TELECOMMUNICATIONS IN MOBILIZATION AND EMERGENCY

5 March 1953

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INDUSTRIAL COLLEGE OF THE ARMED FORCES

Washington, D. C.

Mr. Charles M. Mapes, Assistant Chief Engineer of the American Telephone and Telegraph Company, was born 14 March 1901 at Spring Valley, New York. He was graduated from Massachusetts Institute of Technology in 1923. He joined American Telephone and Telegraph Company the same year and for 13 years was concerned with the provision and maintenance of central office and station equipment and with related work in connection with buildings. After three years with the Bell Telephone Company of Pennsylvania as general plant supervisor, he returned to the American Telephone and Telegraph Company as maintenance engineer in the Operation and Engineering Department. World War II required his services in coordinating Bell System's activities with the various government agencies involved in the allocation of materials and the construction of communications facilities. After World War II he was appointed systems engineer in charge of long-range planning and later held the positions of plant extension engineer and transmission engineer. In January 1951 he was appointed defense activities engineer, coordinating activities relating to the national defense, and held that position until his present appointment in July 1952.

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TELECOMMUNICATIONS IN MOBILIZATION AND EMERGENCY

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COLONEL PRICE: Admiral Hague, General Greeley, gentlemen: The civilian telecommunications systems now in the country are the nerves of our economy. We have the best civilian telecommunications of any country in the world. In spite of that, or because of that, they are generally taken for granted by most people. That is a tribute to the extent and efficiency of the operation of our communications by the operating companies. In the talk the other day on military communications, a compliment was paid to the civilian telecommunications system by the short statement that most continental military telecommunications are conducted over these civilian lines.

Mr. Charles M. Mapes, Assistant Chief Engineer of the American Telephone and Telegraph Company, is well qualified to tell us about the civilian telecommunications systems and the planning that is being done to continue or to restore this telecommunications network in case of emergency in our country.

Mr. Mapes.

MR. MAPES: Thank you. Good morning, gentlemen. I, of course, am very happy to be here and do hope that I can tell you some of the things that the Bell System and the Independent Telephone Companies of this country are doing in this present period of semimobilization, and what we might do if we go into a more active time. I know that many of you have seen the notes that Dr. Osborne, our former chief engineer, used in his talk here a year or two ago, so I am not going to repeat or duplicate that material.

I have with me today a couple of my associates from the American Telephone and Telegraph Company. One of them is Cole Armstrong, who is defense activities engineer for the System. Along with him is Al Swede from our Washington Office, who has liaison responsibilities between the military people and the Bell System; I think it is safe to say that anything you want he will get for you.

Dr. Osborne, when he talked here--two years ago, I believe it was--gave you some figures on the communications development; I would like to start by bringing those up to date.

Chart 1, page 2.--Here is a picture of the general over-all telephone and telegraph situation. For example, in 1951, when Dr. Osborne was here, the country as a whole--and that includes the independent companies--there are about 5,500 of them in the United States--had some

CHART 1

	1951	TODAY
NUMBER OF TELEPHONES IN SERVICE IN U.S.	43 MILLION	48 MILLION
PER CENT OF WORLD TELEPHONES	60	60
PER CENT OF WORLD POPULATION	6	6
TOTAL TELEPHONE CALLS PER AVERAGE DAY	170 MILLION	181 MILLION
TOLL TELEPHONE CALLS PER AVERAGE DAY	6.2 MILLION	6.4 MILLION
PER CENT TELEPHONES THAT ARE DIAL	76	79
PER CENT TOLL CALLS DIALED BY OPERATORS DIRECTLY TO CALLED TELEPHONE	33	41
MILES OF TELEPHONE PRIVATE LINES	650,000	1,100,000
MILES OF TELETYPEWRITER PRIVATE LINES	3,100,000	3,400,000
ONE-WAY CHANNEL MILES-		
BROAD BAND COAXIAL	46,000	62,000
BROAD BAND RADIO RELAY	8,200	41,000

43 million telephones. Today there are 48 million. The percentage of the world telephones is still something like 60. Percentage of world population, six--no change. In other words, we have roughly ten times more telephones than we might have if we had the average for the world. Telephone messages per day were 170 million--now 181 million. Toll messages, that is any distance over 25 miles, were 6.2 million--now 6.4 million. You will say that doesn't look like very much increase, but the actual increase is something over 15 percent in that period. The reason the figures do not go up in that same proportion is that we are extending the local calling areas in many places. Take Newark--if we extend the local calling area beyond the immediate Newark exchange, we transfer certain of the calls that were previously toll calls, 10 or 15 cents, to local. So we have had an actual increase of about 15 percent in the type of call that was called "toll" two years ago.

The percentage of telephones that are dial went up from 76 to 79. The percentage of toll calls dialed by operators directly--that is where you call the operator here in Washington and ask for long distance and she dials the call directly to the distant telephone; actually, she pushes keys, but in effect she dials it directly to the called point--has gone up from 33 to 41. Miles of telephone private lines, from 650,000 up to 1,100,000. Military people have taken a lot of that increase. We will talk about that a little later. Miles of teletype private lines, from 3,100,000 to 3,400,000. Broad band coaxial has grown from 46,000 to 62,000 channel miles. You have all heard of the coaxial cable which carries a tremendous number of conversations on one cable, or will carry television programs or both at the same time. The normal coaxial has eight tubes in it. You need two tubes to make a two-way telephone conversation. But each of those pairs of tubes today will carry about 600 normal telephone conversations at a time. We have with a coaxial cable of eight tubes a nominal capacity of 1,800, using three sets of two tubes each for conversation and one set of tubes for spare.

Broad band radio relay has increased from 8,200 channel miles up to 41,000 miles--this is in a period of two years. That's the microwave system you have all read about. We have it from the far side of the country; that is, from San Francisco right across to New York and then down to the South. We will show you a little more of that later.

That's just a broad picture. The telephone business is growing, and as it grows, we are just like the General Motors or the General Electric Company, or any of the big industrial concerns. We have new models continually being introduced. Some of the new models that have been introduced in these last two years are of great interest to us and I think they are of interest to you. I would like to mention a few of them.

Take the telephone set itself--we have a new model telephone set which is being introduced. We call it the 500-type set. It has characteristics of longer range. That is, it can be put farther away from the central office on the same size of cable. It has a smaller hand set, more closely fitted to the mouth-ear relationship. It has a ringer that is adjustable in volume by the subscriber himself and generally the set is a more efficient instrument.

Actually, during the recent material shortage, we calculated that we saved copper something in the order of 3,000 or 4,000 tons a year due to the fact that we could use smaller gage cables with the new instrument.

This research into things of that kind helps the military also. Our Bell Laboratories had a contract for the development of a Signal Corps set, and the development of this set was materially assisted by the fact that we had worked on our own job, our own 500-type set. The Signal Corps set was different in some ways. You might be interested in the ringer. The ringer in the Signal Corps set is something like a tom tom. In other words it has a diaphragm which is beaten on by a clapper over a resonant cavity. It gives out a sound that is much more discernible under confusion, such as battle or other confusion, than our own instrument might be. It is an interesting development, where you need something different from a commercial product.

Taking the telephones that are dial, we have a new model there, too, a new model central office. We call it the number 5 crossbar. It has been introduced since the war. It has built-in features to do nation-wide customer dialing. I mean that literally. The number 5 system that is currently in operation in Englewood, New Jersey, provides for nation-wide dialing with the customer himself doing the dialing. He has to dial 10 digits, but in Englewood the people can dial 11 million telephones--all the way to San Francisco. We look forward to extending that type of service. It is faster. The calls go through in something like 14 seconds or so, compared to a normal average on operator-handled calls of between a minute and two minutes. So there's a new model there.

In telephone private lines we have some new carrier systems, open wire carrier systems and cable carrier systems. These we have developed in order to save building a brand new cable or open wire plant. You put a carrier in your existing system and you can get more circuits out of what conductors you have. Here again, the development work in the laboratories has been quite a lot of assistance in helping the laboratory to design carrier systems for military use.

On the teletypewriter job, we have a new, so-called number 28 teletypewriter. We think it is better from the maintenance angle. It is faster. It will do 100 words a minute or a little more. Our two previous models did 60 to 75 words. This is of interest to you since faster service is always needed in military communications.

On the broad band coaxial, we have a new system which was cut into service last week between Newark and Philadelphia, in which, instead of the 600 channels per pair of tubes we now get 1,800 channels per pair of tubes. This is done by new designs of amplifiers, repeaters, and so on. You have seen, perhaps, the little huts for these repeaters. They were every eight miles in the original design, to give us 600 channels per pair of tubes. In order to get 1,800 we had to put another repeater station in between--about every four miles.

The broad band radio relay system, which we call the TD-2, provides circuits in big groups. You may see, as you go around the country, radio towers with big, rectangular antennas on top. There are always two antennas--one headed west and the other east, for example. That type of installation will take 12 one-way channels or 6 two-way channels--each broad band. A pair of the channels will handle 600 two-way telephone conversations at the same time. Therefore, on one line of those towers we can handle about 3,000 conversations. Or we can handle, let's see, 10 one-way television channels. We will talk about that a little more later.

These are just some of the things we have in our new models. They are of interest. I think you will find that we are going to keep on doing that kind of thing.

Chart 2, page 6.--I guess we talked about the Bell Laboratories a little and what they have done in development work. I thought this chart might be of interest to show what part of the Bell Laboratories is now devoted to the military job. Here you will see roughly 65 or 70 percent is devoted to the Bell System development. The balance is devoted to military. The tops of these curves, so far as the numbers of people are concerned, might be 9,000 people in 1953, including clerical and all the other assistants to the strictly engineering group; or it might be 2,000 or 3,000 engineers working in the laboratory.

You might say, "Why doesn't the military have more of the laboratory capacity?" or "Why do they have as much as this?" I think we have a pretty good balance here. The military people have come to us and said, "Now, this is the kind of job you can do. We think you are the only ones who can do this kind of job." So we very gladly accept that type of work. Work which can be done by others, we think it better to have it done by them, and we would like, if possible, to continue the work in the telephone field as much as we can. I think that perhaps the main reason it is desirable to continue a large volume in the domestic communications field is that it gives a reserve in case we get into more trouble. It gives a reserve of good, experienced engineering talent that can devote itself more completely to military work, if that is needed.

CHART 2

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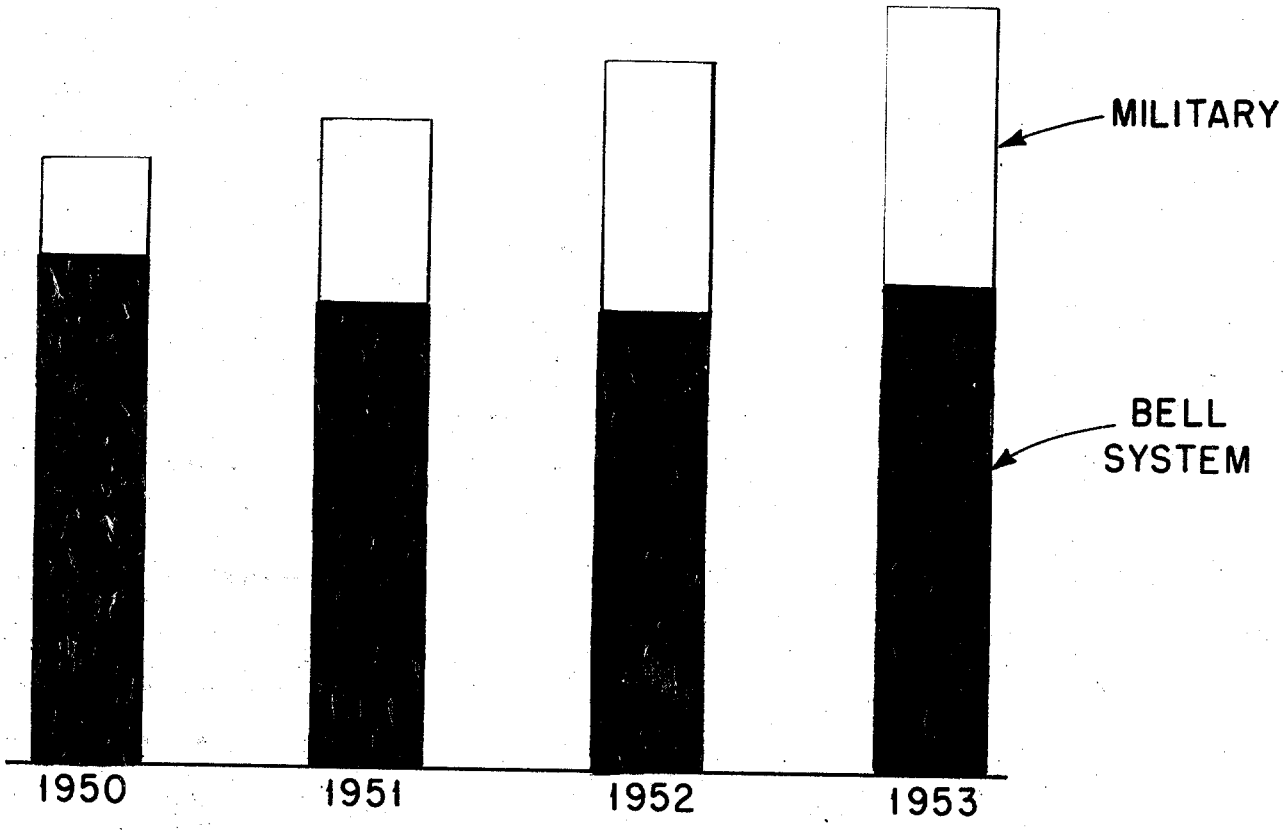
BELL TELEPHONE LABORATORIES MANPOWER



Work in the domestic communications field developed the transistor. As you know, the transistor is quite likely to have very profound effects on the military job. Its compactness, its light weight, its need for very small power, and its ruggedness--really, the transistor is a rugged job as now designed--all make it a tool which we anticipate that military communications will want to use to a large extent. We believe we have pretty good balance here between military and civil effort.

Chart 3, page 8.--Then we have the Western Electric Company. This chart represents the sales of the Western Electric Company. The darker shade represents sales to the Bell System; the lighter shade, sales to Government; white, sales to others. I thought it would be interesting to see how the Western Electric Company performs. As you know, it is our manufacturing agency; it also does our purchasing.

Note the years 1941 and 1942. You see a reasonably rapid cut over to the war job; in other words from a very small percent in 1941 to 50 percent in 1942. In 1943, of course, production for military purposes was much greater. Then, as the war drew to the end, the manufacturers naturally went back very quickly to the production of domestic communications materials, and, of course, continued on that until Korea. You will see that about 1951 military production began to speed up very rapidly again.

The column for 1953 is estimated--total sales of almost a billion, 500 million dollars. Again, I think there is a little parallel here with the laboratory. We ought to take the kind of jobs that are in our special province. As for those that can be done elsewhere, it would seem a very sound thing to have others do them. That not only lets us build the telephone plant of which we are still far short, but also creates the reserve to do this kind of job if we get more active. We think that is in pretty good balance, too. Possibly the government part will continue to grow, but still we need to continue keeping quite a lot of production on the domestic job.

Chart 4, page 9.--You have seen the percent of present capacity which military projects are using in the Bell Laboratories and in the Western Electric. Now we can look at what percent they are using in the operating companies. As you know, the Bell System consists of 21 operating companies--the Pacific Company, the New York Telephone Company, the Chesapeake and Potomac, and so on. They are the ones that give service--do the local job. They are, of course, supplemented by the Long Lines Department, which does the intercity network. On this chart we have a picture of the extent to which the operating companies are already committed to the military job. The first item shows some figures on the intercity telephone circuit mileages. Of the 31,800,000 circuit miles in the plant, military circuits are using about 490,000 or 1.5 percent. In other words there is still a tremendous number of intercity circuits available.

CHART 3

TOTAL WESTERN ELECTRIC SALES
(MILLIONS OF DOLLARS)

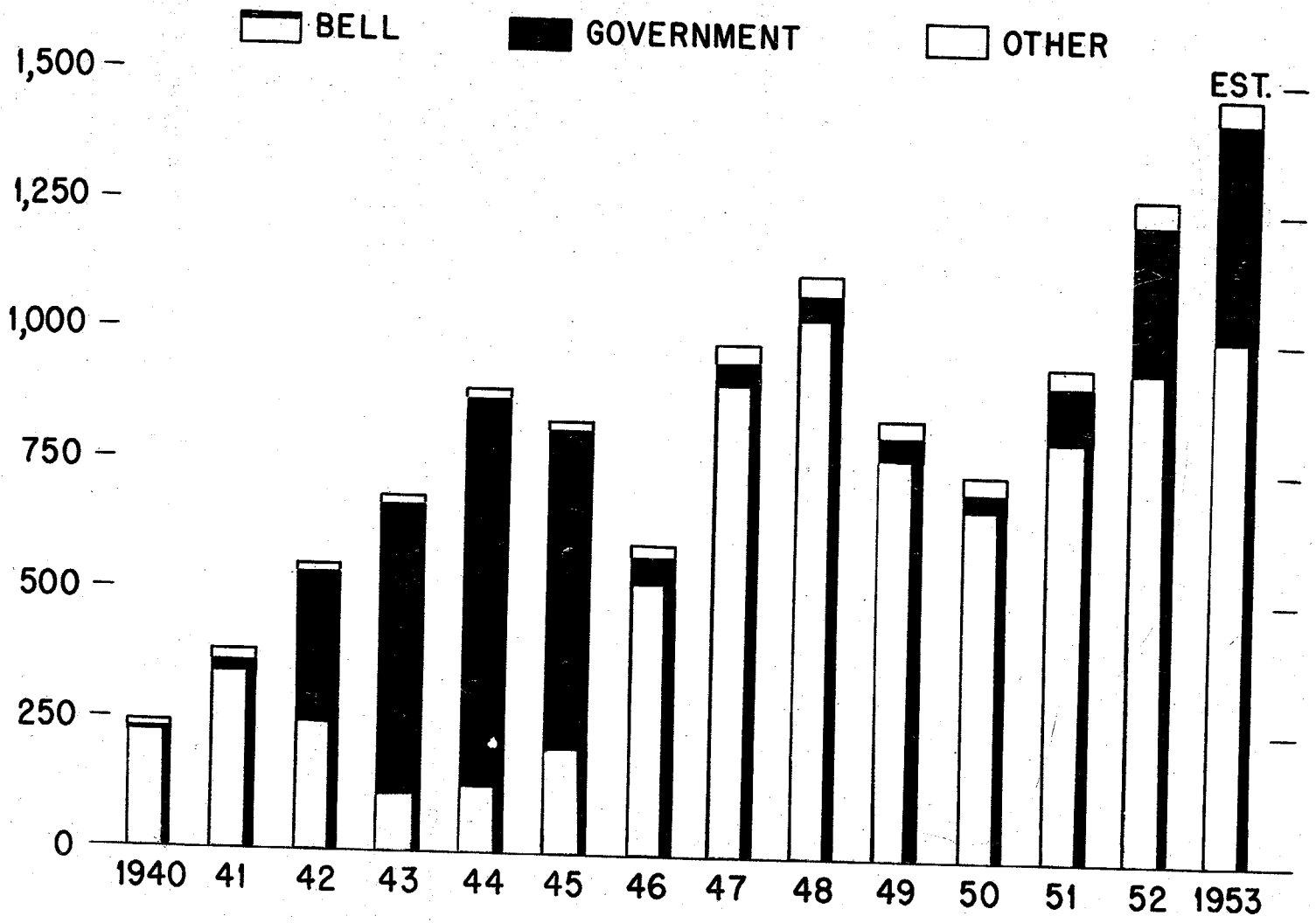


CHART 4

	TOTAL	APPROXIMATE USAGE BY MILITARY	PER CENT MILITARY
INTERCITY TELEPHONE CIRCUIT MILES	31,800,000	490,000	1.5
INTERCITY TELEGRAPH CIRCUIT MILES	7,200,000	500,000	7.0
TOTAL TELEPHONES	48,000,000	400,000	0.8
TOTAL TELETYPEWRITERS	66,000	6,500	9.9

On intercity telegraph the military services are using 7 percent of the circuit miles. On total telephones, less than 1 percent; on total teletypewriters, about 10 percent.

So the reserves here are quite adequate for the military job in this country.

Chart 5, page 11.--This chart shows some of the mileages used by various military organizations: Air Defense Command--full time, 180,000 telephone; 30,000 teletypewriter. Notice this "engineered" amount here--60,000. That represents an arrangement which we have with the Air Defense Command whereby its representatives can say if things get hot, "We have to have these circuits; we don't need them in peacetime; but when we have to have them, we have to have them right away." We have set up an arrangement so that if the ADC calls and says, "We have to have network number X immediately," we take the circuits out of the regular message layout and put them into the military network, and our objective is to do that within a matter of an hour. So far we haven't quite met the hour requirement, but we are going to meet it.

USAF (Administrative other than ADC and SAC) 51,000 telephone; 63,000 teletype. The Strategic Air Command, 12,500 telephone; 18,800 teletype. U. S. Army, Toll, Command and Administrative Networks, 12,000 telephone; 35,700 teletype. FCDA--this is the civil warning network, by which the Air Defense Command warns the various cities of an air attack. It is in operation--it is tested daily and is ready to go in case we get an air attack. Civil Aeronautics--of course you know it takes a lot of talking to run the civilian airplanes.

Chart 6, page 12.--This chart shows part of the answer to, "What do we have to sell." I think it is worth taking a minute to explain. We really have to sell--I am talking intercity now, not local--highways of communication. Comparing communications channels to roads; if you don't have too much traffic, and if you can get adequate transportation with one truck following another, you need only a narrow highway. Similarly if only one conversation following another is needed, a narrow communications highway will do. Instead of measuring it in feet width, we measure it in cycles per second.

If you need a highway which takes a tremendous amount of information, and you have to have that tremendous amount put forward immediately, we have a wider highway. This shows you the highways we have and, roughly, the cost.

For example: A telegraph highway, which has about 100 cycles per second width, costs about a dollar and one-half per airline-mile per month. Actually, if you get into the longer distances, this goes down to about a dollar. Full period telephone, 2,800 cycles width--that costs about three dollars. This also goes down to a dollar on long

CHART 5

PRINCIPAL MILITARY AND RELATED PRIVATE LINE NETWORKS

NETWORK	APPROXIMATE INTERCITY CIRCUIT MILEAGES	
	TELEPHONE	TELETYPEWRITER
AIR DEFENSE COMMAND		
FULL TIME	180,000	30,000
ENGINEERED	60,000	–
U.S. AIR FORCE	51,400	63,800
STRATEGIC AIR COMMAND	12,500	18,800
U.S. ARMY		
TOLL, COMMAND AND ADMINISTRATIVE NETWORKS	12,000	35,700
U.S. NAVY	–	27,700
F.C.D.A.	14,400	–
CIVIL AERONAUTICS ADMINISTRATION	64,900	77,600

CHART 6

PRIVATE LINE CHANNELS

APPROXIMATE BAND WIDTH CYCLES PER SEC.	TYPE OF SERVICE FOR WHICH CHANNEL IS SUITED	TYPICAL MONTHLY INTEREXCHANGE LINE CHARGE-DOLLARS PER AIRLINE MILE
100	TELEGRAPH, TELETYPEWRITER, D-C TELEMETERING	1.50
2,800	FULL PERIOD TELEPHONE	3.00
3,500	MINIMUM QUALITY PROGRAM	4.00
5,000	MEDIUM QUALITY PROGRAM	6.00
8,000	HIGH QUALITY PROGRAM	8.00
15,000	HIGH QUALITY PROGRAM	10.00
4,000,000	PRESENT STANDARD VIDEO	35.00
8,000,000-10,000,000	HIGH DEFINITION VIDEO	UNDER DEVELOPMENT

circuits. Radio program--this is what the broadcasting companies lease to carry their programs cross country--3,500 cycles cost about four dollars. Medium quality radio program is 5,000 cycles--six dollars. At present the broadcasting companies do not lease anything greater than 8,000 cycles. They have found 5,000 cycles generally adequate and therefore, most of our radio business is in the range--3,500 and 5,000 cycles.

High quality program--we have it available if somebody needs it; it is 15,000 cycles for 10 dollars. Television requires about 4 million cycles and that is what is transmitted over our coaxial cable or radio relay. That costs 35 dollars per airline-mile per month. We are working on a highway of 8 to 10 million cycles wide. That would be required, we believe, for theater television. You would have a closed circuit over which the theaters would transmit their own programs intercity for use by theater audiences only. They believe that, to get television comparable to good film, they will need a highway of 8 to 10 million cycles. We think we can do that when needed although we don't have a rate established for it yet.

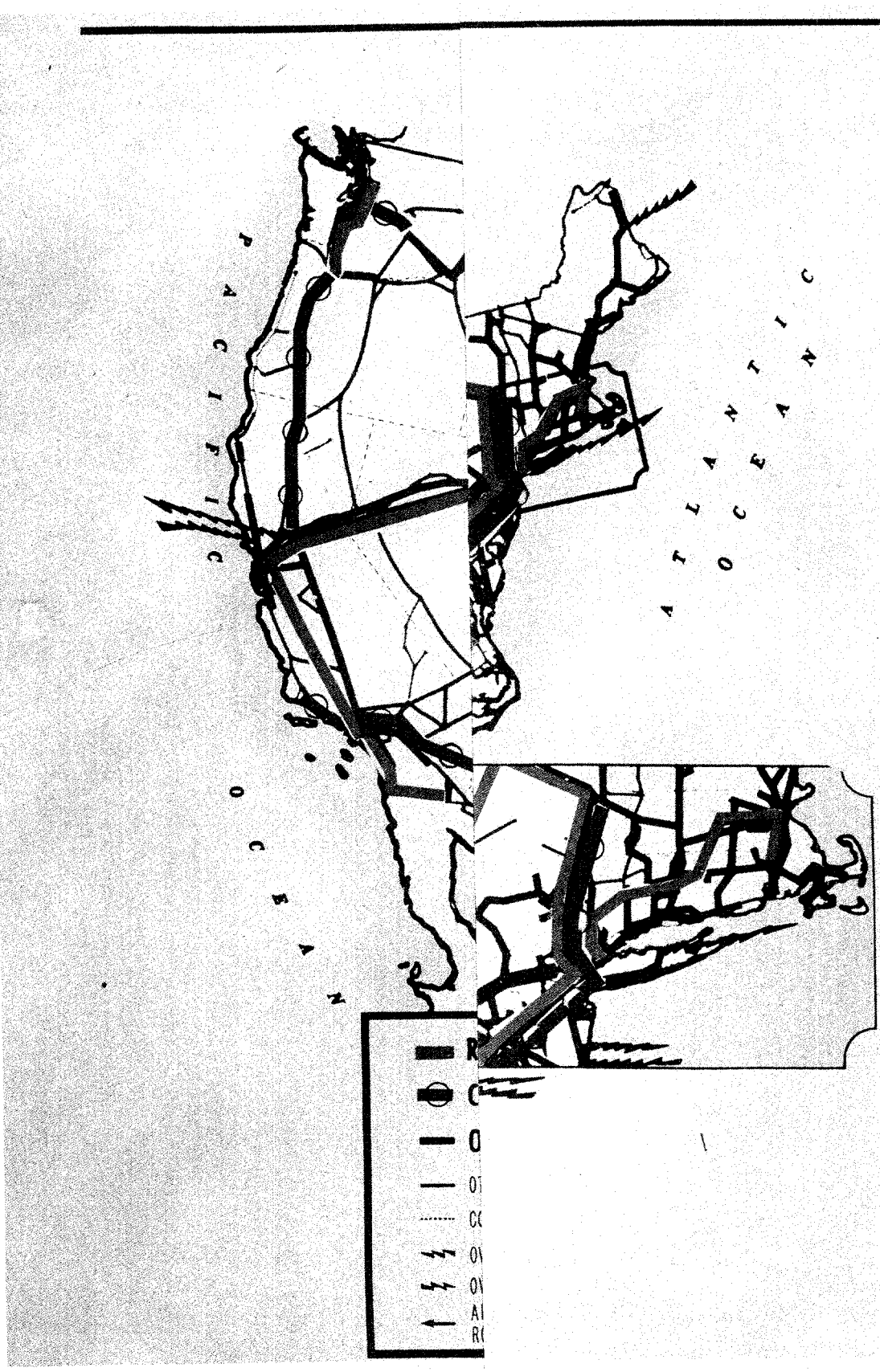
Just in passing we don't know whether military will come to us and say, "We have to have some wide highways," or not. Today I believe there's hardly anything in the military field that is beyond 2,800 cycles. It may be, however, with the data transmission problems, possibly some radar applications, that we will eventually get a requirement for a wider highway. I think we can say we are ready to provide it on a very extensive basis if you need it.

Chart 7, page 14.--We have just finished talking about this wide highway. I thought it would be interesting to show a map indicating the principal toll routes of the Bell System. This chart does it. There are thousands of interconnecting routes we have not been able to show on this map which would show on a more detailed representation.

A lot of that wide highway is currently available. This map actually shows what will be the situation at the end of the year, but better than 90 percent of that is already in today. Channels are used by both the television broadcasters for their pictures and for telephone communications from one end of the country to the other.

Chart 8, page 15.--This chart shows the numbers of circuits that are in those cables I showed you on the previous slide. Down here (indicating) that coaxial has 1,212 working circuits. In here there's an open wire line which has 196. There are a couple of cables that have about 1,600; and a wire line with 150. Total from east to west, currently, 3,200 voice channels are working. I think that reflects some of the things we said before and you will remember that the military services are using only a small percentage of the total available today.

PRINCIPAL TNG COMPANIES



EQUIPPED INTERCITNCIPAL TOLL ROUTES

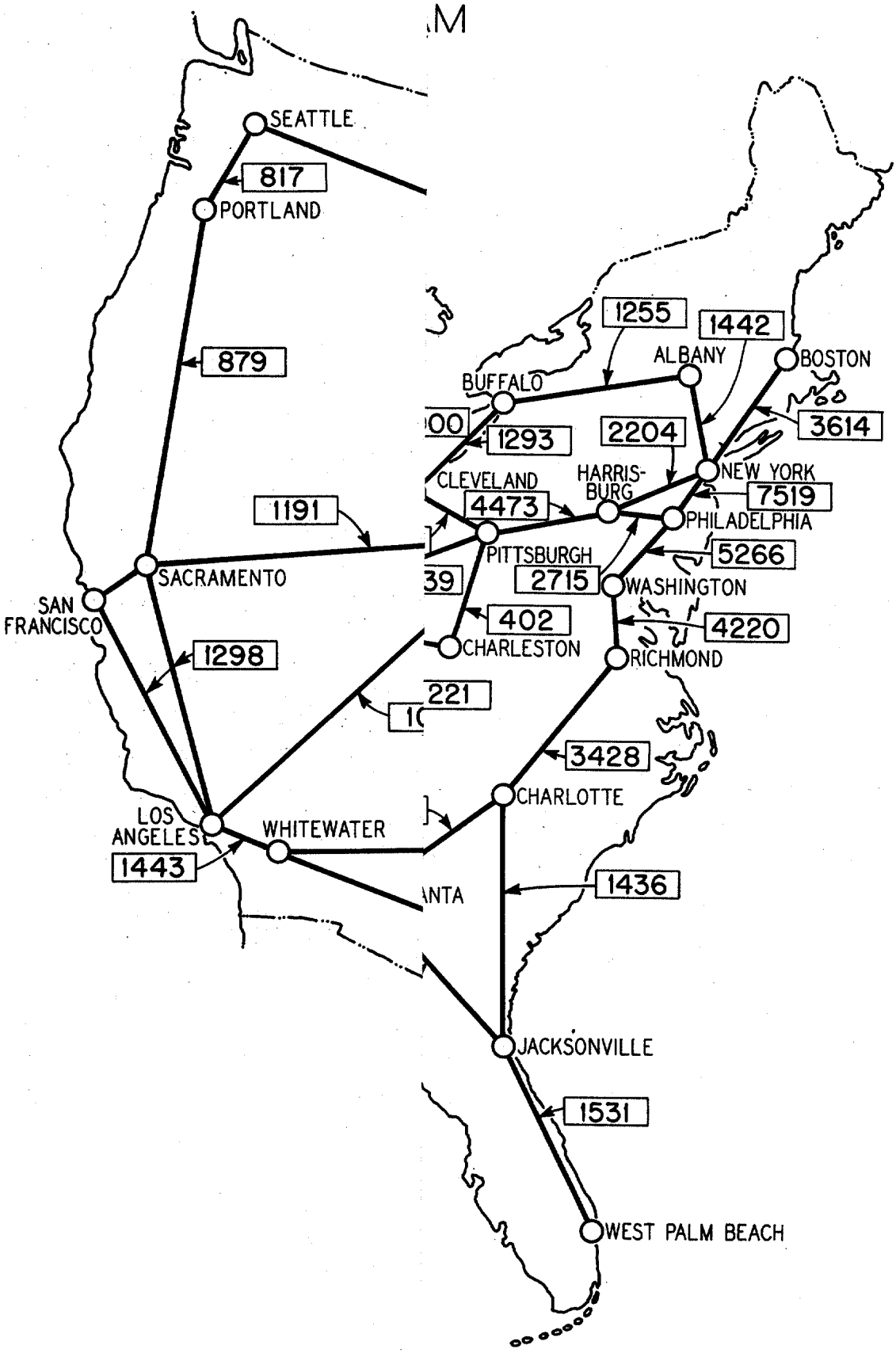


Chart 9, page 17.--The Air Force has come to us with the problem of serving the ADC radar network. This particular chart has a classification on it: that's the Air Force classification.

This looks confusing; perhaps it is, a little. It was a little tough for us to start with. Here's the problem we had to solve. The U. S. Air Force Headquarters is in Washington. The Air Defense Command has headquarters out in Colorado Springs. There are three Air Defense Forces Areas in this country--Eastern, Central, and Western. Air Defense Control Centers; presently there are 11 of those in the country as a whole. There are more than 70 Air Defense Direction Centers with all the associated units to which these particular installations have to be connected. There is CONELRAD and any number of military organizations that have to be connected into this kind of network. The Air Force says, "This is what we have to do and here are the specific plans for the country as a whole."

Chart 10, page 18.--This chart will show you the geographical locations we had to interconnect. These are radar stations, Air Division Headquarters, and Air Defense Force Headquarters locations that are in this radar detection and defense network. You can see they are all over the country. To the extent possible, the Air Force has put them on the main routes. For most locations more than one route is available but a few are not so well situated. In the center of the country we have plenty of alternate routes that can be used by the circuits which interconnect these installations. There are many routes.

I think I ought to stop a minute and tell you what we have been working on in conjunction with the military people as the best protection that can be given to a communications job--that is, to get diversity. You all recognize quite readily that any line, any cable, any radio station can of itself be destroyed by sabotage, military action, or just by equipment going out. Consequently, it is impractical to protect a cable, a complete cable line. You just can't do it. Our view is, the best way is to diversify cables; have them come over different routes and to diversify terminal installations to the extent you can. We have tried to do that in connection with satisfying the military requirements.

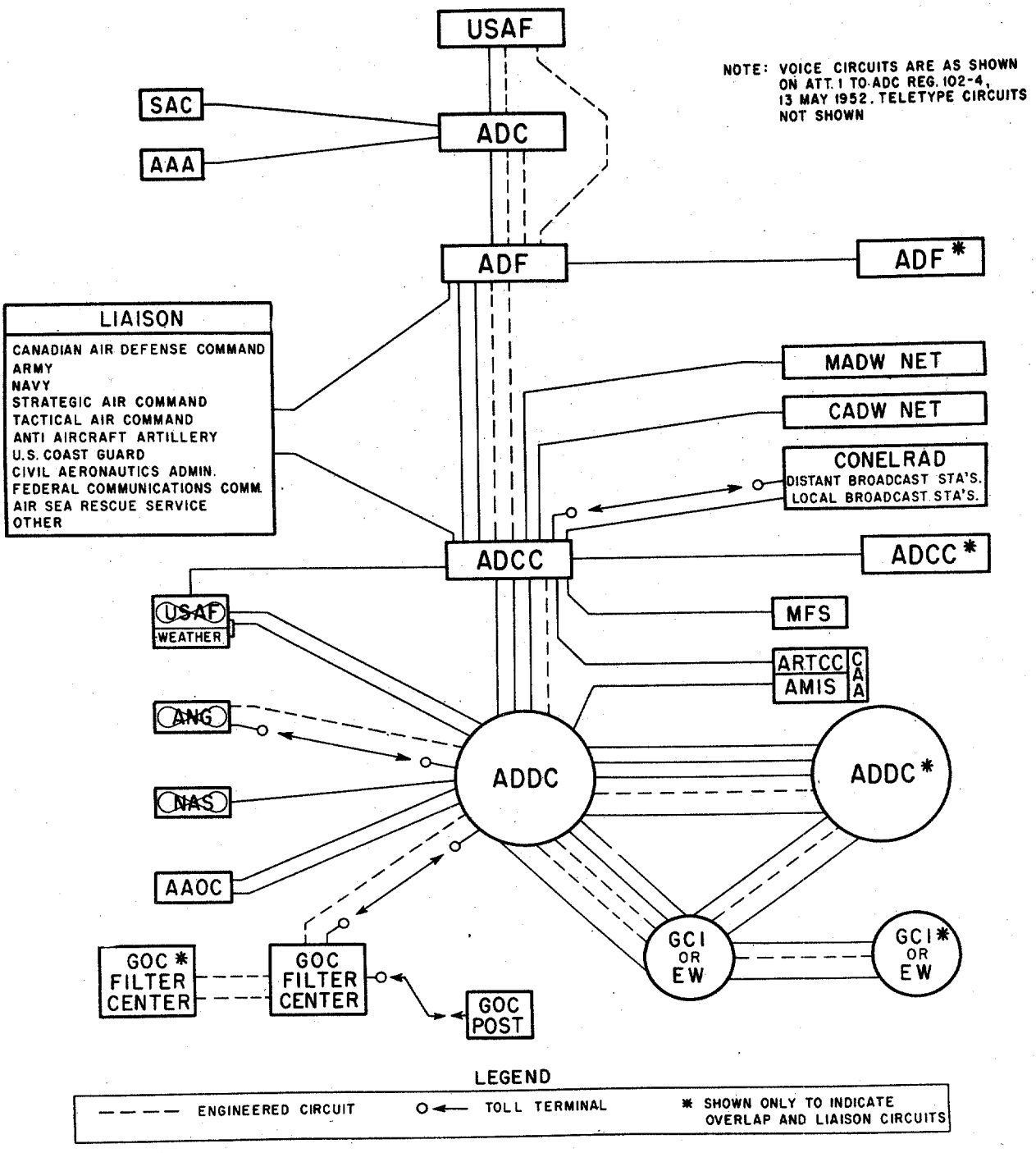
Chart 11, page 19.--This chart shows a Division of the Air Defense setup. This is a division here (indicating). What we are merely showing is the number of circuits we have to connect to the points indicated here. Thus we do not follow on this chart the actual routes. The next chart shows the actual routes we have taken to satisfy that particular demand.

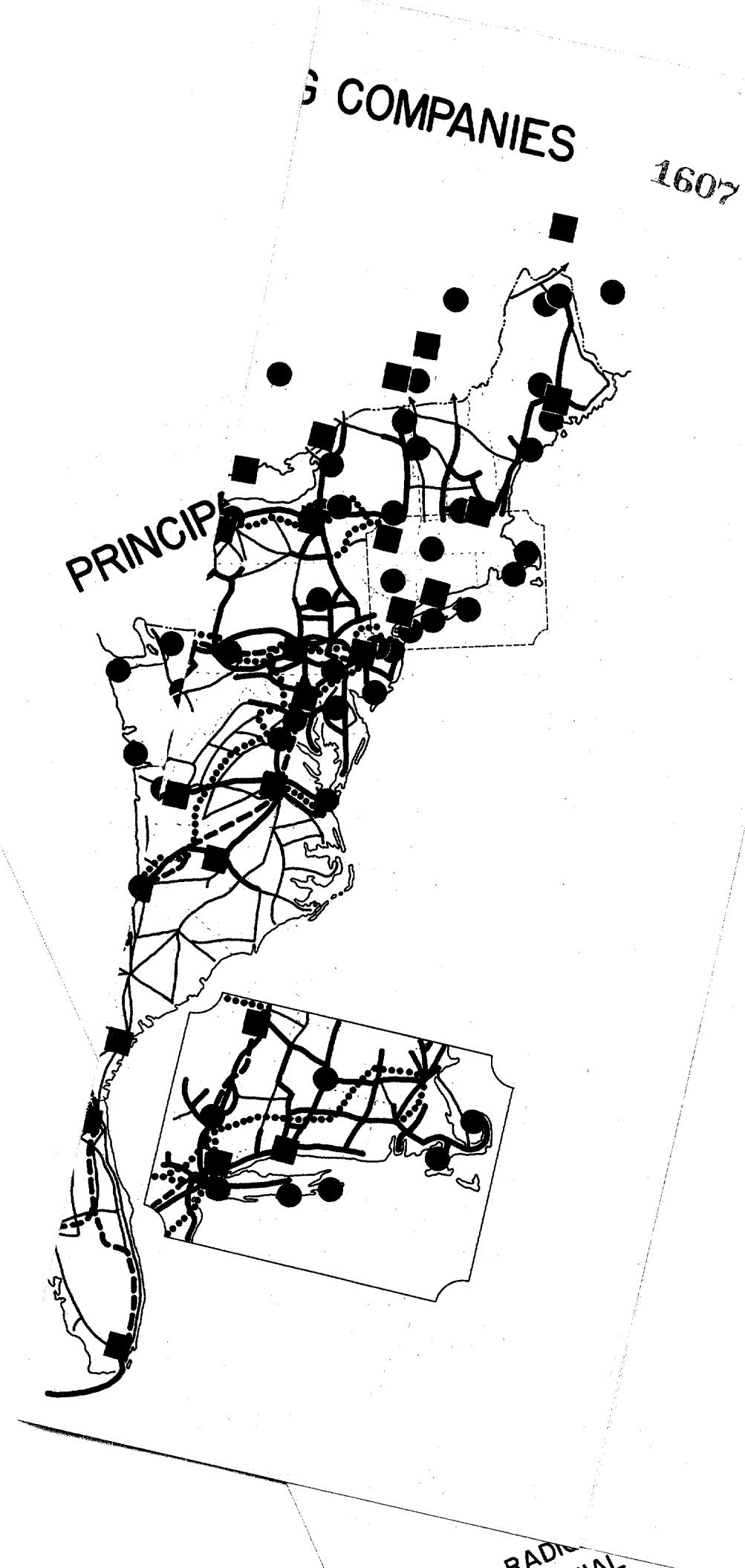
Chart 12, page 20.--You can see we have used in interconnecting these installations practically every one of the major routes we had in that area. You can also see, for example, this is one circuit down here (pointing to Atlanta, Georgia). You can see, in order to get back there

CHART 9

RESTRICTED SECURITY INFORMATION

AIR DEFENSE SYSTEM
STANDARD VOICE COMMUNICATIONS NETWORK

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if we should lose it, you can go back down here (indicating possible alternate routes) or up through here; you can go up east and come back. There are many ways. That is true of most of these places, but it is not true of all of them. If the problem comes and you have some of those fellows out on a limb, what do you do? I have a chart I want to show you later with the fellow out on a limb.

Chart 13, page 22.--We have talked about intercity circuits up to now, and this is one where it shows the problems you encounter right in a community, where you have a base of some character outside of or close to the community; in other words it's a local problem.

Here we have a military base. You have the toll office in the particular town adjacent to that base; if you can diversify the routes to that military base by using two cables, you have additional protection. Somebody says, "Well, supposing you lose the toll office?" Actually you see we have toll routes out of that office in three or four directions. If you lose the toll office, what do you do?

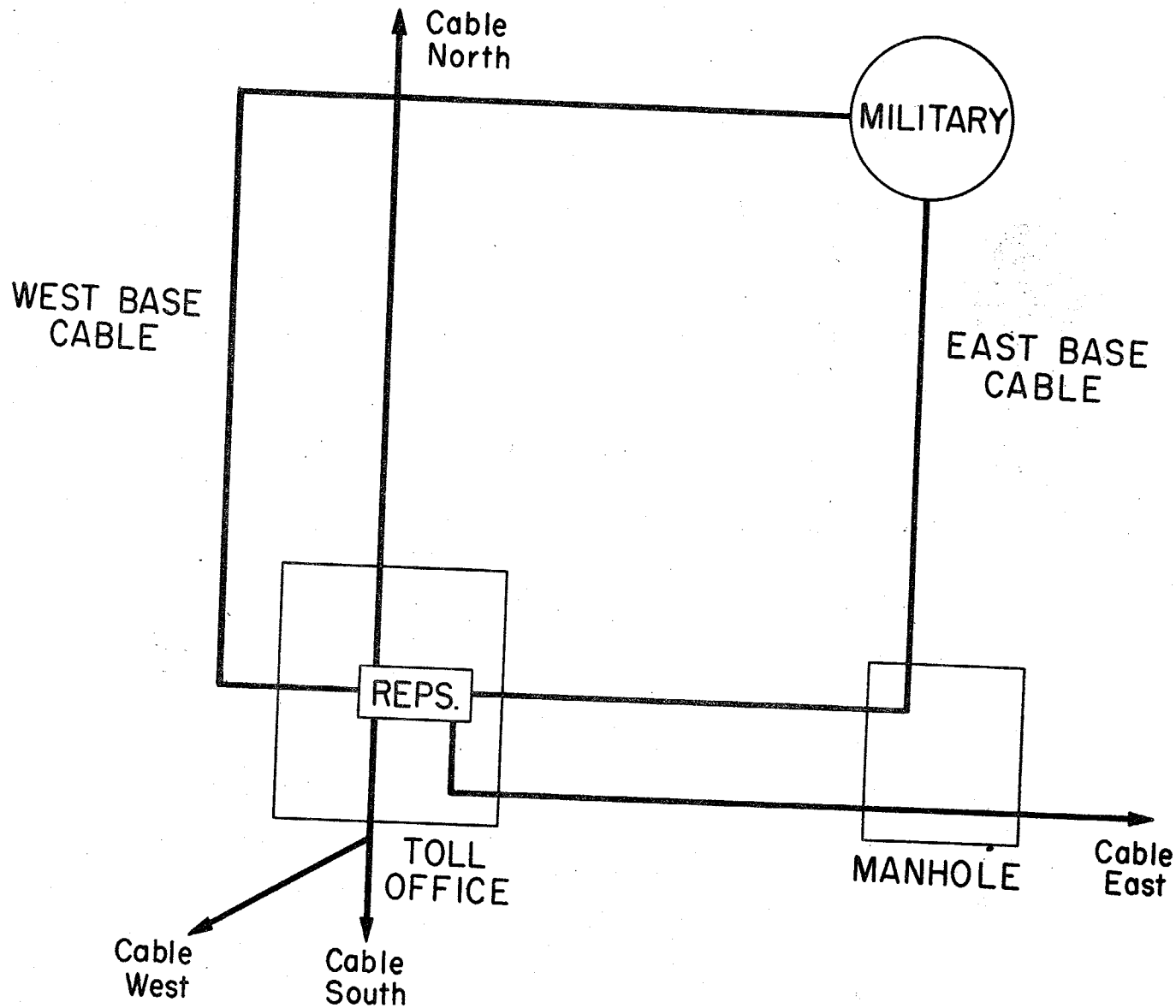
Chart 14, page 23.--We can install relays in, for example, a manhole. We will take this cable and hook it on to a toll line just by throwing a switch to operate the relays which will avoid or by-pass the toll office. We can still give service to the military base or you can put a transfer relay in the cable vault, perhaps, which we don't think will be badly damaged by air-burst atomic bombing. The situation underground seems to be pretty good. You put the transfer relays in the cable vault and you can connect to north, east, or south routes by transferring the circuits directly to the toll lines and avoiding the office itself.

Chart 15, page 24.--This is the chart I mentioned with the fellow out on a limb. There's a very important point out here (indicating). We have one cable coming into here, but this is rather a vulnerable location. How do you protect a case of that kind?

Chart 16, page 25.--Assuming you have to have protection; assuming it is not backed up by enough other stations so that if you did lose it, it would not be too critical; assuming the military says, "You have to give us another route"--actually this is a definite case that has been ordered. We can put a microwave radio relay system that will by-pass all the cable installations and go directly to the city. That is what is being done in this particular case. That requires a lot of good judgment on the part of the military as to whether they have to have that protection and how much it is worth to get an alternate facility of this kind.

Chart 17, page 26.--Here's the picture of another side of the job. This is the job we have to do for Civil Defense. We have talked so far mostly about the military part of the job, but the Civil Defense part of the job is important to the people in the cities and is also necessary if we are to keep our production running.

CHART 13



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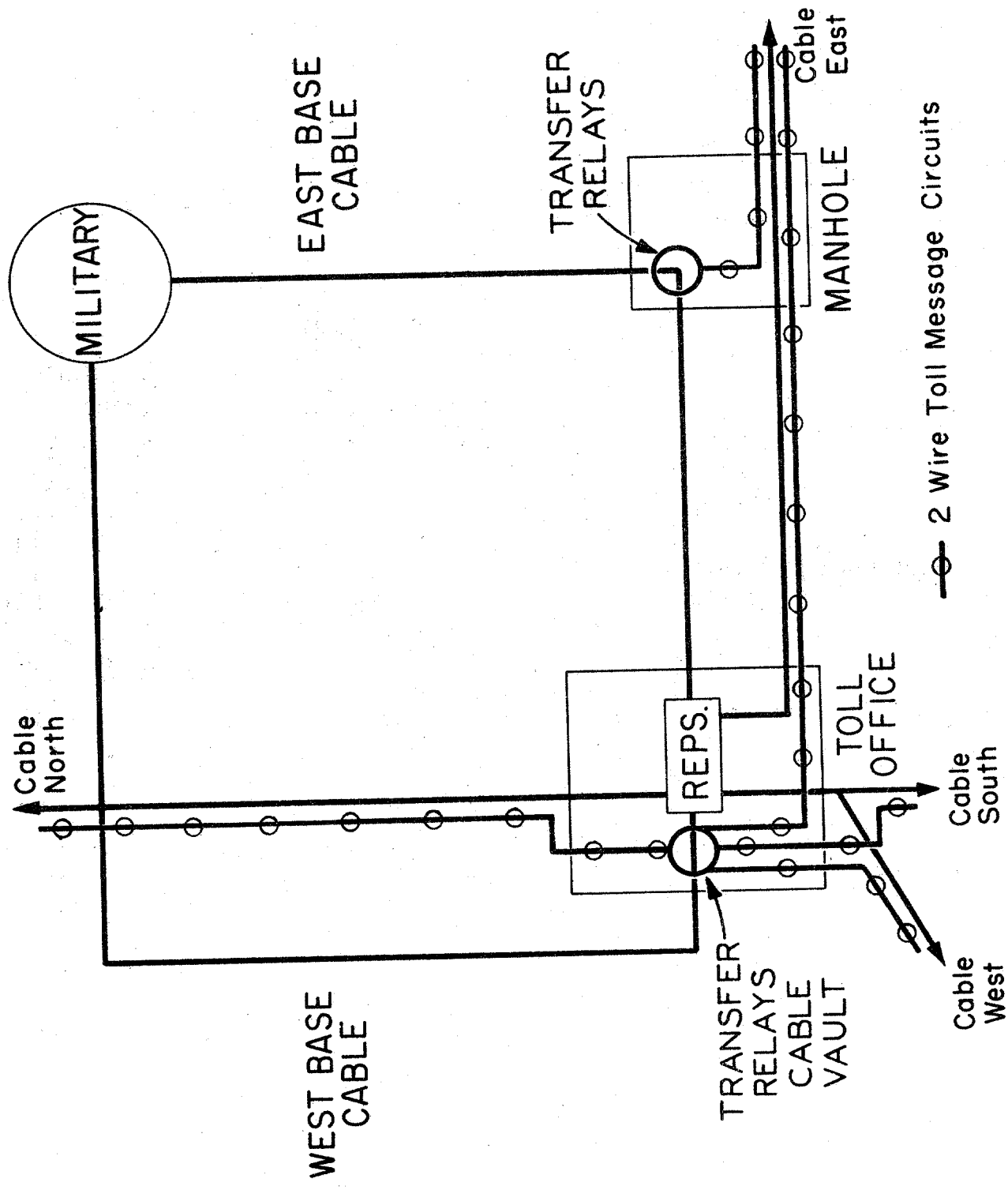
MILITARY
EAST BASE CABLE
TRANSFER RELAYS
Cable East
MANHOLE
2 Wire Toll Message Circuits
Cable North
REPS.
TOLL OFFICE
Cable South
Cable West
WEST BASE CABLE
TRANSFER RELAYS CABLE VAULT

CHART 15

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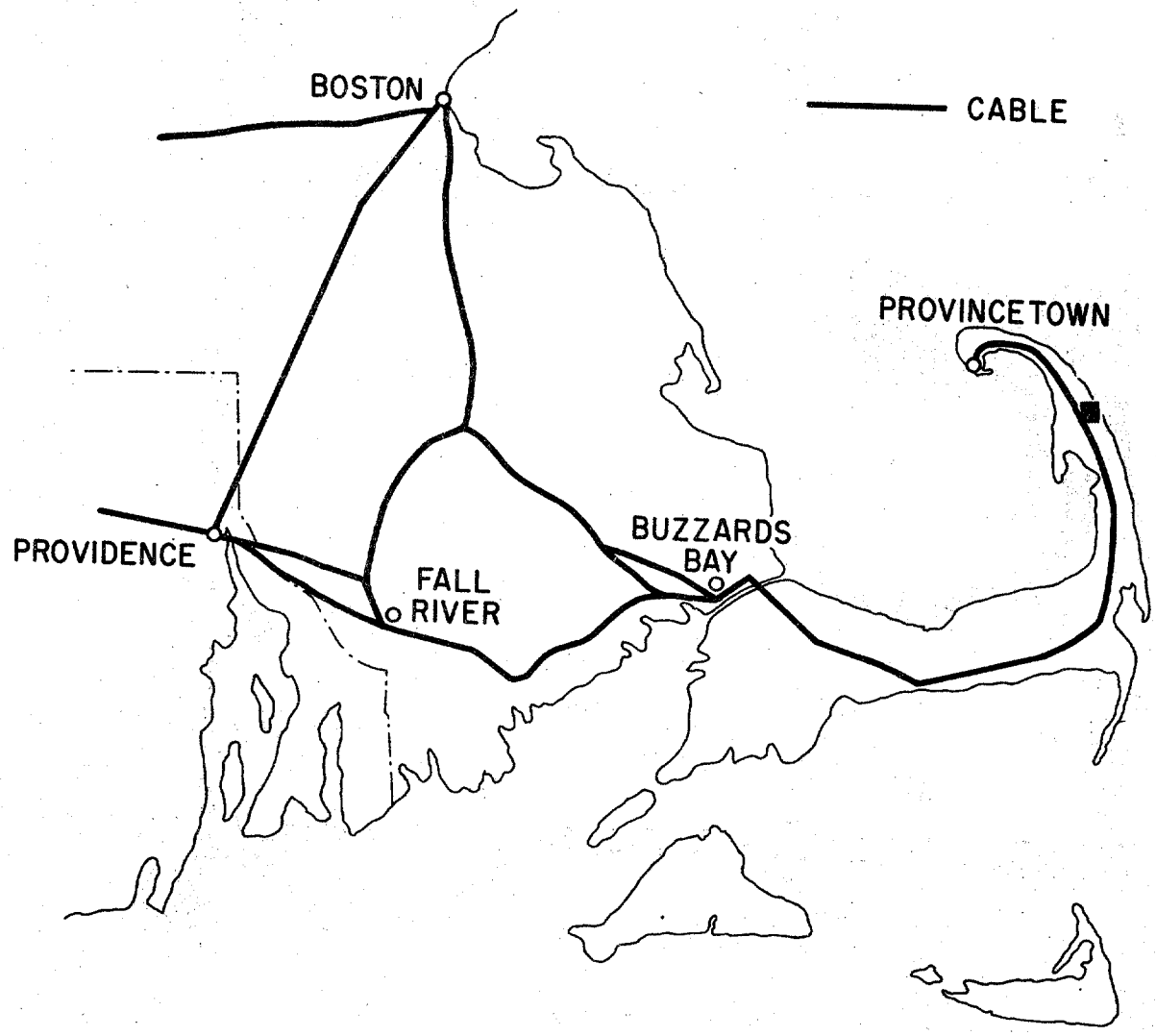


CHART 16

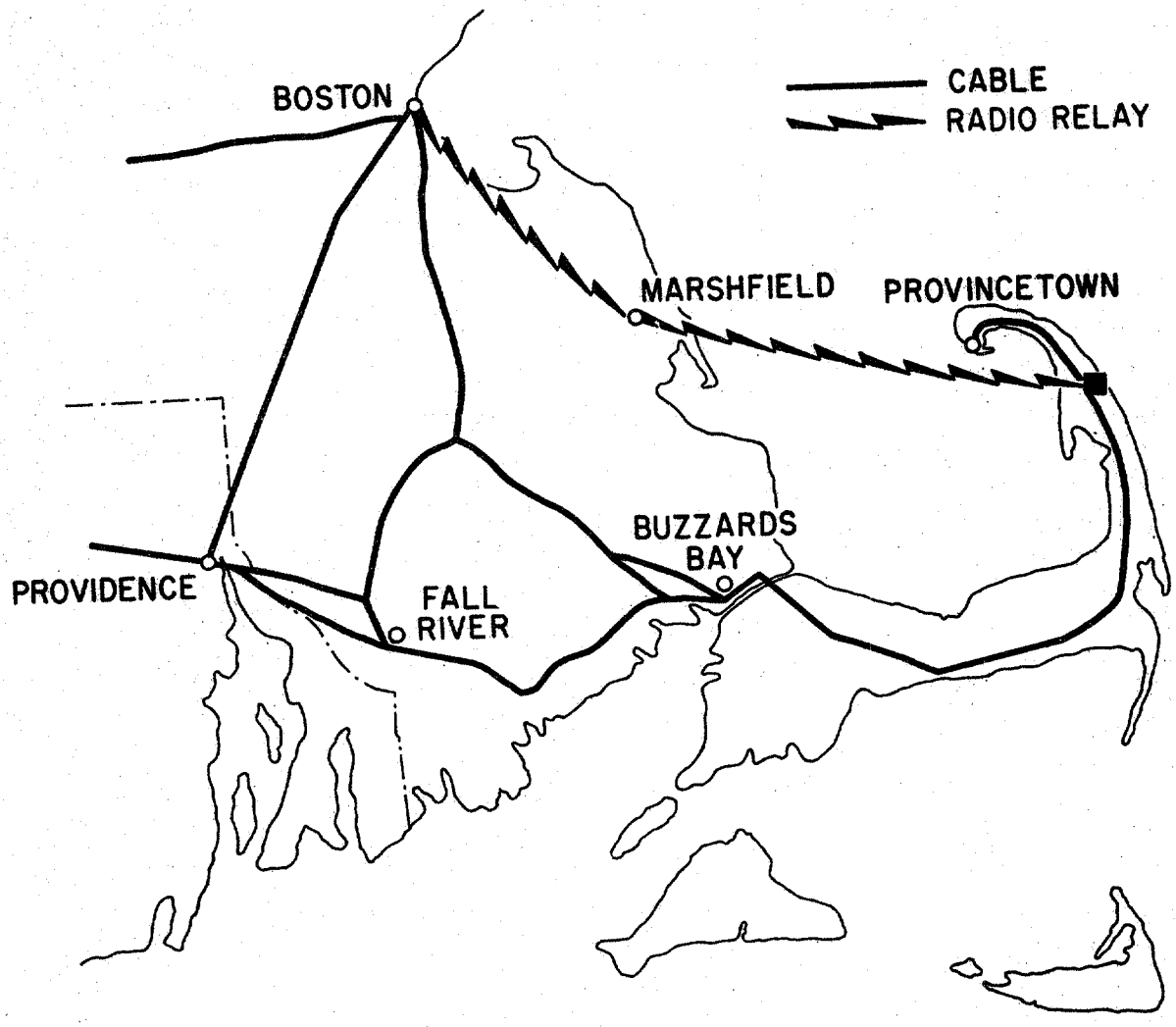
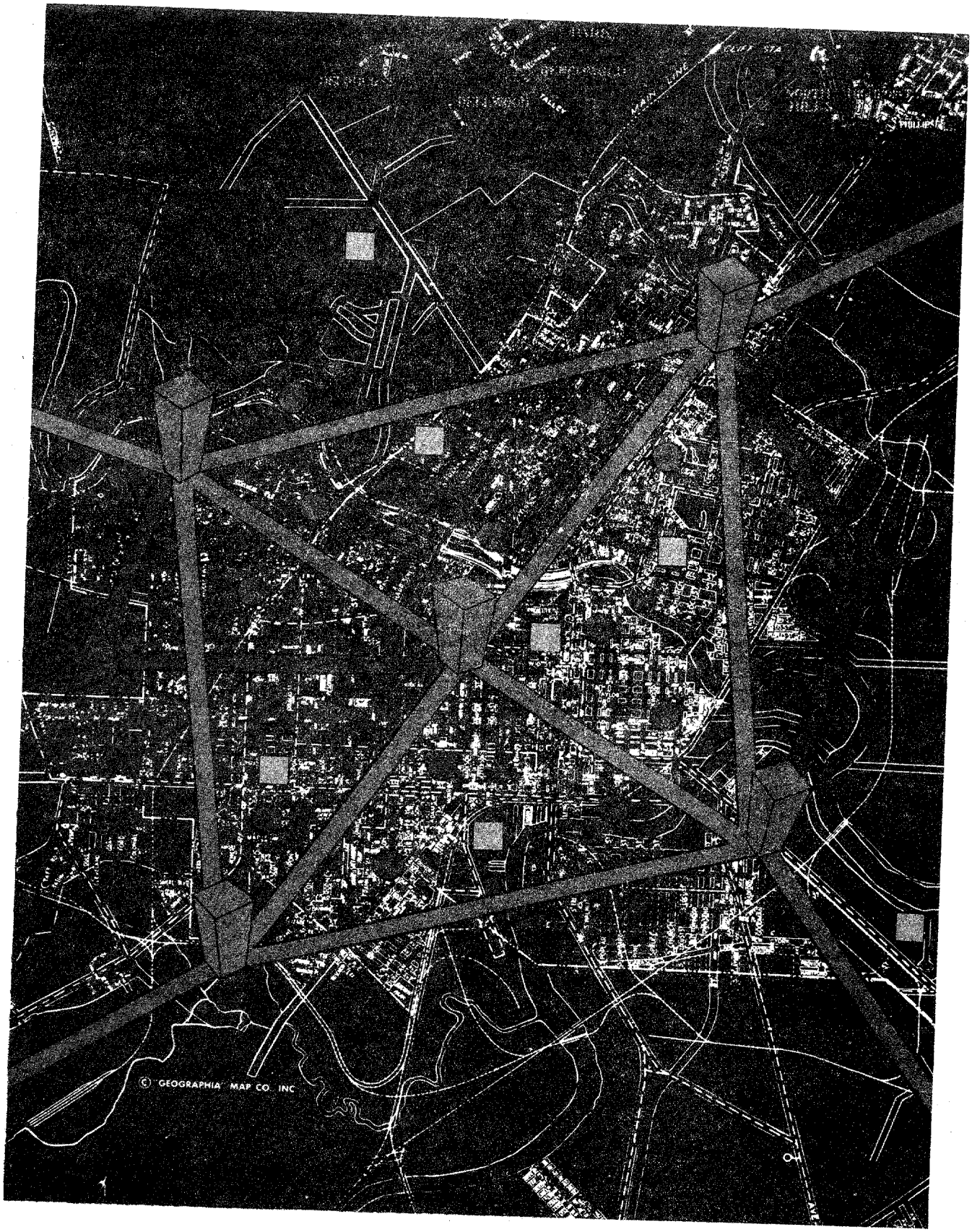

CABLE
RADIO RELAY
BOSTON
MARSHFIELD
PROVINCETOWN
BUZZARDS BAY
PROVIDENCE
FALL RIVER

CHART 17



We have pictured here the type of recommendation we make to the Civil Defense people when they come to us and say, "What are we going to do about communications?" Here is the picture of a town with five central offices. The stars indicate the control centers that Civil Defense would establish. We suggest for adequate protection that they connect two central offices. As you will see, we have them connected to two different central offices.

We have various Civil Defense installations, such as hospitals, schools, report centers, and so on, indicated by small squares and circles.

Chart 18, page 28.--We demonstrate to Civil Defense by this chart that even if we lose one of the central offices when we get a bombing and if we lose service here (indicating), we still have service here (indicating), and we still have service here (indicating). In other words we are diversified to the extent that we can be. We have protected our communications job.

I haven't covered all the things which we could talk about, because of the time element, but there are many others that are very interesting.

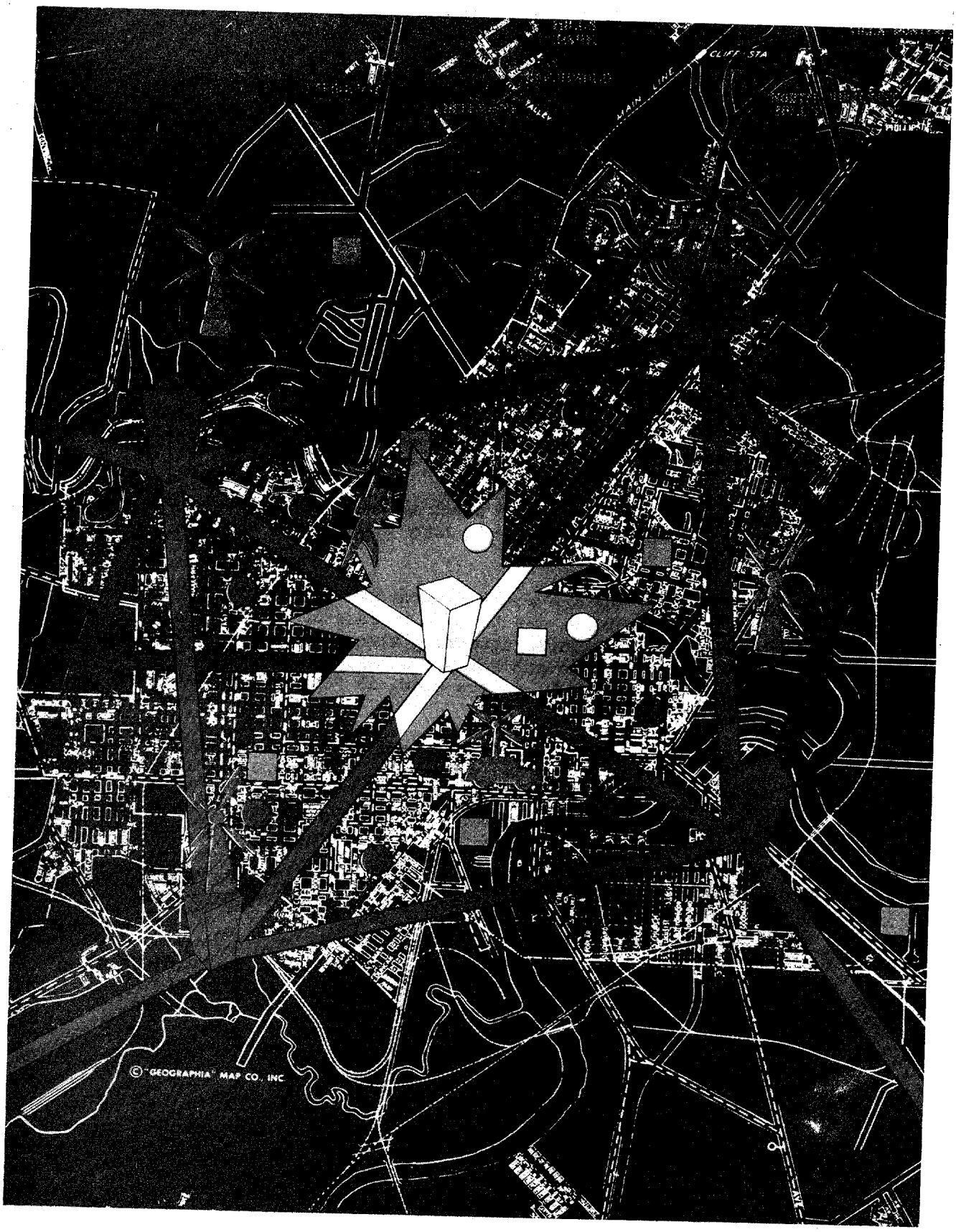
The CONELRAD job is the one where we have set up arrangements so you can take the radio stations off the air in case of air attack, in order to avoid navigational aid to attacking aircraft, and to put back those stations that you want to put back in order that the public will know what is going on. CONELRAD, as you know, is "control of electromagnetic radiation."

The warning and control facilities are set up and arrangements made with the broadcasters to take all stations off the air and put back the AM stations in "clusters" on two frequencies--640 and 1240 kc. The programs will not originate from the main studio any more, but will come from Civil Defense Headquarters.

Antiaircraft people are establishing networks around the various important cities. They also require communications--land, wire, and radio.

Another resource is the international circuits which we have. The A.T.&T. has telephone circuits to about 100 different countries in Europe, Asia, and South America--radio telephone circuits--and those also should be important in any trouble that we might get into. The International Telegraph Carriers have a great many telegraph circuits in addition to the telephone circuits which are available by cable and radio.

CHART 18



Another job is in connection with military camps. We are told that the ability of the men to call home from the camps promotes morale. Therefore, we have tried to get circuits into the camps and to give the fellows a chance to call when they can.

The whole story I have been telling shows that we are really here to serve. We have about 160,000 to 170,000 men who can do the kind of work that military communications personnel require, or the equivalent of 10 or 12 military divisions. We have storehouses all over the country. We have trucks--some 60,000 vehicles.

I think the best thing we can say so far as we are concerned is that our number one job is to do the defense job.

Thank you.

COLONEL PRICE: Mr. Mapes, to open the question period, do you mind discussing briefly the relationship between the various operating companies that are providing civilian telecommunications in the country?

MR. MAPES: I will be glad to discuss it. The Bell System supplies about 80 to 85 percent of the local telephone service and 5,500 or more independent companies supply the balance of the local telephone service. The Bell System supplies substantially all of the intercity toll services; there is a little supplied by the independent companies--I am talking about telephone only, for the moment.

The Bell System has a teletypewriter service which it offers on the same basis as the telephone service. In other words you can have your own teletypewriter the same as you have your telephone. You are given a directory and switching arrangements permit you to call other teletypewriters all over the country. That is a common carrier service.

Then we of course also lease telephone circuits to private concerns, government, and other, and we lease telegraph circuits to private concerns, government, and other. Then, I think, Colonel, you would say, "Where does Western Union fit into this picture?" As you know, it does the public telegraph business. We do not do any public telegraph business; Western Union does it all. By public telegraph I mean the system where you go into an office and say you want to send a telegram.

In so doing, it actually leases a great many of its circuits from us. I would say that Western Union leases somewhere in the order of 65 to 70 percent of its long distance circuits from us; but we are, and we act entirely as, two separate and distinct corporations. There is financial tie-in at all between Western Union and us. They lease from us, just the way other people do. There is only one telegraph company--that is Western Union. That about comprises the domestic job.

In the international field, of course, there are six or eight companies--the Press Wireless; Radio Corporation; American Cable Radio; and others, doing the international job. There again we have no financial tie-in with any of the international telegraph companies. They are separate, competing companies.

I think that covers it.

QUESTION: Our discussion group is interested in some information on CONELRAD. First, if you put your broadcasting stations on two frequencies, how do you eliminate the interference between them? Second, how does this deny navigation aid?

MR. MAPES: Let us say the question of two frequencies comes about only in the larger cities. If you have only a small city with two or three radio stations, they all go on one frequency; let us say, 640 kilocycles. What happens, then, with the canned program? The Civil Defense Director, or whoever is sitting in the control center there, wants to put a program on the air. What he does is talk into his microphone and arrangements are made so that the signal comes out on one of the radio transmitters. In 20 seconds, or so, it shifts to the second radio station; the next 20 seconds it shifts to the other radio station, and so on. By the geographical diversity of the stations around the city, you get a fluctuating indication on direction-finding equipment, which we are told does confuse an approaching airplane that might be trying to use it.

There was a second question I didn't get.

QUESTION: That ties right in. If you have the stations synchronized or hooked into the net, you have the emission on 640 kilocycles, so you can navigate. If, however, the needle is wavering and you are attempting to go on with the mission, how does that affect it?

MR. MAPES: I think actually you may be able to get a little navigation direction there; but you also have the same 640 kc frequency on transmitters in many cities. At any distance the signal strengths will vary enough, we are told, so that the direction finder will point to this city, and all of a sudden the needle will be over here on some other city. In some cases with the larger cities they have used the two frequencies with half the stations on 640 and half of them on 1240 kc.

QUESTION: You have explained the flexibility of the system there, from the point of view of vulnerability. But we want to know what, arbitarily, would be the most vulnerable point of the communications system. Would it be the more thickly populated areas in the northeast, or the single line areas, from a point of view of recovery from disaster, and considering the traffic load?

MR. MAPES: The Civil Defense People have named 67 cities which they call the critical target areas which we presume would be the subject of the first attack, or of attack, anyway. We have concentrated our thinking in regard to disperson, and so forth, on those 67 points. They are, as you might expect, the larger cities. So, I think, to answer your first question, the most vulnerable points, because they will be the ones attacked first, are the larger cities that run from New York down, somewhat in the order of population.

Then the question is: What can we do in these larger cities? Here again, we ought to get dispersal. In Washington, for example, which will no doubt be one of the prime targets of attack, we have separated our toll central office facilities, as well as our routes into the city. We have currently done that. As you may know, there is a big toll building in downtown Washington. There is another one about two miles away from the downtown headquarters building. There is a great deal of equipment, vital equipment, in those two buildings. We don't think they are far enough apart. We have actually established three more switching centers on the outskirts of Washington which are on the cable or radio routes coming into Washington. These also handle toll business. These three dispersion locations can handle about 30 percent of the Washington toll business.

The objective is to head in that direction in the other 67 critical target areas. I don't think we have too much of a problem in the thinly settled places so far as bombing is concerned.

QUESTION: Does the Arlington and Alexandria area have arterial leadouts to the south and west without coming to Washington?

MR. MAPES: They have by this dispersion arrangement. The central office location in that case, if I remember my geography correctly, is Chestnut. It is about two or three miles from the Pentagon. There's a toll central office switching center over there. It has toll circuits terminated right in it. It can fan out to the Washington offices and to those two main downtown buildings.

QUESTION: Yes; that is to Washington. But suppose the tie-in to Washington unfortunately was cut--do they go south to Richmond or west?

MR. MAPES: Oh, yes; they go both ways. You can come into Washington and go out from it at these dispersed points. Yes; I am sorry.

QUESTION: Your organization seems to be one of the biggest of our civil defense organizations. I am wondering whether or not your organization has a program for screening personnel. It seems to be a beautiful spot for subversives to work their way into for the purpose of sabotage.

MR. MAPES: That is an excellent question. Yes we do. We have an excellent way of screening our personnel. We don't ask the FBI to check them all. You know right now the FBI is pretty badly overloaded; all your security clearance groups are terribly overloaded. We don't refer all our employees to them, but we do make a careful check of the people in the organization all over the country, familywise you might say. I really think that in our organization our continuing contacts with the man or woman is the most important feature of our screening operation. In other words we have it organized so that if the boss says, "This fellow seems to be attending a lot of meetings down in the so-and-so district," that word is passed along. If we do have suspicious cases, we get somebody after them.

Again, we have some really basic protection, in that any one individual does not generally have access to the kind of things in whole that would help him in sabotage or in getting the information to some enemy. The responsibilities of one individual, particularly the lower-line people, are such that they would have difficulty getting information which would be of much help.

Our classified contracts are all handled in the standard way.

QUESTION: Sir, the Navy is primarily interested in record communication systems. You haven't said anything much about what we might look forward to by either your company or Western Union Company.

MR. MAPES: In record communication do you have in mind facsimile and things of that character? We have normally provided the interconnecting circuit with the facsimile unit generally supplied by the customer. We supply the connecting circuit. We really don't have a service where we can say to you, "Here is the whole facsimile setup. Go ahead and use it." With the teletypewriter we do. We do have very many combinations of switching arrangements to provide an integrated teletypewriter network of almost any character. We can do that quite readily.

QUESTION: Relative to these different facilities for dispersion, who is going to bear the cost?

MR. MAPES: Let us take two cases; let us take the case of the fellow out on a limb that I talked about. We feel that when a military requirement makes construction necessary, we would not expect to do otherwise; and that the cost ought to be borne by the military organization, whatever it is.

For dispersion in Washington, we bear the cost of the kind of dispersion that I talked about. That is in line with our normal day-to-day operation of switching our calls and protecting the plant.

QUESTION: Applicable to the case of the fellow out on a limb, you say it is reasonable that the customer should pay for the added expense. I agree with you. Would he pay for that as a construction charge or would he pay for the circuits on a mileage basis?

MR. MAPES: The usual procedure in that case is that we tell him how much it will cost to construct the job. Then we say, "Now, if you use those facilities for 10 years at the regular rates that are normally charged to commercial concerns, there will be no construction charge." If, however, you say, "We don't want that facility any longer" at the end of two years, then we will charge the balance of the construction cost, for example eight-tenths, to you at the time of termination of the contract.

There are other ways but that is the usual arrangement.

QUESTION: We understand the speed of the teletypewriter circuit is governed by the speed of putting it on the typewriter. Is any development going on where you can, once it is on the tape, transmit the tape faster?

MR. MAPES: Only in this 28-type teletypewriter, that I know of. For private line systems using these teletypewriters, we expect a commercial speed of 100 words a minute. It will do a little more than that. We don't have any work in progress on the standard teletypewriter to increase that speed to 200 or 300. Perhaps your question indicated that the circuit itself is somewhat limited on speed; it is, today. However, if you have a device that operates at a faster speed--let us say 200 words as an illustration--we can give you a circuit that will take it, but not at the present rate. It will be more expensive because it will take more of the highway we talked about.

QUESTION: Would you explain how you get 600 messages on the one pair of tubes? Will you also mention something about the expansion goals of the Bell Telephone System for the future, how far you see the expansion continuing, and what the proportion of the curve is due to population?

MR. MAPES: Let us take the first question first. How do we get 600 circuits on a pair of tubes, there being eight tubes in a cable? On that question it really is just a matter of electronics. You see, a voice channel takes 2,800 cycles. It takes that much to put a voice over a pair of wires in the highway. What you have to do then, is take a normal speaking voice, such as we have here, and you have to raise it in frequency. For the next 2,800 you put another block above its position normally used on a pair of wires. To carry out this technique you put still another block and another block and another block. You put 600 of those, each in its own frequency space, on this particular pair of pipes.

Now, the second question, the expansion goals of the Bell System, that's a tough one. We have about 39 or 40 million telephones today. That is about one in four of the population. I think our telephone curve will go at least at that rate and probably faster on the basis that our development, our homes with telephones, are increasing in percentage of total homes. Therefore, I would say our local curve will go up a little faster, proportionately, than the population. As regards toll, we are getting a constantly increasing use of the toll service, and we think we are ready, to a large extent, for a very substantial continuing increase. We provide 600, 1,800 or possibly 5,400 voice circuits on a coaxial cable. We don't have that today in actual practice. We have some with 1,800. We don't have any with 5,400, but we have that additional capacity to go to.

As the toll business increases we have to put in new cables, new microwave systems, and things of that kind. Where it is going, I don't know. This dialing trial we talked about in Englewood, the cross-country dialing; we find the customers like it. I have no doubt that, when it is simply a matter of dialing a number you sometimes spend your money a little more readily than when you have to go through an operator. We feel the cross-country dialing is a spot where we can increase toll. So we will need more circuits there.

QUESTION: Do you want to make any remarks about the transmission of color television?

MR. MAPES: Yes; the four megacycle video band used for black and white will transmit the Columbia color system which the FCC has approved. But I think we will have to say there seems to be some doubt whether that will be the final system that is adopted, because the radio and television manufacturers have gotten together and have another system that they hold great hopes for, which is a "compatible" system, similar to the RCA system. I suppose I am getting in deep; but Columbia cannot be used on your existing black and white set without substantial adapters. RCA can be received in black and white. Whichever system is adopted, the four megacycle band will transmit color television as well as black and white.

QUESTION: Mr. Mapes, as I understand it, your organization, A.T.&T., is the parent company; and Western Electric, Bell, and numerous others are subsidiary corporations. What percentage of all telephone communications in the United States fall to this one A.T.&T. system?

MR. MAPES: I think we said before we own practically 100 percent of the stock of our so-called associated companies; the Pacific Company, the New York Company, C&P, Southern Bell, and so forth. We own practically 100 percent of the stock of those companies. Those companies run from 80 to 85 percent of the local business. So therefore, the

control of 80 to 85 percent of local business is under the Bell System. Of the toll business the control is over 95 percent, because the Long Lines Department of the A.T.&T. runs the toll connections.

I don't know whether your question had any inference of whether the Bell System is a monopoly or not. Sure, we are a monopoly; but we are a well-regulated monopoly.

QUESTION: I am a bit confused about the answer to this television question. You indicated that if the color system you think is going to be used goes into effect, the television sets we now have can be used.

MR. MAPES: To receive the pictures in black and white. They will be a black and white reception from color transmission.

QUESTION: If you want it, there will be a major operation to get the color?

MR. MAPES: There will be a major operation; yes. That's a good question. I missed that.

QUESTION: On the personnel picture in time of disaster the military will need a lot of trained communicators, and in time of peace we are training quite a few who leave the services quite often and go into communications work in civilian life. Is there any big plan--is there a cooperation between the two so far as helping out each other is concerned?

MR. MAPES: Let's see. We did have in the last war a telephone cooperation plan. Currently I don't think there's any training of any substantial nature being done by our associated companies for the military. There may be some actual cases. Al, you may know more about that than I do.

MR. SWEDE: There are four affiliated units that the Bell System has scattered around the country. The military had very good reasons during the last war to call about 68,000 Bell System people and put them in uniform.

MR. MAPES: Al, how much is going on now? There are affiliated units, but are our companies doing any training of the military people?

MR. SWEDE: Mainly on request. It is not a great deal.

QUESTION: Mr. Mapes, what developments are being made in the electronic computers for military use? Do your people ever use them any place.

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MR. MAPES: We are using them somewhat. A sort of computer is needed in the design of practically all toll dialing arrangements. In the new automatic dialing arrangements we are introducing in connection with the number 5 crossbar I mentioned, we have developed our own automatic accounting arrangements which record the called number, the various times, and the calling number. This information goes into the machine and out comes a ticket. We have done that.

I think, however, your question is directed to the computers that the laboratory is working on for the military job; the gun directors and things of that character. I can't talk about those. In fact, I just don't know.

QUESTION: Is the Bell System under FCC classified similar to the common carrier? What are your problems in right of way? A lot of people object to telephone poles in their front yard. Are we coming one day to buried cables in the city?

MR. MAPES: Number one: We are a common carrier under the FCC classification, surely; and subject to all the regulations they have established for common-carrier operations.

Number two: On our right of way problems, we use some buried cables in the cities today but to a far greater extent we use cable in conduit. In the outskirts of the cities you will see cable on the poles, located on the street lines, and more preferably, on the rear property lines. The cables have to come somewhere near the house in order to get a drop into the house to connect the telephone.

We don't have too much problem on right of way in a city. It is pretty obvious that if we don't get a right of way people don't get telephone service. So we don't get into too much trouble there. On cross country it is not too difficult, either. We do a great deal of burying cable cross country now. I would say of our Bell cables going in today, better than 80 percent are buried--that is, the cross-country routes.

They go along with a plow and pull the cable in after it. We don't have too much trouble on right of way. The farmer can use the ground on top of it. In the microwave radio sites, we have to buy the land. Locations frequently are on top of a mountain or some out-of-the-way place. We buy the site and put a road to it if there is no road. It is an expensive proposition, but it is the only way we can do the microwave job.

I am not sure that covered your question.

COMMENT: A great many common carriers have trouble in getting things done.

MR. MAPES: We find that if you are decent to a fellow, he is pretty decent to you.

QUESTION: This is a minor question, to get you off the spot, sir. On this automatic long-distance dialing, can the customer place a collect call?

MR. MAPES: I'm glad you asked about that. In Englewood, before the trial of customer toll dialing started, 50 percent of the long-distance calls were of the kind where an operator would be needed even with customer dialing. They were person-to-person calls, calls from coin boxes, and some were collect calls. On the other 50 percent the customer said to the operator, "Give me this number."

We find that the customers like the dialing service well enough so that they cut down calling on a person-to-person or collect basis by about 50 percent.

You can still make a collect call. We think we are going to have to always continue to have collect and person-to-person service. It doesn't make any sense to say you cannot charge the father for the call the boy wants to make to his home.

QUESTION: What percent of your power requirement is dependent on an outside source?

MR. MAPES: That's a good question. We do not depend on the outside sources in emergencies. For ordinary, day-to-day operation we buy all power from commercial companies. In each one of the larger offices we have a stand-by Diesel or gasoline engine generator set. For the smaller offices we have portable engine generators stashed around in garages or some place so we can run out and charge the battery. The telephone office runs on batteries. Maybe that sounds old fashioned. It runs on a wet battery. It will run for some period, say four hours or eight hours, a couple of days. Then, if the battery runs down, we have to charge it. We have engine generators to charge the batteries when we lose the commercial power.

COLONEL PRICE: On behalf of the Commandant and the student body, I thank you for a very interesting and enlightening lecture.

(25 May 1953--350)S/sgh