WHITE PAPER

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Corporation

CONTENTS

Wireless Communications Using CDPD and Circuit-Switched Cellular

EXECUTIVE SUMMARY

Wireless communications offers the promise of freedom to mobile professionals. Freedom from having to locate a wall jack to plug a modem into. Freedom to work outside the office in a variety of remote locations such as hotels, airports, and restaurants. Freedom to send and receive critical real-time information when and where its needed. In short, the freedom to be more productive and be in reach and in control.

To date, much progress has been made toward accomplishing this freedom. A variety of wireless networks and devices have been created for operation with mobile computers. These solutions continue to progress toward lower costs, improved portability, broader wireless coverage, enhanced reliability, and improved performance. To continue this progression, Compaq has developed a more integrated wireless solution for notebook computers that eliminates awkward cables, is more convenient to carry, and works cost effectively over existing ubiquitous networks—namely, Circuit Switched Cellular and/or Cellular Digital Packet Data (CDPD).

What is this new technology? How does it work? Who provides the wireless service, and what are some of the applications it is appropriate for? How secure is it, and when should you consider using it? These and other questions are addressed by this white paper.

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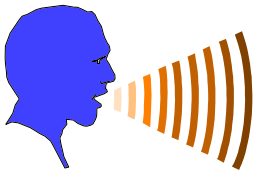
Wireless Communications Using CDPD and Circuit-Switched Cellular
First Edition (July 1997)



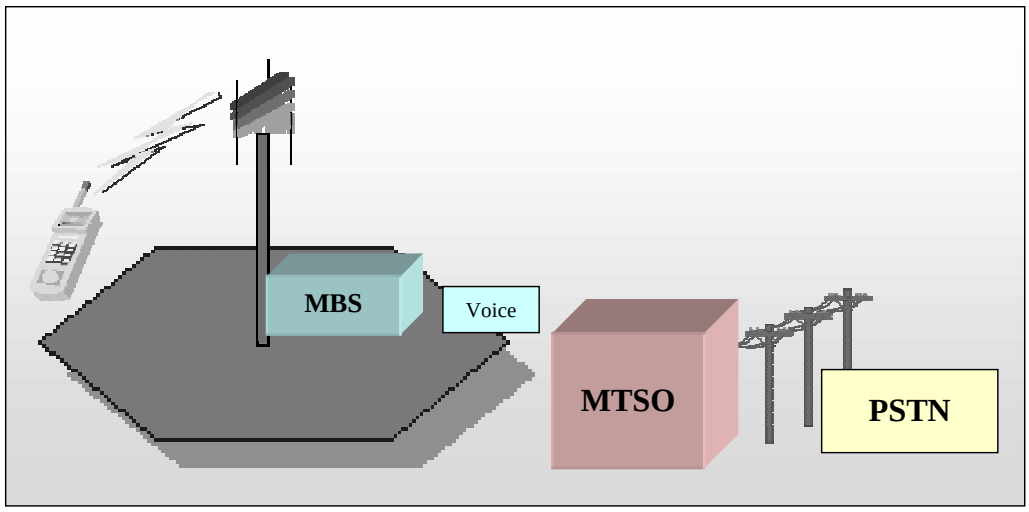
The Cellular Voice Network

THE AMPS NETWORK

In 1969 engineers at Bell Labs developed the cellular telephone technology known as Advanced Mobile Phone System (AMPS). This system uses the 800MHz frequency band and is now widely deployed in North and South America for mobile voice communications.

How it Works

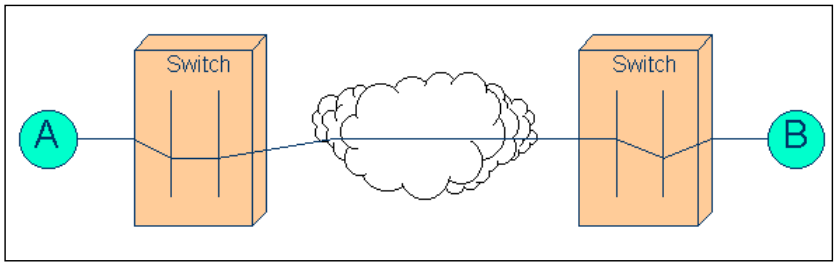
A typical AMPS network for cellular phone operation is depicted as follows:



Analog voice signals are transmitted to/from cells (shown as the hexagonal in the diagram) to a Mobile Base Station (MBS) using Frequency Modulation (FM). From the MBS voice traffic is routed through the Mobile Telephone Switching Office (MTSO) and from there, over the Public Switched Telephone Network (PSTN).

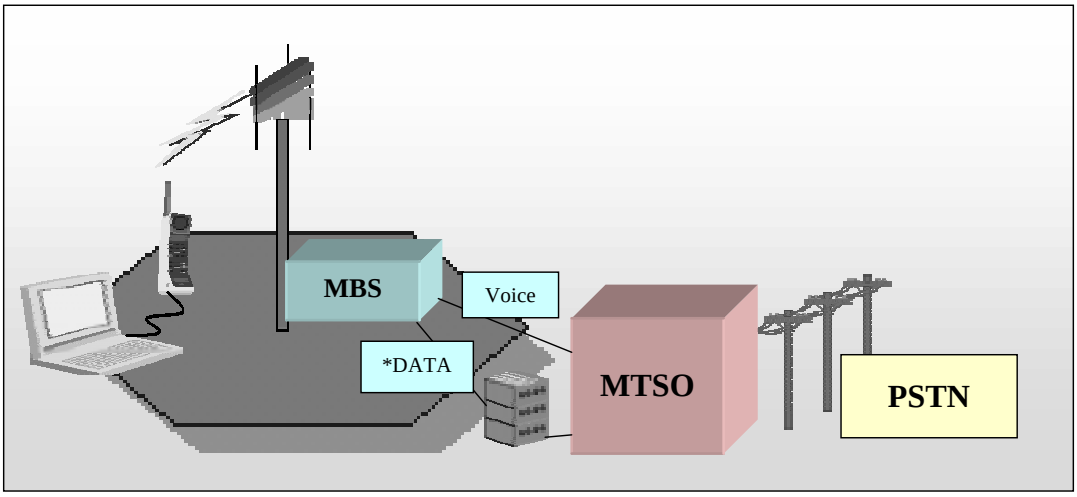
The MTSO establishes a continuous connection, or circuit, between the MBS and the called phone. This results in the network sometimes being referred to as Circuit Switched Cellular (CSC). In this model AMPS could be viewed as the wireless part of the network, and CSC the landline part. To send a voice signal from a mobile phone at point A using AMPS over-the-air protocols to another phone at point B in the circuit switched network, a temporary dedicated path is established for the duration of the communication session. All signals flow continuously over the same path, and charges are based on how long the connection is maintained, i.e., airtime, in the case of a cellular phone.

Circuit-Switched Connection



Sending Data over AMPS

Even though the AMPS cellular network was designed primarily for voice transmission, techniques have been developed in the last few years to send data over the network. The following diagram depicts the use of a modem such as the Compaq SpeedPaq 336 Telephony Modem directly connected to a cellular phone, for sending data over the cellular network.



As shown in the diagram, one way of accomplishing this is to use the same path for data that a voice call uses. In this approach, wireless data service is therefore similar to a standard cellular phone call—It uses the same channels and same frequency as a cellular voice call, but with specialized protocols used by the modems on each end for circuit switched cellular data. At the mobile end—i.e., the notebook computer—it requires the use of a compatible modem such as the Compaq SpeedPaq 336 Telephony modem that connects to a cellular phone and supports the necessary cellular protocols. At the other end—usually a fixed location—this approach generally requires the use a matching cellular protocol modem for maximum performance and reliability.

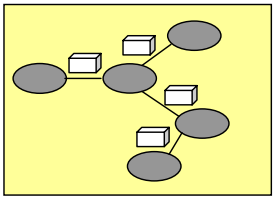
Another approach offered by some carriers is to use modem pools at the MTSO, as shown in the diagram, supporting specialized cellular data protocols such as MNP10 (Microcom Network Protocol), or ETC (Enhanced Throughput Cellular) at the MTSO. This modem pool service has the advantage of not requiring a matching cellular-aware protocol modem at the ultimate destination, and usually results in increased speed and reliability to near wireline quality, while reducing transmission errors and dropped calls across the network. A data call is typically routed to the modem pool by attaching a code such as *DATA to the dial string.

Billing for AMPS data service is generally a function of airtime used, typically in 1 minute increments, with charges based on the user's selected rate plan. And, just as with a normal phone call, all applicable long distance charges, roaming charges, and taxes are also billed.

AMPS Activation

To activate AMPS you supply the Electronic Serial Number (ESN) for the AMPS device to the cellular service provider (carrier). The carrier in turn assigns a phone number to the device.

You Supply:	Carrier Assigns
ESN = 296-00062816	**Phone Number** = 972-555-1212



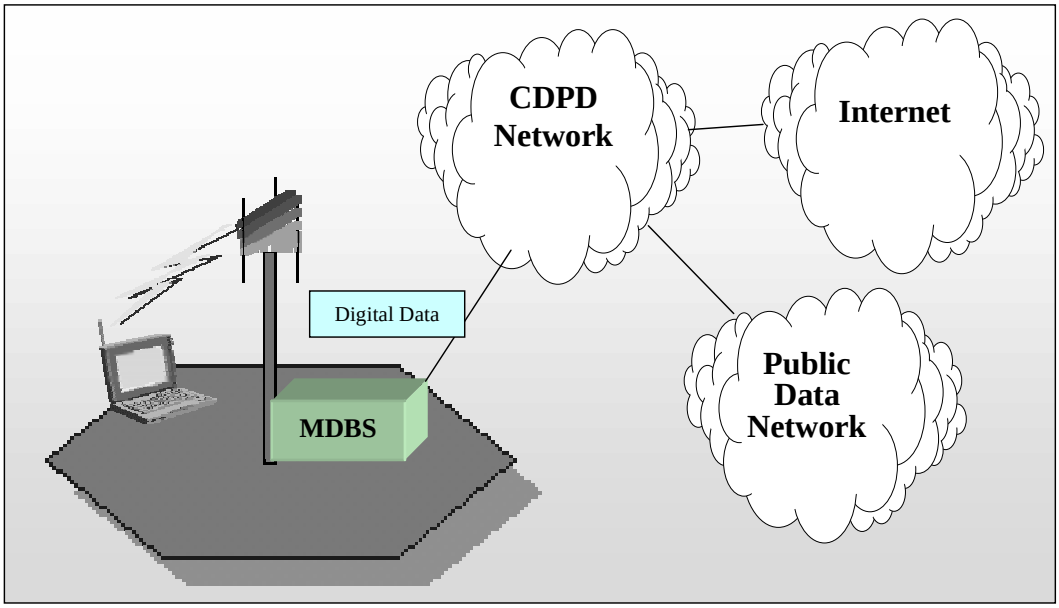
The CDPD Network

THE CDPD NETWORK

In 1992 an industry consortium of leading wireless communications companies joined forces to develop the Cellular Digital Packet Data (CDPD) specification for sending digital data over the existing AMPS wireless infrastructure. The idea was to leverage the existing infrastructure as much as possible without having to build a new digital data network from scratch. The initial goals were high performance (19.2 Kbps), high reliability and security, and seamless roaming, all at a reasonable cost with no interference with voice traffic. In addition, the consortium decided to base the CDPD protocol on standard Internet TCP/IP protocols to make it easy to access Internet resources or use public data networks.

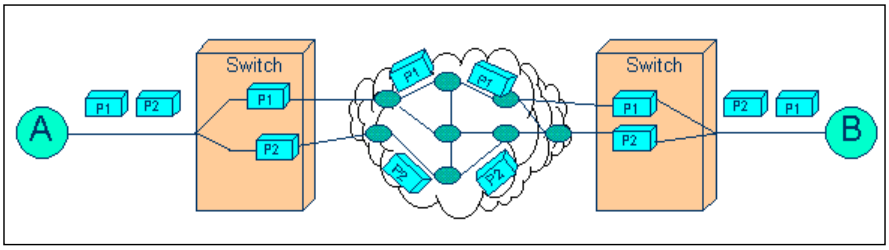
How it Works

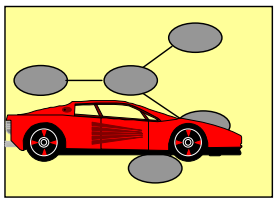
The approach used for CDPD is to send digital data packets over the same frequency spectrum as analog voice, but with different modulation in the air interface. AMPS channels that are not being used for voice calls may therefore be used for CDPD calls. The Mobile Data Base Station (MDBS) receives the CDPD packets and routes them to the Mobile Data Intermediate System (MD-IS) out to the CDPD network. To eliminate interference with voice calls, carriers may either dedicate one or more channels to CDPD usage, or they may deploy a method called "channel hopping" that rapidly moves CDPD calls automatically to the next available free channel.



Sending Data over CDPD

The CDPD network is sometimes referred to as a Packet Data Network (PDN). Since packets may take different paths and arrive at different times, they are sequence numbered so they can be assembled in the correct order at the receiver. User charges are typically based on the number of packets transmitted and received, but some carriers may also offer flat rates with unlimited data. The maximum data rate is 19.2 Kilobits/second.

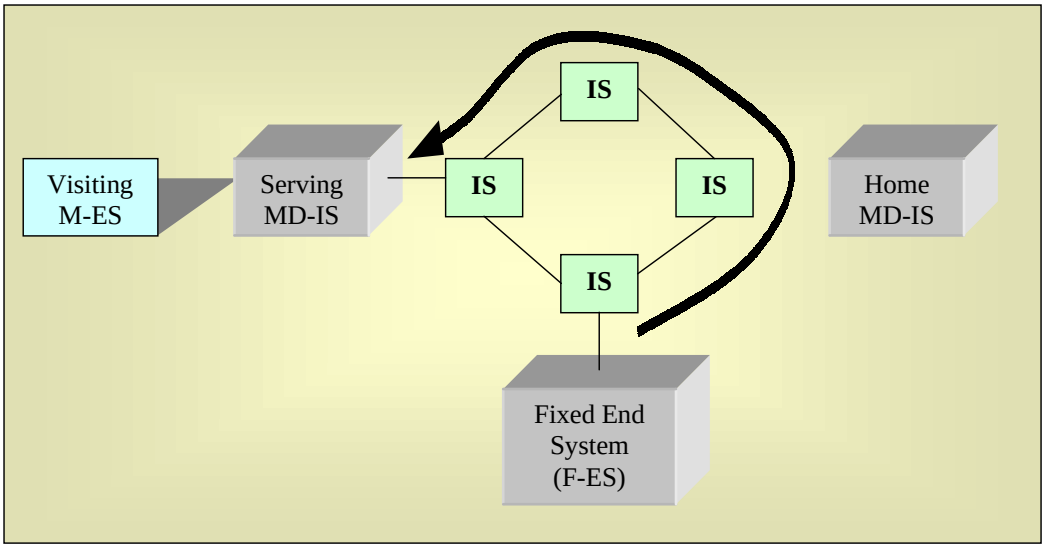




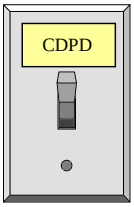
CDPD Mobility Management

CDPD Mobility Management

One of the unique characteristics of the CDPD network is the ability to track the location of all the mobile units and forward packets as needed to them. This needs to be done, not only within a given carrier's CDPD network, but also across carrier networks, for mobile units that are roaming outside the home area. While most communications is between the mobile unit and a Fixed End System (F-ES), there is also the need to support mobile-to-mobile communications. The CDPD specification refers to this whole area as "Mobility Management" and accomplishes this through the use of a "Home" Mobile Data-Intermediate System (MD-IS). The following is a diagram of a typical CDPD network showing how this is done.



To understand how this works, assume that the Mobile End System (M-ES), is visiting another area—perhaps even another carrier's network. The visiting M-ES registers in the network with the Serving MD-IS. The Serving MD-IS sends a message using a special protocol to the Home MD-IS for the M-ES unit. The Home MD-IS makes a note of where the M-ES is located so that it can forward packets to it later. This enables the Home MD-IS to always keep track of the location of its mobile units. Packets destined for the Mobile End System (M-ES), for example from a Fixed End System (F-ES) first go to that unit's Home MD-IS for proper forwarding through the network's Intermediate System (IS) routers. Note that the intelligence in the network is located at the MD-IS locations, and that the IS routers merely route the packets through the network.

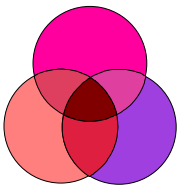


CDPD Activation

CDPD Activation

To activate CDPD service you supply the Equipment Identifier (EID) to the appropriate CDPD carrier of your choice, and they in turn assign an Internet Protocol (IP) address—also called Network Entity Identifier (NEI)—to your device. CDPD and AMPS may be activated separately.

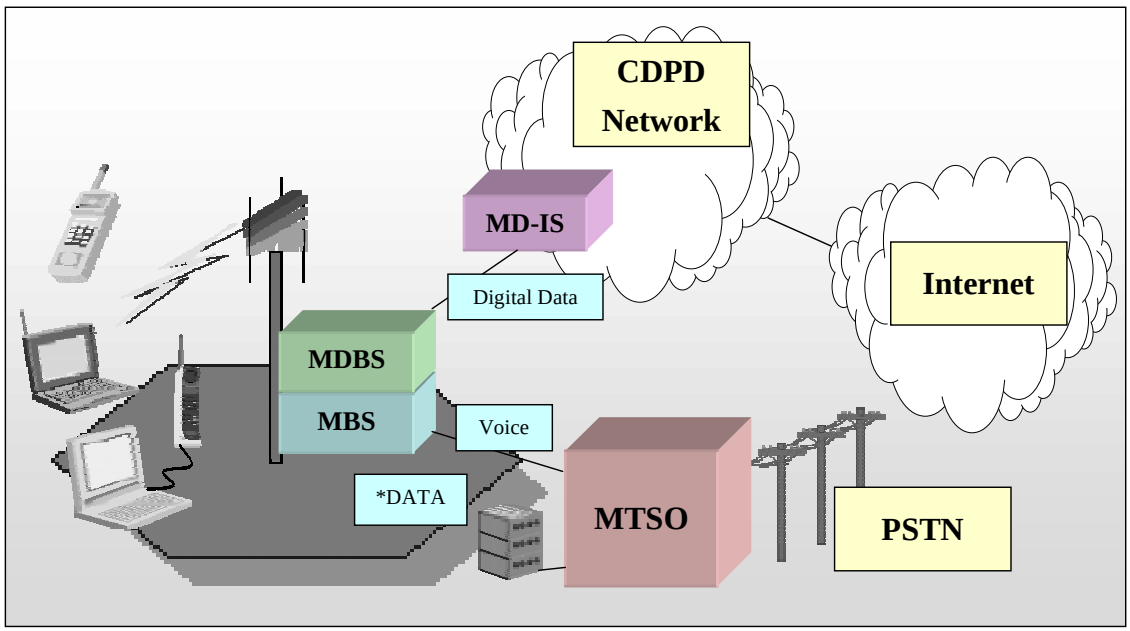
You Supply:	Carrier Assigns
EID = 00-A0-C5-00-1D-60	**IP Address** = 151.130.000.175



Overlaying AMPS & CDPD

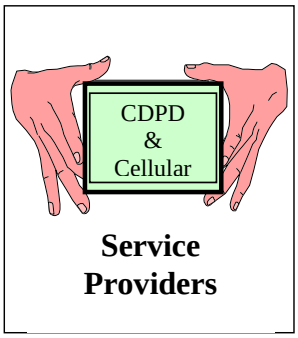
Overlaying AMPS and CDPD

Since AMPS and CDPD share the same frequency channels they can be physically co-located. This enables the sharing of the same basic wireless infrastructure—frequency spectrum, cell sites, towers, antennas, etc.—for both AMPS and CDPD networks. Mobile devices can therefore send and receive analog voice or analog data using AMPS or digital data using CDPD over the same frequency spectrum. The following diagram shows how the AMPS and CDPD networks overlay.



This diagram shows the use of several communications methods and types.

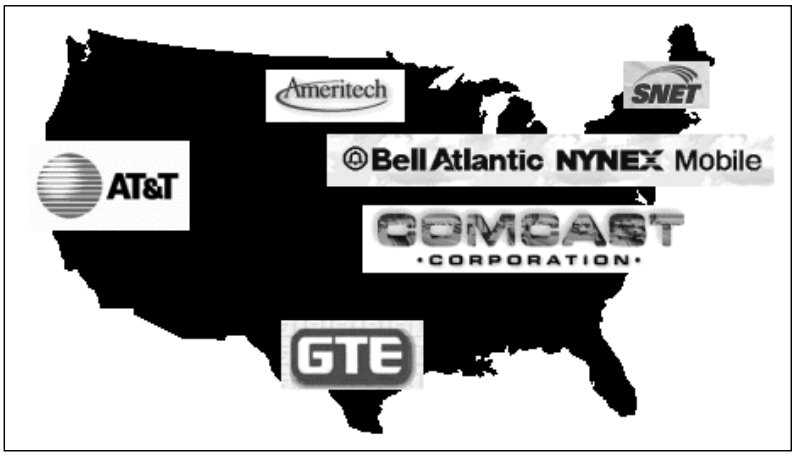
- **Voice:** A cellular voice call may be made over the AMPS analog cellular network going from a cellular phone to the Mobile Base Station, to the Mobile Telephone Switching Office, and finally to the Public Switched Telephone Network.
- **Analog data to a matching modem:** Data may be transferred from a notebook computer using a modem such as the Compaq SpeedPaq Telephony modem directly connected to a cellular phone, communicating over the same AMPS analog cellular used for voice, to a matching cellular protocol modem located at the destination.
- **Analog data through a modem pool:** Similarly, data may be transferred over the AMPS analog cellular voice network by using a special dialing string such as "*DATA" to connect to the service provider's modem pool located at the MTSO for enhanced performance and reliability. This does not require a matching cellular protocol modem at the destination.
- **Digital Data using CDPD:** Finally, data may be transferred over CDPD using a digital radio frequency modem. This device communicates to the Mobile Data Base Station, then out to the Mobile Data Intermediate System (MD-IS) in the CDPD network. The CDPD network may in turn connect to the Internet, to a public data network, or to a corporate LAN.

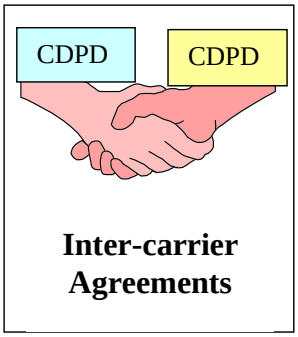


Service Providers

CDPD Service Providers

There are a growing number of service providers that are committed to offering CDPD service along with their normal AMPS service. Some of these are depicted below.





Inter-carrier Agreements

Inter-carrier Agreements

The goal of the CDPD service providers is to offer "nationwide, seamless, wireless data service." Since no single carrier covers all areas of the U.S., nationwide coverage is accomplished through the appropriate inter-carrier and partnership agreements. Inter-carrier agreements between CDPD carriers result in nationwide seamless roaming that takes advantage of the CDPD Mobility Management features. The user generally pays according to the rate plan they signed up for in their home area. The following depicts how some carriers may interconnect their networks using Intermediate System (IS) routers. (For more information on current inter-carrier agreements consult the CDPD Forum web page listed in the Resources section).

The following table lists inter-carrier agreements as of this writing. For the most current information consult the CDPD Forum (see Resources).

Carrier	Signed Inter-Carrier Agreements(s) with:
Ameritech	ATTWS, BANM, GTE
ATTWS	Ameritech, BANM, Comcast, GTE, Southwestco (BANM)
BANM	Ameritech, ATTWS, GTE, Southwestco (BANM)
BCTel Mobility	GTE
Comcast	ATTWS, SNET
GTE	Ameritech, ATTWS, BANM, BCTel Mobility, Southestco (BANM)
SNET	ATTWS, Comcast
Southwestco (BANM)	ATTWS, BANM, GTE

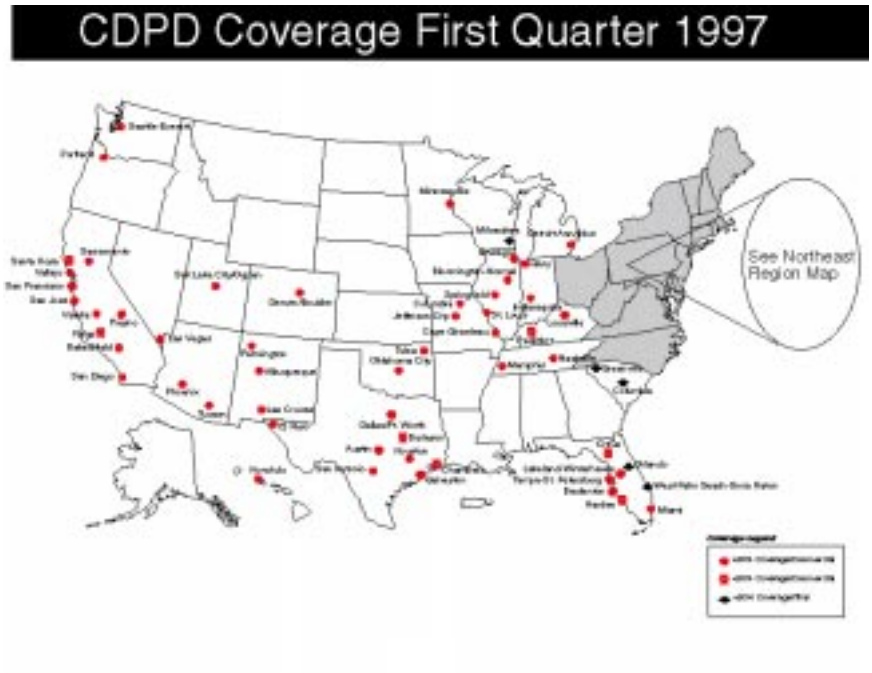
ATTWS = At&T Wireless Services

BANM = Bell Atlantic/NYNEX Mobile

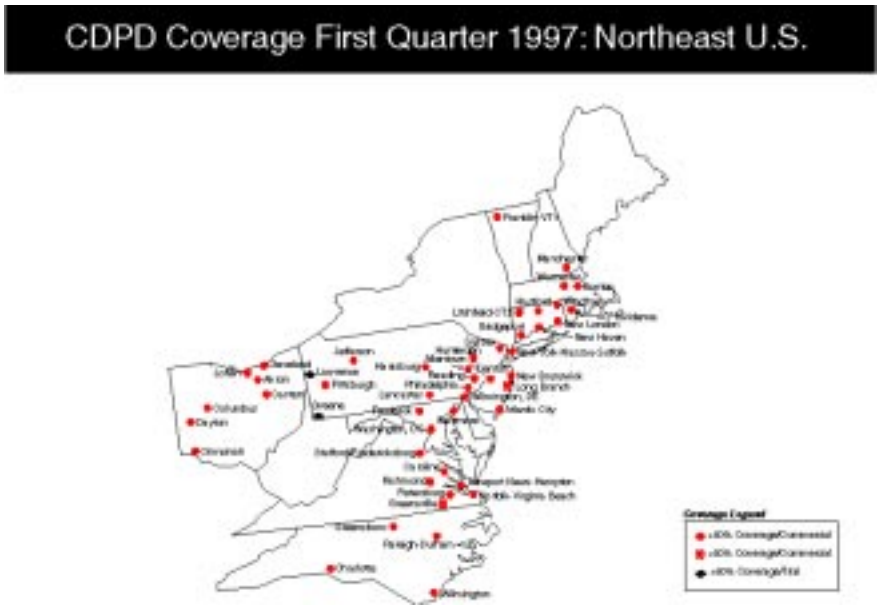
SNET = Southern New England Telephone

Coverage

The coverage for CDPD continues to expand. As of 1Q97 the CDPD Forum reported CDPD service in 130 markets, with coverage in 85 Metropolitan Statistical Areas (MSAs), and 28 Rural Service Areas (RSAs), or approximately 50% of the U.S. population. There is also coverage in 17 international markets including Mexico, Ecuador, and Canada. The following coverage map shows the coverage in the U.S. for 1Q97 according to the CDPD Forum (see Resources).



The following coverage map shows the coverage in the northeastern region of the U.S. for 1Q97 according to the CDPD Forum (see Resources).



NETWORK BENEFITS

Why CSC?

The circuit switched cellular network infrastructure has been over a decade in the making, and it provides virtually ubiquitous coverage. It has achieved a high level of maturity and fine-tuning for robust voice operation. Over time, it has also become more economical, with a variety of rate plans depending on usage patterns, and it supports nationwide roaming through inter-carrier agreements. New modem protocols have been specifically developed for transmitting data over the CSC network, resulting in improvements in reliability and performance and making it possible to use the network effectively for data communications. Some of the main benefits of CSC may be summarized as follows:

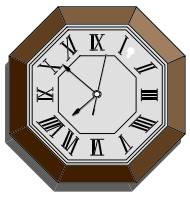
- Nearly ubiquitous coverage in the U.S. using AMPS wireless technology
- Good performance with new cellular modems for data
- Availability of a variety of devices for voice and data
- Good in-building penetration
- Support for roaming
- Availability of a variety of rate plans depending on usage patterns

Why CDPD?

CDPD takes advantage of the AMPS wireless infrastructure but uses a digital protocol developed specifically for data transmission that is based on the popular Internet TCP/IP protocol. This enables Internet and Intranet protocols to work transparently over the CDPD network.

The main benefits of CDPD may be summarized as:

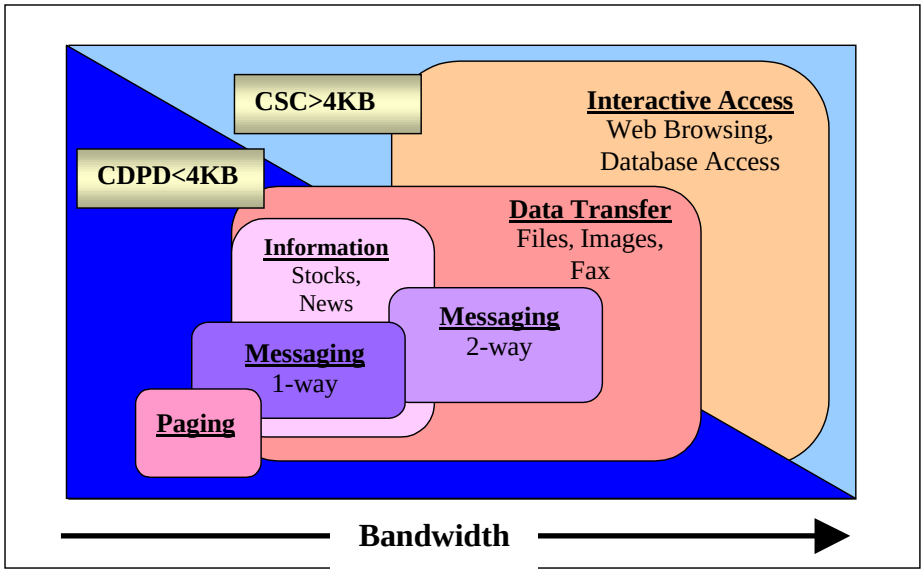
- **Cost**
  - Service: charged for by the packet, no roaming or long-distance charges
  - Equipment: add-on modems and software to existing equipment
- **Coverage**
  - Area: local, regional, nationwide with inter-carrier agreements
  - Penetration: good in-building penetration similar to CSC
- **Performance**
  - Speed: 19.2Kbps
  - Throughput/latency: minimal overhead using Van Jacobsen standard Internet TCP/IP header compression;
  - Fast response time
- **Reliability**
  - Error recovery: Reed-Solomon forward error correction codes
  - Uptime: proven infrastructure equipment
- **Security**
  - Authentication: Diffie-Hellman dynamic public-key negotiation over the airlink to the MD-IS to prevent unauthorized use
  - Encryption: RSA RS-4 data encryption standard over the airlink to the MD-IS, to prevent data eavesdropping



When to use CSC/CDPD

WHEN TO USE CSC/CDPD

The following diagram provides an approximate guide for the appropriate use of CDPD and Circuit Switched Cellular technology.



As shown in the diagram, more bandwidth is typically needed for interactive and database access compared to simple messaging and information service delivery. Circuit Switched Cellular, with its high bandwidth continuous connection, is generally more cost effective for larger file transfers, e.g., greater than 4 KB, sending faxes, or where it is desired to connect to a destination much like a standard wireline modem. These guidelines may vary greatly depending on the specific rate plans offered by the carrier.

CDPD, on the other hand, uses packet switching with transfer rates up to 19.2Kbps. Actual throughput may vary depending on the amount of protocol overhead and connection signal quality. This service is good for shorter bursts of data—typically less than 4KB—though, as mentioned, this guideline is subject to the pricing plan offered by the carrier. CDPD is generally appropriate for short messaging, electronic mail, telemetry, dispatching, or interactive Internet connections.

Billing for CDPD service is typically based on the quantity of data transmitted, rather than airtime as with CSC service. With CSC you typically pay for the number of whole minutes you are on the air, while with CDPD you pay for only the amount of data transmitted. CDPD therefore, may be continuously "connected", i.e., registered with the network, either listening for information, or standing by to transmit. Charges may be incurred only when data is transmitted or received.

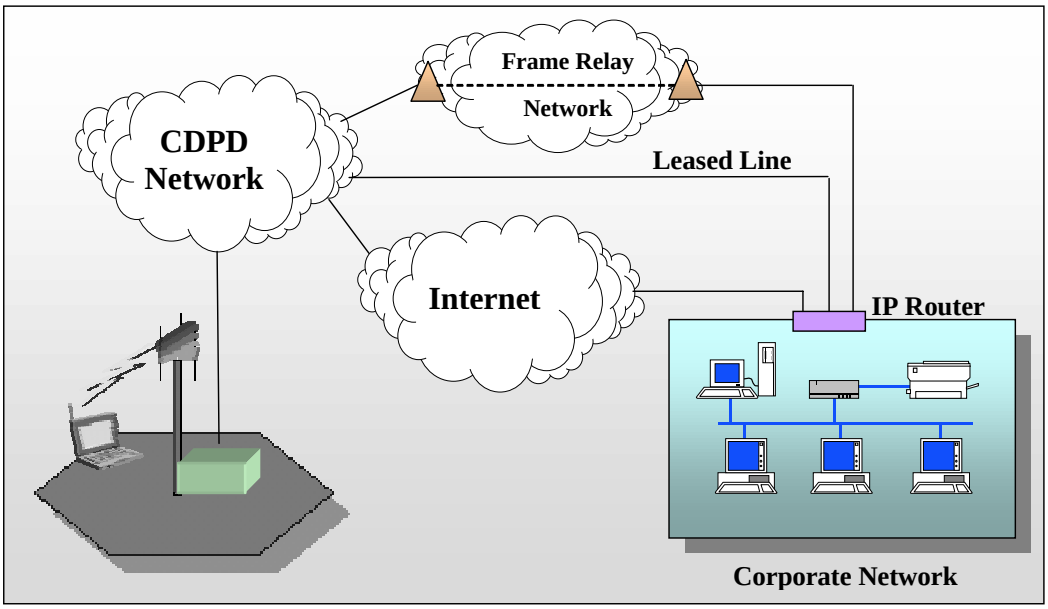
CSC and CDPD rate plans vary depending on the service provider, but typically, a variety of rate plans are available, depending on the user's anticipated airtime usage or volume of data traffic. With CSC there may be additional roaming and long-distance charges, while with CDPD there are no extra roaming or long-distance charges for data transmission.

While CDPD is capable of supporting Internet or Intranet Web browsing, it would probably not be appropriate for frequently accessing sites laden with heavy graphics, or to use it to download large programs or files. For this, it would probably be better to use the CSC service, or better still, to use the landline modem connection, if one were available. CDPD can be effectively used for occasional Web site access, or for interactive access not requiring a lot of graphics transmission. In most Web browsers, the user can elect to turn off the graphics mode and use text only. This would be more cost effective for CDPD access, if it is applicable.

BACKEND CONNECTIONS

CDPD Connection

Since communicating over CDPD is typically a client-server application there needs to be a connection from the mobile device in the CDPD network to the fixed-end corporate Enterprise network where the server application usually resides. The following diagram shows several methods of accomplishing this.



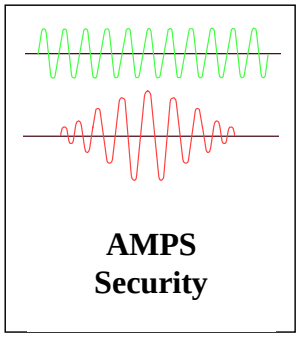
One approach is to provide a connection from the CDPD network to a high-speed Frame Relay wide area network, possibly from another carrier, which in turn, connects to an Internet Protocol (IP) Router at the corporate enterprise. This provides a secure, high performance connection.

A second approach, depending on physical location, is to provide a direct connection, such as a leased line, from the CDPD network to the IP Router at the customer end.

Alternatively, CDPD carriers also provide a link from the CDPD network to the Internet that can be used to connect to the IP Router at the corporate network using standard TCP/IP protocols. This provides one of the quickest and lowest cost ways to connect if cost is a major concern compared to performance and security.

CSC Connection

Connecting the corporate LAN to Circuit Switched Cellular data service is done in a similar way to standard dial-up remote access connections. This is usually accomplished using a modem bank similar to that used by carriers in the Mobile Telephone Switching Office. For supporting connections to CSC, however, these modems may need to support the specialized cellular protocols such as MNP-10 or ETC, unless the carrier already offers a cellular-protocol modem pool service as described earlier.



AMPS Security

SECURITY

Business-to-business communications requires protection against eavesdropping or unauthorized access in today's competitive environment. For this reason, it is important to have a good understanding of the security features of Circuit Switched Cellular and CDPD so that steps can be taken to protect vital communications when necessary.

CSC Security

There has been a lot of publicity about the interception of voice calls over the cellular network. This can be done at present with an appropriately modified radio scanner. It is not as easy as it might seem, however, since the scanner must generally be in the same physical cell and must be operating at the same frequency as the cellular phone. Further, if the user is moving from cell to cell, the scanner must be able to change frequencies to match those in the new cell. Nevertheless, as recent publicity indicates, voice calls over traditional analog cellular are not very secure.

Data, on the other hand, is another matter. Since data is sent through co-operating modems using specialized cellular protocols, it is more difficult to track. Cellular protocols may feature adaptive packet sizing and speed adjustments to accommodate changing channel conditions. It is difficult for an intercepting modem to track these dynamic changes. In addition, the modems may negotiate a compression standard such as MNP-7 or V.42bis that the intercepting modem will need to use to decode the data. Since the intercepting modem does not participate in the negotiation, it may not be aware of the agreed-to protocols in use by the sending and receiving modem for the communications session. This makes it very difficult to intercept data transmission over cellular. Nevertheless, the most secure way to prevent unauthorized interception is to use customized end-to-end security such as data encryption.

CDPD Security

CDPD Security

Security was a prime concern to the designers of the CDPD specification. Since CDPD is a digital data transmission standard from the outset, it was important to build in protection for the most vulnerable part of the link—namely the airlink interface. A basic three-step approach is used:

1. Establish an encrypted channel
2. Authenticate the mobile device
3. Encrypt the data for transmission over the airlink

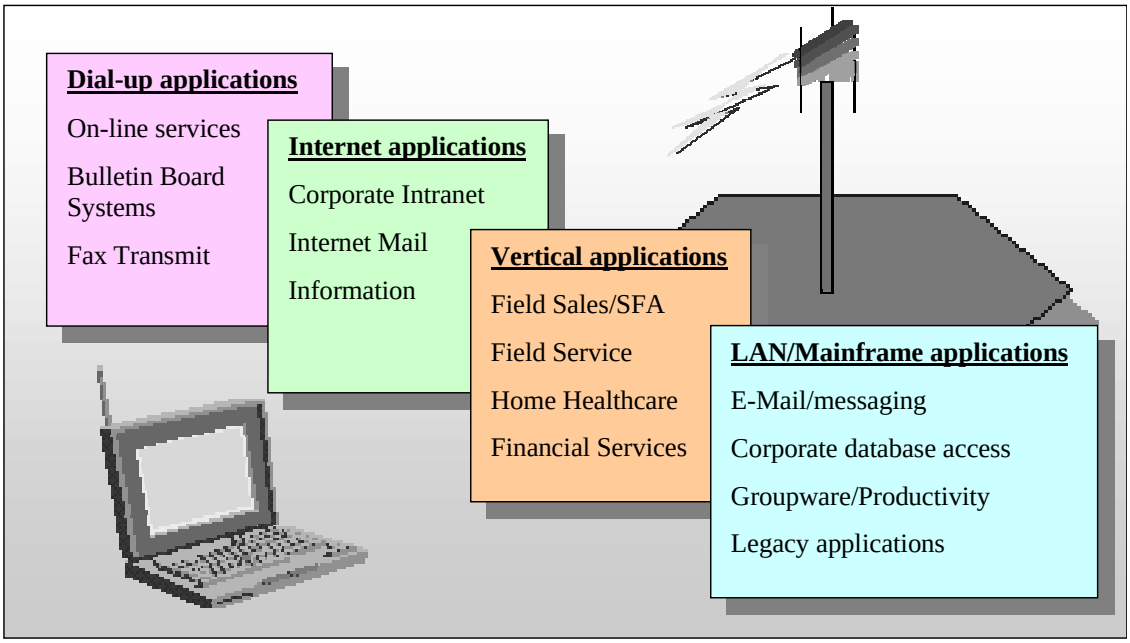
To accomplish the first two tasks, the mobile client and the home MD-IS server exchange secret encryption keys for decoding the data along with dynamically changing authentication codes for authorizing the device. The method used is called Diffie-Hellman public key encryption negotiation. To accomplish the third task, RSA Data Security's RC-4 encryption standard is used because of its high degree of security combined with its compactness and good performance. These measures all work to prevent unauthorized use of network addresses and protect data transmission from eavesdropping over the airlink. The result is very robust security for all communications between the mobile device and the serving MD-IS.

In addition, CDPD transmission may employ data compression (such as standard V.42bis used in most high-speed modems), which would also have to be properly decoded, along with channel hopping, which is difficult for a scanner to track.

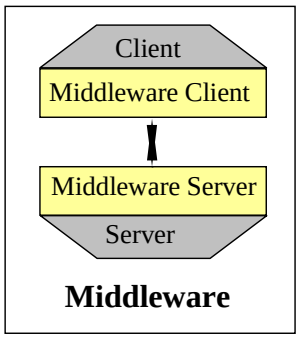
Of course, just as in CSC, users may still employ customized end-to-end security methods if they desire an even higher degree of security for the entire link.

APPLICATIONS

A variety of applications are appropriate for use with Circuit Switched Cellular and/or CDPD. The following depicts some of the major application types.



The following are some of the major application types.



Middleware

An important category of applications support is known "middleware." Middleware basically makes normal wireline applications work reliably over a wireless connection. This is important because of the adverse environment presented by wireless along with the narrower bandwidths and slower response times. Middleware fools the application into thinking it is operating normally over a wired connection, thus enabling standard wireline applications to be used in a wireless mode. Typically it provides a client/server arrangement for end-to-end communications that may also include data encryption for improved security and data compression for improved performance. An additional feature may also include the ability to do "transaction recovery." This enables an interrupted communications session to pick up where it left off rather than having to start over from scratch with a re-transmission. This saves time, thereby reducing cost.

One example of a middleware product is Ericsson Virtual Office (EVO). EVO is designed to support wireless or wireline access from mobile PCs to LAN-based Microsoft BackOffice applications such as Microsoft Exchange. Applications include e-mail, fax, database access, file transfer, Internet access, and group scheduling.

Another example of middleware is Motorola's AirMobile, which supports Lotus cc:Mail Mobile over a wireless link. AirMobile uses software at both ends—at the client and at the server—and supports end-to-end encryption and data compression along with the ability to selectively filter message transmission by message size.

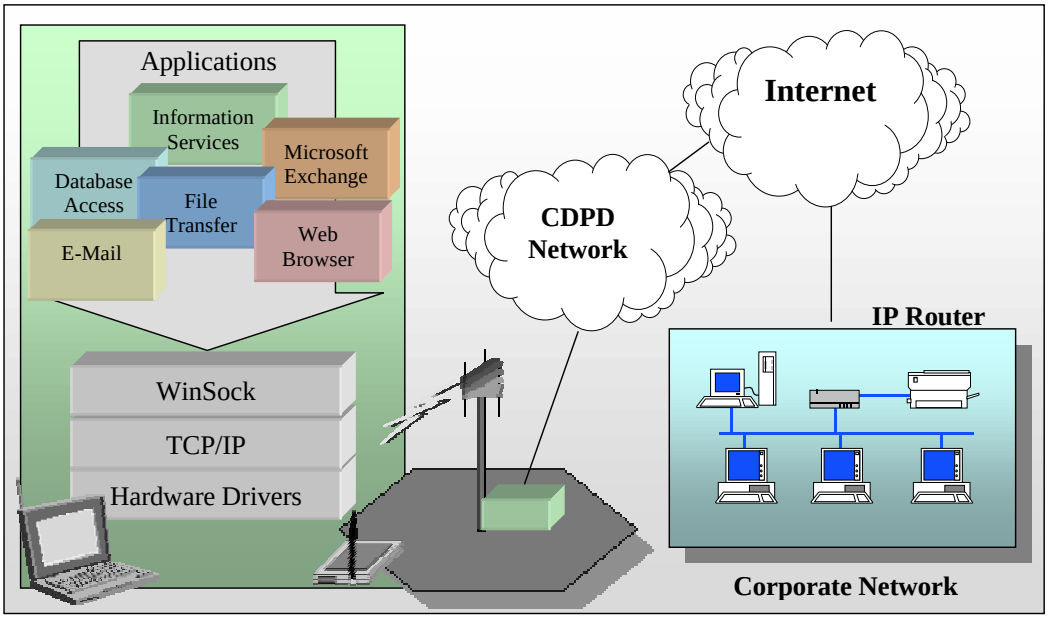
E-Mail

Since electronic mail is one of the most important applications for wireless data, it is desirable to understand some of the criteria for selecting good e-mail software, as well as which wireless service to use when. Whether CSC or CDPD is used, for example, may depend on the size of e-mail attachments, if any. CSC is more appropriate for handling large messages and/or attachments, while CDPD is good for handling shorter messages and attachments. A potential good candidate for a wireless electronic mail application over CDPD might meet the following criteria:

- Support a client/server TCP/IP protocol
- Support a client that will permit the viewing of email headers and attachment sizes before downloading. (For example, Microsoft Exchange or a client supporting the Internet Mail Access Protocol (IMAP4) such as Netscape Communicator or Internet Explorer).
- Support a client that provides the ability to operate in an off-line, disconnected mode, so you send email without having to be connected to the network. (It gets sent on the next connection).

Internet Applications

Since CDPD supports standards-based TCP/IP Internet protocols, many Internet applications may work over CDPD without modification. The following diagram illustrates how a variety of applications may use a standard TCP/IP stack and the Windows Sockets interface to communicate through CDPD over the Internet.



COMPAQ SOLUTIONS

Overview

The goal of the Compaq Integrated Wireless Solution is to provide a convenient and complete mobile data communications center in a Compaq notebook computer environment. To accomplish this, Compaq worked with wireless service providers and 3rd-party CDPD experts to produce two solutions for Compaq notebooks: 1) a one-card solution consisting of the Compaq SpeedPaq Cellular PC Card for Compaq notebooks with built-in modems, and 2) a two-card solution consisting of the Compaq SpeedPaq 336 Telephony Modem and the Compaq SpeedPaq Cellular PC Card for other Compaq notebooks. Both of these solutions turn Compaq notebooks into complete mobile data communications centers operating over CSC and CDPD.

One-Card Solution

One-Card Solution

The one-card solution consists solely of the Compaq SpeedPaq cellular card. This card is a Type II PCMCIA card and only occupies one slot by taking advantage of the modem already designed into the notebook computer. This card supports the analog AMPS technology-based circuit switched cellular network as well as the CDPD network, and represents the ultimate in wireless convenience and portability. It has a removable swing-up antenna attached and comes with the appropriate software for making and monitoring connections to the CSC and CDPD networks. An antenna extension is included for enhancing the signal strength in fringe coverage areas. The following picture shows the one-card solution being plugged into a Compaq notebook PC:

Compaq Notebooks Supported

The one-card solution is supported in the Compaq Armada 7700 and 7300, and may be offered as an option for other appropriate Compaq notebook computers in the future.

Two-Card Solution

Two-Card Solution

The two-card solution is intended for those notebook computers without built-in modems, such as the Compaq Armada 4100 series. It consists of the Compaq SpeedPaq 336 Telephony Modem PC Card and the Compaq SpeedPaq Cellular PC Card. The Compaq data/fax modem card plugs into the top slot and the cellular card plugs into the slot underneath. The two cards are connected together by a small, unobtrusive connector plugged into the outside of the cards. The antenna for the cellular card may swivel out of the way when not in use. As with the one-card solution, an antenna extension is included. The data/fax modem card supports full 33.6Kbps data/14.4Kbps fax landline performance and is also designed to support the cellular radio card, or to plug directly to a compatible cellular phone using the appropriate direct-connect cable. The following is a picture of the two-card solution before the cards are plugged into the two PCMCIA slots:

Compaq Notebooks Supported

The two-card solution is supported in the following Compaq Notebooks:

- Compaq Armada 4100 series
- Compaq Armada 1500 series (requires disabling the internal modem)

Benefits & Features

Product Benefits

Some of the benefits of the Compaq Integrated Wireless Solution are summarized as follows:

Benefit	Description
Convenient to Carry and Use	It is in the form of PCMCIA Type II plug-and-play cards, making it easy to setup, to use, and to carry. No separate battery or charger is needed
Access Anytime/Anywhere	Anytime/anywhere access to time-critical information via the Internet and dial-up access
Complete Solution	It is a complete mobile data communications center all in one place supporting landline data, landline fax, circuit-switched cellular data, and CDPD
Compaq Quality	Compaq designed and tested for quality and performance
Compaq Support	One-stop shopping and support for Compaq portable PCs and wireless solutions

Product Features

Some of the main features of the Compaq Integrated Wireless Solution are as follows:

SpeedPaq 336 Telephony Modem

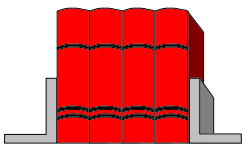
- Included in two-card solution
- Flush mount Type II PCMCIA Plug & Play PC Card
- 33.6Kbps data rate
- 14.4Kbps Group III fax
- MNP-10, ETC cellular data protocol support
- Optional direct-connect to a cellular phone
- Can function as a stand-alone modem

SpeedPaq Cellular PC Card

- Flush mount Type II PCMCIA Plug & Play PC Card
- AMPS circuit-switched data to 14.4Kbps and above
- CDPD to 19.2Kbps
- Connects directly to SpeedPaq 336 Telephony modem (2-card solution), or Connects directly to selected internal Compaq modems (1-card solution)
- Includes antenna cable extension to improve signal strength in fringe coverage areas

SpeedPaq Cellular Manager Software

- One-button switching between landline, AMPS, CDPD
- Displays settings, signal strength, channel number
- Automatically configures TCP/IP stack



Resources

RESOURCES

For more information on Compaq Computer Corporation, products, and solutions, visit Compaq's web site at www.compaq.com.

For more information on CDPD, including specifications and coverage, visit the CDPD Forum web site at www.cdpd.org.

For more information on cellular and CDPD service providers, visit one of the following web sites:

AT&T Wireless Services, Inc.:	www.att.com/wireless/data
GTE Wireless:	www.datalife.gtem.com
Bell Atlantic/NYNEX Mobile:	www.banm.com
SNET Mobility, Inc.:	www.snet.com
Ameritech Cellular Services:	www.ameritech.com/products/wireless
Comcast Cellular Communications, Inc.:	www.comcastcellular.com

For more information on middleware and other solutions, visit one of the following web sites:

MicroAge	www.microage.com
Wireless Telecom, Inc.	www.wiretel.com