Universität Bamberg



Idris

Reviving an Early Unix Clone

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A Little Bit of (Unix) History Repeating

Unix development history [1]

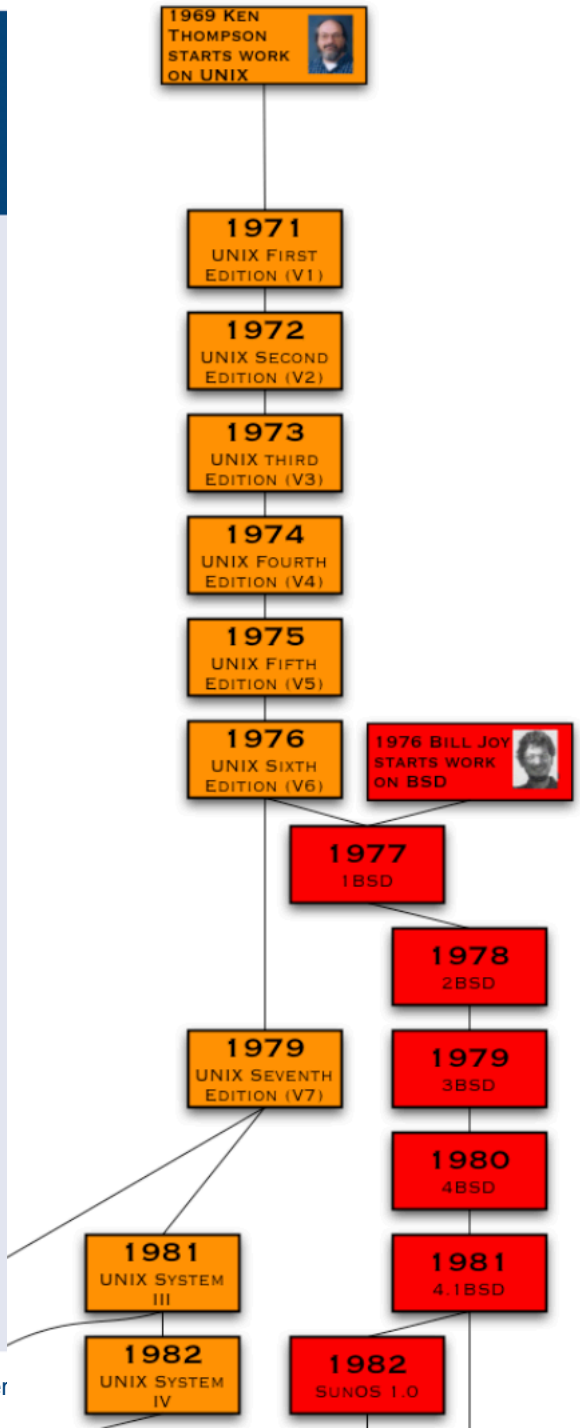
- PDP7 (1969 – assembler, B)
- PDP11: first edition (1971 – assembler, B)
- PDP11: third edition (1973, C)
- Portable C compiler pcc (~1975)

First Unix ports [2]

- Interdata 7/32 (1977, Wollongong)
  und Interdata 8/32 (1978, Bell Labs)

Unix inspired systems

- e.g. Coherent (1980), Minix (1987), Linux :)



Whitesmiths

- Phillip James (P.J. or Bill) Plauger, born 1944
  - B.Sc. in Physics, Princeton University
  - PhD in Nuclear Physics, Michigan State U. (1975)
  - Worked at Bell Labs (1969-75)



- Together with Brian W. Kernighan, Plauger wrote "Software Tools" (1970) and "Elements of Programming Style" (1974)
- Together with Jim Brodie he wrote "Standard C" (1989)

- Is thought to be the inventor of "*pair programming*"

- Developed the first commercial C compiler [3]

From C to Idris

Whitesmiths Ltd.



- Software development company, founded by P. J. Plauger, Mark Krieger and Gabriel Pham
- "*The name "Whitesmiths" was viewed as the opposite of "blacksmiths": a blacksmith worked in hard goods, and a white-smith worked in soft goods (a la soft-ware). We also discovered that white-smiths in the Middle Ages were the tin and silver workers, the workers in fine products.*" [5]

- First commercial C compiler: Whitesmiths C [4]
  - written for the PDP-11 by Plauger
  - later versions for VAX, 68k, Z80, …

In parallel: Start of work on Idris in August 1978

Idris



Start of work on PDP-11 Idris in August 1978

- Re-implementation of 6th Edition Unix in C
  - No use of Bell Labs source code
- Ported to various systems:
  VAX, Motorola 68000 and Intel 8086 [3]
- Binary compatible (on PDP-11) to 6th Edition Unix
  - including the file system format
- Small kernel – minimal version < 100 kB on 68k
  - Completely 6th Edition Unix compatible
  - Later some extensions adapted from 7th Edition Unix
- Additional extensions
  - X10 and X11 window systems, TCP/IP

Idris… Today

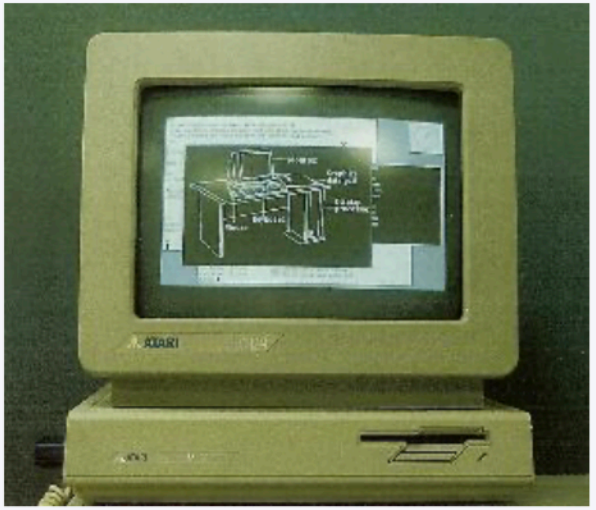
Only a short entry on Wikipedia and some unidentified floppy disk images on bitsavers…

Idris is a discontinued multi-tasking, Unix-like, multi-user, real-time operating system released by Whitesmiths, of Westford, Massachusetts. The product was commercially available from 1979 through 1988.

Background [edit]

Idris was originally written for the PDP-11 by P. J. Plauger, who started working on Idris in August 1978. It was binary compatible with Unix V6 on PDP-11, but it could run on non-memory managed systems (like LSI-11 or PDP-11/23) as well. The kernel required 31 KB of RAM, and the C compiler (provided along with the standard V6 toolset) had more or less the same size.

Idris



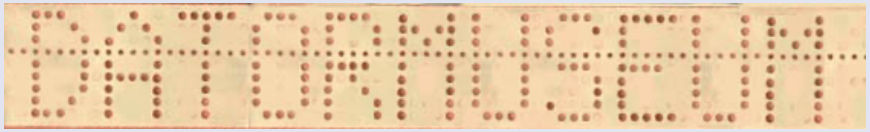
Idris and the X Window System running on an Atari Mega ST

Developer	P. J. Plauger (Whitesmiths)

PD68

Post by Mattis Lind in the VCFED forum in May 2025:

"I received this homebuilt machine from the original builder. He was a member of the PD68 computer club in Sweden. PD68 had their own news letter. […]
It was based on Norwegian designed VME board with a 68000, 512 k memory and a 68230 PIO port and two UARTs. The machine has the Idris 3.x operating system on the hard drive. I have an image of the EPROMs, PALs and the disk. The disk image contain some deleted files that potentially contain sensitive information so I like to clean up the image before making it public. There are some source files as well."



http://www.datormuseum.se/



Swedish Computer Club PD68

Homebrew 68xx computers 1986: VME-bus card [5]

CETUS MILJÖ

CETUS-maskinen finns redan i flera miljöer. De största bland dataamatörer är organiserade i PD68 i Stockholm och DAF i Oslo. Vidare är det en rad skolor, universitet och privatpersoner som tagit del av en tidigare distribution av denna byggsats.

Øyvind Moe är mannen bakom CETUS. Trots sin låga ålder (33) har han redan satt spår efter sig som en av våra mest intressanta leverantörer av VME-datorer.



Han har tidigare jobbat som projektledare vid Kongsbergs Våpenfabrikk i Norge. I dag är han forskare och projektledare i Norwegian Bioinstruments A.S.

Øyvind Moe

68000 PROJEKTET

Det erbjudande som vi gått ut med till Er om köp av IDRIS 3.0 har tagit bra fart.

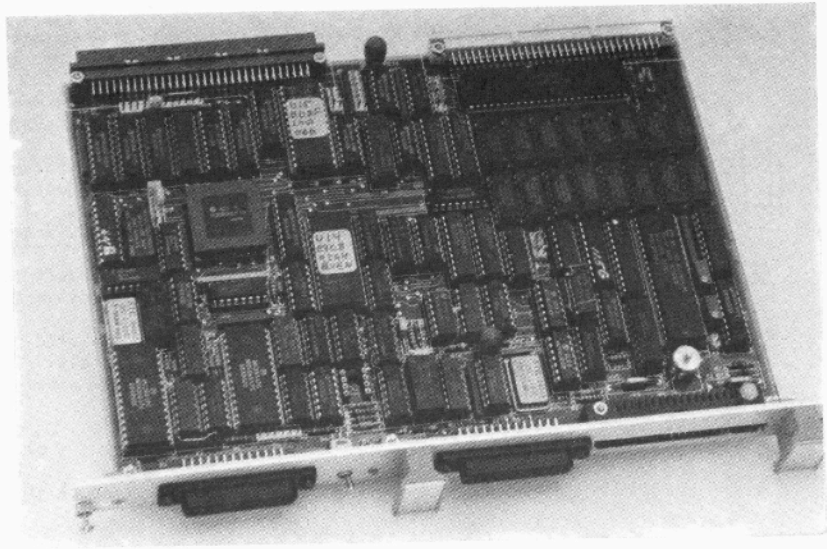
För att ytterligare förstärka 68000-personernas redan priviligierade situation erbjuder vi följande :

Mönsterkort CETUS (68000) INKLUSIVE KOMPONENTER FÖR 4.500:- !!!!!!

Detta kära MPU-lare blir bara mer och mer fantastiskt !!!

Programvaran IDRIS 3.0 och dokumentationen köper Ni i fortsättningen direkt från UNISOFT. Vi säljer bara mönsterkort och komponenter. VILKET PRIS !!!!

Här gäller principen först till kvarn etc. för att bli garanterad leverans.



68000 Project at PD68

- Low price due to large number of purchased board (ca. 70 devices)
- Unpopulated or assembled PCB (cost: 4500 SEK), IDRIS OS, C and Pascal compilers, manuals

```
Vi har även lovat att utbyta erfarenheter och program med det
norska företaget under ett fortsatt samarbete.

Från Norge får vi köpa:
 Ett kretskort utan komponenter.
 "Educational License" för IDRIS.
 Operativsystemet IDRIS 2.2.
 C och Pascal kompilatorer samt editorn Thief.
 Manualer till IDRIS:
  IDRIS Users Manual
  IDRIS Programmers Manual
  IDRIS interface manual for 68k
  Pascal Programmers Manual
  C Programmers Manual
  C interface Manual

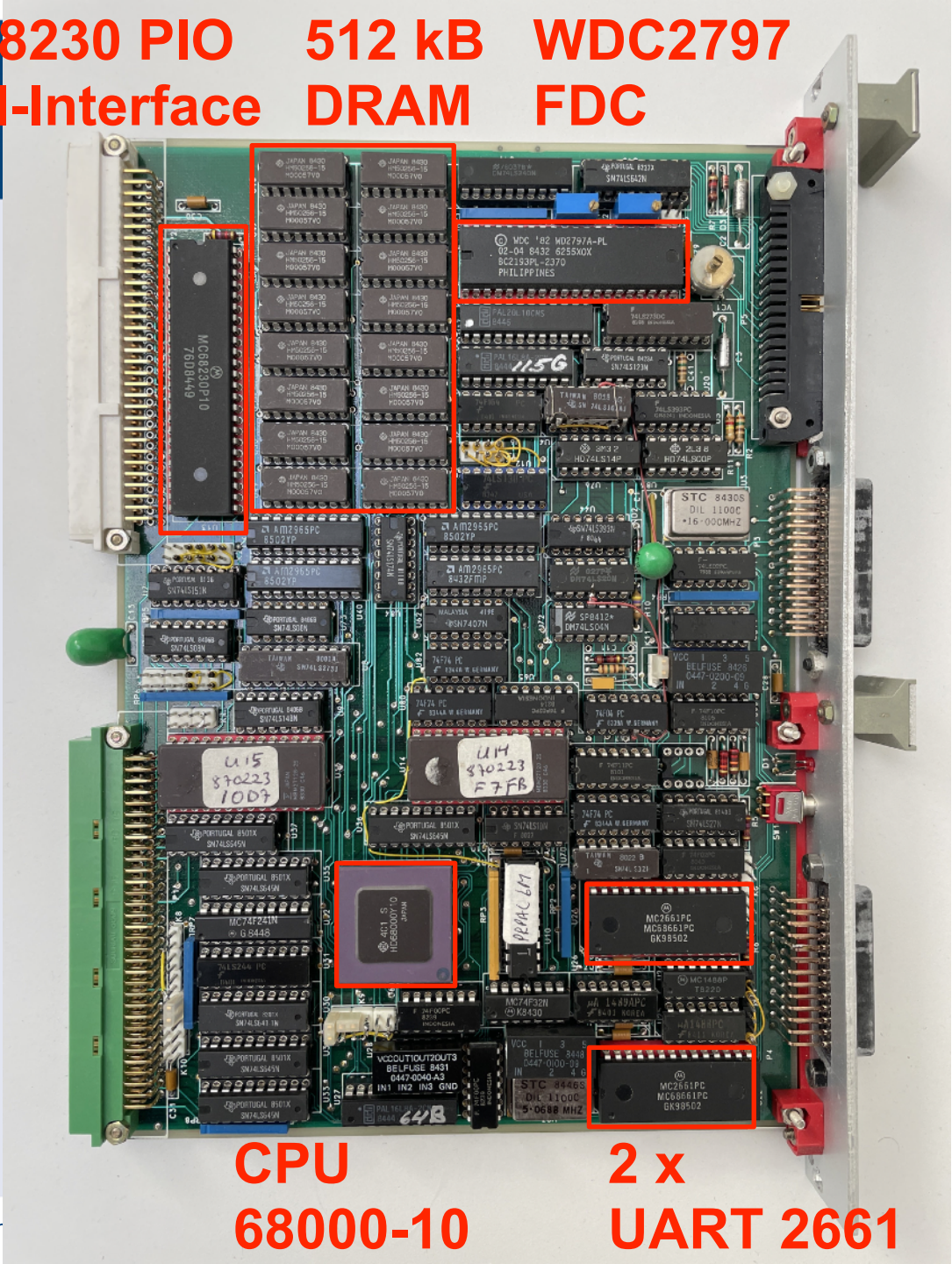
Kortet är felrättat så det blir färre ändringar på nya
kortet.

Vad finns på ett färdigt kort:
 68000 med 512k minne.
 VME bussinterface.
 Floppy diskinterface.
 2 serieportar.
 Parallell interface för SCSI (utan bussdrivkretsar).
```

CETUS VME Board

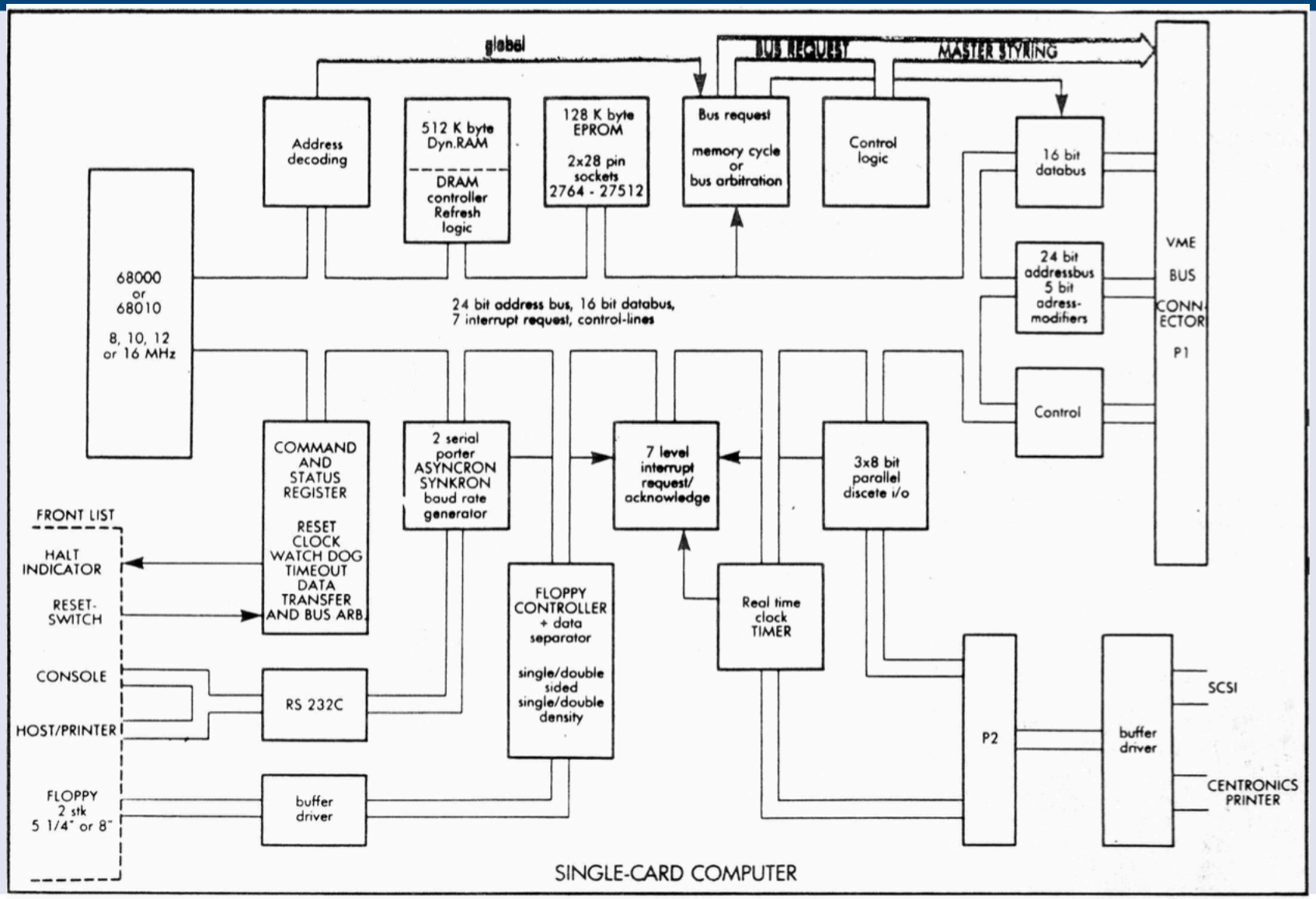
Complete Unix system
on a dual Eurocard PCB:

- 10 MHz 68000 CPU
- 512 kB RAM
- 32 kB EPROM
- 2 serial interfaces
- Floppy controller
- SASI controller
  - …implemented using a MC68230 parallel port (PIA) IC
  - SASI protocol implemented in software



PD68 VME Board

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Running Idris

May 7, 2025 #2

I have now cleaned the image from any possibly sensitive deleted files and it can be found here. I also created a tgz of the two filesystems on the image.

The two filesystems on the image can be mounted using retro-fuse:

Code:

```
v6fs pd68_idris_nec.dsk  /mnt
v6fs pd68_idris_nec.dsk -o fsoffset=20910 /mnt/usr/u
```

Disk image of the PD68 system has two partitions

- File system compatible to 6th Edition Unix
- Partitions can be mounted using the retro-fuse tool [6]

Interesting Things we Found…

What's on that disk?

- Idris user land and development tools
- Ported software (kermit, micro-emacs)
- …but no Idris kernel!
  - CETUS firmware boots from floppy…
    - But we don't have a boot floppy!

- (Some) kernel source code *is* available
  - How can we build a kernel?
    - Cross compiler – no 68k backend in Whitesmith C compiler sources [4]
    - **Use the Whitesmiths C Compiler of Idris itself!**

```
  349 Feb  9  1989 Make
 6498 Feb  9  1989 a.s
 3385 Feb  9  1989 acia.c.org
 1273 Feb  9  1989 buserr.c
 1353 Feb  9  1989 c.proto
 6971 Feb  9  1989 cn.c
  424 Feb  9  1989 defp.h
 9530 Feb  9  1989 fdc.c
 5846 Feb  9  1989 fmt.s
 2752 Feb  9  1989 fmtdev.c
 1765 Feb  9  1989 fpp.c
  704 Feb  9  1989 id302
 8480 Feb  9  1989 main.c
 8062 Feb  9  1989 main.c.org
  178 Feb  9  1989 makedate.h
 2510 Feb  9  1989 makesys.h
 3164 Feb  9  1989 mc68451.d
 6507 Feb  9  1989 mc68681.c.org
 5260 Feb  9  1989 md.c
 1451 Feb  9  1989 nmi.c
 2646 Feb  9  1989 ob.h
77589 Feb  9  1989 res.68k
10460 Feb  9  1989 sms.c.org
  969 Feb  9  1989 smsxfr.s.org
17737 Feb  9  1989 udc.c
```

Building the Kernel

Idea: use the Whitesmiths C compiler and linker of Idris to build the kernel

```
: MAKE 3.1 IDRIS RESIDENT FOR OBK1A
test $1 && /etc/bin/cdriver -proto c.proto +o -v -dnostrict \
        -dlincl -prefix ./ $@
/etc/bin/link -mk -o./idrisk1a -max0xffffffff -pc999999 \
        +text -b0x1000 -m0xffffffff +data -m0xffffffff \
        *.o *.d res.68k /lib/libc.68k /lib/libb.68k \
        /lib/libm.68k \
        +def __etext=__text__ +def __memory=__bss__
date +0
echo "^G"
```

- Required: User mode emulator for Idris
  - M68k emulation using Musashi [7]
  - Which binary format is used by Idris?
    - Luckily, documented in the "Idris Programmer's Manual" [8]

```
00000000  99 2d 09 00 00 00 45 1a  00 00 11 72 00 00 00 00  |.-....E....r....|
00000010  00 00 ff fe 00 00 00 00  00 02 00 00 20 1f 20 4f  |............ . O|
00000020  2f 08 2f 08 2f 00 e5 98  58 80 d1 af 00 08 23 ef  |/././...X.....#.|
00000030  00 08 00 02 00 72 4a 97  67 26 20 6f 00 04 20 50  |.....rJ.g& o.. P|
00000040  23 c8 00 02 01 90 0c 10  00 3a 67 0c 0c 10 00 7c  |#........:g....||
```

Hex dump of /etc/bin/cdriver

User Mode Emulation

Programming File Formats **object**

NAME

object – relocatable object file format

The header consists of an identification byte 0x99, a configuration byte, a short int containing the number of symbol table bytes, and six unsigned ints giving: the number of bytes of object code defined by the text segment, the number of bytes of object code defined by the data segment, the number of bytes needed by the bss segment, the number of bytes needed for stack plus heap, the text segment offset, and the data segment offset. Byte order and size of all ints in the header are determined by the configuration byte.

```
00000000  99 2d 09 00 00 00 45 1a  00 00 11 72 00 00 00 00  |.-....E....r....|
00000010  00 00 ff fe 00 00 00 00  00 02 00 00 20 1f 20 4f  |............ . O|
00000020  2f 08 2f 08 2f 00 e5 98  58 80 d1 af 00 08 23 ef  |/././...X.....#.|
00000030  00 08 00 02 00 72 4a 97  67 26 20 6f 00 04 20 50  |.....rJ.g& o.. P|
00000040  23 c8 00 02 01 90 0c 10  00 3a 67 0c 0c 10 00 7c  |#........:g....||
```

User Mode Emulation

Developed tools:

- Symbol table decoder "isyms" (="nm") [9]
- User mode emulator "ie"
  - Can execute the C compiler, linker and other 68k Idris binaries

```
Idris text: 17690 @ 0x0
0x00003a4e T _getenv
0x00021172 B _end
0x00020190 D __pname
0x0002113c D __stop
0x000003a2 T _main
0x000000aa T _onexit
0x00000000 T start
0x00020072 D _environ
0x0002007a D __paths
0x00000080 T _exit
0x00020000 D __data
0x000000ba T seterr
0x00020076 D _errno
0x00001f10 T _prosuf
0x00003bea T _scnstr
0x00002ecc T _onintr
0x0000374c T _cmpstr
0x00002480 T _fopen
0x00004394 T _lenstr
0x00003d18 T _uname
0x0000332a T _usage
```

```
% ./ie /Users/me/Projects/68k/idris/idris_pd68_root/bin/echo "Hallo"
Hallo
% /Users/me/Projects/68k/idris/idris_emulator/musashi/ie /Users/me/Projects/
68k/idris/idris_pd68_root/etc/bin/cdriver -proto c.proto +o -v -dnostrict
-dlincl -prefix ./ main.c
prototype file: c.proto
main.c:
    /etc/bin/pp -o /tmp/t43667c0 -x -i "|../hdrs/" -d_WSLAS -dOBK1A -dR68K
+lincl /lib/hdrs/id68kn.h ../hdrs/mi68k.h main.c
…
```

System Emulation

- Kernel emulator "iefull"
  - Does not yet emulate all of the CETUS hardware
    - …especially missing is the emulation of the SASI disk
  - Work in progress…

```
% ./iefull /Users/me/Projects/68k/idris/idrisk1a_test

BUSERR sp 0x1a25a usp 0x0 sr 0x0 pc 0x0 f/v 0x0
D0 0x0 D1 0x58 D2 0x0 D3 0x0
D4 0x0 D5 0x0 D6 0x0 D7 0x4
A0 0x0 A1 0x10 A2 0x1a23c A3 0x0
A4 0x0 A5 0x0 A6 0x1a258 A7 0x1a252

BUSERR sp 0x1a25c usp 0x0 sr 0x0 pc 0x0 f/v 0x0
D0 0x9 D1 0x58 D2 0x0 D3 0x0
D4 0x0 D5 0x0 D6 0x0 D7 0x4
A0 0x0 A1 0x10 A2 0x1a23c A3 0x0
A4 0x0 A5 0x0 A6 0x1a258 A7 0x1a254

BUSERR sp 0x1a22a usp 0x0 sr 0x0 pc 0x0 f/v 0x0
D0 0x0 D1 0x58 D2 0x0 D3 0x0
D4 0x0 D5 0x0 D6 0x0 D7 0x4
A0 0x100000 A1 0x100000 A2 0x1a23c A3 0x0
A4 0x0 A5 0x0 A6 0x1a258 A7 0x1a222

NO_RAMD = 0 , 0,5Mb = 1 , 2Mb = 2 , 4Mb = 4 , 6Mb = 6 8Mb = 8
Give ram_disk_size within 10 sec: 1024 blocks

hd = 0, rmc = 1 fdc0 = 2, xd = 3
Give device to boot from within 10 sec:
Give minor number to boot from (0-7) within 10 sec: Boot from hd00:
Idris/68K V3.11x Monday March 30, 1987, 11:45 AM
copyright (c) 1979, 1986 by Whitesmiths, Ltd.
no mmu, system size 2038.5KB
31749.5KB largest process size, 31749.5KB user space, 3000 system buffe
hd00 root filesystem
no swapping
Idris/68k V3.11 890224 (CETUS NEC5126) -fpp -sepid
Controller is busy, retry
Controller is still busy

udcstart cmd: 0x0 0x00x0 0x1 0x7

Idris crash: bad root
```

Bare Metal

- Emulator "iebaremetal"
  - Emulation of the CETUS' "SNACKSbug" firmware
  - Idea:
    Reverse engineer the floppy boot process of the CETUS system
  - Reconstruct a boot floppy
  - Work in progress…

```
**********************************************************************
**                                                                  **
**            Monoboard Idris/S68k V2.2 VME-68000                   **
**                                                                  **
**********************************************************************

self test in progress ...


SNACKSbug 2.1 > HE
.PC .SR .US .SS
.D0 .D1 .D2 .D3 .D4 .D5 .D6 .D7
.A0 .A1 .A2 .A3 .A4 .A5 .A6 .A7
.R0 .R1 .R2 .R3 .R4 .R5 .R6

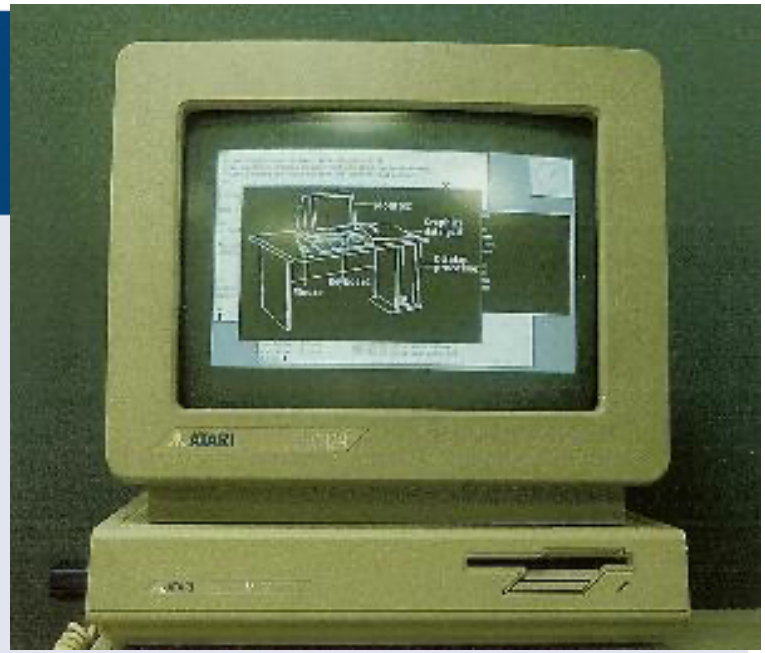
BF    BI    BM    BR    NOBR  BS    BT    DC
DF    DU    FF    FR    FW    G     GD    GO
GT    HE    LO    M     MD    MM    MS    OF
PF    R     RM    T     TM    TR    TT    VE


SNACKSbug 2.1 >
```

Idris on the Atari ST

David M. Stanhope of Computer Tools International (CTI) ported Idris to the Atari ST (1986) [10]

- Boots from ROM cartridge (copy prot.)
- System war lost – only a screen shot on Wikipedia remained



Skip Tavakkolian Jul 28, 1988,

to

In article <46...@pasteur.Berkeley.Edu>, lan...@cory.Berkeley.EDU (James A. Landay) writes:
> How much is IDRIS? How much is STX-Windows? Is there an educational
> discount?
[deleted]
> James A. Landay

IDRIS for ST/MEGA is $149.95 (US), STX-Windows is $49.95 (US).
There is a 25% discount for educational institutions if purchased with an authorized purchase order from that institution. Please note that you will need IDRIS to run STX-Windows.

Sincerely
--
Fariborz ``Skip" Tavakkolian
UUCP ...!uw-beaver!tikal!mcgp1!fst

Usenet comp.sys.atari.st

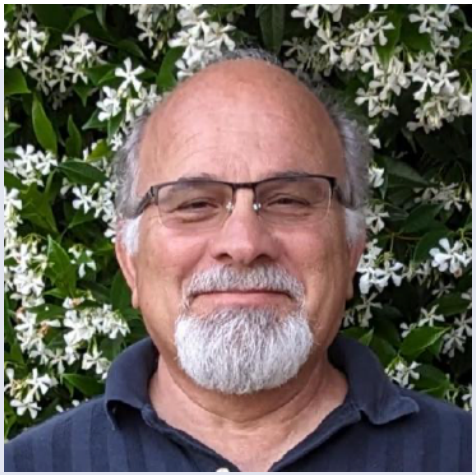
On the software side, Atari announced an $800 version of Whitesmith's Unixlike Idris multiuser operating system for the Mega and ST lines. Idris applications initially available, according to Atari, are Crystal Writer Plus and Crystal Document Management System from Syntactics, Word Era from Tigera, Fusion Network Software from Network Research Corp., and Lex PDQ and Lexet from Trajectory Software.

Idris on an Atari ST Emulator

Universität Bamberg

>IDRIS has been available on many processors including PDP-11, VAXen,
>680X0, and 8086. It was first released in 1978 on PDP-11s. IDRIS 2.2 was
>ported to the ATARI ST (520, and 1040) in summer 1986, by Computer Tools
>International Inc., for which, I am an engineer. The current version is
>IDRIS 3.12, with release 3.2 of the C compiler. The IDRIS68K 2.2 was shown
>at ATARI booth in Fall COMDEX 1986. The 3.12 release was shown at ATARI
>booth in Fall COMDEX 1987.

>Sincerely,
>Skip Tavakkolian [11]



Skip is known as Plan 9 developer today…



9th International Workshop on Plan 9

April 21-23, 2023
University of Waterloo
Waterloo, Ontario
Canada

Michael Engel, University of Bamberg - Chair
Fariborz Tavakkolian, Plan 9 Foundation

…and has a copy of Atari ST Idris! [12]

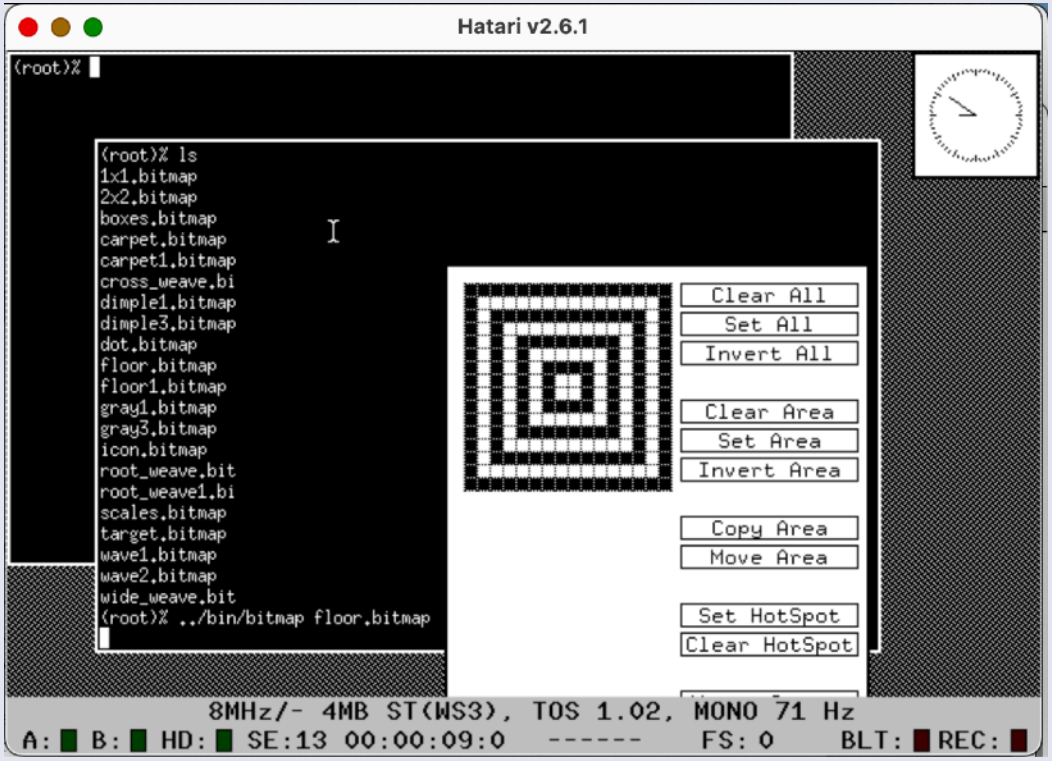
Idris on an Atari ST Emulator

Running Idris in the Hatari Atari ST emulator

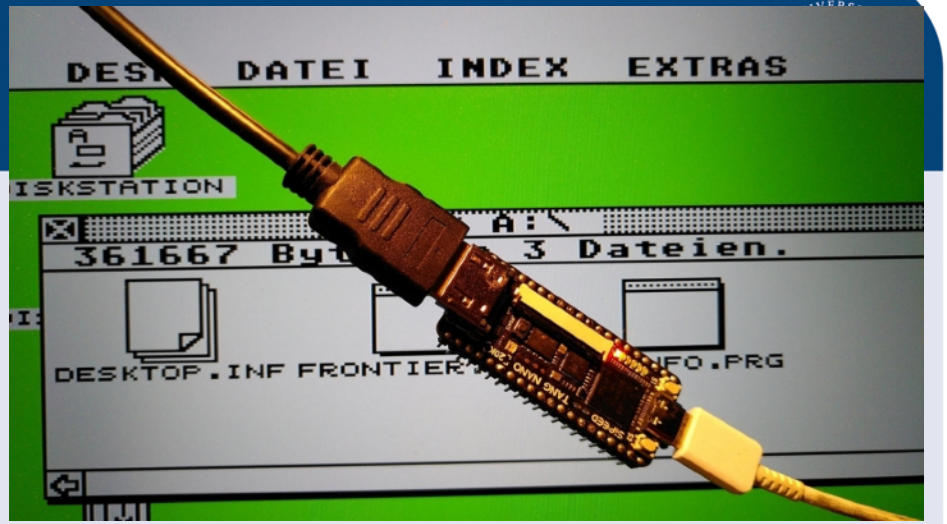
- Booting from floppy works
- Formating the disk image and trying to install the system resulted in SCSI timeouts

Timing problems in Hatari due to unconventional handling of Atari ST ACSI interrupts in Idris

- Fix by Hatari developer Thorsten Otto
- Not yet in Hatari git repo



Idris on Atari ST – FPGA

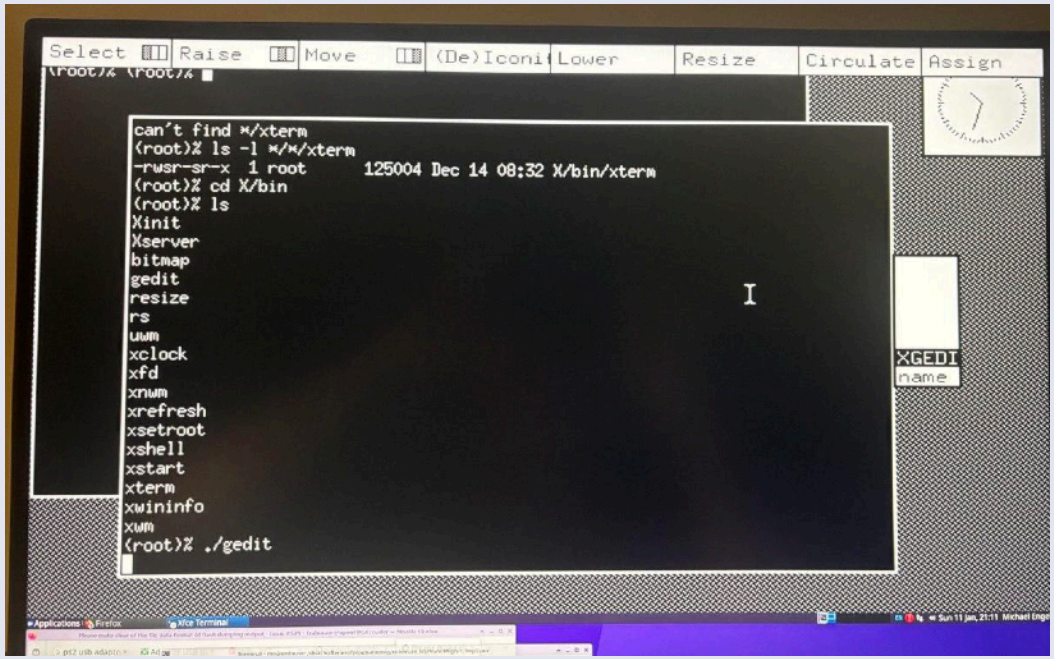


"MiSTeryNano"

Open source Atari ST implementation on a Tang Nano 20k FPGA board [13]

- Inexpensive board
  - ca $35 on aliexpress
- 20k LUTs, 8 MB RAM

Works "out of the box"!



What Now?

The CETUS emulators are not strictly necessary since we can run Idris on the Atari ST (+emulation)

- Kernels can now be compiled using Idris in the Hatari emulator
- Still usefull for cross development
  - …and to get the CETUS system to run again!

Idris source code is *not* available – only some source files of the kernel startup code and device drivers

- We are in touch with the current IP owner (Tasking in Munich) and a former Whitesmiths developer in Australia

…stay tuned!

References

[1] Peter Salus, A Quarter Century of Unix

[2] Richard Miller, The First Unix Port
http://bitsavers.informatik.uni-stuttgart.de/bits/Interdata/32bit/unix/univWollongong_v6/miller.pdf

[3] InfoWorld Interview mit Mark Krieger, Whitesmiths
https://web.archive.org/web/20100505070556/http://www.groklaw.net/article.php?story=2005070705442782

[4] Whitesmiths C-Compiler Source Code
https://github.com/hansake/Whitesmiths-C-compiler

[5] MPU-laren, Tidskrift för Privatdataklubben PD68, Årgång 9, Nr. 4/86

[6] Retro-fuse. https://github.com/jaylogue/retro-fuse

[7] Karl Stenerud, Musashi Motorola 680x0 emulator written in C
https://github.com/kstenerud/Musashi

[8] Whitesmiths, Inc. Idris Programmer's Manual, January 1985, p. III-11

[9] Idris Tools
https://codeberg.org/michaelengel/idris-tools/

[10] "Atari Floods Comdex With Products", InfoWorld November 1987, p. 5.

[11] Usenet – "Operating systems for the ST"
https://groups.google.com/g/comp.sys.atari.st/c/-KJfiTbIa7o/m/Dop7tMTqPqsJ

[12] Idris OS for Atari ST
https://github.com/9nut/IDRIS-OS-for-Atari-ST

[13] MiSTeryNano
https://github.com/MiSTle-Dev/MiSTeryNano