

## **CREWES Project computer systems**

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### **ABSTRACT**

The CREWES Project at the University of Calgary has a broad array of dedicated hardware and software in use. Hardware and software are available for many areas of geophysical research, especially seismic. The computer systems are being used to make models, load data, process data, interpret results, graph, analyze, display, print, and plot.

The main processing system has been enhanced during the past year by a processor upgrade, which doubled the speed, and by completion of the installation of network software. Use of the network has developed to the point where data exchange is simple and efficient between most local software and hardware platforms. The network is also providing CREWES with a method of exchanging information internationally.

The main processing system is an IBM 4381 running the MVS/XA operating system with IBM peripherals. Western Geophysical Canada's complete processing system is in use. IBM and Western Geophysical are continuing to provide and to upgrade their support of the CREWES Project. In addition to the IBM mainframe there are two IBM RT workstations, a Sun workstation, a Perkin-Elmer minicomputer, several PC's, and two Apple Macintoshes. Software is being developed using FORTRAN and C - languages available on the microcomputers, workstations and the main IBM processor. The 2D and 3D Landmark interpretation package is available on an IBM RT. UNISEIS and SIERRA are two of the modeling packages in use. Many additional communication, graphing, windowing, analyzing, word processing, and geophysical tools are also in use.

### **HARDWARE**

IBM Canada Ltd. has donated, through a joint-venture agreement, most of the hardware and system software of the CREWES Project's central processor system. There is an IBM 4381-Q03 with an attached array processor. The IBM 4381-Q03 runs at a speed of approximately 6 MIPS, has 12 channels, and 24 megabytes of main storage. Most seismic processes run in an IBM 3838 array processor at a speed of approximately 30 Megaflops.

There are approximately 15 gigabytes of high-speed disk data storage provided by IBM 3380 drives attached to the system. Each of the two strings of drives is attached to a IBM 3880 control unit.

There are four IBM 3480 double unit cartridge drives allowing a total of eight simultaneously loaded cartridges. The cartridge drives are easier to load, hold slightly more data, and have been found to be more reliable than the standard round reel tape drives. There is one IBM 3420 tape drive used for loading seismic field tapes into the system.

Terminals communicate with the system through a IBM 3174 control unit. There are four IBM 3299 multiplexers attached to the control unit, allowing up to 32 terminals and printers to be connected. These are setup in the Earth Sciences building and attached to the central processor located in the Math Sciences building. Currently, there are six IBM

3192G color graphics terminals attached. Each terminal has a mouse and is capable of displaying a seismic section. Twelve IBM 3279 color graphics terminals are also available for programming and processing.

In addition to the 32 terminal and printers connected to the IBM 3174 control unit, there are also three modems connected via an AEA adapter. Telephone lines have been installed to serve three 2400 baud IBM 5853 modems. An IBM 8232 LAN adaptor provides a direct link between the central processor and the University's ethernet network.

There are two low-speed IBM 3287 printers and a channel-attached IBM 3203 printer. A near letter quality IBM 4234 printer is attached directly to the central processor and is located in the Earth Sciences.

A 42" VERSATEC 8242 model "A" plotter is located in the Earth Sciences building. A Logic Science Auscom Interface attaches the plotter to the IBM channel and an HSR 11A rasterizer off-loads most of the work of plotting from the central processor.

The system has been exceptionally reliable since it was tested and made available to users in May 1989. Excluding periods of scheduled maintenance, the system availability has been over 99%.

## SOFTWARE

The system software of the central processor is IBM's MVS/XA version 2.3 and the job entry system is JES2 version 2.2. IBM and Western Geophysical have provided excellent system support. The system software is upgraded every six months and the Western software is upgraded more frequently.

Western Geophysical's complete geophysical processing system is installed on the central IBM processor. Processing for three component data, 2D data, and 3D data is available. Other available features include processing well logs, data conversion, some modeling and various utilities. Western's IQueue (Interactive Queue) and XED (Expert EDitor) allow completely interactive processing, parameter selection, plotting, and data conversion. Most types of data can also be interactively displayed on the graphics terminals. Complete online documentation is available for batch processing and for every aspect of the interactive system.

The IQueue programming template has been used to add FORTRAN programs to the interactive IQueue processing system with the handling of memory management, trace headers, input data formats, data output, and plotting of output data are done by documented subroutine calls or by the existing interactive IQueue system.

The Sierra modeling package is available for modeling 2D, 3D, converted wave and shear wave data using the full wave equation. Prestack converted wave models have been made with Sierra and processed with the Western software or used to test new software.

## UNIX SYSTEMS

Two multipurpose Unix workstations are available for program development: an IBM RT 6150 with 16 megabytes of memory, 330 megabytes of disk space, a high speed RISC processor, and a graphics display terminal; and a SUN Sparcstation 1+ with 16 megabytes of memory, 773 megabytes of disk space and an 8 bit GX graphics accelerator. Both workstations are fully networked to access data loading and plotting hardware.

The IBM RT runs AIX 2.2.1 and the SUN runs SunOS 4.1. The tools available on the workstations include X Windows, PHIGS, FORTRAN and C compilers. The

workstations are being used for development of seismic processing software and a VSP package is currently being ported from DOS to the X Windows graphical user interface for use on a variety of workstations.

## LANDMARK

A second IBM RT has been made available to the CREWES Project by Landmark Graphics Corp. under their University Industry Partnership Program. The system is comprised of a high speed IBM RT with 16 megabytes of main memory and 990 megabytes of available disk space. There is a 1/2" round reel tape drive, a color plotter, a printer, a mouse, and two megapixel color graphics screens. Landmark's interactive 2D Plus and 3D Plus workstation software is available on IBM's UNIX based AIX operating system. Data processed with Western's software on the main IBM processor can easily be loaded onto the Landmark for interpretation. FORTRAN and C compilers are available for code development on the IBM RT. The UNISEIS modeling package can be used to generate models for later processing and interpretation. Crosshole, VSP, and multi-component seismic have all been modeled on UNISEIS and later processed by CREWES.

## NETWORK

The University network used by CREWES is based on the Internet protocol suite, commonly referred to as TCP/IP. This protocol is used to communicate between machines on the thin-ethernet based local area sub network that runs through the Geology and Geophysics department. This sub-network serves all the CREWES Unix workstations, personal computers and other departmental systems. The CREWES IBM 4381 connects to the University's main thick-ethernet backbone through the IBM 8232 LAN adaptor. The IBM 4381 and other systems at the University access the Geology and Geophysics sub-network through an IBM PC containing two network cards. Routing software on the IBM PC acts as a bridge between the Geology and Geophysics sub-network and the main University network.

All networked CREWES systems can access multiplexed and demultiplexed field tapes from the tapes drives attached to the IBM 4381. The speed of the network makes the data exchange feasible. A 470 trace 2.1 megabyte dataset was transferred from the IBM 4381 to a Unix workstation in 41 seconds. This amounts to a transfer rate of 62 kilobytes per second which is about 12% of the optimal 500 kilobytes per second transfer rate for ethernet. The sub-optimal transfer rate is largely due to the routing of data from one network to the other. Even with this slow-down, the transfer rate is still fast enough to make large dataset transfers feasible.

The network has been used in other ways. Since the University campus is connected to the worldwide "Internet", the CREWES staff have access to worldwide electronic mail and software archive sites. Using electronic mail, some CREWES staff receive an electronic newsletter on geophysics from Stanford University.

## ACKNOWLEDGMENTS

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## SUMMARY OF HARDWARE AND SOFTWARE

### GEOPHYSICAL SOFTWARE

Western Geophysical processing software  
 SIERRA  
 UNISEIS  
 Landmark 2D Plus and 3D Plus  
 Hampson-Russell AVO  
 SIS Vista  
 GMA

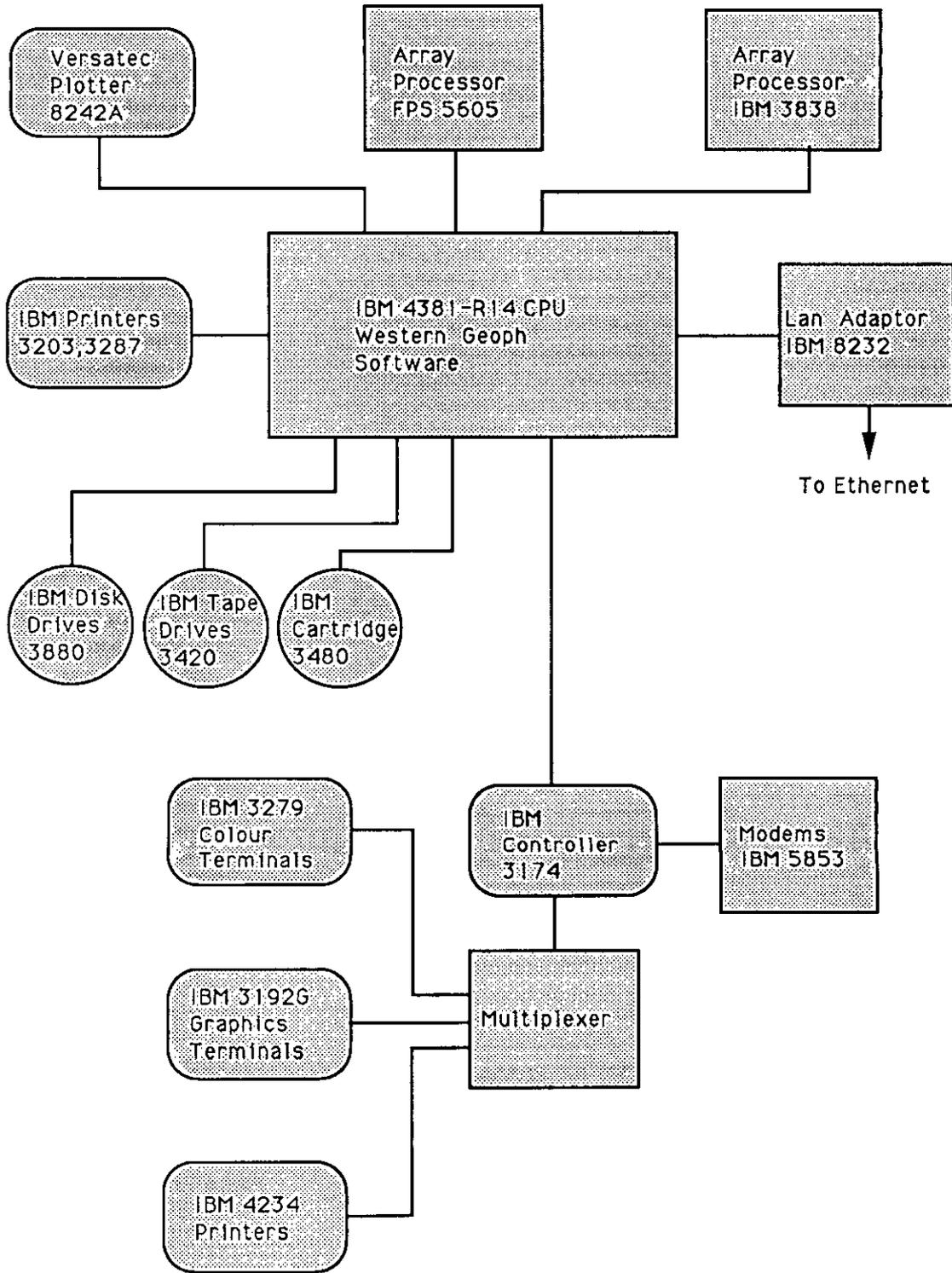
### HARDWARE

IBM 4381	Central processor
IBM 3838	Array processor
FPS 5605	Array processor
IBM 3880	Disk head of string
IBM 3380	15 gigabytes of disk space
IBM 3480	8 cartridge drives
IBM 3287	2 low speed printers
IBM 3203	Channel attached printer
IBM 4234	Near letter quality printer
IBM 3174	Communications controller
IBM 3192G	6 graphics terminals each
IBM 3278	12 color terminals
IBM 8232	LAN (local area network) adaptor
VERSATEC 8242A	Plotter
IBM RT (6150) / Landmark	Unix graphics workstation
VERSATEC C2700	Thermal color plotter
IBM RT (6150)	Unix graphics workstation
Sun Sparcstation 1+	Unix graphics workstation
Apple Macintosh Plus	Personal computers
Apple Macintosh SE	
IBM PS/2 Model 70	

### IBM System Software

MVS/XA  
 JES2  
 RACF  
 ISPF/PDF  
 VTAM  
 SNA

# CREWES IBM/Western Geophysical System



# The CREWES Network

