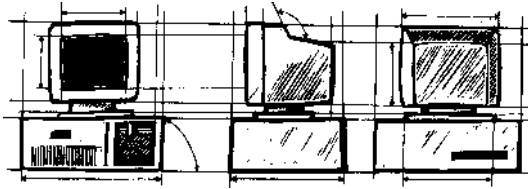


BENCHTEST



Photography by Chris Bell



Acorn R140

In a box that looks suspiciously like an Archimedes lurks Acorn's somewhat less imaginatively named R140 Unix workstation. As Andy Redfern found out, the hardware was a little familiar, but with two operating systems and various windows environments, the R140 is a serious challenger in the cheap workstation market.

For the last five years or so, a favourite New Year pastime has been predicting that the coming year will be 'The Year of Unix'. Every year more interest is being aroused and more systems are being installed, but the enormous explosion in systems has still yet to occur. Many thought it would come through Xenix, but its reputation of being a brain-dead version of Unix was never really lived down. What was really needed was for someone to produce a cheap workstation.

The major advantage of workstations over terminals is that the majority of processes are run on the workstation, reserving any host machine's processing cycles for more time-consuming activities.

The workstation could be defined as an intelligent bit-mapped environment manager connected to a host machine. Usually it has enough power in reserve to give an impressive performance when compared with other desktop machines.

The problem with workstations until now has been the excessive cost. Admittedly the machines have looked and performed impressively, but the price has prevented all but the most wealthy of companies from putting them on every desk in an office. To bring about the Unix revolution, a powerful, cheap workstation is needed. Steve Jobs may think he's cornered the market with the NeXT machine, but Acorn claims it can also compete for a cheap workstation market share.

Hardware

From the outside, the machine looks just like an Archimedes and when I opened it up and checked, it was an Archimedes architecture that greeted me. The machine is a small metal box with an angled plastic piece on the front which has the floppy disk and status lights mounted on it. The keyboard and mouse are no different

from the standard Archimedes hardware. In fact, the only clue that this machine was not a standard Archie was the 19in Philips monitor resting on top of it. Even this isn't a guaranteed difference between the two machines, as there are two cheaper monitor configurations available — a Taxan multisync monitor or a text-only screen. (For a full review of the original Acorn Archimedes see the August 1987 issue of PCW.)

What makes this machine different from a standard Archie is the way in which the hardware add-ons are interfaced and controlled. The first surprise is the hard disk. No longer is there a reasonable 40Mbyte hard disk but a 60Mbyte with a fast seek time. In the PC market, the seek time on hard disks has diminished in importance because the hardware is unable to keep up with the volume of data coming from the disk. On the R140 workstation it's quite the reverse: the processor would sit idling, waiting for the data to be transferred.

So, Acorn decided to put this processor time to some use. All the disk storage is compressed on the fly by the ARM chip set. The company claims that the algorithm used guarantees an average compression rate of 2:1. Not only does this increase the storage capacity of the hard disk, it actually increases the data transfer rate. This is because the volume of data read from the disk is the compressed value, and because the ARM would have been idling anyway, then no time is actually wasted. This technique provides an impressive saving in both disk space and transfer time. At present the technique is only used on binary executable files.

The disk controller used in this case is the Seagate ST506 controller, and there is enough room inside the case to attach another disk. The system can also support a SCSI interface and Acorn recommends that, if

you do need more disk storage, attaching a SCSI device will achieve a better performance. The SCSI interface can also be used to connect tape streamers, laser printers, CD ROMs and scanners to the R140.

As well as the SCSI interface, a serial and parallel port are provided, but (more interestingly) a number of network interfaces are also enlosed. The standard workstation comes with Ethernet, Cheapernet and Econet, while the so-called base system only comes with Econet.

Ethernet has become the most popular network hardware interface over the last few years with companies such as Sun and Apricot fitting it as standard. The main problem in using Ethernet is the cabling cost. This is due to the expensive low-loss cable that is needed to allow the high data transfer rates and the long communication distances.

Cheapernet simply uses the Ethernet network protocol (IEEE802.3 for those interested) at a slower speed. This reduces the cabling cost significantly but also reduces the maximum network size.

The Econet interface is provided to allow the R140 to be networked at sites where users have already installed an Acorn network and want to use the new workstation with the installed network.

The Ethernet board isn't fitted onto the main PCB but resides in one of the four expansion slots. (For a reason one can only guess at they are no longer called 'modules'.) This leaves the user with three free expansion slots. The cards currently announced by Acorn are a SCSI adaptor and a floating point co-processor card which uses the WE32206 co-processor chip. Third-party hardware manufacturers sell a wide range of cards for the Archimedes and these should all be compatible, although special device drivers will need to be written if you



Under the lid the hardware is virtually identical to the Archimedes 440, with the only additions being the new disk drive, the four RISC OS ROMs and the expansion (module) card

want to use them from within Unix.

Apart from those points, this machine has few differences from the Acorn Archimedes model 440. What is far more significant is the software that Acorn provides with the machine. In theory, it will run programs developed for machines as diverse as a Systeme Unix system, an IBM PC and a BBC micro. But do these claims stand up in practice?

Software

The R140 comes with three operating systems, two of which are standard — Unix and RISC OS — while MS-DOS comes as a £100 option. RISC OS is the standard version that is now shipped with every Archimedes (for a full description of RISC OS see Dick Pountain's review in the January issue of PCW). It is installed on the hard disk and has a small partition, around 3Mbytes, for itself. The other disk partition contains Acorn's own implementation of the Unix operating system. In fact, the hard disk arrives around 98% full because most of the Unix tools you could ever want have been included.

Although the disk comes virtually full, Acorn's theory is that you will delete things you don't need to make space for your applications and data files. This method of distribution is also used by Apple when it ships AIX. Sun, on the other hand, provides a formidable pile of 3½in floppy disks containing all the utilities not put on the hard disk to keep it from looking full. On the review system I could have made 6Mbytes available just by deleting the games (2Mbytes), the learn facility (1Mbyte), the on-line manual (1.8Mbytes) and the library files (1Mbyte). I'm not suggesting you should delete any of these things specifically, but if you don't need them, back them up on floppies and then remove them.

Unix is a powerful, complex, multitasking operating system that was developed at AT&T's Bell Laboratories on a redundant PDP-7 computer in 1969. The Acorn Unix is based on 4.3 BSD (Berkeley Standard Distribution) which was originally implemented at the University of California, Berkeley. It is also shipped with device drivers for the peripherals, Berkeley's developers' toolkit, system admin tools, ANSI C compiler, ARM assembler, Sun NFS, X Window release 11.2, IXI's X.Desktop, floppy-to-hard disk data format interchange tools and a whole pile of User Contributed Software (UCS). The hard disk being 98% full is perhaps no longer a surprise!

For a person new to Unix this all sounds like a daunting prospect. In practice many of the elements described are only needed in specific application areas which many people will not use. Let us consider what facilities a non-networked user might require.

Unix can be viewed at three different levels. Firstly, the 'kernel' provides the interface with the actual hardware. The Unix environment isn't hardware specific and the kernel is the interface that makes that possible. Above the kernel is the 'command interface' that processes the demands of the programs and passes them through to the kernel. On top of that layer is the 'shell'. This is the interface with the user, which interprets all the commands they type and passes them through to the command processor.

The Acorn Unix machine provides two shells: the Bourne shell (named after its creator Thomas Bourne) and the C shell (not named after its author Bill Joy). The Bourne shell is a simple shell that is supported on most Unix machines, while the C shell is more complex, requires more

memory and, through the extra features it provides, runs slower. The main difference between them is the script language they use. The script language is analogous to the batch language on a PC, except that it provides more procedural control and provides many extra facilities. The C shell is designed to provide the script writer with a C-like language, while the Bourne shell makes far fewer demands on the programming ability of the user.

The problem with using the shell interactively, like any other command line interpreter, is that it is very unfriendly to the new user. So, above the shell, many Unix implementations now provide a windowing interface. In this case Acorn provides X Window. As Pat Moran on page 154 of this issue has given a full explanation of the X Window history and functionality I shall only list the Acorn-specific features. But even these window managers can be a little daunting when you have to set up configuration files to add your own items to the menus, for example. To help first-time Unix users, Acorn also bundles a desktop environment which provides a fairly standard WIMP interface for the user. Simply point, double click and the application or command is run.

The actual desktop provided is IXI's X.Desktop. This is one of the desktops that were originally rumoured to have found favour with Steve Jobs for use in the NeXT machine. As it turned out, IXI was pipped at the post, but a number of other manufacturers have since expressed an interest. It provides a Mac-style environment (I perhaps should be careful what I say; I don't want IXI and Acorn to end up with an Apple lawsuit to deal with!) and will even run in colour if you purchase a colour analogue monitor.

The preceding explanation could have been written about a number of workstations, so what are the extras that Acorn adds to the system to make life easier for the single user?

Firstly, support is provided for users who work in multiple machine environments. The floppy disk has a number of system commands that allow it to be treated as a BBC B or Master, an Acorn Archimedes, an IBM PC, Xenix or Unix floppy disk drive. This means data interchange between any of the listed formats is simple. The Unix commands that will now support the floppy drive are cp (copy), rm (remove), ls (directory(?)) and cat (display files). Using this mechanism I managed to transfer a number of text files and C programs for use on the R140.

Secondly, being a system manager can be a far from simple task, what

with looking after passwords, any network functions and user and group administration. Acorn has therefore developed a number of utilities for helping a new system manager. For example, 'inituser' provides an automatic way of adding a new user to the password file without having to edit it directly. Simply answer the questions and everything else is done for you.

Finally, any Unix system is logged onto by going through a terminal. The R140 provides four virtual terminals, all of which can be active at the same time. Due to the memory limitations only one of them can be an X Window interface, but there is enough free memory for three more intelligent terminals. For example, when I switched the machine on I logged on as the Unix System Manager ('root' in the Unix jargon) on the terminal called 'console'. By pressing the Break key a list of four different terminals available appeared. I then logged on to the two text terminals as 'demo' and 'guest', so I could play with the examples in the manual. Finally, I switched to the X Window screen and logged in as 'desktop', a special log-on that automatically boots up the IXI desktop. Then, at any point during the processing, the terminal screen can be switched simply by using the Break key.

When any of the text terminals are on the screen, the f3 key gives access to the set-up screen for that terminal. You can then change a whole range of parameters including the translation of some keys, keyboard repeat rates and delay times, and even the text mode the terminal is in. The text modes supported depend on which monitor you are using and whether or not the X Window screen is being used.

The real power of being logged on as a number of users is that tasks can be set up and run under different users without having to log in under a new user name. For example, as you explore the machine you will quickly find that some commands are complex and can be difficult to get out of if you enter them by mistake. Simply hit the break key and move to the console where you are logged on at root. You then have the power to delete any process that is running under any user ID. Delete the process and then return to the original terminal and a message saying 'process stopped' will be displayed, and you will have the shell prompt again.

Networking

Being a Unix workstation which is intended to run a multiple machine environment, the R140 comes with a number of networking support features.

It provides at the lowest level the TCP/IP network protocol which is now a de facto standard on the majority of Berkeley Unix machines.

On top of this, Acorn provides the user with the Sun Network File Server (NFS) and 'Yellow Pages'. The Sun NFS has been implemented and supported on a wide range of machines and allows machines to work in 'client' and 'server' configurations. Yellow Pages is a special suite of utilities that provides a method of many users using many machines. For example, imagine you have a network of R140s and you have a log-on on one. Yellow Pages allows you to log on to any machine and have access to your data using an NFS interface.

In use

On switching the machine on you are booted almost instantly into RISC OS. On the bottom menu bar are the two drives available, the system command icon and the palette modifying utility. The other icon is for Unix — who would ever have believed that booting into Unix could be done from clicking on a RISC OS icon? The RISC OS partition is fairly small but the standard utilities available with RISC OS are all there.

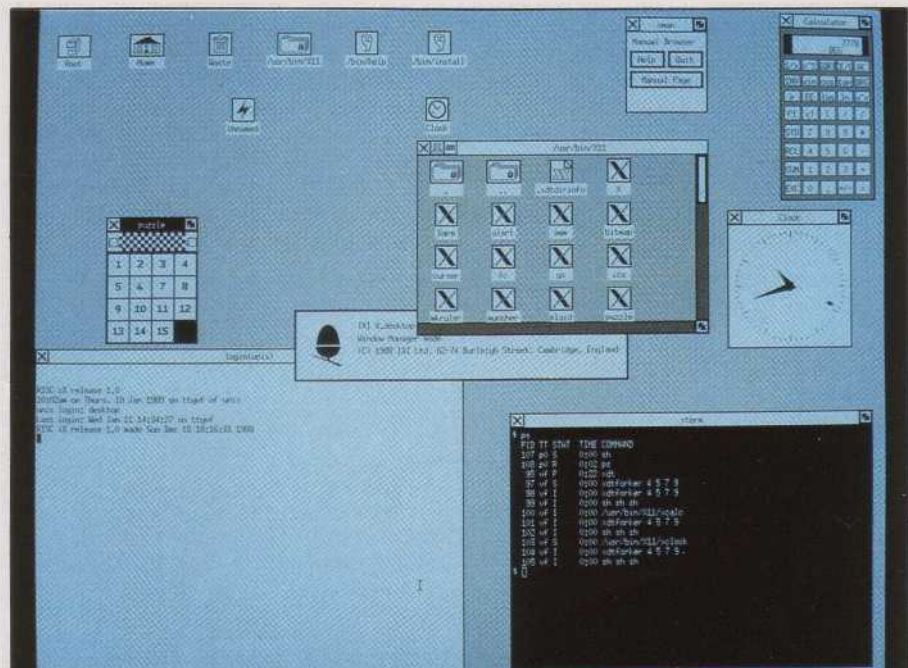
Clicking on the Unix icon activates a dialogue box asking if you really want to go into Unix or not. By clicking on the middle of this box a number of parameters can be set up. For example, you can disable RISC OS completely so that next time you switch the machine on it boots straight into Unix, or you can specify a slow boot which performs all the disk and file checking.

Once you've checked the parameters, click on the Continue box and Unix begins to boot up. A long list of the actions it's performing appears, most of which will be incomprehensible unless you are familiar with Unix. Eventually the log-in prompt will appear.

It takes 58 seconds to boot into Unix without file checking and just over a couple of minutes with the file checking. It then takes another five seconds to load the X Window interface. Shutting down the machine is a little more difficult to quantify, as it does depend on how many processes are running. Using the 'fasthalt' command on a machine with no processes running takes about 20 seconds to re-enter RISC OS. So if you envisage using both RISC OS and Unix there is a time overhead in switching from one to the other to be taken into account.

Quantifying exactly how fast a multi-tasking, multi-user machine runs is far from simple, but it is possible to examine the raw computing power. The main test I performed was to discover how long it took to scroll a file to the screen using the 'cat' command. The file I chose was the 200k 'words' file in the dictionary directory. The following timings were measured using the root log-on with no other unrelated tasks running and with no other users logged on:

- 20 secs on a low-res 80x24 screen
- 23 secs on a medium-res 80x30 screen
- 271 secs in an unmanaged X Window screen
- 335 secs in an Xterm under X. Desktop

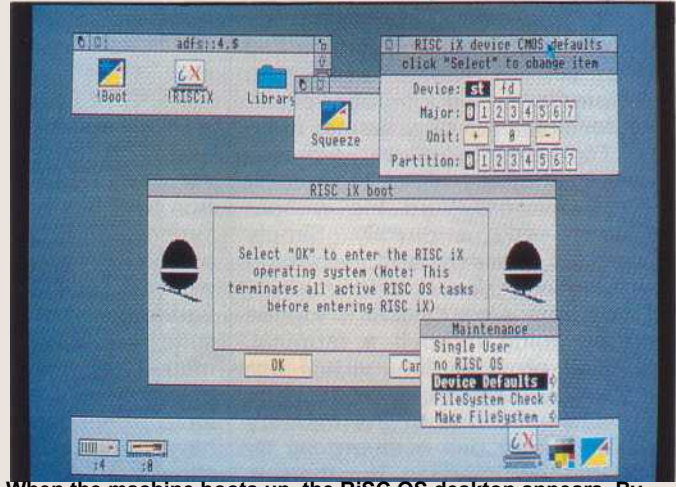


The 19in Philips monitor provides a mono resolution of 1152x960 pixels. In this mode a quarter of the screen is equivalent to a normal 80x25 text screen

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On a Taxan 770 monitor the RISC OS desktop appears in 16 colours, with all the colours being configurable



When the machine boots up, the RISC OS desktop appears. By selecting the RISC iX icon, RISC OS is suspended and Acorn's Unix is loaded

These results provide us with some interesting points. Firstly, a medium or low-res terminal screen is very fast (just compare those times with the scroll time on a PC). Secondly, if you want to use a windowing interface a considerable price is paid in the processor time needed to manipulate the screen. This is inherent in the ARM architecture because the processor is expected to perform so much of the screen handling. Also, X Window is an environment that will port fairly simply from one Unix machine to another. There can be no direct access to the system hardware, as Unix is not an architecture-specific operating system. All the hardware-dependent operations must go through the operating system. A final point is that X Window was never intended for animated graphics. To illustrate this under X, Desktop I ran a graphics demo called Plaid and in another window I executed the same test described as above. The test that had previously taken 5½ minutes then took over 23 minutes to complete.

My one major criticism of the machine is that the Reset key (which is present on both the Compact machine and Archimedes) is still

there. If you press the Reset key in Unix the machine resets. Any files that are open are not closed, any data still in the buffers is lost (this won't be a significant amount because of the autoflush facility) and on rebooting the machine will have to perform a file check to recover and sort out all the problems. This can be a considerable amount of effort and in one instance it took over ten minutes. The problems can be even worse if the machine is connected to a server via NFS.

Acorn is currently looking at the problem and will probably be putting a blanking plate over the switch. But because the key is quite important to RISC OS users it will still be possible to activate it with a pen or paper clip.

Documentation

The documentation is a crucial part of the Acorn system because Unix is not simple to learn. I was impressed with the documentation provided: it enabled me to brush up my Unix, but it also enabled a friend who had no Unix experience to get a good foundation. The Unix manual, totalling over 1.5Mbytes, is on-line, but only the Acorn additions are included in the printed documentation. The

programmers' documentation is supplied separately and if you want a printed version of the full Unix manual it is available for £60.

Prices

The prices, as mentioned before, are for systems without a monitor. The base system which includes everything except the Ethernet card will be £3500, while the workstation system will be £3949. The PC Emulator is £99. Acorn will not be shipping monitors and it will be up to the dealer who supplies the machine to provide you with one. The three monitors considered by Acorn to be the standard options are a Philips 19in monochrome monitor, a Taxan 770 multisync or a Philips mono.

Conclusion

Acorn has tried very hard to make the R140 a product of some class and, to a certain extent, has succeeded. It will sell well into the higher education and the scientific/technical markets. What will be crucial in deciding whether it is a total success is whether it can gain major orders in the office automation market.

My main worries are the lack of memory expansion and the small disk size. With the price of hard disks falling rapidly, investing in a slightly bigger hard disk may have been a good marketing move. But this is an excellent product that feels like a well put-together system. It makes an apt step-up from the VT-style intelligent terminals and fills a gap in the market. It should also provide a fine development machine for software houses.

With a little help from Olivetti, Acorn's parent company, this machine should be a genuine Acorn success.

Technical specifications

Processor:	Acorn RISC 32-bit processor
RAM:	4Mbytes (non-expandable)
ROM:	512k
Mass storage:	60Mbyte hard disk
Floppy storage:	1Mbyte multi-format
Storage options:	SCSI interface or ST506 second drive
Keyboard:	IBM AT-style, 103 keys and a three-button mouse
Monitor options:	19in high resolution 1152x900 (text 144x45 or 96x32) Medium resolution 640x480 in 16 colours (text 80x20, 80x24 and 80x30); text only 80x20, 80x24 and 80x30
Standard interfaces:	RS232, Parallel
Expansion interfaces:	Ethernet, Cheapernet, Econet
Expansion co-processor:	WE32206 maths co-processor
Operating systems:	Unix BSD 4.3 and Acorn RISC OS (MS-DOS also available using emulator). Also X Window managers UWM, TWM and AWM