

# UTILITIES IN THE WAR: COMMUNICATIONS

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When our broadcasting stations on last December 7th interrupted their regular programs to transmit the startling news of the bombing of Pearl Harbor, many telephone people immediately went to emergency posts believing that the demand for telephone service would instantly soar, which it did. In three important Southern California offices, the number of toll calls handled on the 7th was over 75 per cent greater than on the Sunday just preceding, and the news of Pearl Harbor was not received until mid-afternoon.

The present emergency began to affect telephone organizations long before the Pearl Harbor attack, however. The orders placed in the United States by nations later to become our allies, in addition to development work requested by our own National Defense Research Council, had shifted a large portion of telephone research and manufacturing to development and production of defense communication equipment. Soon it became necessary, while carrying on an increasingly active development program, to develop substitutes for materials, shortages of which arose or became imminent, and later it became imperative to find substitutes for the substitutes.

In the operating telephone companies, one early effect of the impending war was upturn in requests for service resulting from the increased pace of aircraft and other industries manufacturing war materials for ourselves and other nations. In short, the telephone companies and related research, development, and manufacturing organizations were considerably affected before December 7th, but after our declaration of war the acceleration of all these activities made the former effect seem insignificant.

Applications for new telephone service continued at a high level and shortages of copper and other strategic materials became so great that it soon became necessary to conserve the supply and direct the distribution of telephone materials to insure deliveries for war and essential civilian requirements. The War Production Board, therefore, on March 2, 1942, issued conservation order LY50. The effects of the shortages have by now been felt by many people. For example, a number of telephone users have changed from individual line service to party-line service in order to permit applicants essential to the war effort to obtain telephone service.

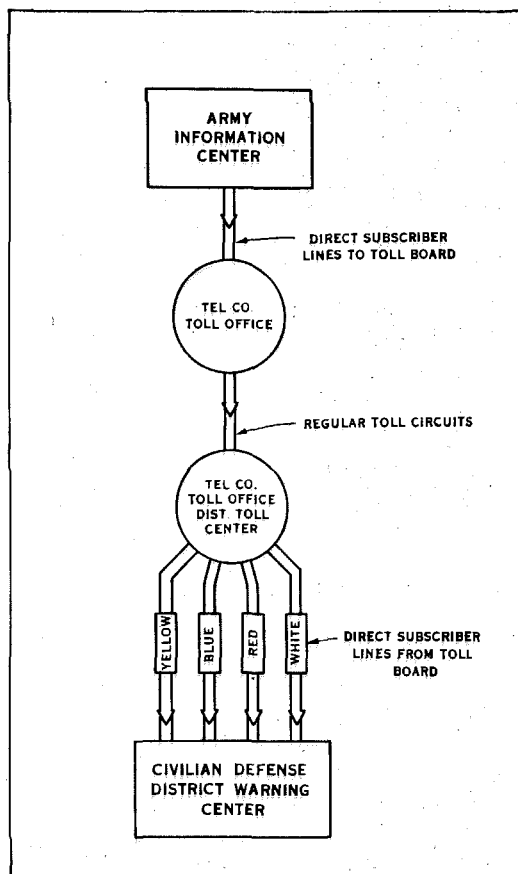
The telephone companies have provided large quantities of facilities for military and civilian defense purposes, in addition to the continued attempt to meet essential demands for telephone service. One of the most interesting uses of telephone facilities is in the aircraft warning network. In 1938 and 1940, thanks to the foresight of our military leaders, extensive war games were held and early versions of aircraft warning systems were given practical tests. These suggested refinements and improvements made possible the high efficiency of the present network, the most extensive system of intelligence ever devised for military

use. Today, upon the ground observer system depends in large part the efficacy of the fighter commands which, day and night, are guarding our shores.

## THE AIRCRAFT WARNING NETWORK

Land area of continental United States comprises 2,977,128 square miles. Much of it has been ruled off, on small sectional maps into units one mile square. In each unit has been placed a symbol indicating the presence or absence of a telephone in that area. Telephones of the Coast Guard, Forestry Service, and similar agencies have been indicated. The telephone companies, Bell and independent, did that job, and turned the maps over to the Air Corps' four Fighter Commands.

That was the start of the present ground observer network. On these maps, starting with an indicated telephone, Air Force officers laid circular templates scaled to an eight-mile diameter, and drew overlapping circles. At some point within each of these circles an observation post was carefully selected and a trustworthy citizen appointed chief observer. To obtain this enormous organization, aid of the Office of Civilian Defense, State Defense Councils, and the American Legion was enlisted. Each



AIR-RAID WARNING CHANNELS

This diagram shows how both the Army Information Center and the Civilian Defense District Warning Center are directly connected to long-distance switchboards.

chief observer appointed his deputy observer, and obtained enough volunteer observers to insure constant coverage of the post—24 hours a day, seven days a week.

So, day and night, those observation posts which have been activated by the Army are manned by these patriotic civilian volunteers. Each of these thousands of posts has its code name; each observer has his instructions—or hers, for many women are among the watchers.

An observer at an authorized observation post, seeing or hearing an airplane, or several, goes to the telephone, says to the operator "Army Flash," gives the telephone number of his post—and initiates a train of events which are astounding both in their complexity and in the speed with which they are executed.

The telephone operator, receiving the "Army Flash" call (and screening out any such call from an unauthorized telephone), connects the observer, either directly or through her toll center, over regular commercial circuits to the regional Fighter Command filter board terminating at a point on the filter board corresponding with the observer's own location.

The filter board, near a city selected because of its tactical location and its telephone facilities, is a very large map of the area it covers, so mounted that it becomes in effect a table. It is marked off into squares designated by code names and numbers. These codes correspond with those of the observation posts in the area. Around the map sit the plotters, all civilians, all volunteers. To them come the calls from observation posts,

each call routed directly to the plotter nearest the mapped location of the post.

Receiving a signal light and an "alert" tone at her position, indicating a "flash" call, a plotter, equipped with a telephone operator's set, answers "Army, go ahead please," and receives the report from the observer at his post.

The observer reports only non-technical facts, as instructed by the Army: Number of planes seen or heard; whether single-, bi-, or multi-motored; apparent altitude; distance from the observation post; and direction of flight.

The plotter adjusts a marker to represent the information just given her, and places it on the map at the proper coordinate location of the reporting observation post, pointing in the reported direction of flight. This is accomplished in a matter of seconds, and the plotter is then ready at once to receive a call from another observation post.

This operation, it must be understood, takes place many times in rapid succession as one observation post after another reports—since the speed of planes is great and observers are located only a few miles apart. It takes but a moment for the markers on the map to make a definite line. Also, reports of a flight from successive observation posts corroborate each other, and thus of themselves rule out an occasional discrepancy on any one report.

The markers, having so swiftly become a line, are now as swiftly evaluated by a "filterer," who places on a small stand nearby cards describing the observed flight, and replaces the markers with arrows indicating direction. To show the speed of the flight, the color of the arrows is alternated at regularly timed intervals.

The information about each airplane flight in a filter area, having been thus evaluated or "filtered," is now ready to be transmitted instantly over private telephone lines to an Army information center.

The heart of the aircraft warning system is the information center. It is here that decisions are made, action is initiated.

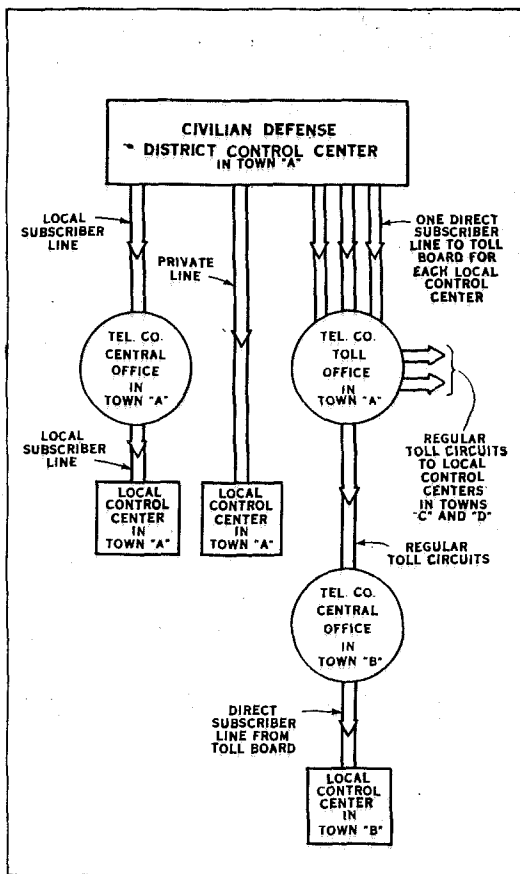
Here is the operations board for the particular defense region. Like the filter board, but larger, it includes all the filter areas of the region. Here, too, plotters place their symbols; but now they are duplicates of the evaluated information received moment by moment from tellers at each filter board in the region.

In the same room are the seaward board, on which all flights approaching from the sea are plotted; and the status board, on which are shown the availability, position, and condition of pursuit squadrons in the region.

On a balcony overlooking these three boards sit the men who decide, and the men who help them. Contact among them, even between those who sit side by side, is by telephone.

First comes identification of the flight, from location and direction, if it can be identified. On the balcony, with this responsibility, are representatives — liaison officers — of the Army, the Navy, the Civil Aeronautics Administration, and the Federal Communications Commission.

On the balcony is the Controller. He is, or acts for, the Commanding Officer of the region. It is he who orders into the air, from the most logical field in the region, pursuit of sufficient strength to effect interception of an enemy flight.



**DISTRIBUTION OF THE WARNINGS**

In this diagram, channels from a District Control Center to the Control Centers of several neighboring communities are represented.

## THE TELEPHONE'S PART

Although little has been said in detail about the use of the telephone in the system described, it must be evident that every operation, from the reports of airplanes seen by civilian observers to the ordering of pursuit into the air, is keyed to and carried out by telephone. And even the pursuit flight is controlled by Army radio telephone sets connected by telephone circuits to information centers.

Fundamental to all is the use of existing commercial telephone lines, both of the Bell System and of independent telephone companies, made possible because the United States is served, as is no other country, by a network of telephone lines not only interconnecting cities and towns and hamlets but reaching out into almost every countryside. "Flash" calls from observation posts, using regular commercial telephone lines, get absolute right of way, of course. Where certain telephone and teletypewriter circuits may be required for the use of the Air Forces exclusively, these are provided in most cases from available lines. Even the intricate and vitally important intercommunicating systems by which coordination is attained at filter and information centers is put together out of standard parts, with a minimum of special equipment. The use of standard equipment—although specially arranged—expedites installation, and minimizes maintenance problems which might result from the use of specially designed facilities.

A large part of the defense network is used by civilian defense organizations, picking up where the Army leaves off. The Army telephones warnings to the warning district centers which are the points of contact between Army and civilian groups. From there on the operations are directed by civilians. The size of warning districts varies but is illustrated by Massachusetts, where nine districts have been established.

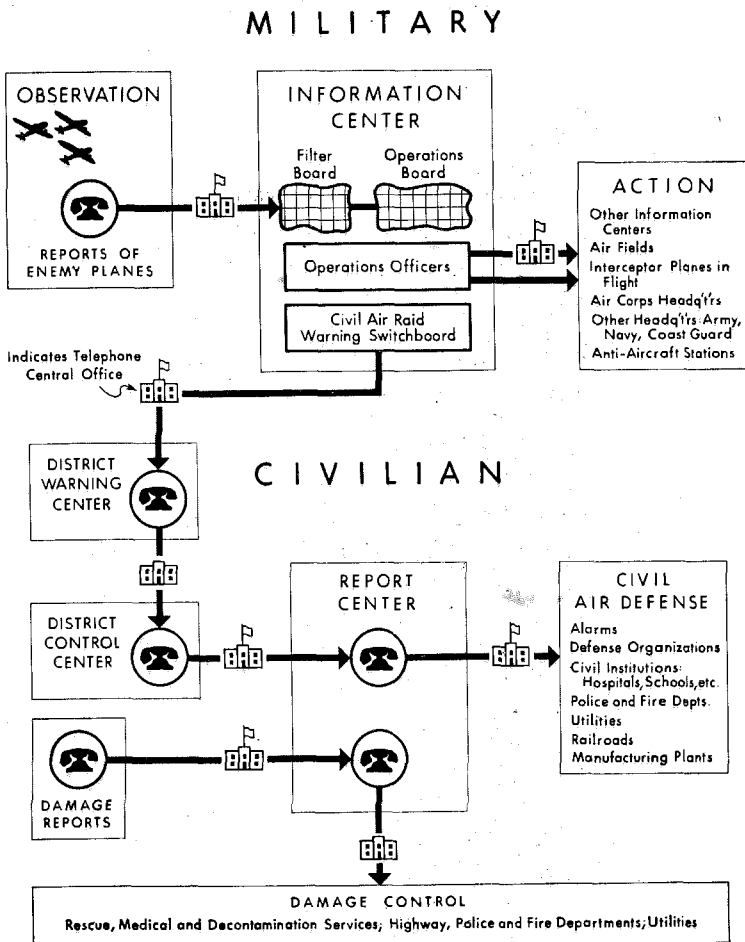
A blackout can be ordered for a region regardless of the degree of warning in effect. This is likewise true of silencing radio broadcasts.

It should be pointed out that these warnings are the subject of continuing study and tests, and may therefore be changed from time to time as experience and circumstances warrant.

The Army arranges to have each Warning Center provided with a special telephone which has four keys. Each key is associated with a line to the long-distance central office, and with a lamp signal. There is a combination of line-and-key-and-lamp for each of the four degrees of warning; the key and lamp are of the same color as the warning they represent.

For example, when the Army sends a yellow warning to a Warning Center, a bell rings and the yellow lamp lights. The Warning Center attendant depresses the yellow key and, using the telephone hand set acknowledges the warning with "Bridgeport Warning District, yellow." Generally the warnings disseminate from the Warning Center by message telephone service to the Control Centers of individual communities. However, there may be variations to this method of routing warnings; e. g., warnings are sometimes relayed through a District Control Center which has been established to coordinate the activities of several neighboring communities. Also, police and other teletypewriter networks are sometimes used for warning dissemination.

# AIR DEFENSE COMMUNICATIONS



### "TELEPHONE LINES AND AIR DEFENSE"

Only the upper portion of this diagram represents military activity. The lower part shows how the telephone serves Civilian Defense as well.

### CIVILIAN PARTICIPATION

This background brings us to the last link of the warning chain, which is forged largely by the individual community. Based on a study of the steps required to prepare for an attack and the time involved, lists are developed of individuals and groups to receive the yellow and blue warnings. Such lists include three groups: (1) Key people in the civilian defense organization, e. g., personnel required to operate the Control Center, and heads of such essential services as fire, police, medical, repair, utilities, etc.; (2) schools, hospitals, and other such institutions where special steps have to be taken to protect large groups of people located on the premises; and (3) Large war plants in those cases where the steps necessary to prepare for a raid require an appreciable amount of time. The exact composition of warning lists must, of course, be determined individually by each community, based on a careful review of its requirements.

Only a limited number of these advance warnings can be transmitted over regular message telephone service. Excessive use of the telephone at such critical times would congest the telephone system, and thus some calls most important to civilian defense might not get through. To avoid congestion of the

telephone system, civilian defense officials and telephone people in each community jointly develop the warning lists, giving due consideration to the capacity of the telephone facilities to handle warning calls. Particularly dangerous at such a time are the so-called "chain calls" of excessive length, whereby a small group is called from the Central Control and they in turn call a larger group, and so on. To show how such calls "snowball," if an attempt were made to reach about 1,000 people in ten minutes, there would be a wave of over 500 calls during the last minute and over 120 operators would be required in a manual central office to complete them within the deadline.

### PATROLLING AND REPORTING INCIDENTS

Wardens are the sentinels of civilian defense. Their functions are similar to those of police patrolmen or guards and watchmen in private business. They are mustered when such patrolling agencies require reinforcement. They start patrolling their posts when the red (or public siren) warning is given, and (1) warn the inhabitants of impending danger, (2) prepare their area for an attack, e.g., effect blackout, clear streets of traffic, and help the public to take cover, (3) spot and report damage and casualties to the Control Center, and (4) render such other assistance as they can.

To reach the Control Center, wardens ask for or dial the telephone number assigned to the Control Center incoming lines. When the Control Center answers, they give a terse but adequate report covering the incident.

The Control Center is the nerve center of civilian defense. It is usually established in a centrally located public building which affords adequate space and good protection. Larger cities may require several Control Centers which are coordinated by a Main Control Center.

The Control Center force is composed of two groups. The first is a group primarily responsible for recording the incoming warden incident reports. They are stationed in a message room. The second is the staff organization, which analyzes each incident and notifies the various emergency services in cases where their help is needed. They are located in a staff room. The Control Center forces are all summoned for duty as promptly as possible following the receipt of a yellow warning. However, as mentioned previously, many Control Centers, particularly in the zones of possible military operations, are manned by skeleton forces continuously.

The facilities used for receiving warden incident reports are another example of efficient planning. In a typical Control Center, the telephone set and signal provided at the incoming telephone positions in the message room were selected so as to meet adequately the needs without requiring elaborate special equipment. Desk stand telephones with head sets, giving the telephonists free use of both hands, are used. The signal of an incoming call is obtained from a regular bell box, minus the cover and bells, which is mounted before the telephonist. When there is call on the line the clapper, which has been painted a bright color, vibrates to announce the call.

### DISPATCHING EMERGENCY UNITS

The Control Center staff is supervised by a chief and has the following members: A medical officer, chief air raid war-

den, representatives of the fire and police departments, the community's gas, power, communications and transportation companies. In small cities many of these jobs may be combined. As mentioned previously, the staff is assembled on receipt of the initial warning. Its function is to analyze incident reports and notify the emergency services involved.

As each member of the staff arrives at the staff room, he places a call to the dispatching point of the service he represents, using the telephone at his position. When it answers, he orders "Stand by for action." A private line connection for continuous, exclusive use between a staff man and his dispatching point may sometimes be required. More often, however, regular individual message telephone lines at staff positions prove adequate, since a connection with the dispatching point,



THE CONTROL ROOM OF A CONTROL CENTER

This is the main message center of the community. It is here that the orders are swiftly issued to meet the situations which are revealed by the wardens' reports.

once it has been established via the central office, can be maintained continuously if required throughout the period of emergency.

Soon after the staff men reach their posts and establish contact with their dispatching points, incident reports start coming into the message room. Immediately after a telephonist completes recording an incident, she sends the report by messenger to the staff room. The chief reads the report aloud. Each member of the staff passes by telephone to his service dispatching point such details as affect it.

From a communications standpoint, the Control Center is the main message center of the community. Communications must be engineered so that incident reports can be translated into action at top speed.

From the Control Center goes information covering incidents which enables the emergency services to make the most effective use of their organization and equipment during the period of emergency. It permits them to go only to those incidents where their help is really needed. It also gives them a good picture of the type and amount of work they will have to do. For orders and other communications between their main dispatching points and various emergency units of the several emergency services, adequate telephone arrangements are usually available.

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## England: 1942

(Continued from page 11)

However, absence of bone presented a problem to the glue industry. A Mid-westerner in our group was much concerned that we had sent considerable quantities of dried beans with no instructions for cooking them. The result was a filling but not a tasty dish. This, he claimed, was ruining the market for these beans in Britain. We had also sent over considerable quantities of salt pork. This was sliced and sold as bacon. Fried salt pork is hardly eatable. This soon became known as American bacon, and most Britishers were convinced that all American bacon is saturated with salt. I tried to do some good by convincing as many people as possible to soak this product before cooking it. These are just two mistakes in a very large program. American beef is earning itself a very good name. Prem, Spam, etc., are becoming well-known names.

Of all things sent to Britain from America by individuals, I believe that the dried fruits were most appreciated. The British are greatly amused by our tea bags, but rather like the idea. Tea is not too scarce, and could be had in any household any hour and in most factories.

The three years of war and the raids, as well as the stoppage in production of non-essential goods, have caused a very great shortage in most goods and services. So many barbers have been called into the service that ten minutes is all the time that can be given for an individual hair-cut. There is, also, considerable unofficial rationing by merchants to their customers.

Britain, in general, has many misconceptions as to what America is like, and the way Americans live. Some of the information given to the public by popular British authors is not based on a real knowledge of America. Our motion-pictures are having a great effect on the British. There are many who hope to rebuild along the lines of American towns as portrayed in our films. Children of people with a dialect, hardly understandable, talk American movie slang.

Except for the very optimistic or pessimistic reports American news channels seem to be giving a fair view of the situation in England.

## Utilities in the War: Communications

(Continued from page 15)

When the several emergency services reach the scene of an incident the senior official present may become the Incident Officer and coordinate activities, or the Control Center Chief may send an Incident Officer to the scene from the Control Center. He establishes a field headquarters and message center serving all the defense units, usually at the nearest telephone which can be used for communication with the Control Center.

### OTHER ACTIVITIES

In connection with civilian defense it is of interest that the Bell Telephone Laboratories at the request of the National Defense Research Council developed a high-volume air raid siren which was described by authorities testing it as the first "real" siren they had heard tested.

In addition to providing arrangements for aircraft warning and civilian defense networks as outlined, networks for many additional essential services are provided. The experience gained in using these from day to day suggests many changes and one

of the important duties of the telephone companies is to make these changes and improvements as quickly as possible after they are requested. This keeps many employees busy, frequently long after regular working hours.

Many plans have been placed in effect by the telephone companies in order to make small supplies of critical materials serve as many telephones as possible. One interesting material-saving device is the new method of joining the sheaths of lead-covered cable where the cable conductors are spliced. Using the old method, the Bell System required annually 2,500,000 pounds of solder of which 40 per cent was tin. The new Victory Joint makes possible a saving of 600,000 pounds of tin annually at the usual rate of use of solder. Another instance of material saving is a recent job in Southern California, where 157,200 pounds of copper were saved by replacing 600 miles of .165 inch copper wire with .104 inch copper wire. This made possible the addition of 39 long distance circuits.

One of the greatest emergency demands on the telephone companies is for service to Army and Navy training stations where the concentrations of young men away from their homes mean many telephone calls. To handle these calls the companies, cooperating with the military authorities, provide booths at many points throughout the training areas and at one or two locations in each area attended pay stations are installed. One pay station built on a trailer and providing five attended booths has been in use at a Southern California Air Base. It is recognized that telephone service aids in maintaining morale and the military authorities have worked with the companies in providing telephones for the use of the men. The conditions to be met by the telephone facilities at training stations are frequently severe because of the usual necessary location of the stations at considerable distance from telephone offices. This sometimes makes it impossible for the telephone companies with the limited materials now at hand to provide as good service as they would like to, but the best possible under the circumstances is provided and users, understanding present obstacles, generally accept this good-naturedly.

When communication specialists are needed, the telephone companies are naturally turned to. Since this country began preparation for war, many specialists have been requested for both military duty and civilian duties connected with the war. In all, over 15,000 Bell System employees have entered the armed forces.

Most of the foregoing discussion has dealt with services being rendered directly to the war and defense effort. The telephone companies must, of course, in addition to providing such services, carry on other services in such a way as to contribute a full part to the nation's welfare under war conditions. That this may be done employees have been organized and equipped to protect and restore service, and buildings have been placed under increased guard and have been provided, where necessary, with additional protective equipment.

Although it is not deemed judicious to publish information regarding many of the steps taken to maintain service, it is true that the telephone companies have taken every precaution to insure calls going through.

Acknowledgement is made to the Bell Telephone Magazine for the use of illustrations and material.