Introduction To Wireless Data

The Pieces Are In Place
Wireless Data Improves Worker Productivity

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Section 1

Wireless Data Market

Technologies and Market Needs Come Together

Benefits of Wireless Data

We live in an age of constant change, driven by the great speed with which information is exchanged. Our growing dependence on computers, cellular phones, pagers, facsimile machines, email and the Internet enables real-time exchange of information, challenging enterprises to act in a proactive and timely manner to stay competitive into the next millennium. Yet, this demand for real-time information exchange is being made on an increasingly mobile workforce. Approximately 48 million U.S. workers have jobs that require them to be mobile much of the time. These workers cannot afford to be out of touch if the enterprise expects to compete successfully in the Information Age. Their work tools must be mobile and must provide them with real-time access to mission-critical information, when and where it is needed, wherever it resides.

The Success of Wireless Data for Business

Wireless data is highly successful in many business applications today. Using wireless has significantly improved worker productivity, increased customer satisfaction and, in many cases, provided a competitive advantage. Most of the success of wireless data to this point has been in the operational side of business in markets such as field service, transportation and public safety. However, an exciting change is that wireless data is starting to be more widely adopted by enterprises to provide real-time access to information for field salespeople and mobile business professionals.

Enterprises automating field activities like order entry and status, pricing and customer problem alerts have been motivated to go wireless. Many organizations in markets such as insurance, healthcare, finance and others are looking to extend their ERP (Enterprise Resource Planning) or CRM (Customer Relationship Management) systems into the field to provide a complete solution for all aspects of the customer relationship.

The pieces are in place for widespread adoption of wireless data. The three major components of a wireless solution are now available: wireless networks, software and mobile devices. Wireless data networks now offer nationwide coverage and have lowered their usage pricing to become more cost-effective for a wider

audience. They have proven themselves for mission critical use in the multitude of business applications in use today.

An increasing number of software applications for mobile devices (e.g., laptops, handheld computers, belt worn e-mail terminals) are available. In addition, middleware that facilitates wireless communication is available for all-popular platforms and networks. This middleware can be used to run standard internet applications or develop custom applications for enterprise use or resale.

The development and adoption of smaller mobile computing devices (e.g., PalmPilot, Windows CE devices, two-way pagers) has made it practical and desirable for business professionals to be wirelessly connected.

Market Size

Wireless data has largely been implemented for business operations in vertical markets. This has allowed the technology to be refined so that the economics are now in place for wireless data to explode into the larger general business marketplace. The indicators and drivers are place to make wireless data a big market and business by the end of 2000. The Yankee Group estimates that in the next few years the number of mobile wireless data users will grow from 4 million today to over 12 million by the year 2002. The following topic, Market Growth, describes the growth factors.

The following chart shows the total market size for the market segments most apt to adopt wireless data.

Target Market	Estimated Market Size
Healthcare	12,000,000
Maintenance	4,000,000
Courier	6,000,000
Real Estate	2,000,000
Financial Services	7,000,000
Insurance	5,000,000

Yankee Group 1999

Market Growth

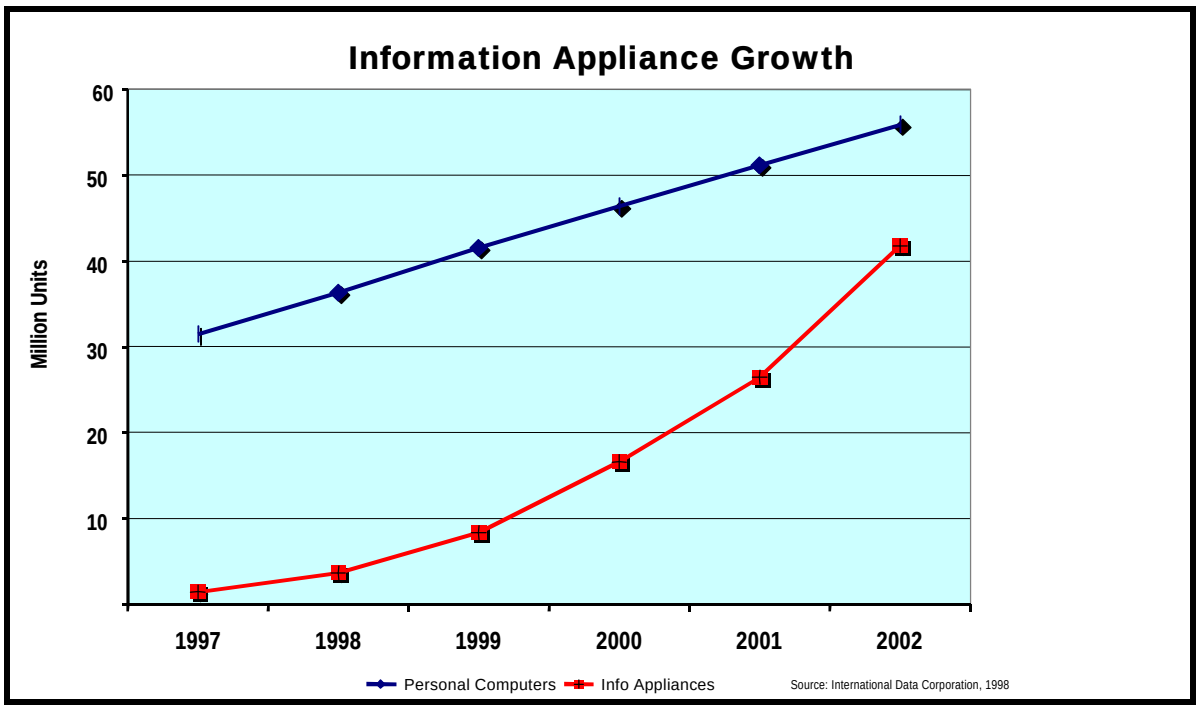
At its core, wireless data—the technology of communicating data from a mobile computer or device to a server application via a wireless network—comprises three of the largest growth trends in Corporate America: The Internet, wireless telecommunications and portable computing. Together, these three catalysts of change create a powerful new way to extend the reach of corporate data and other high-value information to workers in the field.

Driving the wireless data market is the phenomenal growth in laptops, handheld PCs, PDAs, messaging devices, electronic organizers, cell phones, and smartphones, which are being used by mobile workers to replicate, and in some cases replace, desktop computing and communications functionality when on the road and away from the office. New operating systems pack function and performance into these handheld devices and information appliances for a wide range of vertical market and information management applications. Wireless connectivity provides the remote link to the Internet, email, corporate databases and other public and personal information.

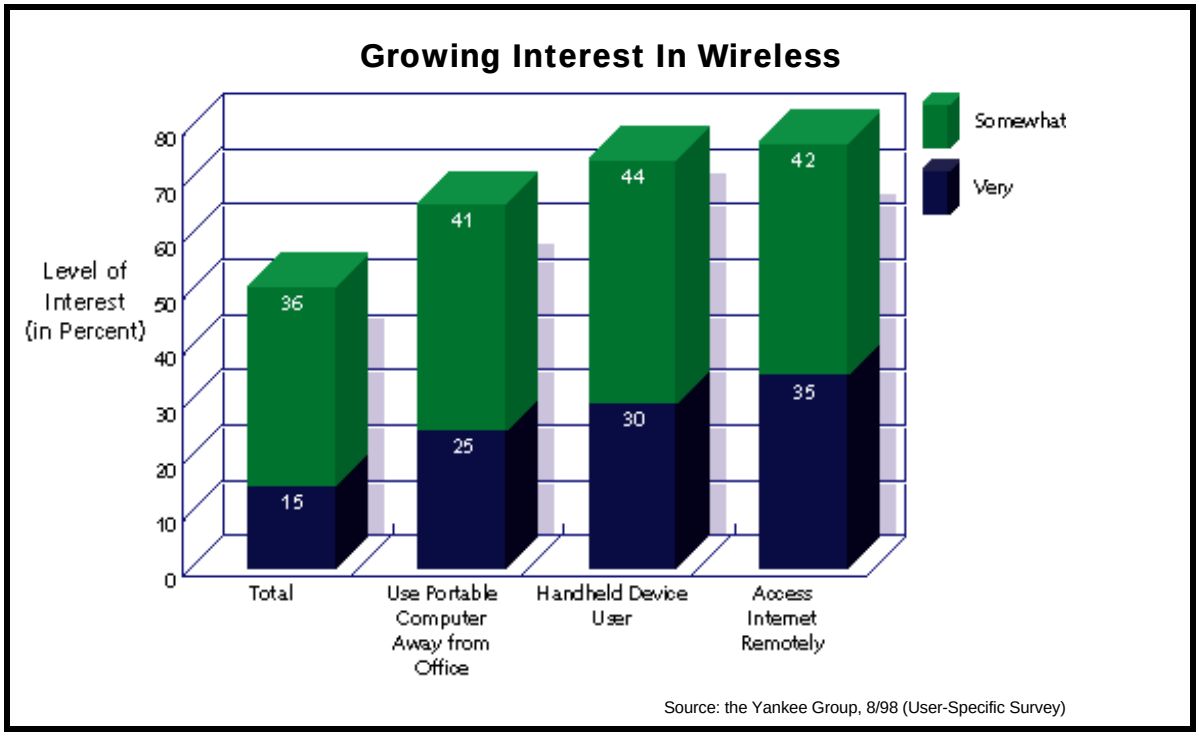
Although wireless data solutions have been available to mobile workers in vertical markets since the 1980s, new devices such as Windows CE handheld PCs, the Palm Pilot, interactive pagers and smart phones make these solutions more affordable and applicable for a broader range of users including:

- Corporate executives for contact management, scheduling, Internet access, and email.
- Field service workers for real-time access to corporate intranets and databases via ruggedized PCs.
- Sales professionals to manage their time and account activity more efficiently with wirelessly-enabled organizers.

The following chart shows the projected growth of personal computers and information appliances. For these devices to reach their potential for increasing productivity, most need a wireless link back to their critical business information—two-way messaging, calendar management, contact look-up—and easy-to-access public information such as flight time updates, driving directions, stock information, business news.



One can see from the following survey results that business professionals have a growing interest in wireless connectivity. This recent survey by the Yankee Group shows that up to 77% of the workers that use mobile computing devices have an interest in wireless connectivity. Fifty-one percent of all of the business professionals surveyed have an interest in wireless. Thirty-six percent of the professionals are very interested in wireless access.



Market Segments

There are three main market segments for wireless data: Business Operations (also known as the "Vertical Market"), Business Professionals, and Consumers. The table below describes the characteristics of the three segments.

Segments	Characteristics
Business Operations	This is a highly successful segment for wireless data. Vertical markets and applications include transportation, field service, public safety, sales force automation and ERP. Customers, including American Freightways, MCI, and Sears, use wireless data to improve their productivity. Several of these success stories are in Section 3 of this report. The primary applications in this segment are mission-critical and/or dispatch oriented.
Business Professionals	Approximately 48 million U.S. workers have jobs that require them to be out of their offices much of the time. These workers need access to their critical information such as email, changing calendar events, task management and contacts. Their work tools must be mobile and must provide them with real-time access to corporate databases, when and where it is needed, wherever it resides. This is the next growth segment for wireless data.
Consumer	This segment is primarily made up of family members or individual users looking for easier and better way to communicate, shop, etc. The Consumer Segment is a future market for wireless data.

These segments are interested in one or more of the wireless applications described in the next topic.

Wireless Applications

The wireless market consists of five primary applications. All of these applications, with the exception of Notification, require a two-way wireless network.

The primary applications, their wireless technologies, and market segments most interested in the applications are shown in the following table. Explanations of each application follow.

Wireless Applications	Popular Networks	Market Segments
Notification (Paging)	PageMart, PageNet, SkyTel	All
Telemetry	Aeris Microburst, American Mobile/ARDIS, BellSouth Wireless Data (Mobitex), Cellemetry, SkyTel	Business Operations (utility meter reading, vending machines, alarm/security, etc.)
Two-Way Messaging	Aeris Microburst, American Mobile/ARDIS, Ameritech, AT&T Wireless, Bell Atlantic Mobile, BellSouth Wireless Data (Mobitex), GTE, Nextel, PageMart, PageNet, SkyTel	All
Interactive Data Exchange (sales order entry/status, ticket purchase)	Aeris Microburst, American Mobile/ARDIS, Ameritech, AT&T Wireless, Bell Atlantic Mobile, BellSouth Wireless Data (Mobitex), GTE, Nextel, PageMart, PageNet, SkyTel	All
Email (supports attachments)	AT&T Wireless, Nextel, Ricochet, PrimeCo, Sprint PCS	Business Professionals and Business Operations

Notification

This is the first wireless technology to be widely accepted by customers in the U.S. Notification is the familiar numeric paging, text paging and the new acknowledgement paging services offered by the paging service providers. This market should keep expanding although many mobile professionals may shift to SMS (Short Messaging Service) on their digital wireless telephones as that capability improves. Notification is the application where paging service providers excel.

Telemetry

This market is Two-Way Messaging for fixed devices. It is unique in that it provides messaging services to devices (e.g., pumps, vending machines, pipelines, electrical substations, traffic signals, etc.) not humans. Today, private networks carry most telemetry activity. However, as public networks offer these services, new devices are also using public networks.

Two-Way Messaging

Two-Way Messaging is the wireless transmission of short messages (usually under 2,000 characters) between belt-worn or palm-size devices rather than full email. While Two-Way Messaging is being used today in devices such as Research in Motion's Inter@ctive Pager, it still faces the challenge to integrate seamlessly important message delivery with existing email services.

With wireless voice systems such as GSM, CDMA, and iDEN "cellular phones" currently adding data capabilities, many mobile professionals may find these services adequate for checking email up to two or three times a day.

The growth of email and the need for real-time response may drive professionals to small Two-Way Messaging devices so that they can handle the growing information flow at anytime (e.g., waiting for others, walking between buildings, meetings) to make them more productive.

Interactive Data Exchange

Interactive Data Exchange includes the set of applications that is usually referred to as "query-response." These messages are based on forms. A form is filled out and the information (query) is sent to a specific database server. The reply (response) is received back into the same or a different form depending upon the application. Interactive Data Exchange also includes "push" messaging. Push messaging occurs when the server initiates a connection and "pushes" messages to a user in the field. Examples of interactive data exchange are police access to criminal information databases, package delivery and tracking, dispatch applications and consumers purchasing movie tickets. Some sales force automation applications such as order entry and order status also fall into this application area.

Email

Two-Way Messaging and Email are different in a couple of ways. Email is defined as messages that are not time critical (can be handled within one or two business days), messages that are large (greater than a few hundred words), and messages that contain attached documents. At this time, Metricom and Wireless Voice Networks can handle true email. Packet data networks such as BellSouth Wireless Data and American Mobile/ARDIS can easily handle moderate-size messages up to and, in some cases, beyond 10,000 characters.

Market Drivers

Customer Awareness

Customers are realizing that they need access to information even when (or especially when) they are mobile. In the 80s, voice mail and the use of cellular telephones transformed the way business is conducted when away from the office. Wireless messaging and information access will cause a similar transformation in business in the first decade of the 21st Century.

Wireless Networks

Packet-data networks—American Mobile/ARDIS, BellSouth Wireless Data, and CDPD—have been available for some time. They have been primarily used by enterprises to wireless-equip many business field operations such as package tracking and service dispatch. With new devices becoming available—the Palm VII, RIM 950 two-way pager and Windows CE devices—these networks are being used by mobile professionals and, in some cases, by consumers. These networks will continue to enhance their coverage to more locations and drive coverage deeper in buildings over the next few years.

With the growth in the industry, additional networks will soon offer wireless data capability. The digital cellular telephone networks (e.g., Sprint PCS, Pacific Bell Wireless) will soon offer switched-circuit wireless service. This service works just like a regular modem connection at rates up to 14.4 Kbps in 1999 and to 28.8 Kbps and beyond in the future. With only a cable, customers will be able to connect their digital telephones directly to their laptops and palmtops.

New Devices

A number of new mobile wireless devices (discussed in Section 2) are becoming available. This second generation of wireless devices provides improved capabilities at lower prices in smaller form factors. Devices often drive the adoption of wireless services for business professionals.

Industry Standards

The computer and communications industry has recently standardized on the Internet protocols and access methods for nearly all data communications. This allows easy access to all types of data. For example, legacy databases now have Internet gateways. This allows remote access to the databases using standard tools included on almost every mobile computing device.

While these protocols were not designed for communication in a wireless environment, wireless middleware is available to optimize the performance of these protocols and provide compatibility with all types of networks and platforms.

Software Applications

Many off-the-shelf software packages already exist for business operation applications. Over the next few years, we will see enterprise applications and

personal productivity tools such as PIMs begin to add wireless capability. Wireless middleware is available to allow developers to easily add this wireless capability or to run standard applications such as email or web browsers over wireless networks today.

Price

The price of wireless service is declining. For example, packet data networks are offering business professionals unlimited two-way messaging for as little as $49.95 a month. Metricom offers unlimited wireless service at under $30 a month. It is likely that wireless voice-and-data networks (CDMA and GSM) will offer data service for $0.05 to $0.15 per minute.

Market Outlook

The market outlook for widespread adoption of wireless data over the next few years is strong. In addition to the drivers above, a couple of new technologies and services make the outlook for wireless data bright. New technologies, like wireless Personal Area Networks (PANs), will make it easier for professionals to connect their computing devices with wide area wireless networks. An important requirement for professionals to adopt new technology is its ease-of-use. The advent of PANs is likely to significantly increase wireless use by mobile professionals.

The cost of wireless devices and network usage is dropping fast. For example, the cost of a cellular telephone and the associated service has fallen significantly over the last 10 years. It is expected that this trend will continue. As the cost of wireless devices and services drop, the overall use of wireless data will grow.

Many new devices are becoming available that fit better with the needs of a broader set of individual needs in the professional segment. The traditional “business operations” applications of wireless data will continue to grow also.

Section
2

Components Of A Wireless Data Solution

Networks, Modems, Computers, Applications and Middleware

The following topics briefly discuss the basic components of a wireless data solution.

Wireless Data Networks

There are two types of data networks—switched circuit and packet. Switched circuit is often called “dial-up”. A device using a switched circuit network only connects to it when data is to be sent. For example, when dialing an ISP to get on the Internet you are using a switched circuit network. In fact, all telephone calls are made over a switched circuit network. The connection is only present when you are talking. With switched circuit networks, you pay for the amount of time you are “connected” and the connection needs to be established each time, usually by dialing a telephone number. While connected on a switched circuit network you have exclusive use of the connection you have established and can send data continuously.

A packet network is one where you are connected all the time and only pay for the actual data sent. On a packet network, your data is divided into small packets. Each packet has a destination and source address attached to it. It is like dialing a number each time a packet is sent, but much faster. Packet networks are more efficient for many kinds of data applications and allow for instant communications without the need to establish a (dial up) connection to the network. Nearly all data-only wireless networks are packet networks. In contrast, nearly all voice-only networks are switched circuit.

Many general remote access computer connections assume the user will establish a dial up connection and, therefore, they have been designed for use in such environments. In order for many applications to use a packet network, the software must be modified to communicate via a packet network. This can be easily accomplished using middleware which provides a standard interface to wireless data networks and shields developers from the many challenges of achieving reliable communication in a wireless environment. (Discussed in more detail later.)

Each of the available wireless data networks is discussed below.

Public Packet-Data Networks

There are four public wireless packet-data networks available in the U.S. today. They and their network speeds are listed in the following table.

Network	Speed (Kbps)
American Mobile/ARDIS	4.8/19/2
BellSouth Wireless Data	8.0
CDPD	19.2
Metricom	12-20

American Mobile/ARDIS and BellSouth Wireless Data (formerly RAM Mobile Data) are nationwide networks offering coverage to more than 90% of the "business population". Business population is considered the top-200 – 300 metro areas. In rural areas, there is less terrestrial coverage and both networks offer complementary satellite services.

CDPD networks are operated by various carriers across the country including AT&T Wireless, Ameritech, Bell Atlantic Mobile and GTE. Altogether, they cover about 50% of the business population. CDPD is good for regional uses and therefore is popular in the public safety market.

Metricom provides wireless dial up access from non-mobile locations. For example, it is used instead of another telephone line to provide internet access. Metricom is currently available in Seattle, the San Francisco bay area and Washington D.C.

Private Packet-Data Networks

In a private network, a company or government agency purchases radio frequencies and buys and operates the entire radio network infrastructure for the exclusive use of that entity. Private networks are primarily operated to ensure network availability at all times. Since the network is privately operated, the bandwidth is not shared with other users as in a private network; therefore, the network can be built to the capacity required to ensure availability.

A well-known private network is the one built by Federal Express. It is an excellent example of how wireless data can provide a competitive advantage and improve worker productivity. There are a number of other private networks, many of which are used by public safety agencies and utility companies.

There are a number of technologies used for private wireless data networks. Many are based on the technologies currently being used for public data networks. Some examples of private packet data networks include Ericsson's EDACS, Motorola's Private DataTAC and Motorola's ASTRO. There are also new technologies emerging for private network use such as TETRA in Europe.

Voice-And-Data Networks

Digital phone networks will soon be offering circuit-switched data at reasonable speeds with high reliability. The technologies that will provide these data services are listed in the following table.

Network	1999 Speed Kbps	2000/2001 Speed Kbps	Type of Data †
CDMA	14.4	28.8 to 56	Dial-up/Packet/SMS
GSM	9.6	14.4 to 56	Dial-up/Packet/SMS
iDEN (Nextel)	*	*	Dial-up/Packet/SMS
TDMA	*	9.6 to 56	Dial-up/Packet/SMS

* Systems plan to support data in the U.S. in the future.

† In most cases implementation of dial-up circuit switch service will precede packet services by a year. Initial 1999 CDMA and GSM services will be dial-up.

These networks will roll out faster switched circuit dial-up speeds over the next two to three years. These networks will also support packet data. This capability will develop over the next several years with speeds ranging from 14.4 to 384 Kbps.

These networks also offer very short message data using a technology called Short Messaging Service (SMS). Using SMS, only a few hundred characters can be sent at a time over the network. SMS is designed as a pager replacement technology for digital phones. SMS can also be used to signal devices to make switched circuit connections or other functions.

The next advancement for data on these networks is the offering of switched circuit data. Switched circuit offers the same dial-up service that one gets using a standard telephone connection. Packet data services will then follow in the early 2000's.

There are a number of third generation technologies—like IMT-2000 and wideband CDMA—that are designed for the higher data rates. However, these technologies are unlikely to be deployed in the U.S. before the middle of the next decade.

Satellite Networks

Satellite networks are in use for a variety of applications today, and several new satellite networks are currently being rolled out. They are primarily for use in rural areas and remote portions of the world—areas not otherwise reached via traditional terrestrial (land-based) networks. The cost of using satellite networks is higher than terrestrial wireless data networks because of the infrastructure required to support such a service. Satellites also require a line-of-site path to be able to communicate. This inhibits their use in building and in urban areas (high-rise buildings block signals on street). Some satellite phones or pagers offer dual modes. They use terrestrial networks when coverage is available and satellite data only when out of terrestrial coverage. For example, Iridium phones and pagers roam between satellite and GSM coverage.

There are two types of satellite networks currently available or in the midst of their deployment, satellite data and satellite voice. Packet-switched satellite data

networks such as NORCOM, Orbcomm and Qualcomm are primarily used to supplement terrestrial networks or in areas/applications where ubiquitous coverage cannot be guaranteed. For example, Qualcomm's Omnitracs is dominant in the Long-haul Transportation market where trucks are moving through the country and need to be in constant communication to monitor progress. Orbcomm is primarily used to monitor and control fixed assets and track assets such as railroad cars. NORCOM is used by American Mobile/ARDIS and BellSouth Wireless Data to complement their terrestrial coverage.

Satellite voice networks include AMSC, Inmarsat, Iridium and Globalstar. These networks are used to provide voice communications in even the most remote areas of the world and to carry switched circuit data.

Wireless Data Modems

There are a growing number of wireless devices that provide connections between computing devices and the wireless networks. On the packet-data front, for American Mobile/ARDIS and BellSouth Wireless Data, there are three major wireless modem providers—Motorola, Research In Motion (RIM) and Ericsson. RIM manufacturers the PC Card shown below.

• RIM Wireless Modem

On CDPD packet networks, there are several modem manufacturers. Some of the modem manufacturers are Inet, Motorola, Novatel Wireless, Sierra Wireless and Uniden. The Sierra Wireless AirCard 300, a PC Card wireless modem that fits completely within the computing host device except for the antenna, is shown below.

• Sierra Wireless AirCard 300

Wireless modems for the Voice-And-Data networks are usually wireless voice handsets. All CDMA handsets and many of the new GSM handsets require only a serial cable to connect the handset to the computing device.

Qualcomm Q 800

Nokia 6100 series

Mobile Computers

There are many varieties of mobile computing devices available. Most of these devices, such as Windows CE-based and 3Com/Palm-based products are wireless ready in that it is easy to add wireless modems and run wireless-enabled applications. Some devices that are now being introduced even include integrated wireless modems.

Laptop Computers

In addition to the traditional Windows 95/98 laptop computers, a new breed of laptop-size Windows CE based products that are wireless ready. To the right is a RIM wireless modem that can be used with the Vadem Cleo.

Ruggedized Mobile Computers

There is a wide range of ruggedized mobile computers available for field workers. There are specialized devices, units using DOS, standard Windows laptops and also rugged Windows CE and Palm devices are expected shortly. Vendors such as Itronix, Norand/Intermec, Panasonic, Symbol Technologies and Telxon are providing rugged systems. Many are available with built-in wireless modems.

Handheld Computers

A variety of new handheld computers are now available. These products are ideal for wireless connectivity. Being able to open a handheld computer up and be instantly connected to email is extremely attractive to many customers.

Palmtop Computers

Windows CE-based palm computers and Palm Computing Platform products are available with wireless options. The Qualcomm PDQ Palmtop, shown to the right, integrates a Palm computing platform with a CDMA wireless phone. The customer can access his email or surf the Web with the PDQ.

The Palm VII, available by mid-1999, is a Palm III integrated with a wireless modem. Customers will use the Palm service which operates over the BellSouth Wireless Data network. The Palm VII supports wireless messaging and query-response.

Small belt worn devices, like the RIM 950 shown at the right, are now available. They provide a convenient two-way messaging and email terminal. These devices can also support the typical PIM functions: calendar, to-dos, contacts.

Auto PC

The Auto PC (based on Microsoft Windows CE) is a complete information and entertainment system for an automobile. A speech interface is used to operate an Auto PC. Simple voice commands allow users to organize phone numbers and addresses, autodial a cellular phone, prompt Auto PC for driving directions and control a high-end digital audio system.

Wireless support options enable Auto PC to provide traffic alerts. With this information, alternative routes can be requested. Auto PC, which comes with navigation software, will provide spoken directions.

Embedded Computers

Many embedded computers have gone wireless. For example, soda machines now send messages when they are low on product or change. Automobiles have wireless data modems that can disable themselves when the auto is stolen or open the doors when the driver locks his or her keys inside. Many fixed and mobile products will contain wireless modems over the next few years.

Wireless-Enabled Applications

There are many wireless-enabled applications available today. Many of these are for the vertical markets that have embraced wireless data in the past. At this time, many application vendors are in the process of introducing applications for the next phase of the market in areas such as sales force automation and ERP or for vertical markets such as insurance, healthcare and finance.

Many of the existing vertical business applications were wireless-enabled using wireless middleware. Others were developed specifically for the mobile marketplace, often using wireless middleware to handle wireless communication challenges. Examples of wireless applications, by vertical market, are given in the chart below.

Vertical Market	Vendor	Application	URL/Phone
Field Service	Astea	Dispatch-1	www.astea.com
	FieldCentrix	FieldCentrix Enterprise	www.fieldcentrix.com
	Future Horizons	Field-PAC	www.future-horizons.com
	Metrix, Inc.	Techlink	www.metrix-inc.com
	Millennium Softworks	Miracle SMS Enterprise	www.miracleware.com
	Tinoway	Custom applications	www.tinoway.com
Information Services	TMS	Field Service Management System	www.tmsi.com
Insurance	ADP	ClaimsFlo Wireless	www.csg.adp.com
Public Safety	WolfeTech	PocketGenie	www.wolfetech.com
	Allinson-Ross	Custom applications	www.allinson-ross.com
	Cerulean Technology	PacketCluster	www.cerulean.com
	Public Safety Mgmt.	CADS, LERS, IMS	813-446-3990
	Software Kinetics	Custom applications	www.sofkin.ca
Transportation	Versaterm Systems	VERSADEX 2K	www.versaterm.com
	Cone Software	Custom applications	www.conesoft.com
	Roadnet Technologies	MobileCast	www.roadnet.com
	Synergistic Systems	Synergy Dispatch	www.syn-sys.com

Wireless Middleware

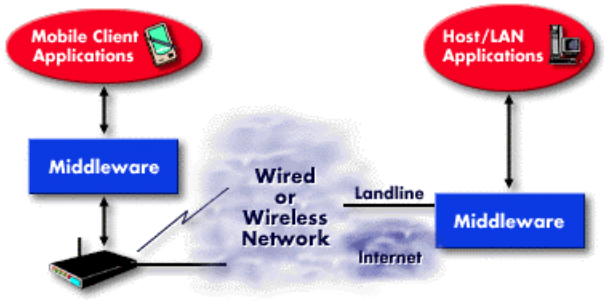
What is wireless middleware?

Middleware, sometimes referred to as the "glue that holds components together" or the "plumbing", is traditionally defined as:

An enabling layer of software that resides between the business application and the networked layer of heterogeneous platforms and protocols. It decouples the business applications from any dependencies on the plumbing layer, which consists of heterogeneous operating systems, hardware platforms and communication protocols. (Source: International Systems Group)

Middleware is used to create a three-tier architecture, which adds a layer of functionality between the client and server. This tier shields developers from the intricacies of the "plumbing" and enables communication between disparate networks. Traditional types of middleware include message oriented or message queuing middleware, database middleware, object request brokers and others.

Wireless middleware brings the same functionality to a wireless environment. Wireless middleware is a software development tool or wireless-enablement tool that provides a common set of APIs to allow applications to communicate via wireless data networks.



What does it do?

Wireless middleware enables developers to quickly add wireless connectivity to mobile applications. It shields developers from the complex wireless protocols of the wireless network and makes it easy to wireless-enable an application, without requiring a detailed understanding of how the wireless network actually operates. Middleware hides the complexity of wireless communications with simple APIs, making it easy to develop and deploy mobile applications.

Most wireless middleware also offers support for multiple networks or operating systems. Since it provides a common API for all, it makes it easy for developers to add support for whatever networks or platforms the user requires.

Some middleware, such as that offered by industry-leader Nettech Systems, also optimizes the communication and provides advanced wireless communication features designed to overcome the challenges associated with communicating in a wireless environment. These features are outlined further in the following sections.

Why use it?

Wireless middleware offers many benefits to software developers:

- It allows developers to quickly wireless-enable their application with easy-to-use software development kits allowing developers to concentrate on what they know best – their application.
- Using middleware protects a developers investment in their application. Developers do not need to "predict the future" to determine what network and platform will be most dominant. Instead, they can choose a wireless middleware provider that offers a broad range of support and be assured that they can support whatever network or platform is required now or in the future.
- By choosing a leading middleware provider like Nettech Systems, they can reduce their development and deployment risk by having the security of knowing that the middleware is field-proven and highly scalable.
- Middleware saves money on airtime expenses and improves the communication performance.

Wireless Challenges

Wireless computing is a very different paradigm from the traditional wired arena. As such, it represents certain challenges such as:

- Industry-standard protocols that are not wireless-ready
- Complex proprietary protocols
- "Unfriendly" communication environment
- Narrow bandwidth/low speeds
- Roaming workforces

These challenges are explained in more detail below.

Industry-standard protocols are not wireless-ready

The wired computing world has largely adopted the set of internet protocols known as TCP/IP as the de facto industry standard. However, while some networks use TCP/IP, it is not well suited for wireless communication. TCP/IP adds excessive overhead to data. Since most wireless data networks charge according to the amount of data sent, this adds unnecessary costs to your bottom line. In addition, TCP/IP is not very efficient in that it requires a three-packet "handshake" to take down and start each connection. In addition, since it wasn't designed for a wireless environment, it does not respond well to fluctuating coverage conditions, resulting in dropped connections and more "handshakes."

Complex proprietary protocols

Many wireless networks use over-the-air protocols that are very efficient but are not directly compatible with wireline protocols such as TCP/IP. For the most part, different networks use different protocols. For the newcomer, these protocols can be complex, adding a layer of complexity to implementing a wireless solution. Moreover, since each network is different, running an application over multiple networks requires developing an application to use multiple protocol drivers.

"Unfriendly" communication environment

Wireless is not your ideal communication environment. When communicating wirelessly, you will encounter coverage holes and fluctuating coverage conditions caused by weather, tall buildings, mountains, etc. Applications need to know how to respond to these situations.

Narrow bandwidth and low speeds

Wireless networks will, by nature, always trail wired networks in bandwidth and speed. Therefore, applications need to compensate by communicating in a different fashion. For example, a mainframe/dumb terminal application is clearly not suitable for wireless communication because for each keystroke, the entire screen needs to be sent from the host to the terminal. Applications need to be created to optimize the data that is sent over the air.

Roaming workforces

Unlike a wired environment workers are always connected, wireless computing implies a roaming workforce. An application needs to be able to "push" messages to mobile workers so that they don't have to constantly poll for messages as they move in and out of coverage. You also need a mechanism that can store messages for workers out-of-coverage (whether in a building, away from a vehicle or simply out of coverage) until they return to coverage. You may also need to deal with considerations such as security.

Wireless Middleware Overcomes Challenges

Wireless middleware, such as that offered by Nettech Systems, can overcome all of these wireless challenges.

Optimizes industry-standard protocols

Wireless middleware optimizes the performance of the TCP/IP protocol over-the-air by cutting packet counts by as much as 80% and reducing the amount of data being sent by 30-to-60%, which reduces airtime expenses, extends battery life and makes TCP/IP a viable option for wireless communication.

Overlays standard interface to proprietary protocols

Wireless middleware such as Nettech's Smart IP provides compatibility between industry-standard TCP/IP protocols and all wireless networks, no matter what the underlying network protocol. In addition, it supports the industry-standard Winsock API to allow application developers to create applications using the interface they are familiar with yet support any network.

In addition, wireless middleware provides a common set of APIs across all networks and operating systems for ultimate flexibility and compatibility.

Middleware handles harsh conditions

Since wireless middleware was designed to operate in a wireless environment, it can do things like adjust automatically to fluctuating coverage conditions to compensate for harsh conditions. By relaxing timers and slowing down and speeding up when appropriate, it can essentially stretch coverage holes to minimize connection loss.

Optimization of communication

Wireless middleware offers features such as compression and transport optimization to minimize the effects of narrow bandwidth.

Communication with a roaming workforce

Since mobility is inherent to wireless computing, middleware can offer features to allow for hassle-free communication with roaming workers. These features include services such as

“push” messaging, store-and-forward message queuing and automatic roaming between networks and devices. In addition, security concerns can be relieved with features such as encryption and user authentication.

In summary, wireless middleware makes it easy for developers to offer applications that provide cost-efficient and reliable communication over wireless networks.

Section
3

Wireless Data In Action

Nettech Systems Case Studies

A variety of wireless solutions are already in use by many organizations. These solutions provide significant cost savings while enabling competitive advantages. Below are a few examples.

American Freightways Boosts Customer Service with Wireless Data

American Freightways (AF), based in Harrison, Arkansas, is a scheduled, for-hire motor carrier of general commodities specializing in moving less-than-truckload (LTL) quantities. It offers next-day delivery to more than 150 million zip code combinations in 28 mid-atlantic, midwestern, southeastern, and southwestern states.

AF has outfitted 1,000 of its trucks with a complete wireless data system to meet its demands for real-time communications between the drivers and its 221 customer service centers. The system uses custom developed software from Synergistic Systems installed on servers in the customer services centers and on Symbol's PPT 4600 handheld portable pen Mobile Data Terminals (MDTs). Synergistic's development for AF was accomplished using PenRight!'s pen-based cross-platform (Windows or DOS) rapid application development tools, which provide a Windows look and feel in a DOS program. This reduced the memory size required for the MDT, thereby lowering the operating costs. The wireless communications employed Nettech Systems' InstantRF middleware which provides compatibility with both terrestrial and satellite networks.

Sears Expands Wireless Application to More Than 10,000 Field Service Technicians

In 1992, Sears first rolled out a wireless messaging application to its field service technicians. Since that time, the total number of users has expanded to more than 10,000 technicians nationwide. This solution consisted of an Itronix XC-6000 rugged handheld PC with an integrated radio modem running a proprietary dispatch and software distribution application under DOS over the ARDIS network.

Recognizing a need to extend coverage to the rest of its field force and update its operating system from DOS to Windows, Sears began to investigate middleware alternatives. Sears' current middleware limited the company to the ARDIS network and DOS operating system, and was no longer supported by its vendor.

Sears needed a middleware provider that supported multiple networks including satellite and the Windows operating system and was compact enough to fit on the mobile computer.

Nettech was chosen because of its multiple network and operating system support and, most importantly, the ability to purchase only a network layer API. This was important because limited memory was available on the mobile device—a thin client was necessary. In addition, because the packet data being transmitted was small, with most messages under nine bytes, additional services were not required beyond the network layer. RFmlib and RFgate were the perfect solution!

Sears' field service group is now using RFmlib in the field and RFgate at the server over ARDIS, BellSouth Wireless Data and NORCOM satellite. Service technicians automatically download their next day's jobs and any software updates overnight via a wireline connection. Throughout the day, technicians communicate with the host computer providing "arrival" and "complete" status. Real-time information such as price estimates, parts availability, and ordering help Sears provide same day service. Technicians are also able to provide the dispatcher with "call cancellations" or "not at home" information for immediate rescheduling. These efforts have greatly improved Sears' field productivity and customer satisfaction.

Through this implementation, Sears can now obtain 100% coverage for its field service technicians who have the satellite system, making them never out of reach. Sears has been able to achieve greater customer satisfaction and improved worker productivity. Phone calls from technicians to order parts or confirm information are down by 50%, which means more time can be spent on the job. In addition, when a customer must cancel or reschedule a service call—which may happen as many as 100 times each day in a service district of 100 to 150 technicians—dispatchers and technicians know about it and can adjust immediately. Because of this more efficient scheduling, customers get faster service.

MCI Improves Customer Service and Sees Return on Investment in Six Weeks with Wireless Dispatch Solution

In the fall of 1996, international telecommunications giant MCI Communications Corporation began looking for a wireless data solution for its dispatchers and service technicians who install and maintain network equipment for MCI's business and residential customers. Formerly, technicians had to drive to an office to pick up printed work orders, keep written notes throughout the day, and then enter the information in MCI's computer system at the end of the day. If schedule changes were required, dispatchers would page the technicians, who would respond by telephone. MCI looked to wireless data technology to improve its customer service and increase productivity to receive a substantial return on investment.

As MCI began to custom develop its application, Dispatch.Mgr, it recognized a need for wireless middleware to provide an easy way for the dispatcher to communicate with technicians. MCI wanted to implement this solution quickly and reliably. To this end, it chose to collaborate with companies that offer leading-edge technology. By using a middleware product, MCI could get up and running

quickly, have the ability to support multiple networks as it expanded its solution in the future, and ensure that its messages were delivered reliably and efficiently. MCI could then focus its resources on where it offered the most value-add.

MCI chose RFexpress from Nettech's InstantRF family of middleware because of its proven record of accomplishment in supporting mission-critical mobile applications. RFexpress supports the broadest range of networks and operating systems, provides store-and-forward messaging capability, offers logical name-based addressing and allows automatic network switching.

Since deploying the wireless data communications solution, MCI estimates that it has saved nearly $7 million in the dispatch and service process. By eliminating two hours of administrative time for field technicians, MCI has gained 25% more time to serve its customers. MCI's improved dispatching efficiencies have enabled the company to reassign about 100 dispatchers and consolidate field service dispatch operations formerly performed at 80 network information centers into 11 regional "ONEcenters."