uClinux - State of the Nation

Presented by

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uClinux

Pronounced "you-see-linux", the name uClinux comes from combining the greek letter "mu" and the english capital "C". "Mu" stands for "micro", and the "C" is for "controller".

- Linux for processors that have no memory management
- targets classic embedded 32bit micro-controllers
- modifications to standard Linux kernel source

History

1998   Kenneth Albanowski and D.Jeff Dione release

           2.0.33 kernel for Motorola DragonBall

1999   Motorola ColdFire support
           2.0.38 kernel

           ARM support

2000   2.4.0 test kernel support

2002   shared libraries

           2.5.46 uClinux merged with mainline

Status of uClinux-2.0.x

- separate patch, and cvs repository
- currently at 2.0.39
- support for m68k , arm, i960, sh2, h8/300, sparc, or32, nios
- flat format application binaries
- no active development?

Status of uClinux-2.4.x

- separate patch, and cvs repository
- currently at 2.4.32
- support for m68k, arm, h8/300, nios, microblaze, blackfin, e1, frv, v850
- forks available for sparc, mips, sh2
- non-integrated mm code
- flat and elf_fdpic format application binaries
- still actively developed and used

Status of uClinux-2.6.x

- fully merged
- mainline support for m68k, h8/300, v850, frv
- in the process of merging ARM
- want to merge blackfin, microblaze
- integrated mm code
- flat and elf_fdpic format application binaries

Popular Architectures?

ucdot poll of most popular architecture
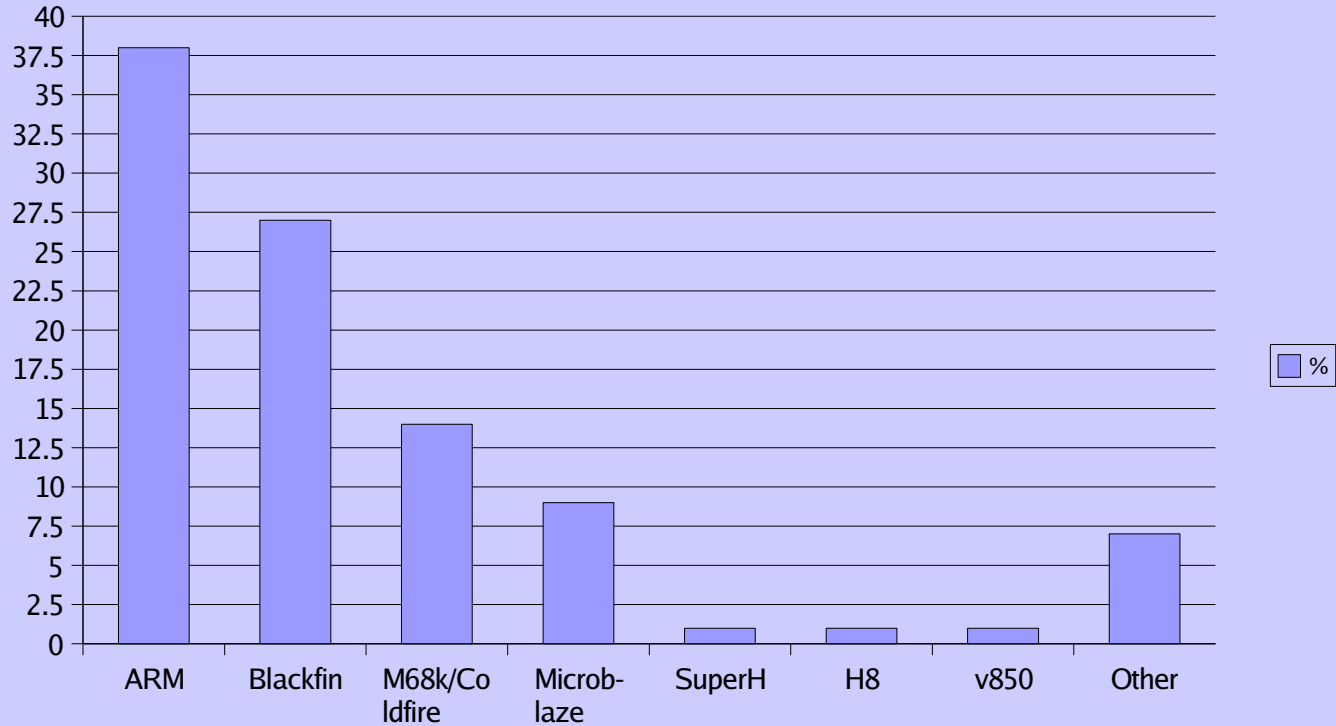
Architectures - M68K

- well supported
- good support for 68328 series (Dragonball)
- good support for ColdFire (520x, 523x, 5249, 527x, 528x, 5307, 532x, 5407)
- some support 68360
- supported in the past 68000, 68302, 68332
- shared libraries
- XIP for kernel and applications

Architectures - ARM

- well supported
- parts from many vendors
- Atmel, Conexant, TI, Samsung, Philips/NXP...
- shared libraries (not integrated at uclinux.org)
- common merged ARM in 2.6 kernels coming
- XIP for kernel and applications

Architectures

NEC v850
  - maintained, up to date in 2.6 kernels

Hitachi H8/300
   - H and S series processors
   - maintained, up to date in 2.6 kernels

Fujitsu FR-V
   - variants with MMU and without
   - same ELF_FDPIC applications can run on both
     MMU and MMUless platforms

Architectures - Blackfin

- Analog Devices DSP
- fast and cheap processors
- actively vendor supported
- supports flat and elf_fdpic application binaries
- merged into Andrew Mortons -mm tree
- blackfin.uclinux.org

Architectures

Xilinx Microblaze
- FPGA soft core processor
- active development community
- commercially and freely supported
- potential merge into main line kernel

Altera NIOS-II
- FPGA soft core processor
- vendor/commercial supported
- attempt to main line unknown

Architectures

MIPS
  - known ports to Brecis parts, Sony PS1 and PSP
  - XIPtech support at 2.4.19

Sparc
  - LEON from Gaisler Research
  - uClinux version using 2.0.x kernel

Hitachi SuperH SH2
  - support in 2.6 kernels
  - status unknown?

Architectures

Hyperstone E1
- active development unknown?
- last kernel support known 2.4.x

OpenCores OR1000
- general software CPU for FPGA
- current status unknown?
- last known kernel support 2.4.x

Limitations

- *vfork (*and *clone)* – no true fork
- *sbrk* – limited use/functionality
  use of *mmap* largely hides this
- *mmap, mremap* – some restrictions
- no memory protection
  no paging
  memory fragmentation
   (some limited protection on some architectures)
- fixed size user space stacks
  cannot be dynamically grown

non MM Status

- recent *mmap* clean ups
- standard buddy allocator fragments badly
  need to be able to do large chunk allocations
- page_alloc2 in 2.0 and 2.4 kernels
- "sidekick" allocator by Phil Wilshire for 2.6 kernels
- ideas for use of specific MPU's

Application Binary Formats

flat format
- small header + text + data + relocs
- supports shared libs
- supports PIC
- supports storing compress text

elf_fdpic format
- elf object format
- supports shared libs

Tools

· standard linux targeted too chain usually ok
· "uclinux" targets for some architectures
  (eg m68k-uclinux)
. historically "elf" target was used (eg arm-elf)
· gcc main line supports PIC, msep-data, id-shared-
  library options on some architectures (m68k,
  blackfin)
· elf2flt easily adds onto existing architecture tool
  chain if using flat format binaries

Simulators

- Skyeye (www.skyeye.org)
  supports ARM, blackfin, coldfire
- GDB/ARMulator
- NEC v850 GDB simulator
- Sparc LEON TSIM
- ...

Myths

1. ***But all processors will have MMUs soon?***

   Many vendors still developing new silicon
   Price/complexity lower

2. ***But it is not real Linux right?***

   Get linux-2.6.20 and compile for non-MMU, how
   can you get more Linux than that!

Resources

www.uclinux.org

www.ucdot.org