I. INTRODUCTION AND HISTORY OF DEVELOPMENT

GRAPHIX is a user friendly graph generating program written in the SAS® macro language. It allows users to produce high quality graphs without knowledge of CA-TELLAGRAF®, SAS®, or the SAS® macro language. It has been developed at Hoechst-Roussel Pharmaceuticals Inc. to minimize the effort spent in producing standardized graphs. Prior to the introduction of GRAPHIX, many graphs were custom coded in the cumbersome CA-TELLAGRAF® command language, and data points were often entered by hand. With GRAPHIX, the coding of CA-TELLAGRAF® commands is eliminated and data points are directly obtained from SAS dataset.

Graph generation has changed greatly at HRPI over the years. We have improved from coding CA-TELLAGRAF® for each graph and entering data points manually to writing a SASTAG program (a technique, developed at HRPI, of using SAS® to generate CA-TELLAGRAF® commands and input data points), and to using GRAPHIX. Presently, graphs can be generated by a CLIST, which drives DMS panels that collect information from end users, and which then makes subsequent macro call to GRAPHIX.
II. CAPABILITIES

GRAPHIX has been developed in response to user needs. Its capabilities are tailored to the graphical requests received by the Medical Systems Department. Some of the specific ones include:

- Accepting data with different organizations.
- Generating messages to describe the graph.
- Presenting data in different graphical formats, e.g., line, bar, scatter, and spaghetti plots.
- Calculating and displaying frequency counts associated with data values.
- Plotting mean and individual graphs.
- Drawing standard errors on mean graphs.
- Entering additional CA-TELLAGRAF® commands to modify the graph.

III. METHODOLOGY

GRAPHIX utilizes the SAS® macro language to generate SAS® code, which in turn generates CA-TELLAGRAF® commands. The input data are required to be stored in a SAS® dataset. The dataset is manipulated by GRAPHIX in the desired structure. The necessary parameters, i.e., mean, standard error, and frequency counts, are calculated subsequently.

Finally, utilizing the PUT statement in the DATA_NULL step, the CA-TELLAGRAF® code is generated and submitted. The two-step processing, namely SAS® and CA-TELLAGRAF®, is transparent to the user. The system programmer at HRPI has written a "SASTAG" JCL procedure to handle the above processing.

IV. MACRO VARIABLES

The macro variables are utilized to describe the data, the statistics, and graphical content and form to the GRAPHIX system. Data are described by the macro variables DATASET and ORGanization. These inform the program of the location of the data and how the data are organized. The statistics are represented by macro variables TYPE, FREQ, SE, and REF(ERENCE).

TYPE variable can be set to equal MEAN, indicating that PROC MEANS is to be performed on the input data and a mean graph is to be generated, or can be set to equal ALL, indicating that individual graphs are to be done. When FREQ variable is set to YES, frequency counts associated with the data values are printed on the bottom of the graph. Standard error lines can be drawn by setting SE equal to YES.

The user also has the option of shifting them if the lines interfere with each other. REF variable tells the location of a reference line; it can be a variable or a constant. The remaining macro variables are used to describe the content and form of the graph.
indicates the graphical form: line, bar, scatter, or spaghetti. XMIN, XMAX, YMIN, YMAX input the x-axis and y-axis minimal and maximal values. CURVAR informs the program which by-variable is represented by a curve, e.g., treatment group, investigator. PAGE can be a string of variables that graphs are paged by. Many other, including XLABEL, YLABEL, TITLE, and LEGEND are used to annotate the graphs. A special variable, TAGCOM, was implemented for those users who have knowledge of CA-TELLAGRAF® commands and desire to modify the graphs. For instance, the user may want to change the type of curve symbol used or the window size (TAGCOM="CURVE 1 SYMBOL TYPE=3"). It may seem that there are a vast number of macro variables to be filled, however, the majority of them have default values.

V. EXAMPLES

The ease of using GRAPHIX and the high quality of the graphs generated can best be demonstrated by some examples.

![Graph examples](image-url)
This technique offers the following advantages:
1. Saves end users from having to learn another language.
2. Makes use of the features from both languages - SAS® to do data processing and parameter calculation, CA-TELLAGRAF® to generate graphs.
3. Saves time and gives accurate, reliable results.

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VI. COMPARISON BETWEEN CA-TELLAGRAF® AND SAS/GRAPH®

CA-TELLAGRAF®
1. Longer history, widely used, proven product.
2. Annotation is simpler.
3. Code is English-like.
4. Multiple charts per page capability.
5. Manual is easier to read.
6. IVISS.

SAS/GRAPH®
1. Interfaces with other SAS® facilities.
3. 3-D capability.
4. Template facility.

VII. FUTURE DEVELOPMENT
1. Multiple plots per page.
2. Additional parameter calculation.
3. Positioning messages based on data values.

VIII. GENERALIZATION TO OTHER COMMAND LANGUAGES

As can be seen, the technique that I have used in writing GRAPHIX can be generalized to other command languages.