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World-Wide Telephony—Its Problems and Future *

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The rapid development of large telephone networks giving a high grade of service between large numbers of telephones in continental areas has laid the foundation for the development of world-wide telephone service. Beginning in 1927 with the establishment of the first commercial telephone circuit between Europe and North America, intercontinental telephone service has, during the past five years, extended rapidly, and with further extensions already definitely planned, will embrace all of the continents and make possible the connection together of practically any two telephones in the world.

Up to the present time radio has been used to overcome the peculiar technical obstacles in the provision of intercontinental circuits. Two portions of the radio spectrum are suitable for this purpose, the long wave providing only a few circuits and the short wave providing for possibly several hundred circuits in the world as a whole. Plans have already been made for the important route between Europe and North America to supplement these with a telephone cable and the use of wire lines for intercontinental routes may become more important in the future.

The full development of intercontinental telephony is affected by a number of general difficulties. Of these the differences in time between different parts of the earth's surface are inherent. Differences in language both affect the ease with which customers can converse over the telephone, and complicate the operating problem. Furthermore, some of the differences in operating and commercial practices in the telephone networks of different continents which have in the past developed largely independently of each other, require consideration in the building up of intercontinental services.

The full development of intercontinental telephony is dependent upon the continued progress in working out these problems and in an extension of the brilliant scientific and engineering achievements which have made possible the present services. It is to be expected that with the further growth of intercontinental service it will be found desirable in the future to adopt a general world-wide plan for the routing of intercontinental messages somewhat comparable to the plans for continental telephone service already under consideration or in use. While political considerations may temporarily affect the form of the world-wide network, ultimately the requirements of economy and good service will no doubt be determining factors in such a plan.

It is to be hoped that the continued closer knitting together of the nations and races of the world by intercontinental telephone circuits will be a great contribution to international friendship and good will.

The authors wish to acknowledge their indebtedness to a number of telephone administrations who have provided them with information regarding present and proposed intercontinental services, supplementing the data previously published. They have also drawn freely on the material presented in the bibliography of Appendix 2, and this material has been of assistance. The authors also express appreciation of the assistance given them by a number of their associates in the American Telephone and Telegraph Company, particularly Messrs. O. B. Blackwell, A. B. Clark, L. Espenschied, O. T. Laube, H. S. Osborne and H. E. Shreeve.

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Introduction

THE rapidity with which telephone service has been extended to world-wide proportions during the past few years is perhaps one of the most remarkable of man's conquests over time and distance. Already it is a commonplace to hear the human voice from thousands of miles away, over land and sea. Distance and the great natural barriers of the world no longer prevent us from talking with each other. Across oceans and over high sierras the voice now carries its full message. Furthermore, these results have been accomplished within a few years. Telephony has demonstrated its international and intercontinental services. The development and extension of those services lies before us. It seems an appropriate time, therefore, to review some of the problems and possibilities in this extension of the application of the electrical arts to the service of mankind.

World-wide telephony has as its foundation the wire line networks on the various continents with their millions of users. The first step was taken toward overcoming the great barrier presented by the oceans in 1891 when the first submarine telephone cable was laid between Dover and Calais. Further submarine cable developments followed including the laying of a continuously loaded cable between Denmark and Sweden in 1902.

In the meantime the problems of spanning great distances over land were being rapidly solved, both in North America and in Europe, through the application of the loading coil and other transmission improvements. In 1911 service was opened between New York and Denver, a distance of 2000 miles (3300 kilometers). By 1913 the development of underground cable had progressed so that a cable was placed in service between Boston, New York and Washington, a distance of over 420 miles (700 kilometers).

But it required still further improvements in the whole art of long distance telephone transmission, including amplifiers and their application to wire lines before long distance telephony could develop beyond the semi-continental stage to truly transcontinental and transoceanic distances. With improved amplifier elements and the perfection of means for applying repeaters came the opening of transcontinental service in America in 1915 initially between New York and San Francisco, 3200 miles (5300 kilometers). This was followed after the close of the war by the rapid development of telephony of continental scope throughout Europe, stimulated by the close cooperation of the European Administrations through the International Advisory Committee on Long Distance Telephony. In South America the trans-Andean telephone line between Buenos Aires and Santiago was opened in 1928. Two years later came the transcontinental telephone line in Australia.

Overseas radio telephone experiments, in 1915, successfully transmitted the human voice from Washington to Paris and from Washington to the Hawaiian Islands. Commercial development of intercontinental telephony, however, followed somewhat slowly both because of the war and because of the tremendous inherent technical difficulties. However, as an interesting fore-runner of what would come later, a public service radiotelephone system was opened in 1920 linking Catalina Island, off the coast of California, with the wire telephone network of North America. In 1927, after a period of intensive experimentation and development work, commercial service between Europe and North America was opened to the public. This was the first step in the expansion of telephone service from a continental scope to a world-wide scope.

Present Situation and Plans for Future Development

Intercontinental telephony has naturally been dependent upon and been preceded by the development of large networks of telephones to which the intercontinental circuits could be connected. The most highly industrialized parts of the earth's surface today are provided with extensive networks of telephone lines covering great areas and interconnecting large numbers of telephones. This is indicated in Fig. 1 which shows the principal national and continental wire telephone networks, and all individual cities not connected to an extensive interurban network which according to latest reports have more than 10,000 telephones. As a result of the improvements which have been made in these wire networks in the last 15 years, both as to transmission and speed of service, they are today generally available and satisfactory for use in connection with intercontinental service.

For the purpose of this paper circuits of less than 600 miles (1000 kilometers) even if they cross continental boundaries will not be considered intercontinental circuits. In the consideration of world-wide telephony we are interested in the long circuits between distant parts of different continents or between continental areas and distant islands, for which the technique developed for long continental telephone lines is not directly applicable.

The extent to which the continents of the world are already interconnected by telephone circuits and the additional connections contemplated by plans now under way are indicated in Fig. 2. These are such as to make possible conversations between any two continents of the earth either by direct circuit or by switching in Europe or in

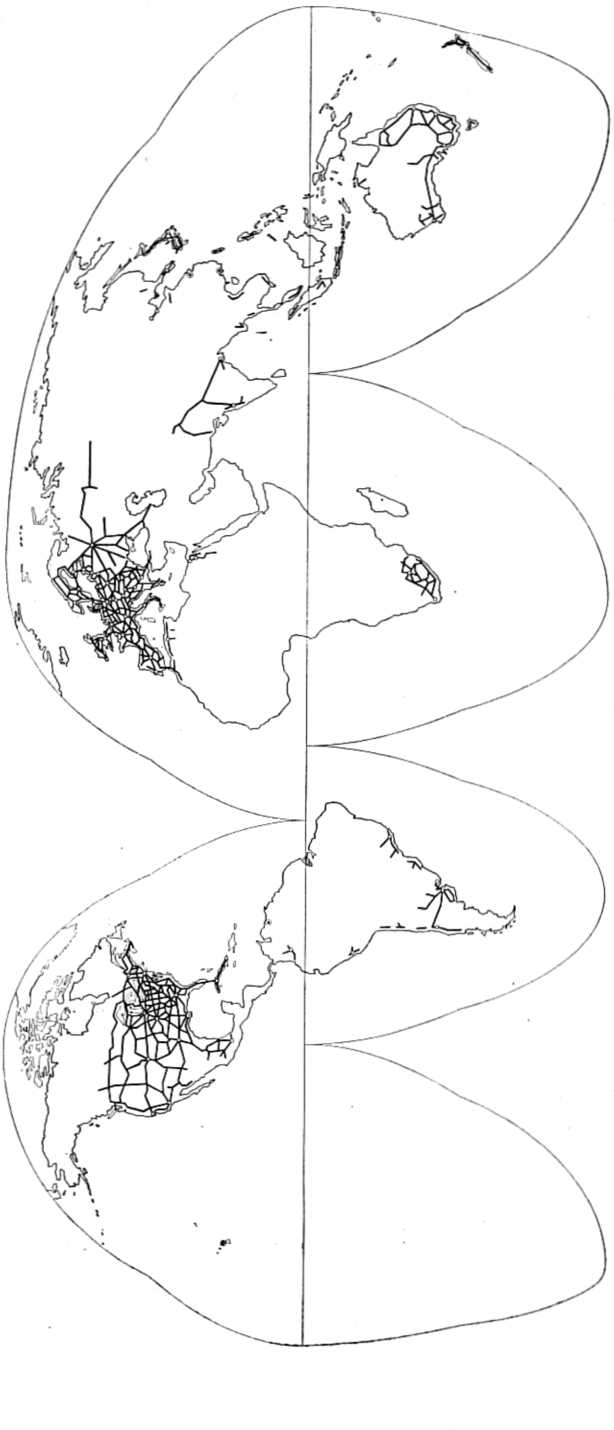

Fig. 1—Wire line telephone networks of the world. Includes indication of areas covered by international, national or interurban networks and individual cities having over 10,000 telephones. Based on information available January 1, 1932.

North America. The existing intercontinental telephone circuits of the world are indicated in Fig. 3. In this figure distinctions are made between full time circuits and part time circuits, that is, those on which terminal apparatus is shared by different points. A distinction is also made between circuits which interconnect wire networks connecting with 20,000 telephones or more, and those terminating in single telephones or networks of less than 20,000 telephones.

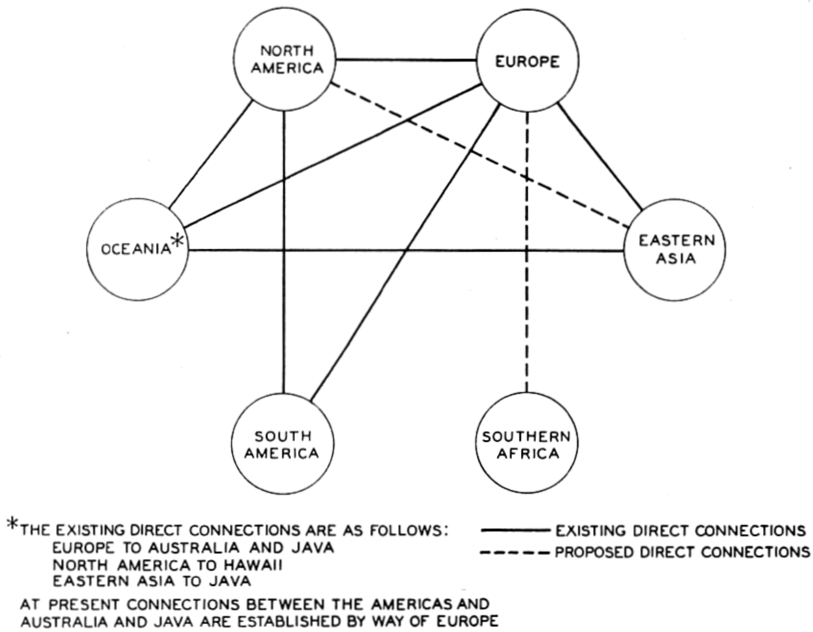

Fig. 2—International telephone relations as of January 1, 1932.

There are at present 37 of these intercontinental circuits totalling about 168,000 miles (280,000 kilometers) in length. All are radio circuits. One, in the New York-London group, is a long-wave circuit operating at approximately 60 kilocycles; the others are short-wave circuits in the range between 6000 and 23,000 kilocycles.

Europe and North America, which are the two largest highly industrialized areas of the world, contain about 90 per cent. of the world's telephones. It is natural that intercontinental telephone business in volume should first develop between those two areas Here service is maintained on a 24-hour basis and a group of four circuits is in use. Elsewhere, however, intercontinental connections consist at the present time of a single circuit, or more frequently,

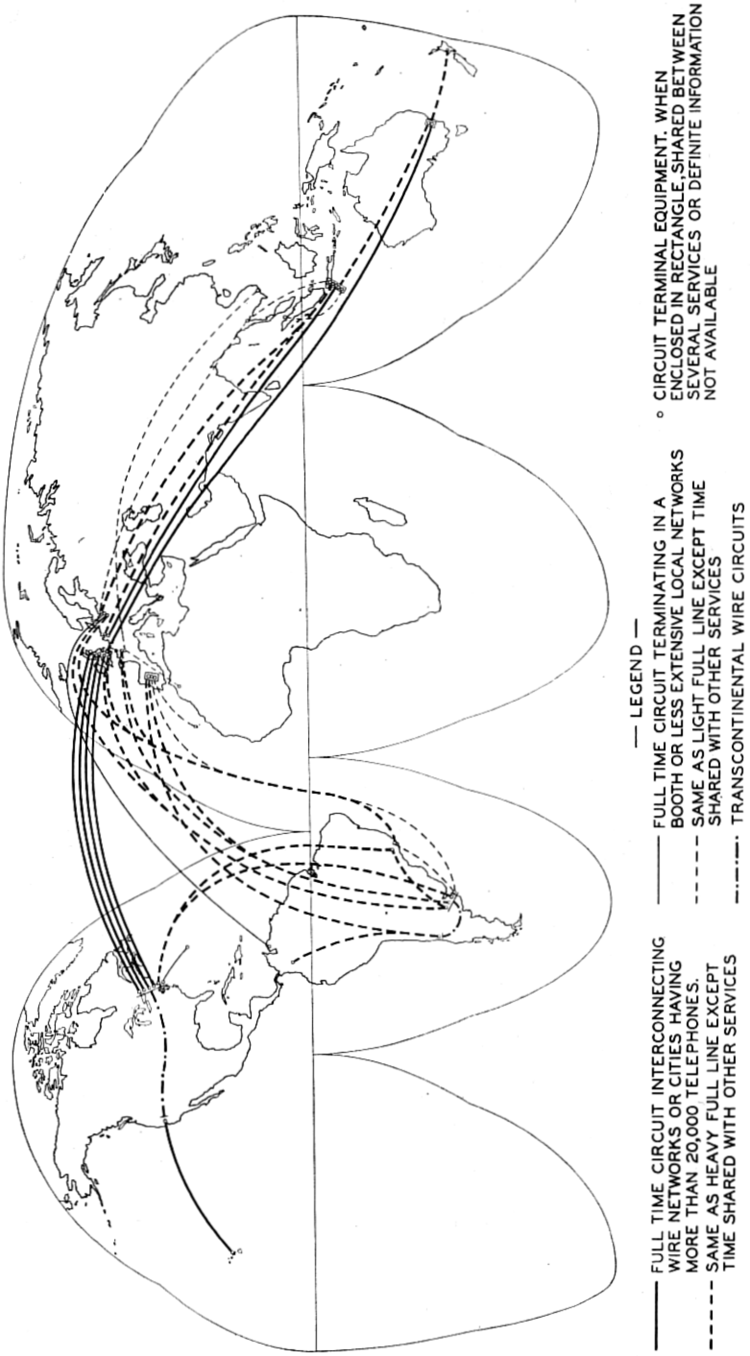

Fig. 3—Long intercontinental telephone circuits of the world. Circuits over 600 miles (1000 kilometers) in length as of January 1, 1932.

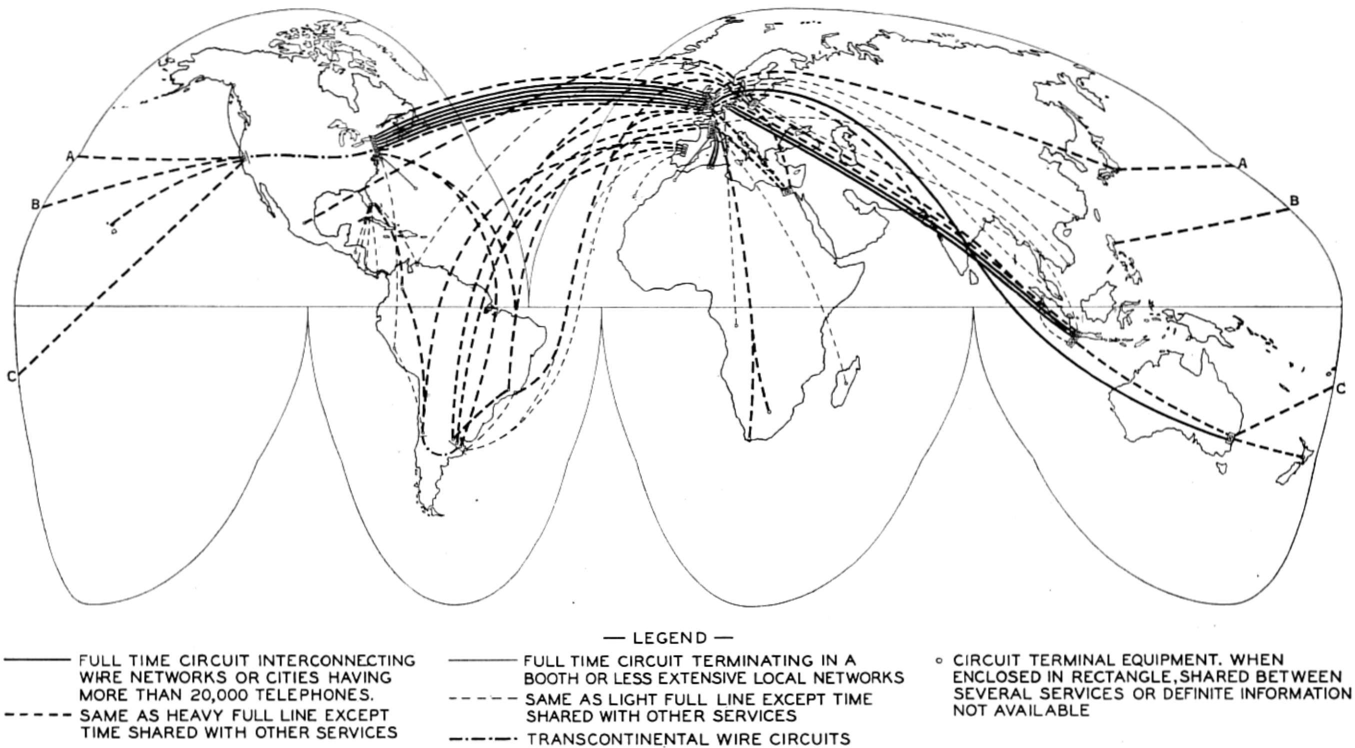

Fig. 4—Existing and proposed long intercontinental telephone circuits of the world. This map is similar to Fig. 3 and includes existing circuits and additional circuits now definitely proposed. Based on information available January 1, 1932.

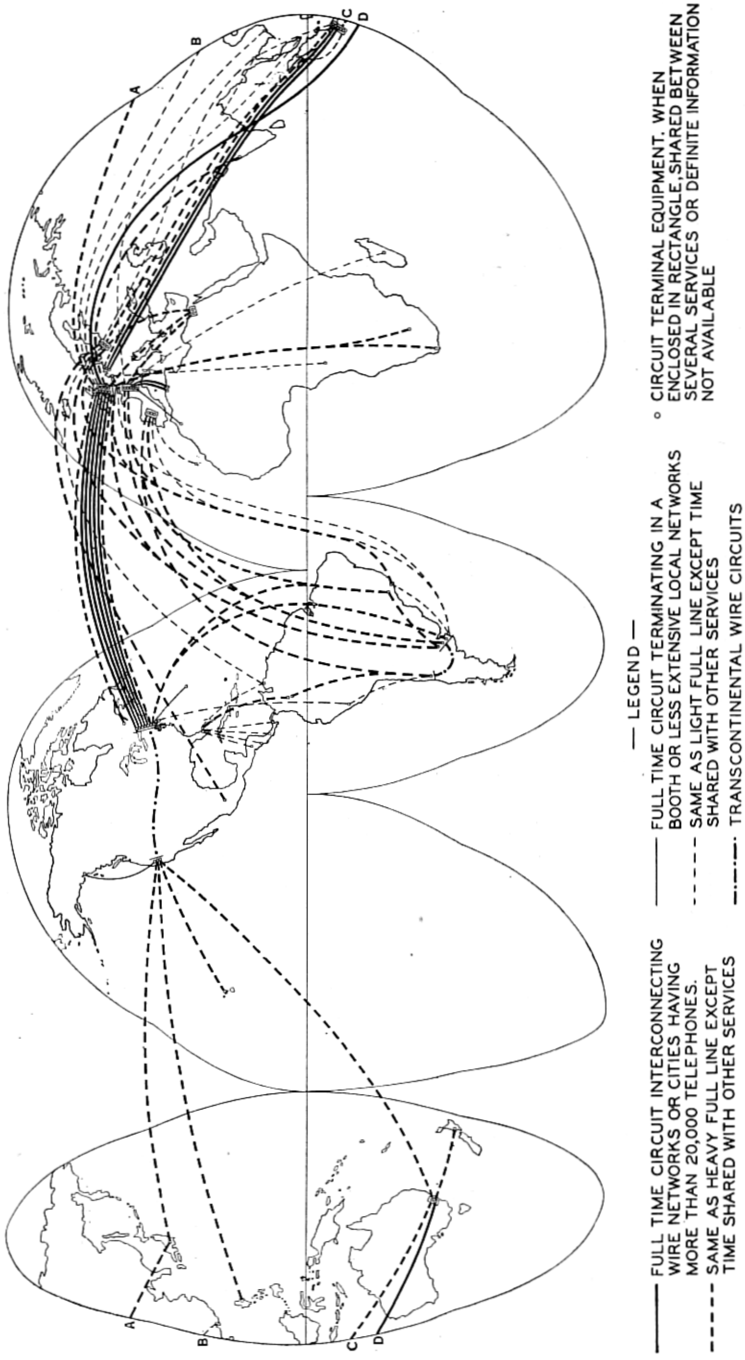

Fig. 5—Existing and proposed long intercontinental telephone circuits of the world. Arranged to show transpacific connections. Based on information available January 1, 1932. Circuits and legend same as shown in Fig. 4.

the part time use of a circuit, the apparatus being arranged to share its time between two or more distant terminals.

One cannot help being impressed by the developments represented by Fig. 3, which have taken place in the short space of five years. We are, nevertheless, in an early stage of development and present service suffers from the limitations of pioneer conditions. Dependence in so many cases upon a single intercontinental circuit which often is shared on a "party line" basis between two or more terminal points, is one of these limitations. Another is the variation in transmission characteristics and the susceptibility to interruptions which in the present stage of development of radio are characteristic especially of short-wave circuits on some of the more important routes. The rapidity with which the first steps have been taken is perhaps the best assurance that advance will continue to be rapid as the commercial demand for increasing amounts of service develops. This is illustrated by Figs. 4 and 5 which show the intercontinental circuits of the world which will exist when the present plans for additional circuits have been completed in so far as these plans are known to the authors.

Fig. 6 shows the extent to which the countries of the world will be tied into one great telephone system when the plans outlined in Figs. 4 and 5 are completed. Fig. 6 also shows the distribution of world trade and population of various groups of countries which are so interconnected. It will be noticed that the world-wide telephone network will include countries having 99 per cent of all the telephones of the world and having 92 per cent of the world's foreign trade. Details of all the present and proposed circuits which have come to the knowledge of the authors are given in Appendix I.

Closely related to the establishment of intercontinental circuits is the establishment of telephone service from European and North American points to a number of passenger vessels normally operating on the North Atlantic and other passenger routes. In addition, work is advancing in the equipment of fishing fleets, tugs, etc., but this service pertains more directly to the continental telephone service.

Technical Problems and Limitations

The unusual technical difficulties of providing satisfactory intercontinental telephone circuits come about not merely because of the distances involved but because these distances include long stretches of sea or undeveloped land. For years prior to the establishment of the first intercontinental circuit, commercial service was given on continental telephone networks over comparable distances, for example, in North America up to about 6000 miles (10,000 kilometers).

World Distribution

Population, Telephones, Foreign Trade

For Countries Having Existing or Proposed International Telephone Connections as of January 1, 1932

Country	Total Foreign Trade 1930 (Millions of Dollars)	Total Telephones as of Jan. 1, 1931 (Thousands)	Total Population (Thousands)
Europe			
All Principal Countries	30,260	10,620	542,350
North America			
United States, Canada, Cuba, Mexico, Bermuda	9,500	21,768	153,780
South America			
Argentina, Brazil, Chile, Colombia, Uruguay, Venezuela	2,590	595	71,090
Oceania			
Hawaii, Australia, New Zealand, Java, Sumatra	2,310	760	69,440
Asia			
Siam, Indo-China	300	12	31,740
Africa			
Morocco, Canary Islands	120	14	5,850
Total in countries having existing connections to international networks	45,080	33,769	874,250
North America			
Central America and Bahamas	120	18	2,720
South America			
Peru	130	14	6,260
Oceania			
Philippines	260	26	12,700
Asia			
Japan, Hong Kong, British India, Malay States	3,810	1,028	410,320
Africa			
Algeria, Belgian Congo, Egypt, Union of So. Africa, Madagascar	1,370	197	47,700
Total in countries having prospective international connections	5,690	1,283	479,700
Total, present and prospective international network	50,770	35,052	1,353,950
All Other	4,140	308	622,550
Total World	54,910	35,360	1,976,500

Fig. 6.

The technique of transmission over long continental distances, however, includes as one fundamental element the use of intermediate amplification at frequent intervals of from 45 to 240 miles (75 to 400 kilometers), depending upon the electrical characteristics of the circuit.

Radio Links

All of the existing intercontinental circuits make use of radio for the long transoceanic jumps, and it seems desirable first to consider the technical problems of radio telephony.

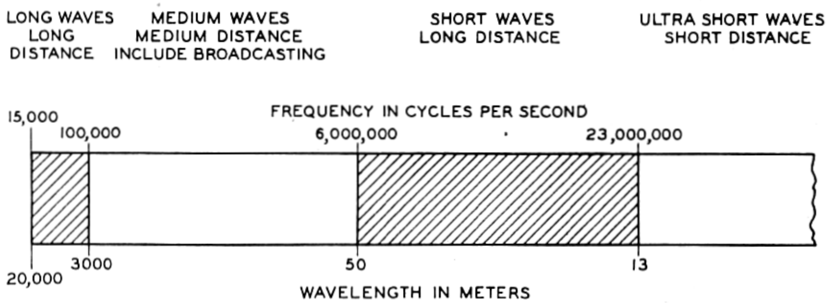

Fig. 7—Radio frequency chart. The bands applicable to intercontinental service are indicated by shaded areas.

Fig. 7 shows the radio spectrum with an indication of the uses made of the various portions of the spectrum. Only the two shaded parts of this spectrum appear to be applicable to intercontinental telephony. One, in the long wave range, extends from about 15 kilocycles to perhaps 100 kilocycles. The second includes the short-wave range from about 6000 to 23,000 kilocycles.

The transmission of these two wave ranges exhibit interesting differences in characteristics. For the short wave-lengths the transmission is frequently referred to as being in the form of "sky waves." This is for the reason that at intermediate distances the waves may practically disappear near the surface of the ground but reappear at greater distances. They appear to have been carried around the curvature of the earth's surface by refraction or reflection from ionized atmospheric layers. While the action in the long-wave range at great distances appears to be also conditioned partly by the ionized layers, the field at the surface of the earth falls off continuously as the distance from the transmitter is increased.

Interesting results are now being obtained in the use for communication purposes of very short radio waves having frequencies above 30,000 kilocycles. The work done to date indicates that these frequencies are not sufficiently deflected from their paths by the atmosphere to follow the earth's curvature. This characteristic appears to prevent the use of these very short radio waves for direct transmission over long distances and limits direct transmission to distances so short that the earth's curvature is not a large factor. For this reason the very high frequency range is not indicated in Fig. 7 as suitable for intercontinental circuits. Where the route is over-land it is possible that such rays may find practical use in forming links in intercontinental circuits particularly where the topography of the country affords advantageous elevated locations for intermediate repeater points. Too little is now known of these very short waves to make their discussion other than speculative.

An important requirement for radio for overseas telephone circuits is the avoidance of overhearing. A number of the overseas circuits now in operation, including the transatlantic group, are equipped with privacy arrangements which so modify the frequency disposition of the voice waves as to prevent overhearing of the conversations by other radio stations not equipped with similar arrangements. Experiments have been made with more elaborate arrangements for obtaining an even higher degree of privacy than that now provided.

Long Wave Circuits

Experience has shown that good results can be obtained in the long-wave range on such circuits as those between North America and Europe which are 3000 miles (5000 kilometers) long and have their transmission paths at a high latitude. A fundamental limitation to the extensive use of long waves, however, is that within the range of suitable frequencies there are theoretically obtainable only about twenty telephone channels between any two points. Actually however, there are not this many available because of the practical limitations imposed by the necessity of sharing this range of frequencies with other types of radio service. The relatively low attenuation of these waves as they are transmitted over the earth's surface makes it appear impractical to use duplicate intercontinental circuits of the same frequency at different points on the earth's surface. The total number of circuits of the long-wave type which can form a part of the ultimate world-wide telephone network seems, therefore, to be very small.

Other limitations in the use of long-wave circuits are that with the amounts of power which it now seems practicable to use (a tube capacity of about 300 kilowatts is used in the transmitter of the present transatlantic long wave circuit) their successful application does not exceed several thousand kilometers and is confined to routes well outside of the equatorial regions. These limitations are necessary to avoid excessive interference from atmospheric disturbances, both because of the relatively large components of these disturbances having frequencies in the range of wave-lengths used by these circuits, and also because of the difficulty of obtaining a high degree of directivity. Advantage has been obtained in the transatlantic long-wave channel by locating directive receiving antennas in the most northerly portions of the United States and Great Britain.

Short-Wave Radio

The short-wave range, as indicated in Fig. 7, covers a very much broader band of frequencies and offers hope for a much larger number of circuits. Only a portion of the entire range can be used at any one time for circuits between any two points because the distance at which the refracted waves reach the earth's surface varies with the frequency. It also varies with the time of day and the season of year, making it necessary, in general, to have about three different wave-lengths allocated for each circuit. In view of this limitation, it appears that this range can provide theoretically perhaps 50 telephone circuits between two given points. This theoretical possibility is reduced by practical considerations and by the necessity of sharing the range with other radio services.

Due, however, to the fact that short waves are more restricted than long waves in distance and in the time of day for which they are effective, it may be possible to use the same frequency for different circuits in several parts of the world without interference. It seems now that the development of the present art may make available throughout the entire world short-wave intercontinental circuits numbered in the hundreds but not in the thousands. This is not an inexhaustible supply of channels for the world to share as is illustrated by the very much larger number of telephone circuits already required for long distance service in the great continental telephone networks. In the United States alone there are about 6500 circuits in long distance service of which 620 are over 600 miles (1000 kilometers) in length.

The fact that by proper selection of frequency it is possible to communicate over the longest distances, gives short waves a flexibility which is unique. They give particularly good results in routes crossing the equator, such as circuits between Europe or North America and South America, for which routes long-wave transmission would be impracticable because of heavy atmospheric disturbances. On the other hand, short-wave transmission is subject to variations and interruptions from fading, distortion, and effects connected with terrestrial magnetic disturbances. These effects appear to be particularly severe on circuits involving routes of transit near the polar regions, such as the route between North America and Europe. Some of these effects are illustrated in Figs. 8 and 9 which give data taken on the United States-Europe route and which show, for comparison, the relatively stable conditions for the long-wave channel. In many respects short-wave and long-wave radio channels admirably supplement each other, being seldom interrupted at the same time.

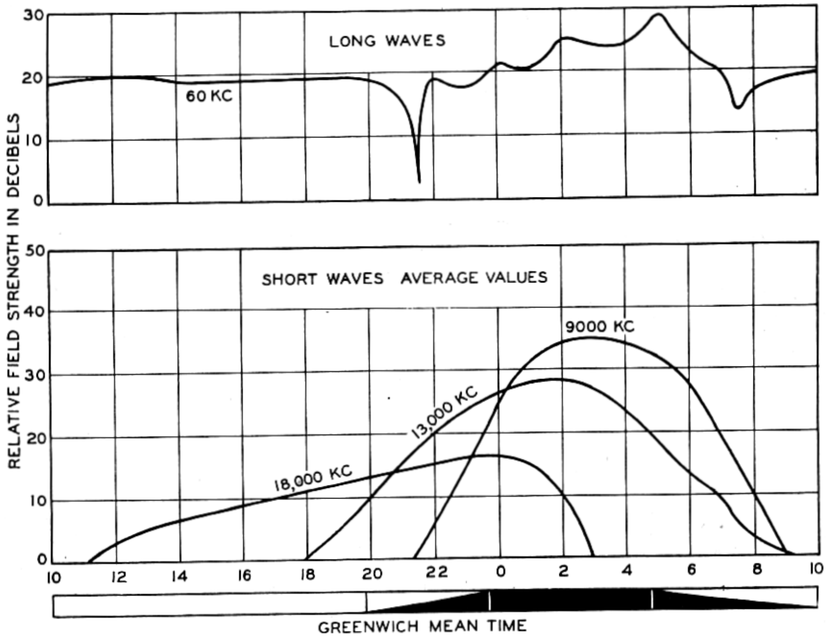

Fig. 8—Diurnal field strength characteristics of long and short-wave transmission over the North Atlantic. Shows effect of sunrise and sunset on the long wave and the necessity with short waves for using different wave-lengths at different times of day.

Short-wave transmission is in an early stage of development and it may be hoped that, with further experience, means will be found to avoid or reduce at least some of the present major limitations.

Wire Circuits

The intercontinental routes offer great difficulties to the placing of wire circuits. However, the limitations of radio, particularly on the intercontinental routes between North America and Europe interconnecting the two largest continental groups of telephones, have naturally led to considerable engineering thought on the possibilities of wire circuits. The most interesting development in this connection is a submarine cable which can be used for long lengths without intermediate repeaters.

Long Submarine Cables Without Intermediate Repeaters

To design long submarine cables without repeaters requires providing the mechanical characteristics necessary for deep sea cables and meeting rather definite limits of overall attenuation. There is a limit

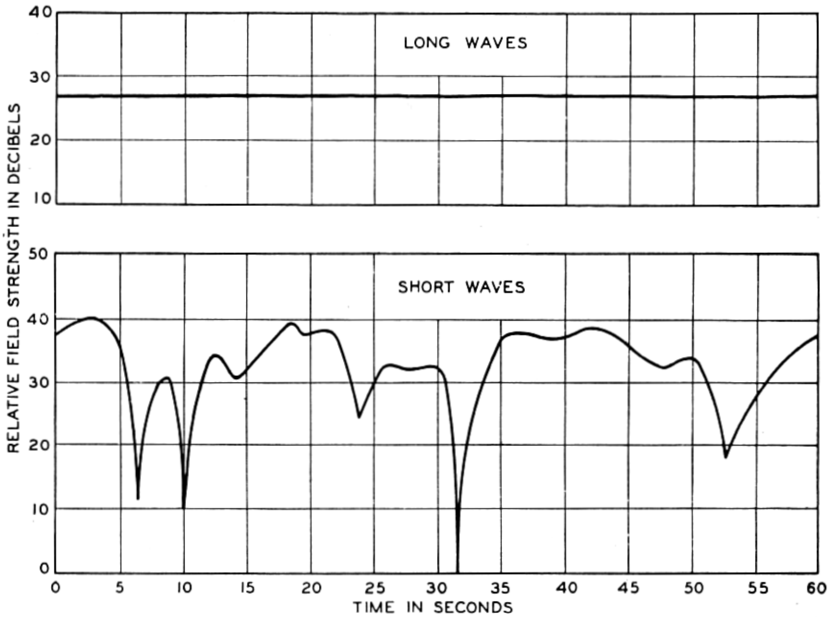

Fig. 9—The upper curve indicates the short period stability of the long waves. The lower curve indicates the rapid variations which are frequently experienced with short-wave transmission.

to the power which can be imposed on the sending end of the cable to avoid excessive voltage stress on the cable insulation. Even though the cable be adequately shielded from extraneous noises, there is a minimum amount of received power with which satisfactory transmission can be obtained because of the thermal agitation in the conductor itself. These two limits result in a maximum attenuation of about 160 db for satisfactory operation over such a cable.

The actual design of intercontinental telephone cables has been largely directed toward the North Atlantic route between the United States and Europe, including a direct section from Newfoundland to Ireland, a distance of about 2100 miles (3400 kilometers). By the use of a new insulating material, paragutta, with dielectric losses about one-thirtieth those of guttapercha, but with similar mechanical characteristics, and by the use of perminvar, a new magnetic material for loading the cable, it has been possible to design a cable for this section meeting both the mechanical and electrical requirements. With the further development of intercontinental communications, it is proposed to lay such a cable within a few years. With the materials now available, such a cable will provide only one channel of communication, and two-way communication will be carried out by using it as a one-way channel automatically switched in the direction of transmission by the voices of the users. Transatlantic cables providing several telephone channels either by the use of separate conductors or by carrier current methods are beyond the range of the present art.

The direct submarine cable while relatively expensive, is expected to provide a high grade circuit having a stability and a freedom from interruption greater than that provided by the present radio circuits. Proper combination of three different types of circuit, long and short-wave radio and cable, in one circuit group, however, should provide a large measure of assurance of continuous high grade service not dependent on the troubles which may affect any one type of circuit, and at an average expense not greatly above that required for radio circuits alone.

Other Wire Routes

The technical possibilities of wire circuits on intercontinental routes are evidently greatly increased where means can be found to avoid long lengths of submarine cables by the use of intermediate repeater stations. On the direct route between Europe and America, nature has not been kind enough to supply a series of islands at convenient distances and reasonably low latitudes to serve as repeater points. By going north, long lengths of submarine could be avoided. For example, a route through Greenland, Iceland and the Faroe Islands could be laid out with a maximum length of submarine cable of 300 miles (500 kilometers). The obvious difficulties of the route are the great extents of inaccessible and sparsely settled country, and the placing and maintenance of submarine cable under very difficult fog, storm and ice conditions. In the early days of submarine telegraphy such a northern route was seriously considered before the cable art had reached the point of permitting direct cables, but it was never used.

An equally bold solution which has been proposed is to float the desired repeater stations in the open sea. A good deal of ingenuity has been exercised in considering the possibilities of both attended and unattended floating repeater stations and of stations submerged below the action of the waves. So far, however, it is by no means clear that the mechanical difficulties and the problems of maintenance can be dealt with satisfactorily.

As time goes on land lines may become possible for many intercontinental routes where now, because of lack of highways or railways and the wild and unsettled nature of the country, they are out of the question.

Operating and Commercial Problems

In addition to the technical problems and limitations associated with the development of a world-wide telephone service which are outlined in the foregoing section, there are numerous operating and commercial problems and still other difficulties of a general nature.

Differences in Time

Limitations of a fundamental character are imposed by the differences in time on different parts of the earth's surface. These differences for a number of the principal metropolitan centers of the world are indicated in Fig. 10. If the business day be assumed to be 8 hours long, it is evident that as a result of the differences in time there is for each city one-third of the earth's surface on which the time is so different from that of the city in question that there is no overlap of the business day. For western Europe this third of the world is for the most part in the Pacific Ocean, so that, as will be noted from Fig. 10, there are few important centers in the world in which the time is more than 8 hours different from that of western Europe. The western part of the United States, however, has time differences of more than 8 hours with a large part of Europe, Asia and Africa. During some portion of the waking day there is an overlap of time between any two points on the earth.

Language

Another limitation, though of a less inherent nature, is the difference in language between different nations. There is as yet no evidence that the electrical requirements for satisfactory transmission of speech are substantially different with different languages, but language differences produce a problem in many intercontinental telephone conversations as often one subscriber is using a language of which he is not wholly master, and this may sometimes apply to both. Under these conditions the transmission requirements of the circuit for a given ease of carrying on conversations is unquestionably greater than when the subscribers are conversing in their native tongue. Hence, there is need in the ultimate development of intercontinental telephone systems for a high standard of transmission.

Language differences also complicate the operating problem, as it is important that the operators understand each other easily. This is

HOURS TIME DIFFERENCE BETWEEN CERTAIN CITIES IN VARIOUS PARTS OF THE WORLD

B ↓ / A →	Los Angeles San Francisco Vancouver	Chicago New Orleans Mexico City * Winnipeg	New York Washington Montreal Santiago	Buenos Aires Halifax	Rio de Janeiro	Paris London Madrid
Los Angeles San Francisco Vancouver	–	+ 2	+ 3	+ 4	+ 5	+ 8
Chicago New Orleans Mexico City * Winnipeg	– 2	–	+ 1	+ 2	+ 3	+ 6
New York Washington Montreal Santiago	– 3	– 1	–	+ 1	+ 2	+ 5
Buenos Aires Halifax	– 4	– 2	– 1	–	+ 1	+ 4
Rio de Janeiro	– 5	– 3	– 2	– 1	–	+ 3
Paris London Madrid	– 8	– 6	– 5	– 4	– 3	–
Berlin Rome Stockholm Vienna	– 9	– 7	– 6	– 5	– 4	– 1
Cairo Capetown Istambul Moscow	–10	– 8	– 7	– 6	– 5	– 2
Bombay Delhi	+10.5	–11.5	–10.5	– 9.5	– 8.5	– 5.5
Bangkok Singapore	+ 9	+11	+12	–11	–10	– 7
Peiping Shanghai Manila Perth	+ 8	+10	+11	+12	–11	– 8
Tokyo Vladivostock	+ 7	+ 9	+10	+11	+12	– 9
Sydney Melbourne	+ 6	+ 8	+ 9	+10	+11	–10

Notes

Computed from "The Time Zone Chart of the World," published by the Navy Department of the United States.

+ Indicates that cities in the row designated "A" have later clock time than those in the column designated "B" and lie within 180° toward the east.

Fig. 10

A → / B ↓	Berlin Rome Stockholm Vienna	Cairo Capetown Istambul Moscow	Bombay Delhi	Bangkok Singapore	Peiping Shanghai Manila Perth	Tokyo Vladivostock	Sydney Melbourne
Los Angeles San Francisco Vancouver	+ 9	+10	−10.5	− 9	− 8	− 7	− 6
Chicago New Orleans Mexico City Winnipeg	+ 7	+ 8	+11.5	−11	−10	− 9	− 8
New York Washington Montreal Santiago	+ 6	+ 7	+10.5	−12	−11	−10	− 9
Buenos Aires Halifax	+ 5	+ 6	+ 9.5	+11	−12	−11	−10
Rio de Janeiro	+ 4	+ 5	+ 8.5	+10	+11	−12	−11
Paris London Madrid	+ 1	+ 2	+ 5.5	+ 7	+ 8	+ 9	+10
Berlin Rome Stockholm Vienna	—	+ 1	+ 4.5	+ 6	+ 7	+ 8	+ 9
Cairo Capetown Istambul Moscow	− 1	—	+ 3.5	+ 5	+ 6	+ 7	+ 8
Bombay Delhi	− 4.5	− 3.5	—	+ 1.5	+ 2.5	+ 3.5	+ 4.5
Bangkok Singapore	− 6	− 5	− 1.5	—	+ 1	+ 2	+ 3
Peiping Shanghai Manila Perth	− 7	− 6	− 2.5	− 1	—	+ 1	+ 2
Tokyo Vladivostock	− 8	− 7	− 3.5	− 2	− 1	—	+ 1
Sydney Melbourne	− 9	− 8	− 4.5	− 3	− 2	− 1	—

− Indicates that cities in the row designated "A" have earlier clock time than those in the column designated "B" and lie within 180° toward the west.

This does not take account of the change in date in crossing the International date line.

* Time after April 1, 1932.

Fig. 10 (continued).

accomplished to a large extent at the present time by providing bi-lingual operators at the terminals of international circuits. Even so, on built-up connections with switches in several countries, operation is cumbersome since the terminal operators may not be able to talk to each other directly. This is one of the problems to which the International Advisory Committee on Long Distance Telephony has been giving attention. It is out of the question in a world-wide telephone system to expect the operator handling the call to be able in all cases to talk directly with the distant subscriber. However, it seems important from the standpoint of giving the highest grade of service that ultimately she should be able in all cases to talk directly and easily with the operator at the distant national terminal, no matter where this may be.

Operating and Commercial Practices

The continental telephone networks have in the past developed to a large extent independently of each other, and it is therefore natural that there should now exist differences in operating and commercial practices, some of which must be considered in giving intercontinental service. In Europe and in the United States, to take, for example, the two largest networks, the point of view in the development of the telephone systems has been somewhat different. In Europe emphasis has been laid on the continuous use of the long toll circuits, developing for them as large a message capacity as possible, while in the United States emphasis has been given to the rapid completion of all calls. This difference in point of view naturally led to differences in practice. For example, the classification of service based upon urgency and the limitation in length of conversations generally in use in Europe are not found in American practice. Also, an important factor in American practice for connections over long distances is the so-called person-to-person service in which a specified person is called rather than a specified telephone number, and the order is considered satisfied only when the person called is brought to the telephone. This service has not been generally used in European practice. These serve as illustrations of the type of difference in practice which must be adjusted between the administrations involved in establishing new intercontinental services, and it is evident that as these services become more used and more nearly universal, these adjustments will become increasingly important.

A consideration which might be important in the development of intercontinental services in some cases is a difference in standards of transmission or of speed of completion of calls. In recent years there has been in all large telephone networks a trend towards higher standards of service and this has been a favorable factor in making possible the beginnings of an intercontinental service.

General Discussion and Conclusions

The extension of overseas telephony during the past five years has already linked together into one system all of the largest continental telephone networks of the world and with the completion of further extensions now under way, this world-wide system will include all but two of the wire networks which give access to more than 20,000 telephones in all six continents of the earth. True, many of these overseas connections are as yet but slender threads of conversation, important perhaps not so much because of the communication which they now handle but because they represent the first realization of great possibilities in the achievement of a world-wide telephone system closely linking together the continents of the earth. In the words of Mr. Walter S. Gifford, President of the American Telephone and Telegraph Company, in the Annual Report of that company for the year 1926, the ultimate ideal of a world-wide system is that it shall enable "anyone anywhere to pick up a telephone and talk to anyone else anywhere else, clearly, quickly and at a reasonable cost."

What are the obstacles to the realization of this ideal for world-wide telephony? Intercontinental service is subject to extraordinary technical and operating difficulties and as yet only the first steps in overcoming these difficulties have been taken. The quality of service at the present time both as regards transmission, continuity and speed of service is not comparable with that given today on the large continental telephone networks, but is more comparable to the standards of service on long continental connections in the early days of their development 15 years ago. The costs of intercontinental service are materially higher than the costs for the longest connections on continental networks even where distances are similar. These facts indicate that to a large extent the future development of intercontinental telephony is dependent upon a continuance of those brilliant advances in the communication art which have made our present intercontinental circuits possible. Further technical developments making it possible to improve the quality and reduce the cost of intercontinental services will, as they become available, have a tremendous effect.

The development of overseas services of large magnitude will require a closer coordination between the telephone plants and practices of the various continental wire networks than exists at the present time. The circuits which will form the connecting link between the subscriber and the terminals of the overseas circuits must have such transmission characteristics as to provide for satisfactory operation of the complete connection, including the overseas circuit and the continental extensions at both ends. In one respect this will impose requirements more severe than necessary where continental service alone is in question. We refer to the velocity of transmission which determines the elapsed time between the speaking of a word at one end of a circuit and its reception at the other end. Losses of power and electrical distortions in circuits may, within limits, be compensated for but time once lost in the propagation of the conversation over the circuit cannot be regained.

Equally important is the closer coordination of operating methods and commercial practices in so far as they affect intercontinental communications. It is natural that continental telephone networks developing more or less independently should represent somewhat different solutions of the operating and commercial problems involved in giving telephone service. Intercontinental service brings new problems and requires the development of new operating methods and new commercial practices designed to simplify and expedite the handling of these connections.

In the closer cooperation between telephone administrations and the consideration of their joint problem which comes with the development of intercontinental telephone service, it is increasingly important that they have commonly accepted methods of measuring and of expressing all of the quantities affecting the types and grade of service to be given. The International Advisory Committee on Long Distance Telephony (The C. C. I.) which has been active in facilitating the cooperation of European administrations in the improvement of international telephony in Europe, has included in its program the development of internationally accepted terms and units which will be of help to the nations of the world in their rendering of intercontinental service.

The commercial success of an intercontinental telephone service depends upon the existence at its terminals of wire networks by means of which large numbers of telephone subscribers can be given connection to the intercontinental circuits. The ultimate development of a really universal service depends, therefore, in part on the creation of large national or continental wire telephone networks in the areas where these do not now exist. It is only in so far as this takes place that it will become practical to realize world-wide telephony.

As world-wide telephony overcomes these obstacles and develops in magnitude and completeness, what form will the system take? It is, of course, too early to give a categorical answer to this question, but present development gives us some indications from which to judge the future.

Considering first the field of use of the various types of circuit, it seems that radio circuits will for a long time fill an important field in the provision of intercontinental circuits. This is particularly true of the short-wave systems which seem to be best adapted for pioneer work such as is going on at the present time on light traffic routes. Here their imperfect reliability is more than offset by their flexibility and relative economy. Long-wave radio will, no doubt, continue to be valuable for certain routes where the direction of transmission is east and west and at a high latitude, but the limit, which is apparently inherent, on the total number of circuits of this type that can be used simultaneously in the world would seem to prevent them from supplying any large part of the world's future needs for intercontinental circuits. Radio telephony, both short-wave and long-wave, must compete for wave-lengths with other forms of radio service. It is evident from the important part that radio must continue to play in world telephony that the increasing needs for wave-lengths for this rapidly growing service will require special consideration in future international radio conferences. Wire circuits which in the present pioneer stage are just beginning to enter the scene, will undoubtedly become more important for the principal circuit groups as intercontinental communication develops.

As the amount of intercontinental traffic builds up, and as the technical form and best routing of the telephonic relations between continents become established, it is to be expected that experience will show the advisability of adopting a fundamental routing and switching plan similar to those plans which have already been considered and put into use for some of the large continental networks. It is now too early to suggest in any detail the form of such a switching plan, but it seems that while political considerations may temporarily affect the form of the network, ultimately the requirements of economy and good service which have determined the form of continental plans now in use will be weighty factors in the planning of a world-wide fundamental switching plan. This gives a clue to some of its characteristics.

The splitting of circuit time between different terminal wire networks, while a valuable expedient for offering service under pioneer conditions, will naturally disappear generally as sufficient traffic develops to justify a full time circuit on a given route. This may be expected to be followed by the development of small circuit groups between the more important continental telephone networks, each group being operated as a unit between fixed terminal points. The advantages, while circuit groups are small, of concentrating intercontinental traffic as far as possible between the same terminals rather than diverting it to individual circuits between different terminal points, are great. As an illustration, between the United States and Europe where the volume of traffic has already led to the development of a circuit group, the operation of the six circuits now contemplated as a unit is estimated to give for the same grade of service a capacity one third greater than would be afforded by six separate circuits of the same character between different terminal points. The inclusion in one group of circuits of three different types, short-wave radio, long-wave radio and cable, will afford a continuity of service and an insurance against interruption far beyond what could be achieved with single circuits. A single circuit group between the two continental networks is also advantageous from a service standpoint because of the simpler operating arrangements.

While the first stage in the development of intercontinental business appears to indicate the concentration of intercontinental traffic in so far as the extent of continental networks makes this practicable, a second stage in the development will naturally be the establishment of additional circuit groups between other points of the networks. This becomes economical and desirable from a service standpoint when the original circuit group becomes large enough to permit of subdivision without great loss in efficiency and when the amount of traffic which can be conveniently handled through additional points in the continental wire networks is sufficient to fill the time of a group of several circuits. Hence, it is to be expected that the ultimate switching plan for world-wide telephony will include between large continental networks, such for example as exist in Europe and in the United States, a number of groups of overseas circuits between different terminal points selected so as to handle the traffic most conveniently and economically. Such a plan would also necessarily provide arrangements for the use of alternate routes. In any case the ultimate best plan from the standpoint of service and economy will depend upon the volume of traffic.

The technical achievements which have made possible the linking together of the continents of the earth with telephone circuits are in a high degree romantic. What may be accomplished for the benefit of mankind by the continued development of this world-wide telephone network depends upon what is said over the telephone circuits. It is the hope of scientists and engineers who have been engaged in this work that this closer knitting together of the nations and races of the world will be a great contribution to international friendship and good will. Mr. Coolidge, President of the United States in 1927, on the occasion of the opening of the telephone connection between the United States and Spain, gave apt expression to this thought when he said, "I believe it to be true that when two men can talk together the danger of any serious disagreement is measurably lessened, and that what is true of individuals is true of nations. The international telephone which carries the warmth and the friendliness of the human voice will always correct what might be misinterpreted in the written word."

APPENDIX I

Intercontinental Telephone Circuits of the World
January 1, 1932

Existing Circuits[1]

Circuit Group Index No.	Circuit Designation	Ownership	Distance Kilometers*	Service Date	Rates[2]	Time Sharing Arrangements
	North America—Europe					
101	(1) London—New York (Long Wave)	British P. O.—Am. Tel. and Tel. Co.	5550	1/ 7/27	$30.00	Not shared
	(2) London—New York	British P. O.—Am. Tel. and Tel. Co.	5550	6/ 6/28	$30.00	Not shared
	(3) London—New York	British P. O.—Am. Tel. and Tel. Co.	5550	6/ 1/29	$30.00	Not shared
	(4) London—New York	British P. O.—Am. Tel. and Tel. Co.	5550	12/ 1/29	$30.00	Not shared
	North America—South America					
201	Buenos Aires—New York	Compania Internacional de Radio (I. T. and T. Co.)—Am. Tel. and Tel. Co.	8580	4/ 3/30	$30.00	At New York with 202
202	New York—Rio de Janeiro	Am. Tel. and Tel. Co.—Companhia Radio Internacional do Brasil (I. T. and T. Co.)	7810	12/18/31	$30.00	At New York with 201 At Rio de Janeiro with 802
	Europe—South America					
301	Buenos Aires—London	Compania Internacional de Radio (I. T. and T. Co.)—British P. O.	11140	12/12/30	£ 6/0	At Buenos Aires with 307, 802 At London with 302, 303
302	Buenos Aires—London	Transradio Internacional, Compania Radiotelegrafica Argentina S. A.—British P. O.	11140	12/12/30	£ 6/0	At Buenos Aires with 305, 308, 312, 801 At London with 301, 303

* 1 kilometer ≈ .6 mile.
[1] See notes at the end of this appendix.

APPENDIX I (*Continued*)

Circuit Group Index No.	Circuit Designation	Ownership	Distance Kilometers	Service Date	Rates [2]	Time Sharing Arrangements
	EUROPE—SOUTH AMERICA (*cont.*)					
303	London—Rio de Janeiro	British P. O.—Companhia Radiotelegraphica Brasileira (Transradio)	9290	5/21/31	£ 6/0	At London with 301, 302 At Rio de Janeiro with 306, 309, 314, 801
304	Buenos Aires—Paris....	Compania Internacional de Radio (I. T. and T. Co.)—Cie. Gle. de T. S. F.	11060	6/11/30	150 G. F.	At Buenos Aires with 311 At Paris with 305, 306
305	Buenos Aires—Paris....	Transradio Internacional Compania Radiotelegrafica Argentina S. A.—Cie. Gle. de T. S. F.	11060	2/ 1/29	150 G. F.	At Buenos Aires with 302, 308, 312, 801 At Paris with 304, 306
306	Paris—Rio de Janeiro...	Cie. Gle. de T. S. F.—Companhia Radiotelegraphica Brasileira (Transradio)	9170	3/31/30	750 F.	At Paris with 304, 305 At Rio de Janeiro with 303, 309, 314, 801
307	Berlin—Buenos Aires...	German P. O.—Compania Internacional de Radio (I. T. and T. Co.)	11920	9/10/30	120.00 M.	At Berlin with 308, 309 At Buenos Aires with 301, 802
308	Berlin—Buenos Aires...	German P. O.—Transradio Internacional Compania Radiotelegrafica Argentina S. A.	11920	12/10/28	120.00 M.	At Berlin with 307, 309 At Buenos Aires with 302, 305, 312, 801
309	Berlin—Rio de Janeiro..	German P. O.—Companhia Radiotelegraphica Brasileira (Transradio)	10030	3/21/30	120.00 M.	At Berlin with 307, 308 At Rio de Janeiro with 303, 306, 314, 801
310	Berlin—Maracay, Ven. .	German P. O.—Venezuelan Govt.	8300	9/13/31	120.00 M.	Not shared
311	Buenos Aires—Madrid..	Compania Internacional de Radio (I. T. and T. Co.)—Compagna Telephonica Nationale d'Espagna (I. T. and T. Co.)	10060	10/12/29	150 G. F.	At Buenos Aires with 304 At Madrid with 313
312	Buenos Aires—Madrid..	Transradio Internacional Compania Radiotelegrafica Argentina S. A.—Compania Transradio Espanola (Transradio)	10060	1929	150 G. F.	At Buenos Aires with 302, 305, 308, 801 At Madrid, with 314

APPENDIX I (*Continued*)

Circuit Group Index No.	Circuit Designation	Ownership	Distance Kilometers	Service Date	Rates [2]	Time Sharing Arrangements
	EUROPE—SOUTH AMERICA (*cont.*)					
313	Madrid—Santiago	Compagna Telephonica Nationale d'Espagna (I. T. and T. Co.)—Compania Internacional de Radio, S. A. (I. T. and T. Co.)	10700	4/17/31	165 G. F.	At Madrid with 311 At Santiago with 803, 804
314	Madrid—Rio de Janeiro	Compania Transradio Espanola—Companhia Radiotelegraphica Brasileira (Transradio)	8140	1930		At Madrid, with 312 At Rio de Janeiro with 303, 306, 309, 801
	EUROPE—AFRICA					
401	Casablanca—Paris	Moroccan Tel. & Tel. Admin.—Cie. Gle. de T. S. F.	1820	11/ 3/30	111 F.	At Paris with 503
402	Madrid—Teneriffe	Compagna Telephonica Nationale d'Espagna (I. T. and T. Co.)—Compagna Telephonica Nationale d'Espagna (I. T. and T. Co.)	1820	1/22/31	30 Pesetas	At Madrid with Madrid-Mallorca
	EUROPE—ASIA—OCEANIA					
501	London—Sydney	British P. O.—Amalgamated Wireless Australasia	17000	4/30/30	£ 6/0	Note 3
502	(1) Amsterdam—Bandoeng	Neth. Govt.—Neth. Indies Tel. Admin.	11740	1/ 8/29	33 Florins	At Amsterdam—Not shared At Bandoeng—Note 5
	(2) Amsterdam—Bandoeng	Neth. Govt.—Neth. Indies Tel. Admin.	11740	12/ 1/29	33 Florins	At Amsterdam—Not shared At Bandoeng—Note 5
503	Paris—Saigon	Cie. Gle. de T. S. F.—Cie. Gle. de T. S. F.	10120	4/11/30	450 F.	At Paris with 401
504	Bandoeng—Berlin	Neth. Indies Tel. Admin.—German P. O.	10830	12/29/29	96.00 M.	At Bandoeng—Note 5 At Berlin with 505
505	Bangkok—Berlin	Siamese Govt.—German P. O.	8610	4/15/31	96.00 M.	At Bangkok—Note 3 At Berlin with 504

APPENDIX I (*Continued*)

Circuit Group Index No.	Circuit Designation	Ownership	Distance Kilometers	Service Date	Rates [2]	Time Sharing Arrangements
	NORTH AMERICA—ASIA OCEANIA					
601	Honolulu—San Francisco	Mutual Tel. Co.—Am. Tel. and Tel. Co.	3850	12/23/31	$21.00	Not shared
	NORTH AMERICA					
701	Hamilton (Bermuda)—New York	Imp. & Int. Comm. Ltd.—Am. Tel. and Tel. Co.	1280	12/21/31	$15.00	Not shared
	SOUTH AMERICA					
801	Buenos Aires—Rio de Janeiro	Transradio Internacional Compania Radiotelegrafica Argentina S. A.—Companhia Radio telegraphica Brasileira (Transradio)	1970	1931		At Buenos Aires—with 302, 305, 308, 312 At Rio de Janeiro—with 303, 306, 309, 314
802	Buenos Aires—Rio de Janeiro	Compania Internacional de Radio (I. T. and T. Co.)—Companhia Radio Internacional do Brazil (I. T. and T. Co.)	1970	12/12/31	75 G. F.	At Buenos Aires with 307, 301 At Rio de Janeiro with 202
803	Bogota—Santiago	All America Cables Inc. (I. T. and T. Co.)—Compania Internacional de Radio S. A. (I. T. and T. Co.)	4260	8/ 1/31	105 G. F.	At Santiago with 313
	ASIA—OCEANIA					
901	Sydney—Wellington	Australian P. O.—New Zealand Govt.	2210	11/25/30		Note 3
902	Bandoeng—Bangkok	Neth. Indies Tel. Admin.—Siamese Govt.	2360	4/15/31	37.50 Florins	At Bandoeng—Note 5 At Bangkok—Note 3
903	Bandoeng—Sydney	Neth. Indies Tel. Admin.—Australian P. O.	5460	12/23/30	73.00 Florins	At Bandoeng—Note 5 At Sydney—Note 3
904	Bandoeng—Medan (Sumatra)	Neth. Indies Tel. Admin.—Neth. Ind. Tel. Admin.	1410	9/16/31	12.00 Florins	At Bandoeng—Note 5

APPENDIX I (*Continued*)

INTERCONTINENTAL TELEPHONE CIRCUITS OF THE WORLD
JANUARY 1, 1932

Proposed Circuits[1]

Circuit Group Index No.	Circuit Designation	Ownership	Distance Kilometers	Service Date[4]	Rates[2]	Time Sharing Arrangements
	NORTH AMERICA—EUROPE					
101	(5) London—New York (Long Wave)........	British P. O.—Am. Tel. and Tel. Co.	5550	1934	$30.00	Not shared
	(6) London—New York (Cable).............	Note 3—Am. Tel. and Tel. Co.				Not shared
102	London—Montreal.....	British P. O.—Canadian Marconi Ltd.	5220	1932	£ 6/0	At London—with 404 At Montreal—Not shared
103	Berlin—Mexico City....	German P. O.—Mexican Govt.	9720			Note 3
	NORTH AMERICA—SOUTH AMERICA					
203	Lima—New York......	Compania Peruana de Telefonos, Limitada (I. T. and T. Co.)—Am. Tel. and Tel. Co.	5920	1932		Note 3
204	Bogota—Miami........	Compania Telefonica Central (Assoc. T. & T. Co.)—Am. Tel. and Tel. Co.	2440	1932		Note 3
205	Maracay—Miami......	Compania Annonima Nacional Telefonos de Venezuela—Am. Tel. and Tel. Co.	2190	1932		Note 3

APPENDIX I (*Continued*)

Circuit Group Index No.	Circuit Designation	Ownership	Distance Kilometers	Service Date[4]	Rates[2]	Time Sharing Arrangements
	EUROPE—SOUTH AMERICA					
315	Madrid—Rio de Janeiro	Compagna Telephonica Nationale d'Espagna (I. T. and T. Co.)—Companhia Radio Internacional do Brasil (I. T. and T. Co.)	8140	1932	150 G. F.	At Madrid with 311, 313 At Rio de Janeiro with 202, 802
316	Brussels—Buenos Aires	Belgian Govt.—Transradio Internacional Compania Radiotelegrafica Argentina S. A.	11320	1932	150 G. F.	At Brussels—with 406 At Buenos Aires with 302, 305, 308, 312, 801
	EUROPE—AFRICA					
401	Casablanca—Paris	Moroccan Tel. & Tel. Admin.—French P. T. T.	1820			Not shared
403	Capetown—London	Overseas Com. Co. of So. Africa—British P. O.	9680	1932		At London—with 301, 302, 303
403A	Johannesburg—London	South African P. O.—British P. O.	9080			Note 3
404	Cairo—London	Marconi Radio Tel. of Egypt—British P. O.	3510	1932		At London—with 102 At Cairo—Note 3
405	(1) Algiers—Paris	French P. T. T.—French P. T. T.	1350	1932		Not shared
	(2) Algiers—Paris	French P. T. T.—French P. T. T.	1350	1932		Not shared
406	Brussels—Leopoldville	Belgian Govt.—Note 3	6000	1932		At Brussels—with 316
407	Berlin—Cairo	German P. O.—Marconi Radio Tel. of Egypt	2910			Note 3
408	Paris—Tananarive	French P. T. T.—French P. T. T.	8760			Note 3
409	Cairo—Paris	Marconi Radio Tel. of Egypt—French P. T. T.	3210			Note 3

APPENDIX I (*Continued*)

Circuit Group Index No.	Circuit Designation	Ownership	Distance Kilometers	Service Date[4]	Rates[2]	Time Sharing Arrangements
	EUROPE—ASIA—OCEANIA					
502	(3) Amsterdam—Bandoeng	Neth. Govt.—Neth. Indies Tel. Admin.	11740		33 Florins	Note 3
506	Bombay—London	Indian Radio Teleg. Co.—British P. O.	7300			At London—with 101
507	London—Singapore	British P. O.—Imp. & Int. Comm. Ltd.	12390			Note 3
508	London—Tokyo	British P. O.—Japanese Govt.	9560			Note 3
509	Hong Kong—London	Hong Kong Tel. Co.—British P. O.	9630			Note 3
	NORTH AMERICA—ASIA—OCEANIA					
602	Manila—San Francisco	Philippine L. D. Tel. Co. (Assoc. T. & T. Co.)—Am. Tel. and Tel. Co.	11220			Note 3
603	San Francisco—Tokyo	Am. Tel. and Tel. Co.—Japanese Govt.	8260			Note 3
604	San Francisco—Sydney	Am. Tel. and Tel. Co.—Australian P. O.	11950			Note 3
	NORTH AMERICA					
702	Miami—Tegucigalpa (Honduras)	Am. Tel. and Tel. Co.—Tropical Radio Teleg. Co.	1480	1932		At Miami with 703, 704, 705
703	Miami—Managua (Nicaragua)	Am. Tel. and Tel. Co.—Tropical Radio Teleg. Co.	1610	1932		At Miami with 702, 704, 705

APPENDIX I (*Continued*)

Circuit Group Index No.	Circuit Designation	Ownership	Distance Kilometers	Service Date[4]	Rates[2]	Time Sharing Arrangements
	NORTH AMERICA (*cont.*)					
704	Miami—San Jose (Costa Rica)........	Am. Tel. and Tel. Co.—Tropical Radio Teleg. Co.	1800	1932		At Miami with 702, 703, 705
705	Miami—Panama.......	Am. Tel. and Tel. Co.—Tropical Radio Teleg. Co.	1870	1932		At Miami with 702, 703, 704
706	Juneau—San Francisco .	Note 3—Am. Tel. and Tel. Co.	2530			
	SOUTH AMERICA					
804	Lima—Santiago.......	Compania Peruana de Telefonos, Limitada (I. T. & T. Co.)—Compania Internacional de Radio, S. A. (I. T. & T. Co.)	2470			At Lima—Note 3 At Santiago with 803, 313
	ASIA—OCEANIA					
905	Bangkok—Calcutta.....	Siamese Govt.—Indian Radio Co.	1620			Note 3

Notes

1. The table includes only circuits over 1000 km. in length. All circuits are short wave radio circuits except as noted in the New York—London group.
2. Rates given are for an initial 3 minute period. Abbreviations used are as follows: G. F. = Gold Francs, F. = French Francs, M. = Marks.
3. Definite information is not available.
4. Probable service date.
5. There are five transmitters at Bandoeng which serve the six circuits shown in the table on a shared basis.

APPENDIX II

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The following bibliography does not purport to be complete but is selected from among the articles bearing on the subject of "World-Wide Telephony" which have come to the attention of the authors.

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