OTARIE: AN INTERACTIVE TOOL FOR PERFORMANCE EVALUATION STUDIES IN TELEPHONE NETWORKS

Jean-Pierre GUERINEAU*, Michel DAO*, Chris BECQUE**

* CNET Paris A/ATR
38-40 rue du Général Leclerc
92131 Issy-les-Moulineaux, France

** British Telecom Research Laboratories
Martlesham Heath
Ipswich, England

In this paper we present a software package which allows the evaluation of the performance of telephone networks. The package has been made as user-friendly as possible by employing the existing functions of a graphic workstation. The paper defines the objectives of the tool and discusses its main characteristics. It then describes the graphical outputs of the existing version and finally presents the future evolution of the tool.

1. INTRODUCTION

This paper presents a user friendly software package called OTARIE which will evaluate the performance of telephone networks. For the purposes of this paper, performance will mean the trunk group losses and the point-to-point losses. The package is still under development, but a first version of the tool has been implemented and is, at the present time, used by operational services of the French Telecom to perform scenario studies for their networks. Before presenting the tool itself, we will first define the objectives of the project and then we will present the main characteristics of the package. We will concentrate on the graphical aspects of the tool by describing the different images obtained on the graphic screen and by showing the interaction between them. Then we will discuss the future evolution of the tool.

In 1984, interest in the development of such a tool was expressed by several administrations (Great Britain, Sweden, Netherlands and France) and so an international collaborative project called "EVA" was set up. The objectives of this project were to discuss the specification of an interactive telephone network performance evaluation tool, but it was decided that the implementation of the tool was not a part of EVA and should be the responsibility of each member. There was therefore great similarity between the aims of the model specified in project EVA and those of OTARIE (which will be presented in more detail later).

Within EVA a common data structure was defined so that the participants could exchange data and compare algorithms. This structure is not used in the
existing version of OTARIE, but will be introduced in the version currently under development. As it will be shown, this new structure will allow us to analyse a wide range of networks with a variety of routing strategies.

2. OBJECTIVES

2.1. Types of Networks and Models

OTARIE will be used primarily as a network planning tool to study different scenarios, so it should be able to analyse a wide range of network structures and a wide variety of associated call routing strategies. In particular it should be possible to include the following various different routing strategies: overflow, load sharing, trunk reservation, crank-back and step by step routing. The study of adaptive routing strategies is not included in OTARIE and similarly it does not consider ISDN.

We want to be able to analyse telephone networks of a large size and with offered traffic streams which are point-to-point Poisson traffics. However, we also want to have the possibility of introducing non-Poisson traffics by defining them by their moments (one, two or three moments). It should be noted that in the evaluation of the network's performance, we do not take into account whether the called subscriber is busy or whether there is no answer. In the same way we ignore blocking in the nodes and repeated attempts by calling subscribers.

2.2. General Features

The user must be able to study one particular network or to compare the performances of two slightly different networks. The comparisons should be made either on the whole network or an a part of the network. With these facilities the consequences of a change in the traffic-routing or of a link or node failure could be calculated.

It should be possible to input data either by hand or by interfacing with existing files, but the internal representation of the data should be independent of the method of input. Also the user should have the possibility of storing the data relevant to many different networks.

In addition to these constraints, it will always be necessary to ensure the coherence of the data, and to foresee the possible use of other tools to choose between network solutions (such as optimisers of traffic routing which minimise traffic losses).

A very important part of the tool will be the interactive presentation of both input and output data on a graphic screen. The feature should allow the user to find bottlenecks in the network easily or to find the characteristics of a given stream. This will be particularly relevant when the package is to be applied by a non-expert user.

Another important feature of the tool should be the ease both with which
interfaces with other traffic and network databases can be added and with which it can be further integrated into a network planning workstation.

This set of objectives leads us to a modular structure for the program so that we can add later new functions or new algorithms.

2.3. Potential Users

The applications of such a tool are varied:

- for research: as a purely research oriented tool, for example to compare performance algorithms or to carry out dimensioning studies,

- for network management: to help day-to-day network managers control the results of network overloads or failures occurring in the network. The network manager could use OTARIE to study the effects of alterations in the network and investigate different actions, such as modifications of routing tables, before applying them to the real network,

- for network strategies: to study long term target networks. OTARIE could be used to study various network scenarios and the effects of overloads, link failures, changes of routings could be tested. The choice of a network structure could be made, not just for a minimum cost, but by taking into account other parameters (eg the quality of service criteria provided under failure conditions). The programming of stand-by plans could be realised using OTARIE,

- for training services: OTARIE could be used to train future network managers by simulating situations that can occur in reality so that they would be able to react rapidly when failures or overloads appear in the network.

3. EXISTING VERSION

A part of the program runs on a main frame (BULL DPS 8/70 Multics), using an alphanumeric terminal to display the menus and to allow input of the data. The user can obtain output results on a printer or he can send the input data and the results to a micro computer with a graphic screen.

3.1. Process of the graphical results

In this section we will describe the interactive visualisation package which considers only the display of output data. This system can be regarded as the first step towards a more sophisticated tool which is still under development.

The present package has been developed on a micro computer (SM90) running under UNIX. The display is presented on a colour bit-map and, the user sends instructions to the system by means of a mouse and cursor.
The program is written in the "C" language and for the input/output interface it uses the graphic standard GKS (Graphical Kernel System). The package is therefore reasonably portable.

3.2. Structure of the System

The system is controlled by a master module which manages the input from the mouse and calls the different images and modules. An image, or object, consists of a graphical representation of results and the associated menus. A horizontal banner is permanently displayed on the screen and contains a list of the current menu options. When pointing at an option with the mouse, a pop-up menu is produced and the user can then select one of the offered functions by again using the mouse. The options offered by the banner are either those specific to the object currently displayed or one of what are called general functions.

There are two types of general function. The first one, "general", allows the user to perform system operations (e.g., quit OTARIE, call a system function, return to the beginning of the program). The second option, "object", allows the user to access those objects or images which can be called from the current object.

Objects which are available in this version, and which are described below, are: a GEOGRAPHICAL NETWORK STRUCTURE, HIERARCHICAL NETWORK STRUCTURE, STREAM BLOCKING RESULTS, STREAM and LINK DETAIL. In terms of interactivity these objects are fully interconnected so that from any current object the user can call any other. For example, when in the GEOGRAPHIC NETWORK STRUCTURE the user can select the "object" option STREAM DETAIL and then by pointing with the mouse to the relevant nodes, the origin and the destination of the stream and the image corresponding to the detail of that stream is displayed on the screen.

3.3. Geographic Network Structure

The geographic representation of networks (figure 1) shows the approximate relative position of the exchanges and the links between them.

![Figure 1: Geographic Network Structure](image-url)
The specific functions attached to this representation that are offered as options on the banner are: "legend", "information" and "visualisation".

With "legend" the user can obtain the meaning of a node’s symbol or of a link’s colour.

With "information" the user can find the capacity of a node or a link by pointing with the mouse.

With "visualisation" the user can modify the representation of the network on the screen. He can make the image represent the sizes of the links or the average blocking on the links.

The user is able to move a node or a link (by assigning a new intermediate point).

Also just a part of the network can be viewed using a zoom function and similarly, the user, having zoomed, can scan the network. The part of the total network that is currently represented on the screen is indicated by a "scroll bar".

3.4. Hierarchical Network Structure

This object is very similar to that of the geographic object already described except that here the positions of exchanges are dependent on their level in the hierarchy. The functions attached to this object are the same as for the geographic network structure.

3.5. Stream Blocking Results

Figure 2: Stream Blocking results

3.2B.5.5
This image (figure 2) presents a matrix of elements whose colours indicate the level of blocking seen by particular streams. Each element is referenced by the origin node and destination node code for that stream. To define the colours a legend ("legend of streams") is displayed on the screen. The numerical value of any given stream can be displayed on request.

If the number of nodes is too large to allow the total matrix to be displayed on the screen the user can use the scanning function to visualise the other parts of the matrix.

The user can also modify the size of the part of the matrix he wishes to study (the study interval) and, once defined, the limits of the chosen area are represented by the scroll bar scale.

3.6. Stream Detail and Link Detail

This object (figure 3) displays all the links in the network that are accessed by a particular origin-destination traffic stream. The colour of the links can represent either the blocking seen by that stream on those links or the traffic offered by that stream to those links. A legend defining the colours is given on the left side of the screen and information concerning the stream itself is also presented in the diagram.

With the visualisation menu the user is offered the following functions:

- use the object to represent the stream's traffic offered to the links,
- use the object to represent the blocking on the links,
- request information on the traffic routing,
- select a particular link,
- select another stream.
When the user selects a link, a list of the streams offered to that link is displayed on the right side of the screen and, if the number of streams is too large, the user is able to scan up and down the list. The origin node, destination node and blocking are presented for each of those streams. Information concerning the link itself is also presented.

By selecting a stream from the list on the right hand side of the screen the user obtains the same object, but now it represents this new stream and its corresponding information. It is therefore very easy to examine in detail the streams and the links of a network and it is also easy to transfer from one image to the another.

4. FURTHER DEVELOPMENTS

A new version OTARIE is under development on a graphic workstation using a 32 bit microprocessor running under UNIX and using a multi-windowing system (SUN 3/260). The various modules presented in section 3 will be implemented on the workstation and the extra facilities provided by its graphics and multi-windowing system will be incorporated. The enhancements will be as follows:

A user will be able to perform different tasks concurrently in different windows. For example he could run an algorithm for one network while looking at the results of another. The existing modules will be adapted to utilise the data structure defined in the EVA project. Great flexibility can be introduced in this latest version, so that the user will be able to define the colours, the symbols of nodes etc. A module allowing the user to compare two slightly different networks is introduced. An other new module will give the user the ability to display graphs and histograms. Further importance will be given to the coherence of data and tools will be provided so the user can check the data.

5. CONCLUSION

The existing network planning tool presented in this paper is a first step towards a more sophisticated goal. Its main principles, such as modularity, standardisation of the internal data, screen representations of the network, and utilisation of the graphic standards (GKS), allow us to add easily new functionalities and new modules in future versions.

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REFERENCE