AFM 100-33

AIR FORCE MANUAL

USAF COMMUNICATIONS-ELECTRONICS DOCTRINE

SHORT TITLE: CED 3300

ARMY, NAVY, AND COMMERCIAL COMMUNICATIONS SYSTEMS

1 AUGUST 1960

DEPARTMENT OF THE AIR FORCE

AIR FORCE MANUAL
NO. 100-33

DEPARTMENT OF THE AIR FORCE
WASHINGTON, *1 August 1960*

FOREWORD

1. Purpose and Scope.—This manual provides general coverage of the communications systems operated by the US. Army and Navy. Major commercial communications systems are also covered. Its purpose is to show the various communications systems that are available, and which may be used to supplement the USAF systems.

2. Policy.—This manual is an integral part of the USAF Communications-Electronics Doctrine, as described in AFR 100-13. It is not directive, but is for the information and guidance of all USAF activities.

3. Citation of References.—The procedures outlined herein will be referred to by citing "CED," followed by the paragraph number; for example "CED 3302.2b."

4. Changes to Manual.—Proposed changes to the manual will be submitted directly to: Communications-Electronics Doctrinal Project Office (AU Project 4736), Research Studies Institute, Air University, Maxwell Air Force Base, Alabama.

BY ORDER OF THE SECRETARY OF THE AIR FORCE:

OFFICIAL:

THOMAS D. WHITE
Chief of Staff

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Colonel, USAF
Director of Administrative Services

This manual supersedes AFM 100-33, 1 January 1958; and AFM 100-33A, dated 15 July 1959.

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CED 3300

ARMY, NAVY, AND COMMERCIAL COMMUNICATIONS SYSTEMS

SECTION I—US. ARMY COMMUNICATIONS

3301. STRATEGIC ARMY COMMUNICATION SYSTEM (STARCOM).

1. Historical Development. — In December 1941, those long-distance radio systems which the Army had, both within and without the continental limits of the United States, were entirely inadequate to handle the traffic requirements. There were no radioteletype networks. The War Department Radio Net covered the nine corps areas, and contained 85 stations and 30,000 miles of circuits. The overseas portion of the radio net consisted of stations in Alaska (but with no stations in the Aleutians), Hawaii, the Philippine Islands, Newfoundland, Puerto Rico, Bermuda, Iceland, Greenland, Jamaica, Trinidad, and Panama. This overseas portion of the radio net included 35 stations and covered 34,125 circuit miles. The total message traffic over both networks during December 1941, averaged about 2,000,000 words per day working at peak capacity. Drastic emergency action was necessary in the latter months of 1941 and the early part of 1942 to meet traffic requirements. Initially, the Army depended heavily upon the commercial systems of Western Union, Mackay Radio, Radio Corporation of America, and the American Telephone and Telegraph Company. Even these systems, plus those the Army already had, were insufficient to satisfy all military needs, which were increasing daily. The commercial systems were being taxed to the utmost in the transmission of war-related civilian traffic alone. In addition, civilian handling of military traffic posed unique security problems.

a. Army Communication Service.—During the early part of 1941, the idea of a world-wide communications system to serve the Armed Forces of the United States was conceived. However, the installation and operational engineers needed to implement this idea were not available to the Armed Forces in any appreciable quantities. These engineers had to be drawn into the Army from all civilian communications organizations. A key organization known as the Army Communications Service was then established in the office of the Chief Signal Officer. See Figure 33-1 for the present organization of the office of the Chief Signal Officer. The first accepted recommendation of this group was the use of high-speed radio systems, and the elimination of the all-manual CW method. The *Boehme System* of transmission and reception was inaugurated. This system had already been in use in corps area nets and overseas stations as early as 1937. This allowed the use of perforated tapes for transmission of messages at rates from 75 to 150 words per minute. However, a radio operator was needed to transcribe the inked dots and dashes at the receiving end. Such circuits were operational from Washington to domestic and overseas headquarters stations during 1941.

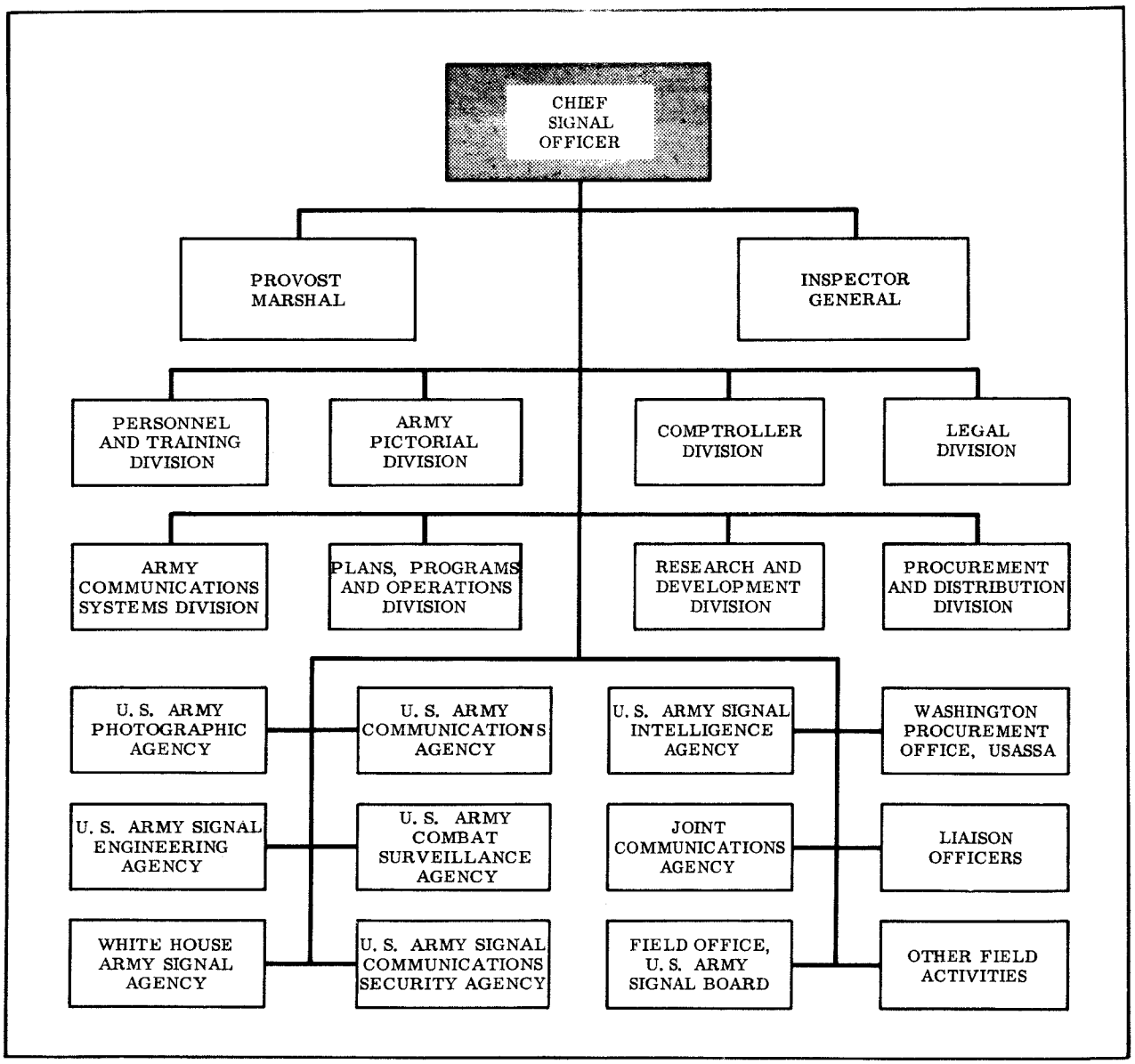

Figure 33-1.—*Office of the Chief Signal Officer.*

b. Radio Printer Circuits. — Since transcription was necessary at the receiving end, the system was still operating too slowly. The next step was the establishment of International Business Machine (IBM) radio printer circuits. These circuits, operating at 100 words a minute, offered printed-page reception from special typewriters, and eliminated manual transcription. Circuits were established from Washington to Algiers, Casablanca, Asmara, Hawaii, and Puerto Rico. This system had many speed-reducing characteristics resulting from the difference in tape width between the ordinary teletype and the IBM machines. Therefore, time was consumed in relaying from landline to radio network, and vice versa.

c. Introduction of Single-Sideband. — In the latter part of 1943, after much engineering study, it was decided that the standard landline teletype had to be made to work on all types of

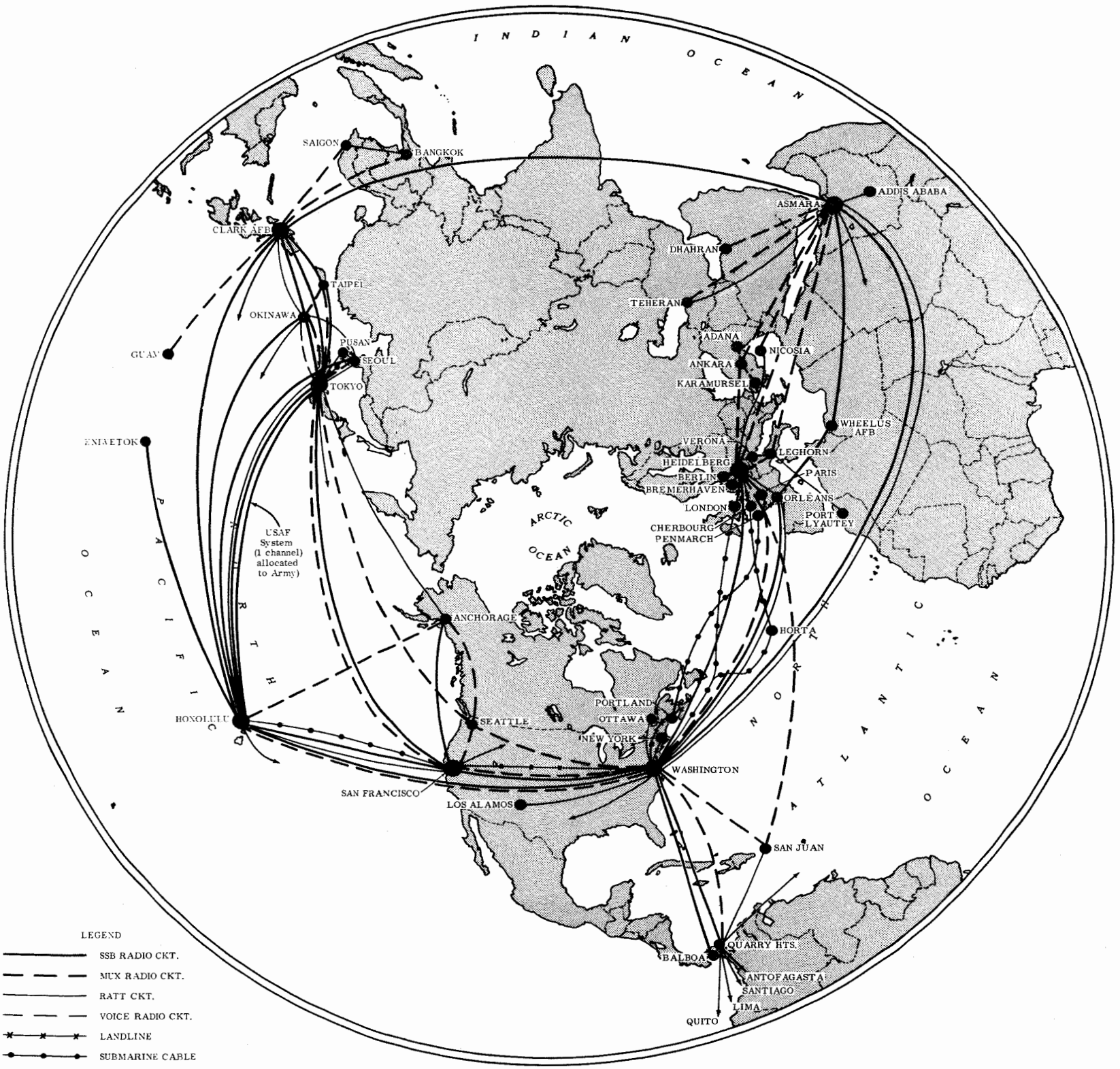

Figure 33-2.—*STARCOM World-Wide Radio and Ocean Cable Circuits.*

circuits. The final solution was the use of single-sideband equipment that provided six independent channels, and an independent two-way channel for voice or radio-photo transmission—all on a single frequency. The six teletypewriter channels each transmitted 60 words per minute simultaneously, a significant increase in traffic on a single frequency.

d. World-Wide Beltline. — A study was made at this time to determine optimum locations for a communications "beltline" around the world. Late in 1943, this beltline was established. Major relay stations were so located that they afforded world-wide coverage while avoiding the auroral zone of absorption. Twenty-four hour operation was established; when circuit failure occurred in the eastward portion of the belt-line, traffic was routed westward to ensure delivery despite localized communications breakdowns. This network of relay stations extended eastward from Washington to Asmara (Africa), New Delhi, Brisbane, San Francisco (either direct or via Hawaii), and back to Washington by landline. Later, the Brisbane station was made a terminal connecting into the main-line at Manila, which replaced Brisbane as a major relay station.

e. Feeder Stations.—With the assistance of the American Telephone and Telegraph Company, a method was developed whereby single-channel radiotelegraph equipment could be converted to radioteletypewriter operation, and could easily fit into the beltline operation. These feeder stations had either single side-band, single-channel, radioteletype, or manual CW radio circuits, depending upon the amount of traffic passing through them. The single-channel, radioteletype circuits were later stepped up to 100 words per minute. By V-J Day, the entire system was handling approximately 50,000,000 words a day. The network had a total capacity of about 100,000,000 words a day.

.2 Responsibility.—STARCOM is organized and operated to transmit and receive official messages and other traffic for the Department of Defense, Department of the Army, and other military departments. Other agencies of the government, as authorized by the Chief Signal Officer, may use STARCOM facilities within prescribed limitations. Engineering, operational, procedural, and security functions concerning STARCOM and control thereof are the responsibility of the Chief Signal Officer.

a. Revision.—Changes in/and additions to the network will be made only with the concurrence of the Chief Signal Officer. This, however, does not prevent commanders from establishing, within their commands, additional circuits required to meet emergencies. Such additions, accompanied by adequate traffic data, will be reported promptly to the Chief Signal Officer.

b. Net Control.—The Department of the Army Communications Center, Washington, D. C., is designated as the Net Control Station (NCS) and will exercise operational control over STARCOM. (See Figure 33-2.) This operational control includes adherence to prescribed procedures, monitoring, circuit discipline, emergency routing as required, and determining priority in the restoration of interrupted facilities.

c. ConUS. — Continental Army Commanders and the Commanding General, Military District of Washington, are responsible for fixed signal communications, including STARCOM, at certain installations under the control of the heads of administrative and technical services or other Department of the Army agencies, and will communicate direct with the Department of the Army with respect to these functions. Commanding officers of certain installations will report direct to Army commanders or the Commanding General, Military District of Washington, with respect to fixed signal communications matters, except for certain stations of the Department of the Army communications system under the control of the Chief Signal Officer, such as the Department of the Army Communications Center, Washington, D. C., and the Seattle, Washington, terminal of the Alaska Communications System.

d. Continental Portion.—The continental Army area portion of the STARCOM under the supervision of the Army commander consists of the Army headquarters communication center and sub-

ordinate or associated relay and tributary facilities. (See Figure 33-3.) The Army commander, within his command is responsible for:

(1) Review, engineering, and submission to the Office, Chief Signal Officer, all requests for new or additional radio, wire, or cable facilities or equipment.

(2) Training of operating personnel at installations within the territorial limits of his Army area in the prescribed STARCOM practices and procedures.

(3) Prevention of misuse of radio, wire, and other communications facilities for the transmission of messages or other traffic, by electrical means, which may be more appropriately handled by mail.

(4) Assuring maximum use of STARCOM facilities for traffic warranting electrical transmission.

(5) Periodic analyses of traffic originating at Teletypewriter Exchange Service (TWX) installations under the Army area jurisdiction to determine routing that offers maximum economy in message tolls.

e. Overseas Portion.—The overseas, base, and separate command portion of the STARCOM under the supervision of the respective commanders consists of the headquarters communication center and designated subordinate and associated relay and tributary facilities. These commanders, within their respective commands, are responsible for:

(1) The review, engineering, and submission of information pertaining to any changes made to fixed signal communications facilities or equipment to the Chief Signal Officer.

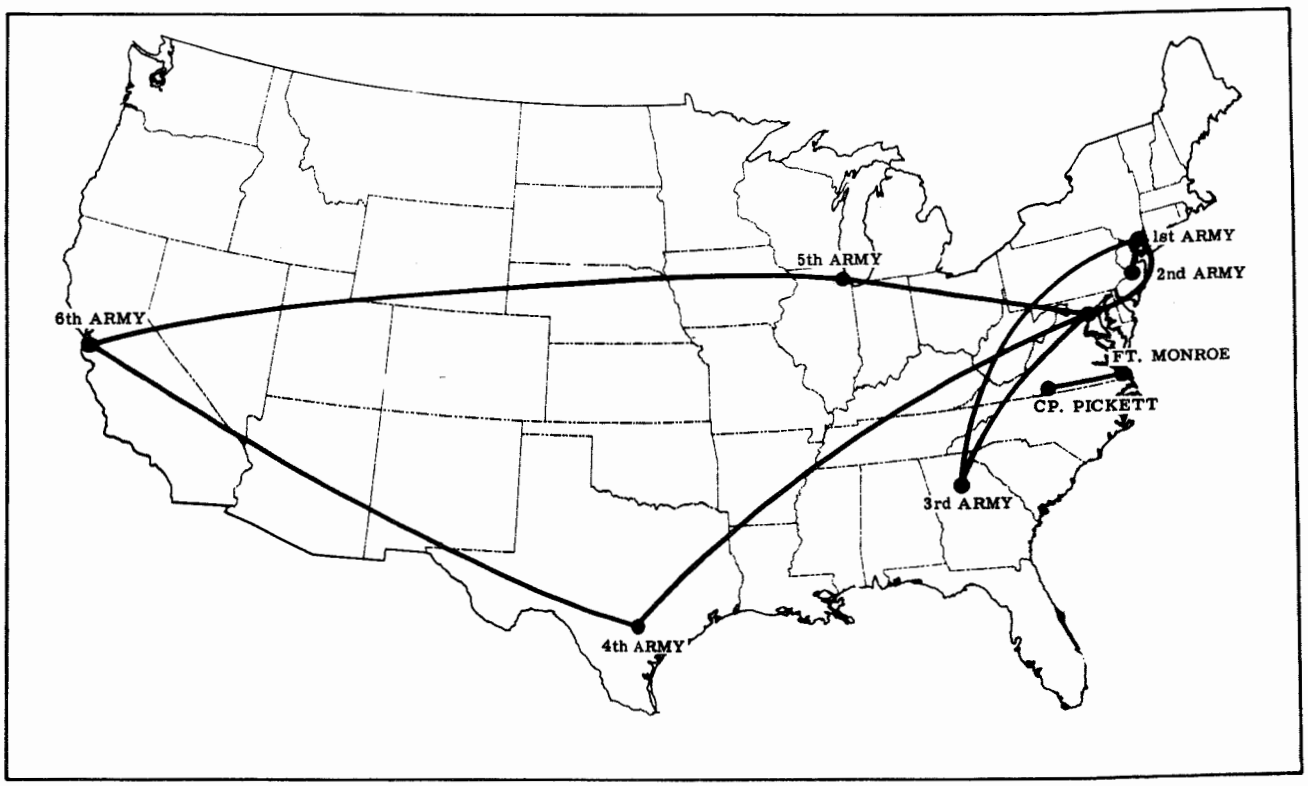

Figure 33-3.—*STARCOM ConUS Radioteletype Circuits.*

(2) The training of operating personnel, at installations for which they are responsible, in communication methods and procedures as prescribed by the Chief Signal Officer.

(3) Prevention of misuse of radio, wire, and other communications facilities for the transmission of messages or other traffic, by electrical means, which may be more appropriately handled by mail.

(4) Assuring maximum use of STARCOM facilities for traffic warranting electrical transmission.

(5) Periodic analyses of traffic originating at Army installations similar to Teletypewriter Exchange Service (TWX) under his jurisdiction to determine routing that offers maximum economy in message tolls.

f. Alaska Communication System (ACS). —The Alaska Communication System is the agency of the Chief Signal Officer designated the responsibility to provide communication facilities in the Alaskan area to meet civil and military requirements. The ACS provides STARCOM communication facilities within the Alaskan area and links the ACS headquarters at Seattle, Washington, with the area.

.3 Teletypewriter Exchange Service (TWX).

a. General. — Teletypewriter Exchange Service is a commercial service employed as a supplement to the STARCOM. TWX installations that have been trained in STARCOM practices and procedures, and are proficient therein, may be authorized to call direct and route traffic in the same manner as any domestic STARCOM station.

b. Responsibility for TWX facilities.

(1) Continental Army Commanders are responsible for TWX routing, operations, and adequate training of personnel at installations under their jurisdiction which are served by TWX facilities.

(a) In coordinated action with the various users of TWX facilities, within their area of responsibility, Continental Army Commanders shall determine what TWX traffic shall be routed to Army relay communication centers for transmission via STARCOM channels to its destination. Because of geographical location, some TWX stations may be located in any one army area and normally work with a network relay communication center located in an adjacent army area. In such cases, the army commanders involved make local arrangements relative to the training of personnel and the control of operations at the borderline TWX station.

(b) When an army commander determines that personnel at certain TWX stations have been adequately trained in STARCOM practices and procedures, the stations are given the tape-relay TWX number of the relay communication center to which the TWX stations normally will transmit messages. TWX stations where personnel have not been specifically trained in STARCOM practices and procedures are given only the teletypewriter exchange number of the STARCOM communication center which will result in page copy being recorded at the STARCOM station. This visual monitoring procedure applies to TWX stations whose personnel have been trained in network practices and procedures, but whose operators send poor tape to the relay communication center because of low proficiency. In such cases, the operational quality will be assessed by monitoring and when sufficient improvement is noted, the TWX station will be given a TWX number which will result in tape recording at the STARCOM communication center.

(2) Within the Military District of Washington and the immediate vicinity, TWX station personnel are trained by the Department of the Army Communication Center, Washington, D. C.

.4 Fixed Communication Centers.

a. General.

(1) Communication centers are the focal points of military communications nets which relay,

receive, transmit, and deliver messages. Personnel designated to operate communication centers become an integral part of these centers. Communication centers are organized and equipped to provide expeditious signal communication service for the commander and his staff by:

(a) Coordinating the use of various means of record signal communication available to the commander.

(b) Expeditiously effecting transmission, receipt, and delivery of messages or other traffic.

(c) Providing adequate transmission security precautions.

(d) Maintaining only such prescribed temporary records as will facilitate the fast, accurate, and secure forwarding of all messages or other traffic received at, destined to, or relayed through the communication center.

(2) The officer in charge of the communication center is responsible for determining the authenticity and official character of each message or other traffic accepted for transmission. He determines the routing of messages through the signal communications channels that will assure the most accurate, economical, expeditious, and secure arrival at the destination. He is also responsible for providing surveillance of each transmission to prevent relay of classified messages in plain language over nonapproved facilities.

(3) Communication centers are not organized or equipped to perform clerical work incidental to the filing of messages for staff reference nor the preparation of additional copies for use or distribution within the headquarters.

(4) The officer in charge of each communication center is responsible for adherence to communication methods and procedures prescribed by the Chief Signal Officer.

b. STARCOM Communication Centers.

(1) STARCOM communication centers are maintained in the Department of the Army, at each continental army area headquarters, at overseas and separate command headquarters, and at such other locations as are necessary. (See Figure 33-4.) They are organized and operated under the general direction and technical control of the Chief Signal Officer and are the immediate responsibility of the signal officer of the command concerned.

(2) The communication centers forming the distant end of overseas STARCOM circuits, which also are a part of the overseas and separate command signal communication system, are operated by troops under control of the appropriate local commander. Ultimately, these communication centers are under the general direction and technical control of the Chief Signal Officer.

.5 Administration Concepts.—The number of communication personnel who report directly to the Chief Signal Officer are a relatively minor part of the total number engaged in the communication field. Since command responsibilities are delegated to the lower echelons, and, since effective command is impossible without effective communication, each of the major field commands operates its own local communications, including the local relay center associated with the global network. As may be expected, all the communications are guided by policies and general plans from the Chief Signal Officer. Where the local communications have a direct effect on the global system, the departmental guidance is considerable. For example, operating procedures must be identical so that a message originated in one command can pass through other commands and other military services in a manner completely familiar to all; equipment must be compatible to allow interworking, and should be standardized to simplify maintenance and resupply; and traffic engineering must be accomplished for the betterment of the whole system within available funds instead of allowing a particular segment to be over-engineered to the detriment of another segment. The overall concept then is maximum delegation of communications responsibility along the lines of command authority where possible, but adequate control where necessary.

.6 The Overseas Portion of STARCOM. —

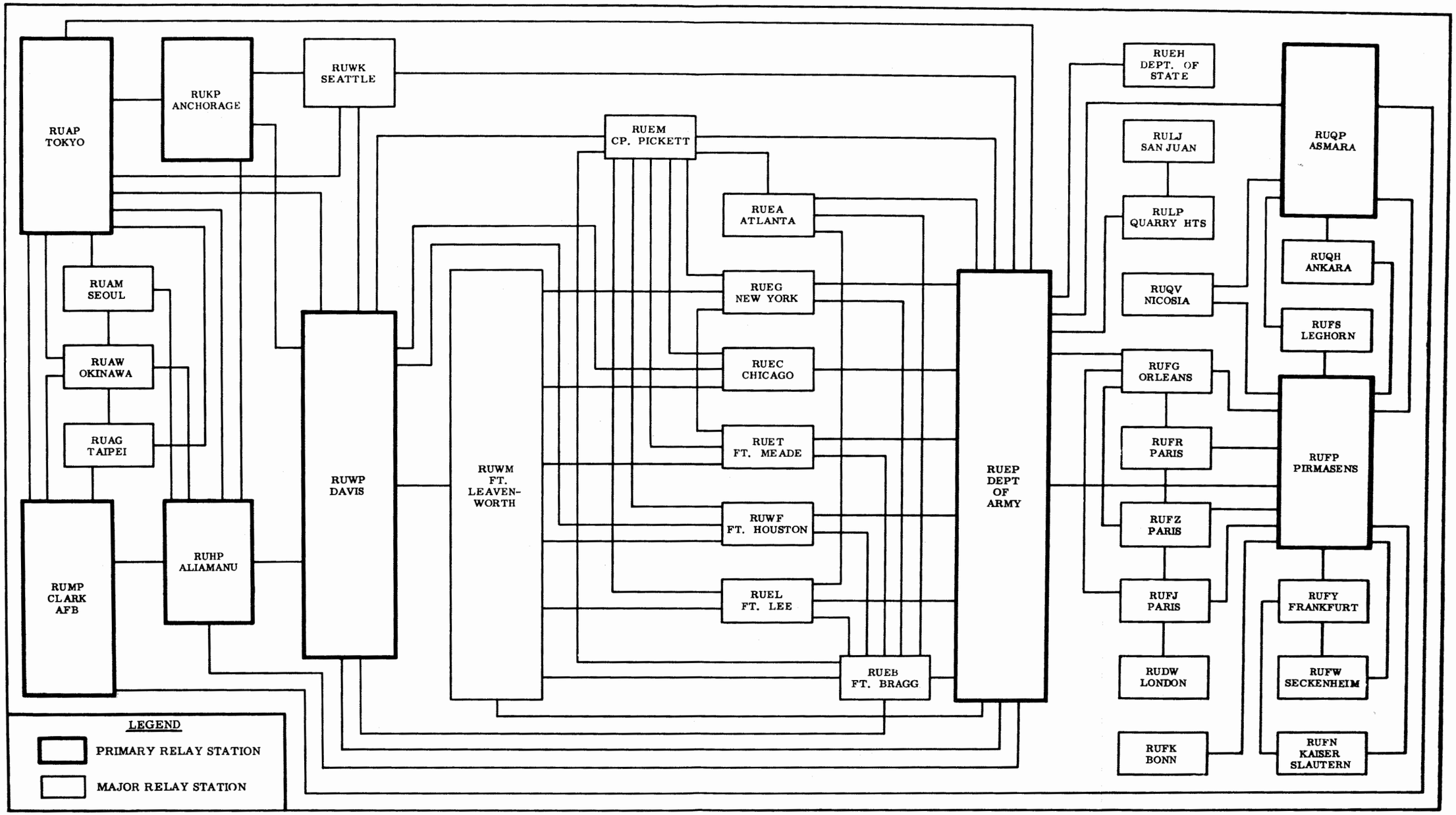

Figure 33-4.—*STARCOM Traffic Routing Diagram (Primary and Major Relay Stations).*

The overseas portion of STARCOM is composed, fundamentally, of a series of strategically spaced relay stations. The location of these stations is primarily dictated by the world-wide deployment of troops. Multichannel teletypewriter circuits connect the Department of the Army Communications Center in Washington with each Continental Army Headquarters and with each overseas command headquarters. Tributary circuits reach out to all Army installations and other government agencies as required. The facilities of the overseas portion consist of fixed point-to-point radio, wire, and cable circuits used with such equipment as single-sideband, electronic time division multiplex, automatic and semiautomatic teletypewriter relay equipment, and high-speed tape reproduction equipment.

.7 STARCOM ConUS Portion. — The principle routes for STARCOM teletypewriter traffic in the ConUS are shown in Figure 33-5. A relay station is located in or near each Continental Army Headquarters, and at the Departmental Headquarters. In the far West, the Sixth Army area has three relay stations along the coast. In addition to the normal Army Headquarters Station, there are centers at Los Angeles to handle a traffic congestion at that point, and another at Seattle which operates as a gateway station to the US. Army Alaska Communications System. The majority of circuit facilities in the United States are leased from telephone companies and from the Western Union Telegraph Company. Exceptions are those Army-owned feeder radio routes that tie the west coast gateway stations to the global net control station in Washington for the handling of overseas traffic.

.8 STARCOM Switched Transceiver Network.

a. Purpose.—Based on a study of subscriber density, the United States Army Signal Corps devised a plan to establish a data processing system which would be used to satisfy all Army requirements for data transmission. This system is known as the STARCOM Switched Transceiver Network. It became operational on 5 November 1956. Most of the technical services of the Army utilize this network to process supply requisitions and related data within the United States. The Overseas Supply Agencies at Brooklyn, New York, and Fort Mason, California, process supply requisitions and related information to overseas locations. Requisitions are handled with 30 to 40 days less delay than they were before this net became operational. The Adjutant General uses this network to process personnel assignments both within the ConUS and overseas. Studies are being made to determine how this network can be utilized in the transition from peace to war. (See Figure 33-6.)

b. Network Composition (ConUS). — Within the ConUS, the STARCOM switched transceiver network is operated by the Army Signal Corps and AT&T. Leased telephone circuits interconnect the telephone company switching centers at Philadelphia, Atlanta, Chicago, Kansas City, and Oakland. There are 52 military installations connected to these switching centers. IBM data transceivers are utilized to exchange punched-card information between all military installations on the network. Initial users of the system are Quartermaster, Ordnance, Signal, and Overseas Supply Agencies in New York and San Francisco. Future users will include other branches of the Army as well as the USAF and the Navy.

c. Overseas Extensions. — Army-operated radio facilities are utilized between Army gateway stations such as the Overseas Supply Agencies at Brooklyn, New York, and Fort Mason, California, the Adjutant General's office, Washington, D. C., the 56th AF Machine Record Unit, San Francisco, California, and Fort Lewis, Washington, and Europe, Panama, Hawaii, Japan, and Alaska.

3302. Reserved for Future Use.

3303. Reserved for Future Use.

3304. Reserved for Future Use.

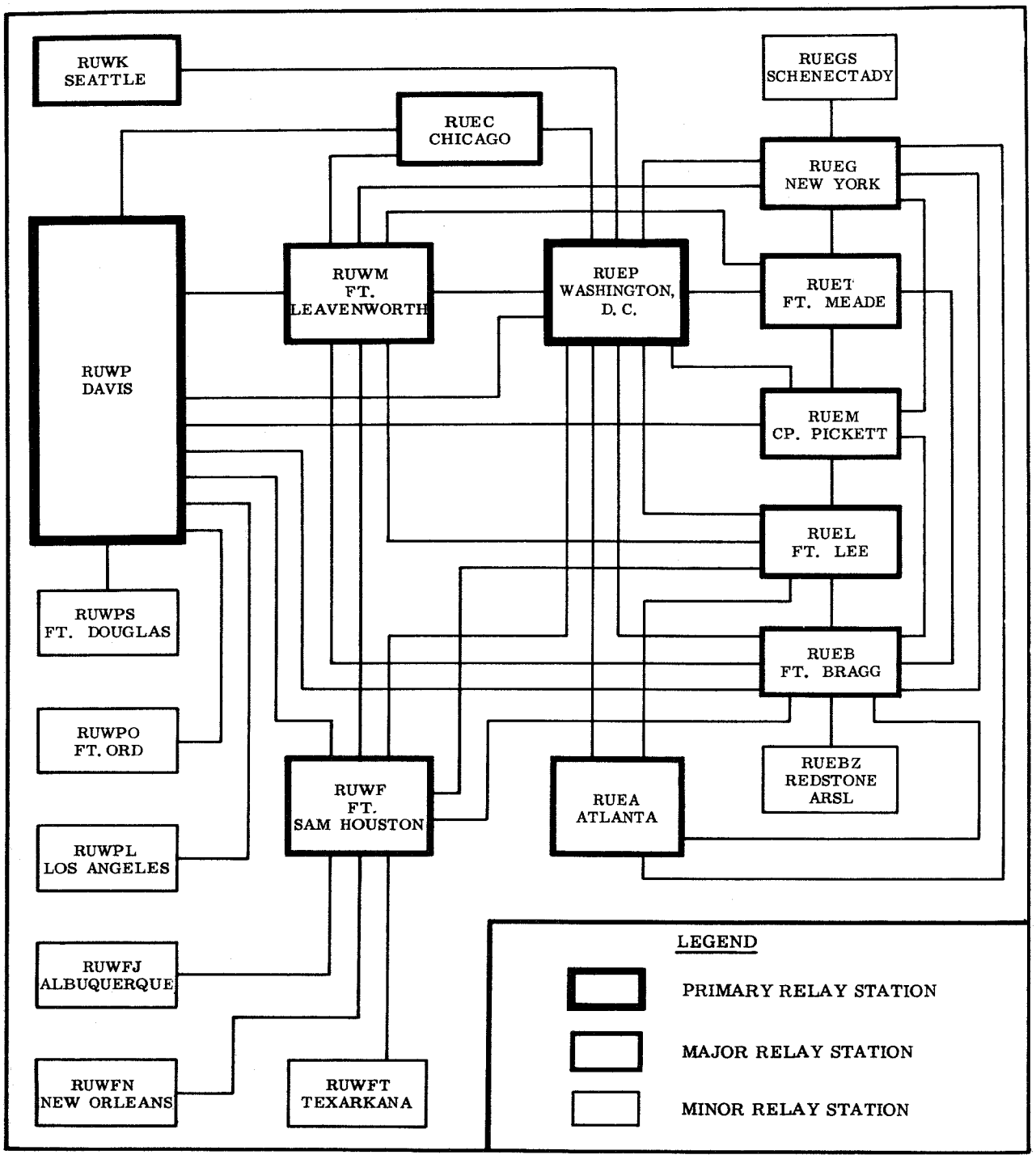

Figure 33-5.—*STARCOM ConUS Portion Relay Traffic Routing Diagram.*

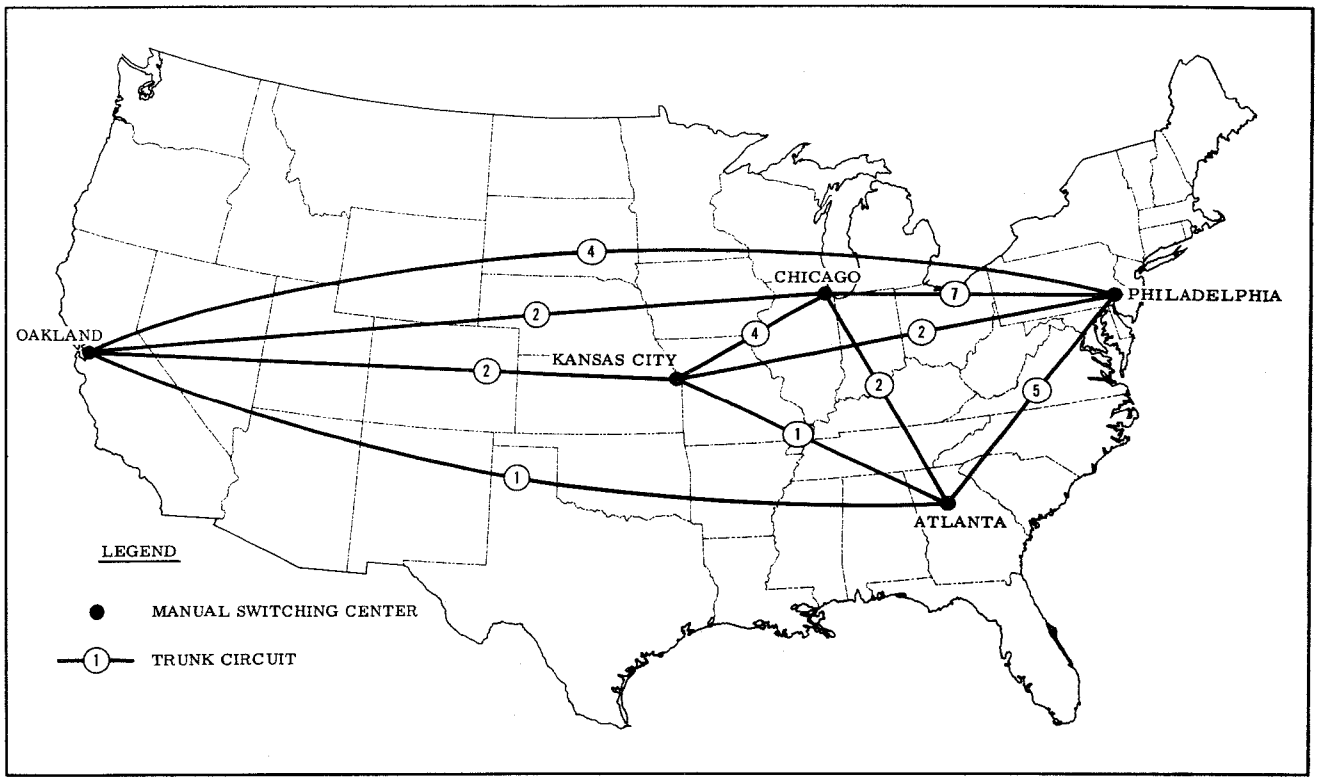

Figure 33-6.—*Army Switched Data and Secure Voice Network.*

SECTION II—US. NAVAL COMMUNICATIONS

3305. MISSION AND DEVELOPMENT.

.1 Historical Development.—Radio communications were first established by the US. Navy on an operating basis in 1903, to provide rapid communications between shore and ship, and between ships. Subsequently, radio circuits were established to link shore stations within the ConUS with each other and with those overseas stations then in existence. Throughout the ensuing years, these circuits have been developed into the present integrated system, the result of transitional periods of research and development, and consequent advances in the art of communications. Prior to 1940, the Naval Communication System within the ConUS consisted of several point-to-point multistation radio circuits. These were supplemented by one Morse simplex-telegraph wire circuit, connecting Boston, New London, New York, Philadelphia, and Washington, between the hours of 0800 and 2000. In May 1941, this telegraph line was replaced by the Navy's first private teletypewriter circuit. Thirty days later, Norfolk was connected to the circuit. This marked the beginning of the transition from radio circuits to teletypewriter land-wire circuits in the ConUS. The present integrated US. Naval Communication System provides for the essential, continuous, and immediate contact between US. Navy operating forces (air, surface, and subsurface) wherever they may be, and contact with the supporting Short Establishment.

.2 Mission.—The mission of Naval communications is to provide and maintain reliable, secure, and rapid communications, based on war requirements adequate to meet the needs of the Operating Forces, the Navy Department, and the Naval Shore Establishment; primarily they are to serve operations and secondarily, to facilitate administration.

.3 Policy.—The policy of Naval communications is:

a. To maintain and operate adequate, efficient, and secure communications fully capable of fulfilling the mission assigned.

b. To cooperate with the military services and other departments and agencies of the US. Government and Allied nations.

c. To encourage development of those commercial communication activities (including amateur) which will enhance the military posture and other interests of the United States.

d. To maintain facilities for adequate communication with ships of the maritime trade, aircraft flying over the sea, and shore radio stations of the maritme service for the promotion of safety at sea and in the air.

.4 Doctrine. — Naval Communications Doctrine is derived from the following:

a. Concept.

(1) The primary concept of Naval communications is to meet the requirements of war. To this end organization, methods, procedures, facilities, and training must be adequate to meet war or emergency requirements and must be flexible in order to provide for rapid expansion.

(2) Peacetime methods must be such that only a few minor changes will be required when shifting to an emergency or war status.

b. Principles.

(1) Based upon the above concept, the following principles have been proved under war conditions:

(a) Reliability, security, and speed are the three fundamental requirements of Naval communications. Reliability is always paramount. It must never be lessened or sacrificed to achieve se-

curity or speed. Whenever there is a conflict between the demands of security and speed, one or the other must be sacrificed in the light of the demands of the situation.

(b) Success of operations in a large measure depends upon effective communications which require a basic knowledge and appreciation of how, when, and where to send messages.

(c) The most detailed instructional publications and the most up-to-date equipment in no way lessen the need for initiative, common sense, and good judgment in the planning and conduct of Naval communications.

(d) Correct methods of operation and precise use of established procedures are essential to effective communications.

(e) Rapid communications must be limited to the minimum required for the successful accomplishment of the operational task assigned. Proper administrative planning and foresight are required to ensure that rapid communications are employed only when other means of communication will not suffice.

(f) Proper choice of frequency is of the greatest importance in establishing and maintaining reliable radio communications.

(g) Communications media which are susceptible to interception should not be substituted in wartime for a more secure means.

3306. BASIC ORGANIZATION OF NAVAL COMMUNICATIONS.

.1 Elements.—The major elements of Naval communications are:

a. The Director, Naval Communications.—The Director, Naval Communications (DNC) is the flag officer within the Office of the Chief of Naval Operations, responsible for the overall supervision and coordination of Naval communications.

b. The Naval Communication System.—The Naval Communication System is a fixed, integrated global communication network which forms the world-wide framework of Naval communications.

c. Shore Establishment Communications.—Communication departments of activities of the Shore Establishment are organizational components of the station or activity which they serve.

d. Communication Organizations of the Operating Forces.—Communication organizations of the Operating Forces are integral components of the ship or unit.

.2 Interrelationship of the Elements of Naval Communications.—The elements of Naval communications bear the following relationship to each other.

a. The Director, Naval Communications, maintains technical control of Naval communications and provides the necessary coordination and planning, at departmental level in connection therewith, in order to insure the provision at all times of efficient communication support for the Naval Establishment. Further, the Chief of Naval Operations (DNC), with due regard for the doctrine which establishes communications as a function of command, exercises management and coordination control of those elements of Naval communications comprising the Naval Communication System and the Naval Security Group.

b. The Naval Communication System, one of the principal elements of Naval communications, is a network of communication systems with associated facilities, integrated into a global system. It is designed and engineered to provide adequate, efficient, reliable, and secure, rapid record and other communication services for the Naval Shore Establishment and the Operating Forces. The Chief of Naval Operations through the Director, Naval Communications, manages, operates, maintains, and provides for the improvement of the Naval Communication System.

c. The communication departments of activities of the Shore Establishment provide com-

munication facilities and services for the activity of which the department is an integral component, and often for other activities collocated in support of the mission of the activity concerned and the forces afloat as may be required. These communication departments are normally tributaries of the Naval Communication System, and in some instances, perform functions in support of the mission of that system.

d. Within the Operating Forces, the communication organizations (divisions, sections, staff departments, communication battalions, etc.) operate and maintain the authorized equipment to provide the communication service essential to the coordinated control of ships, aircraft, and Marine Corps troops in the accomplishment of the assigned missions and tasks. At the level of the Operating Forces, communication is the voice of command in a visible and tangible way; the communication service provided often influences directly and materially the degree of success achieved by the force, squadron, division, or other combat unit.

3307. DIRECTOR, NAVAL COMMUNICATIONS (DNC).

.1 Mission. — The mission of the Director, Naval Communications, is to advise the Chief of Naval Operations and to coordinate within the Office of the Chief of Naval Operations (CNO) concerning Naval communications, Naval Security Group, and frequency spectrum matters. He is also to implement other assigned functions concerning these matters, including the maintenance and operation of the Naval Communication System and the Naval Security Group. (See Fgure 33-7.)

.2 Functions. — The Director, Naval Communications, performs the following functions:

a. Advises the Chief of Naval Operations on Naval communications, Naval Security Group, and frequency spectrum matters.

b. Coordinates, within the Office of the Chief of Naval Operations, matters pertaining to Naval communications, the Naval Security Group, and the frequency spectrum.

c. Formulates plans, policies, and procedures to implement assigned responsibilities with regard to Naval communications, Naval Security Group, and frequency spectrum matters.

d. Administers, maintains, and operates the Naval Communication System, and in connection therewith, utilizes other governmental and commercial communications facilities as necessary to maintain effective service.

e. Administers and provides for the maintenance and operation of the Naval Security Group, including the fulfillment of requirements originating within or imposed on the Naval Establishment with respect to:

(1) Communication Intelligence.

(2) Electronic Intelligence.

(3) Communications Security and Special Communications Security Matters.

(4) The Registered Publications System.

(5) The Armed Forces Courier Service.

f. Procures, assigns, and protects radio frequencies for all electronic requirements of the Naval Establishment, effecting coordination with civil and military agencies of the United States, and with other nations as necessary.

g. Conducts continuing studies and initiates and prosecutes necessary action toward improvement of Naval communications and the Naval Security Group.

h. Formulates and guards operational requirements and prepares military and/or development specifications for communications equipment and systems, including cryptographic, for Naval communications and the Naval Security Group.

i. Supervises and follows-up the development, testing, service acceptance, and procurement of communications equipment for Naval communications and the Naval Security Group.

j. Provides budgetary support for programs relating to the maintenance, operation, and

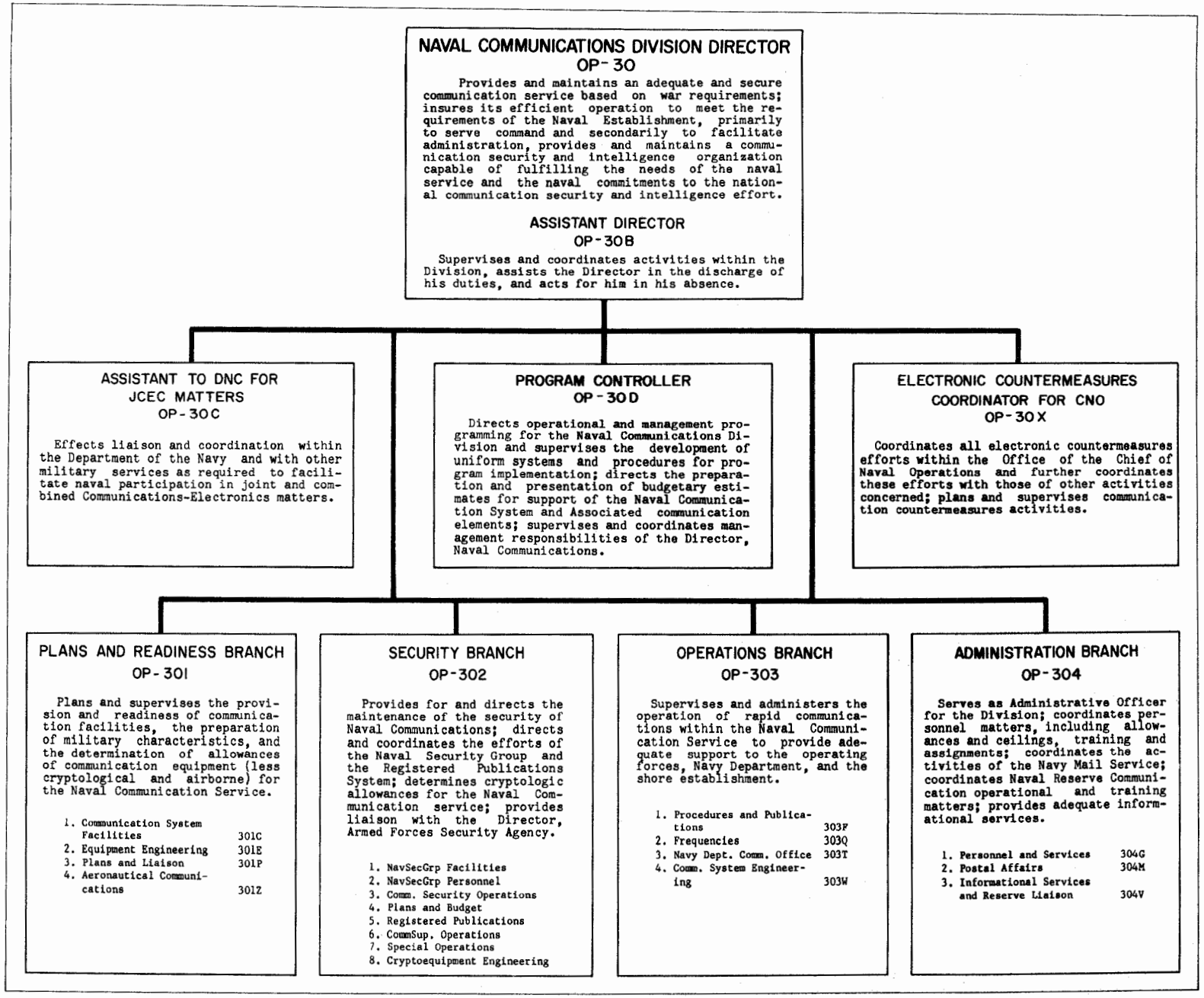

Figure 33-7.—*Office of the Director Naval Communications.*

improvement of the Naval Communication System and the Naval Security Group, including the procurement of communications equipment, commercial facilities and services, support of joint agencies, and public works.

k. Acts as budget activity manager for the annual appropriations for service-wide communications, and as such prepares budget estimates and justifications, and supervises the administration of funds appropriated therefore.

l. Exercises management control for the Chief of Naval Operations over activities of the Naval Communication System, and over assigned activities of the Naval Security Group, including the Naval Security Station, Washington, D. C.

m. Makes provision for the handling of such commercial communications as are authorized by law, under such rules and regulations as may be prescribed by the Secretary of the Navy.

n. Supervises merchant ship communications, and plans to provide adequate and secure wartime communication service to merchant ships.

o. Provides Navy representation on the Joint and Combined Communications-Electronics Committees, the US. Communications Security Board, the Telecommunications Planning Committee, the Interdepartment Radio Advisory Committee (IRAC), as required, on boards, panels, and committees concerned with Naval communications, Naval Security Group, and frequency spectrum matters.

p. Makes provision for cryptographic publications and equipment for the Naval Establishment, and prepares cryptologic allowances and related instructions.

q. Maintains liaison with joint and combined military agencies, civil government agencies and industry in matters affecting Naval communications, and Naval Security Group operations, material, and research.

r. Coordinates and prepares Naval publications pertaining to Naval communications, Naval Security Group, and frequency spectrum matters.

s. Administers, within the Naval Communications Division, military (including Naval Reserve) and civilian personnel matters affecting Naval communications and the Naval Security Group, maintains liaison with other personnel agencies, and makes nominations to the Bureau of Naval Personnel relative to the detailing of military personnel to Naval communications and Naval Security Group duties.

t. Exercises technical control for the Chief of Naval Operations of the Naval Reserve Communications Networks.

u. Maintains liaison with amateur radio organizations and activities, and coordinates matters relating to amateur radio operations.

v. Provides informational services for Naval Communications and Naval Security Group personnel.

.3 The Naval Communications Division.

a. The Naval Communications Division is the staff, within the Office of the CNO, assigned to the Director, Naval Communications, to support him in the execution of his duties. The Division organization presently provides two assistant directors, one for Communications and the other for Naval Security Group matters, and five Special Assistants:

(1) Program Controller.

(2) Assistant for Marine Corps Matters.

(3) Technical Advisor.

(4) Chief Communications Advisor.

(5) Assistant for Administration.

b. The Division is further broken down into three branches, which include the following Sections:

(1) *Plans and Policy Branch.*

(a) Coordinator for Joint Chiefs of

Staff, and Telecommunications Planning Committee matters.

(b) Future Plans Section.

(c) Frequency Allocation Section.

(d) Aeronautical Communications Section.

(2) *Shore System Branch.*

(a) Plant Management Section.

(b) Personnel Section.

(c) Shore Equipment Section.

(d) Plans and Readiness Section.

(e) OPNAV Communication Office.

(f) System Operations Section.

(3) *Fleet Branch.*

(a) Radio Section.

(b) Procedures and Doctrine Section.

(c) Visual Section.

(d) Plans and Readiness Section.

.4 The Naval Security Group. — The Naval Security Group consists of three persons who, under the Chief of Naval Operations (DNC), engage in communication intelligence, electronic intelligence, communication security, administration of the registered publication system, and operation of specified courier transfer stations in the Armed Forces Courier Service.

3308. THE NAVAL COMMUNICATION SYSTEM.

.1 Mission.—The mission of the Naval Communication System is to provide and maintain adequate, efficient, secure, and reliable rapid communication services for the exercise of command, and to facilitate administration of the Operating Forces, Navy Department, and Shore Establishment, wherever located.

.2 Requirements. — The requirements of the Naval Communication System, in support of its mission, are the establishment, management, operation, maintenance, and improvement if an adequate global communication system for command and administration:

a. Between the Navy Department and the Operating Forces afloat and ashore.

b. Between the Navy Department and activities of the Shore Establishment wherever located.

c. Between the Operating Forces afloat (surface, subsurface, air, and ashore), and activities of the Shore Establishment wherever located.

d. Between activities of the Department of the Navy and activities of the Departments of the Army, Air Force, and Coast Guard, and Allied military services as required.

e. Between commands in the Operating Forces in any ocean or area and those in any other location throughout the world.

f. Provision of such other communication facilities and services as the Chief of Naval Operations may prescribe.

.3 Operations.

a. Operationally, the Naval Communication System is a network of communication systems with their associated facilities and equipments, based ashore and integrated into a global Naval Communication System, serving the Operating Forces and the Naval Shore Establishment. The Naval Communication System should be considered as integral to weapons systems and combat operations of the Navy. (See Figure 33-8.)

b. In support of the mission and in accordance with the requirements and doctrines which are applicable and germane, the Naval Communication System is planned, engineered, and developed so that activities of the System are currently organized into one or more of the following operationally integrated components:

(1) Message Center.

(2) Cryptocenter.

(3) Relay Station.

(4) Wire and/or Radio Center.

(5) Radio Transmitting and Radio Receiving Stations.

(6) Control Center.

(7) Visual Signal Station (as required).

(8) Classified Relay Station (interim).

(9) Facsimile Center.

These components are operationally integrated and controlled at any geographical location by the Communication Center, the organization of which is shown in Figure 33-9.

c. Communication Centers are categorized as primary, major, minor, and tributary or user message centers.

d. There are six primary communication centers strategically located throughout the world to furnish complete radio coverage of the major portions of the world's ocean areas. These six, indictated in chart below, form the nucleus of the Naval Communication System.

Location	*Call Sign*	*Routing Indicator*
Washington	NSS	RBEPC
San Francisco	NPG	RBWPC
Honolulu	NPM	RBHPC
Guam	NPN	RBMPC
Balboa	NBA	RBLPC
Port Lyautey	NHY	RBTPC

These centers are linked together by multichannel radio teletypewriter voice and facsimile trunk circuits. In addition, each primary communication center maintains and operates:

(1) A Fleet Broadcast for the delivery of traffic by the broadcast method to all US. Naval ships in the ocean area served by that center. These broadcasts are transmitted by a high-power VLF or LF transmitter keyed simultaneously with high-power HF transmitters.

(2) A Fleet Radioteletypewriter Broadcast, similar to the Fleet Broadcast except that a VLF transmitter is not employed.

(3) A General Broadcast, also similar to the Fleet Broadcast except that a VLF transmitter is not employed. These broadcasts provide time signals, weather (RATT and CW), hydrographic warnings and notices, press (RATT and CW), and merchant ship broadcast schedules.

(4) A Fleet Facsimile Broadcast, similar to the Fleet Broadcast, but with no VLF transmitter.

(5) A high-power HF ship-to-shore circuit, manually keyed.

(6) A high-power, HF duplex or multiplex radioteletypewriter ship-to-shore circuit available for communication with fleet commanders.

(7) Local MF, UHF manual, radioteletypewriter and voice ship-to-shore circuits as required.

(8) Multichannel radio and/or landwire teletypewriter, voice, and facsimile trunk circuits to major or minor communication centers throughout the world.

(9) Radio or landwire teletypewriter circuits to tributary or user activities.

(10) Other radio or landwire circuits as may be required to meet specific requirements.

(11) Radio and landwire link control circuits and facilities at the geographical location of the primary communication center.

(12) Visual signaling facilities as required.

e. Major communication centers maintain

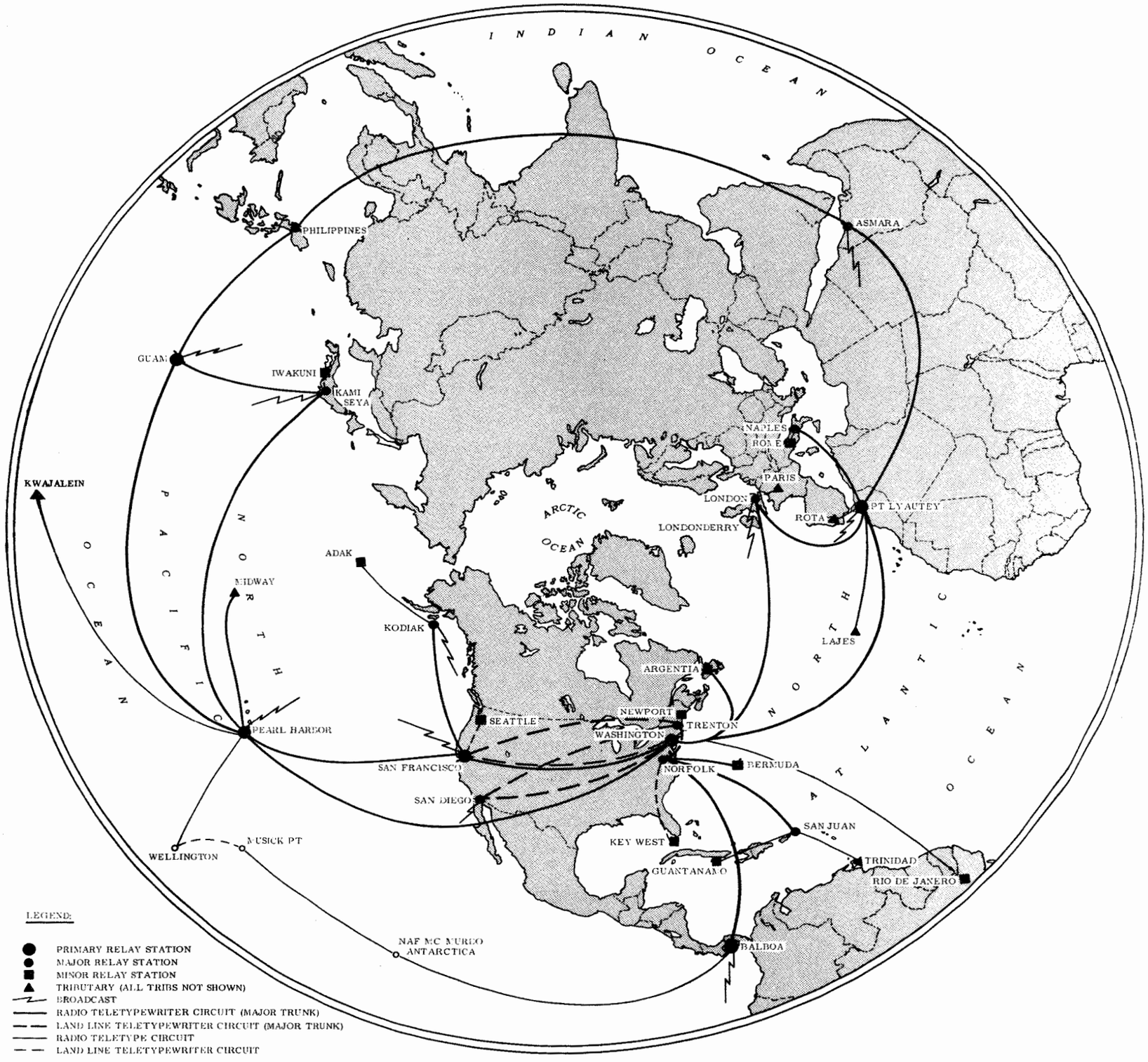

Figure 33-8.—*US. Naval Communication System Teletypewriter Network and Associated Broadcasts.*

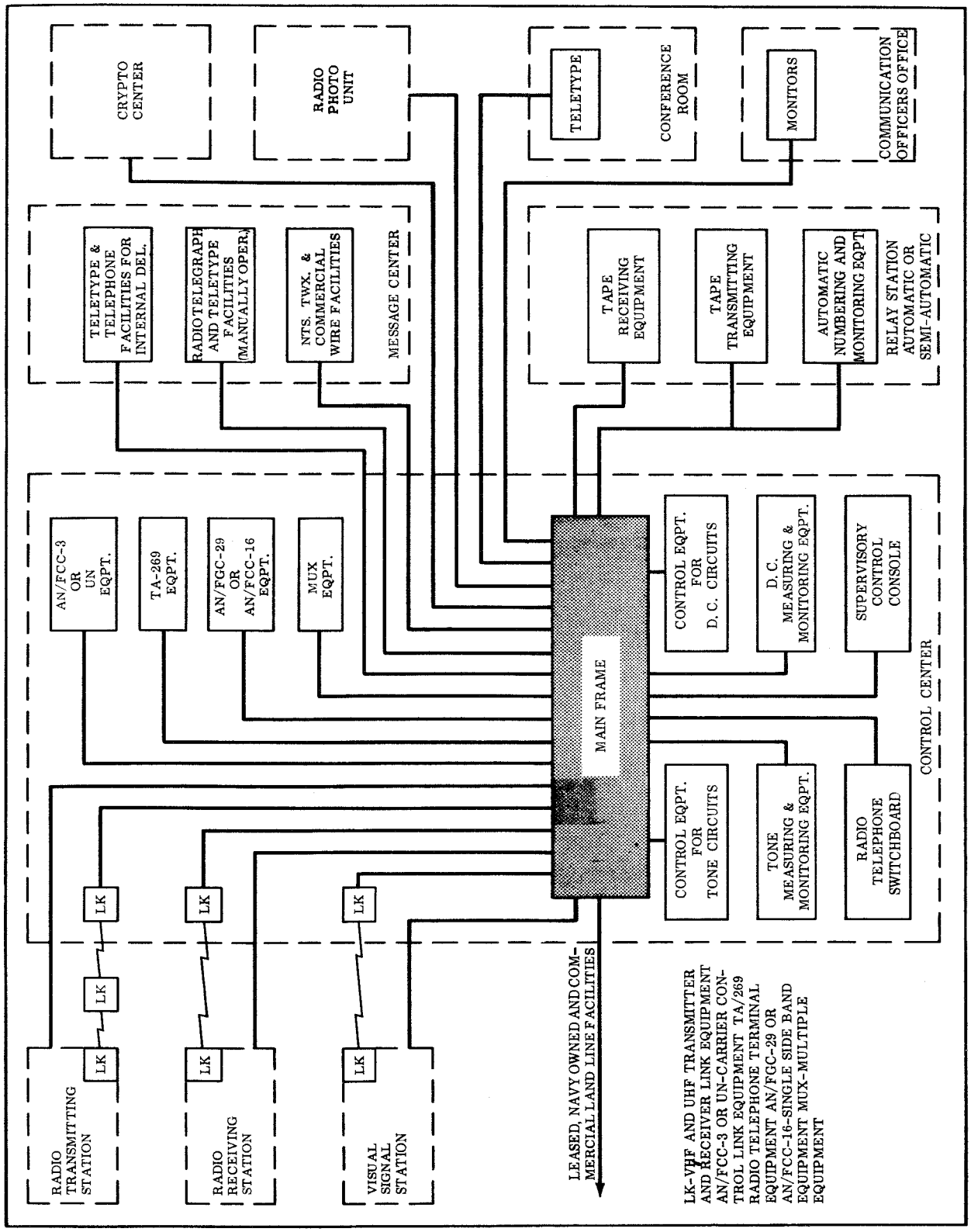

Figure 33-9.—*Typical Navy Communications Center.*

facilities and perform functions, to a limited extent and within their geographical spheres of influence, similar to the primary centers. They also perform a limited fleet support function. Radio or landwire circuits, emanating from the primary communication centers, link the several major centers to the Naval Communication System. Major communication centers maintain and operate:

(1) Fleet broadcasts of limited area coverage.

(2) General broadcasts of limited area coverage.

(3) High-power, HF ship-to-shore circuits as required.

(4) High-power HF duplex or multiplex radioteletypewriter circuits for use with fleet or force commanders as required.

(5) Local harbor circuits.

(6) Multichannel radio and/or landwire teletypewriter, voice, or facsimile trunk circuits to primary or minor communication centers throughout the world.

(7) Radio or landwire teletypewriter circuits to tributary or user activities.

(8) Radio and landwire link control circuits and facilities at the geographical location of the major communication center.

(9) Visual signaling facilities as required.

f. Radio or landwire circuits emanating from the primary and major communication centers link the several minor centers to the Naval Communication System. Very limited fleet communication support is rendered from a few designated minor centers, as may be required. These minor centers maintain radio or landwire circuits to tributary or user activities.

g. The Naval Communication System employs the tape relay method of traffic relay whereby messages are received and routed to their destination in teletypewriter tape form by means of automatic or semiautomatic relay equipment. Tapes are routed by means of alphabetized routing indicators which are directional in character. These indicators are constructed and assigned in accordance with a definite plan. Tapes are routed in accordance with a routing doctrine which specifies the responsibilities of the relay stations concerned. The varied circuits, channels, equipment, procedures, and routing indicators are engineered and coordinated within the system to give the full benefits of the flexibilities, and speed of automatic or semiautomatic relay equipment. This method of traffic handling is designed to reduce in-station processing to a minimum.

h. The Chief of Naval Operations (DNC) maintains a current list, in the JANAP 195 series, of all Navy radio circuits with the frequencies assigned to each circuit. In addition, the channel allocations, schedules, services rendered, and other details are listed for circuits of the Naval Communication System. Charts are promulgated periodically to show the current radio circuits and the area boundaries of broadcasts of the Naval Communication System.

.4 Functions and Responsibilities of the Components of a Communication Center.

a. The Control Center.—The control center performs the following functions:

(1) Operates the radio and landwire link facilities for remote control of the facilities at the naval radio stations by other components of the communications center.

(2) Operates the facilities for testing all circuits or channels when required, analyzing any malfunctions, and taking remedial action to return the circuit or channel to its appropriate terminal or user in the quickest possible time.

(3) Operates the facilities for patching circuits or channels to alternate terminals or alternate units as required.

(4) Operates the telephone switchboard

and the associated facilities of the point-to-point radiotelephone channels.

(5) Operates the intercommunication system between the control center, the naval radio stations, and other components of the communication center and terminal users.

(6) Maintains close surveillance over conditions existing on all circuits and channels.

(7) Directs emergency changes or adjustments to all circuits, maintaining close coordination with distant stations and terminal users.

(8) Operates and maintains the terminal equipment of all multichannel radio circuits.

(9) Operates all frequency measuring equipment in coordination with distant stations; directs all frequency shifts.

(10) Operates and maintains the facilities required for on-line operation.

b. The Message Center. — The message center has the following responsibilities:

(1) Accepts messages via messenger, mail, pneumatic tube, etc., for rapid transmission, and time stamps copies.

(2) Prepares messages for transmission as follows:

(a) Authenticates releasing signature.

(b) Checks signature for security features.

(c) Prepares copy of messages for checking and retention in files.

(d) Affixes message routing indicators, call signs, and address groups as necessary; prepares heading and routes for transmission of messages to appropriate destination.

(e) Checks and files check copy.

(3) Receives messages via electrical means for local delivery or further relay.

(a) Operates room or tributary circuits to and from the relay station.

(b) Scans messages received for garbles, and time stamps message.

(c) Prepares incoming messages for further relay when required.

(d) Prepares check copy of messages received.

(e) Decodes call signs and address groups.

(f) Makes duplicate copies as necessary for internal distribution.

(g) Routes messages to delivery desk where they are logged for delivery by messenger pick-up, pneumatic tube, telephone, etc.

(h) Checks and files check copy.

(4) Maintains message files.

(5) Maintains service section for obtaining and making prompt corrections to messages.

(6) Maintains current message routing and information facilities to expedite routing of messages to proper circuit for transmission. Maintains close liaison with movement report center for ship locations.

c. The Cryptocenter.—The cryptocenter performs the following functions:

(1) Receives and encrypts messages and routes them to the message center for rapid transmission or transmits to relay station directly.

(2) Receives and decrypts messages and delivers them to addressees and others in ac-

cordance with the internal distribution procedures.

d. The Relay Station.—This station:

(1) Receives messages in tape form for further relay. Single address message tapes are distributed to the appropriate outgoing circuits in accordance with the routing indicators and the routing doctrine; multiple address tapes are distributed to the tape factory.

(2) Operates the tape factory. The necessary quantity of tapes for the number of transmissions required is reproduced without alteration to the original incoming tape. The reproduced tapes are routed and distributed to the appropriate outgoing circuits indicated by the routing indicators and routing doctrine.

(3) Relays messages in tape form in accordance with routing doctrine.

(4) Operates a monitor section for purposes of monitoring and recording all outgoing circuit transmissions.

(5) Maintains a service section for the purpose of obtaining and making returns, tape corrections, handling misroutes, etc.

(6) Maintains a file of monitor tapes for an appropriate period of time.

(7) Many of the aforementioned functions will be performed automatically in the near future as the result of the application of newly-developed automatic traffic switching equipment.

e. The Wire and/or Radio Center.—The center operates those radio or landwire circuits which are off-net or not a part of the integrated tape relay network such as:

(1) Circuits to commercial companies.

(2) Circuits to other government agencies.

(3) Fleet and General Broadcast circuits.

(4) Certain ship-to-shore circuits.

(5) Cables, etc.

f. The Facsimile Center.—When the information to be conveyed is in graphic form, the center operates the facsimile facilities as required for the transmission of pictures, photographs, weather maps, charts, and material.

g. The Visual Signal Station.—The station transmits and receives messages by means of flashing light, semaphore, flag hoist, etc.

h. The Classified Relay Station (Interim).

(1) As an interim measure, a high command (on-line crypto) teletypewriter tape relay network has been established, consisting of classified relay stations linked by channels and circuits of the Naval Communication System. This network utilizes on-line crypto equipment for the handling of classified and unclassified traffic between those high commands served by the network.

(2) The methods, procedures, practices, techniques, and functions of the classified relay stations are similar to those of the relay station.

i. The Transmitter Station.—This station:

(1) Provides the capabilities, through efficient operation and maintenance of all transmitting equipment and associated facilities, to meet the current and foreseeable operating requirements of the Naval Communication Station, facility or unit, of which the transmitter station is a part.

(2) Assists the Supply Department in maintaining a complete and current plant account and history of all equipment and facilities provided for the station.

(3) Provides transmitting facilities to be remotely controlled by other naval activities as authorized by the Chief of Naval Operations (DNC).

j. The Receiver Station.—This station:

(1) Provides the capabilities, through efficient operation and maintenance of all receiving equipment and associated facilities, to meet the current and foreseeable operating requirements of the Naval Communication Station, facility, or unit of which the receiver station is a part.

(2) Assists the Supply Department in maintaining a complete and current plant account and history of all equipments and facilities provided for the station.

(3) Provides receiving facilities to be remotely controlled by other Naval activities as authorized by the Chief of Naval Operation (DNC).

.5 Organization of Naval Communication Stations, Facilities, and Units.

a. The Communication Center. — The Communication Center, discussed in CEDs 2014 and 2015, *Wire Communications Systems Planning,* is commonly part of a communication station, facility, or unit. Stations, facilities, and units are each organized according to current Chief of Naval Operations (DNC) directives.

b. The Naval Communication Unit, Station, or Facility.—The functions of the Communication Station (NAVCOMMSTA) and Facility (NAVCOMMFAC) are the same—the term station denotes an operation within the continental United States or its possessions and facility refers to a communications operation on a foreign soil. The Naval Communication Unit (NAVCOMMUNIT or NAVCOMMU) is assigned a limited or specialized functional mission and therefore generally requires less personnel and smaller facilities than a NAVCOMMSTA.

.6 Management.

a. General—From the standpoint of management, the Naval Communication System consists of all Naval Communication Stations, all Naval Communications Facilities and certain Naval Communication Units, including the buildings, grounds, antenna systems, electronic and cryptographic equipment and systems, utilities and facilities and equipment. Supporting funds are provided for procurement, construction, research and development, upkeep and civilian salaries as required for the operation, maintenance, and improvement of the Naval Communication System.

b. The Chief of Naval Operations (DNC). —The CNO (DNC) is responsible for the management of the Naval Communication System and the Naval Security Group. These responsibilities involve the performance of certain functions of management control, including the preparation of budget estimates and justifications, in support of the current and projected program objectives and the administration of appropriated funds. Budget projects and budget programs have been established with provisions for continuous review and analysis to evaluate program progress in relation to the program objectives.

c. The Director, Naval Communications. —The DNC receives annual financial support for the management of the Naval Communication System and the Naval Security Group from the appropriation Service Wide Operations, Navy (SWON). This appropriation is divided into a number of budget activities, which provide the funds to support regularly established activities of the Navy such as the Naval Observatory, the Hydrographic Office, Naval Stations, bases, etc.

3309. NAVAL COMMUNICATIONS ASHORE.

.1 Shore Establishment Communications.

a. Organization. — The organization of the activities of the Shore Establishment generally provide for a Communication Department. The function of this department is the support of the mission of the parent activity and normally involves the provision of local or intra-activity communication services. The facilities and equipments used by the department vary in amount and scope as required by the activity concerned.

b. Responsibility.—At certain locations, in addition to the provision of communication facilities and services in support of the activity con-

cerned, the Communication Department discharges responsibilities for, and operates as a part of the Naval Communications System. At these specific locations facilities are provided for limited Fleet support in the form of Fleet Broadcasts, local and intermediate ship-to-shore circuits, point-to-point radio or wire circuits, or for tape relay functions.

c. Facilities.—Normally the Communication Department of activities of the Shore Establishment provides for a small communication center, consisting of a Message Center and Crypto-center, in support of the mission of the activity concerned. However, where required, it may also provide for a Relay Station, Wire and/or Radio Center, Control Center, Radio Transmitting and Receiving Facilities, and a Visual Signal Station.

d. Use of Established Facilities.—It is the policy, in the interests of economy and efficient use of men, money, and material, where practicable, to install required transmitting and receiving equipments in regularly established radio transmitter or receiver stations of the Naval Communication System and remotely control those facilities from the Communication Center of the activity concerned.

e. Financial Support.—Generally, activities of the Shore Establishment, except as noted, are tributaries of the Naval Communication System, and, as such, the Naval Communication System budgets for the expenses of the circuit connecting the tributary into the system. Where an activity performs functions for, and is an operating part of the Naval Communication System, provision of the necessary facilities to perform those functions is made by the System.

f. Local Management. — Communication departments of activities of the Shore Establishment other than those under the management control of the Chief of Naval Operations are under the management control of their respective bureau or office. The Chief of Naval Operations, however, exercises technical control over their operations.

g. Additional Responsibilities of CNO.—In addition to the exercise of management control of the Naval Communication System and the Naval Security Group, the Chief of Naval Operations (DNC) performs certain managerial functions in connection with the communication departments of other activities of the Shore Establishment under the management control of the Chief of Naval Operations. These managerial functions are:

(1) The establishment of organizational structures and the determination and coordination of functional assignments.

(2) The coordination of the planning for and the assignment of civilian personnel within the overall civilian personnel ceilings allocated.

(3) The coordination of civilian personnel ceilings with military personnel allowances.

(4) The coordination, within the Office of the Chief of Naval Operations, of reviews of organizations when required.

(5) The preparation of budget estimates and justifications, in accordance with current directives, assisting as required in the justification of programs and estimates at all budget reviews. The Chief of Naval Operations (DNC) makes recommendations for necessary appeals for funds and allocates that portion of the final approved SWON funds made available.

(6) The administration, in accordance with current instructions, of the Management Improvement Program, the Manpower Utilization Program, the Work Measurement Program, and similar programs.

3310. COMMUNICATIONS AFLOAT.

.1 Communication Organizations of the Operating Forces.—Every communication organization of the Operating Forces is an integrated unit of that command. Through the ship or staff organization, the commanding officer or commander has direct and positive control of communications; the communications organization participates in the exercise of command through the transmission and reception of signals and messages.

.2 The Operations Department of a Ship.—The Operations Department is one of the command departments of a ship. It maintains all external communications. The Operations Department is also responsible for the combat information center, control of aircraft in the air, and electronics repair. In a large ship, the operations department will both contain signal and radio divisions; in a small ship these two divisions may be combined.

.3 The Communications Department of a Staff.—On a naval staff the communications organization is a staff department or division separate from the staff operations department or division.

.4 Flagship. — On board flagships, ship and flag personnel may be combined into one communications organization, under flag supervision.

.5 Communication Spaces.

a. General.—The number, size, and location of the communication spaces of a ship is dependent upon the size and mission of the ship. In a large ship, the functions of the communication organization are carried out in the following spaces:

(1) *Message Center.*—The shipboard message center contains personnel and equipment for format, write-up, internal routing, delivery, and filing of messages. It is the duty station of the communication watch officer. All messages, other than operational messages received and sent direct from shipboard control stations, must clear the message center before internal routing or external transmission. In shops without space allotted for a message center, the functions of the message center are carried out in radio central.

(2) *Radio Spaces.*—Radio central, also called main radio, is the largest and most completely equipped radio space on board ship. It contains operating positions for radiotelegraph, radiotelephone and facsimile communications. Normally, it is the location where transmitters, receivers, and remote speaker and keying positions are selected and connected to provide communication channels for the remote operating stations throughout the ship. Radio central is located close to the message center; it is the duty station of the supervisor of the watch and of most radio operating personnel. According to the size of the ship, there may be one or more additional spaces containing special or supplemental equipment, or duplicate facilities. Depending upon their arrangement and intended use, these spaces may be designated as the transmitter room, the emergency radio room, auxiliary radio, or other appropriate functional titles.

(3) *Remote Control Facilities.* — Remote stations, consisting of receiving outlets and transmitter keying positions, are established in battle control spaces where a need exists for direct radio communication. These remote stations are connected to radio central, where the desired receivers and transmitters are selected.

(4) *Cryptocenter.* — The functions of the shipboard cryptocenter are the same as those of the cryptocenter ashore.

(5) *Visual Signal Spaces.*—Equipment and spaces for visual communications are provided in the superstructure of the ship. Signal halyards run from the yardarm to flagbags at the foot of the mast for flaghoist signaling. Signal searchlights and semaphore platforms are located in positions where each will have the largest arc of vision and their total coverage will be 360°. Remote control keys for operating yardarm blinker, nancy, and searchlights are placed in convenient and protected positions.

SECTION III—COMMERCIAL COMMUNICATIONS SYSTEMS

3311. HISTORICAL DEVELOPMENT OF INTERNATIONAL COMMUNICATIONS SYSTEMS.

.1 Radiotelegraph.—The commercial development of radiotelegraph began shortly after 1895, when Marconi first demonstrated that intelligible electric signals could be transmitted through space without the aid of connecting wires. In 1895 and 1899, the Marconi Wireless Telegraph Company, Ltd. (British Marconi Company) and the Marconi Wireless Telegraph Company of America (American Marconi Company) were organized to engage in commercial radio communications. All commercial wireless communication in the United States was performed by the American Marconi Company which was controlled by the British Marconi Company. Later, American-controlled companies were organized. The DeForest Wireless Telegraph Company was organized in 1903, the Federal Telegraph Company in 1911, the Tropical Radio Telegraph Company (a subsidiary of the United Fruit Company) in 1913, and the United Wireless Telegraph Company was organized in 1917. Until World War I, however, transoceanic radio communications were unreliable because of the lack of efficient transmitting and receiving equipment. This was due partly to the fact that certain patent rights essential to the manufacture of efficient equipment were controlled by different manufacturers. At that time, radio communications companies confined their operations primarily to ship-to-shore service. Since that time, radiotelegraph facilities have more than doubled, and new companies have appeared in all major portions of the world.

.2 Radiotelephone.—As early as 1915, the US. Government, in conjunction with the American Telephone and Telegraph Company (AT&T), had carried on experiments in the field of radiotelephony. During that year, messages were sent from the Naval Station at Arlington, Virginia, and from Washington, to such distant points as San Francisco, Honolulu, and Paris. However, World War I interrupted further experimental tests in this field. After the war, transoceanic radiotelephone research continued and expanded. The first international radiotelephone circuit was established between New York and London in January 1927. Shortly after the opening of this circuit, the service was extended beyond the terminals of the radio circuit to all of Great Britain and all of the United States by means of wire lines. Service was extended to Cuba and to a part of Canada by the end of 1927. In 1928, service was extended to many countries in Western Europe, utilizing the extensive telephone network connecting London with the continent. Radiotelephone facilities have, of course, greatly expanded. Today, almost every country in the world is linked to another by such means.

.3 Transatlantic Cable.—The first transoceanic submarine cable was laid between Heart's Content, Newfoundland, and Valentia, Ireland, in 1858, by the Atlantic Cable Company, a British company. It operated for only a few weeks. Attempts were made in 1865 by another British company, the Anglo-American Telegraph Company, to lay a cable between Newfoundland and Ireland. At the same time, the 1865 cable was picked up and repaired. The Direct United States Cable Company (British) laid a cable between Nova Scotia and Ireland in 1874. French commercial interests laid a cable between Saint-Pierre, Nova Scotia, and Brest, France, in 1879, and another between Cape Cod, Massachusetts, and Brest in 1898. The American Telegraph and Cable Company, an American company, laid two cables between Canso, Nova Scotia, and Waterville, Ireland, in 1884. A German company laid two cables, one in 1900, and the other in 1904, between New York, N. Y., and Emden, Germany, via the Azores. These companies were prevented from landing their cables in Newfoundland by the fact that the Newfoundland government had granted exclusive licenses for landing cables to the Anglo-American Telegraph Company. Transatlantic cables are now greatly increased in number, and many new companies have been formed for their operation.

3312. TELECOMMUNICATIONS FACILITIES OF THE UNITED STATES.

.1 Telephone.—In the United States, the telecommunications facilities, and the industries supporting these facilities, are privately owned and operated. The telephone facilities are provided by the various operating subsidiaries of the American Telephone and Telegraph Company and approximately 5,300 independently-owned companies which are members of the Independent Telephone Association. The Bell Telephone System, the name by which the American Telephone and Telegraph Company is better known, operates about four-fifths of the more than 50 million telephones in the United States, and is the largest telephone system in the world.

.2 Telegraph.—Domestic telegraph service is provided by the Western Union Telegraph Company. The Company also operates an international submarine-cable network between the United States and Europe, the United States and certain islands in the Caribbean Sea, and by relay over foreign-company facilities to South America.

.3 Teletype.—The Bell Telephone System and Western Union provide facilities for private-line teletype service to industry and to the military services. Western Union (along with AT&T, Mackay Radio, Commercial Cables, and RCA) operates a form of teletype service to London, and also operates press news channels.

.4 Radiotelephone.—The AT&T operates the major facilities for overseas radiotelephone service. In certain overseas and foreign areas, RCA Communications, the Radio Corporation of Puerto Rico, and the Tropical Radio Telegraph Company provide radiotelephone service connecting with the AT&T in the United States.

.5 Cable.—Submarine-cable facilities are provided by the Western Union and two subsidiaries of the International Telephone and Telegraph Corporation (IT&T). The IT&T cable companies are the Commercial Cable Company (operating in the North Atlantic to Europe), and the All America Cable and Radio Company (operating in the Caribbean Sea and the Atlantic and Pacific Oceans to Central and South America).

.6 International Landlines. — International landlines are operated by AT&T and Western Union for telephone and telegraph service, respectively, to Canada and Mexico. Telephone service to Alaska is provided by AT&T in the United States, via facilities of the Alberta Government Telephone Company and the Northwest Communications System in Canada, and on the Alaska Communications System (ACS) lines in Alaska. Many private industries, such as petroleum, railroad, airline, lumber, mining, shipping, operate private radio communication facilities. Some of these facilities are quite extensive and modern, *e.g.*, the railroad radio systems and the microwave relay systems being installed along petroleum pipelines. City, county, and state law enforcement agencies have extensive local networks which are combined by zone and interzone radio stations to provide national coverage. The Federal Bureau of Investigation employs radio facilities and private-wire leases for an extensive national network, as do many other governmental agencies.

.7 Radio Broadcast. — The radio broadcast field is dominated by four major networks, and is supplemented by many regional networks for program relaying. The four major networks are the National Broadcasting Company, the Columbia Broadcasting System, the Mutual Broadcasting System, and the American Broadcasting Company. The member stations of these networks are supplied with program material over the facilities of the AT&T landlines. In the case of the television stations associated with these networks, the video portion of the program material, is relay via coaxial cable and microwave relay systems, and the audio portion is carried over the regular radio program networks.

3313. THE BELL SYSTEM.

.1 Organization.

a. General.—Basically, the Bell System is made up of the American Telephone and Telegraph Company and a group of 21 closely-integrated as-

sociated telephone companies which own and operate telephone plants in their respective geographical territories. Therefore, each associated company exists as a distinct corporate unit and is separated along territorial and functional lines. The associated companies are not controlled by the AT&T company, but like other associated companies, have a license contract arrangement with it. The organization includes the Western Electric Company, a manufacturing and supply organization, and the Bell Telephone Laboratories. (See Figure 33-10.)

(1) *The American Telephone and Telegraph Company.*—The AT&T performs an important interstate operating function through its Long Lines Department which owns and operates long distance lines interconnecting the 21 subsidiary operating companies. In addition, AT&T coordinates the entire enterprise by planning and advising the associated companies on all phases of the business through its staff of specialists.

(2) *The Bell Telephone Laboratories.*—This organization is responsible for all fundamental research and development work of the Bell System. The laboratories are composed of four chief development and research groups. These groups work in close cooperation and the majority of the products of the laboratories represent the work of all. The continued ability of the Bell System to provide high-quality service depends largely on this organization. It has been responsible for a number of new developments in the communications-electronics field.

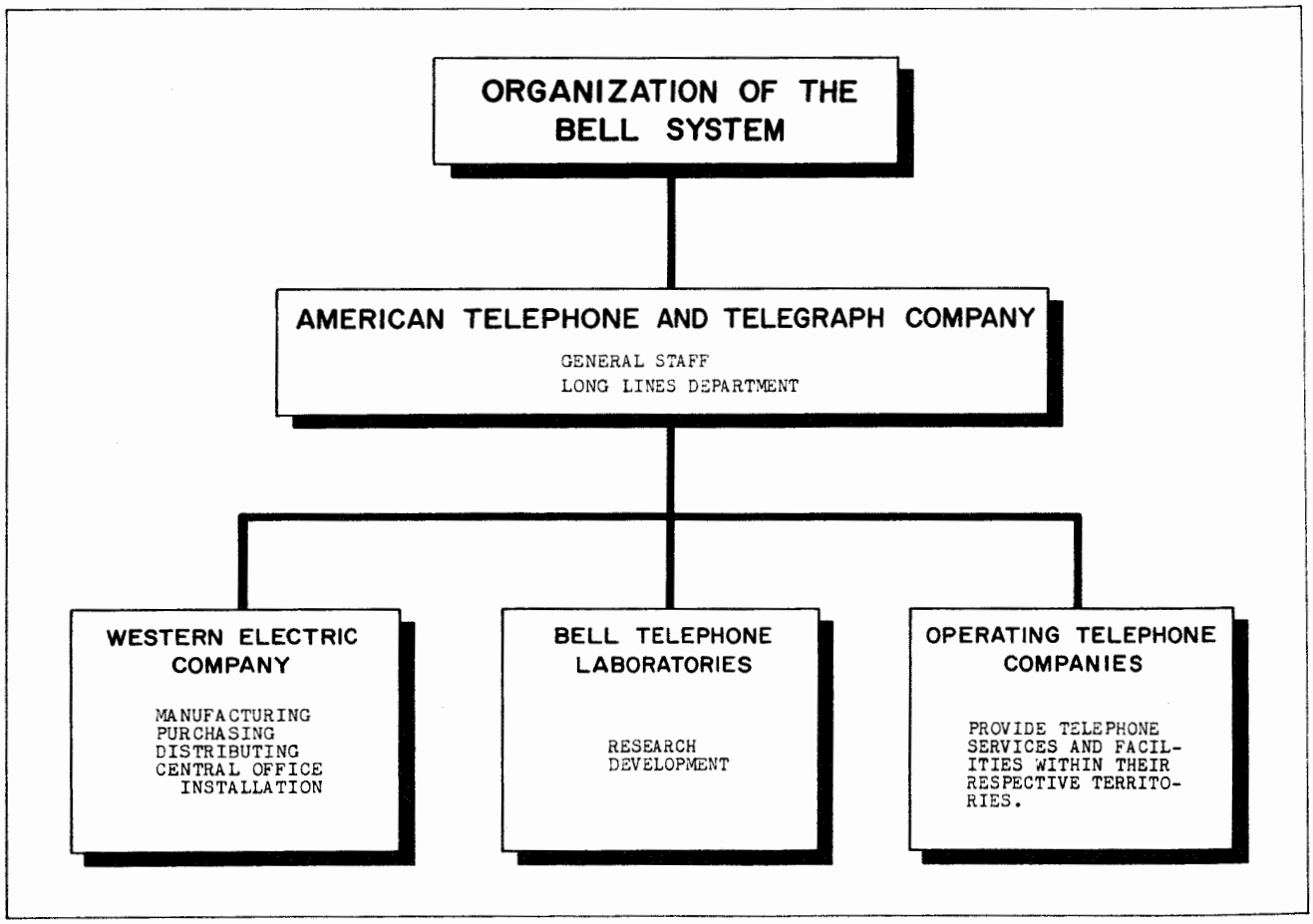

Figure 33-10.—*Organization of the Bell System.*

Figure 33-11.—*Bell System Coaxial Cable Routes.*

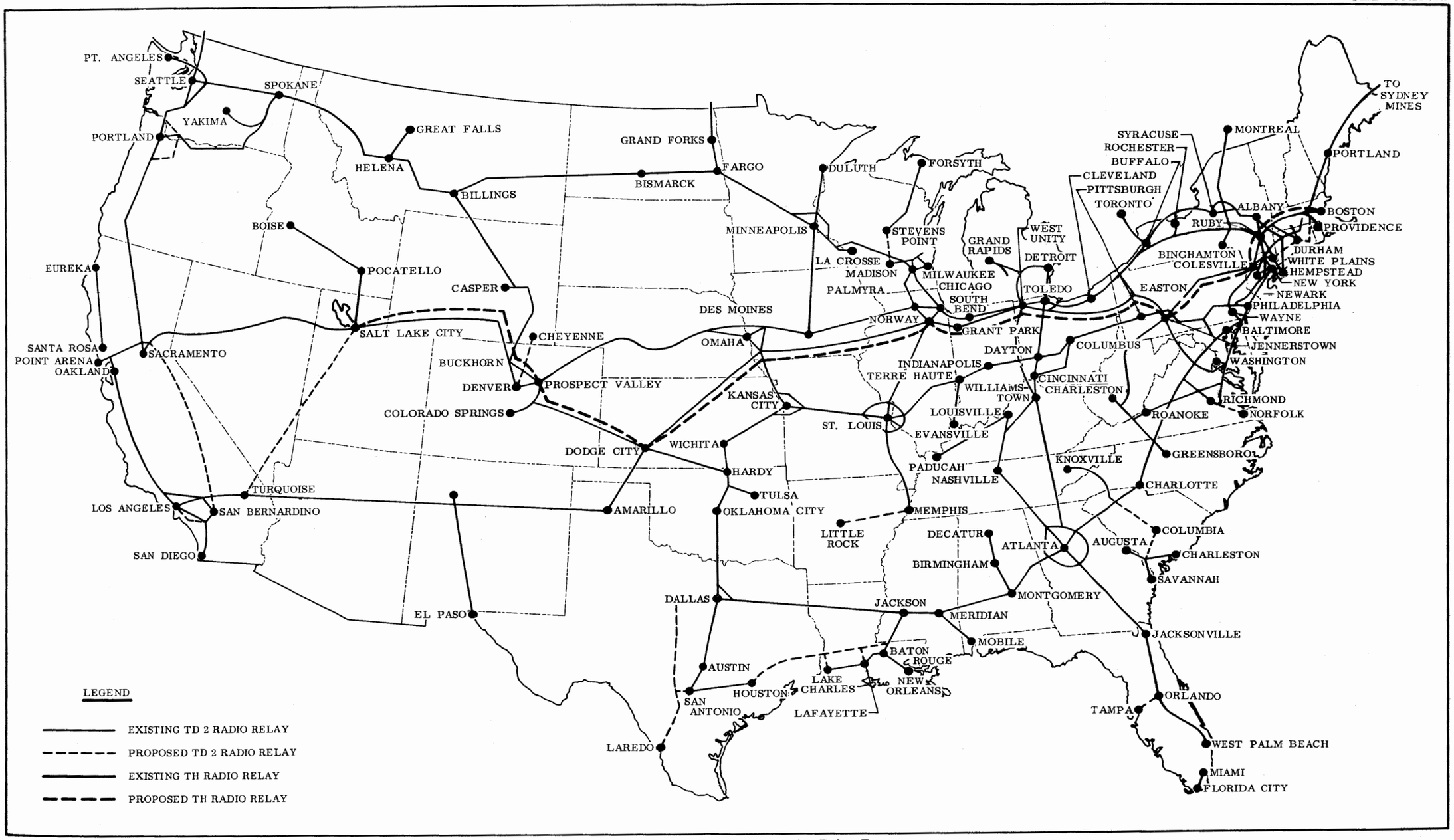

Figure 33-12.—*Bell System Carrier and Radio Relay Routes.*

(3) *The Western Electric Company.*—This organization is the manufacturing and supply unit of the Bell System. The major functions of the company, in relation to the Bell System, are the manufacture of most of the apparatus and equipment, the purchase of most of the supplies, the installation of central office equipment, and the distribution of supplies. At supply houses located throughout the country, Western Electric maintains close supply sources for the operating companies. These facilities service urgent demands, and provide a ready reserve of materials in the event of disaster. The company also acts as a purchasing agent for the Bell System companies. Through ownership of Western Electric, it is possible for the Bell System not only to control adherence to rigid specifications, but also to have a manufacturer whose primary interest is in the quality of service which his goods will render to the ultimate user. Of great importance, also, is the fact that a centralized supply source ensures the compatibility of the various systems. In large measure, Western Electric is responsible for the standardization and integration of the telephone network of this country.

(4) *Other Companies.*—The associated companies' territories vary greatly in size. In some instances, the territory of an associated company may be identical with that of a state, or a portion of a state, while in others it may include several states. The various operating telephone companies are responsible for the telephone service in their own particular areas. Each has a staff organization and operating departments for handling plant, traffic, and commercial matters. Each associated company is a separate entity and is largely self-owned. These companies share, however, in the advantages of a central coordinating headquarters, a common development unit and a nationwide manufacturing unit.

.2 Facilities Provided.

a. Domestic.—The Bell System's primary undertaking is the furnishing of domestic telephone service. The Bell System, with its 21 operating companies, and through interconnecting arrangements with the independent telephone companies, furnishes domestic, local, and long-distance telephone service to over 50 million United States telephones. This concentration of telephones is greater than the rest of the world combined. For the major interstate telephone and radio relay routes in the United States, see Figures 33-11 and 33-12. These are the routes which carry the heaviest circuit concentrations and the television network facilities. The Bell System has four major plant types which are used to interconnect the cities of the United States. (See Figure 33-13.)

(1) *Open Wire.*—A single pair of conductors is used to carry one voice channel, or, with multiplexing systems, 16 channels per pair.

(2) *Multiple Pair Cable.* — Multiple copper paired conductors are used to carry voice circuit on the individual pairs or with multiplexing systems, producing up to 12 telephone channels per pair.

(3) *Coaxial Cable.*—Coaxial cable consists of a center conductor mounted within a concentric tube, and permits transmission of signals. Generally, a plant consists of eight coaxial cables; six for regular service and two for spares. The most recently designed voice-multiplex equipment makes it possible for each pair of coaxials to handle 1800 two-way telephone circuits (one coaxial for each direction). A fully loaded plant will, therefore, handle 5400 two-way telephone circuits. Each pair of coaxials can also carry two oppositely directed one-way television channels and 600 telephone circuits instead of the 1800 two-way voice channels. A complete plant may then be used to carry six one-way television channels (three in each direction) plus 1800 telephone circuits, with two coaxials held as spares.

(4) *Radio Relay.*—Radio relay systems require towers at regular intervals (about 30 miles) for relaying telephone, teletype, or television signals from city-to-city. Carrier waves are relayed from tower-to-tower by means of high-gain antennas, coupled with extremely reliable transmitters and receivers. Sensory units are provided within each station to detect faulty circuits, to inform maintenance crews of failure, and to switch to standby equipment in case of outage. Radio relay stations will

Carrier Telephone System		Line Facilities		Repeater Spacing in Miles (Approx.)	System Lengths in Miles (Approx.)	Voice Channel AM Modulation		Remarks
Type	Number of Voice Channels	Type	Frequency Band			Carrier	Sidebands	
C	3	1 pair of open wire	5-30 kc	130-180	50-2000	Suppressed	Single	
H	1	1 pair of open wire	4-10 kc	See Remarks	25-200	Suppressed	Single	A repeater is available but not normally used. A non-regulated system.
J	12	1 pair of open wire	36-143 kc	30-100	1500	Suppressed	Single	Used on 6-8 inch spaced J transposed open wire.
K	12	See Remarks	12-60 kc	17	50-1500	Suppressed	Single	Uses separate 19 gauge non-loaded cable pair in each direction. The two pairs are usually in different cable sheaths.
L1	600	2 oppositely directed .27- or .375-inch coaxials	68-2788 kc on each coaxial	5.4 mi. for .27 coaxial; 7.9 mi. for .375 coaxial	100-2000	Suppressed	Single	58-cycle power for operation of most of the intermediate repeaters is fed to them over the coaxials. Two oppositely directed video channels may be obtained from a pair of coaxials, in lieu of 600 two-way voice channels.
L3	1860	2 oppositely directed .27- or .375-inch coaxials	312-8284 kc on each coaxial	2.7 mi. for .27 coaxial; 4.2 mi. for .375 coaxial	100-2000	Suppressed	Single	58-cycle power for operation of most of the intermediate repeaters is fed to them over the coaxials. One video channel in each direction, and 660 voice channels may be obtained from a pair of coaxials, instead of 1860 voice channels, if desired.
N	12	2 oppositely directed cable pairs	44-260 kc	8 mi. (19 ga.) 5 mi. (22 ga.)	15-500	Transmitted	Double	Power (d-c) to operate an intermediate repeater is fed over the N carrier pairs to adjacent non-power repeater points (a maximum of one in each direction may be fed).
OA OB OC OD	4 4 4 4	1 pair of open wire will accommodate all four systems	2-36 kc 40-76 kc 80-116 kc 120-156 kc	130 30-130 30-90 30-75	15-500; not more than six repeater sections	Transmitted Transmitted Transmitted Transmitted	Single Single Single Single	Lengths of repeater sections and overall systems depend upon gauge wire, sleet or snow areas, line filter and toll entrance cable requirements, etc.
ON1	20	2 cable pairs	40-256 kc	8 mi. (19 ga.) 5 mi. (22 ga.)	300	Transmitted	Single	May be used as an all cable system, or in combination with Type O systems as a combined open wire and cable system.
TD2	600	2 oppositely directed radio relay channels	20-mc r-f channel in each direction in 3700-4200 mc band	60 (max.) 30 (avg.)	100-2000	Suppressed	Single	All amplitude modulated carrier channels are combined and frequency modulated for transmission over the microwave channels. One video channel each direction may be used instead of 600 voice channels if desired.

Figure 33-13.—*Bell System Commonly Used Carrier Telephone Systems.*

handle at least 12 one-way communications channels, and provide a total of 3000 telephone circuits or 10 one-way television channels. Appropriate spare channels are also provided for maintenance or emergency use.

b. Foreign.—In addition to the telephone network covering the United States, telephone service is available to about 96 percent of the world's telephones through the overseas radiotelephone facilities of the Bell System. (See Figure 33-14.) These facilities connect the United States with various parts of the world through radio channels originating at terminals near New York, Miami, and San Francisco. Connection is made with the Alaska Communication System of the US. Army at Seattle. Since the Bell System operates within the ConUS only, radiotelephone service is rendered in cooperation with the appropriate operating organization in each of the countries concerned.

(1) *General.* — The long-haul international radiotelephone circuits of the world generally use single-sideband transmission which results in

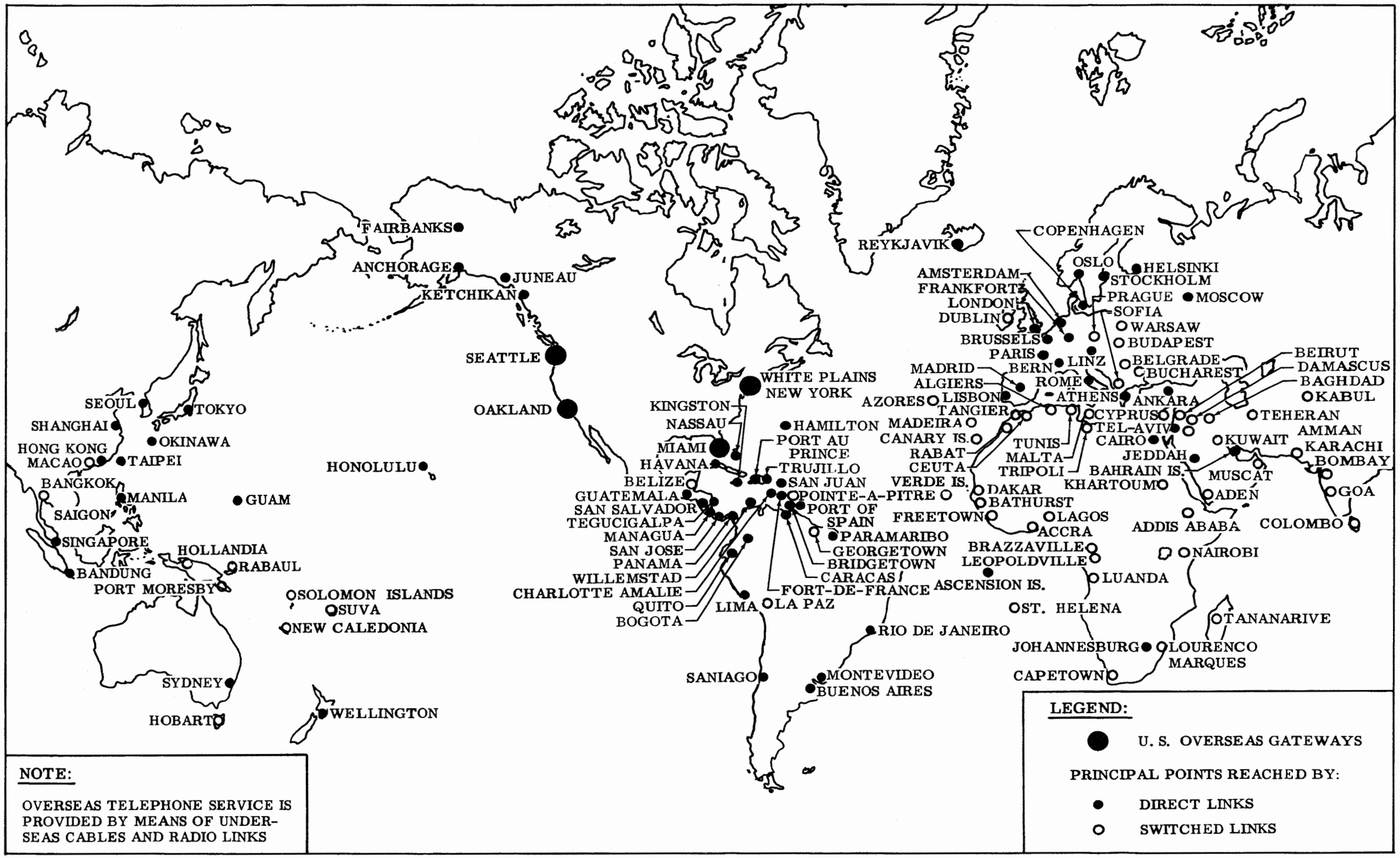

Figure 33-14.—*Bell System Overseas Telephone Service.*

improved intelligibility with narrow carrier bandwidths. More than 90 percent of the Bell System's direct radiotelephone circuits are operating with single-sideband transmission. In fact, the large expansion of international high-frequency radiotelephone services throughout the world would have been impossible without the frequency economy of single-sideband transmission. The reliability of communication over long-distance, high-frequency radiotelephone circuits still leaves much to be desired. This is particularly true of the paths traversing the magnetically disturbed auroral zone. The path from the United States to Northern Europe is, for example, subject to many severe disturbances which sometimes interrupt communication to some countries for hours at a time. To improve the continuity of communications, arrangements have been made with most of the European countries whereby, when direct communication is disrupted, telephone calls can be completed via some other country over connecting wire routes. For example, calls for Sweden are completed via Amsterdam or Brussels when direct service is unavailable. In addition, some circuits to Europe have been set up by relaying through more southerly latitudes to avoid the disturbed northern path. For this purpose, three circuits from New York to Paris are routed via Bamako, in French West Africa. Two circuits from New York to Amsterdam are routed via Paramaribo, in Surinam, on the northern coast of South America. Two circuits from New York to London are operated during the evening hours via Barbados, British West Indies. In order that these circuits will be available immediately on demand, they are operated daily as part of the normal facility routing, as well as on an emergency basis during disturbed conditions.

(2) *North Atlantic Telephone Cable.*— In spite of great technical advances in electronics, the establishment of reliable radio communication to Europe has not been completely successful. A voice cable between the continents of America and Europe has been considered for many years; but it was not until recently that suitable techniques were developed, making such a cable practicable. In the latter part of 1951 and early 1952, discussions were held in this country, followed later by negotiations with the British Post Office and with the Canadian communications personnel, looking toward the construction of such a cable. These negotiations were successful, and work on the technical details and routing began. As might be expected, the selection of the route was one of the most important considerations of the construction plan. The cable could not be laid directly from the United States to England because of the power supply needed for the number of repeaters required for satisfactory transmission. Therefore, a stop at some intermediate point was called for. There were two routing possibilities: from New York by way of Newfoundland to England or Scotland, or from New York by way of the Azores to England. Consideration of the many hazards involved led to the choice of the route from Newfoundland to Scotland. This, the shortest practical route, is north of existing cables, runs through a minimum of pack ice, and misses most of the trawling grounds. The link from Newfoundland to Nova Scotia runs underwater; but from Nova Scotia into Portland, Maine, it uses a conventional radio relay system. There are 36 voice circuits in the cable. To provide adequate communications, it was necessary to install underwater repeaters in the cable at intervals of about 40 miles. These repeaters have three low-power vacuum tubes which will operate for many years without attention. Such repeaters have been in operation in a Key West-Havana cable for four years without any breakdowns. The European cable has been designed to last at least 20 years with no outage due to defects in its manufacture and construction, or due to failure of its operating parts. Extensions to the rest of the Continent will be possible. The extent of the ocean cable network now existing is shown in Figure 33-15.

(3) *Alaskan Telephone Cable.* — The first Alaskan cable was completed in 1904 and replaced in 1924. A second underwater cable between the United States and Alaska was opened for service in 1956.

(4) *Transpacific Telephone Cable.*—In October 1957, a third underwater telephone cable was opened for service. The new cable connects the United States mainland with the Hawaiian Islands. The 2400-mile transpacific cable is similar in design and construction to the 2250-mile Atlantic

Figure 33-15.—*Bell System Underseas Cable.*

telephone cable, and the 900-mile Alaskan cable. The twin cable system is capable of carrying 36 simultaneous conversations, and is the first underwater cable to feature operator dialing. The Hawaiian cable has substantially augmented the 14 radio circuits operating between the mainland and Honolulu. The cable system is also used for teletypewriter service and for transmission of radio programs, but not for television transmission.

c. Private Facilities. — The Bell System has an extensive network of private line telegraph facilities and TWX[1] circuits. Most of the press wires and a large portion of the private line telegraph facilities of large business houses, brokers, and the government are provided by the Bell System. Over 4,000 TWX circuits, and over 4,000,000

[1] Teletypewriter Exchange Service.

miles of private line telegraph circuits, are now in service.

.3 Special Communication Facilities.

a. Mobile Radiotelegraph Units. — The Bell System provides service to mobile radiotelephone units. About one-half of these are private systems, and the balance connect to the regular commercial telephone network.

b. Marine Radiotelephone Service.—Radiotelephone service is available to large transoceanic passenger lines on the high seas, and for smaller boats operating in coastal and harbor waters, and in the Great Lakes.

c. Video Channels.—The Bell System has a nationwide network of video channels which serve the television broadcasting industry.

.4 Security and Mobilization Plans.

a. General.—The entire communications industry is faced with the problems of providing uninterrupted service, despite natural or man-made disasters. Although improvements have been made in engineering design and maintenance methods, interruptions in service still occur. One of the best methods of assuring reliable service is the diversification of circuits. In the new telephone facilities construction program, diversification has been realized by building new routes. As the ConUS telephone networks spread, it became a simple matter to route circuits between any two points over separate lines. With the advent of possible nuclear bombing of many large cities, it is realized that long distance telephone facilities might be seriously disrupted. The bypass and express routes are constructed to protect service from interruption.

b. Alternate Switching Facilities.—Work is being accomplished to ensure that intercity telephone traffic is not wiped out completely in the event of enemy attack or natural disaster. Alternate switching centers, at considerable distance from the main switching centers, and ring cables have been established to provide this protection. The arrangement has been carried out in key cities such as Washington, D. C., and Detroit.

c. Alternate Routing.—The matter of bypassing cities is very important. The Bell System with its many alternate routes provides this capability. With vacuum tube repeaters, carrier systems, and modern transmission techniques, good voice communication no longer depends upon the size of a copper wire. It is now possible to connect the basic carrier, coaxial, and radio-relay systems together, and get a transmission characteristic equal to that of any one of the separate systems. The Bell System provides relief for congested traffic situations in daily operations by use of this alternate routing characteristic. There are seven transcontinental routes. Of these, four are open wire; one is a cable equipped with the paired-cable type of long-haul carrier; another is of the coaxial cable type, along the southern route; and finally, a radio-relay route spans the country from coast-to-coast. A major addition will be another radio-relay route across the southern portion of this country, terminating at Los Angeles. There are many facilities available in the major routes through the country. The basic facilities on these major routes are such that additional circuits can be established as needed, since the cable or the radio-relay towers are already constructed. For example, a radio-relay system will handle 3000 two-way telephone conversations when fully utilized. Only a few of the existing radio-relay systems are so loaded. Additional circuits on these routes will require the installation of repeater and terminal equipment at the various points along the line, but they do not require major construction. In addition to microwave radio-relay facilities, there are other radio systems which also afford substantial help under emergency conditions. The Bell System has available, as standby equipment throughout the country, approximately 100 radio systems that can be used in emergencies, or to bridge the gap which may have occurred in wire lines or cable as a result of disaster. These facilities are of a single-channel variety, and will not now take care of multiple-circuit requirements. The Bell System is currently adding to its emergency radio facilities newly designed portable equipment. This equipment includes portable aluminum towers that can be erected within an hour at a location where toll circuits have been damaged. Work is in progress to provide facilities which can convert this single channel to a multichannel arrangement by the addition of mulitplexing equipment.

d. Mobile Equipment.—Mobile radio stations of the telephone system can be used for immediate temporary service where needed.

e. Personnel and Supplies.—Trained personnel with large stocks of material available to them are located in a large number of locations. The associated companies, as part of their regular service provision, have developed plans for restoration of essential service in emergencies.

3314. INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION (IT&T).

.1 Corporation Background. — IT&T was founded in 1920. Two of its operating companies date from 1878 and 1883; two of its manufacturing companies date from 1879 and 1880. The wide geographical extent and varied activities of the corporation are thus backed by experience nearly as old as the electrical communications industry itself. Long a major supplier of telephone and telegraph equipment overseas, the IT&T system began during World War II to expand its research and manufacturing activities in the United States and it now ranks among the leaders in electronics and telecommunications. The company is unique in the variety and scope of its activities in the twin fields of telecommunications and electronics.

.2 Services.—IT&T provided South America with its first radiotelephone service to Europe and North America; Europe with its first multichannel commercial radiotelephone link and its longest coaxial cable network; Belgium and Switzerland with pioneer nationwide telephone dialing equipment; and the world with its first commercial microwave system. Telephone operating subsidiaries of IT&T provide comprehensive telephone service in Chile, Cuba, Puerto Rico, Virgin Islands, and to certain areas of Brazil and Peru. The company has an interest in the undersea telephone cable facilities and over-the-horizon microwave telephone and television facilities between Cuba and the United States, and the deep-sea repeatered twin submarine telephone cables now in operation between Florida and Puerto Rico. Radio operating subsidiaries of IT&T in Argentina, Bolivia, Brazil, Chile, Cuba, and Puerto Rico provide international radiotelephone service and, except in Puerto Rico, international radiotelephone service as well.

.3 Operating Subsidiaries.

a. American Cable & Radio (AC&R) Corporation.—AC&R is the largest American international telegraph system, owning and operating both cable and radio facilities. AC&R was formed in 1940 when the operations of three IT&T affiliates, All America Cables and Radio, Inc., the Commercial Cable Company, and Mackay Radio and Telegraph Company, were consolidated. Later in the same year, a fourth IT&T company, Sociedad Anonima Radio Argentina (Buenos Aires), was added to the system. AC&R still remains closely associated with the parent company, IT&T. Administrative and operating headquarters for the entire system are located at 67 Broad Street, New York City. The AC&R system offers a complete, global record communication service for the use of government agencies, the general public, and the press. It operates more than 80 international radiotelegraph circuits; more than 15,500 miles of landlines; and approximately 48,000 miles of submarine cable. This cable is multiplexed to provide some 174,500 nautical miles of cable channels. The principal types of service rendered are: point-to-point, ship-to-shore, radiotelephone, multiple addressed press and presscast, and *telex*. AC&R also leases cable and radio channels for private message traffic as well as for certain types of data processing. Figures 33-16, 33-17, and 33-18 show the global communication network of the AC&R system, and IT&T subsidiaries. AC&R maintains and staffs more than 140 overseas traffic offices in addition to its numerous branch offices and main operating centers located in the gateway cities of New York, San Francisco, and Washington, D. C. Six powerful marine stations are located on the Atlantic, Pacific, and gulf coasts of the United States. The system owns and operates a fleet of four cableships for the laying and repairing of its vast cable network.

(1) *All America Cables and Radio, Inc.* —This company was the first to bridge the Americas by telegraph when, in 1881 and 1882, its predecessor companies, the Mexican Telegraph Com-

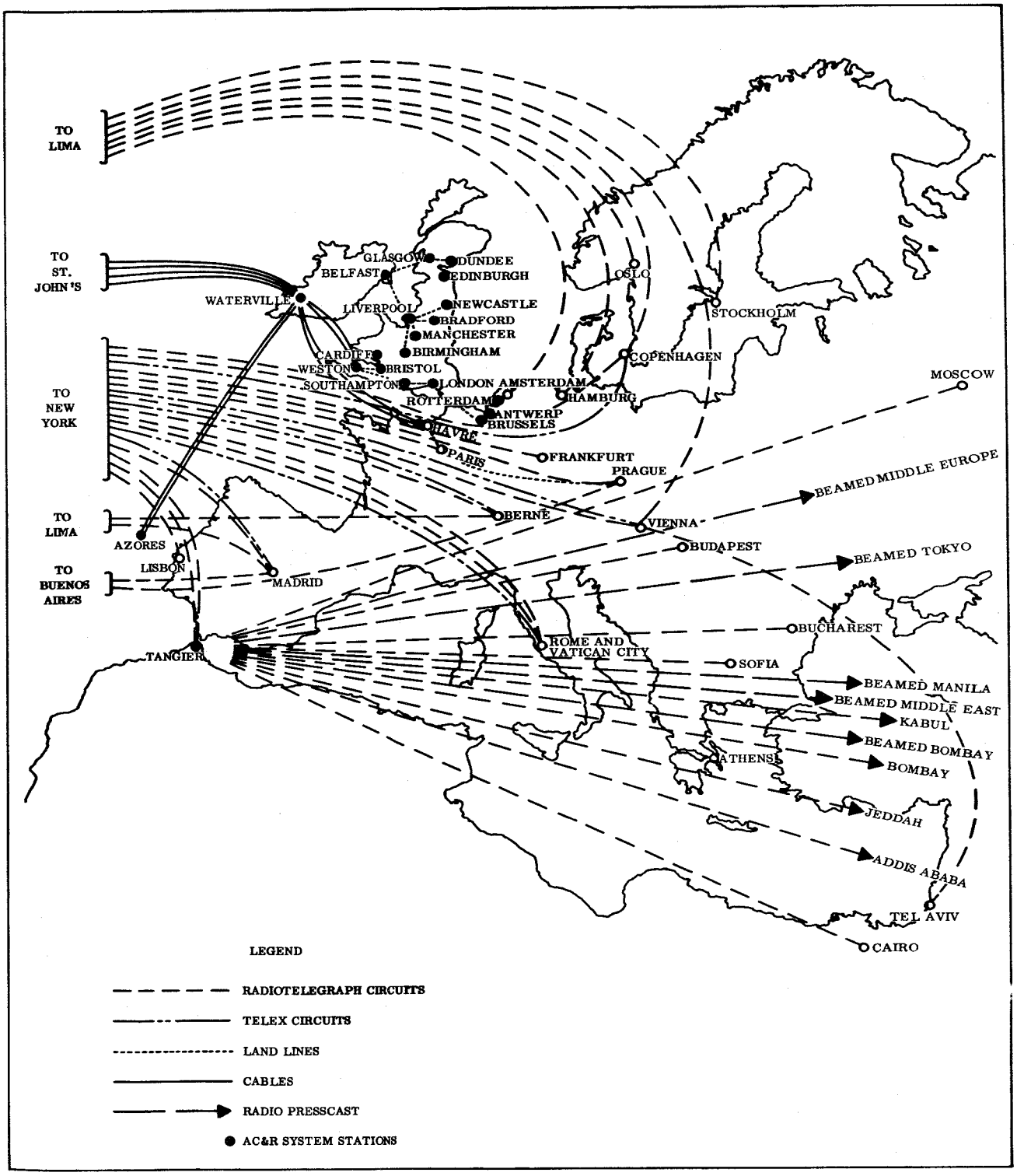

Figure 33-16.—*AC&R Network, European Section.*

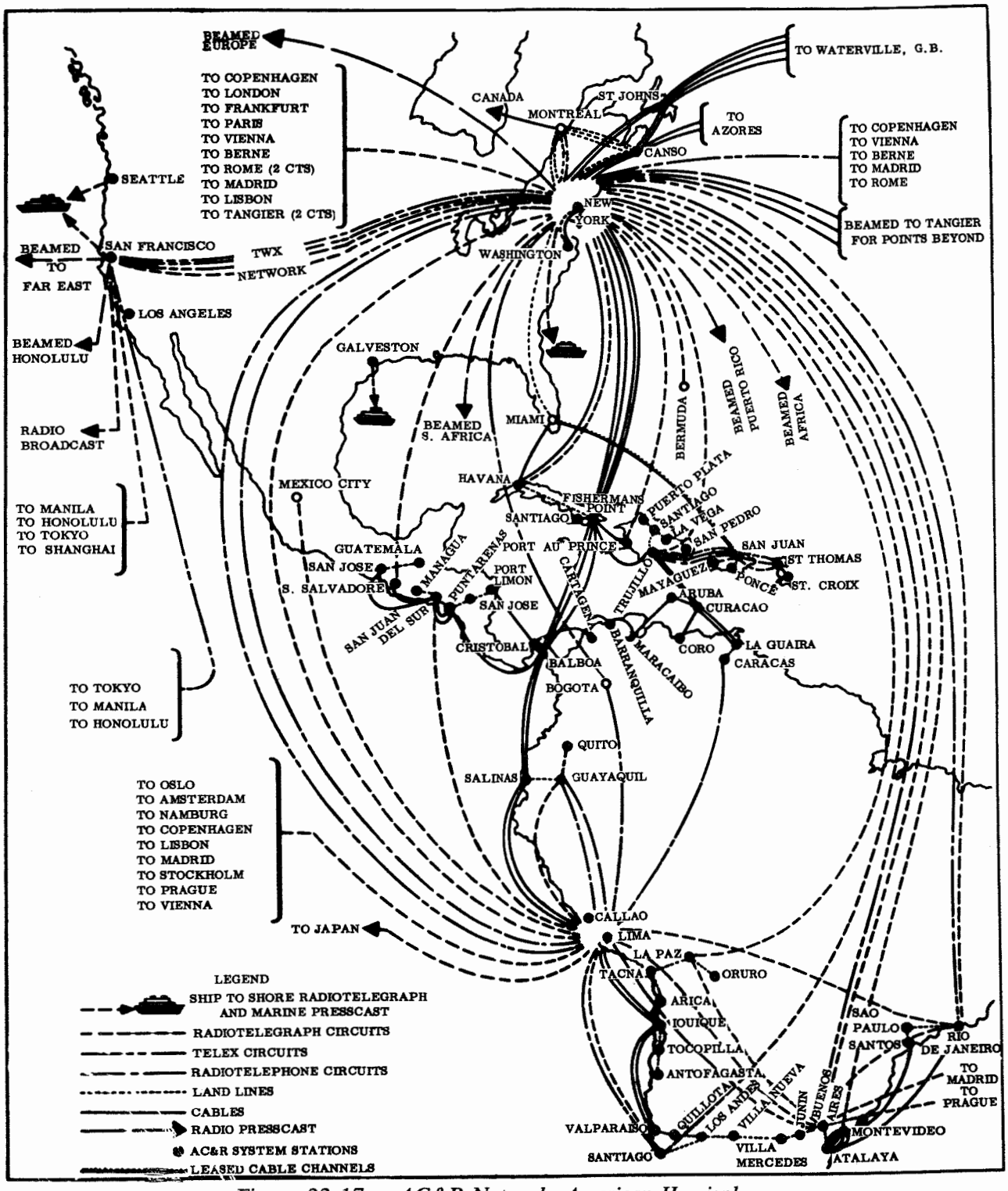

Figure 33-17.—*AC&R Network, American Hemisphere.*

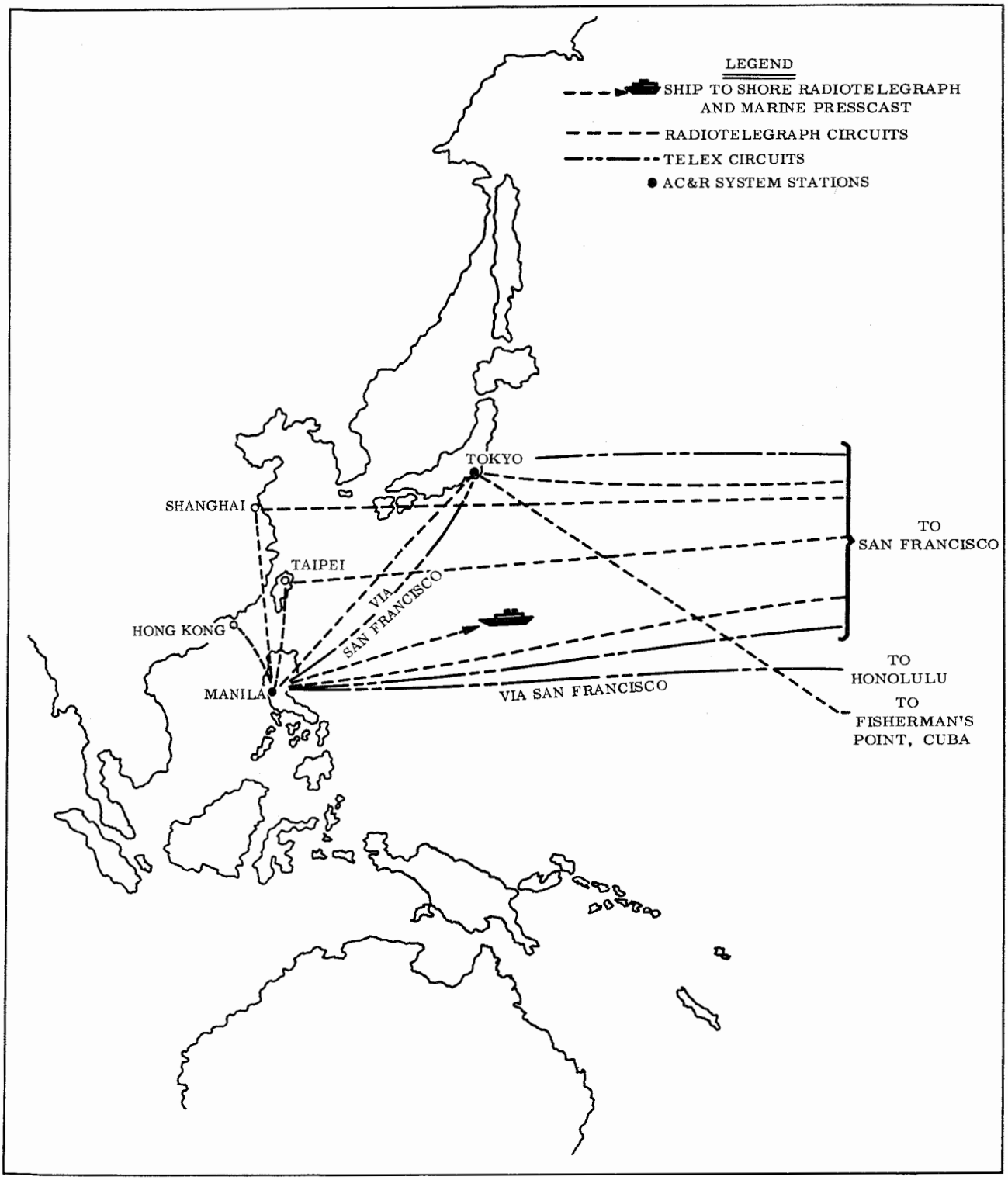

Figure 33-18.—*AC&R Network, Far Eastern Section.*

pany and the Central and South American Telegraph Company, inaugurated submarine cable service connecting the United States with Mexico, Salvador, Nicaragua, Panama, Colombia, Ecuador, and Peru. Service was extended to Chile in 1890 when a cable was laid between Peru and Valparaiso and, through its purchase of the Transandine Telegraph Company in 1891, the Company acquired the cross-continental landline between Chile and Argentina. This made possible the further extension of the system's service to Brazil and Uruguay: direct cables were laid from Buenos Aires northward to Santos and Rio de Janeiro and to Montevideo. Establishment of the company's extensive Caribbean network, along with service to Guatemala and Costa Rica, followed at later dates. The corporate name of All America Cables was formally adopted in 1920 in lieu of Central and South American Telegraph Company, with the Mexican Telegraph Company retaining its own identity, although remaining part of the All America System until 1927. At that time the controlling interest was sold to the Western Union Telegraph Company. The company entered the radiotelegraph field in 1929 when it established its first radio station at Lima, Peru. Its radio network since has been expanded to interconnect several other Latin American countries, the United States, numerous European countries, and the Far East. It also owns and operates an international radiotelephone service in Ecuador, Peru, and the Virgin Islands. Multiplexed circuits, both cable and radio, provide the necessary channels for international *telex* and leased channel services. In 1960, All America commenced its operation of 36 duplex telegraph channels in the Miami/San Juan telephone cable. These outlets are employed for message traffic, *telex,* and leased teleprinter, and/or data channels for private customer use.

(2) *The Commercial Cable Company.*—This AC&R carrier maintains submarine cable service between North America and the European continent. The company owns six transatlantic cables. The first two cables were laid in 1884, connecting Canso, Nova Scotia, with Waterville, Ireland. From these terminals the cables were extended to Rockport, Massachusetts, and Coney Island, New York, in the west, and to several cities in Great Britain on the European side. During its first year of operation, the Commercial Cable Company extended its service to France by laying a cable from Waterville to Le Havre, and followed at later dates with service to company-owned offices in Belguim and the Netherlands. Two of the company's six cables follow a southerly course from Canso to Azores before swinging northeastward to Waterville. At Horta, the cables also connect with foreign-owned cables to Europe, Africa, and Asia. The other four cables, originally laid directly into Canso at the western end, were later diverted to land at St. John's, Newfoundland, thence to Canso and/or Far Rockaway, New York.

(3) *Mackay Radio and Telegraph Company.*—The Federal Telegraph Company, predecessor to Mackay Radio, began operations in 1911 as a domestic radiotelegraph carrier on the Pacific Coast. With the inauguration of service between San Francisco and Honolulu on 28 July 1912, Federal became the first American company to operate a successful transocean radiotelegraph circuit. Today, Mackay Radio owns and operates powerful long-distance transmitting and receiving stations on the east and west coasts of the United States and in Honolulu, Manila, and Tangier. Through these facilities, point-to-point, *telex,* and leased channel services are provided between the United States and numerous countries located throughout Europe, the Middle and Near East, Africa, Latin America, the Far East, and islands in the Pacific. While Mackay Radio maintains direct point-to-point and *telex* services between the United States and many of these overseas areas, message traffic to some points to Europe, Africa, and Asia is relayed via the company's Tangier station. Similarly, Mackay Radio uses the facilities of Radio Austria in Vienna, the Danish Telegraph Administration in Copenhagen, and Radio Suisse in Berne for the relaying of *telex* calls to points other than those served directly. Transpacific *telex* calls to points beyond the Philippines are relayed via the company's station in Manila. Mackay's service to Latin America, connecting in some cases with foreign telegraph administrations, is further augmented through integration of the company's facilities with those of eight other AC&R and IT&T communication companies which operate throughout this area. Com-

munication with ships at sea is effected through Mackay's six marine stations located on the east, west, and gulf coasts of the United States. The company also designs, manufactures, sells, rents, installs, and services shipboard communication equipment and electronic aids to navigation.

(4) *Sociedad Anonima Radio Argentina.*—This company, established in 1922 and acquired by AC&R in 1940, supplements the cable and radio services of the system's three North American operating companies. The company operates point-to-point service between Argentina and the United States, Bolivia, Brazil, Spain, and Czechoslovakia.

b. Compania Intercional de Radio.—This company was founded in Buenos Aires, Argentina, in 1928. Today, radiotelephone and radiotelegraph services (including leased teleprinter circuits and *telex*) link Buenos Aires with principal cities of the American continents and Europe.

c. Compania Internacional de Radio Boliviana La Paz.—This company was founded in Bolivia in 1939. Today, the company's telephone and telegraph facilities link Bolivia's three principal cities; providing direct radiotelephone circuits to Buenos Aires and Santiago, Chile; radiotelephone service to New York via Buenos Aires; and direct radiotelegraph circuits to Buenos Aires, Rio de Janeiro, and New York.

d. Companhia Radio Internacional do Brasil Rio de Janeiro.—This company was founded in Brazil in 1929. The internal system of radiotelephone service links 31 cities in Brazil. Radiotelephone and radiotelegraph circuits (including leased teleprinter channels and *telex*) link Rio de Janeiro directly with major points in America and Europe.

e. Companhia Telefonices Nacional Rio de Janeiro.—This company was founded in Brazil in 1908. Curitiba and Porto Alegre are division headquarters. In addition to providing internal telecommunications service, the facilities are interconnected with systems in Argentina and Uruguay.

f. Compania de Telefonos de Chile Santiago.—This company was founded in Chile in 1930. It offers local and long distance telecommunications service; international service is provided by landlines and radio.

g. Compania International de Radio. — This company was founded in 1928 in Santiago, Chile. Radiotelephone service to all points in Chile is provided through interconnection with Compania de Telefonos de Chile. Radiotelephone and radiotelegraph service is provided to all continents through interconnecting networks with other companies. Radiotelegraph services include leased teleprinter channels and *telex*.

h. Cuban Telephone Company. — This company was founded in Havana, Cuba, in 1908. The company provides local and long distance telephone service throughout Cuba and international telephone service.

i. Radio Corporation of Cuba Avenida Carlos.—This company was founded in Havana, Cuba, in 1922. Radiotelephone service is provided to American and European countries. Radiotelegraph service, including leased teleprinter channels, is provided. In conjunction with AT&T, the company inaugurated over-the-horizon microwave radio service between Cuba and Florida in 1957, making available two-way television and television channels.

j. Cuban American Telephone and Telegraph Company. — This company was founded in Havana, Cuba, in 1919, by IT&T and AT&T. Six submarine cables link Havana, Cuba, with Key West, Florida. This facility operates in conjunction with the over-the-horizon link.

k. Compania Peruana de Telefonos Limitada.—This company was founded in Lima, Peru, in 1920. Local service is provided for Lima and its suburbs, and long distance and international service is provided through interconnections with other companies.

l. Puerto Rico Telephone Company. — This company was founded in San Juan, Puerto Rico, in 1914. This company provides telephone service throughout Puerto Rico.

m. Radio Corporation of Puerto Rico.— This company was founded in Santurce, Puerto Rico, in 1922. The company operates radiotelephone service to other Caribbean islands and the United States. An over-the-horizon microwave link with the Dominican Republic was opened in 1957.

3315. RADIO CORPORATION OF AMERICA (RCA).

.1 Corporation Background. — The Radio Corporation of America was incorporated in Delaware on 17 October 1919. Its creation was the result of both a patent tangle, and a desire that American radio communications should not be under foreign control. Prior to its creation, the British Marconi Company endeavored to obtain exclusive rights for the use of the Alexanderson generator from the General Electric Company. Negotiations were near completion when the Navy Department, through the Assistant Secretary, indicated its objection to the ownership of this and other radio patents by a foreign interest. Thus, RCA was organized and immediately purchased the assets and patent rights held by the British controlled American Marconi Company. In 1920, RCA entered into exclusive cross-licensing agreements giving it rights to the use of other important patents in the radio field, including those covering the DeForest tube. In the same year, RCA established direct radiotelegraph circuits between the United States, England, Hawaii, Japan, Norway, Germany, and France. In 1921, service was inaugurated to Italy, and in 1923, to Poland and Sweden. By 1937, with the advent of long-distance shortwave (high-frequency) transmissions, circuits to Java, French Indo-China, the Philippine Islands, and Hong Kong were also established. In 1927 and 1929, respectively, RCA organized two subsidiaries: Radiomarine Corporation of America, and RCA Communications, Inc. (RCAC), to conduct the public radiotelegraph business which had been handled previously by other departments. RCAC confines its operations largely to point-to-point service between land stations. Radiomarine Corporation handles service to and from ships almost exclusively. By 1936, the international network of RCAC had established 40 international radiotelegraph circuits between the United States and foreign countries and overseas territories. In 1943, 42 circuits were in operation in spite of the closing of circuits to enemy countries and enemy-occupied territory. Since the close of World War II, *TEX*, a two-way customer-to-customer teleprinter exchange, has evolved. *TEX* is considered by many to be a near ultimate in international record communications. The first international *TEX* service circuit was established in May 1950, between New York and Amsterdam. Before the end of 1950, the service was extended to Washington, D. C., and through the facilities of the Netherlands administration, to Germany and Denmark. Later, *TEX* channels were opened to Switzerland, France, Belgium, Norway, Sweden, Luxembourg, Finland, Spain, Portugal, England, Hungary, and the Belgian Congo, and between San Francisco and Honolulu.

.2 Scope of Services.

a. Station Equipment.—The global communications network today is comprised of more than 250 radio channels with which the company provides radiotelegraph service between the United States and 68 countries, *Telex* service to and from 45 countries, and radiophoto service with 45 foreign terminals. In addition, the company operates the terminals of 14 radiotelephone circuits in the Pacific area and provides two-way program transmission service for broadcasters, as requested, with almost any point on the globe. The company maintains extensive facilities for communications with ocean-going vessels and ships plying inland US. waterways.

b. Channels. — The Company furnishes private leased channel communications service to all parts of the world for commercial and governmental customers. Approximately 100 such channels for teletype, telephone, facsimile, and data communications are provided today. Additional channels are being made available for the growing requirements of this service.

.3 Facilities.

a. Headquarters.—The headquarters, and main operating terminal of RCA Communications,

Inc., are located at 66 Broad Street, New York, New York. During 1958, these facilities handled almost 7 million international telegraph messages.

b. New York.—The New York terminal is linked by microwave radio with remote transmitting and receiving stations at Rocky Point and Riverhead, Long Island. Together these installations comprise RCA's coast communications gateway from which radio circuits fan out to reach 50 countries in Europe, Africa, and the Middle East, and South America.

c. Transpacific.—For communications with transpacific points, RCA maintains a terminal office at 135 Market Street, San Francisco, California, and transmitting and receiving stations at Bolinas and Point Reyes, California.

d. International.—RCA operates its own international communications facilities in Guam, Morocco, Hawaii, Cuba, Haiti, Puerto Rico, the Dominican Republic, and the Philippines. Elsewhere abroad, the distant terminals of RCA circuits are operated by local agencies, usually government owned.

.4 Overseas Correspondents.—RCA's many overseas operating correspondents are organizations serving international communications with their services and facilities. RCA maintains liaison with its correspondents at all administrative and operating levels. Policy, technical, and operating matters are invariably resolved quickly and agreeably.

a. Scope. — In most countries, RCA's correspondents operate not only the external communications system but also provide the only facilities for internal telegraph, telephone, and *telex* services. As a result, RCA's international facilities are more efficiently integrated with these internal systems, and thereby provide faster and more effective "through service" to interior points in countries abroad.

b. Foreign Interconnection.—Through its interconnection with overseas correspondents, RCA can provide customers with private international radio channels. Hence, the customer can avoid the time-consuming foreign licensing procedures.

.5 Technical Progress.—The global radiotelegraph system is operated by printed telegraphy methods. Traffic flowing over all major circuits is protected by automatic error detection and correction equipment. This combination of operating techniques and advanced equipment has brought a high standard of accuracy and dependability to overseas radio transmissions.

a. Alternate Routes. — As further insurance of the dependability of its circuits, the company operates a relay station in Tangier, Morocco. This installation provides radio routes for traffic flowing between the United States and Europe, Africa, and the Middle East. The Tangier station also assists in maintaining communications continually between the United States and transatlantic points regardless of radio weather conditions. Another installation at Manila in the Philippine Republic assures uninterrupted communications with transpacific points.

b. Increased Traffic Capability.—During the past 10 years, the company has pursued a long-range program of utilizing more efficiently its allocated radio frequencies. Through the use of frequency and time division multiplex techniques, radio circuits which previously could provide a single radiotelegraph channel of 60 wpm now can carry as many as 16 of these channels. The additional available radio channels resulting from this program have provided for an increased volume of traffic and made available new communications services. (See Figure 33-19.)

.6 New Services.—In recent years the company has introduced on a commercial basis two new services — International *Telex* and Leased Channel Service. These new services mark a new era in international communications. The customer is given direct control over the initial processing of his messages. They also bring to telegraphic communications the one outstanding advantage of the telephone — an immediate, two-way exchange of information. Both *telex* and leased channel services have individual advantages which make them particularly suited to specialized needs. *Telex* service offers flexibility and low cost two-way written communications. Charges are based on

the duration of each call. Leased channel service places at the disposal of a customer the exclusive use of a two-way, point-to-point radio channel for voice, teleprinter, or facsimile communication. Channels are leased on a monthly basis at teletypewriter speeds ranging upwards from 15 words per minute. Channels of greater speeds are available for the international transmission and reception of computer processed data. RCA world-wide *telex*, radiophoto, and radiotelephone circuits are illustrated in Figures 33-20, 33-21, and 33-22, respectively.

3316. THE WESTERN UNION TELEGRAPH COMPANY.

.1 Company Background.—The Western Union Telegraph Company started business on 1 April 1851 as the New York and Mississippi Valley Printing Telegraph Company just seven years after Samuel F. B. Morse sent the first telegram, "What hath God wrought." The name was changed to Western Union in 1956. The properties of over 500 other companies have been acquired by, or merged with Western Union. The most recent and most important merger was with the Postal Telegraph Company in 1943. Western Union provides service through over 2,000 offices and 20,000 agencies throughout the nation. In addition Western Union owns, leases, and operates, or has arrangements with connecting companies for the operation of a network of submarine cables providing communication for all of Western Europe, the Middle East, Cuba, and Central and South America. Figure 33-23 diagrams the corporate structure of the Western Union Company.

.2 Telegraph Facilities.—The introduction of fixed and portable carrier telegraph terminals, electronic repeaters, microwave beam systems, modern terminal equipment and switching centers, and other modern transmission equipment has lead to highly reliable networks for public message services and private wire (leased-line) systems. In recent years, Western Union's own staff of engineers and scientists has pioneered in the development and installation of modern telegraph equipment. Nearly all the pole lines have been retired; and the manual relaying and delivery of messages has been eliminated through the following:

a. A Nationwide Network of Transmission Facilities.—These facilities are composed of the following:

(1) *Carrier Circuits.* — Western Union owns over 4,000,000 miles of carrier-equipped telegraph circuits. This is an increase of 1,500,000 miles within the past 2 years. These circuits furnish high-quality transmission characteristics for Western Union's reperforator switching system and for private wire systems. (See Figure 33-24.)

(2) *Radio Relay.* — Western Union's existing microwave system occupies over 560,000 miles of the 4,000,000 miles of carrier circuits. These channels are less subject to atmospheric disturbances than other radio circuits. Figure 33-25 indicates the existing and under-construction portions of the microwave system, with proposed extensions. All trunk circuits will bypass major cities by approximately 30 miles so that in the event of a national emergency the basic system will be little affected.

(3) *Pole Lines.* — Western Union has retired about 600,000 miles of pole line circuits within the past two years. Only 631,000 miles of pole line circuits remain in service.

(4) *Other Line Facilities.*—To supplement circuits directly owned, Western Union leases approximately 140,000 miles of circuits from other carriers.

b. Relay Centers. — Fifteen reperforator relay centers are located strategically throughout the United States. (See Figure 33-26.) Through this high-speed switching system, telegrams are dispatched and relayed without manual retransmission within the United States and to and from Barbados (B. W. I.), London, and Canada.

c. Efficient Methods of Terminal Handlings.—Aside from telephone and messenger delivery of messages, Western Union provides large volume telegraph users with the lines as follows:

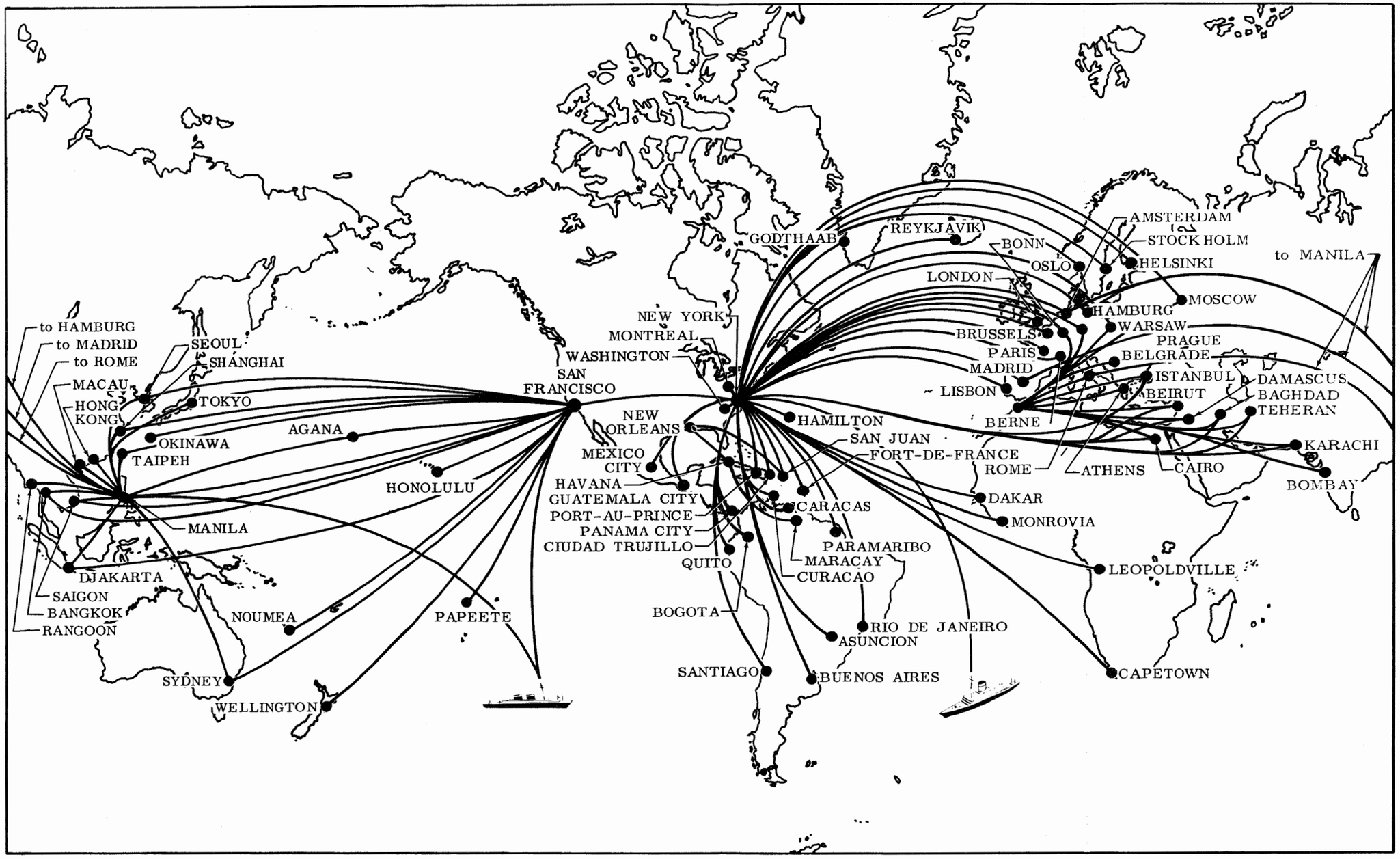

Figure 33-19.—*RCA World-Wide Radio Telegraph Circuits.*

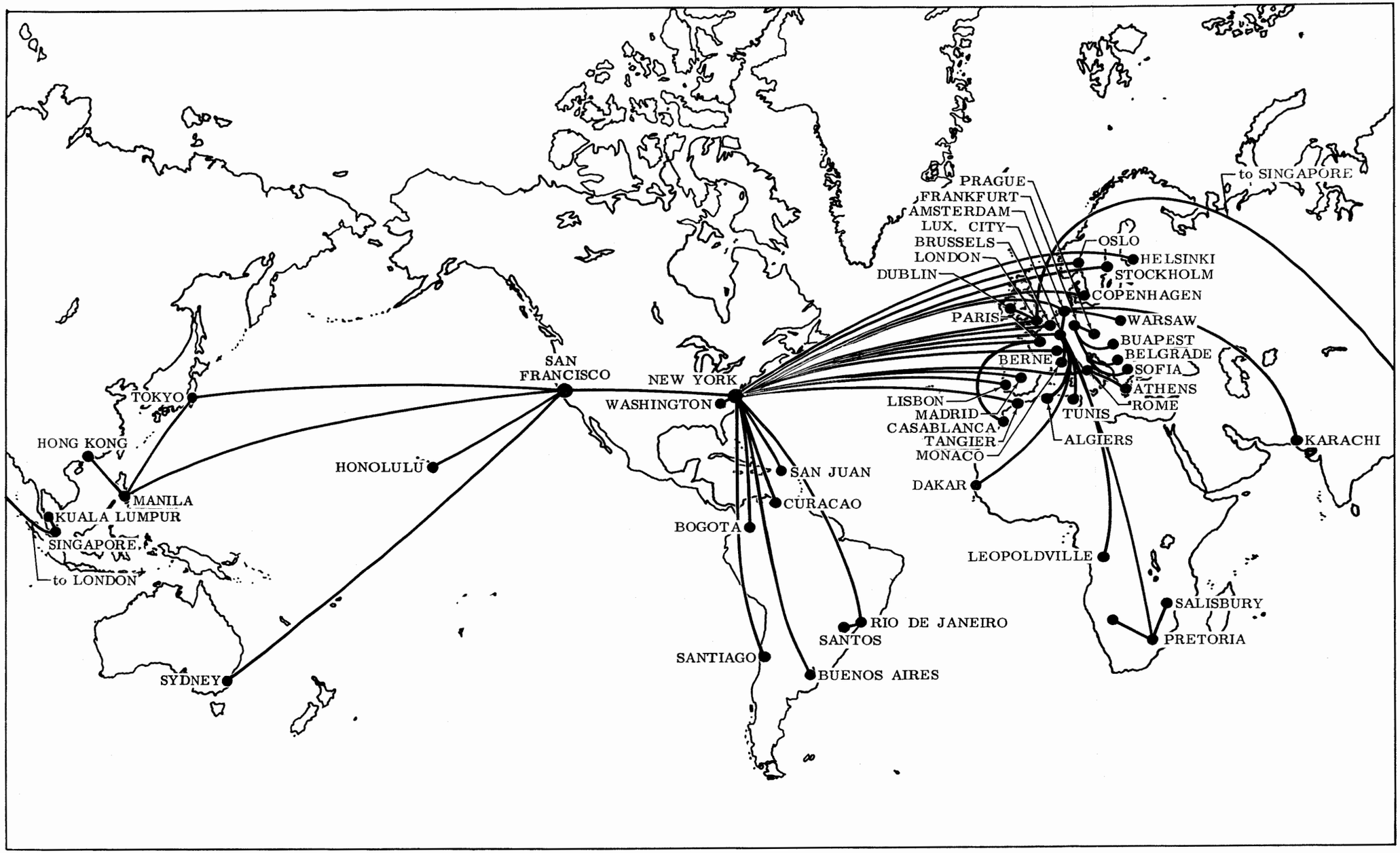

Figure 33-20.—*RCA World-Wide Telex Circuits.*

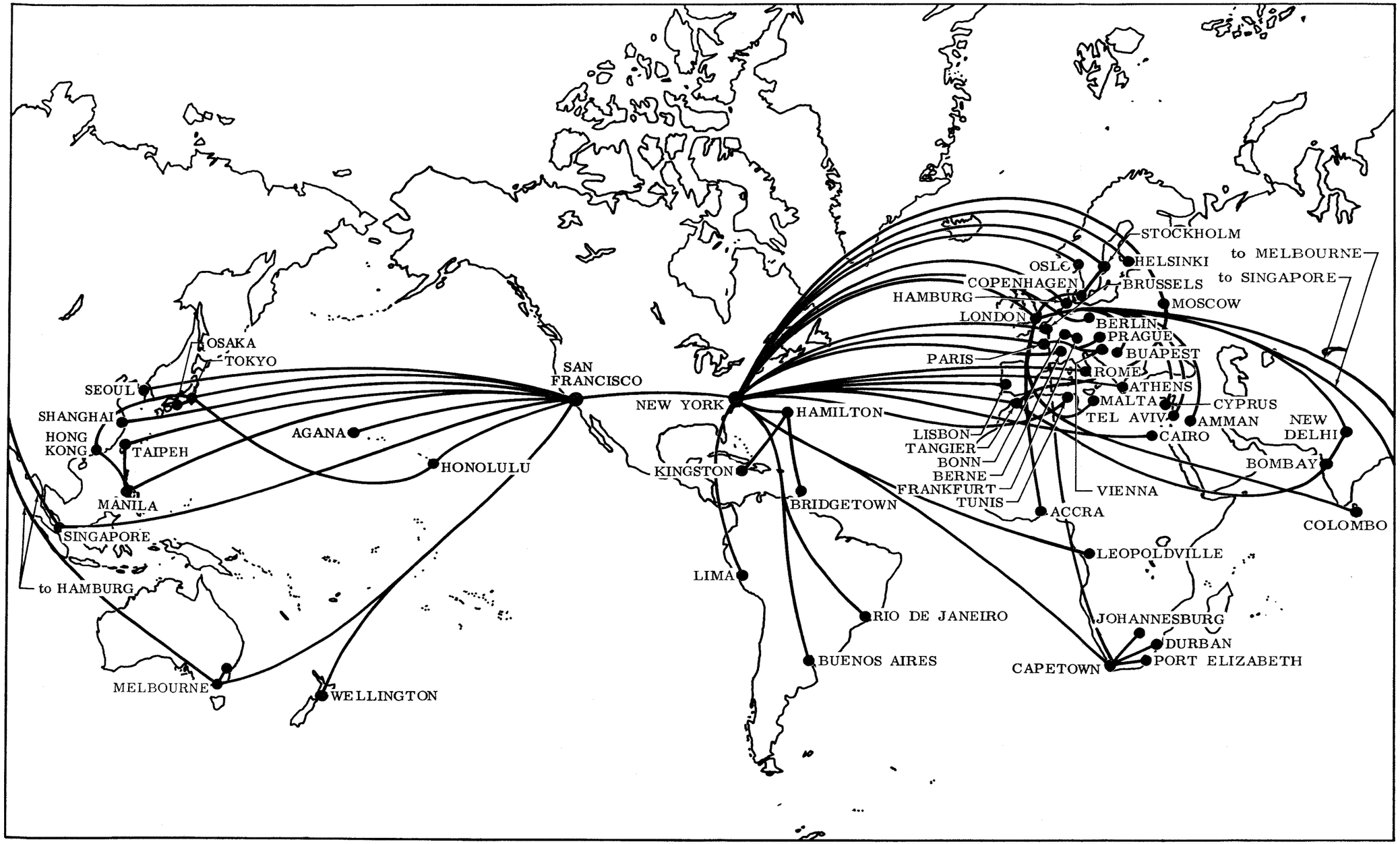

Figure 33-21.—*RCA World-Wide Radiophoto Circuits.*

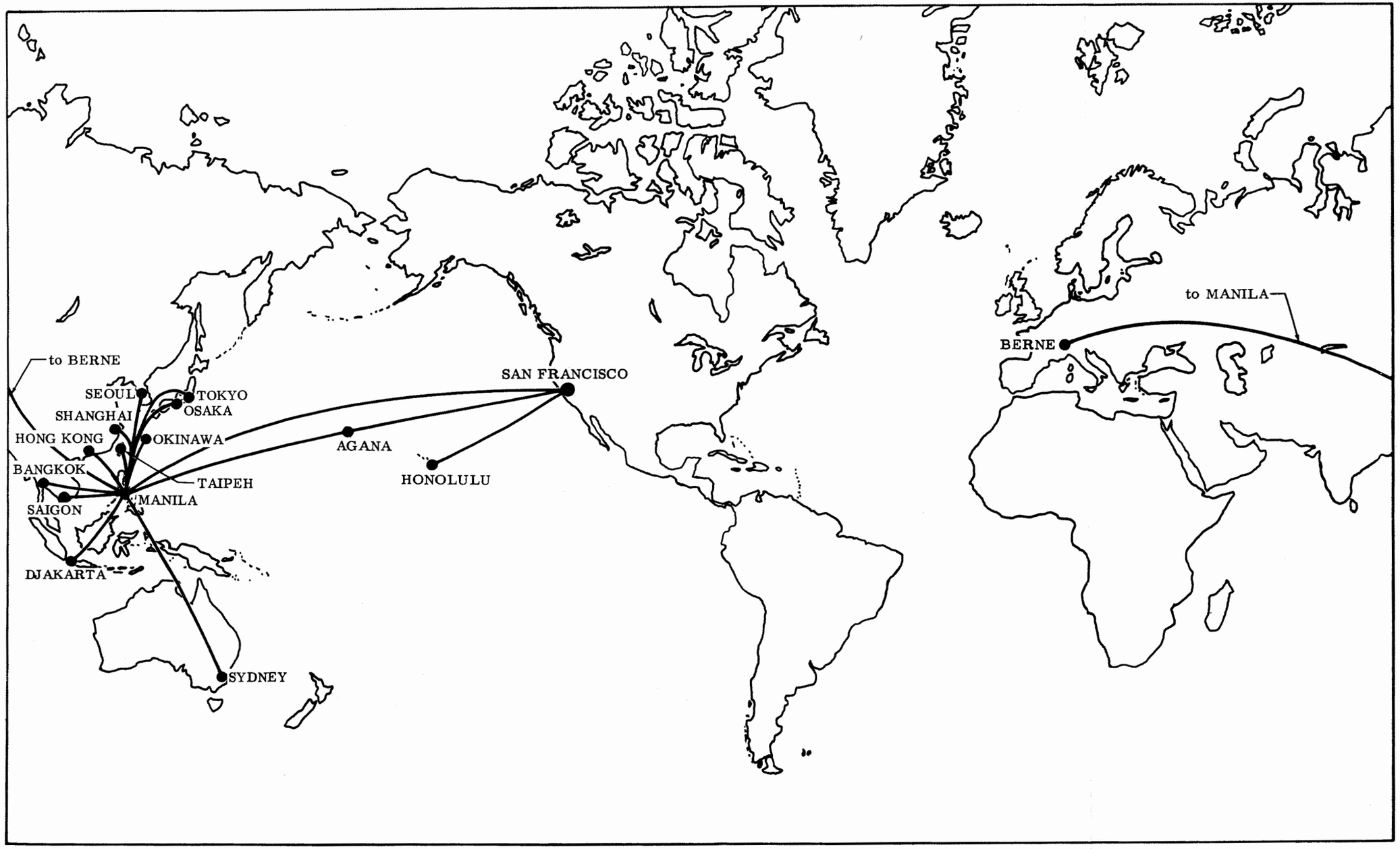

Figure 33-22.—*RCA World-Wide Radiotelephone Circuits.*

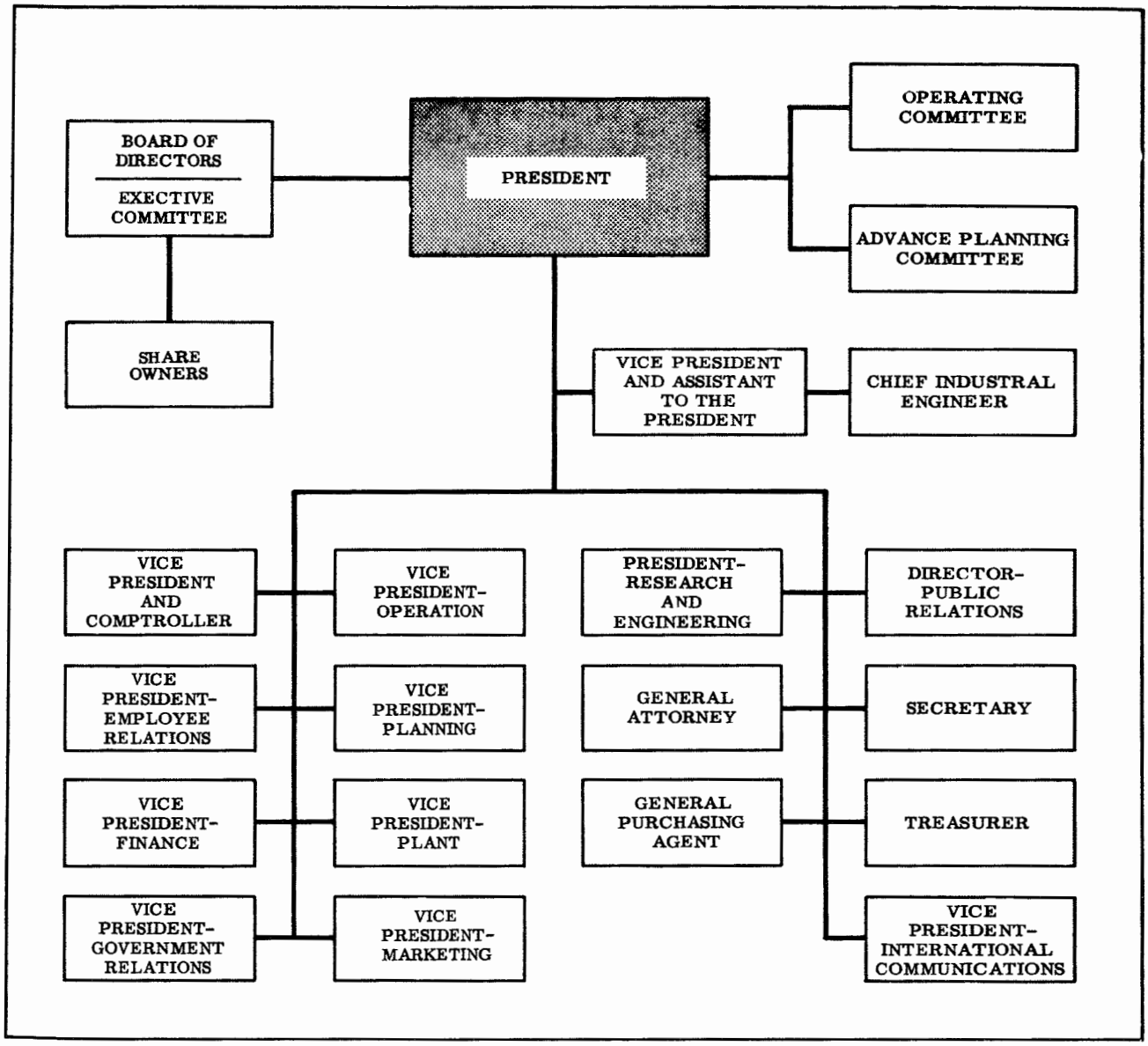

Figure 33-23.—*Corporate Organization of the Western Union Telegraph Company.*

(1) *Teleprinter.* — Teleprinter connections from patrons' premises direct to Western Union offices provide a rapid method of pick up and delivery of messages. When warranted, patrons are provided with direct connections to automatic or semiautomatic reperforator switching centers. Approximately 20,000 customers are supplied with teleprinters.

(2) *Facsimile.* — Western Union provides a compact facsimile machine, called *Desk-Fax,* to 37,000 customers to facilitate the transmission of messages to and from central telegraph offices. Transmission is made directly from typed or handwritten copy, and reception is accomplished with an electro-sensitive paper.

d. Telex.—*Telex,* long used overseas and in Canada, has been introduced in the United States by Western Union. This system enables a subscriber

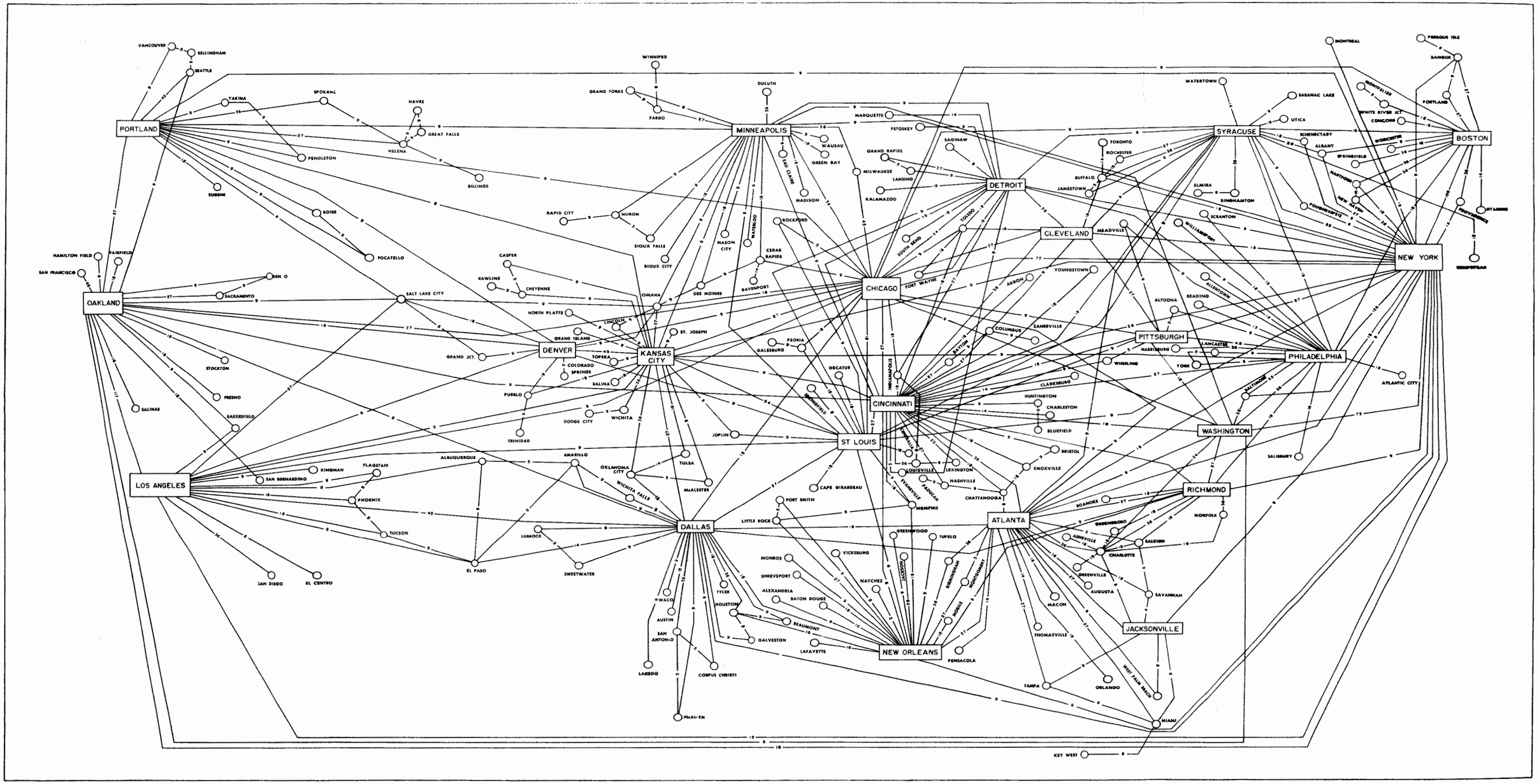

Figure 33-24.—*Western Union Reperforator Carrier Circuits.*

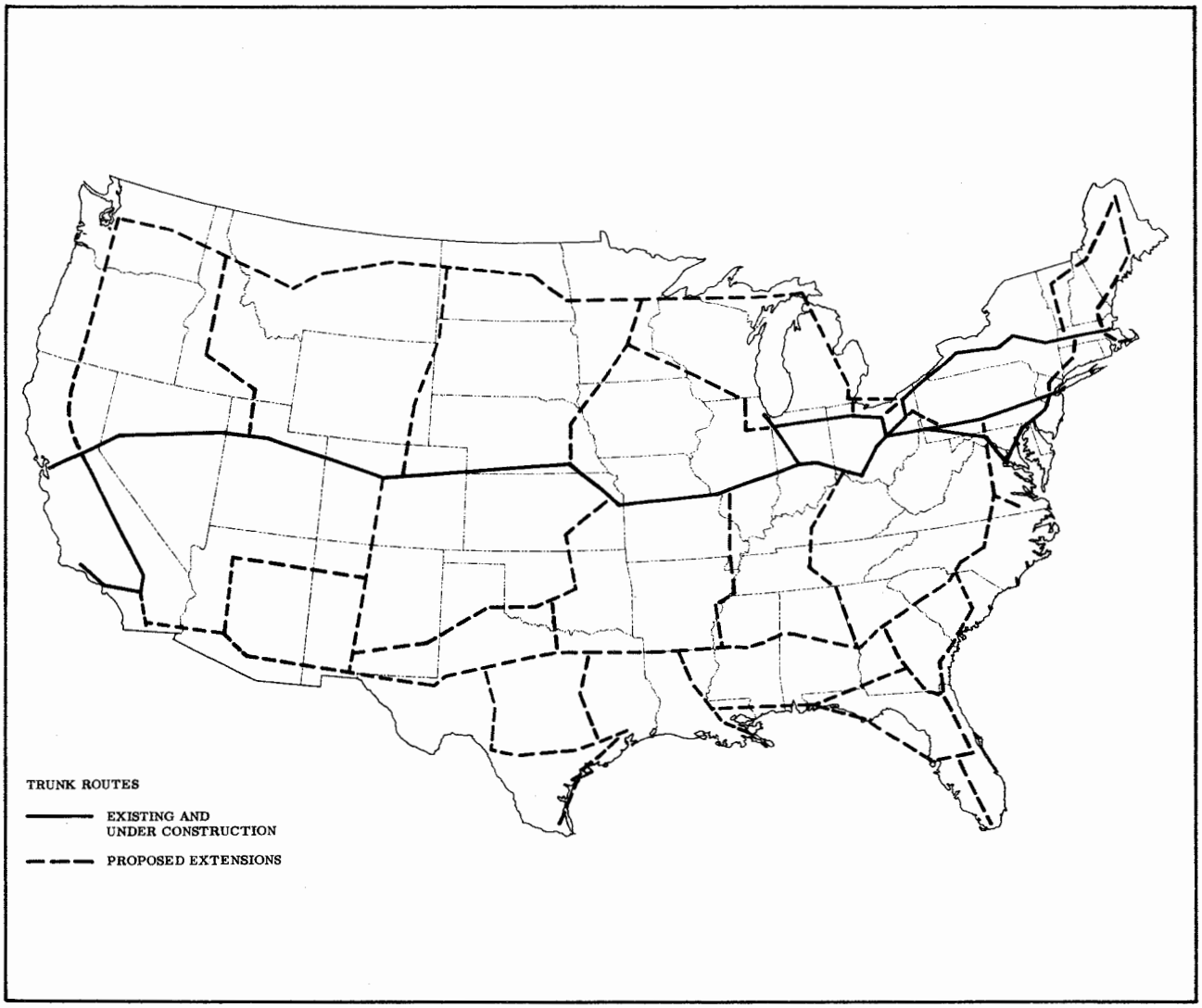

Figure 33-25.—*The Western Union Telegraph Company Microwave System.*

to obtain a direct teleprinter connection to any other *telex* subscriber simply by dialing as one does with a telephone. An automatic answer-back feature assures reception at the distant end even during unattended periods. This service is now available in and between New York, Chicago, San Francisco, Los Angeles, and 30 Canadian cities. Installations of dial centers in 21 additional major cities within the United States, including Honolulu, are scheduled for 1960.

.3 Leased Line and Engineering Services. — Western Union leases teleprinter and facsimile systems employing over 3,000,000 channel miles of circuits to over 2,200 patrons. The systems range in size from single circuits, connecting two or more points, to fully automatic switching networks, which interconnect several hundred patron locations on numerous circuits. Many networks are used for data transmission as well as for message traffic. Although circuits are furnished on a leased basis only, equipment may be leased or purchased. Modification of existing equipment or custom designed equipment is available through engineering services. Western Union's capabilities lie principally in the following areas: printed telegraphy systems, including telegraph

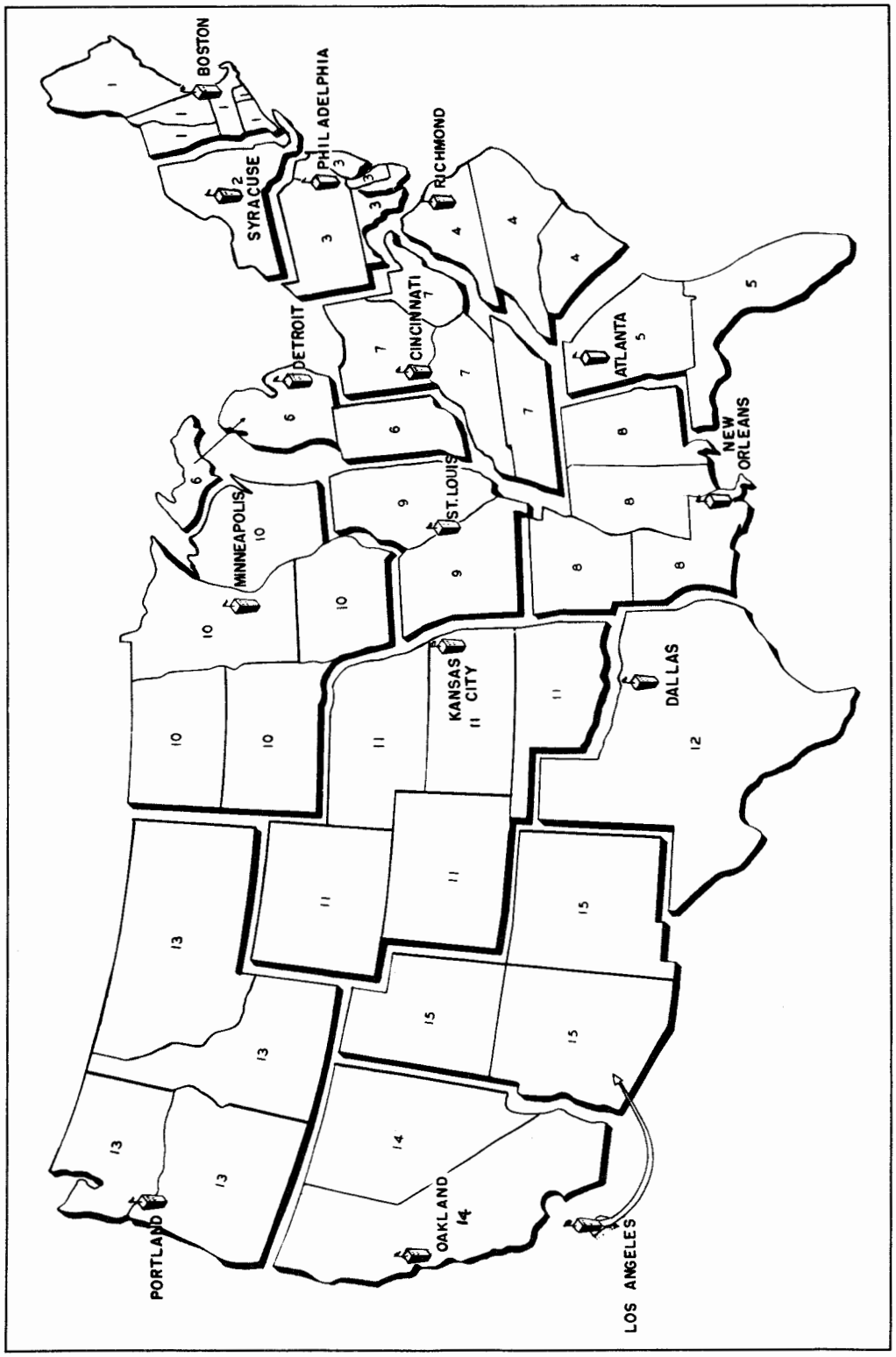

Figure 33-26.—*Western Union Reperforator Relay Centers and Areas Served.*

switching systems and equipment; facsimile systems and equipment; data systems and equipment; wire line and buried or aerial cable systems and equipment, including carrier current equipment; microwave radio systems and equipment; ocean cable systems and equipment; preparation of manufacturing drawings and technical manuals; installation and maintenance training; and theoretical studies relating to communications. Western Union is also engaged in the design, development, and construction of components associated with the facilities listed in CED 3316.2, *e.g.,* filters, networks, transformers, coils, printed circuitry, transistor circuitry, cabinet design, and component packaging.

.4 Commercial Departments. — Western Union's Government Contract Sales Division handles the leasing of systems to government and military organizations and the outright sale of equipment and engineering services to all organizations. A separate Private Wire Services department is responsible for leasing systems to commercial companies.

.5 Cable Facilities. — Western Union's cable system is the largest of the North Atlantic cable facilities, and offers the most modern cable telegraphy service. (See Figure 33-27.) Several of these cables are leased from the Anglo-American Telegraph Company Limited on a long-term basis; the balance are owned by Western Union and include the world's fastest telegraph cable as well as those of the standard, nonloaded ocean-cable type. All of the nonloaded type now have electronic amplifiers installed which have increased their capacity about threefold. These transoceanic facilities consist of seven cables between North America and Europe with a total capacity of 1,950 wpm; two cables to the Azores with a capacity of 560 wpm; three cables to Cuba and the West Indies with a capacity of 2,178 wpm; and one cable to Barbados with a capacity of 104 wpm in each direction. Western Union maintains and operates offices in 14 cities in Great Britain and Ireland, and maintains 11 branches located in convenient sections of London. The company also operates in Antwerp and Brussels, Belgium. It maintains its own offices in Amsterdam, Holland; and in Italy it is associated with the Italcable Company which maintains offices in the principal cities in Italy. In London, Western Union works directly with Cable and Wireless Limited, for the exchange of communications with Africa and countries in the Near and Far East. It also connects with the Great Northern Telegraph in London for the transmission of messages to and from countries of Scandanavia. Western Union operates a combination of landline and submarine cables to Havana where the company maintains its own offices. The circuits extend beyond Havana to provide direct service between New York and Santiago, Cuba; Kingston, Jamaica; and San Juan, Puerto Rico. (See Figure 33-28.) From these four key cities, a highly dependable service is maintained with all places in the West Indies. The company operates a combination landline-submarine cable service from New York to Bridgetown, Barbados where a through connection is made with the Western Telegraph Company serving all countries on the South American continent. The Western Union's submarine cable system totals about 26,600 miles. Figure 33-29 shows Western Union Cable Routes in the Nova Scotia-Newfoundland area.

3317. CONTROL AND USE OF COMMERCIAL COMMUNICATIONS FACILITIES.

.1 Federal Communications Commission (FCC).—The FCC was created by the Communications Act of 1934 as an independent agency, to regulate interstate and foreign commerce in communications by wire and radio. The jurisdiction of the FCC extends not only to private radio broadcasters and to common telecommunications carriers engaged in interstate and foreign commerce, but to communications activities of state and local governments as well. The Act establishing the FCC was enacted "for the purpose of regulating interstate and foreign commerce in communications by wire and radio so as to make available, so far as possible, to all people of the United States a rapid, efficient, nation-wide, and world-wide wire and radio communications service with adequate facilities at reasonable charges, for the purpose of the national defense, for the purpose of promoting safety of life and property through the use of wire and radio communications, and for the purpose

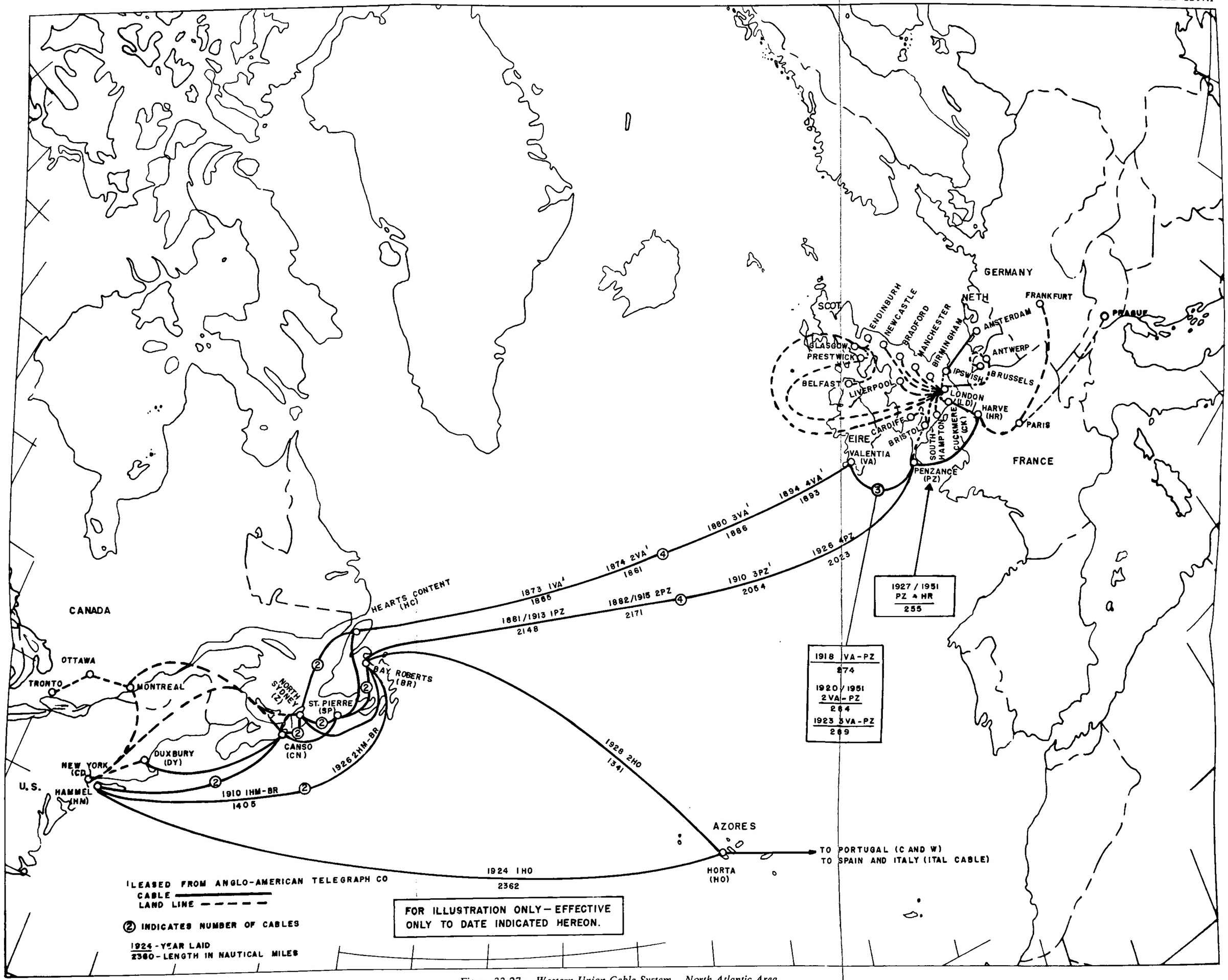

Figure 33-27.—*Western Union Cable System —North Atlantic Area.*

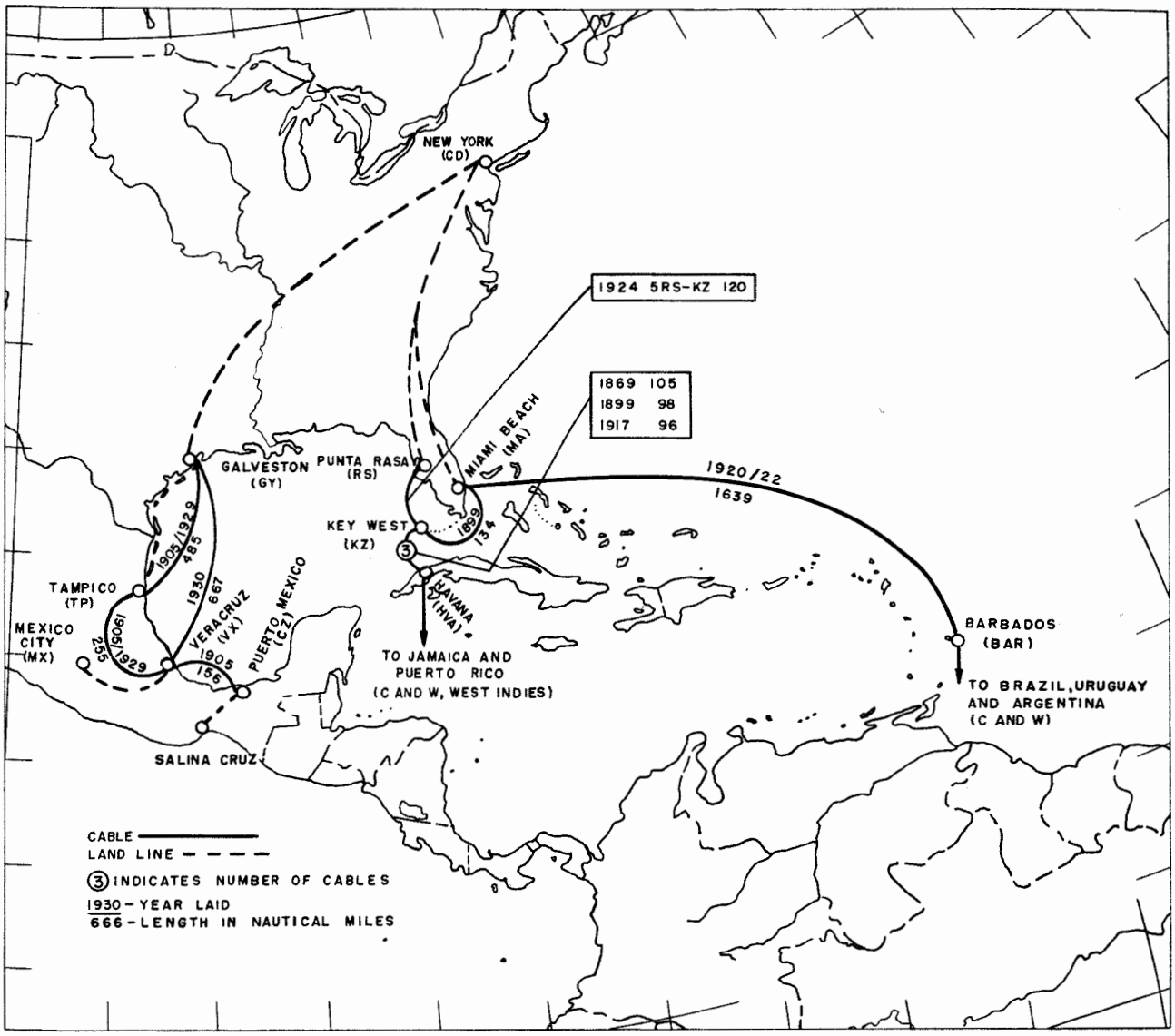

Figure 33-28.—*Cable Systems of Central America and the West Indies Operated by the Western Union Telegraph Company and the Mexican Telegraph Company.*

of securing a more effective execution of this policy by centralizing authority heretofore granted by law to several agencies and by granting additional authority with respect to interstate and foreign commerce in wire and radio communications."[1] The functions and organization of the FCC are covered in every detail. CED 1100, *Basic Concepts, Missions, and Functions.*

.2 Department of Defense Dependence upon Commercial Communications.

—The Department of Defense has made the following statement[2] concerning military dependence on the commercial communication facilities of the United States:

a. Military Policy Regarding Use of Commercial Facilities.—It is impracticable to employ similar concepts and standards in assessing military and commercial communications requirements. In the development of commercial facilities,

[1] Communications Act of 1934, as amended, Sec. I.

[2] Telecommunications. A Program of Progress. dated Mar. 1951.

expected revenue must be a prime consideration. Military communications, on the other hand, as an essential element of command, must first satisfy military needs, with economy of force or funds, an important but secondary consideration. As a result of this fundamental difference, it is impossible for the military to enunciate a policy which will, under all conditions, prescribe the specific degree to which it will utilize or depend on commercial communications facilities. It is incumbent on all military commanders, in compliance with the basic principle of economy of force, to make maximum possible use of all existing facilities available to them, including commercial service. Before reaching a decision to employ other than strictly military facilities, each commander, based on the conditions prevailing in his area, must weigh any advantages from the standpoint of economy against the resulting effect on military security and control, dependability of service, and the rapid flow of military messages. As general policy, therefore, it may be stated that the Military Services will, whenever practicable, utilize commercial facilities and service in the interest of economy of force or funds, provided that acceptable military standards of security control and service can be maintained.

b. Military Use of Commercial Facilities in the ConUS.

(1) *Development of Military Communications.*—During the early period in the development of national communications systems, it was necessary for the military services to construct and operate their own communications facilities in the ConUS. Today, however, extensive and dependable commercial communications networks cover the length and breadth of the United States. From the standpoint of security, the risk normally involved in partial military control of its communications has been considered as being relatively low within the ConUS. This condition is a result of both the close working relationship that exists between the military services and the commercial communication organizations, and the existence of adequate legislation to permit prompt government operation and control if deemed advisable in the national interest.

(2) *Exclusive Military Communications Systems.*—Under these conditions, the construction and maintenance of completely separate communications systems within the United States for exclusive military use would entail an unjustifiable outlay of funds, manpower, and equipment. Military policy concerning use of commercial communications facilities in the ConUS may, therefore, be summarized as follows: within the ConUS, the military services, in establishing communications networks for the purpose of interconnecting their various headquarters, installations and activities, will, by lease or other contractual arrangement utilize commercial facilities and services when available and feasible, except where unusual security or operational conditions are required. The terminal facilities, including communications centers and relay stations of these networks, will be operated and controlled by the Military Services.

c. The Commercial Communications Networks as a Source of Trained Personnel for Military Service.

(1) *Expansion During War.*—In peacetime, the military services can maintain only the nucleus of a wartime communications system. It is also well established that the impact of a state of war or national emergency on military communications systems is instantaneous, and can only be met through immediate expansion of both trunk and terminal facilities.

(2) *Training.*—Modern communications facilities, while extremely efficient, require a comparatively long lead time in the training of operator and maintenance personnel. Hence, in the critical period between the outbreak of hostilities and the time when military training programs can meet overall demands, the commercial systems of the United States represent an important source of additional trained communications personnel for military service.

(3) *Policy.*—In this connection, it is the policy of the military services to maintain a close working relationship with the commercial communications companies of the nation in order that anticipated wartime military requirements may be reflected in peacetime expansion and training programs. Emergency military needs for trained

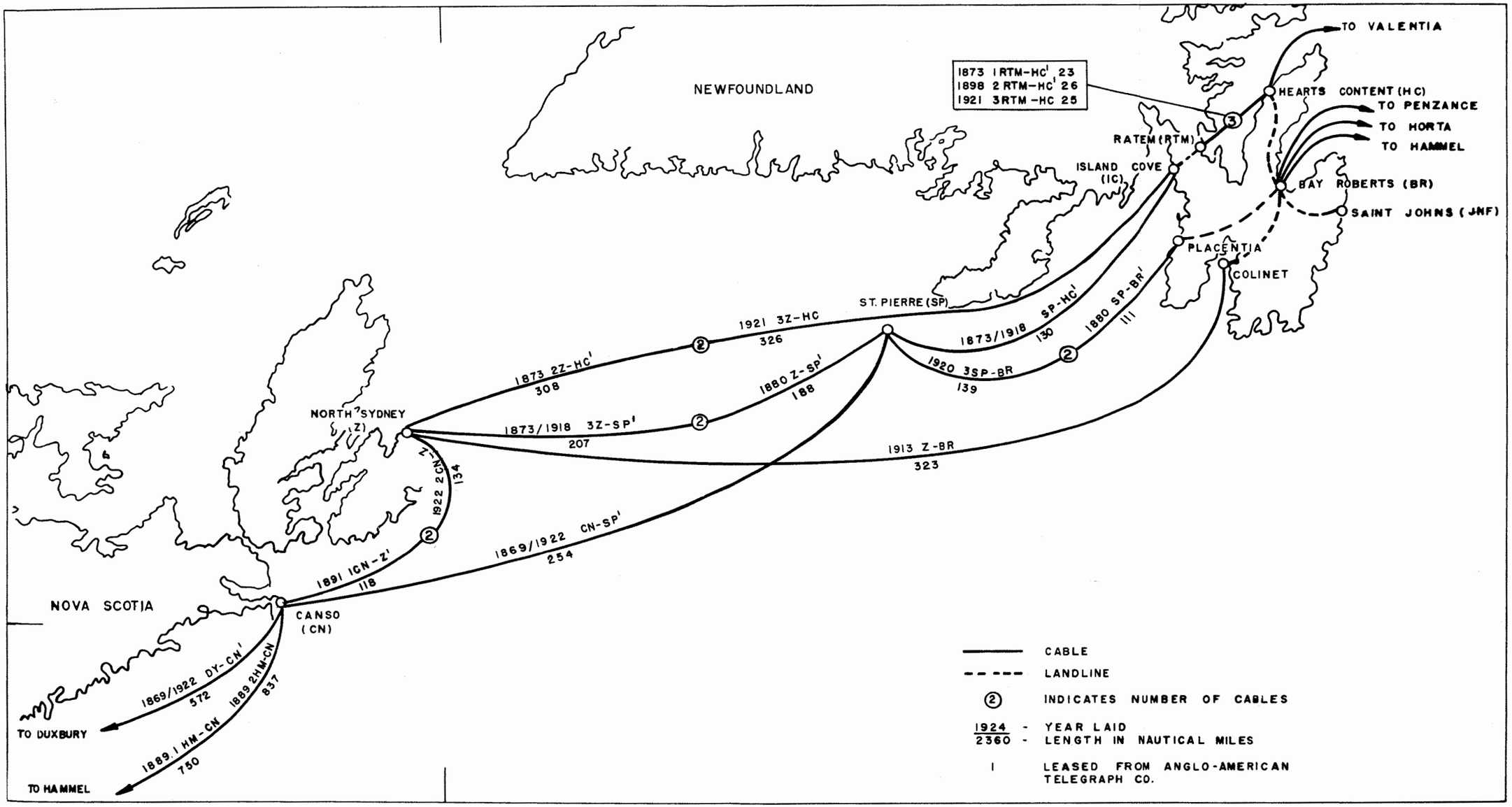

Figure 33-29.—*Western Union Cable System — Nova Scotia-Newfoundland Area.*

communications personnel may then be met without the continued use of vital civilian communications personnel. Therefore, it is the policy of the military services to utilize fixed communications equipment of standard commercial design to the maximum possible extent, and to prescribe similar operational and maintenance techniques.

d. Trends in Military Use of US. Domestic Communications Facilities.

(1) *Use of Commercial Communications.*—The military services do not foresee the necessity for any material change in current policy concerning their use of commercial facilities within the ConUS. In both peace and war, these facilities have proved to be operationally reliable and fully responsive to military requirements. This, in effect, means that for continuous, effective coordination of military operations within the United States, the military services will remain largely dependent on the commercial communications systems of the nation. Hence, while not being in a position to pass judgment on measures designed to improve the economic well-being of the commercial companies, the military services will have a vital interest in any changes which may adversely affect the capacity and operational efficiency of the commercial systems.

(2) *Impact of Long-Range War Requires Study.*—The advent of long-range, highly-destructive warfare, including intensive infiltration by subversive elements, will require greatly increased defensive measures on the part of both military and civilian agencies. The impact of this increased risk on the domestic communications facilities of the nation has not been fully determined, but may reasonably be expected to be of considerable proportion.

(3) *Telecommunications Resources.* — Instrumentalities now exist which provide that in time of war or national emergency, the total telecommunications resources of the nation can be placed at the disposal of the government. The military services are mindful, however, that any successful prosecution of a war effort will require that all agencies contributing to this effort be afforded the use of these facilities on a just and equitable basis. In addition, reasonable safety, comfort, and security for the civilian populace must be ensured. To this end, the military services believe that the domestic communications systems of the United States should be as efficient and dependable as sound engineering, reasonable economy, and good operating practices will allow. Their capacity should reflect the ability to handle greatly increased wartime volumes. Many alternate routings and types of facilities must be available, consistent with the ability of the commercial companies to realize a reasonable profit from their investments.

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