V-LINK

AN EXCITING NEW TOOL
FOR DISTRIBUTING COMPUTER AIDED ENGINEERING

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ABSTRACT

In recent years finite element analysis has begun to shift to 32-bit superminicomputers. Increased productivity and cost performance are two of the major reasons for this shift. This paper will propose a plan for gaining even greater efficiency, productivity and cost savings by distributing data processing between a supermini and a supercomputer. V-LINK[SM], a hardware and software communications system from UIS is a tool that satisfies the requirements for distributed processing by providing easy batch access from a Digital Equipment Corporation VAX® computer to a CRAY-1S. Technical specifications of V-LINK are described in this paper.

HISTORY

Large centralized mainframe computers once dominated engineering analysis. This type of computer was the only one that had the power, speed, accuracy and memory capacity to perform the complex analysis required by engineers. Well-known general-purpose finite element programs such as MSC/NASTRAN, ANSYS, and STARDYNE were first developed on these large mainframes. When newer, faster and more powerful supercomputers such as the CRAY-1S were developed, many of these programs were converted to take advantage of the new capabilities. Conversion to the new supercomputers was only natural, because there always seems to be a problem to solve that just won't quite fit on even the most powerful computer.

In general, because of the large investment in both money and human resources, only large corporations could own their own computers. Smaller organizations generally relied on remote computing services to meet their computing needs. However, no matter how big the organization, the engineer's computing needs always seemed to be last on the data processing manager's priority list. That meant the engineer was allowed to use the computer on off-hours and weekends only. Even today, many engineers are handicapped by the lack of available computer time.

In the late 1960s, a new development took place in the computer industry: the first minicomputers were introduced. Although these computers were inadequate for engineering analysis, they were the first step toward the revolution that swept the engineering community during the late 1970s and early 1980s. This revolution, caused by the introduction of the 32-bit supermini has changed the way many engineers work.

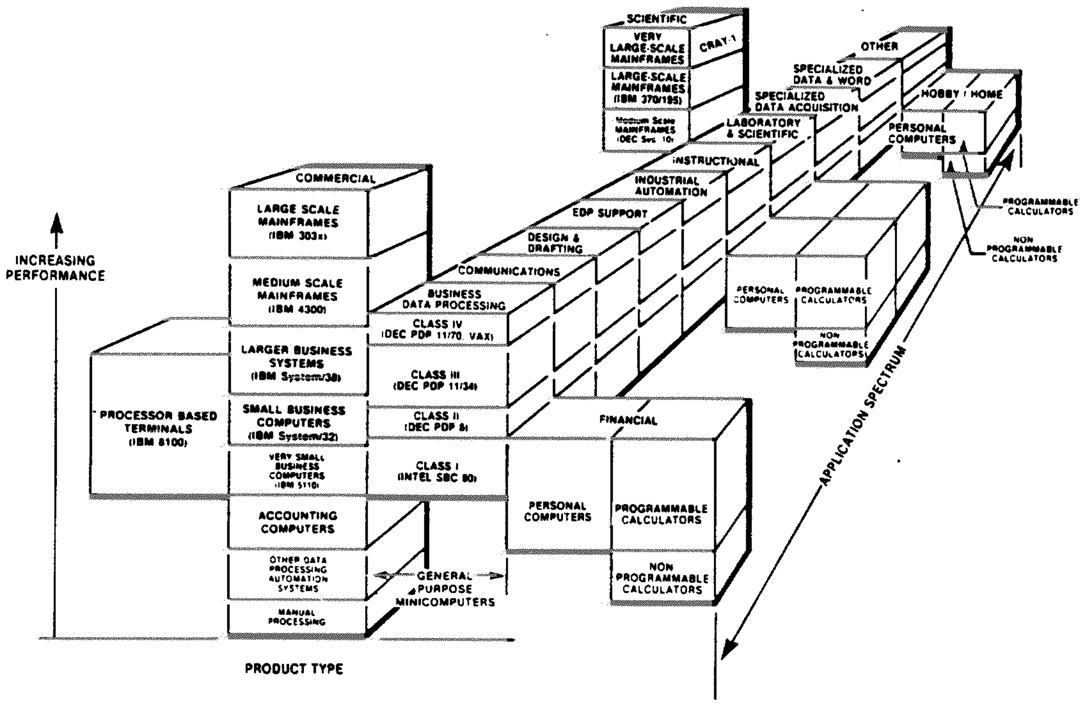
SUPERMINIS

For the first time, a computer small enough to fit in a reasonable-sized office yet powerful enough to perform engineering analysis was available, and at a price that engineering departments could afford. (REF-2) Even more important however, these superminis could be located near the engineering departments using them. Therefore, they were under the engineer's control. Now the engineer could set priorities to suit his project needs and not be tied to the in-house data processing manager. In addition, he didn't need to worry about unsuspected computer processing cost overruns because there were no computer bills.

In addition to power and cost, the superminis were designed for interactive use and therefore were easy to learn and use. All these factors, and others not mentioned, have contributed to the outstanding success of the supermini.

The following chart from DATAQUEST shows the broad spectrum of applications performed on micros, minis, superminis, mainframes and supercomputers. The value of the supermini can quickly be seen by close inspection of the chart. (REF-4)

COMPUTER PROCESSOR SPECTRUM



Many engineering software vendors recognized the advantages of the supermini and converted their software to run on them. The following charts show a partial list of general purpose finite element programs and the minicomputer systems on which they run. (REF-3)

PROGRAM \ COMPUTER	VAX 11/7••	PRIME	PERKINELMER	PDP-11	HP-9000	HARRIS	APOLLO
ANSYS	●	●				●	●
ARGUS	●						
ASAS		●					
ASKA	●	●					
EISI/EAL	●	●					
MSC/NASTRAN	●						●
PM/NASTRAN		●					
NISA	●	●			●	●	
NONSAP	●						
MARC	●	●					
PAFEC	●	●	●				
SAP IV	●	●					
SAP 6	●	●			●		
SUPERB	●						
TPS-10	●	●		●			

FEM Programs on Small Computers

The next chart shows a partial list of finite element modeling programs and the minicomputer systems on which they run. (REF-3)

PROGRAM \ COMPUTER	VAX 11/7••	PRIME	PDP-11	HARRIS	HP-9000	D6 ECLIPSE	APOLLO
DISPLAY/DIGIT	●	●	●		●		
FASTDRAW	●				●		
FEMGEN	●	●	●				●
GIFTS	●	●	●			●	
MENTAT	●	●		●			
PATRAN	●	●		●			●
SUPERTAB	●	●	●				

Stand-alone FEM pre- and postprocessors on Small Computers

In review, the superminis have been successful because of:

- o Processing power
- o Price performance/fixed price approach
- o Satisfying localized processing needs
- o User-friendliness

SUPERMINI SHORTCOMINGS

Despite the power, convenience and overall capabilities of the supermini computers, they present engineers with several problems:

- o The computer system must be maintained and supported.
- o Hardware updates are expensive and time consuming.
- o Finite element analysis requires large amounts of computer resources.
- o A supermini satisfies only local computing needs.
- o Turnaround can be 6 to 80 times slower on a supermini than a supercomputer. (REF-5)

COMPARISON OF SUPERMINI AND SUPERCOMPUTER TURNAROUND

PROBLEM	RATIO VAX/SUPERCOMPUTER	
	CPU	WALLCLOCK
1	16.0	21.4
2	29.3	7.6
3	21.8	39.0
4	21.4	76.6
5	29.6	43.0
6	20.5	6.0
AVERAGE	23.1	32.3

Source: *An Evaluation of Supercomputers for Thermal Analysis*
Olaf Storaasli, et al
NASA TM-83284, NTIS, Springfield, VA 22161

- Mass storage becomes critical. Typically ten megabytes of disk space per wall clock hour are consumed in finite element analyses.

- User friendliness becomes a handicap. Engineering departments almost never identify the total processing need prior to purchasing a system.

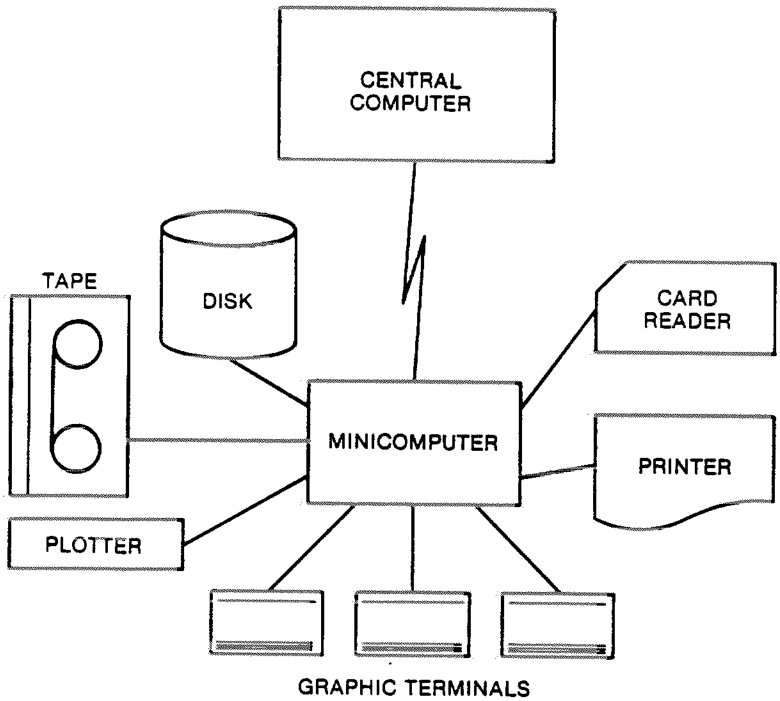
In summary, even though the supermini computer is very capable of performing engineering analysis, it is not the total answer. Popularity has resulted in overloading. This saturation results in slower response time and unreasonable turnaround of the analysis. The net result is lower productivity. To restore (or even increase) the productivity of the supermini, the engineer needs a distributed processing environment with a high-quality, high-speed, user-friendly link to other computers, such as the CRAY-1S. In addition, this link should be transparent to the engineer.

DISTRIBUTED COMPUTER AIDED ENGINEERING (CAE)

The use of interactive processing on a minicomputer in a multicomputer system can increase total computing efficiency. Since a mainframe computer with large capital and support costs operates more efficiently in a multiple-job batch environment, a cost-effective approach to CAE is to transfer the batch processing to a supercomputer mainframe and to use the supermini for data check runs and interactive pre- and postprocessing.

A truly distributed CAE environment offers engineers the best of both interactive and batch processing through the linkage of a minicomputer with a central computer. A possible configuration was presented by John Swanson (Ref 6) in the early 1980s.

DISTRIBUTED CAE ENVIRONMENT



Source: ANSYS in a Minicomputer Environment
J.A. Swanson, Finite Element News, July 1980

The heart of the CAE environment is the minicomputer. Users interface with the system through graphics terminal workstation. Generally, the environment has one to four workstations for optimum system response time. An engineer interactively enters the design or design changes via the geometric modeling module. He views the design on a screen and can obtain a hardcopy using a plotter. Information can be placed on tape for long term storage. The engineer can retrieve information and prepare a finite element model with the aid of an interactive preprocessor. Then, analysis can be performed on the minicomputer or, in instances of large processing requirements, in the batch environment of a remote computer.

Through the addition of the central computer all phases of engineering tasks--from preiminary design to analysis and results--are integrated for better efficiency.

The value of this system is that:

- Project costs are reduced because user productivity is increased.

- Computer tasks are matched to computer capability resulting in finely tuned systems.

- Local computers (minis) are used for tasks that require user-friendly, high-speed interactive processing.

- Remote supercomputers are used for high resource batch processing.

- Interactive graphics capabilities of the mini greatly reduce redesign, redrafting, and trial-and-error model testing, because the model can be examined and verified before analysis.

- Solid geometric modeling software that is available on the minis enables an analytical description of the design to be stored in the computer and, through the use of a high-resolution, interactive graphics device, displayed with an almost photo-like appearance. These displays help the designer establish geometric relationships between parts in the design and also serve as a mathematical basis for analysis, manufacturing, and quality assurance.

Through distributed processing, tasks can be completed with accelerated speed and accuracy, resulting in reduced costs and a cut in new product lead-time. The big question for today is: How do you set up a cost-effective, friendly, distributed data processing network? Where do you find the supercomputer? How do you physically hook it all up?

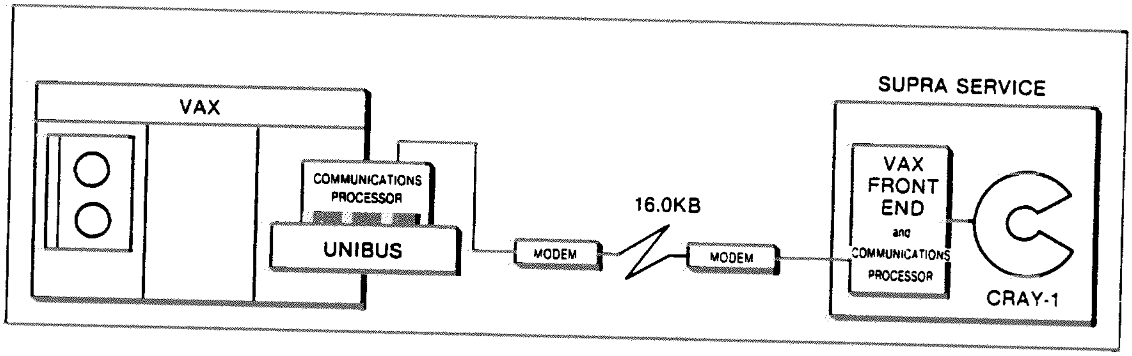
V-LINK is one possible solution. It can satisfy one part of the CAE environment by linking one group of minicomputers, the DEC VAXs, to the power and performance capabilities of a two million word CRAY-1S.

V-LINK is a communication interface system that provides a dedicated, full-time, high-speed link between Digital Equipment Corporation VAX computers and the UIS CRAY-1S supercomputer.

V-LINK is a system of hardware and software designed to give VAX computers powerful distributed data processing capabilities. Now, users of VAX systems can retain the user-friendly qualities of their VMS environment yet have immediate access to the power and performance of the CRAY-1S supercomputer.

The following drawing shows a typical V-LINK configuration.

V-LINK DATA FLOW



V-LINK is composed of five major components: a communications processor, a microprocessor modem, a dedicated telephone line, VAX-resident user-interface software and a front-end VAX to the CRAY-1S.

The communications processor is a single hex height module that plugs into the UNIBUS® of the VAX. It is designed around a high-speed Motorolla 68000 cpu chip and performs all communications protocol processing, typically with 35% data compression. The processor is a DMA device with 16K buffer memory for greater efficiency.

The microprocessor modem allows V-LINK to operate at 16.0KB and uses a powerful data-transparent error-correcting algorithym and advanced bit-slice processing architecture.

The telephone line is a dedicated, conditioned, 9600 baud, voice grade phone line.

The VAX-resident user-interface software was designed with the VAX VMS operating system is a guide. Therefore, the command syntax conforms to VMS standards. The interface software provides easy job control and flexible return of all types of job results. In addition, all commands are documented on the system with VMS HELP. V-LINK commands are so much like VMS that access to CRAY-1 processing is transparent to the engineer.

The link is completed by a UIS VAX that communicates at 500KB via the HYPERchannel to the CRAY-1S. The station software that performs the communications is proven and has been in use for over five years.

To describe V-LINK with a single statement, you might say "V-LINK PUTS A CRAY-1S IN YOUR VAX".

In addition to the V-LINK user-interface software, UIS has written CRAY binary to VAX binary translators for the MSC/NASTRAN OUTPUT2 file. These translators allow easy postprocessing of the MSC/NASTRAN OUTPUT2 files with the PATRAN-G and SUPERTAB geometric modeling programs.

CONCLUSION

Due to the cost effectiveness, user friendliness, and efficiency of minis, recent trends show the migration of Finite Element Analysis from mainframe computers to superminis such as VAXs and PRIME. But, because of their relatively low processing power and throughput, turnaround time is a critical issue for computer solutions of large problems. The answer to the problem is found in a high-quality, high-speed communications link between superminis and a supercomputer such as the CRAY-1S. V-LINK, a state-of-the-art communication interface system, satisfies the distributed data processing need. Users of VAX computer systems can retain the user-friendly qualities of their VMS environment and still have immediate access to the power and performance of the CRAY-1S computer system.

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