CIVIL TELECOMMUNICATIONS--ITS MOBILIZATION AND CONTROL

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Mr. Leighton H. Peebles, Communications Consultant to the National Production Authority, was born in Petersburg, Virginia, 22 August 1883, He attended Union College, Schenectady, N. Y., and received the degree of Bachelor Electrical Engineering in 1906. He workd or General Electric Testing Department from 1906 to 1907. From 1907 to 1918 he was employed at several engineering firms and some of the duties he was charged with were: supervision of American Group of Transoceanic Wireless Stations for American Marconi Wireless Telegraph Company (now RCA); supervision of construction of U. S. Government Nitrate Plant No. 1 at Sheffield, Alabama, and power house for Nitrate Plant No. 2 at Muscle Shoals. From 1918 to 1924 he was chief engineer and partner of Frazer and Company. In 1924 to 1931 he was vice president of International Trading House, Parker, Peebles, and Company. He was with the U. S. Government during the period 1931-1945, first in the Department of Commerce and National Recovery Administration as deputy administrator and division administrator in charge of all utility codes and all other industry codes of a public service nature; then with Securities and Exchange Commission; and later with WPB as director of Communications Equipment Division. From 1945-1948 he was vice-president of International Standard Electric Company, the manufacturing subsidiary of I.T.&T. He was loaned to the U. S. Army for survey of communications in Japan 1946-1947 and in connection with I.T.&T. business visited England, Sweden, and France. From 1948 to 1951 Mr. Peebles was Communications and Electronic Consultant to NSRB and from that time to the present he has held his present position.

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CIVIL TELECOMMUNICATIONS--ITS MOBILIZATION AND CONTROL

3 March 1952

COLONEL MANN: Gentlemen: Turning again to communications, you have heard a lecture on military operations and planning. You have also been furnished a booklet setting forth current operational data on our principal telecommunications system, the American Telephone and Telegraph Company. Today we will learn of civil telecommunications' potential; the problems in this field confronting the Nation as the emergency develops; and the steps being taken, if any, to meet mobilization requirements.

Our speaker this morning has had a vast amount of experience in communications, the most vital from our point of view being his service with the National Security Resources Board in mobilization planning.

I am pleased, indeed, to introduce to you Mr. Leighton H. Peebles, who will speak to us on "Civil Telecommunications--Its Mobilization and Control." Mr. Peebles.

MR. PEEBLES: The subject assigned to me is "Civil Telecommunications--Its Mobilization and Control." To this end I wish to dwell particularly on the sufficiency of the service in time of mobilization and emergency.

Electrical telecommunications divide into two classes, that is, oral and record, telephone and telegraph. I shall first discuss telephone communications systems and roughly compare the situation in this country with that existing in 1940. Insofar as possible I shall keep statistics to a minimum.

In 1940 there existed in the United States some 22.5 million telephones, whereas today there exist some 45 million. Of these the Bell companies controlled 17.5 million in 1940 and some 37.5 million in 1950, the balance--roughly 15 percent of the total--being controlled by the independent telephone operators.

Independent Telephone Companies

It should be borne in mind that while the independent companies operate only some 15 percent of this country's telephones, the area covered by their operations is some two-thirds of the area of this country. They are scattered all over the United States, with concentrations in the Middle West and East.

The doubling of the number of telephones installed between the years 1940 and 1950 represents unprecedented expansion in the history of the telephone industry in an equal time. During the war years

expansion was limited to that determined to be essential. In other words the telephone expansion through 1945 was only some 5 million telephones. During this time construction expenditures averaged about 200 million dollars per year--the lowest since the early thirties. In 1942 the plant in place was adequate for peacetime purposes and had normal margins to care for growth and to provide flexibility for efficient operation. No such margin exists today. Since the war the average annual expenditures on new construction by the Bell System totaled about 1.1 billion dollars, with a peak in 1948 of some 1.47 billion dollars.

The following facts may be of interest:

The United States, with some 45 million telephones in service, has approximately 60 percent of all the telephones in the world. Telephones per 100 population for the United States total about 29.5; its nearest competitor is Sweden, with 25; Canada, over 21; Europe as a whole, with 3.4; while the latest figures for Russia in 1934 showed only .45 telephones per 100 population. The United States at that time had 13.

The telephone system in the United States carries approximately 170 million telephone calls a day. This includes 6 million toll and long-distance calls. Approximately 61,000 teletypewriter messages per day are also sent over the common message network. These telephone and teletypewriter message services are supplemented by extensive private line telephone and teletypewriter services. Communications in America today play a far more extensive and intimate part in the life of the entire population than they do in most other countries.

Organization

As stated before, the telephone companies of this country are mostly described in terms of two groups of companies--Bell companies and independent companies. All companies in both groups work in close cooperation to provide a nationwide telephone service. This division of the industry existed in 1940 but the relationship between the two groups has constantly improved.

Unfortunately, detail data for the independent group are not available to the extent that such data are available for the Bell companies. The independent group consists of some 6,000 recognizable companies. The Census Bureau has reported the independent group as consisting of some 60,000 lines or systems. The large proportion in numbers are farmers' lines and farmers' cooperatives; yet, of the whole number, practically 100 percent of the individual phones can be interconnected at will.

There are some 10 independent companies operating over 100,000 telephones located in such important cities as Rochester, New York; Erie, Pennsylvania; Lincoln, Nebraska; Long Beach, California; Tampa, Florida; Johnstown, Pennsylvania; and other towns.

The Bell operating companies operate some 37.5 million telephones and most of the toll circuits of the country. They include 21 associated companies; each is responsible for Bell telephone operations, local and toll, within a given area and which, taken together, cover the continental United States.

The American Telephone and Telegraph Company is the parent company of the Bell System and has ownership in various degrees in all the 21 associated Bell operating companies, 19 of which are controlled subsidiaries. The long-lines department of the American company, generally speaking, owns and operates the long-distance telephone circuits which provide service between the territories served and the various associated Bell telephone companies and the adjoining independent companies.

The American company also maintains other departments whose function is to render assistance to all the operating companies, the principal ones being as follows:

1. The Bell Telephone Laboratories, Incorporated.--The Laboratories carry on fundamental research in the physical sciences and basic development of new apparatus for systems; they also provide the specific design information culminating in manufacturing specifications.

2. The Western Electric Company, the manufacturing and supply branch of the system.--This company manufactures, purchases, warehouses, and repairs telephone equipment and materials for all the operating companies. It also does most of the installation of central office equipment (see following page).

The principal form of service given by the telephone companies is a message telephone service, both local exchange service and throughout the country toll service. For both exchange and toll service there is rapid extension of machine operation, generally spoken of as dial operation. Seventy-six percent of Bell System telephones are associated with machine-switching equipment for exchange service and this is being extended toward substantially 100 percent. Unfortunately, the percentage of dial exchange operations by the independents is not available, but they are fast changing over to dial equipment.

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WESTERN ELECTRIC COMPANY LOCATIONS

(Thousands Square Feet)
Gross Area

MANUFACTURING PLANTS	Floor Space 1941	1945	1951	Principal Products Manufactured
Hawthorne, Ill.				
Main Plant	4,192	4,203	4,273	Dial Central Office and P.B.X. - Cable and Wire - Loading Coils - Military Electronic
Chicago, Ill.	139	1,626	1,716	
St. Paul, Minn.		288	605	Station Equipment - Military Electronic
Lincoln, Neb.		208	208	Dial Central Office
Clearing, Ill.	171	169	169	Steel Wire and Strand - Hardware
Duluth, Minn.			245	Dial Central Office
Eau Claire		214		
Total	4,502	6,708	7,216	
Indianapolis, Ind.				
Main Plant			1,309	Station Equipment
Speedway			174	Station Equipment
Total	-	-	1,483	
Kearny, N.J.				
Main Plant	2,891	2,953	2,957	Dial and Manual Central Office - Toll Equipment - Station Equipment - Cable - Military Electronic
Misc. Nearby	491	2,016	379	Dial and Manual Central Office - Toll Equipment
Queensboro, Middle Village, N.Y.	101	103	104	Telephone Booths
Haverhill, Mass.		297	296	Manual and Toll Apparatus
Lawrence, Mass.		29	447	Toll Equipment
Jersey City, N.J.		297	455	Toll Equipment
Total	3,483	5,695	4,638	
Pt. Breeze, Md.				
Main Plant	795	919	1,423	Station Apparatus - Cable and Wire - Military Electronic
Baltimore	373	721	166	
Total	1,168	1,640	1,589	
Tonawanda, N.Y.			780	Cable and Wire
Allentown, Pa.				
Main Plant			432	Electronic Tubes, Varistors, Transistors - Military Electronic
Allentown			46	Electronic Tubes, Varistors, Transistors - Military Electronic
Total	-	-	478	
Radio Shops				
Main Plant			628	Military Electronic
Burlington, N.C.			380	
Greensboro, N.C.			297	
Total	-	-	1,305	
Total Manufacturing Space	9,153	14,043	17,489	
Total Distributing House	2,365	2,992	4,030	
Grand Total Space	11,518	17,035	21,519	
Personnel	61,271	77,783	86,254	

Private line service is also an important feature, particularly 1305 to military bodies which have constant need for communication between far-flung centers. The Bell companies have in service some 650,000 miles of private line telephone circuits and 3.1 million miles of private line teletypewriter circuits. In some cases the private lines of one customer form a large network with either automatic or manual switching.

Teletypewriter exchange service is similar to telephone exchange service, for subscriber lines are connected to switching equipment by means of which any line may be connected to any other line throughout the country for such length of time as desired. There are at present approximately 28,400 teletypewriters receiving teletypewriter exchange service, which involves about 2.6 million miles of telegraph circuits. Switching is for the most part on a manual basis.

The telephone companies also provide extensive program transmission networks for radio broadcasting and for television. Audio broadcasting, using 270,000 miles of specially designed circuits, includes five permanent nationwide networks--one of which has 37,000 miles of circuit.

Television transmission networks are developing rapidly and now consist of approximately 17,600 miles. These circuits have characteristics which permit the transmission of information requiring a very broad band of frequencies and may be of particular importance in the military as new developments come into being.

Chart 1, Principal Toll Routes of the Bell System and Connecting Companies, page 29.--Fortunately, the commercial development of the telephone business in this country has resulted in a network of heavy telephone routes which have a great flexibility for providing communication between any two points. Chart 1 shows simply the major routes of this network. Substantially all the cable routes shown are in service at the present time. Some of the radio routes involve construction in 1952, but all the facilities shown will be in being when the 1952 program is completed. It will be seen that circuits can be provided between all important points and that interruption in any particular route would be like throwing a pebble through a tremendous spider web. While service as a whole might be temporarily reduced between other points, it would not be interrupted.

Chart 2, Principal Toll Routes of the Bell System and Connecting Companies, Equipped Circuit Facilities, etc., page 30.--This chart shows the number of circuits provided for by independent telephone companies on typical routes throughout the network, together with the additional capacities already built into these routes which only need

the addition of terminal equipment to make them workable circuits. These indicated capacities give a picture which should be reassuring to the military as to whether or not there are enough circuits. On all main routes, circuits already working are far in excess of what military requirements might be even under extreme emergency conditions. To the extent that the emergency requires these circuits, they can be diverted to military uses.

Do not let this statement lead you to feel that there is plenty of capacity to meet civilian demands. Certain civilian demands may easily be as important as military demands. Today the American public look upon the telephone as an essential requirement, as a matter of protection to call the fire companies, the police, to call the doctor in event of sickness, to call for help in event of an emergency. During the last war when civilians of necessity had to do without telephones, there were thousands of pitiful instances where women with children, located away from large centers, and their husbands in the service were unable to get telephone protection.

Today there exists a backlog of shortages in the industry. There are over a million held orders for service where, because of lack of materials to produce facilities, no service can be supplied. There also exist today over 2 million requests for better grades of service (that is, individual line instead of party) which for the same reason cannot be supplied.

Because of the increased use of the telephone since June 1950, both long-distance and local service has been degraded. Estimates indicate the industry is short 8.9 million-odd cable pairs and shortage in central office equipment facilities to serve some 1.5 million more telephones. The current shortage of about 1.5 million in central office switching apparatus must not be allowed to increase, for such equipment is the nerve center of the entire telephone network. For example, an increase of only one call per telephone per day would most seriously disrupt service in thousands of central office switching systems throughout the Nation.

The current shortage of long-distance circuits of almost 21,000 is numerically the largest shortage in the industry's history. Percentage-wise the current shortage of 18 percent is only a little below the peak World War II shortage of 22 percent, when it will be remembered long-distance calls during the day's peak period on approximately 1,000 routes between the 100 major cities of the Nation were delayed for one hour or more. Reduction of the shortage in long-distance facilities is of basic importance in the rearmament effort.

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The Department of Defense, in its presentation to the President's Communications Policy Board, stated: "It is, therefore, considered in the vital interest of national defense that there be maintained within the United States to meet that need, as many nationwide commercial communication systems as are economically feasible."

Experience has shown that with any emergency, the so-called civilian load increases materially, not only for communications between the military, defense agencies, and manufacturing plants making military requirements, but also as a matter of morale with the soldiers being able to call their families.

You will note that there exists an enormous capacity for additional expansion of existing routes by the addition of terminal equipment to the basic facility now in place. For example, coaxial cable usually has eight coaxial tubes giving present capacity of 1,800 circuits, assuming one pair of tubes is reserved for stand-by. With the new coaxial cable equipment now being developed for application to existing cables, this capacity will be tripled to 5,400 circuits. Also, the main radio relay routes are constructed with towers and buildings capable of handling 12 one-way channels. These, if devoted wholly to telephony, would provide a capacity of about 3,000 circuits, assuming one pair of channels is reserved for stand-by. By application of carrier principles, one of these voice circuits can provide 18 telegraph circuits.

Since continuity of service is of major importance in time of emergency, it is desirable that communication between the important points be provided by a wide variety of types of route, as well as substantial dispersion in geographic location. Between New York and Chicago there are numerous widely separated routes of underground cable construction--some of conventional design, others are coaxial cables, and still others such as radio relay facilities.

Chart 3, Telephone Toll Routes in the State of Ohio, page 31.--Connecting the eastern part of the country with the Pacific Coast, there are now seven independent routes: four heavy open-wire routes; one route consisting of a pair of underground cables of conventional design; and a coaxial cable, also underground; and one a radio relay route. Chart 2 shows only the major toll routes. As an illustration of additional toll routes in a particular state, chart 3 shows all the telephone toll routes in the state of Ohio. You will note that there is a substantial weblike network of toll circuits covering the entire state.

Chart 4, Operating Headquarters of Bell System Companies and Major Supply Warehouses, page 32.

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Personnel and Material

Any plan for mobilization and taking care of an emergency must of necessity involve a reservoir of men and materials. The telephone systems of this country have a tremendous reservoir of trained men and large stores of material. Chart 4 shows the locations throughout the country of the operating headquarters, that is, the district, division, and company headquarters. For the Bell companies there are some 8,300 points where equipment is provided, with skilled personnel on hand to carry on maintenance operations. There are today in the telephone companies some 180,000 trained plant men who are well educated in the work of maintenance and repair. This chart indicates major warehouses of the Bell System at which there are stores of material necessary for the normal program of expansion, rearrangement, and protection of telephone plant. These are supplemented by many hundreds of smaller company stock rooms scattered throughout the entire area. At present the stock of materials in the hands of the companies, or available to them, totals approximately 200 million dollars.

Special Emergency Service Arrangements

An important factor in keeping service going is the ability to immediately rearrange the intercity plant, to meet both current fluctuations in the demand for service and emergency conditions. Such rearrangements are a daily function of the telephone forces and the direction is on a nationwide scale under the supervision of traffic control bureaus located in New York, Boston, Cleveland, Norfolk, Washington, Richmond, Chicago, and San Francisco. The direction is carried out by toll test board men at some 300 switching center locations throughout the country.

Stand-by Power

Telephone communications depend on an adequate and constant power supply; provision has been made to supplement commercial facilities, in order to assure that service would not be interrupted by a power failure. All buildings housing central offices are equipped with batteries having a capacity to run the whole normal volume of telephone communications for periods running from two hours up to several days. The buildings where the installed batteries having short-time capacity are equipped permanently with supplementary sources of power, usually generators driven by gasoline or Diesel engines. The small offices are protected by portable engine generator units, which can be taken to the offices and set in operation before the batteries are drained.

The use of these emergency plants is a regular part of telephone operations. For example, the big blow in the Eastern States a year and one-half ago interrupted the normal power supply at 450 telephone offices, but in no case was telephone service interfered with for lack of power. Of course, some individual lines and phones were out of service until repairs were made, but not for lack of power at the central office.

Chart 5, Emergency and Mobile Radio Equipment, page 33.

Emergency Radio

Another provision for restoring service which has been interrupted is the use of point-to-point radio. The telephone companies have about 100 of such emergency radio equipments operating in the two-megacycle band designed with sufficient power to bridge gaps up to a distance of 50 miles. These equipments, with their associated power supplies, are mounted on trucks and are often dispatched in advance of actual damage to a point where a severe storm is expected. Such equipments provide a limited number of circuits for short periods when toll routes are interrupted.

In addition, the Bell System mobile telephone service is available to help in times of emergencies. The Bell System provides general mobile service to about 10,000 motor vehicles associated with approximately 230 radio channels throughout the country. All these mobile stations have access to the Bell System network. All these facilities could be used as needed by the military and civilian agencies in event of disaster. This chart shows the locations of emergency and mobile radio equipment.

The equipment referred to will be supplemented by several hundred additional land stations, in fixed locations and in portable form, and provided with terminating and control equipment for immediate connection into the telephone network should it be needed at the time of disaster.

Another form of radio equipment which will be in stock for rapid restoration of damaged telephone plant is portable towers and microwave equipment available for quick emergency service in the event of the destruction of a radio relay station. A 200-foot portable tower can be erected and operation established in a few hours.

Chart 6, Trunk and Toll Routes, New York City and Environs, page 34.

Toll Dispersion

Close attention has been given to the effect on long-distance service to a large city should the principal toll office or offices be

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destroyed and also as to whether adequate by-pass arrangements are available for service normally flowing through the city to other points.

The telephone companies are endeavoring to make arrangements for all the large cities so that a substantial percentage of the normal capacity for long-distance messages and the private line circuits would remain in service if the principal toll office or offices were destroyed.

Let us look at the situation in New York. At the present time the great bulk of intercity circuits serving New York terminate at the main toll office, although about 1,000 circuits, or 10 percent of them, terminate at the second toll office--West 50th Street, four miles distant.

Around the city there are a considerable number of toll offices, indicated on the chart, which are normally not used for service between distant points and the central parts of the metropolitan area. Emergency circuits, however, for use by essential customers could be provided very promptly to these outlying toll centers in event of a disaster which took out both of the Manhattan toll centers. If desired, such circuits could be established before the disaster took place.

To insure the continuation of a considerable proportion of the intercity calls from New York (in this case, about 50,000 calls a day) in the event both the principal toll offices in Manhattan were destroyed, provision is being made for the installation of additional toll circuit terminations and of additional switching equipment at Newark, White Plains, Paterson, Morristown, New Brunswick, and Hackensack. Outward traffic is already handled from a large number of outward toll operating points; those which were not destroyed could continue to operate through circuits to the outlying toll centers if the downtown area were destroyed. Inward service is already handled in part through a number of crossbar tandems scattered throughout the city; the number with this type of access will be increased.

Looking toward the future, an important further measure of dispersion is to be provided by the establishment of a second large dial switching system for both inward and outward traffic at Newark, supplementing the one already in service in the main toll office. This Newark system will go into service early in 1953. The third mechanical toll switching system will be installed in White Plains, normally serving the northern part of the metropolitan district, but available in emergency conditions to serve all parts of the district.

Adequate by-passing of circuits around the downtown Manhattan area will be provided by auxiliary cable routes connecting White Plains,

Paterson, and Newark. The radio relay system from Boston and other points north to Washington and other points to the south can be continued uninterrupted by an auxiliary repeater station already in service.

Chart 7, Toll Facilities--Pittsburgh and Environs, page 35.-- This is Pittsburgh, an illustration of a smaller city where simpler arrangements suffice.

Heretofore, outward toll calls have all been dependent on the downtown toll center for access to the toll circuits. This is now being supplemented by the termination of toll circuits at a new central office, Churchill, about six miles from downtown centers. Toll routes to the west and to the south will be associated with the Churchill office by cables which do not pass through the downtown center. This is true also of access to Chruchill from the outward toll offices in various parts of the city.

Chart 8, Toll Facilities--Washington, D. C., and Environs, 36.-- What is being done in Washington is indicated by this chart. Washington in the past has been equipped with two toll offices about two miles apart. Outward traffic is handled from a number of dispersed toll operating points, but these were dependent for access to toll circuits on the two main toll offices. These offices also handle the inward traffic.

The dispersion arrangements which are already partly in service provide for continuation of 20,000 messages a day, or about 30 percent of the capacity of the telephone system, if both the downtown and the uptown offices should be destroyed. This includes the provision of toll terminations and switching equipment at Hyattsville, Shepard, and Chestnut, and access from these points to the various offices in the Washington district. For example, the radio relay systems connecting Washington with New York, Chicago, Baltimore, and the South will have circuit termination at Garden City and switching provisions for toll operating at the Chestnut office rather than going to the downtown Washington office. One feature of this plan is that it gives the Pentagon a toll outlet wholly independent of the present Washington toll offices and of the Potomac River cable crossings.

At the present time plans of this general nature designed to provide for the continuation of an important fraction of the toll service capacity in event of the destruction of the main toll office or offices are under way in 11 of the metropolitan areas in which this form of achievement seems to be most important. Studies are under way in numerous additional cities and will be undertaken for all the cities designated by the Federal Civil Defense Administration as prime targets.

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Chart 9, Principal Cable Network--Small Area in Brooklyn, N. Y., page 37.

Service in a Metropolitan Area

The amount of service required within a large city by the military or other defense agencies is infinitesimal when compared to the vast amount of communication service given daily under normal conditions. In New York City, for example, there are approximately 3.3 million telephones in service and these telephones originate about 16 million calls a day. They are connected to central offices in all parts of the city by a network of about 13 million conductor-miles of underground cables.

This chart illustrates the network of cables for a small area in Brooklyn near the Brooklyn Navy Yard; the lines show cables of 200 pairs or more and show the approximate number of pairs of wires in each section.

These cables are supplemented by additional thousands of distribution cables not shown on the map, which extend as a fine network of tentacles into practically all portions of the intervening areas.

The cables shown on this chart are more than 99 percent underground. Of all cities, large and small, which are rated as prime targets, about 80 percent of all telephone wire is in cables that are underground.

Experience in Hiroshima showed that for air burst atomic bombing, the underground cables will not be damaged except for a small radius around ground zero. High explosive bombs exploded under the earth may, of course, destroy the cables in small areas. However, such damage would be merely local and would not destroy the usefulness of the cables in closely adjacent areas which have not been hit.

The black dots on the chart show the location of central office buildings--the points at which lines are switched to trunks leading to other parts of the city. These buildings are all of steel frame or reinforced concrete construction. Also they are built heavily to carry floor load of 150 pounds per square foot. Generally speaking, telephone buildings would stand up better than most of the buildings in the areas in which they are located.

After a bombing, reaching into the destroyed area and passing through it, would be thousands of pairs of telephone wires terminating in telephone buildings which had not been destroyed and would be ready to provide immediate service to any desired point. Should it happen that the wires at a point where essential service must be given connect with a telephone building that is seriously damaged, if the building is accessible, the wires may be extended through the underground vault through which the

cables enter the building to other buildings outside the destroyed area. If immediate access to the cable vaults is not possible, a quick connection can be made in nearby manholes or by running twisted pairs to a nearby cable which terminates in a building and which is still operating.

If considered essential, advance arrangements can be made to have important circuits from key establishments served by two or more telephone central office buildings in different parts of the city or in different cities if this is appropriate.

Chart 10, Telephone Company Mobile Radio Transmitter and Receiver Locations--Baltimore, page 38.

Use of General Mobile Telephone Service

If local communication is temporarily interrupted within a city, key locations can be immediately connected into the general telephone network by the use of mobile system telephone service, pending the completion of repairs.

This chart shows the locations of Bell System mobile transmitters and the distributed receivers used for normal operations in the city of Baltimore. Two urban channels are associated with transmitters in the city, one highway channel with a transmitter well outside the city to the north. Each channel has several receivers scattered throughout the city. All are controlled through a telephone office near the center of the city.

The chart also shows the location of supplementary alternative transmitters or receivers which will be installed for the two urban channels. It indicates also the site of an alternative control point for all three channels. We may envisage that immediately after a bombing, if a certain key location is out of communication, a car or cars equipped with mobile radio would immediately proceed to the site; if the telephone service alone is disrupted, the car can stay there providing service into the regular communication network the short period of time necessary to restore wire connections.

For Baltimore there are at the present time 130 cars equipped for Bell System mobile service and three channels in service.

Line Load Control

Much of the military requirements are of necessity being provided by private line facilities. However, the regular message service offered

by telephone companies will come into play in many cases. The question may arise in your minds whether, with dial switching systems, the use of the general telephone system under emergency conditions may not be hampered by the overloading of the system due to the large amount of calling by the general subscribers.

This is protected against by the provision of an arrangement which insures that service is available to the lines of essential customers under disaster conditions whether or not it is available to the general subscribers. This arrangement is called "line load control." It provides that the wire chief in charge of the office can quickly and continually adjust the load so as to avoid excessive overloads. This is done by throwing keys which deny outgoing service to various groups of lines, the equipment being so arranged, however, that outgoing service is continued for all essential lines. Furthermore, all the lines are maintained in service for receiving incoming calls, so that the ability of the essential lines to call anywhere is not curtailed.

This arrangement is already in service in most of the cities listed as major target areas and is being extended to others.

Chart 11, Overseas Radio Telephone Service from the United States, page 39.--The American Telephone and Telegraph Company provides telephone service to approximately 90 foreign countries. Any telephone here can be connected to 90 percent of all foreign telephones throughout the world. Foreign telephone service is carried out under operating agreements between the American company and the foreign companies or administrations involved.

Telephone service to Canada, Mexico, and Cuba is handled by wire line connections. In the case of Cuba, these connections are through six deep sea telephone cables, approximately 125 miles in length. Telephone service to overseas points is handled by high frequency radio circuits. The American Telephone and Telegraph Company has in service approximately 115 such radio circuits, reaching directly to 50 countries. Foreign telegraph service to overseas points all over the world is handled by a group of telegraph companies using both the submarine cables and radio.

Protection against Sabotage and Espionage

The telephone companies are taking such steps as seem desirable to protect against sabotage and espionage. These steps are many and are believed to be effective, but they can be increased at any time to the extent desirable. During World War II important telephone offices were protected against sabotage by special door locks, safety chains, electric alarm signals, steel grills on windows, and skylights having access to

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vital equipment, fences, locks on fuel oil pipelines and coal holes, and so on. Flood lighting was provided for certain isolated buildings and for fire escapes and other points of possible entry. Armed gruards were provided at special locations.

Outside plant manhole and cable vaults were locked and substantially all the toll cables and many exchange cables put under gas pressure. Arrangements were made with the local police to keep cable routes and other vulnerable points, such as river crossings, under their surveillance. Most of these precaustions have been reinstated.

In addition to physical protection, access to equipment and operating space or, in many cases, access to the entire building is now limited to properly identified people. For particularly important buildings, equipment spaces are separately locked and access restricted to the limited number of people who have functions to perform in the areas. Employees are carefully screened before hiring and evidence of citizenship is required in all cases. For the Bell companies, determination of citizenship of existing employees is largely completed.

Summary

1. The Bell and independent telephone companies together blanket the entire United States with a network of interconnecting telephone circuits. There are in service some 45 million telephones, 133 million miles of wire in cities and towns, and 28 million miles of intercity telephone circuits.

2. Telephone companies have a very large reservoir of trained men who are skilled in all parts of plant work; they are ready to provide service in the shortest possible time and to take quick action in emergencies. Large stocks of materials are available to these men scattered throughout a very large number of locations.

3. The network of intercity circuits has enormous flexibility to provide for urgent demands not readily foreseen and to offer re-routing possibilities to maintain essential services in the event of destruction of certain sections of intercity routes. Extensive traffic control organizations throughout the country are continually at work readjusting the routes to take care of unusual situations and emergencies.

4. The telephone companies, as part of their regular service provision, have restoral plans providing for the prompt restoration of essential lines in time of disaster and the rapid restoration of all service insofar as possible.

5. The telephone plant is so constructed that in general it is expected that much of it will survive a bombing very well. Cities are

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underlaid with a close network of underground telephone cables with great numbers of pairs of wires which would generally not be destroyed by atomic bombing. Telephone buildings are of unusually strong construction and expected generally to survive bombing better than the surrounding buildings.

6. Special arrangements have been made and others are now being made to minimize the likelihood of interruption of essential service in time of disaster.

a. Alternate routes and alternate offices are being established in and around the larger cities in order that toll service can be continued throughout an emergency.

b. Auxiliary power insures against interruption in case of shutdown of commercial power.

c. Arrangements have been provided to insure adequate capacity to handle calls from essential lines.

d. Duplicate outlets exist or can readily be arranged for important points to the extent desired.

e. Switching of essential lines will be protected to the same degree as people in shelters.

7. The mobile radio stations of the telephone system, protected by alternative transmitting and receiving points, can be used for immediate temporary service where needed. A large number of other emergency radio telephone stations form a part of the telephone system's provision against interruption.

8. The possession of this extensive and flexible communications system is one of the Nation's best assets, both with respect to carrying on the current rearmament program and for military use in case of attack.

I want to re-emphasize, however, that the copper allocations being made to the industry currently are seriously threatening the ability of the industry to keep this far-flung network in a healthy condition. While there would seem to be no question that strictly military needs could be adequately taken care of out of existing facilities, doing so would so seriously cripple the facilities left for essential, though nonmilitary uses, as to affect adversely the business and social life of the country.

I shall now discuss the national facilities of record communications. In 1940 this phase of electrical communications was largely the responsibility of three companies--the Western Union Telegraph Company, the

Postal Telegraph Cable Company, and the American Telephone and Telegraph Company through its teletypewriter facilities. There were four other companies (private systems): They were the Associated Press: United Press Association: Press Association, Inc.; and the Teleregister Corporation. The latter company operated an electric stock quotation service. These companies operated largely through facilities leased from public carriers and their inclusion statistically would have represented duplication.

The two principal telegraph companies were merged in October 1943, the new company taking the name of the larger, namely, Western Union Telegraph Company.

The Western Union Telegraph Company is today the only large corporation which is engaged primarily in the transmission of record communications. It has practically completed a large-scale mechanization program to improve quality and speed of telegraph service. This program includes:

1. A nationwide network of transmission facilities.

   a. Carrier circuits.

   b. Radio relay.

   c. Pole Line and cable plant.

2. Fifteen reperforator relay centers strategically located throughout the country.

3. Efficient methods of terminal handling.

   a. Teleprinter "tie lines."

   b. Facsimile.

   c. Messenger-telecar.

Chart 12, Integrated Record Communications Program, Carrier Circuits, 1950, page 40.—Approximately 1.6 million miles of telegraph carrier channels provide transmission facilities for the reperforator switching networks and for a large expansion of private line service. This comprehensive carrier system is countrywide in scope. The carrier network employs a multiplicity of voice frequency bands, each is split into two portions, which may be handled independently at the terminals. The two portions are further subdivided into narrow channels, as a total of 20 such channels may be derived from a single voice band.

At present approximately 11,000 channel terminals are employed in approximately 175 offices throughout the country.

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Chart 13, Integrated Record Communications Program, Radio Relay Systems now in Operation, etc., page 41.—Among other improvements Western Union is using microwave radio relay systems. At present it is operating this relatively new means of communication over more than 1,000 linear miles of territory. At frequencies above 3,000 megacycles, radio energy can be beamed from one place to another and the energy largely confined within very narrow limits. There are a number of advantages in this system. Three deserve special mention.

1. Interference from other stations on the same wave length is avoided by simply keeping the beams separated.

2. Relatively small radio power is required.

3. Transmission of intelligence at this high frequency is particularly free of "static" interference of the nature which disturbs radio at low frequencies.

The present system comprises two-way radio links between New York and Philadelphia, New York and Washington, New York and Pittsburgh, and Washington and Pittsburgh. The frequencies employed are in the 4,000 megacycle band. Between New York and Pittsburgh nine repeating or relay points are required.

Chart 14, Integrated Record Communications Program, Service Continuity of Existing Radio Relay Systems, page 42.--This chart indicates the reliability of the radio relay service for telegraph purposes. Reliability is being constantly improved. Just recently, Western Union has entered into a contract with the Sperry Gyroscope Corporation for the development of a new tube which will provide appreciably greater transmitting power and is expected to make the present beam system even more reliable.

It is the belief of the Western Union Company that not only does the radio beam provide the means of handling all foreseeable demands for record communication; but should the Nation again be faced with war, the microwave system can be protected from sabotage and maintained more securely than any other known means of communication.

Pole Line and Cable Plant

For distribution of message service to thousands of towns and hamlets throughout the country, the telegraph company has 1.25 million miles of open wire. Within cities and towns, 400,000 miles of cable conductors are used to provide service from customers to main offices.

Chart 15, Integrated Record Communications Program, Minneapolis Reperforator Area, Intra-Area Message Channels, page 43.--This chart is a circuit diagram of the area comprising the states of Wisconsin,

Minnesota, Iowa, North Dakota, and South Dakota. The diagram shows the circuit connections from all localities in the area to Minneapolis, the area center.

Small towns and villages which are some distance from Minneapolis are connected to a city which serves as a local collection point for the surrounding territory. The collection points are connected directly to Minneapolis over one or more carrier circuits.

Chart 16, Integrated Record Communications Program, Minneapolis Reperforator Area, Inter-Area Message Channels, page 44.--Messages collected within the area are transmitted out of Minneapolis over the inter-area trunk circuits shown on this chart. Minneapolis is provided with trunk connections to each of the other 14 area centers and to other large cities where the volume of business justifies direct routing.

Carrier operation is used for all of the trunk circuits shown. The number of message channels is indicated on each route.

Chart 17, Integrated Record Communications Program, Inter-Area Message Channels, page 45.--This tabulation lists the number of trunk message channels at Minneapolis as shown diagrammatically on the previous chart and includes also the trunk message channels provided at all the larger cities.

The reperforator switching centers are indicated by large letters. The large majority of the trunks are between reperforator switching centers, and very few nonreperforator offices have direct trunk connections to another nonreperforator office.

All of these trunk connections are normally operated over carrier circuits.

Chart 18, Integrated Record Communications Program, Proposed Radio Relay Network, Providing Facilities for National and Civil Defense, page 46.--This shows the proposed extension of microwave communication systems to interconnect most of the cities of the United States having a population of 100,000 or more.

The routes have been chosen with reference to both the communication trunk requirements of the telegraph company and high capacity, high continuity circuits which might be required for national and civil defense purposes.

It is expected that when installing such a system, the use of relay points in large cities would be avoided. Instead, the trunk beams would be routed within line of sight of such centers, with only the local loads beamed into the congested areas.

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The initial equipment planning for this network provides for an average of four video channels throughout the system: one of these channels to be broken down into high-speed telefax and teleprinter telegraphic paths, two channels for television operation, and one channel for use in radar transmission. The tower construction and basic microwave design including antennae, however, will allow for appreciable expansion of circuit facilities over the entire path or section thereof.

Now I shall discuss terminal handlings:

Teleprinter Tie Lines

Teleprinter connections from customers' premises direct to the telegraph company's offices provide a fast means of pick-up and delivery service. More than 20,000 such connections are now in service. At cities where reperforator centers are located, a "switching to tie lines" method is employed which insures high-speed service.

Facsimile Tie Lines

Progress in the development of facilities for transmitting and recording facsimile reproductions of printed, typed, or written copy has given Western Union new means for better serving the public. A relatively new development known as "Desk Fax" gives promise of being at least a partial solution to the perplexing problem of pick-up and delivery and at the same time renders a superior service. Desk Fax installations have been made in eight cities, namely, Atlanta, Cincinnati, Dallas, Houston, Los Angeles, New York, Philadelphia, and San Francisco, involving 1,900 customer tie line installations. Western Union is now processing the installation of an additional 1,000 desk fax lines in Washington, D. C., to serve government agencies, embassies, and others.

While the Western Union messenger is still an integral part of the telegraph industry, improved methods have been applied to this branch of the company's operations. Motor messengers have been employed for years. More recent developments, however, have resulted in the Western Union "telecar" employing mobile radio and facsimile receiving equipment, enabling the company to reduce the time required for message delivery.

For the past three years the company has been experimenting with telecar operation in the city of Baltimore. Development of suitable equipment has now reached a point where the company is installing eight telecars in Baltimore and its suburban area.

High-speed Facsimile

Western Union engineers have produced initial models of a high-speed facsimile transmission system which operates at ten times the standard speed for other Western Union systems. The speed of operation is 1,200

words (pica type) per minute. There is an installation in operation now between Washington, D. C., and New York.

Overseas Record Communications Facilities

The United States is served by the following international communications carriers, who provide telegraph connections with overseas points:

1. International Telephone and Telegraph Company (IT&T System), which owns the American Cable and Radio Corporation (AC&R). TheAC&R is a holding company which controls three carriers: All America Cables and Radio, Incorporated, Commercial Cable Company; and Mackay Radio and Telegraph Company Incorporated. IT&T also controls and operates another subsidiary, the Commercial Pacific Cable Company, which is owned 25 percent by American interests and 75 percent by foreign interests.

2. Tropical Radio Telegraph Company

3. Globe Wireless, Limited.

4. Press Wireless, Incorporated.

5. United States-Liberia Radio Corporation

6. RCA Communications, Incorporated.

American Cable and Radio (IT&T System)

All America Cables & Radio, Incorporated, operates a cable system connecting with most countries in South America, Central America, and the West Indies; also a radiotelegraph service between certain South American countries; and radiotelegraph circuits from certain South American stations to points in Europe.

Commercial Cable Company operates six transatlantic cables connecting with Great Britain, Ireland, and France and leases cable connections from London to Belgium and Holland. Also a cable from the United States to the Azores Islands, connecting with Italcable and Cable and Wireless cables to Spain and Italy.

Mackay Radio Telegraph Company operates radiotelegraph circuits to forty-odd countries in Europe, South America, West Indies, Africa, and Asia; also to Honolulu, Manila, Shanghai, and Tokyo. It also operates marine radio stations on both coasts.

The Western Union Cable System, pending divorcement from the present Western Union landline wire monopoly, as required by act of Congress at

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the time Western Union landlines were permitted (through special legislation) to absorb the Postal Telegraph Company, is operating a cable system primarily between the United States and Great Britain, connecting with points in Europe; between the United States and the Azores connecting with Cable and Wireless and Italcable to Spain and Italy; and from the United States to Barbados connecting with the Western Telegraph Company, which is a part of the British cable system, operated by Cable and Wireless, Limited, serving various countries in South America.

The French Cable Company is a foreign concern, owned by French interests. For many years they have operated a cable service between New York and Brest, France. Their system consists of cables running from New York to Cape Cod, thence to St. Pierre-Miquelon and thence to Brest, with further cable connections from France to Great Britain. Also a cable from St. Thomas to the French West Indies, connecting with both All American Cables and Cable and Wireless, Limited, at St. Thomas.

The Tropical Radio Telegraph Company is a subsidiary of the United Fruit Company. Its services are confined principally to Central America. It also connects with Bogota, Colombia, and Rio de Janeiro, Brazil. In Central America it provides Intra-Central American connections. Tropical operates stations in Boston, Miami, and New Orleans in the United States, and also in Costa Rica, Guatemala, Honduras Republic, Nicaragua, and Panama. It also connects from Guatemala City with the government station at San Salvador and from New Orleans and Guatemala City to Belize, British Honduras.

Globe Wireless, Limited, is a subsidiary of the Robert Dollar Steamship Company, operating principally in the Pacific. In recent years a circuit was established from New York to Havana connecting with the Cuba Wireless Company. Globe Wireless operates its own radio stations and public offices in New York, San Francisco, Honolulu, and Manila. From San Francisco it connects with its Honolulu and Manila offices, and from Manila it runs a connecting circuit to its office in Cebu. It also operates a circuit from San Francisco to Shanghai connecting with the Chinese Government Radio Administration.

Press Wireless, Incorporated, was originally formed and jointly owned by a group of metropolitan newspapers and press associations and was organized primarily to provide economical volume rates for news services. Stock in this company was originally held by the "New York Times," "New York Tribune," "Chicago Tribune," "Christian Science Monitor," "Los Angeles Times Mirror," "San Francisco Chronicle," "Chicago Daily News," "Associated Press," "International News Service," "North American Newspaper Alliance," and "United Press." It has now been abandoned by its sponsors and operates as an independent radiotelegraph company. It was originally licensed only to handle press messages, but

during the war it was permitted to handle both government and press messages; this condition still prevails. It operates circuits to important news centers such as: from San Francisco to Tokyo, Shanghai, and Manila and from New York to London, Berlin, Berne, Geneva, Paris, Rome, Lisbon, Buenos Aires, and so on.

United States-Liberia Radio Corporation is owned by the Firestone Rubber Co., Akron, Ohio. It was organized primarily to provide direct radiotelegraph connections from the company's Akron plant to its rubber plantation in Liberia. It operates one radiotelegraph circuit between Akron, Ohio, and Harbel, Liberia. Most of the traffic is handled for the Firestone Company.

The amount of commercial traffic handled on this circuit is negligible.

Amateurs

A valuable communications asset that must not be overlooked is the radio hams or amateurs. There are somewhere in the neighborhood of 80,000 of these scattered through the United States. In times of local emergencies, they have been of great service and I understand they are being organized now to play their part should national emergency occur.

Manufacturers

During any national emergency, such as preparing for war or actual war, the demands of the military for products is such that the availability of strategic metals is largely pre-empted, leaving small quantities for the civilian economy.

Since military communications use essentially the same basic types of communications equipment as the civilian, the manufacturers of such equipment do not have the problems of some other manufacturers, such as changing from making automobiles, freight cars, and so on, to the making of airplanes and tanks. They do, however, have a serious problem in tooling up to make equipment for special installations to meet military specifications for operation under conditions of heat and moisture and extreme cold.

Manufacturing capacity of the United States for the making of communications equipment may be expanded with relative speed if space, materials, and labor are available, by spreading trained supervision and "know how" to a wider than normal area.

Experience during the last war was that approximately 85 percent of the capacity of manufacturers of communications equipment was required

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to meet the demands of the military, this after considerable expansion by most units. In event of war, the probabilities are that an equally large percentage of their production will be required by the military. Much of the capacity now used in producing telephone equipment would probably be devoted to making other equipment. In the last war Western Electric produced important quantities of radio and radar equipment (see following page).

During the present indeterminate situation we are having guns and butter too. The direct military load on the manufacturers of communications equipment, telephone and telegraph, is at present moderate. The indirect load is heavy. So long as equipment installed at a military post or other operation is not purchased and owned by the military, it is rated as civilian equipment and has no preference in manufacture, nor in the allotment of materials. The same is true of service supplied to new or expanded manufacturing plants producing essential equipment for the military. There is a growing resentment on the part of civilians in many parts of the country because they can obtain automobiles, radios, television sets, and any civilian gadget, but cannot obtain telephones. There are many housing developments throughout the country which have no telephone service except possibly one on a pole at a street corner. The reason for this is not that manufacturing capacity is exceeded, but because insufficient materials are allocated to the industry so that it may keep up with the ever-growing demand.

Conclusion

Up to now, copper allocations have not been of sufficient quantity to keep this vital, nationwide communications network in a healthy condition. While there would seem to be no question that strictly military needs could be well taken care of out of existing facilities, doing so would seriously cripple the facilities left for the business, industrial, and essential civilian life of the country.

COLONEL MANN: Gentlemen, I was just checking with Mr. Peebles to see if it was a fair question to him how the thinking of the National Production Authority (NPA) is affecting the possible expansion of communication facilities to meet further expanding mobilization requirements; in other words, whether NPA is having any influence, helping or restricting, in meeting possible mobilization requirements. Mr. Peebles has said that it would be a fair question; so I will ask it.

MR. PEEBLES: First, NPA is an agency for production. It is the National Production Authority. So far as I know, and certainly in the Communications Equipment Division, we are not doing any planning for mobilization.

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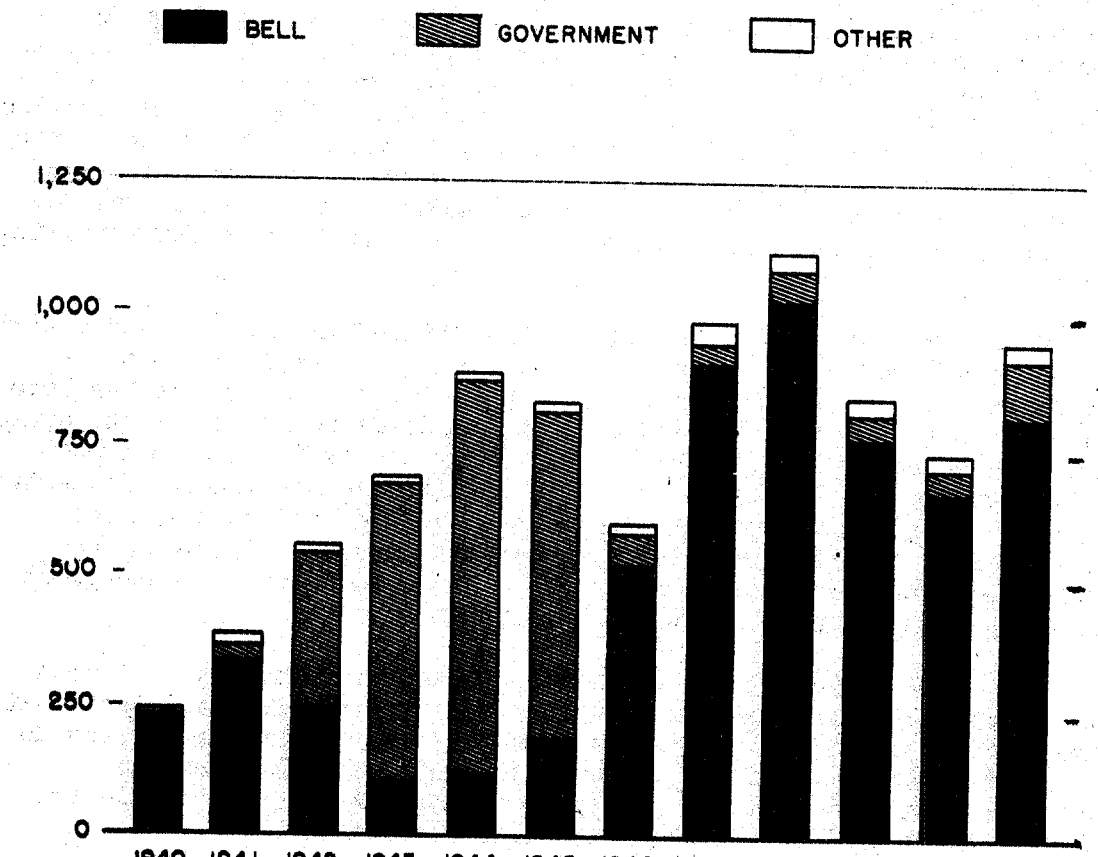
TOTAL WESTERN ELECTRIC SALES

(MILLIONS OF DOLLARS)



	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951
BELL	228	333	248	104	122	189	519	903	1,022	761	662	805
GOVT.	3	36	291	570	751	626	57	38	57	48	46	111
OTHER	11	16	14	12	13	17	23	40	37	32	29	34
TOTAL	242	385	553	686	886	832	599	981	1,116	841	737	950

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We have been trying so far as possible, and have succeeded so far as communications are concerned, in having allocated to the military services 100 percent of their requirements for their communication facilities. We are allocating to the communications manufacturers, where they have orders direct from the military, 100 percent of their requests.

We are, however, having trouble in not getting enough materials to meet the civilian demand. Of course I think the civilian demand is of the utmost importance. In fact, the President's Communications Policy Board, which he appointed something over a year or a year and a half ago, reported to him, I think, last March. The part presented to that Board by the military services stated in substance that the more communications we have, the better it is for the military, because in the event of war, no one knows where the attacks will come; and whatever communications are available to the civilians would be available to the military. So the more we have, the better off would be the organization for repelling our enemy.

QUESTION: Several of us have been stationed in isolated and outlying areas where independent companies serve the area. We found that the expansion that was required during the past two or three years has been held up, first, because the independent companies couldn't get the equipment they needed, even if they had the money to pay for it. But most of them put up the complaint that they didn't have the money. In certain of these new housing areas, we found that the independent companies couldn't meet the requirements for telephone service. I haven't been acquainted with that situation for the past seven or eight months, but has anything developed that would relieve it?

MR. PEEBLES: It is not only the independents that have not been able to meet the requirements in the housing areas. The Bell System at some 5,000 different points in this country today is unable to provide the service that is required, because it can't get the materials for that part of its production. In other words, NPA has been unable to allocate to the Bell System the necessary materials.

Right now the conditions are still bad. In New York not far from the city, there is a 1,000-unit apartment house near a baseball field in upper New York and there are only one or two telephones in a locker outside. There are plenty of points where there are only one or two telephones on a street corner and nobody has been able to get telephones.

The telephone instruments themselves are only a small part of it. Outside plant is necessary. Central office equipment is necessary. In the case of the steel plant, that is being built on the Delaware River; it is necessary to build an entirely new central office, which

in turn, so far as long-distance service is concerned, may make it necessary to reinforce the central office circuits with other circuits. It can be that the establishment of a large central office on the Atlantic Coast may require reinforcement of the circuits on the Pacific Coast. That is something not always realized by people who have not made a study of the communications picture--that what is done here affects the whole country.

QUESTION: I am thinking primarily about whether the government agencies that are controlling these allocations are giving any consideration to the fact that the priority comes to these defense-supporting areas for communication materials where key people are engaged and they might not give a priority high enough to permit them to get this material.

MR. PEEBLES: There is only one priority. There are area directives. If the military or if the telephone company that serves that area applies for a directive, it can get the material.

Insofar as the company not having money enough is concerned, under certain conditions financial arrangements can be made through the Government for loans.

COLONEL MANN: Mr. Peebles, you apparently have satisfied the class. Thank you very much for the knowledge you have brought to us, for your interest in our behalf, and the time that you have spent with us. Thank you.

(22 Sep 1952--750)S/rrb

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CHART 1

PRINCIPAL TOLL ROUTES OF THE BELL SYSTEM AND CONNECTING COMPANIES

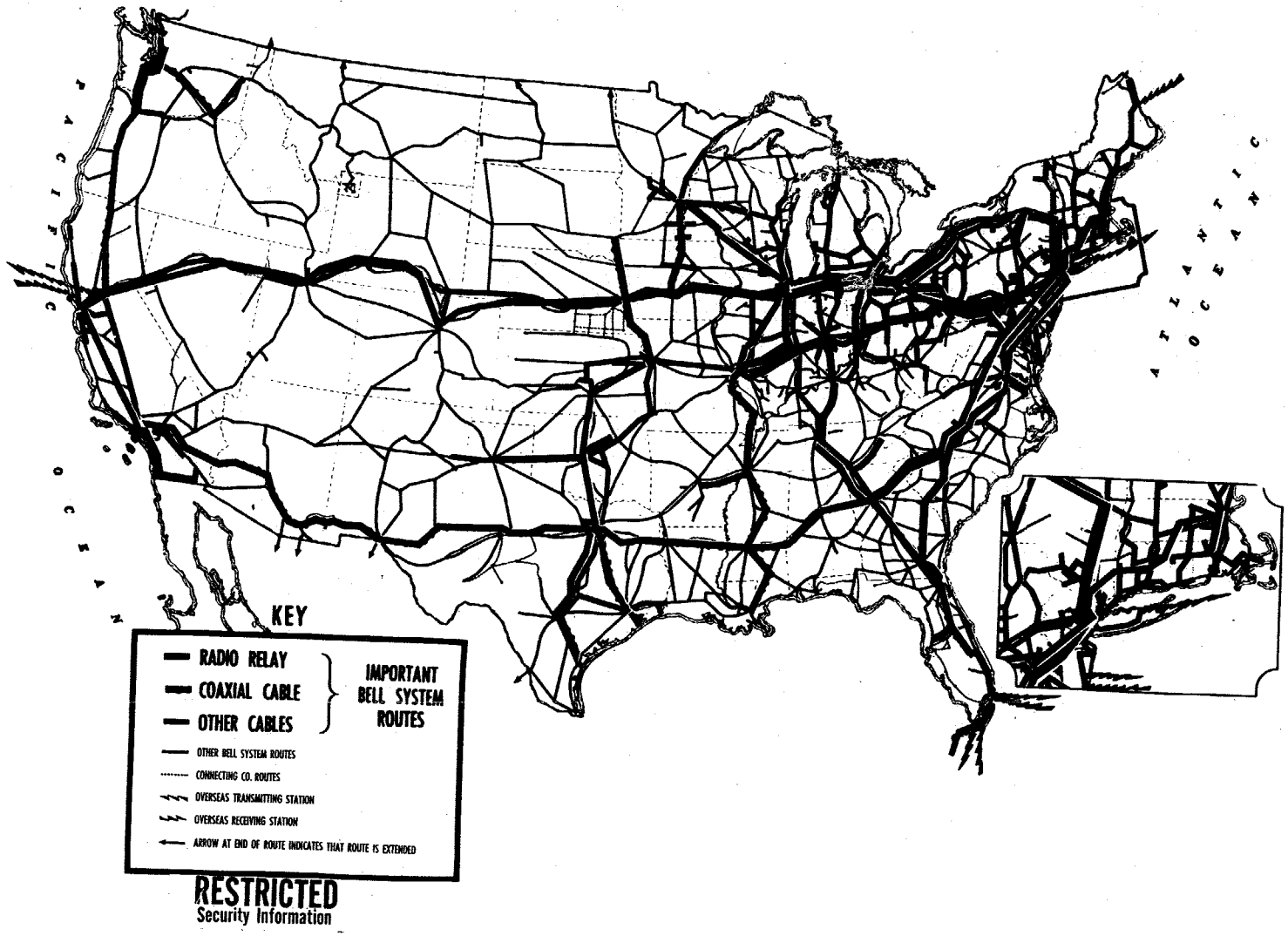

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CHART 2

PRINCIPAL TOLL ROUTES OF THE BELL SYSTEM AND CONNECTING COMPANIES

EQUIPPED CIRCUIT FACILITIES AND TOTAL CIRCUIT CAPACITY ON REPRESENTATIVE LONG HAUL ROUTES

ASSUMING COMPLETION OF PROJECTS NOW PLANNED

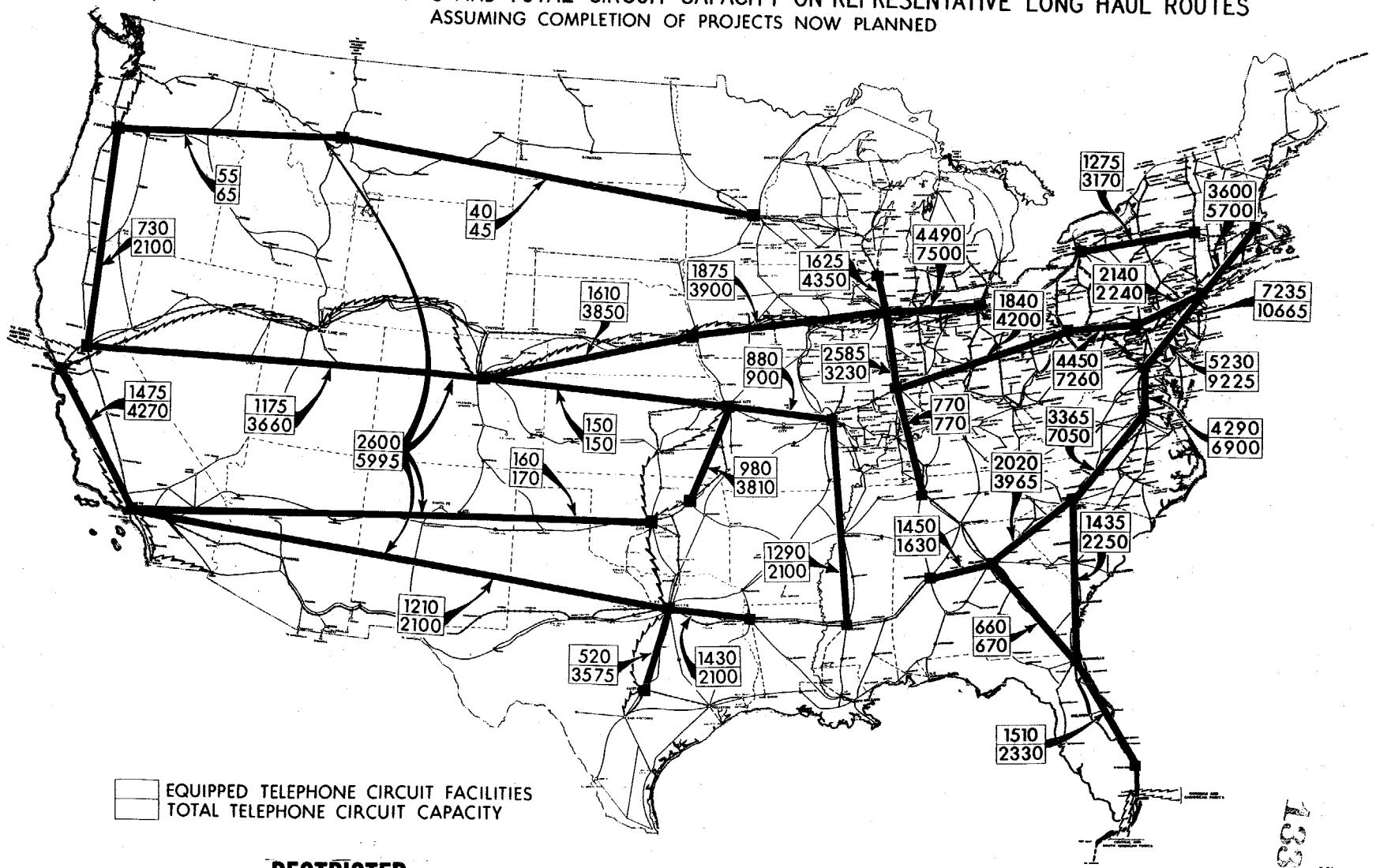

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CHART 3

TELEPHONE TOLL ROUTES IN THE STATE OF OHIO

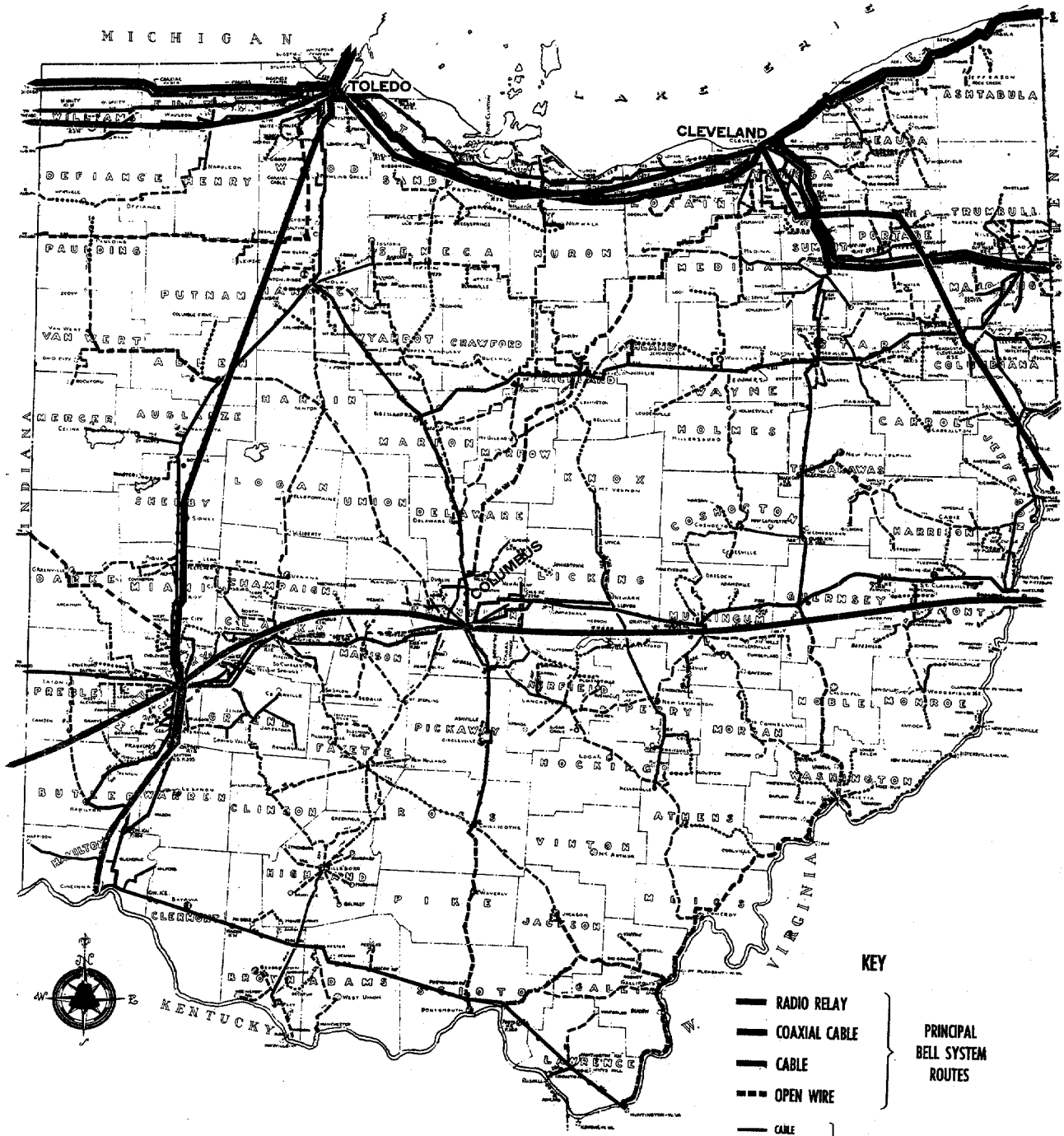

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CHART 4

OPERATING HEADQUARTERS OF BELL SYSTEM COMPANIES AND MAJOR SUPPLY WAREHOUSES

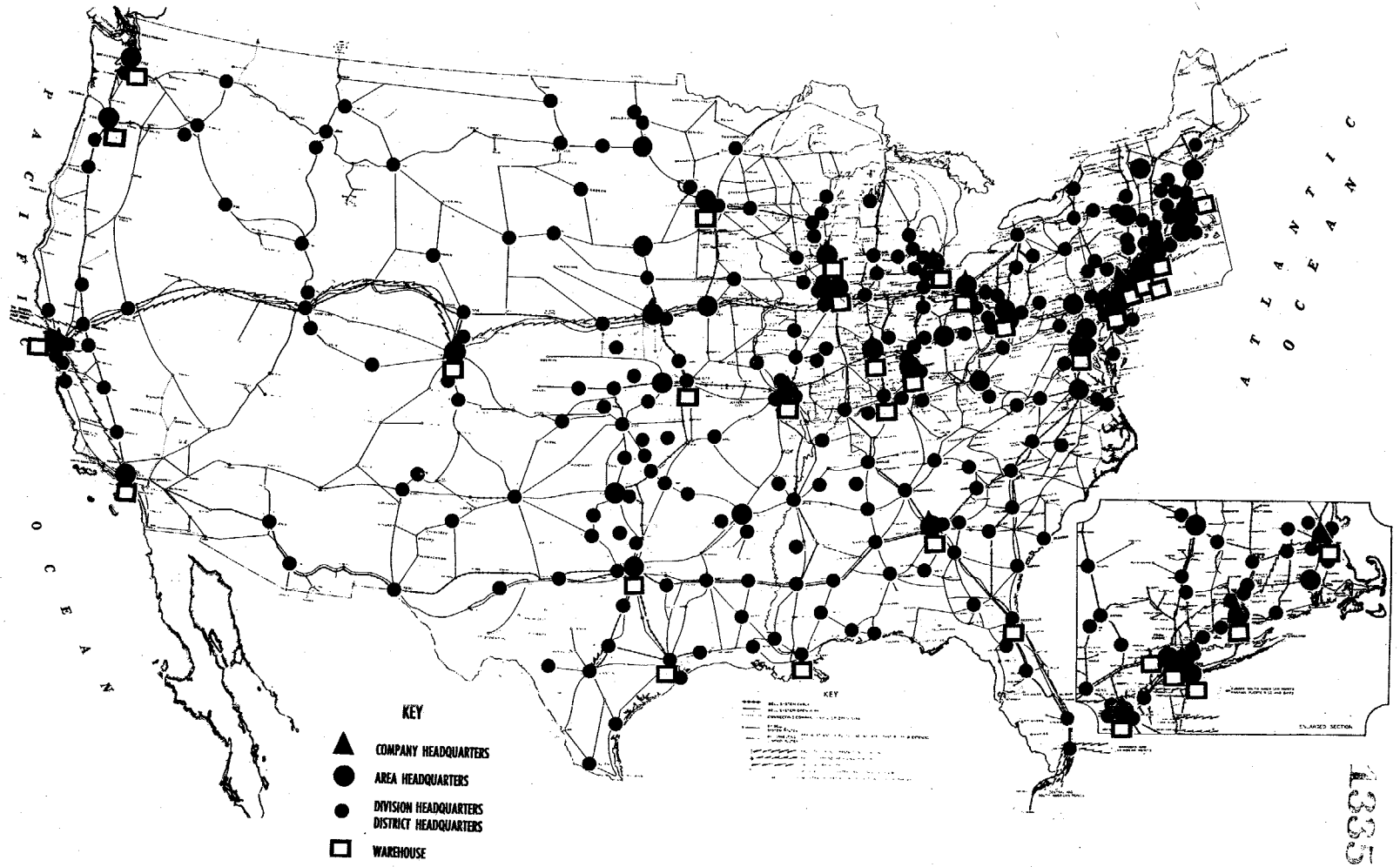

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CHART 5

EMERGENCY AND MOBILE RADIO EQUIPMENT

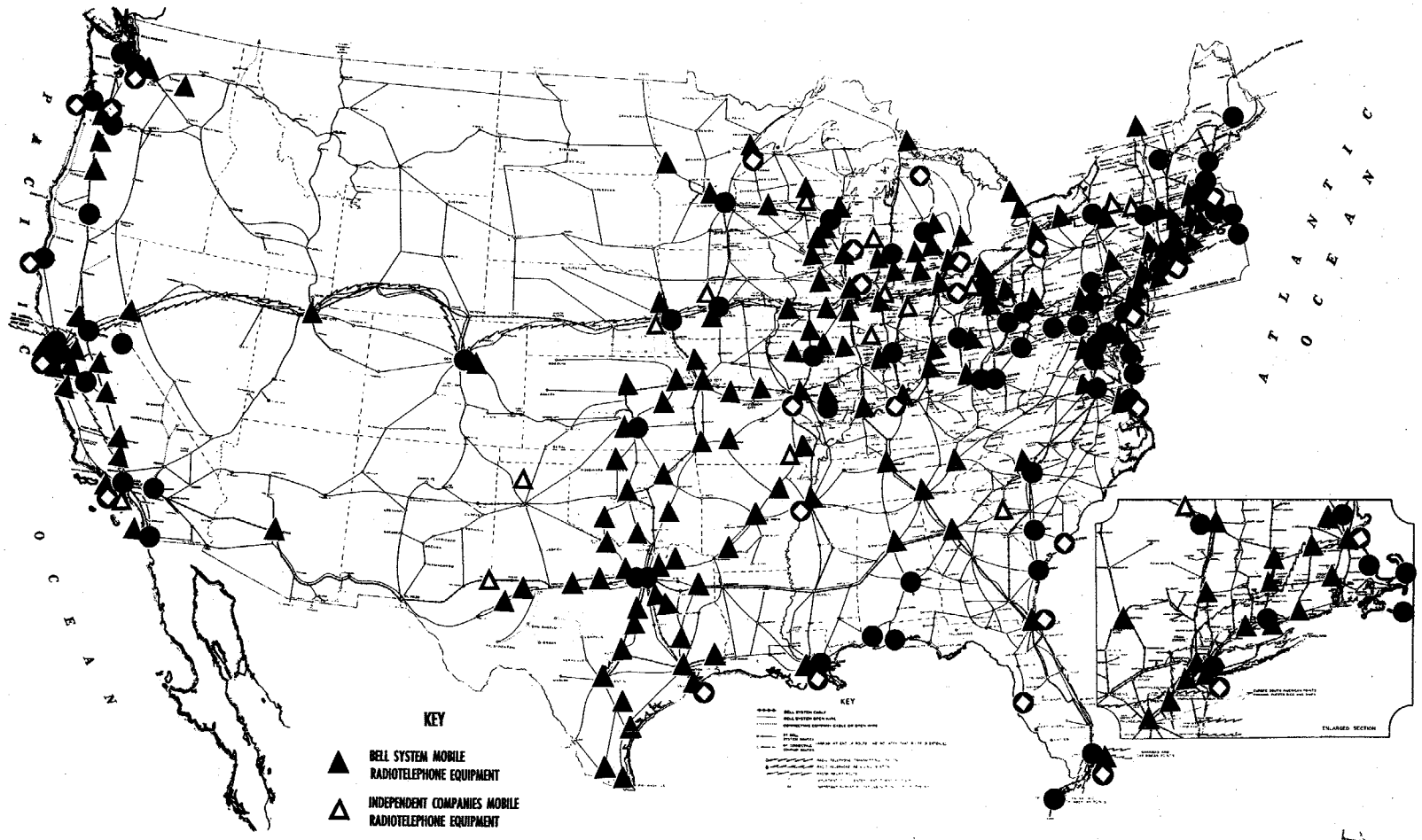

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CHART 6

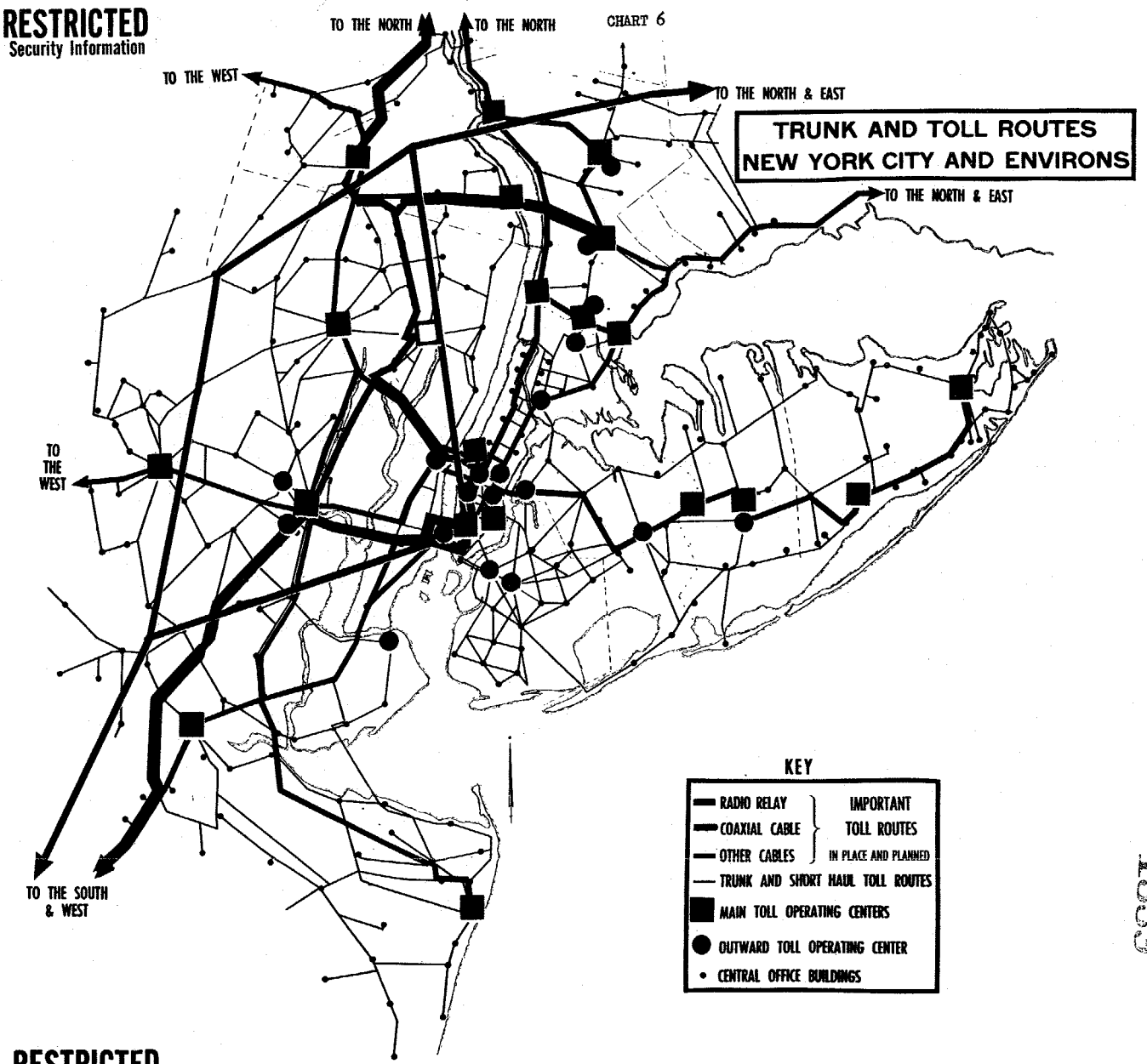

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CHART 7

TOLL FACILITIES - PITTSBURGH AND ENVIRONS

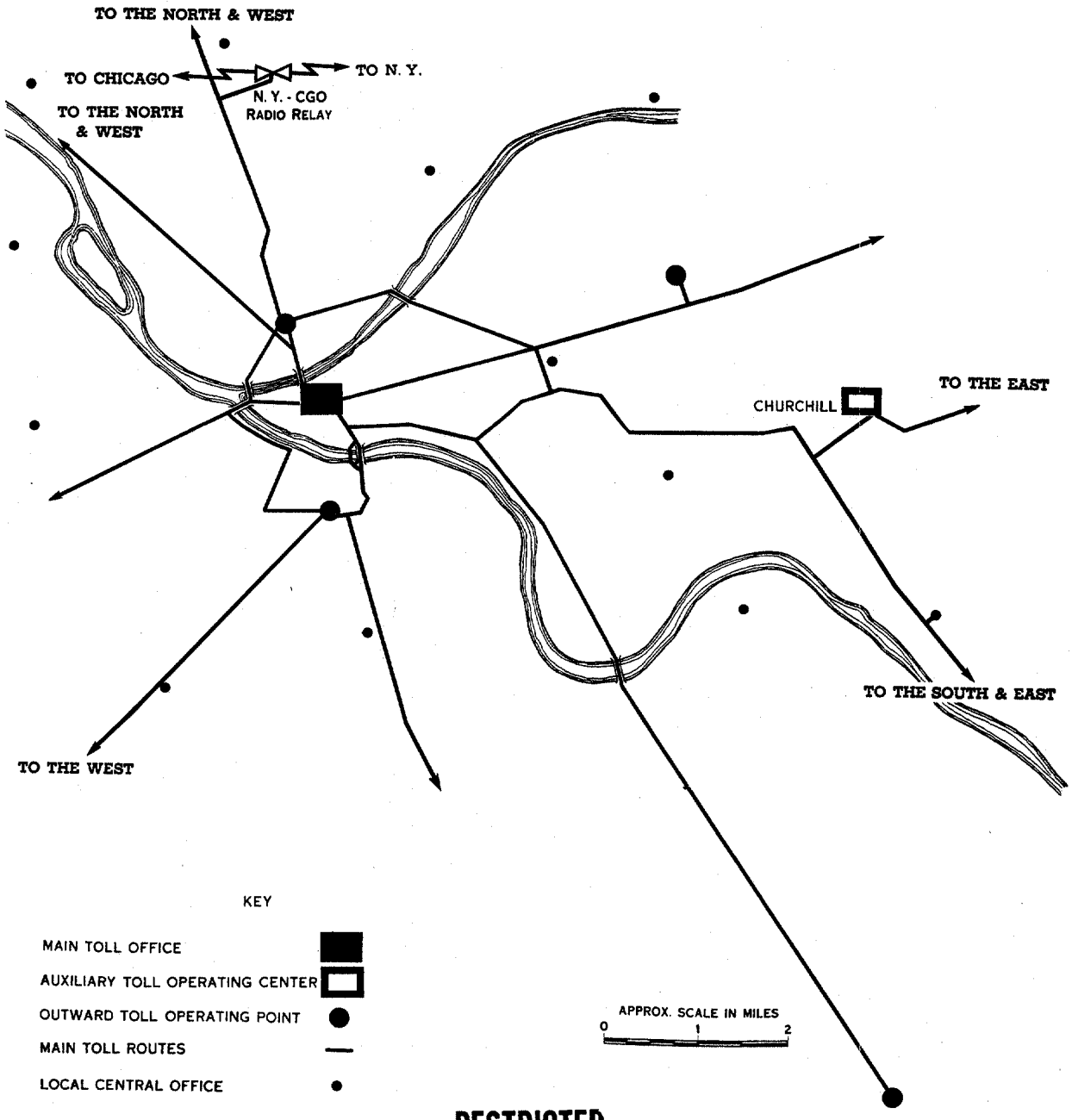

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CHART 8

TOLL FACILITIES - WASHINGTON, D.C. AND ENVIRONS

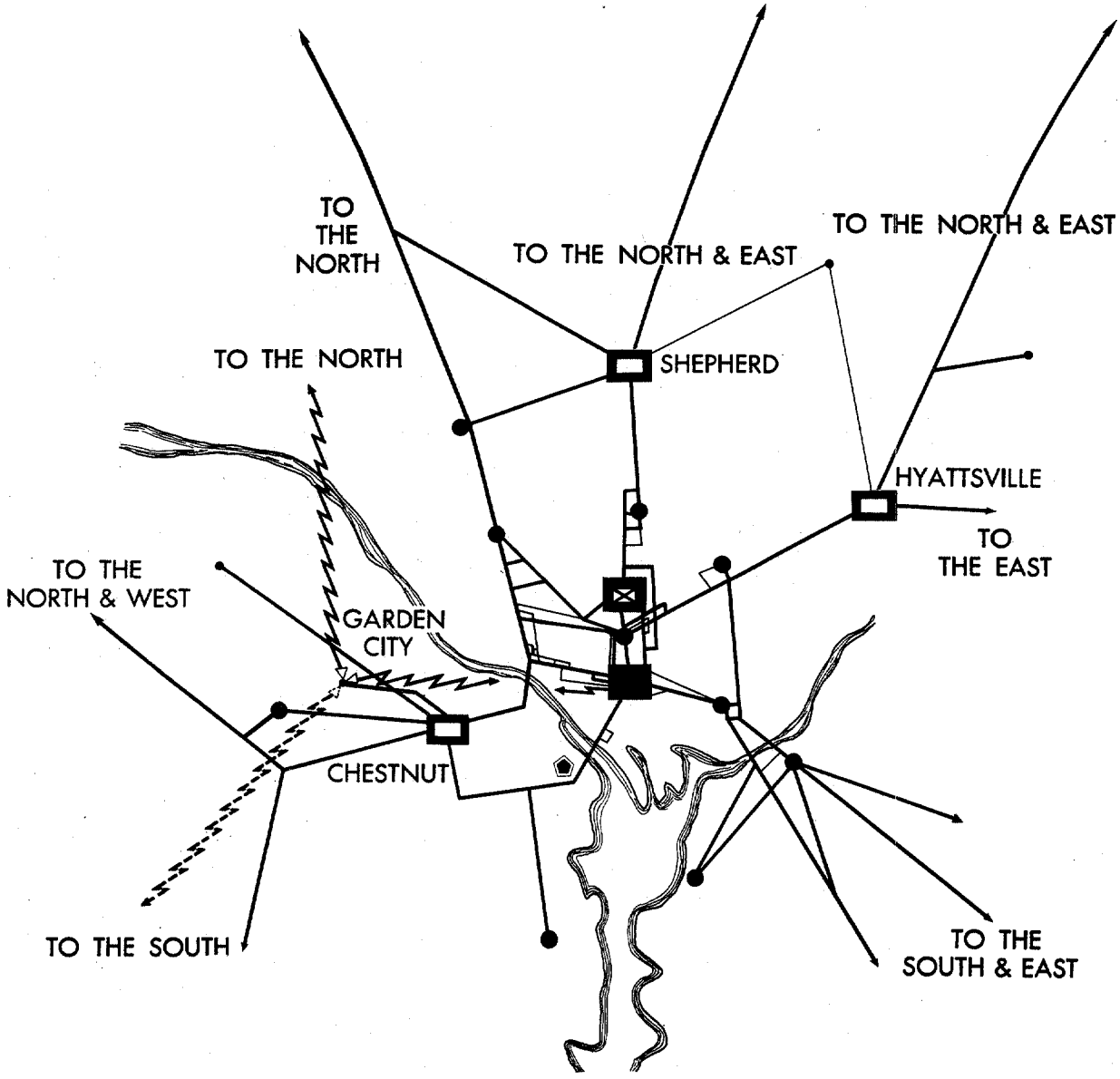

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CHART 9

PRINCIPAL CABLE NETWORK — SMALL AREA IN BROOKLYN, N.Y.

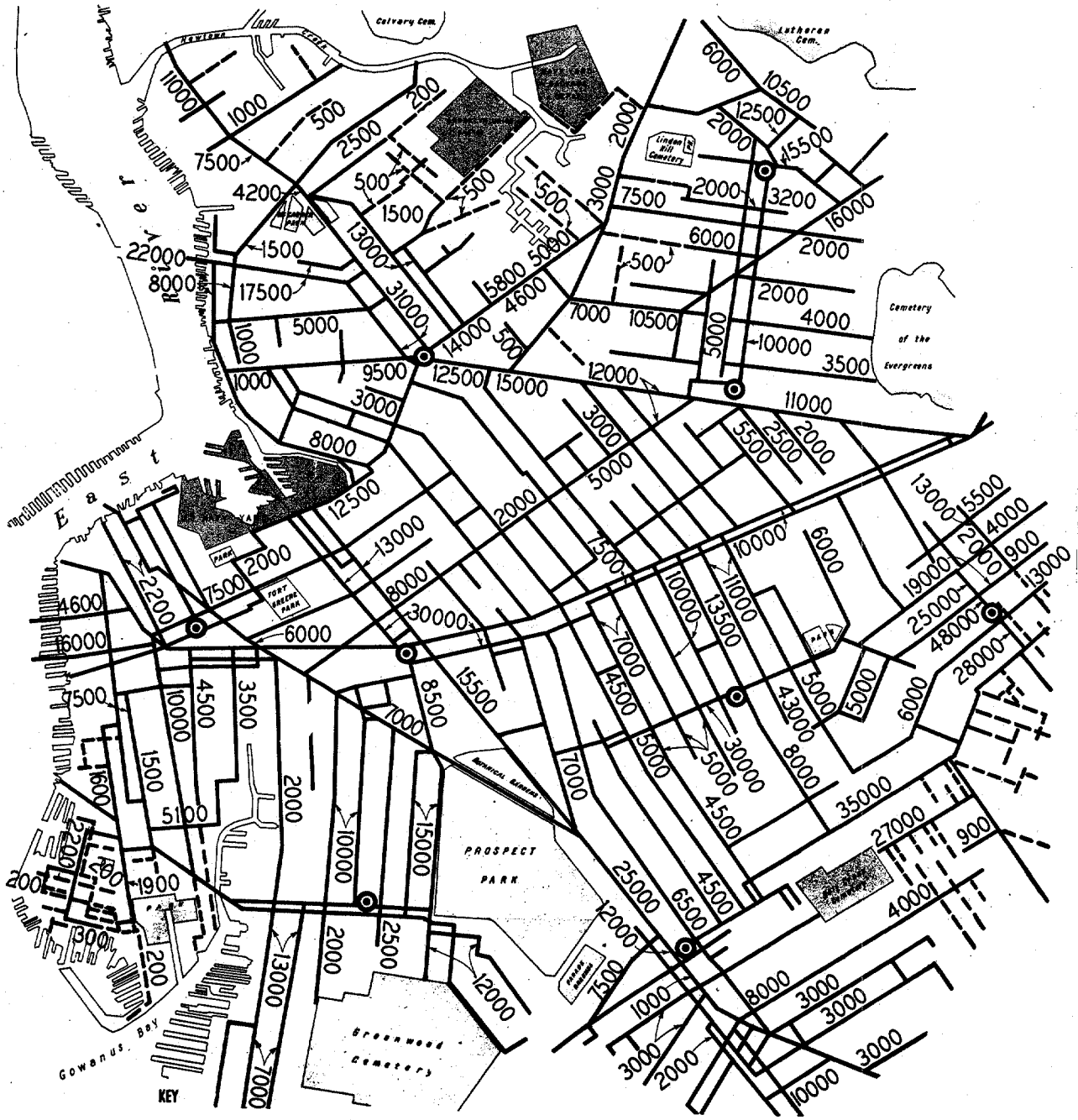

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CHART 10

TELEPHONE COMPANY MOBILE RADIO TRANSMITTER AND RECEIVER LOCATIONS

- BALTIMORE -

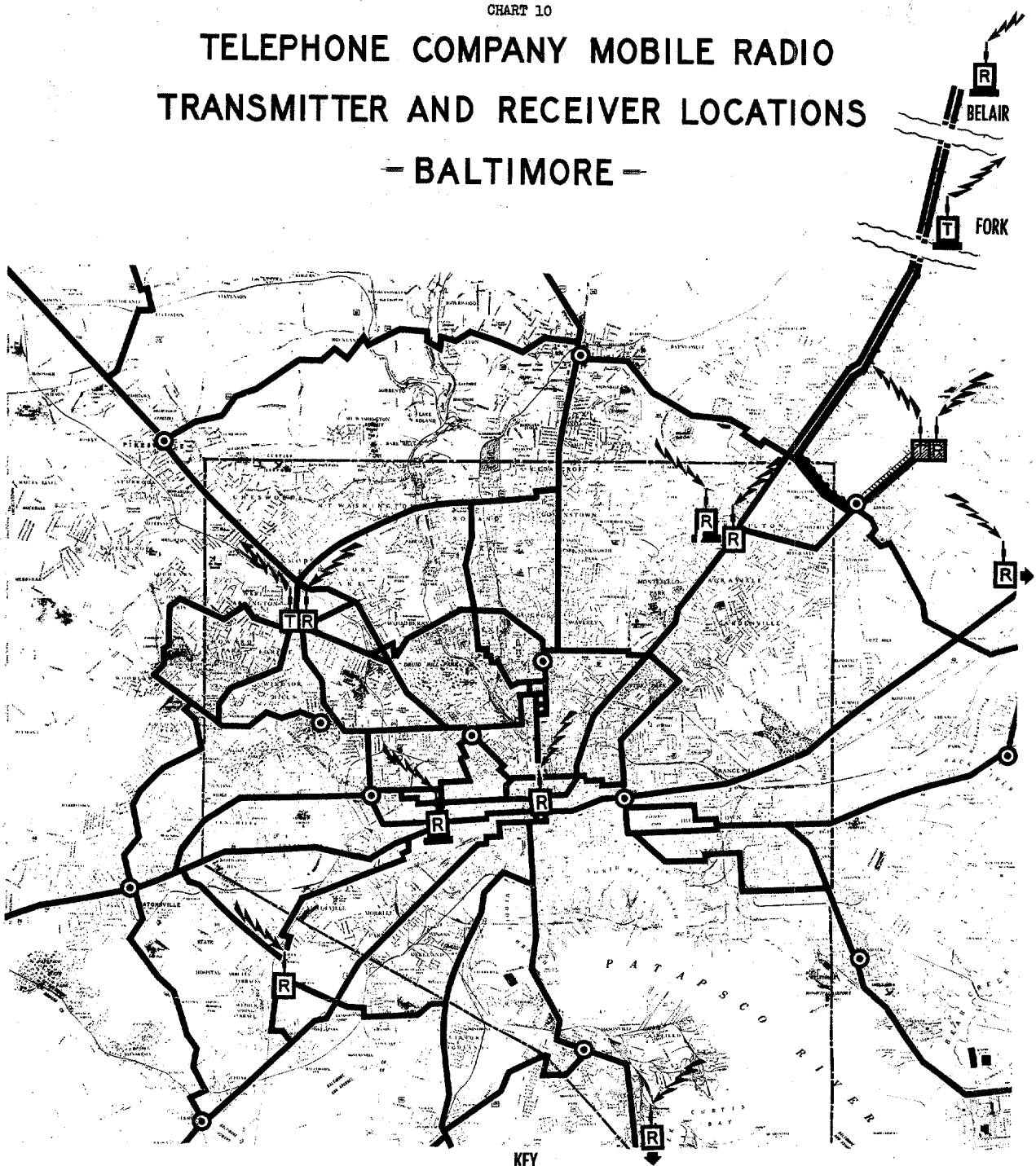

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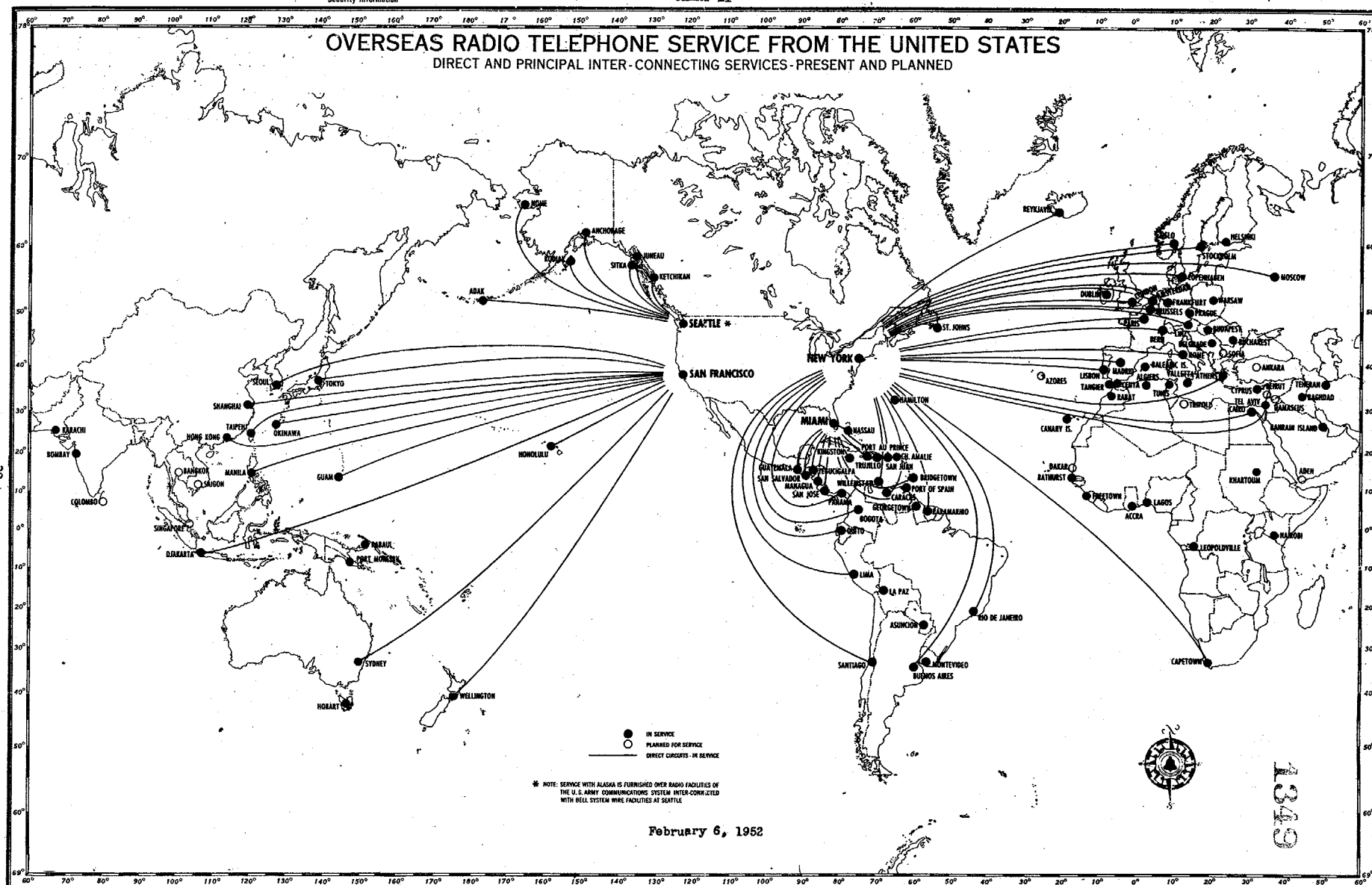
CHART 11

OVERSEAS RADIO TELEPHONE SERVICE FROM THE UNITED STATES

DIRECT AND PRINCIPAL INTER-CONNECTING SERVICES - PRESENT AND PLANNED



February 6, 1952

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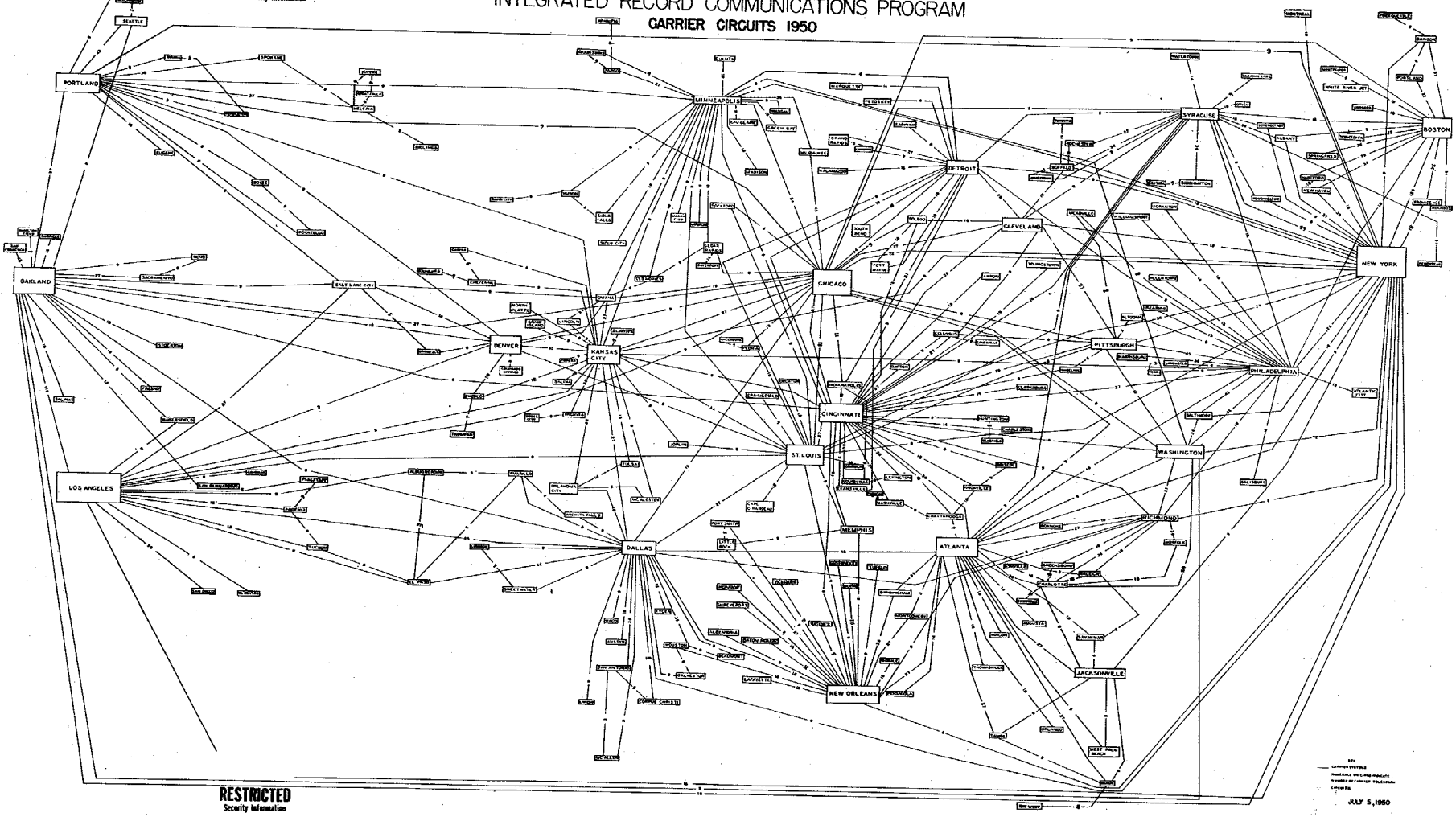
CHART 12

INTEGRATED RECORD COMMUNICATIONS PROGRAM

CARRIER CIRCUITS 1950



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JULY 5, 1950

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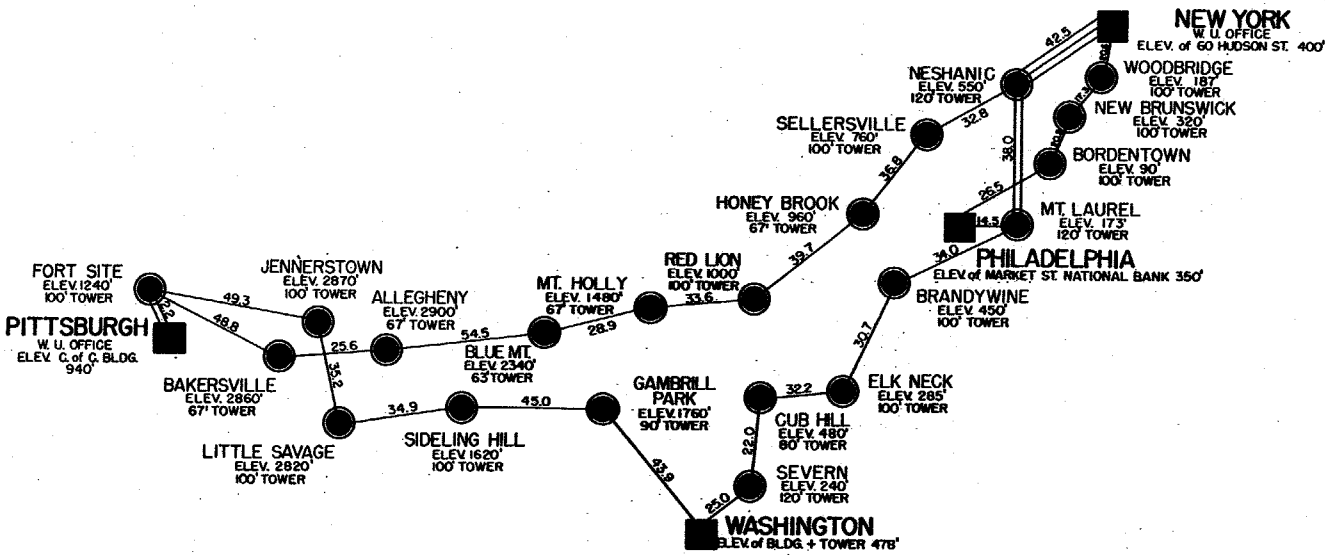
CHART 13

INTEGRATED RECORD COMMUNICATIONS PROGRAM

RADIO RELAY SYSTEMS NOW IN OPERATION

NEW YORK—PHILADELPHIA

NEW YORK—WASHINGTON—PITTSBURGH



DEC. 14, 1949

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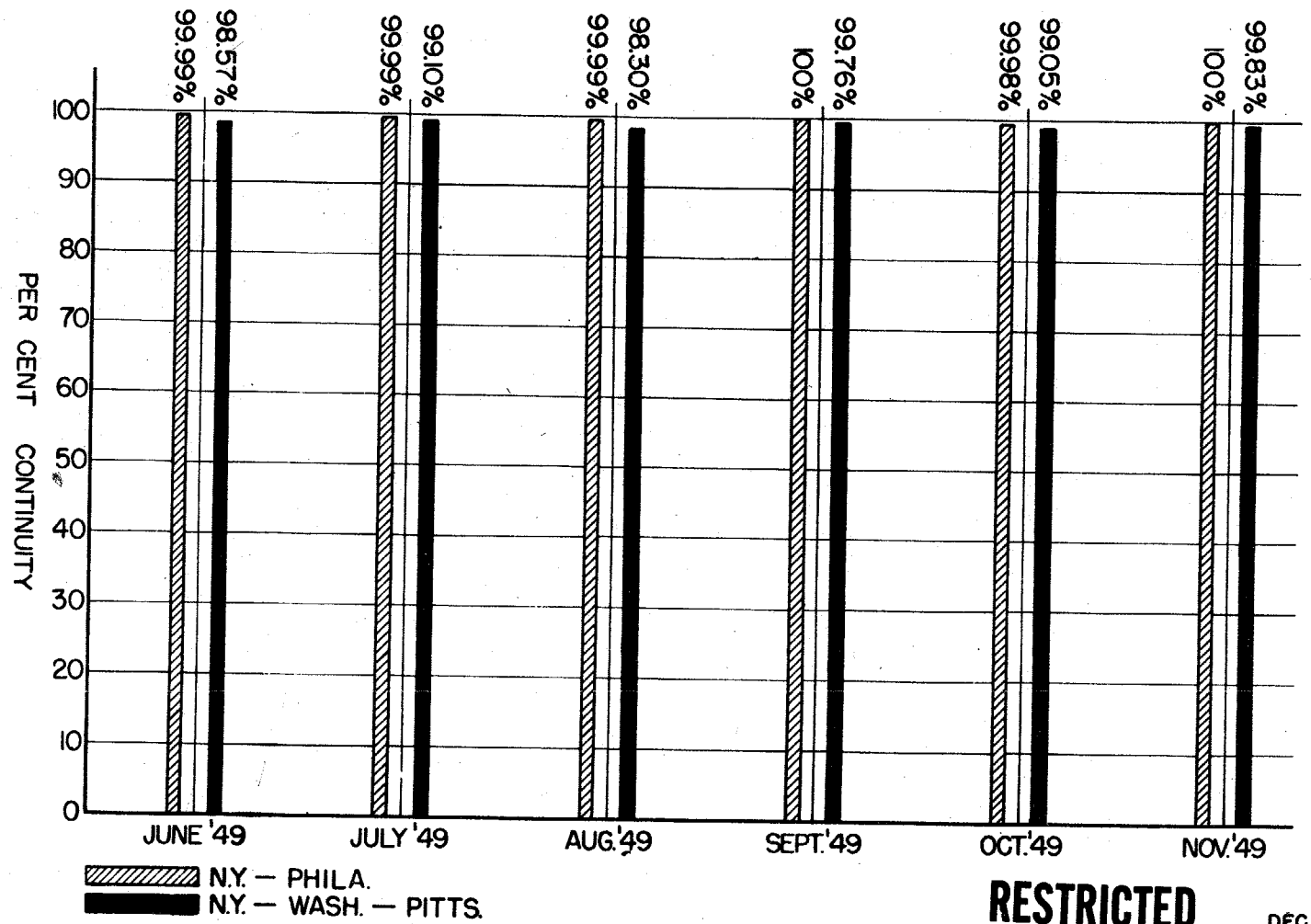
CHART 14

INTEGRATED RECORD COMMUNICATIONS PROGRAM

SERVICE CONTINUITY OF EXISTING RADIO RELAY SYSTEMS



DEC. 12, 1949

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CHART 15

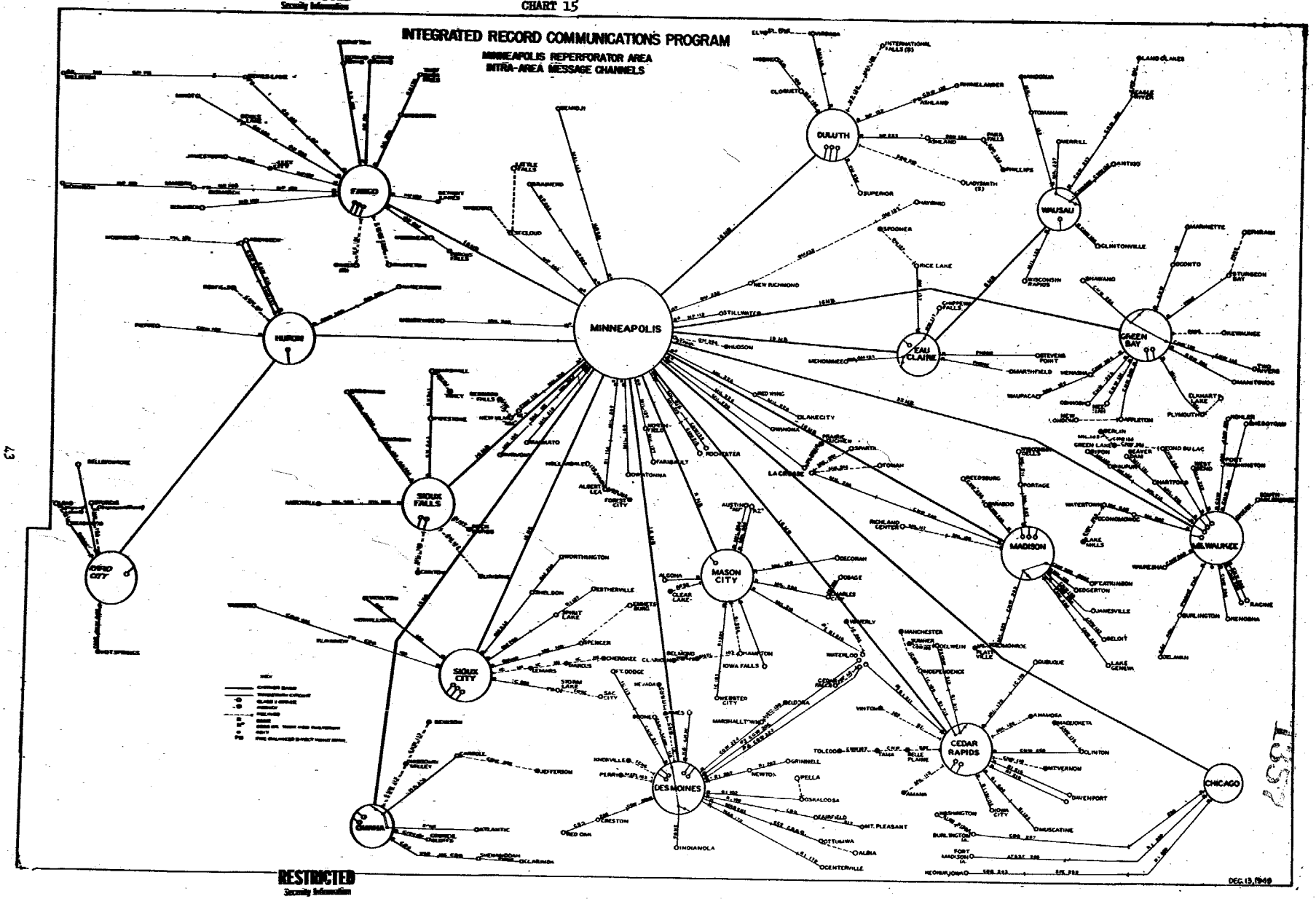

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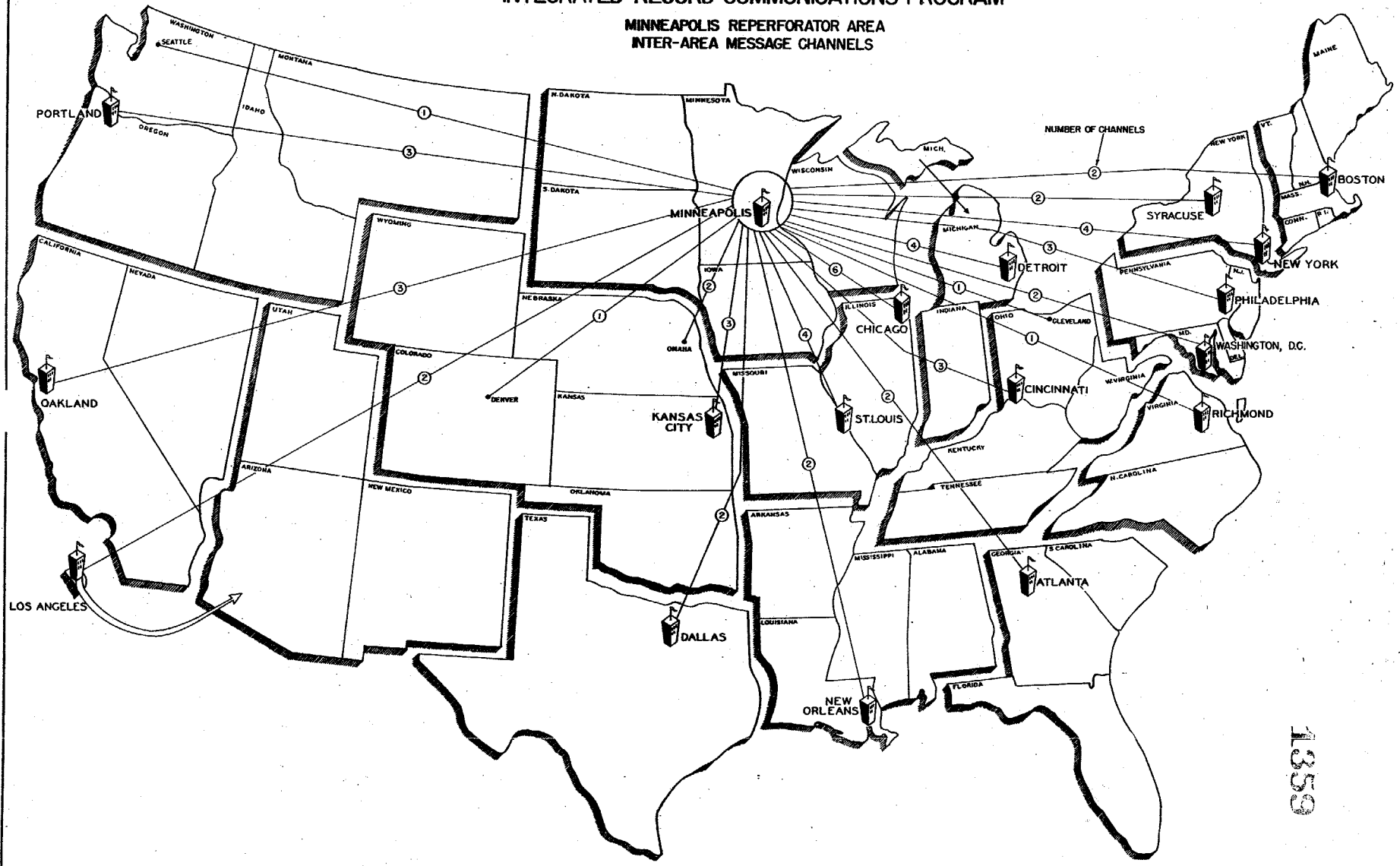
CHART 16

INTEGRATED RECORD COMMUNICATIONS PROGRAM

MINNEAPOLIS REPERFORATOR AREA
INTER-AREA MESSAGE CHANNELS



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DEC. 12, 1949

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INTEGRATED RECORD COMMUNICATIONS PROGRAM

INTER-AREA MESSAGE CHANNELS

4302

	ATLANTA	Jacksonville	BOSTON	CHICAGO	CINCINNATI	Cleveland	DALLAS	DETROIT	KANSAS CITY	LOS ANGELES	MINNEAPOLIS	NEW ORLEANS	NEW YORK	OAKLAND	PHILADELPHIA	PORTLAND	RICHMOND	ST. LOUIS	SYRACUSE	Albany	WASHINGTON	FOREIGN: HALIFAX	MONTREAL	ST. JOHN	TORONTO	VANCOUVER	WINNIPEG	MEXICO CITY
ATLANTA	X		2	3	4	1	2	3	2	1	2	4	5	2	4		5	2	2		3							
Miami		1	1		1								3		1													
BOSTON	2		X	4	4	2	2	3	2	2	2	2	10	3	6	1	2	2	5	1	3	1	2	1	1			
Bridgeport													1										1					
Hartford													1															
New Haven													1															
Providence													1															
Springfield													1															
Worcester													1															
CHICAGO	3		4	X	6	2	3	6	3	3	6	3	8	3	4	2	2	6	3		2		1		2		1	
CINCINNATI	4		4	6	X		3	5	3	2	3	3	8	3	4	2	4	4	3		3							
Akron															1													
Bristol																1												
Chattanooga	1																											
Cleveland						X		2			1		2		2			1	2									
Columbus							1								1													
Louisville				1			1																					
Memphis	1										2							1										
Nashville	1																											
Toledo							1								1													
DALLAS	2		2	3	3		X	2	4	3	2	4	5	3	2	2	1	2	1		2							
El Paso									1																			
Houston												2	1		1													
San Antonio																												
DETROIT	3		3	6	5		2	X	3	2	4	2	6	2	4	1	2	4	3		2			3				2
Ft. Wayne					1																							
Grand Rapids				1																								
Indianapolis				1	2								1		1			1										
KANSAS CITY	2		2	3	3		4	3	X	3	3	3	4	4	2	2	1	5	2		2							
Denver				1				1		2	1		1	1				1										
Oklahoma City							1																					
Omaha				1							2																	
Tulsa							1																					
LOS ANGELES	1		2	3	2		3	2	3	X	2	2	7	12	3	2	1	2	2		2							
Salt Lake City														1														
MINNEAPOLIS	2		2	6	3		2	4	3	2	X	2	4	3	3	3	1	4	2		2							
Des Moines				1																								
Milwaukee			1	2	1			2					1		1			1										
NEW ORLEANS	4		2	3	3		4	2	3	2	2	X	5	2	2		2	3	1		2							
Birmingham	2				1																							
Montgomery	1																											
Shreveport							1																					
NEW YORK	5		10	8	8		5	6	4	7	4	5	X	9	11	3	5	4	11	2	6	3		3			2	
OAKLAND	2		3	3	3		3	2	4	12	3	2	9	X	3	5	2	2	2		2				2			
San Diego									1																			
San Francisco									1						1	1												
PHILADELPHIA	4		6	4	4		2	4	2	3	3	2	11	3	X	2	3	3	4		3							
Atlantic City													1															
Baltimore	1		1	1	2								2				2		1		1							
Newark				1									1															
Pittsburgh			1	2	2	1		1					2					1	1									
PORTLAND			1	2	2		2	1	2	2	3		3	5	2	X		1			1				2			
Seattle				1						1				2											2			
RICHMOND	5		2	2	4		1	2	1	1	1	2	5	2	3		X	1	2									
Charlotte	2																											
Norfolk																												
ST. LOUIS	2		2	6	4		2	4	5	2	4	3	4	2	3	1	1	X	2		2							
Peoria				1																								
SYRACUSE	2		5	3	3		1	3	2	2	2	1	11	2	4		2	2	X		2	3		4				
Buffalo			1	1	1	1		1					2		1													
Rochester			1												1													
WASHINGTON	3		3	2	3		2	2	2	2	2	2	6	2	3	1		2	2		X							

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DEC. 12, 1949

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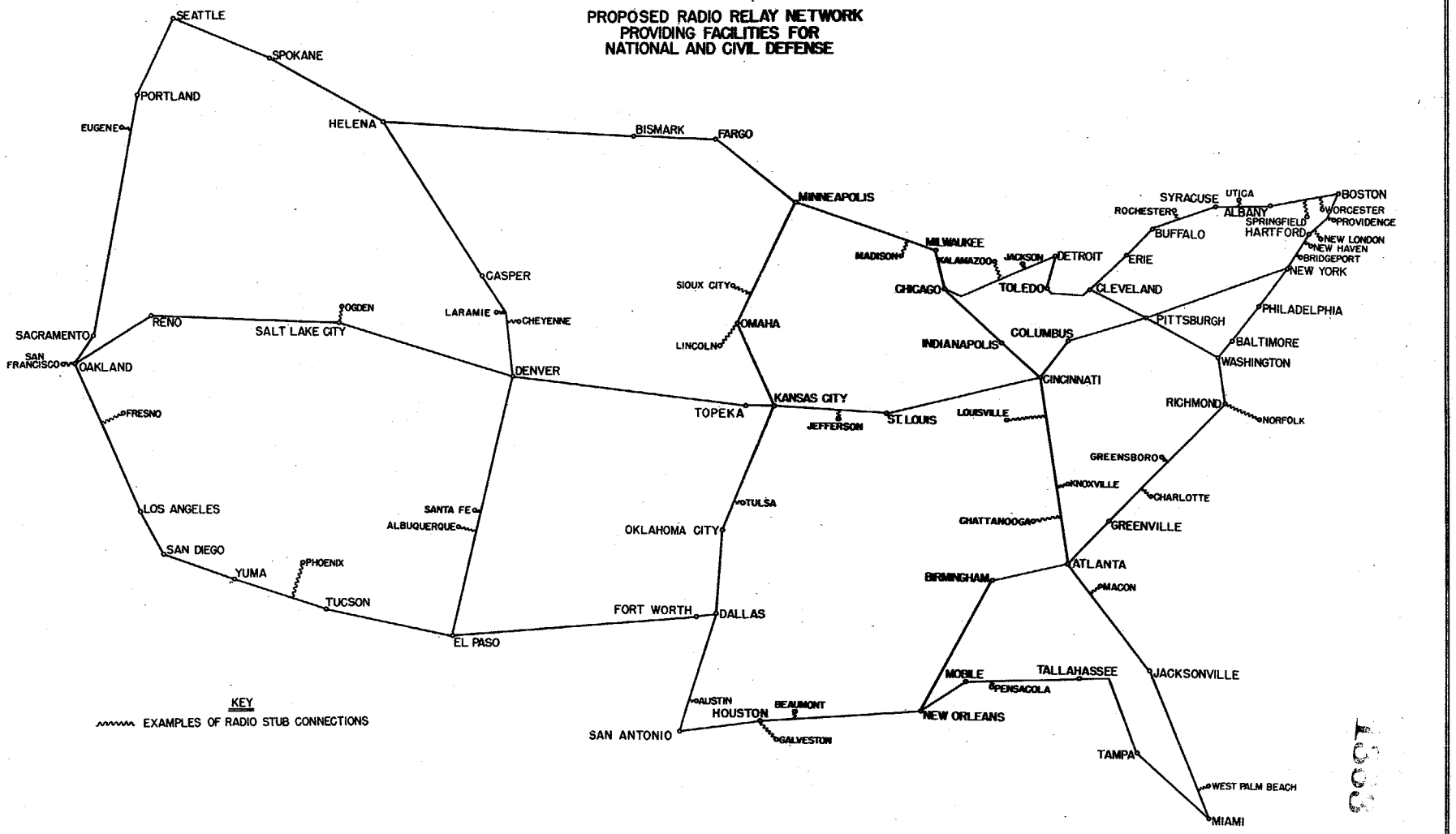
CHART 18

INTEGRATED RECORD COMMUNICATIONS PROGRAM

PROPOSED RADIO RELAY NETWORK PROVIDING FACILITIES FOR NATIONAL AND CIVIL DEFENSE



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