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Wireless Data Communications

The Choices

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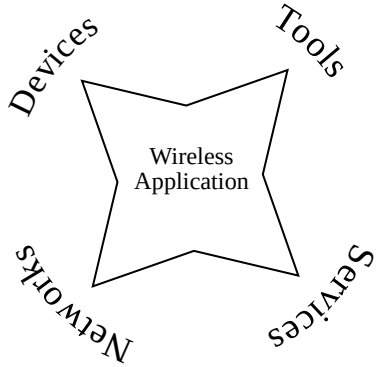
Wireless Data: The Choices

If you're thinking of developing or enabling an application to transmit data wirelessly, it's a good idea to first give some consideration to the environment in which the application will operate, as described in this document. What mobile device will the application reside on and what network will transport the data? What host platform will be used and how will it be connected to the network?

The ever-increasing number of application programming interfaces (APIs) and middleware products available for wireless applications has enabled the application to be more independent of the device and the network. However, complete independence is not yet a reality, and it's most effective to make the decisions regarding the environment(s) in which the application will operate before beginning development.

Where should you start? There is no "right" place, and a decision in one area might affect the possibilities in others.



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In the current market, if you want to use a particular network technology or device, other choices might be eliminated by that decision. For example, if you are developing an application specifically for the Motorola Envoy™ wireless communicator, the initial release is on the ARDIS public data network. If you want your application to run using CDPD technology on the cellular network, you'll need to develop your application with a CDPD-compatible wireless modem in mind, such as the Motorola Personal Messenger™ 100C.

In the same way, the device platform or network technology might determine the development tool, or middleware, you use to develop your wireless application.

If you have an existing customer base, you might need to make your choices based on their requirements. For example, if your customers are already using applications designed for (or built into) a particular device platform, you'll want to develop your application to run on that device.

Or, you might be developing an application for a customer who wants to use the services available to a particular network. For example, if a customer uses RadioMail, you would want to develop the application on a platform supported by a network that also provides access to RadioMail.

This document provides an overview of some of the types of networks, device platforms, development tools, and services currently available for wireless data communications.

Network Technologies

As the demand for wireless data communications increases, so does the range of network technologies being developed to service those needs. Networks differ in the following broad areas:

- **Infrastructure technology**. Some technologies make use of existing cellular voice networks while others are either public or private networks devoted exclusively to wireless data communications. Networks vary in message routing technologies, in protocols used to connect to the network and to translate and transmit the data, and in transmission speeds.
- **Flexibility**. Some networks are narrow in focus, requiring a specific user device and offering a specific type of service, such as paging. Others offer a broad range of choices in the devices used, the applications catered to, and the type of services offered.

- **Coverage**. Networks vary in the coverage provided:
  - global coverage, provided by satellite systems
  - continental coverage, provided by GSM
  - national coverage, provided by wide area data networks
  - regional coverage, provided by CDPD carriers
  - city-wide coverage, offered by some paging services
  - facility-wide coverage provided by wireless LANs.
- **Costs**. Startup and subscription costs to public networks vary greatly depending upon the type of network. Users might pay $15-$30 a month for a paging service and could pay up to $3,000 to purchase a hand-held earth station, plus $3 per minute for satellite service.

Network technologies will continue to offer more services and greater flexibility at lower costs. Users will be able to choose from a wide range of technologies and mix and match wireless with wireline communications in an effort to meet their needs in the most cost-effective manner.

A brief overview of the following network technologies is included here:

- Two-way wide-area packet data networks, including descriptions of DataTAC™ technology and ARDIS, and Mobitex technology and RAM
- CDPD
- Circuit-switched cellular
- GSM
- Paging
- Wireless LANs
- Other technologies, including descriptions of SMR and satellite networks

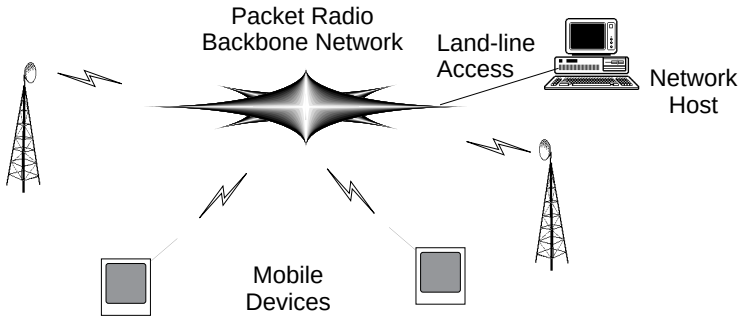
A matrix of two-way wide-area packet data networks is included at the end of this document.

Two-Way Wide-Area Packet Data Networks

Two-way wide-area packet data networks are owned and operated by service providers that offer wireless data communications to the public. Private networks, used by fleet operators and support services such as police, fire, and ambulance services, also use this type of network.

The networks are designed for data transmissions only and use infrastructures of base stations, network control centers, and switches to transmit the data. Enterprise systems (corporations) and third-party service providers can connect host data systems (servers) to the network via phone lines. Depending on the network, customers might pay a one-time fee to establish the connection and register devices with the network, a monthly fee to subscribe to the network, and fees for each message transmitted. Charges are based on the amount of data transmitted, not the connect time.

Two-Way Packet Data Network



Packet data networks allow many devices to share a small number of communication frequencies, making such networks more economical to operate than similar circuit-switched networks. Transmission speeds vary from 4800 bps to 19.2 kbps. However, the actual transmission time and throughput is determined by the network load and overhead and cannot be precisely specified. During peak hours, data moves more slowly.

Mobile users with devices registered with a network can roam freely between network base stations that are set up to provide coverage throughout the network. Roaming from coverage area to coverage area is seamless and transparent to the user.

Two-way wide-area packet networks send information in packets (also called datagrams and message units). Two-way messaging means that messages can

be transmitted as well as received. The networks provide for the acknowledgment of messages successfully delivered and guarantee message integrity through the retransmission of messages received with errors. They can store messages and forward them when the modem is turned on or when the unit is back in coverage area. Users can configure their message confirmation and delivery options to meet their organization's needs most effectively.

Since packet -switched data networks typically use fewer radio frequencies than circuit-switched data networks, delays in transmissions make wide-area packet-data networks most useful for sending small (less than 2k) amounts of data in each message. Wireless WANs are not ideal for online sessions or large file transfers.

ARDIS and RAM are the two largest packet data public networks in the U.S., each covering all major urban and suburban areas. Applications designed for use in metropolitan areas across the country can expect excellent coverage using either of these networks. Applications targeted at rural areas need to verify coverage.

ARDIS is based on the Motorola DataTAC network technology and RAM uses the Mobitex network technology. Both technologies use open standards to encourage third-party development of both hardware and software, so subscribers will have the widest array of options possible. This openness also ensures compatibility among devices produced by different manufacturers.

DataTAC Networks

DataTAC networks are in operation around the world, as shown on the following map:

DataTAC Networks

These DataTAC networks come in the following three “flavors.”

- The DataTAC 4000 networks, which operate in North America:
  - ARDIS, U.S.A.
  - Bell Mobility ARDIS, Canada
- The DataTAC 5000 networks, which operate in Asia and the Pacific:
  - Motorola Air Communications Ltd., Hong Kong
  - CELCOM, Cellular Communications Network, Malaysia
  - SINGTEL, Singapore Telecommunications Ltd., Singapore
  - TAC, Total Access Communications, Thailand
  - Telstra, Australia
- The DataTAC 6000 networks, which operate in Europe:
  - DeTeMobil, Deutsche Telekom Mobilfunk GmbH, Germany

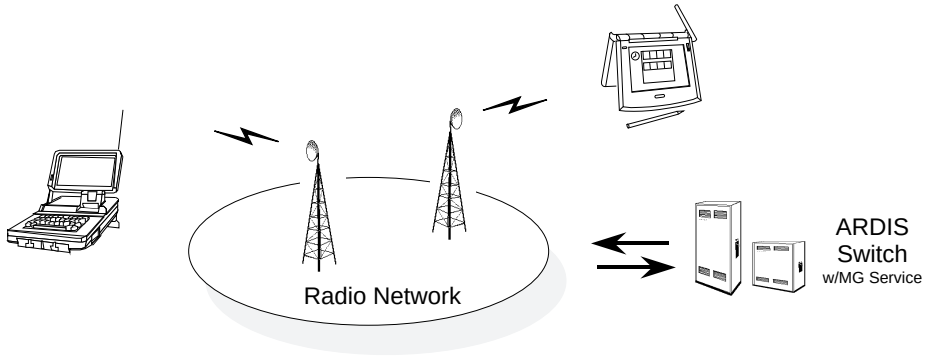
DataTAC networks are being developed in many other countries as well. Applications developed for one DataTAC network can be used in another with minimal modification, particularly if an application programming interface like AirMobile™ is used for development. However, due to regulatory constraints and frequency differences, most devices are country-specific.

The differences among the DataTAC networks include the following:

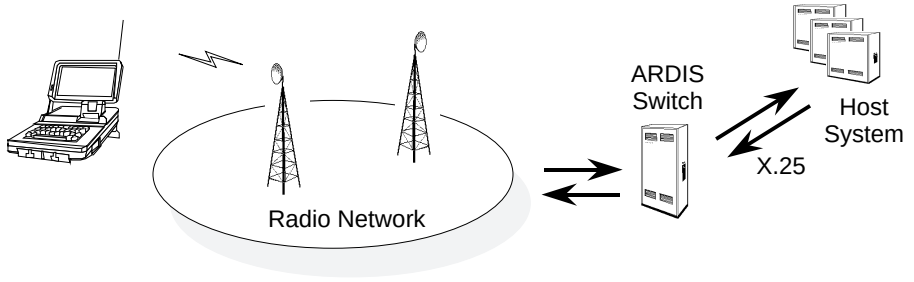
- **The radio frequency**. DataTAC 4000 and 5000 systems use 800 MHz frequencies, while DataTAC 6000 systems use frequencies in the UHF (400 MHz range). This means that different radios are required.
- **The use of frequencies**. Multi-frequency reuse (MFR) is used by DataTAC 5000 and 6000 networks and single-frequency reuse (SFR) is used by DataTAC 4000 networks.
- **The radio protocols**. Over the air (between the host and the modem), DataTAC 5000 networks use the RD-LAP protocol operating at 19.2 kbps. DataTAC 6000 networks use RD-LAP, operating at 9.6 kbps. DataTAC 4000 networks offer the MDC protocol, operating at 4800 bps, throughout their coverage area and the RD-LAP protocol at 19.2 kbps to accommodate traffic volumes in major metropolitan areas. The dual protocol nature of the ARDIS network is handled by dual-protocol software in Motorola's new modems and personal communicators.

DataTAC networks provide host-to-client routing and peer-to-peer routing. Host-to-client routing is suited for applications that require central control functionality or interoperability with other networks or fixed systems. A dedicated private line can be run between the customer or service provider’s server and the network. In peer-to-peer routing, wireless devices exchange messages with other wireless devices without having to route the messages through an outside server. ARDIS PersonalMessaging, which allows subscribers within a work group to send messages to one another, is an example of peer-to-peer routing.

Peer-to-Peer Routing



Host-to-Client Routing



ARDIS

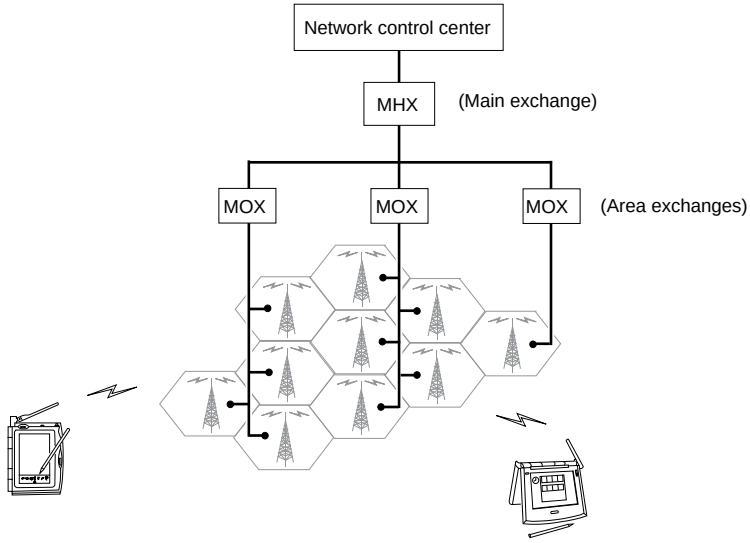
ARDIS has been operating for more than 10 years and is the largest wireless data communication network in the U.S. ARDIS has over 40,000 subscribers and provides coverage in over 400 metropolitan areas and 10,700 cities and towns across the U.S. ARDIS uses MDC 4800 and RD-LAP 19.2 radio protocols and provides deeper in-building coverage coast to coast than any other alternative for interactive, real-time wireless data communications.

Mobitex

Mobitex is a network technology designed exclusively for two-way, wireless data communications. The technology, developed by Swedish Telecom, has been in use for over 10 years. Mobitex networks are operating in Australia, Belgium, Canada, the Netherlands, the United Kingdom, Sweden, France,

Finland, Norway, and the U.S., and are planned for other countries including Germany, Mexico, Singapore, and Chile.

Mobitex networks do not distinguish between host and peer routing. The Mobitex network has a hierarchical (or pyramidal) network structure. Messages are routed from sender to receiver along the most direct path possible.



Each radio cell is served by an intelligent base station. Because intelligence is distributed throughout the network, data is forwarded only to the lowest network mode common to the sender and the receiver. The base station is thus able to handle all local traffic to the cell.

Each device and host attached to a Mobitex network is assigned a unique Mobitex Access Number (MAN). Mobitex protocol guides packets from station to station, adding forward error-control functionality. Messages longer than 512 bytes must be split into segments and transmitted or received one packet at a time. In addition to the natural privacy provided by message packetization and complex network protocols, the application can be designed to provide message security features.

RAM

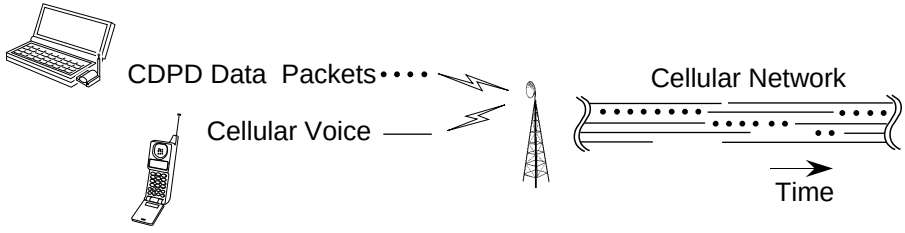
RAM Mobile Data operates a wireless data network that provides coverage in more than 6,300 cites in the top 216 metropolitan areas of the United States as well as in the major transportation corridors and airports. RAM provides service to more than 92 percent of the U.S. urban business population, using 200 radio frequencies across its system.

CDPD

Cellular digital packet data (CDPD) is a new technology that transmits data packets over existing analog cellular networks. CDPD in its most basic form can be used as a wireless extension of an existing TCP/IP network. It is ideally suited for established voice cellular network operators who wish to add wireless data to their existing services. CDPD has the same in-building coverage as the current cellular networks.

CDPD transmits over channels not in use for voice calls, making efficient use of capacity that would otherwise be wasted. It always relinquishes a channel when needed for voice. However, during non-peak traffic times in a typical analog cellular network, approximately 35% of channels are idle at a given time. CDPD can use multiple idle channels by hopping from one channel to another when a channel is needed or when a subscriber is going out of coverage of a cell. Data is held in a buffer if there is no place to hop to.

CDPD Technology



CDPD's data transmission rate (19.2 kbps) and error-correction protocols ensure that the service offering is highly reliable, accurate and efficient. Encrypted data service, together with subscriber authentication, provides protection against eavesdropping and fraudulent use of the service.

CDPD is supported by eight of the largest cellular service providers in the U.S. In the next few years, these and other cellular service providers will be adding data transmission capabilities to their regional networks using CDPD services. CDPD infrastructure is currently in the early phases of implementation. Although the data and voice transmissions share the same frequencies, they use different radio technologies and protocols and have different base station radio requirements and different network switching equipment.

It might still be some time before CDPD provides seamless national coverage comparable to the existing packet data networks. Challenges for CDPD include providing transparent roaming, unified billing, and a consistent service look and feel nationwide.

CDPD is designed to minimize the impact on network software by not requiring any changes to the higher network protocols. This allows users to take advantage of the CDPD network with little or no change to their current applications.

CDPD's open system design encourages the development of a wide array of subscriber devices and application software. Vendor-neutral standards, based on Internet and OSI standards, encourages broad industry support.

Motorola strongly supports developments in CDPD technology. It has recently developed the Personal Messenger 100C modem card to provide CDPD capabilities on an extended Type II PCMCIA card. CelTAC™, The Motorola CDPD wireless data communication system, is an infrastructure carriers use to run a network, and is in operation in several regions in the U.S.

GSM

The global system for mobile communication (GSM) is a digital cellular telephone system used widely in Europe. Its primary purpose is to make international roaming possible among all countries with GSM systems in operation. It allows for encryption, which is not available with analog systems. GSM uses the spectrum efficiently because it can form smaller cells than analog systems can.

Although speech is the most basic and most important service provided by GSM, it also supports circuit-switched data services. Connections are made to fixed hosts through the telephone network by converting the digital data to analog modem tones. The short message service (SMS) is a value-added service that allows users to send short alphanumeric messages of up to 160 characters. A packet data service similar in functionality to CDPD is being designed but will not likely be commercially available until 1997 at the earliest.

GSM requires a special handset or an adaptor for connecting to your laptop. The device is anonymous and includes a subscriber identity module (SIM), which stores the international mobile subscriber identity (IMSI). By inserting the SIM card in any GSM mobile equipment, the user is able to make and receive calls and other subscribed services at that terminal. By decoupling subscriber information from a specific device in this way, personal mobility is provided to GSM users.

Circuit-Switched Cellular

Wireless circuit-switched data is a technology for communicating data over the cellular voice network that is currently offered by many cellular service providers. Using a laptop computer connected to a wireless modem through the communication port, the user dials up a connection, much like using a wireline modem. Users can send and receive data at transmission rates up to 14.4 kbps.

Cellular data connections are session-based (similar to wire-line modem connections). Once a session is established, users pay for the connect time, even when no data is being transmitted (for example, when the user is browsing the directory or file or reading a message).

The obvious advantage of circuit-switched cellular (CSC) is the excellent availability and coverage of the cellular networks. It is currently the most economical way to send large amounts of data wirelessly with acknowledgment. It is considered the preferred solution for bulk wireless transfers.When the connection is made under good conditions, the transfer of data is reliable.

The disadvantages of CSC include the cost of the dedicated connection and the delays caused by setup and disconnects. Also, when a user is in motion, the established session might be dropped abruptly due to topographical obstacles, or data might be lost during the transfer from one coverage area to another. If the transmission is interrupted and must be restarted, the user is charged for the unsuccessful connect time.

For short messages in systems operating at low capacity, CSC might not be suitable due to the high cost and connection time per message. In many countries facing an ever-increasing demand for air time and channels, providing dedicated lines to single customers is a waste of resources.

Paging

Paging is a one-way wireless data service that, in addition to beeping or providing numeric-only information, can also deliver short alphanumeric messages to pagers. One-way data (simple paging) allows broadcast of unacknowledged (unconfirmed) data to one or more recipients.

Paging is the most common form of wireless data communications today. More than 19 million pagers are in use in the U.S., receiving service from over 2500 paging service providers. One-way paging is available in virtually every country around the world. A one-way communication system is the most spectrally

efficient technology for broadcasting data. An operator can send data to 1000 users for the same price as sending to just one user.

Paging has excellent coverage because it uses multiple high-power transmitters and relatively low data rates. Other strengths of paging include low entry costs, reasonable rates, excellent coverage in wide areas and in buildings (even basements), device size (small, lightweight), and long battery life (typically four months).

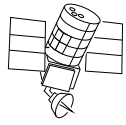
However, paging also has several limitations. Since paging is a one-way service, the recipient has limited ability to acknowledge receipt or respond to the sender without using some other form of communication.

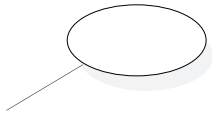
Paging provides no way to ensure the delivery of a message. Because of this, critical messages might be lost if the pager is off or the user goes out of coverage. The maximum transmit rate is typically 512 or 1200 bps, with a delay of several seconds. 200,000 users can share a channel.

Two-way paging, a new technology still under development, allows acknowledgment of messages, although the length of the acknowledgment is very short and not suitable for robust two-way communications.

Sophisticated paging networks such as the Motorola EMBARC™ (Electronic Mail Broadcast to A Roaming Computer) in the U.S. provide reliable street-level and in-building coverage. EMBARC allows users to receive messages (computer data) of up to 30,000 characters (or bytes). The network provides transmissions via satellite to land-based transmitting sites in 70 cities across the U.S. To use the EMBARC network, a user needs a computer (notebook, palmtop, PDA/PIC) and a NewsStream™ Wireless Data Receiver or NewsCard™ Wireless Data Receiver (PCMCIA Type II).

EMBARC Network Components





Wireless LANs

Wireless local area networks (LANs) allow roaming in limited areas (typically a department, building, or campus) while maintaining a wireless connection to the area's wired network (usually an Ethernet backbone). Wireless LANs provide the fastest data rates of the wireless networks (generally more than 1 Mbps). Wireless LANs might be preferable to their wired counterparts for situations in which wiring is difficult or impractical, or where some degree of mobility is needed.

The wireless LAN infrastructure is usually owned and serviced by the user's organization or corporation. Once installed, there is no additional cost (other than maintenance) to add users or increase usage. The installation cost is topology-dependent, but typically runs $200–$500 per attached node.

Wireless LANS are a means of extending and overcoming the limitations of cabled networks. Mobile workers might use wireless communicators to access their desktop systems and networks for e-mail, data, and printer/fax capabilities, as long as they are within range of a network access point. They can also spontaneously create temporary networks by bringing their computing devices into a general meeting area.

Wireless LANs trade their comparatively high transmission speeds for limited coverage area and constrained mobility. If a LAN needs to be extended to a wide area, it cannot be simply scaled up. Rather, a new infrastructure must be put into place to connect to a wide-area wireless data network.

Wireless LANs will be used increasingly to connect mobile workers with each other and with business processes within an enterprise, and application developers will find ways to move data around factories, schools, and institutions more efficiently.

Other Network Technologies

New technologies expected to play an increasingly important role in wireless data communications include specialized mobile radio (SMR) and satellite networks.

SMR

Specialized mobile radio (SMR) has been in place since the early 1980s. Typically, it uses high-powered mobile transmitters (45–70 watts) and a single base transmitter (or repeaters) for an entire metropolitan area. SMR is a cross between standard two-way radio and cellular systems. It is most useful to the vertical application user who is out-of-doors. This network technology is used primarily by industrial and government markets such as service dispatch, utilities, and law enforcement. Nextel is building a U.S.-wide wireless telephone network using Motorola ESMR™ (enhanced SMR) equipment, which will include voice and paging capabilities.

Satellite Networks

Mobile satellite network services can fill the gap in situations in which providing radio coverage with cellular-like terrestrial wireless networks is either not economically viable (such as in remote, sparsely-populated areas) or is physically impractical (such as over large bodies of water).

Satellite networks provide global coverage with some tradeoffs compared to land-based systems. More transmitter power is required, the mobile devices are somewhat bulkier, there is less total channel capacity, and the cost for comparable services is typically greater.

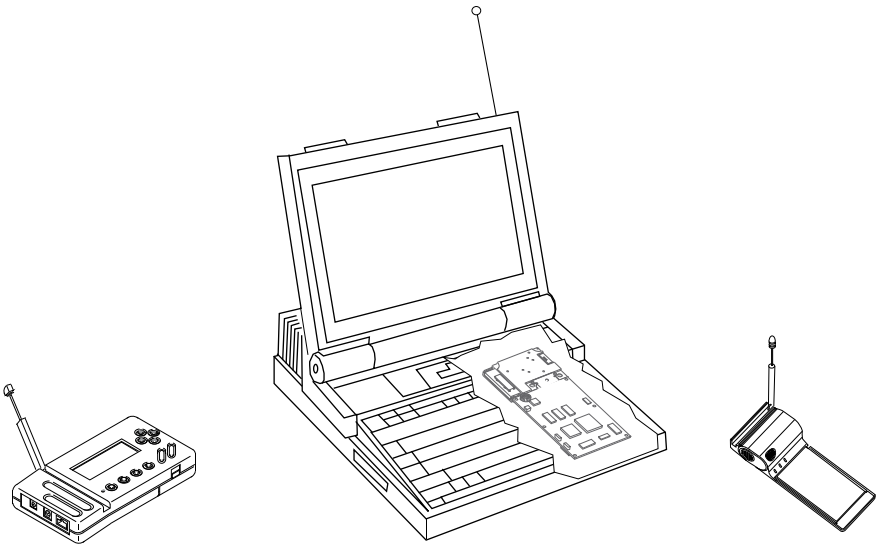
Satellite systems can be categorized according to the orbital altitude of the satellites. Geostationary satellites (GEOS), for example, rotate with the earth such that their position relative to the earth is stationary (or fixed). Their path is a circular orbit in the equatorial plane at 22,300 miles altitude. Each satellite covers approximately one third of the globe.

Satellite networks, such as IRIDIUM, provide services for applications including long-haul trucking, and communications in remote sites such as oil rigs and research stations. Iridium will be ready for service in 1998 and will employ 66 satellites operating at an altitude of 468 miles.

Device Platforms

A wireless data device usually consists of a computing unit together with a modem that allows it to send data by radio. The device itself might be built specifically for wireless communications, such as a pager; it might be a multi-purpose, intelligent device, such as a laptop computer; or it might be a dedicated, stationary unit, such as a telemetry device. The device might or might not have a monitor and a user interface. The wireless modem (which translates the data from the application according to the rules (protocol) of the network) might be built into the device (internal modem), it might be attached to the device through the communication port (external modem), or it might reside on a standard PCMCIA card.

External Modem ***Internal Modem*** ***PCMCIA Card***



As the demand for wireless applications increases, so does the availability of devices to house those applications and to meet the varying demands of the users. Different users require their wireless devices to have different physical characteristics. Some users want lightweight portable devices they can hold easily in their hands. Others want rugged, durable devices that will withstand physical abuse. For some users it is important that the device includes long-lasting batteries.

Users have different needs regarding computing capabilities also. Some need the power of multi-purpose laptop computers, while others require only a device capable of receiving messages in the field. The current range of mobile communication devices can be grouped into the following categories:

- PDAs (personal digital assistants), with integrated, wireless communication features
- PCMCIA modems, inserted into PCMCIA slots in computing devices
- External modems, connected via the communication port on a computing device
- Internal modems
- Pagers

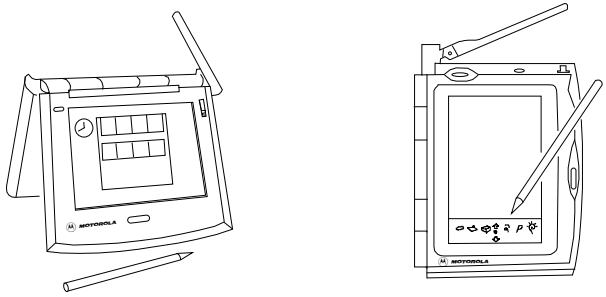
PDAs

Personal digital assistants (PDAs), also known as personal information communicators (PICs), are a relatively new form of computing device. They are beginning to find their way into the mainstream of information users by providing a compact and always-ready method to collect, store, retrieve, and organize data in a quick and intuitive manner.

These handheld two-way communicators are well-suited to extensive mobility. Their low power consumption, small form factor, simple setup and configuration, and intrinsically portable operating systems make them ideal for the user whose information needs cannot be met by the more powerful and cumbersome notebook computer.

The Motorola Envoy and Marco™ devices are popular choices in the PDA category.

Envoy device ***Marco device***



Many other PDAs with slots for PCMCIA wireless modems are available.

Both the Envoy and the Marco systems include a wide variety of pre-installed application software, including wireless e-mail applications. Both systems support an open architecture and standard protocols to facilitate the development of a wide range of third-party applications. Both systems include built-in APIs for wireless applications, allowing the developer to concentrate on the application rather than the specific requirements of wireless communications.

The initial release of both the Envoy and the Marco systems is on the ARDIS wireless data network in the U.S.

The Marco device is based on the Newton platform from Apple Computer and provides an interface which allows users to write and draw notes based on the notepad metaphor. The Marco system comes complete with Newton's personal information management tools for organizing addresses, appointments, and to-do lists. The Marco device also supports the growing library of Newton applications for managing finances, travel, and other important personal data.

The Marco device allows users to access, organize, manage, and exchange information while on the move. It is targeted at mobile professionals and users in specialized markets including sales automation, real estate, financial services, and field service.

The Envoy device uses Magic Cap, General Magic's platform, and provides a graphical user interface using the familiar desktop metaphor. Envoy applications are aimed at the mobile professional who needs to communicate on the move. The Envoy device offers wireless messaging, faxing, flight information retrieval, and personal expense management applications.

PCMCIA Modems

PCMCIA cards are standardized, removable, credit-card sized peripheral cards that can be easily inserted into any computing device that supports them. PCMCIA slots are included in most portable computing devices, making them the standard expansion solution for mobile computing.

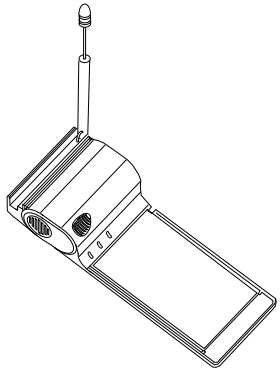
Different types of cards, in different thicknesses, can be used for a variety of purposes, including increasing memory and storage capacity and acting as wireline and wireless modems. This solution is ideal for a range of applications from simple messaging and electronic mail to database querying and updating, information service access, and cable-free LAN access.

Motorola recognized the importance of the PCMCIA interface early on in its development cycle and has developed a family of Personal Messenger wireless modems that are slightly larger than a credit card and can slip into PCMCIA-standard palmtop, notebook, and pen-based computers, and into PDAs.

The family of Personal Messenger modem cards includes offerings of one-way, two-way, wide-area networking, or local-area networking. This means that users will be able to purchase a standard device with a PCMCIA Type II slot, select the appropriate software for their application, and choose the modem card for the type of communication they require. Then they'll be ready to subscribe to their local or wide-area network.

The DataTAC Personal Messenger 100D is available now, the CDPD Personal Messenger 100C will be available in the summer of 1995, and the Altair™ 2.4 Wireless LAN Card will be available soon after that.

Personal Messenger 100D Modem Card



External Wireless Modems

External wireless modems, such as the Motorola InfoTAC™ device, are connected to a laptop computer using the serial communication port. They enable users to send wireless e-mail and to access corporate applications and other more vertical two-way wireless data applications such as dispatching and two-way paging.

The InfoTAC device is an external wireless modem that is small and light enough to carry in your hand. Versions are available for both DataTAC and Mobitex networks. It relies on its own power supply, communications software, and user interface. The InfoTAC device can be used in the following ways:

- As an acknowledgment pager. The InfoTAC device notifies message senders that the user has successfully and accurately received the incoming message.
- As a two-way messaging device. When a message is received, the user can respond with a preprogrammed response, such as approval of a request or the estimated time of arrival. The device receives and stores messages in a reserved 10k message buffer.
- As a modem connected to a portable computer via an RS-232 port. The InfoTAC device enables data transmission over the wireless networks from laptop-based applications.

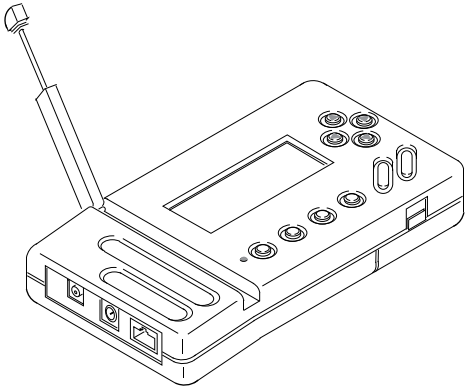
InfoTAC devices can be used on all DataTAC and Mobitex networks.

Many other external wireless modems are on the market.

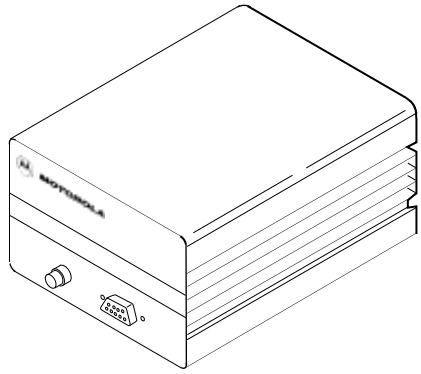
Motorola also manufactures the MRM™ (Mobile Radio Modem) for the OEM market. The MRM is an external modem that allows virtually any computing device that can communicate over a standard RS-232 link to operate in a wireless environment. The modem is compact, environmentally rugged, and highly reliable. The power output of the MRM is one or three watts.

The MRM is specifically designed for wireless communications with such portable computing devices as laptop computers while in a vehicle. Its chassis makes it suitable for in-dash mounting. The MRM can receive and store messages on a continuous basis when the portable computing device is not in operation. Its RAM contents can be maintained for several days during vehicle power disruptions.

InfoTAC device



MRM device

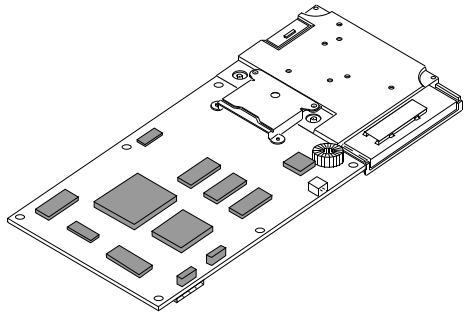


Internal Wireless Modems

Internal wireless modems are designed for integration into portable computing devices, such as notebook and pen-based computers, and into OEM terminal devices. The modems reside inside the housing provided by the manufacturer. Computers with internal wireless modems are beneficial to those who require constant wireless communications while mobile.

Motorola manufactures the RPM (Radio Packet Modem) series of modems for the OEM market. RPMs are available for both DataTAC and Mobitex networks. The RPM is the smallest and lightest radio modem designed for mobile data transmission available, and it can be easily integrated with portable computing devices. The low power consumption extends the battery life and minimizes the load to the device. The modem can be upgraded to incorporate new features by changing the software. RPMs are widely used in specialized field service terminals and in applications like debit card transaction systems.

Radio Packet Modem (RPM)

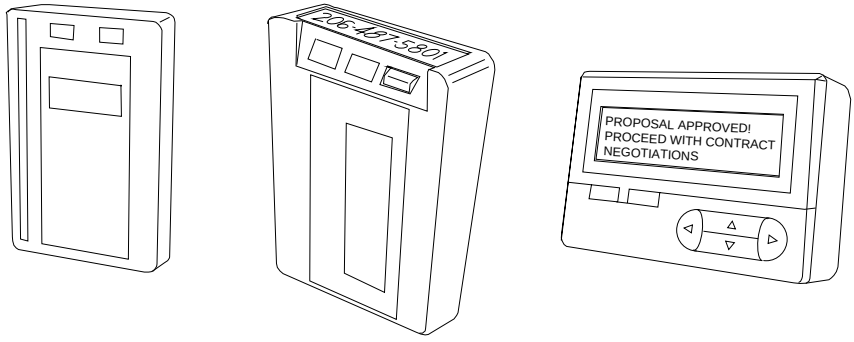


Pagers

With more than 19 million pagers in use in the U.S. today, pagers have been and remain the primary device used for wireless data communications. Pagers fall into one of three categories:

- Tone-only pagers, which beep to notify users to call their service providers and retrieve callers' numbers or messages
- Numeric pagers, which display telephone numbers for the users to call
- Alphanumeric pagers, which display short messages

Pagers



The alphanumeric pagers are becoming increasingly powerful. Some alphanumeric pagers can now send and receive full-text messages, transforming paging technology from a simple but important notification service to a vital information service. Some advanced pages now include RS-232 serial interfaces, which transform the pager into a pager-modem under control of an external PDA or laptop computer.

Motorola has been and continues to be the leader in pager technology, thanks in large part to its ongoing development of new products such as the following:

- The Gold Line™ Pager, which packs a sophisticated pager into the size and shape of a classic fountain pen.
- The Renegade™ Pager, which allows all pager functions to be activated at the touch of a single button.

Connectivity Tools

Most computing applications benefit from the use of development tools. These tools can decrease development time and cost and increase application flexibility. As the demand for wireless data applications increases, so does the number of software development products available for wireless application developers. These products, called connectivity tools or middleware, perform the translations necessary to use an application in a wireless environment.

Connectivity tools differ somewhat in their features and you'll need to choose a tool that best fits your particular needs. Some tools are intended only for host (server) application development while others are meant for mobile device applications. Some tools are device or network specific. Some devices, such as the Motorola Envoy and Marco products, have application programming interfaces (APIs) built into the device.

The Motorola Wireless Products Catalogue contains a list of available developer tools, including descriptions and contact information. This catalogue is available on the World Wide Web at the following address:

http://www.mot.com/wdg/

Motorola encourages developers to explore the possibility of purchasing third-party software development aids, for the following reasons:

- Connectivity tools shorten the development cycle. The process of developing a wireless application can otherwise be long and tedious, requiring

software developers to spend large amounts of time on the wireless integration and communications protocol portion of the application, to ensure proper packet alignment, to perform battery and coverage checks, etc.

- Most connectivity tools facilitate the development of applications that are network and device-independent. This is an advantage to you as a developer since it means that you might only have to develop your application once, while gaining support for multiple networks and devices. As devices and networks change, the tool provider, rather than you, may make the updates needed to accommodate the changes. Application independence is also an advantage to your customers, since they may be able to change devices and networks as a result of users' preference and changes in market strategies without having to spend money on new software.

The Motorola AirMobile™ Software Development Kit (SDK) Suite, for example, is a toolkit for building applications for computers running MS-DOS or Windows and is specifically designed for the wireless environment, providing optimized transport of data.

The kit provides two APIs. The first is at the transport layer to transmit data reliably and efficiently over the air; the second is at the driver layer, which provides a network and device independent interface.

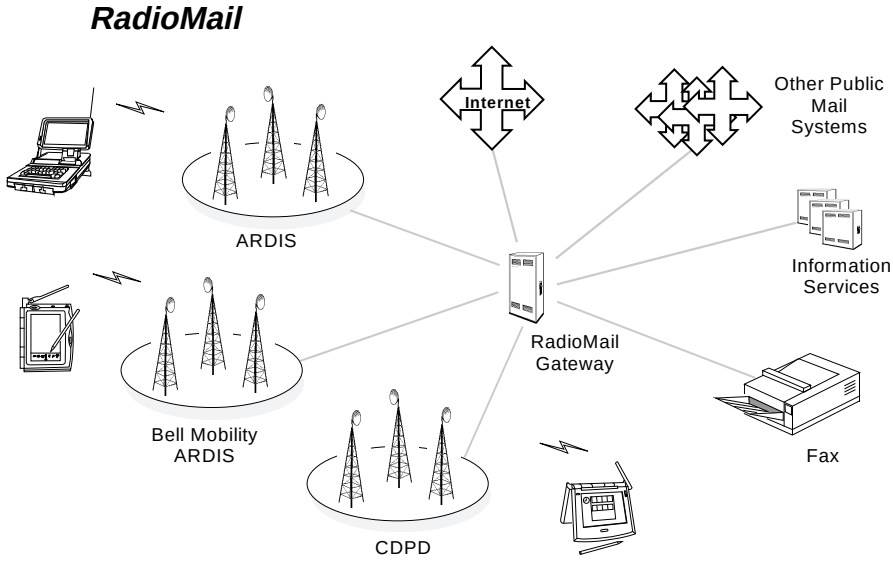
The AirMobile Communication Server SDK Suite for OS/2 is a development platform that allows portable computer users to access host applications over wireless data networks. The SDK Suite for OS/2 allows developers to create transfer agents that reside on the communication server platform. The transfer agents manage the interface between the wired and wireless networks for end-user applications.

The APIs of each SDK have only a fraction of the function calls normally associated with middleware development and effectively insulate the developer from the complexities of wireless data communications. The SDKs can be used to develop client applications as well as communication servers for wireless access to LAN- and host-based applications for DOS/Windows and OS/2 environments. Once an application is developed, the AirMobile runtime clients and servers are licensed to developers for deployment of their wireless solutions to end users.

Service Providers

Many services beyond basic data transmission are available to subscribers of wireless data networks. Some value-added services provide e-mail, faxing, and file transfer capabilities to wireless users. Some provide information services or serve as gateways to other information providers. Others provide the opportunity to place trades or bets.

Many value-added services, such as PersonalMessaging offered by ARDIS and the Short Message Service offered on GSM networks, are provided by the network operator itself. Many other value-added services are offered by independent service providers. For example, users on many networks can subscribe to RadioMail, a service provider that offers e-mail capabilities to wireless users and e-mail access to the Internet. Information providers can, in turn, connect to the RadioMail switch and offer value-added services. A good example would be a wireless travel reservation service. The travel information would be stored on the information provider's hosts, which would be connected via the RadioMail host/gateway to the network.



Wireless E-mail and Messaging

Wireless messaging (e-mail and fax) is the single most popular add-on service used by wireless network subscribers. Wireless e-mail enables two users to turn their devices on and immediately send and receive messages. Wireless fax gives users the ability to communicate with anyone with a fax machine. Most wireless messaging systems include gateways to the larger “wired” worldwide network.

Wireless e-mail is particularly well-suited to packet data networks, since the technology used ensures that packets are not lost. The store-and-forward ability of the networks matches the typical e-mail scenario. Users create and send wireless messages in the same way they create wireline messages; the only difference is that the messages are routed through service providers that allow access to the existing e-mail systems.

E-mail services can be developed specifically for wireless transmissions, or they can be public systems, or they can be included in online services:

- Those developed specifically as wireless e-mail include RadioMail, WyndMAIL, and AT&T PersonaLink. In the Motorola Envoy and Marco environments, e-mail is built directly into the operating system using the in/out box metaphor for store and forward.
- Public e-mail systems include AT&T Mail, MCI Mail, and Sprint Mail.
- Online services with e-mail include CompuServe, Prodigy, GEnie Information Services, America Online, and Delphi.

Wireless e-mail users need to be sensitive to the volume (and cost) of the messages they are downloading or transmitting. They might consider, for example, filtering their messages so that only important or short messages are downloaded.

Applications written to receive wireless e-mail can present the information in a customized format. A program could receive stock quotes and display an updated description of the user’s portfolio. Other development options include mail notification methods to alert users to events such as changes in schedules, inventory and price adjustments, and other dynamic data updates.

Information Services

Information providers have identified an increasing number of opportunities for wireless information services to end users. News, sports, financial, travel, entertainment, and other information services can be offered directly to users (via a host) or in conjunction with an existing mail or gateway service. Mobile users can also choose to receive information services provided by companies such as USA Today, Reuters News Media, and NewsPage Service.

The following are examples of some of the types of services that are available now or will be soon:

- In Hong Kong and Singapore, up-to-the minute stock quotes are broadcast.
- The Envoy device ships with a wireless version of OAG (the official airline guide), which allows instant updates on flight availability.
- Bonds@hand, an application for the Marco device, gives U.S. Government bond pricing information.

As the wireless data industry matures, information services will proliferate, providing access to an ever-broadening range of information. Gateways to these providers will become a requisite part of every network. The availability of information providers will then become less of a development consideration for the application developer.

Similarly, as open technologies become the standard and as APIs for wireless data communications become more readily available, applications will become increasing portable from one device to another. Devices will work on multiple networks, with multiple gateways to service providers open to them.

Pointers to More Information

If you'd like more specific information describing what is involved in developing an application for two-way wide area packet data networks, please read *"Wireless Data: The Considerations,"* published by the Motorola Wireless Data Group. You can download an electronic version of the document from our World Wide Web site, located at the following URL:

http://www.mot.com/wdg/

Wireless Data Networks

DataTAC Networks:	Network	Phone Number
Australia	Telstra	61-2-911-3153 outside Australia 800-633-785 within Australia
Canada	Bell Mobility ARDIS	514-333-3336
Germany	DeTe Mobil	49-228-936-7450
Hong Kong	Motorola Air Communications	852-599-2868
Malaysia	CELCOM	69-3-263-5770
Singapore	Singtel	65-838-2656
Thailand	UCOM	662-248-7240
U.S.A.	ARDIS	708-913-1215
Mobitex Networks:		
Australia	United Wireless	61-2-241-5290
Belgium	RAM Mobile Data Belgium	32-2-715-25 11
Canada	Cantel	416-229-1400
France	France Telecom Mobile Data	33 (1) 43 95 73 64
France	TDR	33-1-46-12-30-00
Germany	GFD	49-201-02054/926-285
Hong Kong	Hutchison Mobile Data	852-599-2800
Netherlands	RAM Mobile Data Netherlands	31-3465-82611
U.K.	RAM Mobile Data U.K.	44-181-990-9090
U.S.A.	RAM Mobile Data U.S.	908-602-5500
U.S.A.	BellSouth Mobile Data	404-249-5000

CDPD Networks:

NOTE: Contact the CDPD Forum hotline at 1-800-335-CDPD for a current list of carriers. Contact your local cellular carrier to inquire about their CDPD program or to express your interest in one.