SPERRY

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Scientific Software

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SPERRY ANNOUNCES

THE INTEGRATED SCIENTIFIC PROCESSOR (ISP)

Sperry Corporation announces the development of the Integrated Scientific Processor, a supercomputer-class system capable of supporting both high-speed vector and scalar computation. The ISP is integrated fully into its host environment, the SPERRY 1100/90. It is unlike other vector processors that are viewed by the host computer as peripherals. The job queue for the ISP is stored in main memory just like other SPERRY 1100/90 jobs, and the ISP accesses its job queue and data directly from memory without crossing a channel interface as do other supercomputers and array processors.

ISP PERFORMANCE

The peak performance of a single ISP is a 133 MFLOPS (Millions of Floating Point Operations per Second) in single precision (36-bit word) and 67 MFLOPS in double precision (72-bit word). Two Integrated Scientific Processors may be connected to a single SPERRY 1100/90 host system.

The high speed memory that supports the ISP is capable of transferring data to an ISP at 133 million single precision words per second (67 million words per second for double precision). This balance between CPU performance and memory bandpass means that the sustainable performance of double precision programs on the ISP will be in the 20 to 30 MFLOP range. This performance figure varies by instruction mix and the vectorization of the program. Single precision (36-bit) would execute nearly twice as fast as double precision and may exceed 40 MFLOPS sustained performance.

ISP SYSTEM BALANCE

These performance characteristics plus the integrated design approach allow ISP throughput to approach 70-90% of its performance - about 6 to 9 times a SPERRY 1100/90. This is in direct contrast to other supercomputers that normally spend considerable time transferring program, input, and output files across an Input/Output channel.

Additionally, the ISP executes under control of one operating system, SPERRY OS 1100. Unlike other supercomputer-host combinations, there is no complicated interaction of several operating systems during job execution. Consequently, the ISP is freed from performing any system software tasks. Unique versus other supercomputers, all system software in the Integrated Scientific Processor Storage (ISPS) executes on the SPERRY 1100/90 CPU, leaving the ISP only the task of executing application code.

ISP CONFIGURATION

A basic Integrated Scientific Processing system consists of a SPERRY 1100/90 CPU with one Input/Output Unit, the Integrated Scientific Processor, and a four-megaword Scientific Processor Storage Unit shared by the SPERRY 1100/91 CPU, the Input/Output Unit, and the ISP.

Added componentry provides enormous configuration flexibility. This allows system performance tailoring for more general purpose processing, more Input/Output processing, or more scientific vector processing. The system can expand to a maximum configuration of 4 SPERRY 1100/90 CPU's, 2 ISP's, 4 Input/Output Processors, and as much as 16 megawords of Integrated Scientific Processor Storage.

WHAT ISP SUPPORTS

All program development software designed for the SPERRY 1100/90, including interactive screen editors, debugging aids, and database management systems, are supported in the ISP environment. ISP also provides users with software to support the development and optimization of applications software. These include a new FORTRAN 77 compiler with extended vector syntax, an automatic vectorization facility, and tools for performance monitoring, interactive debugging, and simulation software support.

ISP DESIGN

The ISP was conceived, designed, and implemented with a balanced resource architecture. The processing speed, the memory bandpass, Input/Output bandpass, and SPERRY OS 1100 enhancements are all balanced to provide the best price/performance possible for a system designed to solve the most complex problems in engineering and science.

DELIVERY DATE

First customer delivery is scheduled for September, 1985.

SPERRY
Integrated Scientific Processor
(ISP) System

Marketing Guide

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SPERRY

TABLE OF CONTENTS

TABLE OF CONTENTS

Figures

Tables

1 INTRODUCTION

1.1 GENERAL

The world of scientific processing is showing dramatically accelerated growth across all areas of technical and business processing. The use of three-dimensional analysis and graphic display techniques, greater granularity in data definition and more accurate solution requirements have required scientists, engineers, and mathematicians to demand more and more computer power at lower cost.

Generally, the computer vendors have responded in two ways – minisized, special purpose processors and supercomputers. In both areas, growth has greatly exceeded initial expectations.

At the small end of the spectrum is the supermini array processor system offering high price performance and ease of use to a marketplace with a moderate performance requirement. In the supercomputer marketplace, about 100 systems have been sold to users with performance requirements so high that they are prepared to sacrifice price, ease of use and maintenance considerations to achieve that level of performance.

When Sperry funded the SPERRY 1100/90 system development, we began the design work for an internal project called EAGLE, now introduced to the marketplace as the SPERRY Integrated Scientific Processor (ISP). The Integrated Scientific Processor is targeted to fill the large void between the supermini and the supercomputer by offering the power of a supercomputer contained in the rich development and support environment of the mainframe. In addition, the SPERRY ISP takes advantage of innovations introduced in both types of systems, such as the applications development environment and pricing concepts of the supermini and the outstanding performance achieved through the vector architecture of the supercomputer. The SPERRY ISP is designed and priced to be sold as an add-on processor to our SPERRY 1100/90 customer base. It is also intended to help expand the Sperry customer base by providing serious competition to other large mainframes and supercomputers.

1.2 SYSTEM

The SPERRY ISP Subsystem is a special, integrated SPERRY 1100/90 processor plus main storage unit that executes scientific vector-oriented FORTRAN code. This special processor is designed with efficient architecture to execute vector and scalar code and to process arrays of data on a general purpose system environment. The SPERRY ISP is unique in its special properties and in its efficient architecture.

To assure that the high computational requirements of present day and future scientific applications are met, computer designers have used a variety of computer architectures, termed parallel. Traditional serial processor design, like the 1100 Series or the IBM mainframe series, call for the execution of instructions within a job one at a time, processing single pieces of data.

Concurrency is achieved across jobs via multiprogramming or multiprocessing. In parallel architectures, concurrency is also exploited within a single job, by executing instructions that process many data items at once. Vector processors, like the Cray™-1 or Cyber™ 205, exploit these concepts to achieve high performance on many general scientific problems, such as numerical weather prediction, nuclear engineering, and structural analysis. These machines have also been used efficiently by the energy community for seismic processing and reservoir engineering. Since these processors exist to perform the floating-point arithmetic which characterizes scientific applications, the standard performance measure of a vector processor has become the MFLOP (i.e., how many Millions of Floating-point Operations Per second the machine performs).

System Performance

The SPERRY ISP subsystem is capable of supporting both high speed vector and scalar processing. The peak performance of a single SPERRY ISP is 133 MFLOPS in single precision (36-bit word), and 67 MFLOPS in double precision (72-bit word). The high speed memory which supports the SPERRY ISP is capable of transferring data at 133 million single-precision words per second (67 million words per second for double precision). This balance between CPU performance and memory bandpass means that the sustainable performance of double-precision programs on the SPERRY ISP is in the 20 to 30 MFLOP range. This performance figure varies by instruction mix and the vectorization of the program. Single precision (36-bit) executes nearly twice as fast as double precision and may exceed 40 MFLOPS.

System Integration

Unlike other scientific processors, viewed by the host computer as peripherals, the SPERRY ISP, as the name implies, is integrated into the SPERRY 1100/90 system just like the general purpose CPU. The job queue for the ISP is stored in main storage, just like other SPERRY 1100/90 jobs. The ISP accesses its job queue and data directly from main storage without needing to cross a channel interface like other supercomputers and array processors. This integrated approach allows the wall clock throughput to approach 70 – 90 percent of its performance – about six to nine times that of a SPERRY 1100/90 system. This is in direct contrast to other supercomputers that normally waste time transferring program, input, and output files across an I/O channel.

Additionally, the entire Integrated Scientific Processing system (ISP System – SPERRY 1100/90 plus Integrated Scientific Processor plus Scientific Processor Storage) executes under control of one operating system, OS 1100. Thus, unlike other supercomputer-host combinations, there is no complicated interaction of several operating systems during job execution. The SPERRY ISP itself is spared any system software tasks. Unique versus other supercomputers, all system software in the SPERRY Integrated Scientific Processor System executes on the SPERRY 1100/90 CPU, leaving the ISP only the task of application code execution.

The amount of time wasted due to file transfer, the need to use valuable CPU seconds for the operating system, and the use of the supercomputer for program development can restrict the execution times of other machines to a wall clock throughput average of 30 percent of their peak performance. This percentage will vary depending on the number of jobs and their size. This efficiency gives the Integrated Scientific Processor system a significant throughput advantage over the channel-attached connection used by other supercomputer – host systems.

A basic Integrated Scientific Processing System consists of a SPERRY 1100/90 processor with one Input/Output Unit, the Integrated Scientific Processor, and a Scientific Processor Storage Unit (the shared system memory). Added components provide configuration flexibility allowing system tailored performance. You can mix general purpose processing, I/O processing, or scientific vector processing, since the system can be expanded to the maximum configuration of SPERRY 1100/94 plus two SPERRY Integrated Scientific Processors plus four Input/Output Processors. Also, all of the program development software built for the SPERRY 1100/90, including interactive screen editors, debugging aids, and data base management systems, are supported in the SPERRY Integrated Scientific Processor environment.

By mid to late decade timeframe, all of the supercomputer vendors (including Cray and Control Data) will have introduced supercomputers which depend on tightly-coupled multiprocessors for speed. Only one vendor, Sperry, will have a proven operating system for managing a tightly-coupled multiprocessor configuration. This advantage is emphasized by the ability to put up to two Integrated Scientific Processors in a single configuration and make them available for immediate efficient use by the customer. This is in contrast to Cray and Control Data Corporation, that require possibly inefficient operating systems to execute on the supercomputer, achieving a lesser level of multiprocessor usage.

The Sperry Integrated Scientific Processing System was conceived, designed, and implemented as a balanced resource architecture. The processing speed, the memory bandpass, the I/O bandpass, and the SPERRY 1100 Operating System (OS 1100) enhancements are all balanced to provide the best price/performance possible for a system designed to be used in the late 1980's world of scientific processing.

Document Concept

This concept of the Scientific Processor linked to the software environment of the general purpose computer is the key point for our sales strategy. This guide prepares you to sell this innovative integration of scientific vector processor and commercial general purpose software environment to the prospective SPERRY ISP customer.

A description of the contents of each of the sections follows.

Section 2 describes the scientific marketplace as it now exists for the supercomputer and large mainframe user. It discusses the direction the marketplace will follow in the next years, the Integrated Scientific Processor's position in the marketplace, and the Integrated Scientific Processor concept.

Section 3 presents a strategy to penetrate this marketplace with the SPERRY ISP system.

Section 4 discusses the hardware components that make up the SPERRY ISP system, the software offering that enables its use in an integrated system, and the various configurations and growth of SPERRY ISP systems.

Section 5 addresses the tactical aspects of selling the Integrated Scientific Processor including who sells it, how to sell it, and to whom it can be sold.

Section 6 describes the sales aids available for your sales efforts.

Section 7 discusses the support plan including support provided during the sales promotion and after sales activity. Customer maintenance support and education plans are also included.

Section 8 analyzes the current competition. Further information will be available via newsletters and DAPS.

Section 9 is a question and answer tutorial that addresses questions most commonly asked about the Integrated Scientific Processor.

2 MARKET BACKGROUND

2.1 SUPERCOMPUTER MARKET OVERVIEW

Once confined to government laboratories doing pure research, the supercomputer marketplace is expanding today.

There are two primary reasons for the expansion of this marketplace:

1. The level of technology in the commercial enterprises such as oil, chemicals, and semiconductors is advancing rapidly.

2. The cost of developing that technology is increasing just as fast.

For example, the aerospace industry has found that simulating a physical experiment on a computer makes it generally less expensive and faster to develop new types of airplanes. Some real physical dangers have been avoided by design testing highly sophisticated fighter planes on the computer.

As recently as the early 1980's, there were approximately 50 supercomputers installed worldwide. Today, there are about 100 machines classified as supercomputers installed worldwide, with 70% of these machines manufactured by Cray Research, Incorporated. Cray has estimated that today 475 organizations exist which would benefit from a Cray supercomputer. That is a potential four billion dollar market.

From its entrance as a startup company in 1974, Cray Research, Incorporated has become preeminent in the supercomputer field. This is an example of the tremendous potential the high performance scientific marketplace offers our company. Because of limited manufacturing capability today, there are few vendors in the supercomputer marketplace, yet there is a marketplace demand expected to grow to 1000 machines valued at 1.5 billion dollars by 1989. The Japanese companies Fujitsu and Hitachi have claimed machines in the Cray class but only Fujitsu with Amdahl Corporation seems willing to market outside of Japan at this time.

The current supercomputer offerings from Cray and Control Data constitute the major world market. These machines have the following common disadvantages:

- They are expensive to purchase and maintain
- They are not versatile
- They are not user friendly
- They don't run popular applications software
- They create a multivendor environment

Sperry's Integrated Scientific Processor addresses these weaknesses. The SPERRY ISP system is:

- A supercomputer of moderate price
- Versatile enough to run both commercial data base and scientific applications on the same system
- User-friendly enough to offer all the software production tools for Series 1100 user expects of our large commercial mainframe

2.2 SHORTCOMING OF THE SUPERCOMPUTER

Rapid growth of the supercomputer market has left the scientific user with some hard choices in the past. Supercomputers like the Cray X-MP, the Cyber 205 and even the Fujitsu machines are not standalone. They depend upon other machines to do the applications code development, storage and retrieval and backup for the code that runs on the supercomputer itself. They need a general purpose computer like the 1100/90 System for the IBM™ 308X as a front-end machine. These computers serve as development environments and output devices that stage programs and data across a link between the supercomputer and its host or front-end computer.

This artificial mating of a general purpose front-end computer and a large back-end scientific computer always involves a link incapable of transferring the amounts of data needed to run the supercomputer at its peak efficiency. The supercomputer operates on large quantities of data in parallel, to process huge numbers of operations per second. This data is transferred to the supercomputer on channels like the IBM block-mux at rates of 3 million bytes per second. The supercomputer is capable of using data at a rate of billions of bytes per second. This imbalance between host and supercomputer is one of the key innovations addressed by the SPERRY Integrated Scientific Processor.

2.3 MARKET OBJECTIVES

Sperry has built a loyal customer base of users who execute scientific programs as an important part of their workload. The UNIVAC 1108 System established this base and maintained it for several years. Recently, the Series 1100 family has concentrated on enhacing commercial processing support and has invested the majority of its new innovations in that realm. Development of the SPERRY 1100/90 System has reemphasized scientific processing within Sperry and has led to the design of the Integrated Scientific Processing System.

There are two major market objectives that the SPERRY Integrated Scientific Processor System (SPS) will help achieve.

First, our current Series 1100 customers require more scientific compute power than is available in our general purpose SPERRY 1100/90 CPUs. Today we're meeting this requirement by the outside purchase of superminicomputers, IBM plug-compatible systems (e.g., Amdahl), or Cray attached systems. Our Series 1100 customer base is multivendor-oriented and scientific expansion can go in many directions. The Integrated Scientific Processor thrust aims to satisfy this power requirement.

Second, we can gain new customers by offering the advantage of high MFLOP scientific performance within a general purpose system that processes huge, highly varied job mix. Additionally, the system performs all the functions of a host efficiently, and allows programmer productivity improvements. It is complete with redundant configurations, I/O caching, and data base computers. The system also has complete International Standards Organization (ISO) network connections and coexistence capabilities that will evolve with the sharing of both communications and data resources. As data base computers, ISO networks, and IBM coexistence evolve during the life cycle of the 1100/90 System, the ISP system will share their use through OS 1100.

Sperry's objective is to reenter the scientific marketplace and reestablish a position that is preeminent in the industry and profitable for the company.

3 MARKET STRATEGY

3.1 TARGET MARKET SEGMENT

The target market for the ISP System is those members of the scientific processing community who require high performance computational performance integrated into a general purpose computing environment.

In the past, supercomputer users came primarily from the large government laboratories that required large computational rates and were unconcerned about ease of use. As scientific computing requirements and familiarity with current machines have grown, the user community has also expanded into all areas of industry, government and academia. Econometric modeling, Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM), movies, auto manufacturing, cryptography, and nuclear engineering are some of the newest areas. The classic areas, that have driven past vendor requirements, are weather prediction, structural analysis, seismic and signal processing, as well as fluid dynamics for wind tunnel simulation and magnetic fusion physics.

The user community is worldwide. In fact, because of the lack of computational resources currently available in the United States university environment, many researchers go to Europe to do their work on American-built machines.

Our target market segment requires high performance scientific processing power combined with a general purpose computational facility that permits all facets of computing from code development, transaction processing, document production, data communications and graphics capability.

Since these machines are expensive, the purchase of a supercomputer takes thought, planning and justification by the purchaser. This is especially true for a government or university procurement.

Major purchasers of supercomputers include:

1. Aerospace industry and automobile manufacturers – companies involved in computer-aided design (CAD) like Ford, General Motors, Boeing and Grumman or structural analysis applications like McDonald Douglas.

2. Semiconductor manufacturers. Circuits have become so complex the power of a supercomputer is needed to check the boolean algebra involved in their design to save costly production and simulation of test circuits.

3. Oil companies, nuclear research groups, nuclear safety organizations, weather services. Simulation of oil reservoirs, nuclear reactor vessels, or weather systems, require more and more computing power. These physical events are so large and complex that a ten-fold increase in model accuracy can cause a hundred-fold increase in computation for a single dimension of the problem.

4. Defense programs. The agencies whose applications include cryptography and signal processing have long been users of supercomputer power.

5. Chemical and drug companies and genetic engineering are potential users. These companies are now buying time from various computer services on Cray and Control Data Corporation supercomputers.

These industries represent the marketplace now. When the supercomputer comes under the umbrella of the large data base information system, the field will expand even further.

3.2 TIME TO ENTER THE MARKET

The supercomputer market is growing dramatically. Cray and the Japanese are pushing scientific computer performance to its limits. However, most of the market consists of companies who need the power of the supercomputer for their scientific applications but are not willing to sacrifice the general purpose environment. These companies may be unwilling to pay the cost in conversion, user unfriendly software, and maintenance and support for the processor power of the Cray or Japanese supercomputers. Sperry offers an alternative, especially to existing Series 1100 customers. The SPERRY ISP offers the unique capabilities of the power of a supercomputer in the general purpose computer environment.

3.3 SPERRY MARKET STRATEGY

The strategy for the marketing of the SPERRY Integrated Scientific Processing System is based on two fundamental market objectives:

1. To keep our Series 1100 scientific base from wandering; and,

2. To expand to the Series 1100 base in the lucrative, large scale technical computing marketplace.

Selling to the Series 1100 Base

The basic marketing strategy for the SPERRY ISP is to regard it as a natural upgrade for a scientific (FORTRAN) SPERRY 1100/90 site. If a customer is using a 1100/91 System for scientific processing, he would upgrade by placing a SPERRY ISP subsystem in his 1100/90 configuration. If his application is commercial processing, he would expand his configuration to a 1100/92 System. Since a SPERRY ISP performs scientific vector applications six to nine times faster than an 1100/90 Instruction Processor, this makes the SPERRY ISP an outstanding price/performance upgrade option.

Base Upgrade to Class VI

The SPERRY ISP is a Class VI processor as defined by the United States Department of Energy. This translates to a sustained performance of greater than 20 MFLOPS in double precision. This performance is on a par with the Cray 1-S systems marketed by Cray Research. This level of performance, coupled with the advantages of the integrated system approach, a much lower price, and a maintenance philosophy which treats ISP as a mainframe extension (rather than an expensive peripheral), gives Sperry an unequaled advantage for offering ISP Systems to our own customer base as a high performance computational system. It also allows Sperry to offer a staged performance upgrade strategy not available from other vendors.

New Account Opportunity

You can bid the SPERRY Integrated Scientific Processing System to procurements ranging from Class VI supercomputers to large FORTRAN mainframes. A specially configured ISP System (1100/91 system, Integrated Scientific Processor 4 Megawords Scientific Processor Storage unit) priced at 5 million dollars, will be offered as an attractively priced base expansion machine. For users requiring more computation power, we can offer two Integrated Scientific Processors with more than 40 MFLOPS (double precision) of sustained FORTRAN scientific processing performance, controlled by one tightly coupled multiprocessing operating system – OS 1100.

The market potential within the large scientific community is very high and will yield sales that are impossible with only a general purpose 1100/90 System.

Seismic and Signal Processing Opportunities

Unlike the SPERRY 1100/80 Array Processor System (APS), the ISP System is balanced to support general scientific computational requirements. However, an Integrated Scientific Processor can certainly address the computational requirements of the seismic and signal processing communities. The SPERRY ISP can be marketed as a follow-on machine to the Array Processor System (APS) in this environment, with a significant speed advantage coming from faster processing power, increased bandwidth, and higher usage.

The Array Processor System was designed for seismic and signal processing. Though the ISP is designed for general purpose scientific processing, it should significantly outperform the APS on seismic and signal processing codes due to overall system balance. Like the Array Processor System, the ISP System can be configured with up to two integrated scientific processors, yielding a total of up to 266 MFLOPS at a burst rate.

4 PRODUCT INFORMATION

The following overview of the Integrated Scientific Processor System is extracted from the ISP System Description, UP-10073, for more information. Refer to that document.

The Integrated Scientific Processor System includes an Integrated Scientific Processor Subsystem tightly coupled to an 1100/90 System.

The Integrated Scientific Processor Subsystem consists of an Integrated Scientific Processor (ISP), a Scientific Processor Storage unit (SPS), a Multiple Unit Adapter (MUA), and a cooling unit. The scientific processor is capable of a peak performance of 133 million floating-point operations per second. The multiple unit adapter allows the scientific processor to access up to 16 million words of Scientific Processor Storage.

The 1100/90 System is the largest general purpose mainframe that Sperry markets. Configurations that support the ISP range from a single processor 1100/91 with 4 million words of storage to a tightly coupled four processor 1100/94, capable of supporting 16 million words of storage. For more information on the 1100/90 System, refer to 1100/90 Systems, Hardware System Description, UP-9288.

The Integrated Scientific Processor System is a transparent way to extend the processing power of an 1100/90 System when additional scientific processing power is required. The balanced system architecture and rich mainframe system software provide the user with high performance, without the usual penalties of program development and machine reliability and maintainability.

4.1 SYSTEM CHARACTERISTICS

The Integrated Scientific Processor System is designed for both current Series 1100 customers who need more scientific computing performance than the 1100/90 System offers, and new customers desiring high performance scientific processing. Both customer requirements are satisfied within a general purpose computing environment.

Significant features of the Integrated Scientific Processor Subsystem include:

1. High performance special purpose processor and storage tightly coupled to the 1100/90 System.

2. Support of both vector and scalar high speed processing.

3. A peak performance of 133 million single-precision (36-bit word) floating-point operations per second and 67 million double-precision (72-bit word) floating-point operations per second.

4. Instructions for computations using single- and double-precision integers and floating-point numbers in both scalar and vector operations.

5. The Executive system, running on the 1100/90 system, manages all the tasks. The integrated scientific processor executes user code only. No system software runs on the Integrated Scientific Processor, using its entire compute power to perform user application computations.

6. A high performance storage that is directly addressable by both 1100/90 Instruction Processor and the Integrated Scientific Processor; file transfers are not required.

7. An integrated system environment that provides for improved reliability and maintainability.

The Integrated Scientific Processor System provides a high computational capability within a mainframe environment, targeted at the scientific marketplace. These users have workloads that contain large amounts of vector and multi-dimensional array processing. Typical applications include mass transport, seismic processing, reservoir engineering, structural analysis, linear programming, and signal processing.

4.2 SYSTEM ARCHITECTURE

The Integrated Scientific Processor Subsystem's architecture is based upon a number of principles for efficient execution of applications:

1. The system is ideal for large, computational-intensive programs.

2. Loop optimization is critical. Registers and control structures are designed for efficient handling of the nested loop processing characteristics of a vector FORTRAN program, with primary emphasis given to optimizing the innermost loop.

3. The storage bandwidth problem characteristic of high-speed processing is minimized by the choice of a register-to-register architecture.

4. Local storage is used by the scalar processor module for fast access of frequently used scalar variables in a program.

5. Data representation is identical to that of the Series 1100 systems. Source language compatibility is provided at the FORTRAN level.

6. The Integrated Scientific Processor Subsystem is integrated into an 1100/90 System via shared storage, with all processors managed by a single operating system.

7. The Integrated Scientific Processor has its own unique instruction set that is optimized to support scientific vector computations.

4.3 SUBSYSTEM HARDWARE COMPONENTS

The Integrated Scientific Processor System consists of an Integrated Scientific Processor Subsystem attached to an 1100/90 System. The Integrated Scientific Processor Subsystem hardware consists of an Integrated Scientific Processor, a Scientific Processor Storage unit, a Multiple Unit Adapter, and an Instruction Processor Cooling Unit.

1. Integrated Scientific Processor

   The Integrated Scientific Processor performs high-speed floating-point vector calculations and scalar operations. The processor uses new architecture, a pipelined machine organization, and instructions that provide increased performance for both integer and floating-point scalar operations embedded in the code. These improvements provide overall increased performance throughput for scientific vector FORTRAN programs of 6 to 9 times over an 1100/90 Instruction Processor.

   One or two integrated scientific processors may be integrated with an 1100/90 System, resulting in configurations ranging from a 1x1x1 (one 1100/90 Instruction Processor, one 1100/90 Input/Output Processor, and one Integrated Vector Processor) to a 4x4x2.

2. Scientific Processor Storage

   The scientific processor storage may be used to replace or complement the standard 1100/90 main storage units. These storage units are treated identically when executing Series 1100 code. The Scientific Processor Storage provides the higher bandpass required to support the speed of the Integrated Scientific Processors. Thus, the Integrated Scientific Processors can only access code or data loaded into the Scientific Processor Storage units. This allocation is transparent to the applications programmer. Both the Scientific Processor Storage and the main storage units may be used in an Integrated Scientific Processor System.

   The Scientific Processor Storage provides 4,194,304 words of storage. Up to a maximum of 16,666,216 words of storage is available with four Scientific Processor Storage units. This storage is directly addressable by the Integrated Scientific Processor, and the 1100/90 Instruction and Input/Output Processors.

3. Multiple Unit Adapter

   The Multiple Unit Adapter allows the Integrated Scientific Processor to address more than one Scientific Processor Storage Unit. It is required when two or more Scientific Processor Storage units are used in a system. It is optional when one Scientific Processor Storage unit is used in a system.

   One multiple unit adapter can be used with one Integrated Scientific Processor and one to four Scientific Processor Storage units. Two Multiple Unit Adapters are required when two Integrated Scientific Processors are used in a system.

4. Instruction Processor Cooling Unit

   Instruction Processor cooling units provide water cooling for both 1100/90 Instruction Processors and Integrated Scientific Processors. One Instruction Processor Cooling Unit is required for each Integrated Scientific Processor in the system.

4.4 SYSTEM SOFTWARE

Overview of the Integrated Scientific Processor System Software

Much of the computing power of the Integrated Scientific Processor System comes from its software. There are two main reasons for the power of Integrated Scientific Processor System software:

1. In the Integrated Scientific Processor System, all data and operating system capabilities are instantly available to both the 1100/90 System and the Integrated Scientific Processor. The user perceives a single system, requiring no special user control.

2. Universal Compiling System (UCS) FORTRAN, a powerful, vector-oriented programming language, produces code specifically designed to take advantage of the hardware architecture of the Integrated Scientific Processor System. Several supporting products make it even more powerful.

This section gives an overview of the software available for the Integrated Scientific Processor System, and what it provides.

Executive System, System Support Processor, and Linking System

The Executive system and the System Support Processor (SSP) perform most operating system duties. The Executive is the principal interface between the user and the system as a whole.

The Integrated Scientific Processor itself performs no operating system activities. The Integrated Scientific Processor operates as a specialized resource under the Series 1100 Executive. All other operating system functions (scheduling, resource allocation, operational and I/O control) continue to execute on the 1100/90 Instruction Processor.

From the programmer's point of view, running on the Integrated Scientific Processor is no different from running on the 1100/90 System. They decide whether code is executed by the 1100/90 System or the Integrated Scientific Processor by choosing a simple compiler option. The Executive then directs Integrated Scientific Processor code to the Integrated Scientific Processor without user intervention. To the Executive, the Integrated Scientific Processor is just an additional Instruction Processor.

The Linking System is the new product that links (unites) separately compiled UCS FORTRAN subprograms into a single program. It lets users link subprograms compiled for the Integrated Scientific Processor to subprograms compiled for the 1100/90 System. This permits the most efficient resource usage. No special control statements are required. When one subprogram type (e.g., an 1100/90 subprogram) calls another (e.g., an Integrated Scientific Processor subprogram), the Linking System organizes the execution.

Integration with an 1100/90 mainframe allows use of all of Sperry's application development software with programs that execute in the Integrated Scientific Processor. One system handles the design, testing, and debugging of FORTRAN applications programs, monitors system usage as needed, and provides run-time support.

Applications for scientific computers normally have tremendous amounts of code and data. The extended mode capability of the 1100/90 mainframe provides sixteen addressing windows that allow up to sixteen user banks to be simultaneously visible. This provides a total addressing space of up to 64 billion words, of which 16 million words are currently addressable.

Programming Languages

UCS FORTRAN, the principal software programming language used with the Integrated Scientific Processor System, also gives it much of its computing power. UCS FORTRAN (UFTN) produces code designed to take advantage of the hardware architecture of the Integrated Scientific Processor, and several supporting products make it even more powerful.

UCS FORTRAN is a high level programming language whose compiler is a component of the Universal Compiling System (UCS). This language provides many array handling features to meet the demands of scientific processing. It conforms to and implements *American National Standard FORTRAN, ANSI X3.9-1978,* called FORTRAN 77. In addition, UCS FORTRAN includes many enhancements to FORTRAN 77 that have been proposed for future levels of FORTRAN. These include many array programming extensions pertaining to the Integrated Scientific Processor System.

The Integrated Scientific Processor achieves high performance processing because:

1. The compiler can detect parallelism in a user source program.
2. As a result of detecting parallelism, the compiler generates object code that uses the Integrated Scientific Processor's vector registers and vector instructions.

Use of FORTRAN array extensions denotes explicit representation of parallelism. When the array extensions of UCS FORTRAN are used, they enable the compiler to recognize parallelism, and compile the code specifically for execution by the Integrated Scientific Processor hardware.

Array programming extensions include:

- array-valued expressions and assignment statements;
- identified arrays;
- array sections;
- conditional array statements (WHERE constructs);
- PACK and UNPACK statements; and
- array-valued intrinsics.

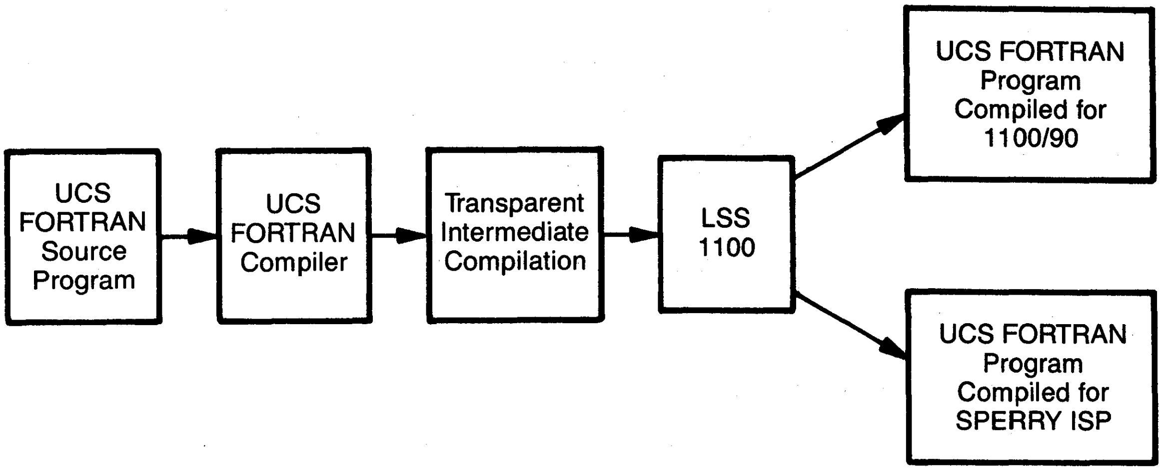
However, the UCS FORTRAN compiler does more than just implement these array extensions. It also optimizes operations that make the resulting object code execute more efficiently on the Integrated Scientific Processor System. Note that these optimizations are in addition to those performed by the vectorizer. (See the following discussion.)

The UCS FORTRAN compiler takes statements that the programmer or vectorizer did not or could not convert to optimized syntax and converts them to statements allowing vector processing. For instance, it:

- divides a loop into vector and scalar portions;
- recognizes special cases, such as sum reductions and dot products; and
- transforms loops containing scalar variable references into loops able to use vector processing. Transformations include:
  - scalar expansion,
  - induction variable substitution, and
  - scalar renaming.

One of the most important optimization operations of the UCS FORTRAN compiler is its handling of conditional branching. Wherever possible, the compiler rearranges the statements in a loop so that it can convert conditional branching to vector operations that are under control of the hardware mask register. The compiler can do this both for loops whose branching remains within the loop and loops whose branching exits the loop.

Selecting compiler options to compile a routine for the 1100/90 System or for the Integrated Scientific Processor is easy. To designate that a routine will execute on the 1100/90 System or the Integrated Scientific Processor, the user specifies an option on the UCS FORTRAN processor call. No other user action is required. The compiler transforms source language input into a common intermediate text and other global data structures, that become input to a machine dependent Language Support System (LSS 1100). LSS 1100 then generates 1100/90 code or Integrated Scientific Processor code, as specified on the UCS FORTRAN processor call.



Existing applications are easily converted for processing on the Integrated Scientific Processor:

1. Use the vectorizer to convert existing FORTRAN source statements to vector-oriented source statements.

2. Compile the vectorized application source program using the Integrated Scientific Processor option on the UFTN call.

3. Link the compiled, vectorized source program using the Linking System.

Other Software Products

The following software products make UCS FORTRAN an even more powerful programming language.

UCS FORTRAN Vectorizer

Even if a user has not explicitly coded using FORTRAN array extensions, he can still incorporate them by using the Vectorizer. The vectorizer is a preprocessor to the UCS FORTRAN compiler. It takes FORTRAN source programs and converts them to source programs using more efficient array structures. Where possible, the vectorizer converts scalar syntax to array syntax. Thus, the user can access the power of the extended language while maintaining source code in FORTRAN 77.

The vectorizer examines a FORTRAN source program for parallelism in DO-loops and either:

- automatically replaces DO-loops with array extensions. This vectorizes the program and may also restructure the code to increase detected parallelism; or
- prints a message stating why the DO-loop cannot be converted to vector processing.

The messages produced by the vectorizer may indicate that alteration of the source program could lead to increased program performance. In this case, the user could restructure the vectorized program code or the original source program code and rerun it through the vectorizer.

The vectorizer reduces system overhead by delaying compilation until the last moment, when the source program has been optimized. The vectorizer also produces the vectorized source program in an easy-to-read format that helps users understand the new source statements with incorporated array extensions. Using this output as an example, users soon learn to incorporate array extensions themselves.

Extended Math Library

The SPERRY Extended Math Library (EML) provides FORTRAN callable mathematical functions and subroutines beyond those provided with the FORTRAN compilers (FTN or UFTN) or the Common Mathematical Library (CML) which is part of UFTN.

Many of the Extended Math Library routines have the same name and function as routines available in the public domain or on other computer systems. The Extended Math Library, however, was created specifically for use with Sperry computers. This allows the Extended Math Library routines to make the best possible use of the features of the Sperry systems. The Extended Math Library includes the functions and subroutines most used by the scientific computing community today, including the BLAS (Basic Linear Algebra Subroutines), a basic building set for many other programs.

All routines in the Extended Math Library may be executed on either the 1100/90 Instruction Processor or the Integrated Scientific Processor. Some of the routines are written in assembler language for the Integrated Scientific Processor version.

The Extended Math Library has the following features:

- Fast Fourier Transforms (FFTs)
- Convolution integrals
- Correlation routines
- Solution to the Weiner-Levinson equation
- Geophysical calculations
- BLAS (Basic Linear Algebra Subroutines)
- Machine precision characteristics

Performance Execution Evaluation Routine (PEER)

To take advantage of the efficiency offered by an Integrated Scientific Processing system, the user needs a way to determine whether a given program should execute on the Integrated Scientific Processor or the 1100/90 computer. Performance Execution Evaluation Routine (PEER) uses statistical sampling and analysis to help the programmer determine the amount of scalar versus vector processing occurring in a FORTRAN program. Performance Execution Evaluation Routine tells which routines require the most processing time, thus pinpointing the most likely candidates for user optimization. The Performance Execution Evaluation Routine lets the user determine whether to execute the FORTRAN program on the Integrated Scientific Processor or the 1100/90 Instruction Processor.

Meta-Assembler (MASM) Procedures

FORTRAN programs that execute on the Integrated Scientific Processor can call MASM subprograms. An extended version of the Series 1100 MASM assembler produces assembly language code for the Integrated Scientific Processor.

4.5 SYSTEM PERFORMANCE

The Integrated Scientific Processor Subsystem supports both high-speed vector and scalar processing. The peak performance of a single Integrated Scientific Processor is 133 million floating-point operations per second in single precision (36-bit word), and 67 million floating-point operations per second in double precision (72-bit word).

The high-speed scientific processor storage module communicates with the Integrated Scientific Processor at the rate of 133 million single-precision words per second or 67 million double-precision words per second.

An 1100/91 System with an Integrated Scientific Processor Subsystem can sustain 6 to 9 times the throughput of an 1100/91 Unit Processor System for highly vectorizable, compute-bound jobs normally found in scientific processing.

Table 4-1 shows vector operation rates, expressed as millions of floating-point operations per second (MFLOPS). These rates are the internal computation speeds of the Integrated Scientific Processor.

Table 4-1. Vector Operation Rates

Operation	Single Precision Rate	Double Precision Rate
Multiply	66.6 MFLOPS	33.3 MFLOPS
Add or Subtract	66.6 MFLOPS	33.3 MFLOPS
Multiply and Add	133.0 MFLOPS	66.6 MFLOPS

A scientific processor that can execute an industry standard benchmark for scientific processors in the range of 20 – 60 million floating-point operations per second is considered a Class VI processor. The SPERRY Integrated Scientific Processor meets the requirement in double precision.

4.6 AVAILABILITY, RELIABILITY, AND MAINTAINABILITY

The Integrated Scientific Processor, Scientific Processor Storage, and Multiple Unit Adapter all have 100 percent throughchecking on their data paths. Control logic is also checked when feasible.

In the Integrated Scientific Processor, arithmetic transformations are checked by duplication or parity predict logic. The scientific processor storage unit uses double-bit error detection and single-bit error correction in its storage modules.

All of these units use the scan-set interface and employ the in-unit-card-test technique for maintenance, following the 1100/90 philosophy.

4.7 PHYSICAL CHARACTERISTICS

The Integrated Scientific Processor uses three cabinets of total dimension 144 inches x 64 inches x 30 inches.

The Scientific Processor Storage unit uses two cabinets of total dimension 72 inches x 64 inches x 30 inches.

Table 4-2 shows the requirements for unit power and cooling are as follows:

Table 4-2. Unit Power and Cooling Requirements

Unit	Power (KVA)		Cooling (KW)	
	400 Hz	50/60 Hz	Liquid	Air
Integrated Scientific Processor	51.3	0.7	34.0	6.5
Scientific Processor Storage	18.0	2.5	N/A	17.0
Multiple Unit Adapter	1.5	1.0	N/A	2.0

NOTE: N/A – Not Applicable

4.8 SYSTEM CONFIGURATION

The hardware components that are added to an 1100/90 system to form an Integrated Scientific Processor System consist of:

- one or two Integrated Scientific Processors
- one to four Scientific Processor Storage units
- zero, one, or two Multiple Unit Adapters
- one Instruction Processor Cooling Unit for each Integrated Scientific Processor
- a second memory port for each SPS unit if 2 ISPs are configured.

Table 4-3 lists the Integrated Scientific Processor Components for each 1100/90 configuration.

Table 4-3. Integrated Scientific Processor Hardware Components[2]

	Number of Units Required						
Integrated Scientific Processor	1	1	1	1	2	2	2
Scientific Processor Storage	1	2	3	4	2	3	4
Multiple Unit Adapter	0 – 1	1	1	1	2	2	2
Instruction Processor Cooling Unit[1]	1	1	1	1	2	2	2
Second Memory Port	0	0	0	0	2	3	4

NOTES:

1. The number of cooling units does not include those required for the 1100/90 Instruction Processors. Two additional cooling units may be configured for redundancy.
2. See 1100/90 Hardware System Description, UP-9288 (current version) for other system components required for each configuration.

Minimum Configuration

The Integrated Scientific Processor Subsystem is used with the 1100/90 central complex equipment, with some restrictions, to form an Integrated Scientific Processor System. The minimum system consists of:

- one Instruction Processor

- one Input/Output Processor
- two Instruction Processor Cooling Units
- one Integrated Scientific Processor
- one Scientific Processor Storage Unit
- one System Support Processor
- one console
- one system clock
- two motor alternators

Figure 4-1 shows the minimum Integrated Scientific Processor System.

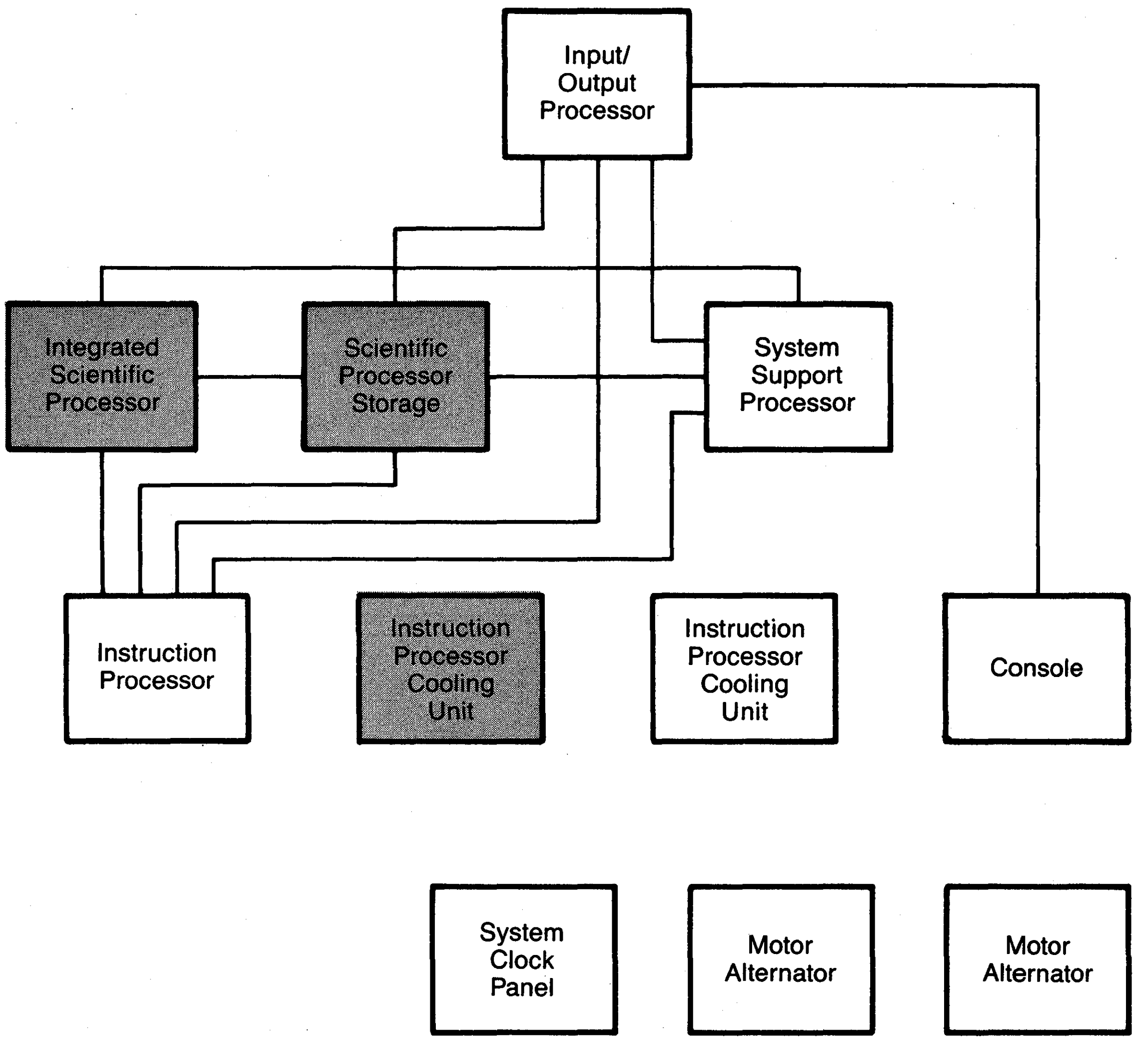


Figure 4-1. 1100/91 Minimum Integrated Scientific Processor System

Maximum Configuration

The minimum system can be expanded by adding one, two, or three Instruction Processors; one, two, or three Input/Output Processors; one Integrated Scientific Processor; one, two, or three Scientific Processor Storage or Main Storage Units for a total of 16 million words; and one or two Multiple Unit Adapters.

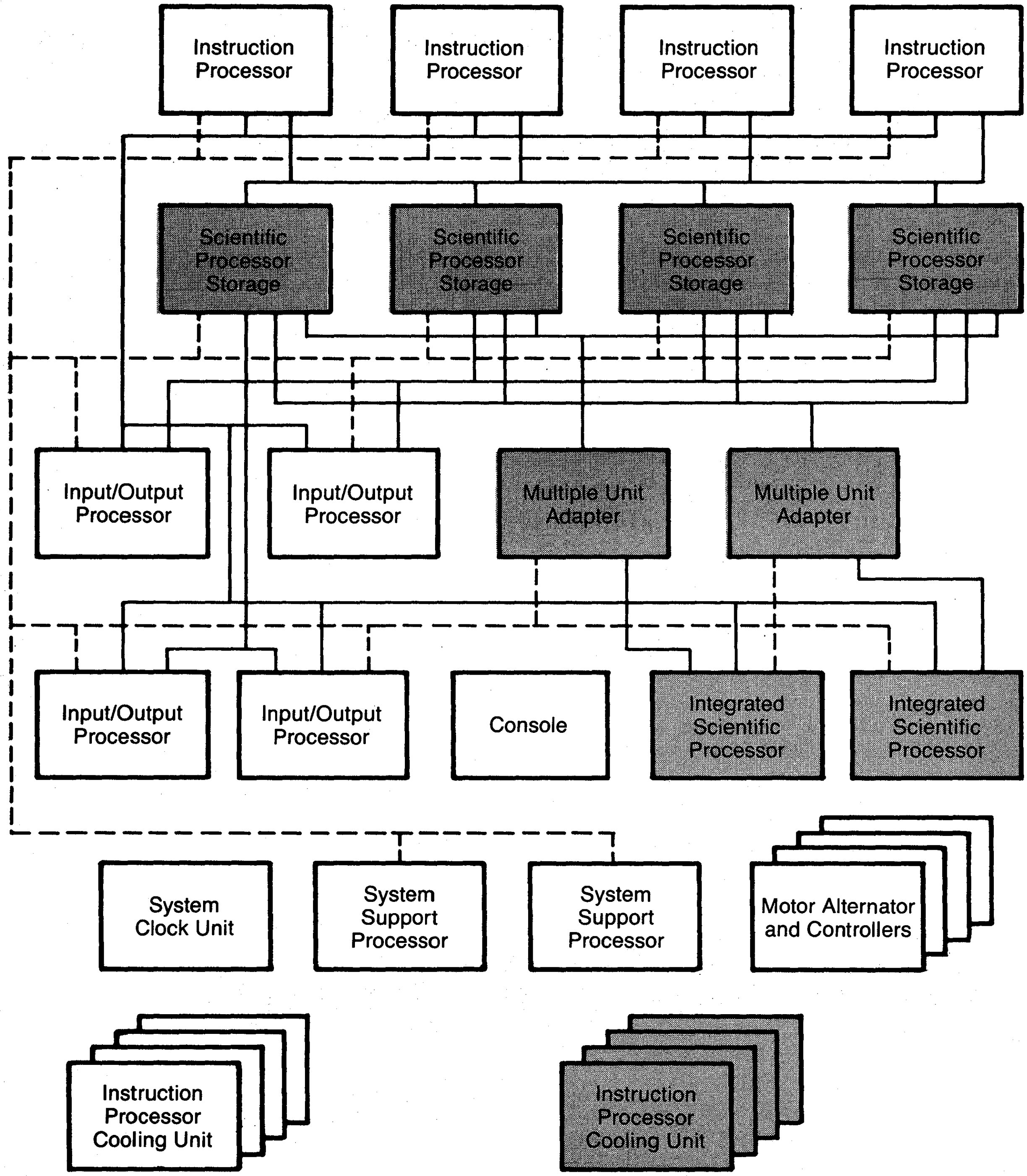
One Scientific Processor Storage unit is required per system. When two Scientific Processor Storage units are used, a Multiple Unit Adapter is required. If a second integrated processor is used in a system using Scientific Processor Storage units, a second Multiple Unit Adapter is required.

Scientific Processor Storage and main storage units can be present within one system. The Integrated Scientific Processor addresses only the Scientific Processor Storage. The Instruction Processor and Input/Output Processor address both types of storage units.

The maximum Integrated Scientific Processor System is:

- four Instruction Processors
- four Input/Output Processors
- two Integrated Scientific Processors
- four Instruction Processor Cooling Units (four additional cooling units may be configured for redundancy)
- four Scientific Processor Storage units
- two Multiple Unit Adapters
- two System Support Processors
- one console
- one system clock unit
- four motor alternators

Figure 4-2 shows the maximum Integrated Scientific Processor System.



NOTE: Connections are actually point-to-point, not bussed. Dotted lines are System Support Processor interfaces.

Figure 4-2. 1100/94 Maximum Integrated Scientific Processor System

5 SALES PLAN

5.1 WHO SELLS IT?

Since the SPERRY ISP constitutes an 1100/90 upgrade, it will be sold by the 1100 Series sales force. Segments of this sales force include salesmen familiar with the Sperry customers involved in industries that need a supercomputer or have scientific applications requiring the high performance achieved by using the Integrated Scientific Processor System.

5.2 WHEN SHOULD IT BE SOLD?

Any scientific customer who is planning to purchase or already has purchased an 1100/90 System is a candidate for the Integrated Scientific Processor. If a customer runs any scientific applications programs, these will benefit from the introduction of an Integrated Scientific Processor into his computer complex.

When a customer requires a supercomputer, pairing of an 1100/90 System plus Integrated Scientific Processor is a good solution and the ISP Subsystem is especially attractive to existing 1100/90 customers.

For the new account a specially priced 1100/90 System plus Integrated Scientific Processor system is planned as an "attack" configuration. Stress the integrated system aspect of the 1100/90 System plus Integrated Scientific Processor, a general purpose computer environment with the available power of a supercomputer.

5.3 HOW SHOULD IT BE SOLD?

The general sales approach is to demonstrate the Integrated Scientific Processor's value to produce high speed FORTRAN productivity. The Integrated Scientific Processor offers FORTRAN processing power coupled with a general purpose computer environment. All the software support tools and data base management systems are available to both scientific and commercial applications. There is supercomputer performance in a good information retrieval environment.

The supercomputer competition will show weakness in the area of adequate program development tools and slow wall clock turnaround due to lack of a common development and operational environment for its supercomputer and the prospect's host computer. Remember the cost of buying a supercomputer, like the Cray, includes the resources the host computer must provide.

The sales strategy for a Sperry base upgrade should be based on the fact that the Integrated Scientific Processor will outperform an 1100/91 System by a factor of 6 to 9 on scientific vector FORTRAN applications. (See Table 5-1).

Table 5-1. 1100 Base Upgrade

Migration Choice	Resulting Performance
1100/91 to 1100/92 plus 4MW of MSU	1100/92 is 1.9 times faster than 1100/91
1100/91 to 1100/91-ISP plus 4MW of SPSU	ISP is 6 to 9 times faster than 1100/91

MW = Megawords
MSU = Main Storage Unit
ISP = Integrated Scientific Processor
SPSU = Scientific Processor Storage Unit
IP = Instruction Processor

Broaden the concept of price with your customers to include:

1. Maintenance costs – Supercomputers typically cost $30,000 to $50,000 per month in maintenance costs, plus the physical space needed for two sets of field engineers/system analysts, one set for supercomputer and one for host).

2. Programmer productivity – Productivity decreases when customers use primitive or incompatible program development tools.

3. Reliability – The Integrated Scientific Processor features 100% through-checking on all data paths.

4. Life cycle costs in general – For example, the Japanese charge $16,000 per month for software.

The SPERRY ISP System pricing and performance compares very well with large mainframes. In a mainframe FORTRAN-based procurement, stress the performance of the system as well as the Integrated Scientific Processor standalone performance.

An unmatched feature of the Integrated Scientific Processor is the growth potential it brings to Series 1100. The 1100/90 System can be grown to an 1100/91-ISP System. If the customer's program development requirements grow, he can add more Instruction Processors or Input/Output Processors. If his execution requirements have grown, an additional Integrated Scientific Processor can be added. This is illustrated in Figure 5-1.

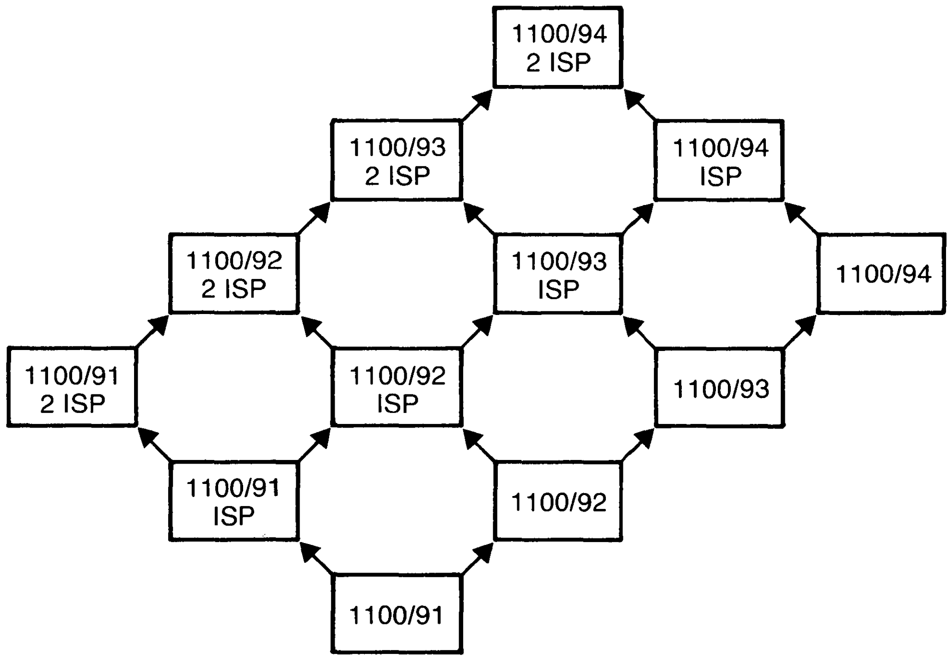


Figure 5-1. 1100/90 and Integrated Scientific Processor Migration

5.4 WHO CAN I CALL?

Contact the following individuals for discussion, sales support, and general questions.

For the Americas Division:

Dr. Barry N. Lurie
Director, Scientific Marketing
Scientific, Energy and Communications Marketing
Wayne, PA 19087
(215) 293-0300 Ext. 290 (SperryNet 424-1290)

David J. Deak
Manager, Major Systems Product Requirements
Scientific, Energy and Communications Marketing
Wayne, PA 19087
(215) 293-0300 Ext. 402 (SperryNet 424-1402)

Larry Olsen
Director, Scientific Marketing – FSD
McLean, VA 22102
(703) 556-5777 (SperryNet 492-5777)

For the International Division:

Lloyd E. Mitchell
Director, Energy and Utilities Marketing
Blue Bell, PA 19424
(215) 542-3113 (SperryNet 423-3113)

6 SALES AIDS

The following sales aids are available to support the Integrated Scientific Processor announcement:

- **Product Sales Brochure** (S7877) – This brochure is a glossy pamphlet aimed at the senior manager. It gives an overview of the SPERRY ISP hardware and software and describes the Integrated Scientific Processor as a natural. upgrade for the 1100/90 system scientific users.
- **Facts & Figures Brochure** (S7878) – This brochure is a performance oriented pamphlet describing the SPERRY ISP performance from a hardware standpoint. Sections describe software tools and the various scientific applications that run on the Integrated Scientific Processor.
- **Product Presentation** (S7874, S7874.1) – This is a slide and script presentation addressing both hardware and software aspects of the Integrated Scientific Processor.
- **Overhead Presentation** (S7875, S7875.2) – A higher level presentation consisting of overhead masters and script extracted from the Product Presentation.
- **System Overview** (UP-10073) – A technical hardware and software overview intended for users.
- **Program Product Specifications (PPS)** – Brief descriptions of program products used with the Integrated Scientific Processor. These include:
  MASP – Meta Assembler Scientific Processor (UA-0910)
  UFTN – Universal Compiling System FORTRAN (UA-0911)
  UVEC – UCS FORTRAN Vectorizer (UA-0912)
  PEER – Program Execution Evolution Routine (UA-0913)
  EML – Extended Math Library (UA-0914)

In addition to these Brochures and publications, the modules of the Integrated Scientific Processor sales training seminar will be packaged as slide scripts to be used as sales aids. These modules include:

- Scientific Marketplace Overview
- Array and Vector Processor Overview
- Integrated Scientific Processor Hardware and Software Overview
- Integrated Scientific Processor Marketing Plan and Strategy
- Competitive Analysis

The competitive analysis section will also be captured on DAPS and will be updated continually.

7 SUPPORT PLANS

7.1 MARKETING SUPPORT

The Integrated Scientific Processor product will be marketed by the sales force that today markets the Series 1100 systems. Direct marketing support for this activity will also be provided by the Scientific Marketing organization under Dr. John Fox, V.P. of Scientific, Energy, and Communications Marketing. Specific questions should be addressed to Dr. Barry Lurie, Director of Scientific Marketing, (215) 293-0300 Ext. 290 (SperryNet 424-1290).

7.2 DOCUMENTATION

Customers ordering the Integrated Scientific Processor subsystem will receive the documentation necessary to install, use and manage the system in the 1100/90 series environment. The manuals provided with the 1100/90 System contain updated sections for SPERRY 1100/90-ISP configurations. The following manuals will also be available:

- Integrated Scientific Processor System Overview, UP-10073
- Integrated Scientific Processor System Guide, UP-11293
- UCS FORTRAN Reference, UP-10313.1
- UCS FORTRAN Vectorizer Guide, UP-9684

7.3 EDUCATION SUPPORT

Courses will be provided by Sperry's World Education Center in the areas of Customer, Technical, and Sales Education. Sales training will also be provided by seminars developed by Scientific Marketing.

Customer Education

Courses that have been updated to include ISP information or developed for the ISP include:

- SE0101 – Basic ANSI FORTRAN
- SE0103 – UCS FORTRAN Programming
- SExxxx – Vector Programming for the Integrated Scientific Processor provided by Pacific Sierra Research Corporation
- SE1109 – 1100/90 Orientation
- SE0511 – 1100/90 Operator Training (self-study)
- SE0525 – 1100/90 Operator Training (Section on ISP)

Sales Training

The seminar course modules developed with slides/script are:

- Scientific Marketplace Overview
- Array and Vector Processor Overview
- Integrated Scientific Processor Hardware Overview
- Integrated Scientific Processor Software Overview
- Integrated Scientific Processor Marketing Plan
- Competitive Analysis

7.4 MARKETING SUPPORT PLAN

Introduction

To support the successful marketing of the SPERRY ISP, here are some helpful suggestions for implementation, as appropriate, by the divisions. The purpose of these marketing support concepts is to create substantial early momentum for the SPERRY ISP program by fostering a sense of partnership with early SPERRY ISP customers.

The concepts include:

- Special early site support;
- Joint development and marketing of applications software;
- Machine time buybacks to support development of applications software by independent software vendors; and
- Machine time buybacks to support benchmark and demonstration efforts in International Division.

The following discussion leaves the implementation of the suggestions at the discretion of Operations or Subsidiary management. Note that techniques suggested here are commonly used by Cray and Control Data Corporation, our primary competition in high-speed computing.

Special Early Site Support

The SPERRY ISP is designed to fit almost transparently into the mainframe environment for the end user. Nevertheless, to obtain the optimum performance from the ISP, the application programmer needs training to understand how to write optimum programs for scientific computers. Additionally, the user may be reluctant to use the Universal Compiling System (UCS) environment that is being newly released with the ISP.

To reduce these concerns, Product Management and Marketing will administer a program in which each early SPERRY ISP customer will have direct access to the appropriate development organization. Thus, questions about how the system software or hardware performs can be addressed and answered directly by the designers, without the time delays normally associated with such a response.

In addition, the relevant field organization should consider committing one systems analyst, skilled in the ISP system, for a period of six months following each early ISP installation.

The field organization might also want to assume conversion costs for early ISP customers by furnishing a negotiable level of conversion support staff, machine time, or both, to assist the conversion effort. The machine time may be at the Eagan, Minnesota benchmark center or customer site.

Joint Development and Marketing of Applications Software

The early availability of applications software for the Integrated Scientific Processor is crucial to the success of the program. Some of the best applications developers are likely to be prospects for the SPERRY Integrated Scientific Processor system. To help customers develop software for the ISP, we should be willing to discuss any and all possible plans. These may include the following:

- Sperry and the ISP customer jointly develop applications software:
  - Sperry and customer furnish appropriate programming support.
  - Sperry furnishes machine time for a discounted price.
- Customer markets software and Sperry gives publicity and referrals.
- Sperry markets software and customer provides maintenance.
- Sperry markets software and provides maintenance.

We should consider stimulating applications development for the SPERRY Integrated Scientific Processor system with manpower, machine time, and increased funding support.

Independent Software Vendor (ISV) Applications Software Development

In addition to customer developed applications software, Sperry believes that independent software vendors need to be encouraged to convert their software to the SPERRY Integrated Scientific Processor system. A plan has been developed to attract these Independent Software Vendors and they will require access to a SPERRY ISP. Thus, Sperry will help customers, who are interested in marketing ISP computer time, by either subsidizing the purchase of computer time for the SPERRY Independent Software Vendor, or referring them directly to the customer service bureau.

Benchmark and Demonstration Support

In addition to providing machine time for software conversion, ISP time must be provided for customer benchmarks and demonstrations. While Sperry will establish an Integrated Scientific Processor benchmark team in the Eagan Data Center (EDC), bringing customers to the Eagan Development Center is costly for Sperry sites outside the United States. Therefore, International Division should consider arrangements with its early ISP customers where Sperry would buy back computer time and support for benchmarks and demonstrations of the ISP for new customers.

8 COMPETITIVE ANALYSIS

8.1 INTRODUCTION

Today, the supercomputer marketplace consists of Cray, Control Data, Fujitsu, Hitachi and NEC. Amdahl is marketing the Fujitsu machines in the United States. The other vendors in Japan have shown no interest in competing outside of the Japanese marketplace. The industry leader is Cray Research, Incorporated, with over 70 machines installed.

Today the Integrated Scientific Processor is unique in the integrated system approach.

Tables in the following sections give price and performance information on the supercomputers marketed by other vendors. The "useful" MFLOPS are taken from a popular scientific benchmark and are a better measure of realized performance than peak MFLOPS.

8.2 COMPETITION BY VENDOR

Cray Research, Incorporated

Cray Research offers the X-MP line of supercomputers (Table 8-1) and they range in price from 5 to 14 million dollars.

Table 8-1. Cray Product Lines

Mainframes				
Model	Main Storage Size	Purchase Price	Extended Main Storage	IOP/IOS
X-MP/11	1 MW	$ 5,000,000	Solid State	Input/Output
X-MP/12	2 MW	$ 5,750,000	Storage Device	Processor
X-MP/14	4 MW	$ 7,250,000	(1024 Megabytes)	
X-MP/22	2 MW	$ 9,000,000		
X-MP/24	4 MW	$10,000,000		DD-49 Disk
X-MP/48	8 MW	$14,000,000		Drives

MW = Megawords

The Cray mainframes are backend machines that depend on a host computer to provide a software development platform for the Cray user. The front-end supported are IBM, CDC, Sperry, Honeywell, DEC VAX™, and Data General. The Cray offers no orderly migration as each X-MP model is not field upgradable. Their MFLOP ratings are presented in Table 8-2.

Table 8-2. Cray Model Profiles

Model	MIPS*	MFLOPS (Peak)	MFLOPS (Useful)	Main Storage Size (64 Bit)	Banks
X-MP/48	471	953		8 MW	64
X-MP/24	237	479		4 MW	32
X-MP/22				2 MW	16
X-MP/14	127	252		4 MW**	32
X-MP/12				2 MW	16
X-MP/11			21	1 MW	16

**MIPS is a measure of scalar speed*
***X-MP/1X uses slower MOS memory*
X-MP/2X and X-MP/48 use bi-polar

MW = Megawords

Control Data Corporation

Control Data's spin-off, ETA Systems, is presently marketing the Cyber 205 in the supercomputer area. The Cyber 205 requires an Loosely Coupled Network (LCN) connection to a Cyber 800 series computer. The user does his editing on the Cyber front-end and sends code and data to the Cyber 205 to be executed. The Cyber 205 makes no use of vector files as the Cray and SPERRY ISP do; therefore, their rating for performance is seldom seen on the vector applications of the supercomputer market (Table 8-3). The peak performance range is for double versus single precision.

Table 8-3. Cyber 205 Model Profiles

Model	MIPS*	MFLOPS (Peak)	MFLOPS Useful	Main Storage Size	Pipes**
611	50	100 – 200		1 MW	1
612				2 MW	1
622	50	200 – 400	8.4	2 MW	2
624				4 MW	2
628				8 MW	2
642	50	400 – 800		2 MW	4
644				4 MW	4
648				8 MW	4

**MIPS are for a 64-bit word*
***A pipe is a unique load/store memory path*

MW = Megawords

NOTES:

Price range is from 5 to 12 million dollars
Estimated maintenance is $40,000

Amdahl/Fujitsu

The Amdahl/Fujitsu machines are just beginning to be marketed outside Japan. The figures for vector speeds are in single-precision mode (Table 8-4). The machines are, however, expensive to buy and maintain, and this allows the SPERRY ISP to be cost competitive with the faster supercomputer offerings (Table 8-5). Fujitsu's new VP-400 is reported to be twice as fast as their VP-200. Amdahl does not currently market the VP-400.

Table 8-4. Amdahl/Fujitsu Model Profiles

Model	Vector Pipes	Main Storage Size	MIPS	MFLOPS* (Peak)	MFLOPS (Useful)
1100	6	128 Megabytes	66	267	
1200	6	256 Megabytes	66	533	17

**Single precision – manufacturer's figures*

Table 8-5. Product Lines and Monthly Maintenance Fees

Amdahl	Fujitsu Equivalent	Purchase ($M)	Monthly Maint. ($K)	Front End
1100	VP-100	9.2	33	Either Amdahl 580
1200	VP-200	13.7	50	or IBM 308X

Hitachi

The Hitachi S-810 machines are not presently being marketed outside Japan. Their product profiles are included for reference (Table 8-6). Hitachi's new M-680H and M-682H models offer performance up to 55 MIPS, but are designed for commercial environments. National Advanced Systems (NSA) will market these models in the U.S.

Table 8-6. Hitachi Model Profiles

Model	Main Storage Size	MIPS	MFLOPS* (Peak)	MFLOPS (Useful)
S-810/20	256 Megabytes	20	630	17
S-810/10	128 Megabytes	20	315	

**Single precision – manufacturer's figures*

Nippon Electric Corporation (NEC)

The NEC supercomputers SX-1000 and SX-2000 are not demonstrable, but NEC claims rates in the excess of the gigaflop (billion FLOP) range. NEC also introduced the ACOS 1500 line, a four-model series that features an estimated performance of 37 MIPS to 130 MIPS. This series is currently available only in Japan.

IBM

IBM has not directly entered the supercomputer market, however, the Sierra models, with high-end scientific performance in excess of 50 MIPS, enable IBM to compete in this growing market.

The SPERRY ISP will outperform any IBM mainframe on scientific vector FORTRAN.

8.3 FUTURE DIRECTION

The future direction of the supercomputer manufacturer seems to be more speed regardless of user friendliness or user conversion. Cray's new machine, the Cray-2, features a liquid florocarbon cooling tank in which the CPU and main storage are immersed. The Cray-2 will consist of multiple processors with speeds in the gigaflop range and billions of bytes of main storage. The Control Data Corporation spin-off, ETA System, will introduce a 10 gigaflops machine, the GF-10, using Complementary Metal Oxide Semiconductor (CMOS) technology in the 1986 timeframe. The Nippon Electric Corporation computer, due to be released in 1985, claims speeds of 1.3 gigaflops and IBM channel capability.

All of these machines find software development costly and sometimes ineffective. To lower development costs, UNIX will probably be the operating system of the Cray-2. Sperry is not aiming at this high-end, high-tech supercomputer market. Our goal is to offer a supercomputer environment to the user who wants performance without penalty. The penalties of maintenance, software reliability, hardware reliability, and code conversions are left to the high end of the supercomputer market.

8.4 COMPETITIVE KNOCK-OFFS

A single operating system controls the SPERRY 1100/90 ISP environment. Cray and Control Data Corporation supercomputers must interact with the host operating system.

All system software runs on the 1100/90 CPU, leaving the SPERRY ISP free to execute applications code. Cray and Control Data Corporation compilers and operating systems execute on the Class VI machine using valuable machine cycles.

Though the burst rate for the SPERRY ISP is slower than these other machines, the single-precision, sustained performance and throughput should compare to the entry level Cray X-MP/1 and the Control Data Corporation's Cyber™ 205. The Cray X-MP/2, as a dual processor system, should be compared against two Integrated Scientific Processors. Again, the sustained performance and throughput for the dual Integrated Scientific Processor system should compare favorably with the dual processor Cray.

Because the SPERRY ISP is totally integrated into the 1100/90 System, all of the support software developed for the Series 1100/90 will support the ISP. This includes online debuggers, data base management systems, and interactive screen editors. The Cray and CDC machines are FORTRAN engines and depend upon the host computers for the bulk of editing and data base needs that scientific users would require. This means file management and maintenance becomes a burden on the host and its link to the Cray or Cyber 205.

The SPERRY ISP uses the extended FORTRAN offered through the Universal Compiling System (UCS). This means that higher level language programs are totally transportable between the 1100/90 Systems and the Integrated Scientific Processor, as well as other Sperry machines.

OS 1100 is a proven multiprocessing/multiprogramming operating system. Cray is just entering into tightly coupled multiprocessor configurations. Presently, Cray operating systems require the user to carry the burden of partitioning his program to run in a multiprocessor environment. Control Data Corporation plans in that area are still in the future. Only Sperry has an operating system that can support such a complex efficiently. Furthermore, no operating system code executes on SPERRY ISP, but Control Data Corporation and Cray manage their multiprocessor systems on the supercomputer itself.

8.5 ONLINE COMPETITIVE INFORMATION VIA DAPS

When you need competitive information about the supercomputer marketplace and its major participants, it must be both timely and readily available. The DAPS MAPPER Systems is the vehicle used to disseminate up-to-the-minute competitive information online whenever you need it. Below are the details on how to access DAPS and a list of supercomputer competitors that are currently available on DAPS. Note that the list below is current only as of the printing of this document. Consult DAPS regularly for additional supercomputer contenders and current computer product details.

Competitive supercomputer system profiles on DAPS vs. SPERRY 1100/90 ISP:

- Control Data Cyber 170 & 180
- Control Data Cyber 205
- Cray Research X-MP/X
- Floating Point FPS-164
- Fujitsu/Amdahl Facom VP Series
- Hitachi S810/10 & 29
- Hitachi M-680 & M-682
- Honeywell DPS 88
- IBM 3084-QX & 3090 Series
- NEC SX 1000 & 2000
- NEC ACOS 1500

How to Access Supercomputer Competitive Information Online Via DAPS

1. Locate any terminal that has access to DAPS MAPPER software in Eagan, Minnesota (either direct sign-on or dial-up). If your terminal is not registered in Eagan, call your node point coordinator; Jan Schrock (S/N 523-3288) in Eagan, or Dottie Hunter (S/N 423-6839) in Blue Bell will be able to help. A communications access request (Form No. SC1-94) must be completed to register your terminal into the UNIDATS direct sign-on network. For a dial-up line into DAPS MAPPER, call (612) 456-2688.
2. Sign on your terminal as you normally would, $$SON – (Terminal No.). then open the session path to DAPS by typing $$OPEN DA. Sign into DAPS MAPPER by entering]TBRANCHNAME MAPPER, e.g.,]TCHICAGO MAPPER.
3. Once signed-on or dialed-into the DAPS MAPPER System in Eagan, you simply type DAPS in the upper left-hand corner of your terminal screen. You will now see a series of menus that will guide you to the supercomputer competitive information you desire:
   - Tab to Sales Representative Information on the first menu and XMIT
   - Tab to Competitive Information on the second menu and XMIT
   - Tab to 1100/90 and 1100/90 ISP Competition on the third menu and XMIT
   - Choose the report number for the desired supercomputer competitor

For additional information on supercomputers competition, call:

John Stephenson (S/N 423-4875)

9 QUESTIONS AND ANSWERS

The following represents a sample of some commonly asked questions about the Integrated Scientific Processor.

9.1 GENERAL

1. **Question:** What is the integrated system approach?

   Answer: Unlike other supercomputers, which are viewed by the host computer as peripherals, the ISP is integrated in the 1100/90 system just like another general purpose Instruction Processor. The job queue is stored in main storage like any other 1100/90 System job. No data crosses a channel interface to initiate job execution as with other supercomputers. Thus there is no front-end/back-end. Rather, there is a multiprocessor mainframe with supercomputer performance.

2. **Question:** What advantages are there in the Integrated System concept?

   Answer: The integrated approach allows a user job to be under control of one operating system. Other supercomputers require host/supercomputer interaction to execute any job. This single point of control relieves the slow link between host and supercomputer for data conversion and transmission. This approach allows the SPERRY ISP System to approach its peak performance more closely than any other supercomputer offering.

   Also, no data conversion is required between machines using various data formats, and the supercomputer user has access to all the support software of the mainframe.

3. **Question:** Where does the SPERRY ISP fit into the supercomputer marketplace?

   Answer: There are the low-end superminicomputers and the high-end supercomputers in the market today. The scientific applications user will find the SPERRY ISP is a superior alternative to these extremes. The low end may not have the computer power the application needs and the supercomputer may be lacking in development and support tools. The users may need not only to run an application very fast, but also to develop new applications or run general purpose computer programs along with their scientific application. These users will benefit from the SPERRY ISP.

4. **Question:** What are the cost advantages for the SPERRY ISP?

   Answer: There are many advantages to the Integrated Scientific Processor. Often these advantages are hard to quantify. In most installations, the cost of the processor is small, compared to the computer center cost including personnel. An Integrated Scientific Processor system may easily save enough through efficiency to pay the cost of additional hardware. Because of the integration, the customer will accomplish more on the SPERRY ISP because of the integration than a machine with the higher raw performance rating.

5. **Question:** How should an Integrated Scientific Processor benchmark be structured?

   Answer: A single-thread benchmark will probably favor machines with higher peak performance. While the SPERRY ISP is a good performance machine and competitive with a Cray X-MP, wall clock turnaround and throughput must be stressed. The SPERRY ISP against a large general purpose computer like the IBM 3081 will win in all cases on scientific vector FORTRAN applications.

6. **Question:** What is the cost of conversion for the SPERRY 1100/90-ISP user?

   Answer: For the customer who already has Series 1100 equipment, the integrated approach has appeal because conversion can be easy and gradual. For the new account, ANSI FORTRAN programs will easily convert to UCS FORTRAN on the SPERRY ISP System, and debugging tools are available to all scientific users.

7. **Question:** What is the maintainability of the SPERRY ISP?

   Answer: A substantial amount of the SPERRY ISP hardware is dedicated to ARM (Availability, Reliability, Maintainability). The processor can be turned on or off and user jobs remain unaffected. In addition, all paths in the Integrated Scientific Processor are thoroughly checked for assured reliable results.

9.2 PERFORMANCE

1. **Question:** What is a MFLOP?

   Answer: The MFLOP (Million of Floating-Point Operations per Second) is the measure of the CPU power of a vector machine. MIPS (Millions of Instructions per Second) is no longer a viable measure of vector machine performance. For a supercomputer, a vector register holds enough data to operate on chunks of data in parallel. On the SPERRY ISP, for example, a single vector add will perform 64 floating-point operations for one instruction. The MFLOP rate then is a measure of the parallel processing power of a supercomputer.

2. **Question:** What is meant by peak performance?

   Answer: Competitors to the SPERRY ISP advertise the peak MFLOP ratings of the machine. This is a strict measure of the speed of the CPU itself. The data is assumed available immediately to the vector processor. The system considerations of main storage bandwidth and overhead are not accounted for.

3. **Question:** How do you measure supercomputer performance?

   Answer: Although it is useful to measure the raw speed of a machine (as in executing the inner loop of a vector operation) other factors need to be considered. Where possible, performance should include I/O time, program setup time, initialization, scheduling, and the system performance. The SPERRY ISP stands well against its competition in the measurement environment.

4. **Question:** How does the balance in the SPERRY ISP help performance?

   Answer: The Integrated Scientific Processor system is a balance between general purpose computer power and scientific application power. Suppose a competitor runs a task that computes for one hour and formats displays for graphic information for another hour on the host. The competitor can run the task 4 times faster in the compute phase but 2 times slower in the output phase because of host/supercomputer transfer rates. The SPERRY ISP system would total 2 hours and the competitor 2¼ hours. This example probably is generous in the output phase for the supercomputer competitor.

5. **Question:** What about dual processor SPERRY ISP systems?

   Answer: The user can start with a single processor SPERRY ISP with any combination of Input/Output Processors and Instruction Processors and grow to the maximum 4 Instruction Processor, 4 Input/Output Processors, and 2 Integrated Scientific Processor systems. The intricacies of scheduling multiple Integrated Scientific Processors is handled by the 1100 OS, that has a proven record for multiprocessing other multiple Instruction Processor 1100 systems.

9.3 SALES

1. **Question:** Who do I call for help?

   Answer:

   For Sales & Marketing Support:

   Dr. Barry Lurie, Director, Scientific Marketing
   (215) 293-0300 Ext. 290 (SperryNet 424-1290)

   David Deak, Manager, Major Systems Product Requirements
   (215) 293-0300 Ext 402 (SperryNet 424-1402)

   Larry Olsen, Director, Scientific Marketing – FSD
   (703) 556-5777 (SperryNet 492-5777)

   For technical discussion, the above or:

   Dr. Jane Kessler, Product Director, Scientific Systems
   (215) 542-2758 (SperryNet 423-2758)

   Floyd E. Mitchell, Director, Energy and Utilities
   (215) 542-3113 (SperryNet 423-3113)