AIPS Memo 91

AIPS BENCHMARKS ON THE SPARC ULTRA 1 AND 2

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Abstract

With the recent announcement by Sun Microsystems of their UltraSparc systems based on a new, 64–bit processor, there has been some considerable interest both inside NRAO and elsewhere in a measure of *AIPS* performance on these new systems. To that end, the `15JUL95` version of *AIPS* was used to obtain several measures of AIPSMark$^{(93)}$ on both an Ultra 1 and Ultra 2 made available to NRAO at Sun's offices in Vienna, Virginia. This report details the compiler and OS specifics and summarizes the results. The old record of 8.7 AIPSMarks$^{(93)}$ on an SGI system has now been broken; the new record by the Ultra 2 is 9.0 AIPSMarks$^{(93)}$.

1 HARDWARE

There were two systems used; one locally and not connected to any network; the other remotely through a remote login via Sun's corporate network (**not** the Internet!) to a system in California. The local system was a Sparc Ultra 1 (the firmware identified itself as a Sparc 12, though that may change in production models), model 170E with the Creator3D High-performance graphics card (24-bit), 256 megabytes of memory, and one *SCSI* bus with two disks (one fast/wide, the other fast but not wide). The remote system was an Ultra Sparc 2 with two processors, each running at 182 MHz, one *SCSI* disk (probably fast, most likely fast/wide), and 768 Megabytes of memory.

2 SOFTWARE

SunOS 5.5 was the operating system used on both computers. For the recompilations done on the Ultra 1, the *SC4.0.1* compilers were used (both Fortran and C). The version of *AIPS* was the stock `15JUL95` system that NRAO has been distributing since August. The actual benchmark run was the so-called "DDT" or *Dirty Dozen Tasks* as described in *AIPS* Memo 85. Briefly described, this measures both the accuracy and the aggregate (wall clock) time for a set of standard data reduction steps with a standard set of data. The

3 DDT RUNS — ULTRA 1

AIPS was installed and running on the Ultra 1 in less than an hour from first contact. A binary tape was used in the process, resulting in ready-to-run binaries. However, these were compiled on one of NRAO's machines (a Sparc 20, SunOS 5.4, *SC3.0.1*) with generic compiler options so they would run on any Sparc system, and thus they were not optimized for the new `sun4u` architecture. The table below shows the timings for all runs on the Ultra 1; this was run number 1. For all runs, the DDT accuracy results were identical to those obtained by NRAO on local machines (i.e. 99 bits for everything except `MX`).

Run	Secs	$A_m^{(93)}$	Notes
1	828	4.83	NRAO binaries; highest "Q" optimization: `-O4`
2	802	4.99	Ultra compiled binaries (*SC4.0.1*), also `-O4`
3	664	6.02	Ultra compiled *SC4*, `-fast -O4 -depend`
4	638	6.27	As for run 3, also added `-xarch=v8plus`

Table 1: Sparc Ultra 1 Timings

Run	Secs	$A_m^{(93)}$	Notes
5	476	8.40	Binaries from run 3 on the Ultra 1 used.
6	446	8.97	Binaries from run 4 on the Ultra 1 used.

Table 2: Sparc Ultra 2 Timings

Following the first run, the *SC4.0.1* compilers were used to completely rebuild all of AIPS, using exactly the same optimization settings as shipped. Basically, this means `-O4` is applied to the numerically intensive "Q" routines, and `-O2` to most other things. No additional optimization related flags were used. This showed only a minor improvement in the AIPSMark$^{(93)}$. It was then decided to add the `-fast` and `-depend` qualifiers to the `f77` command for the "Q" routines (actually, for all relevant modules compiled with `$OPT4` — which expands for SunOS 5 to `-O4` — or higher). In the past, the `-fast` option had been regarded as unsafe, but the accuracy results from the DDT after recompiling `$QPSAP`, `$QNOT`, `$QSUB`, and `$QOOP` and relinking the `INSTEP3` subset was in perfect agreement with the previous runs. These qualifiers resulted in a significant improvement (*i.e.*, reduction) in the time elapsed. Finally, a new (in *SC4.0.1*) qualifier was used: `-xarch=v8plus`. Apparently this alerts the compiler to the exact architecture for which the program is being built, in this case the `sun4u` systems. This gave a small but significant boost in AIPSMark$^{(93)}$.

For all runs on this system, the source and binaries, and the first data area were coexistent on the same *SCSI* disk (fast/wide) and the `TDISK` parameter was set so that the test data from the DDT went on a second (fast, but we think not wide) disk. There were other, slower, disks on the system but they were not used during this test. The other DDT parameters were as set for standard large DDTs, i.e. `EDGSKP` set to 12, `TERSE` set to zero.

4 DDT RUNS — ULTRA 2

As soon as run 3 for the Ultra 1 was complete, the binaries and other critical files were copied to tape, thence to a system on Sun's internal corporate network and copied to the Ultra Sparc 2 in California. Results for the Ultra 2 runs are presented below in Table 2. Following run 5 on the Ultra 2 and run 4 on the Ultra 1, the binaries from run 4 (*i.e.*, with `-fast -O4 -depend -xarch=v8plus`) were copied out to the Ultra 2 (again via tape and then `ftp`) for the final run.

The *AIPS* system, binaries, and all data were placed on the same *SCSI* disk for these two runs. While this system was connected to Sun's internal network, its "owner" had deliberately left it unused for the day and there was no other network access. The speed of the inter-site network connection was sufficient to eliminate "terminal printout slowdown" as a factor in the DDT timing.

One additional set of re-compilations was attempted on the "Q" routines, this time with `-autopar` and `-reduction` (to enable some level of auto-parallelization to be done by the compiler) but there was a system library missing which caused all links to fail. Thus, the attempt had to be abandoned due to the late hour and absence of the crucial object module (`__dopar_ex`).

5 DISCUSSION

The Sun Engineers pointed out that the Ultra 2 used suffered from a rather subtle clock timing effect. Had the chips been running at a slightly slower or faster speed, they felt that a significant improvement in data transfer through the system's crossbar (which runs at 67 MHz). It was also thought by everyone present that the performance would have been boosted on both systems had there been two separate *SCSI* interfaces, each with a fast/wide disk. The effect of the `-autopar` and `-reduction` flags on the AIPSMark[(93)] will, for the present, remain a mystery, though it is probable that it would boost the figure somewhat past the 9.00 level.

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