An INTERTEC®/PRIMEDIA Publication

TELEPHONY®

CARRIERS, CONVERGENCE & COMPETITION

WIRELESS

Tension in the air

Growing numbers of end users, increasing base station links, mounting costs and a variety of services combine **to tax the** wireless network transmission infrastructure

BART STUCK

The number of subscribers to both cellular services in the 800 MHz band and PCS in the 1.9 GHz band mushroomed to more than 59 million in 1997, with forecasts of 80 million in 2000.

The network infrastructures has grown to meet this demand, with more than 51,600 cellular and PCS base stations deployed last year and predictions of 100,000 base stations by 2000.

Transmission costs between base stations and controllers/hubs and between controllers/hubs and switches have increased so much that some wireless carriers now spend 10% or more of their operating expenses on leasing transmission facilities.

The situation has arisen because the number of base transmission stations, base station controllers and mobile switching offices or mobile switching centers has grown, as well as the need to connect to new competitive local exchange carriers, interexchange carriers and the public switched network.

If each base station had a single T-1 line connecting it to a base station controller, the service provider's operating expense for base station transmission facilities alone would be more than $300 million in 1997, more than doubling to $700 million by 2000, for a compound annual growth rate of more than 25%.

Besides monthly private line leasing charges, carriers must account for depreciation costs of transmission equipment, operating costs from managing the transmission network and lost revenue opportunity costs when the transmission network has outages.

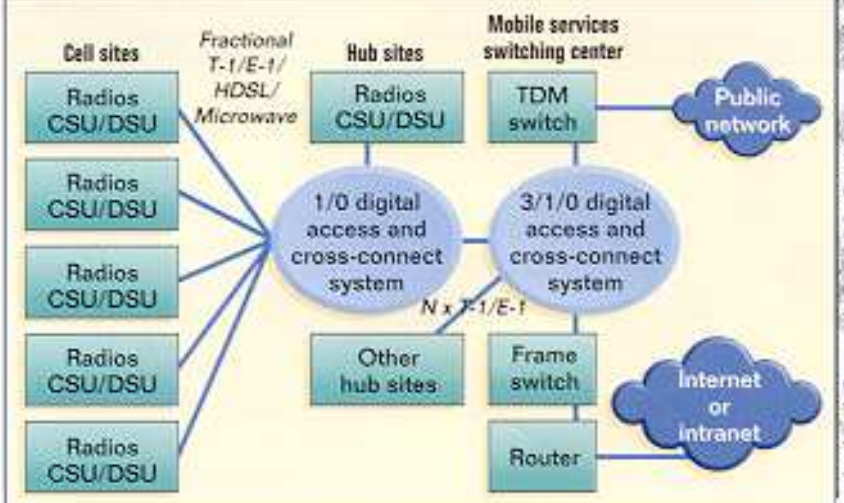
And the number of links per base station is growing, with more RF channels per base station as the number of antennas, antenna elements and sectors per base station grows, and more calls per base station as the speech compression rates continue to drop.

Greater dependence on cellular and PCS demands greater reliability from cellular networks in general and from the network transmission infrastructure in particular.

Subscribers are using wireless for voice, voice mail, voice-activated services, one-way and two-way data, e-mail, fax and fax mail, and they depend increasingly on the wireless network to provide end-to-end reliability. Finally, wireless is proving to be a cost-effective way to provide local telephone service, particularly to the 1 million U.S. residents who have no telephone service today.

In the future, more people will use their cell phones as single points of access. As a result, backup transmission links are multiplying to provide protection switching redundancy in case a primary link goes out.

FIGURE 1
ILLUSTRATIVE EQUIPMENT IN A CELLULAR CARRIER NETWORK



Multitasking links

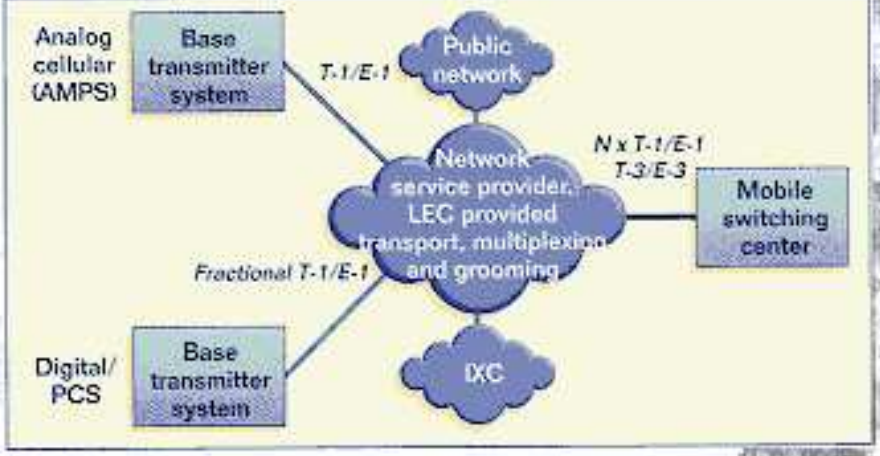
Transmission links in wireless networks are becoming increasingly complex. Some links handle AMPS circuits, others handle AMPS control and signaling links, while still others handle network management.

Some AMPS base stations handle IS-136/time division multiple access circuits or IS-95/code division multiple access circuits.

AMPS networks increasingly have cellular digital packet data links, while short messaging service links are used in other digital wireless networks such as GSM.

Finally, there are links for network element monitoring—data as well as support for dedicated voice—and backup links for both information transfer and control. The growth in overall traffic has led to renewed interest in voice and data compression for containing transmission costs, which again increases transmission network complexity. Transmission engineers have been creative in developing a growing diversity of transmission technologies: fractional T-1/E-1, DS-1, T-1/E-1, fractional T-3/E-3, DS-3, and T-3/E-3; Sonet, synchronous digital hierarchy, ISDN and ATM; high bit-rate digital subscriber line, asymmetrical DSL, symmetrical DSL or very high bit-rate DSL.

FIGURE 2
PUBLIC NETWORK BACKHAUL



An increasing diversity of protocols run over these links, such as Transaction Language 1, Open Systems Interconnection, Service Management System, TCP/IP, frame relay and SS7, supporting ISUP, GTTS, home location register and visitors' location register capabilities. And the number of new applications and services is growing—for example, E911 and fingerprinting.

All these choices—taken together with the demographic differences among urban, suburban and rural areas—threaten to swamp service providers in options.

Each base station vendor offers a set of capabilities with pros and cons, and each transmission equipment vendor complements these features, so sophisticated network planning is more important. Operators must evaluate equipment and tariff trade-offs in order to increase productivity or offer new revenue-generating services.

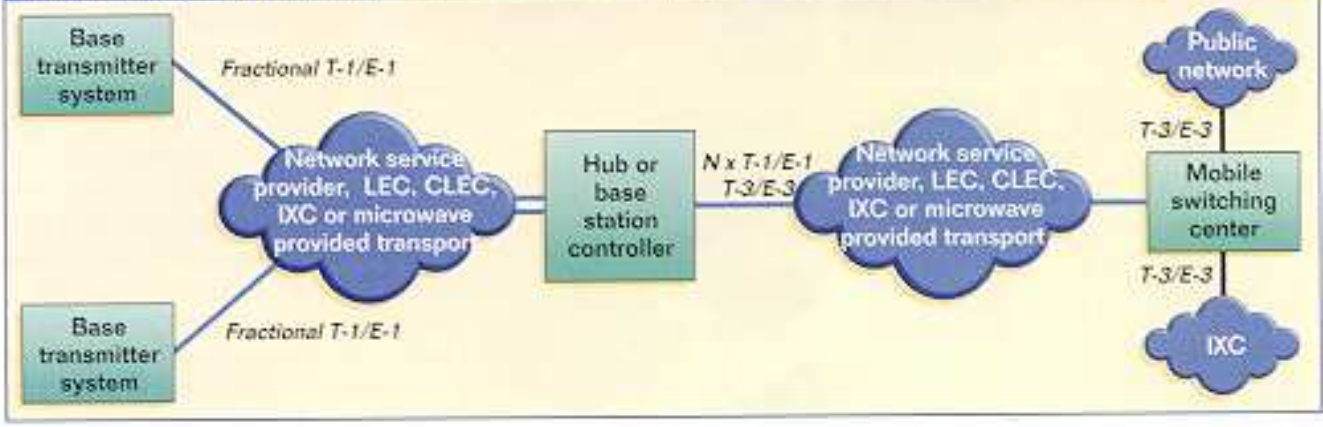
Since the advent of PCS carriers in the past two years, more competitors offer wireless service in each geographic locale. Many of these PCS carriers collocate their equipment with cellular equipment, and they need to manage the different transmission networks for each cellular and PCS carrier.

Pressure from pricing

This is only the beginning of the complexity. Cellular carriers enjoy roughly $50 a month per subscriber for 100 to 120 minutes of use per month. Residential wireline subscribers spend roughly $20 a month per line for 1000 to 1500 minutes of use per month. And business wireline subscribers pay about $50 a month for 3000 to 4000 minutes of use per month.

The discrepancy between wireless' 50¢ a minute of use and wireline's 1¢ to 2¢ suggests that new wireless carrier entrants will attempt to drop prices to attract subscribers,

FIGURE 3
PRIVATE NETWORK BACKHAUL



and those subscribers increasingly will convert their wireline minutes of use into wireless minutes. The impact on wireless networks will be a heightened need for base stations and transmission links.

The FCC recently auctioned local multipoint distribution system (LMDS) spectrum. Many operators of this type of broadband service could collocate their base stations and antennas with cellular and PCS base stations and antennas. In fact, the narrowband cellular and PCS carriers could be the same broadband LMDS carriers. This in turn would place much greater traffic demands on the wireless transmission infrastructure.

The ability to manage an increasingly complex and costly transmission network is becoming critical to the commercial success of both cellular and PCS carriers in the U.S. The need for grooming, consolidation and concentration—traditional strengths of digital cross-connect systems—is growing in importance for wireless carriers. Figure 1 illustrates the potential complexity of the wireless transmission infrastructure.

The cost of transmission facilities has not dropped as fast as average revenue per cellular subscriber has. Two approaches to wireless network transmission infrastructure exist—one based on using the public switched network service provider or incumbent LEC wireline carrier facilities (Figure 2), the other on using private transmission facilities (Figure 3).

The market reality is that public wireline carrier facilities are more widely used than private networks, partly because cellular wireless carriers are often corporate sisters to a wireline carrier in the same geographic region.

Historically, those wireless carriers turned to the wireline affiliate to lease the transmission facility; the lease revenue stayed within the corporate holding company.

New PCS carriers and wireless local loop carriers are revisiting this decision, basing their choice partly on circuit tariffs as well as on how responsive the wireline carrier will be to the needs of the wireless carrier for network control.

Incumbent LECs need to optimize their transmission facilities—some of which may be collocated on common tower sites—to provide wireless customers with sufficient reliability and redundancy, the ability to use any excess transmission capacity for other competitive service offerings and the network control that each customer wants.

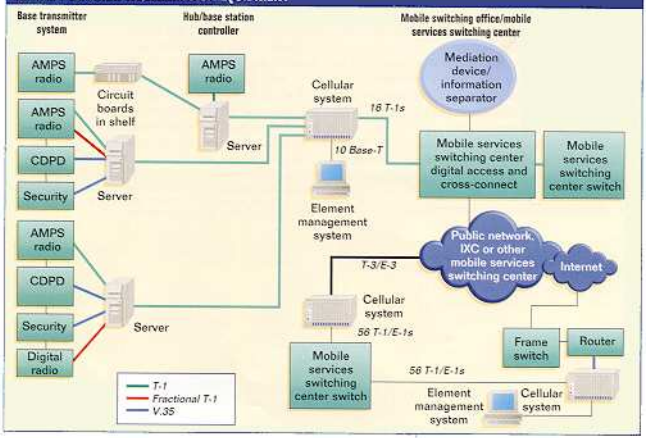
On the other hand, start-ups such as Sprint PCS do not have extensive wireline facilities in most of the 134 markets where Sprint PCS provided service at the end of 1997, so carriers have interest in buying point-to-point microwave transmission systems or installing an optical fiber ring.

Either option can be depreciated as a capital expenditure that meets a portion of the transmission capacity needs.

A hardware checklist

Wireless carriers more frequently are looking for flexible, scalable transmission equipment that can handle the fractional T-1/E-1 speeds of today and scale up to multiple T-

FIGURE 4
SINGLE PLATFORM TRANSMISSION EQUIPMENT



1/E-1 links or even to T-3/E-3 to cover broadband services.

Instead of separate equipment handling DS-1/DS-0 digital cross-connect functionality, inverse multiplexing, CSU/DSU functions, voice transcoding and N x T-1 x 64 kb/s inverse multiplexing, wireless carriers want integrated transmission systems that can be managed from a single network management platform. Multiple boxes from multiple vendors increasingly will be displaced by single box platforms with a variety of add-on modules.

This means investment protection. As new technologies become available, they can be added to the core platform.

Networks should be able to manage any piece of equipment from any point of attachment. Ease of installation and provisioning, rapid deployment and plug-and-play capabilities will be more and more critical. And a need may always exist for an analog port for dialup or public network access to any box.

Environmentally hardened equipment is the most desirable. Wireless carriers would rather stock one type of equipment that can be used in outdoor enclosures or in controlled environment vaults to minimize inventory carrying costs of spares and to simplify operations and maintenance.

Finally, wireless carriers want equipment that is software-programmable, or softer than today's hardware boxes, so that as new transport protocols and even hardware interfaces become industry standards, the equipment can migrate easily to handle these new demands.

Nothing needs to be invented. The list of capabilities will continue to grow with time, so this is an issue of strong system engineering and packaging to meet wireless carrier needs (Figure 4).

Customers will have the choice of a basic level of transmission equipment from base transmitter station and basic station controller vendors. They also can go to third parties for external transmission equipment that is more flexible in some applications.

Numerous equipment vendors—such as Digital Transmission Systems and Paragon Networks International—are supplying wireless carriers with transmission equipment needs.

In general, wireless carriers are looking for a scalable product that can grow from one T-1/E-1 line to 32 T-1/E-1 lines across all network site types—base station cell site, base station controller or hub and mobile telephone switching office—while supporting a variety of transmission technologies such as fractional T-1/E-1, T-1/E-1 and T-3/E-3 at an acceptable initial price and low operations expenses.

They also want equipment that takes up as little space as possible, because space is priced at a premium for a base station site, hub or switching center.

Finally, wireless carriers are demanding a rich set of network management capabilities such as local and remote element management systems, network management systems based on open standards such as TCP/IP with Telnet terminal emulation, SNMP information block interfaces and even local area network interfaces as an option. They also demand the capability to base their network management operations on industry-standard hardware platforms.

More often, network infrastructure vendors such as Ericsson, Motorola, Northern Telecom, Lucent Technologies and Qualcomm are bundling this type of equipment with their offerings—base station transceivers, base station controllers and switching systems.

Wireless carriers are turning to third parties to provide outboard transmission equipment to meet their needs not just for CSU/DSU functionality, but also for digital cross-connect systems, inverse multiplexing, transcoding and enhanced network management capabilities. The transmission hardware and software will become more flexible to meet real needs.

Other vendors have developed products for other markets such as enterprise or telecom carrier and are now selling these to wireless carriers.

Each of these vendors offers a variety of products to meet the different transmission system needs of wireless carriers. Vendors that target wireless carriers have concentrated on packaging, cost, size and functionality to differentiate their offerings. Stay tuned.

Bart Stuck is President of Business Strategies LLC, in Westport, Conn., a consultancy specializing in network computing and telecommunications. His e-mail address is BartStuck@aol.com.