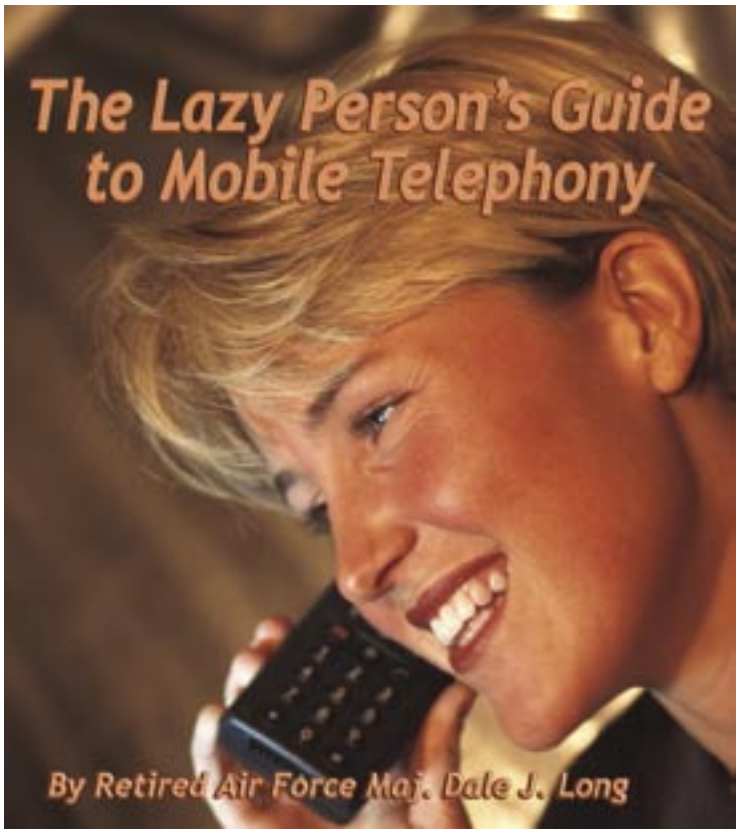

In the last two installments of the Lazy Person's Guide, we reviewed the history and development of analog and digital telephone systems and looked at Voice over Internet Protocol (VoIP). In this issue, we will detach ourselves from the wired world and look at mobile telephony, which may well dominate the world's communication environment within the next 10 years.

Mobile telephony is a good example of the behavioral dilemmas associated with convenience technology. People want the freedom to take a telephone everywhere. Then they complain that they have less freedom because people can call them any time, day or night. Enabling or annoying, mobile telephony is here to stay. Let's take a look at what it is, how it developed and where it may go.

Cellular History

Cellular telephone technology is a hybrid of radio transmission, wide-area networking and traditional telephony. This type of technology is called "cellular" because the system uses base stations to divide a service area into multiple "cells." As a user travels from cell to cell, cellular calls are transferred, or "handed off" from base station to base station.

The cellular telephone is essentially a radio, albeit an extremely complex one. The roots of cellular telephone service stretch back to the mid-19th century. In 1843, chemist Michael Faraday, arguably the world's first expert on electro-magnetism, began exhaustive research into whether or not "space" could conduct electricity. He discovered that the atmosphere could, under certain conditions, conduct energy. His work became the basis for all future work in radio communications.

After Faraday, Dr. Mahlon Loomis of Virginia developed a method of transmitting and receiving telegraphic messages by using the Earth's atmosphere as a conductor. His system used kites linked to the ground with copper wires, laced with copper screens. Between 1866 and 1873 he conducted several demonstrations where he transmitted messages without wires at distances of 14 to 18 miles. A generation before Marconi gained fame for his work with radios, Loomis was the first person to build complete antenna and ground systems, the first to successfully transmit wireless telegraph signals, the first to conceive the idea of transmission traveling in "waves" from his antenna, and he was the first person awarded a patent for wireless telegraphy. Unfortunately, Loomis never gained any significant recognition for his work and many contemporaries thought him a crackpot and fraud. However, Loomis undoubtedly inspired at least some of what came afterward.

The first mobile telephone was installed in a car by the Detroit Police Department in the early 1920s. The basic concept of cellular telephone service began to take shape in 1947 when researchers tried to improve the range of crude mobile car phones by using small service areas (cells) that shared the same frequencies. But the technology needed to support the concept did not exist at the time.

Another problem was prevailing policy. The Federal Communications Commission (FCC) considered mobile phones a type of two-way radio. In 1947, AT&T asked the FCC to allocate a large band of radio frequencies for cellular use. This would allow mobile phone service on a large enough scale to give AT&T an incentive to research cellular technology for commercial use. But the FCC decided to limit cellular phone frequencies so that only 23 cellular phone conversations could occur simultaneously in the same service area. That wasn't much of an incentive.

In 1968, the FCC reconsidered, and said it would increase mobile telephone frequencies if new technology improved the process. AT&T Bell Labs proposed the cellular telephone system we know today. In 1973, Dr. Martin Cooper, a former general manager at Motorola, set up a base station in New York with the first working prototype of a cellular telephone, the Motorola Dyna-Tac. Dr. Cooper is generally considered both the inventor of the first portable handset and the first person to make a call on a portable cell phone.

In 1977, public cellular telephone testing began in Chicago with 2,000 customers. However, because of the high cost of providing the infrastructure, cellular service did not progress beyond the testing stage until the Cellular Technology Industry Association issued practical guidance for cellular telephone providers in 1988. At that point the research and development framework was in place and demand was becoming strong enough to drive commercial development.

Cellular Evolution

The first cellular services used analog signals operating at 800 megahertz (MHz). While these early analog phones worked, they suffered from short battery life because of the power required to transmit the continuous wave used in analog systems. Advances in control systems allowed analog systems to carry 56 calls within a cell, instead of the original 23. Modern cell phones have mostly moved to digital transmission.

Unlike analog, which broadcasts a continuous stream, digital cellular systems sample pieces of the wave, divide it into chunks, and send it in bursts of data. Digital systems make better use of bandwidth, are somewhat more secure and use a lot less power when broadcasting. In addition to the digital shift, a change from nickel-cadmium to lithium-ion batteries significantly increased the average talk/standby time for cell phones.

The most common digital transmission systems use Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA). Cellular TDMA allows three different transmissions to share the same frequency by slicing each of them into pieces that take turns on the wavelength. For the technically-minded among you, it uses 30-kHz channel spacing and three time slots. This allows a cellular TDMA to carry three times as many (168) conversations as an analog cellular system.

CDMA uses a different approach. Each call is identified with a unique sequence code and sliced into pieces that may be broadcast over any available frequency within the entire available bandwidth. This is a form of "spread spectrum" technology, and it makes very efficient use of the available bandwidth of any cellular technology.

There is one other type of cellular system: Personal Communications Service (PCS). PCS is similar to other cellular phone services in its ability to carry voice traffic, but it also includes information-based personal services that are not part of traditional cellular voice services like paging, caller ID, Web browsing and e-mail. Remember, cell phones were originally invented with a limited set of functions for use in cars. PCS was designed by someone who took the time to study the behavior and information needs of people with the goal of making the PCS phone a digital hub. PCS uses TDMA, but a more robust version with 200-kHz channel spacing and eight time slots instead of the 30-kHz channel spacing and three time slots found in the older digital cellular version.

Modern cell phones are evolving at a faster rate than many other consumer technologies, adding new features almost daily. I think the cell phone will eventually become the principal mobile convergence device for most people based on its ability to combine information storage, access, portability and functionality.

Mobile Gestalt

Close inspection of modern cell phones will disclose an impressive array of information technologies packed into a relatively small package, including personal information managers, Internet Protocol capability, Web browsers, file storage systems, portable storage media, multimedia recorders/players, e-mail clients and wireless networking. It's not always a seamless or comprehensible whole, but vendors are getting better at integrating functionality and users are getting smarter about using their "pocket myriads."

The convenience of having any functionality available in one device will be too strong to ignore. There will; however, be some speed bumps along the way. Security will always be an issue. Any time you put all your eggs in one basket, you'd better watch that basket very carefully. Second, the current size and resolution of cell phone screens severely limit the type and amount of information you can present to a user. However, there has been some progress made in display technology in the last few months that will eventually find its way into cellular telephones.

The most striking example of this is the Sony development of "Librie," an electronic reader that reportedly has a 6-inch black and white screen with resolution of 600x800 dots at 170 dpi (dots per inch). The Librie's screen achieves this level of sharpness by using microcapsules 40 microns (A micron is one millionth of a meter.) in diameter that contain dozens of charged black and white particles (with opposite charges) suspended in an oil solution. The device uses electromagnetic fields to draw black or white particles to the surface of each capsule to render the image.

Until now, the best resolution available commercially in electronic displays has been about 150 dpi in high-end liquid crystal display (LCD) computer monitors. While this is considerably sharper than the 80 dpi of a regular computer display, it's not as close to the 200 dpi distinguishable by the human eye. And though the Librie only displays black and white or grayscale static images at the moment, research is apparently underway to modify the technology to accommodate motion and color.

The biggest challenge will be in finding appropriate uses for all this power at our fingertips. For some people, the only thing they will ever really do with a cell phone is call someone else. In those cases, any extra features might as well not be there. Before we take a more detailed look at the functionality of today's cell phones, let's look back at what happened with a somewhat similar attempt at mobile convergence about 14 years ago.

Radio Zippy

In 1990 I was assigned to an aircraft and ammunitions maintenance unit at a tactical fighter wing in the United Kingdom. Mobile telephones were an unknown luxury. Our principal mobile communication device in that era was the Land Mobile Radio (LMR), also known as "the brick" due to its size and weight. Someone got the bright idea to incorporate a telephone keypad on an LMR and develop a bridging system that would allow you to place phone calls through the radio base system to the base telephone system.

One day I was sitting down to lunch with another young captain named Dan when the wing vice commander decided to join us for lunch. Trailing the vice commander like a pilot fish follows a great white shark was Zippy, who had been temporarily detailed from the base communications squadron as the colonel's executive assistant. The vice commander had one of the new radio-phones and was waxing poetic about the possibilities of having his phone and radio in a single device. For example, he thought it would be convenient if instead of having to find a phone, he could call on his radio to reserve a racquetball court for later that afternoon. Zippy, never one to miss an opportunity to either play with a new toy or score some points with the boss, immediately volunteered to try it with the vice commander's new brick.

Five minutes later, both Zippy and the vice commander were a little red around the collar because the handheld refused to cooperate. If someone didn't intervene soon, Dan and I would forever be linked in the vice commander's mind with both Zippy and his

uncooperative LMR. Deciding that I had nothing to lose, I said, "Sir, I can show you how to reserve a court with that thing." Without a word, the vice commander plunked the radio down and gave me one of those focused stares he normally reserved for the gunsights of his A-10 Thunderbolt. To tell the truth, I hadn't the faintest clue how to make a phone call on that radio. But I did know how to get the court reserved. Hoping the vice commander still had a sense of humor, I picked up the radio, switched to the maintenance control center channel and thumbed the transmit key.

"EM-3 to MCC."
"MCC acknowledge. Go ahead EM-3."
"Copy MCC. Would you please call the gym and reserve a racquetball court for CV at 1600 today? Over."
"Copy that, EM-3. Wilco and out."

I looked at the vice commander. He had one eyebrow arched up and a thoughtful expression on his face. Then he laughed, took his brick back and said, "Point taken." If there's one thing a good operator appreciates, it's the simplest, most direct answer to a problem. All he wanted was a way to communicate; it didn't matter how, as long as you got the job done. There are reasons for "radio discipline," and making phone calls via the radio violated most of them. Every radio-phone call would occupy one of the precious radio frequencies we had available for operational communications. The test of the new radio-phones quietly faded off the radar.

Modern Mobility

Our radio-phone experiment didn't quite work out for two reasons: The technology was complex beyond most people's ability to use it, and there were simpler, less costly ways to get the same thing done. We are faced with a similar situation with cellular telephones. They are becoming more functional, but more complex. While a cell phone can include a lot of functions in one portable unit, it is second-best at most of them when compared to more traditional technologies. Here's a quick list of some of that functionality with my opinion of its usefulness.

Text Messaging: This feature was originally added to cell phones in Japan; allegedly so that teenagers on trains could chat with each other when it was too noisy to use their phones. Other uses are for short, quick alerts, much like a pager. It can be a pricey feature when used for sending messages.

Web Browsing: You can access any Web service from anywhere you have cell phone access. Viewing most Web pages on a cell phone screen is often like looking at something through the wrong end of a telescope. But as more people access the Web from cell phones, more sites should move to a more readable format.

E-Mail: While screen size is still a constraint, text-only e-mail works fairly well on devices designed for it like the RIM (Research in Motion) Blackberry or Handspring Treo.

Video Games: Cell phones have view screens and buttons. It is inevitable that games could become a favorite way to drain the battery.

Digital Cameras/Video: This is handy if you need to snap and send something quickly, but the picture resolution is not great, and most cell phones will only send directly to another cell phone on the same service. There are also cellular telephone vendors trying to incorporate television into cell phones. If we have cell phones so we can talk to each other, do we really want to drain the battery watching a television rerun?

Voice Recognition: There are phones that can recognize rudimentary voice commands, like: "Call Chad," but voice recognition is still fairly crude. There are companies working on telephones that will allow you to navigate through menus using voice commands, but they aren't ready for market yet.

Internet Protocol (IP): As I mentioned in the last issue, I think IP will eventually become the dominant technology in voice telephony, and combined with cell phones, it may completely transform the telephony landscape in the next 10 years. First we'll have to overcome a huge legacy artifact: The plain old phone dialing system with it's reliance on geographically-based area codes and strict numbering systems. Maybe someday you will be able to get one portable phone number that will follow you wherever you go, much like a Web-based e-mail address, but it will take a commitment from the telecommunications industry and regulators to change how we dial calls. VoIP may provide the needed lift.

Built-in Personal Digital Assistants: I'm going to test this one personally. When my Kyocera 7135 arrives, I will finally be able to share one personal contact database between my cell phone PDA, Microsoft Outlook on my PC and my Nortel Meridian telephone, and I will have achieved one of my ultimate personal convergence goals.

There are a few off-the-wall things I've heard reported in cellular telephone research and development. One vendor offers foreign language flash cards, Scholastic Aptitude Test practice drills, a metronome, an Etch-A-Sketch and a tide clock. In Korea, SK Telecom offers ring tones that it claims can repel mosquitoes. Two Romanian inventors are reportedly working on a handset that will include a built-in sensor to detect smoke or toxic gases. Last summer Japanese inventors unveiled a tiny ultraviolet light sensor for cell phone users concerned about sunburn.

The main limiting factor in cell phone technology today is the battery. The more you add to the unit, the more power it requires. Soon I expect to see phones with solar panels that can recharge or prolong usage. As more surface area means more power gathered, perhaps there will even be clothing made with solar power collectors that we can plug our telephones into. I suppose anything is possible in a world that is rapidly becoming accustomed to instantaneous, direct personal communications with anyone, anywhere, anytime.

Until next time: Happy Networking!

Long is a retired Air Force communications officer who has written regularly for CHIPS since 1993. He holds a Master of Science degree in information resource management from the Air Force Institute of Technology. He is currently serving as a telecommunications manager in the U.S. Department of Homeland Security.