the ability to deliver and support media applications as the way to differentiate their services in the future. As a result, they planned to have handsets at all price points that supported multimedia

downloads and applications – these handsets featured extensive flash memory as well as expandable memory cards.

The main drivers for increased storage on the mobile handset are music, pictures and cameraphones, video, email and calendar/PIM applications.

- The main drivers for increased storage on the mobile handset, according to the operators, are: music, pictures and cameraphones, video, email (both corporate and personal) and calendar/personal information management applications.

One international operator said that the ability to read memory quickly was as important as the ability to search for data. The current memory read time must not increase as the amount of flash memory increases.

- All operators interviewed stated that the speed with which memory is accessed is important to the user experience. In fact, one international operator said that the ability to read memory quickly was as important as the ability to search for data. The current speed with which handsets can access data is considered acceptable but the operators felt that if the speed decreases, consumer satisfaction with the application would also decrease. Thus, the memory read time must not increase as the amount of flash memory increases.

Operators believe that the amount of flash memory on the handset would increase over the next few years, but the total BOM for the handset would not increase significantly.

- All operators interviewed believe that the amount of flash memory on the handset would increase over the next few years, but the cost per MB would also fall. Hence, the total BOM for the handset would not increase significantly. One operator believed that the amount of flash on the handset would double every 9 to 12 months for the next few years, but then slow down. Analogies were drawn with the PC market.

As the flash memory increases on the handset, operators do not expect any issues with battery life

- As the flash memory increases on the handset, operators do not expect any issues with battery life – the operators expect that battery technology will improve to offset the power requirements of more memory.

- The time taken for the handset to start must not be allowed to increase, even as the number of applications on the handset increases and the amount of flash memory rises. The operators increasingly have to explain to users today why handsets are taking longer to start or load content or games – this adds to the customer service and point of sale costs.

Not all consumers want to stream video or download music, for example. The operators need to be able to define handsets with the correct memory configuration to meet their needs – flexibility and scalability are key.

- All of the operators are also concerned about being able to provide handsets with the right capabilities for the level of consumer, both in terms of price point and demand for applications and services. Not all consumers want to stream video or download music, for example. Thus, the operators need to be able to define handsets with the correct memory configuration to meet their needs – flexibility and scalability are key.

- Finally, more than one operator interviewed stated that as the mobile device becomes more of an entertainment device, even at the lower price points, then storage becomes a prerequisite.

Role of Flash Memory

There are two main types of content that have to be stored in the mobile handset: application code and data, allowing mobile handset designers to optimize performance and store richer content. Two types of flash memory are typically used to store code and data in consumer electronics devices:

- NAND is typically used as data storage as it offers highest density with lower cost. MP3 players typically use NAND flash for storing songs. NAND is typically not used to store application code as the data must be read sequentially – NAND memory does not allow the reading of a specific location. If NAND is to be used for application code, the code is first copied to DRAM. While this provides an effective solution, the additional DRAM requirements offset the cost advantages of NAND.
- NOR is used in the majority of current handset designs and is typically used to store application code, since it does allow the contents of a specific memory location to be accessed. However, it can also effectively store data but is traditionally more expensive than NAND. NOR has also been in the market longer and is widely used in consumer electronics, DVD players automotive applications, and telecom infrastructure.

MirrorBit™ ORNAND™

MirrorBit ORNAND, a new flash memory architecture developed by Spansion, combines key benefits of NOR and NAND flash memory to provide a scalable data storage platform for mobile handset OEMs. MirrorBit ORNAND is based on Spansion's proprietary MirrorBit technology.

MirrorBit ORNAND offers several benefits to the handset OEM:

- Faster write speeds than NOR and faster read than NAND, supporting multimedia applications and features.
- Higher reliability of NOR.
- Cost advantages normally associated with NAND.
- Scalability on a single platform up to 3Gbits, allowing handset designers to scale the flash memory required for each market segment.

As discussed throughout this paper, a flash memory architecture suitable for mobile handsets must be scaleable and flexible to support a range of handset price points and designs focused on specific market segments.

Spansion's family of memory solutions scales in density from 32 megabits for the basic cell phone market up to 3 Gb for the feature and smart phone segments, allowing handset designers to scale the flash memory required for each market segment, thereby optimizing cost and performance. To increase functionality on feature phones, MirrorBit ORNAND can be added to the MirrorBit NOR platform, allowing the use of common software and hence reducing the time of cost for developing new handsets.

Conclusions

Obviously, there is more involved in providing media and content services to consumers than just selling ringtones and games, as this paper discussed. As well as a suitable wireless data network, the mobile operator must also support handsets with sufficient memory to support the media and applications. The data and forecasts in this paper demonstrated three main points:

- Firstly, that the world's demand for mobile handsets will not diminish and that by 2009, nearly 1 billion handsets will be shipped annually.
- The number of "smart" devices increases significantly, from 4 percent of shipments in 2004 to 17 percent in 2009. Hence, 1 in six handsets will have significant flash memory.
- Finally, that the majority of mobile devices will be feature phones – that is they will have more than just basic voice and texting capabilities. This means that even the most inexpensive handsets will be able to play games, access ringtones and display images. Many will have cameras and be capable to recording short videos, as well as playing music.

Comments from the mobile operators interviewed for this paper reinforce the need for low-cost, scalable flash memory in mobile handsets at all price points:

- All of the operators interviewed clearly saw the need for more memory on consumer handsets. There was some evidence from the point of sale that increased flash memory on the handset was a differentiator when consumers were choosing devices and that consumers believed that a device with limited flash memory would have limited ability to play games or download music.
- One international operator said that the ability to read memory quickly was as important as the ability to search for data. The current memory read time must not increase as the amount of flash memory increases.
- Not all consumers want to stream video or download music, for example. The operators need to be able to define handsets with the correct memory configuration to meet their needs – flexibility and scalability are key.

Given these requirements, the MirrorBit ORNAND flash memory architecture developed by Spansion provides a scalable data storage platform for mobile handset OEMs that will allow the handset developers to meet the operators need for multimedia handsets at each price point.

About *iGillott*Research

*iGillott*Research is a market strategy consultancy *focused* on the wireless and mobile communications industry. Founded by Iain Gillott, one of the wireless industry's leading analysts, we research and analyze the impact new wireless and mobile technologies will have on the industry, on vendors' competitive positioning, and on our clients' strategic business plans.

Our clients typically include service providers, equipment vendors, mobile Internet software providers, wireless ASPs, mobile commerce vendors, and billing, provisioning, and back office solution providers. We offer a range of services to help companies improve their position in the marketplace, clearly define their future direction, and, ultimately, improve their bottom line.

A more complete profile of the company can be found at www.igillottresearch.com.

Methodology

All research for this white paper was conducted exclusively and independently by *iGillott*Research. The worldwide wireless and mobile statistics were prepared by *iGillott*Research as part of the *Wireless and Mobile Market Forecast, 2005* (ref: 012005-01). *iGillott*Research's Mobile Media Survey, 2005 was fielded in June, 2005 to 208 consumers in North America, all of whom had cellular phones and MP3 players. The survey was fielded via the Web using a panel from e-Rewards.

Interviews were conducted with several large regional and multinational mobile operators in North America and Western Europe. Interviews were conducted with those knowledgeable of the operators' handset design, development, and procurement process.

Disclaimer

The opinions expressed in this white paper are those of *iGillott*Research and do not reflect the opinions of the companies or organizations referenced in this paper. This white paper was sponsored by Spansion but Spansion personnel were not involved in the carrier interviews or in the ongoing research.