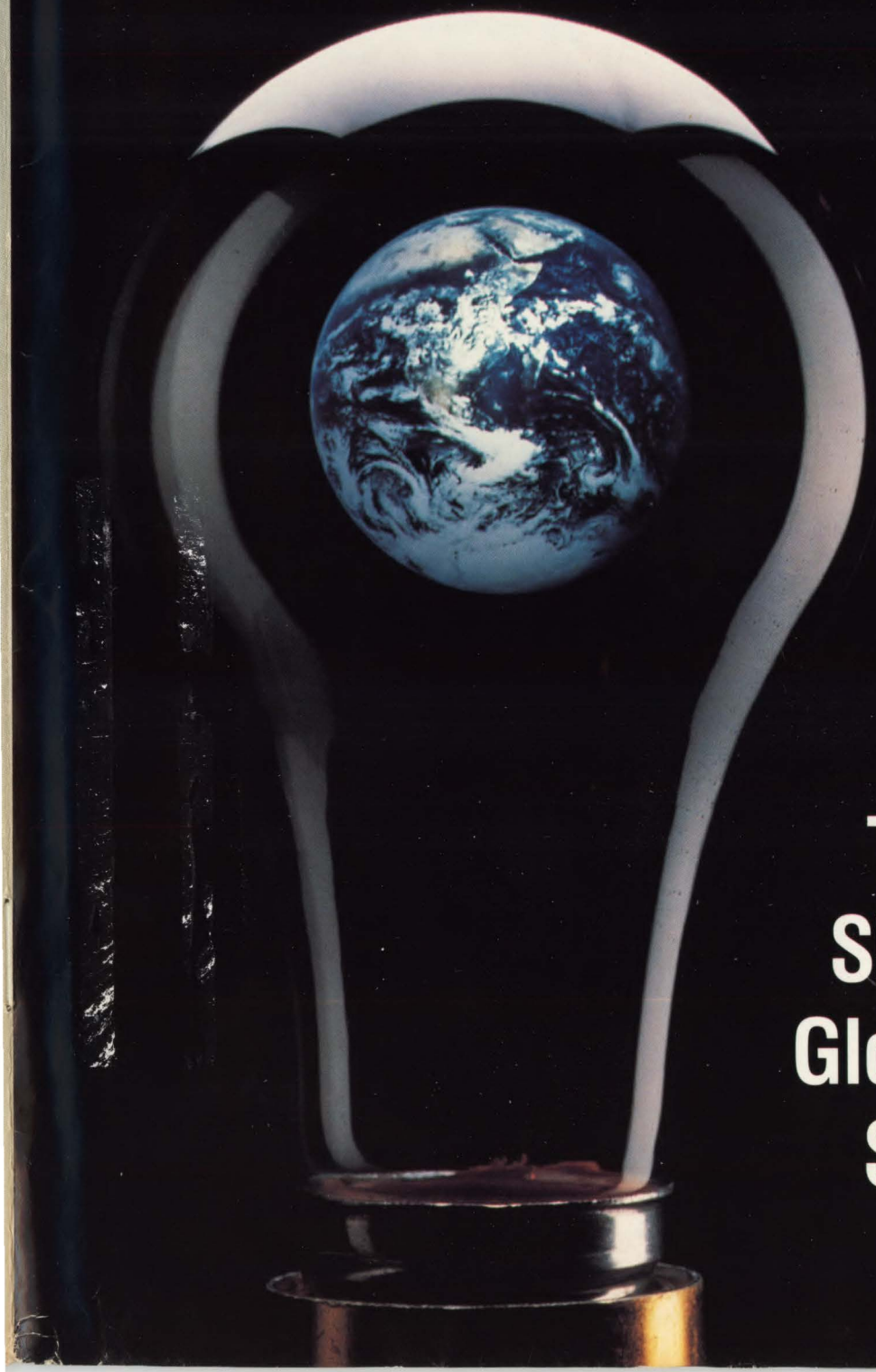
MAINFRAME JOURNAL

For Users of IBM System/370 Architecture & Compatible Systems

November 1989



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COVER:

A theoretical extension to the Global Resource Serialization definition parameters offers benefits to both large and small companies using MVS. Turn to page 26 for details. Photograph by Garry Gay.

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PUBLISHER

Bob Thomas

Two Mainframe "FATHERS" In The News

One ''fathered'' a mainframe hardware architecture and the other ''fathered'' third-party mainframe software, but both are inextricably linked to the multi-billion dollar mainframe market as we know it today. Although their work commenced in the ''fifties,'' both gentlemen have remained very active and, in fact, have been prominently in the news this fall.

Martin Goetz, considered by many to be the ''father'' of the third-party mainframe software industry, was inducted into INFOMART's Information Hall of Fame on September 12th. According to INFOMART President Bill Winsor, ''With the formation of Applied Data Research (ADR) in 1959, Mr. Goetz began a mission to market software as a product instead of bundled as a component of hardware products. By 1969, Goetz helped untie the strings that bound software and hardware as one and both were sold separately for the first time. We recognize Mr. Goetz's role in helping to develop the $25 billion software products industry.''

In 1965, Goetz's pioneering spirit also led him to the development of AUTOFLOW, a computerized flowcharting system, and the first U.S. software patent. He went on to receive additional U.S. software patents for a sorting system and a second one for AUTOFLOW. After he left ADR in 1988, Goetz became CEO of Syllogy Corporation. He is currently a private consultant following the sale of Syllogy's product to Computer Associates.

Gene Amdahl is often thought of as the ''father'' of the IBM 360 Series of mainframe systems. (Coincidentally, as principal architect of the IBM 360 and founder of Amdahl Corporation, Amdahl is a previous inductee into INFOMART's Information Hall of Fame).

In a keynote address at the ICEBOL4 Conference on October 5th, Gene Amdahl startled the audience with his announcement of the imminent introduction of his company's (Andor Systems, Inc.) CPU equivalent to and compatible with the IBM 3090 Model 150, suitable for the office environment. On a single 16″ x 20″ circuit board, consuming only one-third kilowatt of power, the system requires no air conditioning, let alone water chilling. Coupled with equivalents of 3990 and 3380 Model E or K DASD, the entire system requires 40 square feet of floor space and 10 kilowatts of power, compared to the 3090's 1000 square feet and 100 kilowatts of power.

Time is definitely not slowing down these two pioneering ''fathers.'' Marty Goetz and Gene Amdahl are still in the news more than 30 years after their initial accomplishments and they are still right on the leading edge.

Bob Thomas

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READER FORUM

Undeleting An ICCF Member

I enjoy reading *MAINFRAME JOURNAL*. The articles on VSE and VSAM are very helpful. After reading "ICCF Library Management With VSE" by Sharon Hooper Martinez (September 1989), I thought I would pass on a method of undeleting an ICCF member. I manage an academic lab at a two-year technical school and students delete their ICCF members by accident fairly often.

When a member is deleted, the complete member is placed intact on the free chain and this space will eventually be used by someone else. You can use the DTSANALS to locate this member and punch it into the $$PUNCH area. First, type '$DTSANALS' in command mode. This will start up the DTSANALS utility program. Next, type 'CHASE FREE' and press <ENTER>. This tells DTSANALS to only search the free chain. Now, type 'LOCATE/unique character string/' and press <ENTER>. The locate command will find this character string on the free chain. Use a character string that is contained in the member that was deleted. Once the member is found you can use the UP, DOWN and PRINT commands to locate the top of the member. When you have located the top of the member use the PUNCH command to punch the member to the $$PUNCH area. Exit DTSANALS with the EOJ command. Edit a new member, type 'GET $$PUNCH' and press <ENTER>. You have now retrieved the deleted member.

I hope you never delete a member by accident, but if you do all is not lost.

Steve Ronk
Memphis, TN

COBOL Compiler Options

These comments regard the article "COBOL Compiler Options: Understanding Your Choices" (August 1989). Please note that the VS COBOL II compiler parm 'RENT' only makes the object module re-entrant *across* multiple address spaces. This is nice if you actually want to put the program in your Link Pack Area (LPA) and it is used by enough users (jobs) enough times to justify such action. But, more importantly (at least in my experience), the program is *not* re-entrant *within* an address space. An Assembler language program that multi-tasks (via the ATTACH MACRO) must still ENQUEUE and DEQUEUE calls to the supposedly "re-entrant" VS COBOL II program or a COBOL user ABEND will result because it will appear the program has been called recursively if multiple sub-tasks make simultaneous calls to the program.

Brian J. Vosburgh
Evanston, IL

VSE/VTAM Article REALLY Timely!

The article "VSE/VTAM In A Non-Shared Address Space: REALLY!" by Pete Clark (July 1989) could not have been published at a better time. We have flat run out of space in our vanilla VSE/SP 3.2 and I found the article extremely helpful. I plan to implement VAE on our 9377-080 as soon as possible and the article by Mr. Clark has just given me the solution to the problem we have in serving two groups of CICS users. Thank you, thank you, thank you!

I really appreciated this article — great detail and an excellent topic. Thank you for your assistance and for another excellent issue. Many thanks also to Pete Clark for his outstanding contributions. Like the United Way slogan says: "I don't know you, but I love you."

Jim Wilson
San Mateo, CA

Real-World Focus

I've always enjoyed *MAINFRAME JOURNAL*. I find it very pleasant and interesting to read. It is also focused on real-world mainframe shops — not state-of-the-art shops like IBM pushes. The ads are also informative, especially for systems people like me.

Ron Larson
Santa Barbara, CA

Divine Help

Praise the Lord! Recently I acquired a position in our systems section. Communications was a blur until I obtained the following: *MAINFRAME JOURNAL*, reference manuals, dictionaries and hands-on experience. Thanks for your dedication!

Mary Allen McCoy
Baltimore, MD

A Good Answer, But . . .

In the Tech Advisor section of the September 1989 issue, the answer to the fifth question about VTAM/VSE and the use of the ITLIM VTAM parameter was a very good answer. However, the respondent inadvertently said to eliminate connect = auto and use logmode = parameter instead. There is no logmode = parameter in VTAM. It should be logappl = parameter. Still it was an informative answer.

Dan Hatch
Billerica, MA

Need Skeleton Exits

The article "Sort Exit Processing" (September 1989) would have been much better with a few skeleton exits — both BAL and COBOL. "Where Did All The Cycles Go" was very informative.

Gary Shephard
Watauga, TX

Kudos

The September issue of *MAINFRAME JOURNAL* was absolutely fantastic! "ISPF And Text" by Jon Pearkins and Harvey Bookman's "What You Should Know About The TGT" are of particular value to me and my shop. This is my preferred publication over all other reports, magazines and newspapers that I receive.

David W. Thompson
Hill AFB, UT

Mark Friedman's MVS article "The Age Of A Page Or Thanks For The Memory" (September 1989) was well written and complete. Nice job! I also found Ted Keller's article "Where Did All The Cycles Go: A Study Of CICS Processing Patterns" to be informative. I'd like to add that most programmers tune programs. In a shop with 1000 CICS transactions, each transaction contributes, on average, 5-10%/1000 of CICS workload. Even a 90% improvement in one program is tiny.

Gary M. Schultz
Madison, WI

I am a systems training co-ordinator and *MAINFRAME JOURNAL* is a constant source of material for my classes. I eagerly await its arrival each month. Keep up the good work! I'd like more articles on COBOL techniques and structured programming.

Edwin R. Davis
Westfield Center, OH

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IBM Improves System-Managed Storage Products

In October, IBM announced new system-managed storage software that reportedly helps users store large amounts of data more efficiently and better than their storage hardware. The new functions are enhancements to IBM's system-managed products, the Data Facility Storage Management Subsystem (DFSMS). The new enhancements made to DFSMS under MVS/ESA are:

- A new dynamic cache management function that increases the effectiveness of the storage subsystem (available December 1989)
- A new disaster recovery feature, Aggregate Backup and Recovery Support, that protects critical data by automatically copying applications to portable tape files (available December 1989)
- A new data collection utility that accumulates pertinent information which can be used to improve reporting, accounting and capacity planning for the storage subsystem (available February 1990)
- Automatic reuse of disk space that is freed when members are deleted or updated known as Partitioned Data Set Extended (available June 1990)
- Inclusion of the Object Access Method (OAM) as an integral part of IBM's ImagePlus products (available December 1989).

An entry-level DFSMS was also announced (available December 1989) for users in the VM operating environment.

MVS/ESA Acceptance

One way to gauge acceptance of MVS/ESA in the general IBM mainframe market is to look at the current installed base of MVS/ESA as a percent of the total MVS operating system base. Only four percent of the current MVS variant licenses are MVS/ESA. The largest license base is still MVS/XA with 63 percent of the total, while 33 percent of the licenses are MVS/SP. Also notable is the rather lengthy time period for migration from MVS/SP to MVS/XA. Introduced in 1981, real migration to MVS/XA has only taken place in the past five years. This could be a possible indication of an MVS/XA to MVS/ESA pattern. However, it should be noted that MVS/SP to MVS/XA migration was a more complex and somewhat more costly move than a jump from MVS/XA to MVS/ESA. *Source: Computer Intelligence.*

IBM Announces Application Development Solution For SAA

IBM recently announced AD/Cycle, an application development solution for Systems Application Architecture (SAA), that includes software tools and services from IBM and its business partners.

AD/Cycle is designed to help users reduce their applications backlog by using computer automation to improve the quality and management of the application development effort. AD/Cycle products should assist customers during each phase of the application development process which includes such tasks as modeling, analysis/design, producing the application, testing and maintenance.

The AD/Cycle products will follow the SAA Common User Access (CUA) standards and will produce applications that conform to the SAA guidelines. Because AD/Cycle tools and the applications developed with them will conform to SAA, users are said to benefit from a consistent look and feel that will make a tool or application easier to learn and use. Programmers should find it easier to develop applications for the SAA operating systems through the use of specified languages and services.

The tools and services provided under the AD/Cycle framework address key tasks that customers face in building high-quality applications. These tasks, part of the development life cycle, have been defined by IBM in a model that highlights major steps in the process. These steps include: enterprise modeling, analysis/design, producing the application through the use of languages, generators and knowledge-based systems, testing and maintaining the applications once they enter production. The model also includes tools used throughout the development life cycle (called cross life cycle tools) and a set of software services called an application development platform. The software services include: the repository, a consistent user access through the Personal System/2 with OS/2 EE, a variety of programmable workstation services, tool services and an information model which will define how each type of application information will be represented in the repository.

Repository services are provided through Repository Manager/MVS, a new IBM product that serves as the foundation for integration of information and function in AD/Cycle. It supports the definition, collection manipulation and control of application development information. This includes data about a business' data processing environment, organization, activities, processes and assets. Repository Manager/MVS (available in June 1990) will provide repository services for MVS/ESA and MVS/XA. IBM plans to offer repository services for the VM and OS/400 operating systems in the future.

IBM also introduced a new modeling and prototyping tool called DevelopMate. It is intended for business analysts. Enterprise modeling tools are used to help users clarify their application requirements and priorities so that their programming staffs will have accurate information from which to begin their development work. Steps include defining the business requirements and refining a model of the business enterprise and the relationships within the organization. The enterprise model information is stored using Repository Manager/MVS, where it will serve as the foundation for all of the enterprise's software development activities. DevelopMate will be available in December 1990.

AD/Cycle allows developers to write their applications using the SAA programming languages or the Cross System Product (CSP) application generator. CSP Version 3 Release 3 (available in June 1990) runs on a programmable workstation and provides a graphical interface that supports application definition. CSP/370 Runtime Services (generally available in November 1990) generates VS COBOL II application programs using the application definition function of CSP 3.3. These application programs will run in the IMS/VS 2.2 or IMS/ESA 3.1 environment.

In the area of languages, IBM also announced that PL/1 has been designated an SAA langauge. SAA PL/1 will be based on OS PL/1 Version 2, supported today on MVS/ESA, MVS/XA, VM/SP and VM/XA.

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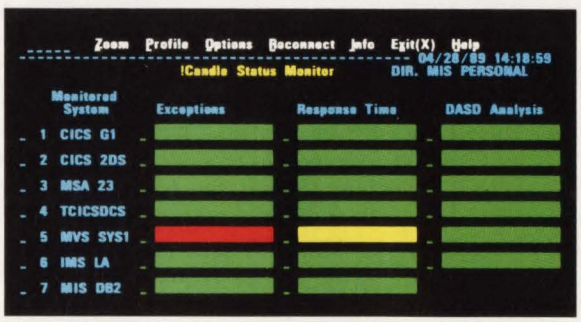

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Mainframe Spreadsheets Take Off Again

By John Kador

Once upon a time, not too long ago, people created spreadsheets by hand. It didn't matter that there were mainframe computers in every organization. They were too difficult to use. It didn't even matter that personal computers were becoming popular. Weren't they best suited for playing Space Invaders?

Then along came VisiCalc and everything changed. The software for creating an electronic spreadsheet almost singlehandedly popularized the PC. The electronic spreadsheet was the catalyst that caused both end users and MIS to perk up and take a good look at the PC. Users and MIS have not stopped buying yet. In 1988, the number of MIPS on desktops surpassed the number of MIPS in data processing glasshouses.

Soon everyone started creating spreadsheets on their PCs. The mainframe crowd, not wanting to be left behind, quickly developed spreadsheets for the mainframe. By the early 1980s, there were more mainframe spreadsheet systems than micro-based products. By the middle of the decade there were about 10,000 mainframe spreadsheets installed across the United States. As mainframe spreadsheets offered a number of clear benefits over their brothers and sisters operating on underpowered PCs, the industry appeared to be in good shape.

Trouble was brewing. First, Lotus 1-2-3 assumed an inexorable lead over its PC rivals and became the indisputable standard for both PC and mainframe systems. If a system could not access Lotus files and make a claim to emulating the "look and feel" of 1-2-3, it could not even be given away. Almost as important, PCs began to get faster and more powerful even as they decreased in cost. With performance no longer a major issue, there were fewer clear advantages to mainframe spreadsheets. A variety of mini-based spreadsheets further eroded the market for mainframes.

Many firms that installed mainframe spreadsheets soon came to re-evaluate their decision. While mainframes are indeed fast, interactive spreadsheet users often felt they just had to wait *faster* for the mainframe to recompile their spreadsheets. Moreover, many departments were charged for the use of mainframes, an economic fact that helped fuel the trend for many firms to off-load spreadsheet work to PCs.

The Final Assault

The final assualt was delivered in late 1987 when Lotus announced that it would port Lotus 1-2-3 to IBM mainframes. Anyone considering purchasing a mainframe spreadsheet system immediately postponed purchases until the outlines of 1-2-3/M, as it was dubbed, became more specific. Lotus originally announced availability for 1-2-3/M in early 1989. Release 3.0 of 1-2-3 was delivered in June 1989.

Lotus 1-2-3/M is a glimpse of what spreadsheets might have become had personal computers never been invented. The mainframe version, in fact, shares much of the same code used to produce the popular PC version. Lotus officials say that fully 80 percent of 1-2-3/M's code is shared by the MS/DOS and OS/2 versions. The big difference is that the big brother of 1-2-3 runs on IBM 370-architecture mainframes under VM. It can pull data directly from SQL/DS or DB2 databases and operates with powerful mainframe graphics packages such as IBM's own Interactive Chart Utility.

The mainframe spreadsheet runs on terminals, preferably IBM's 3279G or 3192 graphics terminals, either of which lets you use both the spreadsheet and graphics capabilities of the program. The text-only 3278 terminal supports the spreadsheet features, of course, but not its graphics.

Early users of 1-2-3/M describe the response time of the system in terms ranging from *instantaneous* to *glacial*. It all depends on what other mainframe activity is competing with the spreadsheet. To accommodate the slow response time inherent in terminal applications, 1-2-3/M includes a *command stacking* feature. With this feature, typical 1-2-3 commands are buffered until the Enter key is pressed, at which time they are all sent to the mainframe-based execution portion of the spreadsheet to be decoded and executed. The results are then returned to the terminal in the form of an updated display.

Logical prospects for mainframe spreadsheets are users who regularly develop corporate spreadsheets or use information stored in an SQL database. Another scenario involves lots of PCs running terminal emulators or connected to local area networks, providing a gateway to mainframe data. In this scenario, 1-2-3/M functions primarily as a tool for corporate macro programmers, centralized database administrators and enterprise-wide systems architects.

Mainframe spreadsheet vendors have mixed feelings about the Lotus-IBM deal. In one sense, it is a threat as many users will undoubtedly seek the security per-

ceived by using software sanctioned by IBM and supported by Lotus. In the short term, certainly, sales stagnated as users waited to see what Lotus would deliver. On the other hand, the Lotus-IBM announcement was not all bad. By agreeing to co-develop a mainframe spreadsheet, IBM and Lotus legitimized the market for any user still skeptical about the merits of mainframe spreadsheets.

Dynasoft Corporation (Rosemont, IL), that offers the Dynaplan mainframe spreadsheet, for one, is not threatened by Lotus 1-2-3/M. "The only thing threatening is the delay," says Ed Spire, president of the company that developed Dynaplan. "The fact that IBM and Lotus said they are going to do it is good news. We welcome the opportunity to have people compare 1-2-3/M with Dynaplan. We already have what they are striving for."

According to Computer Intelligence (La Jolla, CA), a market research firm, mainframe spreadsheets are installed in approximately 10 percent of mainframe data centers. Mainframe spreadsheets are used to address a variety of requirements. The following capsule descriptions will give readers a flavor of how modern mainframe spreadsheets are applied.

Where Are They Now?

There has been considerable consolidation among mainframe spreadsheets. Here is an update on what happened to a number of hopeful contenders that for one reason or another fell by the wayside.

MaxiCalc

This product languished after Martin Marietta sold it to On-Line Software International (Ft. Lee, NJ). Late last year, On-Line quietly sold it to Technologic Software Concepts (Irvine, CA).

Future-Calc

This system was a combination of spreadsheet and programming language. As such it was exceptionally efficient and fast once it was programmed. Lotus bought Future-Calc, presumably as the basis for 1-2-3M, but has reportedly abandoned salvaging anything from it.

MegaCalc

One of the leading mainframe spreadsheets in the early 1980s, this product was acquired by Computer Associates (Garden City, NY) and renamed CA-SuperCalc.

Wendy's Shares Data

Even a disastrous experience with one mainframe spreadsheet system did not turn Wendy's International (Dublin, OH) totally off the concept because the restaurant chain embraced Dynaplan. According to Al Huffman, director of technical services, Dynaplan is serving about 125 users throughout the organization.

The spreadsheet is predominantly used in applications where sharing data is necessary and where there is a lack of a Local Area Network (LAN) to tie PCs together. It is also used to build bridges between the applications which own the data and users who need to analyze the data. Wendy's has designed batch jobs that load the needed data directly into the mainframe worksheet, automatically populating the cells with appropriate data and formulas.

Tradeoffs of Mainframe and Micro Spreadsheets

Criteria	Mainframe Spreadsheets	Micro Spreadsheets
Sharing of data	Easy, networks already exist	Relatively difficult, even with networks
Consolidation of data	Easy	Difficult
Security	Handled by mainframe security system	Difficult on stand-alone basis
Backup	Handled by standard backup policy	Hard to enforce on stand-alone basis
Limits on size	Virtually unlimited	Limited
External files	Data exists on mainframe; no need to download	Downloading required
Cost	Hard to determine	Hard to determine
Convenience	Relatively inconvenient	Relatively convenient

By avoiding the intermittent step of generating reports, it eliminates the wasteful and error-prone practice of manually re-keying information that is already machine readable.

Wendy's has no problem with the spreadsheet's efficiency. "It's not as if we had to add additional capacity," Huffman states. Besides, he is happy to take the cycles that Dynaplan uses during the day and put them to work at night. He asks, "What good are the PC cycles that are turned off every night?"

The Houston Chronicle: Crunching Large Mainframes

When you have extremely large spreadsheets to work with, using a PC is simply out of the question. In some cases, even some mainframes are too constraining, as Othell Owensby, Jr, an analyst in the production administration department of the Houston Chronicle, discovered. The paper uses ESS from Trax Softworks (Los Angeles, CA).

The Chronicle crunches some big spreadsheets. The biggest one helps determine newsprint utilization for the newspaper. The spreadsheet is more than 8,000 rows deep, has more than 187,000 items and requires 9MB of memory to load. The application keeps track of the newspaper's consumption of newsprint and converts newspaper page counts to tons and dollars of paper required to keep the presses running. It does so on a week-by-week basis, with year-to-date summaries.

Although PCs helped to create the huge appetite for electronic spreadsheets, it is ironic that they cannot satisfy it.

But even mainframe spreadsheets have limits. At 9MB, the spreadsheet is at the limit of the TSO address space each user may work with. The Chronicle's mainframe, an IBM 3081 Model KX, runs under MVS/XA. Systems analyst Barry Folsom reports that if Owensby received a 10MB TSO address space, he would be operating at the very limits of the operating system and that might create more difficulties for him. As it is, if the spreadsheet grows any larger, Owensby will have to split the spreadsheet into two parts. Either that or persuade the paper's owners to invest several million dollars to upgrade to a 3090 and install MVS/ESA. It is likely that he will have to split the spreadsheet into two parts.

Although a number of people at the Chronicle use Lotus 1-2-3 on PCs, Owensby never considered it for the paper's larger applications. "Number one, it goes only 8,000 rows deep. Number two, it is not three dimensional. We needed a 3D capability." Even when he does use Lotus, Owensby quickly outgrows it. For convenience he uses the PC for a costing model that generates weekly P&Ls. But the PC can hold only about six months of data before it becomes too large to load, forcing Owensby to split the worksheet into smaller components.

Mainframe Spreadsheet Sweetens Sugar Firm's Accounting

In an effort to stay competitive in the commodity sugar market, one of the largest sugar companies in the country is using a mainframe spreadsheet package to boost productivity. At Holly Sugar Corporation, a subsidiary of Imperial Sugar, there is a corporate commitment to improving productivity among the nine manufacturing plants, according to Marketing Statistician Bill Rembowski. To tie those plants plus other locations together, Holly Sugar installed OmniCalc, a mainframe-based spreadsheet system from Tower Systems International (Costa Mesa, CA). Based in Colorado Springs, Holly Sugar operates an IBM 3081 D under VM/VSE ESP.

To make its staff more productive, Holly Sugar wanted to give end users the ability to develop their own accounting applications quickly and easily. "We wanted to make available the tools and resources they needed to solve their own business or technical problems," Rembowski says.

"We looked at PCs for their spreadsheet capabilities, but without access to the mainframe data, users would have no way to integrate their separate forecasts. Moreover, there is a security problem with everyone running around with loose diskettes full of sensitive, competitive information," he notes. Finally, the time wasted by re-keying into PCs information already available on the mainframe was considered. "For these reasons, a mainframe-based system like OmniCalc was better for us," he says.

OmniCalc Operates in a CICS, VM/CMS or TSO environment to give every terminal advanced spreadsheet capabilities. The system includes multidimensional display support, a feature that automatically adds depth to the two-dimensional matrices. Each plane is its

own "spreadsheet within a spreadsheet," according to Rembowski, allowing similar applications to reside within the same matrix or for cumulative totals to be gathered across applications. "When Lotus 1-2-3 users see this three dimensionality feature for the first time, they go nuts," he laughs. In both cases, all data is available for update at any time. Security is provided by a mixture of user password, user and terminal entry restrictions and data encryption protection features.

Holly Sugar has a unique accounting system that practically begs for a mainframe spreadsheet. All nine manufacturing plants use OmniCalc to keep track of inventories and operations, periodically reporting to headquarters. With more than 50 private labels and nine package sizes to keep track of, the company has to control more than 5,000 inventory items. With the installation of OmniCalc, such functions as budgeting, cash flow forecasting, competitive analyses, performance tracking and cost determinations are available in a multi-user environment to all users on Holly Sugar's dedicated network.

Holly Sugar exploits many of OmniCalc's non-spreadsheet functions. For example, according to Rembowski, the program's cell-indexing function works almost like a database management system. Sales managers actually use OmniCalc to store, manipulate and retrieve information on key customers. In the same way, the company uses the program's word processing and graphic functions. Using OmniCalc on a CICS network, the company has set up a workable electronic mail system to distribute memos, reports, graphs and forms. Rembowski reports that a typical form used to take up to two weeks to create and distribute. Now the same task can be handled in 20 minutes using OmniCalc.

Holly Sugar never had a proliferation of PCs to worry about, so justifying a mainframe spreadsheet was relatively easy. According to MIS Director Norm Keller, "The company has found OmniCalc a less expensive alternative than putting a PC with Lotus 1-2-3 on everybody's desk." As for functionality, the company is much better off, he adds. "There is nothing I can't do with the mainframe spreadsheet that I could with a PC spreadsheet. The reverse statement is not true." If there is an area that Keller would like to see improved, it is the speed of sorting. OmniCalc requires about 40 seconds to sort the company's largest application. "When you consider how long the sort would take under a PC, we're doing all right," he concludes.

Conclusion

Mention spreadsheets to some users and visions of PCs dance in their heads. It is true that PCs played a major role in creating the huge appetite of businesses for electronic spreadsheets. It is ironic that PCs are so successful that by themselves they cannot satisfy that growing hunger. That is where mainframe spreadsheets fill the need. Vendors of spreadsheets for mainframes believe only they can meet the need for software that allows data to pass through the various levels that define systems for corporate databases, departmental systems and end users.

ABOUT THE AUTHOR

John Kador is a free-lance writer specializing in the business applications of mainframe software.

Executive Decisions For Capacity Planning

By H. Pat Artis

Perhaps one of the most common dilemmas faced by capacity planners is trying to estimate just what information their decision makers need regarding system planning. Oftentimes, capacity planners simply overwhelm decision makers with information since they are uncertain of the exact needs of their executives.

In the same way that workload characterization is an important technical aspect of capacity planning, characterizing the information needs of your decision makers is essential to the success of any capacity planning study. Just as the specific characteristics of a workload shape the characteristics of future demand, the economics and politics of senior decision makers define the types and quantity of information needed to support the decision process.

In this article, four important questions for determining the management style, level of detail and information requirements of decision makers for capacity planning will be explored along with options available to senior decision makers. In addition to introducing questions, the benefits and liabilities of each of the alternative solutions will be examined.

Specifically, the questions are the following:

- Service Level Agreements (SLAs): should objectives be set and negotiated with individual users or should the approach be to simply attempt to respond when one or more major departments expresses dissatisfaction?
- Selection of a load objective: does the organization want to commit the economic resources necessary to meet average loads, peak loads or a defined engineering level?
- Planning for new applications: should capacity planning react to new applications as they enter production or interact with applications developers to ensure that new applications are efficient consumers of resources?
- Utility or application-based capacity planning: should the capacity planners attempt to understand the detailed characteristics of end-user workloads or does the utility approach to capacity planning better reflect the needs of the organization?

By asking four simple questions, you can determine where limited resources and budget authority can be applied to meet senior executives' information needs and expectations.

Presenting these questions to senior decision makers in an effective manner can provide guidelines that focus the capacity planners on the needs of the decision makers. Moreover, once a requirement has been identified, staffing and resources for these functions are far easier to justify.

SLAs

One consequence of the transition from batch to on-line applications is that the number of service expectations per day increases by several orders of magnitude. Where the productivity of a department may have depended on the timely delivery of reports each day in a batch environment, a service expectation now exists for each on-line response.

Since the IS department is judged by response time, it is important to understand what the criteria are that the users are employing to evaluate on-line response. Without an understanding of the implicit criteria assumed by the users, it is difficult to evaluate the level of satisfaction or establish credibility with the system's users. There are two approaches that can be used to establish SLAs.

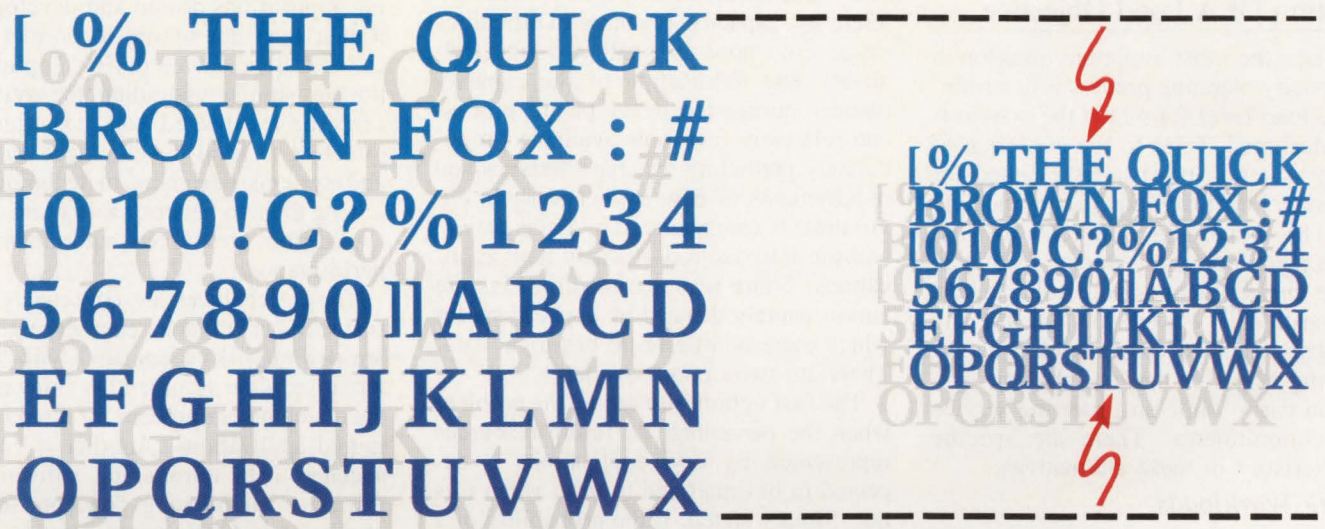
Establish Service Level Objectives

Rather than attempting to negotiate SLAs with each of the user departments, establish and publish Service Level Objectives (SLOs) for on-line and batch services with the commitment that adequate resources will be obtained to maintain the objectives in the future.

One of the risks associated with this approach is that unrealistically high or low objectives may be established without the benefit of a detailed study. Another risk is that the commitment to maintain the objective mandates future budget allocations to maintain service levels.

Negotiate SLAs

Evaluate the service requirements of each of your user groups and negotiate an SLA that outlines load and service level commitments. There are risks associated with this approach. First, the credibility of the IS department may preclude serious negotiations with the users. Second,



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negotiating SLAs is a time-consuming process. Last, your users may never have considered what their service requirements really are to meet the needs of the business.

Selection Of A Load Objective

Perhaps the most important question in the capacity planning process is determining the load level for which the system is to be designed. Prior to the evolution of on-line systems, most users planned for an average load level required for meeting overnight processing requirements. Although planning for an average load in an on-line environment is unreasonable, the key question is whether to plan for any peak that might occur or to select an engineering level for the load that the system can carry while still meeting service level commitments. There are specific characteristics of these alternatives.

Peak Workloads

Due to the tendency of many users to compress a high percentage of their processing into month and year-end periods, significant peaks tend to exist in most workloads. As such, a natural response to capacity planning is to attempt to configure the system to meet any peak that might occur.

The disadvantages associated with planning for peak periods are: 1) responding to any peak is the most expensive approach to capacity planning and 2) demand at peak periods tends to be self reinforcing. That is, the ability of the system to respond to peak demands tends to raise the users' expectation of how much can be *rushed through* in the future.

Engineering Level

An alternative approach to planning for peak loads is to select an engineering level. Simply defined, an engineering level is a designed maximum transaction rate for which your SLOs can be maintained.

By setting the engineering level relatively close, say 98 percent, to the peaks that have been observed in the past, you can be relatively certain that the system will maintain service levels in all but the most adverse conditions. For example, you might suffer degraded service levels for a nationwide on-line system during month-end processing when users in all four time zones are active. Engineering levels represent a desirable strategy unless the economic value assigned to response during peak business periods is large when compared to the hardware investment required to meet the peak.

Insuring Application Performance During Development

Planning for new applications presents one of the most severe problems encountered by capacity planners. Difficulties range from poor application design, relatively late notification of the capacity planner during the development process and relatively few tools available for accurately predicting the characteristics and requirements of new applications. In environments characterized by rapid growth and the introduction of many new applications, future resource requirements are almost entirely dictated by applications for which there is little or no historical data. There are two options available.

The first option is to ignore the problem when the percentage of future resources represented by new applications is expected to be small and to react when it is not. Simply stated, if the probability of a problem occurring is small, the value that can be assigned to or invested in a solution is also small.

The second option is to introduce capacity planning and performance methodologies into the applications development process. For small environments, a future applications inventory can provide a record-keeping system for future resource estimates. For larger environments, training applications developers in performance-oriented methodologies can provide significant long-term benefits.

Application Inventory

To introduce controls into the applications development process, it is recommended that an applications inventory be developed to support the capacity planning process. Simply described, the estimated resource requirements of a proposed application would be cataloged as soon as the application is authorized for development. This is not intended to be an approval process, rather a trip wire to notify the capacity planner of the expected characteristics of the application at the earliest possible time. Periodically during the development process, the estimates for each of the applications in the inventory would be reviewed and updated. There are two primary liabilities. One is potential political problems that can result from the performance and capacity planners being viewed as "development police" rather than interested parties in the process. Another liability is the manpower required to maintain the inventory and interface with the developers.

Software Performance Engineering

The applications inventory process can be significantly enhanced by committing to software performance engineering during applications design and development. Rather than attempting to correct applications' deficiencies during implementation or simply upgrading the system to carry the unexpected load, it is often more effective to train development managers and systems designers in techniques allowing them to better quantify and control applications resource requirements and performance.

These techniques are collectively called software performance engineering. There are several risks associated with this alternative. One is potential elongation of the development process for already committed applications. Another is costs associated with introducing software performance engineering concepts into the applications development process.

Utility Or Applications-Based Capacity Planning

There are two fundamental approaches that can be used for the workload forecasting problem.

Traditional Workload Characterization And Forecasting

This approach evaluates the characteristics and efficacy of each of the system's applications and develops a forecast for each application based on trend analysis or a more complex technique like business element-based forecasting or time series analysis. After forecasts have been developed for each of the applications, the system forecast can be developed by summarizing the forecasts for each of the applications and adding in new applications from the application inventory.

Classic workload forecasting is fundamentally a technical implementation of steering by watching your wake. If you have been going the same way for a long time and there are few periodic aspects to your business, then this is an acceptable technique. Moreover, it is significantly enhanced when forecasts of business volumes are used to drive the forecasts and when reliable estimates are available for new applications. In addition, developing an understanding of the characteristics of applications helps to identify applications that are "rewrite" candidates or questionable uses of critical resources. Classic forecasting techniques perform most

poorly in environments that are typified by periodic or rapidly growing applications. Moreover, classical workload characterization and forecasting may appear to users and executives as another or as a surrogate resource accounting system if one is not currently in place.

Utility-Based Forecasting

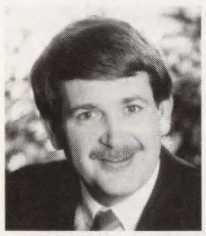
In this approach, the IS resource is treated as a utility. Classic utility economics and forecasting techniques are based on aggregate demand tracking, minimization of cost and the users' ability to pay for services rather than the utility attempting to understand the characteristics of their use. Simply described, if a user can pay for a service, it is assumed that the utilization is a good idea. Utility forecasting techniques are based on a management approved reserved factor, the time delay to add new resources and the peak demand levels that have been experienced in the past.

Utility-based forecasting does not attempt to determine the efficacy or the functional characteristics of the users' workloads. Rather, it attempts to assure that resources will always be available to meet demand. The primary problem with this approach is that it does not react well to a contracting environment. It is based on the assumption that every peak is a predictor of a larger peak that can be expected in the future.

Remarks

In this article, you have examined four simple questions regarding capacity planning activities. By asking four simple questions regarding capacity planning activities, a capacity planner can determine where limited resources and budget authority can best be applied to meet the information needs and expectations of senior executives.

ABOUT THE AUTHOR



H. Pat Artis is a recognized authority in workload characterization, forecasting simulation modeling and capacity planning. He is the author of more than 75 papers and lectures internationally. Artis is President of a private consulting firm, Performance Associates, Inc., 72-687 Spyglass Ln., Palm Desert, CA 92260, (619) 346-0310.

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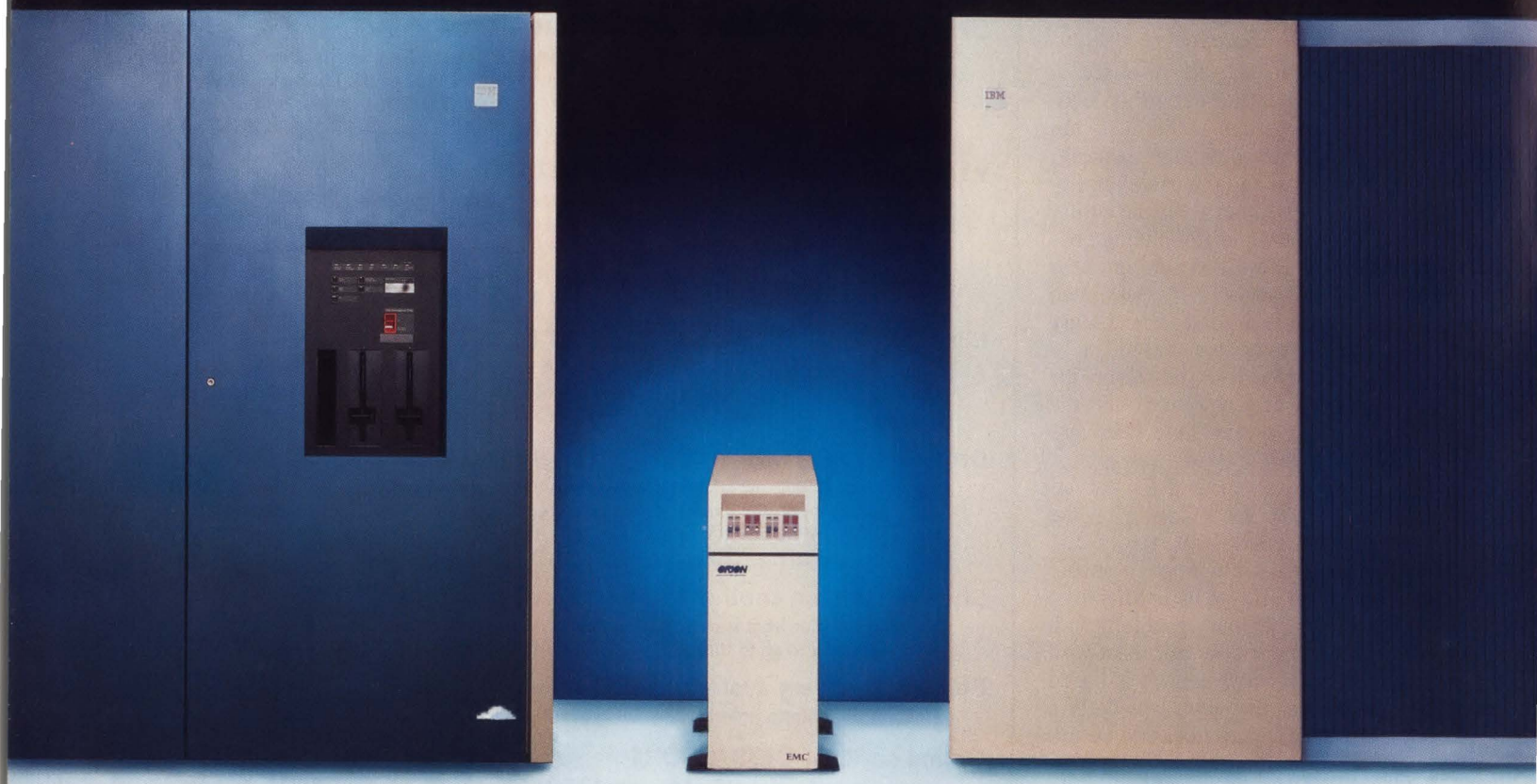

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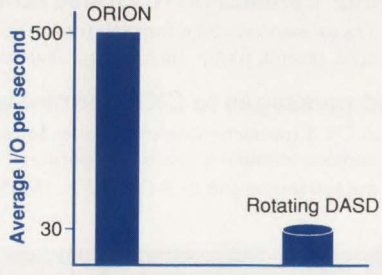

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VM Performance

DMKSNT

Some Non-Conventional Uses

By Kenneth M. McBride

VM/SP and VM/SP HPO provide system definition files that are used to tailor the operating system to a specific computing environment. One of these files is named DMKSNT ASSEMBLE and is referred to as the system name table.

The best way to approach DMKSNT is to pay particular attention to its name. It is nothing more than a table containing system information. Even though it is an Assembly language module and must be processed by an assembler, it does not contain a single line of executable code. The majority of entries in DMKSNT are used by the VM Control Program (CP) to allow virtual machines to share code and restore previously saved copies of virtual storage. The remainder of DMKSNT contains information relating to specialized services such as laser printer support and network communication software.

There are four macro types that can be included in DMKSNT. One of these, NAME3800, is for defining a 3800 printer and is only needed if an installation has this type of device. The NAMENCP macro is used to define control program images for a front-end processor, such as a 3705. The NAMELANG macro is used to specify additional languages to CP and is needed on systems with users who speak a language other than English. The rest of DMKSNT is composed of definitions using the NAMESYS macro. The primary use of NAMESYS is to identify blocks of re-entrant code to be shared among virtual machines and to define "saved systems." Making special use of the NAMESYS macro is the focus of this article.

Hardware Design Principles

In S/370 architecture, virtual storage is defined in terms of segments and pages. A segment is 64K in size and is further divided into sixteen 4K pages. Figure 1 shows the manner in which virtual storage is partitioned into segments and pages. Notice that the segments are numbered zero to 255 and pages are numbered zero to 15 relative to each segment. However, relative to the entire 16MB, virtual storage space pages are numbered zero to 4095. For example, segment zero contains pages zero to 15, segment 88 contains pages 1408 to 1423 and segment 255 contains pages 4080 to 4095.

S/370 provides 24 bits for addressing. Thus the maximum address is 2^{24} or 16,777,216. This represents 256 64K segments or 4096 4K pages and is commonly referred to as 16MB. A virtual address in S/370 uniquely identifies a segment, page and location (displacement) within a page. Through the use of tables maintained by the operating system, a virtual address is linked to a location in real memory or flagged as residing on an auxiliary storage device. DMKSNT is used to map/identify portions of the 16MB virtual storage space for specific purposes. Segments are identified by a number zero to 255 and pages by numbers from zero to 4095.

VM/SP and VM/SP HPO are designed for S/370 architecture and will not work on machines configured for the Extended Architecture (XA). The reason for this is that the XA addressing range has been extended and consequently the page and segmentation scheme has changed. XA provides 31 bits for addressing. This expands the maximum address to 2^{31} or 2,147,483,648 — two gigabytes. The size of a segment is one megabyte. The number of pages in a segment is 256 and the number of segments in a two-gigabyte address space is 2048.

In order to accommodate these changes in hardware architecture, new operating systems were developed. VM/XA/SP Release 2 provides roughly the same capabilities for XA machines that VM/SP HPO provides for S/370 machines, but their implementations are somewhat different. VM/XA does not provide a system definition file similar in function to DMKSNT. Instead, VM/XA provides the same capabilities through the use of CP commands.

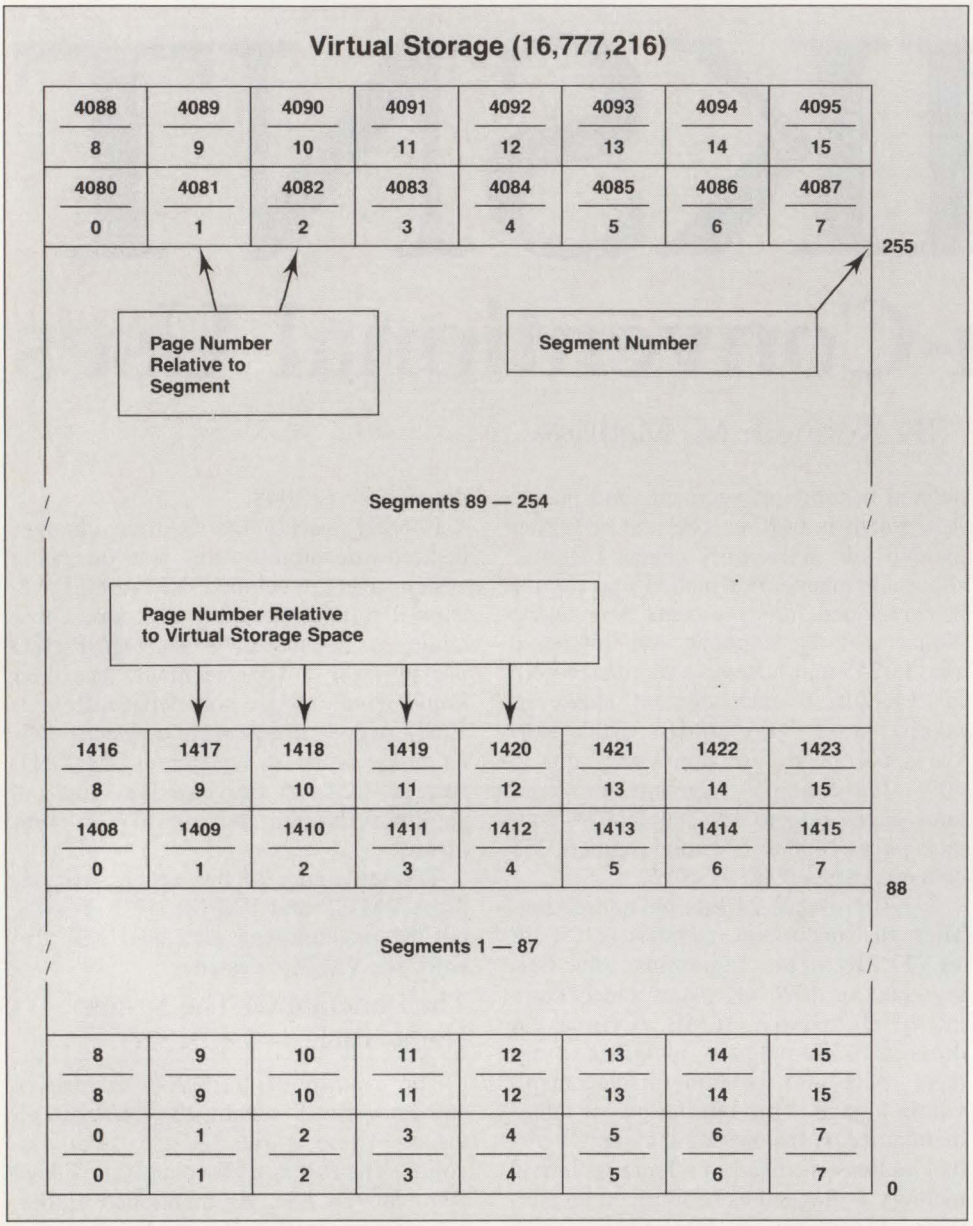
The remainder of this article will address VM/SP and VM/SP HPO (S/370), but the methodology presented will also work for VM/XA systems.

The Function Of The System Name Table — DMKSNT

The majority of DMKSNT consists of entries defined within the NAMESYS macro. These entries fall into two categories. The first is a Discontiguous Shared Segment (DCSS). As mentioned earlier, a segment is a piece of virtual storage that is 64K in size. A virtual machine address space consists of one or more segments. Each segment is further divided into 16 4K pages.

Every virtual machine has its own unique set of logical addresses. These addresses define virtual storage that is not normally shared. Sometimes, however, it is useful and efficient to have users share blocks of virtual storage. This is accomplished by coding entries in DMKSNT which allow two or more virtual machines to share segments and pages. In this context *sharing* means that the virtual addresses associated with each virtual machine correspond to the same data in real memory. A shared block of code or data may include one or more segments.

FIGURE 1



The other use of the NAMESYS macro is to describe *saved* systems. A saved system is a snapshot of a virtual machine's storage, register contents and PSW frozen at a specific point during processing and written to a DASD device. Then, at some future time, a user may restore this system and continue processing as if nothing has changed. Users of CMS will see this in operation by IPLing a name CMS instead of a device address which is the usual procedure. The purpose of saved systems is to provide an efficient way to resume execution without incurring the overhead associated with IPLing by device address. Saved systems offer some interesting and useful possibilities for non-conventional uses of DMKSNT.

Using Stand-Alone Utilities

Consider the following situation encountered by VM systems programmers. A new string of 3380 disk drives is installed and turned over to the software support staff to be prepared and placed into production. Some are to be used as VM packs and others will be formatted as OS-type volumes. All must be initialized and labeled.

The CMS systems disk (190) contains stand-alone utility programs that are used to initialize disk packs. Their file names are IPL FMT and IPL DSF. FMT is the VM Format/Allocate program and DSF is the Device Support Utility used to initialize OS volumes. Since they are stand-alone they must be IPLed in the virtual machine being used to prepare the new disks. The sequence of commands needed to use the VM Format/Allocate program is as follows:

```
SPOOL PUNCH *
  (Spool virtual punch to self)
PUNCH IPL FMT S2 (NOH
  (Punch a copy with noheader option)
IPL 00C
  (IPL the virtual reader to load FMT)
```

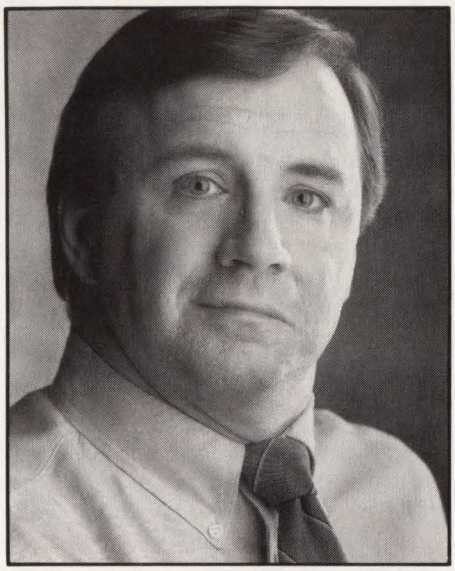
When the IPL is complete the utility is loaded into virtual storage replacing CMS. The virtual machine is totally under control of the FMT program. CMS commands are no longer available and the only way to communicate with CP is to use the immediate command prefix (#) or by using the PA1 key to drop into CP READ. At this point the programmer enters control statements telling the program what volume to initialize, its label and other information about device characteristics and usage.

When preparation of the VM volumes is complete, CMS must be reIPLed and the same sequence of commands executed to punch and load the DSF utility. This is a bit annoying and probably more than one VM systems programmer has wished there were a way to load these utilities without having to continually spool and punch them to the virtual reader. There is a way; DMKSNT offers a solution. They can easily be made into saved systems. This provides a way to directly load them into virtual storage from a saved copy on disk eliminating the need to spool and punch them to the reader.

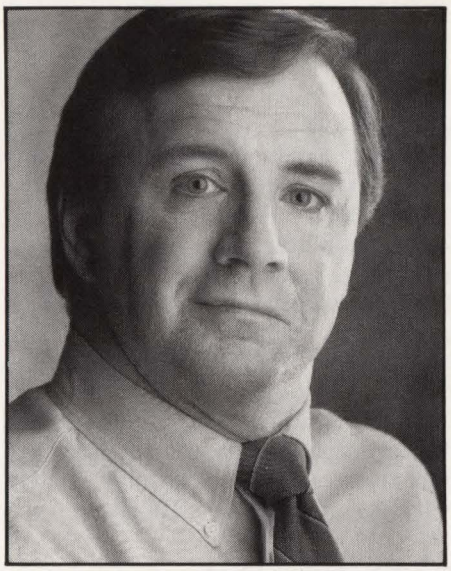
Creating Saved Systems

Use IPL FMT as an example. The first thing needed is to determine approximately how much virtual storage it requires and how its code is distributed in memory. Deciding how much to save is a simple matter of trial and error. A little experimentation will show that IPL FMT requires about 64K to be successfully IPLed.

For such a small amount of virtual storage, the distribution of code is of no concern. The entire 64K should be saved. Larger systems, like CMS, may need to be analyzed to determine what portions of virtual storage really need to be saved and which are simply scratch areas. For example, the standard CMS system does not save the user free storage area located between the end of the nucleus constant area (ANUCEND) and the beginning of the transient program area (x'E000'). CP does not depend on information contained in



You know your CICS from your IMS...



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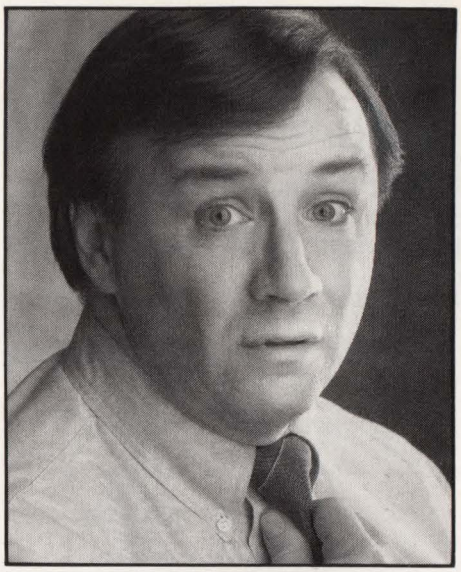

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this area of storage so there is no need to save it.

The 64K needed by FMT represents a single segment of virtual storage. The DMKSNT entry needed to save this segment is:

```
FMT NAMESYS  SYSSIZE=64K,          Virtual machine
                                   size required
             SYSNAME=FMT,          Name to be used
                                   with IPL command
             SYSVOL=ABCPAC,        CP-owned volumes
                                   to hold copy
             SYSSTRT=(XX,XXX)      Starting CYL and
                                   length
             SYSPGCT=16            Total number of
                                   pages saved
             SYSPGNM=(0-15)        Page numbers to
                                   be saved
             VSYSADR=IGNORE        No system
                                   residence volume
```

Clearly, this is a much simpler entry than the one required for CMS. There are two reasons for this. The first is that the CMS saved system is more than just a memory image copy of virtual storage, registers and PSW. It also defines 10 segments to be shared among all CMS users. The second is that FMT does not have a system residence volume that is used during processing. It is completely loaded into main memory. Therefore, the definitions for VSYSRES and SYSCYL are not required. VSYSADR=IGNORE is coded to inform CP that no virtual system residence volume exists.

Note that the SYSHRSG operand is not used. You do not want to share code but only want to save a memory image copy on disk. Sharing segment zero would cause CP major problems. Every time an interrupt was processed, CP would interpret it as a modification to the shared code and would issue the appropriate message alerting the user to this fact: DMKVMA456W CP Entered; FMT — Shared Page 000000 Altered.

Once the new DMKSNT has been incorporated into the CP nucleus, the only thing left to do is to use the SAVESYS command to write the copy to disk. Saving FMT is essentially the same process as saving CMS with only a couple of small variations.

Spool the punch to yourself. Punch IPL FMT just as you would do to use it in the normal fashion. At this point there are two different approaches that can be taken. The first is to simply load FMT (via IPL) and save it after the first message has been written to the terminal. This technique works fine except that it requires a carriage return to generate the first prompt message after IPLing the saved copy. Also, the same virtual console address must be used each time. For example, if the system was saved in a virtual machine with a console address of 009, then it will only work in virtual machines with the same console address.

The second method is a little more involved, but it makes the saved system look and behave exactly like it does when IPLed from the reader. When FMT is saved in this manner it will respond with the message VM/370 Format/Allocate program — VM/SP, on the first line and Enter Format or Allocate: on the second. This message will appear automatically without an extra carriage return, exactly as it does when FMT is IPLed from the reader.

The First Approach

To save FMT after it has been loaded, wait for the message:

```
VM/370 Format/Allocate Program — VM/SP
Enter Format or Allocate:
```

Then type in #CP SAVESYS FMT and the following message will appear:

```
DMKCFH436E Interrupt Pending.
To proceed type Yes, to end type No.
```

The reason for this message is that CP is informing you that the virtual PSW has bit 14 turned on (wait state) and wants to know if this is what you intended. A system is usually not saved when it is in a wait state. This is the reason a carriage return is required before the prompt message is displayed when saving the system with this procedure.

Enter Yes and the system will be saved. CP will write the message System Saved after completing the process. Next, test the saved copy by entering #CP System Reset and then IPL FMT. Wait a second or two and enter a carriage return. You should see the Format/Allocate prompt. From this point on it works just like normal. You will never need to punch FMT and IPL the reader again.

The Second Approach

If you are a perfectionist and want the saved program to behave exactly as the regular version, you will have to use a slightly different technique. In this approach you need to suspend execution of the program at a specific point before saving the system. The virtual PSW will be in running status and pointing to the next instruction to be executed.

Proceed as before. Punch IPL FMT to the virtual reader and IPL with the option 'stop'. This halts the IPL procedure just before the initial PSW is loaded. Your virtual machine will drop into CP mode and the message ADSTOP 9E00 will be displayed on your terminal. At this point enter: ADSTOP 9E8A and type BEGIN. This instruction is reached after the program has been completely loaded into virtual storage. Next, enter: ADSTOP 600 and type BEGIN. The Format/Allocate program actually starts at this address. Prior to this the loader program was executing. When the message ADSTOP 000600 appears, enter: SAVESYS FMT. Notice it is not necessary to use #CP because the virtual machine is already in CP READ. Also, CP does not issue the message about pending interrupts because the virtual PSW is in running status. When FMT is saved by this approach it will appear and behave exactly as the normal version.

One final note. The Format/Allocate program is designed to test for console addresses of 009 and 01F. It will also work for consoles addressed differently. However, when creating FMT as a saved system, problems and complications can be avoided by using 009 or 01F as your virtual console address. The reason for this has to do with the method the utility uses to determine what device to use as its console. Unfortunately, this article does not allow space for a futher explanation of this issue.

The method described for saving the VM Format/Allocate program (FMT) can also be used for the Device Support utility (DSF) and even for a program like Oltsep. Using saved systems works best for simple control programs like FMT or DSF. Control programs that are multiprogrammed, create and manage their own virtual storage or have special timing requirements presenting much bigger challenges. Saving MVS is an especially tough nut to crack but is guaranteed to be interesting as well as a lot of fun. The author once saved an MVS system with two active batch jobs. When the system was restored six months later, the two jobs were still there, plodding along as if nothing had happened.

ABOUT THE AUTHOR

Kenneth M. McBride is a management consultant with more than 15 years technical experience in IBM operating systems. McBride is the owner and principal consultant of K&D Consulting Group, a private consulting firm specializing in EDP auditing. He also serves as an independent consultant to CSA, Inc., the MIS Training Institute, Inc. and National Advanced Systems, Inc.

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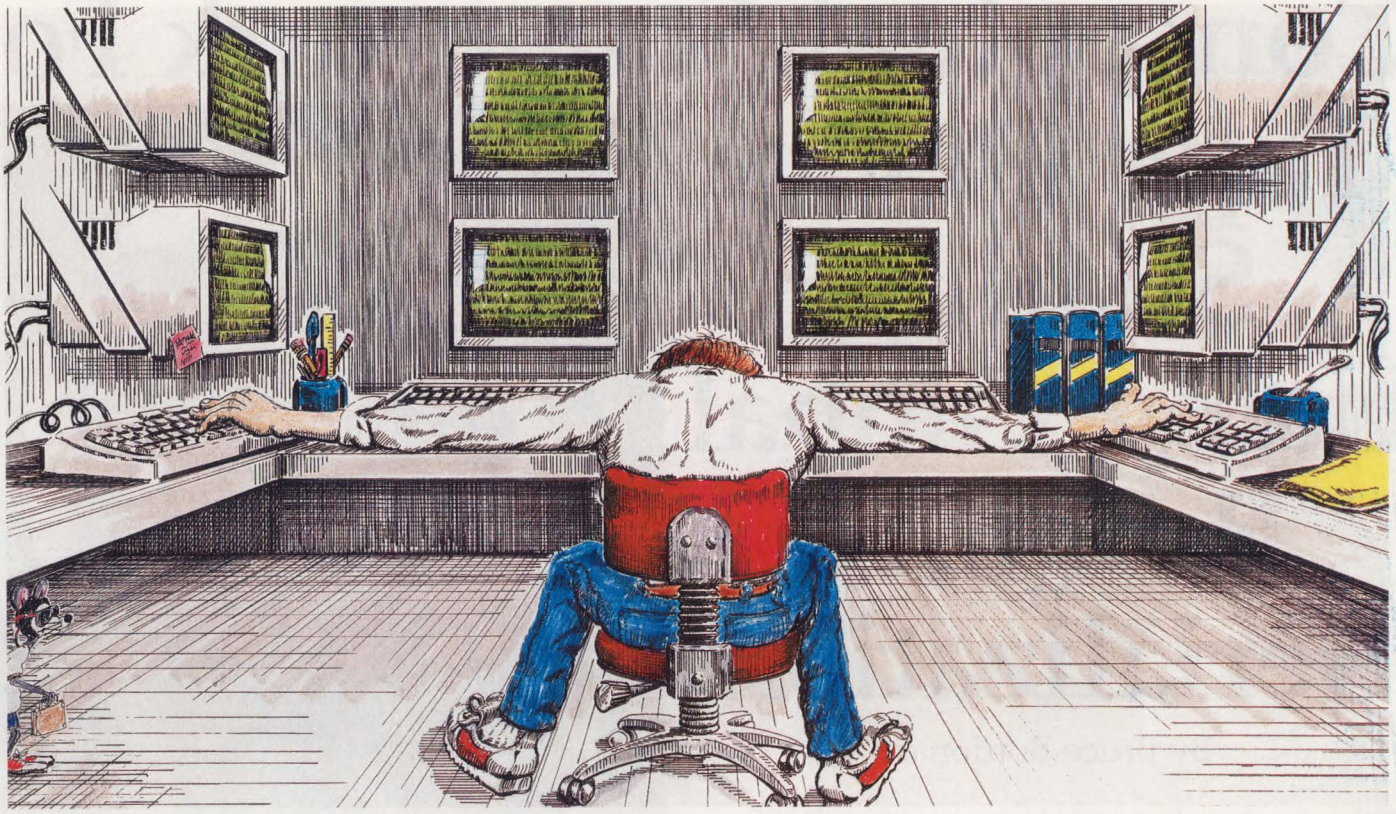

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A Conceptual Framework For Tape Device Sharing Using Global Resource Serialization

By Bruce Bordonaro

There has always been a need to share tape drives among multiple systems. Unfortunately, IBM does not provide a mechanism to enable this sharing with any data integrity. Tape drives may be on-line to multiple hosts at the same time, but it is the user's responsibility to ensure integrity. Integrity in this case means guaranteeing a drive will only be allocated by one user at a time and that sharing systems will not corrupt the data read or written by the user of the allocated tape drive.

In an effort to implement this concept, some third-party vendors have written software to enable tape drive sharing among systems. With this software, allocation information is stored in a disk dataset table shared by each system participating in the shared tape drive complex. As a tape allocation is performed, the system checks the dataset for current allocation information and updates it as appropriate. Since tape drives may be generated with different device addresses (MVS/370) or different device numbers (MVS/XA), a method is usually employed that translates non-unique device numbers to a common name so all sharing systems can recognize the same device. Serialization on the shared DASD file is needed to prevent concurrent update; this is typically accomplished through the shared DASD *reserve* mechanism. While this type of implementation works quite nicely, it is subject to the delays inherent in shared DASD. In most cases, it is not practical to dedicate the entire DASD device to this table file, so the file becomes subject to the normal delays encountered when multiple files are active concurrently.

Methodology

While IBM does not directly provide a means to share tape devices, it does provide the basic building blocks. For 3480 tape drives, there is a sharing option allowed on the MVS VARY device command; the SHR keyword. The older 3420 tape drives do not have a counterpart and may be varied on-line to multiple systems concurrently even though this might not be what is desired. When a 3480 drive is varied on-line without the SHR option, the device is marked with a hardware reserve, exactly like a shared DASD reserve, thus preventing the drive from being accessed by multiple systems concurrently. When the SHR option is used, 3480s are accessible in the same way as 3420s.

The other building block IBM provides is GRS, which is used to propagate enqueue information across systems in a complex as well as eliminate DASD reserves. GRS itself has no provisions for tape device control, but its facilities might be used to build a mechanism to enable tape drive sharing. What GRS lacks in ease of use it more than makes up for in efficiency. Use of GRS, however, is predicated upon the availability of Channel-To-Channel adapters (CTCs) or IBM 3088 Multisystem Communication Control Units (MCCUs). Given this foundation, the GRS global enqueue mechanism may be used to control global tape drive allo-

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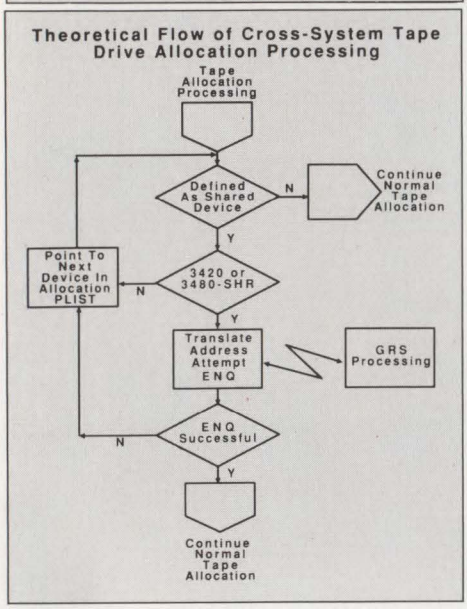
FIGURE 1



cation, along with some modifications in tape allocation processing.

A theoretical extension to the GRS definition parameters in the PARMLIB member GRSCNFxx could be made by IBM to allow translate tables for tape device numbers. In its simplest form, it might be the specification of a new keyword followed by the device number as known on the system and the translated device number. A sample specification might look like:

```
SHRTAPE((44*,24*),(48*,48*),(49*,49*))
```

where multiple ranges and generic specification (* in the last position of the device number) would be allowed. This statement would translate all tape device addresses in the range of 440-44F to 240-24F. It would also specify that 480-48F and 490-49F would not be translated. Any device not specified would be considered ineligible for shared tape drive management. Modifications would also have to be made to some IBM components. Tape allocation processing would need to interrogate the table to determine if a candidate tape drive is eligible for shared tape drive management. If not available, allocation would continue as it currently does.

If the drive is allowed to be shared, however, tape allocation could check that the drive is on-line with the SHR option and then perform a cross-system enqueue on a resource which represents the shared tape drive, such as an enqueue major name of SYSZTAPE and a minor name of the translated device number, for example 44C. This enqueue would be propagated across the GRS complex and upon return, tape allocation would know if the resource (the tape drive in question) was available for allocation. If not, the process would be repeated for the next candidate drive in the allocation parameter list.

If the enqueue was successful, the task issuing the enqueue would become the holder of the resource and, thus, the tape drive and allocation would continue knowing that it has control over the device. Other sharing systems would be prevented from allocating the same tape drive by the enqueue which they would fail to get control of when they attempt to enqueue the same device.

The process would be made more efficient if a means were available to allow the task issuing the enqueue to continue processing without having to wait for the enqueue request to pass all around the GRS ring. In the MVS/ESA implementation of GRS, a new feature called ACCELSYS specifies the minimum number of systems in the GRS complex that must see a resource request before ownership is granted. The minimum value for ACCELSYS is two; therefore, only the issuing system and one other system need know about the resource request before ownership is given to the requestor.

If the requestor knew that the candidate tape drive was not already allocated on another system, the ACCELSYS option would allow the requestor to assume ownership of the resource by issuing the enqueue request. The enqueue request could then be used as a vehicle to inform other systems in the complex that the tape drive was allocated by the system issuing the enqueue request. This information would need to be stored on all systems in an area that has quick accessibility. An ideal time to store the fact that the tape drive is allocated to another system is when the enqueue request is being shipped around the GRS ring. Each system could store some information in the UCB for the tape drive on its system which would indicate the tape drive is allocated by the enqueue-issuing system, such as storing the SMF system ID of the owning system in the volume serial field of the UCB (UCBVOLI).

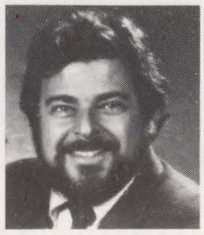
One other necessary consideration would be to modify the MVS UNLOAD command to check that a device is not allocated on another system before actually unloading a tape volume. This is practically the only other exposure to sharing tape devices. Since 3420 tape drives have no sharing mechanism, it would be assumed that they would always be sharable as long as their device numbers were specified as being available for sharing via the SHRTAPE keyword above. The fact that 3480 tape drives support the SHR keyword would allow all 3480 drives to be specified at IPL time and be individually controlled by console operator VARY device commands, making their use much more flexible than 3420s.

Conclusions

This type of facility could be implemented by user modification to IBM code. It would require placing *hooks* in tape device allocation and UNLOAD command processing. Determining where to place the hooks in operating system code and locating the information necessary to perform this type of processing would probably take more time than actually writing the code to do the work. The basics of such a user modification are outlined in the flowchart in Figure 1. Given the IBM directions toward automated operations and continuous availability, I think that it might be likely to see such a facility come into being during some incarnation of MVS/ESA.

Even if not implemented by IBM in the near future, such a facility could be developed through user modifications as outlined in this article. This would be a mechanism of great benefit to both large and small MVS installations. Small installations would receive the ability to share what is usually a limited resource. Large shops would benefit from reduced operator intervention required to move tape drives back and forth on sharing systems. All current users of GRS in multisystem mode would benefit by eliminating the need to purchase third-party software to perform tape drive sharing, in addition to receiving the performance improvement over the shared DASD-controlled implementation.

ABOUT THE AUTHOR



Bruce Bordonaro is a systems software manager for Pershing, a division of the brokerage firm Donaldson, Lufkin and Jenrett, New York, NY. He has more than 12 years of experience in the MVS data processing environment, 10 of which has been in systems programming.

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VSE's New Lease On Life

By Lawrence Stevens

"VSE is alive and well and it looks better now than it ever has. If that does not give the VSE user a 'warm fuzzy feeling,' then I do not know what will," comments Pete Clark, system programming and DB/DC administrator at Olan Mills, Inc. in Chattanooga, TN. Clark has been in the forefront of user efforts encouraging IBM to maintain support and enhance the VSE operating system that has been, since the late '60s, the workhorse for small and midrange IBM/PCM mainframes.

Clark's optimism is based not only on GUIDE meetings over the last year at which IBM has indicated an increased awareness of the needs of its VSE customers, but also on the most recent meeting this past July at which IBM responded favorably to many strategic requirements. "Over the last year users have seen notable changes in IBM's direction concerning VSE and that is very good news," responds Clark.

Other users echo Clark's enthusiasm such as Charles Rice, assistant manager of information services at Carolina Steel in Greensboro, NC. "We did not get everything we wanted, but we certainly got enough to make most of us very happy," exclaims Rice.

The July meeting signals in no uncertain terms the success of a struggle by VSE users to prevent IBM from declaring VSE "functionally stable." Although users have been cautiously confident that support for VSE would continue, IBM's response at the meeting eliminated any lingering doubt. "It was not that any one item was earth shattering for all users, although individual items were certainly earth shattering to many, but IBM's overall positive response to all the issues definitely confirmed what we all hoped and believed — VSE is alive, well and has a future," explains Clark.

IBM Responds

According to those close to the issues, the most important reactions from IBM were responses to key user requirements in the areas of constraint relief and computer center growth. Examples are virtual storage constraint relief, improved DASD access, shared address space storage relief, support for additional real memory and additional partitions.

IBM also intends to continue to increase the affinity between MVS/ESA and VSE. This will take a variety of forms including the introduction of a growing number of common languages, notably COBOL II, that will help to support and transport applications and files across both operating systems. While VSE will only selectively exploit SAA, within the affinity to MVS/ESA an increasing number of ESA applications will run on VSE.

In the database area, IBM's DB2 will, within the next few years, be able to work with SQL/DS even though the two use different versions of SQL and work with different internal procedures. Users will be allowed to draft a query and run it against both DB2 under MVS/ESA and SQL/DS under VM or VSE.

IBM also indicated it would implement a number of VSE enhancements in the area of unattended operations, remote operations and enhanced support for VSE as a distributed node.

While IBM's response has not answered all user requests, few, if any, emerged from the GUIDE meeting disappointed. "I guess no user is ever completely satisfied. Everyone always wants more functions, more features, improved performance, improved stability and improved response times. To a large extent that is what users foresee in IBM's software strategy. This software strategy coupled with future hardware should allow VSE users to continue adding applications, enhancing applications and improving system responsiveness," explains Clark.

Not Another MVS

Bernard G. Schimmele, IBM's program manager of VSE systems, comments, "IBM will continue to support and significantly enhance and extend VSE as an important application support platform for the current and future entry and midrange ES/370 product line. However, it will not be extended to become another MVS/ESA. It will be supporting the typical mainstream user. VSE and MVS/ESA do have different design paths in terms of supported hardware and functions. In many studies of VSE and MVS users, it has become clear that a large percentage is well served by VSE and does not need all the rich function set of MVS/ESA. However, a scope of requirements for VSE evolved, defining the needs of the typical VSE user. We want to give our customers the power and functions they need in VSE for entry to mid-level systems. It should be clear when they need VSE and when they need MVS/ESA."

Most of the functional differences that will remain between VSE and MVS, according to Schimmele, will revolve around the fact that MVS is a multiprocessing system and VSE is a uniprocessing system. Because of this, MVS will provide a richer set of functions. However, IBM will continue to improve the affinity between VSE and MVS in areas like subsystem compatibility and common user applications interfaces. Also, VSE will become more compliant with MVS/ESA at the entry and midrange systems of the ES/3090 family. For example, IBM plans

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to selectively utilize ESA support in VSE to aid in distributed processing of VSE systems connected to MVS/ESA hosts, to more productively support central MVS/ESA application program development for off-load to VSE systems, to make migration easier from VSE to MVS/ESA and, last but not least, to continue giving our customers the best utilization of IBM's hardware.

Evidence of this direction, according to Schimmele, is accepted requirements from GUIDE in areas of constraint relief, support for more than 16MB of real memory, more than 12 partitions and removal of VTAM and POWER from the shared address area.

Since VSE is a uniprocessing system, it does not need and will not get the powerful features that are found in the MVS version of ESA. "If you need the power of MVS/ESA, you would be better off buying MVS/ESA," Schimmele advises.

VSE Users Staying Pat

IBM's assurances are encouraging to users who had been considering other alternatives and also to vendors who may want to re-examine future plans. A systems programmer at a typical VSE data center in the midwest who requested anonymity comments, "At one point we were concerned about our future with VSE because it appeared that IBM might be dropping the ball on VSE and we did not want to be left out in the cold. Of course MVS migration was one of the choices, but it was not being considered very seriously. MVS migration would have been an expensive project and we had no technological reason to justify a migration."

Running three VSE guests under VM was totally satisfactory for the mid-sized insurance company. It was an if-it-ain't-broke-don't-fix-it decision, and, he comments, "It would have been unfortunate to have to migrate simply because IBM wanted us to do so."

Many other installations felt the same way and believe that it was user intransigence that led to IBM's decision to continue enhancing VSE. Jerry Berry, industry analyst with Computer Intelligence, La Jolla, CA, says, "A mass migration from VSE was an unfulfilled wish of IBM." He points out that the base of VSE users, far from decreasing, has increased slightly over the past five years in the U.S.

Between January 1984 and January 1989, the number of licenses rose 10 percent. Although growth has been slipping over the past two years because of market saturation, VSE still enjoys a two-and-a-half percent increase during that period. While MVS and VM have increased more dramatically (MVS grew by about 20 percent during the same period and VM doubled), VSE still holds a slight lead over VM in terms of total U.S. licenses and a substantial lead over MVS in U.S. licenses.

Statistics are, of course, always interesting and can be somewhat misleading. It is generally true that most of the new MVS customers were previously VSE. VSE only grew by 10 percent, but it apparently replaced the 20 percent MVS gained at VSE's expense, indicating a new and larger user growth rate than would be apparent from just reviewing the basic figures. In addition, this growth occurred while IBM was offering financial incentives to migrate to MVS, had announced that VSE would be functionally stabilized and was vigorously promoting VSE-to-MVS migrations.

Various statistical analyses are available concerning data processing systems,

migrations, license counts, use counts and so on. Unfortunately, it is difficult to determine the validity of these. In reviewing several different statistical analyses and in discussing trends and directions with users, there seems to be a significant divergence. Just this year, several migration specialists were using statistics that indicated currently 1,000 to 2,000 migrations were in progress. Computer Intelligence figures indicated 600 and various industry sources indicated less than 200. These figures seem to indicate a cautionary approach to statistics.

Worldwide, VSE holds a commanding lead in terms of the total number of licenses. It is generally believed that the number of worldwide VSE licenses is almost twice as large as its nearest competitor which, interestingly enough, is not MVS but VM. Of course, this is reflective of the fact that many VSE accounts have both VSE and VM licenses. Considering that in a VM/VSE environment a user typically runs more than one VSE production guest system, that could put the number of productively used VSE systems in the range of something like 50,000.

Many observers feel that this trend took IBM by surprise since it marks one of the first times users dictated the market. "IBM went up against a brick wall of users who just did not want to convert," says Lois Pollock, manager of information resources at Warner Electric in South Beloit, IL. Pollock, who runs a 4381, adds that her company does not need the "increased productivity and memory boosts" offered by MVS/ESA. "Those letters do not particularly excite us since we are doing fine with what we have," she comments.

Berry points out that for the smaller systems like Warner Electric, VSE will definitely remain the system of choice. VSE currently runs on about 50 percent of the 9370 series and 60 percent of the 4300 machines. However, only 14 percent of the 308X machines and only seven percent of the 3090s are running VSE, which is supported under VM on all of these processors. Also, VSE is supported natively for the 9370 and 4300 uniprocessors and it is supported as a guest under PR/SM for the 3090 processors. Quite a few users are running natively on 3083s although it is not an officially supported environment. Based on the 3083 native experiences, many believe that it is reasonable to expect that VSE may run natively on a 3090 although for the larger 3090s, PR/SM appears to be the better choice.

Staunch Opposition

Certainly IBM has had an abundance of business reasons for encouraging its customers to adopt the more powerful MVS system. Reducing the number of operating systems IBM supports would lower development and service costs. MVS costs significantly more in license fees or as a one-time purchase than VSE. Typically, more hardware and software are almost always required to run MVS efficiently.

While these reasons may have pushed IBM toward a decision of stability for VSE, user opposition forced IBM to reconsider. Says Eric Vaughan, president of Smartech Systems, Inc. in Dallas, TX, "We communicated through our GUIDE group that in no uncertain terms VSE is the largest installed base and that there is not going to be a mass conversion over to MVS, even if that were IBM's intention." While this recent IBM meeting was encouraging, Vaughan remembers that he was impressed when he met with IBM representatives a year ago and learned they were familiar with GUIDE, GUIDE requirements and GUIDE strategy papers concerning VSE. "IBM is doing a much better job of listening to its customers than ever before," he points out.

Vaughan suggests that another reason for IBM's renewed support for VSE is the discovery, possibly to its surprise, that VSE is playing a large part in making the 9370 series processor a successful product. The introduction of this low-end ma-

chine has emerged as larger companies are working toward decentralizing their processing power and some larger firms are buying 9370s to be used in a distributed network. Continues Vaughan, "I think we may see some companies with 50, 100 or more 9370s all connected and running VSE."

MVS: Too Powerful And Priced Too High?

While there is no question that MVS is a more powerful operating system, the high cost of converting and running it is making cost-justification in the present competitive business climate too difficult for many smaller and mid-size installations. By most estimates, the cost of software for MVS is six times (or more) than for VSE.

Clark cautions, "We are in a leaner economic environment and companies have become somewhat more sophisticated in determining the financial advantages and disadvantages of a conversion. We can no longer make this type of decision except with proper cost justification and a clear return on investment." Clark adds that IBM's financial incentives of years past to migrate to MVS may have played a part in the increased interest in migration to MVS. However, when the incentives ended, the migration enthusiasm may have lessened.

Rice agrees that financial considerations make MVS a poor choice for many companies. He says, "There are advantages to running MVS if you are a large shop with large hardware requirements." He points out that many shops which try to run MVS without increasing hardware find out they cannot do as much as they were able to under VSE. "If we got MVS in here and tried to run it on our 4381, all we would be able to do is bring it up," Rice asserts.

When VSE Is Not Powerful Enough

While some users are committed to VSE because of its efficiency, its ability to run on smaller processors, easy installation and easy maintenance, a few are finding that VSE is straining under the weight of their usage requirements. Although some will ultimately migrate to MVS, others try to extend the life of VSE by combining systems. For example, you might run three VSE guests under VM to combine the batch and transaction processing capabilities of VSE with the interactive en-

See VSE *page 73*

The Economics Of Automated Software Configuration Management

By Leon Presser, Ph.D.

The need for software is insatiable. New applications as well as corrections, enhancements and optimizations to existing software are continuously demanded. The problem of satisfying these multiplying demands is aggravated by spiraling software production costs and lack of competent personnel. There appears to be no relief in sight for beleaguered MIS and software development and maintenance managers. However, this is not the case.

The most costly and disruptive problems facing software managers today have been identified as the inability to control and track changes to the components of software applications while managing the interrelationships between those changes. Consequently, the eventual creation of a correct software release, containing the right versions of the appropriate modules, is a highly unreliable process.

The problem is not limited to source code. It includes the management of changes to all the components of an application including source code, object code, executables, job control language, test data, documentation, procedures and so on. What is needed is a disciplined but straightforward and unobtrusive solution to these problems.

The path to a cost-effective and reliable solution is automation. Software Configuration Management (CM) controls and maintains a full audit trail of all changes to all of the components of a software application, while managing all the interrelationships or dependencies between these changes. In addition, CM provides a framework and ensures the integrity of software assets during the systematic migration of evolving software through the various phases of the software life cycle (for example, development, testing, approval and production). Changes are so widespread and occur at such a rapid pace that effective configuration management can only be implemented with the aid of an automated tool. The use of such tools is now receiving wide acceptance in the marketplace, regardless of hardware platforms.

Automated software configuration management allows timely and cost-effective processing of a CR without creating new CRs and protects the investment in current software assets.

The configuration management problem is present in commercial as well as in scientific and Department of Defense environments. Government installations have for years effectively automated CM. In MIS environments the presence of relational data management systems such as IBM's DB2 make it a necessity to have an automated CM tool in place. To emphasize the point, performance tuning in a DB2 environment cannot be carried out effectively without a CM tool that supports the effort.

The objective of this article is to demonstrate, through a simple example, why these problems are so serious and the impressive economic benefits derived from the use of an automated CM tool.

Scenario

Consider the following situation. A request for a small modification of a rather popular application has been made to the MIS department or software development/maintenance group. The change request seems simple enough to be assigned to a junior programmer who should be able to take care of it in a short time.

Not so fast. In order to better understand the implications of this decision, trace through an abbreviated verison of the typical life cycle of a software Change Request (CR).

Please refer to Table 1 and for the time being concentrate on the information to the left of the vertical line. Under Task Description is presented a sequential list-

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ing, step by step, of the tasks that are carried out in the life cycle of a CR. Under What Could Go Wrong With Manual Or Semiautomated Approach is summarized what could indeed go wrong during the corresponding step. Under New CR is quantified the likelihood that at least one new CR will be created as a result of something going wrong during the performance of the corresponding step in the processing of the current CR. A simple scale of zero to three is used. A value of zero indicates an extremely low chance of new CRs being created, while a value of three represents the almost certain introduction of at least one new CR.

The term *configuration* denotes the interrelated collection of items (modules, source, documentation, test data, procedures and so on) that constitute a software application. The term Configuration Item (CI) is used to refer to any item that is part of the application and can consequently be impacted by a CR.

Analysis

Turn your attention to the information presented in Table 1 to the right of the vertical line. Step-by-step benefits obtained when you automate the processing of a CR are summarized under Improvements By Using CM Tool. Under New CR is quantified the likelihood that at least one new CR will be created when a CM tool is used. Note that with a CM tool you eliminate the possibility of creating new CRs while resolving a given CR. You could add a column to Table 1, label it Estimated Savings, state some basic assumptions and show the savings obtained when a CM tool is used. However, I will not do so here so as not to run the risk of controversy concerning how much it costs to process a CR in a particular environment. You are encouraged to do so based on assumptions you consider valid for your environment. You will find the number to be substantial.

There is no question that the chance of generating new CRs, while resolving the current one, depends on the experience of the allocated staff as well as on the environment in which the CR is being processed. However, regardless of how individual steps are performed, when a manual or semiautomatic approach is employed, a dramatic observation can be made: *Given a software application of a reasonable size, the processing of a CR, regardless of its simplicity, will in turn generate new CRs.*

This observation represents an intolerable situation. It indicates that under current manual or semiautomatic procedures for change and configuration management, CRs procreate at a fast pace. Experience and factual data corroborate that, indeed, this is the case.

Typically, MIS departments and software managers cope with this no-win situation by continually increasing the staff and processing only a fraction of the CRs that need to be addressed. The usual selection criteria is to solve problems submitted by the most influential or vociferous users. This type of (non) response to the needs of the user community results in a vicious and costly cycle, since applications with accumulating open CRs are retired early in their useful life, which in turn fuels the need for expenditures in new software.

The discussion in Table 1 of what could go wrong at each step in the processing of a CR indicates that even when the professional excellence of the staff is as-

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sumed, there exists a high probability of introducing additional CRs because of the following reasons:

- Incomplete or out-of-date descriptions of what was changed
- Poor identification of CIs and their versions
- Incomplete (if any at all) representation of the dependencies between different CIs in a configuration
- Poor isolation of the project that processes this CR from other activities in the development and maintenance environment
- Lack of isolation not only of the current product baseline, but also of the different configurations (for example, development, testing, approval and production) that are required to ensure a reliable software development or maintenance effort
- Inability to guarantee that the final release will be composed of the proper version of each necessary component.

The average likelihood of CR reproduction during the processing of a single CR with a manual or semiautomatic approach comes to almost two (between medium and high) for each of the steps. As the MIS department and software managers are faced with a flood of CRs, this likelihood not only holds true but seriously increases as a result of communications overhead, becoming a certainty for all practical purposes.

As summarized in Table 1, the current state of affairs concerning the processing of a CR with a manual or semiautomatic approach is rather grim. Even if the MIS or software development manager improves operations so that the likelihood of creating new CRs is cut in half, at least three out of 12 steps in the life cycle of a CR will still have a medium likelihood of producing new CRs. To drive this point home, assume that a tenfold increase in quality is obtained over the basic scenario. Still, one out of every two CR processing cycles will have a high likelihood of producing new CRs. Thus, even if a tenfold increase in quality of operation could be put in place overnight, the problem of self-procreating CRs is still out of control.

On the other hand, Table 1 shows that with a CM tool that implements automated configuration management, a CR can be processed without producing new CRs.

Finally, it should be pointed out for reasons of simplicity that Table 1 does not show how long it takes to complete each of the steps needed to process a CR. When a CM tool is installed, the improvements on the time necessary to complete each of the steps outlined in Table 1 is also impressive. On the average, my experience indicates that 25 to 45 percent improvements are easily achieved, which leads to further economic savings.

Summary

Our information-based society is characterized by change. Valid CRs will continue to increase at a rapid pace. However, through a simple example you have seen that the current state of affairs in processing a CR is intolerable: processing a CR creates multiple new CRs. The resultant costs are immense. The waste due to software assets that are being retired early and the resignations of valuable per-

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TABLE 1

Typical Change Request Cycle With And Without CM Tool

Step	Task Description	What Could Go Wrong With Manual Or Semiautomated Approach	New CR	Improvements By Using CM Tool	New CR
1	Initiate CR.	Not all procedures prescribed at this installation are carried out.	1	By automating the installation's standards for creation of projects, all prescribed procedures are carried out.	0
2	Identify all dependencies, analyze them and identify all Configuration Items (CIs) impacted by this CR.	Some dependencies are not properly identified and some needed CIs are omitted or the wrong ones are identified. Optimization of access to CIs by other concurrent projects is performed based on the wrong information.	3	CM tool automatically determines and stores dependencies, producing consistent impact of change information. The list of all impacted configuration items is automatically generated. Concurrent access is optimized.	0
3	Assign programmer(s) and correct versions of CIs to the CR project.	Because of problems in Step 2, wrong CIs get assigned to the CR. This increases the number of assignments "on the fly," with low visibility by the project manager and other projects.	1	Assignment is procedurally streamlined. Adding CIs to the project in later phases is extremely simple with visibility by the project manager and other concurrent projects automatically enforced.	0
4	Obtain correct versions of assigned CIs.	Because of interaction with other projects or functional environments, the wrong versions of items are selected as the base for changes. Previously solved problems are re-introduced in the code and its integrity is seriously affected.	2	CM tool automatically isolates versions, projects and configurations for each environment without redundant disk space allocation. No chance for errors of this type.	0
5	Analyze assigned CIs and their recent changes to fully understand their logic. Identify other projects affecting the same CIs. Schedule access to CIs.	High communication overhead produced by deficient change documentation. Poor understanding of program logic. Bad scheduling of potential access conflicts with other projects.	2	Complete change history and description immediately available. All projects needing access to CIs clearly identified. Efficient scheduling automatically implemented.	0
6	Several iterations of code changes.	Different versions of CIs, each with different change level, proliferate in the host programming environment. This in turn produces overwriting of changes or expensive change merging steps and low confidence on the part of developers.	2	Change and version accounting is performed automatically by CM tool in its central repository. Overwriting and code merging are eliminated. Access collisions with other projects are eliminated and scheduling is enforced.	0
7	Produce test plans.	Changes are poorly identified and documented. In the best case, problems derived from unidentified changes will get discovered in later steps (at a much higher expense) but more commonly when the CR has been closed.	3	CM tool provides full change identification and documentation and complete impact analysis even on apparently unrelated areas of the application. The percentage of problems detected in early phases by improved testing plans increases dramatically.	0
8	Test changes in a working configuration.	Lack of isolation of the CR processing from other projects complicates testing. Wrong versions of CIs get included in the testing scenario.	3	CM tool fully isolates the processing of this CR. Collisions with other projects or configurations are totally eliminated. Testing operates in a secure environment. Testing can certify what it has tested.	0
9	Approve changes and standards (quality assurance).	Poor isolation of the CR processing produces the same problems as in the previous step.	2	Full isolation gets extended to the quality assurance configuration. Validation, change reports and project history information aid the process of approval and enforcing standards.	0
10	Collect all changed CIs.	Wrong CIs get collected.	2	CM tool ensures the integrity of the changed configuration as it evolves from the creation of the project to its final inclusion in the production configuration.	0
11	Create new version of the application and turn over to production.	Turn over wrong versions of CIs. Any problem introduced by this step generates CRs that are orders of magnitude more expensive to detect and fix than the original one. Auditability is handicapped by error-prone procedures.	1	This activity is automatically performed by CM tool in a fully-controlled manner. Integrity of the configuration is guaranteed. Complete audit trails are kept automatically.	0
12	Close CR.	Not all procedures at this installation are followed.	1	Installation procedures automatically carried out by CM tool. Closing of a CR and its tracking up to the next baseline are automatic.	0

sonnel who can no longer handle a no-win situation continues to mount. The resultant unhappiness and frustrations of the user (customer) community cannot continue much longer. MIS department managers and software development/maintenance managers must address this problem head-on.

Automated software configuration management is a proven discipline currently in use at hundreds of installations worldwide that offers a sound solution. It allows the timely and cost-effective processing of a CR without creating new CRs. It helps protect the investment in current software assets. Automated CM tools that lead to immediate and substantial savings are available "off-the-shelf." Such savings will pay for a CM tool many times over!

ABOUT THE AUTHOR

Leon Presser, Ph.D., a former University of California faculty member, is founder and president of Softool Corporation, Santa Barbara, CA.

Sorting On-line

Can It/Should It Be Done?

American Cyanamid And A. E. Staley Break Through Traditional Taboos By Sorting On-line Under CICS

By Mary Lou Roberts

In an industry as dynamic as information systems, teaching old dogs new tricks should be easy. Learning new tricks, after all, is what most of us do on an almost daily basis?

Computer Associates, with a software package recently acquired from Syllogy Corporation (Hackensack, NJ), now intends to test the versatility of industry die-hards. Perhaps the mission the company has undertaken is even more difficult than teaching die-hards new tricks. It is trying to teach old tricks — namely, on-line sorting.

You see, for users of midrange computers such as the System/36, sorting in on-line applications is nothing new. Yet, since CICS was introduced in the 1960s, sorting on-line has been a no-no for users of IBM large-scale mainframes. Such a no-no, in fact, that few people even question it any more.

Everyone has learned to live without it and somehow the world has not come to a grinding halt. So who needs it? Who would dare risk introducing an on-line sorting facility into what is usually the most critical and untouchable environment of any corporation — the on-line CICS system?

CA-CICSORT challenges the pat answers to these questions. This product is, its developers maintain, a completely safe and highly efficient way to sort on-line by invoking the standard COBOL SORT verb with no hooks or modifications to CICS and no degradation of system performance.

There is no longer any reason to avoid on-line sorting because of newer operating systems and CICS enhancements.

If CA-CICSORT is all that CA claims, it will have a major impact on the way CICS application development is viewed. It would eliminate the need to use bubble sorts, alternate indexes and preliminary batch sorting as a means to deliver sorted screens and reports. It would, therefore, reduce program development time. And it would (Oh, joy!) actually improve system performance by a factor of 30 to 50 percent over the use of alternate indexes to accomplish the same task.

Still skeptical? Still nervous about any software that affects your on-line system? Of course, but the experience of these two CA-CICSORT users may help to prove CA correct.

American Cyanamid

The Information Services (IS) department of American Cyanamid, a major research-based biotechnology and chemical company located in Clifton, NJ supports the information needs of more than 35,000 employees as well as the customers of this $4.6 billion company.

Recently, a change in shipping policy required that a program in the order processing system of the Shulton Group, one of the five major divisions of American Cyanamid, sequence data by customer name rather than by shipping carrier. This created a problem because this major IBM 3081 MVS/XA-based system operates under CICS. And, with CICS, it could not sort on-line. Bob Cottone, data center manager, and Carlton Disney, systems analyst, had to look for a way to respond.

Carlton Disney explains, "Our order processing network provides our warehouses with a screen display of all of the orders that are available for shipment. Input to this subsystem is a VSAM KSDS file that is keyed by shipping carrier. In a peak period, we might have about 1,500 records."

However, when the shipping policy change went into effect there was a new requirement to sequence the data by cus-

tomer name. "Unfortunately, there was no space available in the key file," Disney points out. "Furthermore, there were 34 programs which also used this file as input. We looked at various alternatives, but the file modification approach was too time consuming. And because of the number of records in the file, the use of a bubble sort created response time havoc."

With no workable alternative available to them at that point, IS had to reject the user's project request while continuing to search for a solution. In doing so, Cottone and Disney learned about CA-CICSORT.

Disney explains, "CA-CICSORT gave us a great alternative to solving our problem. Instead of redefining the key, we used the customer number that is already in the file data area as a sort key field. Then, file access could be indexed by carrier or, if CA-CICSORT were used, by customer or any other field in the record."

Like any other information systems professionals, Cottone and Disney were concerned about possible system degradation. "But," Disney says, "we found that there was absolutely no degradation in terminal response time or in CICS performance."

Cottone adds, "We kept a careful eye on system efficiency and performance. The last thing we wanted to do was degrade our on-line system but CA-CICSORT did not. Since we put that system into production, not one user has complained at all about response time."

As far as system installation was concerned, American Cyanamid reported few problems. "We made a few mistakes, but they were easily solved. It didn't take any time at all because CA-CICSORT works like a batch internal sort," says Disney.

CA-CICSORT has changed the attitude toward on-line sorting at American Cyanamid. Disney explains, "We've all worked for years with the idea that you can't sort in CICS. And we still believe in trying to design on-line applications so that no sorting is required. But CA-CICSORT definitely opens up new possibilities for meeting users' needs quickly and efficiently. Now we can implement enhancements that were once termed 'too costly' because of the amount of programming effort required."

Cottone agrees, "We are now looking at approaching CICS application development a bit differently. When on-line sorting is required, CA-CICSORT lets us cut down on application development time significantly. We can now deliver quality applications more quickly."

Today, Peter MacTaggart, systems programming supervisor, is working to establish the standards which will govern the use of CA-CICSORT across the entire corporation. "We do want to be able to monitor its use. It's so easy to use that any programmer could use it without us even knowing it. And we do want to be able to control the amount of on-line sorting that's being done," he says.

A. E. Staley

At A. E. Staley, the ability to sort under CICS using CA-CICSORT is similar.

This grain processing company based in Decatur, IL refines raw grain products and produces starches and sweeteners which are sold to other companies to produce such products as soft drinks and candy. Its MIS division, supporting a number of on-line applications, operates an IBM 3090 under MVS/XA with CICS and employs a staff of 25 programmers.

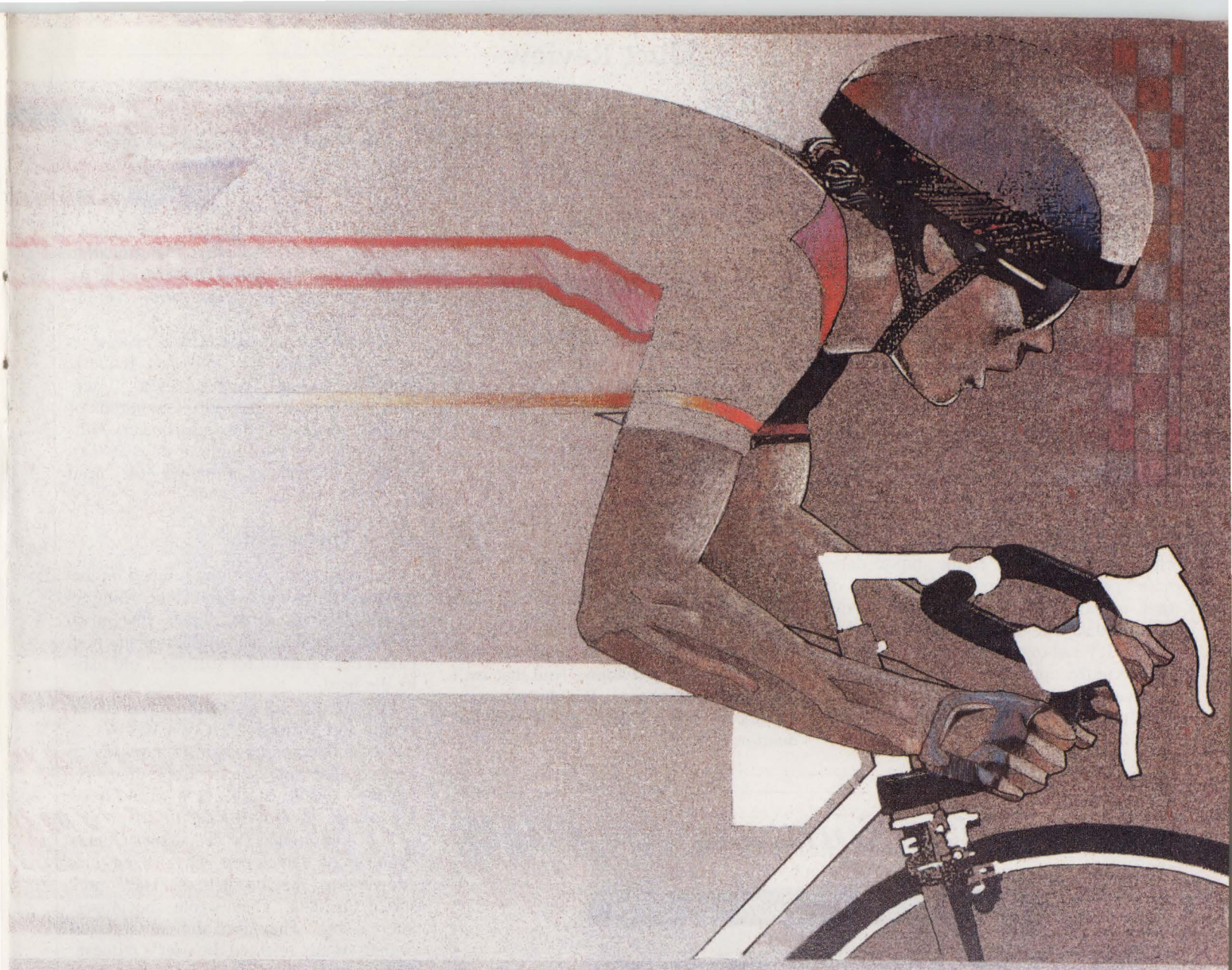
"Before we installed CA-CICSORT," says Mike Brown, manager of technical services, "we had recently been through a very difficult situation with a user request. Our 'ship-to' database maintains a history of customer orders and our users wanted to be able to present that data in several different ways on on-line CICS screens and reports.

"The only way that we could fill this request," he continues, "was to undergo a total redesign of the database. There are 115 programs that access that database. And it took us more than 500 hours to do the job."

Brown notes that all fulfilled user requests at A. E. Staley are charged back to the user departments. "We get lots of requests to look at data on-line in different ways. And many of these requests have never gotten filled because the users don't want to pay the price. But now that's changing with CA-CICSORT," he says.

When the MIS management group at A. E. Staley decided to bring in CA-CICSORT on a trial basis, it intentionally selected a user request similar to the ship-to-database application in order to test it.

"In our rail-car-locate application," describes Brown, "we track the usage of all of our cars to monitor such information as the location of the car, its usage, its current status, the owner and the date it was last used. Users have to be able to access this information in different ways. For example, how many cars are available? Where are they? What was a car



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last used for? When we change the product that a car is carrying, we have to do a complete cleaning and that's very expensive," he notes.

"This application was about the same size and complexity as the other project that took us 500 hours," says Brown. "And even though it was our first project with CA-CICSORT and we were just learning the system, it took us only two days! Actually, today, now that we know CA-CICSORT, it would probably take us only one day. Assuming the knowledge of batch COBOL sorting, it would only take one hour of programming time. That's a lot better than 500 hours!"

As another basis for comparison, Brown points out that the application that used CA-CICSORT delivered even more benefits for their users. "In the ship-to-database application, even after 500 hours of time invested, the users could still only see the data one way. But with the CA-CICSORT rail-car-locate application, our users had the option of looking at the data in several different ways.

"There's no doubt in my mind," says Brown, "that if we'd had CA-CICSORT to begin with, we'd have been able to fulfill the ship-to-database request in two days instead of 500 hours. And that isn't just programming time. It includes testing and the time involved to put it into production as well."

"Now we can implement enhancements that were once termed 'too costly' because of the amount of programming effort required."

Like American Cyanamid, IS management at A. E. Staley has been concerned about any factors that might affect the performance and efficiency of its on-line system. "But," says Brown, "we couldn't measure any difference in CPU utilization or response time. Any concerns that we had about system degradation simply didn't materialize."

The MIS department at A. E. Staley is now going back over old user requests that had previously been rejected. "Users don't want to be charged for hundreds of hours of work. But they may be very willing to pay for two or three days if they can have the data sorted the way they need it," says Brown.

If All This is True . . .

So why hasn't everyone jumped on the on-line sorting bandwagon? According to Martin Goetz, former Chief Executive Officer of Syllogy and holder of the first patent ever granted for software, old habits die hard.

For the past 20 years there has never been a sort utility for CICS. CICS was a real-time operating system running under a batch operating system. Back then, using the COBOL SORT verb would have brought the system down."

So, for more than 20 years, says Goetz, applications developers have been circumventing the problem. "They presorted the data. They wrote specialized internal sorts. They used alternate indexes or they simply rejected the user's request. And everyone came to accept that as a way of life."

But today, Goetz claims, the technological environment no longer prohibits on-line sorting. "We should no longer be held back by a 20-year old technology. With today's new operating systems and the enhancements that have been made to CICS, there's no longer any reason to avoid on-line sorting."

If the industry experts are correct that CICS is going to be with us for yet another 20 years and if the experiences of companies like American Cyanamid and A. E. Staley are at all typical, then it would seem that Goetz is correct. Perhaps on-line sorting is not something to be encouraged. But it may not be something to be avoided either.

ABOUT THE AUTHOR

Mary Lou Roberts is an independent consultant and free-lance writer.

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DB2 Retrieval Efficiency

By Michael Snyder

The progress of IBM DB2 in the data processing marketplace has been remarkable, starting as the "wave of the future" five years ago and becoming, for many organizations, the "wave of the present."

DB2 nomenclature is descended from traditional data processing concepts such as files, records and data fields. In DB2 a file is called a table, a record becomes a row and fields masquerade as columns. This reflects the relational model in which data is regarded as a two-dimensional tabular structure with every line in the array having the same format.

DB2 represents a significant increase in programmer productivity over IMS/DB due to its relational structure and powerful syntax. One of its most striking features is the query optimizer that analyzes a request programmed in Structured Query Language (SQL), consults the data in its DB2 catalog and evolves what it determines to be the cheapest strategy for navigating the database in order to service a request.

The query optimizer does things such as decide whether to read an index as data, to use an index to access data in a table or to scan the entire table in order to more cheaply process a query.

It also decides whether a given SQL command implies sequencing (for instance, containing an Order By or Group By clause) and, if so, determines whether existing indexes on the table will enable this sequencing without invoking a sort.

This article is addressed to applications designers and programmers who already understand how to use SQL. Its purpose is to disclose some performance tradeoffs and in particular to show some areas where the query optimizer is arguably deficient and how to code your SQL to overcome these alleged deficiencies.

The scope of the article is read-only operations; updating is mentioned only in passing. Primary emphasis is on CICS applications. It is current as of Version 1 Release 3 of DB2. Your main sources of performance information are the IBM manuals, *IBM Database 2 Application Design and Tuning Guide (GG24-3004-00)* and *IBM Database 2 System Monitoring and Tuning Guide (GG24-3005-00)*.

Basic DB2 Facts

DB2 runs in its own address space. (Actually it uses a pair of address spaces but that need not concern applications programmers.) Batch, CICS and TSO applications request the services of the DB2 region through the good offices of MVS. With DB2 thus decoupled from the applications that it serves, it implements data sharing among CICS and other address spaces for reading and updating with full data integrity.

DB2 data is *usually* stored in 4096-byte *pages*. Data integrity is *usually* provided by placing locks on pages of DB2 data. A page can contain one or more rows. If a transaction is in the process of updating a given row, other transactions cannot read the page in which that row resides until the first transaction has committed its update. If a transaction is in the process of reading a given row, other transactions cannot update that page *usually* until the reading transaction moves to a different page.

My repetitive use of *usually* in the preceding paragraph is in no way intended to be humorous; DB2 is as full of exceptions and alternatives as any other major piece of system software and many will base a career on mastering its features. The first *usually* alludes to the fact that if the rows are too long for 4096-byte pages, the page size goes to 32768. The second one on locking refers to lock escalation. If too many page locks exist for a given transaction, DB2 might decide to lock the whole table and do away with the overhead of maintaining a large number of page locks. The third one, regarding page traversal, pertains to the fact that a transaction using Repeatable Read will have its read locks persist not until it moves to a different page, but until it terminates or takes some other action to release its read locks.

A given CICS region can communicate with only one DB2 subsystem. A DB2 region can communicate with many other regions (CICS, TSO and batch). CICS cannot function ship DB2 work between

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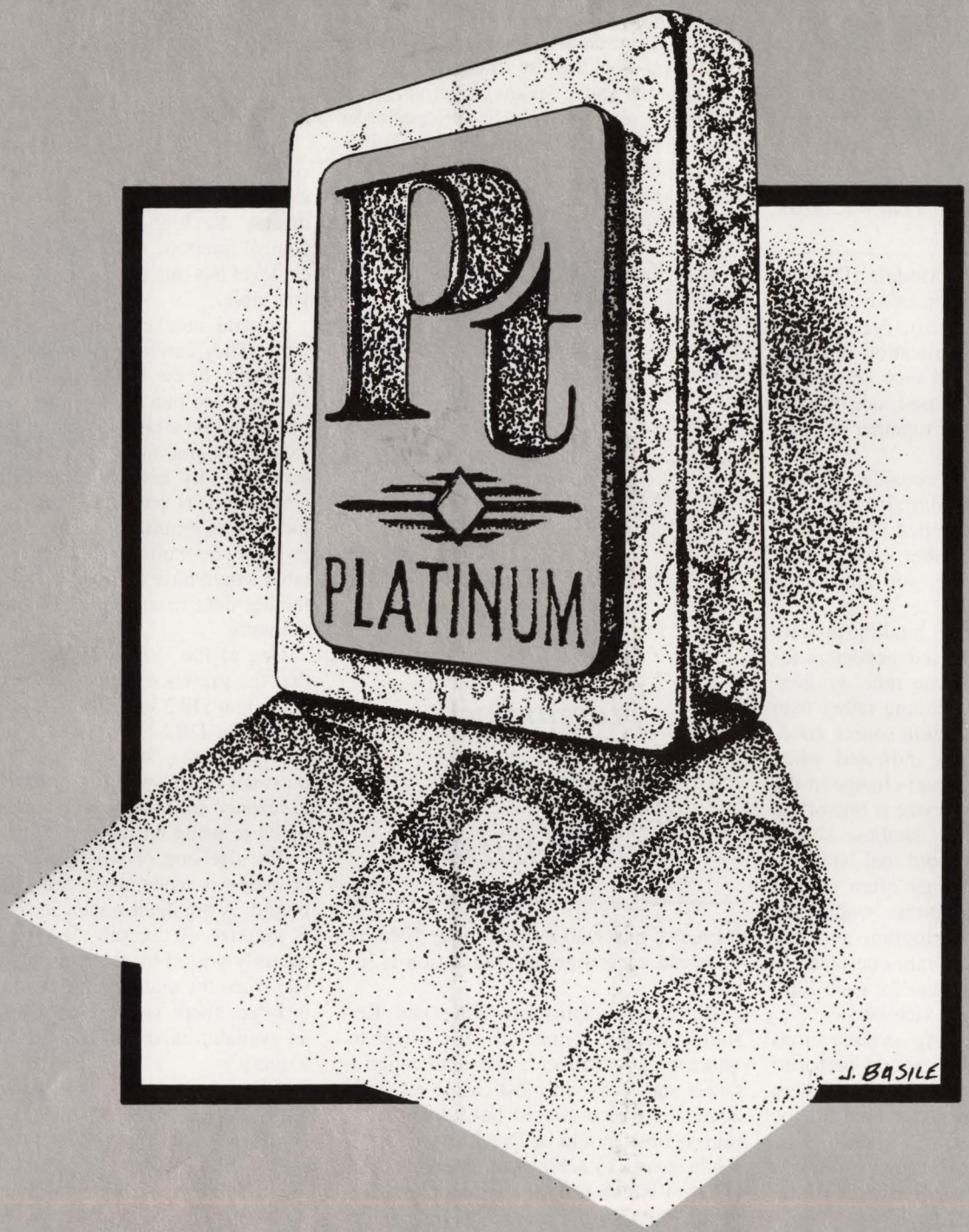

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regions as it can with DL/1 and native VSAM work.

Of the many options available in a production CICS environment, one of the most straightforward ways to provide security for DB2 applications is at the CICS Transaction ID (TRANSID) level. Do note that if different functions of an application need different DB2 security provisions, they must run under different TRANSIDs. (This changes with dynamic plan selection in Version 2 Release 1.)

Programs, DBRMs, Transactions And Plans

A Database Request Module (DBRM) is the encoded expression of all the SQL statements in one program. For each individually compiled application program there is one DBRM and vice versa. Before they can actually be used, one or more DBRMs must be bound together to form a DB2 plan.

If you would like to consider binding analogous to linkage editing where one or more separately compiled object modules are linkedited together into a single executable load module, you are on the right track.

A major effect of the binding process is that it provides data independence for the application; a database redesign generally only requires rebinding rather than alteration of the application source code. Rebinding may also be indicated when there has been a significant change in the size of a database, since size is one of the determinants of DB2's database search strategy — but more about that later.

The linkediting analogy often applies directly to batch programs where the DBRMs of the main program and any subprograms are bound into one plan. In this case, there is one plan for each linkedited load module and vice versa.

While data processing organizations were accumulating their initial performance experience with DB2, some of them always built one plan to include all the DBRMs (one per program) comprising one CICS TRANSID. For each one there was one plan and vice versa. Evolution of our knowledge sometimes leads us to combine the DBRMs of two or more different CICS TRANSIDs into what amounts to a superplan. The sidebar contains a discussion of the reasons for doing this.

A main determinant of how DBRMs are combined into plans is the estimated transaction volume for each application TRANSID. This decision will often have a significant effect on application response time as seen by the user.

DB2 Bind Parameters

Isolation Level should be Cursor Stability to release the resource lock when your program moves off the locked data page. (This assumes that DB2 will use page-level locking on the transaction, which is the usual design objective.)

There are rare cases where Repeatable Read should be specified as the isolation level; this can apply to applications that browse several rows on multiple DB2 pages before deciding which one(s) to update.

Plan Validation Time should be Bind so DB2 security does not have to be checked at execution time. In rare cases, there may be a requirement for an application to check security when it is executed. In this case, the validation time would be Run. This can have serious performance implications due to the binding overhead each time the transaction is invoked.

DB2 represents a significant increase in programmer productivity over IMS/DB.

Resource Acquisition Time and Resource Release Time tell DB2 when to allocate and deallocate the application's tables and locks. In most cases, resource acquisition time should be Allocate and release time should be Deallocate. This is the best way to achieve thread reuse (see sidebar) which is often a major priority. Also, this decreases the potential for deadlocks and timeouts. And, when the application executes most of its SQL code in each transaction, it reduces the lock acquisition CPU time.

In special cases, acquire Use and release Deallocate are a better way to go. This might be preferred when the application is non-complex, infrequently used and tends to execute only a small number of its SQL statements in any given execution.

Resource acquisition and release time comprise an eminently debatable subject. Do not be surprised if your local guru cheerfully declares that this author has his hat on too tight. Do your best to maintain good relations with your local guru.

DB2's Use Of Indexes

DB2 allows indexes to be defined on columns of a table. Unlike a VSAM primary index, which at the lowest level indicates the highest record key in each control interval, a DB2 index at the lowest level has one entry per row in the subject table.

Several indexes can be defined for a table. They can be single-column or multicolumn. In the latter case, two or more columns are indexed together. An example would be a table containing a column called *city* and one called *state*. The context of a city usually requires that it be considered as part of a state. So, if an index were required on this data, it would probably be multicolumn; each row in the table would have a single index entry containing data from both the state and city columns.

One of the stranger aspects of DB2 is that the presence of an index is no guarantee that DB2 will use it. This does not mean that DB2 is dumb; it means that it recognizes that some queries (especially on small tables) will run faster if the table is scanned from beginning to end as compared to using an index.

The decision of whether or not to use an index is made when the DB2 plan is bound. A big determinant in this decision is the size of the subject table (as most recently posted by the Runstats DB2 utility) when the plan is bound — if the table is large, there is more of a chance that an available index will be used to satisfy a query.

As explained further on, the way an SQL query is coded can have an effect on DB2's decision of whether or not to use an index. In many cases, if an index is available on a table, the guidelines in this article should be followed in order to induce DB2 to use the index.

Be aware of the tendency to assume that it is *imperative* to induce DB2 to use an index. Always think this assumption over (and maybe even run an experiment) before automatically assuming that you are smarter than IBM software.

There are two ways DB2 can use an index. The most straightforward case is

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when you are searching for a row with an indexed column value equal to a search argument such as a customer number. If DB2 uses an index in this simple case, it will go through the index tree structure, quickly identifying the row that matches the customer number search predicate.

The other way DB2 uses an index is by a full or partial index scan. Since less data is contained in the index than in the table, it will often scan the index instead of scanning the table, since this can be done faster. For instance, if searching an indexed column for a value greater than (or less than or any other of those inequality operations) a given value, DB2 might scan part of the index (slower than going through the tree structure but faster than scanning the table) in order to see if there are rows in the table that satisfy the search predicates.

To find out if DB2 will use an index, use the Explain function. Explain will also divulge whether the DB2 sort will be used to perform certain types of queries. Explain is *the* major means of indicating whether or not the SQL statements in a program should be scrutinized for performance problems.

Remember that Explain does not require that you code your application first; you can give it an SQL statement and Explain will respond with a description of the search strategy. Also remember that the subject database must exist; it must contain a realistic number of rows and the Runstats utility must have processed it before Explain can make any useful decisions.

Loading a large table from scratch often should be done as a two-stage job if the load process requires making reference to data already inserted during the load. (Assume that an index is available and potentially could be used to support these references.) Since the table was empty when the plan was bound, the optimizer will not use any available index to service these references. The load process can run slower and slower with each additional row inserted until it bogs down completely.

To deal with this problem, stop the load process after a few thousand rows have been inserted, execute the Runstats utility, rebind the plan, then do a plan Explain. Check the Explain to see if DB2 is now prepared to use an available index for the table references mentioned above. If it now says it will use the index, resume the load process and let it run to completion. If it does not yet use the index, resume the load process, load a few thousand more rows, then stop the process and try the above steps again.

Select Only The Needed Data

If your program does not need all of the columns of a table, code a list of the columns you actually need instead of coding "SELECT *".

This will reduce the CPU time of your program. This is because control bounces back and forth between your program and the DB2 address space for every column of every row that you are selecting.

Finally, if your program only needs to see if a given row exists in a table, do not select a single variable from it to see if it is there; instead use the COUNT built-in function. That way DB2 need not transmit any of the database to your program. Here is an example:

The query optimizer develops the cheapest strategy to service a request.

```
SELECT COUNT(*) INTO :DATA-COUNT
FROM . . . WHERE . . .
```

If DATA-COUNT is greater than zero after the SQL call, the row exists. If it contains zero, the row does not exist.

Table Search Predicates

Predicates are the thing(s) that follow the WHERE in a table query. For instance:

```
SELECT . . . FROM . . .
WHERE CUST_NUMBER = :INPUT-CUST-NUM
```

CUST_NUMBER = :INPUT-CUST-NUM is the predicate for the Select. CUST_NUMBER is a DB2 table column and INPUT-MR-NUM is a host variable; that is, it exists only inside the application program, not in a DB2 table. From a performance standpoint, there are a few things to keep in mind when coding these predicates:

- They should agree in type, length and scale. For instance, if CUST_NUMBER in the database is a packed decimal field of seven digits with no decimal fraction, make your host variable INPUT-CUST-NUM a packed decimal field of seven digits with no decimal fraction. If the variable in the database is fullword binary, make your host variable fullword binary. If the variable in the database is 14 alphanumeric characters, make your host variable 14 alphanumeric characters and so forth. Refer to the DCLGEN in your program for the type, length and scale of DB2 variables.
- Do not use arithmetic expressions in the predicates. For instance, instead of:

```
SELECT . . . FROM . . .
WHERE BATCH_NUMBER = :BATCH-NUM + 1
```

do this:

```
COMPUTE SEARCH-BATCH-NUM = BATCH-NUM + 1
SELECT . . . FROM . . .
WHERE BATCH_NUMBER = :SEARCH-BATCH-NUM
```

- If two (or more) columns of the database are being compared for equality with a host variable, compare the columns to the host variable, not to the host variable and to each other. For instance, instead of:

```
SELECT . . . FROM . . .
WHERE COL1 = 'G' AND COL2 = COL1
```

do this:

```
SELECT . . . FROM . . .
WHERE COL1 = 'G' and COL2 = 'G'
```

- Do not use character concatenation or substringing in the predicate of a query because they make DB2 unable to use an index for the search.

If these rules are followed, DB2 will take less time to execute your query.

Predicate Comparision Operators

DB2 will consider using an index with these comparison operators: =, >, >=, <, <=, ¬>, and ¬<.

If the operator is ¬=, NOT BETWEEN, NOT IN, or NOT LIKE, it will never use an index.

The SQL Like

SQL provides a feature whereby a *fuzzy* database search may be accomplished, asking for data that looks *sort of like* the search predicate. DB2 calls it a LIKE request.

This feature of the SELECT command is a serious performance risk because it is much like the FIND command in ISPF: it is a string searcher. DB2 allows *wild card* characters in the search argument (the percent sign and/or the underscore is the wild card character). In most cases the search argument for the LIKE is input by the user and is, therefore, a host variable.

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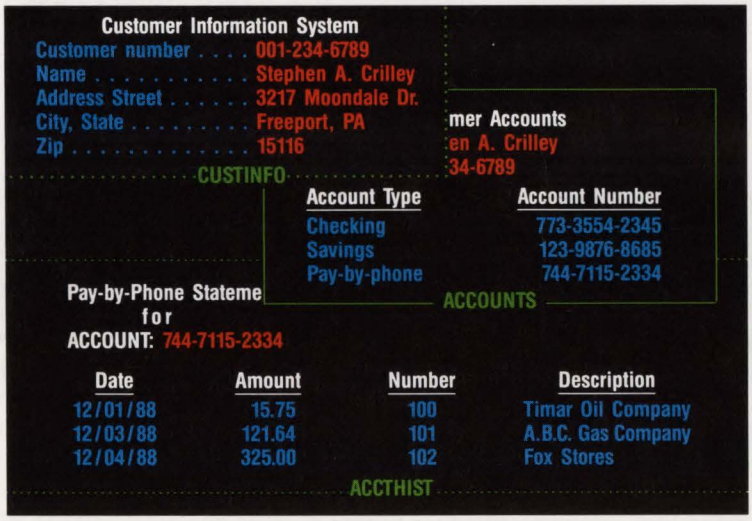

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DB2 Threads: A Stitch In Time

DB2 lives in its own MVS regions and is in communication with using regions (such as CICS). The vehicle for this communication is called the DB2 thread. The thread is represented by MVS control blocks which allow commands and data to be transmitted between the application program and DB2.

There are two types of threads: protected and pool. A protected thread is associated by plan name with one specific DB2 plan. An often-used plan might well have a number of threads dedicated to it; seldom-used plans would use pool threads. Pool threads are a free-for-all; any plan can grab one, if a free one exists.

The effect of this is that the plans with the highest volume of usage can have threads pre-established for them so they will not have to compete for pool threads. The seldom-used plans will not have threads dedicated to them tying up resources; they can settle for a thread out of the pool.

If you could have an unlimited number of threads, there would be no need for dedicated and pool threads. But if there are too many threads trying to execute concurrently, system throughput will suffer.

Initiating a thread for a medium-sized transaction (five to 10 SQL calls) will commonly use up 20 percent of all CPU time consumed by the transaction, so these issues definitely are worth your attention.

This leads to the reason for combining the DBRMs of two or more different CICS TRANSIDs into one large plan: if a DB2 protected thread goes unused for about 45 seconds, it disappears. If you can cause a plan to use that thread before it disappears, you save a lot of thread initialization time. To achieve usage in less than 45 seconds, the CICS system must have enough DB2 transactions that it stays somewhat busy. This requires sufficient human users to keep the system awake. By building large (and thus fewer) plans, the frequency of use of a given plan may become large enough to keep the protected thread from disappearing. M.S.

Since the user is allowed to enter the search argument of the LIKE, DB2 assumes the worst when the plan is bound, which may result in a complete index scan (if an index is available) or a complete table scan (if no index exists) to retrieve all the LIKE data.

As an example to tie this together, consider an application screen containing a data entry field called VENDOR_NAME and the application program uses LIKE in order to do a generic search of the database by name. The user enters %SMITH% in the VENDOR_NAME, asking for database rows containing the string SMITH anywhere in the name field. In this example, there would likely be an index on VENDOR_NAME which DB2 would have to scan completely, looking for all matches.

Even if the user enters no wild card characters, the fact that the application uses LIKE with a host variable induces DB2 to scan the index (if available) or the entire table. It does not adapt its strategy at execution time to the content of the user's request because CICS plans generally are bound long before they are used on-line. If your application uses NOT LIKE, no index will ever be used.

Avoid using LIKE if there is an alternative method for coding a query. For example, consider a table that has a two-byte column called DEPTCODE. This column is always a letter followed by a number and your query needs to retrieve rows whose DEPTCODE begins with 'A'. Instead of coding:

```
SELECT . . . FROM . . .
WHERE DEPTCODE LIKE 'A_'
```

do this:

```
SELECT . . . FROM . . .
WHERE DEPTCODE IN ('A0', 'A1', 'A2', 'A3', 'A4',
                   'A5', 'A6', 'A7', 'A8', 'A9')
```

It is not so elegant, but will run faster.

Between

The SQL BETWEEN clause is preferred for search predicates which describe a range. For instance, to get students whose age is of the range 30 to 39, instead of:

```
SELECT . . . FROM . . .
WHERE STUDENT_AGE >= 30 AND STUDENT_AGE <= 39
```

do this:

```
SELECT . . . FROM . . .
WHERE STUDENT_AGE BETWEEN 30 AND 39
```

OR Versus In

There is no performance difference if you code:

```
SELECT . . . FROM . . .
WHERE ACTION_CODE = 'A' OR ACTION_CODE = 'F'
```

instead of:

```
SELECT . . . FROM . . .
WHERE ACTION_CODE IN ('A', 'F')
```

In this case, do whatever feels right.

UNION Versus OR

If a search predicate involves an OR relationship between two separate columns of a table, any available index will probably not be used, but it will be considered if UNION is used instead.

For example, imagine an inventory file containing two *separate* indexes (rather than a multicolumn index) on the variables INVTY_DIVISION and INVTY_CLASS. Then consider the following query:

```
SELECT ITEM_NAME FROM INVENTORY
WHERE INVTY_DIVISION = '6' OR INVTY_CLASS = 'H'
```

Since the OR refers to two separately indexed columns, no index will be used. However, DB2 will consider the use of an index if the query is coded this way:

```
SELECT ITEM_NAME FROM INVENTORY
WHERE INVTY_DIVISON = '6'
UNION
SELECT ITEM_NAME FROM INVENTORY
WHERE INVTY_CLASS = 'H'
```

UNION does not come free, though, because it will invoke the DB2 sort. If more than a few hundred rows are returned, this could be too costly in terms of performance. Also, since UNION suppresses duplicate rows from the query, the results might not be what is needed. A variant called UNION All does return duplicate data (if it exists) and does not necessarily invoke the sort. The best way to assess the relative merit of UNION versus OR is to run a DB2 Explain.

There is another case in which there is a tradeoff among OR, COBOL coding and UNION. In this case, the OR predicates do not use an equal sign, although they refer to the same column. Using the database described above, consider:

```
SELECT ITEM_NAME FROM INVENTORY
WHERE INVTY_DIVISION < '6' OR INVTY_DIVISION > '8'
```

There is a good chance that the application will perform better if you do it with two queries:

```
SELECT ITEM_NAME FROM INVENTORY
WHERE INVTY_DIVISION < '6'
. . .
SELECT ITEM_NAME FROM INVENTORY
WHERE INVTY_DIVISION > '8'
```

and combine the results in your COBOL program. This method avoids UNION and might induce DB2 to use the index.

If the number of returned records is less than a few hundred and duplicate suppression matches your application requirements, you can consider using UNION:

```
SELECT ITEM_NAME FROM INVENTORY
WHERE INVTY_DIVISION < '6'
UNION
SELECT ITEM_NAME FROM INVENTORY
WHERE INVTY_DIVISION > '8'
```

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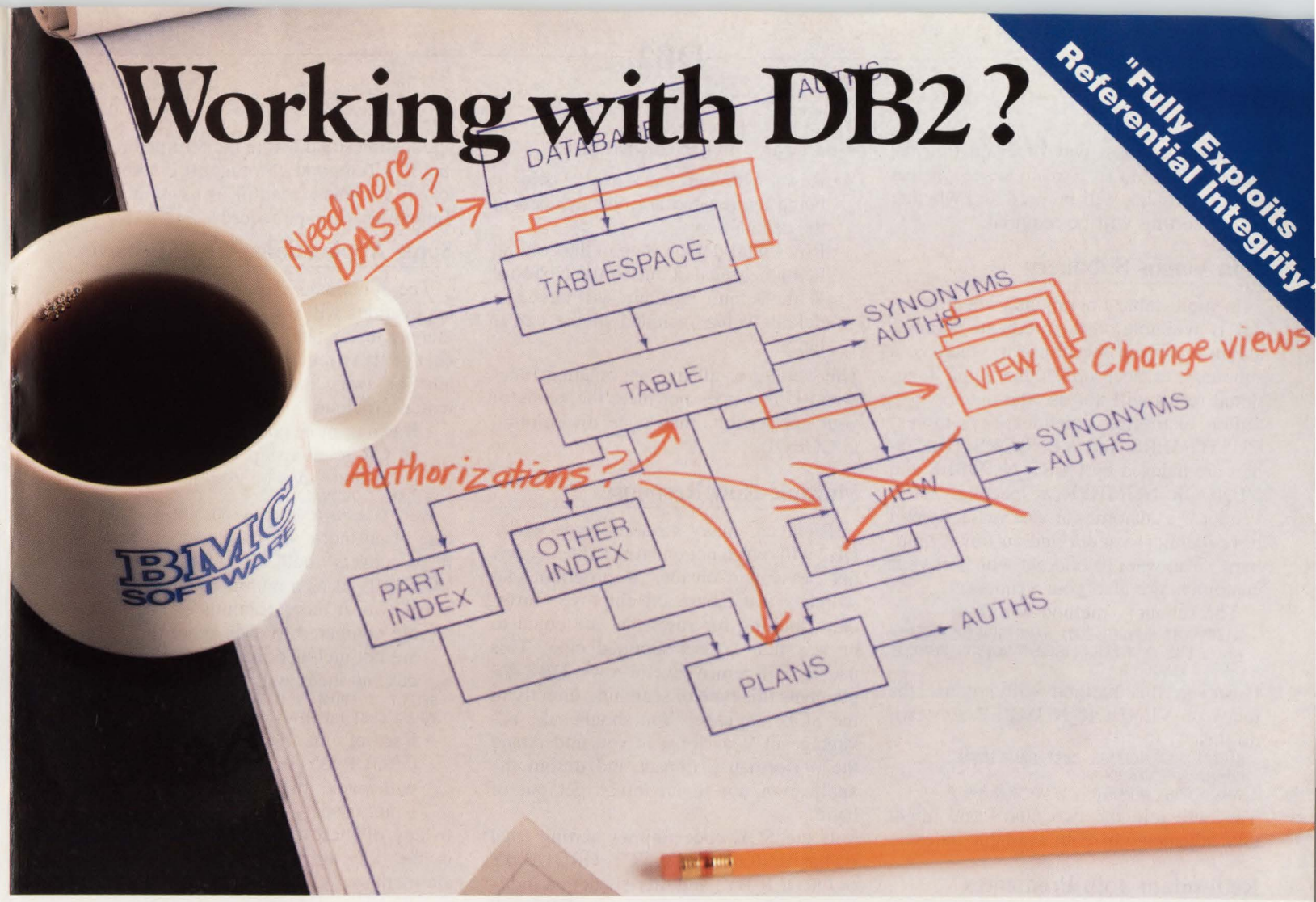

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Again, the best way of evaluating the situation is to do an Explain to see whether or not an index will be used and whether or not sorting will be required.

Join Versus Subquery

In multi-table operations, when an index is available on the predicate column, a Join operation might use it; whereas, a subquery to accomplish the same functional result will not use the index.

For example, consider two tables, CUSTOMERS and VENDORS. The tables are indexed by CUST_NUMBER and VENDOR_NUMBER, respectively. (If a vendor is a customer or vice versa, he will have identical vendor and customer numbers.) You want to find out which of your customers are also your vendors.

The subquery method will do it:

```
SELECT CUST_NUMBER, CUST_NAME FROM CUSTOMERS
WHERE CUST_NUMBER IN (SELECT VENDOR_NUMBER
  FROM VENDORS)
```

However, this method will not use the index on VENDOR_NUMBER. Instead, do this:

```
SELECT CUST_NUMBER, CUST_NAME FROM
CUSTOMERS, VENDORS
WHERE CUST_NUMBER = VENDOR_NUMBER
```

This will join the two tables and might take advantage of both available indexes.

Redundant Join Predicates

Consider two general ledger tables, one containing account number and dollar amount, the other containing account number and account name. We wish to get the account number, name and dollar amount for account codes less than '100200'. The obvious way is:

```
SELECT LEDGER_ACCT_NUM, ACCT_NAME, AMOUNT
  FROM LEDGER, ACCTMSTR
WHERE LEDGER_ACCT_NUM = MSTR_ACCT_NUM
AND LEDGER_ACCT_NUM < ' 100200'
```

Note the use of redundant predicate in the following:

```
SELECT LEDGER_ACCT_NUM, ACCT_NAME, AMOUNT
  FROM LEDGER, ACCTMSTR
WHERE LEDGER_ACCT_NUM = MSTR_ACCT_NUM
AND LEDGER_ACCT_NUM < ' 100200'
AND MSTR_ACCT_NUM < ' 100200'
```

This redundant coding will help DB2 find the most efficient way to handle the query.

Aggregation Functions

SQL offers the built-in functions COUNT, SUM, AVG, MIN and MAX for aggregating data. While these are easy to program in COBOL, letting DB2 do it affords better performance. This is because control does not have to alternate back and forth between DB2 and the COBOL program for each column of each row retrieved.

Be aware, though, of two facts:

- Rows with null data in the column being aggregated are not included in the calculation
- Rows with default data in the column being aggregated due to the Not Null With Default attribute will have the default value included in the calculation.

This applies to all five aggregation functions. If this does not meet the needs of your application, then code the solution in COBOL.

Multiple-Row Responses

There are many circumstances where DB2 will return not one row from a query, but several. Consider a program that searches a database on employee birthdate, looking for rows that are equal to or less than a user-supplied date. This usually will return several rows. DB2 implements this type of searching directly in the SQL language. You should take advantage of it as long as you understand the performance impact and design the application not to let things get out of hand.

If the SQL code implies sorting (that is, has UNION, DISTINCT, GROUP BY or ORDER BY) and there is not an index that satisfies this requirement, DB2 will sort the rows and place them in a temporary work file. If sorting is not needed, it simply retrieves the rows from the table and gives them one at a time to the application.

If sorting is not needed, the application can simply fetch enough rows from the query to fill a CRT screen and make notes of the first and last identifier fields in the returned data. Based on this, paging can be done for the user in much the same way as in non-DB2 applications.

If sorting (and the resultant work file) is needed, DB2 returns more rows than will fit in one CICS response screen and the user would like to page through them, you might have a problem. This is because if the CICS transaction is pseudo-conversational, the work file into which DB2 placed the multiple rows returned from the search is purged after the CICS transaction sends the screen and terminates.

Then this means that if multiple rows are returned from a DB2 search and the application needs to offer the ability to page through them and sorting caused the data to be put in a DB2 work file *and* the transaction is pseudo-conversational, the application should store the returned rows in CICS Temporary Storage. It is simplest to put a whole screenful of rows in each Temporary Storage record.

Some Applications Are Expensive

The functional requirements of some applications will cause DB2 to do things that are just innately costly. If you cannot change these requirements, you should at least be aware that performance is a potential problem:

- If two or more columns of a table have an OR relationship in a search predicate, there may be trouble. Example:

```
SELECT . . . FROM . . .
WHERE COLUMN_A = '111' OR COLUMN_B = '222'
```

Use of an index will be considered only if it covers both COLUMN_A and COLUMN_B as a multicolumn index.

- If two or more columns of one table are compared to each other and they are not included in a multicolumn index, no index will be used. Example:

```
SELECT . . . FROM . . .
WHERE CUST_NUMBER = EMPLOYEE_NUMBER
```

- Use of the UNION, DISTINCT, GROUP BY or ORDER BY clause will invoke the DB2 sort if an index is not used.

In any of these cases, the DB2 Explain is the way to investigate performance alternatives.

Deadlocks And Timeouts

A *deadlock* occurs when two transactions are each waiting on a resource that the other has locked (also called *fatal embrace*). A timeout occurs when a query has to wait a long time for a resource which is locked by another task or when the Interregional Lock Manager takes a long time to grant a lock. The value of *a long time* is a DB2 tuning variable.

In either event, DB2 detects the problem and passes a return code of -911 or -913 in the SQLCODE field; the reason code indicates which of the two problems has occurred. The application program must check for both of these events.

When any of these happens, if data integrity issues do not prohibit a retry, the application program can roll back any uncommitted updates that it accomplished up to the point of the problem. It can either ask the user to try the transaction again or retry the entire transaction starting from its first SQL call.

End-User Query

A major strength of DB2 is the access facilities it offers for interactive user-for-

See DB2 *page 86*

Today's Session Manager

By Ted Streck

As session managers become more sophisticated, evolving into on-line information or presentation managers, end users reap the biggest benefits.

From the moment on-line transactions became a reality, end users suggested, asked for, even demanded improvements. One of the most significant contributions to lessen this constantly growing assortment of end-user requests has been the introduction of session managers. Session managers are those unique tools that allow viewing of screen after screen of information and switching between many on-line applications by simply pressing a single key.

Initially, these tools provided cost savings by automating the repetitive tasks of logging individual applications on and off and gave users an easy-to-use, common entry to a network or to VM. But each year the functionality has grown. Now these tools include mailbox facilities, broadcast functions, Help Desk capabilities, screen sharing, data compression, virtual printer management and a gamut of other features.

So, what's next? Even now, as these tools make life easier, the demand for more ease of use increases. That ease of use includes the challenge of having data from a variety of sources brought to one screen so the end user can be even more productive. True, with a session manager you only need to push a key to change to the next application. However, what many users are really asking for is integration of these applications (eliminating the need to switch between sessions because the information is already in front of them) integrated, convenient and ready to use.

Integrating applications has always been a tall order. Sharing data between applications or simply presenting it from one application to another is normally under application control. This means that any modification to how the data is presented requires a modification to the application itself.

Three Types Of Integration

There are really three types of integration. First, and perhaps most common, is *background integration* or *data sharing*. Background integration passes data back and forth between different applications (the data is then used as a reference for verification or as actual input). MRO for CICS and other types of transaction routing lends credence to this type of integration.

Using this type of integration, the end user can request information from only one source or input to only one application. However, information is shared between the applications in the background because the applications are sufficiently integrated to allow this.

The second type of integration is *static foreground integration*. Here, information relating to two applications is displayed or entered through a single screen or window. This is static because the displayed fields and input fields are always the same. The problem is that one field may be found in CICS while the other resides in IMS. For anything short of LU 6.2, presenting data to or receiving it from both applications is an impressive feat. Later in this article I will explore using an advanced session manager to do this by a method that does not require modifications to the applications and excessive time expenditures from the application groups.

The third integration type is *foreground integration*. In this case, viewed or edited fields are not always the same and reside in separate applications. Data from one application may be used as input to the

next. While this seems the most difficult to handle, the sophistication of some session managers makes this relatively simple.

The Integration Toolbox

Today's evolving session managers provide the necessary tools to perform all three types of application integration. In fact, session managers have progressed to the point that they are really *on-line information managers* or *presentation managers*.

There are a few ways that session managers can integrate applications. First, examine background integration or data sharing. A session manager script can retrieve data from CICS and send it to IMS. (Scripts are programs written in a scripting language; that is, a high-level language that can interact with the applications and the end user.) In this instance, the end user would see the requested data on the IMS screen after the conversation is finished.

Foreground integration (where information from separate applications is displayed or entered from the same screen) requires either a screen with separate windows for each application or a custom screen that consolidates information from the various applications.

The second generation of session managers has evolved to provide this capability. To perform this sort of integration, the session manager must have a method that is easy to understand and use, allowing the use of variables. Also, it must be able to locate data within screens.

In the case of static background integration, the session manager should also allow for the creation and use of screen images while providing the ability to reference and display these newly created custom screens. In essence, the product must be able to create a layer between the session manager and the application programs. This layer, or neutral ground, becomes the vehicle used to retrieve and input data.

Dynamic integration presents a different problem: you cannot create a static method or define a screen with static fields for this situation. You need to apply windows as you know them from the PC world with the ability to set aside pieces of the terminal display for the various applications. If the windows become active with the touch of a key or the repositioning of the cursor, data can be entered from a single display. Cut-and-paste can be used to transfer data from one dynamic environment to another. Fortunately, such features exist in some of today's session managers.

Windows Of Opportunity

Advanced session managers provide the first major step toward resolving integration problems that have plagued the industry for years. For instance, think about some of those applications that will never be enhanced or upgraded, yet still hold valuable information that could be incorporated into new and more often used applications. Session managers with a method to define actions, panel creation and windowing capabilities provide a variety of tools for integrating the old with the new.

The demand for ease of use includes the challenge of having data from a variety of sources brought to one screen so the end user can be even more productive.

Session managers can also ease the difficulty of migrating from an old application to a new one by supplying automated facilities, methods of creating procedures to automate any repetitive tasks such as logons, logoffs, windowing and so on. These simplify user's tasks and screens complete with on-line tutorials can ease the pain of transition. From a human resource viewpoint, it can reduce the training burden required for a new application.

Using an advanced session manager can also eliminate repeated effort. Users must often tediously rekey the same data into several applications. Each time new information is entered, this wasteful cycle is repeated. However, through the use of custom menus and automated facilities, keyed data can be distributed to many different applications. The process of logging on and off can also be performed with session managers, presenting the user with a single apparent application which handles all interaction with several applications.

An advanced session manager is not only a tool for the applications side of the house. For instance, Help Desk personnel can benefit greatly from the increased functionality. More sophisticated session managers allow users to send an image of what is currently on their screen to the Help Desk. Operators can benefit as well, using windows and a single terminal to monitor data center operations (instead of watching a set of terminals).

Making It Work

As with anything else, planning is the key. Before using a session manager in any integration scheme, you need to answer two basic questions.

1. Is application integration cost effective for this problem? The answer depends on the amount of time the integrated function will be used and the resources required to implement the function. Because the more advanced session managers can integrate applications without long development cycles or making modifications to the applications themselves, the answer is usually yes.
2. Which type of integration will solve the problem? The answer to the second question takes a bit of thought. To help you with this process, consider the following.

Dynamic Foreground Integration

This one is easy; windows is the only viable choice. Implementing this simply involves choosing which users get this capability.

Static Foreground And Background Integration

This takes a little more effort. Foreground integration requires custom panels and automated facilities, while background integration might be done with only automated facilities. To decide what you will need to do, you should consult with the parties involved with the affected

applications. Remember that end users most often provide the best input for design since they work with the applications every day. You will also need to determine where the necessary data resides and the data field locations on the screens. If you need to create new screens, the format and content of the screen images will indicate what areas of an application are involved and what data fields must be retrieved or filled.

Do Not Forget To Document

Whatever integration scheme you implement, its ultimate success will depend on how well you cover yourself in the beginning. When an integration function has been created and tested, document the applications involved as well as the screens and transactions used in the function. This is not only good development practice, but also it provides a way to quickly locate areas that need to be updated should the application change.

Stocking Your Integration Toolbox

Once you have determined which type of application integration to implement, you can narrow the field of possible tools. There are a number of important factors you should consider when selecting a session manager with windowing and automated facilities.

Window Shopping

If you are going to need a windows function, make certain that you choose a reasonably robust version. Simple split screen with cut-and-paste may work for some situations, but it may not satisfy every user's needs.

The windows function you choose must let you define your own window configurations. It should allow for both horizontal and vertical divisions that can be modified dynamically without recycling the session manager. Better yet, you should be able to dynamically modify, add and delete windows while working with your applications.

Cut-and-paste is a must for dynamic foreground integration. It alone will allow you to move data between applications. Without cut-and-paste, users will be back to re-entering data into each application. The cut-and-paste function should be simple to use, preferably controlled through the use of PF keys.

The windows function should be able to handle any application that is defined to a window. This way a production version of CICS could be in one window while a test version could be running in another. This application assignment function must also be dynamic to make it easy to use.

You should be able to zoom each window to show a full-screen image. The process should also be reversible so that windows can be redisplayed at their original size. Again, control of this function should be through PF keys.

To conserve resources and make windows easy to use, defining windows, using applications through windows and zoom functions must be accomplished without consuming unnecessary additional storage, VTAM resources or VM resources. Also, make sure that no assumptions are being made by the session manager concerning the screen size. No more than 2K of storage should be necessary to build and present a Model 2 screen. Make certain that the product you choose adheres to bind images for model definitions.

Windows can be a wonderful tool if you are thorough in choosing a session manager. When looking for this function in a session manager, pick the one that provides the most flexibility while utilizing the smallest amount of resources.

Choosing The Right Product

When selecting a session manager, you should closely scrutinize the capabilities of its automated facilities. Make sure that the automated facilities that carry out actions are robust enough to deal with more than one application at a time. Some products do not allow for as great a degree of error detection and recovery as others. One reliable test is to make sure that the automated facilities of a product can perform every function of a 3270 keyboard.

Another watch point: automated facilities should not call internal functions or programs. This can be a quick route to integration suicide. Do not bet your entire system on what is happening within an automated facility; it must be far enough removed that it does not cripple the rest of the session manager.

ABOUT THE AUTHOR

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Tuning VSAM Index Control Intervals

Selecting An Index Control Interval Size

By Michael D. Sachais

This tutorial will teach you how to test and choose the most effective index Control Interval (CI) size to use when DEFINING a given KSDS cluster.

Testing The Index CI Size

To ensure that the index CI size you calculate is large enough to store the keys of all the data CIs in the Control Areas (CAs) of the cluster, you need to test it. This is done by performing the following steps:

- Redefine a test cluster with the data and index CI sizes you determine to be proper
- Reload the cluster with data records using the IDCAMS REPRO command
- Reanalyze the index records of the test cluster to ensure no unused data CIs exist.

Redefine A Test Cluster

The first step in testing the index CI size is to define a test cluster. The following items should be reviewed before defining the test cluster.

- The data CI and CA sizes used to redefine the test cluster should be the same as the ones used in the steps you used to calculate the proper index CI size.
- The FREESPACE parameter used to redefine the test cluster should be set to FREESPACE(0 0). This is because the FREESPACE parameter will force some of the CIs in the CA to be left unused. The purpose of testing the index record is to ensure that no CIs in the CA are left unused. Therefore, the FREESPACE parameter will interfere with your test.
- The test cluster should be allocated in cylinders to ensure a CA size of one cylinder that can store the maximum number of data CIs. This will give you a better estimate of how well keys are compressing in a CA. You do not need to allocate the test cluster space to be the same size as the cluster you are tuning. A space allocation of one primary and one secondary cylinder should suffice.

FIGURE 1

Partial LISTCAT For The KSDS Cluster MY.KSDS.FILE.

```
CLUSTER ---------- MY.KSDS.FILE
   DATA ---------- MY.KSDS.FILE.DATA
     ATTRIBUTES
       KEYLEN----------41      AVGLRECL---------- 156   BUFSPACE----------9728   CISIZE----------4096
       RKP -------------- 0    MAXLRECL---------- 156   EXCPEXIT----------(NULL) CI/CA---------- 150
       SHROPTNS(2,3)   SPEED   UNIQUE          NOERASE   INDEXED     NOWRITECHK  NOIMBED     NOREPLICAT
       UNORDERED       REUSE   NONSPANNED
   INDEX ---------- MY.KSDS.FILE.INDEX
     ATTRIBUTES
       KEYLEN----------41      AVGLRECL---------- 0     BUFSPACE---------- 0    CISIZE----------1536
       RKP -------------- 0    MAXLRECL----------1529   EXCPEXIT----------(NULL) CI/CA----------23
       SHROPTNS(2,3)   RECOVERY UNIQUE         NOERASE   NOWRITECHK  NOIMBED     NOREPLICAT  UNORDERED
       REUSE
```

FIGURE 2

Partial Printout Of An Index Record From The Cluster MY.KSDS.FILE After The Index CI Size Has Been Tuned.

```
RBA OF RECORD – 0
000000   0DF90301  00000000  00000000  00000000  01000018  02130CF5  00000000  00000000
000020   00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000
000040   00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000
000060   00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000
000080   00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000
  "
  "      (MORE KEY ENTRIES)
  "
000DE0   40F1F1F1  F0F04040  40404040  404040F9  F9F94040  40C40027  00
```

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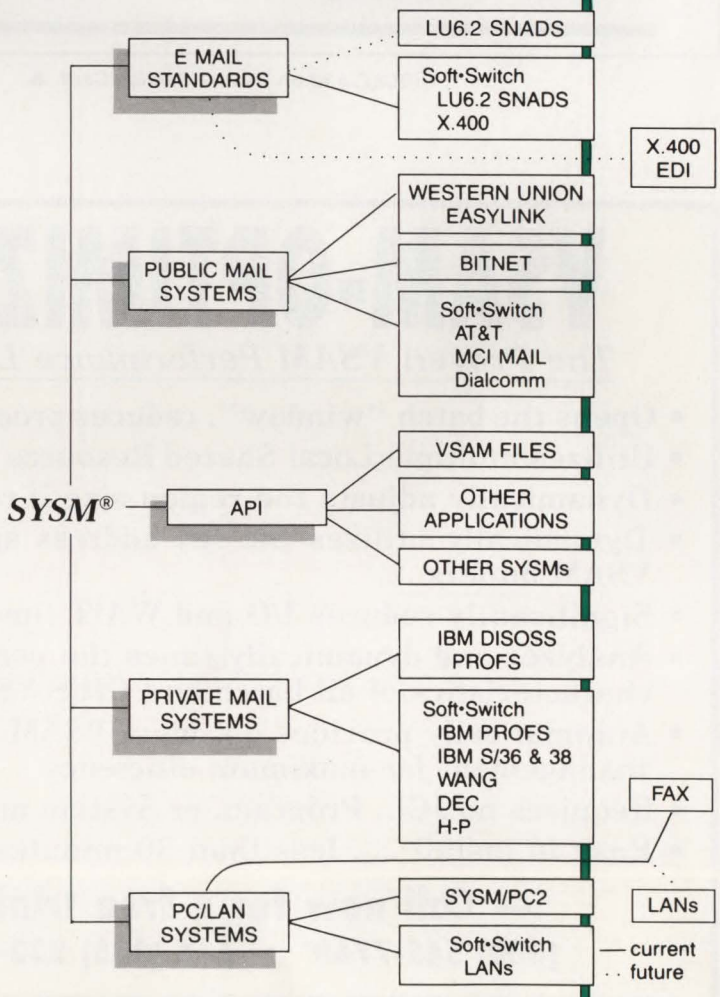

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Load The Test Cluster With Data Records

Once the test cluster is defined, the next step is to load it with data records. This is accomplished using the IDCAMS REPRO command. The records loaded into the test cluster should be loaded from the cluster you are tuning. The number of records loaded into the test cluster should be a multiple of the number of records which fill one CA. I recommend using three or four CAs of data. This will enable you to better determine whether or not CIs within the CAs are being utilized. The number of data records that can fit into one CA of a fixed length cluster can be calculated as:

NUMBER OF RECORDS PER CONTROL AREA = (CI/CA) X RECS/CI

where:

CI/CA = The number of data CIs per CA; this value can be obtained by running a LISTCAT on the test cluster and using the CI/CA value in the DATA ATTRIBUTES subsection.

RECS/CI = The number of data records that will fit into one data CI; this number is calculated by dividing the DATA CISIZE minus 10 by the average data record length in the cluster.

The data records in the cluster MY.KSDS.FILE are 156 bytes long as shown in the LISTCAT in Figure 1. Therefore, the number of records per CI (REC/CI) can be calculated as:

$$\frac{4096 - 10}{156} = 26.19 \Rightarrow 26 \text{ (rounded down)}$$

When the NOIMBED parameter is used to DEFINE a cluster with a data CI size of 4096 on a 3380, there will be 150 data CIs per CA (or cylinder in this case). The number of data records that will fit in one CA is, therefore, 3900 and was calculated as:

3900 = 150 CI/CYL × 26 REC/CI

You should, therefore, REPRO a multiple of 3900 records from the cluster being tuned into the test cluster.

Reanalyze The Index Records

After loading the test cluster with the data records, you need to reanalyze the index records of the test cluster to ensure that the index CI size used is sufficient. Figure 2 illustrates a portion of one index record from the test cluster MY.KSDS.FILE.TEST. In your previous analysis of an index record from the clus-

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ter MY.KSDS.FILE, you calculated the average length of a key entry in the index record. The average key entry length should not change significantly when the index CI size changes because the average key entry length is dependent on the key compression occurring on the keys of the cluster. It is not affected by the size of the index CIs and, therefore, unnecessary to recalculate the average key entry length when you reanalyze the test clusters index records.

The purpose of tuning the index CI is to allow the index records to store the keys to all the data CIs in the CA. You may recall that when all the data CIs are utilized, the free CI pointer list will be empty. Therefore, in your analysis of the test cluster index records, you need only concern yourself with the free CI pointer list.

If there are no free CI pointer lists in the index records, you know the index CI size is large enough to store the keys to all the data CIs in the CA.

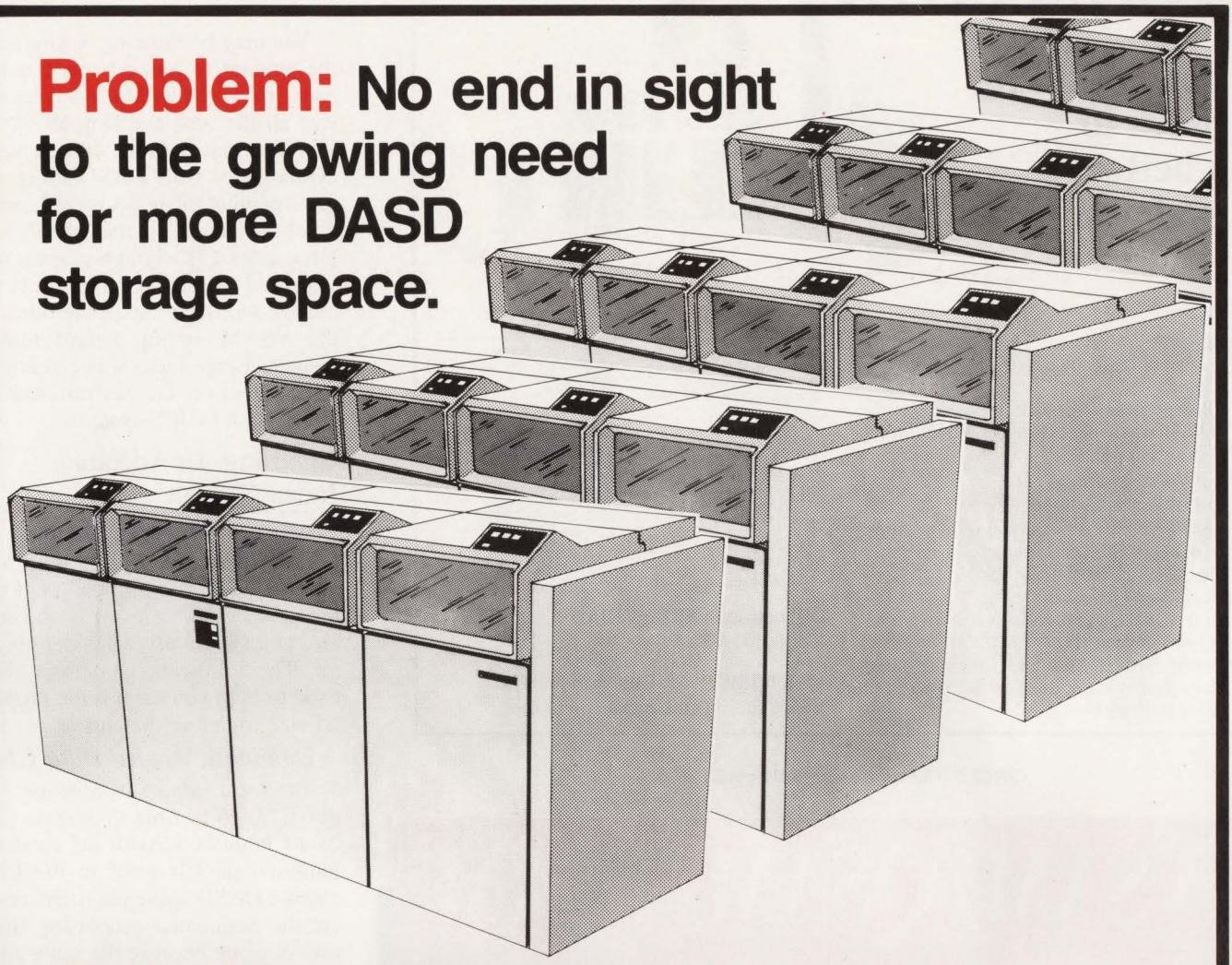
If there are free CI pointer lists in the index records, you will need to increase the size of the index CI and repeat the steps needed to retest the index CI size. If you had performed your initial analysis of the index record correctly, rarely will you have to retest the index CI size in this hit-or-miss fashion.

Using Figure 2, notice that the pointer to the unused space at offset X'12' is X'0018'. When the beginning address of the unused space equals X'18' (the end of the header information), there is no free CI pointer list. Therefore, there are no unused data CIs in the CA signaling that the index record is large enough to store the keys to all the data CIs in the CA.

Before determining that the index CI size used is sufficient, analysis of the free CI pointer list in various index records should be performed. For simplicity, in this example only one index record will be analyzed to determine the index CI size. From your analysis of the index record in Figure 2, you could conclude that an index CI size of 3584 should be sufficient to access all the data CIs (150) in the CAs of the cluster MY.KSDS.FILE.

You may also conclude that there is some unused space left in the index record when an index CI size of 3584 was used. Extra unused space in an index record is essentially wasted DASD space, but, unless you use an excessively large index CI size, the total amount of wasted space in all of the index records is usually so minute that it can be ignored.

Problem: No end in sight to the growing need for more DASD storage space.



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You may be thinking to yourself that if the amount of unused space is insignificant, maybe I should use a large index CI size all the time and skip all of the analysis and calculations. If you were concerned only with DASD utilization and ensuring that the index record can address all of the data CIs in the CA, always using large index CIs would be a great idea. But you need to consider the effects a tuning change will have on all the other parts of the VSAM system before making the change. Large index CIs can have a negative effect on the performance of your BATCH and CICS systems.

Choosing An Adequate Index CI Size

When you calculate the minimum index CI size needed to be used to access all of the data CIs in the CAs of the cluster, this is not necessarily the index CI size you should use when defining a cluster. The following guidelines should be used to help you choose the proper index CI size to define the cluster.

Eliminate Wasted Data CIs

The most important function of an index CI is to be able to address all of the data CIs in the CAs of the cluster. When unused data CIs exist in the CAs of a cluster, DASD space requirements will increase. Sequential processing times will also degrade because the same amount of data will now be spread over more DASD space and additional index records will have to be accessed to access the data. In addition, CA splits will increase because there will be fewer CIs available in each CA. Therefore, CAs will be split more often.

You should never use an index CI size smaller than the minimum CI size you calculate. This should ensure that all the data CIs within the CAs will be utilized. However, using larger CIs than the minimum CI size that has been calculated is permissible.

Separate Index CI Sizes From Data CI Sizes

In a CICS LSR environment, main storage buffers are shared between index and data CIs. If index CIs are the same size as data CIs, they will share the same buffers causing data CIs to overlay index CIs and vice versa. This degrades the performance of an LSR environment.

Because most optimum data CI sizes are large (4096 bytes and above), index CI sizes should never be larger than 4096

and should remain below 4096 if possible. If the minimum size of the index CI calculated in the previous section is 4096 bytes or larger, you should consider using the cluster in a CICS NSR environment rather than in an LSR environment.

Large Index CIs Increase Data Transfer Times And Buffer Requirements

Large index CIs like large data CIs require more buffer space to store the CIs. They also increase the amount of data transfer time required to transfer the index CI from DASD to main storage buffers. When index CI sizes are overallocated, excessive amounts of unused space will exist in the index records. Therefore, large index CIs which contain large amounts of unused space not only waste DASD space, but also waste buffer space which can degrade processing times.

When using an index CI larger than the minimum index CI size calculated, you should try to remain as close to the minimum CI size as possible. This will reduce the amount of unused space in the index records as well as buffering requirements and processing times.

Recommendations For Choosing Index CI Sizes

The major concern you should have when choosing an index CI size is to ensure that the index record can address all of the data CIs in the CAs of the cluster. The minimum index CI size to use can be determined by analyzing the index records of the cluster you are trying to tune. The minimum index CI size to be used will vary with every cluster and is dependent on the keys of the data in the cluster.

In general, the index CI size should never be larger than 4096 bytes. The larger the data CI size, the smaller the index CI size will need to be because fewer data CIs can fit into one CA when larger data CIs are used. Therefore, the index record will need to store fewer data CI keys.

When the cluster is going to be used in a CICS LSR environment, it is important to try to keep the index CI sizes different from the data CI sizes of your clusters. This will allow the CICS LSR buffer pools to be utilized more efficiently, which in turn will reduce CICS response times.

When the minimum index CI size calculated forces the index CI size to conflict with data CI sizes in a CICS environment, the following options are available to determine the index CI size to be used:

- Reduce the index CI size thereby wasting data CIs and DASD space possibly increasing the efficiency of the CICS LSR buffers
- Use the larger index CI size thereby wasting no data CIs possibly degrading the efficiency of the CICS LSR buffers and CICS response time
- Use the larger index CI size thereby wasting no data CIs and use CICS NSR buffers thereby increasing the buffer requirements in a CICS environment.

The decision you make should be based on the availability of resources and the needs in your particular shop. Can you afford the extra DASD or increased response times? Only you can decide.

When the cluster is going to be used only in a batch COBOL environment, separating the index and data CI sizes is not important because the index and data CIs will probably not share buffers. Therefore, you should choose the proper index CI based on the minimum index CI size that has been calculated.

The process of calculating the proper index CI size for a VSAM KSDS cluster can be automated in many ways. I have written a short SAS program that will perform the index analysis on a KSDS cluster. The program determines whether the index CI size of a cluster is sufficient, reports on the amount of DASD space being wasted by the cluster and recommends the minimum index CI size that should be used when defining the cluster. A copy of this program may be obtained by requesting "Mike's SAS Program" in the comments section of the Reader Service Card and return it to *MAINFRAME JOURNAL*.

ABOUT THE AUTHOR

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Queuing Theory

An Aid In Analyzing CICS Performance

By Ted C. Keller

A handy tool for analyzing performance is queuing theory. While queuing theory consists of numerous formulas and obscure principles, there are elements that can be easily used without complex mathematical training. In this article, I will present some of the more basic concepts of queuing theory and some simple formulas with an emphasis on how these can be useful, particularly in a CICS environment.

Important Terms

Before going too far, you will need to know the definitions of some terms, concepts and symbols. Even though there are several deeper technical meanings and mathematical implications to many of these terms, I will try to keep my approach as simple as possible.

A *system* is anything that can provide a service or services for customers. A *server* provides some kind of service. Customers enter or *arrive* within a system and receive service from one of the servers. If the servers are busy when the customer enters the system, the customer will wait in a line or *queue* until one of the servers becomes available.

A bank can be seen as a system. The tellers are servers providing a service. Customers enter the system and wait for the completion of a service. If all servers are busy when the customer enters the bank, the customer will enter a queue and wait for the availability of a server. Supermarket check-out lines, job queues in the operating system and I/O systems can all be seen as queuing systems. All have servers which provide a service to customers who are arriving at a random rate and who may have to wait if all servers are busy.

The two major factors influencing how systems perform are the rate at which customers arrive in a system and the average amount of work each server must perform per customer. The Greek symbol *lambda* is usually used to represent the average number of customers to arrive per period *(average arrival rate).* If customers arrive in a system at an average rate of two per minute, you could say that: lambda = 2.

The second major factor influencing service is the average amount of work to be performed per customer. This is commonly expressed by the symbols E[s] or Ws and represents the *average service time* for the server itself. The time spent queued (waiting to get to the server) is expressed as E[q] or Wq. The total time spent in the system is W, which is the sum of the time spent receiving service at the server and the time spent waiting in the queue: W = Ws + Wq = E[s] + E[q].

The product of the amount of time spent at each server (E[s]) and the arrival rate of customers (lambda) defines *traffic intensity,* a measure of the amount of work arriving per unit of time. The symbol *u* is used to represent traffic intensity: u = E[s] × lambda.

For example, if three customers arrive in a bank each minute and each requires an average of two minutes work at a teller station, then you could say there was a traffic intensity of six. An average of six minutes of work would arrive in the bank each minute.

The symbol *c* is usually used to represent the *number of servers*. It is assumed that all servers perform work at the same average rate. If there were eight tellers working in a bank, c = 8.

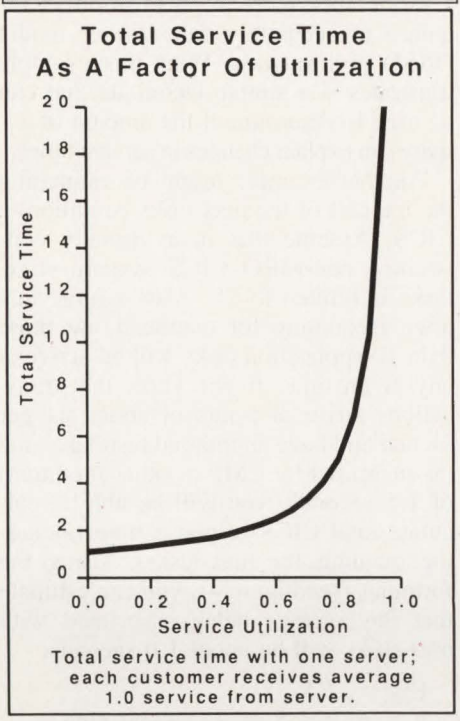
The final important term is *utilization,* commonly represented by the Greek letter *rho*. This is a measure of how busy the servers are on the average. Utilization can be determined by dividing the amount of work arriving each period by the number of servers available: rho = u/c.

Thus, if six minutes of work arrives in the bank each minute and there are eight tellers to handle the work, on the average each teller and all tellers will be about 75 percent busy. Although it may not be completely obvious, utilization should always be less than one. Otherwise, more potential work would arrive per period of time than could be possibly accomplished and, in theory, the number of customers waiting in the queue would become greater as time passed. For this reason, queuing theory formulas all break down whenever rho is greater than or equal to one.

Queuing Formulas

One of the most useful queuing formulas calculates total service or wait time using the average arrival rate for customers, the average amount of service re-

FIGURE 1



Total service time with one server; each customer receives average 1.0 service from server.

quired by each customer and the total number of servers. In systems with a single server, the formula is quite simple:

$$W = \frac{E[s]}{(1 - rho)}$$

If customers enter a single drive-up window on the average of one every five minutes and remain at the window an average of two minutes each, the following will be true:

E[s] = 2 (by definition — service time at the server)

lambda = .2 (.2 arrivals per minute — one every five minutes)

u = lambda × E[s] = 2 × .2 = .4 (An average of .4 minutes of work arrive each minute.)

rho = u/c = .4/1 = .4 (server is 40 percent busy)

W = 2/(1 − .4) = 2/.6 = 3.33

Thus, you will find the machine busy about 40 percent of the time (rho — notice that with a single server, utilization is the same as traffic intensity) and customers will spend an average of about 3.33 minutes in the system: two minutes at the window and 1.33 minutes waiting in line.

Figure 1 shows how total system time will increase as a system with one server becomes more fully utilized. This graph with a service time of 1.0 can be used to estimate the impact of utilization on total service time for single server systems. For example, you can see that a customer will spend about four times as long in a system when the server is 75 percent busy as he might if the server were lightly utilized.

The formula for total service time becomes considerably more complex when there are multiple servers:

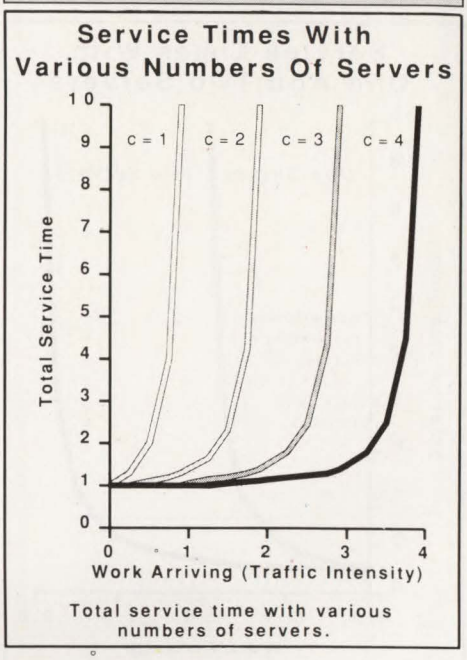
$$W = E[s] + \frac{C(c,u) \times E[s]}{c \times (1 - rho)}$$

C(c,u) is the probability that all servers will be busy at any instant and is calculated as:

$$C(c,u) = \frac{\frac{u^c}{c!}}{\frac{u^c}{c!} + (1-rho) \times \sum_{n=0}^{c-1} \frac{u^n}{n!}}$$

I will not further expand this formula, but Figure 2 will demonstrate the relationship of traffic intensity and total wait time. It is interesting to observe that total service time increases without limit as the available servers approach full utilization. It can be seen that adding a server can make a tremendous difference when the servers are 80 to 90 percent busy or more. Figure 3 presents this same information but on a different scale. It is easy to see that within a certain range of activity, adding one server can result in a five- to ten-fold improvement in total service.

FIGURE 2

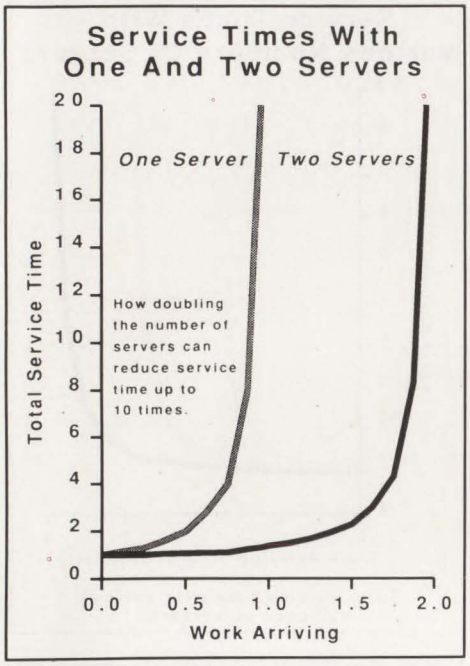


Total service time with various numbers of servers.

Notice also that at lower levels of activity, the difference is not quite so dramatic.

Figure 4 illustrates another principle. Generally stated, the more servers in a system, the better the service at any level of utilization. For example, in a system

FIGURE 3



with only one server that was 75 percent busy, total service time would be four times the individual server time (E[s] — which in this graph is shown with a value of one). In a system with two servers who are 75 percent busy (doing twice as much work as the system with one server), total service will be only 2.3 times E[s] and in a system with four servers, it will be about 1.6 times E[s]. The primary reason for the difference is the chance that all of the servers being busy at any given time is less when there are more servers.

Another handy formula is commonly known as Little's Law. It states that the total number of customers in a system, L, or in a queue, Lq, can be determined from customer arrival rate and wait time.

L = lambda × W

and

Lq = lambda × Wq

Little's Law provides a handy way to determine some interesting things about a queuing system. For example, if you know that an average of three customers arrive per minute and there are an average of six customers in the system, you can easily calculate that customers spend an average of two minutes in the system.

Practical Applications

Queuing theory can be particularly useful in debugging performance problems. While few real-world situations (especially computer resources) are isolated enough to conform to pure queuing theory, this can still be useful to help explain how things behave.

For example, a non-cached DASD volume contains a few files being used on a CICS system. You understand that these files are accessed only by the CICS system and the relative amount of activity on each file remains fairly constant. You have noticed that when the volume is lightly used, its average service time is about 20 ms. You have also observed that when activity grows to 45 to 50 percent busy, service time degrades to about 38 ms. The question is whether this degradation in service time can be explained by queuing theory. In other words, is the degradation explainable simply in terms of queuing for the device?

If you were to assume that the typical time actually spent providing the I/O service (seek, latency, transfer and so on) was about 20 ms, then you could use the formula for total service (see Figure 1) to determine the theoretical impacts of device contention:

E[s] = 20 (by definition)

rho = u = .50 (50 percent busy)

$$W = \frac{20}{(1 - .50)} = 40$$

This shows that the difference in service time can probably be explained primarily by contention for the device. Had the observed service time been 60 to 70 ms instead of 38 ms, you could presume that something other than normal delays waiting for this single server were involved. You would need to explore other sources of contention (such as overly busy channels and so on) to explain this additional service delay.

Of course, total DASD performance involves many factors that cannot be predicted with simple queuing formulas. Considerably more sophistication is required to accurately calculate or model DASD performance. What this example illustrates is a simple technique that can be used to determine if the amount of activity can explain changes in service times.

Another example might be estimating the impacts of the max-tasks condition in CICS. Assume that in a virtually constrained non-MRO CICS system, max-tasks is limited to 15. Also assume that after accounting for overhead, no more than 10 application tasks will be active at any given time. If you know that transactions arrive at a rate of about six per second and have an internal response time (as measured by CMF or other monitors) of 1.5 seconds, you will be able to calculate total CICS response time (including queuing for max-tasks). Using the formulas (see Figure 4), you can estimate that the average delay associated with max-tasks will be about 1.0 seconds:

E[s] = 1.5

u = 6 × 1.5 = 9 (about nine seconds of work arrive each second)

rho = 9/10 = .90 (servers or tasks should be about 90 percent busy)

C(c,u) = .67 (probability that all tasks will be in use at any given time)

W = E[s] + E[q] = 1.5 + 1.0 = 2.5

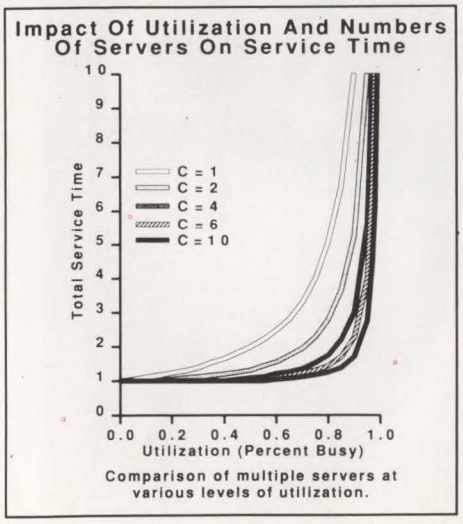
Wq = 1.0

Lq = 6 × 1.0 = 6 (an average of 6 tasks waiting for max-tasks at any given time.)

Transactions would spend an average of 2.5 seconds in CICS — 1.5 seconds actually processing and 1.0 waiting for max-tasks if queuing were the only factor. In reality, delays for max-tasks will probably be longer than this due to other delays which are not accounted for in these simple formulas and other factors (such as short-on-storage or CPU constraint) which might also be present in such an environment. This example shows an easy way to estimate the impact of queuing for max-tasks.

In this example, if you are using some kind of network monitor that reports the host delay is about 2.5 seconds, you can be fairly certain where most of this time is being spent. If the time reported were materially longer than this, you will need to find some factor other than max-tasks delay to explain the additional delay. There might be problems with short-on-storage

FIGURE 4

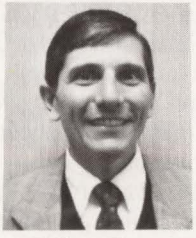


conditions, CPU constraint or delays in the NCP.

Another example of how queuing theory can be handy in understanding CICS performance could be in the analysis of CICS CPU usage. With few exceptions, a CICS region is limited to the amount of CPU that can be provided by a single processor, regardless of how many processors are in the processor complex. When CICS CPU demand (CPU demand is the sum of the time CICS is actually using the CPU plus the time it is waiting to use the CPU) is high, queuing for the use of the processor increases. Using Figure 1, you can see that it will take about 10 times as long to obtain CPU service when CPU demand is about 90 percent as when the region is lightly utilized. If a task typically uses 20 ms of CPU, it might take about 200 ms to obtain this when CPU demand is this high. This affects not only the transaction's direct consumption of CPU, but also CICS task control and terminal control overhead. In this case, the impact may be even greater than tenfold if CICS applications utilize the CPU for prolonged periods (that is, are compute bound) without relinquishing the processor.

Queuing theory can be useful in analyzing performance. It can be used to help determine if observed delays can be explained by queuing for servers. This can help you to isolate performance problems and bottlenecks. Since most performance issues are considerably more complex than queuing for a single server, it would be inappropriate to try to model performance based strictly on these formulas. However, used with understanding and caution, queuing theory can be one of the performance analyst's most powerful tools.

ABOUT THE AUTHOR



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VSE *from Page 35*

vironment of VM.

According to Berry, in the U.S. until January 1988 there had been a decline in the number of CPUs running VSE native and an increase in the number running it in combination with VM. But as VSE increased in utility through IBM and third-party vendor and user enhancements, this trend has decreased. In 1984 about 25 percent of the U.S. VSE licenses were VM/VSE.

The number rose to about 41 percent in 1988 but then dropped to 37 percent this year. An often-quoted remark by Clark, "VSE never runs better than when it runs native," seems to be gaining in popularity. "VSE native in a heavy production environment has numerous and substantial performance advantages which can easily be identified and quantified," comments Clark.

Another combination is systems which run VSE and MVS under VM. This classification has remained constant at about five percent of the U.S. license base. This is significant in that it is the likely combination if the installation were in the process of a VSE-to-MVS conversion, which has typically been the case.

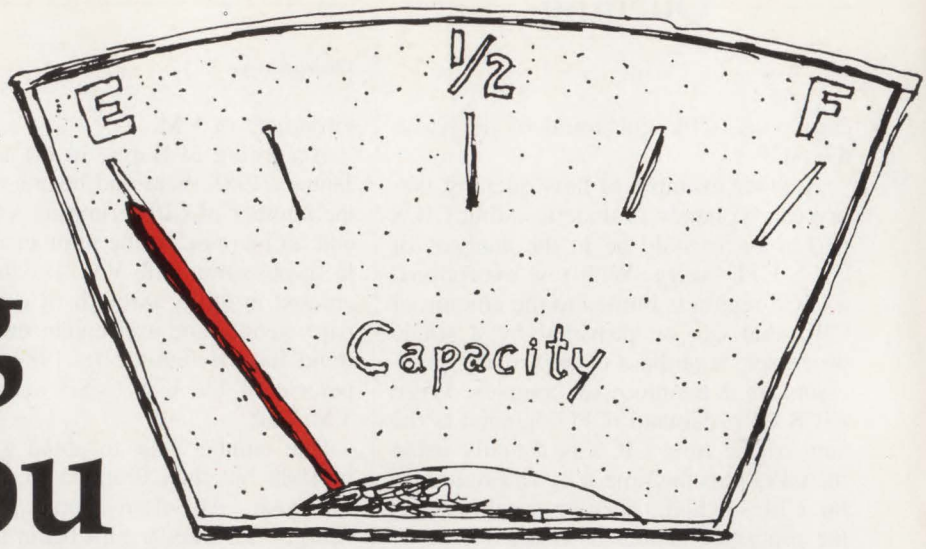
However, today it could be an MVS user who has installed VSE distributed processing nodes with a central MVS host. VSE would be installed at the central site as a support node for the remotes and as a test facility. This is significant in that if there were no MVS/VSE node licenses in the figure, if the percentage remains constant, if 90 percent are converting to MVS and if each conversion takes a year, since VSE has continued to add new users at a faster rate than its losses to MVS migrations, this migration could never be completed without substantially changing some of the previously denoted variables.

While companies decide whether they can make do with VSE or whether they need to migrate to MVS/ESA, the most important thing to users is that now they have a choice. As Rice says, "VSE is not for everyone, but it certainly is for some. Now we are sure VSE can be used as long as it is needed."

ABOUT THE AUTHOR

Lawrence Stevens is a free-lance writer based in Springfield, MA.

Capacity Planning When You Are Out Of Capacity



By Mark Friedman

An ongoing capacity management project should observe and record what happens to computer workloads during periods when major configuration changes occur. In this article I will describe a major configuration change to relieve a significant capacity constraint at a large-scale MVS complex. Also, I will review the impact of this change on the performance of the key workloads at the complex.

The data center studied upgraded its MVS CPUs from Amdahl 5860 uniprocessors to Amdahl 5870 attached processors with almost double the processing power. Prior to the upgrade, major applications at the data center were CPU-constrained.

Monitoring Change

Monitoring change is important for several reasons. The computer capacity planner is routinely engaged in monitoring gradual, incremental changes. Major configuration changes are relatively rare events that can result in sudden and unanticipated performance changes. You should not waste the exceptional opportunity to observe the effects of the new configuration on the old, familiar workload. In tracking the impact of a major configuration change on a familiar workload, there is a chance to compare and reconcile theoretical results from modeling simulations against empirical observations.

If the configuration change results in an increase in processing that will relieve an existing configuration constraint, monitoring the change is important for reasons other than tool calibration and validation. How the constrained workloads and the organizations responsible for them react to lifting capacity constraint is of special interest.

Latent Demand

The capacity planner's language describing the "out-of-capacity" situation is instructive. The workload characterization terminology invoked is almost completely tautological. Sudden growth of a workload immediately following relief of a capacity constraint is called *latent demand*. A workload that does not show evidence of latent demand is termed *stable*.

What is reflected here is anxiety about the effectiveness of your tools and the accuracy of your predictions exactly at the point where the organization is spending money based on those tools and recommendations. Unfortunately, like many anxieties, this one has a root cause grounded in experience. As a practical matter, it is often difficult to predict the impact of relieving a long-term capacity-constraint. One aspect of this difficulty is technical, another is managerial.

The technical difficulty is that in the period prior to a major configuration change, the usefulness of performance measurement data on workloads that are bottlenecked or constrained by the configuration is diminished. What is measured is the workload under constraint, not the workload at its *true* or *natural* level of demand. The measurement data for such workloads is limited to a narrower range than *actual* behavior. Peak load measurements will clearly show the effect of the system bottleneck but not the actual peak load.

The range of experience with the workload prior to the change may be too narrow to predict the behavior of the workload in the new environment where its circumstances are dramatically altered. However, by observing the behavior of the workload across major changes, you can measure the full size and scope of the workload and gain precisely the insight into the behavior of the workload that is needed to make accurate assessments for future growth projections.

Capacity Constraints

The managerial difficulty is that running under capacity constraints has repercussions within the organizations that depend on computer resources. When those resources are not adequate, organizations react in different ways. Application tuning may become a higher priority or an organization may find alternative ways to get its work done. Options for using the corporate mainframe may be considered. Plans for new applications may be shelved. The capacity planner is challenged to maintain lines of communication with application development and end-user departments during periods of capacity constraint to assess the organizational reaction.

The proponents of business element-based computer capacity forecasting can legitimately claim that their methodology

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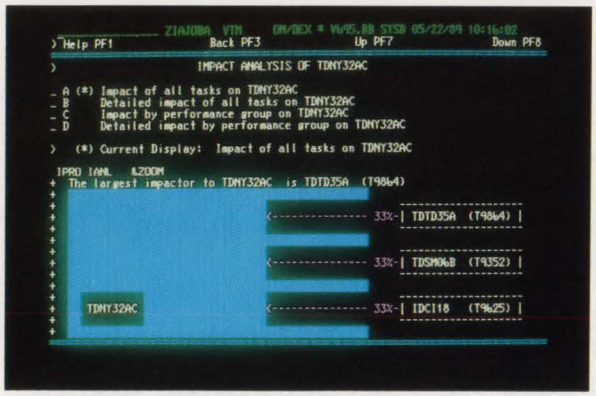

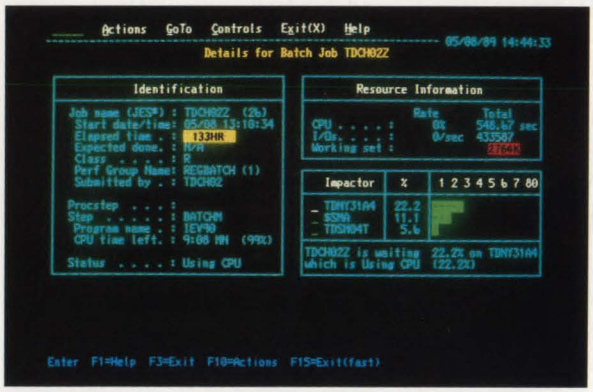

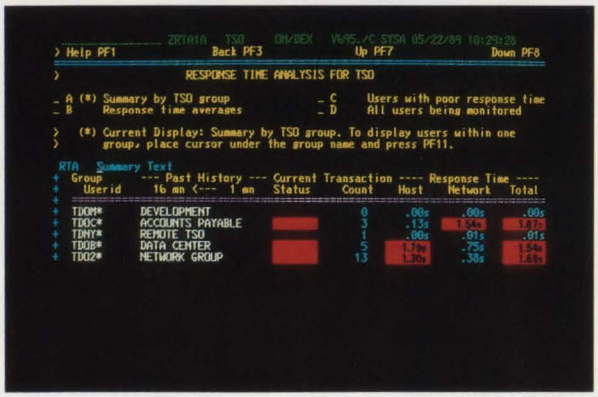

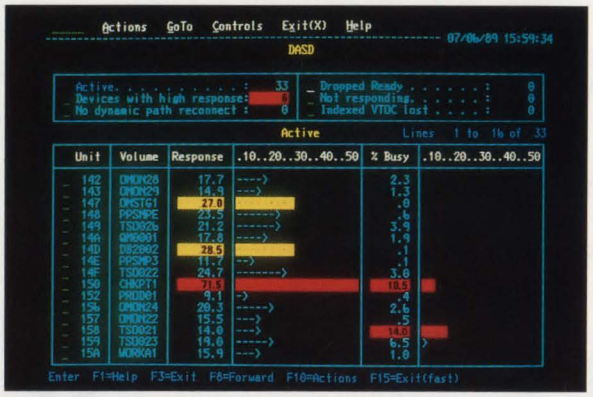

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offers an alternative for precisely this set of circumstances. Business elements correlated with historical data on computer workload growth, their proponents argue, can accurately predict capacity requirements across major configuration changes. Even the business element approach may need modification in the constrained environment, however. The organizational impact of capacity constraints can cause more than the disturbances in the historical record that business element forecasting can account for in its simple model of the organization's behavior.

Capacity constraints which are sufficient to impact service levels for strategic data processing systems can result in wide-reaching organizational consequences. A fairly typical result is to cause top management to question the ability of the MIS department to deliver. This kind of fundamental inquiry into the credibility of MIS can impact development plans, leading to deferral and delay of planned systems, a search for alternative hardware/software delivery platforms, radical surgery on existing applications or other consequences.

As noted above, one organizational reaction to capacity constraints is a search for more efficient alternatives to the *status quo* in data processing. If this quest is successful, it is likely to feed-forward and impact future processing requirements. The result will be, in business-forecasting terms, a change in the relation between DP costs and business activity which will require recalibration of the business element-based forecasting model.

The focus of this article is the impact of degraded performance during the period of extended capacity constraints on one of the client organizations. Because the human element in workload forecasting is difficult to quantify, it is often ignored. How the organization adapts to a period of capacity constraint is an important determinant of the growth pattern that will occur when the constraint is relieved.

The remainder of this article is organized into two major sections: background information on capacity planning and the major technical issues in the area of computer workload forecasting. It is intended to provide a flavor of the methods and concerns of the capacity planning group as it records, sifts and interprets the available measurement data on computer performance.

CPU Capacity Planning

Briefly, *workload* and measurements of *workload levels* are defined. Also, the goal of the capacity planner to produce forecasts of future workload growth, latent workload demand and its relation to historical forecasting is explained. Finally, there is a brief justification for doing capacity planning based only on prime shift resource consumption and service levels.

Data Center Computer Workloads

Among its activities, the capacity planning group typically maintains an historical database of information on the systems and the major workloads of a data center. The capacity planner breaks down the utilization of the data center according to key resources and major workloads. For the purposes of this article, the behavior of a computer system workload is characterized along three primary dimensions:

How a company adapts to capacity constraint is an indication of the growth pattern when constraint is relieved.

the rate of the arrival of new work, resource consumption of the workload and system response time. Some basic discussion of these terms is provided below. The body of analytical techniques that deal quantitatively with workload arrival rates, service time distributions and response time is known as queuing theory, a subdiscipline within Operations Research.

Characterizing Computer Workloads

The arrival rate of new work is normally given in units of work over time. For interactive systems, the appropriate unit of work is a *transaction*. A transaction is defined as the natural unit of work that the user of an interactive system sees. It represents all the work that is done between the time the user initiates a request to the time the system prepares and sends the appropriate response. Unfortunately, obtaining data that accurately measures the beginning and ending of transactions as users see them is complicated and expensive. Consequently, you are often forced to use measurements of transactions which only approximate the *true,* that is, user-perceived transactions that are involved in man-machine dialogues. In contrast, the unit of work for batch workloads in MVS is well-defined and causes little concern over measurement validity.

Most of the workloads in the data center studied that are of interest are transaction-processing workloads, so the idiosyncrasies in the definition and measurement of transaction-processing workload units are a matter of concern. Here, when data is presented for an on-line transaction workload, it refers to measurements of transactions internal to the processor itself. I use what I can get and will make no apologies for it, but the results must be interpreted in this light.

Transaction resource consumption is most often represented as a multi-valued function over the various computer resources used. This multi-valued function can also be conveniently represented as a vector. There are numerous problems related to characterizing the workload's resource consumption vector or profile due to incomplete and incompatible measurement sources.

The measurement of transaction response time that is reported, the third important area of workload characterization, is captive to the idiosyncratic definition of transaction boundaries. Generally, you are satisfied to collect and report internal systems response time with the hope that network and communications delays are relatively insignificant. Obviously, it is not possible to ignore the impact of the data communications network delays in many instances. Adding network response time to the internal transaction response time would yield a measure of transaction response that would closely approximate what the user sees.

Forecasting Workload Growth

Forecasting user workload growth and anticipating future capacity needs is the mission of the capacity planner. One of the initial goals of a capacity planning project is to build a database of historical information on resource utilization and service levels. As an accurate and detailed record of the past, the capacity planning database is designed to help data center management and the client organizations that use the center to plan for fu-

ture growth. The historical database is a primary source of information for use in forecasting. It is a tool and not an end to itself.

Statistical Forecasting

Statistical-based forecasting of historical trends has well-known and obvious limitations. One common mistake made in statistical forecasting is to make long-term projections based on limited data. Long-range extrapolations of rapid short-term growth conditions lead to growth estimates that drastically overshoot the mark. For example, growth projections based on the first few years of explosive growth in the home computer marketplace led to wildly optimistic estimates of the size of the market for these machines.

Forecasting from historical trends is also limited by the assumption that the future will be consistent with the past. The effects of sudden and dramatic change cannot be easily incorporated into these historical models. Projections of the use of computer equipment in this country made during the 1950s, for instance, could not anticipate the price/performance breakthroughs that were the result of the invention and subsequent advance of transistors, integrated circuits and microchips. Semiconductor advances were influential in propelling the computer business from a specialty business into a commodity market far larger than was predicted by the most wildly optimistic forecasters.

The computer technology breakthrough example suggests that it is difficult to predict growth once a supply-side or capacity constraint is relieved. The historical impact of the supply-side constraint is imminent in the data that is used to project the future. Technically speaking, a growth curve based on historical data from a period of a supply-side constraint can provide little in the way of information that can be used to predict what will happen when the supply constraint is absent. To take a well-known, recent example, Coleco, the makers of the Cabbage Patch dolls, could not accurately forecast demand for its product when that product was in short supply. Today, having produced something like 120 million dolls, or about four dolls for every child in America under the age of 10, Coleco's market forecasting folks have a more realistic view of the buying capacity of American families for toys of this kind.

To improve the accuracy of growth projections, forecasters often try to obtain user plans and schedules. A recent trend in DP capacity planning is to attempt to derive independent, "business-oriented" growth indicators which are natural forecasters of future DP activity. These trends reflect widespread recognition that the historical data in the capacity planning database needs to be augmented with user organization growth plans and development schedules to improve the quality and accuracy of forecasts.

Latent Demand

Sometimes, relieving a serious configuration constraint which, in turn, relieves a system bottleneck is followed by a period of rapid, unconstrained growth. This is sometimes known as *latent demand* or *pent-up demand*. The term latent demand as used by forecasters and capacity planners refers to instances where, following a major boost in capacity, a significant portion of the additional capacity is absorbed quickly.

A workload's sudden growth immediately following a capacity constraint is called latent demand.

The use of the term by those involved in forecasting is an admission of failure in one's methods. For instance, it can only be applied to a workload retroactively. The frequency with which latent demand is encountered suggests some underlying mechanism that may be useful in predicting or explaining when and where latent demand occurs.

Computer Workload Growth Trends

One pervasive factor in computer capacity planning is that most computer workloads are increasing in their demands for systems resources. If a continuously growing workload is configuration-bound for an extended period, it seems reasonable to expect a period of sharp growth following a configuration change that relieves the configuration bottleneck. The capacity constraint is, for a time, an artificial damper on workload growth. Once the constraint is removed, the normal pattern of growth continues.

When capacity constraints impact workload growth, service levels begin to deteriorate. It is not uncommon for the organization responsible for workload growth to put the brakes on development efforts and implementation schedules that would add still more work to an already overloaded system. When the bigger machine is installed and the constraint relieved, growth resumes. The phenomenon is a familiar one to many computer capacity planners. The fact that it is sometimes described as a *freeway effect* means the phenomenon is not unique to the data processing industry.

As you invest in larger and more powerful computer systems, the applications appear to absorb additional resources at ever increasing rates. In other words, computer workloads often grow at compound rates — in tandem with increases in computer price/performance, which are growing at (smaller) compound growth rates. Conditions of explosive growth in the size of computer workloads appear to be the rule, rather than the exception. It is commonly reported that computer workloads are growing at compound double-digit rates. Growth rates typically reported in the industry range from 25 percent annual growth in the demand for CPU processing power to 40 percent annual growth in DASD space requirements. A 40 percent growth rate compounded leads to a doubling of demand every two years. A 25 percent annual growth rate compounded will double resource consumption in three years.

Configuration changes that are required at regular intervals to stay abreast of this kind of growth are both expensive and disruptive. They are endured to gain the benefit of improved performance associated with relieving a capacity constraint. When there is significant latent demand, the relief provided by the upgrade is often fleeting. To the capacity planner actively engaged in managing capacity and performance trade-offs for the benefit of the organization, it is disconcerting to observe a pent-up workload soaking up recently added capacity like a sponge. Forecasting workload growth from historical trends is of no help under these circumstances. The *true* size of the workload re-

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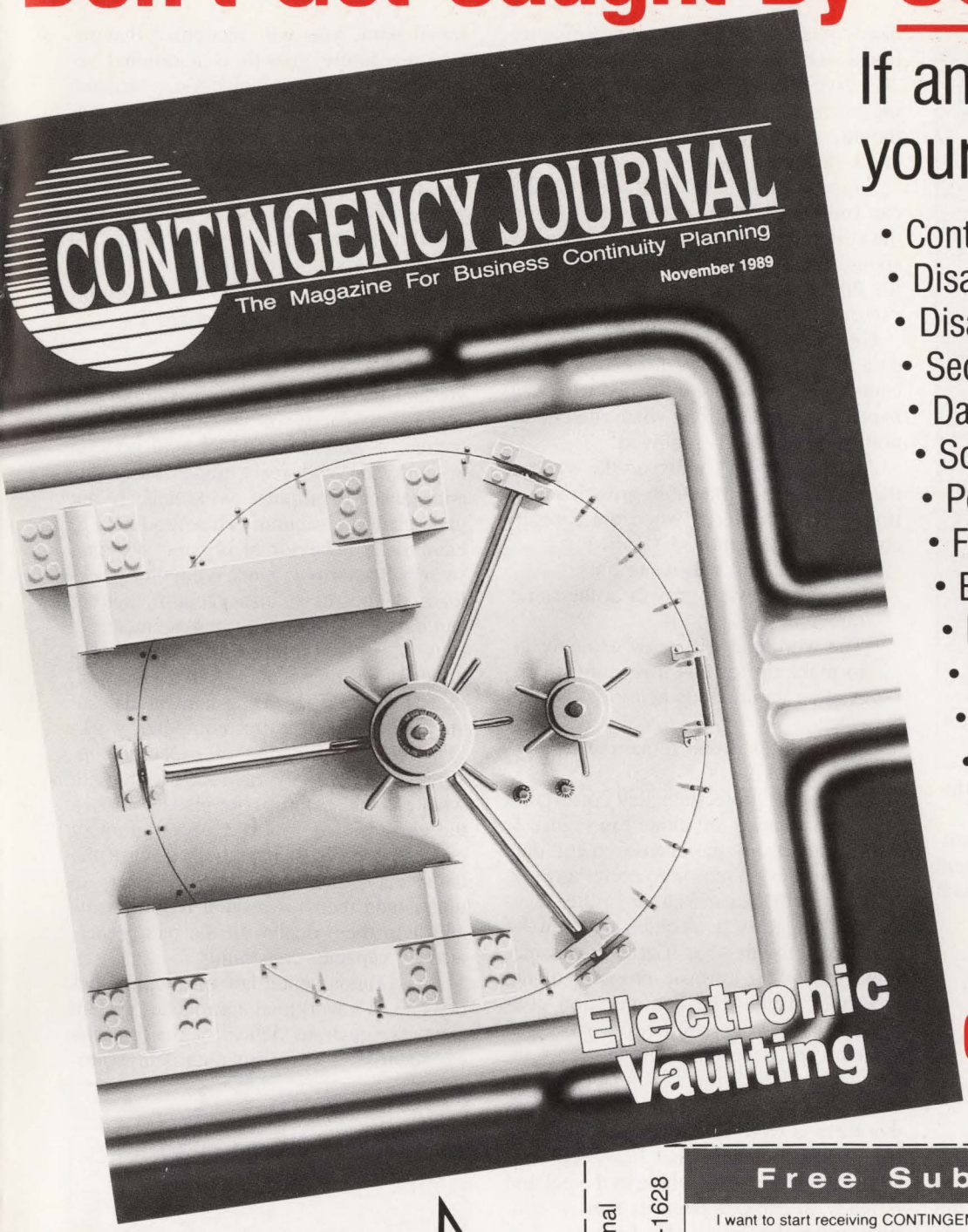

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FIGURE 1

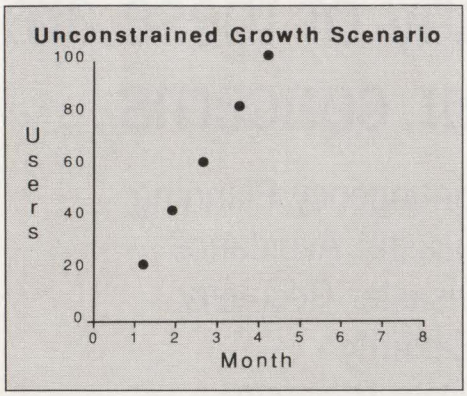
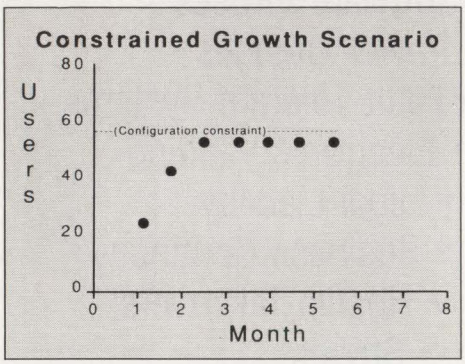


FIGURE 2



leased from its capacity constraint is difficult to estimate.

With these thoughts in mind, try to provide a more precise definition of latent demand. Latent demand is associated with the following set of conditions:

- The workload is being observed under conditions of constraint
- Workload growth is stymied by a bottleneck
- Once the bottleneck is relieved, workload growth will resume
- It is difficult to predict the rate of growth of the workload once the bottleneck is relieved.

Under the circumstances outlined above, it is more precise to say that the demand is *latent* in the sense that there is no way to predict the size and impact of the *true* demand from the available usage data, which is from the constrained system. Once a workload reaches a configuration-dependent system saturation point on the system, it becomes impossible to measure to what extent a pent-up demand for resources exists. From that point of view, latent demand is a symptom of the failure of historical forecasting methodology.

To illustrate the failure of historical forecasting under these conditions, look at the following workload growth scenario. Assume there is an interactive terminal workload for an application that has 20 active users. If this workload is growing linearly at the rate of 20 new users a month, you would construct the growth curve in Figure 1.

Suppose, however, the configuration can only support 50 active users before the system begins to encounter serious response time problems. The growth curve for this system will look like the one in Figure 2.

Given only the historical time series data in Figure 2, the performance analyst cannot predict with confidence what will happen to the workload when the configuration constraint is removed.

At the capacity limits of the system, there are several plausible growth scenarios to be considered when the capacity constraints are removed:

- The workload will resume its previous upward growth at the same rate
- The workload will grow explosively to make up for lost time until it can resume its previous historical growth rate
- The workload will remain at its current level.

The growth projections that correspond to these scenarios are plotted in Figure 3.

Working from the measurement data alone, there is no reason to prefer any one of the growth scenarios to any other. Scenario 1 suggests a mechanistic view of workload growth — as if growth is something that is an intrinsic property of the workload itself. The configuration constraint acts as a damper on workload growth, but once the configuration constraint is relieved, the workload begins to exhibit its old vigor. Scenario 2 suggests that there is workload growth inertia. Here the growth potential that has been constrained continues to bubble in the pot and is ready to explode from its narrow confines once the lid is off. Scenario 2 is more fatalistic than Scenario 1. The analogous physical model is Bernoulli's principle, illustrated by an expanding gas trapped in a narrow chamber, which explodes when it is released from its confines. In Scenario 2 the system finally achieves equilibrium, stabilizing at its previous growth rate, but not until the system has made up for lost time.

Scenario 3 is one possible result of a feedback loop that cuts off further growth in the workload when the out-of-capacity situation arises. If the out-of-capacity condition creates a degree of organizational pain, you will recognize that restricting future growth is a rational response of the organization. Organic systems which have the ability to process information about and adapt to their environment often behave in this fashion. When the growth of a system reaches capacity and it is inhibited from further growth, likely responses to this condition can create a situation in which no further growth will occur — at least for a while.

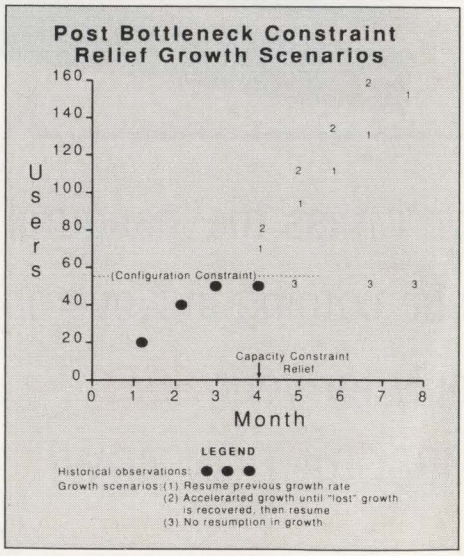
Organizational Responses To Capacity Constraints

In order to pursue these ideas further, you need to understand the behavior of a system at capacity, or what kind and what degree of pain is produced, and how an organization will react under these circumstances. Computer workloads are not generated in a vacuum. They are likely to exhibit the behavior of organic systems, such as Scenario 3. Since computer workloads do not exist in a vacuum, neither can data center capacity management.

A working hypothesis for building a good forecasting model is that organizations matter. How the organizations that are responsible for the computer workload react to a period of capacity constraint will probably have a lot to do with what growth scenarios are plausible when the constraint is relieved. A program of capacity management must get out of the data center and work with the users to understand their processing requirements and help them deal with the pain generated by capacity constraints.

It is a fundamental law of queuing theory that as a workload approaches system capacity, queuing delays begin to grow exponentially. These queuing delays pro-

FIGURE 3



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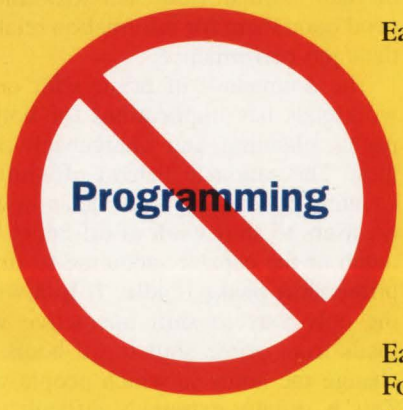

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duce a rapid degradation in system response time. Users of production transaction processing systems often rely on the computer for work activities that are important aspects of their daily jobs. When the user interaction with the computer is disrupted, work schedules are impacted and so is job performance and job satisfaction.

The user of a computer system that begins to encounter significant response degradation is often a dissatisfied user. Poor response time can have serious organizational consequences, especially with today's on-line production systems where users must interact with computer systems in order to accomplish their normal working tasks.

One of the things that dissatisfied users do is complain. They usually complain directly to the programmers they perceive as responsible for the stricken system. Unfortunately, these programmers and their managers are usually not the people who are responsible for acquiring new computer equipment. Computer performance and capacity is normally the responsibility of data center systems programmers and systems managers who are far removed from the users of the system that are feeling the pain and doing the complaining. It is often true, unfortunately, that these same systems programmers and systems managers are further insulated from dissatisfied users of the systems they manage because they are able to exploit their ''insider'' leverage and expertise to ensure that their required level of access to computer resources is maintained in the face of the capacity constraints.

If there is no communication between the user organization and the technical support staff responsible for equipment acquisition, there is no way for complaints about service to reach the ears of the people who can best take action to improve matters. This communication is a two-way street. Capacity planning personnel need to know about user growth plans so that they can anticipate out-of-capacity problems. Without this kind of information, the systems staff is in a position of fire-fighting. This requirement for a dialogue between applications (representing the user) and systems concerning performance and capacity requirements is often formalized as a Service Level Agreement (SLA).

An SLA is a contract between the applications and systems departments with mutual obligations and responsibilities. It establishes the framework for systems and applications to communicate on matters concerning systems performance and capacity. An SLA typically works as follows: systems promises to supply sufficient capacity to provide a certain level of service for a given workload at a given cost. When service falls below acceptable levels, systems agrees to diagnose the problem and remedy it. For its part, applications agrees to provide timely notification of workload growth plans. Should service become unsatisfactory due to workload growth beyond the capacity levels agreed to and without timely notification, then the responsibility for poor performance falls on the applications side of the house.

Procuring additional computer capacity takes time and costs money. That is why many business and government organizations have instituted formal computer capacity planning programs and SLAs to help in forecasting future computer capacity requirements. The capacity planning group maintains historical data on workload resource consumption and works with the user to help define his future processing requirements. The hope is that in working with the user and tracking historical data, capacity planning can reduce the pain for all concerned by avoiding serious out-of-capacity situations.

From 50 to 80 percent of all the service consumed in many data centers done so during prime shift.

Having reached a capacity constraint, the reaction of a user organization to the capacity constraint might well determine the growth scenario that would be expected once the capacity constraint is relieved. When the organization first encounters response time problems, its first reaction is often to initiate systems tuning. Systems tuning may identify areas where resource consumption can be reduced and alleviate the trouble once and for all. Growth Scenario 3 can be expected if the capacity constraint is a catalyst for tuning efforts which significantly reduce the workload's resource consumption requirements.

Once the system is tuned and the problems of poor response time remain, the issue of capacity management is unavoidable. Because capacity constraint relief is often not timely, the user organization is often forced to take steps of its own to control its workload and reduce the impact of the out-of-capacity situation. One action that a user organization would typically take when it encounters capacity constraints that begin to affect the performance of its computer systems is to prioritize existing work and defer new users and applications. Scenarios 1 and 2 then are likely results following the relief of capacity constraints when the user organization has acted to defer work.

Prime Shift Workloads

The information that follows includes a look only at workloads during prime shift hours. A word of explanation is required. It is during prime shift that the system must support the most users and the most demand for service. Proportionally, 50 to 80 percent of all the service that is consumed in many data centers is consumed during prime shift.

Production On-Line Workloads

Unlike the large batch systems of 10 years ago, most of today's service demand is for critical on-line systems. Users of the system interact in real time with these systems. They use them in the course of their normal work activities and depend upon them for information related to their job performance.

The dominance of prime shift on-line workloads has implications for both capacity planning and chargeback strategies. The rationale behind off-shift discounting policies is to provide an incentive for users to shift work to off-hours when much of the capacity acquired to support prime shift peaks is idle. It follows that the only way to shift interactive workloads from prime shift to off-hours is to change the hours in which people work. This is usually extremely difficult to accomplish and probably no discounting policy can make it happen. The result is that computer capacity planning must take this prime shift workload as a given and plan accordingly.

Peak Loads

From a performance standpoint, you are also primarily interested in periods of peak loads. It is during peak periods that utilization of system resources is highest. When utilization of resources is at its highest, then, from queuing theory, response time suffers the most from the effect of contention for overloaded resources. Thus, peak periods offer an opportunity to observe the system under stress. If there are bottlenecks in the system, it is more likely that they will be visible during periods of peak loads than at other times.

From a capacity standpoint, the system must be adequate for ordinary peak loads. *Ordinary* means those periods of peak load which occur routinely. There are also *extraordinary* peak loads or so-called *peak* peaks that are irregular and less predictable. A peak load that follows an extended system outage would be considered extraordinary. On the other hand, a peak load that occurs routinely during prime shift in mid-morning and mid-afternoon is ordinary. It is both regular and predictable. By definition, a system that is routinely overloaded by ordinary peak loads is out of capacity.

Cost Accounting For The Information Utility

Historically, the rise in on-line production systems has transformed the data center from a production job shop to an information utility. Since there is usually no way to shift peak loads around in today's on-line production systems, it is necessary to configure the system so that it is large enough or has sufficient processing capacity to handle ordinary peak loads. This has economic implications for the users of the data center. In a data center with cost accounting, it is necessary to recover the costs of maintaining peak load capacity for the users and workloads who require it. Similar to cost recovery strategies used in other utility industries, some combination of fixed cost recovery (connect charges and load sensitive charges — resource utilization based charges) provides the overall flexibility that is necessary to support an information utility.

Production Batch Workloads

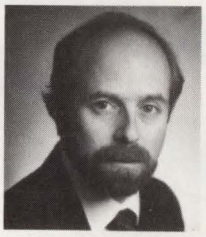
In today's on-line environment, batch production work cannot be ignored entirely. Of particular significance is batch production that is ancillary to the production on-line systems. This workload includes four types of batch work:

- Concurrent batch database maintenance and development
- Concurrent production batched reports and updates
- Stand-alone batch database maintenance and development
- Stand-alone production batched reports and updates.

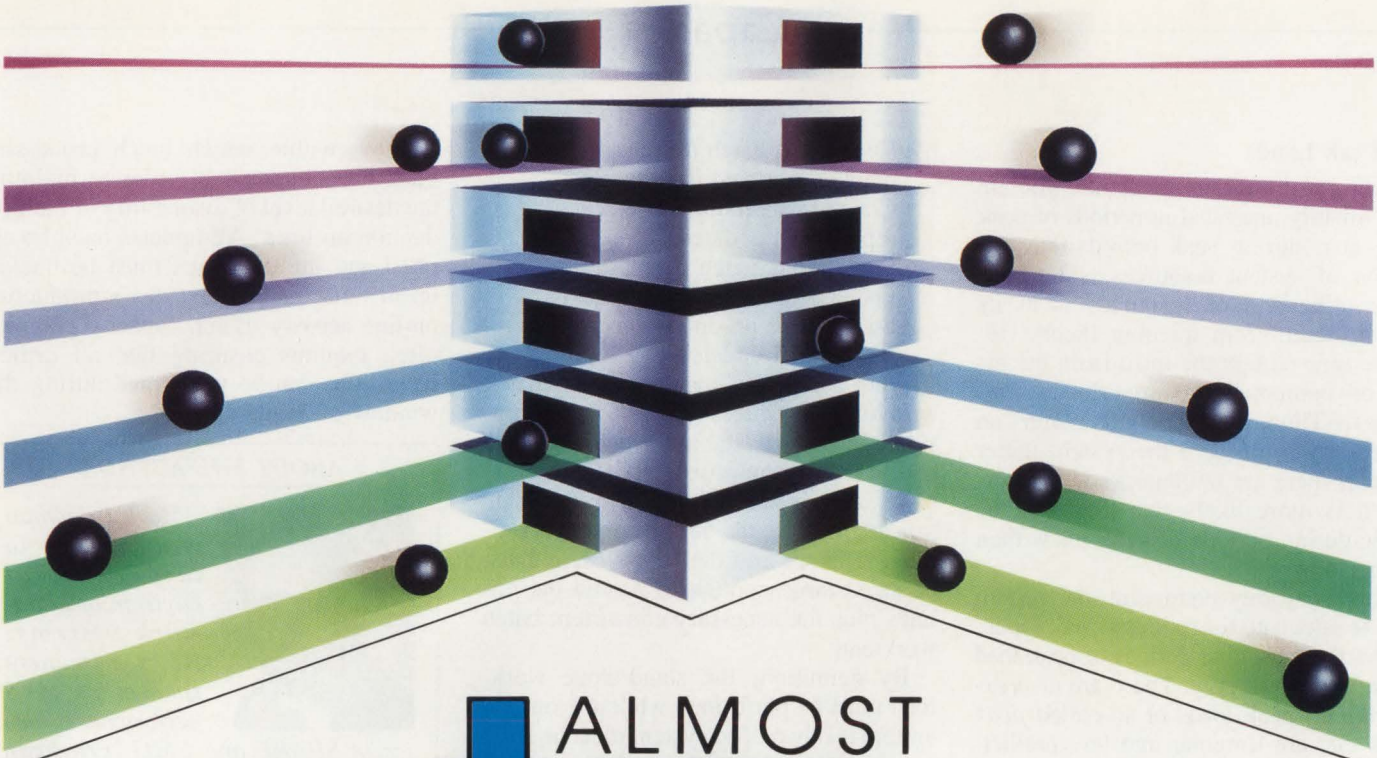
From a capacity standpoint, this batch workload introduces the following considerations. For database synchronization and integrity purposes, the concurrent batch work is normally done on the same processor where the on-line system is running. This means that the system must be sized large enough to handle the on-lines plus the necessary concurrent batch workload.

By definition, the stand-alone workload must be performed while the on-line system is down. The system must be large enough to process the stand-alone work in time to bring the on-line system back up according to schedule. The stand-alone batch workload includes batched database update processing (typically more efficient than one-at-a-time updating) and database backups. There is normally a time window within which batch processing must be completed in order to maintain the desired level of availability of the production on-lines. All updates must be applied and the databases must be backed up in time for the next day's production on-line activity. Batch capacity planning often requires ensuring that all critical batch jobs can be performed during this window of availability.

ABOUT THE AUTHOR



Mark Friedman is a Director in the Technical Division of Landmark Systems. He is a frequent speaker on MVS performance topics at SHARE and CMG. Friedman has 10 years experience as an MVS performance analyst and a developer of performance analysis software tools. Landmark Systems Corp., 8000 Towers Crescent Dr., Vienna, VA 22180, (703) 893-9139.



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ISPF

The String Manager

By Jon E. Pearkins

The ISPF Editor is a productive tool for text formatting. The T Line Commands are the main tools.

Formatting Text

Text Enter (TE) entered on the first line of the screen will make available a full-screen. You can then type without having to worry about where one line ends and the next begins.

Text Format (TF) provides standard line lengths for text. When used in conjunction with the RIGHT Primary Command, you can do practically anything.

Text Split (TS) is just what you need when you want to add a word or phrase to a line but there is not enough room on the line to insert it. If you are like me, you will soon find you use it more than the other two, especially if you assign it to a PF key. Tom Zirtzlaff, project leader for P.A. Bergner & Co. (Milwaukee, WI), uses it most when inserting another parameter into an already full line of JCL and when editing a line of COBOL containing several long data names. The TS Line Command splits any line into three lines. Assuming the cursor is on the same line as the TS was typed, the text before the cursor will be on one line, a new blank line will be inserted and the text after the cursor will be moved to the left-most column of the (also new) third line.

For getting maximum advantage out of the TS Line Command, assign :TS to a PF key you do not normally use. Then all you have to do is position the cursor at the point in a line where you want to split it and hit the PF key. If you do not want the new blank line in the middle, just hit ENTER and it will disappear.

Bill Yarberry of Enron Corp. (Houston, TX) asks, "The wrap feature is really nice when you are doing documentation. How would you write half a page of documentation in TE mode and subsequently *flower box* it so that it can be inserted as comments in a program?"

On the Command Line, type BOUNDS 4 68 and TE in front of the line where you would like to insert the comments. Start typing and do not worry about words that seem to be straddled between lines. When you hit ENTER, you will find that your text starts in column four on every line and never strays past column 68.

The first time you do this, you will have to create the asterisks that will surround the box. Type EDIT BOX on the Command Line to create a two-line file without losing your present file. The first line

Solutions to your problems and answers to your questions

is a line of asterisks filling up columns one through 71. You can do this by using the typamatic feature of IBM 3270s. Hold down the asterisk key and it will continuously type asterisks across the line. Stop in time to leave the last column (72) blank.

The second line is just two asterisks, one in column one and the other in 71. One way is to use the R (Repeat) Line Command to create the second line and use the space bar beginning in column two to remove all the asterisks between columns two and 70. Then hit PF3 and you will be back in your first file where you were typing the text.

Type the COPY BOX Primary Command and use the B (Before) Line Command in front of the first line of text you want to surround. The two asterisk lines will be inserted just before the text. Use the Copy Line Command to insert a copy of the asterisk line at the end of the text: C in front of the asterisk line and A on the last line of text. Type the M (Move) Line Command in front of the second line (containing only two asterisks) and OO (Overlay) in front of the first and last line of text. The result is an asterisk box around your text.

The same approach could be adapted to programs with other commenting conventions, like /* to begin and */ to end each comment line.

Too Short

Ever get frustrated because the ISPF Command Line is too short for a CHANGE command with long search and replace strings? The following solution is not elegant, but it does get the job done.

Pick a character not used anywhere in the file. My favorite is the stick ("|") or solid vertical bar, located over the number one on most IBM 3270 keyboards. You will now have to type two CHANGE commands, instead of one. The first will change (possibly all occurrences of) the string you are searching for to a stick. The second will change the stick to the replacement string. For example, if you could not fit the following CHANGE statement on one line:

```
CHANGE "from string" "to string" ALL
```

you could break it up into two statements:

```
CHANGE "from string" "|" ALL
CHANGE "|" "to string" ALL
```

Again, be sure the character you have chosen does not occur anywhere in the file. Otherwise you may find yourself in the position of the neophyte programmer I knew who wanted to have a single blank between sentences, instead of the traditional two. Thinking only of the blanks, he forgot the period in the replacement string:

```
CHANGE ". " " " ALL
```

As the results were displayed milliseconds later, he realized his mistake. Each sentence now ended with a single blank and no period. Fresh out of school, he remembered just enough mathematics to recollect that everything is reversible:

```
4 + 3 = 3 + 4
```

so he typed:

```
CHANGE " " ". " ALL
```

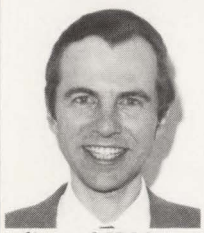
hoping to get back where he started, so he could try again. If you have been following the story, you know what he ended up with: a period and two spaces between each word.

Next Time

Are there other ways to work with text using ISPF? Certainly. After all, text formatting was the most popular topic, according to reader response. If you have text-related suggestions, ideas or questions about ISPF, contact *MAINFRAME JOURNAL*.

The next article will explore one reader's approach to getting the most productivity out of his PF keys, take a brief look at ISPF edit macros and show you how ISPF takes the topic of recursion and lets you work on 20 files at once.

ABOUT THE AUTHOR



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DB2 *from page 58*

mulated ad hoc inquiries. Whereas the typical CICS application is designed always to handle data in a consistent fashion, ad hoc work is unpredictable in the requests made against the data. Users often like doing their own queries because they can get fast results without having to induce the programming department to do it for them.

This type of work needs to be limited (preferably prohibited) when production operational databases are involved. This is because it is easy to dominate DB2 with ad hoc queries to the point where CICS throughput suffers markedly.

Another facet to the ad hoc issue is that many users will prefer to have a recent but static database, rather than one that is changing while they make successive studies of its data over a period of minutes or hours. In order to correlate data from multiple queries, such users would prefer that the data not change between runs.

These facts combined mean there often will have to be an extract of the operational database for ad hoc use, which in turn means that the disk space requirement is usually doubled.

Conclusion

DB2 does offer a lot of advantages in productivity both for programmers and end users. And it uses more computer resources than older access methods, just as one would expect. It is difficult to predict whether a given DB2 query innately requires two times the computer power of the same query written for VSAM or 10 times the power. However, if the query is casually designed, using a thousand times the resources of the same query written in VSAM should not surprise anybody.

Write your queries so that they will lead the DB2 optimizer to the best solution to the problem and always use Explain to ensure that you are indeed leading it down the right path. The results can be truly gratifying.

ABOUT THE AUTHOR

Michael Snyder is senior technician in the application development group at Kaiser Foundation Health Plan, Inc. His background includes 20 years of applications development concentrating on analysis, design and coding.

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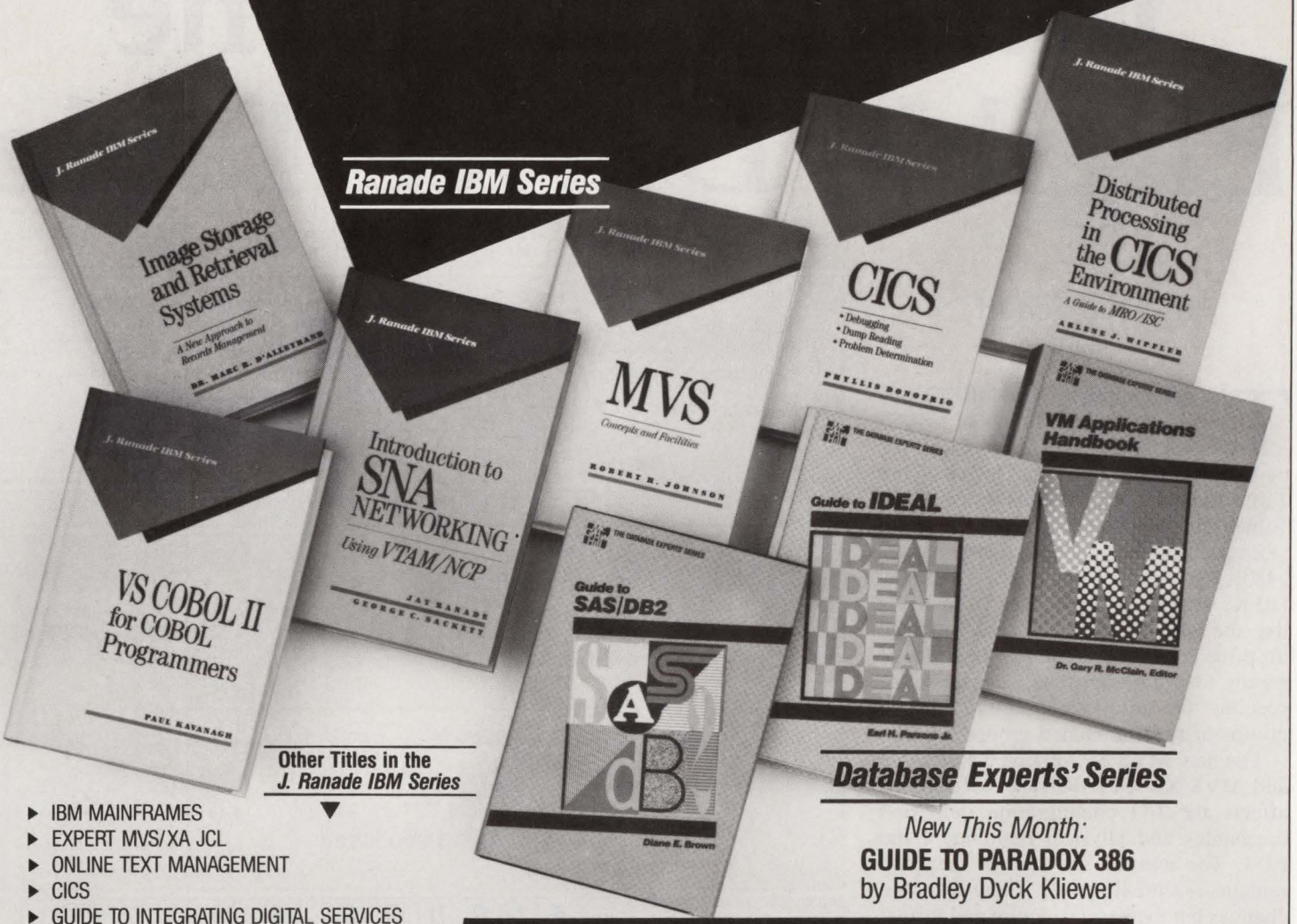

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Interrogating The Eligible Device Table

By Fred Schuff

The Eligible Device Table (EDT) was introduced with MVS/XA (MVS/SP R2.1.x.) The EDT replaced the two predecessor tables, the Device Name Table (DEVNAMET) and Device Mask Table (DEVMASKT) to keep track of devices and the related generic (that is, 3380, 3480, 3705) and esoteric (that is, SYSDA, DISK, TAPE) device names. The EDT, like the DEVNAMET and DEVMASKT in prior operating systems, provides a means to programmatically locate/select specific devices belonging to device groups or specific named groups.

The new MVS/SP Version 2 Release 2 and MVS/XA DFP Version 2 Release 3 affects the I/O configuration definition mechanics and physical building of the EDT. The internal structure of the EDT remains essentially intact. There are some changes but the basic structure and format follow the pre-Release 2.2 Version.

The EDT is a good mechanism to locate data about the device configuration within a system from executing programs (this is the interface used by JES). Breaking the EDT down into its components and then decoding the information allows dynamic access to device data without having to change code or modify internal tables each time the I/O configuration is modified.

When writing code to look at the devices in the system, the most common practice is to run the Unit Control Block (UCB) chain. The operating system also provides a utility routine to scan the UCBs, one at a time, with some generic (for example, 3380) or esoteric (for example, TSO) device names. An alternative is to access the EDT directly to look at devices in groups by device type (tape, DASD, unit-record and so on) or by esoteric/generic device names.

Of course, wandering through these ta-

FIGURE 1

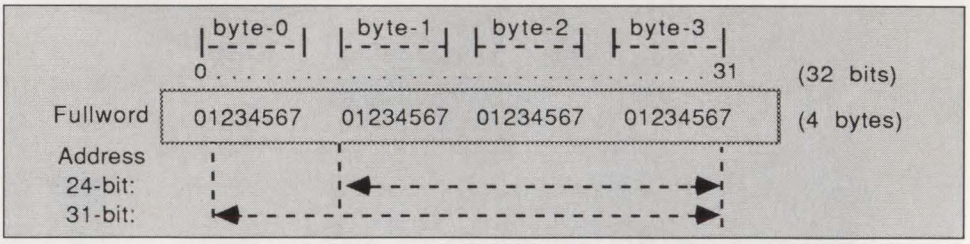

FIGURE 2

```
              MACRO
    &NAME     MODE24  &REG=15
              LA      &REG,*+6
              BSM     0,&REG                  GO TO 24-BIT MODE
              MEND

and           MACRO
    &NAME     MODE31  &REG=15
              CNOP    2,4
              L       &REG,*+6
              BSM     0,&REG                  GO TO 31-BIT MODE
              DC      A(*+4+X'80000000')
              MEND
```

FIGURE 3

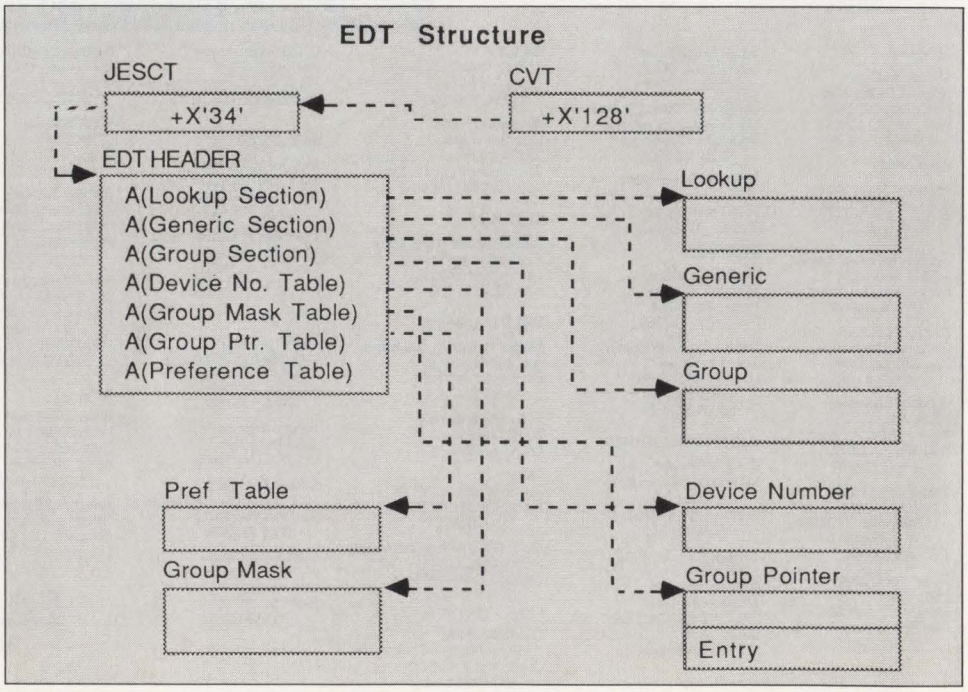

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FIGURE 4

EDT Header Layout

+00	A(Lookup Section)	(4)
+04	A(Generic Section)	(4)
+08	A(Group Section)	(4)
+12	A (Device Number Table)	(4)
+16	A(Group Mask Table)	(4)
+20	A(Group Pointer Table)	(4)
+24	A(Preference Table)	(4)
+28	EDT ID Name	(8)
+36	Create MM/DD/YY	(8)
+44	Create HH.MM (5)	Reserved (3)
+52	"EDT" (3)	Level (1)

FIGURE 5

+00	number of entries in table/section	(4)
+04	length of each entry	(4)

FIGURE 6

Lookup Value Section Entry Layout

+00	Unit name in EBCDIC (i.e. "3380 ")	(8)
+08	Lookup Value (i.e. X'3010200E')	(4)
+12	A(Group Mask Table Entry)	(4)
+16	Number of Generic Section Entries	(4)
+20	A(First Generic Section Entry)	(4)
+24	Flags	(4)
+28	A(Alt. Group Mask Table Entry)	(4)
+32		

FIGURE 7

Generic Section Entry Layout

+00	Generic Device Type (i.e. X'3010200E')	(4)
+04	Number of Generic Device Groups	(4)
+08	A(First Group Pointer Table Entry)	(4)
+12		

FIGURE 8

Group Pointer Sub-Table Entry Layout

+00	A(Group Section Entry)	(4)
+04		

bles can be a little easier with a few notes from those who have been there before. First of all, since the EDT is above the 16MB line, it is a good place to do some 31-bit addressing which expands the use of a fullword (32 bits) to add seven more bits for creating or calculating addresses (see Figure 1).

Bit-0 (leftmost) is still reserved as the flag bit for indicating end-of-list for address lists. Bits one through seven are now added to the addressing portion of the fullword to make the address 31-bits long rather than the three-byte (byte one, two, three) 24-bit address.

One of the major problems with conversion to 31-bit addressing is the use of the seven bits (bit one through seven in byte = zero) for data rather than addressing. Where those bits hold data or flags, running in 31-bit mode yields erroneous results.

To switch addressing modes, two macros in Figure 2 are simple and useful.

By coding the "MODE24" or "MODE31" macro in a program, you switch from 24-bit to 31-bit addressing mode or vice versa. The Branch and Set Mode (BSM) instruction uses the high order bit of R15 to trigger the 31-bit addressing mode and the rest of R15 as the 31-bit address. If bit zero of R15 is zero, then the switch is made back to 24-bit addressing and branch to the address in R15.

Locating the EDT is relatively simple through the JES2 Control Table (JESCT):

```
L   R2,16(R0)          A(CVT)
L   R3,X'128'(R2)      A(JESCT)
L   R4,X'34'(R3)       A (EDT HEADER)
```

After locating the EDT (R4), switch to 31-bit addressing because the EDT is above the 16MB line:

```
MODE31 15       SWITCH TO 31-BIT MODE
```

The EDT is really a series of tables. There is the main EDT comprised of a Header and three other sections (Lookup Value Section, Generic Section and the Group Section). There are also four subtables, the Group Mask Table, Group Pointer Table, Preference Table and the Device Number Table. Together these make up the EDT.

The description in Figure 3 illustrates the EDT in MVS/SP 2.1 and MVS/XA DFP 2.2 systems.

The EDT Header is laid out as shown in Figure 4. Looking at each of the individual sub-tables and sections provides a good picture of the data which is available.

Lookup Value Section

This section, like all of the sections and sub-tables, begins with two words as shown in Figure 5.

The Lookup Value Section defines all of the Generic and Esoteric Device Names and initiates the chain to reference device data from those specific eight-character

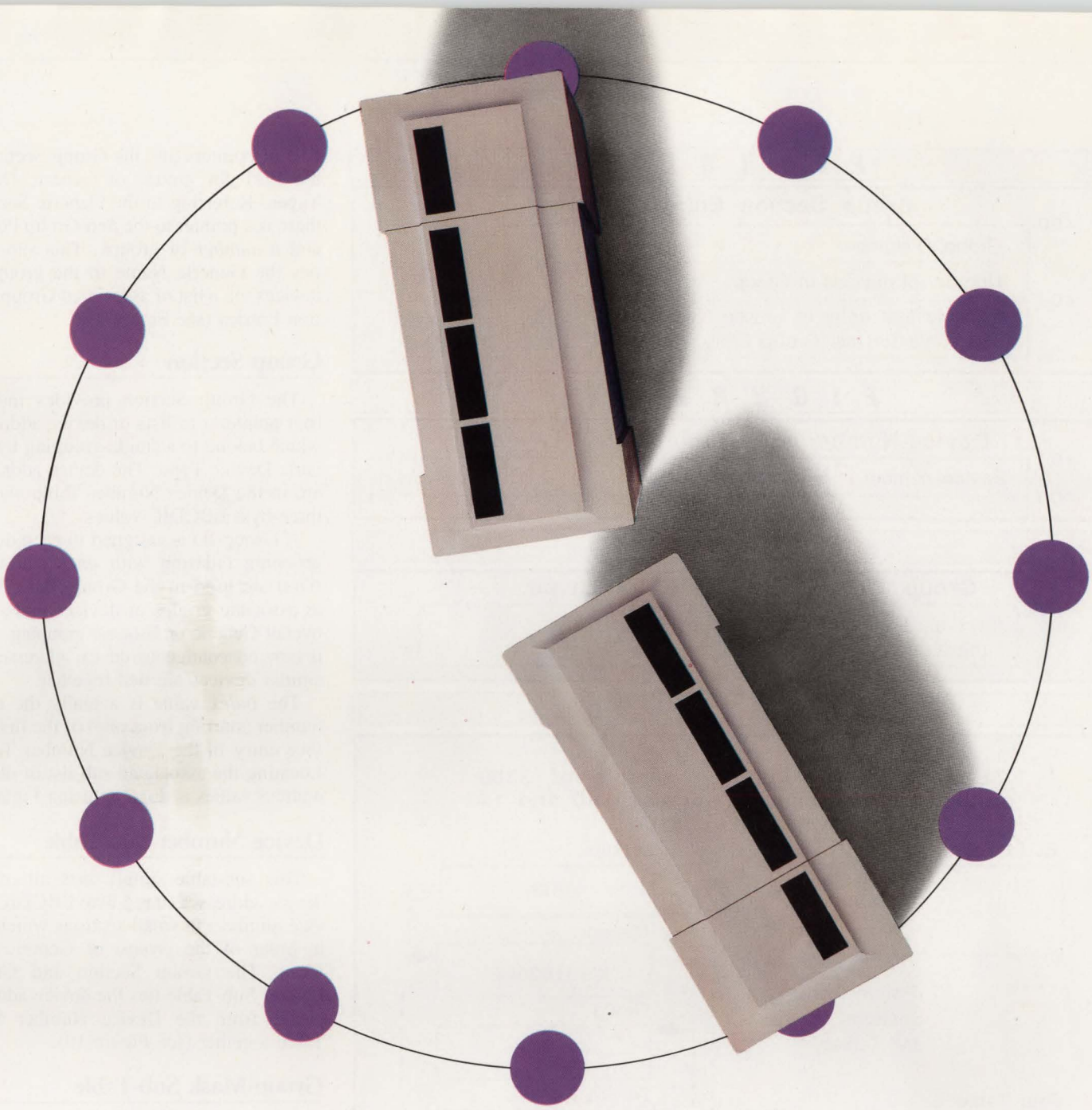

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FIGURE 9

Group Section Entry Layout

+00	Group ID Number	(2)
+02	Number of devices in Group	(2)
+04	Index to first entry in Device Number Sub-Table for this Group Entry	(2)
+06		

FIGURE 10

Device-Number Sub-Table Entry Layout

+00	Device number in EBCDIC (i.e. "1A0")	(3)
+03		

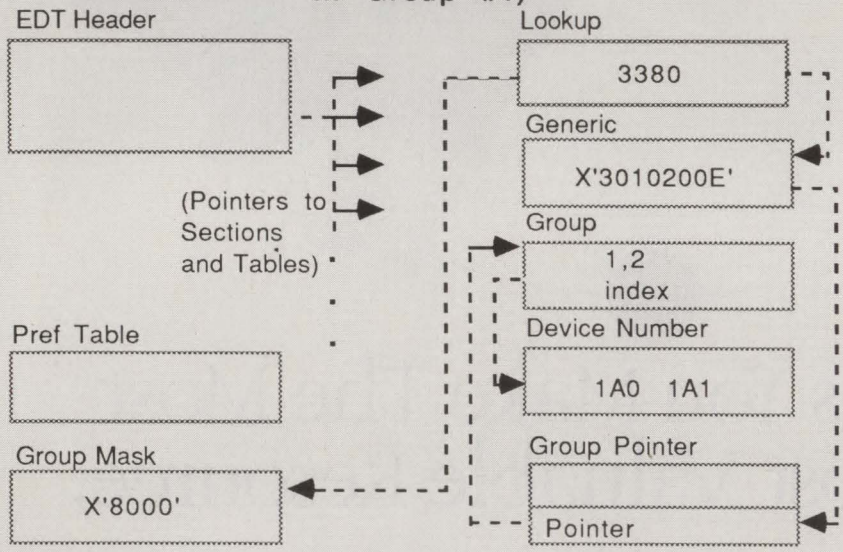
FIGURE 11

Group Mask Sub-Table Entry Layout

+00	Bit-map (1 bit per Device-Group ID) (bit 0 => Group ID = 1)	
+0n		

FIGURE 12

EDT Internal Pointers (example of 3380 defined as 2 devices at address 1A0 and 1A1 in Group #1)



EBCDIC names. The current length of each entry in the Lookup Value Section is 32 bytes.

The Lookup Value Section points to both Group-Mask Sub-Table Entries and the first Generic Section Entry for this EBCDIC-named Device Group (see Figure 6).

Generic Section

This section provides an entry via Generic Device information as defined in the UCB-TYPE (four byte) field. Specific Generic Device location (like Generic 3380 = X'3010200E') can be initiated in this manner by scanning for the desired four-byte Generic Value and then locating the specific groups of those devices defined within the system (see Figure 7).

Group-Pointer Sub-Table

The Group-Pointer Sub-Table contains lists of pointers into the Group Section of the EDT for groups of Generic Device Types. Referring to the Generic Section, there is a pointer to the *first* Group Pointer and a *number* of groups. This sub-table ties the Generic Name to the groups of devices via a list of associated Group Section Entries (see Figure 8).

Group Section

The Group Section provides indexes (not pointers) to lists of device addresses which belong to a single grouping by Generic Device Type. The device addresses are in the Device Number Table and are three-byte EBCDIC values.

A Group-ID is assigned to each device grouping (starting with one) and those ID(s) are used in the Group-Mask Table to associate groups of devices under one overall Generic or Esoteric grouping. This is how noncontiguous device addresses for similar devices are tied together.

The *index* value is actually the entry number (starting from one) of the first device entry in the Device Number Table. Locating the associated sub-list of device address values is done by using Figure 9.

Device Number Sub-Table

This sub-table simply lists all of the device addresses (three-byte EBCDIC device number) in small sections which are in order of the *groups* of Generic Devices. The Group Section and Group Pointer Sub-Table ties the device address pieces from the Device Number Sub-Table together (see Figure 10).

Group-Mask Sub-Table

The Group-Mask Sub-Table is a bit map. Each bit represents one entry in the Group Section (starting with one). The bit mask ties these Group IDs together to relate all of the groups for a given Generic Device Type directly. Remember that the Lookup Section Entry points to this *bit map* to define all of the Generic Devices of the same grouping (see Figure 11).

Now you can look at the internal pointers within the EDT structure to see how the different section and sub-tables relate the data in the EDT (see Figure 12).

Sample EDT Scan Program Description

To actually scan the EDT is rather simple. It just involves keeping track of where you are. The scanning can be expanded to obtain actual device information (like

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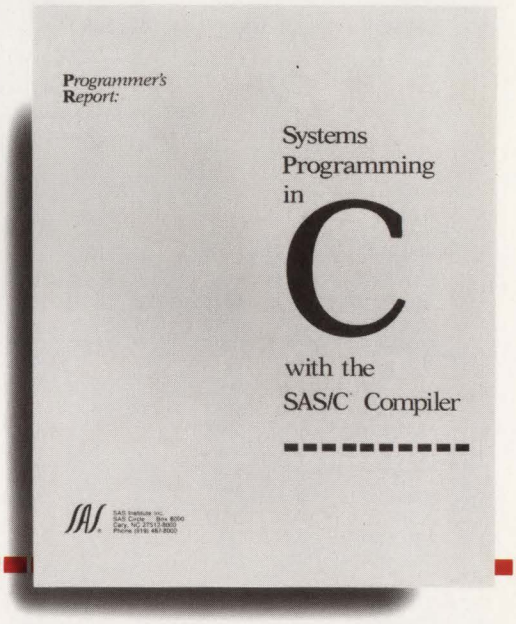

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FIGURE 13

```
*
*                    DECODE MASK TABLE BITS TO FLAG BYTES . . .
*
            L       R11,X'10'(R4)          A(MASK TABLE HEADER)
            L       R11,X'04'(R11)         L'EACH TABLE ENTRY (BYTES)
            ST      R11,MSKCOUNT           SAVE IT
            LA      R1,MSKTABLE            MASK BYTES
MASK001     SR      R14,R14                CLEAR
            SR      R15,R15                CLEAR
            IC      R15,0(R10)             R15 = X'000000XX'
            SLL     R15,24                 R15 = X'XX000000'
            LA      R0,8                   COUNT
MASK002     SLDL    R14,1                  R14 = X'00000001' OR
*                                                X'00000000'
            O       R14,=F'240'            MAKE IF '0' OR '1'
```

At this point, R14 has a value of 0 or 1 and we continue to process through all of the Group Mask bits in the byte:

```
            STC     R14,0(R1)              SAVE MASK BIT
            LA      R1,1(R1)               NEXT MASK BYTE
            SR      R14,R14                CLEAR R14
            BCT     R0,MASK002             LOOP THRU ALL 8-BITS
```

APPENDIX A

Sample Output Of EDT Scan Program

Section 1: By Device Name

DEVNAME	DEV-TYPE	COUNT	UCB-ADDRESS										
3705	50004015	2	050	840									
3791L	500040F1	20	640	650	660	670	680	690	6A1	6A2	6A3	6A4	6A5	6A6
			760	770	780	790	7A0	7B0	7C0	7D0				
CTC	10004100	3	700	FE0	FF0									
BRIDGE	00012000	1	346											
			- - - OFF											
PP	00022000	12	1A1	1A3	1A7	1B2	1B6	261	262	263	266	272	273	501
			PROD01		PROD04		PROD06		PROD11		PROD07		PROD02	
			PROD03		PROD14		RPT001		- - - OFF		- - - OFF		PROD01	

*
*
*

Section 2: By Device Address

VOLSER	CUU	MNT	3	3	B	C	C	D	S	S	S	W	V	S	S	*	*	*	*	*	*
VOLSER	CUU	MNT	3	3	R	P	T	I	Y	Y	Y	O	I	Y	Y	*	*	*	*	*	*
VOLSER	CUU	MNT	8	5	I	*	*	S	S	S	S	R	O	S	S	*	*	*	*	*	*
VOLSER	CUU	MNT	0	0	D	*	*	K	*	D	S	K	*	T	A	*	*	*	*	*	*
VOLSER	CUU	MNT	*	*	G	*	*	*	*	A	Q	*	*	S	L	*	*	*	*	*	*
VOLSER	CUU	MNT	*	*	E	*	*	*	*	*	*	*	*	*	L	*	*	*	*	*	*
VOLSER	CUU	MNT	*	*	*	*	*	*	*	*	*	*	*	*	D	*	*	*	*	*	*
VOLSER	CUU	MNT	*	*	*	*	*	*	*	*	*	*	*	*	A	*	*	*	*	*	*
------	---	---	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAGE21	120	PRI		Y											Y						
PAGE22	121	PRI		Y											Y						
TSO010	1A0	STO	Y												Y						
PROD10	1A1	PRI	Y			Y		Y			Y	Y		Y		Y					
TSO009	1A2	STO	Y											Y	Y	Y					

*
*
*

VOLSER, status and so on) from the UCB. This is done by scanning the UCBs to find the matching UCB(s) for those device addresses which met your selection criteria from the EDT.

An EDT scan program was written to display the devices defined under each of the Generic or Esoteric Device Types and list the DASD devices by VOLSER and Device Address with the list of associated Device Names for each device. The program uses the structure of MVS/SP 2.1 and DFP/XA 2.2 control blocks.

As the EDT is scanned, data is extracted and placed in several tables, of fixed size, for Device Types and then associated VOLSERs. Note that the addressing mode switches from 24-bit to 31-bit mode as each Device Type is scanned. The I/O requests are made in 24-bit mode while the EDT must be accessed in 31-bit mode.

Splitting apart the Group-Mask Table (bit map) is done by processing one byte at a time (eight bits) and using the SLDL instruction to isolate one bit at a time in R14 (see Figure 13).

It is at this point that you go to the next byte in the bit map until all of the bytes are exhausted.

```
            LA      R10,1(R10)             NEXT BYTE
            BCT     R11,MASK001            LOOP THRU ALL N-BYTES
```

The sorting and reporting were created for my needs and can easily be changed for the types of reporting that you would prefer. Another alternative would be to make this code into a *callable* routine to return a table of either Device Types — Generic or Esoteric, return all Device Addresses for a given Device Type or return all Device Types associated with either a specific Device Address or a VOLSER of a DASD volume.

Actually, there is really little code or processing that is required in such a routine to locate and extract data from the EDT. Sample output is attached in Appendix A.

In Conclusion

That is about all there is to it. The EDT provides a simple source of information that can be dynamically accessed at program execution time. This frees you from defining and maintaining additional tables of devices and device names. Once the EDT structure is understood, extracting information is rather simple. You should, from this point, be able to forge ahead and use the EDT to help with your specific requirements.

Due to space limitations, the sample program to extract information from the EDT and the layouts of the EDT Control Blocks for MVS/SP R2.2 and DFP/XA R2.3 are not included. For copies of this information, send a 5½″ DS/DD formatted floppy (IBM PC compatible) to me along with a self-addressed and stamped envelope.

ABOUT THE AUTHOR

Fred Schuff is a systems programming consultant for Systems/Software Engineering, a systems and management consulting firm in Wayne, PA. Schuff has worked in a number of different industries in systems programming, database support and application design and consulting. S/SE, 940 W. Valley Rd., Ste. 1603, Wayne, PA 19087, (215) 341-9017.

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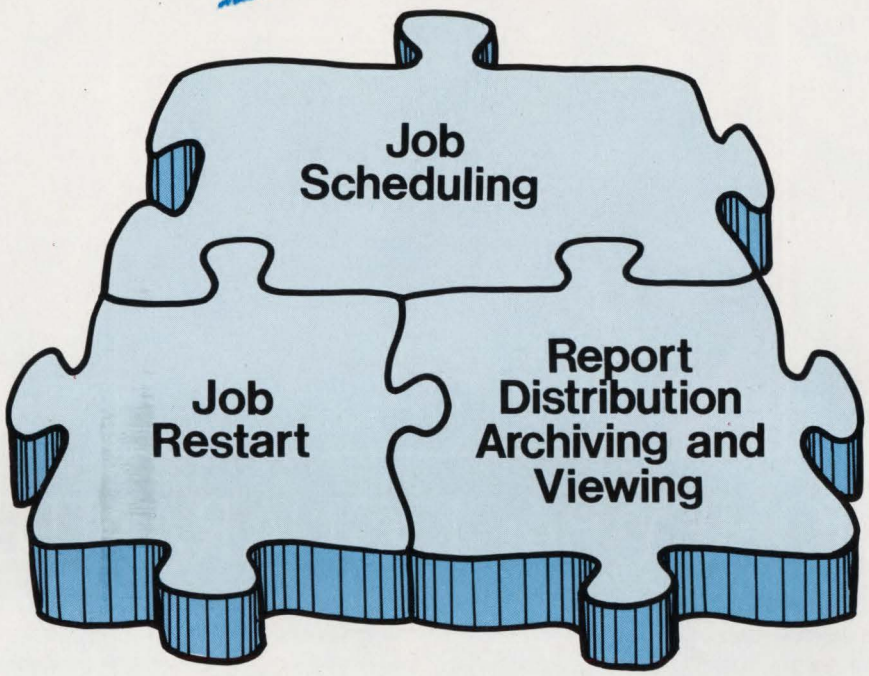

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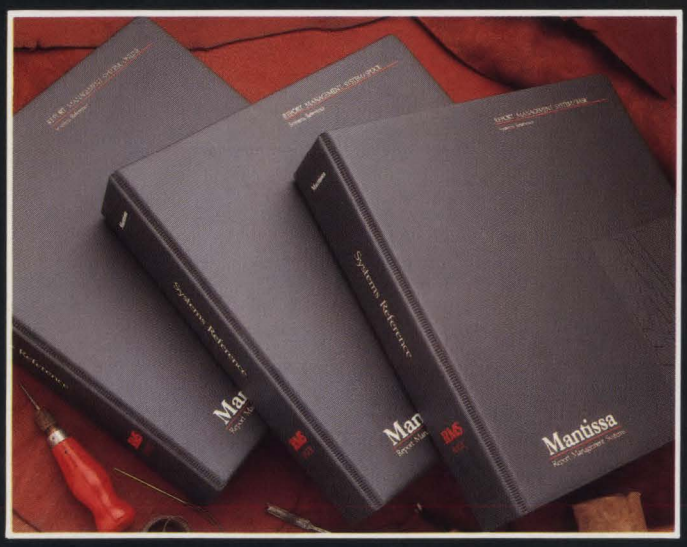

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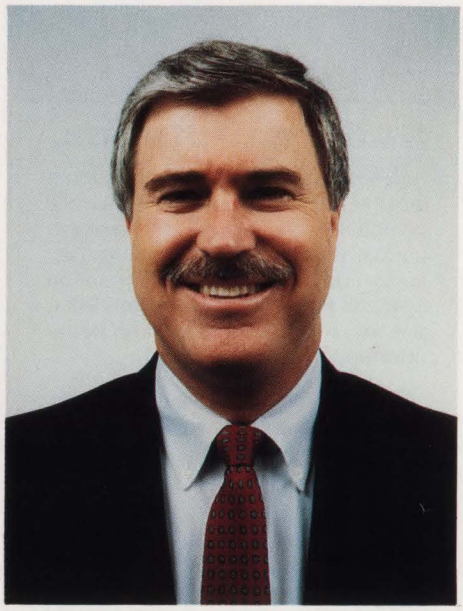
The UNIX Juggernaut

How Will It Affect Mainframe Environments In The 1990s?

By Michael C. Scroggie



Michael C. Scroggie, President and CEO of Unicorn Systems Company

With the 1980s quickly coming to a close, it is time to reflect on the changes we have seen in our industry over the past 10 years and ponder the issues which will have major impact in the 1990s. During the 1980s we have seen the continued dominance of IBM in the mainframe sector, the rise and fall of several minicomputer manufacturers and the birth and adolescence of the PC industry. Looking back, one of the more unexpected trends, in my opinion, is the explosion in the popularity of UNIX. Like most "mainframers," I hardly knew of its existence in 1980 and only until recently thought that, although appropriate for scientific and engineering applications, UNIX would never really impact or penetrate the commercial marketplace. Many mainframers still feel this to be true and that the IBM System/370 and DEC VAX architectures will continue to dominate the mainstream of information processing in corporate America. Before we get too smug with this opinion, it may be worthwhile to reflect on the explosive growth of UNIX in recent years.

A Brief History

UNIX is celebrating its twentieth anniversary this year. From rather humble beginnings within Bell Laboratories, UNIX has evolved from a software development environment to become a full-fledged operating system. UNIX had early success in engineering, scientific and university environments and has given birth to the C language. Many variants of UNIX have evolved over the years. During this evolution, several efforts to standardize UNIX have led to POSIX, X/OPEN, TEP/IP and MAP. As of 1988, International Data Corporation estimates that UNIX represents nine percent of a $121-billion market which is projected to increase to 19 percent of a $185-billion market by 1993. Not bad for an operating system that hardly existed outside of AT&T in 1980!

Why All The Fuss Anyway?

When pondering the impact of UNIX on the "glasshouse," it is interesting to consider the following:

- UNIX is the only significant industry de facto standard not invented by IBM
- UNIX is the first universal OS that is offered by virtually all hardware manufacturers; several firms which formerly offered a proprietary OS have made a major or total commitment to UNIX (Unisys, NCR and Nixdorf)
- UNIX has taken over as the predominant university OS; most graduates are trained in UNIX these days, not IBM System/370 or DEC VAX
- Many of the "fast-growth" hardware companies are UNIX based and are eroding the market share of the traditional minicomputer companies (Wang, Prime, DG and HP); the new "stars" are Sun, ARIX, Pyramid and Sequent
- New startup hardware companies can no longer afford to develop a proprietary OS; virtually all use a UNIX variant (Steve Jobs of NeXt estimates that the cost to develop a proprietary OS adds $2,000 to the system cost for each end user as compared to using UNIX)
- IBM has made a major investment in AIX, which represents a parallel strategy to SAA
- The United States government requires UNIX on most new hardware procurements
- New hardware innovation is incorporated faster by UNIX vendors; product life cycles average 18 months as opposed to four to five years for proprietary systems
- Most RISC microprocessor architectures are UNIX based
- Amdahl today offers a full-feature UNIX OS (UTS) and IBM is soon to provide AIX/370 on the 3090.

Back To The Future

Looking forward over the next decade, there are several trends which will have a significant impact on our industry. UNIX is properly positioned to take advantage of these trends:

- A strong user emphasis on "open systems" architecture as opposed to existing proprietary architectures
- Continued trends toward distributed, departmental and cooperative processing systems
- Practical integration of image, voice and data
- Continued growth of networking, especially LANs
- Practical implementation of AI/expert systems
- Increased use of RISC architectures
- Universal use of relational DBMS technology
- Growth in the Systems Integration marketplace.

Can UNIX Play A Major Role In Corporate America?

UNIX has yet to evolve as a "production-quality" operating environment, which is required for commercial acceptance within Fortune 500 companies. Today, UNIX is weak in several areas (as compared with the customary IBM environment) such as data integrity/recovery, system security, production-quality utilities (sort, backup, disk management and so on) and "commercial-grade" application software. UNIX also lacks a sophisticated interrupt structure and file system, which limits performance and throughput. However, significant progress is being made in many of these areas within Open Software Foundation (OSF), UNIX International and IBM Laboratories. New releases of the versions of UNIX due late this year should significantly improve the stability, performance and production quality of UNIX.

What are the challenges/opportunities for UNIX in the future? In my view, one of the most important issues is that the UNIX marketplace needs a consistent operating systems direction and standard. The "UNIX wars" which have been going on for the past year and a half are frustrating and counterproductive. Other improvements which make UNIX much more palatable to mainframe environments are likely to come from third-party software companies including:

- A high-performance OLTP monitor that is CICS compatible
- An ISPF-like programmer interface
- SNA network support
- NetView compatibility
- SAA coexistence (if not compatibility).

Epilog

To believe that UNIX has no place in the commercial sector is, in my opinion, wishful thinking. In the early days of PCs, there were also predictions that they would not significantly impact corporate MIS.

Without realizing it, we mainframers may wake up in 1999 (unless we are smart enough to be retired by then) and look around to see that most of the MIS real estate is owned by UNIX. We might even find that we are now bilingual and understand gibberish such as "daemons," "semaphores" and "curses" and that our current IBM jargon is studied in the anthropology department of universities rather than the computer science department!

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