



# On submitting kernel patches

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# Scope

- Describing Linux kernel specific procedures
- Many points apply to other large OS projects
  - Details usually differ
    - Each project has an own culture
  - Smaller projects typically use simpler procedures
    - But basics tend to be similar
- In general not all points apply to all patches
  - For simple bug fixes much of this can be skipped
  - Guideline, not fixed procedure
  - Complex changes should try to avoid shortcuts

# Why submit patches to Linux mainline?

- Review (usually) increases code quality
- Free testing by the user base
- Avoids user interface conflicts
  - Can be very painful if not avoided
- Free forward porting service
  - Interfaces won't go away
  - For intrusive changes often required
- Best way to distribute a change
  - Change will be often just available in next release of popular distributions
  - Best case for hardware vendors
  - And even convenient for private features



# •General overview

- Write/test code
- Code review
- Code gets fixed as needed
- Maintainer merges code
- Code gets tested
- Gets incorporated into release



# Preliminaries

- Coding Style should be correct
- Change should work of course
- Extensively documented elsewhere
  - See resources, paper
- Prepare for some additional work
  - And to do some revisions
  - Use some way to allows patch revision (quilt, git)
- There will be criticism
  - It's not meant personally even if harsh

# Getting attention

- Patch is more like publishing a scientific paper
  - than a traditional checkin
  - Exceptions: when you become the maintainer
- There is a shortage of reviewers
  - But without review it is difficult to get something in
- And maintainers are often very busy
  - And sometimes there is no clear maintainer for some area
  - Needs other reviewers
- Linux kernel is an attention economy
- Who can sell their patches best gets the reviewers

# Case study: dprobes

- Dynamic instrumentation framework
  - Attach probes in RPN language to kernel/user space
  - Originally ported from OS/2
  - Submitted in 2.4 time frame
- No user community, very little interest
  - Dropped from major distribution due to lack of interest
- Team posted many versions of the patches in 2.4
  - Didn't attract significant reviews
  - Main contentious area: VM interface for user probes
  - Byte code interpreter not popular
  - No clear maintainer to process the code

# •Dprobes: lessons

- You have to sell the feature
  - Especially if it's new and innovative
  - Only became popular when others started to hype
  - Adopt a user base early
- When parts are problematic split them out
- Don't wait too long to redesign
- Don't try to submit all features in the first step



# •Dprobes: the solution

- Finally redesigned to kprobes
  - No byte code, only kernel probes in C
  - Went in relatively quickly due to simplicity
- Quickly used by kernel community with C probes
- Lives on as kprobes/systemtap
  - Systemtap as a user friendly script language frontend
  - User base now due to independent hyping effort
  - But still no user probes

# Types of submissions

- Clear bug fix
  - Easiest case: Can be usually added quickly
- Cleanups
  - Timing is important
  - Don't overdo it. Bug fixes are more important!
- Optimizations
  - Depends on how much it helps
  - And for what workload
  - And how intrusive it is

# Hardware Drivers

- Most common code in the kernel
- Most important part is code style, basic interfaces
  - Look at existing drivers for guidances
- Must be Linux code
  - Follow standard Linux design patterns
  - Avoid adaption layers
  - Coding Style
- Well established procedures for the standard types
  - Networking, block devices, etc.
  - Sometimes more difficult for more exotic ones
- Difficult areas:
  - Needing special hooks in core code

# •New core functionality

- Hooks, hooks, hooks

- “I just want to add this hook to improve the world”
- Each hook has large maintenance overhead
- Breaks coding assumptions, makes it difficult to follow coding flow, requires all hook users to check etc.
- Maintainers usually not sympathetic

- First try to avoid hooks

- If you do them they need very careful design

- One way is to trade cleanups for such controversial changes

- Do some significant work to clean up subsystem or resolve existing problems
- Then as part of that add your hooks in a clean way
- That is how Xen paravirt ops got in

# •Splitting submissions into pieces

- Large patches cannot be effectively reviewed
- Split patches into logical chunks
  - File boundaries are not logical chunks
  - Exceptions are for new drivers
- Patches must be bisectable
- Don't mix cleanups/refactoring with functional changes
- Don't post too many patches at a time
  - Space out posting of larger patchkits
  - Post in logical chunks

# Case study: perfmon2

- Performance counter interface
- Original simpler in tree version on ia64
- “Second system” version out of tree
  - Years out of tree development
  - User base with feature development
  - Very complicated code
- Very complicated interfaces for all the features
  - Scared reviewers away
- Now new merge attempt with a much simplified version
  - But interface still very complicated



# •perfmon2 lessons

- Submit quickly
- Be conservative with novel design patterns
  - Like output plug-ins
- Don't add too many features out of tree
  - Later it's hard to untangle them
  - And rationales will be lost
- Have a basic functionality version

# •Interfaces

- Reviewers focus on user space interfaces
  - “Code changes, but interfaces stay forever”
  - Often very difficult discussions
  - Doesn't matter for many drivers
- KISS: Keep it simple, ..
  - Have a rationale for all aspects
  - Remove unnecessary debug interfaces
- Different interface styles
  - file system, ioctl, sysfs, syscalls
- Compromise with en-vogue interface styles
  - Should make sense for the problem
  - Should not unduly complicate your code



# •Interfaces II

- Consider the 32bit compat layer
- Have some design/user documentation
  - Manpage for syscalls
  - And ideally test code, especially for syscalls
- On the other hand in kernel interfaces are less critical
  - Can easily change later
  - But when widely used should be still well designed

# •A good description

- Patch submission is a publication
  - Must compete in the attention economy
  - People like to read good stories
- Description of the patches is important
  - When applicable hard numbers quantifying a improvement are good
- For larger patch series write an introduction
  - Explain what the patch does and how it improves Linux
  - Describe rationale of contentious design decisions
  - Describe open problems
- When you have problems with English get help
  - Of course only for larger submissions
- Document changes over time

# •Establishing trust

- Accepting a patch means that the maintainer trusts you
  - That you know what you're doing
  - That you deal with problems
- Trust is built up over time
- More trust makes the process easier
  - Extreme case maintainer
- Do development publicly on mailing lists
  - Including bug processing
- Ideally single engineer should be main interface
- Working on other areas can establish trust
  - For example fix bugs elsewhere, do cleanups

# •Timing: when to post

- Post early patches as RFC
  - When it basically works but still has problems
  - For complex code even multiple RFC stages
  - Gives you early feedback
  - Good description still important
- Ideally do parts of the development process on the mailing list
- Don't merge when it's too unstable
  - Can give a bad reputation (“ACPI/JFS effect”)
  - But doesn't have to be perfect either
  - Crashes not good, missing functionality is
- Don't post shortly before/during merge windows
  - It's too late then
  - Unless it's a small incremental change

# •Dealing with code reviewers

- Reviewing is open for all
  - Actually there is a shortage of reviewers
  - But sometimes there are bad reviews
    - You have to recognize that
- Main focus on the interfaces
  - Both user interfaces and kernel interfaces
- Don't rely on them for logic bugs

# •When the reviewer asks for a redesign...

- First often they are right
  - You might to have to just do it.
- They often don't realize how much work it is
  - Try to negotiate if it's unreasonable
- Sometimes they are wrong
- You have to judge it:
  - is it worth it
  - Does it make sense?
- Who asks for it?
  - Maintainer is more important than random reviewer
  - Can also check git logs to judge person

# •Resolving problems

- Sometimes submissions get stuck
  - Not enough interest
  - Maintainer loses interest
- Ask the maintainer in private mail for advice
  - Most are reasonable and willing to help
  - If the maintainer doesn't cooperate you can also go higher up the food chain
- For complicated features negotiate a merging plan
  - Especially for dependencies in different trees

# •Dealing with controversial features

- Discuss the basic design in advance
- But if discussion is fruitless having working code is also good
- Only part of the submission is controversial?
  - Can you split it out and get the uncontentious parts in first?
  - Later there might be a chance to resubmit them again once the code is established
  - Or you need to redesign only these parts



# Resources

- /usr/src/linux/Documentation/
  - SubmittingDrivers
  - SubmitChecklist
  - SubmittingPatches
  - CodingStyle
- OLS paper from proceedings
  - <http://halobates.de/on-submitting-kernel-patches.pdf>
  - Has more details and further references
- Questions?

# Backup



# The all-powerful maintainer

- Maintainers have the power over the code
  - They merge or reject your code
  - There are (difficult) ways to appeal
- Who watches the watchmen?
  - Judged by the results
- Maintainers are (usually) constructive
  - But there can be (rare) exceptions
- Don't get into conflict with the maintainer
  - But do not everything mindlessly they ask for
  - Sometimes they are wrong or didn't think something through
  - Explain issues politely
- When there is no clear maintainer merging is difficult
  - Some catchall maintainers as fallback
  - Usually have to attract reviewers unless it's simple

# What is code review?

- Linux review is
  - Design review
  - Coding style review
  - Interface review
  - Obvious bugs review



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