Porting Linux to a new architecture, done right

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Overview

1. Status of new architecture ports
2. Typical approaches to new architectures
3. Lessons Learned
About me

- s390 architecture 2002-2005
- PowerPC/Cell architecture 2005-now
- 32/64 bit syscall emulation
- Maintaining include/asm-generic
- Reviewing new architectures
- Learning about ARM
Recently merged architectures

- arm
- xtensa
- avr32
- blackfin
- mn10300
- microblaze
- s*core
- tile
Upcoming architectures

- nios II
- lm32
- UniCore
- OpenRISC
- c64x
- MMIX
- nameless 48-bit architecture
- nameless DSP architecture
What makes architecture ports so hard?

Typical approaches to new architectures
Language barrier #1: English

Homes of the current architecture maintainers
Language barrier #2: C
Language barrier #2: C

GNU C99
Language barrier #2: C

GNU C99 with static annotations
Language barrier #2: C

ILP32/LP64 GNU C99 with static annotations
Language barrier #2: C

freestanding ILP32/LP64 GNU C99 with static annotations
Language barrier #2: C

object-oriented freestanding
ILP32/LP64 GNU C99 with static annotations
Language barrier #2: C

pragmatically object-oriented freestanding
ILP32/LP64 GNU C99 with static annotations
Language barrier #2: C

pragmatically object-oriented freestanding ILP32/LP64 GNU C99 with static annotations and enforced coding style
Architectural challenges

- Symmetric Multiprocessing
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- Noncoherent I/O
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- Out-of-order I/O
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- Multiple ABIs
- Multiple ISAs
- Multiple platforms
Architectural challenges

- Symmetric Multiprocessing
- Noncoherent I/O
- Out-of-order I/O
- Memory management units
- Multiple ABIs
- Multiple ISAs
- Multiple platforms
- Timekeeping
Where to start

- Copy from x86
Where to start

- Copy from ARM
Where to start

- Copy from Tile
Where to start

- Do not copy at all!
Generic header files

42 versions of struct stat?
Generic header files

- 42 versions of struct stat?
- One minimal syscall list!
Generic header files

- 42 versions of struct stat?
- One minimal syscall list!
- Cover all the simple implementations
Generic Architecture template

- Early Boot code
- zImage compression
- Library functions
- device tree
- Trap handling
- Signal handling
- ptrace
- pci
User space: runtime

- glibc/eglibc
- uClibc
- klibc
User space: distro

- Full distribution
  - Debian, Fedora, OpenSUSE, Ubuntu, Gentoo, ...
User space: distro

- Full distribution
  - Debian, Fedora, OpenSUSE, Ubuntu, Gentoo, ...
- Embedded distribution
  - buildroot
  - yocto
  - emdebian
User space: distro

- Full distribution
  - Debian, Fedora, OpenSUSE, Ubuntu, Gentoo, ...
- Embedded distribution
  - buildroot
  - yocto
  - emdebian
- Busybox initramfs
Lessons Learned
Lesson #1

Start small
Lesson #2

Generalize existing code for your special case
Lesson #3

Understand the development process
Lesson #4

Follow the upstream kernel
Lesson #5

Debug your system with qemu with gdb
Lesson #6

Simplify drivers using virtio and hvc
Describe SoC in a flattened device tree
Lesson #8

Clean up after sparse and checkpatch
Lesson #9

Run lockdep enabled kernels
Lesson #10

Become a git master
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Questions?