Linux kernel development process

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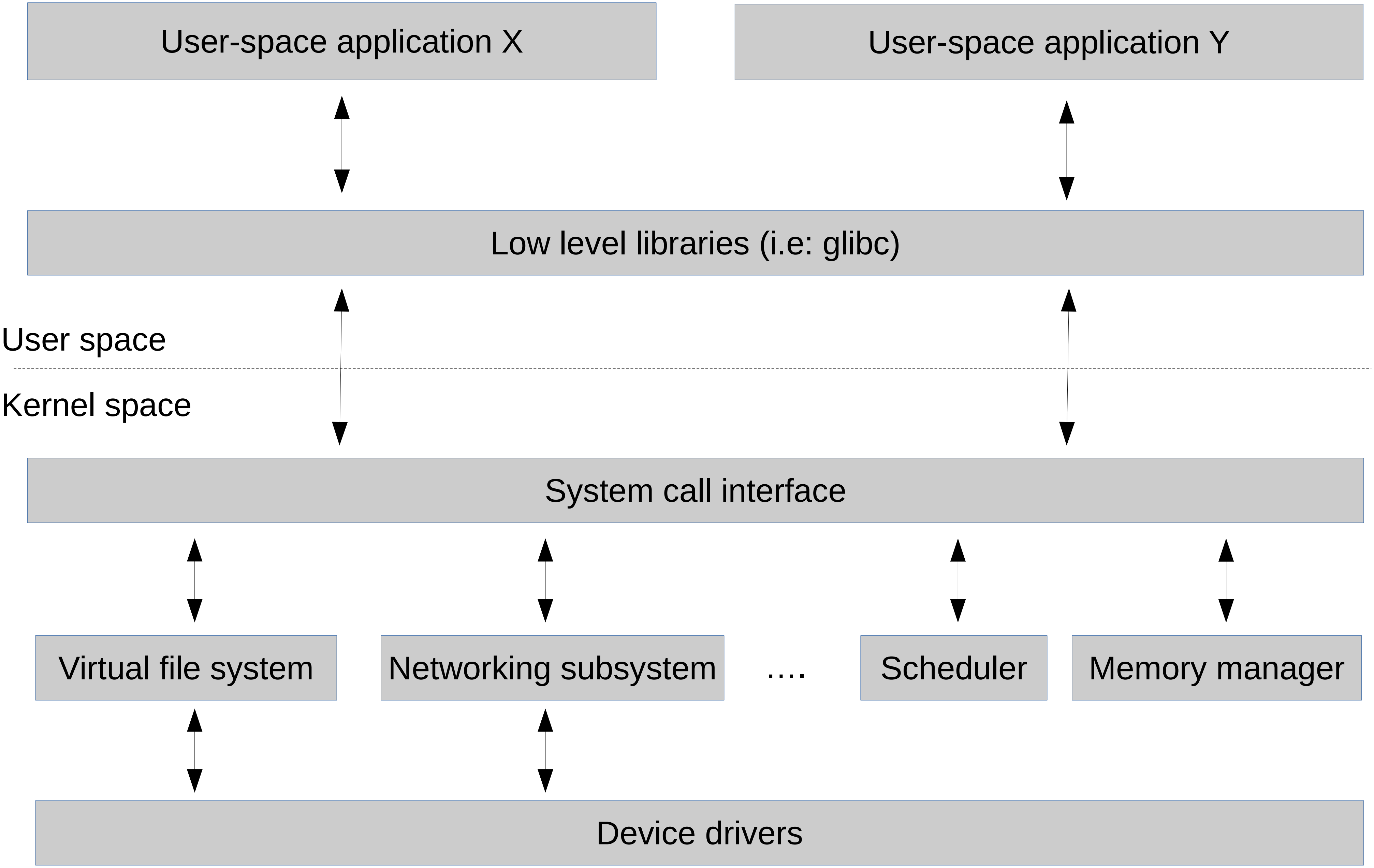
Agenda

- The Linux kernel
- Downstream, Upstream and Mainline
- Linux development process
- Contribution steps
  - Pitfalls
  - Good practices
  - Tools

The Linux kernel



User-space application X

User-space application Y

Low level libraries (i.e: glibc)

User space

Kernel space

System call interface

Virtual file system

Networking subsystem

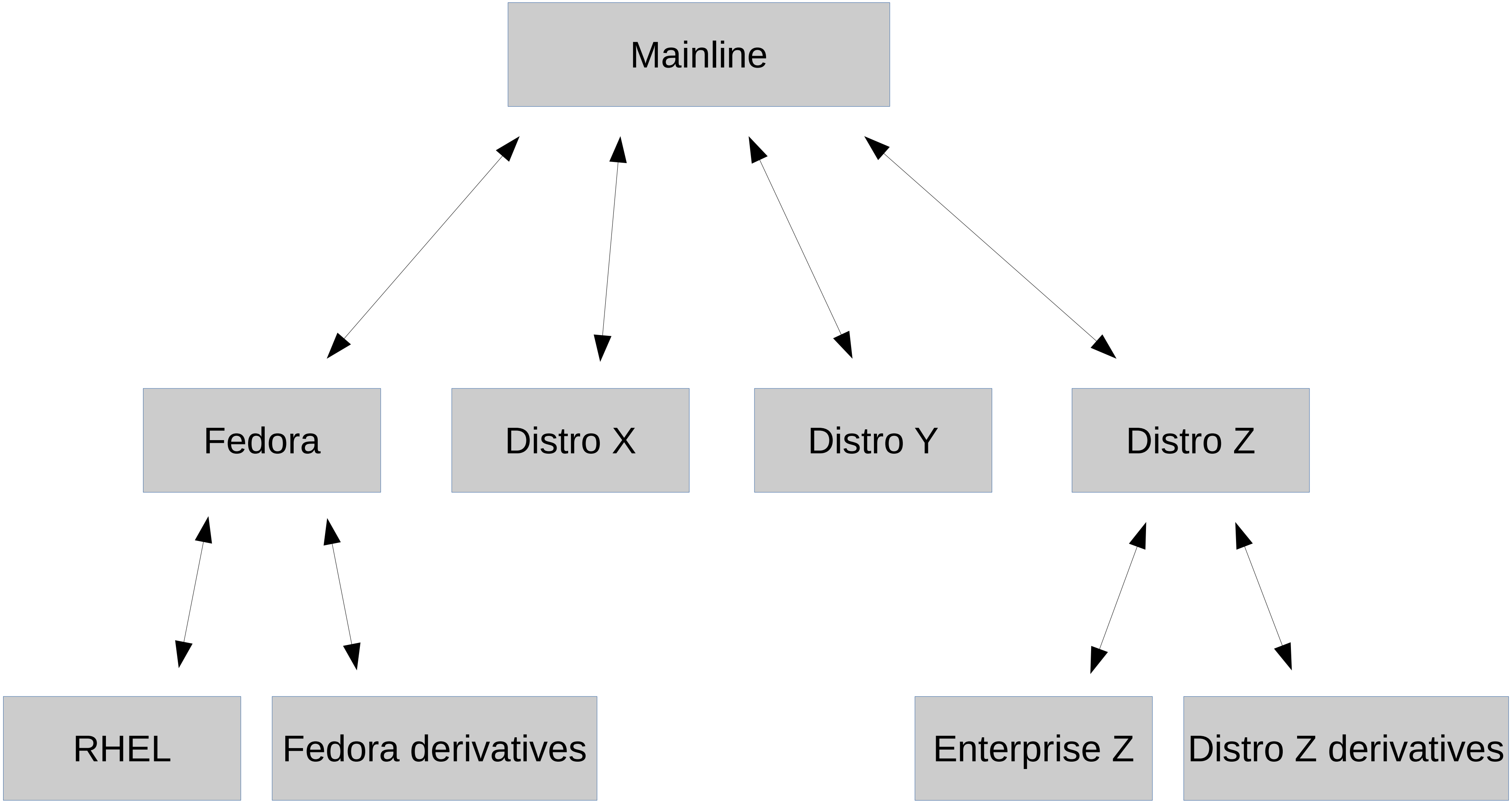
….

Scheduler

Memory manager

Device drivers

Downstream, Upstream and Mainline



Linux Development Process

Linux development process

Linux is the largest collaborative software project in the world.

Linux development process

Due to the scale of the community, each maintainer has their own optimized workflow.

Linux development process

It's a very costly operation for maintainers to diverge from their workflow.

Linux development process

So even when there is a single community and documented development process...

Linux development process

...there isn't a single way to submit a patch.

Linux development process

There are different ways to submit patches to different subsystems.

Linux development process

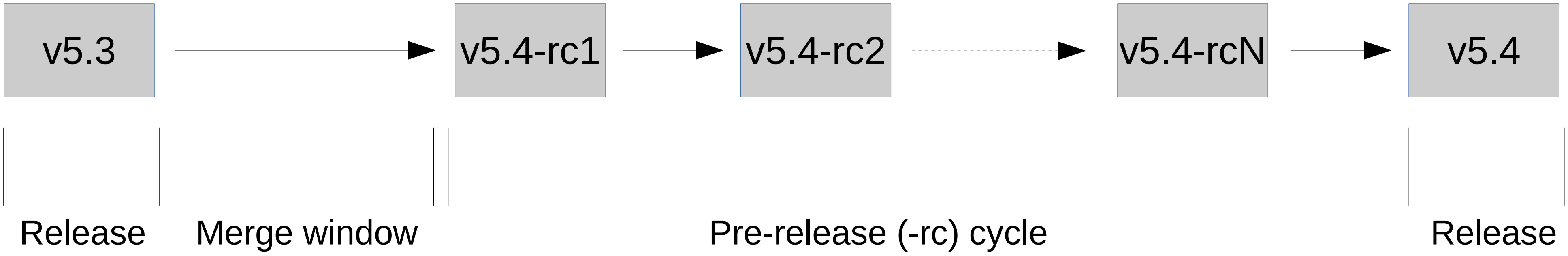
“Linux is evolution, not intelligent design”

- Linus Torvalds

Linux development process

- Most projects use a feature based release model
- Linux instead uses a time based release model

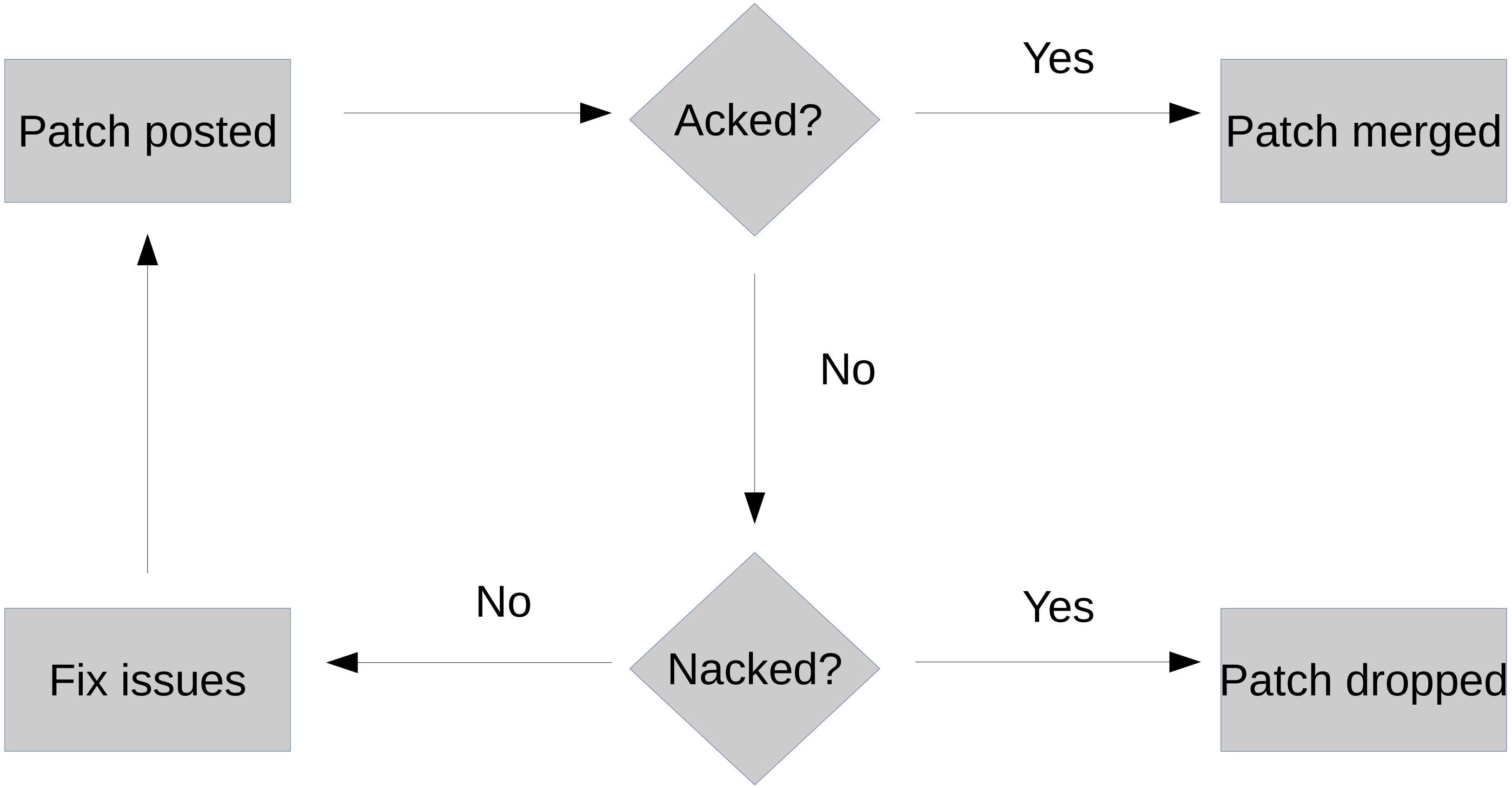
Linux kernel release cycle



Linux kernel trees

- linux.git: Linus Torvalds' tree
  - git://git.kernel.org/pub/scm/linux/kernel/git/torvalds/linux.git
- linux-stable.git: contains previous versions on which fixes are backported
  - git://git.kernel.org/pub/scm/linux/kernel/git/stable/linux-stable.git
- subsystem trees: each maintainer has a tree used for development
- linux-next.git: integrates all the subsystem maintainer trees for testing
  - git://git.kernel.org/pub/scm/linux/kernel/git/next/linux-next.git

A patch flow to mainline



Patch posted

Acked?

Yes

Patch merged

No

Fix issues

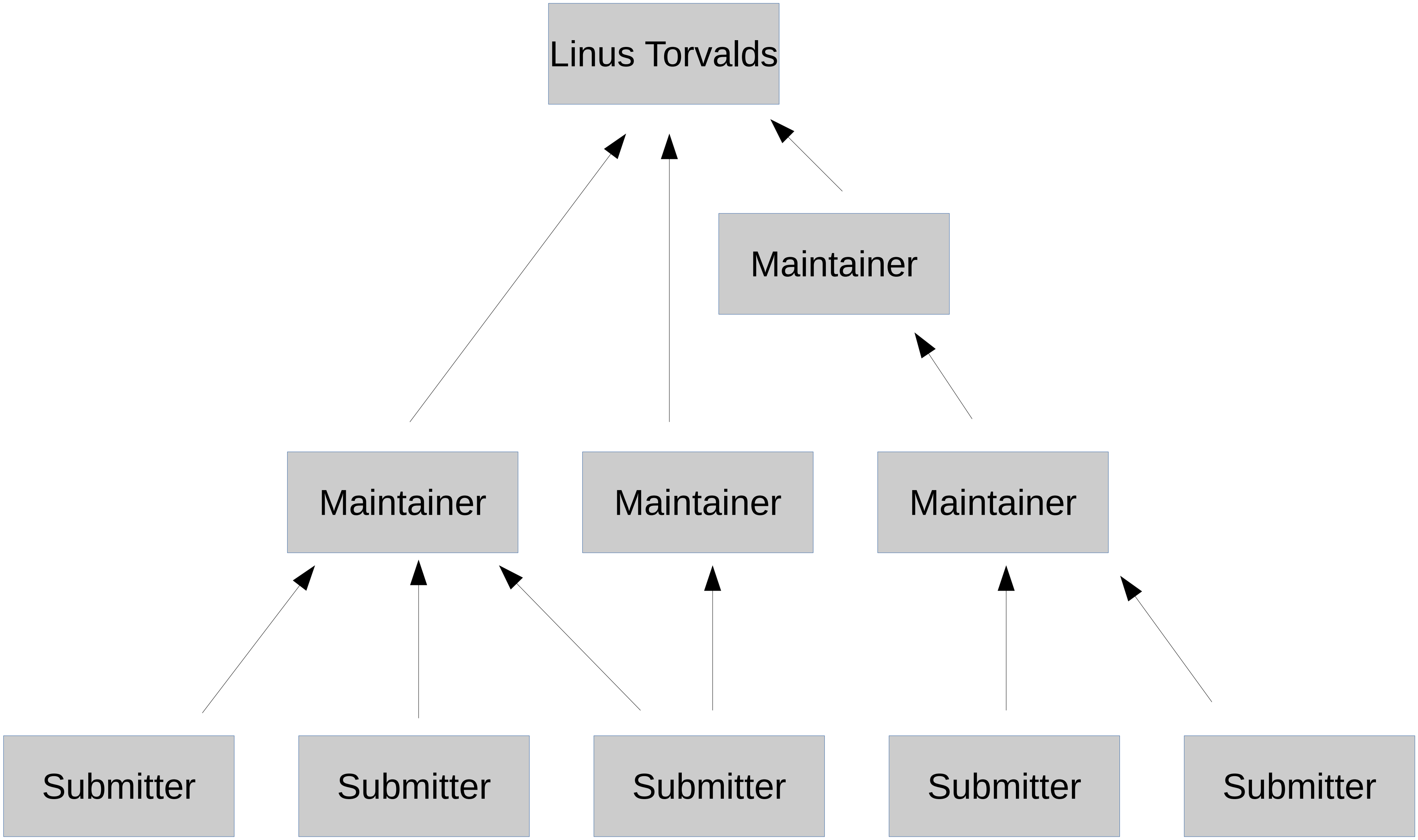
No

Nacked?

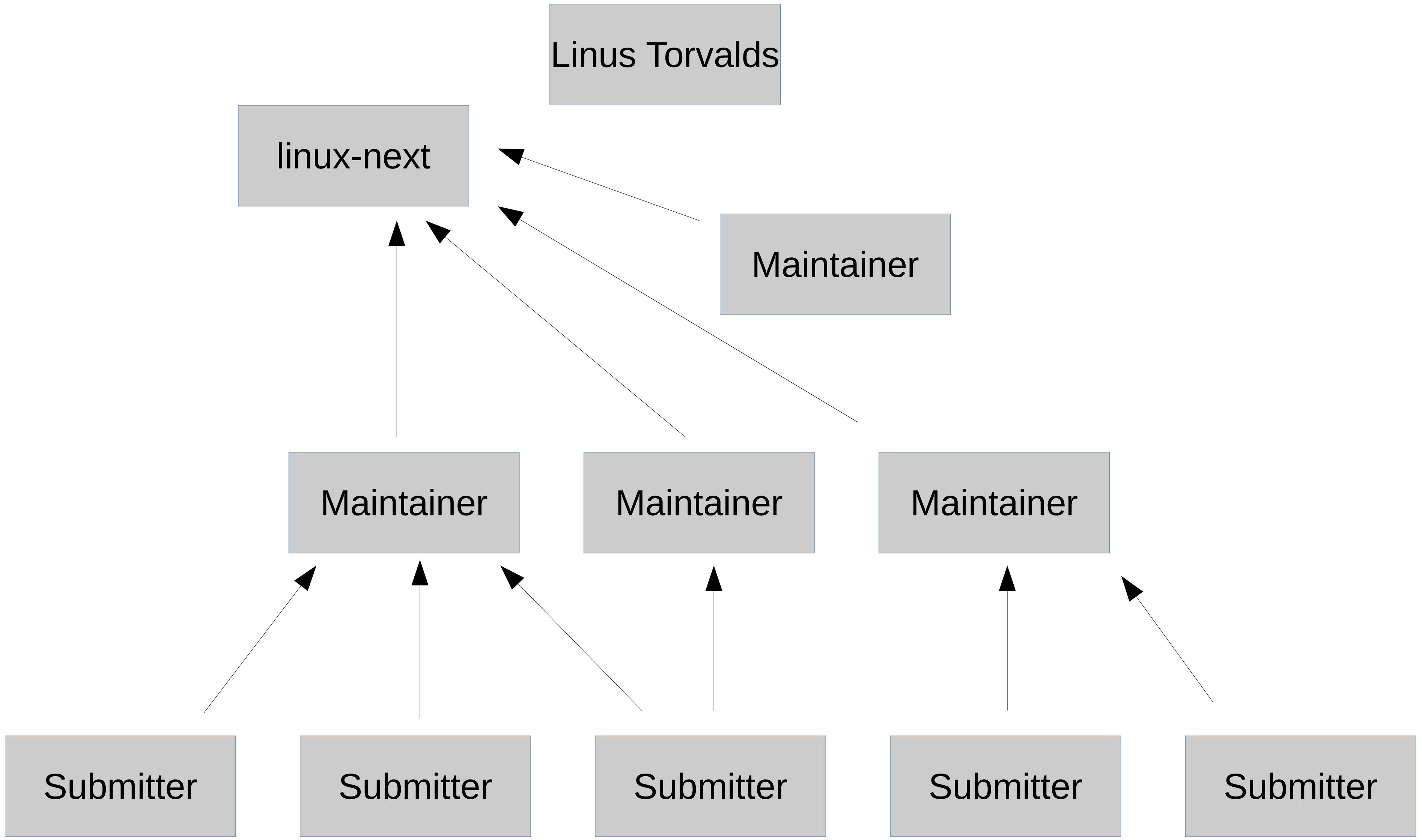
Yes

Patch dropped

A patch flow to mainline



A patch flow to mainline


Linus Torvalds

linux-next

Maintainer

Maintainer

Maintainer

Maintainer

Submitter

Submitter

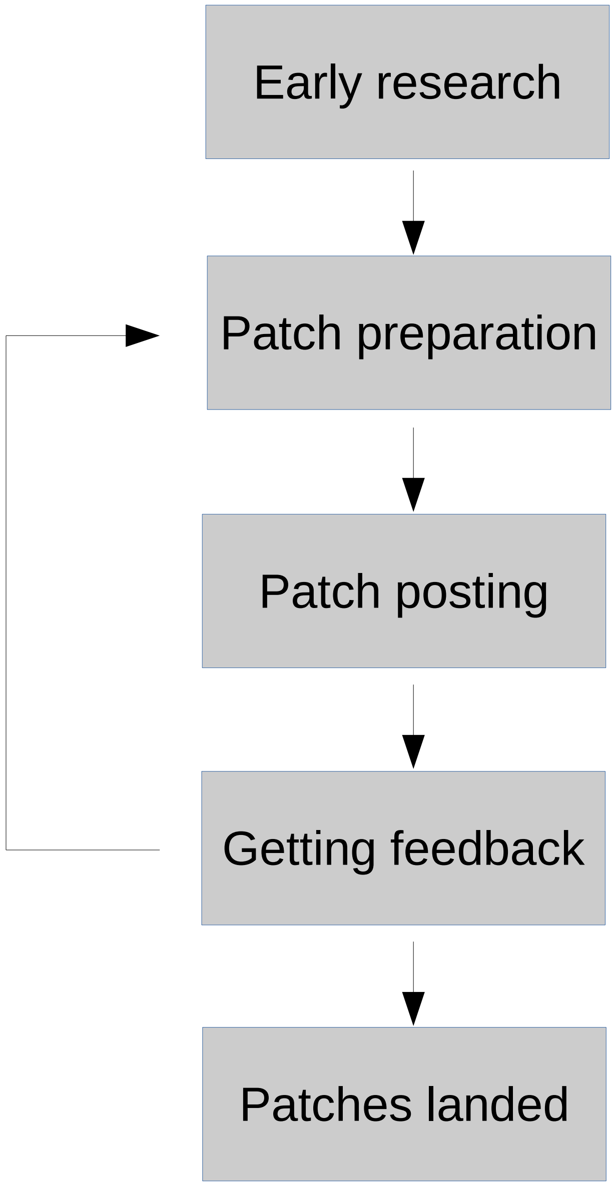
Submitter

Submitter

Submitter

Contribution Steps

Contribution Steps



Early research

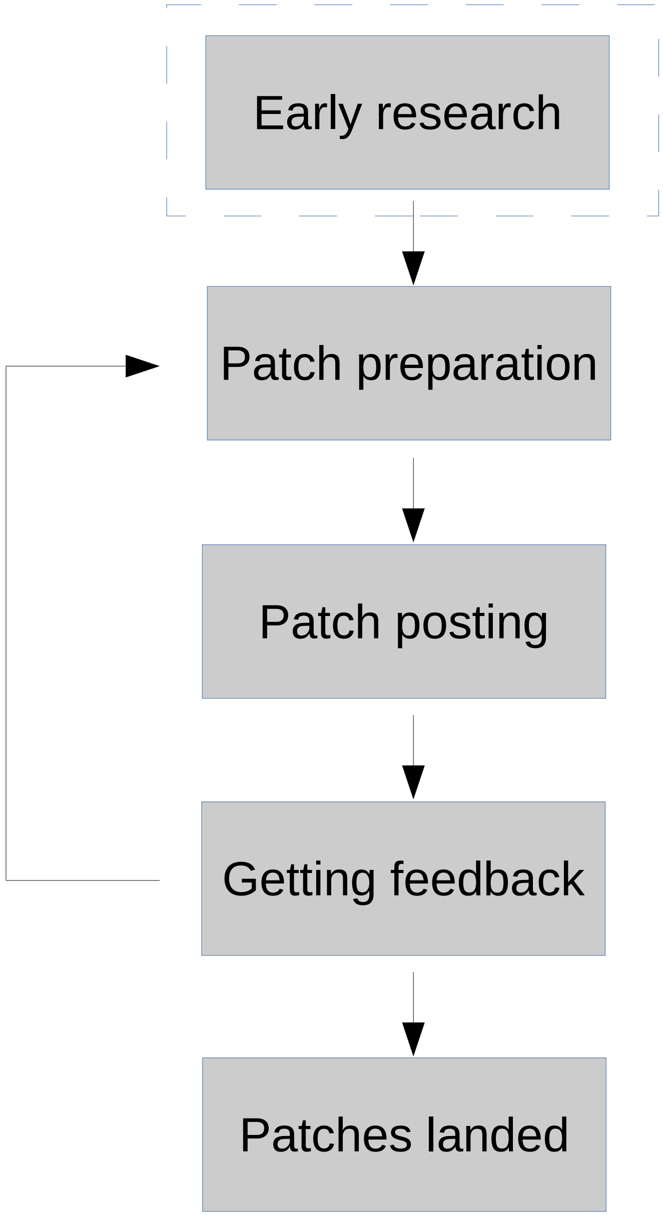
Patch preparation

Patch posting

Getting feedback

Patches landed

Contribution Steps


Early research

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Early Research

- The development process must be understood before preparing a patch.
- This is one of the most important steps for a successful contribution.
- This is a must when contributing to Linux for the first time.
- This is also recommended even if you have prior experience, when contributing to a new subsystem for the first time

Early Research - Documentation

- The development process and the contribution process is well documented.
  - Documentation/process/development-process.rst
  - Documentation/process/howto.rst

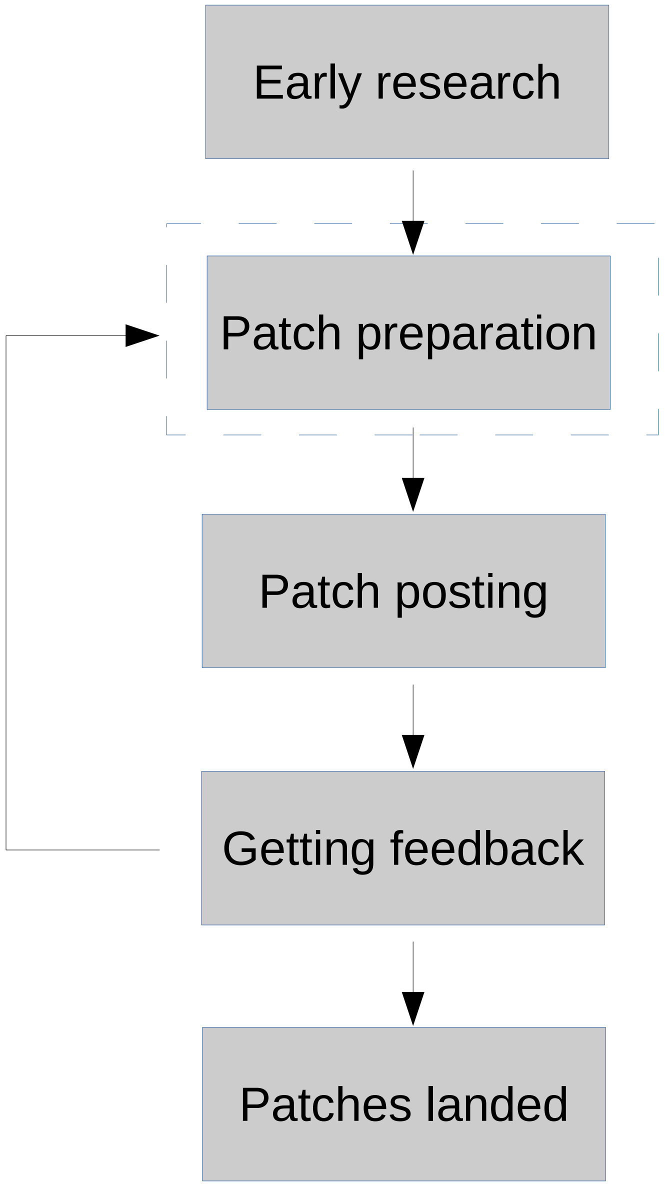
Early Research - Preferences

- Subsystems maintainers can have their own preferences.
- Learn the subsystem conventions for easier interaction.
- Look at the MAINTAINERS file to know who are the maintainers of a given subsystem.
- Search the subsystem mailing list archives for older threads to learn these unwritten rules.

Early Research - Preferences

- Some subsystems have their own documentation:
  - Documentation/devicetree/bindings/submitting-patches.txt
  - Documentation/networking/netdev-FAQ.txt
  - http://www.linuxtv.org/wiki/index.php/Development:_How_to_submit_patches
- Learning these preferences can feel like wasted time, but it really pays off in the long run.

Contribution Steps

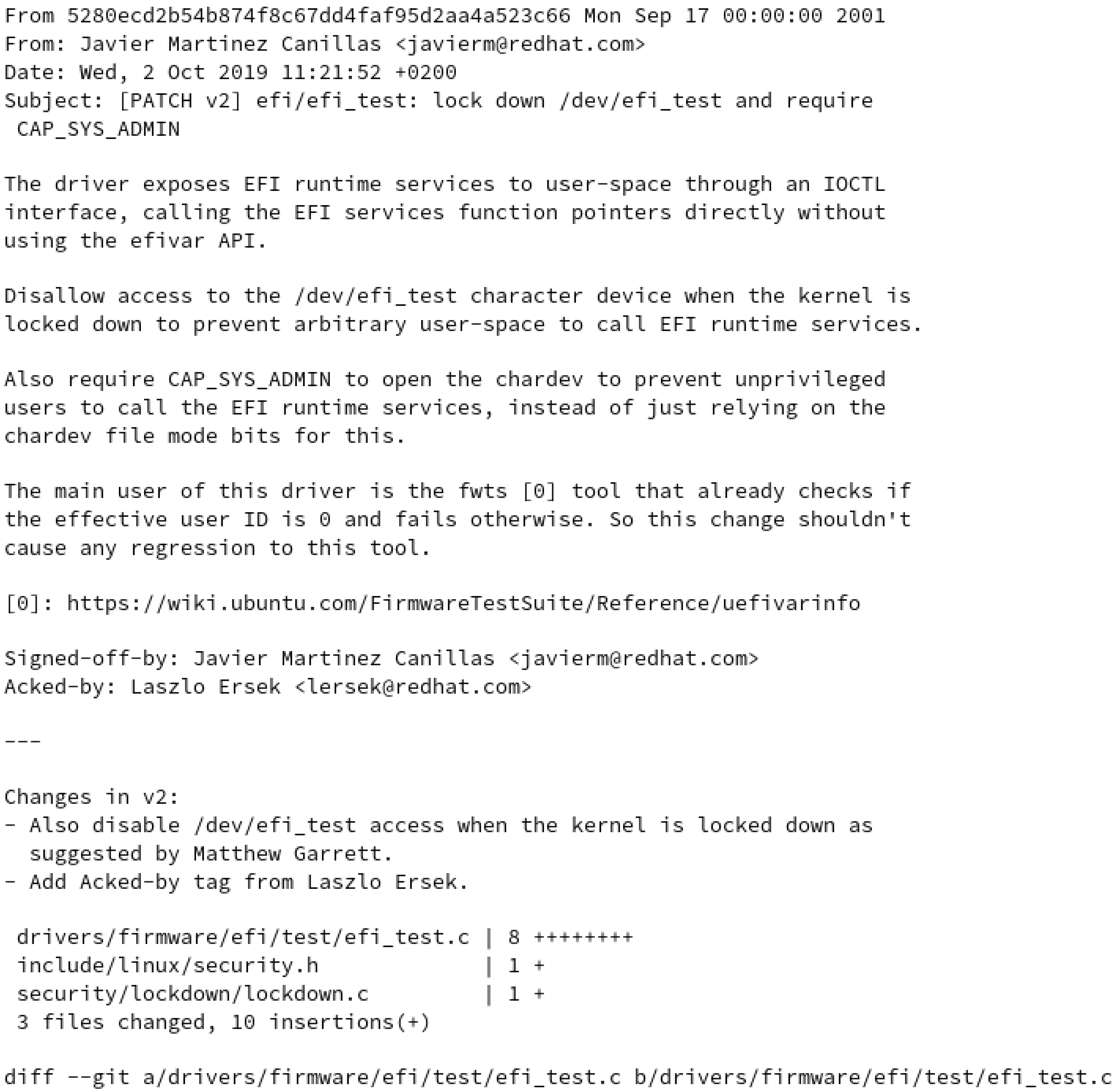


Patch Preparation - Format

- Make sure patches conform to the canonical patch format.
- This is also very well documented.
  - Documentation/process/submitting-patches.rst
- git format-patch
- Check the git log to use a proper subject line
- Include Certificate of Origin (Signed-off-by)
  - http://developercertificate.org/

Patch Preparation – Changelog

- Good commit messages explain **why** a change is needed, not **what** is changed.
  - The patch contents can answer what but not why
- What is in the commit message ends in the git tree
- Comments not suitable for the changelog should be included between a “---” marker line and the actual diff
  - For example patch history and changes by revision



```
From 5280ecd2b54b874f8c67dd4faf95d2aa4a523c66 Mon Sep 17 00:00:00 2001
From: Javier Martinez Canillas <javierm@redhat.com>
Date: Wed, 2 Oct 2019 11:21:52 +0200
Subject: [PATCH v2] efi/efi_test: lock down /dev/efi_test and require
 CAP_SYS_ADMIN

The driver exposes EFI runtime services to user-space through an IOCTL
interface, calling the EFI services function pointers directly without
using the efivar API.

Disallow access to the /dev/efi_test character device when the kernel is
locked down to prevent arbitrary user-space to call EFI runtime services.

Also require CAP_SYS_ADMIN to open the chardev to prevent unprivileged
users to call the EFI runtime services, instead of just relying on the
chardev file mode bits for this.

The main user of this driver is the fwts [0] tool that already checks if
the effective user ID is 0 and fails otherwise. So this change shouldn't
cause any regression to this tool.

[0]: https://wiki.ubuntu.com/FirmwareTestSuite/Reference/uefivarinfo

Signed-off-by: Javier Martinez Canillas <javierm@redhat.com>
Acked-by: Laszlo Ersek <lersek@redhat.com>

---

Changes in v2:
- Also disable /dev/efi_test access when the kernel is locked down as
  suggested by Matthew Garrett.
- Add Acked-by tag from Laszlo Ersek.

 drivers/firmware/efi/test/efi_test.c | 8 ++++++++
 include/linux/security.h             | 1 +
 security/lockdown/lockdown.c         | 1 +
 3 files changed, 10 insertions(+)

diff --git a/drivers/firmware/efi/test/efi_test.c b/drivers/firmware/efi/test/efi_test.c
```

Tags in the commit message

- Signed-off-by: the signer was involved in the development of the patch or in the patch's delivery path
- Reported-by: gives credit to people who find bugs and report them
- Tested-by: indicates the patch has been tested by that person
- Reviewed-by: indicates the patch has been reviewed by that person
- Acked-by: a person was not directly involved in the preparation or handling of of a patch but wishes to signify and record their approval
- The full list is in Documentation/process/submitting-patches.rst

Patch Preparation – Changes Split

- Split the changes in reasonable chunks so they can be reviewed easily.
- Patches should do only one thing, each logical change should be separated.
- Patches that can be grouped logically, should be posted as a patch series.
- A patch series should have a specific purpose.

Patch Preparation – Changes Split

- Patch series should not do too many things at once, it's better to split.
- Patches in a series should be added to be applied incrementally.
- Individual patches should not break bisect ability (for both build and run time).
- If a series contains fixes, these should be first. This allows them to be applied even if there are discussions about the other patches

Patch Preparation – Cover Letter

- Patch series should have a cover letter (PATCH 0/N) that explains what the series is about, how it was tested, etc.
  - git format-patch --cover-letter
- The cover letter should explain the dependencies between the patches and which patches should be applied by whom.

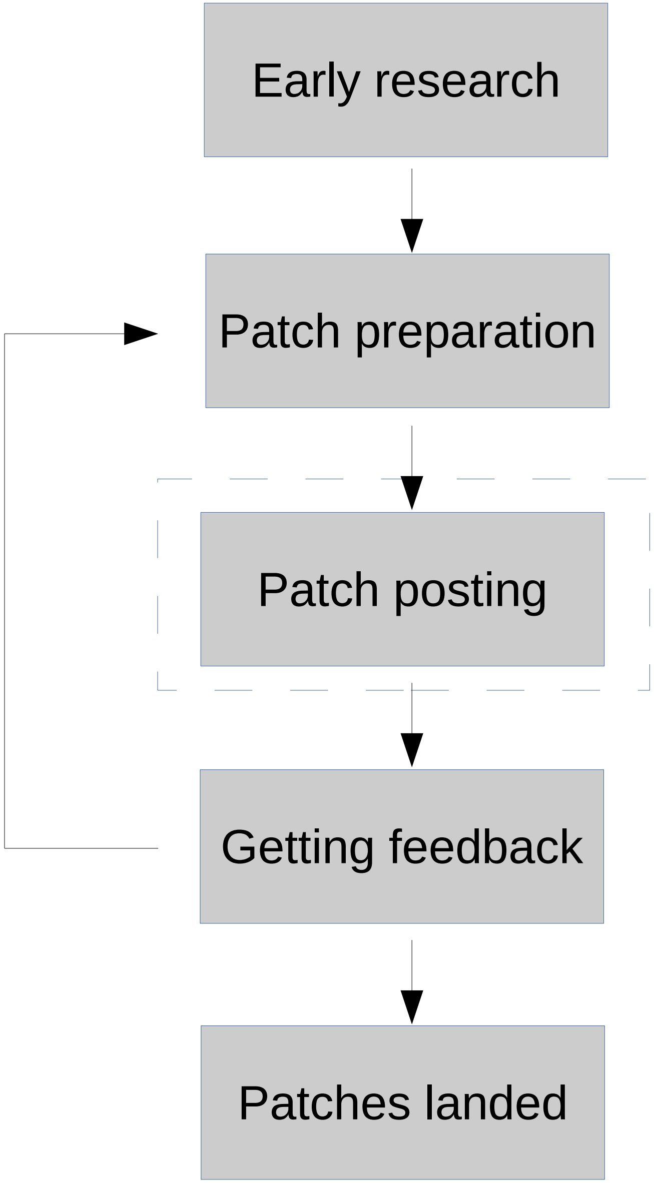
Patch Preparation – Dependencies

- If possible, all patches should go through the same tree.
- Or, let Kconfig handle the dependency (i.e: A depends on B).
- Make it clear if there are cross subsystem dependencies and indicate what these are.
- Cross subsystem dependencies (different ways to solve the conflict)
  - Split by kernel releases
  - Get Ack from maintainers and push everything through a single tree
  - Shared immutable branches between maintainers containing the dependencies patches

Patch Preparation - Tools

- git format-patch
- ./scripts/checkpatch.pl
- coccinelle
- sparse
- smatch
- cppcheck
- git rebase -i –exec

Contribution Steps



Patch Posting

- Documentation/process/submit-checklist.rst
- Use git send-email since it does the right thing.
- If not sure about the patches, add RFC to the patches subject.

Patch Posting – Who to CC

- It’s important to think about who should receive the patches and who shouldn’t.
- The MAINTAINERS file tells the maintainers and mailing list to send the patch to.
- The get_maintainer.pl script suggests a cc list.
- This it’s only a suggestion, don’t follow it blindly.

Patch Posting – Who to CC

- The decision to copy all patches in a series to all recipients is made on a case by case basis.
- Some people don’t like to be copied on random patches.
- Others prefer to get the entire series to have more context.
- Research the maintainers preferences to see what fits better with their workflow.

Patch Posting – CC'ing Cover Letter

- For patch series, the cover letter should be sent to all people receiving the patches.
- This way, everyone will have enough context to understand the patches.

Patch Posting – When to Post

- Maintainers also have different preferences on when patches should be posted.
- Some maintainers expects submitters to follow the development process, i.e:
  - Only post bug fixes during the -rc cycle
  - Not post features during the merge window
- Other maintainers don't expect developers to know the dev process and picks both fixes and new features at any time.

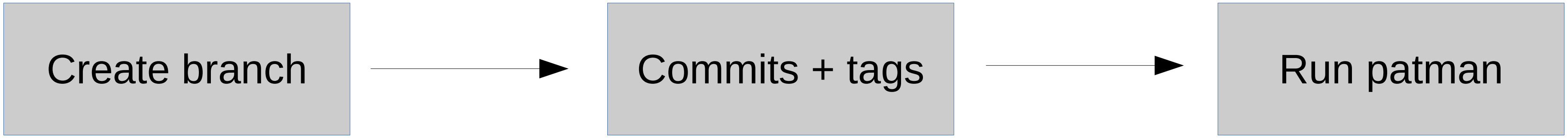
Patch Posting – Patman

- Developed by Simon Glass for the u-boot project
- Tool to automate patch formatting, check and submission
    - http://git.denx.de/?p=u-boot.git;a=blob;f=tools/patman/README
- Useful for any projects where the submission process includes posting patches
- Converts a git branch in a set of patches and post them

Patch Posting – Patman

- Behavior controlled by a set of tags in the commits
- Creates cover letter, logs, etc from metadata
- Invokes checkpatch.pl to verify the patches
- Calls get_maintainer.pl to fill cc list (or use tags in commits)
- Supports dry run option to simulate what would be done

Patch Posting – Patman Workflow



Create branch → Commits + tags → Run patman

- For each patch series revision, the output will be consistent
- Reduces an unnecessary source of errors and annoyances versus when it's handed manually

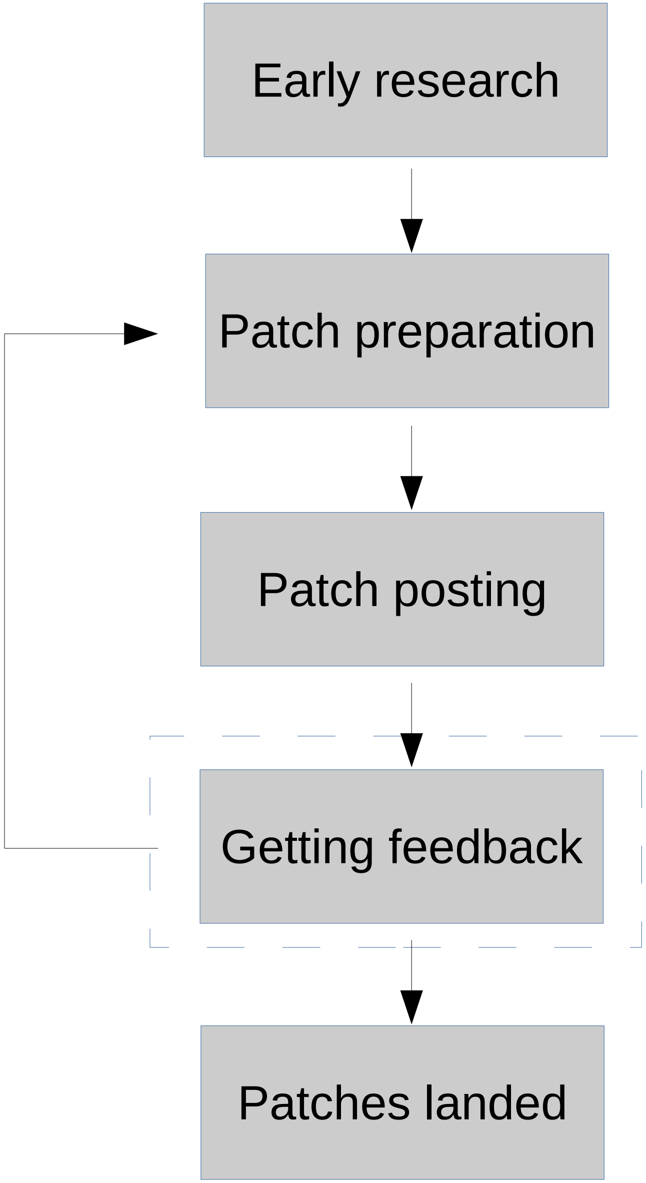
Patch Posting – Patman Tags

- Series-to: email address or alias to send this patch series
- Series-cc: email address or alias to copy this patch series
- Series-version: set the version of the series. Will add a v<n> to the patch subject
- Series-prefix: Set the patches prefix (i.e: RFC or RESEND)
- Cover-letter: Content of the cover letter, fist line is the subject
- Cover-letter-cc: email address or alias to copy the cover letter
- Series-changes: Changelog for patch series revision
- Commit-notes: Notes for each commit, appear after “---” cut
- Patch-cc: email address or alias to copy this patch

Patch Posting – Patman Options

- patman command line arguments
  - patman -n (dry run)
  - patman -c<n> (use the n first commits)
  - patman -s<n> (skit the first n commits)

Contribution Steps



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Getting Feedback – Asking for it

- Give maintainers at least a week to answer.
- Some expect more time, so research their preferences.
- After a reasonable time, an action could be taken:
  - Some maintainers expect you to ask in the patch thread
  - Others maintainers expect the patch to just be resent
- This may depend on whether or not the subsystem uses patchwork.

Getting Feedback – Answer Inline

- **Don't top post**! Always answer the emails in-line.
- When discussing your patches remove unnecessary context from the email.
- People don’t want to scroll hundred of lines to read an answer of a couple of lines.
- But keep enough context so people answering after some days or weeks, can remember what the discussion was about.

Getting Feedback – Patch Revisions

- After feedback has been addressed, a new revision should be posted.
- A version v<n> should be included in the subject (i.e: [PATCH v2]).
- git format-patch -v2
- A log of the changes should be added between “---” and the diff.

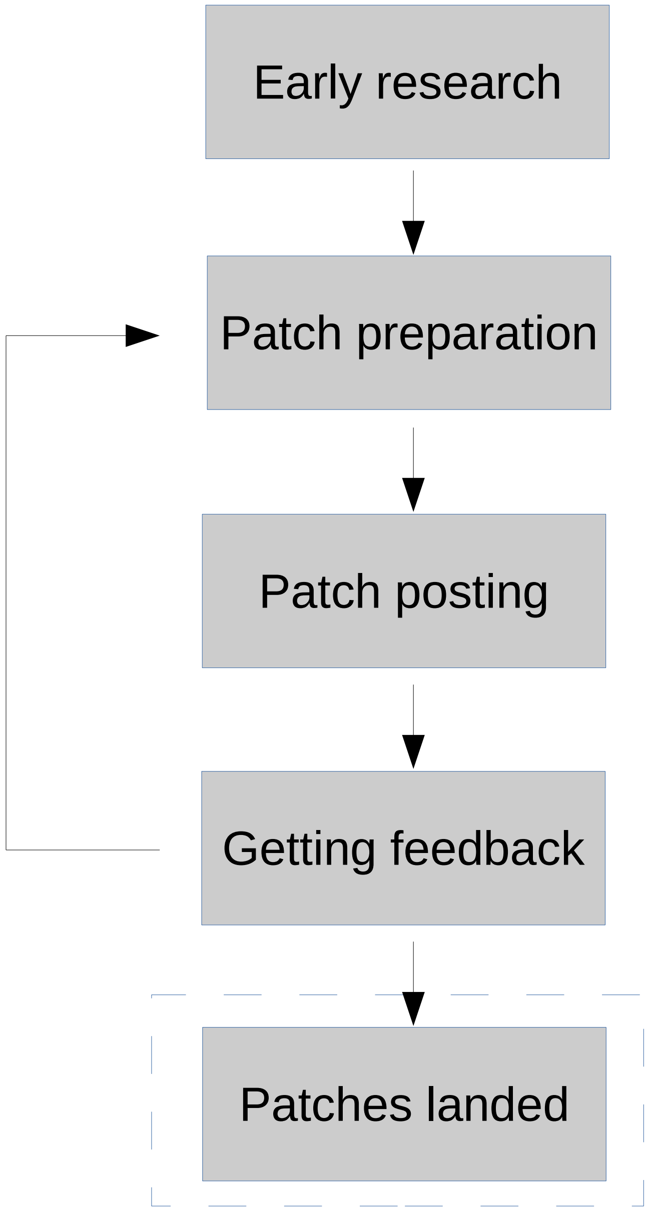
Getting Feedback – Patch Revisions

- Patches that have been ignored and are resent should have a RESEND prefix
- git format-patch --subject-prefix="RESEND PATCH"
- If a new patch is added to a series, mention it in the changelog.
- Patman makes all this easy (Series-version, Series-changes, Series-prefix).

Getting Feedback – Sending a new version

- Wait some time before sending a new version.
- It's possible that maintainers didn't have time to review yet.
- Sending too quickly could create more work for them.
- But could be that maintainers are not answering because a new version is coming.
- Again, this could depend on the maintainer so research the preference.

Contribution Steps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Patches Landed

- The work is not done when patches get merged.
- Patches will get a lot of manual and automated build & boot testing (kernelci, 0-day, etc).
- Make sure to be responsive in a timely manner if issues are found.
- Don't post patches and then disappear if bugs are found after merging.

Patches Landed

- Open source is about trust and this has to be earned.
- Maintainers expects submitters to be trustable.
- If that's not the case, they will be less fond to merge patches in future.
- It can affect the reputation of both the developer and the company they work for.
- So keep an eye to the subsystem you contributed and be ready to fix issues if these are found.

Questions?

Thank You!