

Supercomputer SX-3 Overview

SUPERCOMPUTER SX-3 OVERVIEW

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1. System Configuration

In February 1992 National Institute for Environmental Studies (NIES) installed the SX-3 system, SX-3/14 with the operating system SUPER-UX.

The SX-3 provides a peak vector performance of 5.5 GFLOPS, and has the following features:

- 1 Gbytes of main memory
- 3 Gbytes of extended memory
- 53 Gbytes of magnetic disk capacity
- 28 Gbytes of high speed magnetic disk capacity
- 790 Gbytes of mass data processing system
- Ultra Net operated at 800 Mbps

Fig.1 shows the system configurations with the SX-3 and the other central machines; SUN Server 490, SGI Power 4D/310GTX, SGI Power 4d/35TG. The network is based on a FDDI backbone ring connecting the Ultra Net with CISCO router. A LANP and an Ultra Hub are used to attach the SX-3 to the FDDI.

The NIES-NET is connected to the IMnet (Inter Ministry Network) and the TISN (Todai International Science Network) by a router, so everyone can get access to the SX-3 upon obtaining authorization together with a password and user-id.

2. Introduction to SX-3 support tools - ANALYZER-P/SX

In addition to the general-purpose support tools available for use on the SX-3, performance improvement support tools will support tuning work designed to make the SX-3 hardware perform at the utmost of its capabilities with FORTRAN77/SX.

-Provides the variety of information needed for tuning-

ANALYZER-P/SX is a functionally improved and expanded version of the earlier ANALYZER/SX, and is used to analyze the information required for tuning programs written in FORTRAN77/SX from the standpoints of vectorization and parallelization.

These are two methods of analysis: static analysis, where the static characteristics (such as the modular structure of the entire program) of the source program are analyzed; and dynamic analysis, where the program is actually executed and the dynamic characteristics (such as the execution time and the execution counts) of the program are analyzed (Table1). The information obtained from these analyses is output in list format, and it can also be stored in an analysis information database.

-Improving program performance by promoting vectorization and parallelization-

How does the information analyzed and output by ANALYZER-P/SX prove useful in tuning work?

When attempting to improve performance, it is necessary to first identify where tuning needs to take place. The user can obtain the needed execution information from dynamic analysis by specifying the

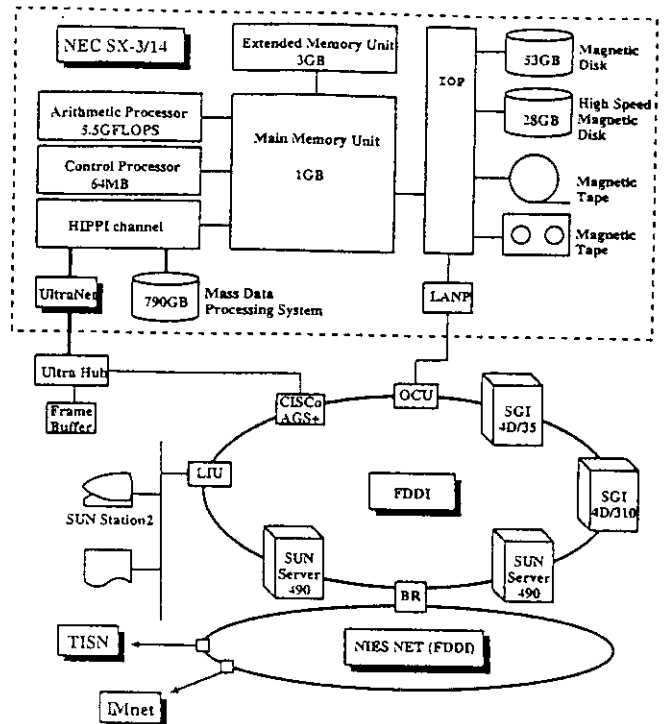


Fig.1 System Configuration

Table1 Primary Information Analyzed and Output by the ANALYZER-P/SX

Static analysis information	Information concerning the entire program	<ul style="list-style-type: none"> - Program structure information (information expressed by tree structure) - Cross reference information concerning calls between program units - Information on correspondence between virtual arguments and real arguments - Cross reference information concerning common block elements - Information concerning synchronous/exclusive control - Warning messages concerning improper control of multitasking
	Information concerning program units	<ul style="list-style-type: none"> - Cross reference information concerning names in English letters
Dynamic analysis information	Performance information	<ul style="list-style-type: none"> - Elapsed time, CPU time - MOPS value: number of operations per second - MFLOPS value: number of floating-point operations per second
	Vectorization information	<ul style="list-style-type: none"> - Vectorization ratio (vector operation ratio) - Average vector length - Bank conflict generation
	Parallelization information	<ul style="list-style-type: none"> - Parallelization ratio: Percentage of program executed in parallel - Synchronous exclusive wait time - Average number of processors used - CPU usage: Execution time using multiple processors - Residence time: Time one or more processors was executing
	Others	Execution counts

program unit, DO loops and sections of measurement, thus uncovering the locations that need tuning. Once these locations have been determined, the user studies how those portions of the program are executed and what kind of tuning would be best by comparing the vectorization calculations and the parallelization information.

In tuning by vectorization, raising the vectorization ratio is important, as is improving the efficiency of vectorization by increasing the average vector length and by eliminating the causes of bank conflicts. In tuning by parallelization, it is important to increase the parallelization ratio and also to make efficient use of the processors in those areas that are already parallelized. It is also important to expand and equalize the execution time of a single task so that the effects of overhead generated by parallelization are reduced. The efficiency of parallelization can be confirmed by using the parallelization information mentioned above.

-Detailed follow through on important points required-

In addition to improving performance by promoting vectorization and parallelization, inline coding of frequently called external procedures is also an effective tuning method. The effectiveness can be checked through execution count information.

When actually tuning a program, it is important to make sure that attempts at vectorization and parallelization do not cause the program to run incorrectly or change the sequence in which data is accessed. Valuable information can be obtained through static analysis so that dependency analysis concerning data references is simplified. Furthermore, with multitasking programs, warning messages are output concerning exclusive control of common variable references and synchronous control between tasks.

In closing, ANALYZER-P/SX is an excellent support tool for tuning work since it outputs essential information needed to improve program performance.

-PARALLELIZER/SX -

PARALLELIZER/SX is an interactive tool that supports vectorization and parallelization according to the analysis of parallelization. It permits tuning according to the analysis of performance. When the user issues an inquiry, PARALLELIZER/SX outputs requested information by consulting the static or dynamic analysis information of a program analyzed and stored by ANALYZER-P/SX.

PARALLELIZER-SX runs under the X Window System.

3.Usage of the SX-3

The usage of the SX-3 resources is monitored and controlled through user administration activities like account application processing, user accounting, etc.

Fig.2 and Fig.3 show the session time and cpu time usage from April 1994 to May 1995.

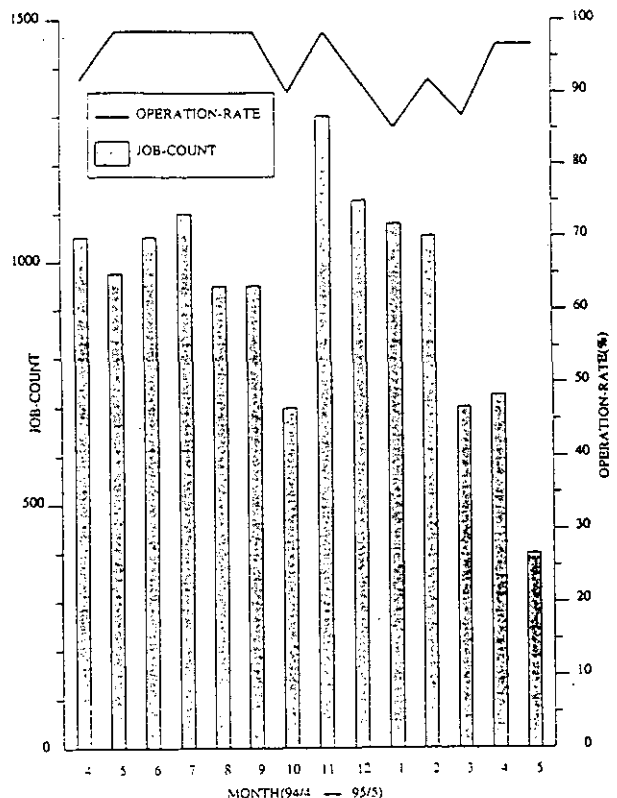


Fig.2 Usage of JOBS

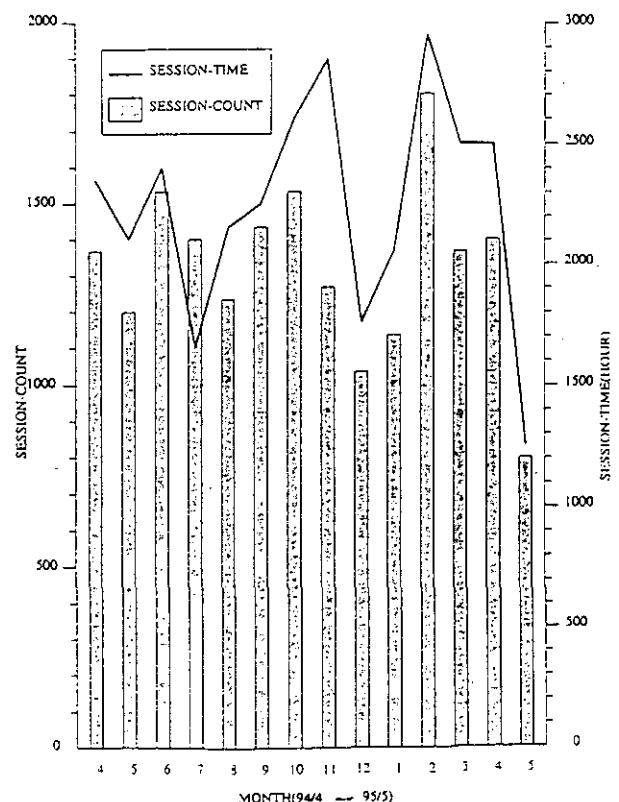


Fig.3 Usage of Sessions