by Robert E. Gradle

Consider, if you can, an Army without field radios. An Army that could not communicate with friendly aircraft overhead. An Army without radar, or the ability to detect approaching enemy forces. An Army whose heavy artillery accuracy was based solely on a "point-and-shoot" technique.

Hard to imagine?

Thank goodness. But this terrifying scenario could be reality if it were not for the U.S. Army Signal Corps and the long-standing cooperative effort between the Corps and the civilian C-E industry.

The effort goes back to the 1870s, when Army units battling the Indians in the west used telegraph equipment manufactured by Western Electric. And during the Spanish-American War in 1898, the telephone was first used in military operations.

In 1917, the Signal Corps, with the fledgling Army Aviation Service under its wing, asked civilian industry for help in developing a system for radio communications between aircraft and ground locations and between aircraft themselves.

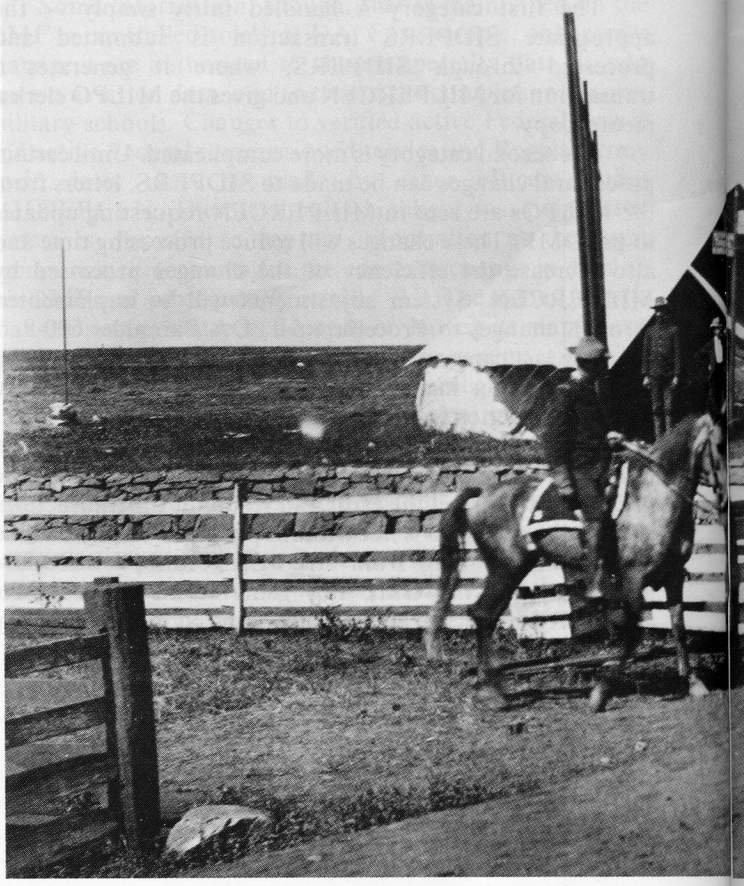
Within six weeks of the Corps' original request, a civilian corporation was able to conduct field tests of the new equipment. Less than five months later, final testing had taken place and the Army immediately placed quantity orders for the equipment. In light of the lengthy procurement process we face today, that short time period seems like a miracle.

Historians note that developments in radio communications had little impact on the conduct or outcome of the war. That's not surprising. U. S. involvement in the war was short — just 19 months — which gave little time to develop and implement new technology.

Nevertheless, World War I and the advent of effective radio communications from aircraft and ships did change the way military people thought about communications. At the same time, the war demonstrated

Partners in progress

The U.S. Army Signal Corps and the civilian C-E industry work together for a stronger, more secure nation.



civilian industry's ability to respond quickly and effectively to critical military demands. In the process, industry gained useful experience in standardization and quantity production.

From Lineman to Soldier

Like millions of their countrymen, thousands of industrial employees switched from civilian garb to military uniform during the first World War. Many of the 25,000 AT&T people who enlisted served in the Signal Corps, a logical use of their talents and expertise. Indeed, 12 "Bell Battalions," each consisting exclusively of employees from a Bell operating company, were formed. Eventually, there would be 14 Bell Battalions and nearly 5,000 Bell workers in the Corps. Considering that the Corps' total manpower before the war was fewer than 1,300, the company's contribution was significant.

These Battalions saw extensive service in France, creating a new communications network of more than 100,000 miles of wire, 100 switchboards and more than 3,600 stations. Interestingly, observers reported that French Marshal Foch preferred the American facilities to the French because they usually worked better.

When the war was over, General Pershing noted that the work of the Signal Corps was one of the greatest accomplishments of the American Expeditionary Forces. And one historian recently wrote that the Bell Battalions "somehow successfully combined the experience and skill of a peacetime business organization with the

(Left) Carrier telephony goes to war in Spiral-4 cable. These GI's in Italy are preparing the cable for overhead suspension. (Above) A 1917 or 1918 view of early aviation radio equipment.

(Below left) The Signal Corps telephone and telegraph station at Camp Meade, Pennsylvania, in 1898. Telephones were first used in military operations during the Spanish-American War. (Below) France, WWI... Vital messages were switched over this W.E. "Camp" switchboard.

imagination, esprit and courage necessary to military operations, remaining a striking — and stirring — example of the application of corporate resources, almost unchanged except for the wearing of uniforms and the assumption of military ranks, to national purposes."

The dedication to national purpose was not limited to those who donned military attire. In 1917, General Pershing asked that a Women's Telephone Operating Unit be established. More than 7,500 women volunteered; 100 who could speak fluent French were selected initially; eventually 233 American women went to Europe as part of the unit. Many of them served just behind combat lines.

The Monumental to the Mundane

If communications technology had little chance to influence the outcome of World War I, the opposite was true of World War II.

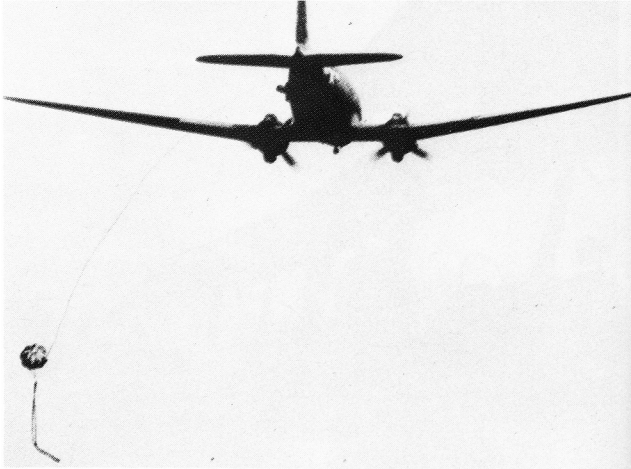
Cooperation between the Signal Corps and civilian industry during the war ranged from the monumental — creating a global military communications network — to the seemingly mundane — finding new ways to wind wire so it could be unrolled quickly and smoothly from an airplane.

In 1939 — more than two years before the attack on Pearl Harbor — the War Department asked that a civilian telephone laboratory work with the Army Signal Corps to design a network plan to accommodate military needs and those of the Departments of State and War.

The task was extremely complex. But it formed the foundation for military communications during the war years and beyond.

The network plan developed for the Army included a mix of radio communications and wire; telephony and telegraphy; and fixed and mobile systems. It also included plans to overcome problems in traffic, compatibility, reliability and security.

When soldiers "go over the top," they take their telephone lines with them no matter how rough or dangerous the going may be.



How does one lay cable over terrain impossible to traverse? Military and civilian experts found new ways to wind wire so it could be unrolled quickly and smoothly from an airplane.

Immediately after Pearl Harbor, the Signal Corps contracted Western Electric to develop, manufacture and supply transmission equipment needed to interconnect signal centers outside the United States with each other and with the domestic network. The company also became a prime supplier of numerous types of telecommunications equipment to the Army.

By 1943, the communications network was so advanced that General Eisenhower could communicate from Africa directly and secretly with General MacArthur in Australia. And by war's end, the network was able to transmit a message around the world in only nine seconds, a feat considered impossible only a few years before.

The Birth of Radar

Another major project had its roots in the pre-war years. As early as 1934, the Army Signal Corps Laboratory and the Naval Research Laboratory had been working on radio detection and ranging, later called radar. But the military laboratories needed help in developing systems using higher frequencies that would allow them to use smaller antennas. In 1937, the military groups turned to civilian industry for help, and work began on this highly secret military program. To do the job, nearly all components had to be designed and fabricated from scratch.

The labs developed nearly 100 types of radar during the war. They included fire control radars on ships, submarine radar and sonar, mobile radars, navigation and bombing radars, and Army radars such as the integrated search and fully automatic track radars.

Cooperative Effort

- Early in the war, the Corps came to civilian industry for advice on developing a carrier system using a field cable that could be plowed underground, along with appropriate carrier and terminal equipment. It had to be a multicircuit link capable of transmitting at least 100 miles. The result of the cooperative effort: the spiral-four cable, which could be buried, laid above ground or strung from poles or trees. It was used extensively.
- The Signal Corps defined a need for complex communications systems that could be transported to a site, quickly assembled and transformed into operational status. The result was a "modular" or "package" approach, creating building blocks in advance so only the blocks had to be connected to provide a working system.

• In 1941, the Signal Corps asked industry to modify commercial designs of carrier equipment for military use overseas under extreme conditions. Some equipment was "tropicalized," for instance, for use in the South Pacific.

• When the Signal Corps needed help building a trans-Alaska circuit, the Bell System pitched in, and together we engineered, manufactured and installed packaged carrier systems for the 2,000-mile route. When complete, the Alaskan connection allowed telephone and telegraph messages to be transmitted 7,000 miles from Washington, D.C., to Fairbanks.

• Industry designed and manufactured special headsets and microphones for use under combat conditions, on ships and in aircraft.

Cloak-and-Dagger

The need for security in communications provided a series of interesting cloak-and-dagger stories.

Late in World War I, the Signal Corps and AT&T had developed a way of enciphering and deciphering teletypewriter messages so the transmissions would be secure. The method was modernized between the wars, and the Signal Corps began using the new techniques soon after Pearl Harbor.

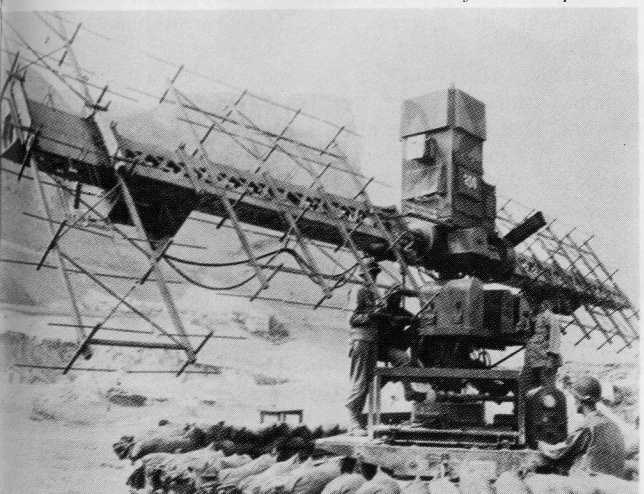
Throughout the war, equipment and techniques were refined to provide long-haul transmission of encrypted messages, to allow one multichannel radio system to handle several encrypted messages simultaneously, and to develop light-weight mobile systems.

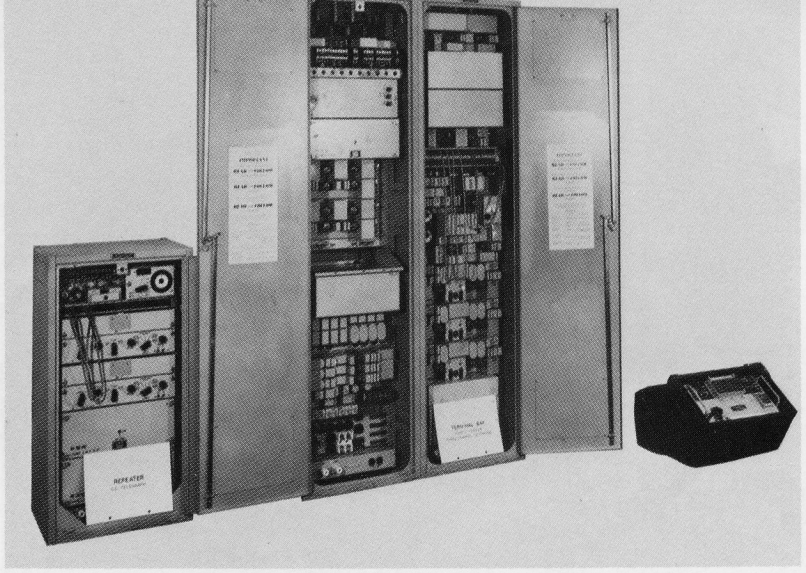
But the teletype systems had their limitations. There was a need for two-way, immediate communication that was highly secure. Voice encoding systems at the time were too easily decoded by anyone who could intercept the transmission. So the Signal Corps began "Project X" to try to find a completely secret speech enciphering and transmission system.

If you were around at the time, you might have known Project X by another name. If you were in the Signal Corps, you knew it as "Sigsaly" or "Ciphony I." If you were in a transmission center, all you knew about the project was the audible control tones that sounded like the theme of a popular radio program, and you probably referred to it as "Green Hornet." But, the Germans didn't call it anything, because they didn't know the project existed. After the war, Americans found a German intercept station that had recorded reams of the signals. The Germans apparently thought they were the output of a complicated telegraph system.

Project X was illustrative of the imagination, innovation and dedication of the civilian teams that worked on war projects. The method might seem primitive now, but it was the first use of digital speech transmission using pulse code modulation. And it was a precursor of the digital age that followed.

Twisting and turning like a huge mechanical insect, this SCR-268 Radar scanned the Italian skies for Nazi planes.





Modular equipment made it possible during WWII to quickly transport and assemble complete communications systems.

A Top-Secret Dream

Strangely enough, another top secret project evolved from the dream of a scientist. D. B. Parkinson had been working on precision testing devices for telephone equipment. One night, Parkinson had a dream, probably inspired by radio reports of the battle of Dunkirk. The dream had Parkinson on an anti-aircraft crew, using his telephone testing technology to shoot down every enemy aircraft that flew overhead. After doing some additional research, Parkinson and his colleagues notified the Signal Corps, which was interested immediately.

From the time of the dream in mid-1940, it took only 18 months before the first production models of the new M9 Gun Director were on their way to Britain. And none too soon. This revolutionary new device was able to destroy 76 percent of all German V1 buzz bombs entering the M9 defense sectors. Thanks to a scientist's dream.

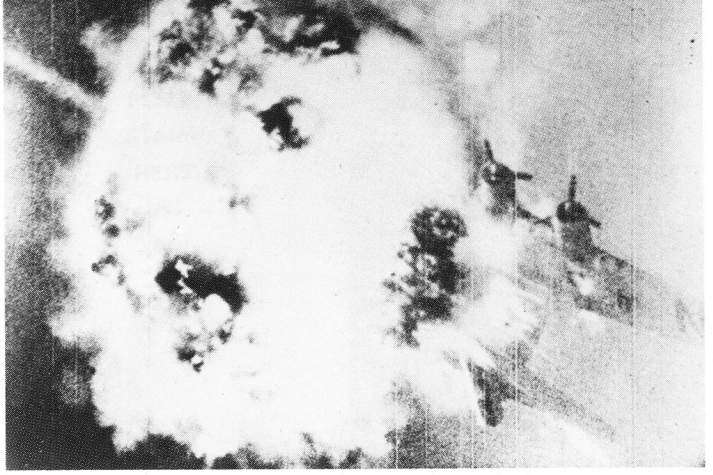
The Affiliated Plan

But if the technological work in designing and manufacturing communications and electronics systems was impressive, so too was the involvement of people.

Nearly 70,000 AT&T employees served in the armed forces in World War II, the largest single group being assigned to the Signal Corps. Unlike the Bell Battalions of World War I, Bell employees were spread among existing Corps units in an "Affiliated Plan" designed to take advantage of the unique background of the telephone people. The Affiliated Plan was devised by the War Department in the late 1930s to identify people who could augment existing Signal Corps units in an emergency without crippling the national communications service that would be even more critical in war. Communications employees received preliminary training before the war, then were called upon to become a nucleus of experienced communcations people within Signal Corps units.

Meanwhile, a Field Engineering Force (FEF) — a group of troubleshooters — was formed to help get the radar project started in the field. But circumstances were such that the FEF expanded in numbers and function. The original group of 20 engineers grew to 431, and included technicians from Bell System operating companies, universities and broadcast stations.

Soon after the war began, Bell Labs was asked to establish a school to train teachers in military schools. The staff for the School for War Training was drawn from



During the Korean conflict, civilian industry managed development of Nike. (Left) The Nike flashes just beneath the target plane's wing, and (right) the firey fragments of the devastating missile rip the target apart.

Automatic Voice Network), the first worldwide switched network for private telephone and data transmission.

AUTOVON has been expanded and upgraded continually since then, and continues to serve all of DoD.

In addition to AUTOVON, there are many other communications networks civilian industry has helped the military design, install and operate. They include the Joint Chiefs of Staff Alerting Network (JCSCAN) and the system that supports the President of the United States wherever he goes.

What is now the White House Communications Agency (WHCA) began in the early 1940s as a communications detachment of the Signal Corps. Later it became the White House Signal Agency, and in 1963, the White House Communications Agency under the administrative control of the Defense Communications Agency.

The Dynamics of Innovation

Through more than 100 years of partnership, the Army and industry have worked together, and the American public, in whose service both are pledged, has been the beneficiary. This has been true in terms of national security and in terms of the civilian telecommunications system.

There have been valuable civilian payoffs from military research and significant military applications from innovations originally intended for civilian use.

Radar, of course, is a prime example of how a system developed for military use has civilian application. The world's transportation network would be handcuffed without it.

On the other hand, the transistor, a civilian invention, has had many military applications. For example, it has allowed military communications systems to become smaller, lighter and more mobile, while increasing their capacity and capability. Computers would be several generations behind the times were it not for the transistor.

A recent example of military use of a civilian product is the 11th Signal Brigade's application for the Dimension R private branch exchange. Dimension originally was designed as a flexible system that could be housed on customer premises and allow the customer to restructure the system himself. Special models of Dimension are designed for hospitals, for example, or for hotels.

But now Dimension has put push-button telephones, quite literally, in an Army tent. The PBX itself is housed in a trailer. And in field exercises, Dimension has proved much more reliable than its predecessors.

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A Changed — and Changing — Environment

Today we operate in an environment quite different from those World War I and II days when the Signal Corps could simply come to civilian enterprise and ask that communications systems be developed. Changes in regulation, legislation and competition have combined with new technology and with new threats to our national security to make this a different world.

But one thing will never change: the close relationship between the U. S. Army and civilian industry.

The ultimate result is a stronger, more secure nation.

For the past eight years, Robert E. Gradle has served as Vice President-Government Communications of the American Telephone and Telegraph Company's Long Lines Department in Washington, D. C.

He served in the U. S. Army infantry during World War II, rising to the rank of captain. He joined AT&T in 1947 and has held various positions with the company in operations, engineering and accounting. He also was Vice President and General Manager of Bellcomm, Inc., a Bell System subsidiary which performed systems engineering work for the nation's space program.

Gradle is a member of the Board of Advisors for the Foundation of the U. S. Army Signal Corps Museum and Science Center, Inc. He also is a member of the Association of the U. S. Army and other military associations, and has served as Chairman of the Board of the Armed Forces Communications and Electronics Association.