Berkeley Software for UNIX† on the VAX‡
(The Fourth Berkeley Distribution Tape, November 1980)

A new package of software for UNIX will be available from the Computer Science Division of the University of California at Berkeley in early November 1980. This is an updated package of software for UNIX/32V† licensees, and includes a refined version of the paging kernel for the VAX as well as a large number of other programs. This document describes the major differences between standard UNIX/32V as distributed by Western Electric and the November 1980 distribution known as 4BSD. 4BSD includes:

Languages for the VAX

Interpreters for APL, LISP and both an interpreter and compiler for Pascal. The APL interpreter is the PDP-11 version, moved to the VAX. The LISP system, known as "Franz Lisp", is written in C and LISP, includes both an interpreter and a compiler, and is compatible with a large subset of MACLISP. The Pascal system is the instructional system that has been distributed previously for PDP–11's‡. The language implemented is standard Pascal. The implementation features excellent diagnostics, and allows separate compilation with full type checking.

New System Facilities

The system is now fully and transparently demand paged. As distributed it will support individual process sizes up to 6M each of data and stack area and 6M of program. These numbers can be increased on systems willing to dedicate increased disk space for paging the process image.

A new load-on-demand format allows large processes to start quickly. A *vfork* system call allows a large process to execute other processes without copying its data space. The system supports access to the console floppy disk, and large UNIBUS disk drives. It reboots automatically after hardware and software failures, running an automatic procedure that recovers from normal minor disk inconsistencies. If hardware or software failures cause unexpected problems on the disks, then a interactive semi-automatic repair program can be used to fix up the disks.

System performance enhancements

The system performance has been enhanced in many ways. Basic system overheads have been reduced by tightening up the system code and improving system data structures. Disk throughput has been increase by increasing the logical block size on the disks to 1024 bytes. Systems that run UNIX/32V convert to the new format by saving files using the tape archiver and reading them into the new system. System algorithms such as the swapping and cacheing algorithms have also been improved to increase system performance.

Because of the format changes in the file system and because some of the changes described here required recompilation of all programs, a bootstrap tape and all programs are distributed.

A display editor

The tape includes the display editor, *vi,* (vee-eye) that runs on over 100 different intelligent and unintelligent display terminals. This editor uses a terminal description data base; a library of routines for writing terminal independent programs using this data base is also supplied. The editor has a mnemonic command set that is easy to learn and remember, and deals with the hierarchical structure of documents in a natural way. Editor users are protected against loss of work if the system crashes, and against casual mistakes by a general *undo* facility as well as visual feedback. The editor is usable even on low speed lines and dumb terminals.

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Command and mail processing programs

The tape also includes a new command processor *csh* that caters to interactive users by providing a history mechanism so that recently given commands can be easily repeated. The shell also has a powerful macro-like aliasing facility that can be used to tailor a friendly, personalized, command environment. A new interactive mail processing command supports items such as subject and carbon copy fields, and distribution lists, and makes it convenient to deal with large volumes of mail.

Job control facilities

The system now supports the multiplexing of terminals between jobs. It is no longer necessary to decide in advance that a job is to be run in the foreground or background; running jobs may be moved from the foreground to the background and vice-versa, and mechanisms exist in the C shell *csh* for arbitrating the terminal between the active jobs.

Debugger support

A version of the symbolic debugger *sdb* is included in the distribution that can be used to debug Pascal, C, and FORTRAN 77 programs. The assembler has been rewritten and the C compiler modified to reduce greatly the overhead of using the symbolic debugger.

Other software

Also included are a several other useful packages including programs to simulate the phototypesetter on 200 bpi dot-matrix plotters (these programs were moved from the PDP–11 to the VAX and many fonts available on the ARPANET have been converted to the required format), a bulletin board program, routines for data compression, a slow-speed network for connecting heterogeneous UNIX systems at low cost (1 tty port per connection per machine and no system changes), and a new, flexible macro package for *nroff* and *troff* called −*me*.