



LINUX INTERNALS

A BRIEF TOUR OF THE KERNEL SOURCE TREE

[Source: Wikipedia on “Linux Kernel”](#)

...

Development

The kernel changes made in year 2007 have been submitted by no less than 1900 developers – but there may be a lot more because developers working in teams usually count as one. It is generally assumed that the community of Linux kernel developers is composed by 5000 or 6000 members; also, as of 2013, the 3.10 release of the Linux kernel had 15,803,499 lines of code. Without smart project management, it would not be possible to maintain development of such a large codebase.

Instead of a roadmap, there are technical guidelines. Instead of a central resource allocation, there are persons and companies who all have a stake in the further development of the Linux kernel, quite independently from one another: People like Linus Torvalds and I don't plan the kernel evolution. We don't sit there and think up the roadmap for the next two years, then assign resources to the various new features. That's because we don't have any resources. The resources are all owned by the various corporations who use and contribute to Linux, as well as by the various independent contributors out there. It's those people who own the resources who decide...

—[Andrew Morton](#), 2005

Linux is evolution, not intelligent design

—[Linus Torvalds](#), 2005[105][106]

By this statement it is meant that [evolution](#) often does odd (and "sub-optimal") things exactly because it does incremental changes which *do not break* at any point. As a result, any released version of the Linux kernel is fully usable, even if, for example, device drivers do not support all features of the hardware they are written for.

...

For U & Me - Interview

“There are no ‘road maps’ or rigid rules when it comes to Linux”

With more than two decades of history, the Linux kernel is one of the biggest and fastest developing open source projects, with about 53,600 files and around 20 million lines of code. To understand the story of Linux better and to learn about future open source technologies, Ankita K.S. from OSFY interacted with Kaiwan N. Billimoria, proprietor of kaiwanTECH and author of the book, 'Hands-On System Programming with Linux'.

Full interview: [OpenSource ForYou, April 2019](#)

Kernel versions

From the *Linux Kernel Programming 2E* book:

The modern Linux kernel release number nomenclature is as follows:

```
major#.minor#[.patchlevel][-EXTRAVERSION]
```

This is also often written or described as `w.x[.y][-z]`.

The square brackets around the `patchlevel` and `EXTRAVERSION` (or the `y` and `-z`) components indicate that they are optional. The following table summarizes the meaning of the components of the release number:

Release # component	Meaning	Example numbers
Major # (or <code>w</code>)	Main or major number; currently, we are on the 6.x kernel series, thus the major number is 6.	2, 3, 4, 5, 6
Minor # (or <code>x</code>)	The minor number, hierarchically under the major number.	0 onward
<code>[patchlevel]</code> (or <code>y</code>)	Hierarchically under the minor number – also called the ABI or revision – applied on occasion to the stable kernel when significant bug/security fixes are required.	0 onward
<code>[-EXTRAVERSION]</code> (or <code>-z</code>)	Also called <code>localversion</code> ; typically used by distribution kernels and vendors to track their internal changes.	Varies; Ubuntu uses <code>w.x.y-<z>-generic</code>

Table 2.1: Linux kernel release nomenclature

So, we can now interpret our Ubuntu 22.04 LTS distribution's kernel release number, `5.19.0-40-generic`:

- **Major #** (or `w`): 5
- **Minor #** (or `x`): 19
- `[patchlevel]` (or `y`): 0
- `[-EXTRAVERSION]` (or `-z`): `-40-generic`

*It's important to realize that kernel releases are **time-based** and NOT feature-based. Approx every 10 weeks we get a new kernel released.*

“... The kernel community provides the same guarantees no matter whether the change is between major versions, minor versions, or stable versions; "it promises that it will not break user space". It might break user space by accident, but it will fix the kernel if it does. Those breakages can occur

on any kind of upgrade, though; no upgrade type is more or less prone to accidental breakage. "Version numbers still, really truly don't matter". ..."

Modern schema for kernel version numbering is the so-called "fingers-and-toes" one ! Linus says- when I've run out of digits (20 of 'em), I'll move to the next major number.

So, effectively, we have

- 3.0 to 3.19, and then 4.0
- 4.0 to 4.19, and then 5.0
- 5.0 to 5.19 and then 6.0
- ... and so on...

Along the way, the last stable kernel released that year (typically in December) is marked and maintained for a (much) longer time period; these are the so-called Long Term Stable (LTS) kernels.

They're usually a big hit with product and service companies...

Which kernel version to use?

Linux OS : Security and Hardening – An Overview

Modern OS Hardening Countermeasures

Common Hardening Countermeasures include

- 1) Using Managed Programming Language
- 2) Compiler Protections
- 3) Library Protection
- 4) Executable Space Protection
- 5) [K]ASLR (address space randomization)
- 6) Better Testing

"If you are not using a stable / longterm kernel, your machine is insecure"

- Greg Kroah-Hartman

All this is good, great, but... the Most Important Thing:

"If you are not using the latest kernel, you don't have the most recently added security defenses, which, in the face of newly exploited bugs, may render your machine less secure than it could have been"

← **Kees Cook**, Google (Pixel Security), KSPP lead dev

Who will provide this (very) Long Term kernelSupport?

- LTS (Long Term Stable) kernels
- **SLTS** (Super LTS) kernels too!

from the **Civil Infrastructure Platform (CIP)** group [\[link\]](#)

A Linux Foundation (LF) project.

Src: <https://wiki.linuxfoundation.org/civilinfrastructureplatform/start>

CIP activities

Kernel maintainership

The first action taken by the CIP project is to select and maintain Linux kernels for a very long time (+10 years). To achieve this goal we have a group of experts. All the actions and decisions related to the maintenance of the Linux kernels selected by the CIP project are available at [CIP Kernel maintenance](#).

The current released CIP kernels are as follows.

Version	Maintainer(s)	First Release	Projected EOL	Target Releases/Month*
SLTS v6.1	Nobuhiro Iwamatsu & Pavel Machek	2023-07-14	2033-08	2
SLTS v6.1-rt	Pavel Machek	2023-07-16	2033-08	1
SLTS v5.10	Nobuhiro Iwamatsu & Pavel Machek	2021-12-05	2031-01	1
SLTS v5.10-rt	Pavel Machek	2021-12-08	2031-01	0.5
SLTS v4.19	Nobuhiro Iwamatsu & Pavel Machek	2019-01-11	2029-01	1
SLTS v4.19-rt	Pavel Machek	2019-01-11	2029-01	0.5
SLTS v4.4	Ulrich Hecht	2017-01-17	2027-01	1
SLTS v4.4-rt	Pavel Machek	2017-11-16	2027-01	0.5

*) Critical issues can trigger additional releases.

How would a professional Linux product company select a kernel version and what would the product life cycle be like? [See this Wikipedia content on RedHat's product life cycle and kernel backporting](#).

A relevant paragraph from the above article / [“Why does Red Hat Linux use such an old kernel?”](#):

“Kernel backporting[\[edit\]](#)”

To maintain a stable [application binary interface](#) (ABI), Red Hat does not update the kernel version, but instead backports new features to the same kernel version with which a particular version of RHEL has been released. New features are backported throughout the Production 1

phase of the RHEL lifecycle.^[47] Consequently, RHEL may use a Linux kernel with a dated version number, yet the kernel is up-to-date regarding not only security fixes, but also certain features.^[48] One specific example is the `SO_REUSEPORT` [socket](#) option which was added to Linux kernel 3.9, and was subsequently backported and became available since RHEL 6.5, which uses version 2.6.32 of the Linux kernel.^{[49][50][51]} “



Ref:

[Some 6.0 development statistics, Jon Corbet, 03 Oct 2022, LWN](#)

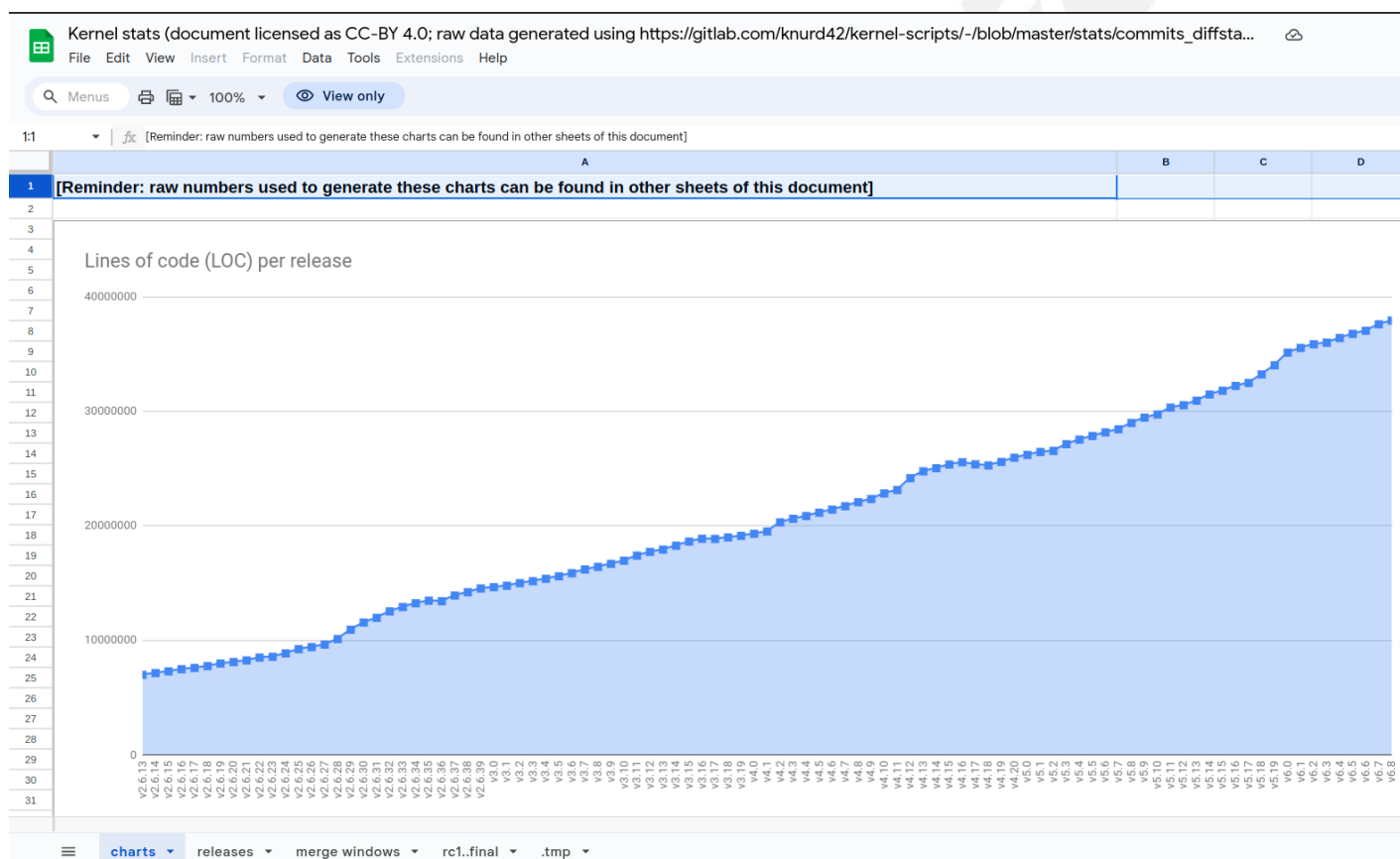
Some 6.0 development statistics

Posted Oct 4, 2022 5:07 UTC (Tue) by **knurd** (subscriber, #113424) [[Link](#)]

I maintain a spreadsheet with a few charts that visualize growth, lenght of the devel cycle, and a few other things, maybe it answers some of the questions you have:

https://docs.google.com/spreadsheets/d/1_yH7lFmZxAoSWrtsd...

A peek:



Over 30 million lines of code from 5.11 ! (6.8 is close to 38 million SLOCs).

Contributing Upstream – a very brief note

Key points

- Look up the latest MAINTAINERS file:
<https://elixir.bootlin.com/linux/latest/source/MAINTAINERS>
 - Linux kernel mailing lists:
 - There are many! very subsystem (or even more) specific
 - Best, lookup [MAINTAINERS](#)
 - list of lists at vger.kernel.org:
<https://elixir.bootlin.com/linux/latest/source/MAINTAINERS>
 - **Prerequisites – Required Reading; official kernel documentation**
 - Working with the development community
The essential guides for interacting with the kernel’s development community and getting your work upstream.
 - [A guide to the Kernel Development Process](#)
 - [Submitting patches: the essential guide to getting your code into the kernel](#)
 - [Code of conduct](#)
 - [Kernel Maintainer Handbook](#)
 - [All development-process docs](#)
 - How do I know whom to send email to?
 - lookup [MAINTAINERS](#)
 - use `scripts/get_maintainer.pl`
 - f.e., to talk to everyone concerned with the ‘mm’ subsystem:


```
$ scripts/get_maintainer.pl --email mm/
Andrew Morton <akpm@linux-foundation.org> (maintainer:MEMORY
MANAGEMENT)
linux-mm@kvack.org (open list:MEMORY MANAGEMENT)
linux-kernel@vger.kernel.org (open list)
```
- or
- ```
$ scripts/get_maintainer.pl --email --separator , mm/
Andrew Morton <akpm@linux-foundation.org> (maintainer:MEMORY MANAGEMENT),linux-
mm@kvack.org (open list:MEMORY MANAGEMENT),linux-kernel@vger.kernel.org (open
list)
```
- (the last one – the LKML – is always cc’ed)
- details here: <https://docs.kernel.org/process/submitting-patches.html#select-the-recipients-for-your-patch>

### Email

- Email reply style: **Avoid top-posting** and favor interleaved quoting:  
[https://en.wikipedia.org/wiki/Posting\\_style#Interleaved\\_style](https://en.wikipedia.org/wiki/Posting_style#Interleaved_style)
- **Interactive git send-email tutorial ! (excellent)**  
<https://git-send-email.io/>
- mailing list Etiquette Guide!



<https://man.sr.ht/lists.sr.ht/etiquette.md>

### Quick Tips

- Use minimum of the first 12 chars for a commit hash (ID)
- ALWAYS use `git send-email` to send a patch
- `git format-patch` ...
  - Once your commits are ready to be sent to the mailing list, run the following commands:

```
$ git format-patch --cover-letter -M origin/master -o outgoing/
$ edit outgoing/0000-
$ git send-email <...> outgoing/
...
```

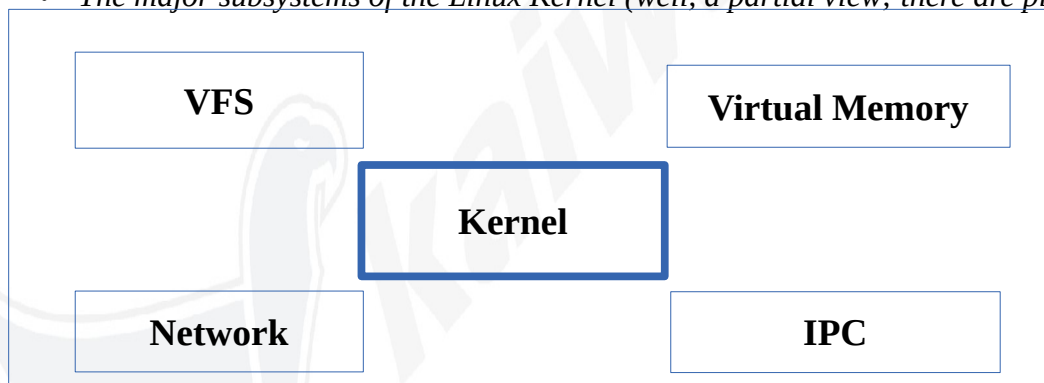
- See <https://git-send-email.io/#step-5>

Very simple (though incomplete), gentle guide:  
[Basic Guide to Linux Mailing Lists](#), Oct '21.

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## Brief kernel source tree tour

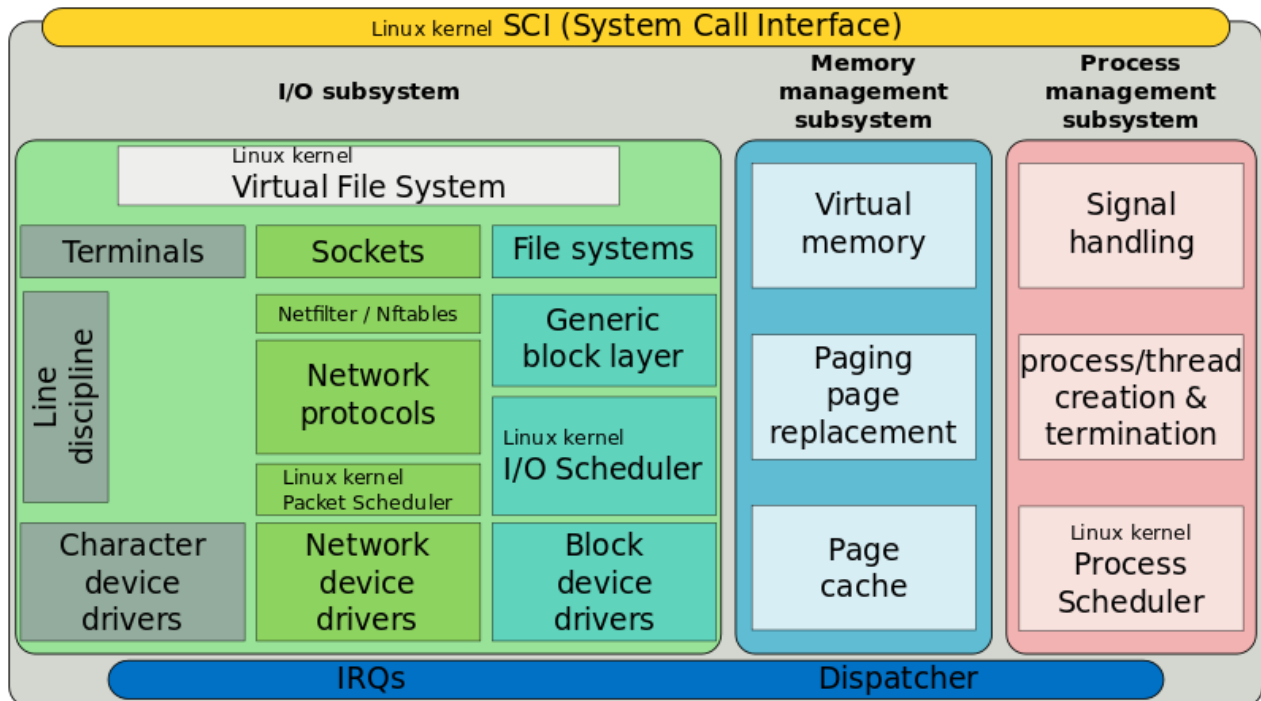
- *The major subsystems of the Linux Kernel (well, a partial view; there are plenty more)*



- The “**Kernel**” box is the heart of the Linux operating system. It has the following key responsibilities:
  - allow processes to create new copies of themselves
  - scheduler: determine which process will have access to the CPU and effect the transfer between running processes
  - receive interrupts and route them to the appropriate kernel subsystem
  - manage signalling

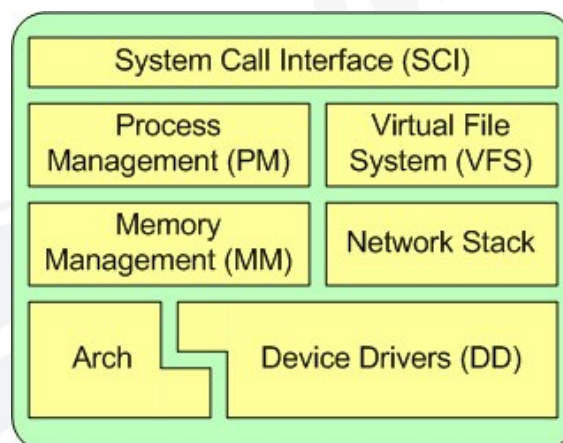
- manage the timer hardware.

[Simplified Structure of the Linux Kernel : Wikimedia](#)



<< Alternate: another perspective of the Linux kernel architecture.

Source: [IBM DeveloperWorks article](#) >>



## Source Language

Screenshot from <https://github.com/torvalds/linux> (as of 5.15-rc6, 22Oct2021):

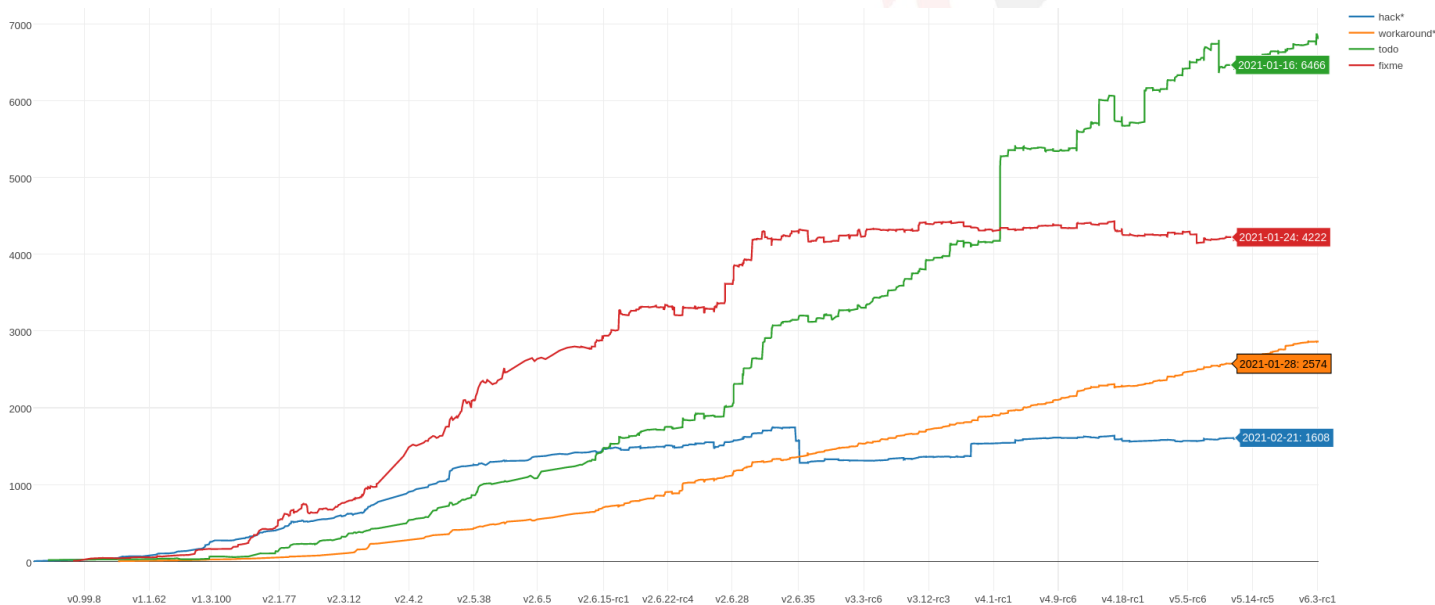
Who says 'C' is outdated!?

### Languages



Check this out! :-)

[https://www.vidarholen.net/contents/wordcount/#hack\\*,workaround\\*,todo,fixme](https://www.vidarholen.net/contents/wordcount/#hack*,workaround*,todo,fixme)



Source

While Linus Torvalds supervises code changes and releases to the latest kernel versions, he has delegated the maintenance of older versions to other programmers.<sup>[104]</sup> Major releases as old as 2.0 (officially made obsolete with the kernel 2.2.0 release in January 1999) are maintained as needed, although at a very slow pace.

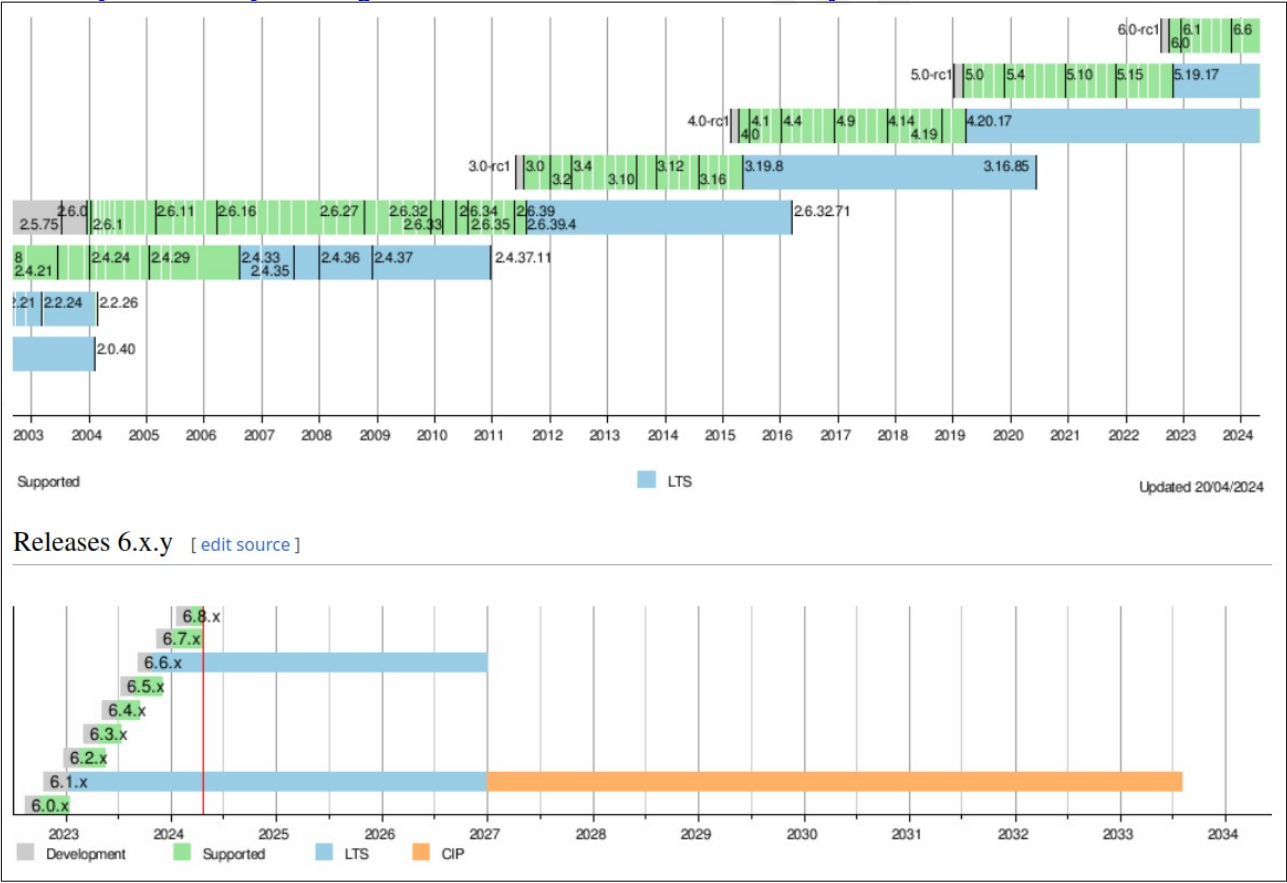
| K<br>er<br>ne<br>l<br>se<br>ri<br>es | Orig<br>inal<br>releas<br>e date    | Current<br>version         | Maintainer                                                            | Support Model                                                                                                                         |
|--------------------------------------|-------------------------------------|----------------------------|-----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| 0.01                                 | 17<br>September<br>1991             | 0.03                       |                                                                       | <b>EOL</b>                                                                                                                            |
| 0.10                                 | November<br>1991                    | 0.12                       |                                                                       | <b>EOL</b>                                                                                                                            |
| 0.95                                 | 8 March<br>1992                     | 0.99.15                    |                                                                       | <b>EOL</b>                                                                                                                            |
| 1.0                                  | 14 March<br>1994                    | 1.0.9                      |                                                                       | <b>EOL</b>                                                                                                                            |
| 1.1                                  | 6 April 1994                        | 1.1.95                     |                                                                       | <b>EOL</b>                                                                                                                            |
| 1.2                                  | 7 March<br>1995                     | 1.2.13                     |                                                                       | <b>EOL</b>                                                                                                                            |
| 1.3                                  | 12 June<br>1995                     | 1.3.100                    |                                                                       | <b>EOL</b>                                                                                                                            |
| pre2.0                               | 12 May<br>1996                      | pre2.0.14                  |                                                                       | <b>EOL</b>                                                                                                                            |
| 2.0                                  | 9 June 1996                         | 2.0.40 <sup>[105]</sup>    | David Weinehall                                                       | <b>EOL</b> (Officially made obsolete with the kernel 2.2.0 release) <sup>[106]</sup>                                                  |
| 2.2                                  | 26 January<br>1999                  | 2.2.26 <sup>[107]</sup>    | Marc-Christian Petersen (former maintainer Alan Cox)                  | <b>EOL</b> (Unofficially obsolete with the 2.2.27-rc2) <sup>[108][109]</sup>                                                          |
| 2.4                                  | 4 January<br>2001                   | 2.4.37.11                  | Willy Tarreau (former maintainer Marcelo Tosatti)                     | <b>EOL</b> (Maintained from December 2008 to December 2011), last stable release of the 2.4 kernel series. <sup>[110]</sup>           |
| 2.6                                  | 18<br>December<br>2003              | 2.6.15                     |                                                                       | <b>EOL</b>                                                                                                                            |
| 2.6.16                               | 20 March<br>2006                    | 2.6.16.62                  | Adrian Bunk (former maintainer Greg Kroah-Hartman) <sup>[111]</sup>   | <b>EOL</b> (1st <b>long-term</b> stable release from March 2006 to July 2009, replaced by 2.6.27.x) <sup>[112]</sup>                  |
| 2.6.27                               | 9 October<br>2008                   | 2.6.27.62 <sup>[113]</sup> | Willy Tarreau (former maintainer Greg Kroah-Hartman)                  | <b>EOL</b> (2nd <b>long-term</b> stable release from October 2008 to March 2012) <sup>[114]</sup>                                     |
| 2.6.32                               | 3 December<br>2009 <sup>[115]</sup> | 2.6.32.61 <sup>[116]</sup> | Willy Tarreau (former maintainer Greg Kroah-Hartman) <sup>[117]</sup> | 3rd <b>long-term</b> stable release from December 2009 to mid 2014, <sup>[118]</sup> used in <i>Debian 6 Squeeze</i> <sup>[119]</sup> |

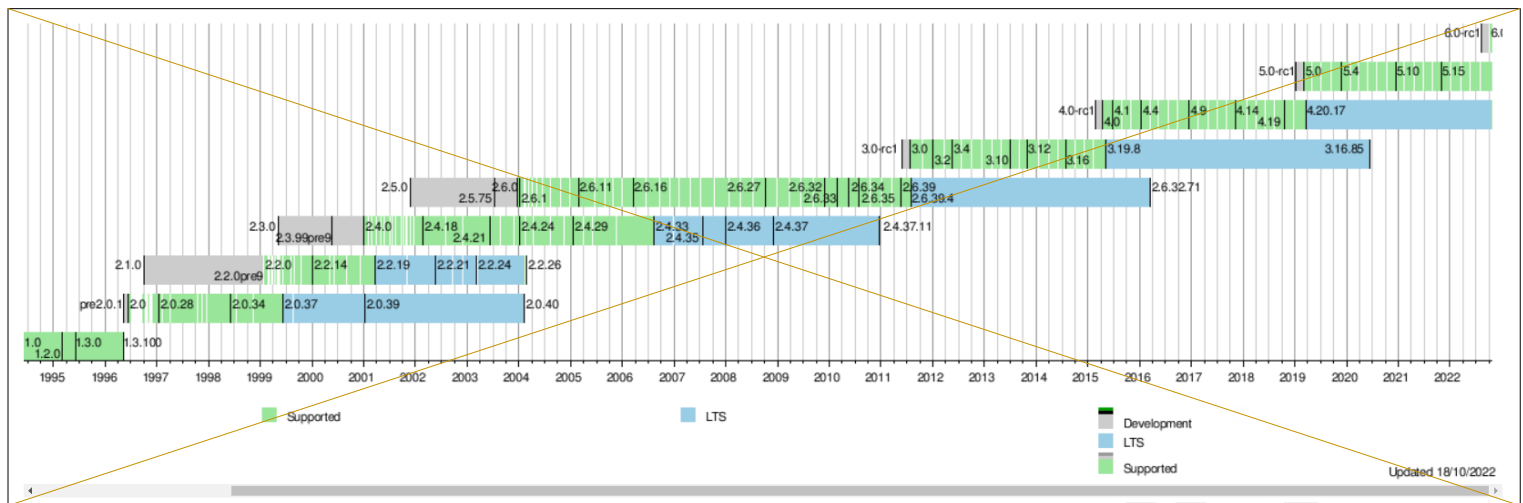
|        |                       |                |                              |                                                                                                                                                                                                                                        |
|--------|-----------------------|----------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2.6.33 | 24 February 2010[120] | 2.6.33.20[121] | Greg Kroah-Hartman[122]      | <b>EOL</b> (4th <b>long-term</b> stable release from March 2011 to November 2011, Base for Real-Time-Tree, replaced by 3.0.x)[121][122]                                                                                                |
| 2.6.34 | 16 May 2010[123]      | 2.6.34.14[124] | Paul Gortmaker[118][125]     | 5th <b>long-term</b> stable release from January 2011 to mid 2013[118][125]                                                                                                                                                            |
| 2.6.35 | 2 August 2010[126]    | 2.6.35.14[127] | Andi Kleen[128]              | <b>EOL</b> (6th <b>long-term</b> stable release from December 2010 to March 2012)[128]                                                                                                                                                 |
| 2.6.39 | 19 May 2011[129]      | 2.6.39.4[130]  | Greg Kroah-Hartman           | <b>EOL</b> (Maintained from May 2011 to August 2011), last stable release of the 2.6 kernel series.[130]                                                                                                                               |
| 3.0    | 22 July 2011[83]      | 3.0.101[131]   | Greg Kroah-Hartman[118][132] | <b>EOL</b> (7th <b>long-term</b> stable release from July 2011 to October 2013 (Base for Real-Time-Tree))[118][132]                                                                                                                    |
| 3.1    | 24 October 2011[133]  | 3.1.10[134]    | Greg Kroah-Hartman           | <b>EOL</b> (Maintained from October 2011 to January 2012)[134]                                                                                                                                                                         |
| 3.2    | 5 January 2012[135]   | 3.2.53[136]    | Ben Hutchings[118][137]      | 8th <b>long-term</b> stable release from March 2012 to 2016, used in <i>Ubuntu 12.04 LTS</i> , <i>Debian 7 Wheezy</i> and <i>Slackware 14.0</i> . [118][137] It has unofficial extended supported by Canonical until April 2017. [138] |
| 3.3    | 19 March 2012[139]    | 3.3.8[140]     | Greg Kroah-Hartman           | <b>EOL</b> (Maintained from March 2012 to June 2012)[140]                                                                                                                                                                              |
| 3.4    | 21 May 2012[141][142] | 3.4.74[143]    | Greg Kroah-Hartman[118][144] | 9th <b>long-term</b> stable release from May 2012 to October 2014[118][144]                                                                                                                                                            |
| 3.5    | 21 July 2012[145]     | 3.5.7[146]     | Greg Kroah-Hartman           | <b>EOL</b> (Maintained by Kroah-Hartman until the release of 3.6.1, from July 2012 to October 2012).[146] It has unofficial extended supported by Canonical until April 2014.[138][147]                                                |
| 3.6    | 1 October 2012[148]   | 3.6.11[149]    | Greg Kroah-Hartman           | <b>EOL</b> (Maintained from October 2012 to December 2012)[149]                                                                                                                                                                        |
| 3.7    | 11 December 2012[150] | 3.7.10[151]    | Greg Kroah-Hartman           | <b>EOL</b> (Maintained from December 2012 to March 2013)[151][152]                                                                                                                                                                     |
| 3.8    | 19 February 2013[153] | 3.8.13[154]    | Greg Kroah-Hartman           | <b>EOL</b> (Maintained from February 2013 to May 2013)[154] It has unofficial extended supported by Canonical until August 2014. [138][155]                                                                                            |
| 3.9    | 29 April 2013[156]    | 3.9.11[157]    | Greg Kroah-Hartman           | <b>EOL</b> (Maintained from April 2013 to July 2013)[157]                                                                                                                                                                              |
| 3.10   | 30 June 2013[158]     | 3.10.24[159]   | Greg Kroah-Hartman[118]      | 10th <b>long-term</b> stable release from August 2013 to September 2015.[118][160]                                                                                                                                                     |
| 3.11   | 2 September 2013[161] | 3.11.10[162]   | Greg Kroah-Hartman           | <b>EOL</b> (Maintained from September 2013 to November 2013)[162]                                                                                                                                                                      |

|                                                                                                                                                                                                                                                                                                                             |                      |              |                                               |                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------|-----------------------------------------------|----------------------------------------------------------------------|
| 3.12                                                                                                                                                                                                                                                                                                                        | 3 November 2013[171] | 3.12.17[172] | Jiří Slabý (formerly Greg Kroah-Hartman)[173] | 11th <b>long-term</b> stable release from November 2013 to 2016[124] |
| 3.13                                                                                                                                                                                                                                                                                                                        | 19 January 2014[174] | 3.13.10[175] | Greg Kroah-Hartman                            | Supported version.                                                   |
| 3.14                                                                                                                                                                                                                                                                                                                        | 30 March 2014[3]     | 3.14[3]      | Linus Torvalds                                | Latest stable version.                                               |
| 3.15                                                                                                                                                                                                                                                                                                                        | 13 April 2014[4]     | 3.15-rc1[4]  | Linus Torvalds                                | Latest development version.                                          |
| <b>Legend:</b><br><div>Old version</div> <div>Older version, still supported</div> <div>Latest version</div> <div>Latest preview version</div><br>3.17 5 October 2014[193]<br>3.17.2[194]Greg Kroah-Hartman<br>Latest stable version3.18 19 October 2014[195]<br>3.18-rc3[196]Linus TorvaldsThird Release Candidate version |                      |              |                                               |                                                                      |

The above table in this material is bound to get outdated; please refer to the [Wikipedia page](#) for the latest version.

As of 20 April 2024  
Src: [https://en.wikipedia.org/wiki/Linux\\_kernel\\_version\\_history](https://en.wikipedia.org/wiki/Linux_kernel_version_history)



Releases 6.x.y [\[edit\]](#)

| Version | Original release date         | Current version                   | Maintainer     | EOL | Prominent features | Notes                                                              | <a href="#">[hide]</a> |
|---------|-------------------------------|-----------------------------------|----------------|-----|--------------------|--------------------------------------------------------------------|------------------------|
| 6.0     | 2 October 2022 <sup>[3]</sup> | 6.0 <sup>[4]</sup> 2 October 2022 | Linus Torvalds |     |                    | Named "Hurr durr I'ma ninja sloth" <sup>[sic]</sup> <sup>[5]</sup> |                        |

Legend: ■ Old version ■ Older version, still maintained ■ Latest version ■ Latest preview version

Releases 5.x.y [\[edit\]](#)

| Version | Original release date             | Current version          | Maintainer                                       | EOL                               | Prominent features                                          | Notes                                                                                                                                                                                                   | <a href="#">[hide]</a> |
|---------|-----------------------------------|--------------------------|--------------------------------------------------|-----------------------------------|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| 5.0     | 3 March 2019 <sup>[6]</sup>       | 5.0.21 <sup>[7]</sup>    | Greg Kroah-Hartman                               | June 2019 <sup>[7]</sup>          |                                                             |                                                                                                                                                                                                         |                        |
| 5.1     | 5 May 2019 <sup>[8]</sup>         | 5.1.21 <sup>[9]</sup>    |                                                  | July 2019 <sup>[9]</sup>          | • io_uring, a new way to do asynchronous IO <sup>[10]</sup> |                                                                                                                                                                                                         |                        |
| 5.2     | 7 July 2019 <sup>[11]</sup>       | 5.2.20 <sup>[12]</sup>   |                                                  | October 2019 <sup>[12]</sup>      |                                                             | 5.2-rc2 is named <a href="#">Golden Lions</a> <sup>[13][14]</sup><br>5.2 is named <a href="#">Bobtail Squid</a> <sup>[15]</sup>                                                                         |                        |
| 5.3     | 15 September 2019 <sup>[16]</sup> | 5.3.18 <sup>[17]</sup>   |                                                  | December 2019 <sup>[17]</sup>     |                                                             |                                                                                                                                                                                                         |                        |
| 5.4     | 24 November 2019 <sup>[18]</sup>  | 5.4.217 <sup>[19]</sup>  | Greg Kroah-Hartman & Sasha Levin <sup>[20]</sup> | December 2025 <sup>[20]</sup>     |                                                             | 20th LTS release, used in <a href="#">Ubuntu 20.04 LTS</a><br>5.4-rc2 is named <a href="#">Nesting Opossum</a> <sup>[21]</sup><br>5.4-rc5 is named <a href="#">Kleptomaniac Octopus</a> <sup>[22]</sup> |                        |
| 5.5     | 26 January 2020 <sup>[23]</sup>   | 5.5.19 <sup>[24]</sup>   | Greg Kroah-Hartman                               | April 2020 <sup>[24]</sup>        |                                                             |                                                                                                                                                                                                         |                        |
| 5.6     | 29 March 2020 <sup>[25]</sup>     | 5.6.19 <sup>[26]</sup>   |                                                  | June 2020 <sup>[26]</sup>         |                                                             |                                                                                                                                                                                                         |                        |
| 5.7     | 31 May 2020 <sup>[27]</sup>       | 5.7.19 <sup>[28]</sup>   |                                                  | August 2020 <sup>[28]</sup>       |                                                             |                                                                                                                                                                                                         |                        |
| 5.8     | 2 August 2020 <sup>[29]</sup>     | 5.8.18 <sup>[30]</sup>   |                                                  | November 2020 <sup>[30]</sup>     |                                                             |                                                                                                                                                                                                         |                        |
| 5.9     | 11 October 2020 <sup>[31]</sup>   | 5.9.16 <sup>[32]</sup>   |                                                  | December 2020 <sup>[32]</sup>     |                                                             |                                                                                                                                                                                                         |                        |
| 5.10    | 13 December 2020 <sup>[33]</sup>  | 5.10.147 <sup>[19]</sup> | Greg Kroah-Hartman & Sasha Levin <sup>[20]</sup> | December 2026 <sup>[20][34]</sup> |                                                             | 21st LTS release; used in <a href="#">Debian 11 "Bullseye"</a> <sup>[35]</sup><br>3rd SLTS release, <sup>[36]</sup> 5.10.19 is named <a href="#">Dare mighty things</a> <sup>[37]</sup>                 |                        |
| 5.11    | 14 February 2021 <sup>[38]</sup>  | 5.11.22 <sup>[39]</sup>  | Greg Kroah-Hartman                               | May 2021 <sup>[39]</sup>          |                                                             | Named "💖 Valentine's Day Edition 💖" <sup>[40]</sup>                                                                                                                                                     |                        |
| 5.12    | 25 April 2021 <sup>[41]</sup>     | 5.12.19 <sup>[42]</sup>  | Hartman                                          | July 2021 <sup>[42]</sup>         |                                                             | Named <a href="#">Frozen Wasteland</a> <sup>[43][44]</sup>                                                                                                                                              |                        |



How would a professional Linux product company select a kernel version and what would the product life cycle be like? [See this Wikipedia content on RedHat's product life cycle and kernel backporting.](#)

**Get the Linux kernel 'finger banner'**

```
curl -L https://www.kernel.org/finger_banner
```

As of 21 April 2024

```
$ curl -L https://www.kernel.org/finger_banner
The latest stable version of the Linux kernel is: 6.8.7
The latest mainline version of the Linux kernel is: 6.9-rc5
The latest stable 6.8 version of the Linux kernel is: 6.8.7
The latest stable 6.7 version of the Linux kernel is: 6.7.12 (EOL)
The latest longterm 6.6 version of the Linux kernel is: 6.6.28
The latest longterm 6.1 version of the Linux kernel is: 6.1.87
The latest longterm 5.15 version of the Linux kernel is: 5.15.156
The latest longterm 5.10 version of the Linux kernel is: 5.10.215
The latest longterm 5.4 version of the Linux kernel is: 5.4.274
The latest longterm 4.19 version of the Linux kernel is: 4.19.312
The latest linux-next version of the Linux kernel is: next-20240419
$
```

FYI:

Compressed and archived linux-0.01.tar.bz2 is 62 KB.

Uncompressed linux-0.01 tree is 275 KB.

Compressed and archived linux-2.6.10.tar.bz2 is 35 MB.

Uncompressed linux-2.6.10 tree is 227 MB.

Uncompressed linux-2.6.16 tree is 340 MB.

Compressed and archived linux-2.6.20.tar.bz2 is 41.4 MB.

[April 2008] Uncompressed linux-2.6.25 tree is 317 MB.

Uncompressed linux-2.6.27 tree is 327 MB.

[Dec 2008] Uncompressed linux-2.6.28 tree is ~ 340 MB.

[9 June 2009] Uncompressed linux-2.6.30 tree is 390 MB.

[06 Jan 2011] Compressed linux-2.6.30 tree is 64.5 MB.

[06 Jan 2011] Uncompressed linux-2.6.30 tree is 448 MB.

Uncompressed linux-2.6.35.11 tree is 458 MB.

[Aug 2011] Compressed 2.6.39.4.tar.bz2 tree is 72.6 MB <-- last 2.6.x.y kernel src tree

[Jul 2011] Compressed linux-3.0.tar.bz2 tree is 73.2 MB.

Uncompressed linux-3.0 tree is 494 MB.

[Oct 2011] Compressed linux-3.1.tar.xz tree is 60.8 MB.

Uncompressed linux-3.1 tree is 498 MB.

[Mar 2012] Compressed linux-3.2.11.tar.xz tree is 62.1 MB.

Uncompressed linux-3.2.11 is 505 MB.

[May 2012] Compressed linux-3.3.7.tar.xz tree is 63 MB.  
Compressed linux-3.3.7.tar.bz2 tree is 75 MB.

[Aug 2012] Compressed linux-3.4.8.tar.xz tree is 63.7 MB.  
Uncompressed linux-3.4.8.tar.xz tree is 517 MB.

[Dec 2012] Compressed linux-3.6.11.tar.xz tree is 65.8 MB.

[May 2013] Compressed linux-3.8.13.tar.xz tree is 67.7 MB.

[Jul 2013] Compressed linux-3.10.1.tar.xz tree is 69.8 MB.

[Jul 2014] Compressed linux-3.10.48.tar.xz tree is 70 MB. <-- 10<sup>th</sup> LTS; Aug '13 to Sep '15  
Uncompressed linux-3.10.48.tar.xz tree is 573 MB.

[Oct 2014] Compressed linux-3.14.23.tar.xz tree is 75 MB.  
Uncompressed linux-3.10.48.tar.xz tree is 614 MB.

...

[Jan 2016] Compressed linux-4.4.21.tar.xz tree is 87 MB.  
Uncompressed linux-4.4.21 tree is 710 MB.

...

[Mar 2016] Uncompressed linux-4.5.0 is 1640 MB (1.6 GB)

...

[Mar 2016] Uncompressed linux-4.5.0 is 1640 MB (1.6 GB)

...

[Feb 2018] Compressed linux-4.15.4.tar.xz tree is 97 MB

[28 Mar 2018] Compressed linux-4.15.14.tar.xz tree is 98 MB  
Uncompressed linux-4.15.14 tree is 903 MB.

[03 June 2018] Compressed linux-4.17.tar.xz tree is 98 MB  
Uncompressed linux-4.17 tree is 903 MB.

[23 Nov 2018] Compressed linux-4.19.4.tar.xz tree is 99 MB  
Uncompressed linux-4.19.4 tree is 908 MB.

[03 Mar 2019] Compressed linux-5.0.tar.xz tree is 101 MB  
Uncompressed linux-5.0 tree is 934 MB.

[24 Nov 2019] Compressed linux-5.4.tar.xz tree is 105 MB <-- 20<sup>th</sup> LTS rel; Nov '19 to Dec 2025  
Uncompressed linux-5.4 tree is 1011 MB.

<< My [Linux Kernel Programming book](#) (Mar 2021) is based on the 5.4 LTS kernel >>

[18 Aug 2021] Compressed linux-5.10.60.tar.xz tree is 112 MB <-- 21<sup>st</sup> LTS rel; Nov '19 to Dec 2026  
Uncompressed linux-5.10.60 tree is 1098 MB.

<< My [Linux Kernel Debugging book](#) (Aug 2022) is based on the 5.10 LTS kernel >>

The kernel source tree shown below of the stable vanilla kernel version 6.1.25; 6.1.y kernels are the 23<sup>rd</sup> long term support (LTS) release.

```
$ ls
arch/ CREDITS fs/ ipc/ lib/ mm/ samples/ tools/
block/ crypto/ include/ Kbuild LICENSES/ net/ scripts/ usr/
certs/ Documentation/ init/ Kconfig MAINTAINERS README security/ virt/
COPYING drivers/ io_uring/ kernel/ Makefile rust/ sound/

$
$ head -n6 Makefile
SPDX-License-Identifier: GPL-2.0
VERSION = 6
PATCHLEVEL = 1
SUBLEVEL = 25
EXTRAVERSION =
NAME = Hurr durr I'ma ninja sloth
$
$ ls -F arch/
alpha/ arm64/ ia64/ m68k/ nios2/ powerpc/ sh/ x86/
arc/ csky/ Kconfig microblaze/ openrisc/ riscv/ sparc/ xtensa/
arm/ hexagon/ loongarch/ mips/ parisc/ s390/ um/

$
+
```

```
$ ls -F
arch/ crypto/ Documentation/ ipc/ LICENSES/ README sphinx_1.7.9/
block/ cscope.files drivers/ Kbuild MAINTAINERS samples/ tags
certs/ cscope.out fs/ Kconfig Makefile scripts/ tools/
COPYING cscope.out.in include/ kernel/ mm/ security/ usr/
CREDITS cscope.out.po init/ lib/ net/ sound/ virt/

$
$ head -n6 Makefile
SPDX-License-Identifier: GPL-2.0
VERSION = 5
PATCHLEVEL = 4
SUBLEVEL = 0
EXTRAVERSION =
NAME = Kleptomaniac Octopus
$
$ ls -F arch/
alpha/ arm64/ h8300/ Kconfig mips/ openrisc/ riscv/ sparc/ x86/
arc/ c6x/ hexagon/ m68k/ nds32/ parisc/ s390/ um/ xtensa/
arm/ csky/ ia64/ microblaze/ nios2/ powerpc/ sh/ unicore32/

$
```

<< Note-

Starting from 2.6.24, the i386 and the x86\_64 (the 64-bit variant of the 32-bit x86 architecture), have been unified into a common *arch/x86* directory.

Similarly, the *include/* branch now has a *include/asm-x86* directory.

>>

## The MAINTAINERS file


Very useful!

I once had an issue with getting the Python-based GDB scripts running on an ARM-based system. Looked up the MAINTAINERS file, grepping for help; I soon found it!

```
linux-5.10.3 $ grep -i -A5 "gdb " MAINTAINERS
GDB KERNEL DEBUGGING HELPER SCRIPTS
M: Jan Kiszka <jan.kiszka@siemens.com>
M: Kieran Bingham <kbingham@kernel.org>
S: Supported
F: scripts/gdb/


--
KGDB / KDB / debug_core
M: Jason Wessel <jason.wessel@windriver.com>
M: Daniel Thompson <daniel.thompson@linaro.org>
R: Douglas Anderson <dianders@chromium.org>
L: kgdb-bugreport@lists.sourceforge.net
S: Maintained
linux-5.10.3 $
```

Wrote to the maintainers, and had a very helpful reply in 20 minutes !!


**Kaiwan N Billimoria**
Tue, Jul 18, 2017, 4:00 PM

Hi, Am trying to make use of the GDB helpers 'lx-\*' via the CONFIG\_GDB\_SCRIPTS kernel option. Host sys: Ubuntu 17.04 x86\_64 4.10...

---


**Kieran Bingham** kieran@bingham.xyz via ksquared.org.uk
 Tue, Jul 18, 2017, 4:19 PM


to me, jan.kiszka

Hi Kaiwan,

On 18/07/17 11:30, Kaiwan N Billimoria wrote:

- > Hi,
- >
- > Am trying to make use of the GDB helpers 'lx-\*' via the
- > CONFIG\_GDB\_SCRIPTS kernel option.
- > Host sys: Ubuntu 17.04 x86\_64 4.10.0-26-generic.
- >
- > Steps I followed are as per the documentation here:
- > <https://www.kernel.org/doc/html/v4.11/dev-tools/gdb-kernel-debugging.html>
- >
- > Yet, it does not seem to work: gdb doesn't recognize any 'lx\*' commands.
- > Does it work for ARM-32 ??

Yes, I have used gdb-scripts on both ARM32, and ARM64


**Jan Kiszka**
Jul 18, 2017, 5:44 PM

Ask CodeSourcery folks, can't tell. But the Linaro toolchain supports this mode.

But is the MAINTAINERS file itself well maintained? See this article: [MAINTAINERS truth and fiction](#) (LWN, January 14, 2021)

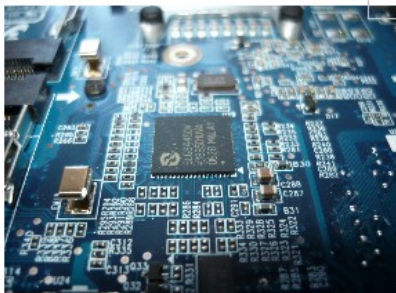
**Miscellaneous / Optional****[Quora] How large is the largest function in Linux kernel?**

Short Answer: as of 4.7 Linux:

"total functions: 22600

file with most functions: linux-4.7-rc1/drivers/infiniband/hw/hfi1/chip.c  
( 577 )

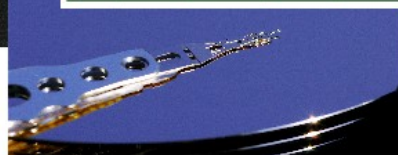
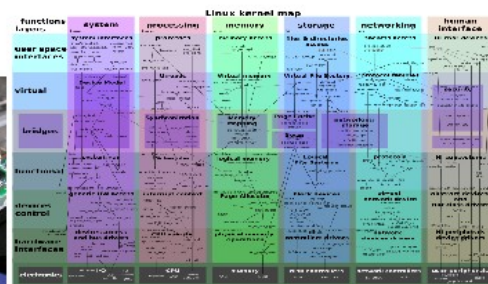
file with largest function:

linux-4.7-rc1/drivers/staging/lustre/lustre/ptlrpc/wiretest.c      function at  
line num: 48      function size: 4179 lines".**Linux Operating System  
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