Efficient Kernel Backporting

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http://www.linaro.org

Linaro

Agenda

- Why do feature backporting
- Before backporting
- Feature organization
- Deal with Conflicts
- After backporting
- Expectations on upstream

Why do backporting

Why use old LTS

- Time to market product want kernel:
  - Best stable kernel
  - A target kernel as system baseline, for
    - Out of tree patches
    - System compatibility
  - Less regression testing required

  A steady LTS

Feature Missed in LTS

- Latest feature missing
  - Latest drivers, functions or security updates, like
    - Arm64 PCI-E support on 3.18/4.1
    - Cgroup writeback, hibernation on arm64, KASAN on 4.1
    - Or out of tree features:
      HMP/EAS on ARM for big LITTLE arch.

Solutions and Disadvantage

- Solution: LTS + feature backporting
  - An example: Linaro Stable Kernel
    - https://wiki.linaro.org/LSK
- Perfect solution? No
  - Repeated work for enabled feature
  - Less review/testing from community
  - Trouble with newer API or coupled kernel components

Other Solutions?

Keep rebasing on upstream kernel?

- Less stability
- kernel API change, like: driver API, /proc, /sys, ioctl
- Keep regression testing

Best Feature Candidate

- Good resources to know request feature
  - Get feature info from requester, what/why
  - Get feature profile from lwn.net or wiki
- Know the feature versions
  - First target is always the upstream patchset
  - An old version feature maybe acceptable, if it's using old kernel API

How to do Backporting

Get Feature Commits

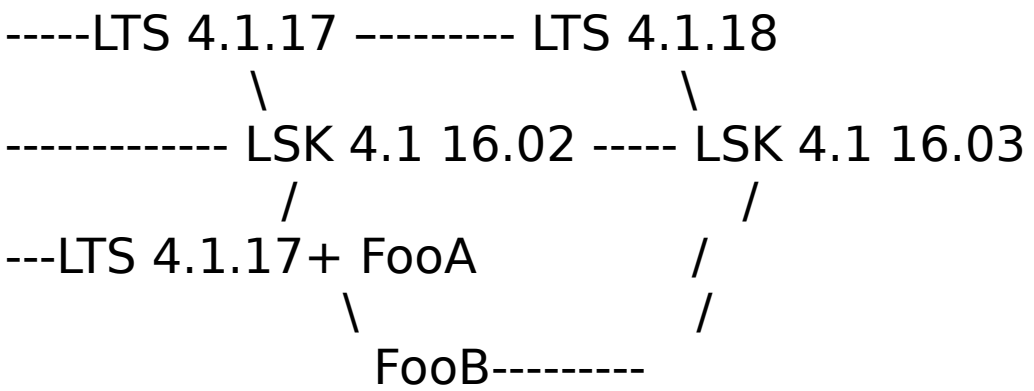
- Get feature patchset from lkml
- Collect feature commits in git tree
  - From related source files and headers
    - Git log v4.1..upstream – drivers/base/power/opp
  - If feature name mentioned
    - git log -i -G'kasan' v3.18..upstream (54 commits)
    - git log -i --grep=kasan v3.18..upstream (126 commits)
  - By involved authors
    - git log --author=tj@kernel.org --reverse v4.1.18

Feature Organization

- Rules for feature Organization
  - Each of feature isolated in a separated branch
  - Dependent feature based on others branch instead of LSK mainline
    - Tree mode branches
    - A example: pax_usercopy rely on KASLR
- Benefit
  - Feature Selectable
  - Reading, retrieve and debug

Feature Organization

- An example of LSK organization:



Backporting with Git

- Pick up wanted changes/commits

  $git cherry-pick -sx commit1..commit2

  - git cherry-pick a patchset range
    - Get all commit at once, easily disturbed by dependent missing.
  - git cherry-pick patches one by one.
    - Easy to control for every commits

Conflicts

- Middle changes missed conflicts
  - Direct code base changed
    - Like, removed line doesn't exist.
    - Know reasons of the changes by 'git log -S/Gstring', pick or skip
  - Miss some dependencies,
    - Like some new code line in close section
    - Find and pick them by 'git blame' or 'git log -p'
  - Feature coupled with other kernel components
    - Cut off the connection maybe better
    - Or bring trouble on the other kernel part

Tool for Conflicts

- Conflicts solution reuse
  - Use git rerere to reuse conflicts solutions
- Find commits that trigger conflicts
  - Tools git log, git blame

    git log -G'extern void inet_twsk_put' – include/net/inet_timewait_sock.h

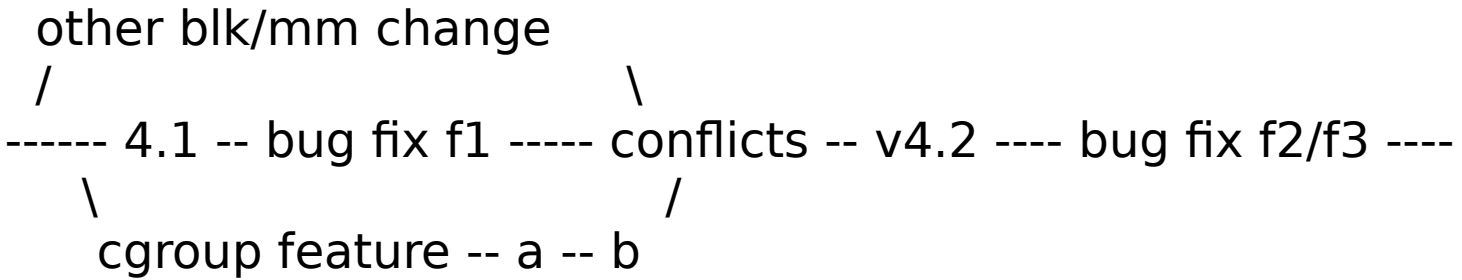
    git blame – drivers/base/power/opp/core.c

Reduce Conflicts

- Reduce conflicts
  - Find out all related changes on feature related field
    - Pick up from base to upstream direction
  - Pick up the related set commits instead of only single related patch,
    - Use gitk not git log --graph to find out the commit set

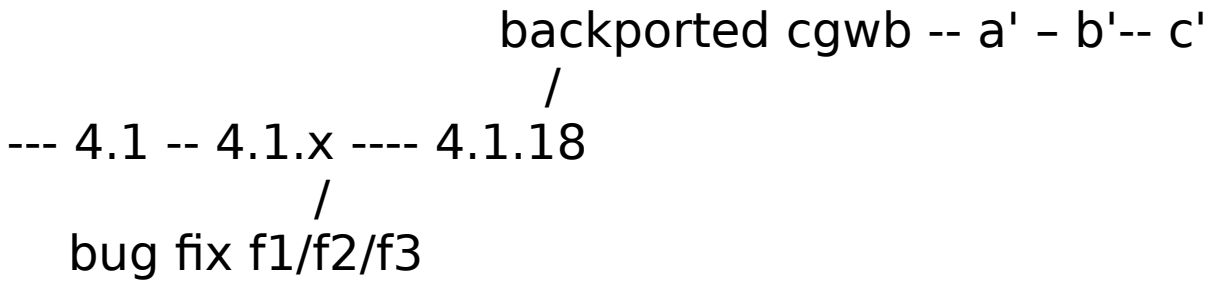
Feature/LTS Conflicts

- Example, a upstream situation:



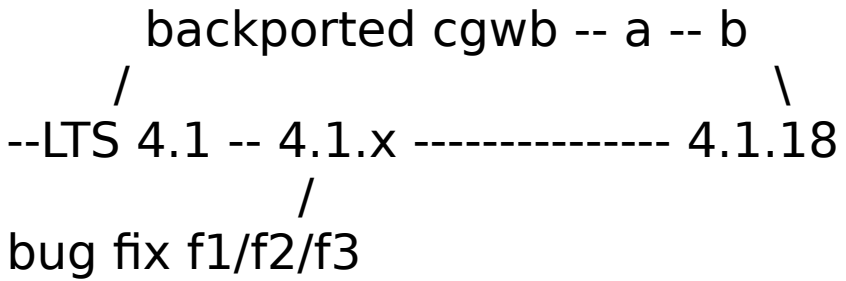
Feature/LTS Conflicts

- Usual solution for cgroup writeback LTS branch:



Feature/LTS Conflicts

- A better way, postpone conflicts to merge
  - Do the backporting on v4.1 kernel, and left the conflicts on merging to 4.1.18



Don't Do ...

- Don't change kernel/user API /sys, /proc etc
  - System libs, applications rely on them
- Don't pick up big coupled kernel parts
  - Cut off early
- Don't change driver API
  - Downstream drivers

Post Backporting

- Review if all necessary commits picked
  - Scan and compare all changed and related commits

    git log --cherry v4.4...v4.1/topic/KASAN -- ./mm/kasan ./include/config/have/arch/kasan.h ./include/linux/kasan.h ./arch/arm64/mm/kasan_init.c ./arch/arm64/include/asm/kasan.h
- Testing for the feature
  - Seek testing method from community

Post Backporting

- Scan bug fix for picked commits

  https://git.linaro.org/people/alex.shi/scripts.git/blob/HEAD:/chkfix.sh

  The latest features are often buggy, so scan the upstream kernel, to see if any commits which you picked was mentioned by others, that's probably a bug fix.

Post Backporting

- Notice your users of Any API changes if you have to do
  - Explain reasons
  - And give compatible solution for changes

Expectation for Upstream

- Stable
- The less API change, the better.
  - Standardization of API?
    - POSIX, Libcgroup, DRM, memfd, etc.
    - Driver API
  - keep old function when new ones introduced
    - Good examples, cgroup v2 coexist with cgroup v1
- Collaboration on backporting
    - LTSI/LSK

Summary

- Why Backporting is a common needs in industry
- How to do backporting and how to resolve conflicts
- Standardization needs on upstream

Thanks!