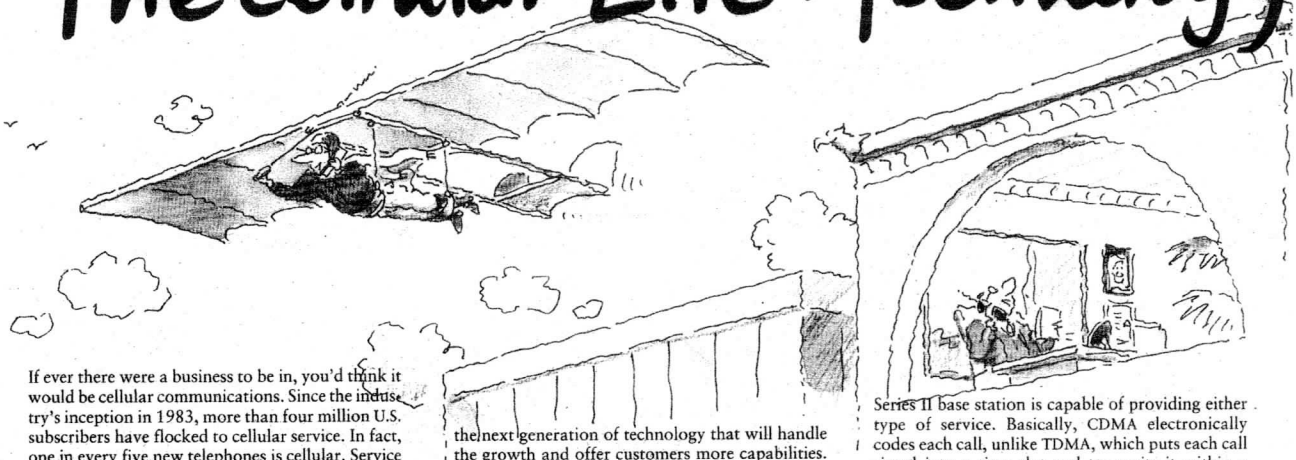
The Cellular Life: Technology



If ever there were a business to be in, you'd think it would be cellular communications. Since the industry's inception in 1983, more than four million U.S. subscribers have flocked to cellular service. In fact, one in every five new telephones is cellular. Service growth rates are a phenomenal 40 to 60 percent every year. And phones are getting smaller, cheaper and truly portable. Even now, new models slip easily into pockets and pocketbooks.

Cellular system operators hardly can keep pace with service demands of consumers hooked on the mobility wireless communication offers. Nor will growth rates diminish. By the year 2,000, cellular customers could mushroom to 25 million.

Yet as the industry emerges from the go-go '80s, many issues cloud a promising future. Finding efficient ways for cellular users to make and receive calls nationwide, perhaps internationally, is a key problem. Given the complexity of linking U.S. cellular systems equipment together, packing more conversations into the limited radio-frequency spectrum, and dealing with conflicting domestic and international standards, is the dream of personalized universal wireless communications really possible?

Yes, say experts at AT&T. *LabNotes* asked Jim Brewington, president of AT&T's Cellular Communications Division, and Jesse Russell, AT&T Bell Laboratories' R&D director for Cellular Radio Systems, to elaborate on the opportunities and challenges of AT&T's goal of providing technology for a nationwide (and, some day, international), interconnected wireless network.

***LabNotes*: To give us some perspective, could you trace the history of wireless communications from its earliest days?**

Russell: As far back as the late '40s and early '50s, AT&T saw the value of mobile communications. Such a service would improve people's flexibility and enhance productivity, but regulators had to be convinced of the feasibility of the technology and the consumer value of the service concept.

Since AT&T introduced the first commercial cellular telecommunications system in Chicago in 1983, cellular has become an essential tool for modern business people. Sales and service workers have become more productive because cellular frees them from the restraint of a wire. As a result, demand has skyrocketed, pressuring service providers to expand the capacity of present systems or launch new ones. AT&T is working hard to provide the next generation of technology that will handle the growth and offer customers more capabilities.

What are some of the technical challenges AT&T faces?

Russell: We've reached the point now where we are running out of radio-frequency spectrum. Because there is only so much radio-signal spectrum, there isn't much room for growth, and that has resulted in very little downward change in service prices. AT&T is introducing new analog/digital technology, called the AUTOPLEX® System 1000 Series II transmission base station, or cell site, that will squeeze more conversations into the available radio spectrum. Two technologies, both developed at Bell Labs, help make this advance possible. The first, low-bit rate digital speech coding, reduces the number of bits needed for each conversation, thus allowing the system to handle more calls. The second technology boosts the efficiency of the radio spectrum. It's called Time Division Multiple Access, or TDMA, and it will allow three conversations in the same bandwidth now occupied by a single analog conversation. Future releases of TDMA may double capacity to six conversations.

On March 28, AT&T made technological history in Dallas when the first digital cellular phone calls

Jesse Russell

were placed in a field test of AT&T's TDMA Dual-Mode IS-54 system. Two prototype TDMA mobile phones, made by Motorola and OKI, were used to place calls in both a digital and analog mode. The test is part of "lockdown" testing designed to give manufacturers confidence that their IS-54-based equipment works with other vendors' products.

Aren't other companies proposing different call multiplexing technologies, such as Code Division Multiple Access?

Russell: Yes, CDMA access technology has been proposed, and Bell Labs is working to provide interested customers with this technology. AT&T's Series II base station is capable of providing either type of service. Basically, CDMA electronically codes each call, unlike TDMA, which puts each call signal into a time slot and transmits it within a single frequency. CDMA allows calls to be placed one on top of another, or multiplexed, to share the entire frequency band. At the receiving end, the calls are separated by a device that recognizes the code assigned to each call. It's predicted that a CDMA system might handle 20 times more calls, but it's not as well understood as TDMA. CDMA is very dependent on power control and on careful synchronization of digital systems. That's why we've created a strategic alliance to pursue this technology with Qualcomm Inc., a California-based cellular-equipment manufacturer that proposed the new standard.

Different call-handling technologies aside, how soon will cellular subscribers be able to talk and drive coast-to-coast?

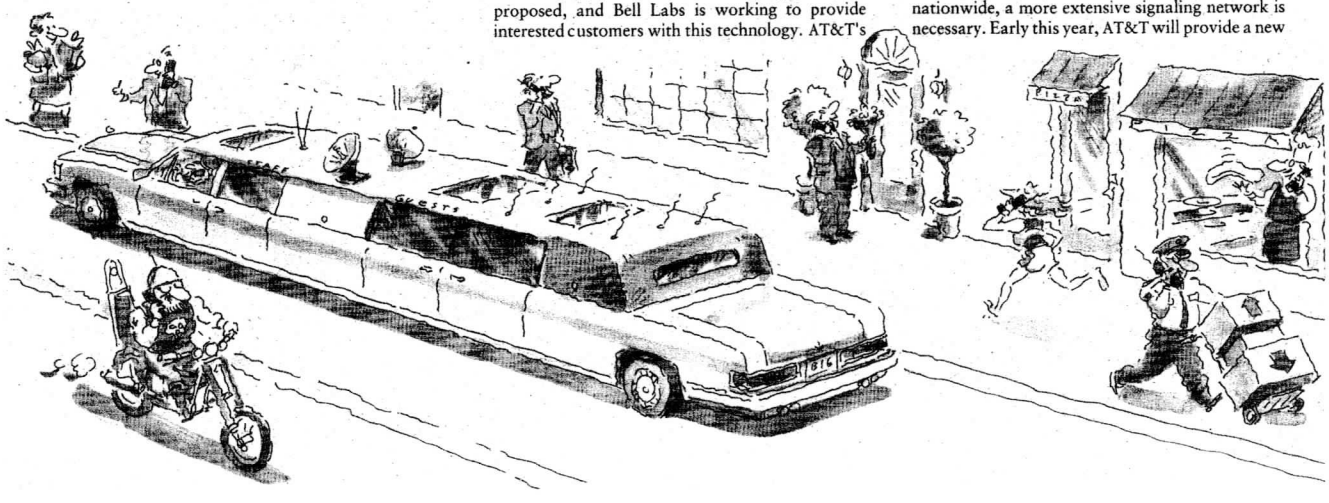
Brewington: Cellular was originally conceived as a nationwide service that would allow you to travel from New York to Seattle without dropping a call. But the way cellular licenses were awarded changed all that. In the early '80s, the FCC divided the country into population centers and licensed two service providers for each area — a local telephone company and an independent operator. Now, new systems awarded by lottery are starting up in rural areas. Many of these vendors' systems use a variety of different switching equipment, so all these service areas can't always talk to each other.

AT&T's goal is to provide technology for an interconnected, nationwide network capable of handling cellular traffic without overloading. In a sense, this wireless network would be similar to today's telephone network. Accomplishing this goal will require efficient data bases and, in particular, sophisticated billing systems to link systems together nationwide.

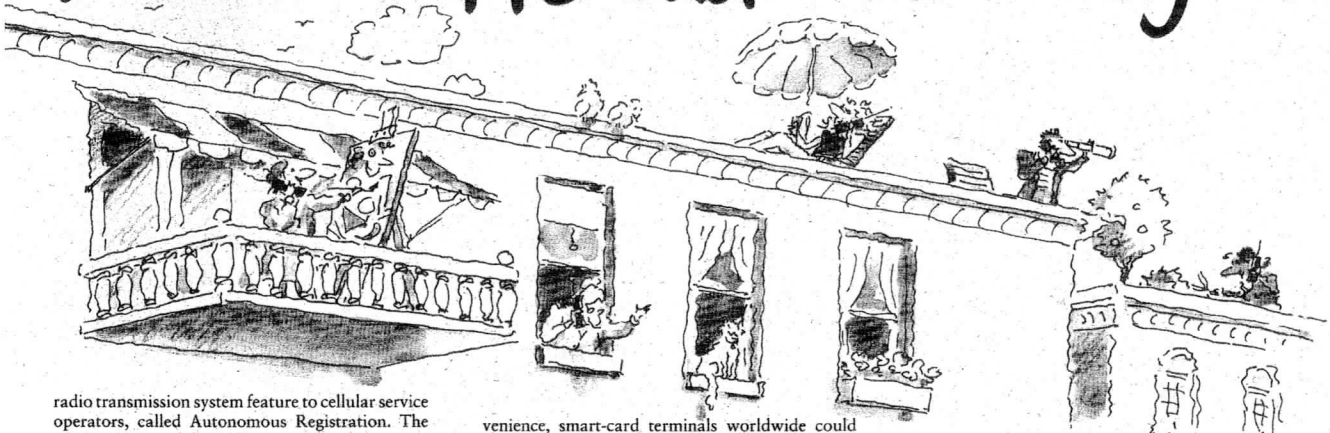
AT&T has been working with other companies to allow nationwide interconnection, using a standard called IS41. We are working with other equipment manufacturers to test this standard at our Indian Hill, Ill., laboratories. The new software should be available this year.

That sounds fine for making calls, but how will cellular subscribers receive calls in the United States?

Brewington: As roaming becomes easier and customers want to make *and* receive telephone calls nationwide, a more extensive signaling network is necessary. Early this year, AT&T will provide a new



Advances Herald a New Age



radio transmission system feature to cellular service operators, called Autonomous Registration. The system automatically sends a paging signal out over a data link each time a mobile customer enters a new area. The data message basically says, 'Here I am, and here's my number.' Then the local switch passes that information to another data base that handles billing arrangements and determines what type of service to provide customers. All this will happen transparently.

Let's take the national service concept one step further. When will there be universal international service?

Russell: There are six technology platforms necessary to build worldwide personal communications networks: smaller cell sites, radio spectrum segmentation, uniform radio channel protocols, a broadband-transport network, distributed network intelligence, and a network-independent numbering plan.

Of these, uniform radio channel protocols and a network-independent numbering plan are essential for international service. Right now, there is not a set of international frequencies assigned; whereas in the United States, there's one common set of frequencies. Uniform radio channel protocols allow the use of a common set of control procedures that are independent of the frequencies assigned. The idea of the network-independent numbering plan is to link local cellular service companies to the international and national numbering plan networks. That way, if a user wants to make a call, any system worldwide will be able to identify that user and provide service.

Does this mean that consumers eventually will get personal telephone numbers for use worldwide?

Russell: Yes, although it may not happen in the next decade. However, a single telephone number isn't the issue here. It goes beyond that. What we're talking about is unhooking consumers from telephones by using some form of smart-card technology, like a credit card with an electronic-identification number. Smart-card technology would allow you to go to special terminals worldwide and get service, and not just telephone service.

For example, I'm a basketball fan of the New York Knicks, but I travel a lot. So how do I see a Knicks game in Los Angeles or even, say, London? Using smart-card technology, I simply access a video computer outlet and get the game sent to my hotel room TV. I can't do that today, but I'd like to. Just as money-access machines offer flexibility and convenience, smart-card terminals worldwide could provide instantly a wide array of communication and entertainment services.

Given the political and economic considerations of foreign telephone companies, most of which are operated by governments, is a worldwide network feasible?

Brewington: Yes, it is, but it will take time. In Europe, a pan-European system, called Group Speciale Mobile, is taking shape. GSM is a standards body that has defined a new system that European telephone companies will use to provide

Jim Brewington

cellular service in capital cities by 1992. This system will provide a common European set of frequencies and standards. However, European companies still have to deal with a host of other issues, such as how to handle billing arrangements.

Motorola has proposed a low-orbit satellite system, called Iridium, to provide worldwide service. Wouldn't such a system be prohibitively expensive?

Russell: Satellites play an important role in the future of universal communication service. One of the key technology issues satellites can solve is the problem of finding people. If you can use a satellite triangular-location method to pinpoint a cellular user's position anywhere on the globe, that's an advantage.

But a satellite cellular system of this type would cost billions of dollars, require licenses from government regulators worldwide who control scarce radio frequency allocations, and consumers initially would have to shell out thousands of dollars for each phone.

One of AT&T's advantages is its ability to design terrestrial networks, and that's where we've got an edge. We'll be looking at defining gateways around the globe that allow networks built by other companies with different communication expertise to link into AT&T's Worldwide Intelligent Network. We want to be the integrator of those networks. Our role is to envision the future and what kinds of services consumers want and fit these pieces together into an integrated network. That's our most important strength as a company.

What's the AT&T picture for cellular equipment sales worldwide?

Brewington: There's an interesting story in the turnaround of AT&T's wireless business. In the early '80s, AT&T was virtually the only service provider. Following an initial growth spurt, there was tremendous optimism about cellular prospects. However, the industry, including AT&T, projected unrealistic service growth rates, and when those projections didn't come true, everyone started to back off.

In fact, based on those projections, AT&T got out of the market for car phones, although we remained in the cellular transmission and switching business. At that time, we committed to introducing new technology, and today we're beginning to see the fruits of that work. Late last year, AT&T regained U.S. market leadership in cellular systems with a $600 million equipment sale to GTE Mobile Communications. We also are achieving success internationally. We've won large contracts in Korea and, most recently, in the Philippines, and we are working to provide cellular equipment to Japan.

What's happened to set AT&T apart from its competition?

Brewington: There are several things. The number one reason is quality, quality of service and the quality of our products. *There's* the Bell Labs advantage. AT&T has one of the best customer service operations in the industry. When one of our customers calls us, the remote diagnostics capabilities of our network equipment often allow us to clear trouble in minutes. That's vital to cellular providers because it may only take a short time for them to lose a significant portion of their market share.

Another thing that distinguishes us from the competition is our technology. Our new Series II transmission base station beats the socks off anything else. It's flexible, powerful, smaller, offers improved reliability, and it reduces maintenance and operations costs.

Of course, you need a good switch to go with the base station. Our Bell Labs development people not only designed a switch to serve more than 100,000 subscribers, but they increased reliability by 50 percent. That's a real success story. □