Spectacular advances in communications technology often overshadow the patient evolution through which a telephone system continually grows and develops. One little-heralded project, dialing over ocean cables, is a major step in that evolution.

O. Myers and C. A. Dahlbom

Overseas Dialing: A Step Toward Worldwide Telephony

In a time when the world seems to be getting smaller, the rapid transmission of information may be vital to the life of nations, businesses and individuals. In the last decade the phenomenal growth of communications has increased man's feeling of a shrinking world and at the same time it has offered him effective tools for coping with it. Telephony is usually in the vanguard of communications technology, so it is not surprising that in the last ten years the number of the world's telephones has practically doubled. On the continent of Asia it has, in fact, trebled.

This growth has profound implications for the development of long—and ever longer—distance telephone communication. And because more than 97 per cent of the world's telephones are either part of, or connect with, the Bell System Network, Bell Laboratories has a unique responsibility in the development of an integrated global network.

Many advances have been made. TASI, developed at the Laboratories (RECORD, *March*, 1958), is now in use on the two transatlantic telephone cables and on the cable to Hawaii, and greatly augments their message-carrying capacity. Some advances of great promise—satellite communications, for example—are still in the experimental stage but are far more than merely visionary dreams. Yet others, such as operator-dialed overseas calls, the subject of this article, are in full development and will be realized in the near future. Also, many more ocean cables are planned to meet the anticipated demand for more international message circuits. If we can dial over these cables their efficiency will be greatly increased.

At present, "ringdown" (manual) operation is used on cables between the United States and Europe. A New York operator, for example, rings a London operator and gives her the number being called. When the conversation is completed, New York again rings London and the connection is taken down. Plans are moving rapidly to have operators dial these calls to their destinations;

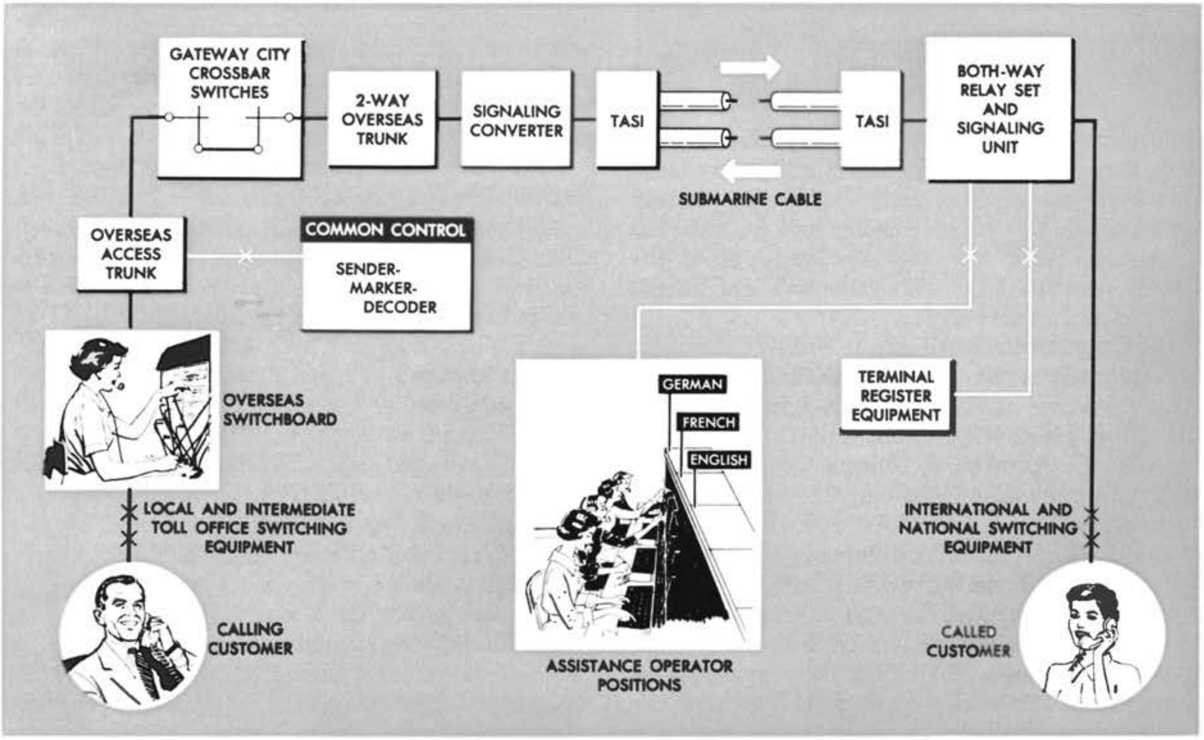
these plans should be implemented in 1963. The next steps will be direct distance dialing to certain cities overseas and, finally, worldwide DDD. Meanwhile, operator dialing will allow connections to countries abroad to be set up faster and will increase the available circuit time.

It was no small task for telephone engineers and officials of the countries involved in the overseas dialing project to plan a worldwide program and to get it started. Some features of the various national telephone networks are reconciled without great difficulty, but there are others that one would like to wish away in the interests of a unified way of operating. The American and Canadian networks share a common numbering plan, an integrated trunking and switching plan and the same supervisory and digital signals. Thus the two countries may be thought of as the North American network. In Europe we have a different story.

Within the United Kingdom and the continent there are almost as many different ways to perform the switching, signaling and transmission jobs of telephonic communication as there are countries. Each national network may differ from any other. To translate between these various systems, another connecting network is required. For this international network, the Committee Consultatif Internationale Telegraphique et Telephonique (CCITT) has recommended standards of numbering, signaling, switching and transmission. The membership of the CCITT includes some 76 private operating agencies and national telephone administrations. The A.T.&T. Co. has been a member since 1929.

The European systems and the American systems have each reached highly sophisticated states of the telephone art independently, with no need until recently to coordinate their developments. This is particularly the case in signaling techniques, and it raises many complex problems of how to transmit information between the hemispheres. TASI, with its unique speech channel multiplexing, introduces other difficult problems. Add to these complications the fact that a compatible transatlantic network will be part of a global network that will be converted ultimately to customer dialing and we have a rather formidable problem.

Happily—and this article could point a moral in international cooperation—telephone engineers and administration officials recognize the need for a worldwide dialing network. Some guide lines for its development have been delineated in the plans for dialing between North America and Europe. A few of the most pertinent agreements are listed below as a point of departure for a more detailed discussion of the particular problems.



General plan of the international network. Language operators will be needed only in Europe.

- ▶ There will be a new supervisory signaling plan that will be the same in both directions in respect to format and frequencies.
- ▶ Address information will be sent by multifrequency pulsing at 10 digits per second.
- ▶ All cable circuits will handle two-way traffic (traffic originating at either end).
- ▶ Only machine access will be allowed to transatlantic channels.

In the proposed transatlantic network, the numbering plan used in Europe will meet CCITT recommendations; North America will use the standard North American plan. Each country will maintain the internal features it likes. For European international calls, the CCITT numbering plan uses a two-digit country code, a language digit, an area code which may be a single digit, an office code and a line number. On a call to London from any other country in Europe, for example, the dialing might proceed as shown in the table below.

DIGITS DIALED	SWITCHING INFORMATION
44	Country code, United Kingdom
2	Language digit
1	Area code, London
222	Office code
1234	Line number

The language digit, the second entry in the table, denotes the language of the calling country. This is to ensure that calls requiring operator assistance in the called country will be directed to an operator who speaks the language of the calling country. The office code will not necessarily contain three digits.

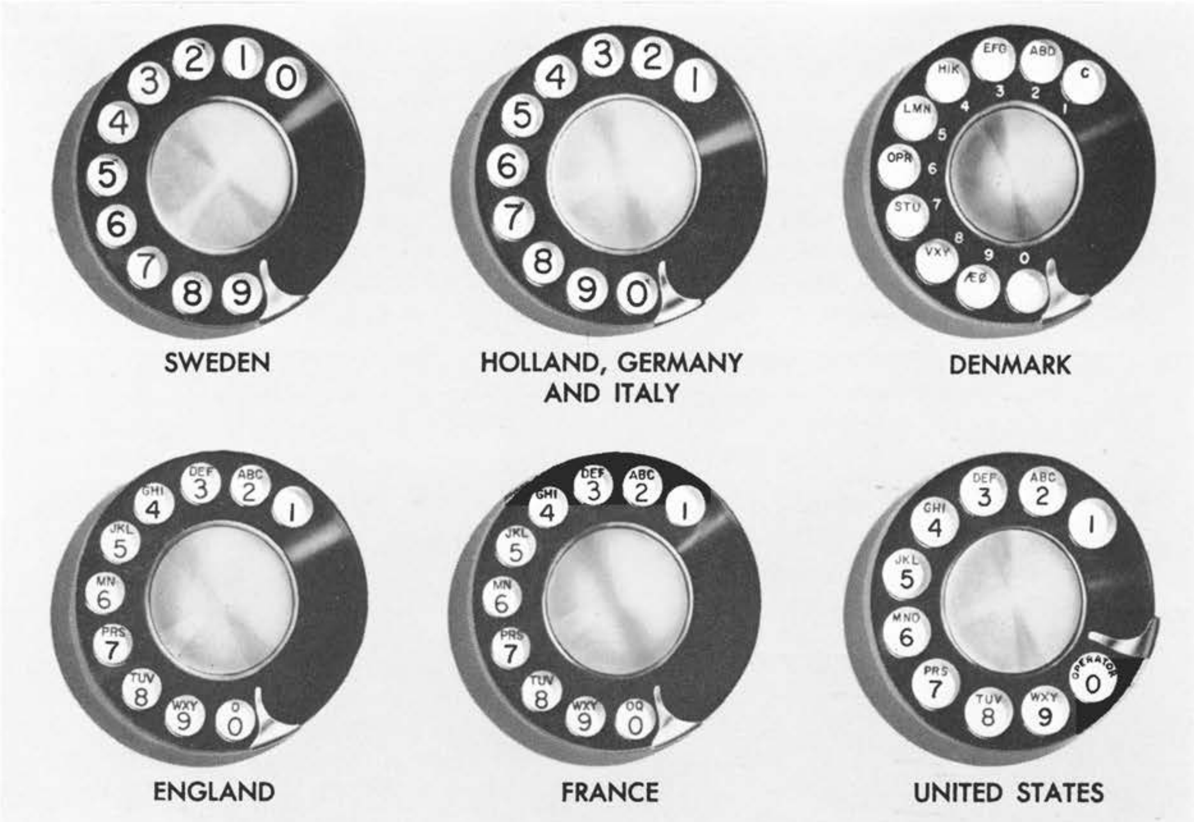
The arrangements will not be quite the same in both directions on the transatlantic circuits. Mainly because of differences in numbering and switching philosophy, some aspects of dialing from North America to Europe will vary from dialing in the other direction. The major difference is the "gateway city" concept of the United States and Canada. With this mode of operation, calls to Europe from any point of origin in either country will be routed through a gateway city—New York and Montreal are typical—and dialed from these points. This is a very manageable concept because special equipment for overseas dialing need be installed only in the gateway cities. Similarly, special operating requirements are limited to staffs in these cities.

The European plan, on the other hand, prefers two types of operation called "terminal" and "transit," depending on whether the call is routed directly to the terminating country or switched through another country. If the call is terminal, the complete national number is sent ahead. If the call is transit, only the country code is sent to the transit points. The terminal country, when it is reached, requests the language digit and national number. Although this type of operation has the gateway-city advantages of limiting the requisite special equipment and operating procedures, it has the present disadvantage that all calls using the same country code must be routed via a single city. Thus, even though a short, direct route may exist between two cities, a call between them may have to be directed over a longer route through that single city. The alternative to this plan is the use of extra codes or more complicated translation.

Ultimately, transit operation may be needed for international alternate routing. In preparation for this, the North American gateway city equipment will be designed to send both terminal and transit signals. On calls from Europe to North America, no distinction need be made, because on this continent the same mode of operation serves all calls. In every case the complete address information is sent and received and the same group of registers is used for "via" and "terminal" traffic. The CCITT recommends two kinds of registers at each switch point, a two-digit register for transit calls and (usually) a ten-digit register for terminal calls. The language digit is stored in the trunk circuit, not in the register.

The language digit represents a small problem, though a practical rather than a technical one. On calls from North America to Europe the language digit must be sent and it will be inserted by switching equipment. On calls in the other direction, however, it is not practical to have assistance operators in the United States who speak the languages of Europe. Therefore, by agreement, all calls to the United States will be handled by European operators who speak English.

There are other numbering problems besides those discussed. One becomes immediately apparent with a glance at the dials used around the world (*see photograph on page 243*). On the Swedish dial, for example, the numeral "0" is in the position of the numeral "1" on the other dials. Mechanical translation may be necessary to reconcile this dial with others. The differences between



Telephone dials from several countries showing some of the variations in lettering and numbering.

the English dial and the American dial are slight and operators could be trained to make the necessary translations between England and North America. But for customer dialing, the problem may be somewhat greater. When customer dialing is eventually introduced, all-number calling will probably be adopted.

Difference In Numbering Plans

Another problem arising from the difference in numbering plans has the same general outline—a minor difficulty if operators dial, but more serious if customers dial. This problem stems from the idea of a "closed" or an "open" numbering plan and the methods of determining that full address information has been received.

In the North American (closed) numbering plan, senders and registers "count" the digits that are dialed and "know" when the last one has been received. This arrangement can be made because there are a fixed number of digits for each telephone number. In some European (open) plans the number of digits varies. Eight to ten digits not including the prefix "0" are used in England, for example. Timing or special translation is used to indicate that the last digit has been received. In London, the area code, "1," indicates that nine digits (prefix "0" followed by eight digits) will be dialed. In other areas the number is considered complete if, after a fixed time, no further digit is received. When operators dial, an end-of-keying signal will be transmitted to indicate that the number is complete.

Another problem is that differences must be reconciled in modes of assistance operator and address signaling. The CCITT proposes either an arythmic or a binary code. Each code has 16 possible signal combinations; ten represent decimal digits, the eleventh and twelfth signal "Code 11" and "Code 12" operators for assistance. These last combinations correspond, respectively, to the North American 3-digit inward operator code "121" and the 4-digit delayed call operator code "115X." Three of the remaining four combinations in the CCITT code are spares, the other indicates end of pulsing.

For supervisory signaling the problem is a bit more complex. The CCITT recommends "spurt-type" signaling in which there are tones on the line only when trunk control, status, or address information is transmitted. When the line is idle or during conversation no tones are present. The North American network, on the other hand, uses continuous supervisory signaling in which there is a low-level tone always present on the line when it is idle. Interruptions of this tone transmit the signaling sequences. When signaling is completed and conversation has started, the tone is removed.

Another point of comparison is that the various line sequences—connect, disconnect, on-hook, off-hook—are represented in the CCITT plan by spurt signals of fixed duration and a specified combination of frequencies. To assure a high degree of accuracy, acknowledgment signals are needed. They are not needed with continuous signaling.

The supervision problem is further complicated by TASI. Continuous tone cannot be used on this system because its central idea is that the absence of any tones or speech energy on a channel indicates that it can be switched instantly to another

COMPARISON OF TRUNK CONTROL AND STATUS SIGNALS

Signals	Standard Bell System SF Signaling for Intertoll Trunks (2-way Operation) Frequency = 2600 CPS ▭		Signaling for Transoceanic TASI Derived Trunks (2-way Operation) Frequencies {2600 CPS ▭, 2400 CPS ▬}	
	Direction of Transmission		Direction of Transmission	
	Orig-Term	Term-Orig	Orig-Term	Term-Orig
Idle Condition	⇨	⇨	No Tone	No Tone
Seizure	No Tone	⇨	➡	No Tone
Delay Dial	No Tone	No Tone	—	—
Proceed To Send (Start Dial)	No Tone	⇨	➡	⇨
Address Signals	MFKP	⇨	MFKP	No Tone
Customer Answer	No Tone	No Tone	No Tone	▬ 850
Called Customer Hang-Up (On Hook, Clear Back)	No Tone	⇨	No Tone	▭ 850
Disconnect-Forward (Clear-Forward)	⇨	⇨	⇨ ➡ }	No Tone
Disconnect-Acknowledge (Release Guard)	—	—	⇨ ➡ }	⇨ ➡ }
Ring Forward (Forward Transfer)	▭ 70-130	No Tone	▭ 850	No Tone
Busy-Reorder-No Circuit (Busy Flash)	No Tone	Audible Tone (30, 60, 120 IPM)	No Tone	*Audible Tone (30, 60, 120 IPM)

⇨ Continuous Tone
Duration of Pulses Indicated in Milliseconds

*For Calls to United Kingdom & Europe, a Busy Flash Signal ▭ 850 or an Audible Tone

Trunk control and status signals as they are used on present Bell System and on transoceanic trunks.

Over-all view of the Long Lines overseas switchboard room at the A.T.&T. Co. in New York City, one of the gateway cities.

talker. The signaling plan proposed for the transatlantic facilities is, therefore, a compromise between spurt and continuous signaling; each type is used where it is most advantageous. The chart on the opposite page compares the types of signals used for TASI derived trunks with those of standard North American plan.

It is important to remember that the transatlantic network will be compatible with both the European and the North American network, and that all countries will retain their internal features. Thus, in the matter of signaling, a converter will be used at each terminal to accept the type of signaling used on TASI and convert it to the type of signaling used either in North America or Europe. (See diagram on page 241.)

On the matter of trunks, CCITT operation in Europe is generally limited to one-way trunks. On the transatlantic circuits, trunks will be designed to handle calls originating at either end. The economies of two-way trunking are important, and for Europe, this type of operation will eventually become standard where it is economical.

Economy—at least in the narrow sense of the word—is, of course, not the only object of the decision to use two-way trunks. Nor, indeed, is it the aim of any other change or development described in this article. That aim is faster, more efficient handling of international traffic. Paradoxically, one result of improved methods of transmission is that they usually perpetuate and even increase an aspect of the traffic problem that they were intended to solve—its volume.

It is almost a truism that message circuits added to a crowded route will stimulate even greater volumes of traffic than had existed previously. Traffic doubled in the year following the cut-over of the first transatlantic cable to England. Conversation time per call also increased. An increase in traffic has occurred with each new cable and it can be predicted for planned cables. So the future of telephony is one of continued growth; its form is anybody's guess.

There are clear indications, however, that temper the guess with fact. It is quite likely that in the future, satellites will be used for intercontinental calls. Cables will, of course, be used for diversity and for protection against interference. In fact, some cable operating and signaling methods may be adapted to satellite operation. Worldwide calling with satellites will require a complete reappraisal of existing numbering, trunking, signaling, transmission and switching plans. Indeed, so great is the promise of satellites that work has already been started on worldwide numbering. Transmission, signaling, and trunking will be studied too. Intercontinental centers will probably perform the functions on a worldwide basis that regional centers now perform on a national basis. The horizons of technology broaden with new possibilities, and the physical horizons seem to grow closer as this technology brings nations to only seconds apart.

We are often told that the only real barrier between nations is their inability to understand one another. Understanding waits on a transfer of intelligence one to the other and the basis of this is a transfer of information. In a very real sense, the ultimate refinement in communications is not merely of the future, but will help to shape it.