OPTIMIZING SYSTEM USAGE IN A MULTI-CPU ENVIRONMENT

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OVERVIEW

As a customer's need for extra data processing power increases, a common, and often appropriate, response is to purchase additional HP3000 CPUs or to upgrade to larger HP3000s. When faced with this prospect and when the current environment already includes two or more CPUs, very substantial cost savings may be realized by a careful review of the existing hardware, application software and other elements of the total picture. This case study summarizes the approach used and results obtained by one large company with eight HP3000 CPUs.

BACKGROUND

In this case the HP environment consisted of eight Series III CPUs, 30 disc drives, 11 tape drives, 10 line printers and 384 ports, all purchased within a three year period. There was one additional CPU (with peripherals) on order and there were open requests for two more. Many of the ports were shared by users through the company's port multiplexor, so the number of terminals seemed to be staggering.

This hardware was spread unevenly among three autonomous departments. There was a clear need for additional horsepower in each department, and each department's solution called for additional hardware purchases. Each department had its own operations group ranging in size from two to nine people.

At the division manager's level there were a number of questions:

1. Were the computers being used to their fullest potential?
2. Were the current computer resources distributed over the three departments in a roughly equivalent manner?
3. Did planned growth warrant one, let alone three, additional CPUs? and
4. How could efficiency be improved and costs cut?

A team of three senior people, one from each of the systems groups, was assigned to review system usage and develop a methodology for addressing the division manager's concerns.

ASSESSING THE EXISTING SITUATION

HARDWARE INVENTORY

It was immediately apparent that the first step should be to introduce the three team members to each other. (The groups were quite autonomous!) The next step was to inventory the hardware, exclusive of terminals. (Terminals were not included because the project was to focus on the higher priced items and on service to the user. There was certainly a sufficient number of terminals.) Though each group kept its own inventory records, a manual

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inventory was quickly done by visiting each of the four computer rooms and counting CPUs, memory boards, disc drives and the other peripherals. A chart depicting all the CPUs and their configurations (memory, disc, tape drives and line printers) was drawn up.

SOFTWARE INVENTORY

To get a clear picture of the application software being used, personnel in each of the major functional areas (marketing, engineering, manufacturing, shipping, etc.) were interviewed. When the software inventory was completed there were found to be no fewer than 37 major applications being run on the eight CPUs and a host of minor ones. (How often we overlook word processing.) One CPU alone was found to be running eight applications.

A chart similar to the hardware inventory one was developed and relative usage weightings (light, moderate, heavy) were assigned to the applications as well as a designation as to whether the application was overwhelmingly interactive (nearly no evening batch processing), overwhelmingly batch (heavy evening and cyclical usage) or simply overwhelming whelming (heavy day usage and heavy evening reporting). Functional relationships between applications were noted and peak periods were identified. Data relationships within and between applications were also identified as well as any tape or DSLINE data exchanges.

STAFFING

One department had two operators for a single machine (to insure coverage in case of illness or vacation), a second department had eight operations personnel for four machines (heavy batch production and two computer rooms in different buildings), and the third department had one full-time and two half-time operations personnel for its three CPUs. The ratios of operations personnel to CPUs were 2:1, 2:1 and 2:3. The number of operators was found to be primarily constrained by application system design.

SYSTEM USAGE

Line printer usage was roughly measured in terms of boxes of paper printed per month per line printer.

Disc space usage and disc leveling on all machines was checked using FREE2. Data base capacities for all major applications were compared against high water marks to determine if there was hidden waste of disc space.

Disc I/O, memory and CPU utilization, system table sizes and program performance were analyzed using OPT/3000. Basic computer usage information available through the REPORT command was collected regularly by operations personnel over a two month period.

Determining whether the throughput was acceptable proved to be less easy to define. Three barometers of processing sufficiency were defined:

1. Was the computer processing all the work required in the time available? (Particularly batch.)

2. Were the people whose jobs required heavy computer usage having to work overtime due to the 3000s inability to process peak loads?

3. What was the level of user frustration, if any?

Throughout the measurement period, the focus remained on the systems as a whole rather than the efficiency or performance of particular programs running on the systems.

ASSESSING THE SITUATION, COMING ATTRACTIONS

The rapid fire purchase of HP3000 hardware had been necessitated by the bringing on-line of new applications systems, the cutover of enhancements to existing systems and the increased workload due to sales, manufacturing and shipment increases related to order activity and product introductions. A best effort to forecast additional machine requirements meant plotting the expected increases in sales, manufacturing and shipping against resource requirements. (E.g., if sales were expected to grow 50% in the next year, then the volume of order processing computer activity could be expected to grow 50%. If order processing required a fully configured Series III, then upgrading to a Series 44 would be sufficient for only one additional year. So either the 44 should be leapfrogged and a 64 considered or the application should be split and distributed over two or more machines.) The resource requirements for planned and proposed systems were mapped according to the same criteria as existing systems (batch or interactive? cyclical? light, moderate or heavy usage?) and the impact of planned enhancements to current systems was forecast as well. (What would IMAGE logging do to order processing requirements? How about the planned addition of sales order audit trails to the order processing system?)

The forecasting effort did not lend itself to the simplistic numerical analysis of OPT/3000 so appropriate percentages were guessestimated and relative terms (e.g., planned enhancement 'A' would be roughly equivalent to an additional MRP run or would add 10% more overhead) were employed.

The forecast also took into account what was known or guessed to be forthcoming from Hewlett-Packard. Known items, e.g. an upcoming release of MPE promising performance improvements, were included in the plan as well as heavily rumored product announcements. (When this study was undertaken it was widely rumored that a substantially more powerful CPU than the 44 was on its way. The announcement of the 64 followed by one month the decision to cancel the open order for the 44 and two pending orders for 44s.) Rumors obviously carried less weight in purchase planning than known facts and were discounted entirely unless substantiated to some degree by trade publications or industry sources.

ISSUES AND ANSWERS

By this time the overall picture had developed quite clearly. The methods of optimizing company wide system usage were determined to be:

o Shift Applications Among CPUs.

The objectives here were to

1. Establish better interactive vs batch processing balances to reduce contention, especially at peak periods,
2. Place functionally related applications on the same processor to increase efficiency and control, and
3. Spread applications with similar processing cycles across different CPUs to avoid bottlenecks.

o Reduce Functional and Informational Redundancy.

1. Separate databases for each manufacturing line were to be consolidated (when on the same CPU),
2. Manufacturing costs and similar calculations being done in two or more areas were to be performed in only one area, and
3. Vendor files, customer files and the like were to be broken out into stand alone databases to be shared by many applications rather than each application carrying its own version.

o Monitor System Performance.

1. A plan was drawn up to regularly monitor system performance via CPU and connect time tracking at the system level and expanded use of OPT/3000,
2. Additional training for operations on the use of diagnostic tools was scheduled, and
3. The development of simple application specific performance analysis tools was planned.

o Consolidate Operations.

1. The three operations staffs were consolidated into a single operations group,
2. The operators were cross-trained on systems in other departments, and
3. Batch jobs were run concurrently as much as possible instead of sequentially. (This alone accounted for a 30% throughput improvement).

o Establish Guidelines

1. Guidelines for the development of efficient IMAGE and KSAM based systems were developed using performance tips from IUG articles as a starting point,
2. A plan was drafted to keep development people up to date on software changes and users group articles, and
3. The group elected to take advantage of HPs performance consulting when it seemed appropriate. Members of the development staff in the affected areas were always involved with HPs analysis.

o Level Hardware

Memory and disc drive resources were spread more appropri- ately among the eight CPUs based on the application weighting and OPT/3000 results from earlier phases of the project.

o Define Adequate Levels of Support

Meetings were held with the key users to review system per- formance on a regular basis and fore-stall response time pro- blems.

o Eliminate Non-essential Processing

There goes the word processing. Standalone word processors were purchased to replace the systems available on the 3000.

RESULTS

The purchase order for a new 44 was cancelled and the two proposals for additional CPUs were rejected.

The division came to view the HP3000s as shared resources and started to realize economies of scale.

Proposed changes in the operational procedures were adopted and up to 30% throughput improvements were realized.

As the company's sales continued to grow, so did the need for computer resources, but at a markedly slower rate.

CONCLUSION

Optimizing performance across several CPUs requires flexibility in usage and allocation of human and hardware resources. If the analysts, programmers, operations staff and users function as part of the same team, then overall improvement in system performance can be very drama- tic.

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Joel Martin is responsible for the Research, Design/Development, Pro- duct Documentation and Product Testing functions of Project Resources.

Mr. Martin currently manages a team of HP3000 data processing professionals in the development of enhancements to PRI products.

Mr. Martin also acts as a Consultant and Guest Lecturer.

Prior to joining Project Resources, Mr. Martin spent four years as a Senior Programmer, Senior Systems Analyst and Programming Supervisor for ROLM Corporation. He was the lead Analyst in the design, development and implementation of their Order Processing Systems as well as a number of smaller marketing systems on the HP3000. During this time Mr. Martin did numerous Performance Studies of multi- and single-CPU environments. He was the sole delegate from a group of 60 Analysts to attend an International Users Group Meeting for the HP3000 in San Antonio, Texas.

Mr. Martin spent two years as a Programmer/Analyst with ASK Computer Systems where he worked on both the HP1000 and HP3000, developing the Physical Inventory Module and the Purchase Order Printing System.

Mr. Martin was part of IBM's Summer Technical Program in Poughkeepsie, New York where he participated in a PL/M compiler development project.

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