## Linux Kernel Development

#### Greg Kroah-Hartman gregkh@linuxfoudation.org

github.com/gregkh/kernel-development



## 38,566 files 15,384,000 lines

Kernel release 3.4.0

## 2,833 developers 373 companies

### 10,500 lines added 8,400 lines removed 2,300 lines modified

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### every day

### 5.79 changes per hour

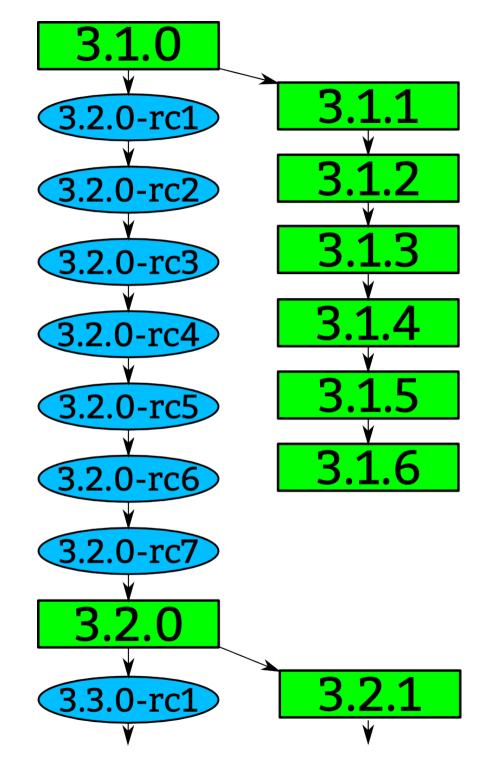
### How we stay sane

### Time based releases Incremental changes

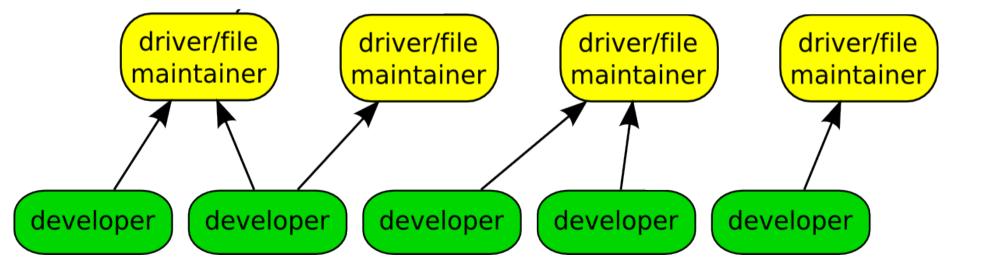
### New release every 2<sup>3</sup>/<sub>4</sub> months

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







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>

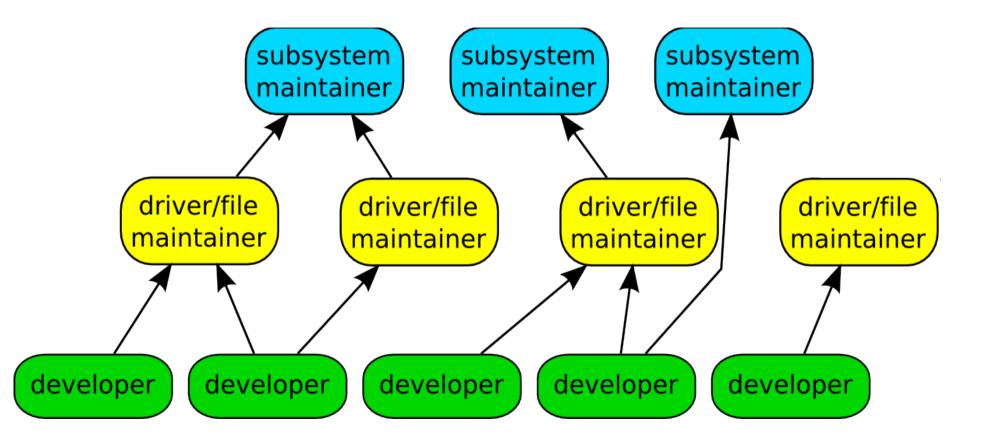
#### Developer's Certificate of Origin

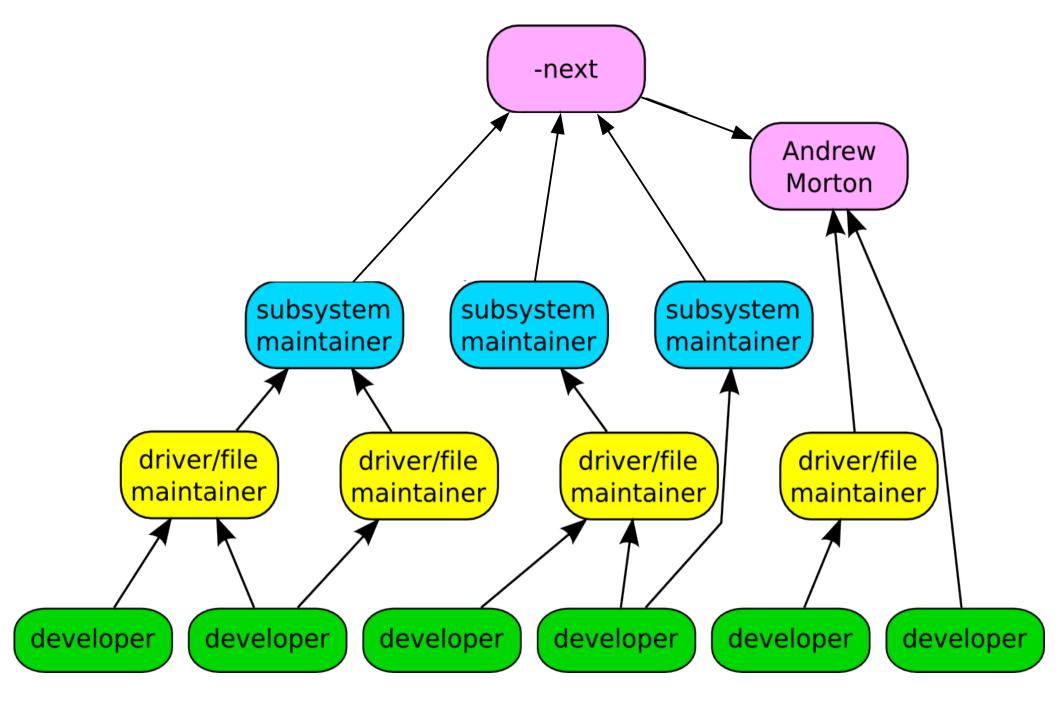
(a) I created this change; or

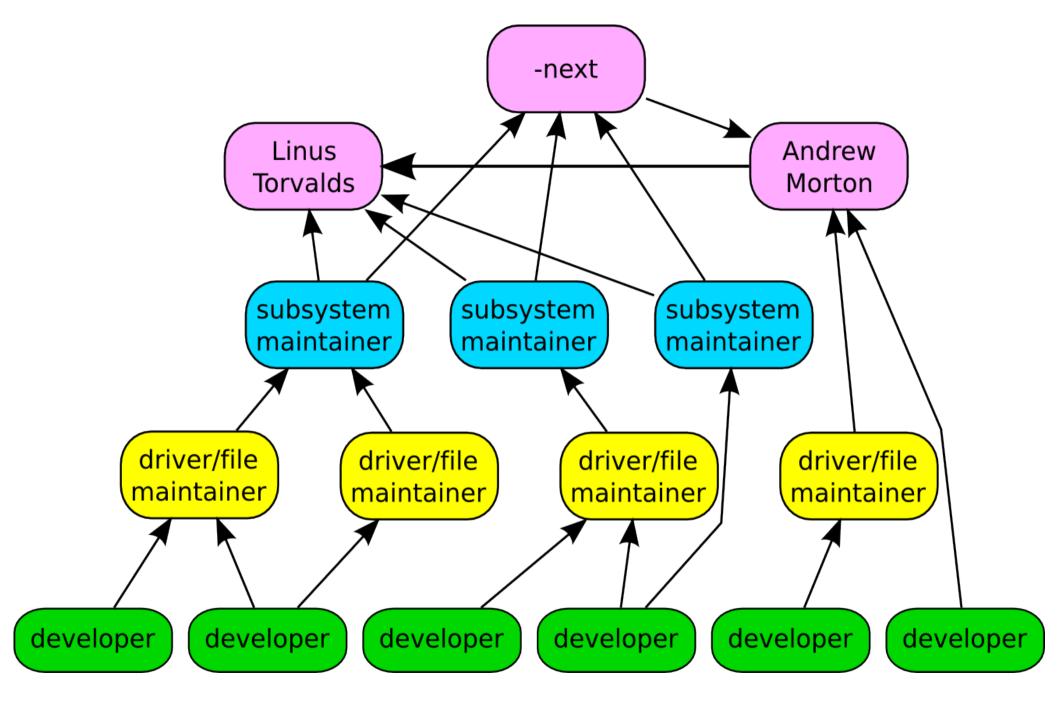
(b) Based this on a previous work with a compatible license; or

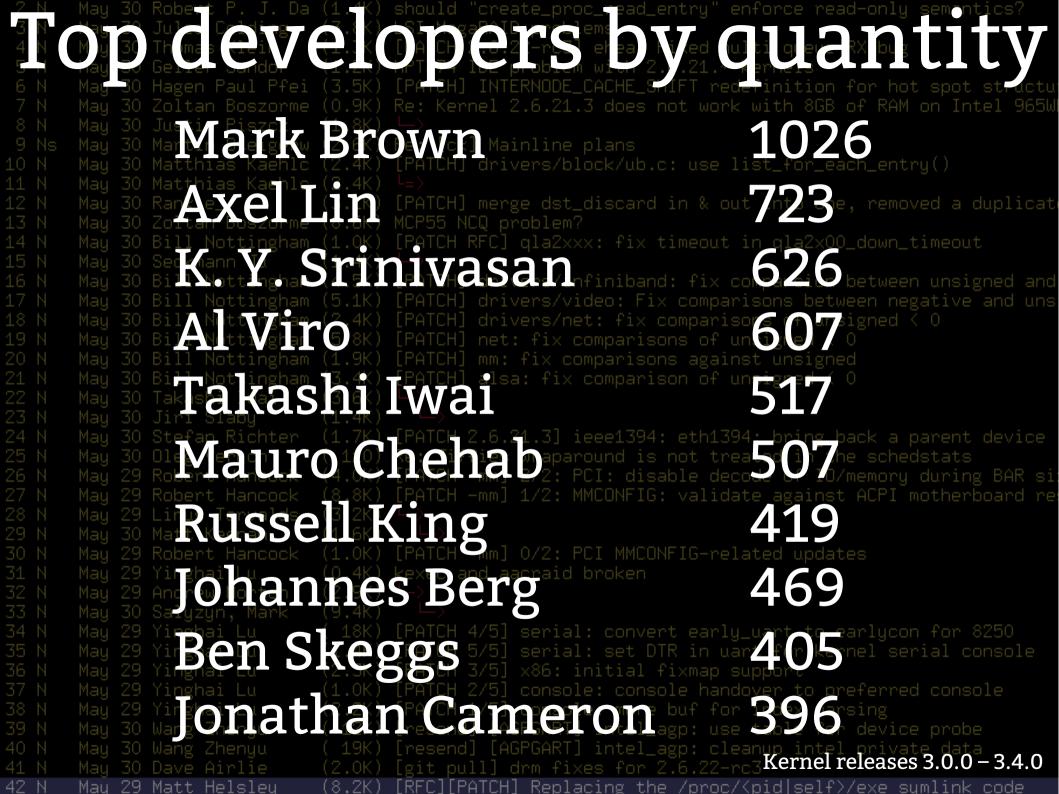
(c) Provided to me by (a), (b), or (c) and not modified

(d) This contribution is public.









Top Signed-off-by Greg Kroah-Hartman 4767 David S. Miller 3857 John Linville 3252 Mauro Carvalho Chehab 2412 Mark Brown 2230 Linus Torvalds 1984**Andrew Morton** 1573 **James Bottomley** 1089 Takashi Iwai 953 **Russell King** 930 3.4.0

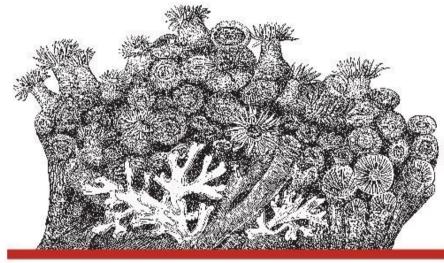
#### Who is funding this work? 1. "Amateurs" 14.2% 2. Red Hat 10.1% 3. Intel 8.6% 4. Unknown Individuals 5.2% 4.0% 5. Novell 6. IBM 3.7% 7. Texas Instruments 3.6% 8. Broadcom 3.0% 9. Consultants 2.3% 10. Wolfson Micro 2.1%

Kernel releases 3.0.0 – 3.4.0

Who is funding this work? 11. Samsung 1.9% 12. Google 1.8% 13. Oracle 1.7% 14. Freescale 1.5% 15. MiTAC 1.4% 16. Qualcomm 1.4% 17. Microsoft 1.3% 18. Linaro 1.2% 19. Nokia 1.2% 20. AMD 1.1%

Kernel releases 3.0.0 – 3.4.0

Run the kernel.org release on your machine



### LINUX KERNEL IN A NUTSHELL

A Desktop Quick Reference

Documentation/HOWTO

Documentation/development-process

#### kernelnewbies.org



Google "write your first kernel patch"

kernelnewbies.org/KernelJanitors/Todo

### Linux Driver Project

drivers/staging/\*/TODO



#### github.com/gregkh/kernel-development

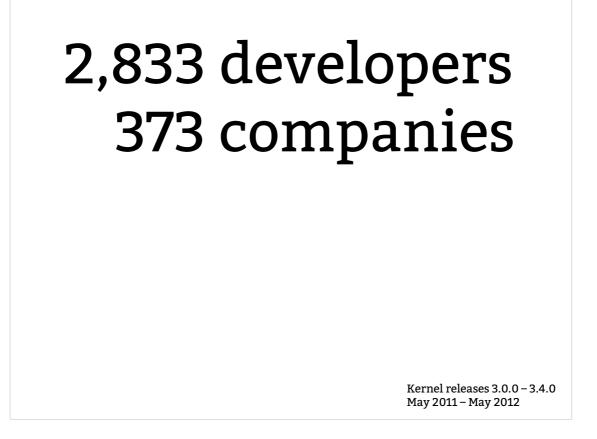


I'm going to discuss the how fast the kernel is moving, how we do it all, and how you can get involved.

#### 38,566 files 15,384,000 lines

Kernel release 3.4.0

This was for the 3.2 kernel release, which happened January 4, 2012.

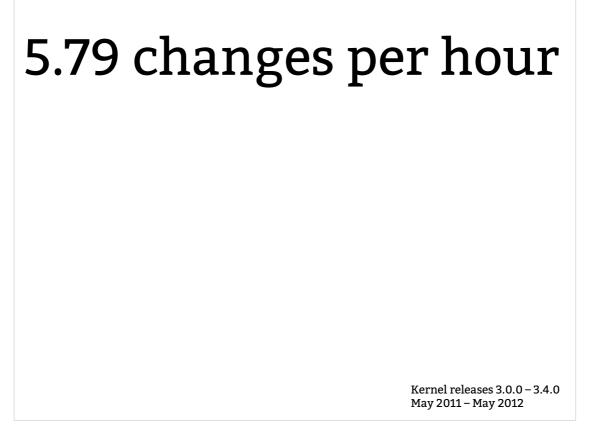


- This makes the Linux kernel the largest contributed body of software out there that we know of.
- This is just the number of companies that we know about, there are more that we do not, and as the responses to our inquiries come in, this number will go up.

#### 10,500 lines added 8,400 lines removed 2,300 lines modified

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every day



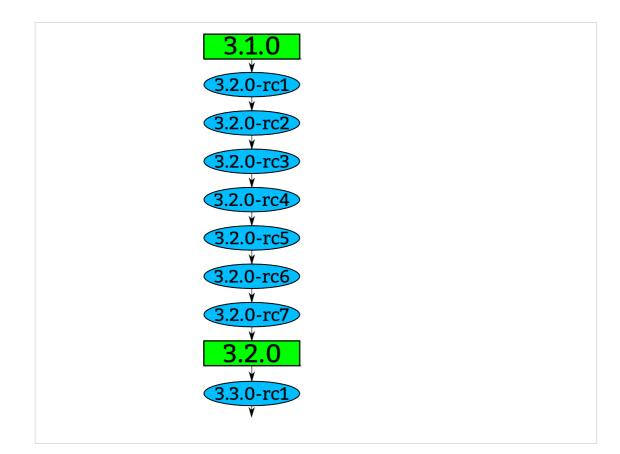
- This is 24 hours a day, 7 days a week, for a full year.
- We went this fast the year before this as well, this is an amazing rate of change.
- Interesting note, all of these changes are all through the whole kernel.
- For example, the core kernel is only 5% of the code, and 5% of the change was to 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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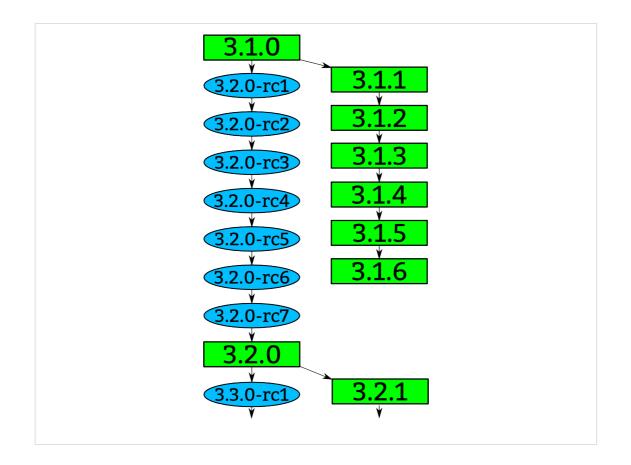
84 days to be exact, very regular experience.



How a kernel is developed.

Linus releases a stable kernel

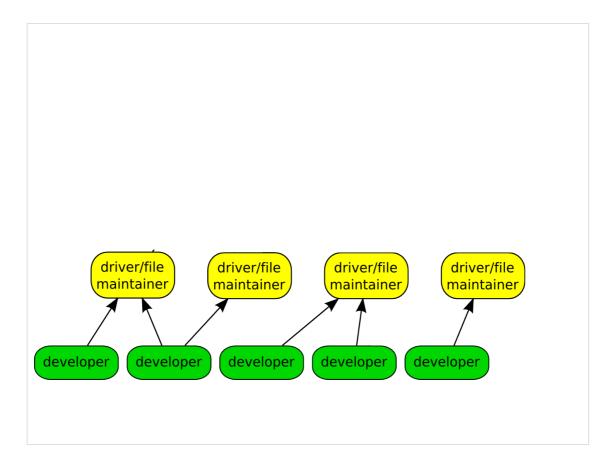
- 2 week merge window from subsystem maintainers
- rc1 is released
- bugfixes only now
- 2 weeks later, rc2
- bugfixes and regressions
- 2 weeks later,rc3
- And so on until all major bugfixes and regressions are resolved and then the cycle starts over again.



- 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...



- 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
           Robert Jarzmik <robert.jarzmik@free.fr>
Author:
AuthorDate: Tue Apr 21 20:33:10 2009 -0700
           Greg Kroah-Hartman <gregkh@suse.de>
Commit:
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);
}
```

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

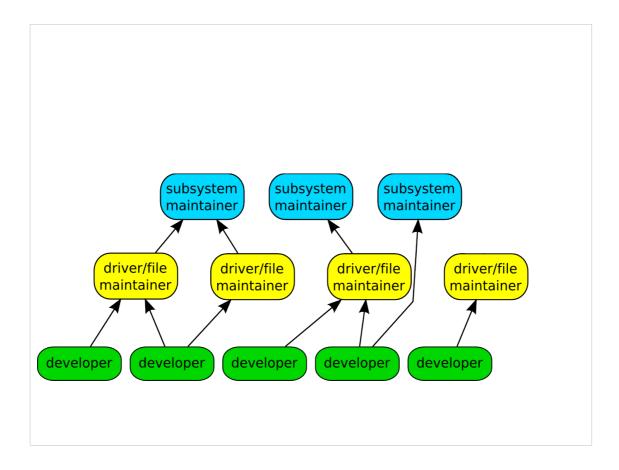
(a) I created this change; or

- (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.

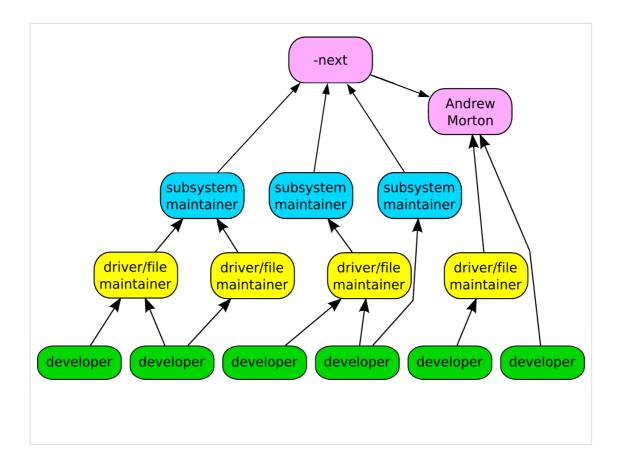
This is what "Signed-off-by:" means.

- 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.
- 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.

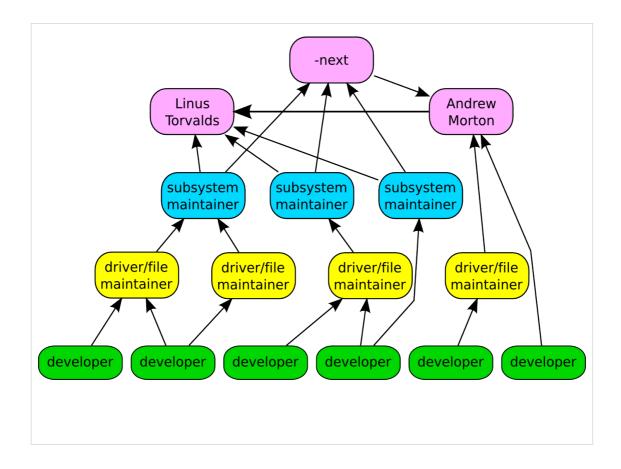


After reviewing the code, and adding their own signed-off-by to the patch, the file/driver maintainer sends the patch to the subsystem maintainer responsible for that portion of the kernel.

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	" enforce read-only seminitics? <b>Quantity</b> read-inition for hot soot structu
7 N May 30 Zoltan Boszorme (0.9K) Re: Kernel 2.6.21.3 does not ( 8 N May 30 Ju Marker Brown Mainline plans 9 Ns May 30 Matchias Kaenic (2.4K) PHILHI drivers/block/ub.c: us	work with 86B of RAM on Intel 965W <b>1026</b> se list for each entry()
11 N May 30 Matchias Kall (3.4K) (=> 12 N May 30 Ran (3.4K) (10) [PATCH] merge dst_discard in 4 13 N May 30 Zortan Doszonne (0.0K) MCP55 NCQ problem?	& out <b>7</b> 123 <sup>e</sup> , removed a duplicat
14 N May 30 Bill Nottingham (1.0K) [PATCH RFC] qla2xxx: fix times 15 N May 30 SetKann Y. Srinivasan finiband: f 16 N May 30 Bill Nottingham (5.4K) [PATCH] deivers (videous fix, and	out in gla2×00_down_timeout ix cc 6266 between unsigned and
17 N May 30 Bill Nottingham (3.1K) [PHTCH] drivers/video; Fix comp. 18 N May 30 Bil ANT Van (3.4K) [PATCH] drivers/net: fix comparisons of 19 N May 30 Bill Nottingham (1.9K) [PATCH] net: fix comparisons at	mparisons between negative and uns ariso 607 igned < 0 of un 6070 arinst unsigned
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27 N May 29 Robert Hancock (1988) [HITCH -MM] 172: MMCUNFIG: Va 28 N May 29 Li <b>RUSSell</b> ck <b>King</b> 29 N May 30 Ma Robert Hancock (196) [PATCH 201] 0/2: PCI MMCONFIG:	11date against HUF1 motherboard re 419 -related undates
31 N May 29 Yi Johannes Berg	469
34 N May 29 Yi Ben Skeggs 5/5] serial: convert e 35 N May 29 Yi Ben Skeggs 5/5] serial: set DTR in 36 N May 29 Yi Mana La Sker Sker Sker Sker Sker Sker Sker Sker	arly_uarton_carlycon for 8250 n uar <b>4</b> 05nel serial console ap support
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Mark – embedded sound KY – hyperv David – networking Joe – janitorial Alexl – janitorial Al – vfs and filesystem Russell – ARM maintainer Takashi – sound maintainer Jonathan – IIO Ben – nouveau developer

2 N May 30 Kohene P. J. Da (1.4K) should "create pit read en fit 3 N May 30 JuTropp (Signed-off 4 N May 30 Gelt Paul Pit (3.5K) Fight Internote Forte Shiet re	fore read-only semantics?
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) N May 30 201tan Boszorme (8.6K) MLP95 NLU problem? H N May 30 311 Not Things (1.5K) PATCH RFC] qla2xxx: fix timeout S N May 30 51 Not Lingham (4.5K) POTCH1 drivers/infinihand: fix	in qla2x <b>3252</b> Pout
Mauro Carvalho Chehab	sons of un2412
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N May 30 Jini Slaby (1.4K) N May <b>DinnuSchTorvalds</b> .6.21.3] ieee1394: eth13 N May 28 Extent Harack (4.0K) [2016] see wraparound is not tr	94: bring <b>1984</b> th device eated in t <b>1984</b> the
May Andrew Morton 1/2: MMCONFIG: valid	late again <b>1573</b> herboard re
N May 29 Robert Hancock (1 0K) [PATCH ]mm] 0/2: PCI MMCONFIG-re N May <b>James Bottomley</b> aid broken	1089
N May 30 Salyzyn, Mark (9.4K) N May <b>Takashi Iwai</b> CH 4/5] serial: convert earl N May <b>Takashi Iwai</b> CH 5/5] serial: set DTR in u	y_uart to ear <b>953</b> r 8250 art for kerne <b>953</b> console
N May 29 Yinghai Lu (2.3%) [PATCH 3/5] x86: initial fixmap N May Russell King Forth 2/5] console: console han N May Autor Spectrum Lizk String TCH 1/5] console: more buf fo	support dover to pref <b>930</b> isole r index parsi <b>930</b> isole
N May 30 Wang Zhenyu (12K) Seend [Holbart] intel_agp. ds N May 30 Wang Zhenyu (19K) [resend] [AGPGART] intel_agp: dl N May 30 Dave Airlie (2.0K) [git pull] drm fixes for 2.6.22- N May 29 Matt Helsley (8.2K) [REC][PATCH] Replacing the /prod	eanup intel private data rc3 Kernel releases 3.0.0 – 3.4.0

Greg – driver core, usb, staging David – networking John – wireless networking Mauro - v4l Linus – everything Mark - embedded Andrew – everything James – SCSI Takashi – sound Russell - ARM

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. IBM	3.7%	
7. Texas Instruments	3.6%	
8. Broadcom	3.0%	
9. Consultants	2.3%	
10. Wolfson Micro	2.1%	
	Kernel releases 3.0.0 – 3.4.0	

- 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. Samsung	1.9%
12. Google	1.8%
13. Oracle	1.7%
14. Freescale	1.5%
15. MiTAC	1.4%
16. Qualcomm	1.4%
17. Microsoft	1.3%
18. Linaro	1.2%
19. Nokia	1.2%
20. AMD	1.1%
	Kernel releases 3.0.0 – 3.4.0

Samsung 980 patches Qualcomm 707 patches

Run the kernel.org release on your machine



This book tells you how to build and install a kernel on your machine.

Free online

Documentation/HOWT0

Documentation/development-process

These documents in the kernel source directory are the best place to start if you want to understand how the development process works, and how to get involved.

The HOWTO file has links to almost everything else you ever wanted..

kernelnewbies.org



http://www.kernelnewbies.org

Google "write your first kernel patch"

This is a video of a talk I gave at FOSDEM, going through the steps, showing exactly how to create, build, and send a kernel patch.

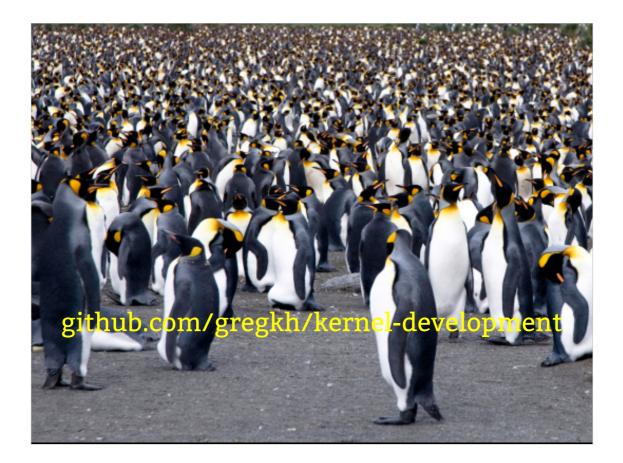
kernelnewbies.org/KernelJanitors/Todo

So you know how to create a patch, but what should you do? The kernel janitors has a great list of tasks to start with in cleaning up the kernel and making easy patches to be accepted.

### Linux Driver Project

drivers/staging/\*/TODO

- The staging tree also needs a lot of help, here are lists of things to do in the kernel for the drivers to be able to move out of the staging area.
- Please always work off of the linux-next tree if you want to do these tasks, as sometimes they are already done by others by the time you see them in Linus's tree.



**Obligatory Penguin Picture** 

