The Business Opportunity for Consumer Wireless Applications

3G americas

November 2004

TABLE OF CONTENTS

Executive Summary

Advancing data capabilities for cellular networks are creating significant business opportunities for developers of applications, particularly consumer applications where messaging and entertainment applications are experiencing widespread adoption. This white paper is written for such developers, as well as operators engaged with developers, to substantiate the opportunity, provide insight into the wireless data market, explain how wireless applications differ from wireline applications, identify the development approaches, and discuss the effective business models. Enterprise applications are also seeing significant adoption, but differ substantially due to different types of users, a greater emphasis on higher-end platforms, including smartphones, PDAs and notebook computers, and different development approaches. Because of the differences between these two markets for wireless applications, this paper concentrates specifically on consumer applications.

The business opportunity is driven by a number of factors, including the massive scope of GSM/UMTS deployments, which today encompasses 1.18 billion subscribers worldwide. Data service is available in over 200 countries from 217 operators. General Packet Radio Service (GPRS), Enhanced Data Rates for GSM Evolution (EDGE), and Universal Mobile Telecommunications System (UMTS) technologies provide greater data capabilities than ever before, and coupled with powerful devices, enable a huge variety of applications with large numbers of subscribers willing to pay for them. This white paper reports on the following:

- The GSM family of technologies has the largest subscriber base of any cellular technology, almost ten times higher than the CDMA2000 family of technologies.
- In 2003, wireless Internet usage grew by 145%, indicating rapid adoption of data services.
- There are significant differences between applications developed for wireline environments and those developed for wireless environments. Developers that take the time to understand these differences will be best positioned to succeed in this exciting new market area.
- The ideal wireless application takes into account the needs and desire of the mobile user, and is not just a mobilized version of an existing application. For example, mobile applications can determine the user's location, preferences, and presence to tailor content to their immediate needs.
- A market driver is the rich diversity of mobile devices. However, this creates challenges for developers who can produce for the lowest common denominator or can design for specific devices.
- Effective Digital Rights Management specifications and systems are now available to protect developer content.
- Operators are offering value-added services that can significantly enhance the effectiveness of applications. Services include Wireless Application Protocol (WAP) gateways, billing systems, DRM systems and location-based services.
- The GSM family of technologies -- GSM/GPRS/EDGE and UMTS/HSDPA -- offer effective security mechanisms to protect sensitive applications such as mobile commerce.
- The GSM/UMTS family offers significant flexibility in how data is delivered to users, including Short Message Service (SMS), Multimedia Messaging Service (MMS), WAP and general IP-based packet communications. Data can be delivered upon user request or it can be pushed to the user so that it is immediately available and up-to-date.
- Language options for development include browser-based markup, Java and native applications, providing a set of tradeoffs between ease of development and application performance. Java is rapidly becoming the preferred application approach.
- Wireless business models differ from wireline models. Developers can maximize their likelihood of success through partnerships with entities such as operators and wireless distributors, and through appropriate pricing models.

Introduction

Today's users want more from their wireless handhelds than just the ability to make and receive phone calls. Increasingly they want their devices to provide access to information and applications that will allow them to make better use of their time, keep them informed of current events, and communicate via text, e-mail, instant and multimedia messages. They want to be able to keep track of their favorite teams, obtain weather forecasts, and read top news stories. They also want games and other forms of entertainment to fill their idle moments, whether mobile, away from home, or out of their office.

There is a huge opportunity for creating successful businesses by developing wireless applications and content. Such content for the GSM family of technologies already covers an extremely wide range. Examples include: browser-based content such as news feeds, weather and general information; messages delivered by short message service, multimedia messaging service or wireless e-mail including jokes, horoscopes, photos, and e-cards; downloadable content such as ringtones, screen savers, music and video clips; downloadable applications such as games and instant messaging clients; as well as calendar and contact information. However, these are just the beginning. Device capabilities are expanding with large color displays, Java capability, and high-speed wireless connections, enabling developers to create ever more sophisticated applications. As users look to their one mobile device for telephony, organizer capability, information access, and entertainment, the business opportunity for wireless applications and content will continue to expand.

The GSM family of technologies supports a complete application development and distribution eco-system including devices, infrastructure, applications and tools.

In this white paper, we discuss the rapid growth of the global wireless market, dominated by the GSM/UMTS family of technologies. We explain how wireless applications differ from other applications, the approaches and tradeoffs of different development approaches, and wireless application business models. We also include a list of resources available for developing and marketing wireless applications.

Wireless Market Overview

The potential of the wireless application and content market can be assessed from the scope of GSM/UMTS deployments. Today, 1.18 billion subscribers are using GSM[1], almost ten times more than CDMA2000 family technologies. Nearly every GSM network in the world today supports GPRS, which delivers data throughput rates up to 40 kbps. This makes GPRS the world's most ubiquitous wireless data service, available in over 200 countries, with service from 217 operators and a choice of more than 591 handsets. Various analysts predict unit sales of over 150 million GSM/GPRS devices in 2004.

EDGE, an upgrade to GPRS that boosts data rates to 100-130 kbps, is another success story. As of November 19, 2004, 134 operators in 77 countries worldwide were working with EDGE. This includes 40 operators offering commercial service, a number that increases daily.[2] EDGE has reached critical mass in terms of covered population, geography, infrastructure and devices.

UMTS further boosts data capability with typical throughput rates of 220 to 320 kbps. UMTS deployments are also accelerating. There are 52 commercial UMTS networks already in operation in 27 countries, with 74 additional networks either pre-commercial, planned or in deployment, or licensed; fourteen UMTS networks are currently in trial.[3] Early predictions were that operators would choose between EDGE and UMTS. However, there are now, 27 GSM operators in 20 countries worldwide that are deploying both EDGE and UMTS. As of September 2004, there were 10.7 million UMTS customers worldwide.[4] These numbers are also quickly growing.

---

[1] EMC World Cellular Database, September 2004

[2] Information compiled by 3G Americas from EMC World Cellular Database and public company announcements, November 19, 2004

[3] Information compiled by 3G Americas from EMC World Cellular Database and The UMTS Forum, *Global UMTS Network Status*, November 19, 2004 (www.3gamericas.org/PDFs/umts_worldwide.pdf)

[4] UMTS Forum, press release *3G/UMTS Customer Numbers Hit 10 Million Milestone*, September 22, 2004

With respect to UMTS, The Shosteck Group states that, “During 2007, we estimate 70 million new subscribers, bringing the total to 125-150 million...” In addition, the firm predicts that 140 million UMTS handsets will be sold in 2007.[5] Other leading analyst firms have predicted even higher subscriber counts.

The stage is clearly set for massive numbers of subscribers with access to high-performance data services. Companies that take initiative developing applications and content can tap into a market that is beginning to see significant growth. In 2003, for example, wireless Internet usage grew 145% with 134 million people trying or using services.[6] This figure could grow to 600 million users by 2008.[7] Mobile Java applications are expected to grow from $1.4 billion in 2003 to $15.5 billion in 2008.[8] Yet, global data revenues on average are still below 10% of wireless service revenues. This indicates that companies have not yet established dominant positions and leaves the field open for new entrants as well as existing players to realize considerable new revenue.

Another wireless application area that has seen huge growth is messaging. With more than 400 billion messages sent globally in 2003, SMS is the most popular form of wireless messaging. Despite the wide variety of SMS applications that exist, person-to-person communications still accounts for 90 percent of text messaging.[9] New and more powerful messaging approaches such as multimedia messaging, wireless instant messaging, and wireless e-mail represent the next stage of growth beyond SMS, and present opportunities for developers to create applications, services and content to leverage these new capabilities.

Devices that can take advantage of wireless data services span a variety of forms, including notebook computers, PDAs, smartphones, and mobile telephones with microbrowsers. Notebook computers use either PC card modems or can use mobile telephones as modems via Bluetooth, IR or cable connections. For the most part, wireless applications for notebooks are existing networking applications that sometimes have wireless optimizations. It is with smaller devices that developers are applying their greatest efforts in creating wireless-specific applications and content. Is the opportunity greater for applications that execute locally on the device or for Internet-hosted content? The answer is that both are equally important, as is true with the Internet at large where people split their time between working with local applications and using Web-based applications.

While enterprise adoption of wireless data is making great strides, the applications and content generating the greatest revenue today are either entertainment oriented, including games and downloadable ringtones, or communications oriented, such as text, instant messaging and wireless e-mail. In Asia, where 3G deployments lead the world, music and video downloads are extremely popular. Other areas such as mobile commerce also show vast potential.

Not only does the wireless market provide access to a huge growing subscriber base, it provides users who are willing to spend money on content and applications. In the Internet-connected computer market, users expect much of the content and applications to be free. But in comparison, it is estimated that wireless users will spend USD 4 billion worldwide on music alone in 2004.[10]

Wireless Development Considerations

While wireless applications represent a tremendous opportunity for developers, there are significant differences between applications developed for wireline environments and those for wireless environments. Differences include new business models, diverse regulatory requirements, different types of user devices, different usage patterns, and different development environments. Those developers that take the time to understand these differences will be best positioned to succeed in this exciting new market area.

---

[5] The Shosteck Group (www.shosteck.com) Strategic Wireless Seminar, June 22-27, 2004 - Tirennhia, Italy; white paper *UMTS - When and Why It Will Happen: Timetables and Forecasts,* September 2003; The Shosteck Group E-Stats, September 2004

[6] Source: Ipsos-Insight, based on interviews with more than 7,100 adults in 13 global markets, May 2004; from their report *Face of the Web*, May 11, 2004

[7] Probe Research, *Mobile IP Users Population/2003 in Review*, February 2004

[8] Arc Group, *Mobile Application Platforms and Operating Systems - Enabling Technologies and The Evolving Role of Java*, March 2004

[9] Visiongain, Ltd., Messaging Forecasts and Analysis: 2004-2009, September 2004

[10] Source: Consect in partnership with Billboard Magazine, *The 2004 Mobile Music Report*

Just like the Internet at large, wireless applications can be divided into those that use a browser to access Internet (or operator) hosted content, in this case using the phone's microbrowser, or those applications that execute locally on the user's device, such as an IM client or game. Wireless applications may even be composed of cooperating client and server components -- where the server is part of the operator infrastructure in an enterprise or accessible via the Internet.

The ideal wireless application takes into account the needs and desires of the mobile user, and is not just a mobilized version of an existing application. Specifically, the application should:

- **Be entertaining and easy to use:** Developers should make the experience of using the application enjoyable through appropriate use of graphics and audio, and should minimize the amount of time users have to wait for tasks to complete. The application should also minimize the number of keystrokes required for any operation or to access information.
- **Accommodate the device:** The application should accommodate the smaller screen size and constrained user-input options of the mobile device.
- **Support spontaneity:** Since users almost always have their mobile devices with them, the application should encourage use on short notice for short intervals of time.
- **Be easy to obtain:** The application should be readily available through wireless distribution models, as discussed below in the section on wireless business models.

Device Variety

One of the challenges for developers is that unlike desktop PCs that are relatively standardized, mobile devices vary in their capabilities. Differences include: screen size; user-input options; type of content supported (e.g., picture, video, and audio formats); whether execution environments are supported and which ones (e.g., Java and Java versions); and connectivity options (e.g., cable, IR and Bluetooth).

Developers must decide whether to design for the lowest common denominator, or whether to design for specific devices. The lowest common denominator approach accommodates the greatest variety of devices, but cannot take advantage of more advanced features. Developers can reach all subscribers regardless of their devices with the development of applications for SIM cards. However, SIM applications remain limited in their abilities. On the other hand, designing for specific devices limits the market, but can result in much more compelling applications. A hybrid approach is also sometimes feasible: where an advanced version of the application relies on more advanced features, such as being based on Java; but where another version of the application uses a more widely-supported approach, e.g., the microbrowser or even SMS-based SIM applications.

Many operators provide detailed Web-based information about the capabilities of different devices for developers. Device vendors also provide details on the capabilities of their devices on their Web pages.

Wireless Connections

There are also a variety of technical considerations that make wireless applications unique. One is that there are a variety of transport protocols, including text message transport, multimedia message transport, microbrowser protocols, and general purpose IP-based networking, which can be used to deliver information upon request or to push information so that it is always available and up-to-date. This topic is discussed in more detail below in the section "Development Approaches." When communicating data across wireless connections, there are four important considerations:

1. **Throughput:** Wireless networks are getting faster, and new networks offer near-broadband capabilities, but in general throughputs are lower than wireline alternatives such as DSL and cable modems. Most wireless networks, however, match or exceed dial-up speeds.
2. **Latency:** This refers to the delay in data traversing the wireless network. Delays are generally higher than in wireline networks. For text messages, this may be seconds or tens of seconds. For IP packets, round trip time is typically 650 msec for GPRS, 300-500 for EDGE Release 4, and about 200 msec for UMTS. To optimize the user experience, the application should minimize the amount of back and forth traffic, operate on local data stores, and use caching whenever possible.

3. **Connection Stability:** Wireless data connections are typically very stable when users are stationary with a good signal, but if the user is moving, especially at higher speeds, RF conditions will vary tremendously and data connections can be disrupted. For communications-oriented applications, this can result in delays for data, or even in users or applications needing to reestablish the data connection. Well designed wireless applications accommodate lost connections by not locking up waiting for data and by being able to resume upon reestablishing the connection.
4. **Usage Costs:** For applications that communicate, or that users download wirelessly, developers must take into consideration the data billing plans of their users. Some are flat rate, while some are usage based. For usage-based plans in particular, developers should ensure that the amount of data communicated by their applications matches user cost expectations.

For more information about the actual capabilities of GPRS, EDGE and UMTS networks, refer to the 3G Americas white paper, *Data Capabilities: GPRS to HSDPA* available at: www.3gamericas.org.

Digital Rights Management

Developers may want to protect certain content, such as music files. For example, a content provider may only want songs to be playable, or an application to be executable on one specific device, and to restrict distribution of such files between users. Specifications exist to support this, such as the Open Mobile Alliance (www.openmobilealliance.org) Digital Rights Management, now in version 2.0. Support for DRM is built into many mobile devices, but developers should check that their target devices support the desired specifications. Additionally, developers should provide the operator's with a means to be compliant with the various regulatory and security agencies.

There are also third-party providers, e.g., Cellmania (www.cellmania.com) that implement stores for downloading content and have servers that execute DRM.

Value-Added Services

Wireless applications may also interact with other systems, such as value-added services provided by the operator. Examples include WAP gateways, billing systems such as e-wallet systems, DRM systems, and location-based services. These can add tremendous value to an application, such as automatically determining the location of the user to provide relevant location-based content. Location information may be to the cell site level, or eventually within a few meters. Billing services can include charging content or applications to users' wireless accounts or their pre-stored credit card information.

What services are available, how these are implemented, and what application interfaces are provided varies by operators, so developers must work with individual operators to take advantage of these services. However, even if details vary by operator, application developers can develop system-level architectures that accommodate multiple operators.

Security

Security for wireless differs from wireline in that the medium is not "private" and theoretically others can eavesdrop on communications. For many applications, especially entertainment, this is generally not a concern. But for more sensitive applications, such as mobile commerce, developers may need to evaluate security requirements. Fortunately, today's wireless technologies provide a considerable number of security mechanisms.

The GSM/UMTS family of networks authenticates user devices against credentials stored in the SIM card. With UMTS, authentication can be mutual with the device also authenticating the network. GPRS, EDGE and UMTS all offer the capability of encrypting the radio link, and many operators have implemented this capability. GPRS/EDGE uses 64 bit encryption and UMTS uses 128 bit encryption. Developers relying on encryption should confirm that the operator is using encryption.

For WAP-based communications, additional security protocols are employed, either Wireless Transport Layer Security (WTLS) between the device and WAP gateway, or Transport Layer Protocol (TLS) on an end-to-end basis between the device and the content server. The WAP gateway can also restrict users' access to different content and services based on their subscription options.

SIM-based applications can include their own security with custom end-to-end encryption and digital signatures. Mobile transaction applications on the SIM also include local authentication such as time-out features and PIN protection to safeguard the access to the application.

For the most part, developers do not have to build security mechanisms into their actual applications; instead they can rely on the security services provided by the network. Meanwhile, for enterprise connectivity, GPRS/EDGE/UMTS networks are compatible with the Virtual Private Networking systems that most enterprises use for securing remote access for their mobile workers.

Development Approaches

There are a number of different approaches for developing wireless applications. The primary development decisions include which wireless transport and development language to use.

Wireless Transports

Transport options include SMS, MMS, WAP and general IP-based packet communications. These are described in the following table.

Table 1: Different Wireless Data Transports

Transport	Characteristics	When to Use
Short Message Service (SMS)	Ability to send/receive text message up to 160 characters Binary data can also be sent by applications Operators provide both general purpose-mail and messaging-specific interfaces e.g., Short Message Peer-to-Peer Protocol (SMPP) Available even during voice/data session	Simple mechanism for delivering text-based messages to users Can be used by applications as a notification mechanism, e.g., new e-mail available for download
Multimedia Messaging Service (MMS)	Ability for mobile devices to send/receive multiple formats of audio, graphic, and video messages Messaging inbox gives user control over which messages to download	Well suited for entertainment-oriented applications
Wireless Application Protocol (WAP)	Delivers Wireless Markup Language (WML), Extensible Hypertext Markup Language (xHTML) and other content to the microbrowser on the phone	Robust protocols to deliver centrally managed content Well suited for applications that do not require the transfer of much data Can be used to select and download Java applications Includes a push mechanism for notifications
General Purpose IP	Ability to send/receive IP packet data at rates of about 40 kbps for GPRS, 100-130 kbps for EDGE and 220-320 kbps for UMTS	Best suited for applications that transmit relatively large amounts of data Provides greatest flexibility in application type Generally requires custom application development on mobile device

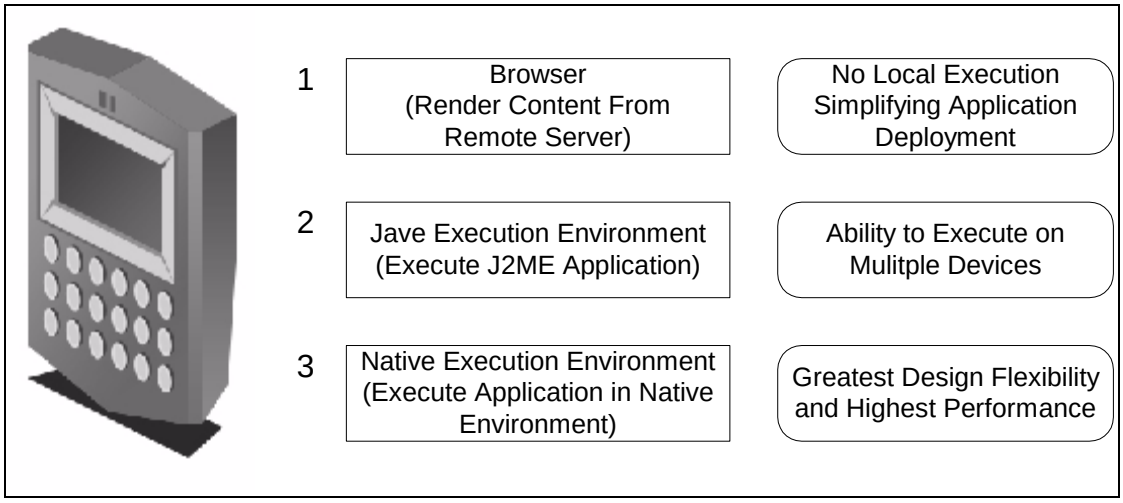
Development Languages

As for development languages to use, the options, from simplest to most complex, include the following:

1. **Browser-based markup:** Nearly all phones today include a WAP browser, supporting either WAP 1.21 or WAP 2.0 specifications. The WAP 2.0 markup language is based on xHTML and is consistent with Web-content specifications used in the Internet. Many phones are adding support for other browser-based markup languages, such as SVG, which allow developers to build more functional and compelling applications. The advantage of this approach is that the content or application can reside on a centrally managed server and no client code is involved. The disadvantage is that the application does not operate locally, and there are typically delays between key strokes and responses. Applications must be carefully designed so users can obtain desired information easily and quickly.
2. **Java:** Java has become one of the dominant languages for computer software development. With Java 2 Micro Edition (J2ME), the same Java language can be used to develop applications that execute on mobile devices such as phones and PDAs. On most mobile devices, J2ME is used in a configuration called the Connected Limited Device Configuration (CLDC.) Two profiles are currently available, including Mobile Information Device Profile (MIDP) 1.0 and MIDP 2.0. MIDP 2.0, available on newer and more powerful devices provides a richer overall set of features for applications. The advantage of developing J2ME applications is that a wide variety of phones now provide a J2ME execution environment. J2ME applications can be downloaded wirelessly during a WAP session, or loaded from a connected PC via cable, IR, or Bluetooth. Though J2ME provides a relatively standardized environment, developers still need to test their application for selected target devices. For applications that execute locally on the device, Java is rapidly becoming the preferred development approach.
3. **Native application:** Only available for higher-end platforms such as smartphones and PDAs, native applications are typically written in C++ or managed code environments using tools provided by a mobile platform vendor. The primary platforms are Palm OS, Microsoft Windows Mobile, and Symbian OS. The advantage of developing a native application is that it offers the greatest design flexibility and highest performance. However, of all the development approaches, it involves the greatest effort, and the resulting application will operate on a narrower range of target devices.

The following figure summarizes these approaches.

Figure 1: Different Development Approaches for Wireless Devices



An emerging technology that blurs the line between browser-based applications and device applications is Web Services. In this approach, downloadable application components run within a framework and collaborate with Web-based resources to deliver application functionality to the user. It is designed to take advantage of the best of both worlds – the power and control of device applications and the simplicity and manageability of browser-based applications.

SIM Cards

Common to all these development approaches is the use of SIM cards in all GSM/UMTS devices.

The SIM card stores the users' credentials, allowing users to easily transfer their wireless accounts to new devices. Any subscriptions to games or services a user had with an older device are immediately available with the newer device.

The SIM card also stores small Java applications that will run similarly on all handsets and all networks. SIM cards still have limited capacity and power and should not be compared with phones and flash cards. However, they bring additional benefits to application providers, such as:

- **Unified customer experience:** the SIM can support permanent or pop-up menus to which the subscribers react. These menus are available on all handsets, regardless of their make and models.
- **Device portability:** as subscribers upgrade their devices, they will transfer their SIM into the new device for service continuity. The SIM will carry the SIM applications into new devices.
- **Security:** the SIM can securely store parameters such as the subscriber's personal information or authentication keys. It can verify a PIN, generate a signature, encrypt data, and can also protect the rights to a device J2ME application.
- **Standard environment:** application developers immediately benefit from their experience in Java or WML languages when they develop on Java Card SIMs.

Business Models

As important as the technical approach for developing an application are business model considerations. How wireless products are marketed, distributed, and purchased is significantly different than for non-wireless products.

The entities involved in the business of wireless applications include application or content providers, publishers, and distributors. The application or content provider creates the material to be sold, whether it is downloaded video, news items or a Java game. The publisher aggregates content and makes it available from a central site. The publisher can be an operator or an Internet portal such as Yahoo. The distributor makes the content available to the user, to be either downloaded or pushed to the user, providing the "store front" and billing mechanisms. The distributor can be an operator, a distributor working in concert with an operator, or a distributor working independently of operators. Examples of companies that distribute mobile content and applications are Cellmania, CNET, Handango, and Handmark. Links are provided in the Resources Section at the end of this paper.

One of the best ways of obtaining visibility for content or application is to have it listed in the home decks (starting-point microbrowser Web pages) of operator-based portals, as these navigation pages are viewed by a large number of their subscribers. Having applications listed involves first developing compelling content and then supplying it to the operator using procedures they specify in their developer support programs.

Larger operators use their portals to distribute content that they have licensed from others. Examples include news feeds, ringtones, screen savers and music. Billing models include one-time payment for access to downloads or content for a specific duration, or monthly subscriptions.

With respect to downloadable games, operator experience indicates that the most successful business model is to sell monthly subscriptions to a collection of downloadable applications. Vendors should regularly update the collection of applications to encourage customers to repeatedly visit the site, and to maintain their monthly subscriptions. This arcade approach creates recurring revenue streams and allows vendors to establish a brand. It also allows vendors to create separate collections of applications that serve different market segments. Most importantly, the arcade approach encourages customers to try different applications and reduces the perception of purchase risk by providing alternatives in the event that the customer is not satisfied with an initial download.

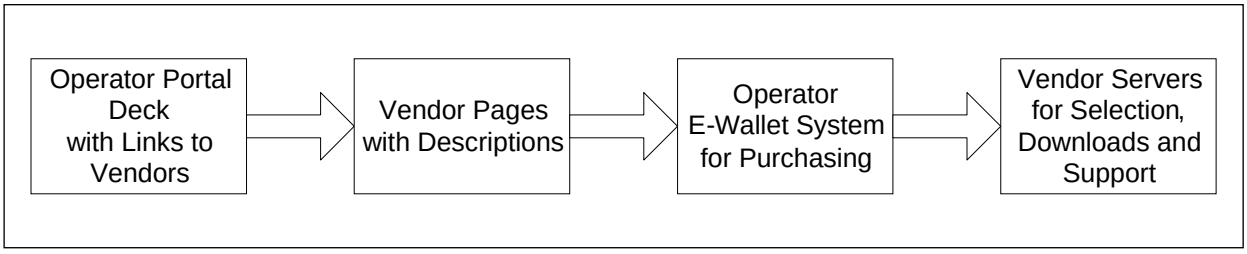
By working closely with operators, developers can ensure that the operators' portal has links to their arcades and ensure compliance with any of the operator's regulatory requirements. Successful applications may also be listed in an operator's home deck as a top pick, which significantly increases visibility of the application.

Another reason to work with operators is to link into their purchasing systems, such as e-wallets that allow purchases to be easily charged to subscriber's mobile phone accounts, or even to their credit cards. This requires following integration procedures that many operators document on their developer Web sites.

Operators may also perform certification testing to ensure proper operation of any content or applications they make available via their sites.

The following figure shows an example of a purchase process using an operator's e-wallet system.

Figure 2: Example of Purchase of Content or Applications



In this flow, the operator portal provides links to vendor applications. Users can then browse the vendor-provided information to determine their level of interest. If they decide to make a purchase, they follow a link to the operator purchase system where an e-wallet system can charge the purchase to the account information on file. The e-wallet system then sends the user back to the vendor site for final selection (in the event of a purchase to a collection of applications or content), actual downloads and support.

An alternative approach is for a subscriber to purchase applications directly from a distributor. This is more common for applications that execute on PDAs or smartphones.

Conclusion

The wireless market represents a significant opportunity for application developers, particularly those developing consumer-oriented applications. GSM/UMTS represents a massive global market of 1.18 billion subscribers. Though wireless applications differ significantly from wireline applications, developers who are successful are those who become familiar with this technology area, partner with the right companies, especially operators, and leverage available value-added services such as billing systems. Wireless business models differ from wireline models, but successful models are well understood. For example, with games, an arcade approach with a monthly subscription has proven effective.

With increasing capability of networks and devices, and a receptive subscriber base eager to use their devices for entertainment and communications, there is virtually no limit to the opportunity for innovative developers, particularly those that establish their market position now while market leadership has yet to be consolidated.

Acknowledgments

The mission of 3G Americas is to promote and facilitate the seamless deployment of GSM, GPRS, EDGE, and UMTS throughout the Americas for the benefit of consumers. 3G Americas' Board of Governor members include AT&T Wireless (USA), Cable & Wireless (West Indies), Cingular Wireless (USA), Ericsson, Gemplus, HP, Lucent Technologies, Motorola, Nokia, Nortel Networks, Openwave Systems, Research In Motion, Rogers Wireless (Canada), Siemens, T-Mobile USA, Telcel (Mexico), and Texas Instruments.

We would like to recognize the significant project leadership of Research In Motion for the creation of this paper.

Resources

This section lists some of the resources available to developers to develop, promote and distribute their applications.

Operators

AT&T Wireless developer site: www.attwireless.com/developer

Cingular Wireless Developer Forum: http://alliance.cingularinteractive.com

T-Mobile developer site: http://developer.t-mobile.com/tmobile

Vendors

Ericsson Mobility World: www.ericsson.com/mobilityworld

Gemplus Developers: www.gemplus.com/partners/wireless

HP Mobile Bazaar: www.cooltown.hp.com

Lucent's MiLife™ Developers Program: www.lucent.com/developer/milife

Motorola Developer Programs: www.motorola.com/content/0,,1989,00.html

Forum Nokia: www.forum.nokia.com

Nortel Networks Developer Program: www.nortelnetworks.com/prd/dpp

Research In Motion BlackBerry Developers: www.blackberry.com/developers

Siemens Mobile Developer Portal: https://communication-market.siemens.de/portal/main.aspx?pid=1&LangID=0

Platforms

Microsoft Windows Mobile: www.microsoft.com/windowsmobile

Palm OS: www.palmsource.com

Openwave Developer Network: http://developer.openwave.com/dvl

Sun J2ME: http://java.sun.com/j2me

Symbian: www.symbian.com

Note that many device and handset vendors also provide developer resources. Developers should visit their sites for devices they are targeting.

Specifications

3GPP: www.3gpp.org

Java 2 Micro Edition: http://java.sun.com/j2me/index.jsp

Open Mobile Alliance: www.openmobilealliance.org

W3C: www.w3.org

Application Distributors

Cellmania: www.cellmania.com

CNET: www.cnet.com

Handango: www.handango.com

Handmark: www.handmark.com

PalmGear: www.palmgear.com