

# Stephen Borrill

## Running Unix/Linux on Acorn Computers

# About me

- First encountered Unix in 1993
- Avid Acorn computer user since the BBC B
- Worked for Acorn and its education subsidiary Xemplar from 1996 to 1999
- Founded Precedence Technologies in 1999 to continue the work done at Acorn and Xemplar
- NetBSD developer since 2007

# Acorn Computers

- Founded in 1978 in Cambridge
- Initially used 6502 8-bit CPUs
- BBC model A and B released December 1981
- Own LAN (Econet)

Acorn 



# Acorn RISC Machine (ARM)

- Project started October 1983
- Designed by Sophie Wilson and Steve Furber
- First silicon (ARM1) April 1985 from VLSI
- Initially a 2<sup>nd</sup> processor for the BBC using the Tube interface
- Spun off into Advanced RISC Machines in 1990 in conjunction with Apple and VLSI

# Archimedes

- Archimedes A3x0 and A4x0 released June 1987
- Starting at £799
- ARM2 8MHz
- ARM accompanied by
  - VIDC1a (video controller)
  - IOC (I/O controller)
  - MEMC (memory controller) – max 4MB



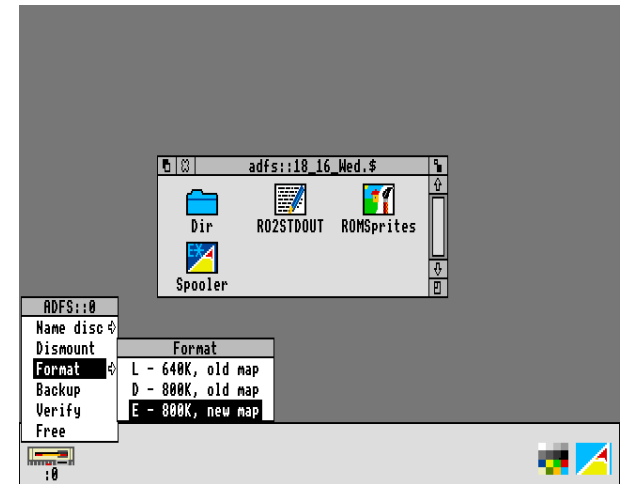
# Operating systems

- Archimedes released with Arthur 1.2
- Arthur written at last minute
  - Single tasking
- ARX (written in Modula-2+) was not ready
  - Rumoured to have pre-emptive multitasking, multithreading, multi-user operating system
  - Never released



# RISC OS

- RISC OS 2.00 released April 1989
- Co-operative multitasking
- ROM-based (512KB)
- Little memory protection
- One process can easily kill entire machine



# Product Refresh

- Designated by /1 prefix (e.g. A440/1)
- Released June 1989
- Same ARM2 8MHz, but updated MEMC1a
- Start at £999 (1MB and no HDD)
- Range included R140 RISC iX workstation
  - 47MB ST506 hard drive
  - First release of RISC iX (1.1x)
  - Included AKA25 Ether1 Ethernet podule
  - £3500



# 2<sup>nd</sup> Generation Archimedes

- Released June/July 1990
- ARM3 25MHz
- MEMC1a with 4MB RAM now on plug-in board
- Up to 4 memory boards (16MB)
- SCSI podule and 100MB SCSI HDD included
- A540 for RISC OS (£2499)
- R260 for RISC iX (£5000 with 8MB RAM)
- R225 discless RISC iX workstation (£3000)

# 3<sup>rd</sup> Generation Archimedes

- Released from September 1991 (A5000)
- ARM3 25MHz (later 33MHz) or ARM250
- Parallel IDE hard drive, (S)VGA graphics
- A5000 up to 8MB RAM (with add-on card)
- RISC iX not supported due to hardware changes (technically can run with some devices not working)

# RISC iX

- Developed in 1998 for unreleased A680
- First publically released on R140 in 1989 (v1.1)
- R260 included v1.2
- BSD 4.3 based
- Cost £1000

# RISC iX quirks

- Required special podule backplane for efficient interrupt handling on early machines
- Uses NIS not BIND, so no DNS
- Slightly odd filesystem layout reflecting trends at the time (X/Open, SVR4.0), e.g. no /bin
- Both 4.3BSD binaries (/usr/ucb) and Sys V (/usr/5bin). Acorn-specific tools in /usr/acorn

# Aside: A680

- Never released
- Prototypes exist (I have 2)
- Platform for RISC iX development
- 1998 era
- Desktop Publishing



# Aside: A680 hardware

- Dual on-board MEMCs (8MB RAM)
- On-board SCSI (rumoured to burn)
- ARM2 (can be upgraded to ARM3)
- Monochrome graphics (BNC)
- Tiny RISC OS (8 modules) just enough to bootstrap RISC iX

# Using RISC iX

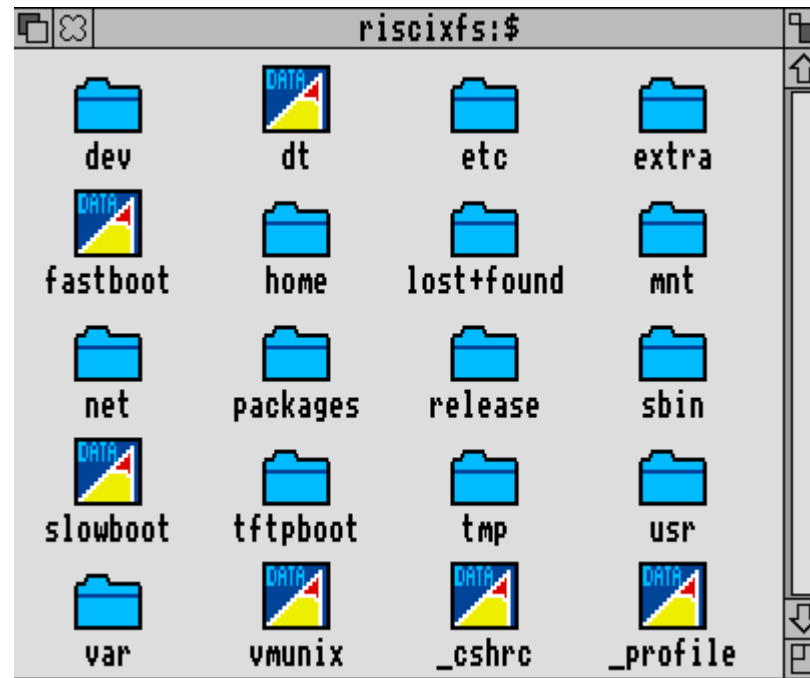
- Can run (some) RISC iX binaries from RISC OS using `execv`

```
*execv ls
.cshrc          dt          l
.profile        etc          lib
bin             extra       lost+found
c               fastboot    m
dev             home        mnt
*execv fsck /dev/sd0a
** /dev/sd0a
** Last Mounted on /
** Phase 1 - Check Blocks and Sizes
** Phase 2 - Check Pathnames
** Phase 3 - Check Connectivity
** Phase 4 - Check Reference Counts
** Phase 5 - Check Cyl groups
SUMMARY INFORMATION BAD
SALVAGE? y

Used: 7660 files, 63823 kbytes
Free: 22654 kbytes, 266 frags, 5597 blocks, 0.
***** FILE SYSTEM WAS MODIFIED *****
*
```

# RISC iX from RISC OS

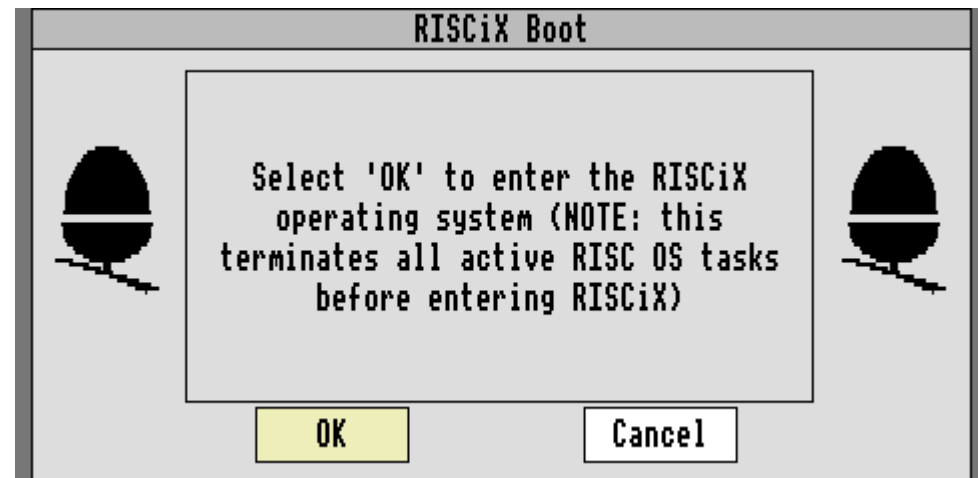
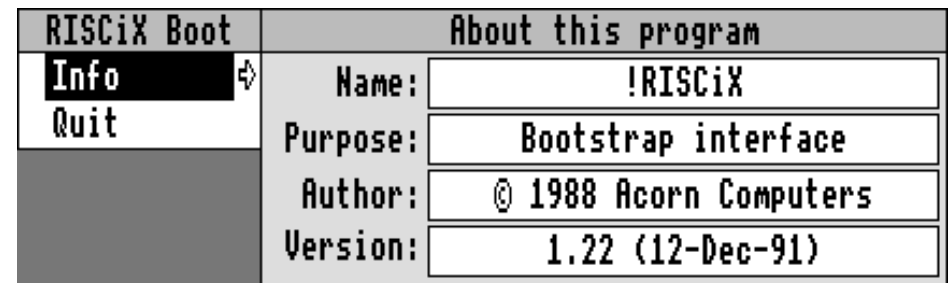
- Can access RISC iX filesystems using RISCiXFS module





# Booting RISC iX

- Minimal RISC OS boot sequence
- !RISCiX app to boot and also configure
- If noRISCOS set, will boot without user interaction



# RISC iX on A440

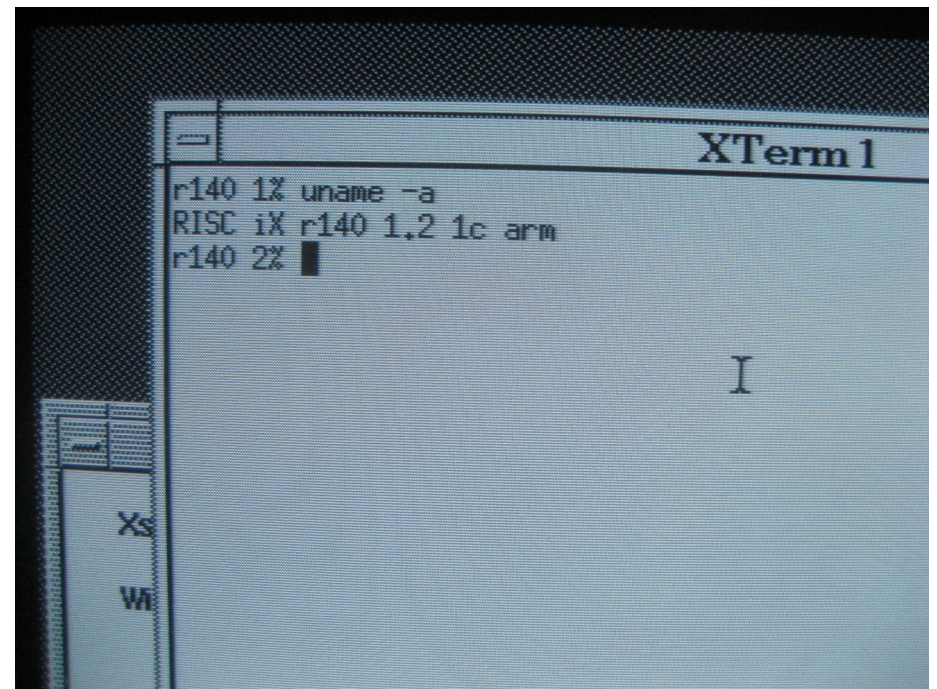
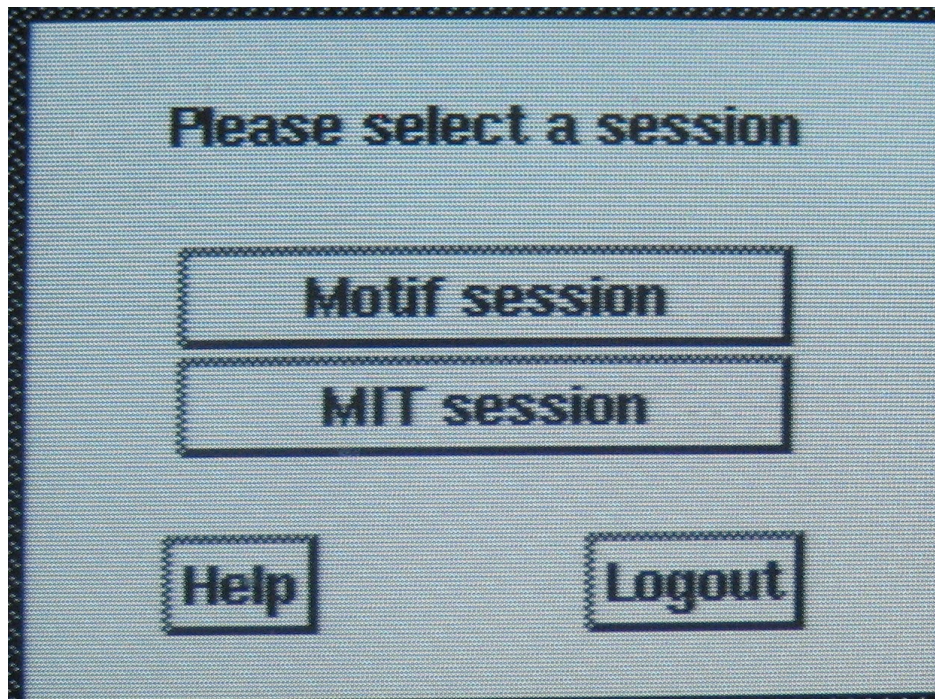
```
login: steve
Password:
Last login: wed Jan  1 11:05:20 from 192.168.0.171
RISC iX 1.21c made Tue Sep  7 10:45:54 1993
r140 1% su -
Password:
```

```
      X/Open* XPG3 BASE
```

```
*X/Open is a Trade Mark of X/Open Company Limited in the UK and other countries
# dmesg
```

```
Jan 16 16:30
RISC iX 1.21c made Tue Sep  7 10:45:54 1993
ARM3 processor, cache enabled
real mem  = 4194304
avail mem = 2949120
30 buffers (240 Kbytes)
st[0-1]: internal controller
scsi 0: slot 1
et0: slot 3: iss 1, address 00:00:a4:00:09:cd
Swap size = 8.1 Mb
root fstype 4.3, name /dev/sd0a
swap fstype spec, name /dev/sd0S
# uname -a
RISC iX r140 1.2 1c arm
```

# RISC iX running X11



# Benefits for RISC OS

- BSD TCP/IP stack
- Standard BSD sockets API
- NFS client
- Ethernet networking
- SCSI support

# RiscPC

- Released April 1994
- Supports up to 256MB RAM
- VIDC2 and up to 2MB VRAM (24-bit colour)
- Pluggable CPU cards (initially 30MHz ARM610, later 40MHz ARM710 and 200/233MHz StrongARM)
- Can have 2<sup>nd</sup> 486/586 CPU for PC compatibility
- Standard PC I/O (PS/2, IDE)

# NetBSD

- Source code repo 21<sup>st</sup> March 1993
- 0.8 released April 1993
- BSDi vs USL lawsuit settled January 1994
- 1.0 released for 6 platforms October 1994
- 1.0 (finally) free of legal entanglements
- Designed to be highly portable e.g. allowing drivers to be reused across platforms

# RiscBSD

- Port of NetBSD to Acorn RiscPC
- Requires 32-bit CPU mode, so cannot run on older hardware
- Started in 1994 in London
- Freely available early in 1.2 release cycle, but not part of NetBSD release

# NetBSD/arm32

- Initial commit January 1996
- Official NetBSD port in 1.3 release (January 1998)
- New name for RiscBSD
- Renamed to NetBSD/acorn32 for 1.6 (September 2002)
- Other arm32 hardware has separate ports (e.g. NetBSD/cats)



# NetBSD/acorn32

- Still supported
- Will be in NetBSD 9
- Runs all NetBSD 32-bit ARM binaries, so compatible with Raspberry Pi, etc.

# NetBSD/arm26

- First committed May 2000
- Included in NetBSD 1.5 (July 2002)
- Ported in Cambridge, UK
- Supports pre-RiscPC machines
- Renamed to acorn26 in March 2002 for consistency with acorn32

# NetBSD/acorn26

- Requires 8MB RAM
- FOURMEG kernel configuration exists, but I've not got it working yet
- 8MB machines rare (only A540/R260 and A5000)
- Last source release NetBSD 8.0
- Last binary release NetBSD 7.0
- Removed January 2018, so not in 9.0

# NetBSD/acorn26 vs RISCiX

- NetBSD supports A5000-generation machines
- NetBSD does not support A680
- Many more peripherals supported by NetBSD (e.g. newer NICs)

# Kernel sizes

- 1315406 NetBSD-1.6
- 1520838 NetBSD-2.0
- 1687142 NetBSD-3.0
- 1848275 NetBSD-4.0
- 1949437 NetBSD-5.0
- 2113370 NetBSD-6.0
- 2142467 NetBSD-7.0
- *909763 RISC iX 1.21c*
- 2779436 NetBSD-1.6
- 2980108 NetBSD-2.0
- 3020932 NetBSD-3.0
- 3018179 NetBSD-4.0
- 3288773 NetBSD-5.0
- 3505849 NetBSD-6.0
- 3593716 NetBSD-7.0
- 3830244 NetBSD-8.0

# Linux

- Linux developed partly in response to BSD legal problems in early 1990s
- Initially very x86 specific
- Not designed with portability in mind

# ARMLinux

- Port to ARM started in 1994 in Southampton
- Initial port on A5000, so supports pre-RiscPC machines (unlike RiscBSD)
- RiscPC support added later
- Development slower than RiscBSD as OS was not portable (predates Linux support for SPARC, MIPS, Alpha or M68k)
- Acorn hardware no longer supported

# Sources

- <https://ftp.netbsd.org/pub/NetBSD-archive/NetBSD-1.3/arm32/FAQ>
- <http://wiki.netbsd.org/ports/acorn26/>
- NetBSD CVS
- Own hardware
- Official Acorn documentation
- [https://en.wikipedia.org/wiki/Berkeley\\_Software\\_Distribution](https://en.wikipedia.org/wiki/Berkeley_Software_Distribution)
- <https://en.wikipedia.org/wiki/NetBSD>
- <https://en.wikipedia.org/wiki/Linux>
- <http://www.arm.linux.org.uk/machines/riscpc/>
- <http://www.arm.linux.org.uk/docs/history.php>
- <https://www.4corn.co.uk/articles/riscix121c/>
- <http://chrisacorns.computinghistory.org.uk/Riscix.html>
- [https://en.wikipedia.org/wiki/RISC\\_iX](https://en.wikipedia.org/wiki/RISC_iX)
- [https://en.wikipedia.org/wiki/Acorn\\_Archimedes](https://en.wikipedia.org/wiki/Acorn_Archimedes)
- [https://en.wikipedia.org/wiki/Acorn\\_Computers](https://en.wikipedia.org/wiki/Acorn_Computers)