

# new Horizons

Volume 1

Harwell Computing Centre Newsletter

Issue No. 1

## The Harwell Computing Centre

The Harwell Computing Centre is now one of the largest and most sophisticated computing centres specialising in scientific and engineering applications to be found in Europe.

On page 3 of this Newsletter you will find a simplified diagram showing the hardware systems which are contained within the Centre. Of particular note is the CRAY-2™ supercomputer with its 256 Mega (64 bit) words of directly addressable main memory and its four processors operating with a 4.1nsec. clock; the IBM 3084Q mainframe system with 64 Megabytes of main memory and 400 Gigabytes of on-line storage; and a clustered VAX VMS system comprising a VAX 8530 and two VAX 750's. These machines are all interconnected by means of a 50 Megabit/sec Hyperchannel local area network, with some additional connectivity provided by Ethernet systems.

The CRAY-2 supercomputer is designed for very large scale calculations. Its massive memory and extremely fast processors mean that it is now possible to undertake three dimensional simulation for large complex systems on a production basis. The CRAY-2 operates under the UNICOS operating system, which is UNIX™ based, and provides full interactive facilities. Of particular interest is the use of high performance graphics workstations in conjunction with the CRAY-2, with process to process communication permitting the results of simulation to be viewed on the workstation whilst the processes are running on the

CRAY.

The IBM 3084Q is the work-horse within the Centre. It is used for routine scientific calculation, scientific data processing, computer aided design, database applications and administrative and financial systems. It also provides the central file store to supplement the disc storage on the CRAY -2, provides access to the CRAY-2 and supplies supporting services such as printing and plotting.

The VAX VMS facility has recently been extended by the addition of a VAX8530 processor. This is a 4 MIP machine with 32 Megabytes of memory and is linked in a cluster arrangement with two VAX 11/750's. The VAX VMS systems are used to provide an alternate access route to the CRAY-2, particularly in conjunction with DECnet which is used extensively as the communications medium within the Authority and by many other organisations. The VAX 8530 will provide a production VMS environment for particular applications that are inappropriate for either the IBM 3084Q or the CRAY-2. Of particular importance is the support for knowledge engineering - "Expert Systems" - which are being developed by the Computer Science and Systems Division in conjunction with other projects at Harwell and elsewhere with-(contd on page 2, col 2)

## Editorial

Welcome to *New Horizons*.

This is the first issue of a series of newsletters from HCC - the Harwell Computing Centre. *New Horizons* is intended to keep users informed of developments in the Computing Centre and also to encourage communication amongst our users.

After more than a year of detailed planning, the CRAY-2 supercomputer is now in full operational use. As you will read elsewhere in this Newsletter, the CRAY-2 represents a major breakthrough in supercomputing. Users of the Harwell Computing Centre now have access to the most powerful computer system available in the UK. The Computing Centre is, of course, continuing to supply a wide range of services based on its IBM3084Q mainframe system and has facilities for undertaking appropriate work on DEC VAX computers.

To complement this first issue of *New Horizons*, HCC is also producing a Computer Services Handbook which will be available shortly. This provides a summary of the systems and services available from the Harwell Computing Centre, the telephone numbers to call for registration and assistance, and full details of the charging systems used. If you would like a copy of the Handbook, please complete and return the form on the back page of this newsletter.

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## New Horizons

Contributions from users are essential

*New Horizons* is a regular newsletter from HCC - the Harwell Computing Centre. It is designed both to provide a means for keeping users informed of developments, and to encourage communication amongst users.

The demand for computer resources within the Authority is constantly increasing both in volume and sophistication. In order to match this demand HCC is pursuing a planned programme of hardware and software upgrades, and of broadening the scope of services offered. As new systems or services are planned, installed and used, *New Horizons* will provide a regular summary of progress, technical hints and feedback.

*New Horizons* is designed to help users get the most out of HCC services. In order to achieve this your comments, experiences and advice will be essential. Please write to or telephone the Editor (see page 4) if you have a contribution which you think will be of benefit to other users.

## The Harwell Computing Centre

(cont'd from page 1)  
in the Authority.

The diagram also shows a VAX 780 running the DEC version of UNIX, ULTRIX. This machine is primarily intended as a support processor for the UNICOS operating system which runs on the CRAY-2. However it also provides a gateway to enable graphics workstations to be connected to the CRAY-2.

Some indication of the ways in which terminals and other computer systems can connect to the various services in the Computing Centre are illustrated on the diagram. Included are support for asynchronous and synchronous terminals, RJE/NJE and DECnet connections.

All this hardware is supported by highly professional staff and by an extremely wide range of applications and systems software. The entire Centre is dedicated to the provision of first rate advanced computing services in support of the activities of the Authority and for many valued customers. Please call the telephone numbers given in this Newsletter if you require additional information on any topic associated with the Centre.

## Graphics

A major application area

HCC have provided a Graphics Support Service for over 5 years. Until recently this has been based on Ghost, GDDM and Gino on the IBM and CRAY systems. With the advent of the CRAY-2 and high performance graphics workstations, however, the emphasis is changing.

The 'traditional' graphics support provided by HCC has been oriented towards 2-dimensional 'display' graphics. These include bar- and line-charts generally produced as a static image or print-out. More sophisticated work, including real-time graphical representation, demands significantly greater computing power and/or specialised display hardware. Both these limitations have now been addressed, and HCC Graphics Support is now well advanced in providing 3D graphics systems, and in optimising their operation and performance.

The enormous computing power and massive storage of the CRAY-2 enables the research scientist to carry out much more complex calculations which more closely approximate the real world - a three-dimensional world. As a corollary, however, there is a need to be able to display the results of these calculations in three dimensions, and also to be able to rotate and transform the objects, or even to animate them. A finite-element analyst can now look through, inside and around his model as he has never dreamt of before.

Various codes, such as FLOW3D, are available to run advanced graphics on the CRAY-2, and the Graphics Support Group is spending a significant proportion of its time identifying the most appropriate 'splits' for applications, such that they take full advantage of the best features of the CRAY and the workstations.

Workstations currently installed and being evaluated are: Hewlett-Packard 320SRX; Sun Microsystems 3/260 and Silicon Graphics' IRIS 3120. These are connected via Ethernet to a gateway system on Hyperchannel and thence to the CRAY-2 network.

The workstations are significant computing engines in themselves. The IRIS 3120, for example, contains a Motorola 68020 and 4Mb of memory. It has specialised hardware for complex geometry and 3D vector transformation, as well as dedicated display memory for optimum performance. This approach frees the CRAY from having to deal with formatting and enables it to concentrate on the 'number-crunching'. In addition, the interactive UNICOS operating system on the CRAY-2 allows the user to alter the course of events as he sees the results displayed on his workstation.

This is an exciting and growing area of use for the CRAY, and the Support Group are looking for new applications with advanced graphics potential.

Perhaps you know of one...?

## Documentation

New manuals and updates to existing documents will be listed in *New Horizons*.

Manuals for the CRAY-2 are currently being reviewed and updated, but an 'Introduction to UNICOS for New Users' is available now. Cray documentation cur-

rently available for CRAY-2 users includes:

SR-0018	CFT77 Reference Manual
SR-0066	SEGLDR Segmented Loader
SR-2010	UNICOS Primer
SR-2011	UNICOS Commands Reference

## The CRAY-2 Supercomputer

The CRAY-2 represents a breakthrough in computer technology. With its massive memory, powerful CPUs and robust design it sets the standards for the next generation of supercomputers.

Whole new areas of modelling and simulation are opened up by the availability of 256 Mwords (2 Gigabytes) of common addressable memory, while the 4 independent CPUs, each more powerful than a CRAY-1, and 4.1 nanosecond clock cycle ensure that applications can take full advantage of the memory. Depending on the type of code, the CRAY-2 offers throughput between 6- and 12-times that of the CRAY-1. Users also benefit from a UNIX-based interactive operating system (UNICOS), enabling results to be examined at the terminal.

The power of the CRAY-2 derives partly from its advanced physical design. The machine stands only 45 inches high and is 53 inches in diameter. Its 14 columns are arranged in a 'C'-shaped 300° arc. Despite its compact dimensions it contains nearly a quarter of a million integrated circuits, 5.68 miles of wire, and weighs 2.75 tons!

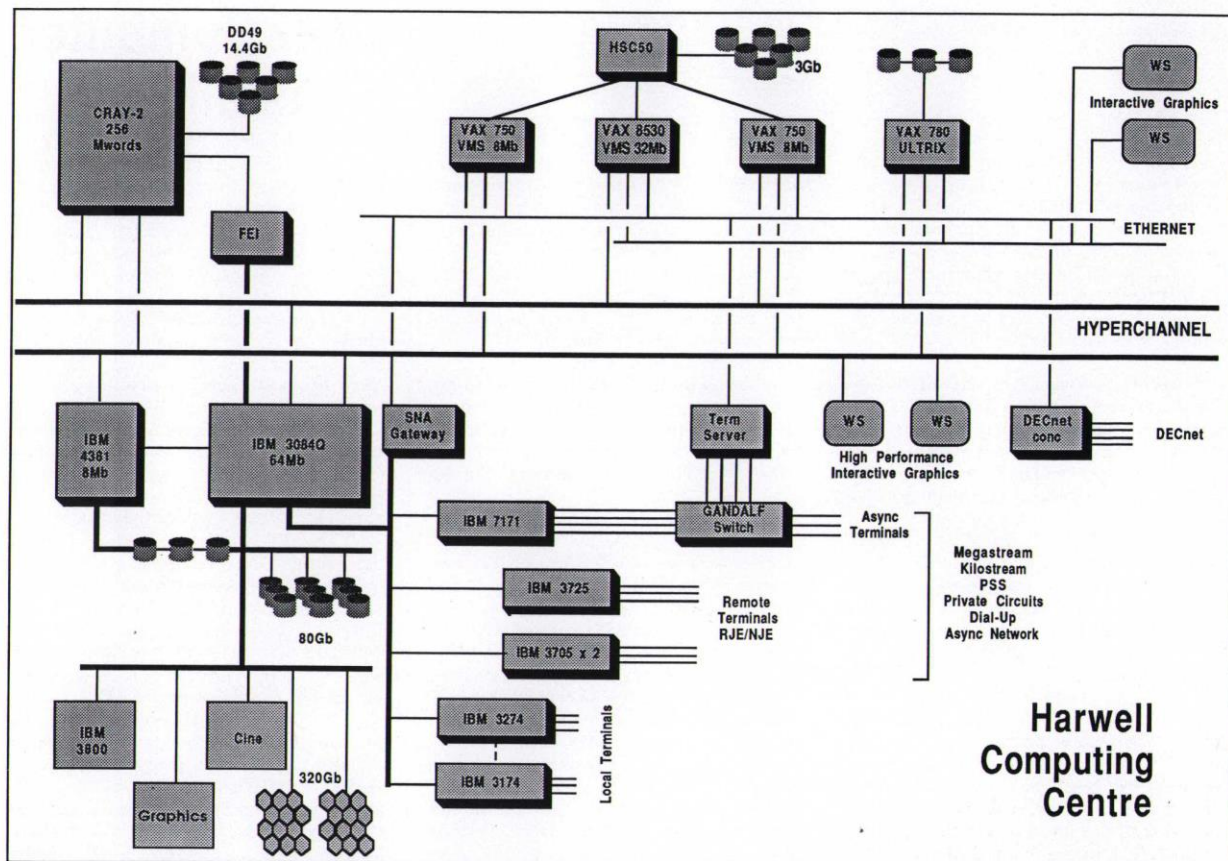
The integrated circuits are arranged on 320 4x8x1 inch modules, each containing over 750 integrated circuits arranged in 8 layers. This method of packing results in

modules which contain 40% integrated circuits by volume. This density presents significant design challenges to dissipate the amount of heat generated.

High operating temperatures affect the reliability of components, but dense packing is essential to the performance objectives of the CRAY-2. The design breakthrough which enabled these objectives to be met is liquid immersion cooling. The electronic components are in direct contact with a continuously flowing bath of inert fluorocarbon liquid, which maintains a stable temperature of between 21° and 27°C.

The low operating temperature is complemented by a significant reduction in the number of components to achieve outstanding reliability. Compared with the CRAY-1, the CRAY-2 has achieved a 15:1 reduction in modules per CPU, and a 10:1 reduction in memory modules. With an advanced interactive operating system and an expanding library of codes the CRAY-2 is already significantly enhancing the computing capability of the Harwell Computing Centre.





## Communications and Access

The Harwell Computing Centre provides an advanced and comprehensive communications and networking service. It is designed to make the power of the Cray, IBM and DEC systems available to a wide spectrum of users.

Computer manufacturers develop networking systems which complement their own hardware and software characteristics, and in general are designed to provide interactive terminal access, file transfer and job submission. IBM's Systems Network Architecture (SNA) is the basis of communications to the IBM 3084Q, whilst DECnet provides the links to the DEC VAX systems. Both systems are used on site at Harwell, and also provide access for other Authority users, as well as the increasing number of external customers.

The IBM links provide access for the popular IBM 3270-type synchronous terminals. There is a screen population of over 1200, of which about 400 are active simultaneously during busy periods. In addition, there are a growing number of asynchronous terminals, which can be switched by the Gandalf PACX system to a wide variety of services. As well as IBM and VAX, these include PSS to external systems and to other Authority systems such as the ICL computers at Risley. Remote job entry and retrieval of printout is also supported.

For users requiring access to the CRAY-2, they are usually attached via either the IBM or DEC 'front-end' systems running CRAY 'station' software, which allows both batch and interactive

working. In fact, users can acquire and dispose of files from either front-end no matter to which they are actually connected. For example, a user could be utilising the VAX/VMS interactive interface whilst benefitting from the massive storage capacity and file-handling capability of the IBM.

All three major systems, CRAY-2, IBM and VAXs, are interlinked by a very high bandwidth (50 megabits/second) bus called Hyperchannel, and the CRAY stations also operate over this bus. The ability for this bus to support high throughput file and job transfer between the IBM and any VAX in the AEA DECnet is a Harwell development.

Supporting the latest in UNIX-based graphics workstations requires a high-performance connection to the CRAY-2. This is provided using TCP/IP protocols (an industry standard) over Ethernet via Hyperchannel.

We believe we have achieved the goal of providing full connectivity to and between HCC systems. This is true not only for the sophisticated graphics expert, but also for the casual user connected at 300 bits per second via a dial-up line.

If you are a new or potential user please do not hesitate to contact us. You can find the contact point in the HCC Reference Card included with this issue.

## UNICOS

UNICOS is based on the popular System V UNIX operating system, and has been developed to provide the most flexible and compatible user environment for CRAY-2 applications.

UNIX was conceived to provide an environment which is not only powerful, but also portable. Software portability enables applications to be moved between different hardware environments with minimum disruption. It also enables Cray to develop and implement new hardware without major impact on existing applications.

Making use of the proven UNIX kernel, well-defined and stable interfaces, and powerful utilities, UNICOS provides an environment which is inherently interactive in order to make full use of CRAY-2 facilities.

To ensure that this is achieved, user-transparent enhancements have been made to enhance I/O performance (including asynchronous I/O operation), reduce system overheads, improve device mapping, and provide multi-tasking and multi-CPU operation. Additional subsystems support networking and provide a batch job capability.

Cray has augmented the standard UNIX utilities (which includes powerful interactive debugging tools) by the addition of an ANSI 77 auto-vectorising FORTRAN compiler (CFT77) as well as Pascal and C.



## ge...The Back Page...The Back Page...The Back Page.

The Back Page is intended to become the major forum for user communication in *New Horizons*. The Editor welcomes all communications which will be of benefit to the overall quality of the HCC service. These include suggestions, techniques, technical hints, useful codes etc.

As this is the first issue there is not a great deal in the way of user contributions, but we would like to start the ball rolling with these items:

**Help.** A User Support identifier 'help' has been set up on the CRAY-2. Users who do not wish to ring the Help Desk on extension 2980 (or who find it engaged!) can now send us their problems by mailing them to the identifier 'help'.

**News.** Read all the CRAY-2 news items you are informed about at logon. You may well find the answer to your problem or query. The news facility is an excellent way to keep users up to date with the latest state of the system - so please use it!

**Getting started.** If you do not already have a terminal or do not have access to one you will probably need advice on what type of terminal to get. This will be affected by the type of work you anticipate doing, the speed at which you need to operate, and the method of communicating with the computer centre. There

are many different types (and costs) of terminal available, and it is important to make a selection which is not only right for today, but will last for a significant amount of time. You may be able to obtain advice from colleagues who have experience in this area. Alternatively, contact the Network Help Desk, extension 2922. If you need to use the computer at once, or only for a limited time a selection of terminals is available for use on the Ground Floor of the HCC building.

You will also need to obtain an account number and a user identifier from HCC. This is for both charging and security purposes. Application forms can be obtained from Computer Administration on extension 2052.

As well as the documentation explained elsewhere in this issue of *New Horizons*, there is a variety of training courses available. 'An Introduction to the Harwell Computing Centre' provides a good starting point. It explains what facilities are offered, describes the HCC system, and shows through demonstrations how it operates. Details of this and other courses can be obtained from Colin Bartlett on extension 2419.

If you have a specific application area you would like to see in more detail, an individual demonstration can be arranged through the Information Service Manager, Richard Bernard, on extension 3832.

## Contact!

Below are listed some key HCC telephone numbers. These include contacts for commercial and contractual arrangements, new user registration, help facilities and general information. Telephones are normally manned from 0830 to 1700hrs Monday to Thursday, and on Friday from 0830 to 1600hrs. Please refer to the reference card for further details.

Commercial Manager	0235-432865 or extn. 2865	Contact Lionel Cousins for details of charging and contractual arrangements.
Computer Administration	0235-432052 or extn. 2052	User registration, documentation and service calls.
User Support	0235-432980 or extn. 2980	Help with operating systems, languages, graphics, editors, applications and availability.
Marketing Support	0235-432080 or extn. 2080	Information on HCC, requests for presentations, Customer Support Manager visits to discuss user requirements.
Network Information	0235-432922 or extn. 2922	Terminal connections, modem and line faults, operational network queries.

## JET Computer Installation

The JET (Joint European Torus) project, based at Culham, has been using Harwell's computing facilities on a bureau basis since 1978. During that time growth in demand has often exceeded 50% per annum, and this has led to JET procuring a dedicated computer system, which is installed at Harwell.

The new IBM 3090-200E system includes a Vector Facility and over 70Gbytes of disc storage, as well as a large Mass Storage Facility. It is linked to Harwell's existing IBM 3084Q and CRAY-2 systems to give an extended service to JET users. The Harwell Computing Centre has been awarded the contract to provide a comprehensive 'facilities management' service for the installation.

The JET installation is sited in one of the original RAF hangars, a number of old laboratories having to be demolished before construction could commence. The fully air-conditioned computer hall was constructed in 10 weeks, and the complete service was in operation only 26 weeks after the JET contract was placed.

In parallel with constructing the building, operating system software was installed and tested using the Harwell IBM 4381 and 3084Q computers. The operating system environment was based on the current Harwell MVS/XA system, and the new system was available for pre-production testing within hours of handover by IBM.

During the following weeks the new system was thoroughly tested, and the transfer and migration of JET data to the new environment was completed. Because of the close proximity of the new and existing systems the transfer was accomplished without disruption of service to the JET user community.

The service 'went live' on June 22, 1987, and has been operating extremely satisfactorily. The Computing Centre is linked to JET via high-speed communication lines, which allow fast transfer of experimental data as well as interactive and batch access from the JET site.

The success of the project is due in no small part to the close cooperation between HCC, JET and IBM, and the professionalism and dedication of all those involved.

## Receiving New Horizons

If you do not wish to receive further editions of *New Horizons*, or if any of the details on your address label are incorrect, or if you have any comments, or if you think a colleague would like to be on the mailing list, please complete this form and return it to the Editor at the address below. Thank you for your help.

Name \_\_\_\_\_ Position \_\_\_\_\_  
Organisation \_\_\_\_\_ Telephone \_\_\_\_\_  
Address \_\_\_\_\_

Comments \_\_\_\_\_

Please send me a copy of the Harwell Computer Services Handbook (tick in box): ☐

*New Horizons* is produced by the Harwell Computing Centre. All extension numbers refer to the Harwell exchange: 0235-24141. All correspondence should be addressed to the Editor: Olivia Douglas-Pennant, Room 2-03, Computer Science and Systems Division, Building 8.19, Harwell Laboratory, Oxfordshire OX11 0RA. Telephone 0235-24141 Extension 3614. UNIX is a trade mark of AT&T Bell Laboratories. CRAY is a trade mark of Cray Research Inc.