

COMMERCIAL-IN CONFIDENCE

SCIENCE RESEARCH COUNCIL
RUTHERFORD & APPLETON LABORATORIES

COMPUTING DIVISION

D I S T R I B U T E D C O M P U T I N G N O T E 3 3 2

PERQ
DISCUSSION PAPER 1
Background

issued by
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1. INTRODUCTION

The work of Xerox PARC has stimulated world-wide interest in networks of powerful single user systems. The Rosenbrock Report expected that the multi-user mini programme of the ICF might be an interim solution to providing quality interactive facilities and that, in the long term, single user systems would become cost-effective. The ICF has purchased a number of low-powered single user systems such as the IBM 5100 for evaluation. At the same time, the Distributed Computing Systems Programme has purchased a number of small single user systems (LSI-11, Teraks) having only some of the properties of the Xerox PARC Alto.

The main components of a single user system are:

- (1) High Speed User Microprogrammable Processor.
- (2) Large Virtual Memory (Mbytes) and local filestore.
- (3) Large High Quality Display with user-friendly input devices.
- (4) Fast Communication Interface to link it to other similar systems and central facilities.
- (5) Low Cost - less than £15K initially.

In May 1979, Three Rivers Computer Corporation announced a system, the PERQ personal computer, which fulfills most of these functions. Full details are given in Appendix 1. It was clear that a commercially available Alto-like system (but more powerful) at a reasonable price (about £15K) would have a significant effect on the UK research scene. Both the ICF and DCS are immediate customers for such devices but it is already clear that this development will affect the whole of science as distributed computing systems (DCS) techniques become more widespread. Indeed, the successful marketing of such a device will impact most computer related research, especially 'Office Automation'. The Interactive Computing Facility can expect such systems to be a primary CAD tool in the years to come. Also, the Special Interest Group in Artificial Intelligence see the need to develop such systems to handle specific applications. In order to evaluate the system as early as possible, SRC managed to get the British Embassy in Washington to order a system on their behalf. In fact, SRC were the first company to place an order with Three Rivers (June 1979).

It was also clear that once it became known that such systems were on the market, SRC would get many grant applications requesting this system and this would involve the SRC in the purchase of a considerable amount of USA equipment. Fortunately the DCS Academic Coordinator, R W Witty, had been having discussions with ICL concerning the DCS Programme and ICL's internal research projects in this area. The possibility of ICL producing systems of this type quickly, by some means, was broached. ICL responded positively and it is now possible to summarise the current position. A timetable of the main events so far is given as Appendix 2.

Subsequent sections give more details of Three Rivers, ICL and SRC's current positions. Finally, some specific proposals are made as to how to proceed.

2. THREE RIVERS

Three Rivers is a small company (less than 50 employees) in Pittsburgh which has specialised in the production of high quality graphics equipment over the last few years. Its electrostatic refresh display is probably the fastest display on the market. Its high quality colour raster system is also well regarded in the USA.

Brian Rosen, the developer of the PERQ, was previously at Xerox. The PERQ was officially launched at SIGGRAPH in Chicago (August 1979). The prototype system was on show but with very little software. At SIGGRAPH 1980 two PERQs were running impressive demonstration programs and attracted considerable interest. The original intention was to ship a maximum of 25 systems in 1979 to selected sites. Delivery of the SRC's system was initially scheduled for October 1979 but is now likely to be January 1981.

A major problem with Three Rivers is that the company is small and it will be difficult for them to increase production to handle the orders coming in. There are signs that the company has a significant product and that it will be difficult to get their product to the market place in sufficient quantities to satisfy demand.

3. ICL

ICL have been actively involved in a number of research projects aiming at the development of a substantial single user system and, in particular, looking at the problems associated with a highly reliable distributed system.

In September 1979 SRC discussed with ICL the possibility of ICL marketing the PERQ. A number of suggestions were made, ranging from ICL buying up Three Rivers, to being just the local agent and providing maintenance. As a result of these discussions, ICL sent Roger Vinnicombe to talk to Three Rivers in October 1979, and later, the ICL Utica plant did a formal evaluation of the product.

ICL are negotiating an option with Three Rivers that will allow ICL to market and possibly produce PERQ systems for the European market. ICL have placed an order with Three Rivers for an early delivery of a second PERQ to the UK.

Discussions have continued between SRC and ICL concerning the best way of getting PERQ systems into use in the UK with adequate software to make the product a success.

4. EDINBURGH

There is strong interest in the PERQ from other sources. Edinburgh University, both through its own in-house programme and in collaboration with the ICF, is keen to be involved in the development of the system. Discussions have taken place between ICL, Edinburgh and SRC.

5. RECOMMENDATIONS OF ICF

The PERQ computer is a significant advance on existing single user systems. ICL's initiative gives the opportunity for such systems to be purchased from a UK company. Already SRC is starting to receive grant applications requesting funds to purchase PERQ systems from Three Rivers and develop software. These will be passed to the DCS Panel.

The following recommendations are made:

- (1) Coordination of grant applications requesting PERQ systems is desirable, especially if investigators are attempting to enhance the basic software. The ICF or the DCS Panel are appropriate bodies to provide such coordination initially.
- (2) Subject to a satisfactory outcome of the negotiations between ICL and Three Rivers, the ICL initiative should be supported by negotiating all SRC purchases of PERQ systems from ICL and providing them through the ICF/DCS equipment pool in sufficient quantities to meet the research needs of the universities. Early systems would be obtained by ICL from Three Rivers while later ones might be produced by ICL. Maintenance for all systems would be provided by ICL.
- (3) ICF should purchase at least three systems from its single user terminal budget to allow evaluation of all aspects of the PERQ system.
- (4) At some stage, when the ICL position is clearer, a joint proposal from ICF and DCS to start a collaborative programme with ICL should be put to the Engineering Board.

6. RECOMMENDATIONS OF DCS

The DCS Panel has recommended that SRC should fund a coordinated programme to develop the PERQ with funds for PERQ purchase of the order of £150K to £200K per annum for the next three years. This was supported by the Computing and Communications Sub-Committee at its meeting on 15 February 1980.

7. RECOMMENDATIONS OF CCSC

At its November 1980 meeting the CCSC recommended that the Roberts Programme's Software Technology initiative should use PERQ as the 'common hardware base' for UK academic software tools.

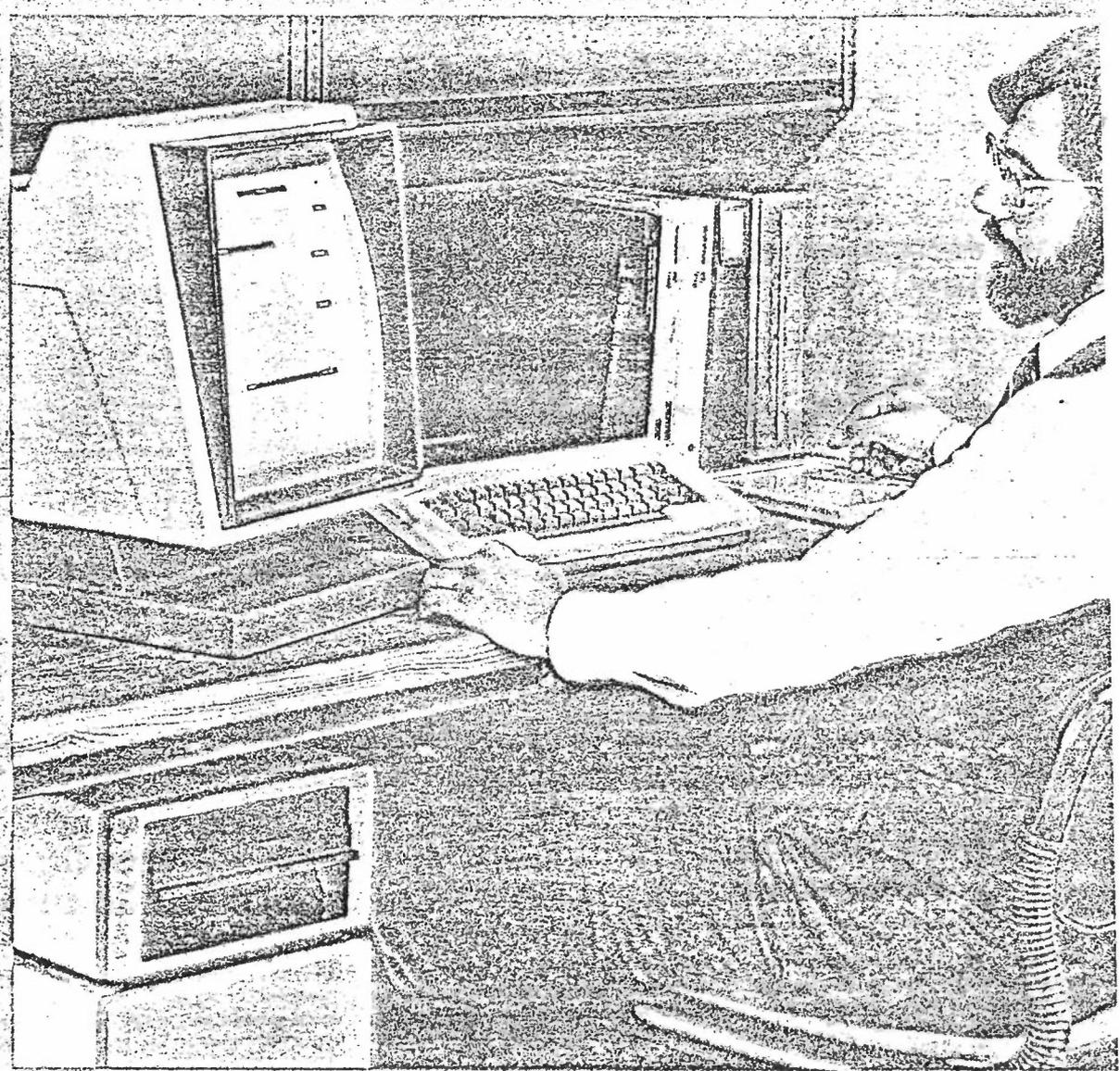
8. CONCLUSIONS

The implementation of the above recommendations would:

- (1) Provide support and encouragement for a timely initiative by British industry.
- (2) Provide a practical stimulus to UK research.
- (3) Create an efficient mechanism to feed the benefits of UK research directly into British industry.
- (4) Foster improved links between the research and industrial communities.
- (5) Make UK research more cost-effective in this area by promoting software sharing etc.
- (6) Enable more cost-effective use of scarce capital resources by allowing investigators to borrow from an equipment pool.

PERQ

A Landmark Computer System



Three
Rivers
Computer

PERQ

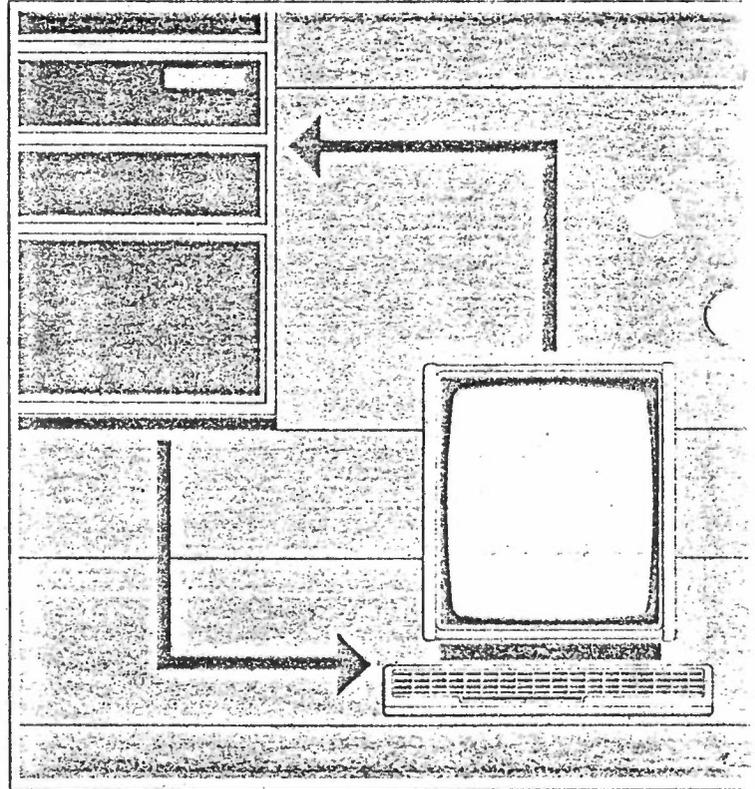
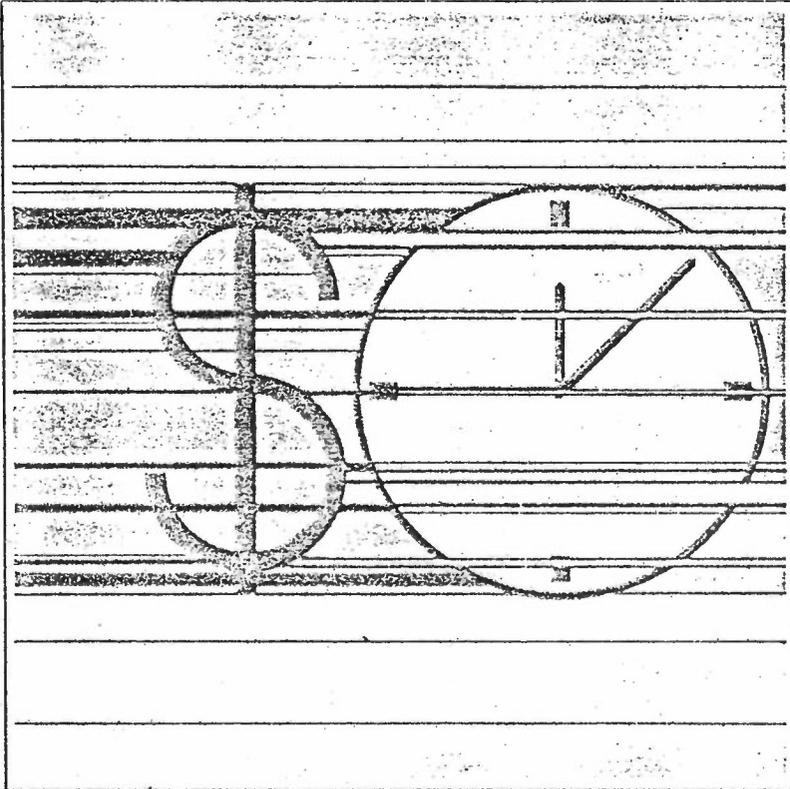
A Complete Single User Workstation

With

- Microprogrammed Processor with language directed Architecture
- 256K byte MOS memory, expandable to 1 megabyte

- 12M byte rigid disk
- Interactive Graphics Display
- 10M bit packet broadcasting network

- Keyboard and Pointer
- RS-232 and GPIB (IEEE-488) interfaces
- Speech Output



Time Sharing Alternative

PERQ provides all the benefits of a time shared mainframe without the drawbacks. For about the same cost per user, each user gets a very powerful CPU, a minimum of a quarter megabyte of memory with a big virtual address space, a high resolution video display with full graphics capabilities, a keyboard, and a large capacity rigid disk—integrated into a complete system right at his desk. PERQ has consistent, rapid response time, unaffected by other users' load. System reliability is increased because a failure in one workstation does not affect other

users. A high speed network accesses shared resources such as printers, tape drives, and distributed file systems as if they were local.

And because PERQ workstations provide computing resources on a per person basis, installations can be expanded incrementally.

So, if your response time suffers during prime time, if your users are demanding improved facilities, or if you are seriously considering any new time sharing system, let Three Rivers show you the advantages of PERQ.

Intelligent Terminal

PERQ as an intelligent terminal can stretch your existing system's capabilities. Many of the cycles on your mainframe are used in editors, command processors and debuggers, with very little time spent on the large number crunching problems your computer was designed for. By off-loading many common functions into PERQ, which has been specifically designed to excel at these interactive tasks, you can extend the viability of your current installation.

In addition to prolonging the lifetime of your mainframe, PERQ gives you the capabilities of distributed processing, interactive graphics, online document generation and electronic mail facilities.

If you are looking for a graceful transition from 1960 system architecture to 1980 computing, let PERQ intelligent terminals breathe new life into your existing facilities.



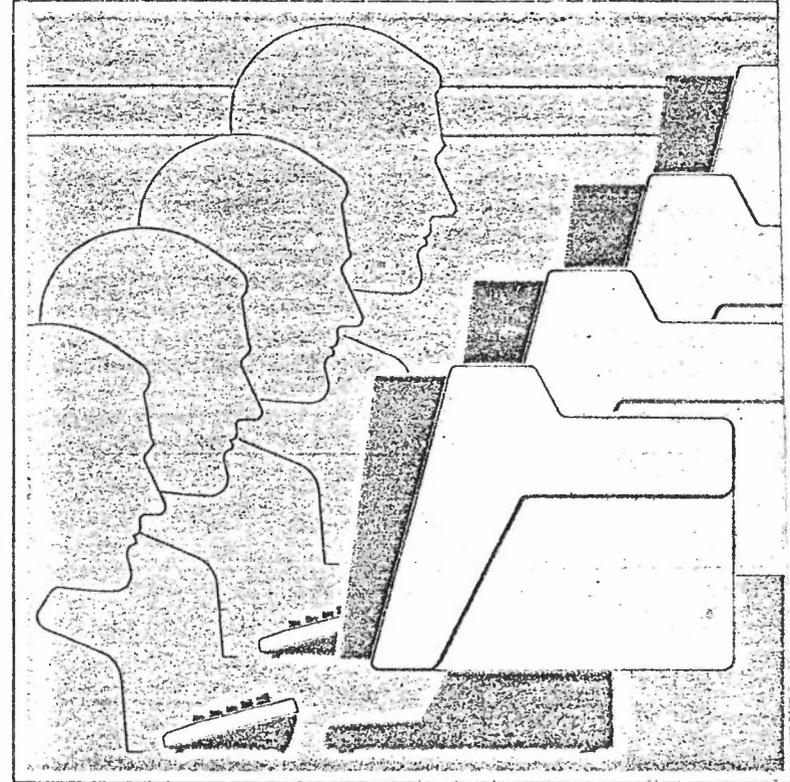
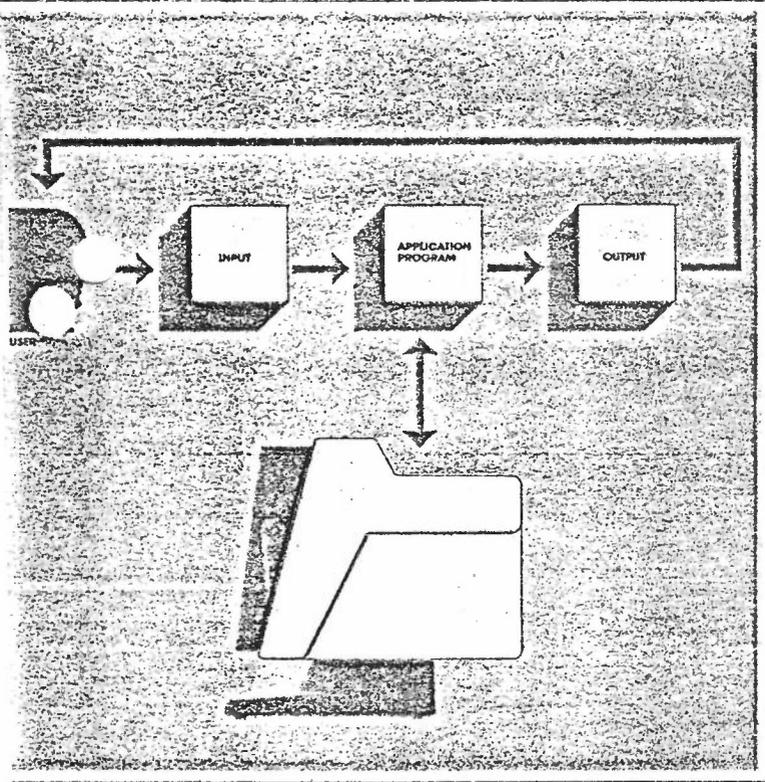
Three
Rivers
Computer

Plus
 advanced, multiple
 process operating system
 large, segmented virtual
 memory

- Distributed file system
- Compiler, linker, symbolic debugger
- Display oriented text editor

- Low cost
- Designed for reliability
- Extensive human factors engineering

- Flexible packaging concept
- Nationwide service



OEM Computer

PERQ gives original equipment manufacturers and systems houses nonsense computing power at surprisingly low cost. Its high quality text and graphics capabilities, large capacity memory and disk, plus its powerful, language oriented processor design make PERQ an extremely flexible OEM computing element.

Extensive reliability and maintainability features, national service facilities, and human factors engineering mean that systems based on PERQ are winners.

OEMs will also appreciate the sophisticated programming environment PERQ provides to get their applications programs written and debugged quickly.

And PERQ has a very attractive OEM discount schedule.

Lab, Office or Small Business

PERQ fits in anywhere a single computer station is needed because its integrated design includes all the facilities of larger systems.

As a laboratory computer, PERQ allows program development in a high level language with the execution speed of machine coded programs. The GPIB interface makes control of laboratory facilities easy and inexpensive.

In an office, PERQ provides superior text processing facilities as well as the computational capabilities of much larger systems. Its distributed processing architecture gives you computing power at the point of need.

Small businesses get much richer facilities and capabilities than those found in microcomputer based systems. Features like big disk, high quality display, large memory and multi-station expandability are standard equipment on PERQ.

About Three Rivers Computer

Three Rivers Computer Corporation is a manufacturer of advanced technology computers, peripherals and systems. Active in computer science research and development since 1970, our engineering team has had extensive experience in applying the latest technology to new situations. This experience, coupled with practical innovation is the foundation of Three Rivers' powerful new products for business, government, industry and research.

Incorporated in 1974, the company produces several different product lines in addition to the PERQ system including:

- High performance calligraphic (vector) display processors
- Color raster display equipment
- Management information presentation systems featuring color graphics
- Special purpose memory systems
- High Fidelity Audio A-D and D-A conversion systems

Installations of these products throughout the US and in several foreign countries has earned Three Rivers an excellent reputation for quality and reliability. Our production facilities are expanding rapidly to meet increasing demand.

Three Rivers is headquartered in Pittsburgh, PA and maintains a close relationship with computer research communities across North America.

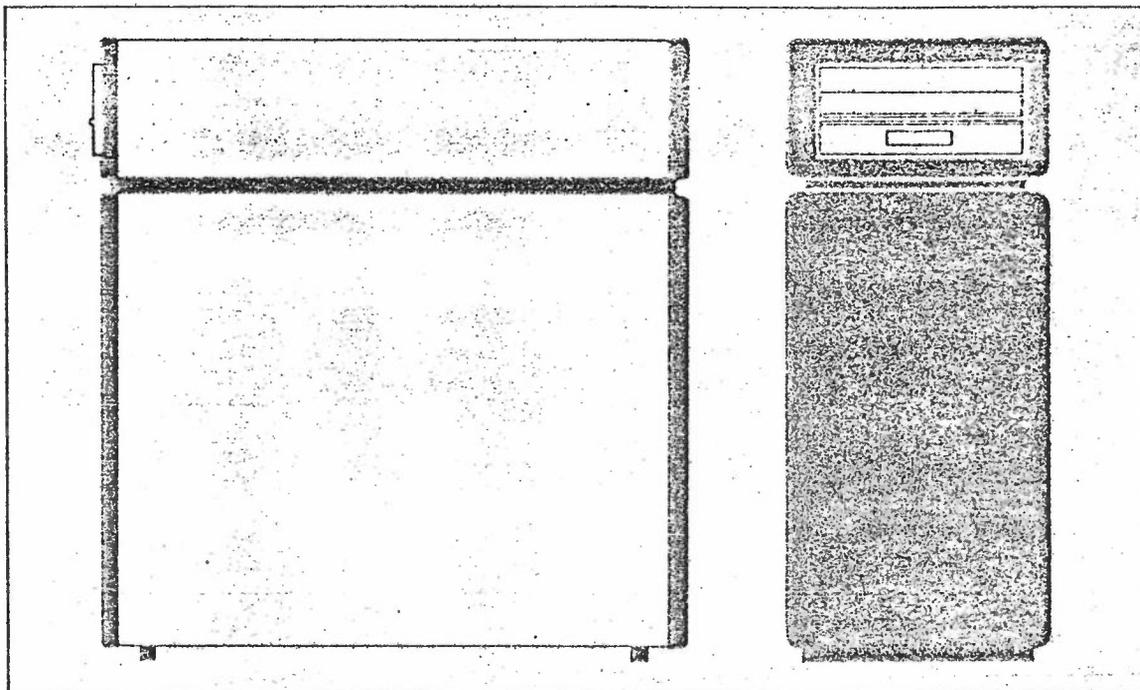


**Three
Rivers
Computer**

Three Rivers
Computer Corporation
160 North Craig St.
Pittsburgh, Pennsylvania 15213
412/621-6250

Hardware Facilities

Three Rivers
Computer Corporation
160 North Craig St.
Pittsburgh, Pennsylvania 15213
412/621-6250



Speech Synthesizer

A Continuously Variable Slope Delta Modulator is employed at a 16 kilobaud data rate to provide arbitrary stored speech output. Pre-recorded CVSD data is stored on the system disk for voice response, audible signaling, and other speech applications.

Network

A proprietary, wide-band network interconnects PERQ systems on a single coaxial cable using cable TV technology. Up to 64 PERQ workstations can be connected on up to 2000' of cable. Broadcasting packets of data at 10 megabits per second, the network allows one PERQ to access files on another system. The network is also used to provide access to shared resources such as printers and tape drives which cannot be provided to each workstation economically. By connecting a resource to one PERQ on a network, all other PERQ workstations can share that resource.

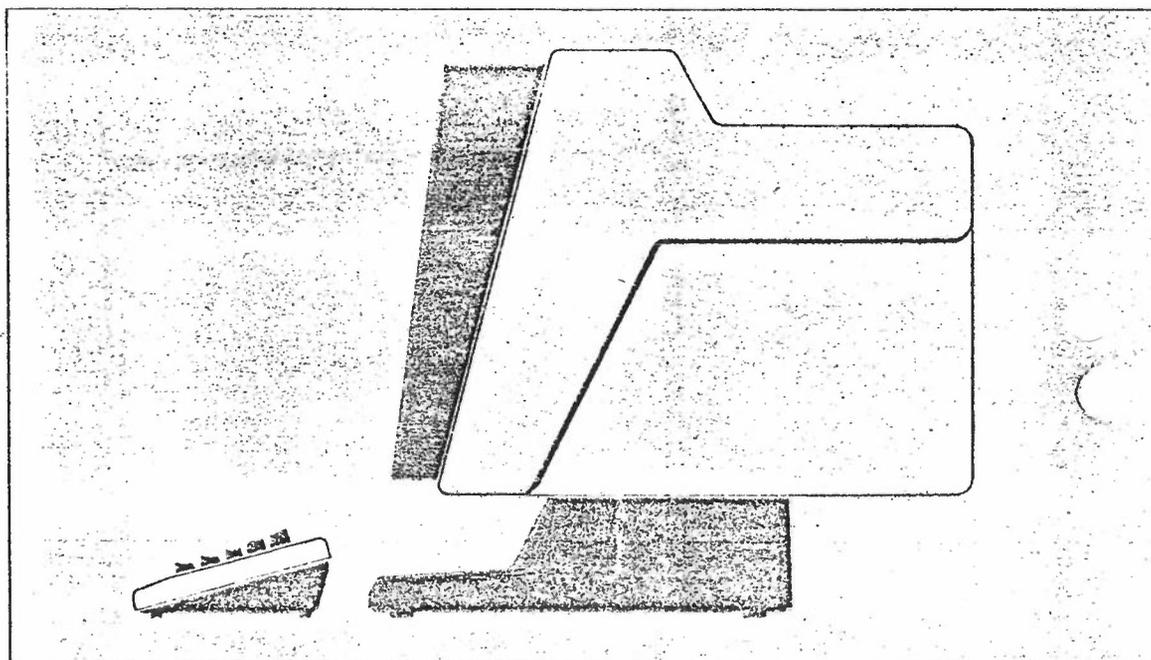
RS-232 Communications

With a full duplex, multiple protocol, high speed serial data port, PERQ supports asynchronous, bisynchronous and SDLC/HDLC/ADCCP protocols at speeds up to 56K bits per second. All line and protocol parameters are programmable and modem control is standard.

GPIB Interface

PERQ provides a full IEEE 488-1975 standard implementation of the General Purpose Instrumentation Bus. The GPIB provides a simple, compatible way of interfacing a wide range of medium speed peripherals, as well as laboratory facilities, production test equipment and instrumentation.

Hardware Facilities



Processor

PERQ includes a high speed, microprogrammed 16-bit CPU with high level language directed architecture and integrated I/O controllers. The native instruction set is the P-code byte sequences that a compiler generates for an "ideal" PASCAL (or other structured language) machine. The PERQ processor executes in excess of 1 million P-codes per second, 10-20 times faster than conventional interpreted P-code. The instruction set is modifiable so that additional languages can be supported without compromising execution speed. A writable control store option is available for users to do their own language development, or to optimize application programs. The microcycle time is 170 ns.

Memory

256 kilobytes of RAM with 680ns (average) cycle time is provided. A 1 megabyte RAM option will be available. PERQ's memory system features a virtual addressing scheme with segmentation, swapping and large address space. A parity option is available for the RAM.

Display

Every PERQ workstation includes a high resolution graphics display. A 768 point by 1024 line, bit mapped, raster scanned image is displayed on a 15" CRT with portrait orientation (long side vertical). The screen surface is approximately 8½ x 11 inches, the same size as a standard page. The display is not interlaced—all 1024 lines are refreshed 60 times per second to provide a flicker-free, high resolution presentation.

The display bit map occupies a part of main memory, and special hardware and microcode in the processor facilitate rapid manipulation of the image. For text, characters are "painted" into the bit map from a software defined font which can be any size, shape or complexity. Multiple fonts are supported as well as proportionally spaced characters to give the screen typeset quality.

Disk

PERQ has a built-in 12 megabyte (formatted) rigid disk. The disk uses Winchester technology with 97ms average access time and 7 megabit/sec transfer rate. The medium is non-removable. As an option, 24 megabyte capacity is available. Also available is a 12 megabyte, double sided, cartridge density, IBM compatible floppy disk drive.

Touch Tablet

The on-screen cursor is positioned by an easy to use "touch tablet." This finger operated pointing device is used to select and manipulate items on the display. As the user moves his finger on the surface of the small rectangular tablet, the cursor moves to track the position of the finger. The mechanism is simple, reliable and easy to operate.

Keyboard

PERQ features a 60-key, high quality, solid state keyboard with good "feel," N-key rollover and autorepeat. The straightforward typewriter layout has large tab and return keys. The keyboard is detachable.

Software Facilities



Operating System

PERQ implements a powerful operating system designed to support a single user in an extremely rich environment. Multiple process capability gives the user the ability to have more than one context established at a time. This allows rapid switching from editor to compiler to debugger for instance, without normal "start up" delays. Multiple processes permit background I/O spooling, network access by other systems, etc., without disturbing the user. The operating system also supports the PERQ's virtual memory system which manages very large programs with ease.

File System

PERQ provides a sophisticated distributed file system which features multiple, tree-structured directories, file versions, linked and contiguous files, security protection, and access to files on other PERQ systems as easily as if they were stored on the local disk. PERQ's file system design stresses reliability. All critical information is redundantly stored, and verification checks on disk operations insure the integrity of files.

Display Window Manager

All PERQ subsystems use the display window manager to manipulate screen information. The window manager partitions the screen into separate areas or windows. Windows may be moved around the screen, enlarged or contracted in two dimensions, scrolled and clipped under direct user control. Windows can overlap each other, and can be as large as the entire screen or as small as a postage stamp. Menus and "light buttons" are also supported by the window manager. The process mechanism uses the window manager to allow direct user control of multiple concurrent processes.

PASCAL Compiler

A full PASCAL compiler is included with all PERQ systems. All Three Rivers supplied software is written in PASCAL. The language is extended with strings, separate compilation facilities, dynamic array parameters, "others" clause, and additional predefined types. The compiler has optimization algorithms to minimize code size and execution time.

Symbolic Debugger

PERQ's interactive debugger can access all variables by name, set and clear breakpoints at the source line level, provide variable "watching," and procedure call/return tracing, etc.

Editor

The standard PERQ editor is a very sophisticated document manipulation system which displays on the screen an image of the document as faithfully as possible. Correct placement, size, font, face, and appearance is maintained while editing. The editor has full formatting features including fill and justify, header/footer, and automatic page numbering. Figures and diagrams can be included in the text. Multiple fonts, faces and styles can be used as well as custom logotypes. PERQ's editor uses select-and-act sequences in which the pointer is used to select text to be manipulated, followed by entering the desired command. Making extensive use of the PERQ window manager, the editor can use split screen techniques to display and manipulate more than one section of the text at a time.

Network Support

The PERQ high speed packet broadcasting network is fully supported by all components of the system software. Network support includes processor-to-processor communication at the packet, byte stream, or page level. The network can access files on another PERQ at the sector level. It can also be used as a communications vehicle to other systems or as a pipeline to remote resources such as printers, tape drives, large file systems, etc.

TIMETABLE OF EVENTS1979

- May 4 Prof Coulouris, QMC, gives R W Witty draft specification of PERQ received from Three Rivers.
- May 8 F R A Hopgood discusses the PERQ with Bob Sproull of Carnegie-Mellon University, Pittsburgh (at Seillac Workshop on Man-Machine Interaction). Both Carnegie-Mellon and Ron Baccker of University of Toronto feel that the system is a significant advance over anything else on the market and had Letters of Intent in for purchase of systems.
- June 21 After discussions with Three Rivers, Rutherford order PERQ via British Embassy.
- July 2 R W Witty meets Dr Thomas of ERCC to talk about their plans for a DCS-based facility. Details of the PERQ are given to ERCC. Dr Thomas suggests that R W Witty should talk to the research group of Charlie Portman at ICL's West Gorton plant.
- August 8 F R A Hopgood sees PERQ at SIGGRAPH in Chicago and discusses delivery etc with Rosen of Three Rivers.
- Sept 12 R W Witty and D A Duce visit West Gorton. Details of the PERQ are given to ICL.
- Sept 14 - Oct 10 Several discussions with ICL urging them to consider marketing PERQ.
- Oct 8 Peter Lever of ICL confirms that the company has given approval for Three Rivers to be approached.
- Oct 10 Rutherford and ICL discuss collaboration over PERQ.
- Oct 16 Roger Vinnicombe of ICL visits Three Rivers.
- Oct 18 Rutherford writes to ICL urging them to market PERQ.
- Oct 25 ICL replies indicating that they hope to negotiate a licencing arrangement with Three Rivers.
- Nov 15 ICL/RL meeting to discuss long-term collaboration, ICL's plans and the involvement of the West Gorton group.
- Nov 15? Utica Plant of ICL visit Three Rivers to consider manufacturing costs etc.
- Nov 27 Rutherford write to ICL indicating areas of interest to SRC.
- Dec 6 Meeting ICL, ERCC, Rutherford to discuss ERCC plans and to attempt to stop leaks from Edinburgh of ICL's plans.
- Dec 17 Meeting ICL, Rutherford to discuss detailed plans for evaluation exercise.
- Dec Meetings between SRC and ICL at various levels to discuss possible collaboration.

Timetable of Events (continued)

1980

Jan 14, 15 R W Witty (DCS) and R Rae (ICF) visited Three Rivers in Pittsburgh to evaluate the system.

Jan 22 Debriefing meeting with ICL.

Feb 18-22 ICL visited Three Rivers to begin negotiations for a marketing option.

Mar 10 Debriefing meeting with ICL.

Mar 12 Logica VTS (W Newman) meet SRC. Logica have ordered two PERQs. Agreement to help each other to get PERQs up and running. Logica interested in interfacing PERQ to Cambridge Ring.

May Newman visits Three Rivers.

May Bill Elliot of Graphical Software Ltd visits Three Rivers.

July Hopgood sees two PERQs running good demonstration programs at SIGGRAPH.

Aug CMU takes delivery of first customer PERQ.

Nov 13-18 R Witty (SRC) and R Vinnicombe (ICL) visit Three Rivers. SRC PERQ built and running successfully in factory.

Nov CCSC recommend PERQ for Software Tools initiative.

Nov 25 SRC PERQ shipped to UKTSD, New York. Stuck awaiting export licence from Americans.

1981

Jan 7 UKTSD say Americans finally issued export licence.

PERQ PROPOSALS

During the last few months, there have been a number of groups interested in developing PERQ systems for various applications. Some of the major ones are:

- (1) Prof Coulouris, QMC - Grant awarded by DCS providing two PERQ systems from the DCS pool for research in man-machine interaction.
- (2) Dr J A M Howe, Edinburgh, would like to develop an AI program environment for the PERQ. He has enquired if ICF would support an EMR in this direction.
- (3) Prof M Rogers, Bristol, would like to implement the Mead-Conway Circuit Design system on the PERQ and has enquired about ICF's interest in this area.
- (4) Newcastle University would like to develop a UNIX-like environment for the PERQ.
- (5) Dr G E Thomas, ERCC, has had a number of joint discussions with ICF and ICL to consider what part Edinburgh could play in the PERQ programme.
- (6) Logica VTS are purchasing PERQ systems and will interface the PERQ to the Cambridge Ring. They have enquired whether SRC would fund an expansion of their activities.
- (7) Graphical Software Ltd, Cambridge (Bill Elliot of Imperial) have ordered PERQ.