

Linux Kernel Development

Greg Kroah-Hartman
gregkh@linuxfoundation.org

github.com/gregkh/kernel-development

39,000 files
15,600,000 lines

2,841 developers
407 companies

10,600 lines added

8,100 lines removed

2,250 lines modified

10,600 lines added

8,100 lines removed

2,250 lines modified

every day


6.03 changes per hour

Kernel releases 3.1.0 – 3.5.0
July 2011 – July 2012

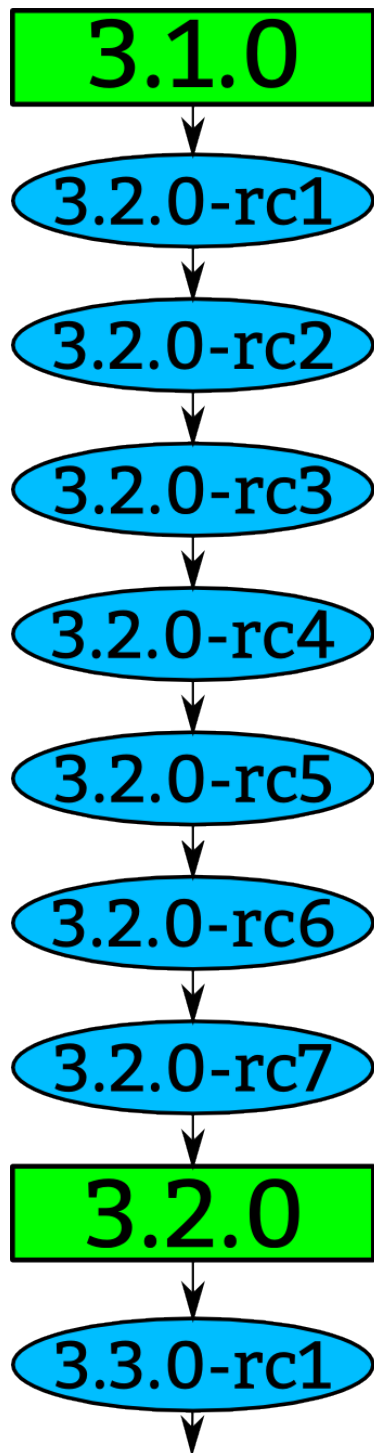
How we stay sane

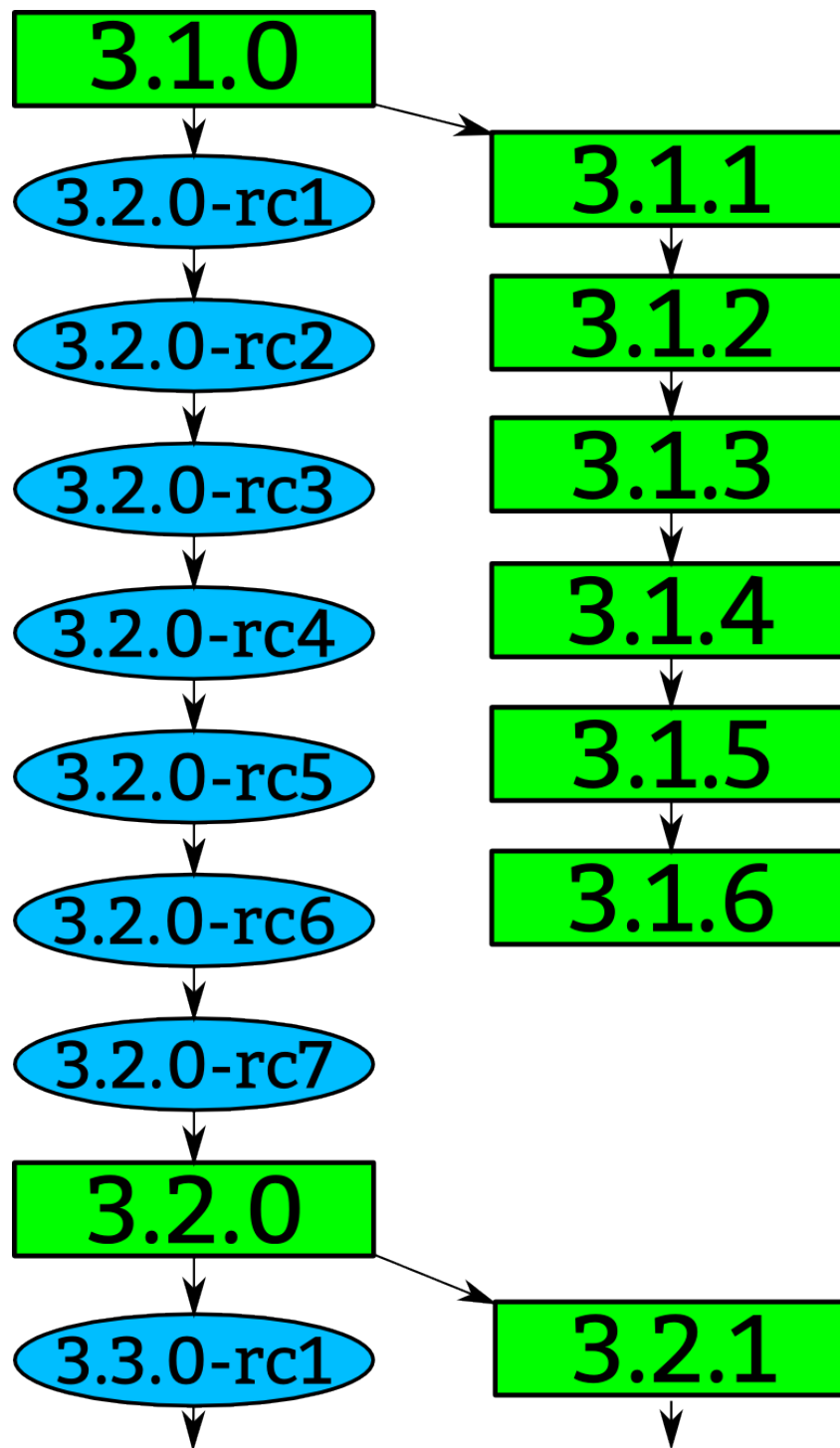
Time based releases

Incremental changes



**New release every
2³/₄ months**





“Longterm kernels”

One picked per year

Maintained for two years

3.0 and 3.4

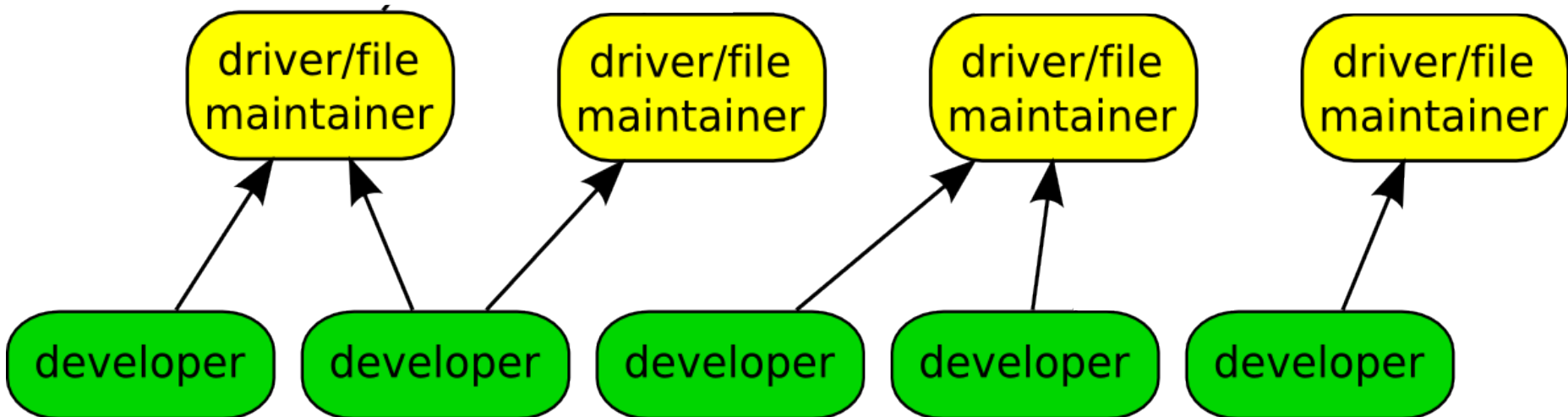
developer

developer

developer

developer

developer



commit ecf85e481a716cfe07406439fdc7ba9526bbfaeb
Author: Robert Jarzmik <robert.jarzmik@free.fr>
AuthorDate: Tue Apr 21 20:33:10 2009 -0700
Commit: Greg Kroah-Hartman <gregkh@suse.de>
CommitDate: Thu Apr 23 14:15:31 2009 -0700

USB: otg: Fix bug on remove path without transceiver

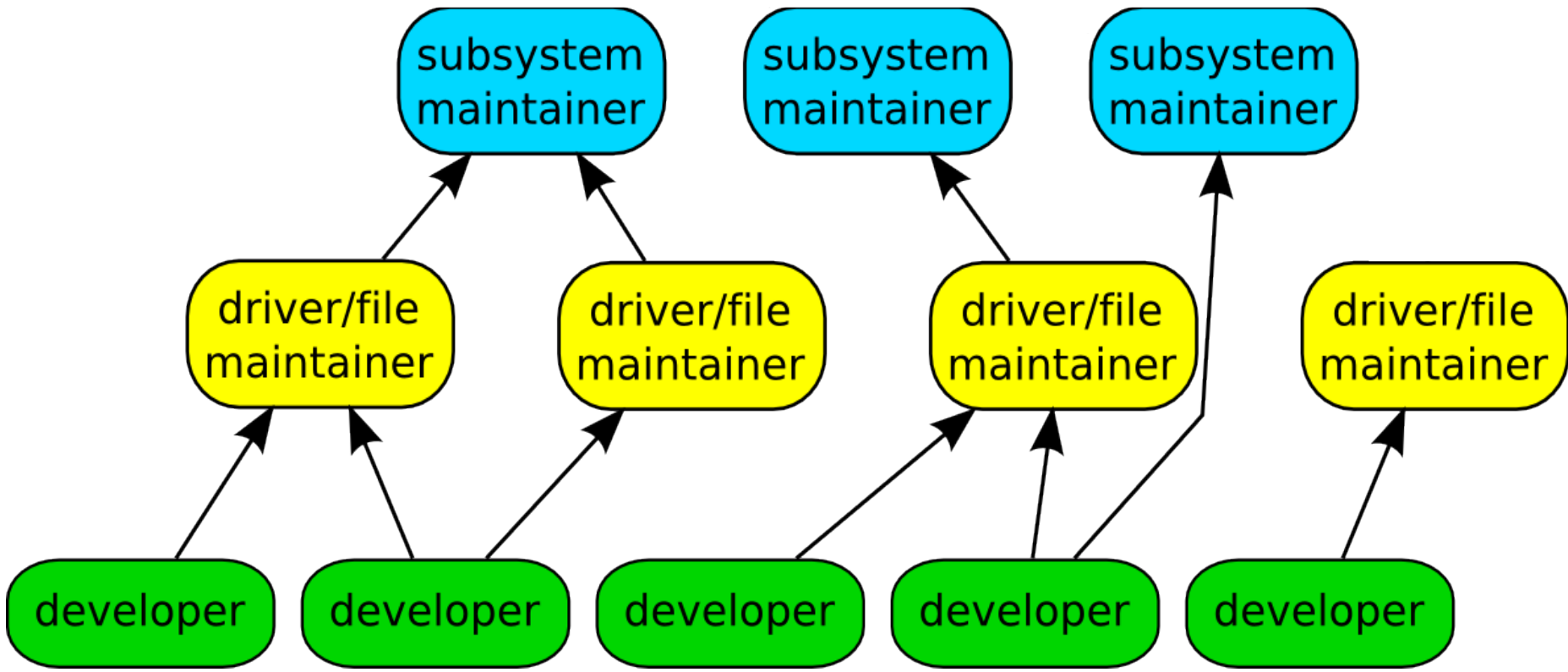
In the case where a gadget driver is removed while no transceiver was found at probe time, a bug in `otg_put_transceiver()` will trigger.

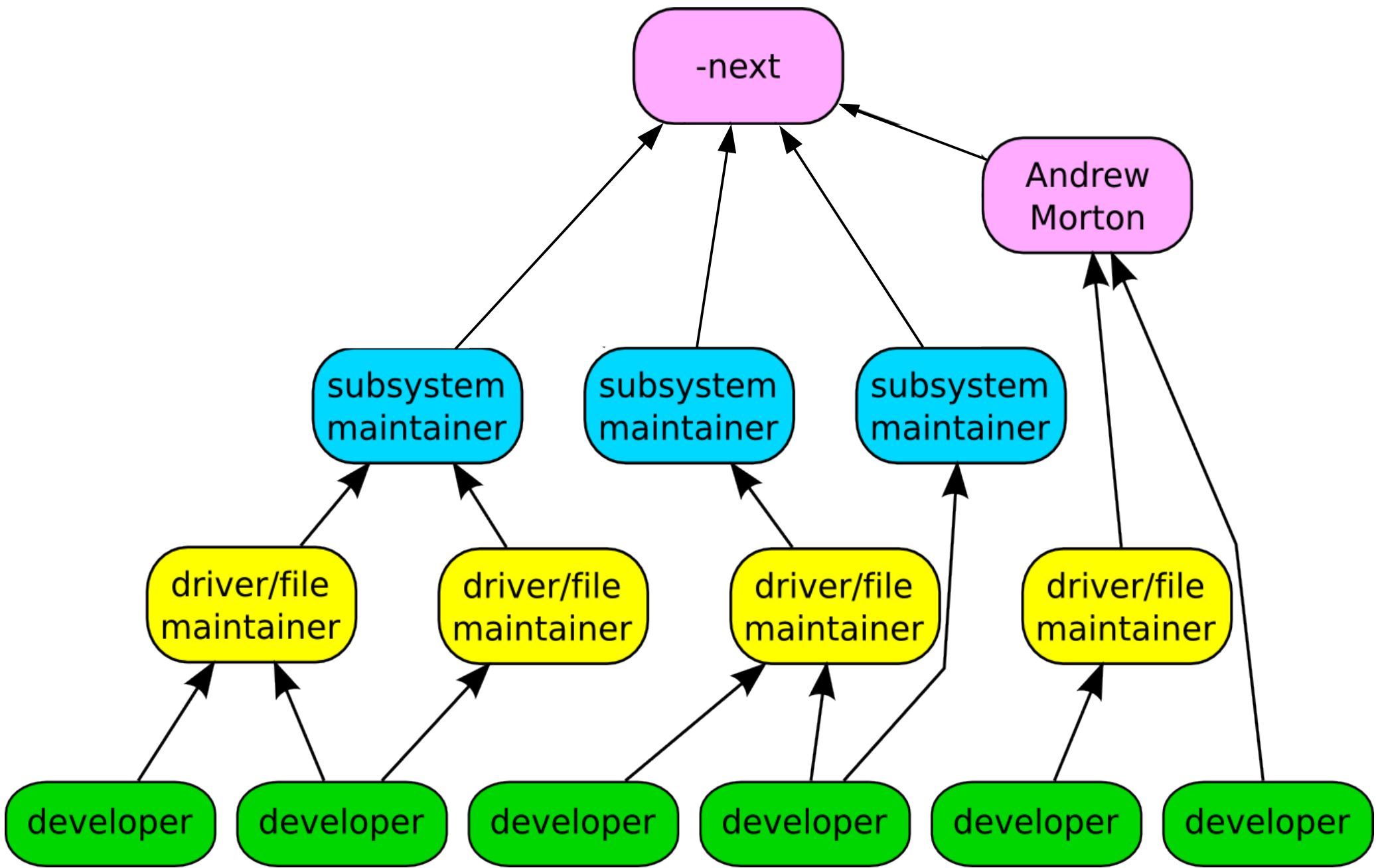
Signed-off-by: Robert Jarzmik <robert.jarzmik@free.fr>
Acked-by: David Brownell <dbrownell@users.sourceforge.net>
Signed-off-by: Greg Kroah-Hartman <gregkh@suse.de>

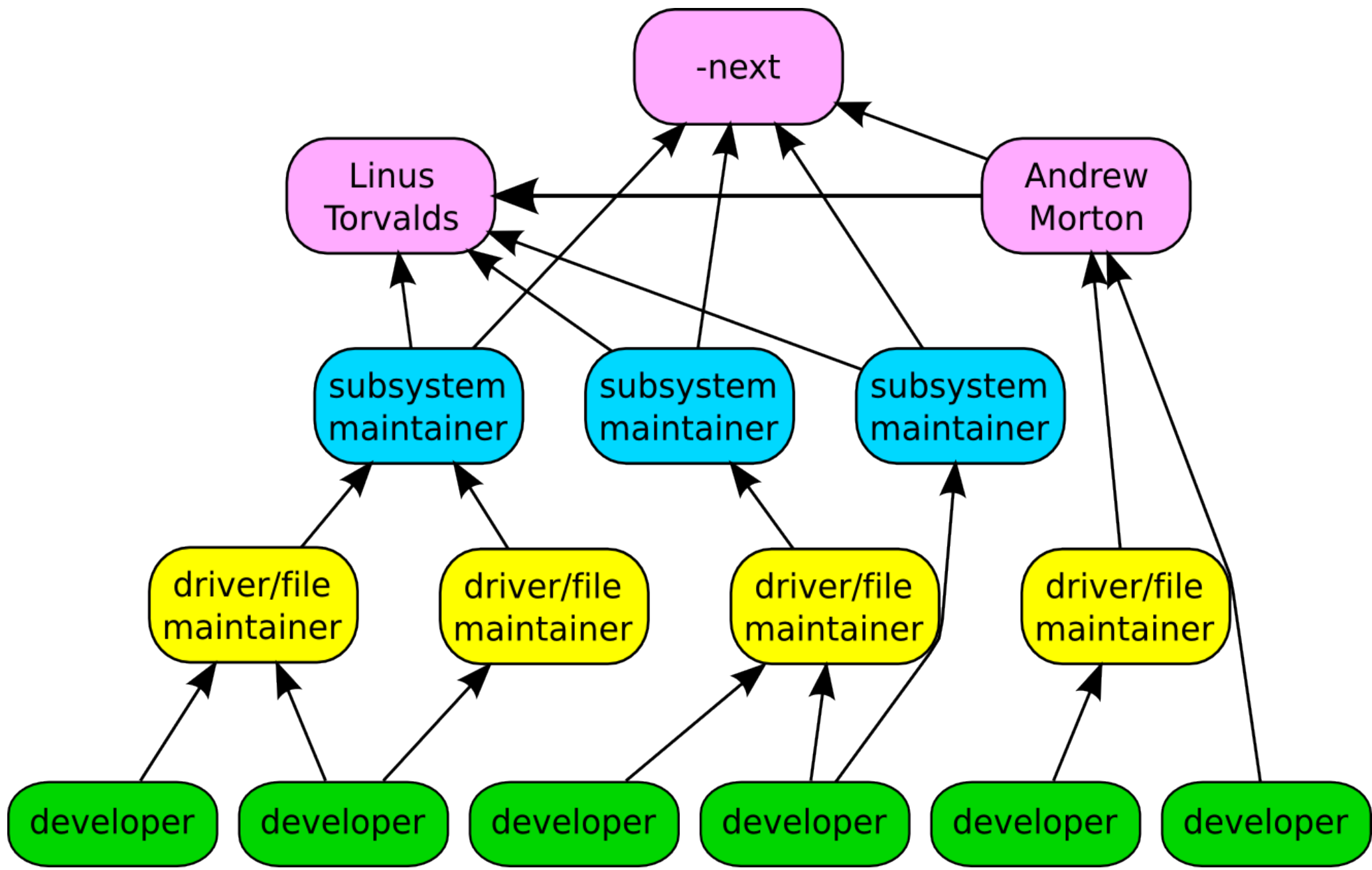
```
--- a/drivers/usb/otg/otg.c
+++ b/drivers/usb/otg/otg.c
@@ -43,7 +43,8 @@ EXPORT_SYMBOL(otg_get_transceiver);
 void otg_put_transceiver(struct otg_transceiver *x)
 {
-    put_device(x->dev);
+    if (x)
+        put_device(x->dev);
 }
```

Developer's Certificate of Origin

- (a) I created this change; or
- (b) Based this on a previous work with a compatible license; or
- (c) Provided to me by (a), (b), or (c) and not modified
- (d) This contribution is public.







Top developers by quantity

1	May 30	Robert P. J. Da	(1.4K)	should "create_proc_read_entry" enforce read-only semantics?	1026
2	May 30	Julian David	(7.4K)	LSI MegaRAID controllers: problems with multi-gen	879
3	May 30	Thomas Gleixner	(1.2K)	[PATCH] ehea: fixed multi-gen RX bug	879
4	May 30	Gellert Sándor	(2.5K)	[PATCH] lib: problem with 2.6.21. kernel	681
5	May 30	Hagen Paul Pfi	(3.5K)	[PATCH] INTERNODE_CACHE_SHIFT redefinition for hot spot structu	681
6	May 30	Zoltan Boszorme	(0.9K)	Re: Kernel 2.6.21.3 does not work with 8GB of RAM on Intel 965W	540
7	May 30	Juho Vihari	(1.8K)	↳	496
8	May 30	Mark Brown	(2.8K)	Mainline plans	486
9	May 30	Matthias Kaehle	(2.4K)	[PATCH] drivers/block/ub.c: use list_for_each_entry()	473
10	May 30	Matthias Kaehle	(2.4K)	↳	410
11	May 30	Randy Dunlap	(1.2K)	[PATCH] merge dst_discard in & out into one, removed a duplicat	406
12	May 30	Zoltan Boszorme	(0.9K)	MCP55 NCQ problem?	404
13	May 30	Bill Nottingham	(1.0K)	[PATCH RFC] qla2xxx: fix timeout in qla2x00_down_timeout	404
14	May 30	Sean An	(1.4K)	↳	404
15	May 30	Bill Nottingham	(5.5K)	[PATCH] drivers/infiniband: fix comparisons between unsigned and	404
16	May 30	Bill Nottingham	(5.1K)	[PATCH] drivers/video: Fix comparisons between negative and uns	404
17	May 30	Bill Nottingham	(2.4K)	[PATCH] drivers/net: fix comparisons of unsigned < 0	404
18	May 30	Bill Nottingham	(0.9K)	fix comparisons of unsigned	404
19	May 30	Bill Nottingham	(1.9K)	[PATCH] mm: fix comparisons against unsigned	404
20	May 30	Bill Nottingham	(1.4K)	[PATCH] also: fix comparison of unsigned < 0	404
21	May 30	Takashi Iwai	(3.6K)	↳	404
22	May 30	Jiri Slaby	(1.4K)	↳	404
23	May 30	Stefan Richter	(1.7K)	[PATCH 2.6.21.3] ieee1394: eth1394: bring back a parent device	404
24	May 30	Oleg Nesterov	(1.1K)	↳	404
25	May 29	Robert Hancock	(1.5K)	[PATCH] mm: PCI: disable decode of 16M memory during BAR si	404
26	May 29	Robert Hancock	(8.8K)	[PATCH -mm] I/O: MMCONFIG: validate against ACPI motherboard re	404
27	May 29	Linus Torvalds	(7.4K)	↳	404
28	May 30	Matthias Kaehle	(1.6K)	↳	404
29	May 29	Robert Hancock	(1.0K)	[PATCH -mm] O/2: PCI MMCONFIG-related updates	404
30	May 29	Yinghai Lu	(0.4K)	keyex and aacraid broken	404
31	May 29	Andre Bittton	(0.9K)	↳	404
32	May 30	Salyzyn, Mark	(9.4K)	↳	404
33	May 29	Yinghai Lu	(18K)	[PATCH 4/5] serial: convert early_uart to earlycon for 8250	404
34	May 29	Yinghai Lu	(5/5)	serial: set DTR in uart for kernel serial console	404
35	May 29	Yinghai Lu	(2.5K)	[PATCH 3/5] x86: initial fixmap support	404
36	May 29	Yinghai Lu	(1.0K)	[PATCH 2/5] console: console handover to preferred console	404
37	May 29	Yinghai Lu	(1/5)	↳	404
38	May 30	Wang Zhenyu	(4K)	[PATCH] use table for device probe	404
39	May 30	Wang Zhenyu	(19K)	[resend] [AGPGART] intel_agp: cleanup intel private data	404
40	May 30	Dave Airlie	(2.0K)	[git pull] drm fixes for 2.6.22-rc3	404
41	May 29	Matt Helsley	(8.2K)	[RFC][PATCH] Replacing the /proc/<pid self>/exe symlink code	404

Top Signed-off-by:

Greg Kroah-Hartman	5474
David S. Miller	3986
John Linville	3123
Mauro Carvalho Chehab	2667
Mark Brown	2546
Linus Torvalds	2005
Andrew Morton	1632
James Bottomley	1027
David Airlie	987
Axel Lin	887

Who is funding this work?

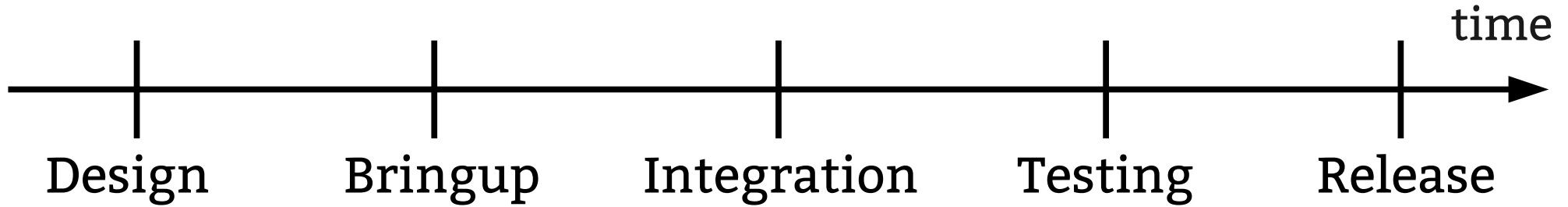


1. "Amateurs"	14.2%
2. Red Hat	10.1%
3. Intel	8.6%
4. Unknown Individuals	5.2%
5. Novell	4.0%
6. Texas Instruments	3.6%
7. IBM	3.1%
8. Linaro	3.0%
9. Broadcom	2.6%
10. Consultants	2.3%

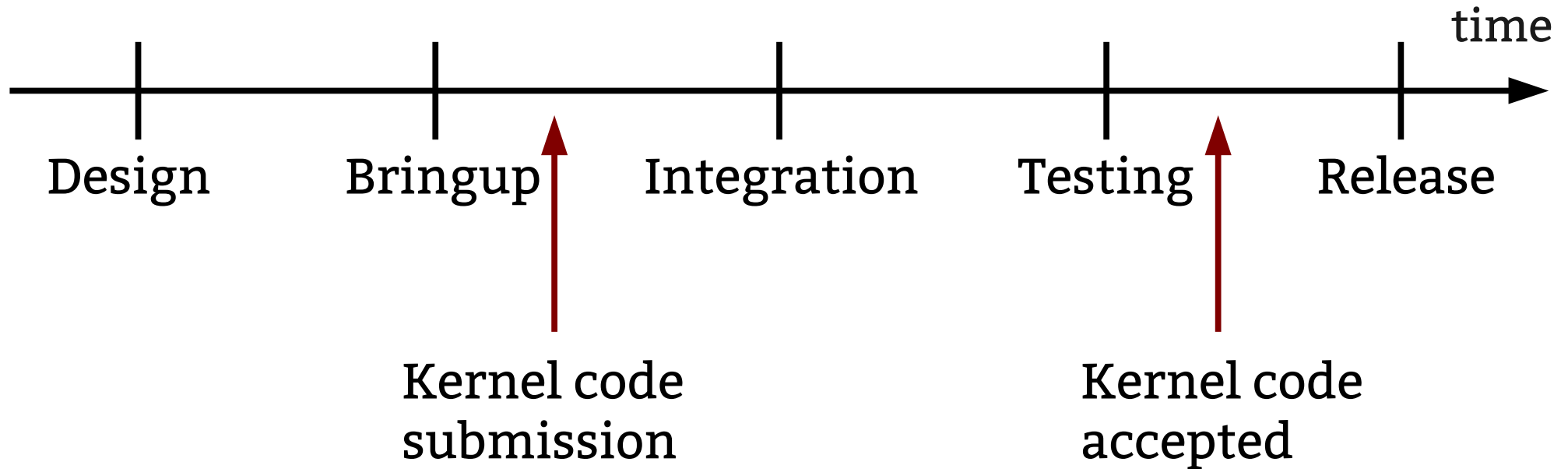
Who is funding this work?

11. Wolfson Micro	2.2%
12. Google	2.0%
13. Samsung	2.0%
14. Oracle	1.7%
15. Ingics Technology	1.7%
16. Qualcomm	1.6%
17. Freescale	1.2%
18. Wind River	1.1%
19. Nokia	1.0%
20. Linux Foundation	0.9%

Product Development



Product Development



Ideal

**“Working upstream
saves time and money”**

Dan Frye – VP Open Systems, IBM

Dirk Hohndel – Chief Technologist, Intel



github.com/gregkh/kernel-development

Linux Kernel Development

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I'm going to discuss the how fast the kernel is moving, how we do it all, and how you can get involved.

39,000 files
15,600,000 lines

Kernel release 3.5.0

This was for the 3.5 kernel release, which happened July 21, 2012.

2,841 developers 407 companies

Kernel releases 3.1.0 – 3.5.0
July 2011 – July 2012

This makes the Linux kernel the largest contributed body of software out there that we know of.

This is just the number of companies that we know about, there are more that we do not, and as the responses to our inquiries come in, this number will go up.

First one year timespan that we have surpassed 400 companies.

10,600 lines added
8,100 lines removed
2,250 lines modified

Kernel releases 3.1.0 – 3.5.0
July 2011 – July 2012

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every day

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Kernel releases 3.1.0 – 3.5.0
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This is 24 hours a day, 7 days a week, for a full year.

We went this fast the year before this as well, this is an amazing rate of change.

Interesting note, all of these changes are all through the whole kernel.

For example, the core kernel is only 5% of the code, and 5% of the change was to the core kernel. Drivers are 55%, and 55% was done to them, it's completely proportional all across the whole kernel.

How we stay sane

Time based releases
Incremental changes

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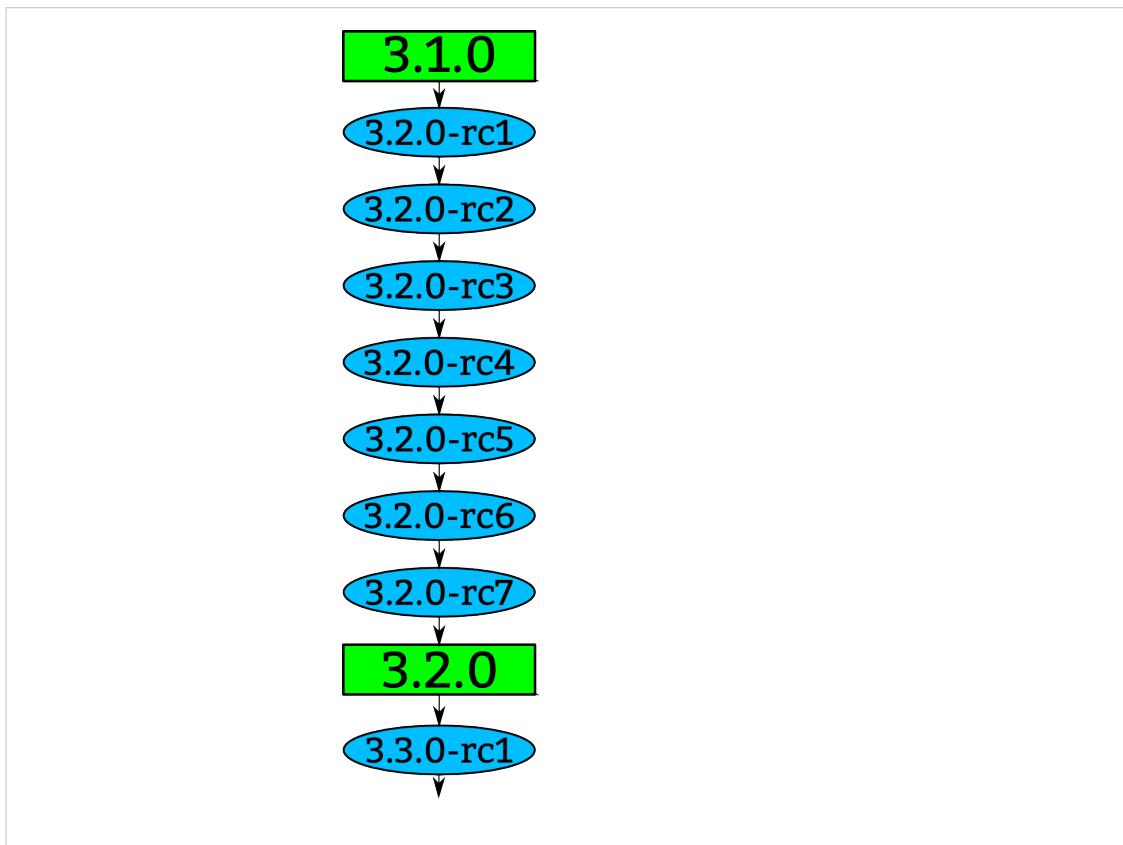
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84 days to be exact, very regular experience.



How a kernel is developed.

Linus releases a stable kernel

- 2 week merge window from subsystem maintainers

- rc1 is released

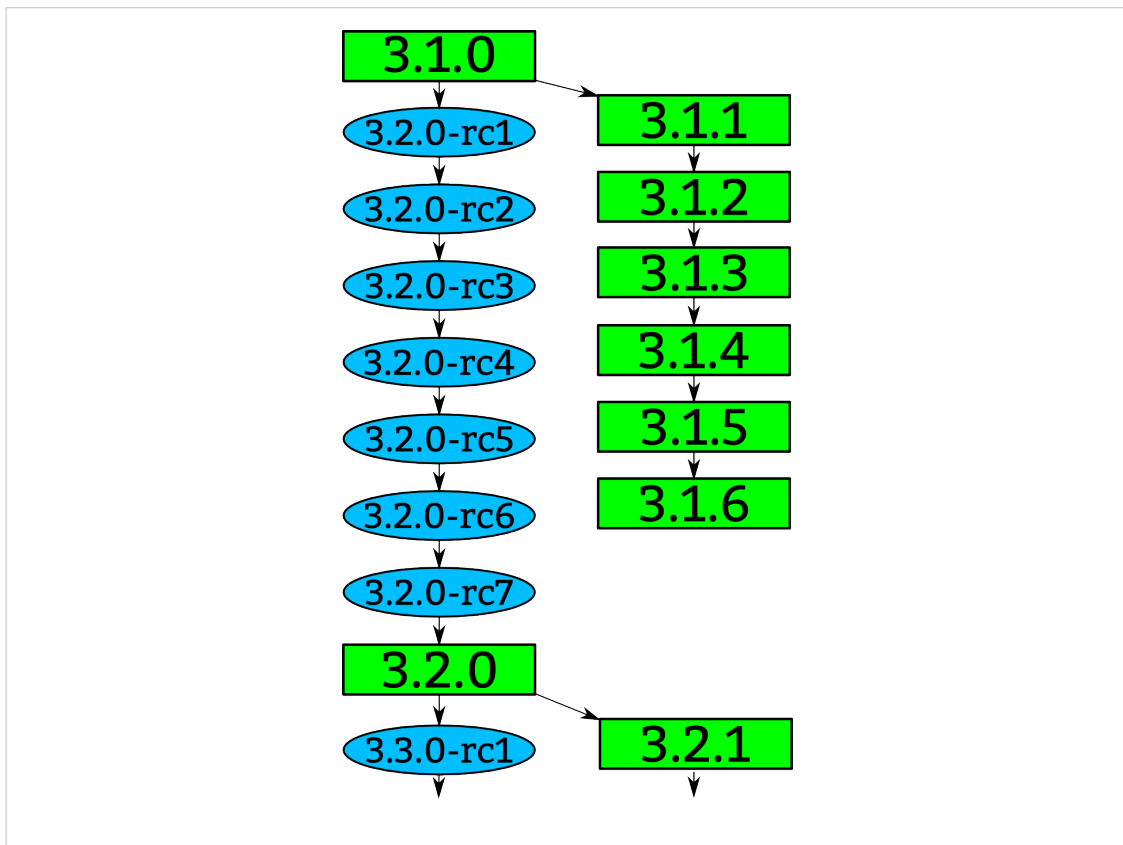
- bugfixes only now

- 2 weeks later, rc2

- bugfixes and regressions

- 2 weeks later,rc3

And so on until all major bugfixes and regressions are resolved and then the cycle starts over again.



Greg takes the stable releases from Linus, and does stable releases with them, applying only fixes that are already in Linus's tree.

Requiring fixes to be in Linus's tree first ensures that there is no divergence in the development model.

After Linus releases a new stable release, the old stable series is dropped.

With the exception of “longterm” stable releases, those are special, the stick around for much longer...

“Longterm kernels”

One picked per year
Maintained for two years

3.0 and 3.4

I pick one kernel release per year to maintain for longer than one release cycle. This kernel I will maintain for at least 2 years.

This means there are 2 longterm kernels being maintained at the same time.

3.0 and 3.4 are the longterm kernel releases I am maintaining.

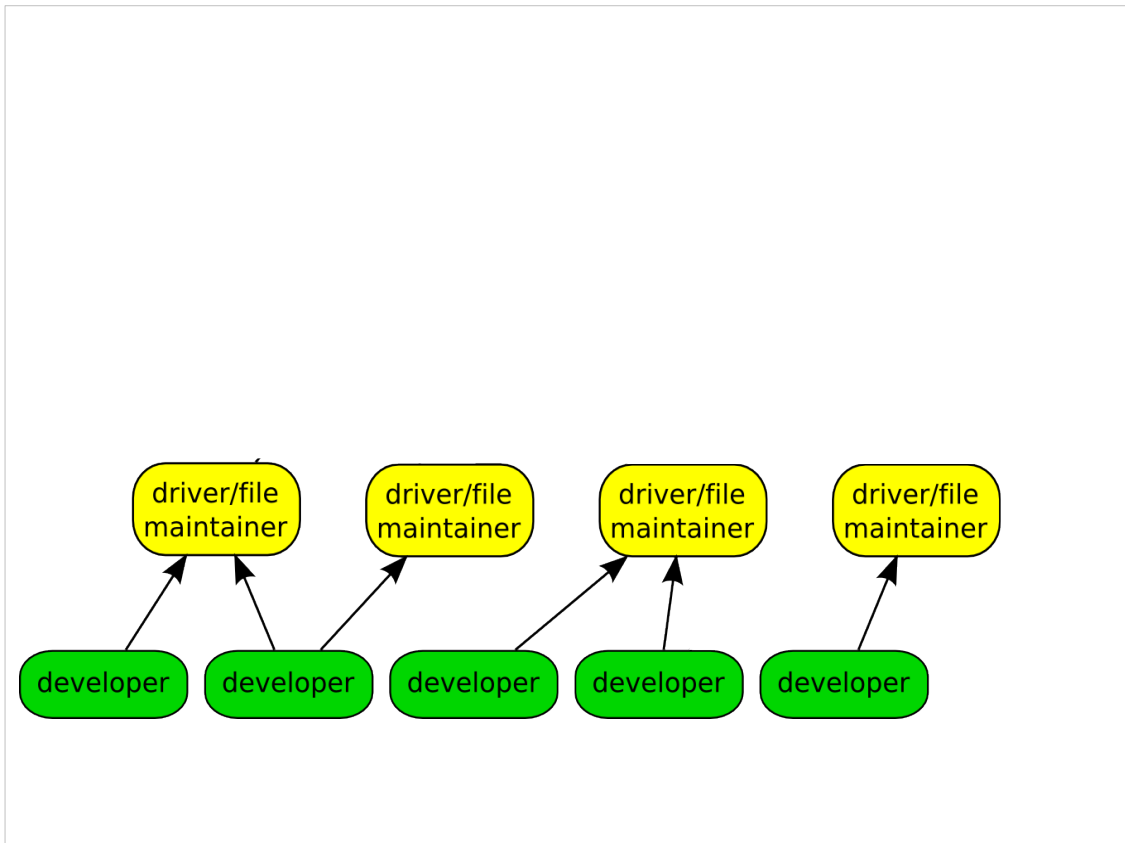
Ben Hutchings is maintaining the 3.2 kernel as a longterm kernel for the Debian project.

The LTSI project is based on the longterm kernels.



Like mentioned before, we have almost 2900 individual contributors. They all create a patch, a single change to the Linux kernel. This change could be something small, like a spelling correction, or something larger, like a whole new driver.

Every patch that is created only does one thing, and it can not break the build, complex changes to the kernel get broken up into smaller pieces.



The developers send their patch to the maintainer of the file(s) that they have modified.

We have about 700 different driver/file/subsystem maintainers


```

commit ecf85e481a716cfe07406439fdc7ba9526bbfaeb
Author: Robert Jarzmik <robert.jarzmik@free.fr>
AuthorDate: Tue Apr 21 20:33:10 2009 -0700
Commit: Greg Kroah-Hartman <gregkh@suse.de>
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USB: otg: Fix bug on remove path without transceiver

In the case where a gadget driver is removed while no
transceiver was found at probe time, a bug in
otg_put_transceiver() will trigger.

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Signed-off-by: Greg Kroah-Hartman <gregkh@suse.de>

--- a/drivers/usb/otg/otg.c
+++ b/drivers/usb/otg/otg.c
@@ -43,7 +43,8 @@ EXPORT_SYMBOL(otg_get_transceiver);
 void otg_put_transceiver(struct otg_transceiver *x)
 {
-     put_device(x->dev);
+     if (x)
+         put_device(x->dev);
 }

```

This is an example of a patch.

It came from Robert, was acked by David, the maintainer at the time of the usb on-the-go subsystem, and then signed off by by me before it was committed to the kernel tree.

The change did one thing, it checked the value of the pointer before it was dereferenced, fixing a bug that would have crashed the kernel if it had been hit.

This is also a “blame” trail, showing who changed each line in the kernel, and who agreed with that change.

If a problem is found, these are the developers that you can ask about it.

Because of this, every line in the Linux kernel can be traced back to at least two developers who are responsible for it.

This is better than any other body of code.

Developer's Certificate of Origin

- (a) I created this change; or
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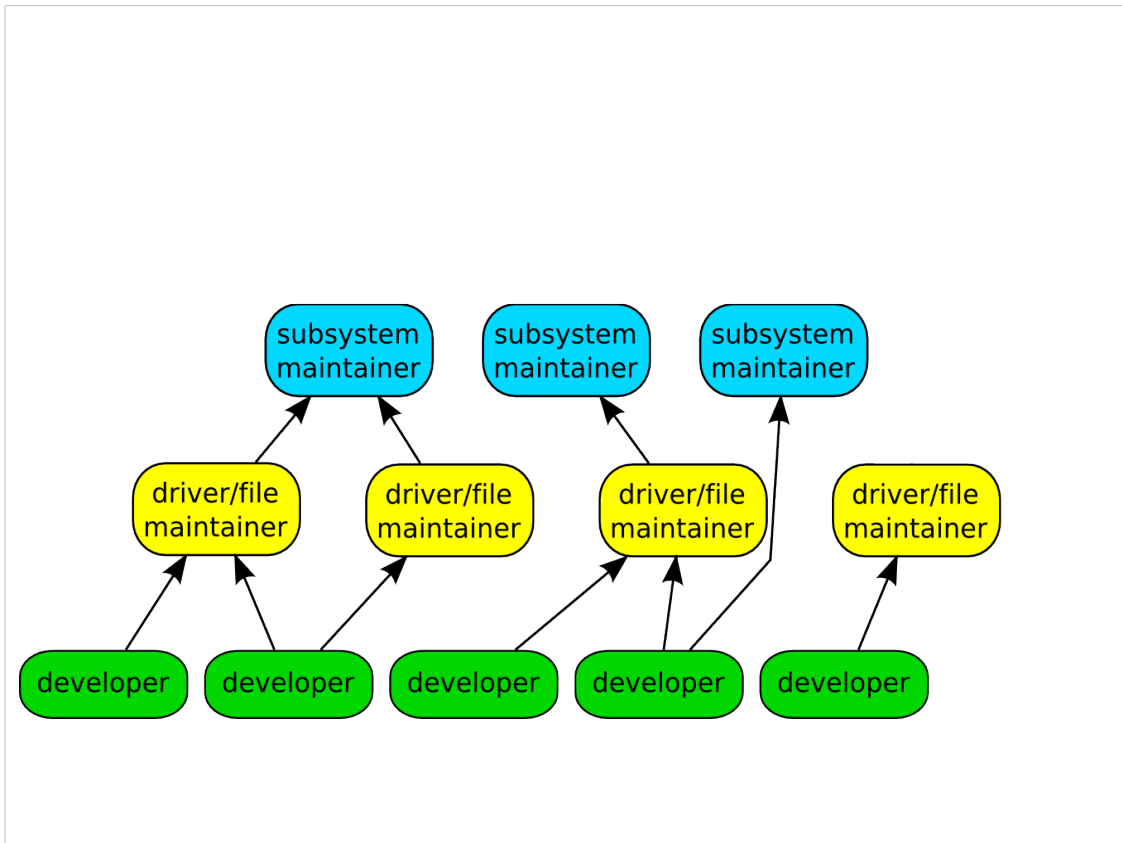
This is what “Signed-off-by:” means.

All contributions to the Linux kernel have to agree to this, and every single patch has at least one signed-off-by line, usually all have at least two.

This is also a “blame” trail, showing who changed each line in the kernel, and who agreed with that change.

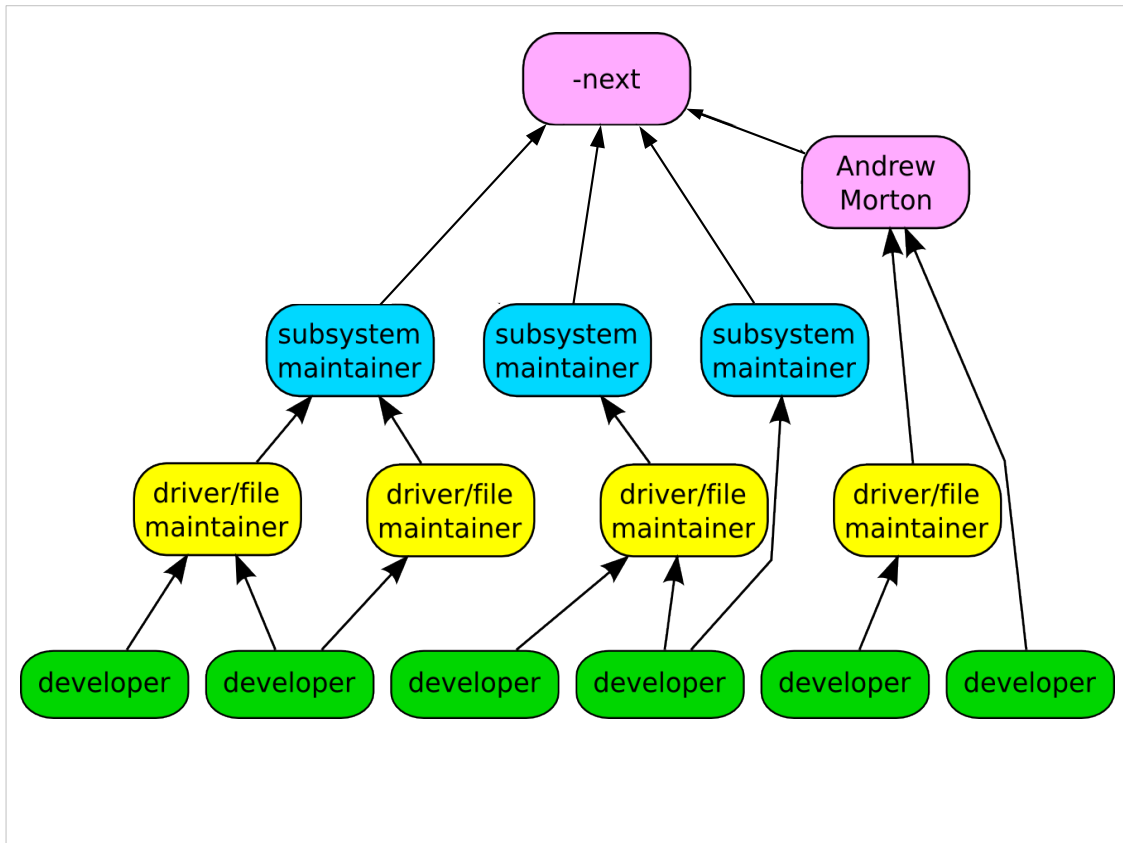
If a problem is found, this is the developers that you can ask about it.

Because of this, every line in the Linux kernel can be traced back to at least two developers who are responsible for it. This is better than any other body of code.



After reviewing the code, and adding their own signed-off-by to the patch, the file/driver maintainer sends the patch to the subsystem maintainer responsible for that portion of the kernel.

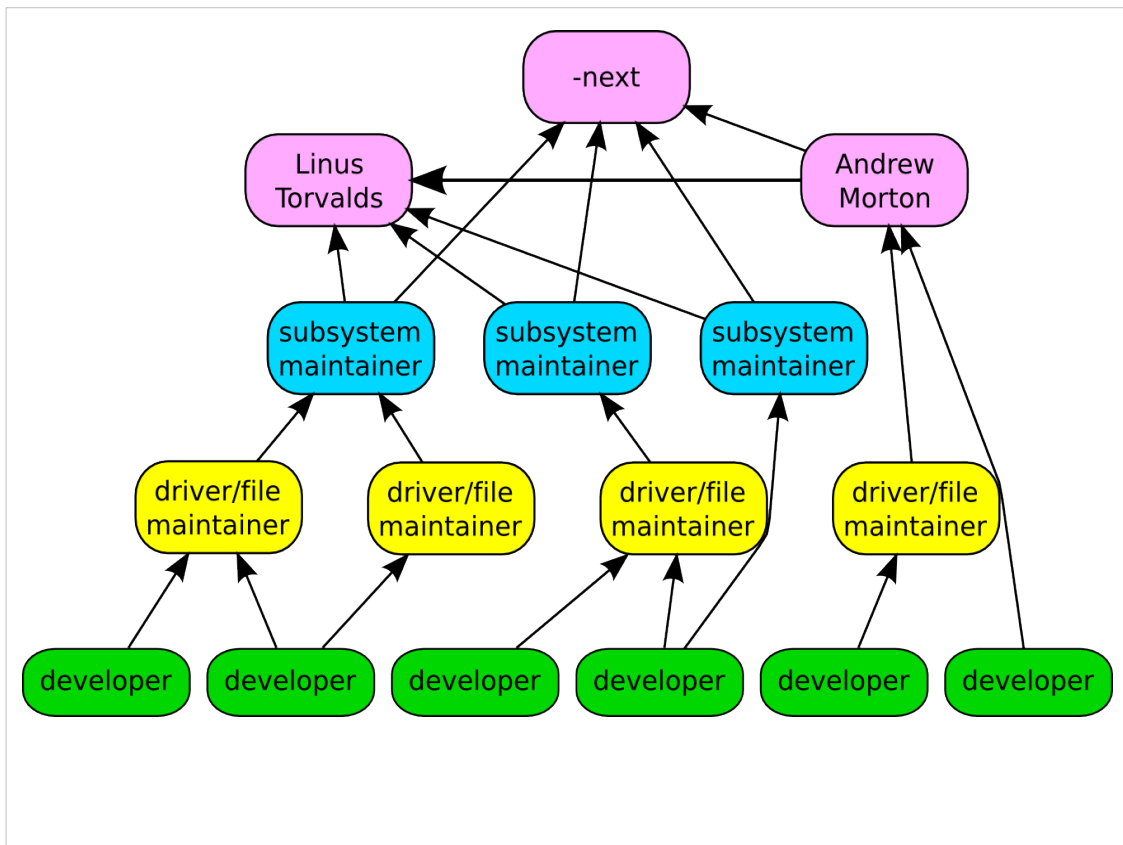
We have around 150 subsystem maintainers



Linux-next gets created every night from all of the different subsystem trees and build tested on a wide range of different platforms.

We have about 150 different trees in the linux-next release.

Andrew Morton picks up patches that cross subsystems, or are missed by others, and releases his -mm kernels every few weeks. This includes the linux-next release at that time.



Every 3 months, when the merge window opens up, everything gets sent to Linus from the subsystem maintainers and Andrew Morton.

The merge window is 2 weeks long, and thousands of patches get merged in that short time.

All of the patches merged to Linus should have been in the linux-next release, but that isn't always the case for various reasons.

Linux-next can not just be sent to Linus as there are things in there that sometimes are not good enough to be merged just yet, it is up to the individual subsystem maintainer to decide what to merge.

Top developers by quantity

1	Mark Brown	1026
2	Axel Lin	879
3	Al Viro	681
4	Mauro Chehab	540
5	Russell King	496
6	Johannes Berg	486
7	Takashi Iwai	473
8	Dan Carpenter	410
9	Ben Skeggs	406
10	Greg Kroah-Hartman	404

Kernel releases 3.1.0 – 3.5.0

Mark – embedded sound

Axel – janitorial

Al – vfs and filesystem

Mauro – v4l

Russell – ARM

Johannes – intel wireless

Takashi sound

Dan – janitorial

Ben – nouveau

Greg – USB, staging, tty, etc.

Top Signed-off-by:		
Greg Kroah-Hartman	5474	
David S. Miller	3986	
John Linville	3123	
Mauro Carvalho Chehab	2667	
Mark Brown	2546	
Linus Torvalds	2005	
Andrew Morton	1632	
James Bottomley	1027	
David Airlie	987	
Axel Lin	887	
Kernel releases 3.1.0 – 3.5.0		

- Greg – driver core, usb, staging
- David – networking
- John – wireless networking
- Mauro - v4l
- Mark – embedded sound
- Linus - everything
- Andrew – everything
- James – SCSI
- David - graphics
- Axel - janitorial

Who is funding this work?



1. "Amateurs"	14.2%
2. Red Hat	10.1%
3. Intel	8.6%
4. Unknown Individuals	5.2%
5. Novell	4.0%
6. Texas Instruments	3.6%
7. IBM	3.1%
8. Linaro	3.0%
9. Broadcom	2.6%
10. Consultants	2.3%

Kernel releases 3.1.0 - 3.5.0

So you can view this as either 20% is done by non-affiliated people, or 80% is done by companies.

Now to be fair, if you show any skill in kernel development you are instantly hired.

Why this all matters: If your company relies on Linux, and it depends on the future of Linux supporting your needs, then you either trust these other companies are developing Linux in ways that will benefit you, or you need to get involved to make sure Linux works properly for your workloads and needs.

Who is funding this work?

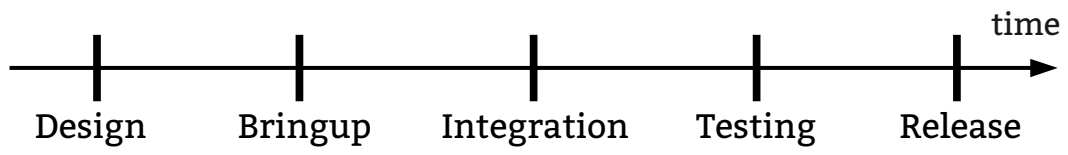


11. Wolfson Micro	2.2%
12. Google	2.0%
13. Samsung	2.0%
14. Oracle	1.7%
15. Ingics Technology	1.7%
16. Qualcomm	1.6%
17. Freescale	1.2%
18. Wind River	1.1%
19. Nokia	1.0%
20. Linux Foundation	0.9%

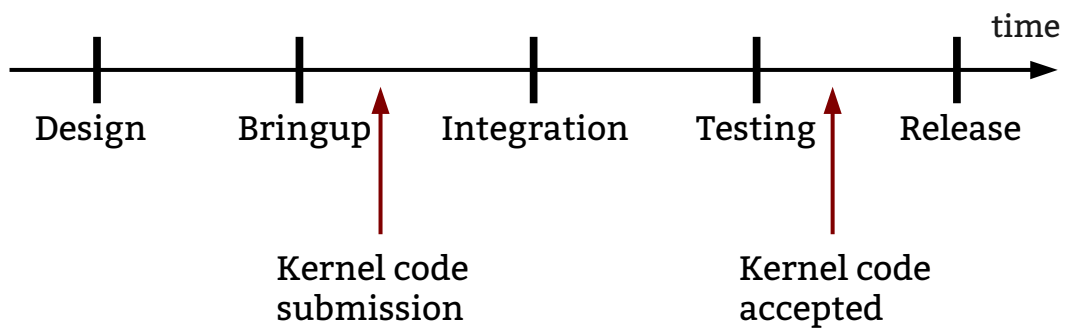
Kernel releases 3.1.0 - 3.5.0

Samsung 1047 patches
LF - 501 patches
Qualcomm 707 patches

Product Development



Product Development



Ideal

“Working upstream saves time and money”

Dan Frye – VP Open Systems, IBM
Dirk Hohndel – Chief Technologist, Intel



Obligatory Penguin Picture

