Rightsizing SAS(R) System Mainframe Applications: Consider the RISCs

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ABSTRACT

A major trend in today's Information Technology (IT) industry is mainframe rightsizing to lower cost RISC/UNIX platforms. As with other new industry trends, there are a few companies who are early adopters. However, the majority of companies prefer to wait in the wings to see how it should be done. This paper presents the experiences of a number of early adopters in the rightsizing of SAS mainframe applications. Concerns, implementation issues, and problem solutions are discussed for various SAS applications in multi-tiered client/server computing.

We show that the power of new RISC based UNIX systems is ideal for a "no compromises" approach to supporting SAS Institute's Cooperative Processing Strategy.

A UNIQUE POSITION

SAS Institute has delivered to their customers a very powerful and versatile legacy. By its design and contemporary evolution the SAS System permits users to rise above many of the serious data processing problems that continue to plague the Information Technology industry.

The SAS System has been with us through the era of the large corporate mainframes, minicomputers, super minicomputers, workstations, and the entire evolution of the personal computer (PC). The degree to which the SAS System allows users to preserve their data, programs, and user interface is unprecedented by most measures of computer usage.

The computer industry continues to evolve and refine itself, just as the SAS System evolves to meet SAS users' needs. In today's data processing landscape, the big question for data processing managers is not one of whether or not to use the SAS System, but rather, how to effectively deploy SAS usage in light of business pressures to rightsize and contain costs?

MAINFRAME MIGRATION PLANS

Currently, there are several terms circulating in the IT community which we should try to state clearly for the purposes of this report.

Downsizing

This is a mainframe migration plan were all the applications on the mainframe are to be moved to a new platform. This can occur in situations where a corporation's IT department has implemented a major billback processing which the full data processing cost of running SAS jobs falls back to the department.

For example, one large airline company uses the SAS System to analyze profitability and logistics to compute the next year's routes and pricing. Traditionally, the cost for these SAS jobs was absorbed by the corporation as a cost of doing business, but in 1993 a restructuring occurred and corporate IT decided to billback all of the data processing costs. The departmental cost for one year's worth of SAS jobs was $200,000 to $300,000. The department decided to move all of their SAS programs and data to a UNIX based RISC platform. The yearly savings on the mainframe services paid for the new RISC system, the SAS migration, and staff training.

Changes in billback procedure is just one of many reasons for downsizing. Others include the loss of the mainframe through lease expiration, mainframe overload (making time to completion of SAS jobs unacceptable), or other cost reasons.

Offloading

This mainframe migration plan is the process of removing specific applications or jobs from the mainframe, specifically to free up mainframe cycles. Whereas, downsizing means moving 100% of the data processing to another, generally more focused, smaller platform, offloading implies that only some of the data processing is going to be removed from the mainframe.

For example, the catalog direct sales division of a US based company uses the SAS System for market
research. A major source of data is the division's sales and orders database. This transaction-based data is stored in a DB2(R) database on the mainframe. The data grows at approximately 400,000 observations a week and the data is used by the Sales, Order Processing, and Accounting departments in addition to the Marketing department. The SAS jobs impacted the performance of the entire transaction-based operation such that the whole organization suffered. The company chose to offload the SAS processing to a UNIX based RISC platform and download cartridge tapes once a month to the new system. The money saved by not having to upgrade the mainframe allowed the company to keep both an acceptable level of performance on the transaction-based system and provided the marketing research team a higher performance SAS System platform.

There are other reasons for offloading the mainframe besides saving on upgrade costs and improving users' jobs throughput. But, the important notion in an offload is: the mainframe is still a part of the data processing landscape and plays an important role.

Rightsizing

This is a mainframe migration strategy that states you should do the "right thing" when considering either a downsizing or offloading project. The "right thing" constitutes a careful analysis of all the data processing factors involved. Some of the cost saving factors of going to the new platforms are very compelling but less apparent factors may be at play. Some of the questions to consider are:

- How much data is there to be dealt with, what is its form, what is its source, rate of change, and need for movement around the organization?

- Is a network infrastructure in place capable of handling increase network activity?

- Are you prepared culturally? Do you have staff with a focus on the new technology and operating systems? Is there management support and interdepartmental cooperation for the effort?

- Will you make the investment in education and consulting services to help insure the success of the project?

These are a few of the issues we find when advising on the migration of SAS System applications. The MultiVendor Architecture(TM) (MVA) design of the SAS System provides a clear path for migration to new platforms. The next question is what is the structure of a rightsize?

CLIENT/SERVER COMPUTING

Client/server computing is yet another one of the terms we need to define in order to insure a good understanding of our intention. In the SAS System, client/server computing starts from the simplest notion. McIntyre [1] states "Client/server computing is one process or task making a request for services from another process or task". His approach has merit when viewing the needs of the corporate SAS user.

For example, SAS/SHARE(R) and SAS/CONNECT(R) can be used for concurrent record level access and locking within the database either locally or remotely. This represents the more conventional client/server notion of a remote procedure call (RPC). Thus, we would have good agreement the SAS System is client/server enabled. However, from the standpoint of network utilization the SAS user may be far better off downloading the entire SAS Data set to the local system for SAS processing.

This issue moves the client/server computing discussion to more of a philosophy or way of thinking than hard fast rules about distributed computing environments. The SAS System does indeed make use of the conventional client/server tools, but the SAS System permits the user a much greater view of the concept.

There is a substantial amount of information available about client/server computing in general, and the interested reader is encouraged to study the topic.

Client/server Logical Model

The client/server paradigm has a logical model, see Figure 1. The key to successfully deploying client/server computing is the rational use of this model so, let us look at this model from the standpoint of the SAS System mainframe migration.

We have three prime considerations in designing the optimal client/server solution: Presentation, Application Software and Data Management.
1 - Presentation

The user in front of a terminal, workstation, or PC: The SAS System permits a wide range of user interface options: batch SAS job submission, command line execution, or a fully interactive environment. The SAS application developer can benefit from a high performance environment like those provided with workstations, Xstations, or high performance PCs. Often people in a production environment only need a character-based terminal if the SAS applications use only a simple user interface. SAS production applications that need high quality graphics or use extensive interactive sessions should use the same types of workstations, Xstations, or PCs as the development staff.

2 - Application Software

SAS Application software - written by, or for the user: This SAS software can be both the user's application software with various SAS software products, or the SAS Software alone, as in the case of someone using SAS/ASSIST(R).

Often a further refinement is introduced in the application software. This is separating the application into task logic and business rules, or business policy. For example, in an airline reservation application, a user process may ask for the percent of aircraft capacity available on planes with more than 400 seats. Assume the airline does not have any of the very large aircraft. You should have a business policy that does not let the query reach the database and waste time making a search.

3 - Data Management

The source of the data: This can be SAS Data sets, external (i.e. flat) files, or a relational database system (RDBMS) via SAS/ACCESS(R). In any configuration, the main idea is one of a database server.

You should begin a migration project by visualizing your new deployment in these terms.

Client/server Partitioning

After you have begun to view the SAS applications in terms of the client/server logical model, the next step is to view how the application should be partitioned. This is where things like computer hardware and network design play a large role in the migration strategy.

Figure 2 shows the various client/server partitioning options. The SAS System permits you to work in any of these options. It is choosing the best option that proves to be more difficult. In Figure 2, notice the timeline overlaid with the various options. The general trend is to move all of the presentation layer and as much of the application layer out to the client space. Some of the points driving this trend are:

- Networks become overloaded. By today's standards the idea of driving the users interface, in total, is already obsolete. The X system is itself a client/server system, but it is very common to have the X server software running in the client's system.

- Distributed corporate structure. It is becoming very common for larger companies to have offices, warehouses, manufacturing facilities, etc. in more distributed locations. These different facilities often have their own internal data management needs in addition to communication needs to corporate offices.

- More powerful systems. Performance and capability improvements in the PC line of computers continue. More impressive, though, are the advances in RISC-based server and workstation class machines. More on this later.

- Computer industry maturity. When compared with just a few years ago the computer industry has come to common ground on several technologies. Some of these advancements are de jure other are de facto. Consider:
  - DOS(R)/Windows(R) as the standard Intel(TM) x86 operating system,
  - UNIX as the standard workstation and server operating system,
  - TCP/IP as the standard network stack,
  - Mainframe, Server, Workstation, PC as the standard IT hardware suite.

We believe in the continued growth of client/server computing and in the trend of migrating more processing and data storage to client space.
THE THREE-TIERED MODEL

The three-tiered model is a good hardware base to work from for SAS mainframe application migration. This model is shown in Figure 3.

Mainframe layer

In a full downsize project the mainframe tier is removed and spawns several focused servers, but most of the SAS mainframe migrations we have seen are offloads. Generally, the mainframe is integrated with the company's business strategy. An example was given earlier of a SAS application offload where the mainframe was to continue as the backbone transaction processing computer. We have seen other reasons for companies to maintain their mainframe efforts:

- Large volumes of data, i.e. a corporate repository of information.
- Extensively developed hardware and software system for applications other than SAS applications. For example, banking companies may have entire networks dedicated to credit card transaction management.
- The need for a large managed magnetic tape facility. We see several customers in the medical and pharmaceutical industries using medical data supplied by the government on various magnetic tape formats: IBM 3480/3490 cartridges, 9-track reels, and 8mm DATs.

Server layer

The trend in platform selection for the server layer is toward RISC based open systems. There are clearly specific cases for other proprietary operating systems and the SAS System provides support for many of them, however, we are discussing this matter as a trend. The continued movement toward open system architecture and the downward spiral of system and software costs will continue to apply pressure to the IT community. UNIX is the only commonly available multi-user operating system from a wide range of computer manufacturers and this type of interoperability in one of the promises of the open systems movement.

Most computer manufacturers are choosing the RISC processors over CICS processors. Figure 4 shows the currently available processors commonly encountered in servers, workstations, and high performance PCs. The interested reader is referred to an excellent reference that discusses processor technology in more detail [2]. For SAS applications the processor technology issues are twofold:

- The RISC processors have better floating point performance that CISC processors given the same operating frequencies. In the base case all numeric variables in the SAS System are floating point and substantial improvement in SAS job throughput is seen with RISC based systems.
- RISC processors scale better from the desktop to the data center. For example, consider the Hewlett-Packard line of RISC processors, the PA71xx family. The PA7100/LC is used in the smallest desktop system, the HP712/60, which is priced near the 60 and 90 MHz Intel Pentium systems. The PA7100s and PA7150s are used in top of the line workstations and large data center 12-way symmetric multiprocessor (SMP) systems. The benefit in SAS applications is all these systems use the same SAS binaries and SAS Data sets are easily interchanged.

Client layer

The SAS System allows you a broad range of options for client platforms and operating systems. Choices in hardware and operating system platforms for SAS applications can be much harder. Four general themes and a new deal, are seen based on a broad set of criteria.

1 - Terminals

Terminals connected to a computer are the least capable of the various options. They generally have the lowest price point but place the largest burden on the network and the host system. The main reasons for using terminals are legacy issues with users, cost per seat, and installed base. The SAS applications are static, submitted from the command line, and only simple screen control options are used. The SAS System supports a multitude of PC based terminal emulators if a terminal interface is needed. But, terminals have the advantage of being simple electronic devices and nothing is needed in the way of disk drives, local operating system support, etc. as in the case of a PC.
2 - PCs

The PC is a strong candidate for use as a client system. The notion of using terminal emulation on the PC instead of a terminal was discussed in the previous section. Additionally, the PC offers local intelligence and processing power. Two excellent papers were presented at SUGI 19 this year which give good discussions on the issues and strategy for deploying PCs for SAS applications [3] [4].

Some of the points in favor of the PC are:

• The windowing interface offered by the Windows 3.x environment is user friendly and familiar to millions of PC users. The SAS System for Windows effectively uses the windowing environment providing the SAS user with an intuitive interface to the SAS System. This makes the SAS user more productive and facilitates the visualization capabilities of SAS products like SAS/ASSIST.

• System prices and availability for the PC are very good. There is nothing else in the computer industry to compare with what has happened to the price of PC computing. The PC is now a commodity item and subject to extreme price pressure and we see nothing on the horizon to alter this course.

• The installed base of PCs in companies varies to a great extent. Some early adopters of PCs deployed large numbers of the original PCs, PC XTs, and ATs, i.e. 8088 and 80286 processor based systems. To effectively use Windows 3.x and the SAS System in particular, you need at least 386, better if 486, better yet Pentium class machines.

• Commercial Off-The-Shelf software (COTS) is a term coined by the U.S. Department of Defense and covers software you can easily get for computers. This is the real strength of the PC market. A software organization can justify millions of dollars of development effort yet sell right to use copies for extremely low prices because of the large market potential.

For SAS Applications there is a downside to the PC. Some points to consider:

• The size of SAS Data sets is subject to limitations. Data sets in the range of 100s of Kbytes to 10s of Mbytes are possible for lookup applications. Doing serious SAS processing with data sets of these sizes takes a long time, if processing can be done at all.

• Processing power is limited and goes along with the size of SAS Data sets. For example, the fastest Pentium processors, 90 and 100 MHz, still lag behind slower RISC processors for floating point work and overall performance.

• PC may not be as inexpensive as you think. Many of the items that go into a computer are similar between PC and RISC systems. Larger CRTs, faster disk drives, RAM and cache memory, etc. are often times the same price on a workstation or a PC.

• The PC is a single user device. The directions of DOS, Windows 3.x, Windows NT, and OS/2 are still toward a single seat view of the computer. There are certainly major advances in the multitasking capabilities of these systems. However, unlike UNIX systems other users do not log into your system.

3 - Xstations

From the perspective of the SAS system, the Xstations are high performance graphics terminals. They offload the X server part of the SAS application and provide the high quality graphics interface to the user. Some of the Xstations provide flexible disk support and are multimedia enabled. The main application we see in the SAS environment is for Xstations on a SAS application server where the department needs graphics performance beyond the PC interface but does not want to purchase workstations. This method avoids the costs of maintaining additional operating system, license costs, etc..

4 - Workstations

We view workstations as RISC based UNIX systems. We believe these are very often the best platforms for the SAS System. They have many of the same benefits of the computers in the server layer and overcome the shortfalls of the PC in the client layer. There are some issues in deploying workstations to consider for SAS applications. On the positive side:

• UNIX is a mature and stable operating system. UNIX has evolved from a university and laboratory environment to a commercial grade product. There are still various versions and manufacturers having specific focuses, but there is much standardization activity and
in the near future the COSE process will yield a standard interface for the user.

• **UNIX** and RISC processors have the power to handle much larger data sets and SAS jobs than the PC. This power also includes disc I/O which is very commonly the major bottleneck for performance.

• Networking in UNIX is mature and stable. There are at least five different PC network strategies in the market. Most of the PC network packages are resource servers for files and peripherals. Since the PC's evolution, with DOS, never included multi-user system there was no need for telnet, ftp, etc. into a networked PC.

A few of the downside issues with workstations:

• The price performance ratio of the workstations is better than the PC but, the initial price of the workstation may be higher than low end PCs. As the computer industry matures however, the same kind of price pressure currently on the PC is starting to affect workstations as well.

• Learning a new operating system. UNIX is more powerful that DOS, Windows, and OS/2 but it is also more complicated. From within the SAS System the differences between SAS for Windows or SAS on OS/2 and SAS on UNIX are amazingly small. We have experienced PC SAS users moving to SAS on UNIX with very little difficulty. Products are available which shield the user from UNIX commands (i.e., HP VUE).

• COTS on UNIX workstations continue to lag behind the PC in the number of different applications available and price. This general trend will continue, but with the emerging standards in UNIX the prices for software should come down when developers have a larger installed base to sell to.

5 - A New Deal

We have approached the PC and workstation concepts in pure form. The PC is positioned as a Intel CISC processor based system running DOS/Windows or OS/2 as the operating system. The workstation is positioned as a RISC processor based system running the UNIX operating system, but we do have a new deal.

There are two strategies on the market today, and at least one other in the wings, using RISC based systems to run Windows NT. Digital Equipment Corporation (DEC) has Windows NT available on their Alpha AXP RISC processor. IBM has introduced the first of the PowerPC 60x RISC processors for Windows NT and OS/2 (Workplace OS). Hewlett-Packard announced the PA7100/LC that is designed to support Windows NT types of operating systems.

Our perspective on this matter is that the high performance capabilities of RISC technologies are coming to the PC client space. The authors do not know the Institute's plans for supporting the SAS System on these new platforms. The benefit to the SAS user will be to have the ability to run larger SAS jobs on the client system.

**SUMMARY**

We have shared experiences and insights gained from working on many SAS System rightsizing projects. SAS MVA greatly facilitates the migration of the SAS Programs and Data sets. We have tried to provide some of the other pieces to the puzzle to help you gain a better perspective of the hardware and operating system issues.

Client/server computing was discussed from the broader viewpoint the SAS System permits and the client/server logical model was presented from the perspective of the SAS mainframe migrations.

The Three-Tiered Model is a viable approach to migrating SAS application and examples were provided to help you design a migration plan that makes sense for you particular situation. Within the structure of the Three-Tiered Model we have given details on the various processor systems you will encounter and guidelines for operating system selection.

For server layer systems the best choice is a RISC based UNIX system sized to meet the needs of your SAS applications. For client layer systems cases exist for the redeployment of PC or terminals, but for new SAS migration projects you should consider the new low cost RISC based UNIX systems.

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REFERENCES


CLIENT/SERVER LOGICAL MODEL

- Displays screens
- Accepts input
- Invokes business services
- Interprets service results
- Imposes business policy
- Ensures logical consistency
- Read/Write access to data
- Physical data integrity

Figure 1

CLIENT/SERVER PARTITIONING OPTIONS

Distributed Presentation
- Data Model
- Application
- Presentation

Remote Presentation
- Data Model
- Application
- Presentation

Distributed Function
- Data Model
- Application
- Presentation

Remote Data Access
- Data Model
- Application
- Presentation

Distributed Database
- Data Model
- Application
- Presentation

Intelligent Workstation

Figure 2

1991

1996
## CPU CHARACTERISTICS

<table>
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<th>PROCESSOR</th>
<th>TYPE</th>
<th>ARCHITECTURE</th>
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<td>Superscalar/Supercalibrated</td>
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Figure 4