GOING MOBILE

The Newest in Communications Technology for Contractors

You can’t be everywhere at once. Owners and employees of today’s contracting firms have to communicate a wide range of information over a variety of distances. Foremen have to give instructions to employees on each floor of the highrise building that they are constructing. Project managers have to be available to settle minute-by-minute problems at the jobsite, even when they are at the company offices. Construction company owners often have to discuss strategy with members of the office staff while driving across town to inspect yet another project. And office personnel have to transmit revised blueprints from the drafting table to the dirt field across town.

But shouting, running to pay phones, or hiring bicycle messengers every half-hour won’t do. So how does a contractor communicate effectively in a dozen different environments at once? Mobile communications equipment is the answer. Today’s impressive variety of mobile communications equipment can satisfy almost every need. Even contractors who are already using this equipment to some extent can benefit by exploring new innovations in communications technology.

A construction company’s typical business day presents several situations in which mobile communications equipment can be useful. Your equipment needs will vary depending on which situations occur, and what information needs to be transmitted. So you should analyze the verbal and data traffic patterns in your company before investing in equipment or updating your current equipment.

For instance, do you work on very large commercial jobsites where a foreman or other member of the supervisory staff might have to deliver orders or instructions to employees who are more than speaking distance away? Do your foremen or supervisors often find themselves needing to talk to someone at the corporate headquarters, at a branch office, or even at the office of a subcontractor or supplier while in their vehicles or on the jobsite? Does your project manager, while in his company truck, need to relay specifications to the site foreman? Does your CEO often get caught

Pagers provide a portable, inexpensive way to send simple messages and even data to field personnel.
in meetings at clients’ offices with no way for you, at the corporate office, to get him on the phone?

All of these are basic examples of the main situations in which mobile communications would be effective. The primary location interactions suitable for this type of equipment include: site trailer or office to jobsite; company vehicle to vehicle, office or site; within the jobsite; and from your office to another firm’s office.

Equipment . . .

There are different types of mobile communications equipment to answer each different need. The equipment can be divided into three main types: pagers, radios, and radio-telephones, the vast majority of which are cellular telephones.

“A pager is the simplest method of contacting someone, when you don’t need that person to respond in voice right away,” explains Dino Karahalios, public relations specialist for Motorola, a leader in mobile communications equipment. Most paging systems consist of a terminal from which any number of pagers can be signalled using radio frequencies. The pagers themselves are easily portable; small enough to clip on a belt or carry in the hand or pocket. Most pagers operate within a local range, although regional— and even nationwide— paging systems are emerging.

Facsimile Machines
A Communications Solution

Mobile Communications is one way that many businessmen, including contractors, can save money and time. But in the construction business, words aren’t the only things that need to be exchanged rapidly; changes in site plans or design specifications also have to be transmitted quickly and accurately, often under tight deadline schedules.

“In the past if a contractor was working with an engineer in another state, the only means of sending blueprints, contracts, or site plans was through overnight courier or U.S. mail,” says John Sheehan, senior vice president for the communications products group of the Ricoh Corporation, a manufacturer of office communications equipment. Although facsimile machines have also been available since 1930, Sheehan explains that until a few years ago, analog facsimile machines “were slow, provided inconsistent copy quality, and had to be operator attended at both stations to transmit and receive documents.” With the old analog “fax,” a typical page took six minutes to transmit. Poor copy legibility necessitated resending documents, reading them over the phone, or sending documents through overnight package delivery.

CH2M HILL experienced all the usual difficulties with traditional fax machines. “Frankly, we were down on ‘fax,’” says Diane Pankratz, office systems director for the Oregon-based engineering firm. “Many of our people were disappointed with the performance and relatively poor copy quality delivered by the facsimile equipment we had used since the early 1970s.”

CH2M HILL has an especially great need to rapidly transmit hand-written information coast to coast: the firm has 40 domestic and international company offices. Yet, says Pankratz, computer-to-computer communication or electronic mail weren’t the sole answers to their transmission problems. The company’s array of paper traffic includes not only engineering drawings and hand-written memoranda, but proposal information, letters to clients, time sheets, and accounting data. These materials “had to be rushed to our offices, our vendors, and our clients—even to our project sites.”

The answer: new technology in facsimile equipment. “Today’s digital equipment transmits documents in less than 30 seconds per page to anywhere in the world,” says Sheehan. “These machines operate unattended and have features that make them not only reliable, with consistent copy quality, but also less labor intensive and extremely cost effective in the office environment.”

Patrick Householder, a sales manager of Telautograph Corporation, set out to convince skeptics at CH2M HILL that the new generation of ‘fax’ machines could meet their demands. He says that the major reason for using facsimile equip-
ly use sophisticated microprocessor technology to send small amounts of data—such as a material cost or revised specifications in the case of construction industry users—from a terminal located in an office to the pager. The information is shown on a small LED display similar to those on digital watches, and the devices usually have a limited memory capacity, up to about 120 characters.

**Private Versus Common Carrier . . .**

How you go about purchasing—or leasing the use of—a paging system will depend upon your needs. This brings up a basic operating distinction in the industry which applies to all types of mobile communications equipment: private versus common carriers.

Eric Schimmel, staff vice president of the Mobile Communications Division of the Electronic Industry Association explains that a private system is one in which “a business entity goes to an equipment manufacturer to purchase radio equipment, then obtains a license from the FCC to operate that equipment for his own business purposes.” Construction firms may want to operate a closed radio system to provide communication between employees of the company. “Most industries and businesses operate on these private systems,” Schimmel says.

A common carrier, on the other hand is “a system operated by a professional provider of a communications service,” says Schimmel. “This provider buys the equipment and obtains a license to sell his service to subscribers or customers.” Radio, telephone and paging systems are the primary systems operated by common carriers; radio systems are, for the most part, privately licensed.

Paging systems can be operated either privately or through a common carrier. “A doctor or a lawyer wouldn’t want to pay for a private

ament is ease of operation—most modern machines can operate unattended. Sheehan agrees, saying that the new fax units are “as easy to use as regular paper copiers and push-button telephones, and are less expensive than many desktop copiers.”

Householder explains that transmitting through facsimile also eliminates the time-consuming keyboarding necessary for computer networking. And most importantly, facsimile units can handle graphics as well as type; Sheehan says that the new fax machines “can transmit virtually any type of document, including combinations of halftones, graphics and signatures.”

The cost savings with today’s fax machines are substantial. “The line cost in the first minute of a transmission from New York to Los Angeles will be approximately 69 cents,” explains Sheehan, “with each additional minute costing about 46 cents. Thus, the cost of sending a four-page document from New York to L.A. is typically only about $1.15.”

Pankratz and others at CH2M HILL say they are “completely satisfied” with their new digital fax equipment. Telautograph’s vice president of marketing, Frank May, says the company expects a great increase in the number of satisfied customers in the future. “As the market continues to expand,” he says, “we believe that you will find digital fax machines sprouting in the marketing executive’s office, the personnel office, even the CEO’s office—anywhere that rapid and flexible communication is needed.”

“For those businesses,” says Sheehan, “that find themselves sending high volumes of documents through overnight delivery services, or even through the time-consuming and often error-prone method of reading information over the phone, the time to buy a facsimile machine has arrived.” He offers several points to look for in selecting a high-speed facsimile machine.

• **Compatibility or Standards** — Based on transmission speed, there are three categories of facsimile machines: groups one, two and three. High-speed digital machines fall into group three and can communicate with groups one and two. But machines from groups one and two cannot transmit to group three transceivers, unless the transceiver is equipped with group three options. This can present a problem if, for example, the main office needs to communicate with its regional branches.

• **Speed** — Generally, the faster the machine, the higher the initial purchase cost. With high-speed machines, the money you save on phone line usage can usually justify the initial expenditure.

• **Image Quality** — This is especially important when sending graphs, artwork, drawings, photos, etc. The number of halftone shades of grey offered by the transceiver will affect the quality of reproduction. Overall, the image quality of transmissions has improved noticeably with common resolution now at 200 x 200 dots per inch.

• **Service** — Many major manufacturers operate a toll-free, nationwide service hotline for their customers. Many user problems can easily be corrected via these hotlines and through the phone company, thereby eliminating the need for an on-site service call.

• **Confidentiality** — This is fast becoming a priority to fax users who want to protect the integrity of their documents. Look into fax units offering compatibility with encryption devices if document security is a concern in your business.
system when they could get good 24-hour service through a common carrier,” says Schimmel. However, larger companies who plan to put a lot of users on a paging system might find it feasible to invest in a private system which they can operate themselves.

Two-way radios, or “two-way land mobile radios” as industry experts refer to them, are probably the most popular mobile communications device on the market. “With the pager, only a message was possible; two-way radios expand the communications potential because immediate response is possible,” says Karahalios. These radios are available in mobile or portable styles. Mobile radios are usually installed under the dashboard of a car or other vehicle; portable radios are smaller and can be carried in the hand or coat pocket. The latter, while ideal for contractors working all over the jobsite away from vehicle or office, have traditionally had less range than the larger mobile radios. This difference is disappearing, however, with the introduction of repeaters into the market. “Repeaters are devices which take the radio signal being produced by a portable or mobile unit and repeat it, transmitting it further along and thus increasing the range of the unit,” Karahalios explains.

One other important distinction is whether the radio operates in the VHF (very high frequency) or UHF (ultra high frequency) range. Schimmel says that “VHF used to be the only band available for two-way radios; then the

FCC allocated some channels in the UHF band for radio use because the VHF band was so crowded.” Low VHF is below 50 megahertz (MHz), and high VHF is above 150 MHz. UHF channels available for two-way radio are between 450 and 950 MHz.

Most newer radio systems operate in the UHF range, while most older systems operate in the VHF range or lower UHF range. However, what you will need depends on what channels are available in your metropolitan area. “Almost all the channels in major metropolitan areas on VHF and UHF are occupied today,” says Schimmel. In fact, overcrowding of the airwaves is a major concern of the FCC and other organizations involved in mobile communications.

The most recent change in this system was the FCC’s move to open up the 800-1000 MHz range to mobile communications users. A substantial portion of this range is now allocated to commercial operators of trunked radio or cellular telephone systems who then sell their services to subscribers.

Within this basic dichotomy the array of radio equipment is virtually endless. Many different facets of your operation must be examined before you can determine your radio needs, including the range you require, the number of units you will be using, and the amount of privacy you will need.

**Setting Up Your System . . .**

“There are several ways to configure a radio system,” says Fred Davis, manager of repeater operations for Kemp Communications, Inc., mobile communications dealer. “You could get a license to have a private system, with your own base station in your office and an antenna on the roof. Then you might add your own repeater, and put it in a high, remote location, so that you can communicate on your system within a much larger area. If you own your own equipment and you are the only system on it, then there is no limit to the number of mobile units you can operate on that system.”

“Or as an alternative,” Davis continues, “you can share a repeater with other companies which have radio systems. This is called a “community repeater,” and you would want about 60-80 mobile units—about 10 customers—on it. This is, of course, much less expensive than having your own repeater and renting the location for it yourself; but with a community repeater, you must monitor for clearance before you can use it. So in other words, you have even less privacy than you would with your own system.”

The alternative to a private system is the SMR, or Special Mobile Radio service, which the EIA’s Schimmel calls “a hybrid of private and common carrier systems.”

According to Special Industrial Radio Service Association, SMR service was established in the mid-1970’s.
to “provide a communications service to private radio licensees on a commercial basis.” The key to the effectiveness of this system is trunking. “Trunking is a method of connecting several channels into one mobile relay system which is used for both private and commercial applications,” says Karin Norton, SIRSA’s Director of Communications.

In a traditional radio system, a private radio licensee—such as a company—is licensed to use one channel. In this situation, says Davis, “someone else nearby—30 miles away for instance—can apply for a private license and obtain authorization to use the same channel. As many as 10 or more licensees may share a channel in the same geographical area. This can cause interference.” According to Schimmel, it also creates “busy hours”: periods during the day when certain channels in a particular area are clogged with users. If the channel you’ve been assigned to is in use, you may have to wait for free time; meanwhile, other channels that you don’t have access to may be lying idle.

With SMRs, says Schimmel, “an individual or a company obtains a special license for five to twenty channels (usually in multiples of five), depending on his ability to fulfill a loading requirement of 100 units per channel. Then, this operator arranges for subscribers—businesses offering a variety of services and using the radio at different times—to share the use of these channels.”

The SMR system uses trunking equipment which allows computerized random assignment of channels to the system’s subscribers,” Schimmel continues. In other words, the system can scan over the five or more channels and assign a vacant one to you for that time. All units in your system will automatically switch to that channel, allowing you to communicate without having to wait, and allowing for efficient usage of channels which otherwise might have been idle. This type of system also allows you more exclusive use of a channel, since while it is assigning channels, the trunking system will automatically skip over those in use.

Besides exclusive use and convenience, trunking provides much cleaner channels because they are operated in the 800+ MHz range. “At 800 MHz the FCC doesn’t allow any other licensee within approximately 70 miles
(far beyond most systems’ range) on the same frequency,” explains Kemp Communications’ Fred Davis. “So there is virtually no interference— unlike a regular 450 UHF system.

Unfortunately, for this exact reason, setting up an SMR or any new trunked system is not possible in many major metropolitan areas. “There are a finite number of channels available, and in most cities there is a waiting list for authorization to operate a system,” says Davis. So the FCC won’t allocate the use of that many channels to one trunked system in a busy area.”

**Special Services . . .**

Within the range of VHF and UHF frequencies, the FCC has designated that certain frequency bands be allocated for specific purposes. With some exceptions, the FCC has allocated frequency bands above 800 MHz for use by common carriers, while those below that level are for private systems not operated for a profit.

The Business Radio Service Association designates certain frequency bands for use by any business operation, subject to proper authorization. In addition, the Special Industrial Radio Service designates other frequencies to be used only by people engaged in industrial activities such as the operation of farms or ranches, mining, and utility and infrastructure construction, among others. Applicants for this service, which is operated by the association’s profit-making subsidiary, can request the use of frequency bands both above and below the 800 MHz level, depending on the type of use.

For contractors interested in this service, it should be noted that the list of eligible users for the Special Industrial Radio Service includes the following: “[those] regularly engaged in the construction of roads, bridges, sewer systems, pipelines, airfields, or water, oil, gas, or power production, collection or distribution systems. Other engineering projects, normally classified as heavy construction activities, will be considered on the merits of the showing made, however, the construction of buildings is not in this category.” Commercial contractors, then, should apply for use of the Business Radio Service.

These are simply some of the options available in mobile and portable radios today. For instance, digital transmission to supplement voice with data messages between a base station terminal and a mobile or portable unit is also available for radio systems. Many of today’s radios come with a special visual readout area for reception of these messages. Other options to consider include portable radios which can be converted into mobile units; “tone coded squelch,” which minimizes the reception of messages from other radios in the area which are on your channel but do not have your tone frequency; and timers, which automatically revert your system to standby after 60 seconds, preventing inadvertent and prolonged transmissions which tie up a repeater or channel for co-users.

The big news in the mobile communications industry is cellular tech-
nology, the latest improvement in the radio-telephone sector of the industry. "Cellular technology allows more users to use telephones in their cars and beyond," says Karahalios. In the midst of its third year, the cellular industry has brought increased profits and increased competition to the mobile communications industry. With this technology a geographic area is divided into separate cells, each with its own pickup/transmission tower. The development of this technology is meant to prevent clogging of channels, once a problem with older radio-telephone systems.

Only two licensed commercial operators are authorized to operate the systems in each city, FCC officials explain. These carriers then sell the use of the system to subscribers. The subscribers are the owners of cellular telephones, which are battery-run and operate out of a car or, in the case of the new portable cellular telephones, a briefcase or even a pocket. Although the sale of the telephone units and subscription to the service can require two separate business transactions, Ray Boggs, consultant for the market research and consulting firm Venture Development Corp. says that they are closely coordinated: the service company can recommend sales firms which carry compatible equipment and vice versa.

Essentially, these telephones, which transmit over radio waves, "use the same technology as two-way portable and mobile radios," says Karahalios. One major difference is that the cellular telephones operate on the higher end of the UHF range — 800 MHz and above. A key advantage of cellular telephones over mobile radios is the transmission distance. Cellular telephone users can make "long distance" calls to cellular systems in other metropolitan areas, as well as to regular telephones in the local and long distance calling areas.

"Basically there are three types of calls," explains Boggs. "The core of any cellular system is the Mobile Telephone Switching Office, or MTSO, which is hardwired to each cell site or transmission tower in the system and to the regular telephone network (see illustration).

With this arrangement, says Boggs, a cellular telephone user can:
• call a regular phone or another cellular phone outside his particular cell system;
• an outside phone can call a mobile or portable cellular phone;
• cellular phones within the system can call each other.

Each cellular unit has an identification number which is transmitted to the MTSO in the course of any transmission; in this way the carrier company can bill each subscriber for his calls.

In addition, an option called "roaming" is available in many areas. As Boggs describes it, "if you are a subscriber to a system in Washington, D.C., but you are driving near Baltimore, Maryland and you want to make a call, you would want to hook into the signal of a Baltimore service. With roaming capability your phone is allowed to tap into the Baltimore system, using your phone's identification number to assure that you are still billed for the service. It is not technically difficult, it just requires an agreement on billing arrangements between your carrier and the one in the other city."

The key to the efficiency of a cellular system is its switching capability; that is, the speed with which a cellular telephone can switch from one cell site to another as the car moves through different sites. The more rapidly the equipment can lock into different sites, the more the operators of the system will be able to subdivide cells without destroying transmission integrity. With greater numbers of cells and sub-cells, more subscribers can be added to a system without clogging.
Improving switching capabilities is one of the cellular phone industry’s greatest priorities, since studies by marketing research companies such as Venture Development, Inc., predict that the “cel-tel” industry “will grow to almost 1.4 million phones by 1990, making it one of the fastest growing product categories in the communications industry.”

**Future Technologies . . .**

Mobile communications is a multi-billion dollar industry that is constantly changing; as quickly as a potential user can learn about the variety of devices on the market, new equipment and better options are being developed.

The trend for all sectors of the industry is toward more efficient portable equipment: portable radios that can transmit as far and as clearly as mobile ones; portable cellular telephones in briefcases that are both lightweight and contain a battery system capable of supporting the telephone for hours; and pagers that are smaller and more lightweight than those currently available. Another “hot item” in the mobile communications industry is secure systems, in which radios and other devices use “an encrypted mode of operation which prevents eavesdroppers from monitoring private communications,” according to Motorola.

Other innovative technology to look for includes nationwide paging and paging terminals that print hard copies of messages; mobile and portable radio systems that can network into cellular telephone systems; and more sophisticated data transmission in pagers, radios, and telephones. Whatever your needs, the mobile communications industry can probably satisfy them—in fact, probably the biggest problem you’ll encounter is that mobile communications are becoming so popular, airwave space is becoming a precious commodity!

(For more information contact: National Association of Business & Educational Radio at 703-739-0300; the Special Industrial Radio Service Association at 703-528-5115 or; the Federal Communications Commission at 202-632-5050.)

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