



Let's port
together.
Debian fun for
everyone.

Peter De
Schrijver

Steve
Langasek

Outline

Let's port together. Debian fun for everyone.

"Most civilised people are out of touch with reality because they confuse the world as it is with the world as they think about it, talk about it and describe it."

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Overview I

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Portability issues

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Accessing peripheral hardware

Example system architectures

Trends in system design

Out of order transactions

Non-coherent I/O

Userland hardware access

Fixing porting bugs

Types of build failures

Identifying build failures



Overview II

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Failures from unsatisfiable build-deps
Upstream portability problems: pointers and ints
Debian bugs: sudo support
Fix the bug

Outline



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FixitFixit

- ▶ Correctness
- ▶ Debian is "The Universal Operating System"
- ▶ Debian is the most used Embedded Distribution
- ▶ Hardware advances will make Debian feasible on new platforms
- ▶ It's enlightening to see and play with other architectures/systems



C types

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FixitFixit

▶ ANSI-C

- ▶ $\text{sizeof}(\text{char}) \leq \text{sizeof}(\text{short}) \leq \text{sizeof}(\text{int}) \leq \text{sizeof}(\text{long})$
- ▶ short and int are at least 16bit
- ▶ long is at least 32bit
- ▶ $\text{sizeof}(\text{ptr}) \neq \text{sizeof}(\text{int})$
- ▶ signedness of chars is arch dependent

▶ Tips

- ▶ use int as much as possible for computations, loop variables,...
- ▶ use ISO C99 types (`u_int8`, `u_int16`, `u_int32`, ...) for external comms
- ▶ don't abuse chars to 'save memory'
- ▶ use the latest gcc version with `-Wall`



Bitfields

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FixitFixit

typedef struct bitfields

```
{  
    unsigned char bitfield0:3;  
    unsigned char bitfield1:5;  
}
```

IA32 representation :



PowerPC representation :





Endianness

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FixitFixit

Consider 0x12345678

Little endian : 0x78 0x56 0x34 0x12

Big endian : 0x12 0x34 0x56 0x78

PDP endian : 0x34 0x12 0x78 0x56

- ▶ External interfaces
- ▶ Use macros to convert between CPU and specific endianness



Alignment

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FixitFixit

- ▶ Most RISC cpus require aligned accesses
- ▶ Unaligned accesses are trapped (mostly)
 - ▶ slow
 - ▶ not possible in kernel land
- ▶ Unaligned accesses are seldomly atomic with respect to SMP/other bus masters
- ▶ Better
 - ▶ avoid them
 - ▶ have the compiler generate the code



Intel style system

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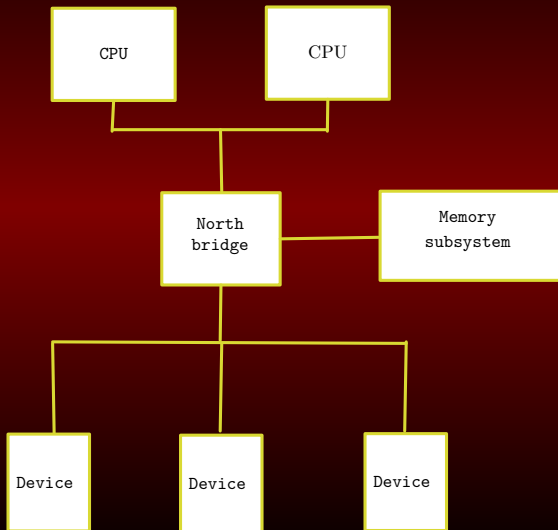
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FixitFixit

- ▶ Main components
 - ▶ CPU complex
 - ▶ Northbridge
 - ▶ Southbridge
 - ▶ Memory subsystem
- ▶ Main interfaces
 - ▶ Frontside bus
 - ▶ PCI
 - ▶ AGP



Opteron style system

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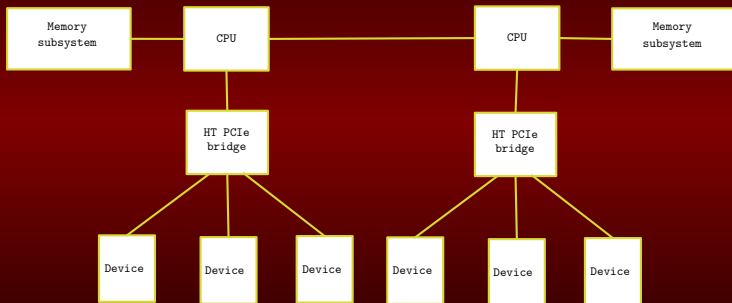
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FixitFixit

▶ Main components

- ▶ CPU
- ▶ Hypertransport - PCIe bridge
- ▶ PCIe - PCI bridge

▶ Main interfaces

- ▶ Hypertransport
- ▶ PCIe
- ▶ PCI



Trends in system design

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FixitFixit

► Observations

- CPUs became much faster then memory
- bus and memory bandwidth have gone up faster then latencies
- parallel busses become very hard at high speeds

► Solutions

- Caches
- Burstmode transfers
- Advanced DMA
- multiple highspeed serial links



Out of order transactions

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FixitFixit

- ▶ examples
 - ▶ CPU
 - ▶ bus bridges
- ▶ use read/write barriers
 - ▶ CPU instructions
 - ▶ "magic" reads

possibly out of order :

```
stw r20,0x20(r21)
```

```
stw r22,0x24(r21)
```

always in order :

```
stw r20,0x20(r21)
```

```
eieio
```

```
stw r22,0x24(r21)
```



Non-coherent I/O

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FixitFixit

- ▶ Some systems do not support "bus snooping"
- ▶ Invalidate cachelines
 - ▶ network traffic
 - ▶ disk buffers
 - ▶ other kinds of streaming I/O
- ▶ non-cacheable memory
 - ▶ microcode
 - ▶ ring buffers



Addressing

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- ▶ Virtual addresses
- ▶ Physical addresses
- ▶ Bus addresses
- ▶ Translation Physical to Bus addresses
 - ▶ identity mapped
 - ▶ fixed offset
 - ▶ page based translation
 - ▶ not memory mapped
 - ▶ IA32 I/O ports
 - ▶ PowerPC DCB
- ▶ Always access hardware via special functions



Transaction atomicity

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- ▶ Multiple CPUs
- ▶ other busmasters (eg. on PCI)
- ▶ reads and writes are atomic only if aligned
- ▶ atomic read/modify/write is CPU specific
 - ▶ ia32: lock prefix on specific instructions
 - ▶ mips: ll/sc
 - ▶ arm: swap
 - ▶ ppc: lwarx/stwcx
- ▶ bridges may break locks



Userland hardware access

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FixitFixit

- ▶ Hardware access from userland is problematic
- ▶ Seperate command transport from driver logic
 - ▶ Firewire : libraw1394
 - ▶ USB : libusb
 - ▶ SCSI and ATAPI : scsi generic like ioctl
 - ▶ ...
- ▶ Provide abstraction layer for accessing hardware



Major causes of architecture-specific build failures

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FixitFixit

- ▶ software bugs in your package (see previous slides)
- ▶ architecture-specific build-dependency problems
- ▶ temporarily unavailable build-depends
- ▶ missing versioned build-depends + bad timing
- ▶ toolchain-specific bugs: try a new toolchain?
- ▶ build-env-specific bugs (sudo support)
- ▶ buildd-specific bugs



Step 1: notice the package hasn't built

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FixitFixit

- ▶ many different resources today to help you track this - use one!
 - ▶ by maintainer:
<http://people.debian.org/~igloo/status.php?email=<email>>
 - ▶ by package:
<http://buildd.debian.org/<package>>
 - ▶ by arch:
<http://buildd.debian.org/~jeroen/status/architecture.php?a=<arch>>
 - ▶ arbitrary list of packages:
<http://buildd.debian.org/~vorlon/packagesumm.php>
- ▶ drilling down gets you a build log:
<http://buildd.debian.org/fetch.php?pkg=db4.3&arch=hppa&ver=4.3.29-5&stamp=1147065979&file=log>



Step 2: read the build log

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- ▶ <http://buildd.debian.org/fetch.php?pkg=db4.3&arch=hppa&ver=4.3.29-5&stamp=1147065979&file=log>

The following packages have unmet dependencies:
java-gcj-compat-dev: Depends: ecj-bootstrap-gcj
($\geq 3.1.1$) but it is not going to be installed

- ▶ obviously not a bug in the upstream source code of db4.3
- ▶ **is** a bug that needs to be addressed for the release!
- ▶ fixing it is out-of-scope for this workshop... porters + maintainers need to agree whether to support java bindings on this arch



Step 2: read the build log - pointers and ints

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- ▶ New gccs are nice - they give build failures where before packages would be silently broken!
- ▶ <http://buildd.debian.org/fetch.php?pkg=swt-gtk&arch=alpha&ver=3.1.2-2&stamp=1142711970&file=log>

```
xpcom.cpp:  In function 'jint
Java_org_eclipse_swt_internal_mozilla\
_XPCOM_PR_1Malloc(JNIEnv*, _jclass*, jint)':
xpcom.cpp:144:  error:  cast from 'void*' to
'jint' loses precision
```

- ▶ 64-bit pointers != 32-bit ints
- ▶ straightforward fix in concept, swt-gtk is a special-case due to Java ABIs :(



Step 2: read the build log

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FixitFixit

- ▶ some packages fail consistently across alpha, mips, mipsel:
`dpkg-buildpackage -rsudo`
- ▶ `http://buildd.debian.org/fetch.php?pkg=freetype&arch=alpha&ver=2.2.1-1&stamp=1147731281&file=log`

```
rm -f /debian/tmp/usr/include/freetype2/freetype/  
cache/*
```



Step 3: start hacking

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- ▶ No magic formula for fixing all build failures, you have to learn about different kinds of build failures one by one
- ▶ so let's start hacking!