

A SIMULATION MODEL FOR OVERSEAS TELEPHONE

OPERATIONS DISTRICTS

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ABSTRACT

The American Telephone and Telegraph Long Lines Department is responsible for international telephone traffic. To handle this traffic Long Lines has eight International Operating Centers (IOC), or districts, throughout the country. In the system, variable factors include the number and schedules of telephone operators, circuitry configurations, and country data such as traffic volume and quality of service. As a result of this multiplicity of factors, the effects of proposed or expected changes in the system are extremely difficult to estimate computationally. The model described here is a computer program written in the GPSS-V simulation language which simulates stochastically each event in the handling of overseas telephone calls through an IOC for a period of up to 24 hours.

THE OPERATING ENVIRONMENT

With a few exceptions, each foreign country's traffic is the responsibility of only one IOC. An IOC consists of from one to five subdivisions called units, which are groups of about 30 operator positions (switchboards) on the average, but the number varies widely. A unit may be defined as a set of positions which have access to a common group of circuits.

Basically, there are two types of circuitry: domestic and overseas. To connect a domestic and a foreign party, one of each of these types of circuits must be used. Each position may have up to six such circuit pairs in use at any one time. Circuitry can be broken down as follows:

<u>Domestic</u>	<u>Overseas</u>
Incoming (TX)	Outward-only
multiplied	Inward-only
non-multiplied	Two-way
Outgoing (LD)	

LD trunks are used only when the operator must call the domestic party, either to connect him with a foreign caller, or to make a subsequent attempt when a previous try at the overseas connection has failed. When a domestic party calls in to the IOC, a TX line is used. In a non-multiplied environment, each set of TX lines leads into one unit only. The unit to which the caller is connected depends in this case on the country he wishes to call. Consequently, each unit in an IOC with non-multiplied TX trunks is responsible for a different group of countries. On the other hand, in a multiplied TX setup, circuitry is configured in such a way that incoming calls are assigned to units partly by chance and partly in relation to the relative workload on each unit at the time of the call's arrival. Thus, each unit in an IOC so engineered must be able to handle calls to every country for which that IOC is responsible.

Outward-only overseas trunks can only carry calls from the IOC to a foreign country; inward-only trunks carry calls coming into the IOC from overseas; two-way lines can handle both types of calls. In all cases, an overseas line is capable of handling calls to one country only. Any call to that country may compete for that circuit, including, for some countries, calls through other IOCs or direct dial calls not requiring operator assistance.

PROCESSING OF A CALL

In the simulation itself, the characteristics of each call, along with the action times, are determined from probability distributions taken from operating room studies. The events in the life of a telephone call are described below;

- 1) The call attempts to seize a TX line. If none are available, a busy signal is recorded. Otherwise,

the call waits until an operator answers it. If the wait exceeds an acceptable length, it is terminated. If it is a non-hangup call, the call proceeds to step (3). However, some calls are made on a hangup basis, in which the operator hangs up and calls back the caller, thus freeing the TX line for another incoming call. The call proceeds to the next step.

- 2) The operator calls back the domestic party. If an attempt in this or a later step is unsuccessful, the operator waits for a period of time and then returns to this step.
- 3) The call attempts to seize a foreign circuit. This involves taking both an overseas trunk and a line within the foreign country.
- 4) If information and/or language assistance are required, they are obtained. Whether they are required or not are two of the call's characteristics.
- 5) The operator attempts to reach the foreign party. If this is successful, the conversation takes place, at the end of which the circuits are freed and the operator punches the call ticket.

USE OF THE MODEL

The program simulates operators' handling of telephone traffic through an IOC subject to one of the circuitry configurations outlined above. The model can handle up to 325 operators and 25 countries. The input is a data set provided by the user which contains (1) the work schedule of each operator on duty during the simulated period, (2) the IOC's circuitry configurations, and (3) country data including:

- Half-hourly call volumes
- Probability of requiring language assistance
- Quality of the foreign country's service
- Ratio of inward to outward traffic
- Description of traffic not handled by IOC simulated (if any)

The output of the model includes for each unit the number of call arrivals, the percent taking more than ten seconds to answer, and successful terminations in each half hour, as well as handling times for inward and outward calls and operator utilizations. Since the model is a direct simulation of the events in an IOC, additional statistics may be taken if desired by locating accumulator variables at strategic points in the

program. Also, since the model is stochastic, several runs can be made, using different random number seeds each time, with the results averaged to obtain a more accurate long-run estimate. Although the model clearly cannot optimize the organization of an IOC, a manager can use it to analyze the service that a certain configuration is likely to provide, and then use his experience to make changes which can, again, be tested by the simulation.