Subject: How Cell Phones Work
Posted by root on Thu, 15 Jun 2006 03:44:03 GMT
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Cell Phone Codes
All cell phones have special codes associated with them. These codes are used to identify the phone, the phone's owner and the service provider.
Let's say you have a cell phone, you turn it on and someone tries to call you. Here is what happens to the call:

When you first power up the phone, it listens for an SID (see sidebar) on the control channel. The control channel is a special frequency that the phone and base station use to talk to one another about things like call set-up and channel changing. If the phone cannot find any control channels to listen to, it knows it is out of range and displays a "no service" message.

When it receives the SID, the phone compares it to the SID programmed into the phone. If the SIDs match, the phone knows that the cell it is communicating with is part of its home system.

Along with the SID, the phone also transmits a registration request, and the MTSO keeps track of your phone's location in a database -- this way, the MTSO knows which cell you are in when it wants to ring your phone.

The MTSO gets the call, and it tries to find you. It looks in its database to see which cell you are in.

The MTSO picks a frequency pair that your phone will use in that cell to take the call.

The MTSO communicates with your phone over the control channel to tell it which frequencies to use, and once your phone and the tower switch on those frequencies, the call is connected. Now, you are talking by two-way radio to a friend.

As you move toward the edge of your cell, your cell's base station notes that your signal strength is diminishing. Meanwhile, the base station in the cell you are moving toward (which is listening and measuring signal strength on all frequencies, not just its own one-seventh) sees your phone's signal strength increasing. The two base stations coordinate with each other through the MTSO, and at some point, your phone gets a signal on a control channel telling it to change frequencies. This hand off switches your phone to the new cell.

Let's say you're on the phone and you move from one cell to another -- but the cell you move into is covered by another service provider, not yours. Instead of dropping the call, it'll actually be handed off to the other service provider.

If the SID on the control channel does not match the SID programmed into your phone, then the phone knows it is roaming. The MTSO of the cell that you are roaming in contacts the MTSO of your home system, which then checks its database to confirm that the SID of the phone you are using is valid. Your home system verifies your phone to the local MTSO, which then tracks your phone as you move through its cells. And the amazing thing is that all of this happens within seconds.

The less amazing thing is that you may be charged insane rates for your roaming call. On most phones, the word "roam" will come up on your phone's screen when you leave your provider's coverage area and enter another's. If not, you'd better study your coverage maps carefully -- more than one person has been unpleasantly surprised by the cost of roaming. Check your service contract carefully to find out how much you're paying when you roam.

Note that if you want to roam internationally, you'll need a phone that will work both at home and abroad. Different countries use different cellular access technologies.

Let's take a good look inside a digital cell phone.

Inside a Cell Phone

On a "complexity per cubic inch" scale, cell phones are some of the most intricate devices people use on a daily basis. Modern digital cell phones can process millions of calculations per second in order to compress and decompress the voice stream.

Let's talk about what some of the individual chips do. The analog-to-digital and digital-to-analog conversion chips translate the outgoing audio signal from analog to digital and the incoming signal from digital back to analog.

The microprocessor handles all of the housekeeping chores for the keyboard and display, deals with command and control signaling with the base station and also coordinates the rest of the functions on the board.

The ROM and Flash memory chips provide storage for the phone's operating system and customizable features, such as the phone directory. The radio frequency (RF) and power section handles power management and recharging, and also deals with the hundreds of FM channels. Finally, the RF amplifiers handle signals traveling to and from the antenna.

The display has grown considerably in size as the number of features in cell phones have increased. Most current phones offer built-in phone directories, calculators and games. And many of the phones incorporate some type of PDA or Web browser.

Some phones store certain information, such as the SID and MIN codes, in internal Flash memory, while others use external cards that are similar to SmartMedia cards.

Cell phones have such tiny speakers and microphones that it is incredible how well most of them reproduce sound. The speaker is about the size of a dime and the microphone is no larger than the watch battery beside it. Speaking of the watch battery, this is used by the cell phone's internal clock chip.

What is amazing is that all of that functionality -- which only 30 years ago would have filled an entire floor of an office building -- now fits into a package that sits comfortably in the palm of your hand!

In 1983, the analog cell-phone standard called AMPS (Advanced Mobile Phone System) was approved by the FCC and first used in Chicago. AMPS uses a range of frequencies between 824

megahertz (MHz) and 894 MHz for analog cell phones. In order to encourage competition and keep prices low, the U. S. government required the presence of two carriers in every market, known as A and B carriers. One of the carriers was normally the local-exchange carrier (LEC), a fancy way of saying the local phone company.

Carriers A and B are each assigned 832 frequencies: 790 for voice and 42 for data. A pair of frequencies (one for transmit and one for receive) is used to create one channel. The frequencies used in analog voice channels are typically 30 kHz wide -- 30 kHz was chosen as the standard size because it gives you voice quality comparable to a wired telephone.

The transmit and receive frequencies of each voice channel are separated by 45 MHz to keep them from interfering with each other. Each carrier has 395 voice channels, as well as 21 data channels to use for housekeeping activities like registration and paging.

A version of AMPS known as Narrowband Advanced Mobile Phone Service (NAMPS) incorporates some digital technology to allow the system to carry about three times as many calls as the original version. Even though it uses digital technology, it is still considered analog. AMPS and NAMPS only operate in the 800-MHz band and do not offer many of the features common in digital cellular service, such as e-mail and Web browsing.