Cellular Wireless Modem Primer

wireless internet portability mobility GSM/GPRS CDMA wireless internet portability mobility GSM/GPRS CDMA wireless internet portability mobility GSM/GPRS CDMA wireless internet portability mobility GSM/GPRS CDMA wireless internet portability mobility GSM/GPRS CDMA wireless internet portability mobility GSM/GPRS CDMA wireless internet portability mobility GSM/GPRS CDMA wireless internet portability mobility GSM/GPRS CDMA wireless internet portability mobility GSM/GPRS

MultiTech® Systems

Content

Cellular Wireless Modem Primer

Introduction

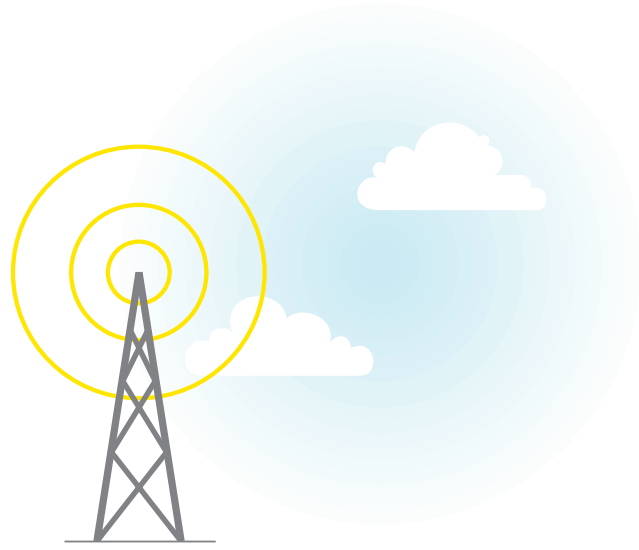
Cellular wireless modem technology can be a confusing topic. Especially as it relates to the transferring of data over a cellular network. But, Multi-Tech is here to tell you that it is easier to comprehend than you might think. In fact, we like to say a cellular modem is "just a modem!"

What do we mean? Well, to start, a cellular modem works much like a standard analog dial-up modem in that it connects to your computer or host device through a serial interface and configures and dials using AT commands. Where it differs is that it uses a wireless cellular network to make the connection through its antenna as opposed to a physical connection to an analog phone line. Beyond the connection, it acts and functions just like a regular modem.

The real learning curve, however, lies with cellular technology itself. After all, cellular wireless has really only become mainstream in the last few years. Therefore, the goal of this primer is to educate you on cellular wireless modem technology by comparing it to another technology that most of us are familiar with: the analog modem.

We'll start by comparing the history of modems over the Public Switched Telephone Network (PSTN) and the wireless network. Next, we'll illustrate the similar network architecture and primary modes of connections. Continuing, we will explain the steps you'll need to take in order to implement your wireless solution. Lastly, we'll familiarize you with the common applications and additional benefits you'll receive with wireless technology.

After reading this primer, you should have a good understanding of wireless data technology, how to implement your Multi-Tech wireless modem solution, and the benefits of utilizing a Multi-Tech wireless modem in your application.



History of Modems

Over the PSTN

Modems came into existence as a way to allow terminals to connect to computers over standard phone lines. The word "modem" is a contraction of the words modulator-demodulator. The sending modem modulates the data into a signal that is compatible with the phone line, and the receiving modem demodulates the signal back into digital data.

Multi-Tech's first modem, the Acoustic Coupler began shipping in 1971.

The first commercial modem was developed in 1970. Over the course of 30 years, advancements in technology brought analog dial-up modem speeds from 300 bps to 56K bps. In the analog dial-up world, 56K is probably the fastest speed we will achieve over the PSTN network.

Over Wireless Networks

Wireless modems work the same way as a dial-up analog modem, except they convert digital data into radio signals and back. What's interesting is that the evolution of the modem over a cellular wireless network has occurred at a much more rapid pace. In fact, the first wireless modem was developed in the 1990's and over the course of only 14 years speeds have gone from 9,600 bps to 153K bps. These speeds are expected to get even better as the technology evolves.

In the cellular world, there are two competing standards: GPRS and CDMA. To see how they compare, take a look at our technology comparison chart:

Cellular Wireless Data Technology Comparison

	GSM/GPRS	CDMA2000 1xRTT
Connections	CSD (GSM) or Packet-switched (GPRS)	CSD (IS95-B) or Packet-switched (1xRTT)
Data Rates	9600bps - 85K bps	9600bps - 153K bps
SMS Support	Yes	Yes
Service Activation	SIM card	Over-The-Air (OTA)
Billed	Per minute (CSD) or per megabyte (Packet data)	Per minute (CSD) or per megabyte (Packet data)
Access to IP Services	Yes	Yes
Carrier Support*	AT&T, T-Mobile, Cingular	Sprint, Verizon
Coverage	Major metro areas	Major metro areas

* U.S. National carriers listed. Carriers vary by country. For more detailed carrier support, go to www.gsmworld.com (GSM/GPRS) or www.cdg.org (CDMA).

Network Architecture

There are three primary modes of cellular wireless modem connections: Circuit-Switched Data, Short Message Service and Packet-Switched Data. All three share common characteristics to analog dial-up modem connections as illustrated in the following chart:

Primary Modes of Connection

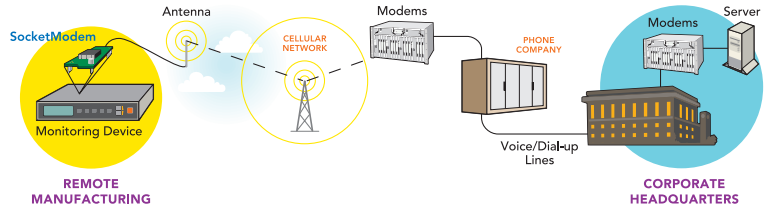
Analog Dial-up Modem	Wireless Modem
Modem-to-Modem Connection	Circuit-Switched Data
Instant Messaging	Short Message Service (SMS)
Modem-to-Internet Connection	Packet-Switched Data (Internet)

Circuit-Switched Cellular Data (CSD)

Circuit-switched cellular data connections work the same way dial-up modem-to-modem communication works, except they use the air interface to access wireless network resources. To illustrate, let's review a typical modem-to-modem circuit-switched data connection. First, you dial out using a modem connected via a phone line to the PSTN. The call is then routed through the switch at your local central office (CO) to the modem you are connecting to, opening the circuit. During the call, the routed line is dedicated to the two modems.

In a circuit-switched cellular data connection, the cellular transmission replaces the phone line connection to the PSTN. Therefore, you dial out via any analog cellular network, and are connected to a receiving modem pool that also resides on the wireless network. A circuit-switched cellular data connection allows you to connect from almost anywhere with a connection speed of up to 14.4K bps. CSD cellular wireless connections are ideal for applications that require a quick wireless replacement of an existing point-to-point analog dial-up connection. They integrate seamlessly with your current application requiring little infrastructure change.

Circuit-Switched Data Communication

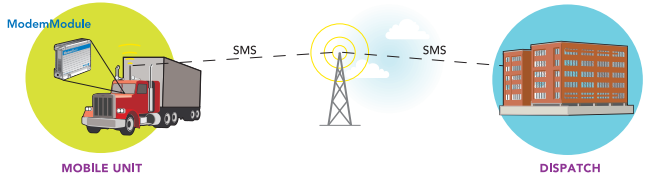


Short Message Service (SMS)

Short Message Service is analogous to Instant Messaging in the Internet world. It allows you to send text messages of up to 160 characters to mobile devices. SMS is similar to paging, however, SMS messages do not require the mobile device to be active and within range and will be held for a number of days until the device is ready to receive them. SMS messages are transmitted within the same cell or to anyone with roaming service capability.

SMS provides mobile-to-mobile, mobile-to-email, and email-to-mobile communication. The messages are sent to an SMS server. The server then forwards them to their mobile endpoint or to an SMTP mail server for Internet delivery. A good example of an SMS data application would be notifying a driver of the address of their next pickup.

SMS Data Communication



Packet-Switched Cellular Data

Packet-Switched cellular data involves overlaying a packet based air interface onto existing circuit-switched networks. This gives the user an option to use a packet-based data service. The Internet is an example of a packet data network.

Packet switching is a technique where the information (voice or data) to be sent is broken up into packets, of a few Kbytes each, which are then routed by the network between different destinations based on addressing data within each packet. Use of network resources is optimized as the resources are needed only during the handling of each packet.

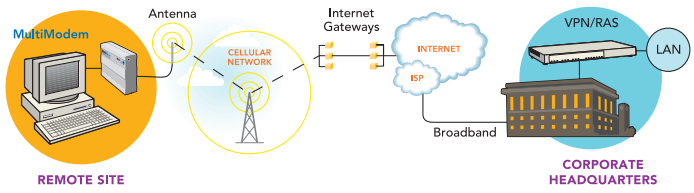
In the cellular world, this efficient use of scarce radio resources means that large numbers of users can potentially share the same bandwidth and be served from a single cell. The actual number of users supported depends on the application being used and how much data is being transferred.

To illustrate, let's look at an analog dial-up modem-to-Internet connection. First, your modem connects to an Internet service provider (ISP), and the ISP connects you to the Internet. In order to do this, the modem routes packets between you and your ISP. The ISP receives each packet and routes it appropriately onto the Internet. The same process occurs to get data from the ISP to your computer.

Packet-switched cellular data, used by GPRS and CDMA connections, works exactly the same way. It enables mobile Internet functionality by allowing interworking between the existing Internet and the cellular network. Any service that is used over the fixed Internet today – File Transfer Protocol (FTP), web browsing, chat, e-mail, telnet is available over the cellular network as well.

Packet-switched cellular modem connections also facilitate instant connections whereby information can be sent or received immediately as the need arises, subject to radio coverage. In fact, cellular modem connections are often referred to as being "always connected". High immediacy is a very important feature for time critical applications such as remote credit card authorization where it would be unacceptable to keep the customer waiting for even thirty extra seconds.

Packet-Switched Data Communication



Implementing Your Wireless Modem Solution

The process of implementing your wireless modem solution is fairly straightforward, and can be broken down into three basic steps: determining your wireless technology, choosing a carrier and a plan, and activating the service.

Determining Your Wireless Technology

Before you begin looking at wireless modem technology, you must first decide whether you are going to go with GSM/GPRS or CDMA (See the Wireless Data Technology Comparison chart on page 2). The wireless modem you choose is designed specifically to support one technology or the other.

Choosing a technology should really be based on the coverage of the carrier, the application where it is being used, and whether you have (or prefer) a relationship with one carrier over another. A primary difference between the technologies is that CDMA is faster than GPRS. In addition, CDMA is also slightly more expensive both in the hardware and in the service.

For more detailed information on GSM/GPRS and CDMA technologies visit the following web sites at www.gsmworld.com (GSM/GPRS) and www.cdg.org (CDMA).

Choosing a Carrier and a Plan

After you've chosen your technology, then you need to choose a carrier that offers it. There are many carriers out there offering wireless data service. You need to find one that meets your needs based on their network coverage.

In addition to looking at coverage, you also need to look at the wireless data plans the individual carriers offer. These plans vary widely in how the service is billed. Speaking in generalities, the following chart outlines the types of costs associated with a dial-up analog modem application as compared to the plans available for wireless data applications.

Carrier Plans

Internet Application (Packet Data)	
Analog Dial-up Modem	**Wireless Modem**
Monthly Phone Line ($25 - $50) + ISP Charge ($9.95 - $19.95)	Unlimited monthly data wireless plan w/ carrier ($29.95 - $59.95+) **OR** Monthly XX Megabyte plan ($39.99) + charge for exceeding allowance (.004 per KB)
Point-to-Point Application (CSD)	
Analog Dial-up Modem	**Wireless Modem**
Monthly Phone Line ($25 - $50) + Long Distance Charges (if applicable)	Same data wireless plan above + extra monthly charge for incoming CSD calls ($10.95) + per minute charges associated with those calls

Note: Plans vary widely per carrier. These costs are for example only.

To further explain, let's look at a common application: using your cellular wireless modem to connect to the Internet. To do this, you can use Dial-up Networking in Windows just like you would with an analog modem. The difference is that instead of paying a monthly charge for the analog line and a monthly charge to an ISP you simply set up a wireless data account with a wireless carrier. In this case, your wireless carrier becomes the ISP as they provide the connection to the Internet.

Activating the Wireless Service

Once the carrier and plan have been determined, then you need to activate the wireless data service with your modem. This process is different depending on the technology.

With GPRS, the process of activating the cellular data service is much like activating a cell phone. Once you have set up an account with your carrier, they (the carrier themselves or a third party agent) will provide you with a SIM (Subscriber Identity Module) card. This SIM card contains all of the access rights including identification for billing. The card also contains storage space for SMS and a phone book. It is plugged into a slot in the front of your wireless modem. The SIM card can be swapped out easily with new hardware providing you with more flexibility and mobility.

With CDMA, the wireless modem, depending on the carrier, utilizes IP-based Over-The-Air (OTA) activation technology. Upon installation, the modem immediately and securely registers onto a wireless network via standard registration messaging. The wireless network automatically identifies the device (through the Electronic Serial Number), collects user data, and completes the activation and provisioning. In most cases, the wireless modem is pre-provisioned for the various carriers, which means you need to order a specific model for your carrier of choice.

Applications

The applications for a cellular wireless modem are exactly the same as those for a standard dial-up modem. In addition, GSM/GPRS and CDMA facilitate new data applications that were previously not available over dial-up connections, such as vehicle tracking and job dispatch.

Applications

Analog Dial-up Modem	Wireless Modem
Appliances	Appliances
ATM Terminals	ATM Terminals
Automotive	Automotive
Data Collection	Data Collection
Gas Pumps	Gas Pumps
Industrial and Medical Remote Monitoring	Industrial and Medical Remote Monitoring
Internet Applications (FTP, e-mail, web browsing)	Internet Applications (FTP, e-mail, web browsing)
Remote Diagnostics	Remote Diagnostics
Remote Metering	Remote Metering
Remote LAN Access (VPN)	Remote LAN Access (VPN)
Security Systems	Security Systems
Vending/Gaming Machines	Vending/Gaming Machines
	Job Dispatch
	Vehicle Tracking

Benefits

In general, wireless modems provide a seamless integration with your application. They connect to your host device through an RS-232 or USB interface, configure and dial using AT commands, and connect to the cellular network through an antenna. What's more, they provide additional benefits above and beyond dial-up analog modem connectivity including better accessibility, portability, mobility and an overall cost savings.

Accessibility

In some applications, or even some emerging markets, access to a standard PSTN line for a dial-up connection can be difficult. With cellular wireless, you can install your device/machine and connect to the Internet anywhere you can get a cellular connection.

Portability

With a dial-up modem, your device/machine is connected via a physical line providing limits to where it can be located. With cellular wireless modems, you can locate your device/machine anywhere you can get a cellular connection, which means you can easily move it around. This increased flexibility allows you to move a vending machine, an ATM, or a convention kiosk to different locations with ease.

Mobility

Mobility is a completely new application that was previously not available to dial-up modems. Cellular wireless modems, for example, are ideal for vehicle tracking as they can be paired with a Global Positioning System (GPS). In addition, nonvoice cellular wireless services can be used to assign and communicate new jobs from office-based staff to mobile field staff. The 160 characters of a short message are sufficient for communicating most delivery addresses such as those needed for pizza delivery or a courier package delivery. With GPRS or CDMA, a photograph of the customer and their premises could even be sent to the field representative.

Cost Savings

Utilizing cellular wireless technology can also eliminate the hassle and expense of running PSTN lines to locations where they are not readily available. And, while the cost of cellular wireless modems might be more expensive than traditional analog dial-up modems, the overall service plan is often less expensive. In addition, with CSD applications, you save the cost of long distance charges otherwise accrued with a traditional dial-up modem-to-modem connection. There is also savings associated with a wireless solution's quick time-to-market, providing you with rapid deployment of your application.

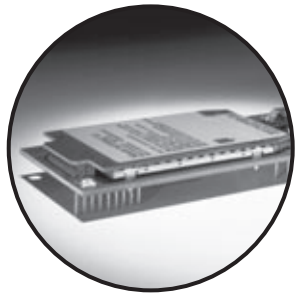
Multi-Tech's Wireless Modem Solutions

Multi-Tech's wireless modems utilize GSM/GPRS or CDMA technologies to communicate data and voice over worldwide cellular communications networks. The external models are ideal for applications needing a complete wireless modem equipped with an industry standard RS-232 or USB interface. The embedded models are ideal for developers looking to add wireless communications capabilities with a minimum of development time and expense.

MultiModem GSM/GPRS and CDMA

- External data/fax/voice wireless modem
- GSM/GPRS or CDMA2000 1xRTT models
- Rugged industrial chassis
- Desktop or panel mounting
- RS-232 or Universal Serial Bus (USB) interfaces
- LED status display

SocketModem GSM/GPRS and CDMA



- Embedded data/fax wireless modem
- GSM/GPRS or CDMA2000 1xRTT models
- Easy integration
- Space efficient Universal Socket Connectivity
- Fully type approved

ModemModule GSM/GPRS and CDMA

- Embedded data/fax/voice wireless modem
- GSM/GPRS or CDMA2000 1xRTT models
- Compact industrial chassis
- Board-to-board or board-to-cable mounting
- Fully type approved

Since 1970, Multi-Tech has provided corporations in over 135 countries with superior modem technology, delivering the most reliable and highest speed connections possible. By consistently exceeding customer expectations in quality, performance and support, Multi-Tech has become the world's most successful maker of corporate modems. Cellular wireless modem technology is a logical next step that best matches our customer needs and our experience.

For more detailed information on Multi-Tech's cellular wireless modem solutions, go to **www.multitech.com/PRODUCTS/Categories/Modems/wireless/** or give us a call at **1-888-288-5470 (U.S./Canada) or +(763) 785-3500**.

Glossary of Terms

Cell - The geographical area served by a cellular tower.

CDMA (Code Division Multiple Access) - A digital cellular technology that uses spread-spectrum techniques. Unlike competing systems, such as GSM, that use TDMA, CDMA does not assign a specific frequency to each user. Instead, every channel uses the full available spectrum. Individual conversations are encoded with a pseudo-random digital sequence.

CDMA2000 1xRTT - 2.5G CDMA, doubles the voice capacity of cdmaOne networks and delivers peak packet data speeds of 307 kbps in mobile environments. Backward compatible with cdmaOne networks.

CO (Central Office) - The central office is the lowest, or most basic level of switching in the PSTN network.

CSD (Circuit-Switched Data) - Circuit-switched data provides a temporary connection of two or more communications channels using a fixed, non-shareable path through the network.

FTP (File Transfer Protocol) - A protocol used to transfer files over a TCP/IP network (like the Internet).

GPRS (General Packet Radio System) - A standard for wireless communications which runs at speeds up to 85K bps. GPRS, which supports a wide range of bandwidths, is an efficient use of limited bandwidth and is particularly suited for sending and receiving small bursts of data, such as e-mail and Web browsing, as well as large volumes of data.

GSM (Global System for Mobile communications) - One of the leading digital cellular systems. GSM uses narrowband TDMA, which allows eight simultaneous calls on the same radio frequency. GSM was first introduced in 1991. As of the end of 1997, GSM service was available in more than 100 countries and has become the de facto standard in Europe and Asia.

Packet-Switched Network - A method of transferring information in which data is broken into small pieces, called packets, and transported over shared communications channels.

Provisioning - The process of expediting all the tasks between receiving a request for a service (for example: access to a wireless network) and making that service available to the customer.

PSTN - The Public Switched Telephone Network that traditionally routes analog voice/data calls from one location to another over copper wires.

OTA (Over-the-Air) - IP-based activation technology, used by CDMA networks, that utilizes the wireless network to automatically identify the device, collect user data and complete provisioning.

SIM (Subscriber Identity Module) - A smart card, used by GSM/GPRS devices, that securely stores the key identifying a mobile subscriber.

SMS (Short Message Service) - Similar to paging, SMS is a service for sending short text messages (up to 160 characters in length) to mobile phones/devices.

Telnet - The TCP/IP standard network virtual terminal protocol that is used for remote terminal connection service and that allows a user at one site to interact with systems at other sites as if that user terminal were directly connected to computers at those sites.

VPN (Virtual Private Network) - A private communications network that utilizes dedicated equipment and data encryption to securely connect remote sites or users together over the public Internet.

Notes

World Headquarters
Multi-Tech Systems, Inc
2205 Woodale Drive
Mounds View, MN 55112 U.S.A

Tel: (763) 785-3500 or (800) 328-9717
Fax: (763) 785-9874
Technical Support: (800) 972-2439

www.multitech.com

EMEA Headquarters
Multi-Tech Systems (EMEA)
United Kingdom
Tel: +(44) 118 959 7774
Fax: +(44) 118 959 7775

Multi-Tech Systems (EMEA)
France
Tel: +(33) 1-64 61 09 81
Fax: +(33) 1-64 61 09 71

Multi-Tech Computers Pvt. Ltd. (India)
Tel: +(91) 124-5010780 or 124-2340780
Fax: +(91) 124-2340776

86002052 02/04

MultiTech® Systems