South Pole computer system

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Two Hewlett-Packard (HP) minicomputer systems were installed at Amundsen-Scott South Pole Station during the 1974-1975 austral summer season. These general-purpose systems provide for data acquisition and on-site data reduction and analysis. Researchers can output data in real-time. Personnel from the University of California, Davis, service the systems and help other scientists program and interface their experiments to the systems. Hardware and system support software are described here.

Hardware. The two systems are basically identical. One is for on-line data acquisition; the other is for off-line data analysis. Each system consists of:

• HP 2100S minicomputer with 32K of 16-bit parity-check memory, floating-point hardware, extended arithmetic unit, memory protect, direct memory access, and timebase generator
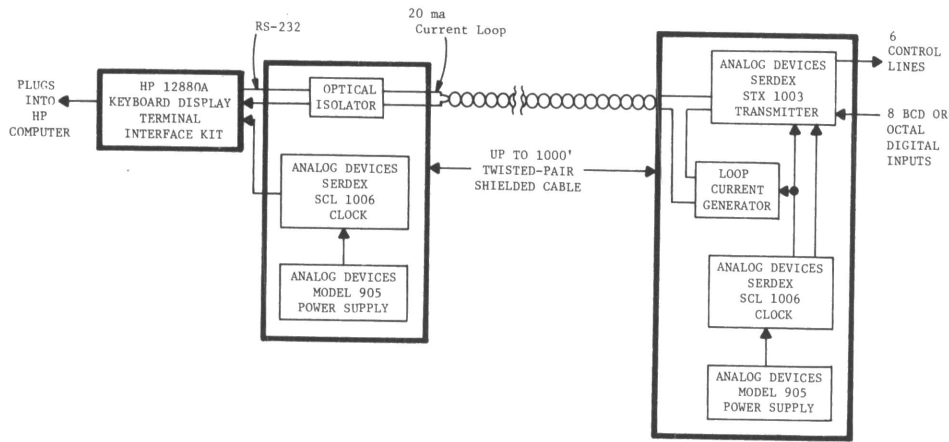• System console (cathode ray tube)
• Paper-tape reader (eight-level, 1-inch)
• Paper-tape punch
• Line printer (80-character width, 365 lines per minute)
• Two nine-track magnetic-tape drives (45 inches per second, 800 bits per inch

The following hardware is available for maintenance:

• HP 2100S minicomputer with 16K of 16-bit

Assignment of the on-line computer system input/output channels.

Channel	Assignment
10	Time base generator for RTE
11	-
12	Paper tape reader interface
13	Line printer interface
14	Paper tape punch interface
15	CRT interface
16	Magnetic tape interface
20	Magnetic tape interface
21	University of California micrometeorological interface
22	University of Nevada interface
23	-
24	-
25	-

Serial communication system for University of Nevada.

memory, floating-point hardware, extended arithmetic unit, timebase generator
- System console (cathode ray tube)
- One nine-track magnetic-tape drive (45 inches per second, 800 bits per inch)

A complete stock of electronic components is kept at the station for maintenance use. University of California personnel have been trained by Hewlett-Packard in maintenance of the minicomputers and magnetic-tape drives.

An identical computer system is at the Davis campus. Additionally, it has a magnetic disk system for rapid development of programs.

Interfacing experiments to the on-line system. The on-line computer system has 14 internal input/output channels (table). Seven channels are assigned to peripheral devices, three now interface with experiments, and four are vacant.

Of the three experiments, the University of California polarimeter is interfaced to the on-line system by an HP 12930A universal interface with 16 input and 16 output lines. This interface can transfer up to 1 million 16-bit words per second. The connection to external equipment must be within 5 meters of the computer system.

The other two experiments are interfaced to HP 2570A coupler/controllers located near the experimental equipment. The coupler/controllers are each connected to the on-line system by an HP 12770A serial data communications interface. This interface allows the coupler/controller to be up to 3,000 meters from the computer system via two sets of twisted-pair shielded wire.

The coupler/controller is a programmable bidirectional data link that enables communication among up to eight digital interface slots. The serial data communications interface is plugged into one of these slots, and any of a number of standard HP interface cards can be plugged into the remaining slots. Thus, the computer is effectively brought to the experiment. Throughput is approximately 400 8-bit words per second.

The coupler/controller is expensive and must be connected to an HP computer for testing. Personnel at the University of California, Davis, are developing a cheaper alternative that can be connected either to a teletype or to an industry standard teletype port on any computer. This means experimenters can interface and check their hardware at their home location without connecting to the HP computer. A simple application is shown in the figure. Throughput is 218 4-bit words per second.

Operating systems and user programming. Because the chance of a disk failure exceeds the chance of computer memory failure, the decision was made not to include a disk drive. One impact of this decision involves the amount of time spent developing programs. With the HP factory- provided paper-tape software, program development is tedious and time consuming. Therefore, to expedite program development, a magnetic tape system was created.

User-written programs for on-line data acquisition and off-line data analysis are implemented with two separate but compatible software systems. The first is a program development and file-handling system that uses magnetic tape for mass storage. With this system, programs can be prepared for execution under the other system, HP-RTE-C (Hewlett-Packard Real-Time Executive, Core Based). HP-RTE-C offers a flexible environment for running several programs simultaneously for both on-line and off-line applications. Both software systems can co-exist in the computer's memory, and an operator can

easily transfer control from one to the other using keyboard commands.

Before deciding to use the on-line data acquisition facility, a prospective user must be aware of time and memory capabilities and limitations. The University of California, Davis, service group can be of help in determining what options are available and should be contacted far in advance of serious design of an experiment so that the needs of the user can be evaluated and the right decision made.