Chapter 3
Enabling Technologies

"I think content is the king. Content is going to drive the space. At the end of the day, people will buy and adapt to new technology because of the content attached to it."
—Jim Beddows, Vice President of Wireless Entertainment, Twentieth Century Fox [39]

Although the royals rule, they can only conquer new areas if they are served by a suitable court of servants and are armed with the appropriate troops. Similarly, mobile content can only be as strong as the technologies used to deliver it. In mobile gaming, the content is the game play. The same technologies that enable us to use more and more business applications through our phones are powering the next generation of mobile games. To demonstrate key technologies that will enable mobile gaming to conquer its audience, we'll look behind the scenes of a fictional game called *The Plot*.

Enter *The Plot*!

All of a sudden, magazines, newspapers, television, and the Internet were crammed with stories and advertisements about the craze over The Plot, *a new multiplatform game with a conspiracy theme. The local carrier had joined forces with a big-name game publisher to experiment with the new concepts of mobile gaming, mixing the hottest mobile technologies with astonishing storytelling and full media coverage.*

In fact, The Plot *was a competition—the best players were given a free luxury holiday in Hawaii. It was designed as a massive marketing campaign for the data services. Regardless of the phone model, everyone was welcome to participate in the game that could be described as one of the most intelligent marketing efforts ever made.*

The Plot *WAP settings were readily configured in all new handsets sold through the carrier. Customers who already had cell phones with Java support were able to download* The Plot *from the carrier portal without additional charge. And all customers who purchased game-optimized cellular handsets during the special campaign period were given the game on a memory card.*

The Symbian Operating System—The Open Playground

The best experience of The Plot *was reserved for those with game-optimized devices. A version of* The Plot *with 3D graphics, built-in messaging capabilities, and downloadable add-ons was available on the Nokia N-Gage game deck. Using the large color screen, players were able to wander in 3D city levels, known in the game as The Plot Underworld, and accomplish tasks that were updated using the data connection. The game assignments were a combination of adventure and action, as they consisted of solving the given missions and chasing the plotters.*

N-Gage is equipped with a 104Mhz ARM processor and includes digital signal processing hardware used for audio and phone functionality. To fully exploit the hardware power in applications such as games, an operating system that is optimized for cell phones is required.

Symbian OS is becoming a standard operating system for smartphones, as the device manufacturers supporting Symbian have taken decisive steps to ensure that the installed base of terminals with Symbian OS is as large as possible. To date, Symbian has been implemented or licensed by the majority of manufacturers, representing more than 70% of all cell phone makers.[40]

An open operating system allows everyone to participate in the competition and creates a device-agnostic environment. It brings cell phones closer to the world of personal computing, where thousands of individual

developers market their software. In practice, this means that application developers are free to experiment with real phones and toolkits before marketing their software directly to phone owners.

Game developers are able to start developing games for Symbian phones and move on to N-Gage game projects smoothly because the underlying technology and development tools are similar. Several programming languages are available, but the developers prefer a language called C++ because it can be compiled into the native program code for the processor, resulting in faster games. In addition, the best support for game programming for N-Gage is initially in the C++ software development kits available for registered game developers from Nokia.

Thanks to the Symbian OS and compiled C++ code, *The Plot* for N-Gage can use processing-intensive, animated 3D graphics and fully employ game-optimized features such as game play buttons and local multiplayer connectivity.

Java on the Handset—J2ME

The Plot *was also available for a large population of Java-capable handset owners. The Java game was a stripped-down version of the N-Gage game: The missions were similar but smaller and simpler and did not use 3D graphics. Still, a number of missions were available for download and offered challenges that varied from tough puzzles to easy action sequences.*

The emergence of Java, an application programming language and runtime environment developed by Sun Microsystems, revolutionized software development starting from the mid-1990s. The core idea behind the design of Java language was the capability to make the runtime environment available on as many different computing environments as possible and thus maximize the number of places where Java programs could be used. Now a special version of Java is aiming at the same goal in the mobile world and is widely supported by handset manufacturers around the world.

Java 2 Platform Micro Edition, J2ME, is a version of Java 2 technology that is optimized for use with small devices such as PDAs and cell phones.[41] It has millions of potential developers because the larger-scale versions of the language and runtime environments are extensively used in both server and application programming.

The J2ME applications, properly called MIDlets, do not run natively in mobile devices. This means that the device must be provided with a special code interpreter, Java Virtual Machine, for executing MIDlets. Consequently, software written with Java needs more resources than the native applications that do not need an interpreter to run.

Because of the memory limitations of low-end cell phones, the permitted application size is relatively small. In some cases, the maximum application size is only a few dozen kilobytes. Newer handsets allow larger Java applications.

There are two ways to deliver mobile Java applications. The most common way is to download over the air (OTA) directly to the cell phone. Another option is to first download the MIDlet to a desktop PC and then install it to a phone via a serial cable, infrared, or Bluetooth connection.

Carriers encourage Java OTA downloads because they are able to generate revenue from the increased airtime. Additionally, they charge the third-party content providers for the billing of the transaction. In many cases, carriers sign revenue-sharing deals with game publishers and developers to generate more data traffic and to promote OTA download as a delivery channel.

The Newer, Funnier WAP

Despite the attractiveness of the more developed mobile gaming platforms, most of the players participated in The Plot with WAP handsets. They also would have been keen to try the latest technologies but did not want to purchase a new cell phone solely for this purpose.

The game play using WAP was a bit different from N-Gage and mobile Java playing. A new player registered in the beginning and received a unique ID and password. The ID and password could then be used to log in to the game. For many phone models, the separate login was normally not needed because the game server could recognize the player automatically as soon as he entered the main page of the game.

Each time the player got in the WAP game, he was assigned to a team mission—a task that could not be solved alone. Now the player had 30 minutes to complete the assignment with the help of the other players to be able to reach the next level.

The term "wireless application protocol (WAP)" has gone through some hard times. In some aspects, it has become an example of everything that went wrong when the convergence of the Internet and the telecommunications business first started. Despite the difficulties of the past, WAP still remains the most widely available technology for content browsing in the mobile environment. The two major put-offs for WAP—the slow connection speed and the relatively crude output—are less of a problem today, and the new version offers new and interesting features for mobile games.[42]

The first feature is the capability to "push" content to cell phones. The behavior of a WAP push message is similar to that of a text message—the phone beeps when the message is received, and it is shown to a user. The received message includes hyperlinks that can be used as starting points for browsing. For example, in *The Plot*, a push message, which takes the receiver to the browser application, can be used to invite a friend to the game or to deliver a new mission automatically to the player or team.

Wireless web browsing has also improved to support color and richer content. A new format, XHTML, is replacing the old WML documents in the modern browsers. It provides a better and more consistent user experience across regular and wireless web since it can be used in both.

Playing with Messages

New assignments were announced regularly as long as the player was able to stay in the game and complete the given tasks. Players who could not accomplish the tasks were automatically dropped out. The details about the assignments were given via WAP, and all communication among team members was carried out using text and multimedia messages.

In a typical SubPlot, as the missions were called, the player was presented with an image of the place in The Plot *Underworld where the mission started. After a few moves, the game informed him that to get to the end of the mission, he needed to communicate with another player in a different location in the game to obtain vital information on how to proceed. It was quickly discovered that the quickest way to work out the puzzles was usually to exchange multimedia messages that included pictures of the game locations and then discuss the situation via text messages until a solution was found.*

Text and multimedia messages are becoming an integral part of mobile gaming. Text messaging is already familiar to millions of cell phone users. Multimedia messaging (MMS)[43] complements text with images and sounds and is especially useful with new phones that allow sound recording and digital image snapping.

In the case scenario, the players of *The Plot* solve the mysteries together using messaging as a communication channel. *The Plot* players that use the Nokia N-Gage game deck are also able to benefit from the messaging technologies. The 3D game contains the capability to send multimedia messages from certain game situations that require cooperative play. The difference is that the message is created in and sent from the game deck itself, whereas in the WAP and Java games, the game server has a library of precreated game images that are sent from the server to the other players.

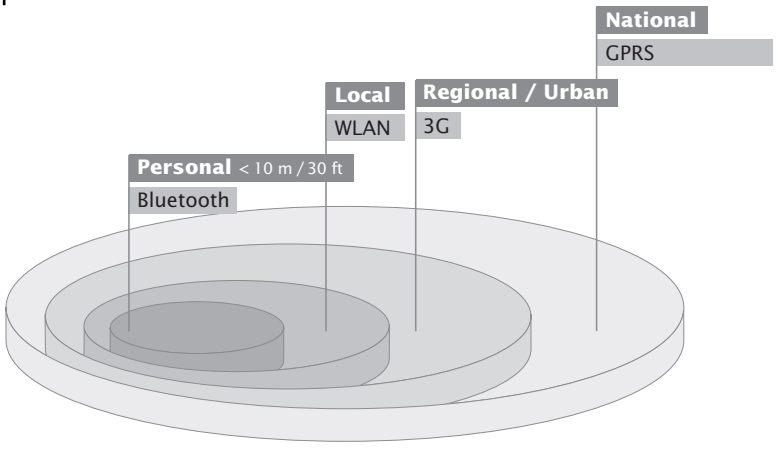
Networking—An Integral Part of Mobile Games

The Plot *was not solely a marketing campaign. It was a practical exercise to teach the use of mobile data connectivity to cellular subscribers, presenting content that every customer can access. Motivated by the exotic awards—such as trips to Hawaii—the subscribers not familiar with WAP and Mobile Java got excited about the game. Along the way, they found out that using wireless data services is not that hard after all.*

The carrier behind The Plot *did not offer everything for free; revenue was generated from the increased data usage as people signed in for the service. The game also generated extra messaging traffic as the players contacted each other and tried to solve the given mysteries.*

Various networking technologies that are available for game-optimized mobile devices create a fertile environment for cross-platform games. Because there is no single mobile network technology that can serve all possible needs, each of the solutions has its optimal place and purpose in the mobile environment. Communication range, speed, latency, coverage, and cost determine what different technical solutions should be used for (see Figure 3.1).

Figure 3.1 Mobile networking technologies.



To begin with, *personal networks* are best for connecting closely located terminals or other devices together. The Nokia N-Gage game deck is equipped with a Bluetooth connection to facilitate local gaming and internetworking at close ranges with other Bluetooth-enabled devices.

Local networks typically are used in narrow areas where mobile connection is needed. A wireless local area network (WLAN) is widely used in hotel lounges, airports, and other public areas. WLAN or WiFi networks are more often used by laptops, palmtops, PocketPCs, and similar portable computers than by phone-like devices.

The emergence of the advanced 3G networks facilitates the need for regional, high-speed Internet access. Because of the expenses in building the network, *regional networks* supporting 3G are initially built to cover geographically limited areas, such as particular cities.

Finally, current *national networks* cover larger areas and provide access to the Internet at slower data transfer speeds than the technologies for shorter distances. The generic packet radio system (GPRS) currently is a widely used technology for providing mobile data connections in national networks.

High Speed, High Action with Bluetooth

Soon after the game was released, it became evident that the N-Gage players of The Plot *were the heaviest users of networking. Most were captivated by the unique local multiplayer mode, which allowed networked action game play in both cooperative and competitive modes, not available with other devices.*

These Local Action SubPlots were most often played with friends specially gathered together, whereas the Team Puzzle SubPlots often involved co-operation with ad-hoc teams among players that did not necessarily know each other in real life. The action typically started with one of the players initiating the SubPlot by sending a text message in a premium number and receiving an unlock code. Others would then use the unlock code to join him and begin frantic chasing and shooting in the most hideous corners of the Underworld…. Before too long, this play mode was spontaneously named "BlastPlot" by the player community.

Bluetooth is a specification for a short-range, low-power radio link capable of connecting mobile devices within 30 feet with a speed up to 1Mbps. It is an ideal technology for cell phones because the burst-like technology consumes little power. Bluetooth-enabled devices detect each other automatically, so a local network among terminals is created. The Bluetooth network, or piconet, can accommodate up to 8 players communicating simultaneously. When the number of connections increases, the bandwidth is shared among all participants, and the throughput decreases correspondingly.[44]

So far, in the mobile world, the Bluetooth connection has mainly been used for connecting a phone and a headset together without wires. Another traditional use for Bluetooth has been a connection between a phone and a personal digital assistant (PDA) device, such as a Palm Pilot or an HP iPAQ. When a phone acts as a modem, the PDA device can be used to browse the web, read email, and perform various other activities.

For Nokia N-Gage, Bluetooth is the enabling technology for local network game play. Networked games can be created for players close to each other, whether in a cocktail party setting or for a group of friends challenging each other in a mock battle. For multiplayer action games, the time delay between sending and receiving data from other game devices, or latency, is an important measure. Too big of a latency effectively prevents

seemingly synchronous game play and destroys the experience. The latency of a Bluetooth network with N-Gage game decks is less than 50 milliseconds, which is short enough to keep the network game play smooth.

Carriers might not automatically generate revenue from Bluetooth-enabled games because the network is created locally between the terminals. Nonetheless, it is good to acknowledge that once mobile game players learn to play networked games locally, they are also more willing to experiment with distant game play. In addition, game designers can build opportunities for tying local network play into game services offered by the carrier, in the manner described in The Plot scenario.

Rock Your Opponents Miles Away—Gaming over GPRS

GPRS and similar packet-based, data-connection technologies enable an always-on Internet connection for mobile terminals. The connection speed depends on the carrier offering the service. Theoretically, GPRS is capable of providing a connection speed of 115Kbps. In practice, carriers balance between data and voice capacity. The more data transferred in the network, the less voice capacity can be provided and vice versa. Typically, the bandwidth is similar to Internet access from a home computer using a modem dial-up connection.

In contrast to Bluetooth, GPRS is not limited to short-range playing. It facilitates remote game play, as long as a carrier offers a GPRS service in the area where the players are located. In some countries, carriers offer unlimited monthly Internet data access for mobile devices. This is ideal for gamers because they do not have to worry about additional "hidden" charges. The monthly Internet traffic fees for online games might astonish many who have signed up for volume-based data accounts. To maximize the revenue from mobile games, carriers should exercise care in setting the transfer charges. If the fees are too high, gamers will prefer Bluetooth and nononline alternatives and will not embrace wide area mobile multiplay.

And There's More... Over the Air

The N-Gage gamers unraveling The Plot *could download and install extra missions over the air. This amounted to a fair deal of network access even for players who only were interested in the single-player games. The greatest buzz on downloadables began when the game proceeded to the stage at which players first discovered the in-game helpers. They were given a chance to download over the air supernatural boosters for their player character: SuperIntelligence, SuperSpeed, and SuperStrength.*

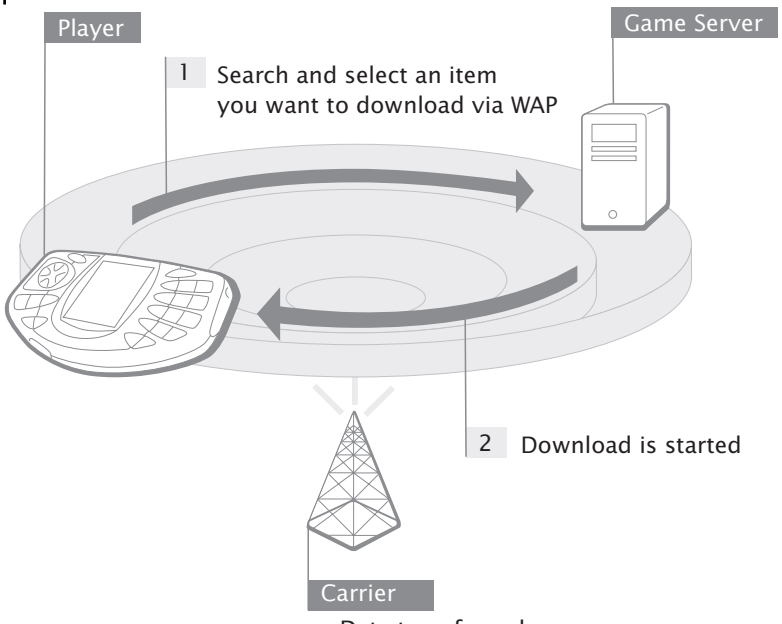
For a few weeks, every N-Gage gamer was furiously looking for these game aids. Not only did they make great power-ups in BlastPlots, but they also proved to be necessary in some of the latest puzzle missions. Web sites and chat forums were filled with discussions, hints, and tips on where in the game levels these boosters could be found. All the boosters were gradually mapped out, after which it was relatively easy to collect them all—until one day, one of the players accidentally noticed The Plot SuperVision link on his favorite WAP service, the public transport route finder….

The OTA (over the air) download mechanism is used when N-Gage games are updated and enhanced with a direct, wireless download. OTA was first presented as a download process when Sun Microsystems released the recommended practice of user-initiated downloads for Java MIDlets in 2001. WAP protocol made it possible to retrieve data from Internet servers. Previously, content had been pushed using messaging, which was not very convenient given the limited amount of data and the delays in delivery. Downloading is more efficient because it uses a data connection as the bearer. It has been adopted for various kinds of content supported by the phones, including the now-usual MIDI ringing tones, phone wallpapers, game levels, and so on.

There are several ways to initiate the download. For native N-Gage games, the download of extra features might be built into the game since networking is a basic service available for applications. If any extra charge is associated with the download, confirmation can be requested from the user before proceeding with the download.

Another way to initiate the download process is to use a WAP browser for searching and selecting an appropriate item to be installed (see Figure 3.2). When a link in a WAP page is clicked, phones with the OTA capability can automatically download and install the item into the phone. This process typically is used for downloading Java games and phone enhancements, such as ringing tones and color wallpapers, on WAP sites.

Figure 3.2 The direct download model.



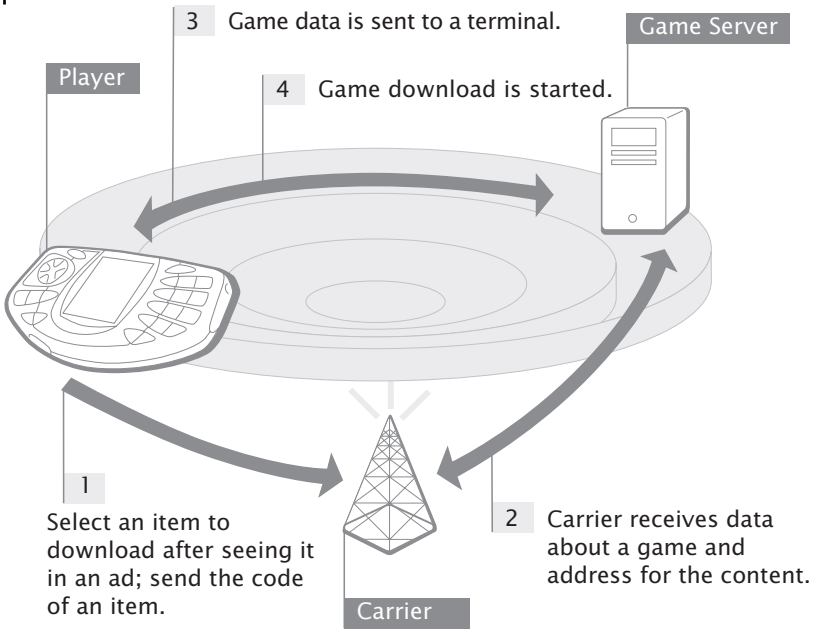
OTA download servers can be developed and maintained independently because the communication between a phone and the server is based on open specifications. To download games and other content over the air, the mobile subscriber needs to have data access provided by the carrier. OTA download is an interesting opportunity for application developers, and there are likely to be several out-of-the-box solutions providing software for game-download services.

The biggest issue for OTA distribution and the delivery of games and related products is the payment transaction. Today, there are two alternatives: revenue sharing deals with the carriers or a direct agreement with the game players.

If a revenue-sharing deal with a carrier is signed, text messages are used to initiate the download process. This way, the carrier is able to charge a premium price for the text message and share the revenue with a game developer or publisher. Text message–initiated downloads are interesting because games and extra services can be advertised via TV, magazines,

the Internet, or newspapers. When a customer sees the ad, he can order the product by sending a message to a premium number (see Figure 3.3), just as he might type in a URL on a computer. The game or application is downloaded after the user provides confirmation.

Figure 3.3 The carrier-assisted download model.



Individual game developers and publishers also have another option: to make a direct agreement with the gamer. Both prepaid accounts and monthly billing can be used to collect revenue. Of course, in this case, the game provider needs to have its own invoicing, payment processing, and customer care in place. This system needs to be able to handle potentially large numbers of customers efficiently. Therefore, for most mobile games providers, partnering with a carrier has been the preferred choice.

The Network Is the Game

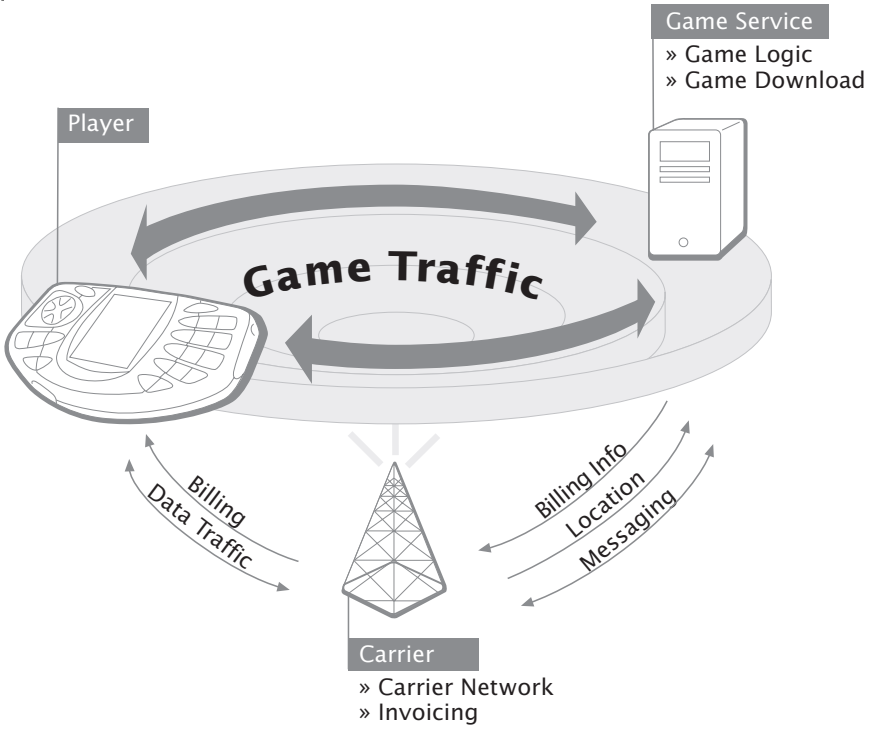
Toward the end of the game, The Plot *got quite intensive. Most of the casual players had already dropped out, and only the ones with a serious intention to win the game had managed to stay. At this point, the location-based features were unveiled. To accomplish the new IntenseMissions and find The Plotters, the gamers were given new clues based on their real-life location. By now, the players had formed small groups because, at the IntenseMission phase, the clues were given randomly for team members, and there was no chance to solve the mysteries alone in the given time. The teams were also given secure access to a digital map service that could be used to track the individual team members and their movements. Every once in a while, The Plotters appeared on the map screen, giving the players a chance to find and capture them.*

Technically, The Plot *consisted of services furnished by the carrier and a game publisher. The carrier provided billing, messaging, data access, and the location interface. The game publisher was responsible for hosting the game service, which included the game engine, player management, and ranking lists. In addition, the game service presented different interfaces for the game—WAP and HTML—and facilitated the download of Java games and N-Gage extra features.*

Networked games require a game server that provides logic for the game play. In its simplest form, a game server can match two players who use N-Gage game decks for multiplayer games.

The game server can handle a wide array of other tasks. A carrier and a game studio together can provide most of the services needed (see Figure 3.4). Traffic logging, billing, messaging, and location are features that a carrier can bring into the game concept. The game studio typically implements server software for handling online gaming and potentially numerous other extra services, such as extra characters and qualities, additional game levels, game patching and bug fixes, cheat codes, trials and demos, and related material (ring tones, wallpapers, MMS messages, and so on).

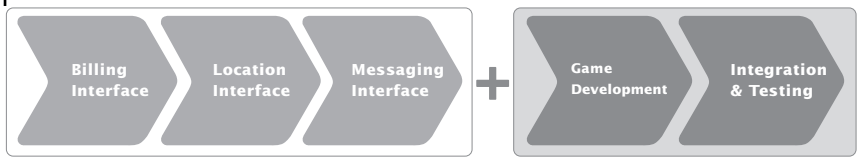
Figure 3.4 The architecture for a networked game.



Carriers manage billing systems and the core components for messaging and network infrastructure. They are in a key position to offer a single interface for carrier services that can be used by all game developers, both internal and external. This way, the carriers can leverage the investments in the system infrastructure and can drive the network usage.

A common carrier game platform can also hasten time-to-market for all new games because a single party does not have to develop everything from scratch (see Figure 3.5). The core components are already in place, and the game developers can focus on their key competence—innovation and game design.[45]

Figure 3.5 Platform-based development accelerates time-to-market for new games.



Phase 1: Game platfrom services

Phase 2: Game development

Who Operates a Game Server?

The emergence of the mobile game ecosystem opens new avenues for competition. Game server ownership is one such example in which several parties vigorously compete to acquire a leadership position. Several parties might operate the game server and services. Primarily, there are two alternatives: the carrier-assisted model and the independent model.

In a carrier-assisted model, a game developer, a publisher, or a third-party cooperates with a carrier to roll out the game services. The carrier gives access to its billing and messaging interfaces. Table 3.1 presents the strengths and weaknesses of different players when game-server development is done in cooperation with a carrier.

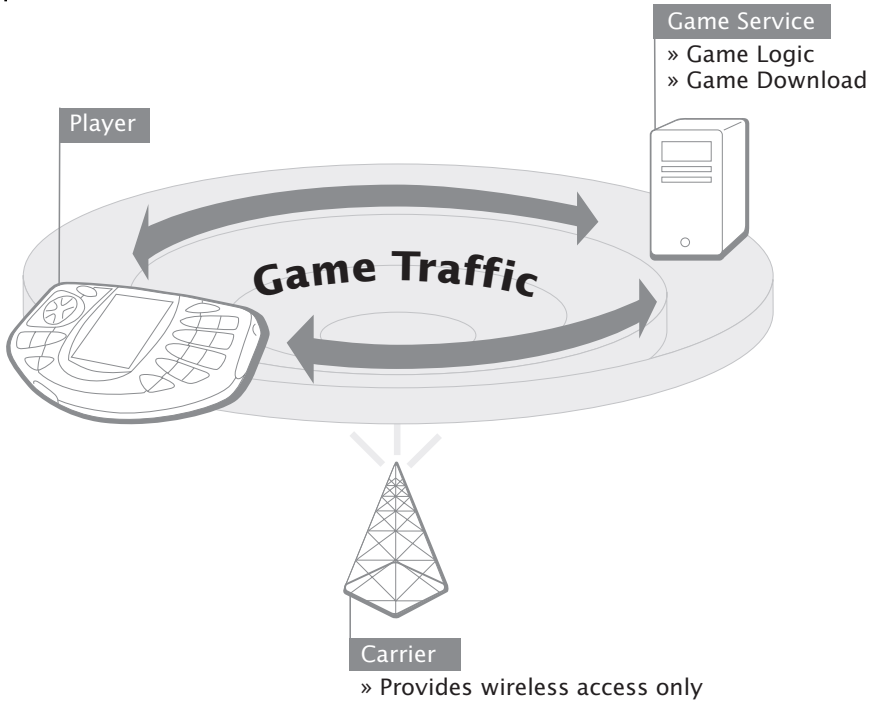
Table 3.1 Game Platform Developers in Review

	Systems Integrator	Game Publisher	Game Developer
Strengths and benefits	Systems integrators have the best knowledge of integrating complicated entities such as billing.	A single platform for all games, distributed by the publisher, hastens time-to-market for new games.	A game developer knows what services are needed from the game play point of view.
	One common platform can be developed for a carrier to facilitate all games, enabling faster time-to-market for new games.	Knowledge of the business aspects of games.	
Weaknesses	No experience in the game business.	Limited experience in systems integration.	Limited experience in systems integration.

In an independent model, the players in the game business provide services on their own, separate from any carriers (see Figure 3.6). For example, all Internet-type services, such as the download of additional game levels, patches, cheats, trials and game-related content, wallpapers and ring tones, can be offered directly. Obviously, the network access, provided by a carrier for the end users and by an Internet service provider to the game providers, is needed to deliver the content.

Because game providers do not have access to carrier-provided services, they need to handle billing, messaging, and other functions normally offered by the carrier differently. One option is to integrate them into the game platform using the game provider's own facilities.

Figure 3.6 The independent model for games provisioning.



Spotting Your Target—Location-Aware Games

Steve was one of the players who had proceeded to the IntenseMissions. Because his team members had signed up for them, they had given permission to be contacted if they happened to be in the area where The Plotters had been sighted. Nothing had been happening for a few days in the game when Steve was going to spend a Friday night downtown. To his pleasant surprise, as he arrived at the central subway station, he received a message from the game. The message told him that his team had been assigned to solve a mission in the area.

The map with the message revealed that this area contained a special level of The Plot *Underworld. To enter the level, two real-life locations would have access points. The map also contained the last-known positions of Steve's teammates. He was instructed to first get together with either one of the two other members of the team that were also nearby.*

Location-based games are the first step toward augmented reality, in which actual locations and real events are linked to imaginary stories in the game world. They are one of the first technologies with the potential to revolutionize the world of games. Several other, even more futuristic technologies are in store, such as see-through screens that allow imaginary objects to be added to a view seen by the player.

Usability is an issue that needs special attention in relation to developing compelling mobile games. A product with good usability is easy to use. We all know that cell phones are not well suited for inserting lengthy lines of text, especially during game play. Also, the amount of data provided to a gamer during a game should be designed so that it does not distract the player from the game itself. The tiny screen and the limited keypad pose a challenge to game developers.

One way to restrict information overflow is to focus on events taking place close to the game player or his actual geographic location. Moving from content to context helps a player sort information out more effectively and leaves more time for actual game play.

By knowing the location of the player, the game server is able to provide contextual information. If the location of a participant can be shared with other players and the game organizer, the game can be modified according to all participants' positions.

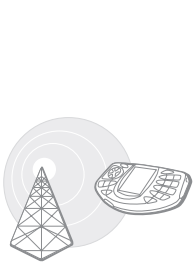
Handset-based location and network-based location are the two main techniques for determining where the cell phone user is.[46] Today, network-based location provided by a carrier is more widely used (Table 3.2). In the United States, the Federal Communications Commission (FCC) mandated in the 1990s that all carriers in the country must provide the accurate location of emergency calls by 2001. Most carriers could not meet the deadline, but the infrastructure for location provisioning does, to a certain extent, exist at the moment.

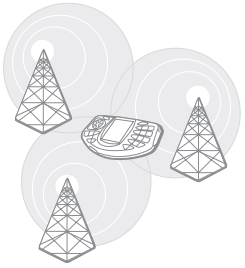
In regions outside the United States, carriers have taken a slightly different path toward location-based services. Because the provisioning of accurate locations for cell phones is not compulsory, carriers have started to provide proximity-based services. They locate a cell phone with an accuracy ranging from a few hundred meters to several kilometers, depending on the density of the base stations. In urban areas, base stations are close to each other, and the location of a terminal can be pinpointed more accurately. Today, proximity-based services are used in many European cities to provide information about gas stations, hotels, and other points of interest.

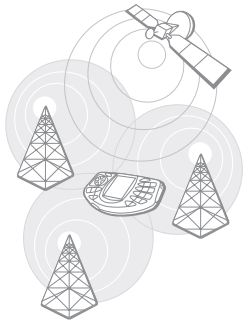
Handset-based technologies are less common because few terminals can tell their own location. During recent years, some phone models have been equipped with a GPS receiver. A GPS phone can pinpoint its location within few meters. To be able to function, a GPS receiver must be used outdoors or through a window with a direct line of sight to the sky.

Another new way of providing handset-based location information is to install a custom application for a Symbian-equipped phone. The software is able to determine base stations nearby and send the information to a special location server. When a base station code is received, the server checks the location of that particular base station and sends the location back to the user (Table 3.3).

Table 3.2 Network-Based Location Technologies



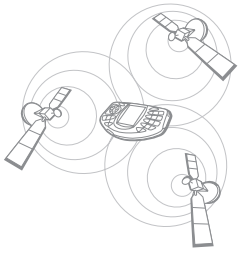




	Cell Site	Triangulation	GPS-Assisted Triangulation
How does it work?	A base station close to a cell phone owner can be located. A carrier has a register of all base stations and their location.	Several base stations receive the cell phone signal; the location of the terminal is calculated based on signal strength. The carrier has a register of all base stations and their location.	This is the same as triangulation, but a GPS receiver of a cell phone is used whenever possible. This is a mix of network- and terminal-based location technologies.
Accuracy	From a few hundred meters to several kilometers. More accurate in urban areas.	Less than a few hundred meters. More accurate in urban areas.	Less than 10 meters when the GPS can be used.
Suitability for mobile gaming	Better than nothing. Enables several proximity-based services.	Suited for games in which the location of the user must be known with an accuracy of a few hundred meters.	At the moment, there are no game-dedicated mobile terminals with a GPS receiver.

When the location of the terminal is determined directly without carrier assistance, the party managing a location server needs to know the location of each base station accurately. Typically, a carrier owns this information, but in the future, there might be other parties providing the information as well. For example, virtual network operators (VNOs), the parties that rent network capacity from carriers, might have access to the data.

Table 3.3 Terminal-Based Location Technologies in Brief



	GPS	Software Based
How does it work?	The GPS system uses 24 space satellites orbiting the earth to provide accurate location for GPS receivers.	The custom software of a terminal determines the closest base station and sends the information to a location server.
Accuracy	Less than 10 meters	From a few hundred meters to several kilometers. More accurate in urban areas.
Suitability for mobile gaming	At the moment, there are no game-dedicated mobile terminals with a GPS receiver.	Enables several proximity-based services. The open question—who operates the location server—remains a topic of discussion.

After messaging with both of his team members, Steve agreed to rendezvous with Jason. He arrived at a pub they had chosen as the place to meet. Minutes passed, but Jason did not appear. Looking at his watch, Steve decided to request the tactical map from the game. It showed that Jason was just two blocks away. Sure enough, when Steve was putting his phone down, he felt Jason's tap on his shoulder. They could continue the mission….

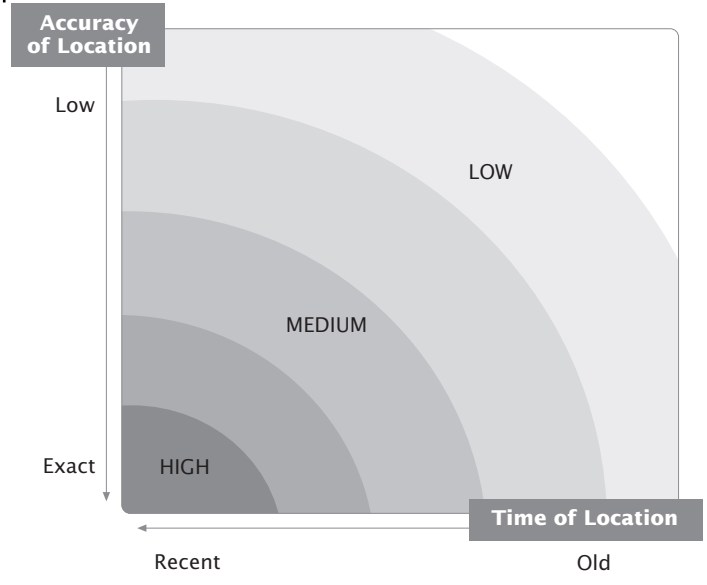
Location is nothing more than latitude and longitude coordinates without content. In mobile games, the content can be either pushed to or pulled from the terminal. The difference in game play and user control is substantial. When content is pushed to a terminal, the gamer has registered for a service and has accepted that the game provider can track his location.

Earlier in the case scenario, Steve automatically received a message when he arrived in a new place. This is an example of a push service in which the locations of the players are tracked. Without the express permission of the gamers, this might be considered a violation of privacy.

Pull services operate differently. When Steve located Jason during the game, he used a pull service by sending a location request to the carrier. In response, he received both his current position and Jason's last recorded position. With pull services, a carrier does not have permission to track individuals constantly, but the players can decide when they want to participate and, at the same time, have their location tracked for game play purposes.

Both accuracy and timeliness have an impact on the sensitivity of the location information (see Figure 3.7). Naturally, accurate location-based services are more sensitive than proximity-based services. If the location of the user is known with an accuracy of 1 mile, the situation is different than when the whereabouts are known within a radius of 100 or 10 feet. In the same way, position data that is 5 minutes old is more sensitive than data that was tracked a week ago.

Figure 3.7 Privacy sensitivity of location information.



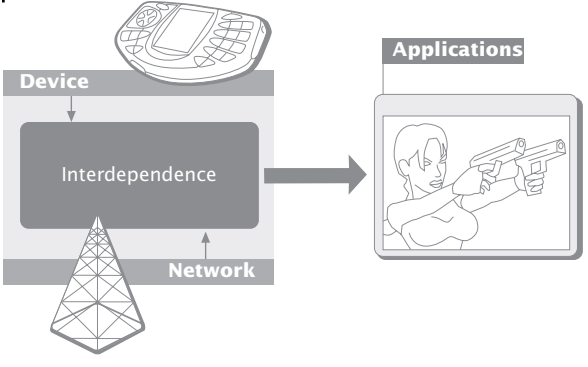
Game developers should cooperate with carriers to find appropriate solutions that tackle the privacy issues of location-based services. In all cases, the permission of the gamer is needed to facilitate a game with location information. Once granted, however, the potential to entertain and inform the mobile gamer grows exponentially. Location-based services are one of the most exciting areas that make mobile gaming mobile. Instead of sacrificing quality or complexity, mobility in this instance can add strength and diversity to gaming.

Conclusion

Software development for traditional game consoles takes place in close cooperation with a device manufacturer. It is essential for the developer to get appropriate development tools and adequate information about the technical features of the console. This enables the development of state-of-the-art software that uses the performance capabilities of the console, avoiding possible hardware conflicts.

In many ways, mobile game development is similar to the process of making a home console game. A developer needs to know the device capabilities and weaknesses and build the game around them. With mobile games, both terminal and network service capabilities should be known and taken advantage of (Figure 3.8). Clever application of both terminal and network technologies defines how "intelligent" a mobile game turns out to be.

Figure 3.8 Interdependence of devices and networks.



The transition from second-generation mobile networks and terminals to the third generation has already started around the world. Several different technologies exist for both the network and the terminal, but the interdependence of these two remains. The rollout of the technologies enables new applications and services, but at the same time, cooperation among the different players in the ecosystem becomes more important. This is especially true when game developers and carriers work together. A carrier needs the innovative minds of game creators to make the market boom. On the other hand, a mobile game developer needs access to billing, messaging, and other systems that reside in the carriers' networks.