Managing Mobile Code

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Computers are becoming smaller, and as a consequence, increasingly mobile. Just witness the evolution from room-sized behemoths to palm-sized pets that easily fit in our pocket. Although laptop and handheld computers have proved very useful to millions of users, they have not even begun to reach their true potential. Largely missing until now have been easy connections to private intranets and the Internet at large. By connections we mean more than just a modem or wireless connection. We mean sharing and accessing important information, which in addition to network connectivity, involves content, security and client/server mechanisms. Our desires are to have our appointments automatically kept up to date on our PDA as we travel; to use our smart phones to change our flight plans; to reliably and efficiently access our e-mail from anywhere; to receive news tailored to our own interests; to access key data in our corporate databases; to receive real-time traffic information; and, most importantly, to have greater freedom in our lives.

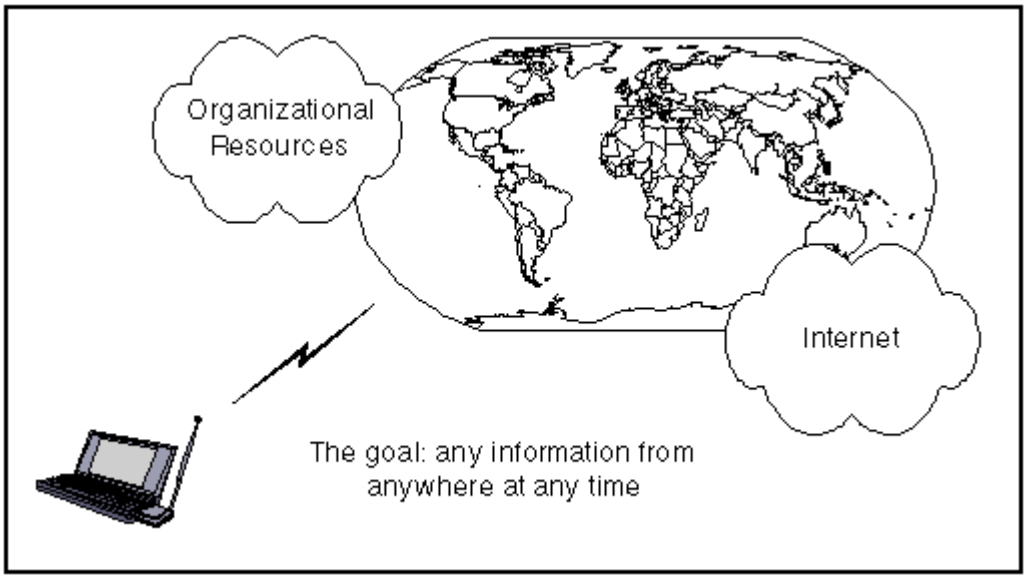

Figure 1: Always connected.

Much of the technology for this kind of connectivity exists today. But it is spread among many sources,

including wireless service providers, content developers, handheld computer vendors, OS vendors and application developers. Now a whole new category of company is emerging--the third-party service provider that operates gateways to connect mobile clients to fixed-end networks using mechanisms that span from Layer 1 to Layer 7 of the ISO networking model. Our task in this chapter is to lay out the issues involved in providing complete mobile connectivity, to introduce the types of networks you should be considering as well as the tools and services available and to show the different approaches used for different types of applications. We also highlight various services becoming available to help pull it all together.

Our table of contents:

Platforms

More than anything else, it is new computing platforms that are driving mobile computing. The number of choices keeps increasing at a bewildering rate. And unlike the desktop PC world, which is dominated by Microsoft Windows, the choices are both greater and more bewildering as each platform offers different types of benefits. What we see is that the communications options for each platform are different. Although we mention laptop computers, most of our emphasis is on smaller devices, such as handheld computers and smart phones.

Full-Function General-Purpose Laptops

We are all familiar with laptop PCs running operating systems such as Windows 98 or MacOS. You get general-purpose computing, but are stuck with greater weight (three to eight lbs.) and limited battery life (two to five hours). These types of computers offer the greatest number of options for communications (including modem, wireless, Ethernet, cable modems and DSL connections) because they support standard networking hardware and software. But, they are also less mobile than their smaller cousins.

Limited-Function General-Purpose Computers

These are scaled-back systems optimized for weight and longer battery life. Examples include computers that look like subnotebooks but are based on Windows CE. Weighing only a pound, users can get eight hours of battery life. A VGA type of display with an almost full-size keyboard provides a reasonable user interface for skinny versions of standard office productivity applications, such as Microsoft Office. Communications options are good, but require versions of communication software that explicitly support

the platform. Hardware such as wireless modems or wireless LAN cards need appropriate drivers, but most wireless and modem communications companies are working to support this platform.

Handheld Computers

The two current platforms dominating this part of the market are the PalmPilot and handheld computers based on Windows CE. Both support modem communications and both support wireless communications with specific networks. The Palm VII, as shown in Figure 2, has a built-in wireless modem that operates with the BellSouth Wireless Data network. The Palm unit currently uses the Palm OS, but Java may be an option in the future.

Companies such as Telxon and Symbol Technologies that supply handheld systems for vertical markets, such as warehousing, have their own handheld systems traditionally based on MS-DOS. These companies are now migrating to the Windows CE and PalmPilot platforms.

Figure 2: Palm VII

Smart Phones

The advantage of a smart phone is that by definition it comes with a communications channel built in. There are two types.

One type has a computing platform that supports a variety of applications. Examples include the Nokia 9000 product family (which flips open to reveal a complete, though tiny, keyboard) and the Qualcomm pdQ CDMA Digital Smart Phone based on the PalmPilot platform. WinCE will also start appearing in smart phones.

The other type includes a microbrowser for accessing Web content. An example is the PocketNet phone from AT&T Wireless Services, as shown in Figure 3. Web access is via a gateway operated by the cellular carrier and Web content must be formatted specifically for the platform. In the future, these types of phones will use a standard set of communications and scripting protocols called Wireless Application Protocol (WAP). By 2000, a good percentage of cell phones sold will come with WAP browsers built-in. As for operating systems, many will be based on either the EPOC operating system from Symbian or Windows CE from Microsoft.

Figure 3: PocketNet phone

Messaging Devices

The last type of platform is gathering increasing attention. These are small messaging devices about the size of an alphanumeric pager. Examples include the PageWriter 2500 from Motorola and the RIM Inter@ctive pager from Research in Motion. See Figure 4. These devices operate on two-way paging networks or wireless WANs such as BellSouth Wireless Data or ARDIS. Service includes e-mail intelligently forwarded from corporate e-mail systems or from the Internet and select Web content.

Figure 4: RIM Inter@ctive Pager

Network Options

Mobile computers are only as helpful as their ability to communicate. The choices here are numerous, with everything from personal area to wide area. Let's begin at close range and radiate outward.

Personal Area Networks

These are the networks that span our body and several meters beyond. About the only option today is infrared communications based on the Infrared Data Association (IRDA) standards. Many laptops and some handhelds and smart phones have IRDA ports built it. Data rates are 115 Kbps or 4 Mbps. You need to aim the device and distance is limited to a meter. But expect significant progress in this area over the next year with a new radio-frequency technology called Bluetooth that will be built into many mobile devices (see Figure 5). Bluetooth will use specialized communications protocols at the physical and medium-access control layers. At higher layers, it will either emulate serial port connections or enable the use of networking protocols such as TCP/IP. With a cost goal of $5 per device, Bluetooth could truly become ubiquitous.

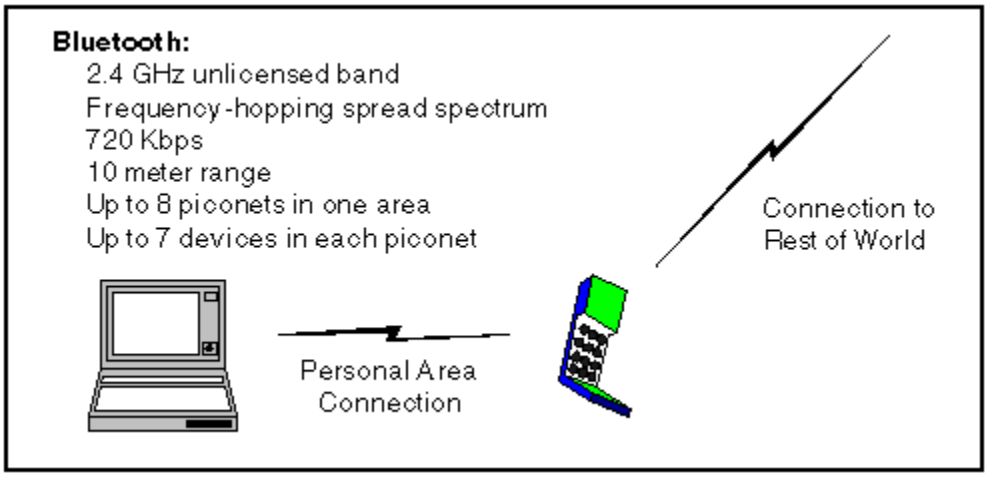

Figure 5: Bluetooth technology for personal area connections.

Local Area Networks

Plugging a mobile computer into a wired network such as Ethernet will depend mostly on whether the computer has a PC Card slot. More likely, you will be interested in using a wireless LAN. These are becoming quite popular because of a recently completed interoperability standard (IEEE 802.11), rapidly decreasing prices (below $200 in some instances), convenient form factors such as PC Cards, and increasing throughput rates, now as high as 11 Mbps. Wireless LANs operate in unlicensed bands which simplifies deployment. Realize that coverage will be restricted to where you place access points. These cost between $1000 to $1500, provide a bridge to the wired network and offer coverage areas between 30 and 100 meters depending on the particular product, the technology used and the physical environment.

You can plug in a wireless LAN card if the computer has a PC Card slot, which many handheld do. And some vendors are integrating wireless LAN technology directly into handheld computers. Watch also for developments in the home market with the HomeRF standard designed for low-cost wireless LANs and cordless phones.

Wireless LANs employ specialized physical layer and medium-access-control protocols, but are designed so that standard networking protocols (TCP/IP, SPX/IPX and NetBEUI, for example) can be used.

For more details on local-area wireless, see the Network Design Manual chapter at:
http://www.networkcomputing.com/netdesign/wireless1.html

Wide Area Networks

What we really want is connectivity from anywhere. You can do this with most mobile computers with a conventional modem. But, because we are mobile, we are likely not to have a convenient place to jack in. Again, wireless offers the greatest potential. Today, wireless networks provide data rates that are in the 10-to-14-Kbps range. This is slow by some standards, but more than sufficient for e-mail, driving directions, traffic updates, stock quotes, calendar synchronization, airline schedules, and thousands of other applications just waiting for the market to ripen.

BellSouth Wireless Data (http://www.bellsouthips.com) and ARDIS (http://www.ammobile.com) are two providers with broadly available service. Both networks use specialized communications protocols, making the number of applications you can run limited. A variety of devices (RIM Inter@ctive Pager, Palm VII) come with wireless modems built in for these networks. Service is relatively expensive at about 25 cents per KB. Cellular Digital Packet Data (CDPD) is an overlay to the cellular network, and because it is based on IP, allows any IP application to operate; though throughput is a consideration. CDPD service is available on a flat-rate basis for about $55 per month or on a usage basis at about 5 cents per kilobyte. Using modems over the analog-cellular network is also possible, though tricky.

Many are waiting for when data service is broadly available over digital cellular and PCS networks. Such service is already widely available in Europe and Asia and in some areas of the United States where GSM networks offer circuit-switched data service. Circuit-switched data service for CDMA should be available by the end of 1999. See Figure 6. Higher speed (50 to 384 Kbps) packet data for digital cellular will start to roll out in 2000 and will be broadly available by 2002.

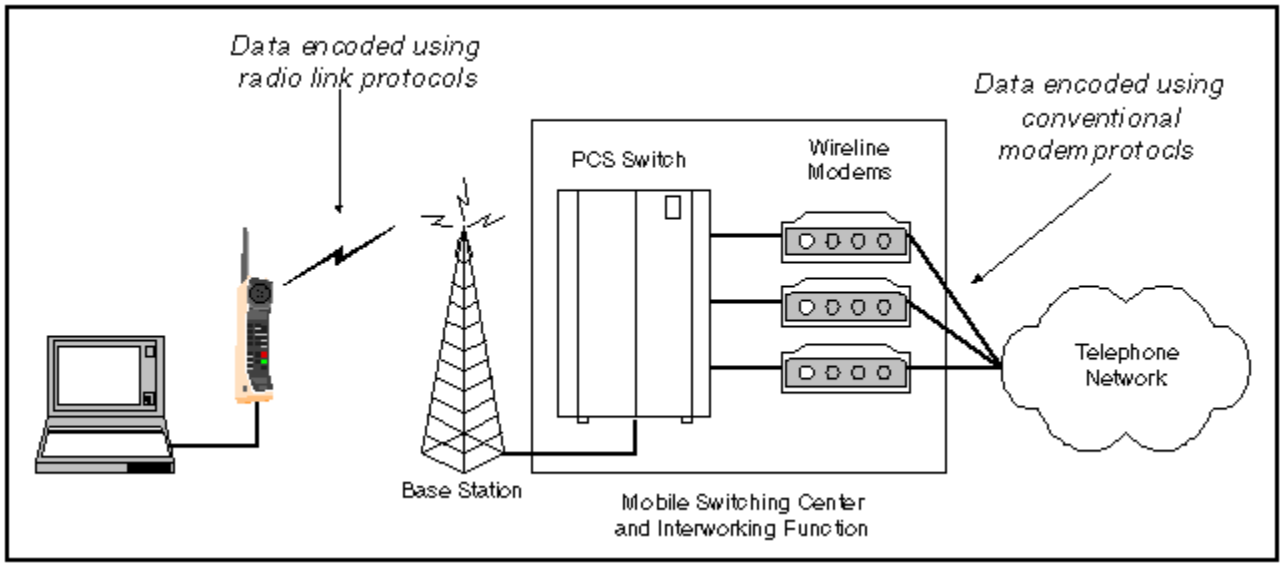

Figure 6: Digital cellular (or PCS) circuit-switched data.

Metricom is another service provider. Its Ricochet service (http://www.ricochet.net) offers approximately 30-Kbps service at a flat rate of $30 per month. Service is limited at this time to a small number of cities that include the San Francisco Bay area, Seattle and Washington.

Architecture

A variety of networks are available for mobile communications. But which communications architectures that make the most sense? There are two fundamental ones to look at. One we call a traditional communications architecture. The other we refer to as a mobile communications architecture, an architecture more well-suited for handheld computers and wireless networks.

Traditional Communications Architecture

In this architecture, a remote computer establishes a dial-up connection to a network. See Figure 7. By going through a remote-access server (RAS), the remote computer can function as a network client with complete access to services such as e-mail and databases. The RAS server functions as a router, allowing standard networking protocols such as TCP/IP to extend from the remote computer to services on the corporate network.

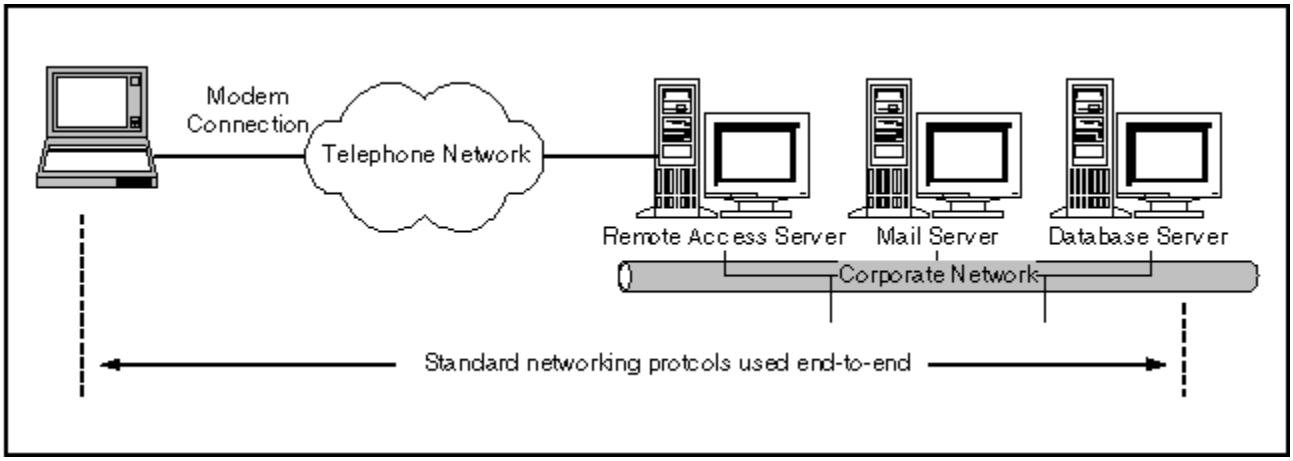

Figure 7: Traditional communications using wireline modems.

Mobile Communications Architecture

Whereas a traditional communications architecture can be used by handheld computers, there are some issues to consider. One is that client software is not necessarily available for the platform of interest. Another issue is that compared to wireline networks, today's wireless networks operate at lower speeds, have greater latencies and do not always support standard networking protocols. A different approach is required, namely to use an intermediate server that we refer to as a mobile server or a mobile gateway. See Figure 8.

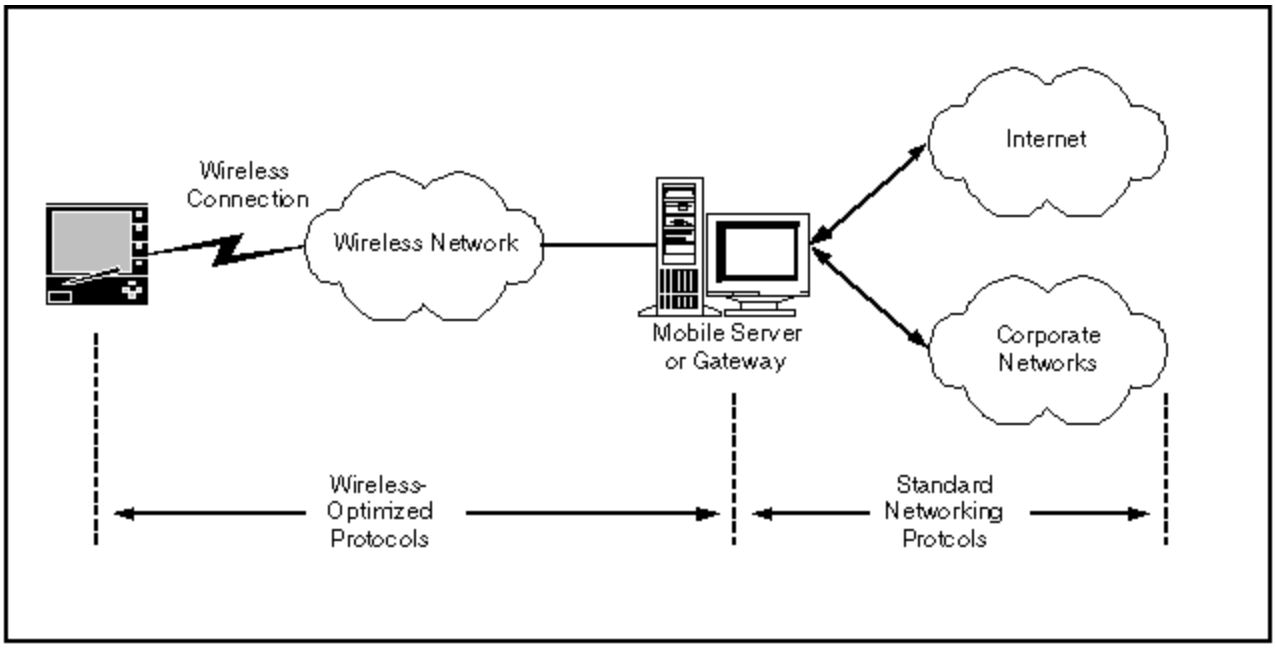

Figure 8: Mobile communications using a wireless network.

The gateway can perform a variety of functions. One is to use protocols optimized for wireless networks, such as WAP, to communicate with mobile devices, while using standard networking protocols to communicate with back-end services. Another is to format information for the smaller screen sizes of a mobile device.

An interesting question is about the location of the gateway because there are a number of possibilities. In some cases, the wireless carrier themselves will operate the gateway. This is the case today for AT&T's smartphone, the PocketNet. Alternatively, an organization could deploy their own gateway as part of a wireless-middleware solution. Finally, there are third-party organizations beginning to specialize in this kind of service. See the Services section for a list of such providers.

Note that there are security implications of this new architecture. Since the gateway acts as a proxy for the mobile user, the corporate network may need to authenticate the gateway in addition to the mobile system. In certain instances the gateway will communicate with corporate systems across the Internet, in which case, secure tunnels using VPN protocols may need to be employed.

Applications

Applications are where the rubber hits the road for mobile computers. It is the applications that determine how useful these platforms are. The focus in this chapter is on connectivity. So, we'll ignore the standalone applications, such as editors, word processors, spreadsheets and organizers. Of interest is how we can make applications on these platforms communicate with services located elsewhere.

There are two fundamental issues for these smaller platforms. One is that availability of client software is limited compared to more established platforms. Second, is that the networks we would really like to use, such as wireless WANs, operate at speeds that cause problems for many client/server types of applications. As a result, we often need to consider specialized mobile

versions of applications, the use of middleware, the installation of additional gateways, or service bureaus that outsource the gateway. Let's look at different categories of applications.

E-Mail and Messaging

We all want our e-mail wherever we go, but today's volume of e-mail with large attachments is not always well-suited for smartphones or handheld computers. With some e-mail clients, you may be able to configure the application to limit the amount of information that is downloaded. For example, with Qualcomm's Eudora, you can tell the mail client to skip over messages of a certain size. See Figure 9. If the message is larger than the designated size, the user receives just the first screen of the message with an option to download the rest of the message later.

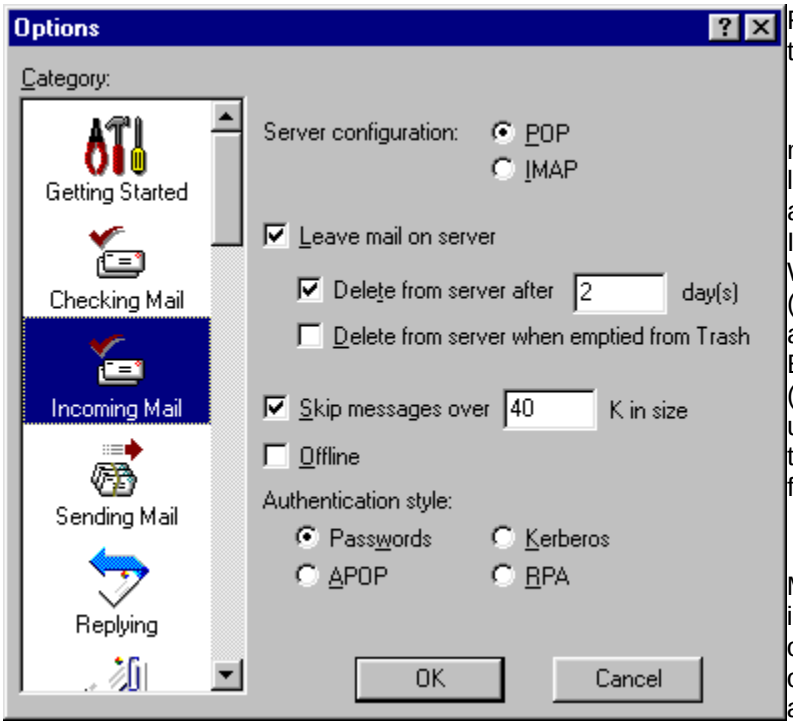

Figure 9: Configuring an e-mail client to limit the size of message downloads

Beyond configuring your existing e-mail clients to work better over slower links, a number of other approaches are available. Using the RIM Inter@ctive Pager with the BellSouth Wireless Data network (http://www.bellsouthips.com/), you get a second e-mail address. With the Blackberry Service (http://www.blackberry.net) you can set up filters where selected e-mails sent to your main mailbox are then forwarded on to you.

Major e-mail vendors such as Microsoft and Lotus continue to improve the remote-access capabilities of their products. Find out what your options are. You might also consider accelerator products that speed up mail downloads. These are available from Traveling Software (http://www.laplink.com) and Infowave (http://www.infowave.com).

As we list in the Services section, an increasing number of companies are providing specialized gateway services to interface between mobile devices in the field and private networks.

Calendar

A popular use of handhelds is for managing calendars. Wouldn't it be nice if your calendar was kept synchronized with your organizational calendar? This is easy when you are in your office because all the calendar programs provide some form of synchronization. But what about when you are on the road? Here too there are an increasing number of options. Check to see if your enterprise calendar product supports remote clients. If not, third-party providers can offer tools or services to bridge the gap. Las Vegas Digital Communications (http://www.SyncThis.com/) is an example of such a service.

Database Applications

Though wireless messaging and mobile Web content may get us personally excited, it is database applications that in many cases get the real work done. Major vendors are developing specialized versions of their databases to target new mobile platforms. For example, IBM (http://www.ibm.com) has introduced

DB2 Everywhere, a version of its DB2 database software that is aimed at handheld devices operating Windows CE and Palm OS. Meanwhile, Oracle (http://www.oracle.com/mobile/) has a lightweight database client, Oracle8I Lite that supports Windows 95/98/NT, Windows CE, Palm OS, EPOC32 and Chorus.

Figure 10: Ameranth UltraPad 2700

Productivity
An increasing number of companies are targeting small mobile computers for specialized applications. For examples, you can actively trade stocks with Fidelity Investments (http://www.fidelity.com) using a handheld-wireless messaging devices. Companies such as Ameranth Technology Systems (http://www.ameranth.com/) working in conjunction with Symbol Technologies (http://www.symbol.com) have developed wireless systems to improve the efficiency of restaurants. See Figure 10. Expect to see an increasing number of turn-key systems to improve productivity in any number of areas.

Query-Oriented and Web-Access Applications
This is one of the fastest growing application areas with an increasing number of Internet portals offering specialized content for mobile devices, whether handheld, smartphones or pagers. Expect an increasing wealth of content that includes news, reference, directories, travel, financial information and entertainment. For instance, see Palm.Net at http://www.palm.net/ for a list of query based applications for the PalmPilot.

Services

NAME OF SERVICE	DESCRIPTION	LOCATION
AirFlash	Wireless Internet portal. Services are sold to carriers, which resell the service.	http://www.airflash.com
Amika Now	Intelligent software agents for forwarding information.	http://www.amikanow.com
AvantGo	Delivers a variety of information to Palm and Windows CE devices.	http://avantgo.com
BlackBerry	Wireless access to Microsoft Exchange using a smart messaging device from Research In Motion.	http://www.blackberry.net
GoAmerica	Delivers Internet content and also resells wireless service.	http://www.goamerica.com
Las Vegas Digital Communications	Outsourced Exchange server with support for Windows CE and PalmPilot clients.	http://www.SyncThis.com
MicroStrategy	Financial information for mobile devices.	http://www.microstrategy.com
MSN Mobile	Wireless Internet portal from	http://mobile.msn.com

	Microsoft.	
Palm.Net Service	Resource center for the Palm VII	http://www.palm.net
Roku	Personal and Internet content delivered to mobile devices.	http://www.roku.com/
Saraide.com	Wireless Internet portal. Services are sold to carriers, which resell the service.	http://saraide.com
Wireless Knowledge	Joint venture between Microsoft and Qualcomm to provide wireless access to private Exchange servers (and other services in the future). Services are sold to carriers, which resell the service.	http://www.wirelessknowledge.com
WolfeTech	Wireless Internet portal with support for multiple devices	http://www.wolfetech.com/
Yahoo	Source of mobile content as well as a place to buy mobile products and services.	http://mobile.yahoo.com/

Note that other large Internet portals, including America OnLine, are expected to soon start providing specialized content for mobile and wireless devices.

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