

SCIENCE AND ENGINEERING RESEARCH COUNCIL
RUTHERFORD APPLETON LABORATORY

COMPUTING DIVISION

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Drs Gurd and Watson, Manchester University,
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DISTRIBUTION: R W Witty
 F B Chambers
 Miss G P Jones
 Dr D A Duce
 Investigators/Gurd and Watson

(see next page)

1.2 Common Base Policy

The whole academic community, not just Computer Science, is a major user and developer of software and so the degree of ease with which software can be developed affects the scientific productivity of many researchers.

The SERC has approved a plan to increase the productivity of scientific research requiring computing by:

- (1) facilitating scientific cooperation by:
 - (a) person to person links
 - (b) computer to computer links
 - (c) common software and hardware base policy.
- (2) Set in motion a coherent plan to exploit software tool production by making such tools/techniques widely known and available in forms which can be readily used by the whole user community.

Currently the academic software technology base is very non-uniform in that the knowledge, experience, tools, techniques and equipment vary considerably between projects. The motivation to create a common Hardware and Software Base is to bring together all of the best existing tools, packages and techniques into a uniform framework so that the 'whole' is more effective than the 'sum of diverse parts'. This will be achieved via EMR contracts to move existing software into the common base, specific purchases, the direct results of SERC research projects using the common base equipment and the 'snowball' effort that will be generated as a natural consequence of providing a state of the art hardware base. A good example of the common base 'snowball' effect is the widespread use of the Unix operating system which has enabled a large number of software tools to be made available throughout the UK academic community.

The Common Base Policy briefly is:

- (a) common software base,
- (b) common hardware base,
- (c) common communications.

The SERC wish the common software base to be the Unix operating system and the common hardware base to be the PERQ. The PERQs should be networked together via Cambridge Rings, SERCnet and PSS to allow widespread cooperation between users and developers. This combination of software and hardware is widely accepted as being the best combination for developing software in the coming years. A common base does not imply rigid standardisation however.

Computer technology develops at a rapid pace and it is expected that the next few years will see the cost of single user systems decline and their quality and capability increase. Therefore today's PERQ is seen as only the first machine forming the common hardware base. The common base will develop over the coming years.

1.3 Outline

In outline the Common Base Policy comprises

- a. Pascal (ISO Standard)
- b. Fortran 77 (Ansi Standard)
- c. GKS (draft ISO Standard)
- d. UNIX (32 bit virtual memory - de facto standard)
- e. PERQ (High performance single user system)
- f. Cambridge Ring (Local Area Network)
- g. X25 (Wide Area Network)

The following gives a more detailed exposition of the technical components and philosophy of the policy.

2. LANGUAGES

2.1 Pascal and FORTRAN 77

Pascal and Fortran 77 have been chosen as they are the two most popular scientific languages. They possess the properties of portability and official standard definitions. There is a large amount of software already written in them which allows people to make use of existing investment.

There will be considerable SERC support for Fortran 77 and Pascal. This will take the form of software tools and techniques developed by the Software Technology Initiative and the activities of the SERC Computing Service team. Thus the CBP will act as a focus for many different activities.

The technical definition of Pascal is given in (ref 1).

The technical definition of Fortran 77 is given in (ref 2).

2.2 Other languages

Other languages will be available with the set of software tools in the CBP. For instance the Unix 'C' language is already available and Ada is under development by York. LISP and Prolog are being implemented.

These other languages will not receive the same degree of support and tool development as Pascal and Fortran. They are not 'blessed'. This situation must be reviewed regularly. Specific minority groups eg Ada community will receive minority support through individual committees eg STI.

Evolution of status from 'other' to 'blessed' is possible.

2.3. Mixed Language Working

It is a requirement of the CBP that 'blessed' languages should be interworkable at the procedure call level ie a Pascal program can call a Fortran subroutine which can call a Pascal procedure etc. This is a vital capability to ensure maximum use of standard components. It is ridiculous to have to, say, reimplement a Fortran graphics package in Pascal because Pascal cannot call Fortran.

Interworking has implications for compiler construction and operating system development. It has its limitations and difficulties, eg the difficulties in enforcing type checking across procedure interfaces, but its benefits outweigh its drawbacks. (Reference Tony William's paper).

3. GRAPHICS

In line with the policy of supporting international standards and portability aids the CBP has 'blessed' GKS 7.2 as its basic graphics package. GKS will be available on all SERC machines, not just PERQ, to help the transfer of graphics software and, via metafile standards, pictures themselves.

There will have to be a significant amount of software mounted on top of GKS to give the scientist the graphics facilities he requires. Much of this graphics library porting work will be led by RAL Graphics Section.

The technical definition of GKS is given in (ref 3).

The technical definition of metafile standards is under development by ISO.

4. OPERATING SYSTEM

4.1 CBP UNIX

Unix is already a de facto standard in many academic institutions in both USA and UK. It has enabled a great deal of software to be shared amongst research groups and has built up a large quantity of widely applicable software.

Unix is being used increasingly by industry again both in the USA and UK. The CBP philosophy is based on the following properties of Unix.

- a. It is popular ie a de facto standard.
- b. It is implemented on a wide variety of makes and sizes of computer (IBM 370 - M 68000).
- c. It is manufacturer independent.
- d. It is cheap (\$150 per PERQ).
- e. It has a large body of user level software.
- f. It is used by both industry and academia.

For the scientific community Unix is likely to become the standard small machine operating system because 'small' machines seem to get bigger everyday!

The CBP Unix has the following properties

- a. It is full '32 bit'.

Arithmetic is 32 bits by default to overcome the annoying limitations of microprocessors. 8,16,32,64 bit quantities are available.

- b. It is virtual memory.

Full 32 bit addressed linear address space (via paging) removes the size restriction which is often so frustrating.

- c. CBP Unix is System III.

The technical specification of Unix is given in (ref 4).

4.2 UNIX Evolution

There are several versions of UNIX either in existence or soon to be announced. These include Berkeley 4.1 and 4.2, Bell version 7, System III and System V.

The CBP philosophy is to run the same, stable version of UNIX on all the different types of hardware supported by the CBP ie only one version of UNIX will be supported by SERC.

There must be a balance between the benefits of new developments and the benefits of stability and standardisation. Thus moving to a new version of UNIX will be a major evolutionary step for the CBP, especially if and when more than one CPU type is involved.

5. SINGLE USER SYSTEM

The PERQ was and is the first machine which satisfies the requirement for a high performance single user system (see Appendix 1). Other machines are likely to follow (some are already here). The expected proliferation of machines will tend to fragment the software development activities because some things will always be machine specific. The Council therefore wishes to balance the benefits of standardisation (which acts against change) with the need to give state of the art facilities to scientists (which requires change). The future CBP is therefore expected to include more than just today's PERQ but such changes must be taken infrequently and given very careful consideration beforehand.

It should be borne in mind that the criteria for choosing a single user system must be that it runs the common software base rather than has some new hardware feature. The investment in software is already so large that computers must be purchased which run the Council's software rather than the Council's money be wasted on reimplementing existing software on some new hardware. Manufacturers will have to understand the changing balance of power between them and their customers. The manufacturer independence of Unix is a key factor in this equation.

The recommended CBP PERQ configuration is:

PERQ: 1 Mbyte main memory
16K writeable control store
24 Mbyte disk
tablet
puck (3 button 'mouse')
LAN interface
X25 front end (one per installation for connection with
WAN)
1 Mbyte floppy disk
100 pixels per inch A4 display

For advice on peripherals such as printers suitable for use with PERQ contact CBP User Support at RAL.

The technical specification of the PERQ is given in (ref 5, ref 6).

6. LOCAL AREA NETWORK

6.1 Cambridge Ring

The CBP requires a fast local area network to link its machines together. The Cambridge Ring has been chosen because it is

- a. a UK draft BSI standard (CR82, ref 7).
- b. DCS Programme's common equipment
- c. has protocols already implemented for Unix which are a de facto UK academic standard.
- d. much greater installed base in the UK than 10 MHz Ethernet as UK universities through their own efforts, together with DCS and JNT, have installed more than 20 Rings already.
- e. it is an easily purchased and maintained commodity from a variety of UK suppliers.

The technical specification of the Cambridge Ring is given in (ref 7).

6.2 LAN Evolution

The Cambridge Ring is not the only LAN currently available, but has been chosen as the CBP LAN for the above reasons.

There are several different types of Ethernet and Token Ring LANs available or soon to be announced. The IEEE 802 standard initiative is having a beneficial influence but has yet to be adopted as an ISO standard.

The CBP will therefore stay with the Cambridge Ring and its associated CR82 protocols until the world wide LAN developments have stabilised sufficiently to enable an evolutionary step to be made.

6.3 Campus X25 Switches

Where a campus has installed an X25 system to act as a LAN then the SUS can access this via the hardware and software given under section 8, ie X25 campus LANs are 'blessed' by the CBP.

7. SERVERS

The long term objective of the CBP is to exploit the advantages of distributed computing and LANs which can be realised as Servers. The following Server requirements can be identified as desirable but not yet deliverable as 'service' equipment. There is an urgent need to develop such servers into commercial products.

7.1 Publication Quality Printing

There is a requirement for sophisticated, high quality (at least 300 pixels per inch) text and graphics printing capability to complement the Single User System's display.

Examples are hardcopy of scientific papers (camera ready including diagrams), graphical software tool output, 'mathematical' text (proofs) and so on.

It is envisaged that this need will be met by small, relatively cheap (£10K) laser printers, one per department, configured as a LAN server. Until this technology is readily available (1984?) such items as Diablo daisy wheel printers and Versatek graphics devices are suggested (Contact RAL CBP team for advice).

7.2 LAN/X25 Gateway

It is seen that an LAN to X25 (SERNet and PSS) gateway will be the most cost effective way of connecting a number of machines to the WAN. No products are currently available.

7.3 LAN/LAN Gateway

Multiple campus LANs, whether the same type or not, are likely to arise with the consequential need to connect one LAN to another.

No products are currently available.

7.4 File Server

Single user systems cannot hold all of the data to which a single user requires access. Nor can a SUS handle file backup and archiving requirements.

In the short term the CBP recommends that SUS are not used stand-alone but are connected to multi-user machines with suitable peripherals to allow file access and archiving.

The more desirable solution is to have file and/or archive servers. No products are currently available.

8. WIDE AREA NETWORK

The CBP requires a national wide area network to link both people and machines. The network must be compatible with JNT/NMC policy. The current CBP uses SERNet and PSS which are technically compatible X25 networks linked by a gateway.

The CBP also requires access to Europe (Scandinavia) and the USA. Such links are not all easily available.

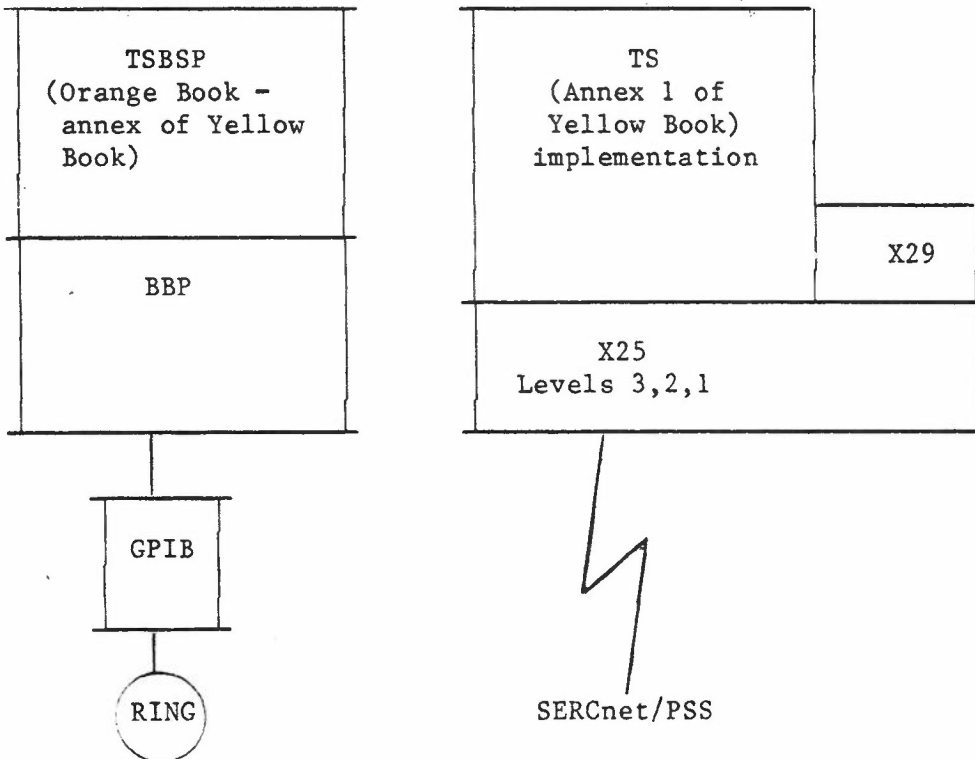
The PERQ-X25 connection, in the short term, will be via the York LSI-11 transport service front end originally designed for the PDP-11. Studies are in hand for 'in-board' solutions.

The technical specification of SERCnet X25 network is given in (ref 8).

9. PROTOCOL STRATEGY

JTMP (Red Book) Job Submission	MAIL (Grey Book) Electronic Mail
FTP 80 (Blue Book) File Transfer	TS 29 (Green Book) Remote Terminal Login

.....TRANSPORT SERVICE INTERFACE.....



9.1 CBP Protocols

The protocol strategy is based on the de facto UK academic standards approved by the SERC/CB JNT in their 'coloured books'. The adoption of the Wide Area Network protocols of transport service and above for the local area network use gives a useful unification of LAN/WAN facilities. The average user sees only one and the same mechanism to move files, mail etc between machines independent of distance (ie local or wide area net). The adoption of transport service also gives a degree of hardware independence for local area networks.

The use of wide area protocols for local area networks is 'conservative' in that it does not allow various advantages of LANs to be exploited eg speed, reliability. More LAN specific (light weight) protocols could be employed for high speed intermachine interaction (eg remote process execution). Such protocols should only be 'blessed' if they attain a measure of widespread acceptability. Specific research projects are likely to require lightweight protocols. They should not be discouraged in appropriate circumstances.

Transport Service around the Ring is implemented by TSBSP (Transport Service Byte Stream Protocol) running above BBP (Basic Block Protocol). These are the de facto UK academic Ring standard protocols based on Cambridge University's work.

Currently the JNT is having the Mace box built by Orbis which will be a high speed intelligent interface having TSBSP and BBP in it so providing a DMA transport service to its host.

The protocols specifications are given in (refs 9-15).

9.2 Conferencing, Bulletins

Electronic Mail as implemented over the Grey Book is an extremely useful facility. However, experimental work at various sites in the world has shown the potential advantages of more sophisticated facilities above simple mail. Such facilities include message based conferences and public electronic bulletin boards.

No ISO approved or de facto standards exist in these developing areas. The CBP could possibly evolve to include such facilities.

9.3 Protocol Evolution

The JNT coloured books and the CR82 Ring protocols are not ISO standards nor are they likely to be. It will be necessary eventually to change the protocols on both WAN and LANs in the light of current development work on protocols to whatever emerge as international standards. This will be a major change for the entire network community and will not come quickly.

10. PORTABILITY

Fortran 77 and Pascal will allow PERQ CBP software to be moved to and from other non PERQ computers. However it is recognised that even when programs are written in Fortran 77 and Pascal much work often has to be done to move them because of the inbuilt operating system dependencies. By using 32 bit, virtual memory Unix as a de facto standard execution environment it should be much easier to move programs in Pascal and Fortran 77 from one CBP Unix system to another.

Portability is also one of the reasons for backing national and international standards generally, hence the use of the GKS graphics package. GKS will be available on all SERC supported machines.

Portability of software is also one of the aims of the networking side of the CBP. Good communications are needed if software is to be easily shared by geographically dispersed research groups.

11. APPLICATIONS SPECIFIC SUPPORT

The CBP is expected to be expanded to include some items related to specific applications. These might possibly be the NAG library, RAL graphics library etc as well as software development tools from the STI, IKBS etc. In addition much applications specific software will be generated 'on top of' the CBP and which will be generally available but which will not actually be part of the CBP. The CBP is supposed to form the 'base' not the totality of available software.

12. GENERAL POINTS

- a. Great stress should be laid on the fact that the CBP does not see single user systems as standalone systems. Networking is the key to file backup, mail, software update and interchange.
- b. CBP links people just as much as computers.
- c. CBP aims to back international standards if possible.
- d. Software sharing and portability only really come when both the programming language and execution environment (ie operating system) are defined. The corollary is "it's OK to change the machine - just don't change the (user/program and program/operating system) interfaces".

13. REFERENCES

1. ISO Standard Pascal (BS 6192)
2. Ansi Standard Fortran 77
3. GKS draft ISO standard
4. UNIX Manual
5. PERQ glossy
6. PERQ hardware manual
7. CR82 UK Ring hardware specification
CR82 Interface Specifications
Orange Book
8. SERCnet X25 specification
9. TS29: Green Book
10. FTP80: Blue Book
11. JTMP: Red Book
12. MAIL: Grey Book
13. Transport Service: Yellow Book
14. TSBSP, BBP
CR82 Protocol Specifications: Orange Book
15. Mixed Language Working
A Williams
RAL

A P P E N D I X 1

THE PERQ

The Perq is a high powered, single user computer system with a high precision display system which provides a significant improvement in the quality and speed of interaction. Its main features are:

(1) High Speed Processor

Approximately 1 million 'high level' machine instructions per second giving around two-thirds the CPU power of a VAX 11/780. The CPU is micro-programmable for further speed gains.

(2) High Quality Display

A4 size, 1024 x 768 pixel, high resolution black and white display featuring 60Hz non-interlaced refresh rate which enables pictures to be moved cleanly and rapidly as well as giving a significant improvement in the clarity of text and diagrams equal to a printed A4 page.

(3) User Friendly I/O Devices

A 2-D tablet and voice synthesiser, allied to the high quality screen, enable a much improved man-machine interface to be created.

(4) Large Virtual Memory

A 32 bit address paged virtual memory system.

(5) Local Filestore

A 24 Mbyte Winchester disk and 1 Mbyte floppy give a single user a large amount of local storage capacity.

(6) Fast Communications

Local communication at 10 Mbits/sec via Cambridge Ring. Standard RS232 serial and IEEE 488 parallel interfaces are also provided.

A high quality, superbly interactive computing system is created if each investigator has his own single user PERQ linked to his colleagues' PERQs and other departmental computing resources by a Cambridge Ring, with inter-university cooperation being fostered by the National X25 network connections.