Upstream in a Downstream Environment

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Introduction

- Embedded Linux Group at Altera (Programmable Solutions Group of Intel) 
  Austin, TX
- Maintainer for arch/arm/mach-socfpga in Linux
Agenda

- Background of Altera’s open source activity/non-activity
  - Focus on the Linux kernel and U-Boot
- Downstream environment and solutions
  - Network, machines, tools, legal framework
- Reap the Benefits Upstreaming
  - Upgrades, customers, suppliers
- Suffer the consequences of NOT Upstreaming
- Goal
  - Share war stories
  - Highlight how obstacles were overcame
Background: Altera

Provides logic solutions which include FPGAs, SoCs, CPLDs and power management products.

- FPGA = Field Programmable Gate Array
- CPLD = Complex Programmable Logic device
- designed to be configured by a customer or a designer after manufacturing
- SoC’s combine ARM CPU’s with FPGA’s on the same die
Background

What is SoCFPGA?
- SoC + FPGA
- ARM CPU + Hardened IPs + FPGA
- Cyclone5/Arria5/Arria10
  - Dual Cortex A9 + FPGA
- Stratix10 – Quad-core 64-bit (A53) + FPGA
- Upstream effort started in 2012

Nios II
- Proprietary CPU architecture, designed to fit on Altera FPGAs
- Upstream GCC support
- Was completely down stream until v3.19
- Now completely upstreamed
Background: Altera’s upstreaming activity

- **In Linux kernel (kernel.org)**
  - v3.5
    - 0 patches with altera.com emails
  - v4.5
    - 294 patches with altera.com emails
      - Support for SoCFPGA cyclone5, arria5 and arria10 devkits
      - Support for NIOS II
      - Drivers(USB, STMMAC, TSE, etc.)
    - 6 people from Altera listed in MAINTAINERS file

- **In U-Boot**
  - v2012.04
    - 0 patches with altera.com emails
  - V2016.03
    - 97 patches with altera.com emails
      - Support for SoCFPGA cyclone5, arria5
Background

What we knew about upstreaming!

- Management buy-in
- Upstreaming is important and will benefit.
- Some patches could benefit competitor
  - Usually an issue for most companies
- Goal is to stay up to date with community release

Scheduling
- Upstream patches first
- Cannot forecast patches acceptance

- No dedicated “upstreaming team”
  - Push comes to shove, upstreaming gets de-prioritized
Legal Environment

Work with your legal department on a framework

- Acceptance of upstreaming
  - What is upstreaming?
- Which projects can you contribute to?
  - GPLv2, GPLv2+, BSD
- What can/can’t be upstreamed
  - Hopefully all kernel code can be upstreamed
- Validity of confidential stamp on emails
  - Some corporations add legal disclaimers to emails
# Differences between most Corporations and Community

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<th>Most Corporations</th>
<th>Community</th>
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<tr>
<td>Email</td>
<td>Outlook</td>
<td>Evolution, Thunderbird, Pine, Mutt, text-based</td>
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Email support

Avoid Outlook
- Formatting issues
- Cannot apply patches with ‘git am’

Company email policy
- Legal disclaimers

Most have a SMTP port for outbound patches

Replies
- Have an email address that you can access anywhere.
- Use SMTP port on Evolution
  - Evolution has a work around to handle Outlook

Finally got opensource.altera.com
Environment (cont.)

- Source code management
  - Perforce/CVS/SVN/Clearcase
    - Hard to generate patches
  - GIT
    - Claim: “GIT is too hard!”
    - Workflow changes/benefits
    - Get GIT training!

- Coding standards
  - Internal vs. Community

- Issue Tracking
  - Added process
    - ClearQuest/FogBugz
    - Mixture of commit logs in GIT
  - Deploy Patchworks and pull in upstream patches
Environment (cont.)

Release strategy
- Tarballs/Package of files
  - Lose a lot of benefits from GIT
    - History of changes – ‘git blame’
    - Complete history of entire kernel
    - GIT bisect
- Mixture of GIT repo and release package
  - Maintain GIT benefits
  - Deliver FPGA images
  - www.rocketboards.org/github

Workstation
- Virtual Machine
- Dedicated Linux workstation

IT Security
- GIT protocol blocked
  - Separate network for open source work
  - Work remotely
Steps to Upstream a patch

- Get on latest kernel(master) or linux-next
  - Subsystem maintainer’s own branch

- Develop/test
  - Build test allmoddefconfig/other architectures
  - Run checkpatch.pl

- Send patches via git send-email
  - Can get a lot of responses
  - Can get no responses
    - Friendly pings after ~a week or so
  - Can get a lot of bikeshedding[3]
Steps to Upstream a patch (cont.)

“Continuous effort — not strength or intelligence — is the key to unlocking and using our potential.” – Winston Churchill

- Important is to stay engaged with your patches
- Convince maintainers why your patch(s) are important and should get merged
Handling patches

Goal is to upstream patches first vs applying it locally first
- Doesn’t really happen all of the time
  - Why?
    - Unfamiliar with upstream process
    - Management pressure to deliver
      - Classic mentality of “we can upstream it later” exists
    - Accountability
    - A matter of effort
      - Upstream patches are not a toss over the wall and forget

Apply accepted upstream patches
- DTS bindings do not have to change
Benefits of upstreaming

Patches applied on top of vanilla Linux kernel

- Downstream Patches
- Upstream patches

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Benefits of Upstreaming (cont.)

- **Linux upgrade**
  - Simple as a ‘git rebase’ and fix a few conflicts
  - Take ~2 hours by 1 person
  - Can be handled by a small team (testing)

- **Altera customers/partners feedback**
  - 100% positive
  - Kernel updates can be done very quickly
  - Choices

- **Testing**
  - SoCFPGA Cyclone5 Devkit part of arm-soc board farm
  - Part of kernelci.org
  - Mainlined drivers get much more test coverage than any internal testing can cover
  - Constantly tested against many mainline
Consequences of not Upstreaming

Different versions for different devices
- Product cycles cannot keep up with Linux changes
- 8.3 changes per hour in Linux v3.19 kernel [5]
- v4.2: “1.09 million lines of code were added this time around with 285,000 removed, for a total growth of 800,000 lines of code.”[6]
- Upgrades take more effort

Cannot test against latest
- No support for latest

Effort to combine/upgrade?
- Estimate is 2 – 4 weeks
- Test effort doubles to triples

Customers stuck on older versions

Cherry-picking fixes extremely hard

Community cannot help
Conclusion

- Obstacles can be overcome
- Enable the community!
References

[1] https://www.youtube.com/watch?v=L2SED6sewRw
[5] https://www.youtube.com/watch?v=tE3804cOtXA
[6] https://lwn.net/Articles/654633/
Thank You