CIRCUIT SIMULATION · VLSI DESIGN · 2D MODELLING · FINITE ELEMENT ANALYSIS · DOCUMENT PROCESSING · STATISTICS...

ACORN
CAMBRIDGE
WORKSTATION

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The Acorn Cambridge Workstation has been designed specifically for scientists, engineers and users requiring more than just another micro.

This is the new generation of desktop computing, enabling the individual user to run large, complex programs in industry standard, high level languages - previously only possible with mainframes and super-minicomputers - but without the delays of timesharing.

Fast, 32 bit processing gives the computational performance of a super-minicomputer with the freedom and response of a micro.

The Workstation user has a complete system free from reliance on centralised computing services, with massive improvements in personal productivity. Communications are available to other Workstations or to super-minicomputers to remove the limitations of standalone micro systems.

The Acorn Cambridge Workstation will enhance and improve existing central computing facilities - not make them redundant.
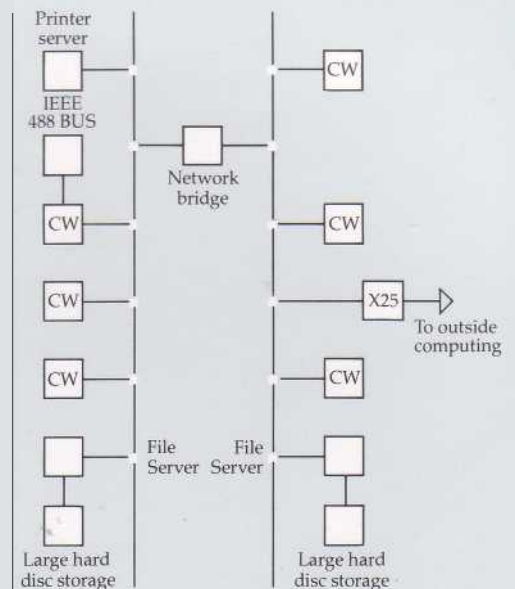
THE CAMBRIDGE WORKSTATION

The current generation of microcomputers are used, mostly, for tasks which are not computationally demanding. Applications such as wordprocessing and simple spreadsheet analysis use the organisational features of micros rather than any true numerical capabilities. The emergence of 16-bit personal computers gave the *expectation* of much improved computing performance, allowing the micro to tackle applications previously confined to supermini and mainframe computers.

However, the *reality* has been that the newer processors offer more memory accessibility (but typically less than 1Mb), allowing larger programs to be run, but no real advances in true computing power; in fact one of the commonest implementations is actually slower than some prominent 8 bit micros.

One of the main factors determining the performance levels of personal computers is their heritage of both hardware and software. Chip designers were constrained by a desire to maintain a degree of software compatibility with 8 bit product ranges and software designers used that compatibility to update 8 bit software rather than start afresh.

The Acorn Cambridge Workstation transcends these limitations. The 32 bit processor is a completely new design owing more to supermini design than to previous microcomputer designs. The operating system software is also new but, from the end users point of view, there is one important link to the past.

Not, however, a link to microcomputers but to supermini and mainframe computers: that link is the languages that are standard with the Workstation at no extra charge. The languages are the four most popular with scientific computer users and the one ever popular in the increasing field of artificial intelligence research.


ACORN DISTRIBUTED COMPUTING

The Acorn Cambridge Workstation can form the basis of a distributed computing network, using Acorn fileservers or existing facilities as a file store. Each Workstation has a network interface as standard and a X-25 gateway is available for access to central computing or other X-25 packet-switched networks - long distance and even international intercomrnunication is possible via public packet-switched networks

DIRECT SUPER-MINI COMPUTER (VAX) LINK

To take the strain off an overloaded super-rninicornputer, a direct link to a DEC VAX is available. Files may be transferred to a VAX via serial lines, or the VAX filing system can be accessed transparently by the Workstation user as if it were a local file store. Files stored on a VAX can be archived in the usual manner.

4000

3000

2000

1000

Time
(seconds)
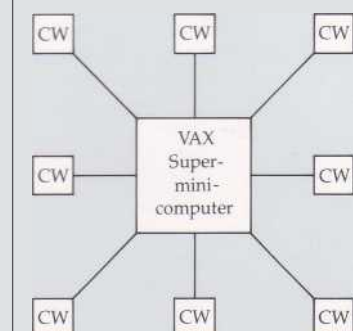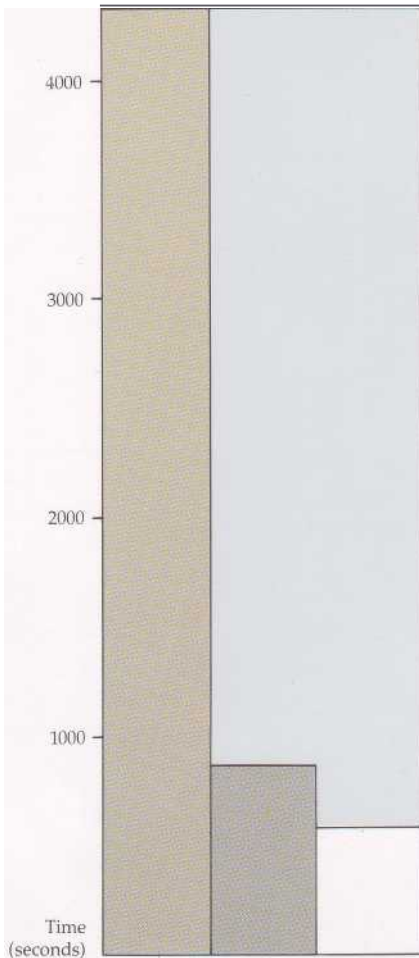
Acorn Carnbridge Workstation

Typical super-mini computer' in single
user mode.

Typical heavily
loaded super-minicomputer' in
multiuser mode.

'In house tests
using a DEC VAX 11/750 (without FPA
under UNIX 4.2 bsd, Acorn Cambridge
Workstation at 8 MHz).

The Acorn Cambridge Workstation is designed as a general purpose computer to provide high level computing power *on* the desk top, not *at* the desk top. The user is in complete control of the environment in which programs are run, with no interference and delay necessary to service the demands of other system users. Thanks to the fast and powerful National Semiconductor Series 32000 chip set, 32 bit processing using industry standard languages can be provided on the desk top. The languages are, FORTRAN 77, ISO PASCAL, C and Cambridge LISP. These are full implementations of the languages not subsets tailored for use on micros. The Workstation hardware provides the exact environment these languages were devised to run in, a large contiguous address space, hardware floating point processing, and a fast error correcting hard disc unit. Of course, being an Acorn product we also include BBC Basic.

The porting of existing mainframe and supermini applications software can be a painless procedure, since the same high level languages are available.

The surprisingly compact, two-box design combines a high resolution, high contrast, direct etched monitor, processors, 1 Mbyte of memory, network interface, 640 Kbyte (double density) floppy disc and/or 20 Mbyte Winchester disc all in one unit with a separate, fully equipped 92 key keyboard. All interface connectors are on the back panel and memory expansion up to 4 Megabytes is internal.

Terminal emulation for VT52, VT100 and Tektronix 4010 is also available in ROM.

PERFORMANCE

The 32 bit processor was designed to be a mainframe in silicon. The internal architecture closely models super-minicomputer construction and is optimised with software in mind, giving excellent support for high level language compilers. Included is an IEEE standard floating point support processor (NS32081) providing both single and double precision arithmetic (32 bit/64 bit). Benchmarks generally give only a very narrow picture of computer performance. A better measure is real applications, such as SPICE shown opposite. With a typical, fully loaded, multiuser super-minicomputer it may be possible for a user to get only a single run/day; with the Acorn Cambridge Workstation an order of magnitude improvement is possible - a real increase in personal productivity.

SOFTWARE - LANGUAGES

Extensions to the standard:
- hexadecimal constants
- character & in identifiers
Fortran 66 compatibility (as option)
- DO loops execute at least once
- Hollerith constants in DATA and CALL
- quoted constants not of type CHARACTER
Single precision (32 bit) and double precision (64 bit reals; option for 64 bit single precision) Post-mortern backtrace facility showing source line nurnbers
Trace facility
Fully compiled

FORTRAN 77

Conforms to ANSI X3.9-1978/ISO
1539-1980 (E)

Extensions include machine language inserts
Integers are represented in 32 bits (16 bits for shorts), floating point numbers in 32 bits (64 bits for doubles), characters in 8 bits.
C library implements the following functions (and macros) as described in UNIX bsd 4.2 documentation:
- Section 3 - where appropriate
- Section 3S (10) - as complete as possible
- Section 3M (maths) - majority
- Section 2 - calls to operating system primitives possible
Fully cornpiled

C

The language conforms closely to that
as described in the book 'The C
Programming Language' by
Kernighan
and Ritchie, published by
Prentice-Hall, 1978

Extensions to the standard include: -
characters 'S' and '-' in identifiers -
non-decimal constants
- bit vector operators
- some systern prograrnrning functions
- OTHERWISE clause in CASE statement -
'include' files
- machine language inserts
- separate compilation facility with MODULE, IMPORT, and ALIAS constructs

Real numbers stored in double precision (64 bit)
Post-mortern backtrace facility showing source line numbers
Checks for unassigned variables possible
Fully cornpiled

PASCAL

Conforms to BS 6192:1982, 'ISO Pascal
Level 1' Category A, (also known as
ISO 7185)

Multi-length arithrnetic package lirnited only by the rnachine's memory
Interpreter and compiler
Full screen editor
Additional constructs based on Common Lisp proposals

LJSP

Cambridge Lisp

Upwards compatible with BASIC 1 and other earlier versions and contains the following enhancements:
- LISTIF cornrnand
- improved LIST formatting
- 10 digit precision of printing
- extension to EXT# - OPENUP function - OSCLI
staternent - ON PROC statement Full screen
editor; To retain compatibility, operates as a stand alone
system
Floating point operations carried out in software with the same precision as
BBC Microcomputer BASIC
Interpreted

BBC BASJC

Fully compatible with BBC
Microcomputer BASIC

A C O R N
AND THE CAMBRIDGE CONNECTION

Founded at Carnbridge in 1978, Acorn is now one of the most mature companies at the forefront of Britain's technology and comrnunications revolution. Acorn's product range started with small computers for the growing enthusiasts market and steadily evolved with more and more sophisticated features. This development was justified when, in 1981, the specification for the proposed BBC microcomputer was published. This cornplicated and extensive systern was ideally suited to the well advanced ideas Acorn had for the Proton computer. Acorn's endeavours were rewarded with the successful acquisition of the BBC contract despite fierce competition. In 1984 a further 4 year contract was signed.

With growth frorn a turnover of under £0.5m in the late seventies to £93m in the mid eighties, a key elernent in Acorn's success has undoubtedly been the company's sustained and continuing research and developrnent effort. Involving over a third of the cornpany, this has been by no rneans directed solely at the consurner market.

Acorn has strong links with Cambridge University and in particular the Cornputing Laboratory where much of the specialised equipment was developed by, or in conjunction with, Acorn. Development lines cover areas from speech recognition to satellite communications and advanced networking techniques. Acorn is rapidly becoming recognised as a leader in the new technology of designing on silicon.
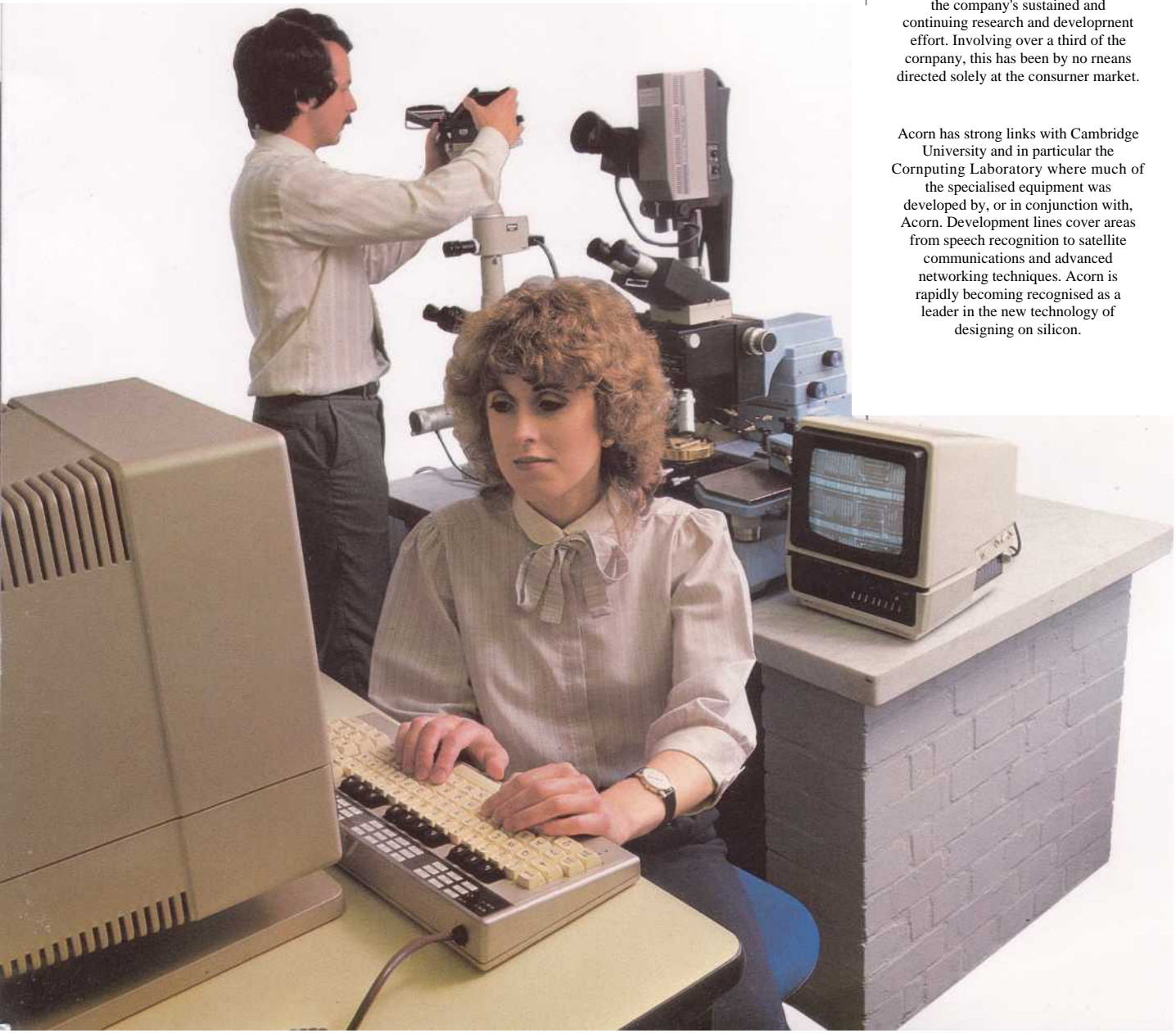
QUALITY
ASSURANCE

Tight quality control and careful production engineering have led to Acorn products being widely recognised for quality and reliability The Workstation hardware has been designed and manufactured to a high standard of reliability and safety and complies with BS 415. The compilers and operating system have been subjected to:
- internal acceptance tests
- certification by international standards bodies, (NCC/GSA for Fortran 77, BSI for ISO Pascal)
- independent audits, and
- extensive field trials

All software development has utilised high *level* languages

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THE ACORN CAMBRIDGE WORKSTATION

Product Range

A *Powerful Package:* The Acorn Cambridge Workstation has been designed as a complete package of hardware and software, fully equipped to meet the computational demands of engineers and scientists.

Model No:	ACW 100	ACW 121	ACW 143	ACW 443
Monitor	Mono (14")	Mono (12")	Colour (12")	Colour (12'
Floppy disc		2 x 640Kb	640Kb	640Kb
Winchester			20Mb	20Mb
Memory (RAM)	1Mb	1Mb	1Mb	4Mb
Max Memory (RAM)	1Mb	4Mb	4Mb	4Mb

SOFTWARE	HARDWARE

Standard features with each Workstation at no extra charge:

Operating system: PANOS
Languages:
FORTRAN 77*
ISO PASCAL*
C*
CAMBRIDGE LISP*
BBC BASIC
32000 ASSEMBLER

* These are full mainframe implementations, not cut down versions for micros

User Guides:-
PANOS Guide to Operations
PANOS Programmer's Reference Manual
BBC Basic Reference Manual
FORTRAN 77 Reference Manual
ISO PASCAL Reference Manual
C Reference Manual
CAMBRIDGE LISP Reference Manual
Acorn 32000 ASSEMBLER Reference Manual
Function key card booklet

Computational processor
CPU: NS 32016
Floating Point Unit: NS 32081
ROM: 32 Kbyte
RAM: As above

I/o Processor
CPU: 6502
RAM: 64Kbyte
ROM: 32Kbyte
Acorn ADFS in ROM + DFS (Version 2) in ROM
Network (Econet ™) ROM

RS423 Serial port
Centronics parallel printer port
RGB (TTL) output
D-type analogue socket
BNC Video
37 way D-type 1MHz bus
Keyboard
LAN socket

User Guides
Acorn Cambridge Workstation User Guide
Filing System Manual

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Performance

(1) RAW *Performance*

8 MHz clock speed

RAM has access time of 150 ns with no wait states

Full speed bus cycle in 4 clock cycles:
— read data (16 bits)
— write data (16 bits)
— fetch instructions into queue
— acknowledge interrupt
— transfer data to/from slave (FPU)

8 byte prefetch queue

Typical instruction times in microseconds at 8 MHz for 32 bit (doubleword) fixed point operations:

move	register to register	0.38
	memory to memory	2.12
add	register to register	0.50
	memory to memory	4.25
mult	register to register	10.37
	memory to memory	13.75

8 and 16 bit operations are faster

Typical instruction times in microseconds at 8 MHz for floating point instructions:

	32 bit	64 bit
add register to register	9.25	9.25
mult register to register	6.0	7.75
divide register to register	11.13	14.75

(source: National Semiconductor Corporation)

(2) *Real Applications*

SPICE* (A circuit simulation program)

	Time (seconds)	
	Acorn Cambridge Workstation	VAX 11/750 (withoutFPA) under Unix 4.2 bsd
RAM Cells	1010	1612
Two bit counter	3100	4248
5-stage ring oscillator	1710	2743
Differential sense amplifier	160	156
	5980	8759
Job throughput: No of runs/ day in practice	10	1
		(if multi-user)

Conversion effort: 1 day

This was to convert 17000 lines Fortran IV to Fortran 77

*SPICE, unmodified, is the property of the University of California, Berkeley. This is an in-house test conducted by Acorn Computers Scientific Division.

THE ACORN CAMBRIDGE WORKSTATION

PANOS

Operating system: PANOS has been designed by Acorn for professional users, with advanced mainframe applications and software development in mind. It is in the modern style, being both modular and extensible, being written in the high level language Modula-2.

This modular approach offers the ability to amend, reconfigure or add to parts of the operating system without a total rewrite. Also, because it has been designed for a desktop workstation, it does not consume a great deal of systems resource; which is frequently a problem when much larger operating systems are transported from mainframes and minicomputers.

A feature of PANOS, rarely found with other operating systems, is the ability to support cross language calls for Fortran, C and Pascal. This means that program suites written in any of these languages are available to applications writers working in a different high level language.

PANOS supports:

— program loading and execution — a procedural model of program execution, thus programs can invoke other programs
— command line interpretation
— command files with parameter substitution
— event handling
— cross language calls
— stream based I/O model with filing system treated as part of file name
— support for Acorn filing systems: ADFS, NFS and DFS
— time stamping on files

PANOS Procedure library (callable from high level language programs) consisting of the following modules:

DecodeArg	argument decoding
Convert	type conversions
Store	memory allocation
I/O	stream based input/output
Error	error handling
File	file management
Loader	system loader
TimeAndDate	time and date handling
Handler	event, condition handling
GlobalString	global string variable management
BBC	direct access to BBC micro
Command	command interpretation
Program	program, procedure execution
Random	random numbers
Wild	pattern matching

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PANOS

PANOS Utilities:

Linker which:

— supports independent compilation of
 modules
— supports cross language calling standard
— accepts input in Acorn Object Format
— generates output as relocatable images

Full screen editor with:

— arbitrary length lines
— search and replace operations
— selection, delete, move and copy of
 blocks
— undelete operation
— multiple windows and multiple buffers
 — command window providing access to
command interpreter

Further utilities for system configuration,
file management and others:

access	set file or directory permissions
catalogue	display file or directory data
configure	adjust system startup parameters
copy	copy files or streams
create	create files or directories
delete	delete files or directories
echo	echo expanded argument to screen
help	provide on-line help
move	move a file
set	set system parameters
show	display system parameters
star	execute a '*' command

Installation command files to facilitate
installation from the distribution media