The kernel report

(ELC 2012 edition)

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The Plan

Look at a year's worth of kernel work

...with an eye toward the future

Starting off 2011

2.6.37 released - January 4, 2011

11,446 changes, 1,276 developers

VFS scalability work (inode_lock removal)

Block I/O bandwidth controller

PPTP support

Basic pNFS support

Wakeup sources

What have we done since then?

Since 2.6.37:

Five kernel releases have been made

59,000 changes have been merged

3069 developers have contributed to the kernel

416 companies have supported kernel development

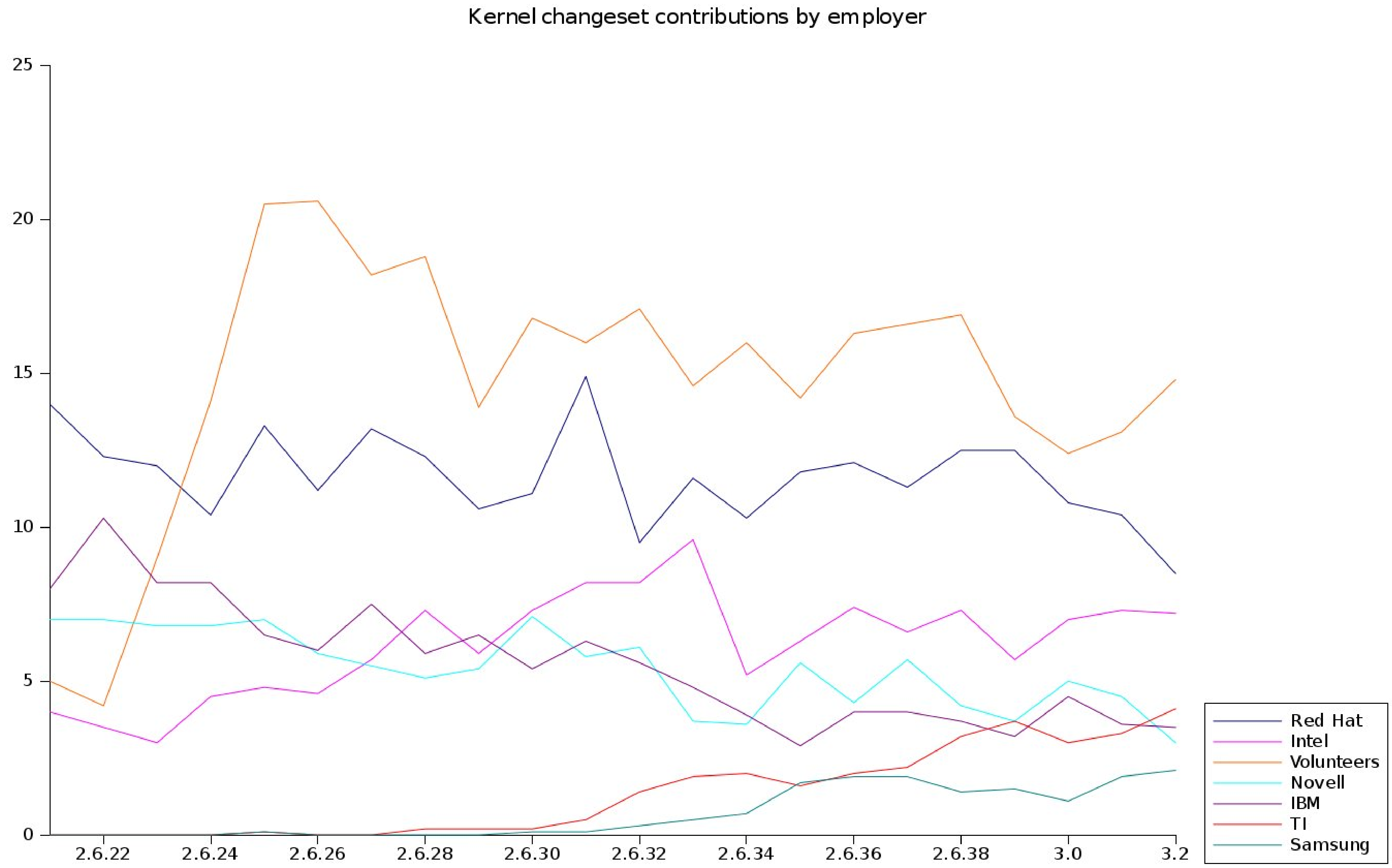
February

As you can see in these posts, Ralink is sending patches for the upstream rt2x00 driver for their new chipsets, and not just dumping a huge, stand-alone tarball driver on the community, as they have done in the past. This shows a huge willingness to learn how to deal with the kernel community, and they should be strongly encouraged and praised for this major change in attitude.

– Greg Kroah-Hartman, February 9

Employer contributions 2.6.38-3.2

Volunteers	13.9%	Wolfson Micro	1.7%
Red Hat	10.9%	Samsung	1.6%
Intel	7.3%	Google	1.6%
unknown	6.9%	Oracle	1.5%
Novell	4.0%	Microsoft	1.4%
IBM	3.6%	AMD	1.3%
TI	3.4%	Freescale	1.3%
Broadcom	3.1%	Fujitsu	1.1%
consultants	2.2%	Atheros	1.1%
Nokia	1.8%	Wind River	1.0%


Kernel changeset contributions by employer
25
20
15
10
5
0
2.6.22
2.6.24
2.6.26
2.6.28
2.6.30
2.6.32
2.6.34
2.6.36
2.6.38
3.0
3.2
Red Hat
Intel
Volunteers
Novell
IBM
TI
Samsung

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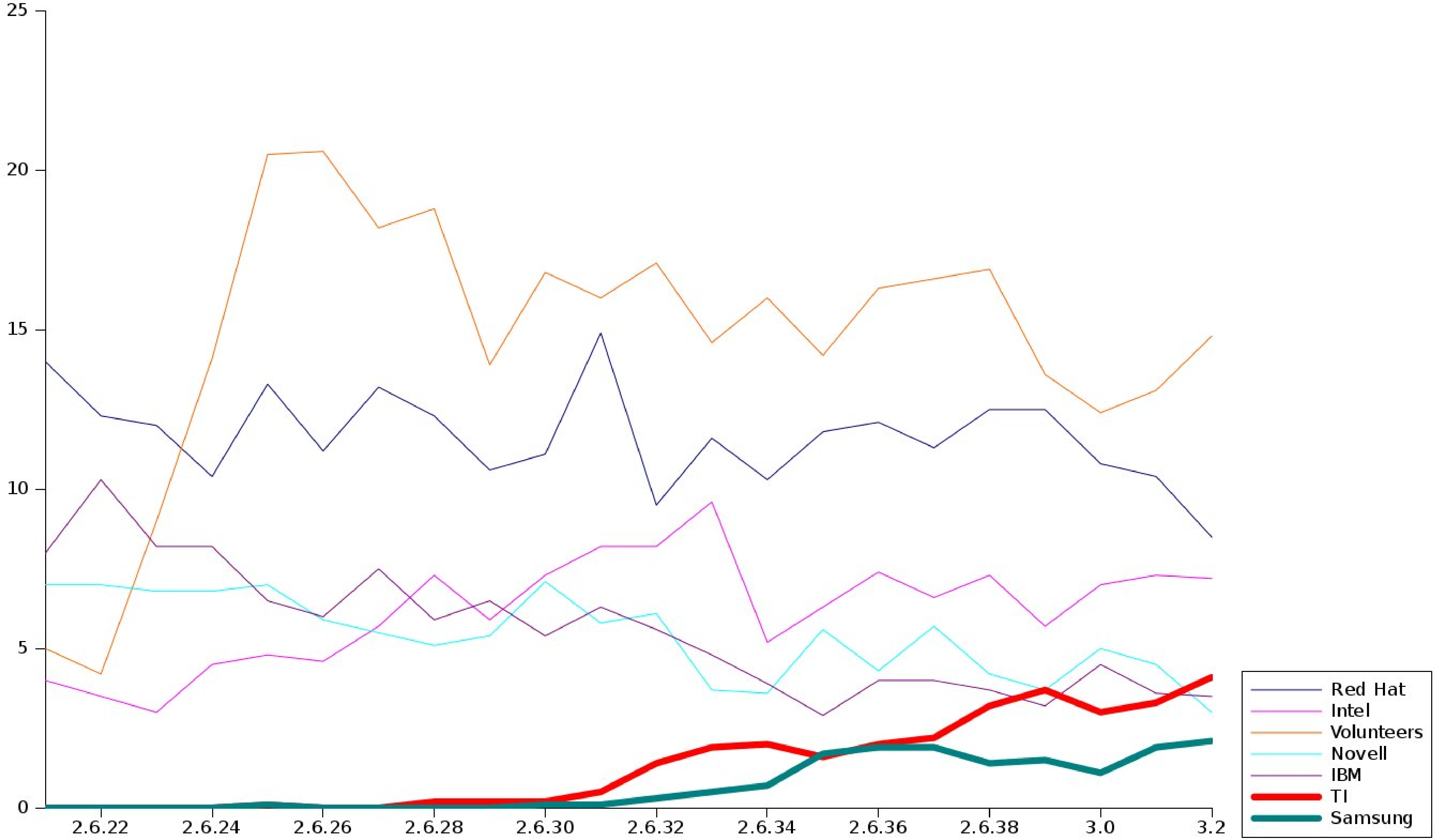


Also in February

Red Hat stops releasing individual kernel patches

March

2.6.38 released – March 14, 2011

(9,577 changes from 1198 developers)

Per-session group scheduling
dcache scalability patch set
Transmit packet steering
Transparent huge pages
Hierarchical block I/O bandwidth controller

> Somebody needs to get a grip in the ARM community. I do want to do these merges, just to see how screwed up things are, but guys, this is just ridiculous. The pure amount of crazy churn is annoying in itself, but when I then get these "independent" pull requests from four different people, and they touch the same files, that indicates that something is wrong.
>
> – Linus Torvalds, March 17

What is the “ARM problem”?

Wildly varying hardware
“Embedded” mindset
Little high-level oversight or communications

Results

- Lots of little subtrees
- Lots of duplicated code
- A big ugly mess in general

Why is this happening

For years we have asked embedded vendors to contribute back to the kernel.

Why is this happening

For years we have asked embedded vendors to contribute back to the kernel.

...now they are doing it!

Cleaning up the mess

- More high-level oversight
  - Arnd Bergmann's arm-soc tree

- More cleanup work
  - GPIO consolidation
  - Pinmux subsystem
  - Common clock framework

- Move toward device tree
  - Eliminate lots of “board files”
  - Someday: one ARM kernel for all systems

April

Native Linux KVM Tool

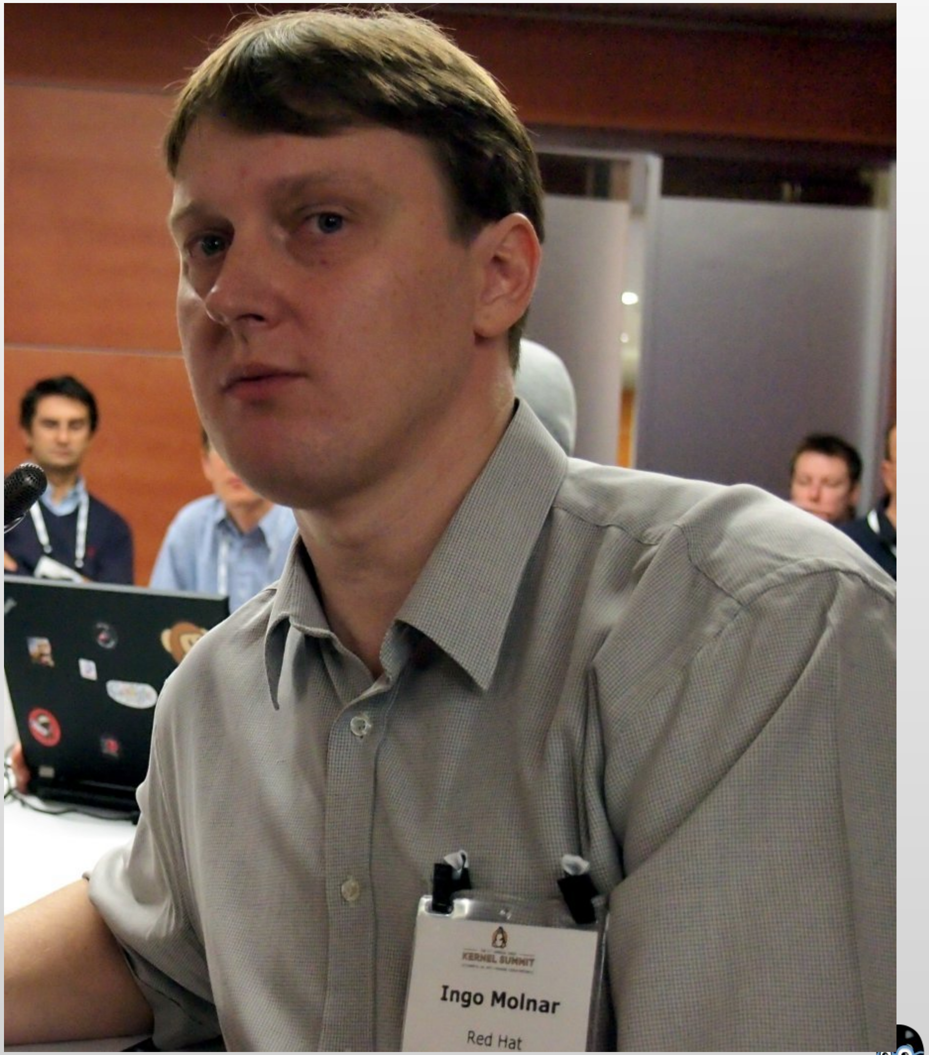
A simple QEMU replacement

- Aimed at kernel developers

The sticking point:

- The desire to add it to the kernel tree

> I think it's only a matter of time until someone takes the Linux kernel, integrates klibc and a toolchain into it with some good initial userspace and goes wild with that concept, as a single, sane, 100% self-hosting and self-sufficient OSS project, tracking the release schedule of the Linux kernel.
> – Ingo Molnar, April 5



User-space code in the kernel tree?

Advantages

Wider visibility of the code

Develop ABI and users together

Encourage thinking across the boundary

Better integration

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Disadvantages

Kernel tree bloat

ABI stability problems

Other projects are disadvantaged

Where does it end?

April

The mobile space is about proprietary drivers
– Mark Charlebios, Qualcomm Innovation Center

May

Seccomp - sandboxing for Chrome

- A simple bitmask to limit available system calls

“Why not make it more powerful?”

- Various filtering schemes proposed
- Perhaps use tracepoints as enforcement points?

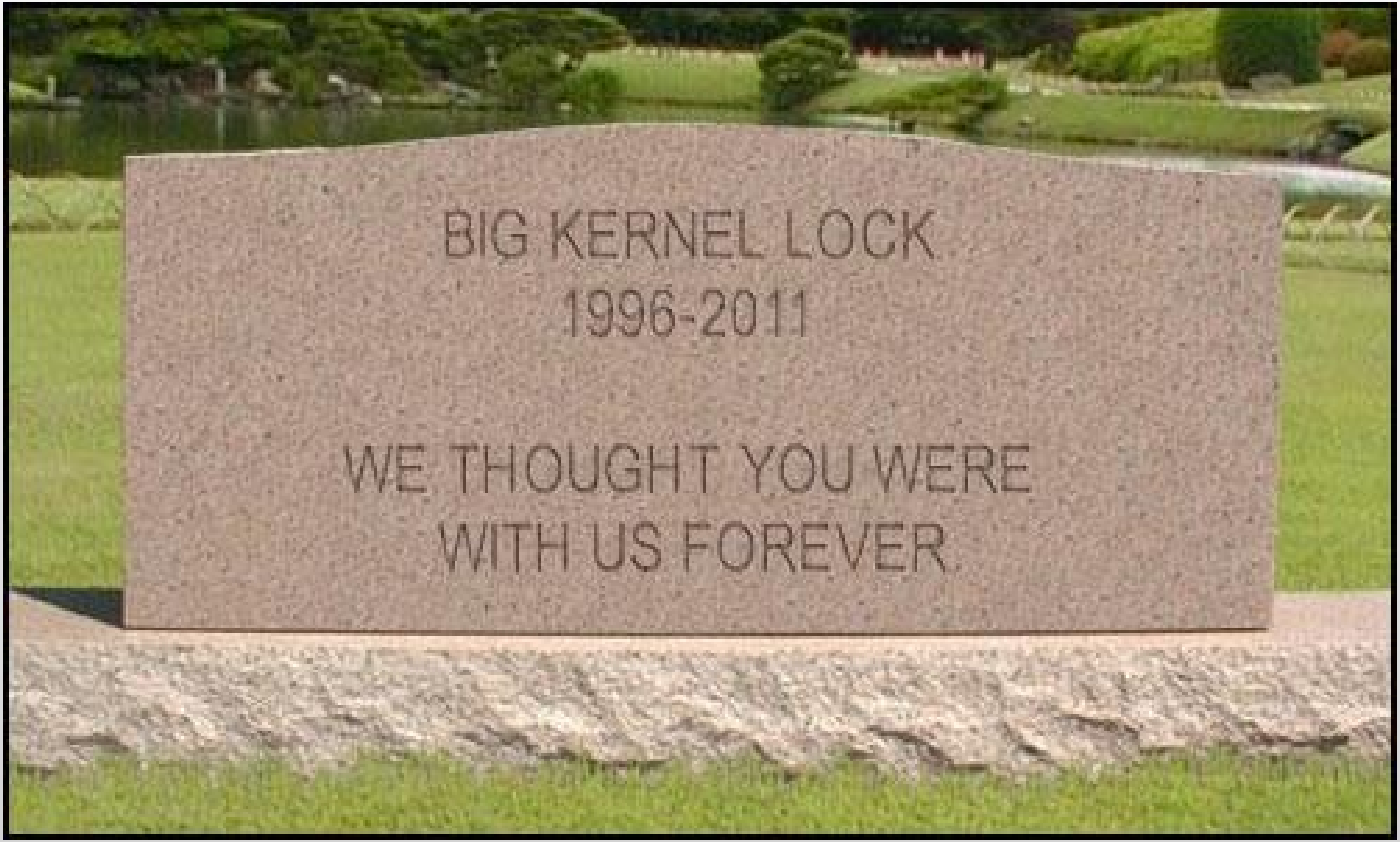
The end result

- Nothing merged

Yet another kernel release

2.6.39, May 18, 2011
(10,269 changesets, 1,258 developers)

Directed yield
IPset
Transcendent memory core
User namespace support
Media controller subsystem


BIG KERNEL LOCK
1996-2011
WE THOUGHT YOU WERE
WITH US FOREVER

During the 2.6.40 merge window

The voices in my head also tell me that the numbers are getting too big. I may just call the thing 2.8.0. And I almost guarantee that this PS is going to result in more discussion than the rest, but when the voices tell me to do things, I listen.
– Linus Torvalds, May 23, 2011

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If you do this, I will buy you a bottle of whatever whiskey you want that I can get my hands on in Tokyo next week.
– Greg Kroah-Hartman

June

Ext4 snapshots posted

Save copies of a running ext4 filesystem

Useful for

- System rollbacks
- Backups
- Factory reset
- ...

Why put all this effort into shoehorning in such a big an invasive feature to ext4 when btrfs does this all already? …

The wonderful thing about ext4 is its a nice basic fs. If we're going to start doing lots of crazy things, why not do them to the fs that isn't yet in wide use and can afford to have crazy things done to it without screwing a bunch of users who already depend on ext4's stability?
– Josef Bacik

What's up with ext4?

- “Bigalloc”
  - Allocate blocks in units >4096 bytes
  - Makes operations on large files much faster
  - Merged for 3.2

- In the works
  - Snapshots
  - Inline data for small files
  - Secure erase support
  - Metadata checksumming
  - ...

In other words

Ext4 will continue to develop and grow for a while yet.

> I'm actually finding that ext4 has found a second life as a server file system in large cloud data centers. It turns out that if you don't need the fancy-shmancy features that Copy-on-Write file systems give you, they aren't free.
> – Ted Ts'o

UEFI secure boot

- The objective:
  - Only give control of the system to a “trusted” boot loader

- This concept has value
  - Thwart bootloader rootkits
  - Ensure the system is running what you think it is

- There is only one problem:

Who is “trusted”?

The owner of the computer?

The hardware vendor?

The software vendor?

The entertainment industry?

UEFI secure boot could easily be a mechanism by which we lose control of our computers.

Where things stand

Lots of work to call attention to the problem

Some concessions gained

- All [x86] systems can be put into “setup mode”
- It will be possible to install a signing key

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But:

- Installing that key may not be easy
- No provision for booting from CD
- ARM systems can be totally locked down

July

3.0-rc7-rt

- The first new realtime patch set since March
    - Users had been stuck on 2.6.33

The state of realtime

Nice determinism on good hardware

May have a solution on per-CPU data

...but involves scary locking assumptions

Plan is to merge most of it in the next year

...time will tell...

Open issues in realtime

Deadline scheduling
CPU isolation

The 3.0 release is delayed

Nasty bug in the dcache scalability patches

The debugging crew:

- Linus Torvalds
- Al Viro
- Hugh Dickins

...it still took them several days to figure it out

Some parts of the kernel have reached a truly scary level of complexity.

3.0 kernel released, July 21

(9,153 changes from 1,131 developers)

New POSIX clocks

BPF JIT compiler

sendmmsg() system call

ICMP sockets (unprivileged `ping`)

Namespace file descriptors

Cleancache

August

好 Pizza 不吃嗎？
•比薩斜塔，就是一盒又一盒的 pizza 斜斜的疊起來， pizza 山已經在 BoF 等著你，快來挑戰你吃 pizza 的極限吧！
COSCUP
開源人年會

x32

64-bit mode is great, but:

- 64-bit data is rarely needed
- Programs get larger, slower

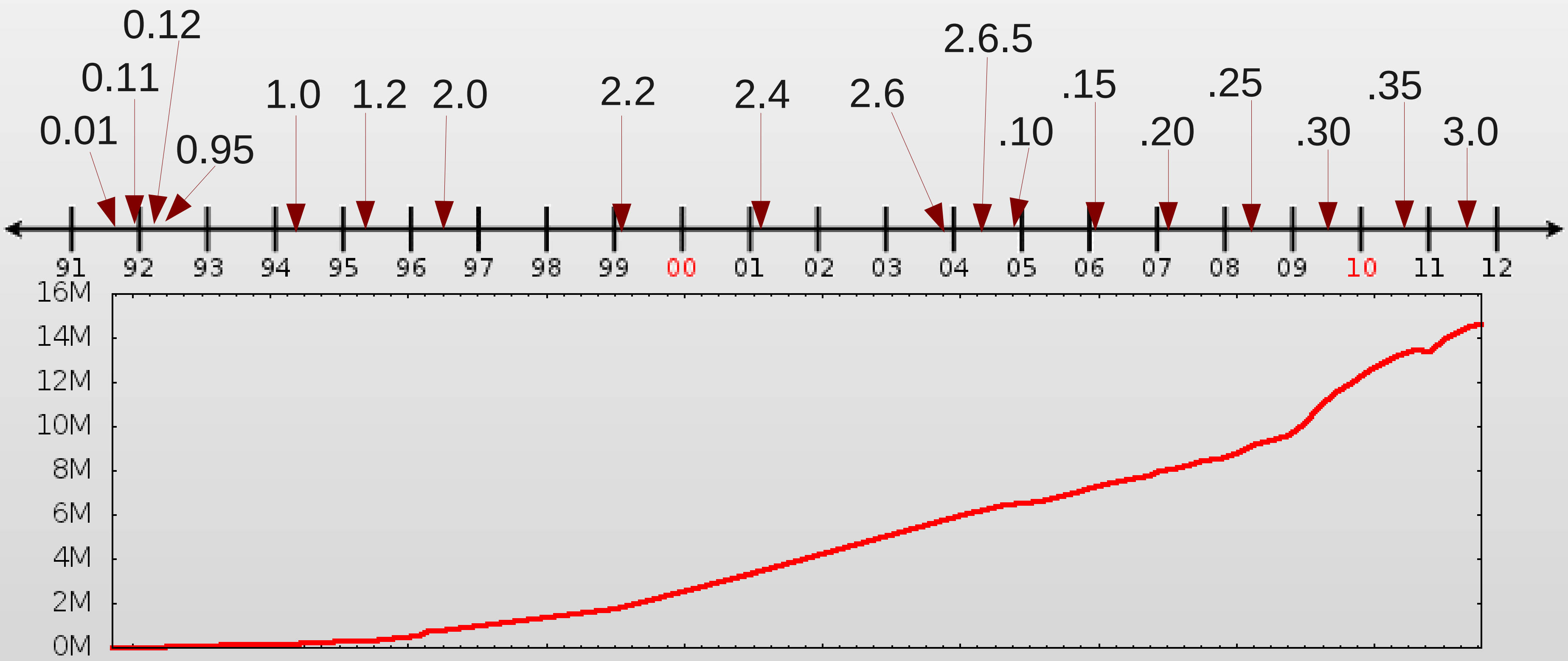
The best of both worlds: the x32 ABI

- Run in full 64-bit mode
- Use 32-bit data and pointers

Mostly a user-space problem

- But kernel support is needed

20 years of Linux



Kernel.org compromised

What is known:

- Attackers had been on the system for some time
- Stolen credentials used; trojaned SSH installed
- Numerous associated machines compromised
- No attempts to corrupt software distribution

The immediate result:

- kernel.org is down for almost two months
- The 3.1 kernel release is delayed

What has been done

A new kernel.org infrastructure has been built

- Lots of machines to separate functions
- New staff hired

Access has been restricted considerably

- “Maybe 450 shell accounts is a bad idea...”

A new kernel web of trust has been built

Vast support from the Linux Foundation

Still....

We do not take the security problem seriously enough.

September

Oracle to use Btrfs by default

...sometime really soon now

Btrfs

Some new development work happening

- Lots of internal work
- Scrub feature

Stability is the biggest concern

Still missing

Btrfsck

- a hard problem, seemingly

Still under development.

Meanwhile

- Root block history array
- Read-only data recovery tool

Also missing: RAID 5/6 support

- Patches exist

October

2011 Kernel Summit

Two pivotal summit outcomes

1) Maintainers should say “no” more often

2) Widely-used code should be merged even if it is not up to normal technical standards

A slow moment at the Summit

The **3.1** kernel

October 24, 2011 (8,693 changesets, 1,168 developers)

A 95 day cycle (average is 76)

Dynamic writeback throttling
OpenRISC architecture
PTRACE_SEIZE
lseek() hole finding
...

Embedded long-term support initiative

Two-year stable kernel maintenance

- One kernel/year
- Starting with 3.0

A separate tree for products

- Backports and such

A staging tree for upstreaming

November

Per-group TCP buffer limits

Limit kernel memory used by TCP buffers

- Accepted for 3.3

The first overt limit on kernel memory use

- Wanted for containers and such
- Lots more to come

Control groups

A simple mechanism for grouping processes

- ...that everybody hates

The real problem is the controllers

- Memory usage
  - (Now kernel memory usage too)
- Block I/O bandwidth
- Scheduling
- CPU affinity
- …

Expect a lot of cleanup work in this area

LTTng pulled into staging

- A comprehensive tracing toolkit
  - Widely used in some areas

- Intended for merging into 3.3

Two pivotal summit outcomes

1) Maintainers should say “no” more often

2) Widely-used code should be merged even if it is not up to normal technical standards

The outcome

LTTng loses

December

The Android mainlining project

An effort to get the Android kernel code merged

Includes

- **Binder** - interprocess communication
- **Logger** - user-space logging system
- **Low-memory killer**
- **Pmem** - contiguous memory allocation
- **RAM console**
- **Timed GPIO**
- **Ashmem** - shared object storage

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January

Happy New Year

3.2 released, January 4, 2012
(11,828 changesets from 1,309 developers)

Proportional rate reduction
Extended verification module
CPU scheduler bandwidth controller
Cross-memory attach
Hexagon architecture
Btrfs recovery
I/O-less dirty throttling

3.3 merge window

“team” network device
Network priority control group
TCP buffer size controller
Byte queue limits
Open vSwitch

ARM LPAE support
The Android drivers return
DMA buffer sharing API

Expect 3.3 sometime in March

February

Greg KH joins the Linux Foundation

Stuff not covered

Writeback
Transcendent memory
Barriers
Preemption disable
Perf and ftrace
Pin controller
RAID x 4
Opportunistic suspend
Power domains
Common clocks
Signed tags

Compaction stalls
GPL violations
GPL termination
Patch review
Testing tools
SCSI targets
Bufferbloat
Power-aware sched.
Solid-state storage
IIO
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Questions?