Linux Kernel Development

Greg Kroah-Hartman
gregkh@linuxfoudation.org

github.com/gregkh/kernel-development

cc BY NC SA

39,700 files
15,870,000 lines

2,497 developers
406 companies

Kernel releases 3.2.0 – 3.6.0
October 2011 – September 2012

10,700 lines added

7,600 lines removed

2,340 lines modified

Kernel releases 3.2.0 – 3.6.0
October 2011 – September 2012

10,700 lines added

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2,340 lines modified

every day

Kernel releases 3.2.0 – 3.6.0
October 2011 – September 2012

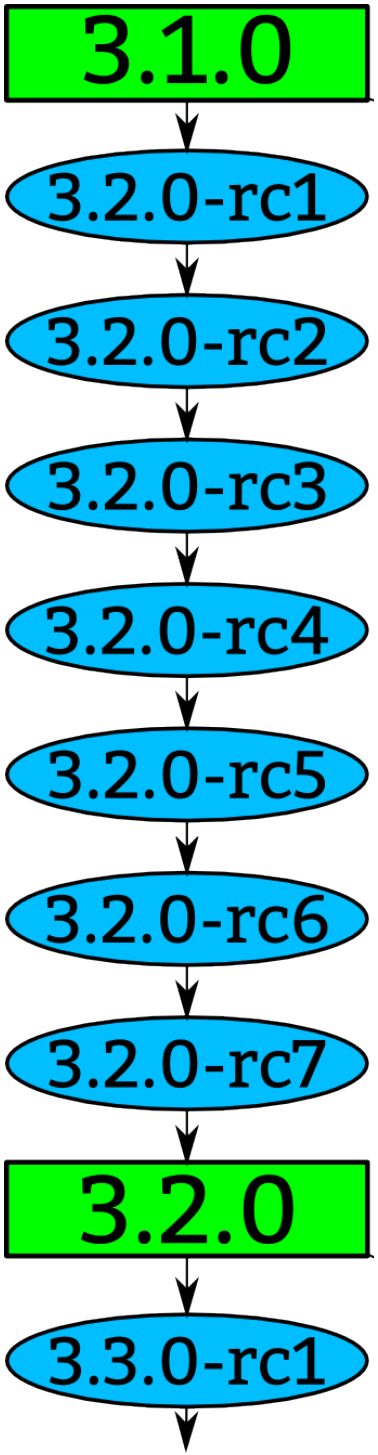
6.64 changes per hour

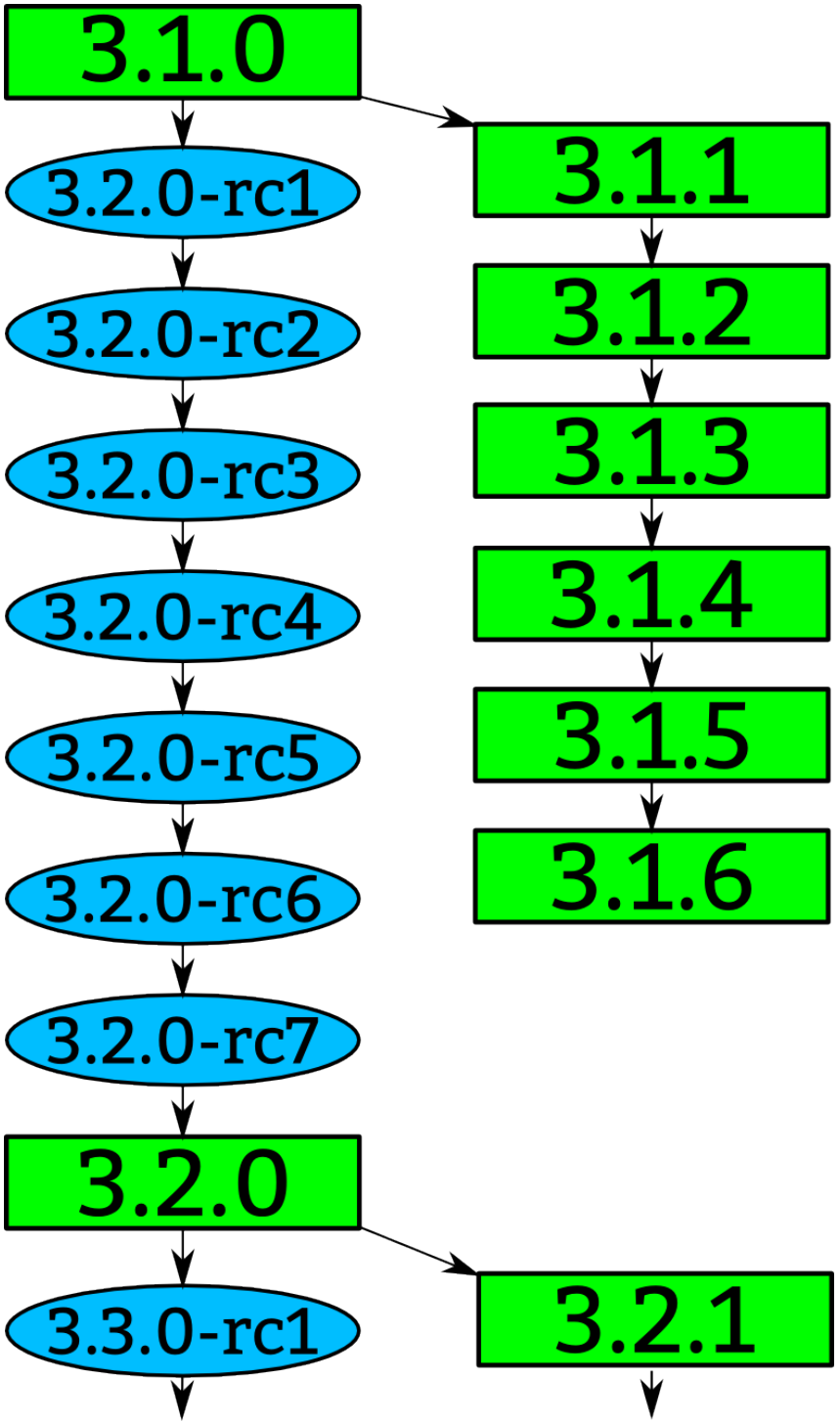
Kernel releases 3.2.0 – 3.6.0
October 2011 – September 2012

How we stay sane

Time based releases
Incremental changes

New release every
2¾ months
Kernel releases 2.6.20 – 3.4.0


3.1.0
3.2.0-rc1
3.2.0-rc2
3.2.0-rc3
3.2.0-rc4
3.2.0-rc5
3.2.0-rc6
3.2.0-rc7
3.2.0
3.3.0-rc1

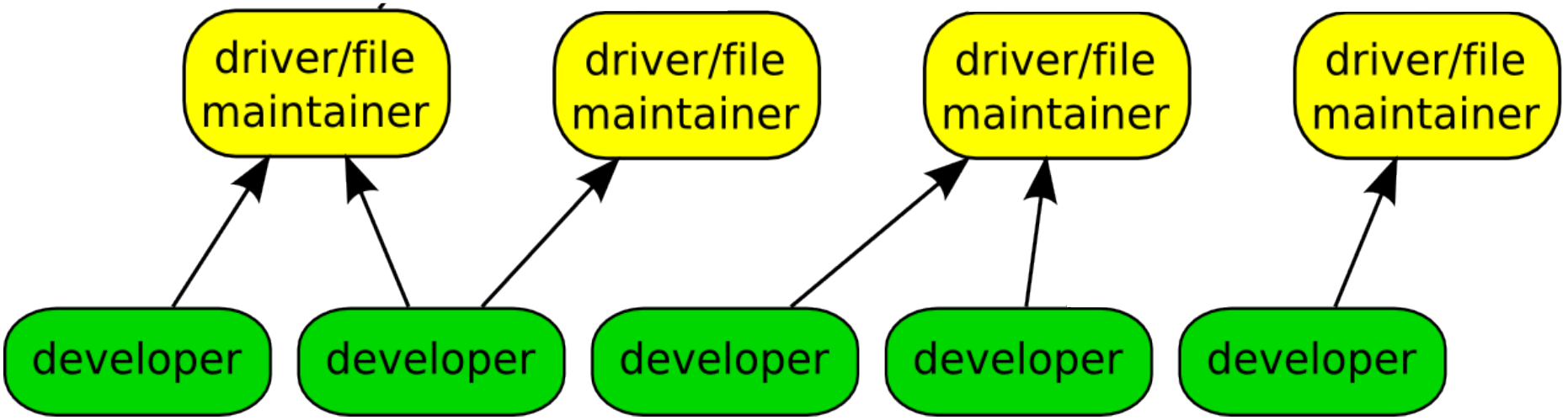

3.1.0
3.2.0-rc1
3.2.0-rc2
3.2.0-rc3
3.2.0-rc4
3.2.0-rc5
3.2.0-rc6
3.2.0-rc7
3.2.0
3.3.0-rc1
3.1.1
3.1.2
3.1.3
3.1.4
3.1.5
3.1.6
3.2.1

“Longterm kernels”

One picked per year
Maintained for two years

3.0 and 3.4

developer
developer
developer
developer
developer


driver/file maintainer
driver/file maintainer
driver/file maintainer
driver/file maintainer
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);
 }
```

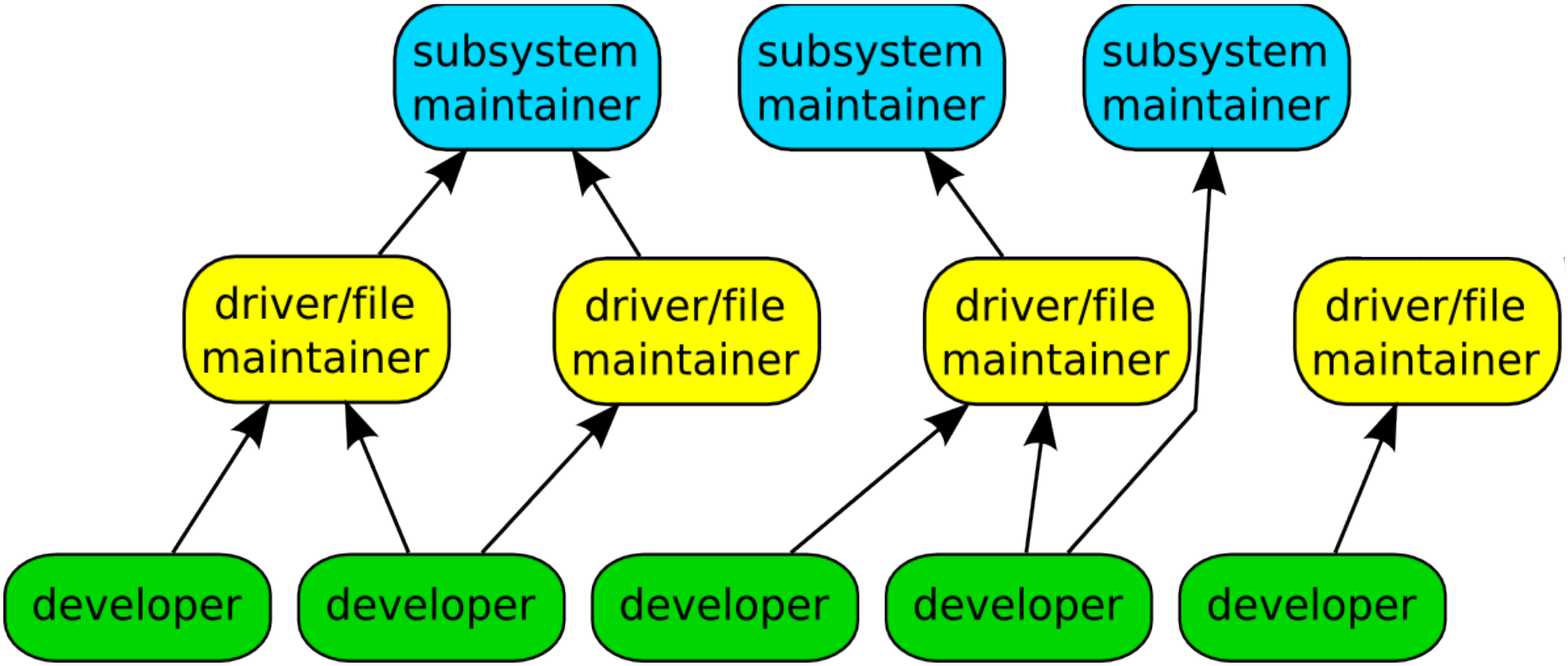
Developer's Certificate of Origin

(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.


subsystem maintainer
subsystem maintainer
subsystem maintainer
driver/file maintainer
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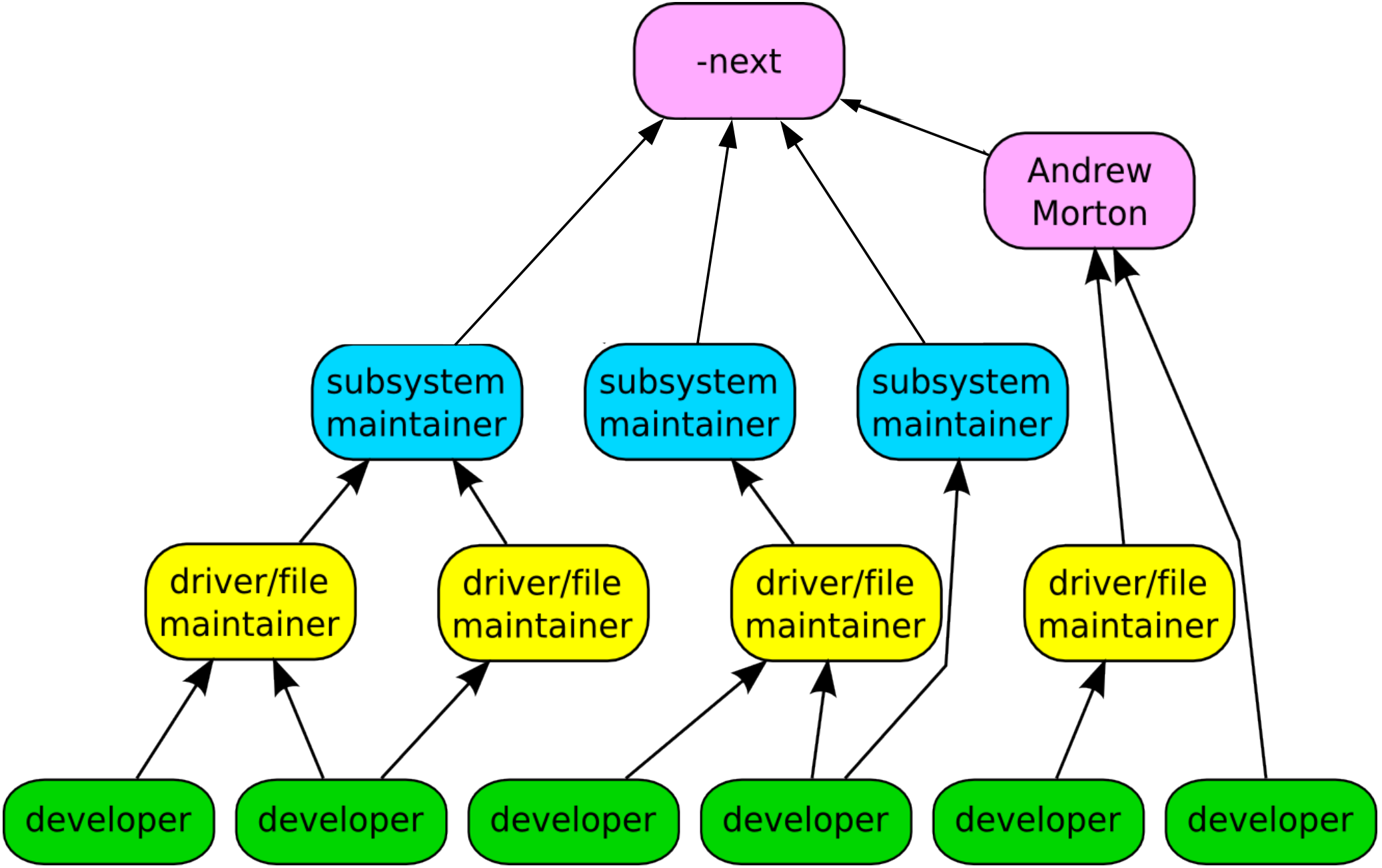
driver/file maintainer
developer
developer
developer
developer
developer


-next
Andrew Morton
subsystem maintainer
subsystem maintainer
subsystem maintainer
driver/file maintainer
driver/file maintainer
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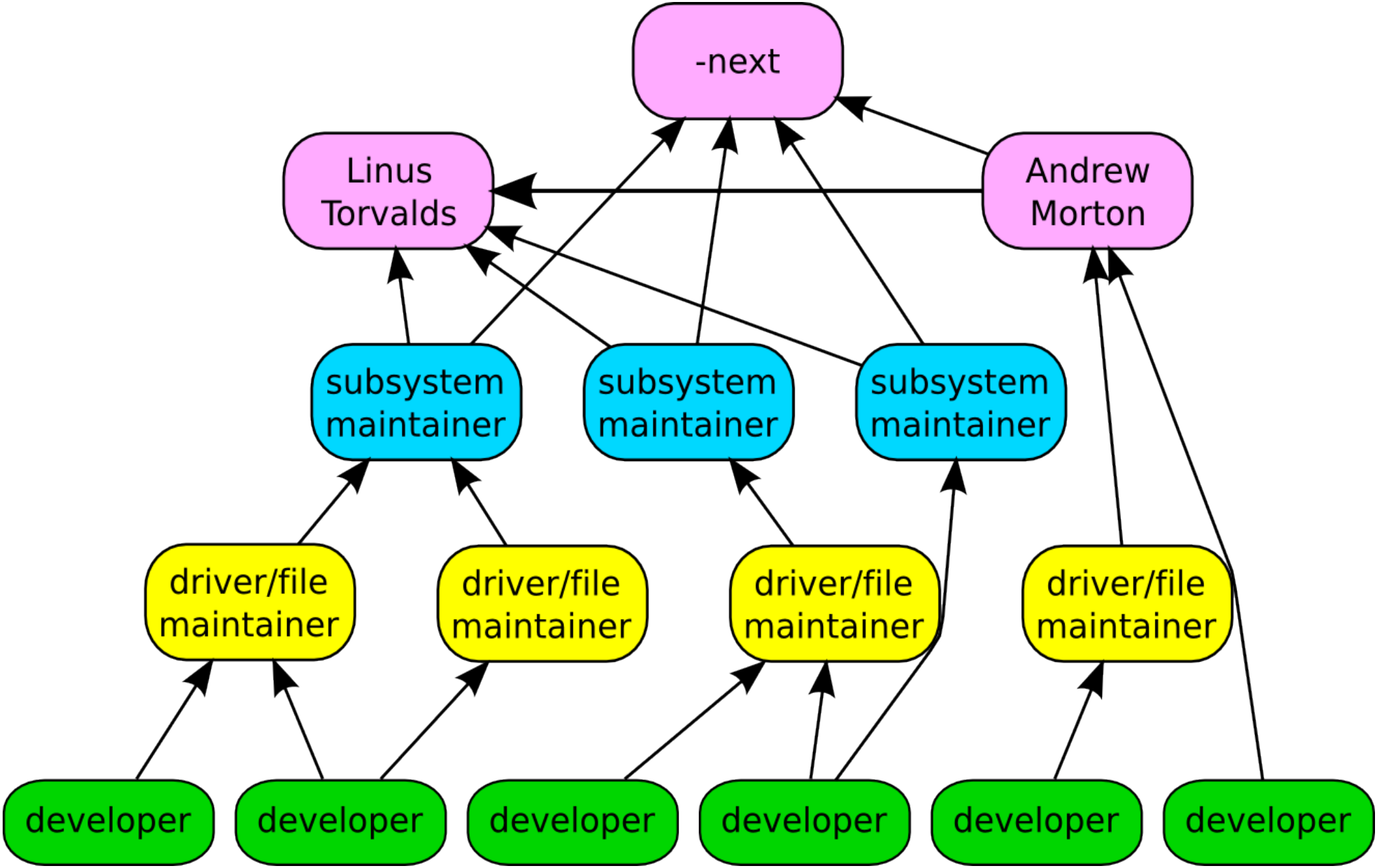
driver/file maintainer
developer
developer
developer
developer
developer
developer


-next
Linus Torvalds
Andrew Morton
subsystem maintainer
subsystem maintainer
subsystem maintainer
driver/file maintainer
driver/file maintainer
driver/file maintainer
driver/file maintainer
developer
developer
developer
developer
developer
developer

Top developers by quantity

Mark Brown	932
Axel Lin	722
H. Hartley Sweeten	611
Al Viro	589
Johannes Berg	460
Mauro Chehab	432
Greg Kroah-Hartman	429
Russell King	398
David Miller	390
Eric Dumazet	337

Kernel releases 3.2.0 – 3.6.0

Top Signed-off-by:

Greg Kroah-Hartman	4179
David S. Miller	3338
John Linville	2227
Mauro Carvalho Chehab	2041
Mark Brown	2155
Linus Torvalds	1593
Andrew Morton	1360
Al Viro	796
David Airlie	777
Axel Lin	728

Kernel releases 3.2.0 – 3.6.0

Who is funding this work?

1. “Amateurs”	13.8%
2. Red Hat	10.6%
3. Intel	9.4%
4. Unknown Individuals	4.0%
5. Texas Instruments	3.7%
6. Novell	3.6%
7. Linaro	3.4%
8. IBM	2.8%
9. Google	2.3%
10. Consultants	2.2%

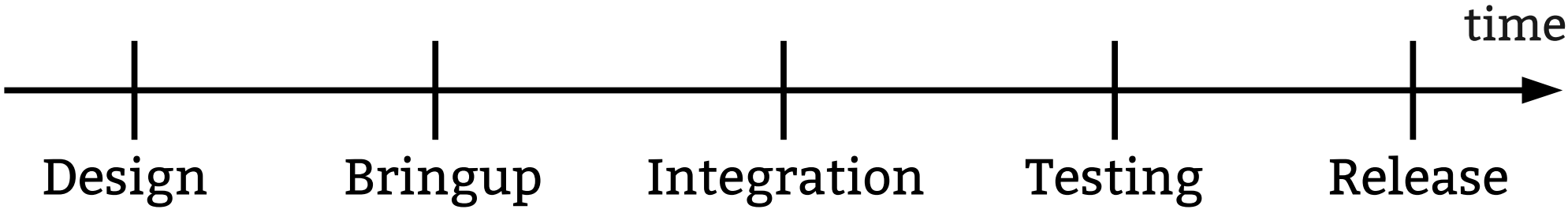
Kernel releases 3.2.0 – 3.6.0

Who is funding this work?

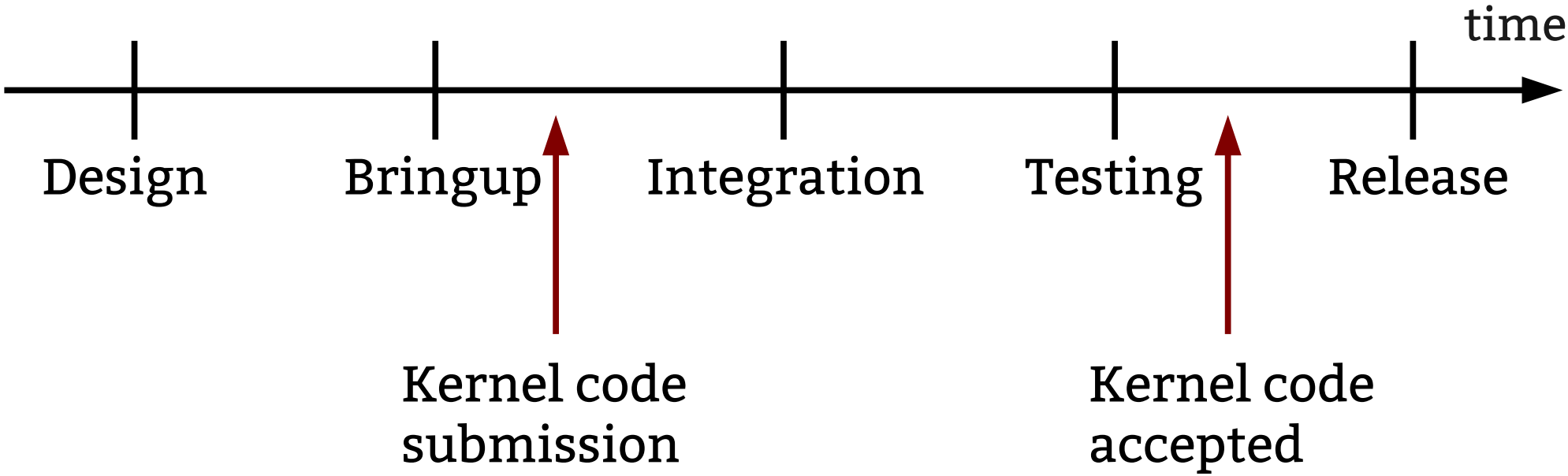
11. Wolfson Micro	2.2%
12. Samsung	1.9%
13. Ingics Technology	1.7%
14. Oracle	1.7%
15. Qualcomm	1.6%
16. Vision Engraving	1.4%
17. NVidia	1.3%
18. Broadcom	1.3%
19. Linux Foundation	1.2%
20. Renesas Electronics	1.2%

Kernel releases 3.2.0 – 3.6.0

Product Development



Product Development



Ideal

“Working upstream saves time and money”

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

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Linux Kernel Development

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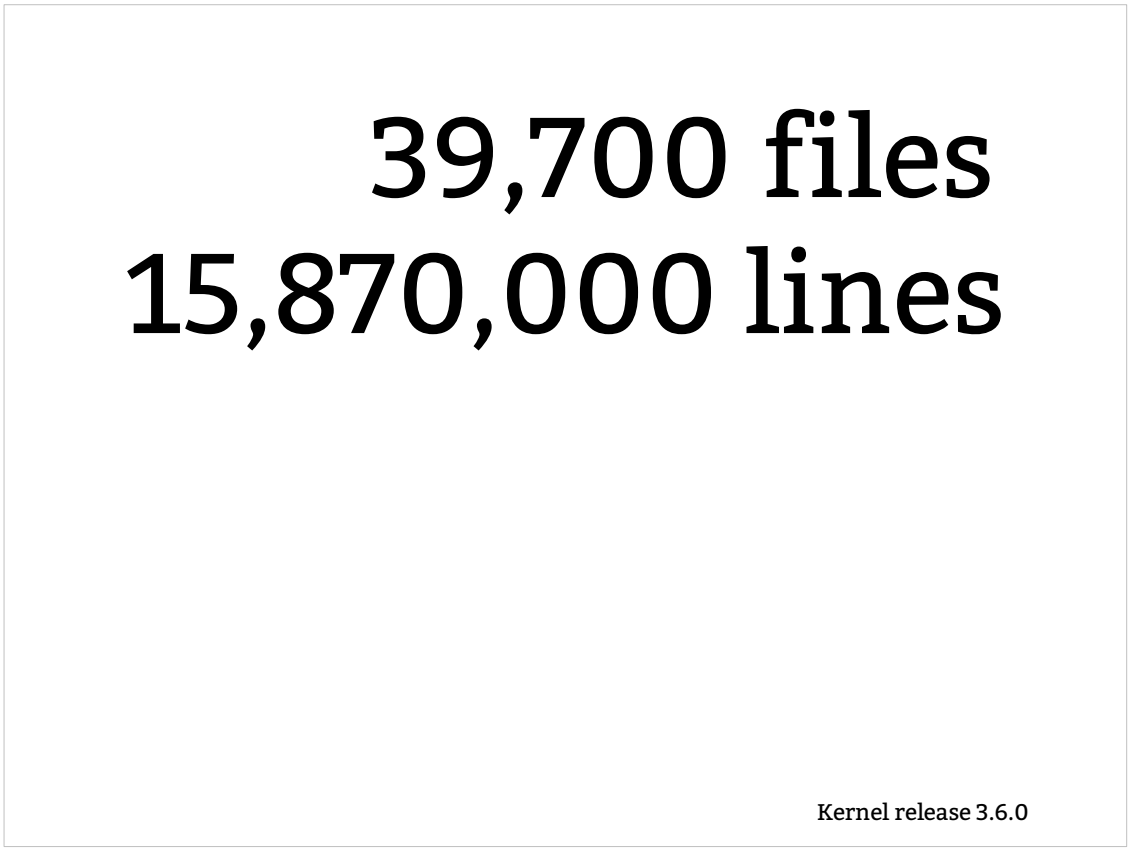
I'm going to discuss the how fast the kernel is moving, how we do it all, and how you can get involved.



This was for the 3.6 kernel release, which happened September 30, 2012.

2,497 developers
406 companies

Kernel releases 3.2.0 – 3.6.0
October 2011 – September 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.

10,700 lines added
7,600 lines removed
2,340 lines modified

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6.64 changes per hour

Kernel releases 3.2.0 – 3.6.0
October 2011 – September 2012

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.

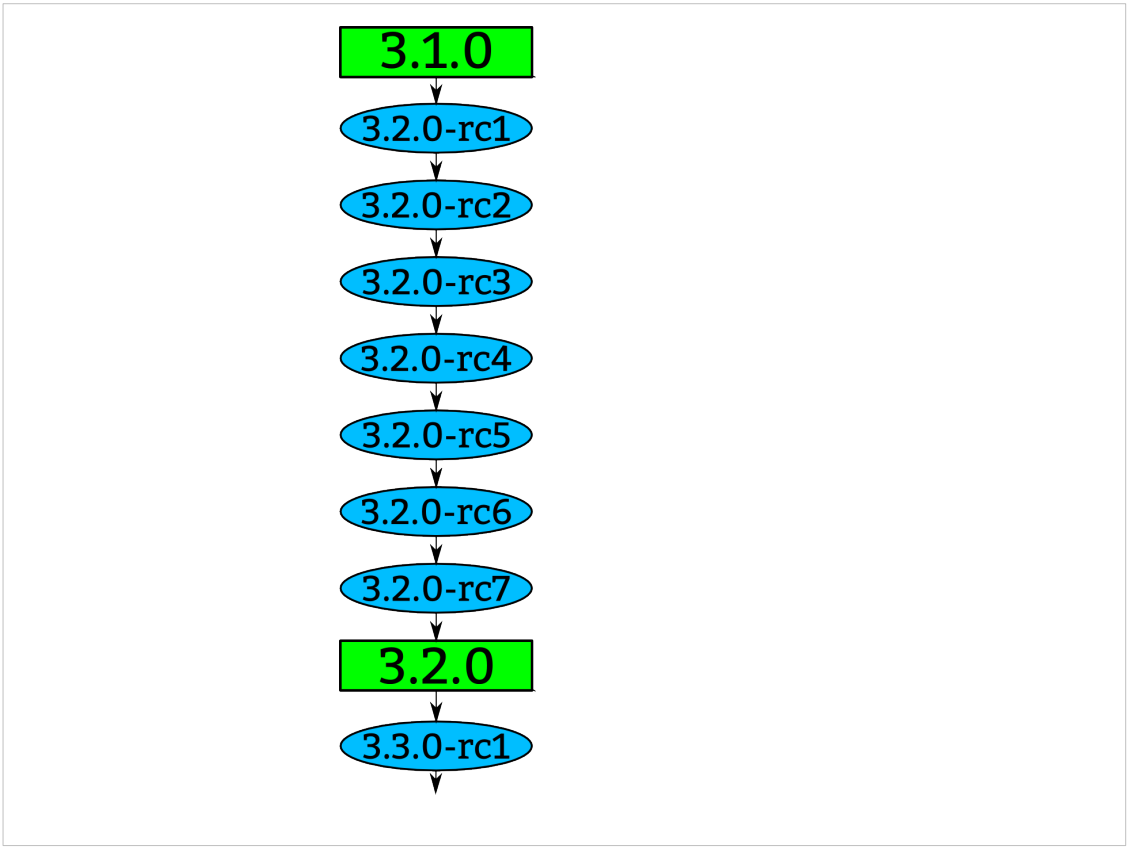
Interesting note, all of these changes are all through the whole kernel.

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.

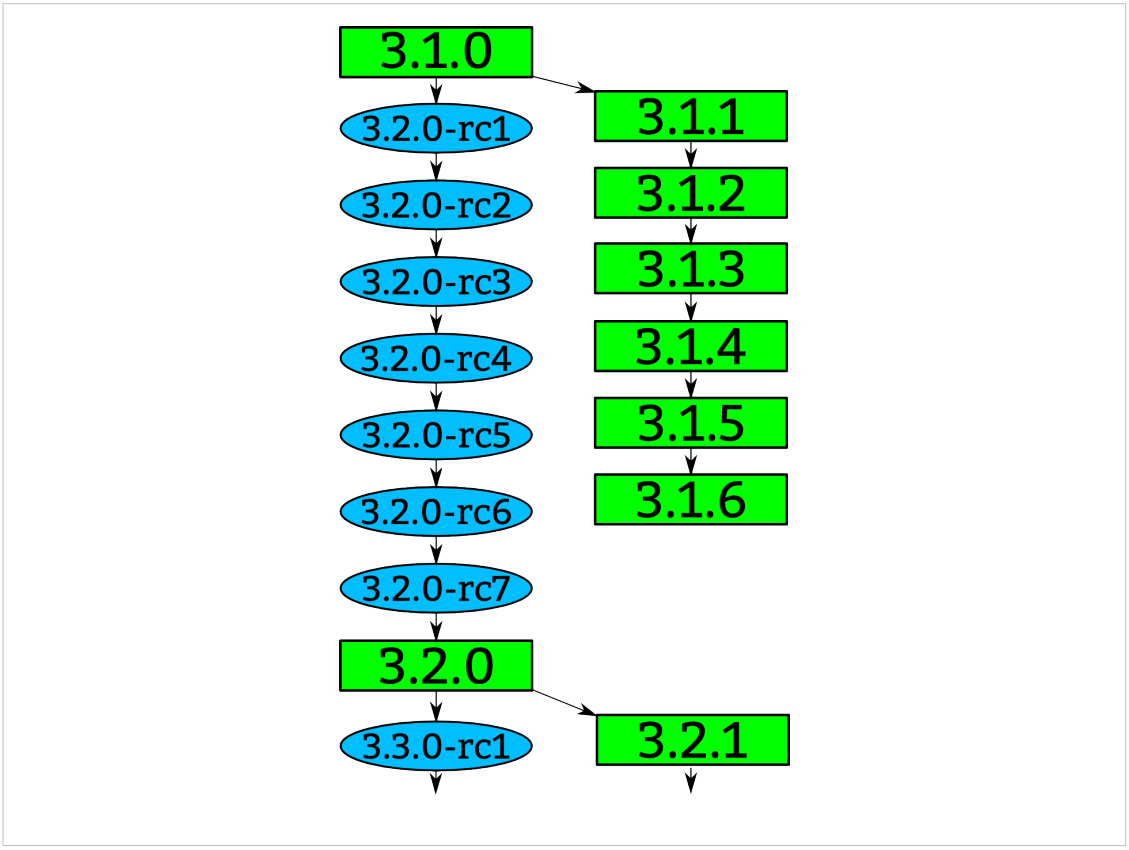
How we stay sane

Time based releases
Incremental changes

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

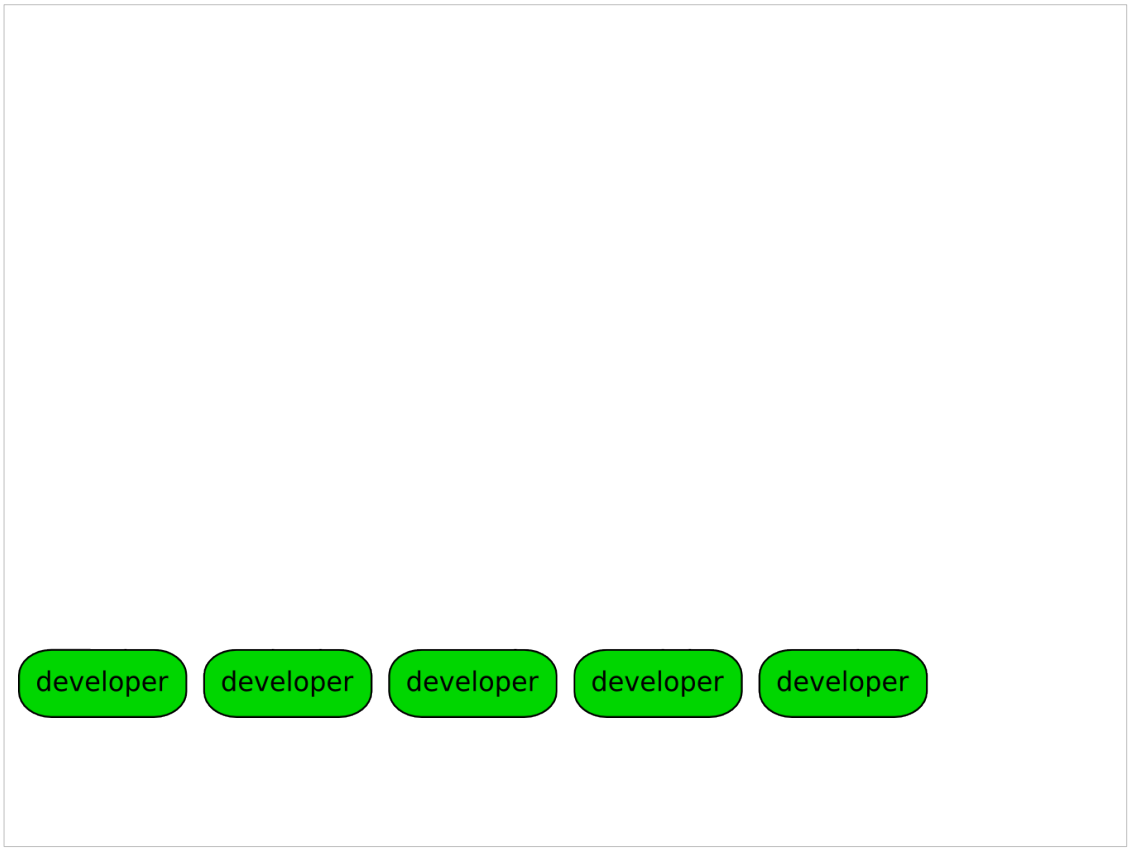
I pick one kernel release per year to maintain for longer than one release cycle. This kernel I will maintain for at least 2 years.

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.

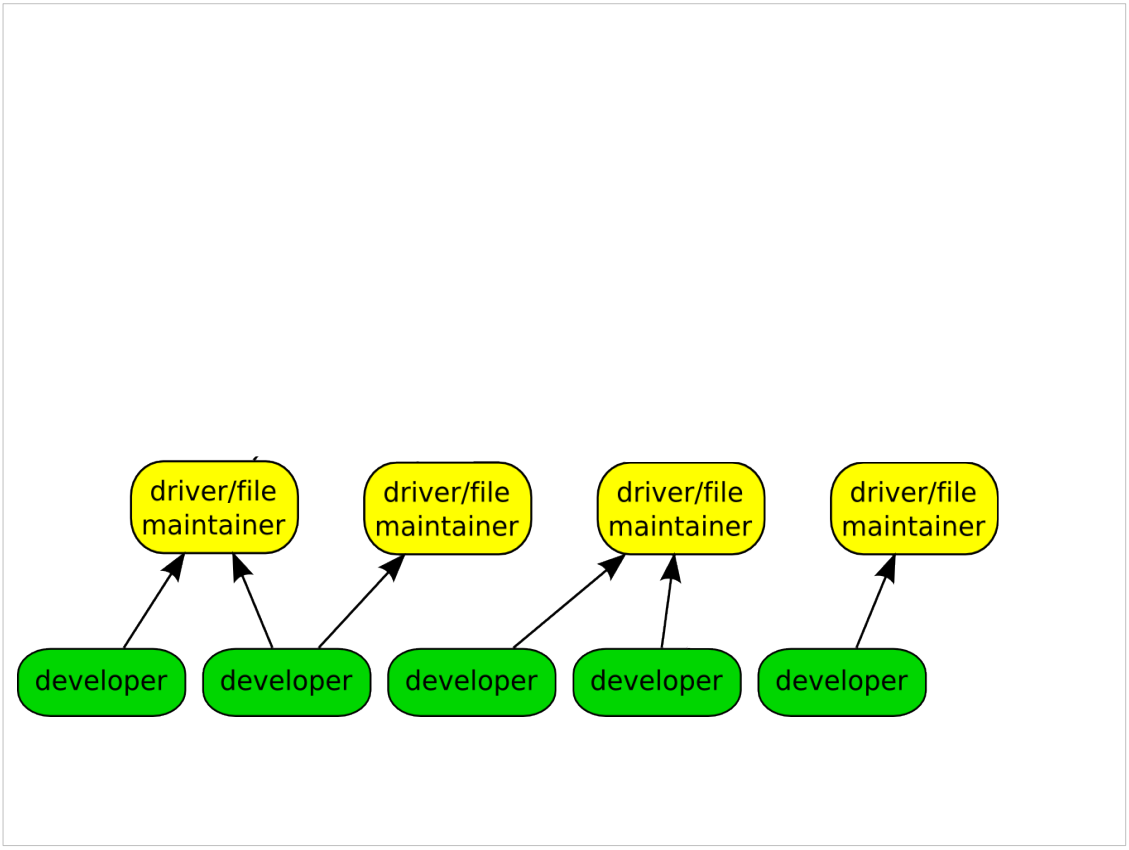
Ben Hutchings is maintaining the 3.2 kernel as a longterm kernel for the Debian project.

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

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    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);
 }
```

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 commited 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

(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.

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.

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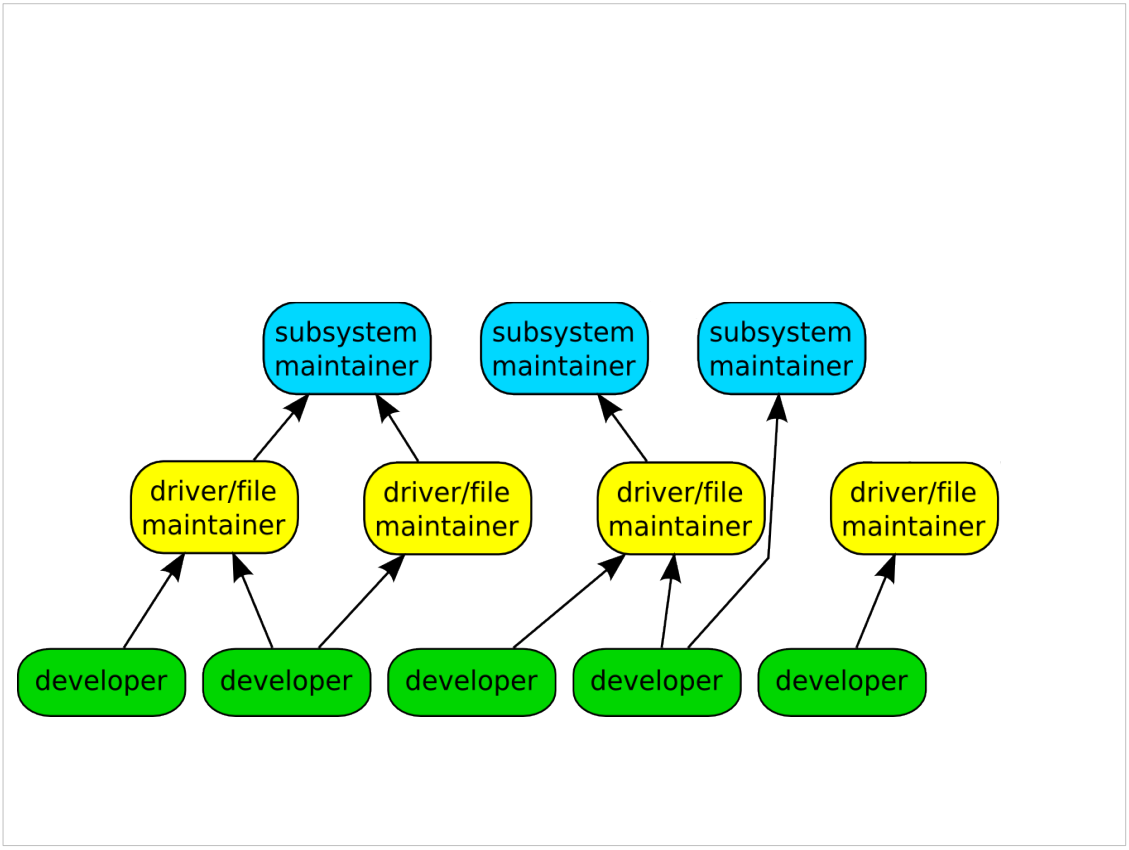
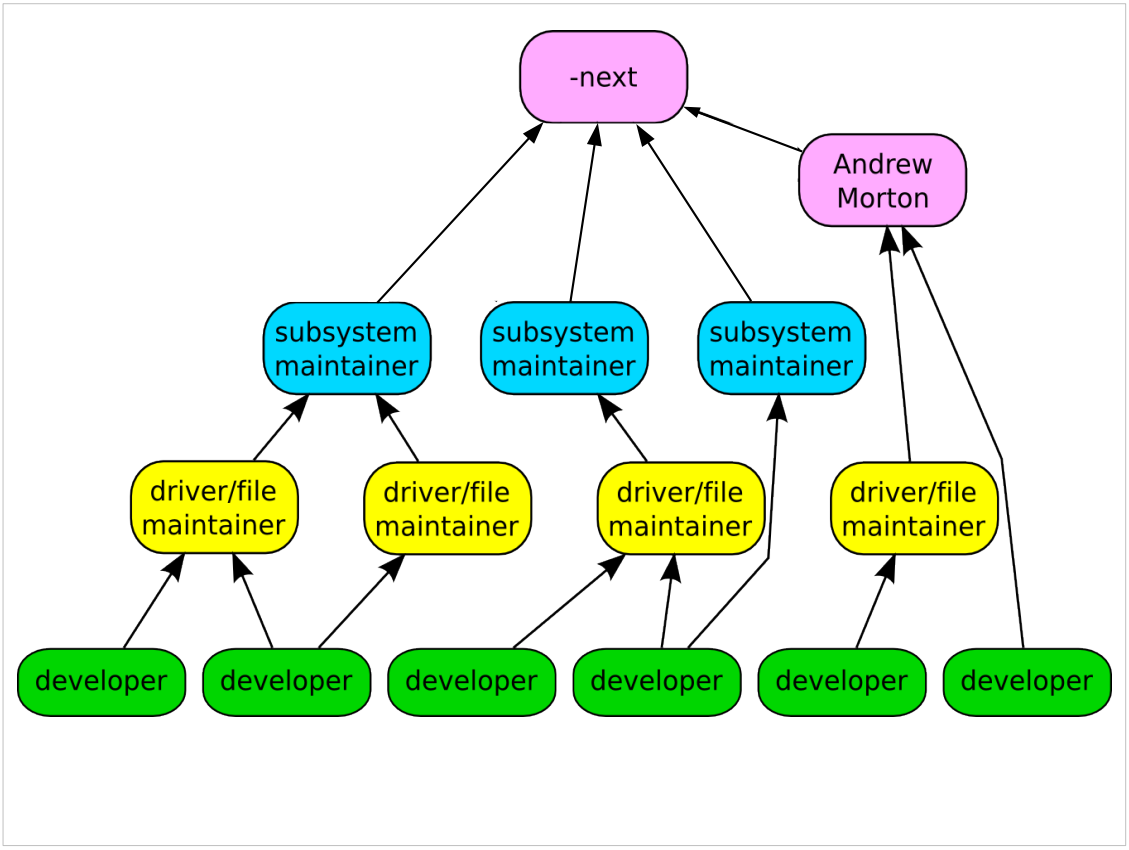


After reviewing the code, and adding their own signed-off-by to the patch, the file/driver maintainer sends the patch to the subsystem maintainer responsible for that portion of the kernel.

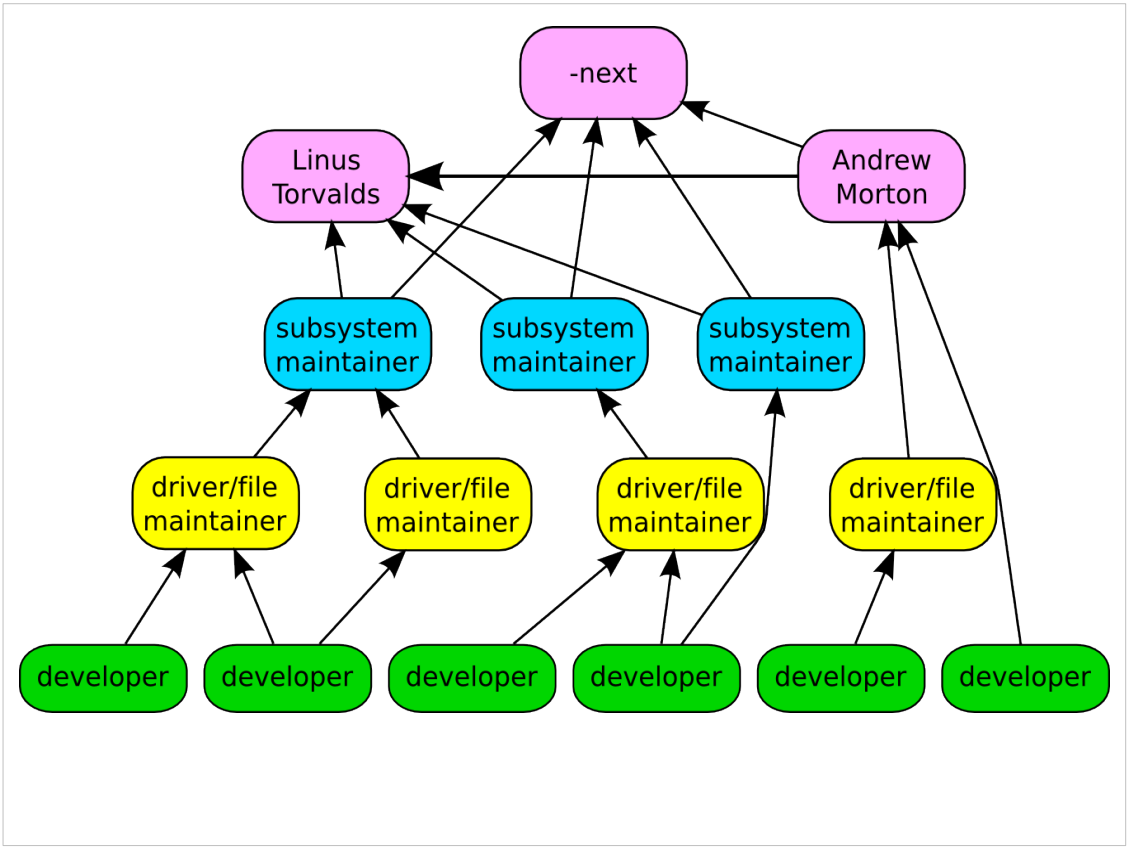
We have around 150 subsystem maintainers



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.

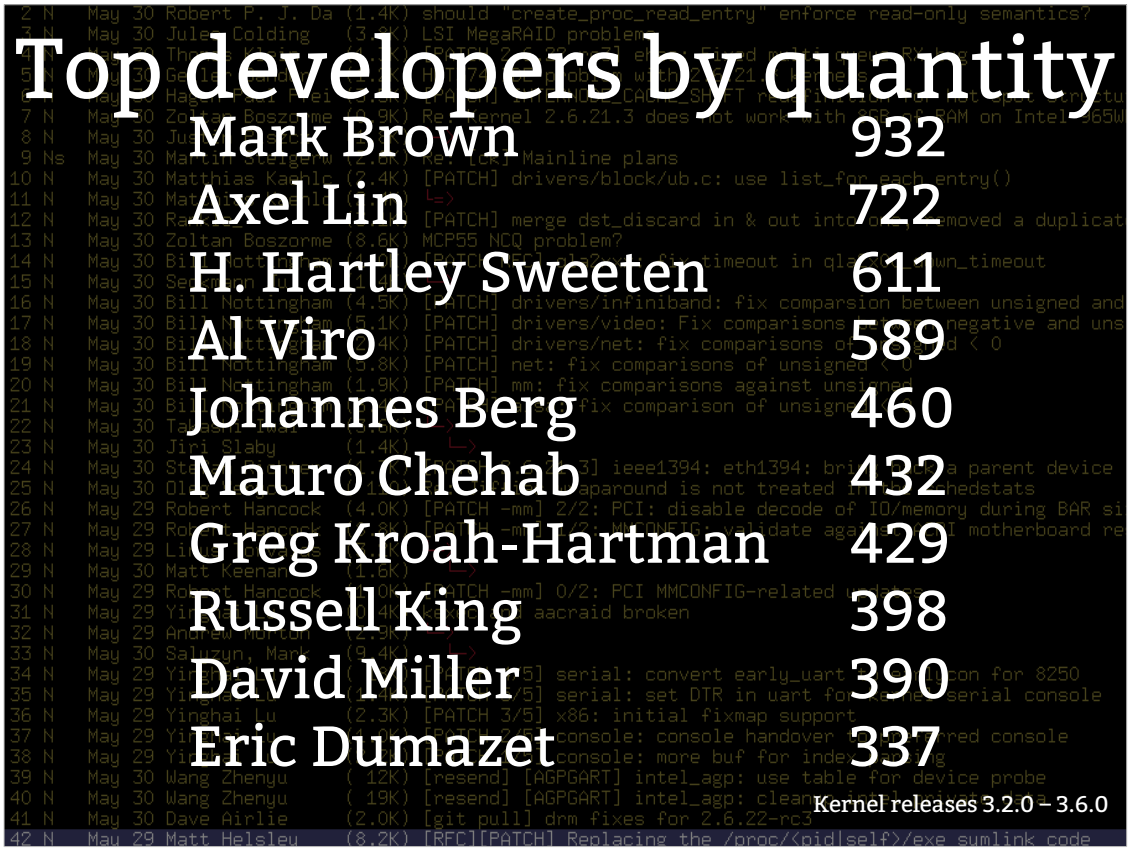


Every 3 months, when the merge window opens up, everything gets sent to Linus from the subsystem maintainers and Andrew Morton.

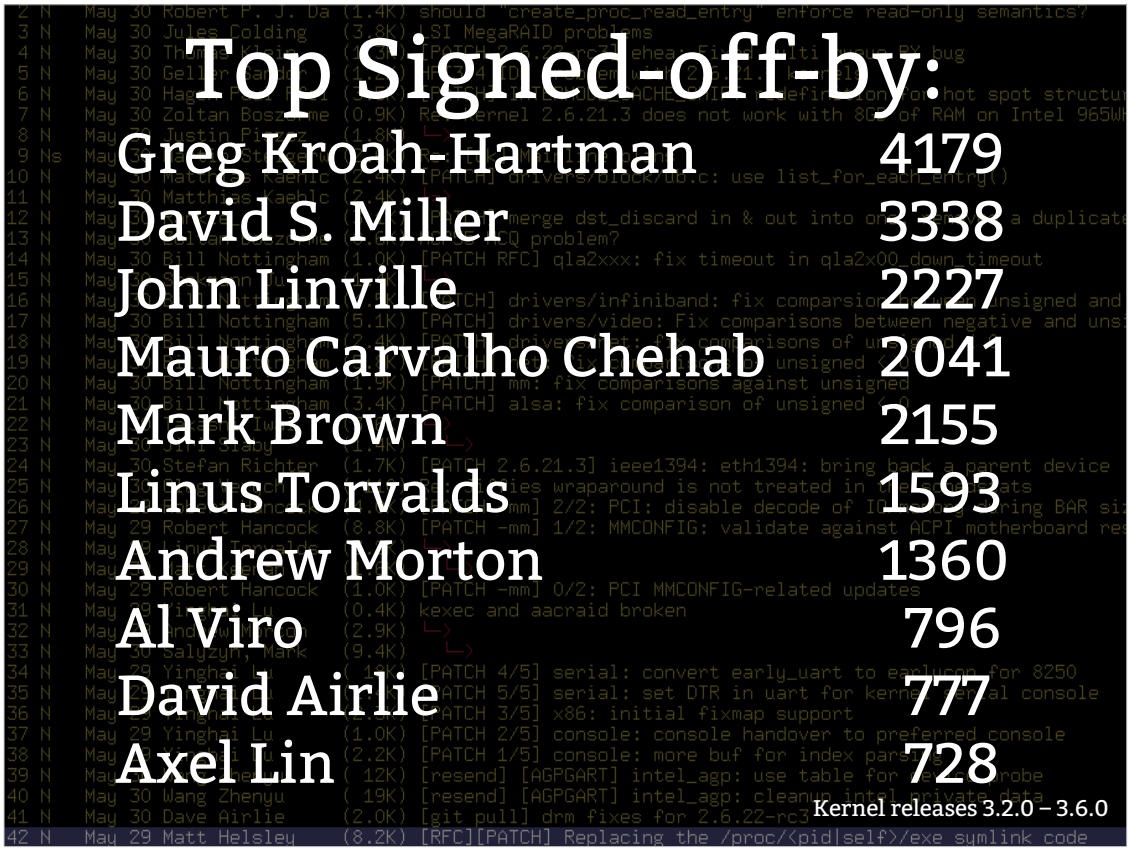
The merge window is 2 weeks long, and thousands of patches get merged in that short time.

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.



Mark – embedded sound
Axel – janitorial
Hartley – comedi
Al – vfs and filesystem
Mauro – v4l
Russell – ARM
Johannes – intel wireless
David – networking
Eric - networking
Greg – USB, staging, tty, etc.



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

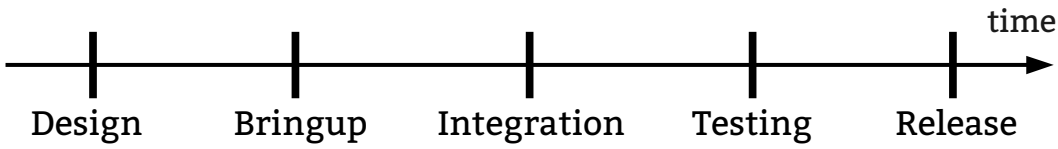
So you can view this as either 20% is done by non-affiliated people, or 80% is done by companies.

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

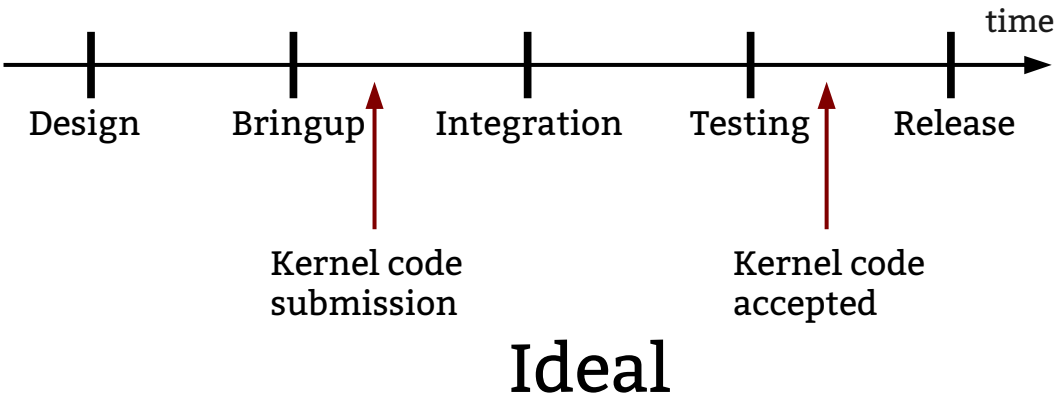
Why this all matters: If your company relies on Linux, and it depends on the future of Linux supporting your needs, then you either trust these other companies are developing Linux in ways that will benefit you, or you need to get involved to make sure Linux works properly for your workloads and needs.

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