



AN INTEGRATED BUSINESS APPLICATION ARCHITECTURE

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ABSTRACT

An integrated business application architecture has been implemented in the Information Systems and Communications Group and the Information Systems and Products Group, two of IBM's group headquarters. The language base used is APL so that the maximum productivity can be achieved. The cornerstone of this architecture is an APL-based graphics package called A Presentation Graphics System (APGS). The architecture is a closed-loop system with the flexibility to expand as more application systems are needed. Increases in productivity and quality have been realized through the implementation of this architecture for both the management, the planning staff and the application programmers.

INTRODUCTION

In any corporate headquarters, one of the major functions is business planning. The primary responsibilities of the business planning function in IBM's IS&CG and IS&PG are market research, forecasting, plan development and analysis and financial analysis. The activities are usually driven by the planning calendar and the time pressure can often cause the quality of plans to suffer. In addition to the time constraint problems that the planning staff constantly faces, there is an ever increasing amount of data involved in the business planning process. Automation has become a necessity.

This paper is intended to describe the business planning systems application architecture currently implemented in IBM's IS&CG and IS&PG Headquarters. A tremendous productivity gain has been realized through the implementation of this applications architecture.

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The architecture has fulfilled the majority of the needs of the business planning community in the areas of automating the plan development and analysis, publication of the plans, and presentation preparation process. No longer do the planners have to work long hours just to get the numbers to add up and balance. Now, the planners have time to do more "what-ifs" as well as do several more plan iterations. As a result, the quality of the business plans is enhanced.

The architecture is a closed-loop APL based system with the flexibility to expand as more installed business application systems are needed. APL was chosen to be the language for implementation for the following reasons:

- o APL allows quick turnaround for application development, enhancement, and maintenance activities.
- o APL handles arrays, i.e., multi-dimensional data, with powerful primitives for easy data manipulation.
- o Graphical data can be represented in a very natural way in APL, and even more so in APL2 where coordinates can be represented as complex numbers.

Functionally, this closed-loop architecture consists of four major parts:

- o Business applications
- o A Presentation Graphics System (APGS) and its interface
- o Executive Reference Library (ERL) system
- o Application Usage Tracking Output (AUTO) system

The following sections are devoted to each of the four major components of the architecture as illustrated in Figure 1.

BUSINESS APPLICATIONS

The primary objectives of all the business applications are to assist the users in the planning community to develop plans for all the products designed, developed, and manufactured by IBM's IS&CG and IS&PG.

All major business planning applications were originally developed in VSAPL and are run in the VM environment. They are currently being migrated to APL2.

The applications provide the users with interactive, full screen capability for data updating and report writing. PF keys, color, and highlighting are extensively used to enhance user friendliness. All applications are invoked through the use of EXEC's and stack commands so that the users need not have any knowledge of APL. As a matter of fact, the users may not even know that they are running an APL application.

With the ever increasing number of users, two of the most important requirements for these applications are simultaneous multiple user update and security. VM does not provide an easy way of simultaneous file sharing between multiple users. Here, an APL auxiliary processor, APL Systems Extension (AP999), has been utilized very successfully to provide the solution to these two requirements.

A service machine, running in a disconnected mode, has the only physical access to the data base. The users of the application system send read/write requests to this service machine; data and messages are passed between the machines through the VMCF feature of AP999. Since only the service machine has the link to the data base, no user can access the data base except through the application system. The service machine can be programmed to handle data security at any desired level, e.g., mini-disk, file, record, or data field. It can also provide an audit trail for data base access.

Another feature of AP999, the virtual spooled printer interface, has provided a five to ten-fold efficiency increase in output printing.

A typical business planning application system has three subsystems: data input/update, reporter, and utility (Figure 2.)

The data input/update subsystem allows the users to input new data and make changes to them. The reporter subsystem lets the user query against the system's data base and produces and distributes reports. In addition to the traditional reports in listing form, graphics output can be automatically produced. More detail will be given about the graphics output in the next section.

All application systems are installed for the end users' production use with no operational involvement on the programming staff's part. The users will use the utility subsystem to authorize new users, manage data base files for archiving and restoring, transmit files to other locations in the corporation, etc. In this way, the programming staff can concentrate their resource on development and enhancement work. In order to make this kind of environment successful, the application systems must be designed in a way that insures ease-of-use. Education, documentation, training, and on-line helps are all essential factors.

All the business application systems are used individually. Whenever appropriate, data bridges are built for data transfer from one application to another. This facilitates automatic initial data loading. The data integrity is better preserved and processing time is greatly reduced by not having to key in the data twice.

Access to the application systems are not limited in terms of locality and terminal devices. Not only do local users have access to the application systems, but remote users can have access through the use of a dial-up facility on personal computer type of devices or through the corporate VM network. Terminal devices currently used are IBM'S 3270's and 3101, Tektronix¹ 4015, and a number of IBM PC based workstations.

A PRESENTATION GRAPHICS SYSTEM (APGS) AND ITS INTERFACE

APGS is the comprehensive APL-based graphics package developed internally by IBM's Information Systems and Technology Group for generating presentation charts. The major functions that APGS provides are:

- o SCRIPT² to graphics interface
- o Business chart plotting
- o Customized chart creation
- o Hard copy output
- o Digitizing
- o Terminal display
- o Book feature

Because of its rich functionality and the capability to support a variety of devices, APGS has lent itself to be a highly successful productivity tool in our VM environment. The majority of the user population has learned and used the package to prepare documents and presentation materials. The use of APGS has had a profound effect on all levels of the planning process and with all levels of management in IS&CG and IS&PG.

Two key functions of APGS that play a major role in the application architecture are the business charts plotting and the book feature.

When used in a stand-alone mode for business chart plotting, APGS lets the user design the charts he wants to plot by overriding the default values of numerous parameters that define a chart. The parameters control the data attributes, the title and legend contents and the axis attributes.

1 Tektronix is the trademark of Tektronix, Inc.

2 SCRIPT is a document composition product of IBM Corp.

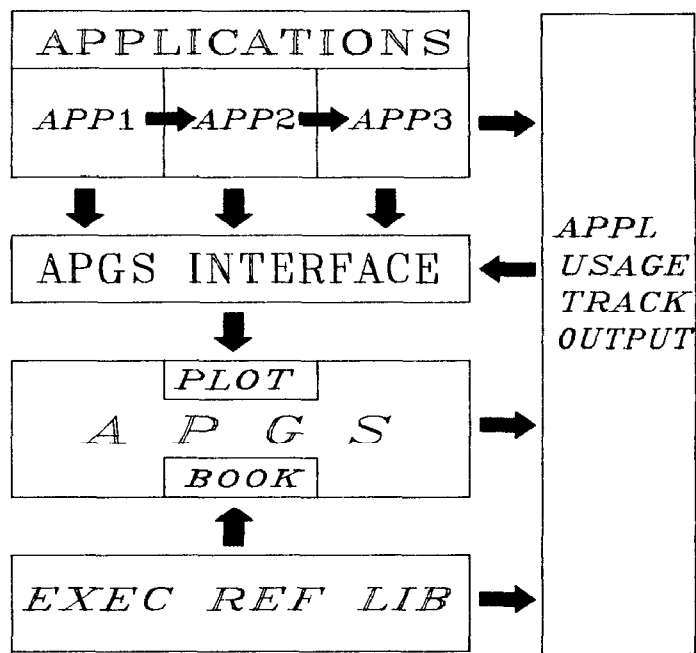


Figure 1. The Integrated Business Application Architecture

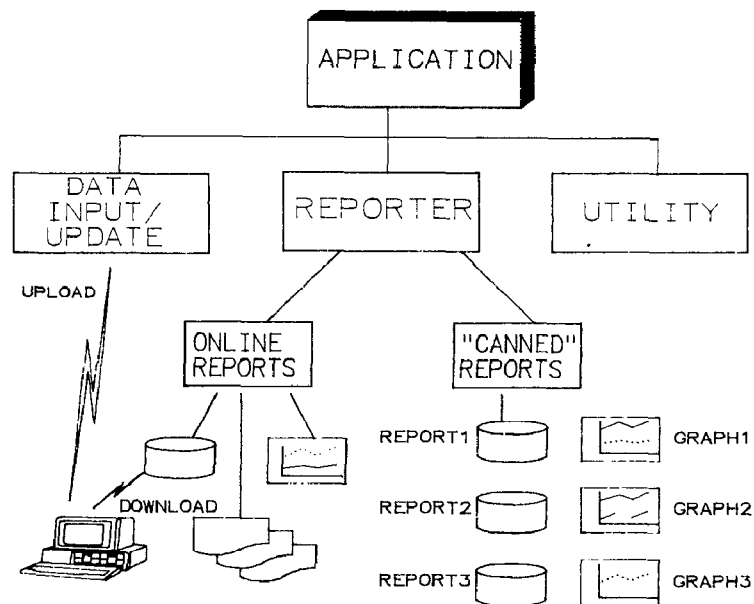


Figure 2. A Typical Business Application System

The user can change the parameters and view the results on the display terminal until the chart produced satisfies him.

If a user wanted to create some business charts to present the data produced by the reporter subsystem of a business application system, he usually would take the report in listing form and key the data into a graphics package in a stand-alone mode. But this mode of operation is both time consuming and error prone.

Under normal circumstances, a set of business charts with the same graphics attributes are used over and over again with the different data content. Thus rises the need for automatically generating a set of pre-defined charts from the application reporter subsystem directly. The APGS Interface was developed to fulfill this need.

The APGS Interface transfers the data from the business application system to the APGS plotting function. It consists of a set of template functions that can easily be modified by an APL programmer. These template functions collect the data and its associated attributes from the application system and pass them to APGS. Thus, the application programmers can free themselves from coding the graphics functions at a detail level.

The APL programmer has the capability to set any of some one hundred or so chart attribute parameters according to user's specifications through the use of these template functions. Alternatively, he can use APGS in a stand-alone mode to set up the attributes with the plot function and store them in a PLOT file. This PLOT file can then be read in by one of the APGS interface template functions to set up the chart characteristics automatically. Any attribute that is dependent upon the application data can still be modified dynamically to produce the desired charts. In this manner, the APGS interface works in a table-driven fashion. When new types of charts are required, new PLOT files are the only things that need to be added. No programming changes are needed.

The first time a user requests the creation of some graphics output in an application, the APGS plotting functions are read in from the public library where the production version of APGS is installed. The application systems do not and should not include the actual APGS functions in their workspaces. This prevents the proliferation of APGS functions which can become a maintenance nightmare. This also allows for easy inclusion of future APGS functional enhancements.

The user can choose from three graphics output formats - screen display, a graph file, and a plot file. The screen display of the graphics output helps the user determine whether the chart is satisfactory. Once the user decides he wants to keep the graphics output he can save them in either a graph or plot file or both. The reporter subsystem usually provides a way for the user to save these report requests. Charts can thus be

re-created periodically by running the "canned" requests every time the data is updated.

After the user signs off the application he can use APGS (in stand alone mode) to:

1. Plot the graph files to create hard copies,
2. Use the graph files with the book feature for presentation and reference purposes,
3. Annotate and/or modify the graph files with the move feature to customize the charts, and
4. Modify the data and associated attributes saved in the plot file with the plot function and then re-create the graph files.

Before APGS and its interface were installed on our system, color charts were created by cutting and pasting color transparencies on computer generated black and white copies. Several problems arose from this kind of operation:

1. The graph generating functions were stored with the application workspaces. Every application had a different copy of the functions after the programmers customized them to satisfy the user's unique requirements. Maintenance and standardization became impossible.
2. It was very costly to have senior planning staff do the cutting and pasting.
3. Slow turnaround made last minute changes nearly impossible.

After APGS and its interface were installed, the users could create color charts easily. Updating data is no longer a problem. Now the planning staff can spend more time on plan development and analysis rather than wasting time on clerical activities. They now routinely take the graphics output from the application directly to management presentations.

EXECUTIVE REFERENCE LIBRARY SYSTEM (ERL)

A key need in IS&CG and IS&PG, or in any business, is to have crisp, clear, timely, and accurate information available to executives so that they can make better decisions faster. We have found that graphics, such as that used in our Executive Reference System, is one way to fulfill that need.

Often when a subject is presented to different sets of audiences, different sets of foils or flip charts need be prepared. Either a lot of shuffling with a single set of hard copy is done or multiple sets of hard copy are produced. Updating of the charts could become a burden. One way to alleviate the burden of using lots of hard copy is to use the book feature of APGS for

presentations (Figure 3). Graph files, organized in chapters, are included in the "electronic book". The graph file names are used to retrieve and display the charts through APGS's display function. A single chart can then be included in more than one book. Whenever that chart is updated or refreshed, all the books that contain this chart are updated accordingly. Of course, in order to use the book feature for presentation for a sizable audience, a large projection medium must be used. For smaller audiences, a color graphics terminal such as 3279, 3179, or 3270 PC will do the job.

Productivity gain should not be limited to staff members only. The benefit of an executive's productivity gain can mean even more to the business. Traditionally, when an executive needs a certain piece of information, he would ask his staff to provide it. This often causes delays due to file searching, absence, telephone tags, etc. And when the information is finally obtained, it is often out of date. With the technology advancement more and more executives are becoming more computer literate and beginning to take advantage of the direct access to computers where a vast amount of corporate information is stored.

One way to increase the executive's productivity is to provide him with the capability to instantly access the information he needs. "Electronic books" put together in the aforementioned manner can be a very handy reference book for the executives (Figure 4). The staff members will have the responsibility of keeping the books up-to-date. Some vital information may be updated automatically according to some pre-defined schedules.

Through a simple CMS EXEC and a catalog text file, an Executive Reference Library system has been set up to allow the designated executives access various information at the press of a button. The EXEC reads in the catalog file which contains the book titles, brief abstracts and the APGS bookfile names. It then displays the book titles and the abstracts on the screen through the use of Display Management System (DMS)³. After the user selects a book, it invokes the APGS book feature to display the selected book. The content of the book may include both narratives and charts. The user can then browse the entire book.

The kind of Executive Reference Library system can serve not only as a reference tool but also as an "early warning" system for management to identify problem areas of business and help analyze the cause. It can thus be used as a management control tool.

As a part of the APGS book feature, requests for printer and plotter output can readily be made by the user directly from the chart display screen.

³ DMS is a full screen handling product of IBM Corp.

APPLICATION USAGE TRACKING OUTPUT (AUTO) SYSTEM

In the type of environment described above, it is most desirable to keep track of what is happening on the system in order to ensure that all resources are utilized most effectively and efficiently.

The Application Usage Tracking Output (AUTO) system was designed to keep track of the usage of all the installed applications. Every time an application system is accessed, a record is punched to a service machine. The record contains such data as the application name, the application module invoked, date, time, user function, CPU time consumed, elapsed time, etc. The CMS INDICATE USER command provides the necessary system data and the system's user table provides the data related to the user. These records are summarized in SAS⁴, and CMS flat files are created for various analysis breakdowns of the application usage.

An APL workspace takes the CMS flat files and passes the data through APGS interface to APGS for chart creation. The charts are put in a book as part of the Executive Reference Library system. Figure 5 illustrates a typical AUTO chart showing the monthly usage of various applications.

Information gathered through AUTO helps the I/S management manage their resource in a more efficient way. Resource can then be spent on the most frequently used applications for functional enhancements and performance improvement.

RELATED WORK

Additional work has been completed recently to make the system even more versatile. These enhancements include:

- o Data download from the host applications to PC for spreadsheet applications,
- o Data upload from PC spreadsheet applications to host applications for mass database update, and
- o Data import from any CMS print file to APGS plot function. The CMS file can be produced by any means. For example, a CMS print file can be produced by a PC spreadsheet application and then uploaded to the host.

SUMMARY

APL has been successfully used as the language base on which this business application architecture is built. The introduction of APL2 will only enhance APL's role as the programming language in application programming support in a dynamically changing business environment.

⁴ SAS is the trademark of SAS Institute, Inc.

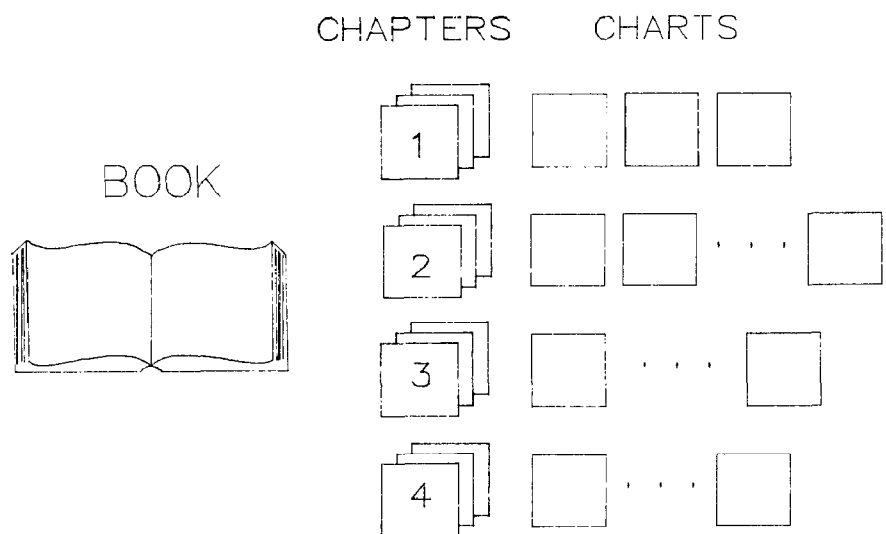


Figure 3. The APGS Book Feature

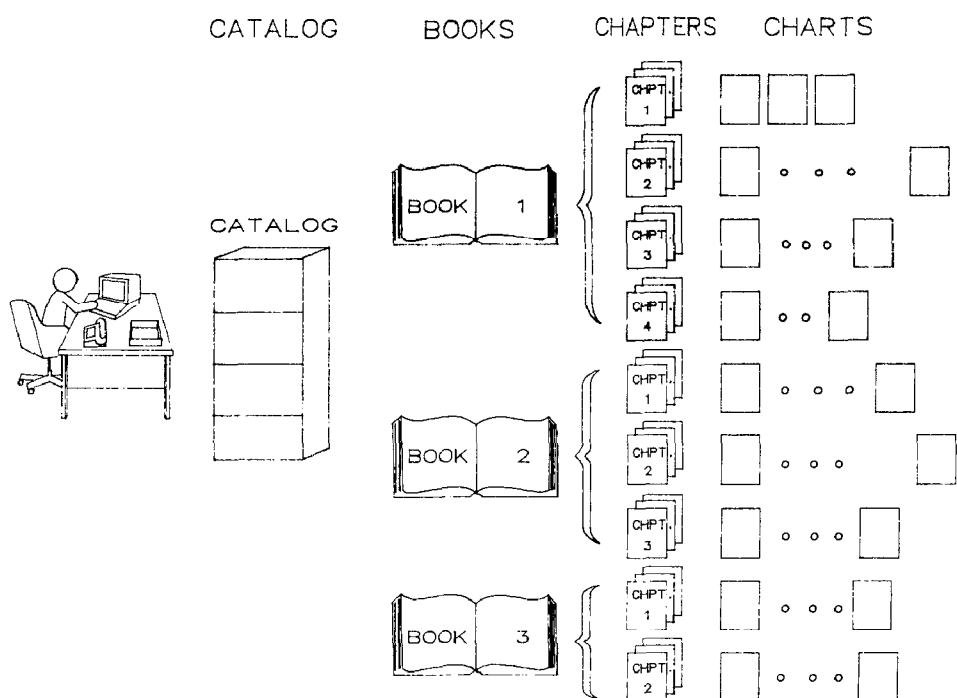


Figure 4. The Executive Reference Library System

APPLICATION USAGE TRACKING OUTPUT (1984)

NUMBER OF ACCESSES

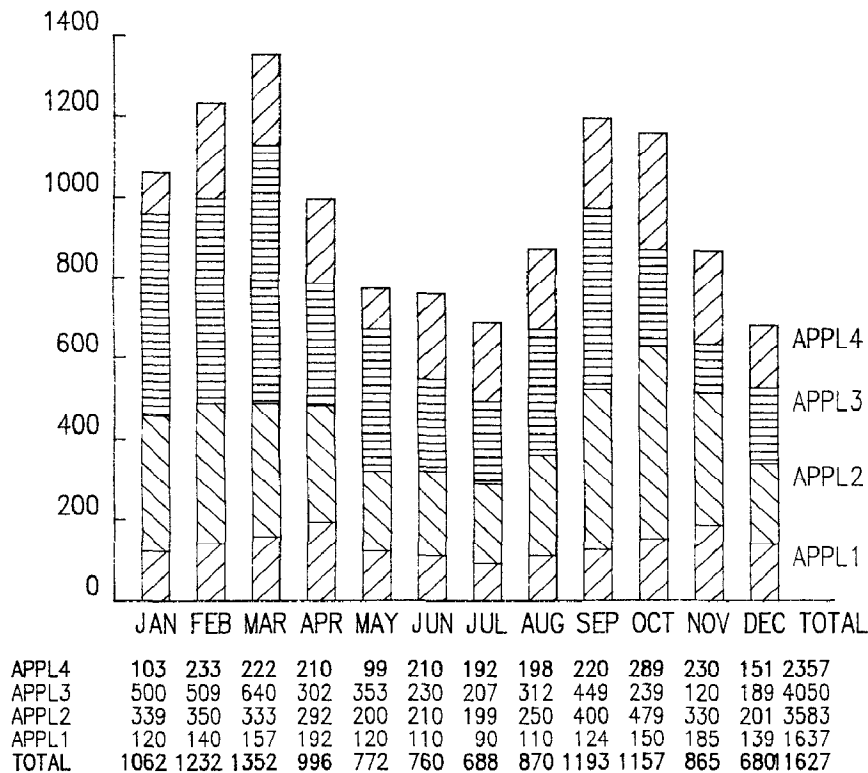


Figure 5. An AUTO Chart

As a result of the implementation of this architecture, significant productivity gain has been realized by both the planning staff and executives. Through the tools such as APGS and its interface, programmers' productivity has also increased. Undoubtedly, APGS has played a major role in this architecture and contributed most to the cohesiveness of the entire system.

ACKNOWLEDGEMENT

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