Motorola

GSM Cellular
Data Communications
Training Guide

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Motorola Technology

Motorola's worldwide leadership in electronics and communications is once again demonstrated in the cellular phone and data products the company has proudly pioneered for use on the GSM network. As you'll see when you read through this short brochure, Motorola products offer your customers significant options that will let them choose how they want to use their GSM phone with a personal computer or similar digital data device. Whether sending data over a landline, or in an ideal cellular environment, or under demanding cellular conditions, Motorola gives your customers the option of selecting the best possible mode of operation.

There are also exciting new levels of performance available to Motorola customers in some of the products you'll see described on the next few pages.

Match that level of performance and new product innovation with the quality that the entire world has come to expect from Motorola products and you have a product line that's both fun and exciting to sell. But then, isn't that what you'd expect from a leader?

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What's this world coming to?

A financial advisor sits in a hotel room preparing for an important meeting with a customer the next morning when he realizes that he needs an important document that's stored on his computer back at the main office. It's late in the evening. Nobody is at the office. Tomorrow, he'll be leaving early in the morning, before anybody gets in. He has a laptop with a modem, but the hotel's phone services doesn't support a data connection from his room. So, he connects to the home office computer using his GSM phone. The file is downloaded. He's able to get a good night's sleep.

A sales representative has just left her customer's office. She's uncovered an exciting opportunity where time is of the essence. If she hurries, she could get her sales quotation in before the competition and probably get the business. So, right from her car, right from the customer's parking lot, she sends a fax to her office describing the information she needs and asking for a fast estimate to be prepared and sent to her client. Before she can pull out of the lot and cue up in traffic, the estimate will be on its way.

A surveyor needs to send drawings made of a remote site into the office before closing time. He knows he'll be in the field for three more days before returning, but the office needs the drawings right now. They were created on the spot, using his laptop computer, so he simply faxes them, right from the site, using his GSM phone.

A news reporter has taken some photos using her new digital camera and wants to get them to her newspaper editor before the next deadline. But it's a two hour drive back to her hotel room and the nearest available telephone connection. That would mean missing this evening's edition of the paper. Instead, she uses her laptop computer and her GSM phone to transmit the photo files, in full color, along with the fully typed copy of her story, straight to her editor's desk.

A businessman takes advantage of some time between flights at the airport terminal to log on to his office email (electronic mail) system. Using his GSM phone and a laptop computer, he downloads all of his correspondence for the day, even though his office is halfway around the world and his co-workers are all still in their beds sleeping.

Just a short time ago, these stories would have been science fiction. But now, they're happening every day. The cellular data communications revolution is upon us and your customers are looking for ways to get in on the action.

To help them, you need the right line of products and a little knowledge of how data communications work over the GSM network. With this book and the latest line of GSM data-ready products, Motorola has provided you with both.

More than just a telephone.

The word “telephone” comes from two Greek words: tele (meaning “at a distance”) and phone (meaning “sound, voice”). But the world is changing rapidly, and the telephone network is no longer used for transmitting merely voice sounds over long distances.

Today, more than 50% of the traffic on the world’s telephone network consists of pictures, text and data — anything that can be converted to a digital format. That’s because more and more people are making use of fax machines, email and the ability to send computer files back and forth. They’ve been using these technologies at the office for many years. But now they’re starting to use them at home and even while traveling.

Consider some of the following ways that cellular phones are being used right now for more than just voice messages.

The fax has become an indispensable tool for business in the nineties. But when you’re on the road, it’s not always easy to find a fax service. And when you do, it can be inconvenient and expensive to use. That’s why more people are using a notebook computer along with a cellular phone to send and receive faxes when they’re traveling.

Email is rapidly becoming as popular as the fax when it comes to business communications. At the office, many people routinely start their day by reading and responding to email. Now there’s no need to change that routine, even when you’re traveling. With a cellular phone and a notebook computer or other appropriate portable data device, it’s possible to read and respond to your email, forward messages to others or even compose and send messages to everyone on your list.

Network connections are also possible through a cellular phone. With a notebook computer and a cellular phone, you can dial into your main office network from a remote location and work much the way you would if you were at the office. Or, you can dial up the Internet as well as commercially available network services.

Data communications include much more than sending mere text back and forth. It includes not only the transfer of computer files, but full two-way communications between digital devices. With a cellular phone and an appropriate digital device, remote sensors and monitoring devices can send and receive data to a base station. Applications are growing rapidly for this type of communication. It’s being used by messenger and delivery services, meter readers, emergency rescue services, surveillance operations and even agricultural businesses. It’s used in exploring for oil, gathering data for weather and environmental research, and even for handling credit card transactions in remote locations.

Short message service is offered as a part of the basic GSM network. This feature allows the sending of short alphanumeric messages over the GSM network to subscribers who see them displayed in their handset. However, with a computer and the right software, it’s possible to manage a large volume of short messages with ease.

Because new applications for digital communications over cellular are added every day, it’s impossible to list them all. If you haven’t already had customers ask about them, you can expect it to start happening soon. You’ll find yourself answering questions like ...

“Can I use this phone with my portable computer?”

“Will I be able to receive faxes as well as send them?”

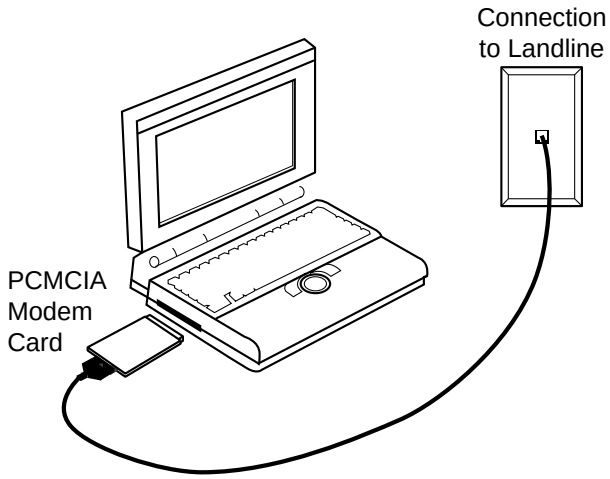
“What kind of modem will I need?”

“How can I hook up my PCMCIA modem to a cellular phone?”

You can answer all these questions and more if you have a basic understanding of data communications over the GSM network. This book is designed to give you that understanding.

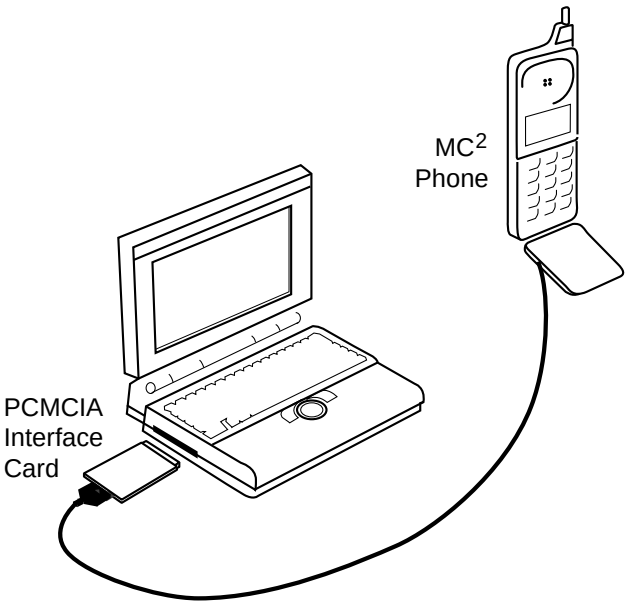
The Basic Connection

Normally, to connect two digital data devices over a telephone network, you need a modem. A modem is a device which translates digital information into sounds which can be sent over the phone system and translated back into digital information by another modem at the other end. A typical hook-up would look something like this ...



For a landline connection, you have to have a modem to convert data into sound.

However, the GSM network is a digital network. So there's no need for a modem to translate digital data into sound, not as long as you're using your data device with a GSM phone. To use a personal computer over the GSM network, all you need is an interface between your computer and your phone. The connection would look something like this ...

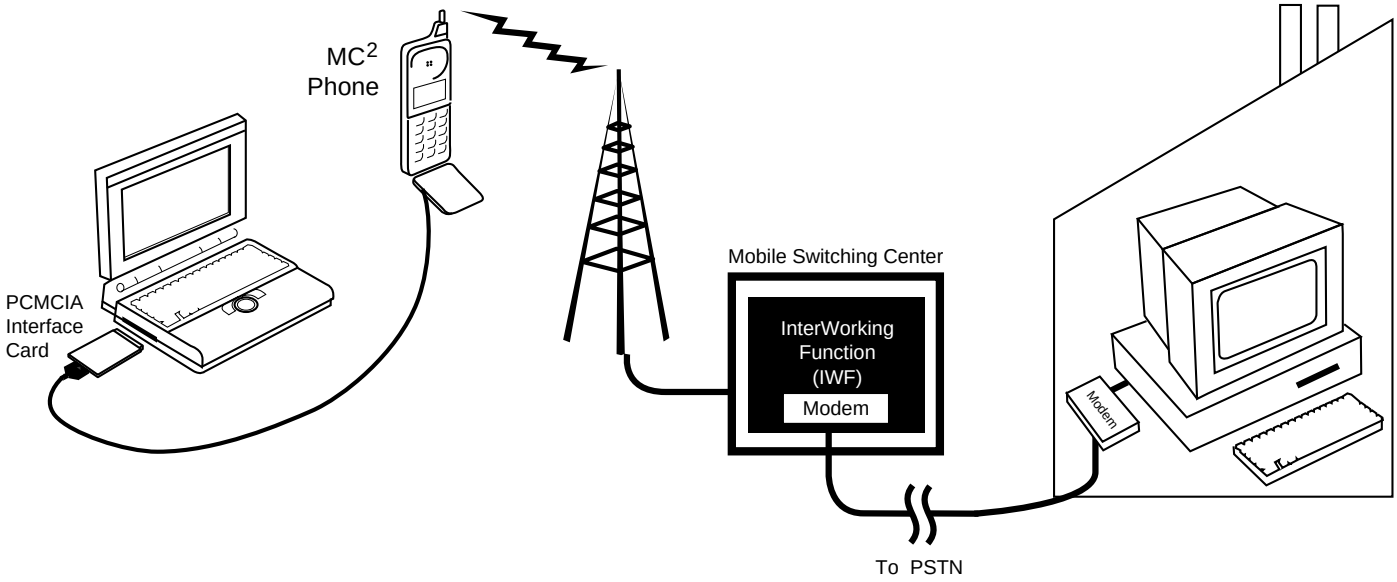


When you connect to a GSM phone, all you need is an interface.

Although there is no modem in the diagram above, there are a couple of important points that you should be aware of. The GSM phone in this case must be "data capable" since not all GSM phones can be connected through an interface to a digital device such as a laptop computer. Also, the GSM customer in this example must have subscribed to data service if the connection is going to work. We'll talk more about both of these issues later. For now, we just wanted to make the point that your customers use an interface card and don't need a modem, *as long they're using their data devices with a GSM phone.*

The fact is, a modem may enter into the picture somewhere along the connection. If your customer is calling a data device connected to a

landline, then two modems will be necessary, one connected to the landline device and one provided by the GSM network in something called the Interworking Function (IWF). Your GSM customer won't need a modem, but knowing that modems are involved, somewhere along the connection path, could be important. The connection would look something like this ...



There will even be times when one GSM customer *without a modem* calls another GSM customer *without a modem* , and there are still two modems in the connection because the call had to be routed over a landline to get from customer A to customer B. In such a case, the two network providers would provide the modems *behind the scenes.* The two subscribers wouldn't even be aware of them.

The digital device in all of these examples could be a personal computer, a personal digital assistant like the Apple Newton, a fax device, a credit card reader, almost anything. All your customer needs to get started is the digital device, an interface device, a data-ready GSM cellular phone and an account that will allow data transmissions. There's basically only one other decision to make. Some of your customers may want to use their digital device with their GSM phone one minute and with a regular landline the next. If they already own a modem, then all they need is a GSM interface. If they don't own a modem, they'll probably want an interface that includes a built in modem.

Motorola CELLect™ 1+ Interface Card

The Motorola CELLect™ 1+ card is a direct interface for use with Motorola MC² phones. The Motorola CELLect 2 card contains an interface for use with Motorola MC² phones and a modem for use with landline phones. This gives your customers the ability to choose the solution that best suits their needs.

Now, let's take a minute to investigate the Motorola product line in more depth.

Motorola CELLect™ 2 Interface/Modem

The Motorola Solution

Motorola 8400 phone with CELLect 2 Card

Motorola CELLect 1+ Card

Motorola CELLect 2 Card

Motorola offers a full range of communications products that you can offer to your customers looking to engage in data communications over the GSM network.

Not all GSM cellular phones will work with a digital device such as a laptop computer. A data-ready phone, like one of the Motorola MC² phones, is required. You can tell if a Motorola phone is data ready by looking for the MC² logo displayed on the phone. It means that the phone has been carefully designed to perform data communications in a cellular environment. MC² products perform especially well when used in conjunction with other Motorola data products, such as the CELLect interface cards described below. There are two types of GSM Motorola MC² phones available.

MC² 2400 phones are capable of transmitting data at a rate of 2400 bits per second (bps) over the GSM network. Most newer models are capable of operating at 9600 bps, but earlier models (which your customers may already own) operate at the 2400 bps speed. If your customer has a 2400 bps phone, you should make sure that the GSM network will support data transmissions at that speed.

MC² 9600 phones are capable of transmitting data at a rate of 9600 bits per second (bps) over the GSM network. Most newer Motorola phones are of this type.

There are two basic types of Motorola PCMCIA interface cards currently available.

The CELLect 1+ card is an interface card that provides the user with fax and data communications over the GSM cellular network. If your customer already owns a modem for use with their portable data device, all they need is an interface. In such cases, you may want to suggest the CELLect 1+ product. The CELLect 1+ card features flash upgradable software which can be easily updated without special equipment.

The CELLect 1+ card also features Digital Data Fast™ which supports the industry standard V.42bis compression protocol and is compatible with many modems supporting the same standard. This allows the CELLect 1+ card to support throughput speeds up to 36,000 bps (bits per second) over the GSM network. And it works *now* on existing unmodified GSM data networks.

The CELLect 1+ card is also V.110 compatible. If your GSM network provider offers an ISDN connection, and the user wishes to connect to another ISDN user (bypassing the network's IWF altogether creating a direct digital connection end to end) this feature can allow you to set up a call in 2-3 seconds rather than the 20-30 seconds required for traditional connections. However, even with an ISDN connection, the actual data transfer rate is still limited to 9,600 bps over the GSM network.

The CELLect 2 card is an interface card with the same advanced features of the CELLect 1+ card and includes a modem for use with standard landline phone systems. If your customer doesn't already have a good quality modem, you might want to suggest the CELLect 2 product since it includes a modem.

The CELLect 2 card also features V.42bis compression for landline use capable of delivering total throughput up to 57,600 bps.

This covers the basic products your customer will need to begin data communications over the GSM cellular network. You now know which products to recommend and how to connect them. The rest of this book has been designed for those who would like to better understand some of the more advanced features of these Motorola products.

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* NOTE: The earlier version of the CELLect 1 Card (Part Number S5571A) is not capable of non-transparent transmission, does not contain communication software in the package and is not V.110 compatible. Check your inventory to see which version of the product you have in stock.

CELLect 1+ Card

Standard Features:

- GSM data interface
- Digital Data Fast V.42bis compatible mode allows up to 36,000 bps throughput over the GSM network.
- V.110 compatible mode permits fast ISDN call setup.
- PCMCIA Type 2 card interface
- Communications and fax software*
- Industry standard Hayes AT command set
- Up to 9600 bps transparent/non-transparent asynchronous transmission*
- Flash programmable upgrades
- Group III, Class 1 & 2 fax

Standard Package Includes:

- Interface card
- Cable
- Phone mounting bracket for use with laptop computers
- Communication and fax software*
- Card and Socket Services

Part Number:
S5702A*

* NOTE: The earlier version of the CELLect 1 Card (Part Number S5571A) is not capable of non-transparent transmission, does not contain communication software in the package and is not V.110 compatible. Check your inventory to see which version of the product you have in stock.

CELLect 2 Card

Standard Features:

- GSM data interface and landline modem
- Digital Data Fast V.42bis compatible mode allows up to 36,000 bps throughput over the GSM network.
- V.42bis data compression in landline mode allows up to 57,600 bps throughput over landline
- V.110 compatible mode permits fast ISDN call setup.
- PCMCIA Type 2 card interface
- Communications and fax software
- Enhanced Hayes AT command set
- Up to 9600 bps transparent/non-transparent asynchronous transmission
- Flash programmable upgrades
- Group III, Class 1 & 2 fax

Standard Package Includes:

- Interface card
- Cable
- Phone mounting bracket for use with laptop computers
- Communication and Fax Software
- Card and Socket Services

Part Number:

Australia	S5671A
Germany	S5663A
Finland	S5666A
France	S5667A
Italy	S5668A
Norway	S5665A
South Africa	S5672A
Spain	S5670A
Sweden	S5664A
Switzerland	S5669A
UK	S5662A

Three basic types of data communications.

Data communications. To understand data communications there are a few basic concepts that you should be familiar with, such as transmission speed, rate negotiation, error correction, data compression, transparent vs. non-transparent service, and throughput. Many of these deal with modem technology, because whenever a call involves a data device on a traditional landline phone, modems will be involved.

Fax communications are a special type of data transfer. Sending and receiving a fax will involve many of the same issues just discussed. But fax transmissions must conform to one of two internationally accepted standards: Class 1 or Class 2.

For any two fax machines to establish a communications link, a number of events need to occur. The phone must be dialed at one end and answered at the other. Both machines must agree to use the same transmission speed, resolution, modulation scheme, etc. The image transfer must take place. Both machines must agree upon when it's time to start a new page and when it's necessary to change some of the settings agreed to earlier. Finally, somebody has to hang up the phone.

The intelligence necessary to handle these tasks could reside in the fax machine (the fax modem in the case of a PC with a PCMCIA card) or in the fax software. If your fax modem is a Class 1 device, it looks to the application software to handle all of these tasks. If your fax modem is a Class 2 device, it handles some of these tasks internally while leaning upon the software to handle the rest. So which is better? As you might guess, the answer isn't the same for everyone. While Class 2 fax modems might be a little faster (because they share some of the processing burden with your computer), they are harder to update. The "rules" that govern what happens during a fax transmission are constantly changing. With a Class 1 fax modem, when the ITU-T comes up with a change in the rules, you simply update your software. With a Class 2 fax modem, the rules are burned into a chip (EPROM). Sometimes, that chip can be loaded with new instructions (flash programmable) and sometimes it can't.

When helping your customers sort through this, there are two things to keep in mind. First, their software must match their fax modem. Some fax software will support both Class 1 and Class 2 so there's no problem. Second, fax modems are very class conscious. If one fax modem is Class 1 exclusively, it won't talk to a fax modem that's Class 2 exclusively.

To ensure the ultimate in customer satisfaction, Motorola has designed both CELLect cards so that they are both Class 1 *and* Class 2 compatible. Furthermore, the software that comes with every CELLect card is capable of operating in *either* mode.

Short Message Service (SMS) is a special type of data communication. It's part of the GSM specification which allows short alphanumeric messages (up to 160 characters) to be sent to any GSM handset. The message is displayed in the handset's window. Sent messages are stored by the GSM system until they can be delivered to the subscriber's phone. Messages can be sent to a specific subscriber, broadcast to a set list of subscribers, or even broadcast to a specific cell (for traffic reports and other local information).

The ability to send and receive these short messages is built into most GSM phones on the market today without the need for any additional equipment such as an interface card. However, to send a message from a phone, it's necessary to use the telephone keypad as an alphanumeric data entry device. It's possible, but it's tedious. For those customers who make frequent use of this service, a personal computer

will make the task much simpler. Messages can be entered from a standard keyboard and then sent to an easily managed list of recipients. To create and send SMS messages from a personal computer or digital assistant, your customers will need an interface card like the Motorola CELLect and the appropriate software.

Motorola provides software with every new CELLect 1+* card and CELLect 2 card that allows your customer to create short messages using a PC. These short messages are then sent over the cellular network as a normal data transmission to the GSM network host. There, these short messages are re-transmitted over the GSM network as SMS messages to the mobile recipient.

* NOTE: The earlier version of the CELLect 1 Card (Part Number S5571A) may not contain communication software in the package. Check your inventory to see which version of the product you have in stock.

REMEMBER: You can tell if a Motorola phone is data ready by looking for the MC² logo displayed on the phone. It means that the phone has been carefully designed to perform data communications in a cellular environment.

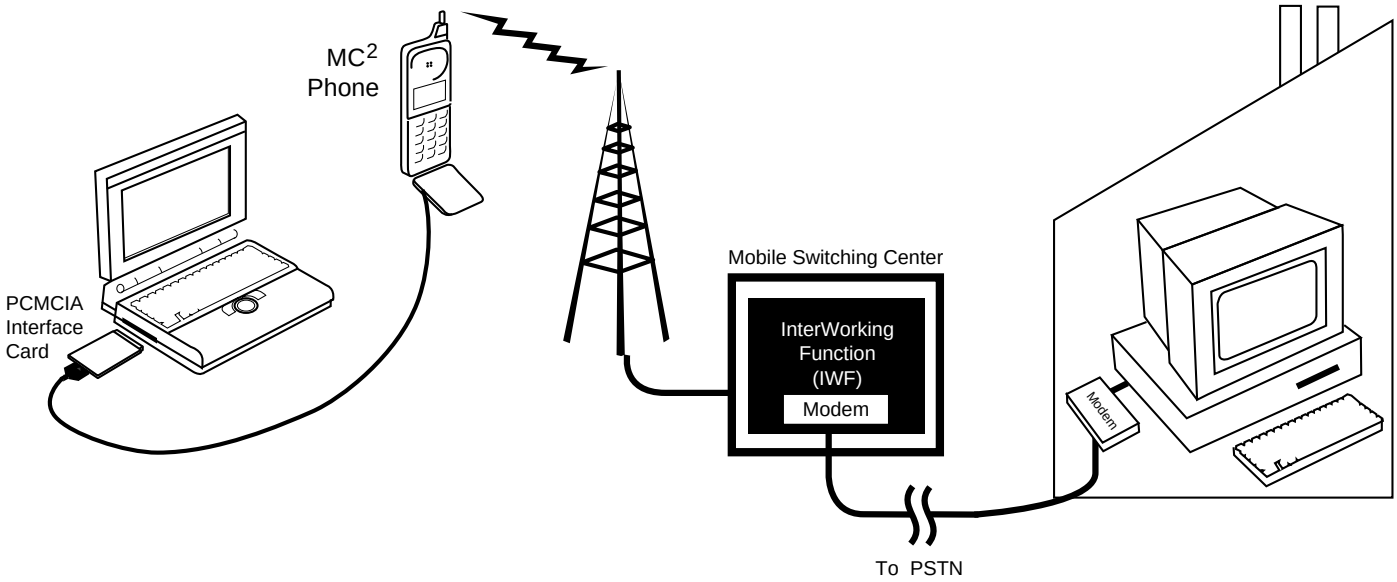
The Fundamentals of Data Communications

In this section, presented in what we hope is a logical and easy-to-follow order, are some of the concepts you'll need to understand in order to answer your customers' technical questions about data communications over the GSM network.

Modems. A modem is a device that translates digital information into sound that can be sent over any phone system and translates incoming sound back into digital information. (This process is referred to as MODulating and DEModulating the sound. Hence, the name MODEM.) Although the GSM network is already digital, when your customer is trying to establish a connection with a digital device that's connected to a standard landline phone system, two modems are necessary. (See page 2.) The GSM network will provide one modem. The digital device on the landline side must provide the other modem.

The performance of any connection will be largely dictated by the modems being used. When a connection is made from a GSM phone, through the IWF, through the modem provided by the GSM network and to a landline modem, the performance of that connection may be limited by one of the two modems in the path. Because of this, situations could arise where your Motorola phone supports data services which are not supported by the network in your area.

Whenever two modems connect, the speed at which they can send and receive data is limited by the slower of the two units.



Transmission Speed. The speed at which modems send data back and forth is measured in bits per second (bps). The fastest speed allowed by the GSM network is 9,600 bps although there are modems on the market which are capable of achieving transmission speeds that are much faster. Most modems will support more than one transmission speed, allowing them to communicate with older modems at slower speeds.

Data Compression. Computer engineers have come up with a number of clever schemes to compress data. Most data compression techniques are similar to using abbreviations in written language. "ST." stands for "STREET." But "ST." has three characters and "Street" has six characters. If a computer were to take the word "STREET" and replace it with "ST." it would have compressed the data by 50%. Later, the data can be expanded back to its original form and no one would know that anything had happened except that the data would have taken 50% less time to send.

These data compression schemes are usually established by an independent international agency known as ITU-TC (International Telecommunications Union - Telecommunications Committee) and carry designations such as MNP5 or V.42bis. Before a data compression scheme can be used, both modems must be compatible with it. So the first thing that any two modems do, before a connection can be opened, is make sure they're both talking the same language. It's called *negotiation.*

Negotiation. Before any data can be sent from one digital device to another, both devices must go through a negotiation process. This is a back and forth process where they attempt to find a common language and a common speed at which they can operate. But it's not simply a matter of determining whether or not they are both capable of operating at the same speed. The connection must also be clear enough to handle the desired speed. So two devices might both be capable of transferring data at 9,600 bps, yet have a bad connection. When this happens, they'll attempt to step down to a slower (less demanding) speed. In addition to negotiating over the compression protocol and transmission speed, both devices must agree upon a common error correction protocol.

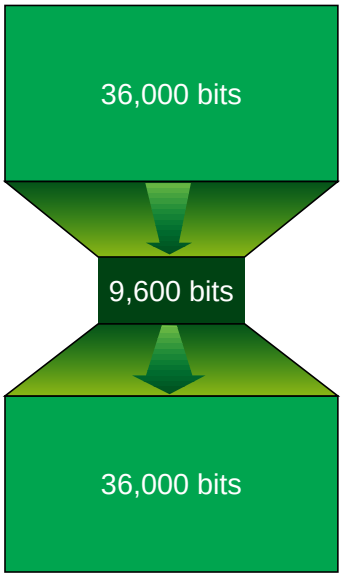
Error Correction. Data communication often involves important activities. The information being sent might include anything from financial transactions to lifesaving medical information. So the data that's received has to match the data that's sent, exactly. There's no room for error. But errors can and do occur due to interference along the way. To overcome this problem, the receiving machine will stop every so often and echo the information received back to the sending machine. If it doesn't match, the whole "packet" will be discarded and sent again.

Error correction schemes are included in common modem protocols such as V.42. But the GSM network has its own internal error correction scheme known as the Radio Link Protocol (RLP, discussed in the following section). Although it may seem as though the more error correction you have, the better off you are, there's a price to be paid for error correction. While data compression speeds things up, error correction slows things down. Unnecessary layering of one error correction scheme on top of another can reduce the ultimate *throughput* of the connection.

Throughput. Let's say that we have a connection that's capable of transferring data at 9,600 bps, but the data has been compressed down to 27% of its original size. This means that we can take 36,000 bits of data, compress it down to 9,600 bits, transfer it in one second, and expand it back up to 36,000 bits at the other end. So it appears as though the data is coming through at 36,000 bps. That's not really the speed of the connection, but it's the speed at which the data is coming through, known as *throughput.* However, on a bad day with lots of interference, many packets of data will have to be transmitted over and over again before they're finally received without error. Our ultimate throughput could be cut back drastically.

So a true 9,600 bps connection could appear to be operating at twice that speed, or half that speed, depending upon the compression protocol that's in use, the error correction scheme that's in use, and the quality of the connection. Ultimate customer satisfaction is based on the actual throughput achieved. Motorola has always designed its products with a view toward obtaining the highest possible throughput.

However, some data files have more room for compression than others. The throughput you can achieve depends upon the type of file you're sending.



Computer Files Don't All Compress At The Same Rate

Email files typically compress to about 60% of their original size. Flat text files typically compress to about 50% of their original size. Bitmapped graphic files can often be compressed to nearly 30% of their original size. JPEG graphics are already compressed and normally don't lend themselves to further compression.

Fundamentals of GSM Data Communications

Four Requirements for GSM Data Communications

1. A data-ready GSM phone
2. An interface
3. A GSM provider who offers data transmission service
4. An account which includes all necessary services. (In most cases, a separate data/fax number may be needed.)

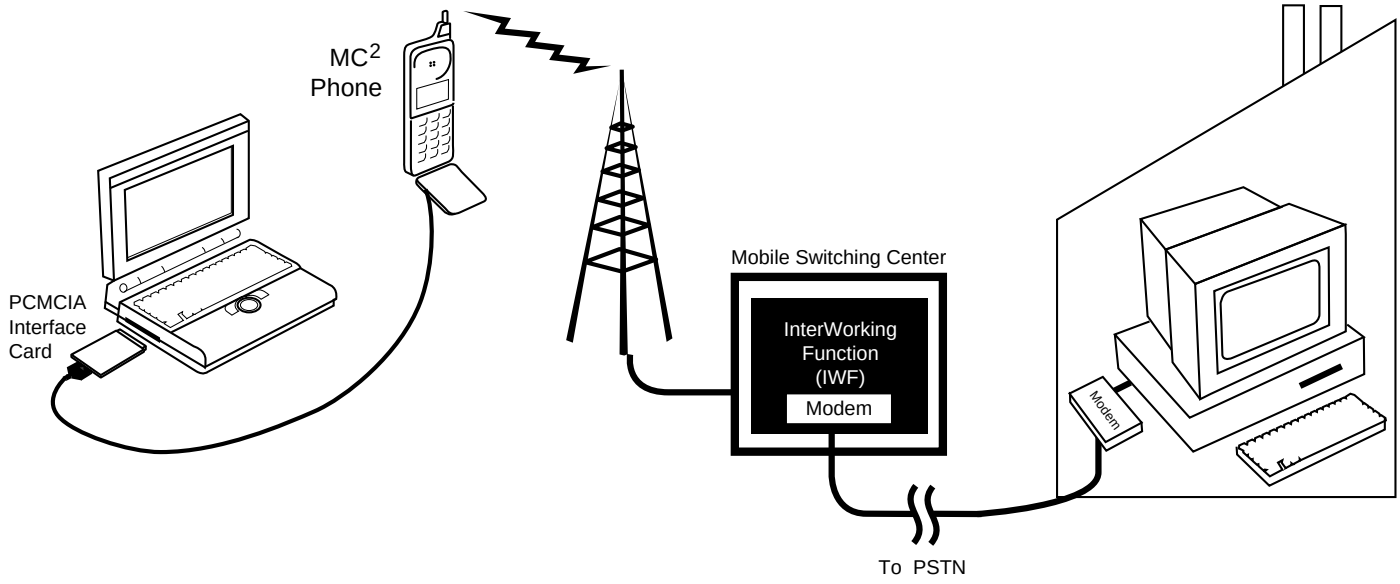
In this section, we'll cover some of the basic concepts necessary to understand data communications over the GSM Network. First, you'll want to help your customer to understand that data communications will not be possible unless four basic conditions are met. They must have a data-ready GSM phone. They must have an appropriate interface between their GSM phone and the data device they're using. They must be using a GSM network provider who offers data transmission services. It's also necessary to make sure that all of the appropriate data services have been enabled on your account before you can use them.

Each subscriber has a SIM card which identifies the services enabled on that customer's account.

Subscriber Identity Module (SIM) Cards contain a small computer chip with information about the subscriber such as phone number and type of service. If you have enabled data communications or fax communications on your account, this information will be recorded on your SIM card. Data communications will most likely be assigned to a second phone number, not to the same number that's used for voice communications. If your customer's account does not currently allow data communications, have them contact their provider to add this service. Once the SIM card has been reprogrammed, data and/or fax services will be available as long as the other conditions are met.

It's true that the customer's account information travels with the SIM card, no matter what phone it's being used on. But if the customer takes their SIM card out of their own data-ready phone and attempts to use it in a phone that's not data ready, then data communications will not be possible. You may want to remind your customer that the best way to be certain that a phone is data ready is to look for the MC² logo.

The InterWorking Function (IWF) is the part of the GSM network infrastructure that handles functions like data communications. Although voice calls are not passed through the GSM network's IWF, all data calls (including SMS) are handled by the IWF. The IWF is necessary to set up a data call properly to establish a connection with a landline modem, another GSM phone with a data device, a landline fax machine, or another GSM phone with a fax machine. The IWF also originates (sends) and terminates (receives) SMS messages, handles error correction, flow control and all rate adaptation.



There are times when a TRANSPARENT connection is desirable.

- Point-to-point compression schemes such as V.42bis are available in the transparent mode only. Compatibility with V.42bis can yield up to 36,000 bps throughput.
- When you're roaming, some GSM networks still do not support non-transparent data transmissions. It's good to have a choice.
- Some software packages for email and other applications have built in error correction schemes that can't be bypassed. Using such software over a non-transparent connection will result in redundant error correction and potentially slower connections.

It's good to have a choice!

There are times when a NON-TRANSPARENT connection is desirable.

- When you're in motion, in a train, bus or taxi for instance, you'll travel through a variety of cellular conditions. These could include the possibility of weak signal strength areas and multiple handovers. The RLP in a non-transparent connection offers a more robust radio link. That means less chance of having a connection terminated by poor conditions or a lengthy handover. Under such circumstances, a non-transparent connection offers the lowest ultimate error rate.
- Some GSM networks may not support a transparent connection.

It's good to have a choice!

Forward Error Correction (FEC) is a type of error correction that's employed by the GSM to make sure voice calls are received with good clarity and minimal noise. When a stream of digital data is sent at one end of the connection, the goal is to make sure that the same stream of data is received at the other end. But these 1s and 0s can become corrupted through radio interference along the way. So an additional amount of data is included with each transmission which allows the phone at the receiving end to check for errors. In essence, this additional data describes the data being sent, telling the receiving phone that "the data I'm sending you should look like this." From this, the receiving phone can tell if the data coming in is correct. If the incoming data is incorrect, the receiving phone will attempt to "fix" it based on the description of what it should look like. The system isn't perfect. Under bad conditions (such as a weak signal strength) there will be many errors and the receiving phone won't be able to repair all of the data. But even with a few dropouts, it's most likely that the speech will still be intelligible (and even acceptable) at the other end. Although more precise error correction schemes are available, they could slow the transmission down to unacceptable speeds.

Forward Error Correction is used on all GSM transmissions. It results in data that has integrity for voice communications even under adverse conditions. But for some types of data communications, greater precision may be required. A single error in the transmission of financial data, medical data or statistical information could have disastrous results. So, for data communications, another form of error correction is offered by the GSM network.

Radio Link Protocol (RLP) is a more precise type of error correction used for the wireless portion of the connection. When the data at the receiving end is "checked" and found to contain errors, the receiving phone is no longer limited to trying to repair the data on its own. The RLP can request that the sending phone *retransmit* the data, again and again if necessary, until the data is received without errors. As you might guess, this can slow down the ultimate throughput of data, but it's important to ensure that the integrity of the data is preserved.

The RLP is not the only method of correcting errors. Other schemes are also used in the data communications business. At times, one of these other schemes will be invoked automatically by the software your customer is using. This could result in a situation where two error correction schemes are being used, one on top of the other, when one would be sufficient. This can slow things down dramatically. Also, V.42bis data compression is not currently possible while using the RLP. The use of V.42bis compression can increase throughput in a 9600 bps connection to as much as 37,000 bps depending upon the data being compressed.

Partly for this reason, some GSM networks provide users the option of not using the RLP for data communications. When a data connection is established through the IWF without using RLP error correction, it is referred to as a *transparent* connection.

Transparent vs. non-transparent connections. A transparent connection passes straight through the IWF without RLP error correction. A non-transparent connection uses the RLP error correction scheme. Although there are times when it is clearly desirable to have a transparent connection, not all phones and interface cards will allow you to bypass the RLP function. All Motorola MC^2 phones and interface cards* support transparent as well as non-transparent data communications.

There are times when it might be desirable to establish a transparent connection. There are other times when it might be desirable to establish a non-transparent connection. (See the information boxes at the left.)*That's why Motorola products are designed to give your customers a choice.*

* NOTE: The earlier version of the CELLect 1 Card (Part Number S5571A) is not capable of non-transparent transmission. Check your inventory to see which version of the product you have in stock.

How to Get Technical Assistance

The information contained in this book is designed to give you a working knowledge of data communications over the GSM network and a basic understanding of some of the issues involved. After purchasing a CELLect card, your customer may have questions pertaining to installation and configuration. Such help is readily available by calling the Motorola help line in your country.

From these countries, your customers can obtain assistance during the following hours:

U.K.	:08:00 – 18:00	Tel: 0990 – 143067
Germany	:08:00 – 18:00	Tel: 0130 – 824787
Sweden	:08:00 – 18:00	Tel: 020 – 797855
Norway	:08:00 – 18:00	Tel: 800 – 11814
France	:08:00 – 18:00	Tel: 0590 – 1845
Other European	:08:00 – 18:00	Tel: 00 – 44 – 1202 – 716172

In order to have your customers' problems resolved as quickly as possible, they should have the following information ready before they call:

1. Their data card serial number
2. Model of data card and phone
3. Make and type of computer
4. What cellular network they are using
5. What software they are running, and if possible, what version (If they don't know this, the engineer can help them find out.)
6. What error is occurring? Does the program give a specific error message?

If they have this information ready, the Support Analyst should have their problem solved quickly.

Glossary of Terms

bps – bits per second refers to the rate at which information is transmitted. Not to be confused with “baud.”

baud – The speed, measured in signals per second, at which two modems communicate. Since each signal can represent more than one bit, don’t confuse baud with bits per second. (bps).

data compression – The reduction of data by removing repetitive data or place holders and replacing them with shorter strings of data in order to reduce the size of a file. This is done in such a way that the original data can later be restored to the file with little or no loss of integrity.

error checking – A scheme by which the data at the receiving end of the connection is compared to a “standard” in an effort to determine if errors have occurred during transmission. This could be as simple as adding up the value of the bits received to determine if the total is “odd” or “even.” It could also be as elaborate (and time consuming) as echoing back all data to the sending unit for comparison with the original data.

error correction – A scheme for fixing errors that have been detected. This could be as simple as changing the value of the data to make it “add up” properly, or as elaborate as calling for the data to be retransmitted (and rechecked, or course).

FEC – Forward Error Correction is a type of error correction that’s employed by the GSM network to make sure voice calls are received with good clarity and minimal noise. It’s used on all GSM transmissions. Forward error correction works at the *forward* end of the connection. If errors are introduced during transmission, the receiving phone attempts to “repair” them. If it can’t, the errors are left uncorrected. Forward error correction never calls for the sending phone to retransmit data.

IWF – InterWorking Function is an important part of the GSM network which basically splits the data connection into two parts. On one side of the IWF is the radio link and all of the coding and protocols necessary to support it. On the other side of the IWF is a standard analog modem which allows the connection to the PSTN to be established.

modem – Modulates and demodulates serial information to tones and back for transmission over phone lines.

non-transparent connection – A data connection over the GSM network that employs both forward error correction (FEC) and the radio link protocol (RLP).

PC card – Also known as a PCMCIA cards. PCMCIA is an acronym that stands for Personal Computer Memory Card International Association, a non-profit trade association that has set up standards for personal computer input/output slots that will accept small credit card-size devices which can contain anything from additional random access memory to fax/modem devices and interfaces to network cards.

PSTN - Public Switched Telephone Network, the landline telephone system

RLP – Radio Link Protocol is a more precise type of error correction used for the wireless portion of the connection. If errors are introduced during the transmission, the receiving phone can call for the sending phone to retransmit the last packet of data, again and again if necessary, until the data is received error free.

SMS – Short Message Service is a service which allows short alphanumeric messages to be sent out to GSM phones.

throughput – The total amount of data received per second after it's uncompressed. The actual connection rate might only be 9,600 bps (bits per second). However, if 36,000 bits of data can be compressed down to 9,600 bits, sent over the connection in one second, and expanded back into 36,000 bits of data at the other end, then the *throughput* of data is 36,000 bps even though the actual data transmission rate is only 9,600 bps.

transparent connection – A data connection over the GSM network that employs forward error correction (FEC) but not the radio link protocol (RLP).