Living Downstream Without Drowning

LLVM Dev Meeting 2015
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Sony Computer Entertainment

TERMINOLOGY

- Upstream = llvm.org project
- Downstream = project with your changes
- Local change = one of your changes that will (or could) go upstream
- Private change = one of your changes that you intend NOT to send upstream
  - All private changes are local
  - Not all local changes are private

THE FLOOD

Open-source Commit Data for 2014

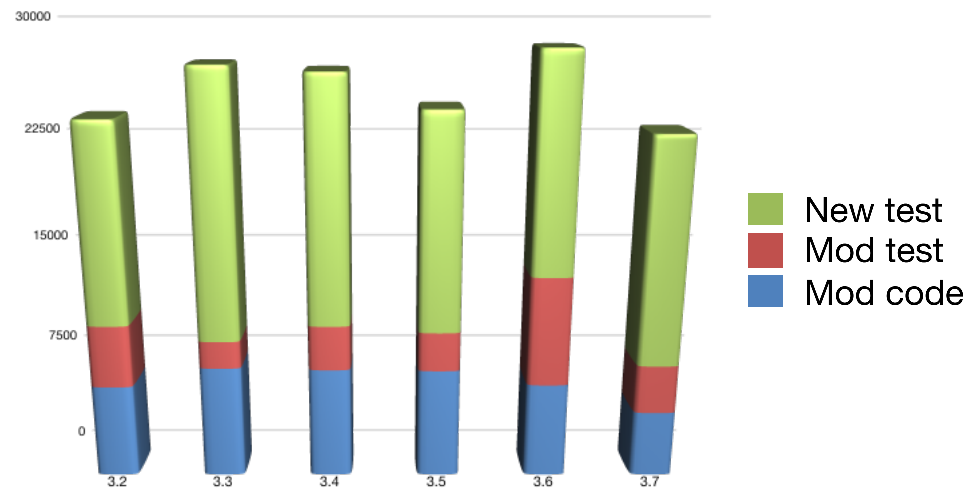
- ➢ For LLVM+Clang specifically, ~50 commits/day
  - ➢ Just a bit higher now…
- ➢ Plus: compiler-rt, compiler-tools-extra, libcxx, lld…
  - ➢ Another ~20 commits/day

LIVING DOWNSTREAM

Sony's historical local changes

- ➢ Some big lumps (X86-64 instruction subsets)
- ➢ Some smaller but still intrusive features (partial re-initialization; dllimport/dllexport for ELF)
- ➢ Toolchain stuff (driver)
- ➢ Default C++11 (trivial coding, >100 tests)
- ➢ Misc other stuff

OUR LOCAL LINE COUNTS



THE TSUNAMI HITS

- Rebase from LLVM 2.9 to 3.0
  - ~8 months of upstream changes
  - Took 3 months of my time (+ help) to finalize
- 4-way merge review

Upstream old	Our old
Upstream new	Our new

LEARNING TO SWIM

- Dog-paddle
  - Pull from llvm.org every 2-3 months
  - Still took ~1 month each to finalize
- Moving with the current
  - Patch tactics
- Need a life-boat
  - Automation

DEVELOPMENT MODE

- ➢ Consider long-term project direction
- ➢ Do the big feature
- ➢ Do the re-design/refactoring
- ➢ Textual consistency of source basically irrelevant
  - ➢clang-format pretty much expected
  - ➢Although gratuitous churn considered unfriendly

MAINTENANCE MODE

Maintenance, sustaining, continuing engineering…
They all mean the same thing

- ➢ Fix the bug as safely as possible
- ➢ Minimize risk of introducing a new bug
  - ➢ "Surgical" fix
  - ➢ Smallest possible change, textually and functionally
- ➢ Very limited use of this in LLVM

LONG-TERM LOCAL CHANGES

DO

- ➢ Maintenance mode is your friend
  - ➢Minimize textual scope of changes
  - ➢Create a subclass for your special behavior
  - ➢Put local tests in local (new) files

- ➢ Use “local change made here” comments
  - ➢Diffs provide better info
  - ➢Bug reference helps archaeology
  - ➢Distinguish your changes from mistakes

CHANGE TAGS EXAMPLE 1

- Diff for a function we added to Path.h

```
+// SCE: begin bug 2844.
+#ifdef LLVM_ON_WIN32
+/// @brief converts a string to UTF8 encoding and prints it to a output stream.
+///
+/// @param InputStr Input string to convert.
+/// @param OutputStr Output stream.
+/// @result True if the conversion succeded.
+bool convEncExternalToUTF8(const StringRef InputStr, std::string& OutputStr);
+#endif
+// SCE end.
```

CHANGE TAGS EXAMPLE 2

➢ From a recent conflict report

```
++<<<<<<<< HEAD
 +#include "llvm/ADT/Triple.h"
 +#include "llvm/MC/MCDirectives.h"  // SCE: bug 10867
++========
+ #include "llvm/ADT/TargetTuple.h"
++>>>>>>>> opensource
```

LONG-TERM LOCAL CHANGES
DON’T

- ➢ Never delete upstream code (use #if 0)
- ➢ clang-format is your enemy
  - ➢ Textual consistency of the source is crucial
- ➢ Avoid the end of the file/namespace/class

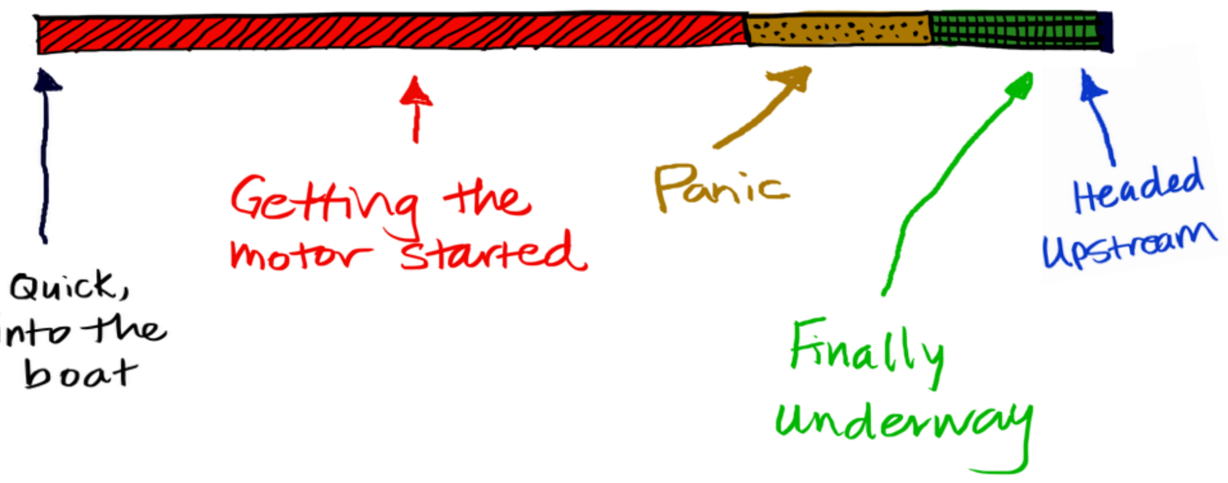
PUSHING CHANGES UPSTREAM

- ➢ If you possibly can, do it upstream first!
- ➢ Or, you undo all the no-merge-pain tactics
  - ➢ Do the refactor
  - ➢ Do the reformat
  - ➢ Put the change where it belongs
    - ➢ Even at the end of the file/namespace/class…
  - ➢ Integrate into existing tests where it makes sense
  - ➢ Upstream review is a Good Thing™

DEPLOY THE LIFEBOAT

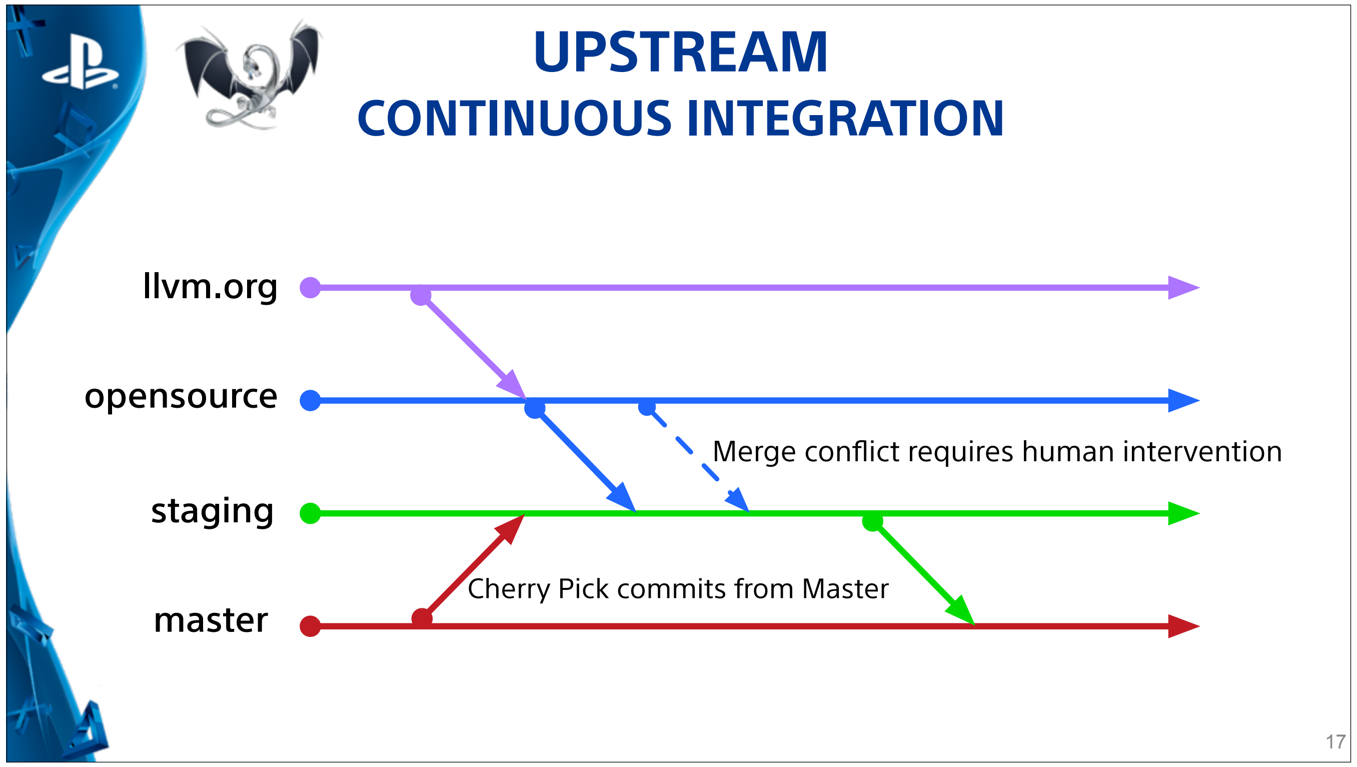
- Automation is our lifeboat
- by implementing Continuous Integration and a phased building approach we’re working to get a handle on constant flow of commits.
- Automation helps us to be effective at merging commits and build/test
- Through Healthy Investments in infrastructure we can build and test extremely quickly!

NAVIGATING THE STREAM

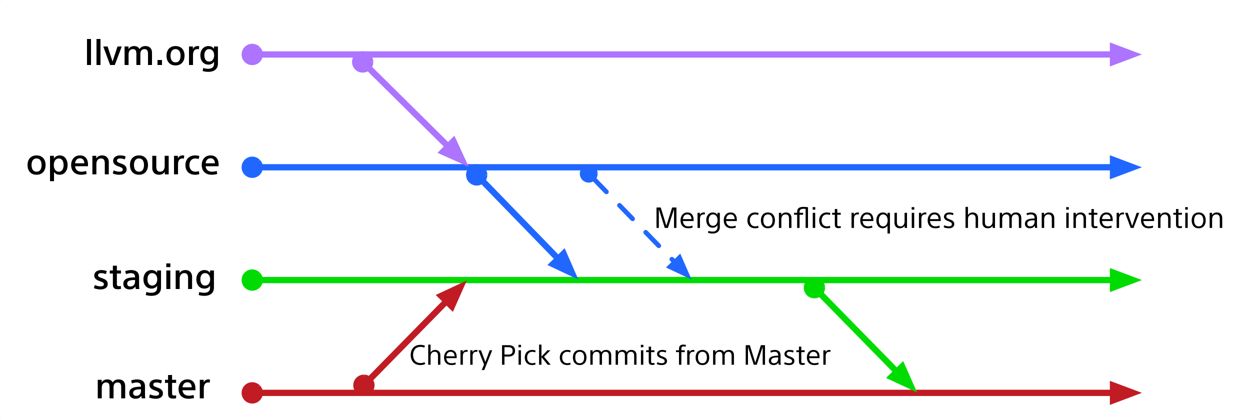


5 Add'l Clicks: How Do We Navigate The Stream…

- Into The Boat - Begin the process of integrating upstream work w/internal patches - no automation here yet!
  - by working through the process manually we are able to pinpoint exactly what automation will work best for us when we are ready to implement
- Starting The Motor - when we notice volume of commits occurring upstream
  - Try to automate things we think are worth automating
  - Apply automation quickly but try to avoid unintended consequences
- Panic - Keep engineers involved with the process of dealing with merge conflicts - Merge Pain
- Underway - Employ Continuous Integration - bot which attempts merge and files tickets if merge not clean
- Headed Upstream - Get to a place where integration with upstream happens on a consistent regular basis, with minimal human intervention

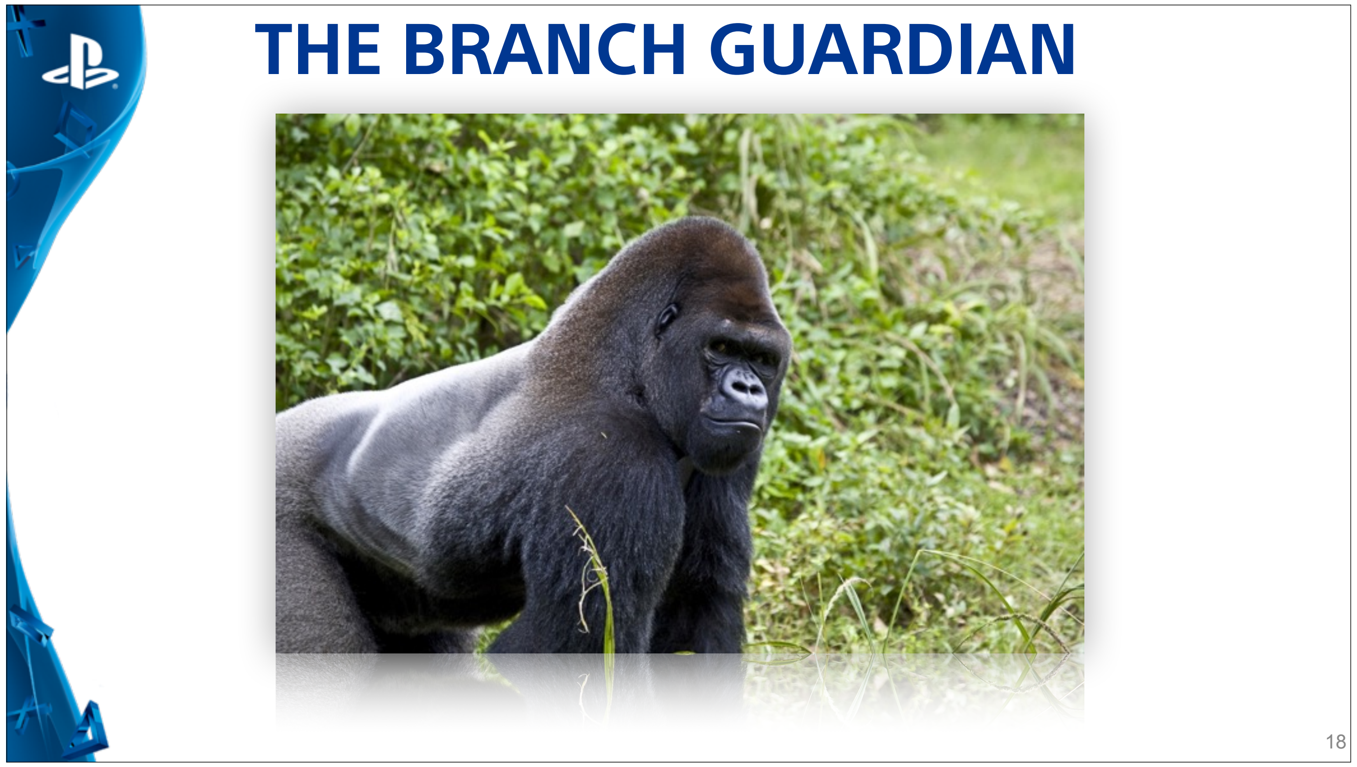


UPSTREAM CONTINUOUS INTEGRATION


llvm.org
opensource
Merge conflict requires human intervention
staging
Cherry Pick commits from Master
master

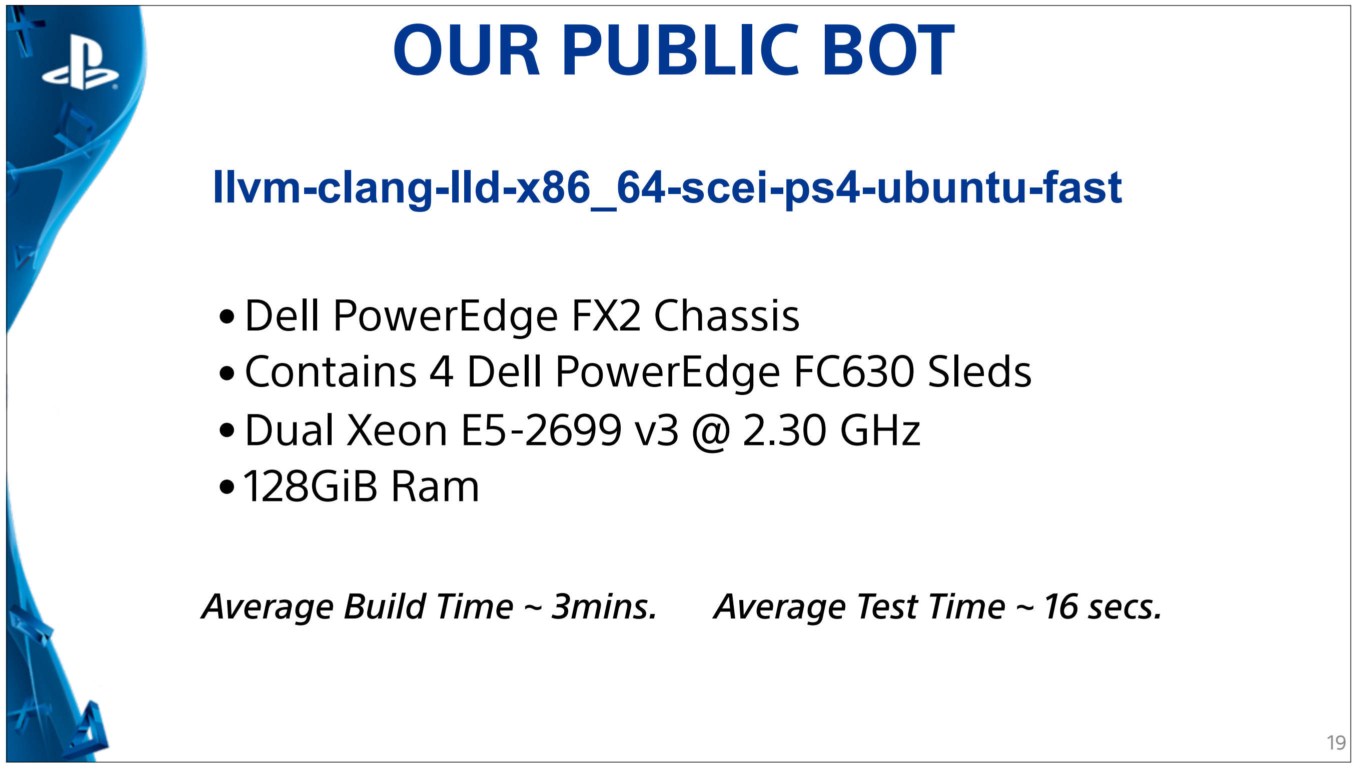
5 Add'l Clicks:

- Start with commits to the llvm.org master branch
- After a passing build/test we import those commits to our opensource branch, which is a merged tree of llvm, clang, compiler-rt and lld
- Our staging branch is used to merge upstream commits with commits from our private branch which is represented by the bottom line labeled master
- End goal is to reduce the iteration time so we can eventually automate as much as possible.



THE BRANCH GUARDIAN

- We are still doing manual bulk merging
- An incorrect merge would be really bad and cause much unnecessary work
- The Gorilla represents Paul R. as he is the one tasked with protecting our branches from the rest of us doing something wrong.
- Our opensource branch is the only branch currently managed 100% by a bot
  - This allows us to gather more data to ensure automation deployed is as close as possible to what we need



OUR PUBLIC BOT

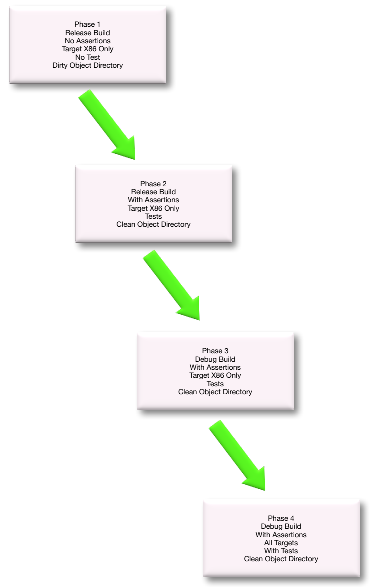
llvm-clang-lld-x86_64-scei-ps4-ubuntu-fast

- Dell PowerEdge FX2 Chassis
- Contains 4 Dell PowerEdge FC630 Sleds
- Dual Xeon E5-2699 v3 @ 2.30 GHz
- 128GiB Ram

Average Build Time ~ 3mins. *Average Test Time ~ 16 secs.*

- Earlier this year we were able to contribute new hardware to the community
- This bot builds our triple
- Acts as first line of defense against new commits breaking
  - llvm, clang and lld and of course our triple
- Runs on Ubuntu - on average typical build is ~ 3min and test is 16 sec.
- Windows bot TBD - hopefully by end of the year

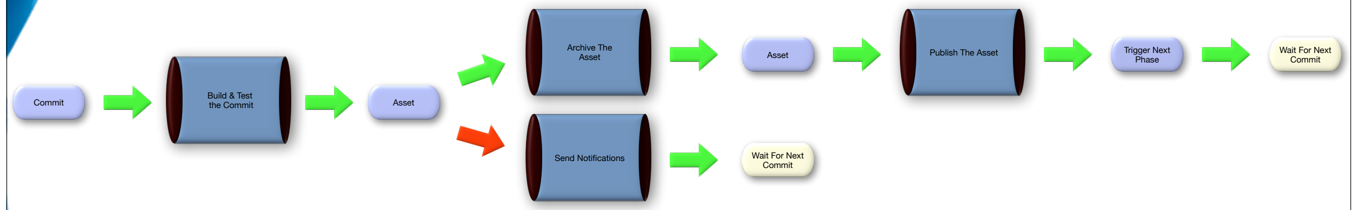
INTERNAL BUILD PHASES



LLVM, Clang, Clang Tools Extra, Compiler-rt & LLD

5 Add’l Clicks
- Four phased build approach on open source branches
- Building on Linux, Mac and Windows Hardware to maximize coverage
- Phase 1 - Fast - RO - Dirty - X86 Only ~27sec
- Phase 2 - Turn on Asserts and Tests, Clean - ~6min
- Phase 3 - DA & Clean - ~8min
- Phase 4 - DA & Clean & All Targets - ~9.5min
- Commit total travel across phases ~25min total
- Private branches use 3 phases because we omit Phase 4

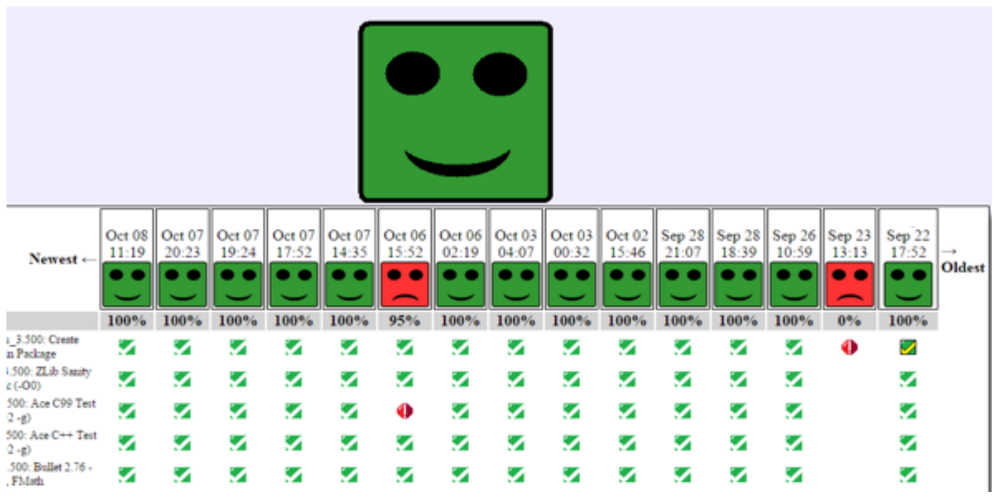
BUILD PIPELINE



8 Add'l Clicks!

- Start with commit from upstream and we build & test it
- On completion a build asset is produced
    - if success an asset is a built compiler with its' supporting files
    - if failure an asset is mostly just a collection of log files
- A failing asset triggers a notification and the process just goes back to waiting for the next commit
- A successful asset is archived in a git repository
    - Why git - it was already available and we knew how to use it - a simple solution
    - Also, git provides the ability to easily search for an asset later on
- Once archived an asset is published via internal API
    - Makes asset available to other processes, internal teams and clients
- Then trigger any reaming phases and go back to waiting

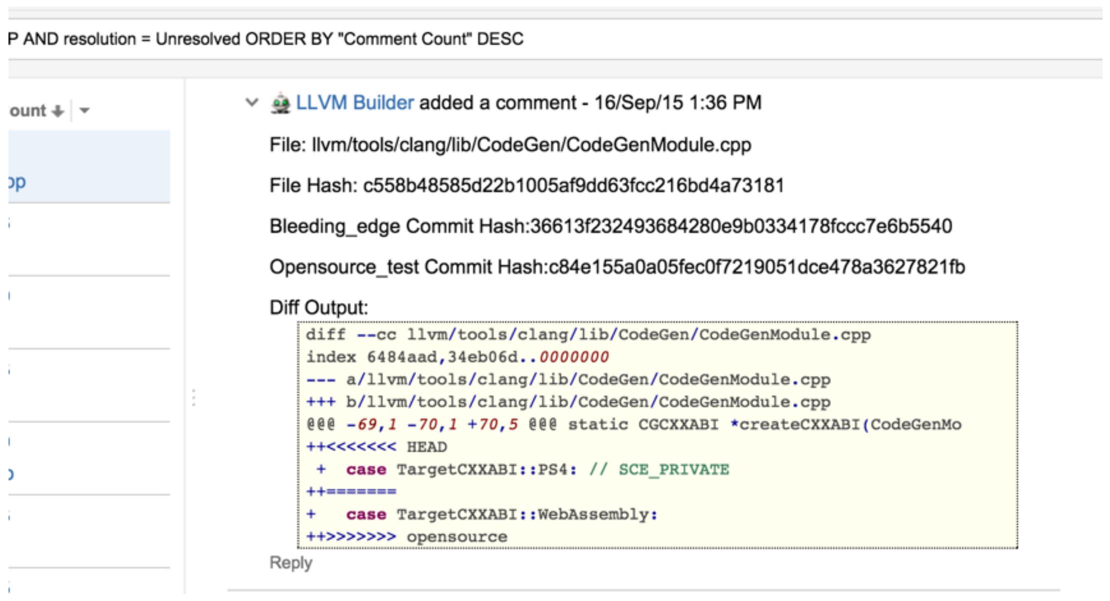
SMILEY FACE



Newest ←	Oct 08 11:19	Oct 07 20:23	Oct 07 19:24	Oct 07 17:52	Oct 07 14:35	Oct 06 15:52	Oct 06 02:19	Oct 03 04:07	Oct 03 00:32	Oct 02 15:46	Sep 28 21:07	Sep 28 18:39	Sep 26 10:59	Sep 23 13:13	Sep 22 17:52	→ Oldest
	🟩	🟩	🟩	🟩	🟩	🟥	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟥	🟩	
	100%	100%	100%	100%	100%	95%	100%	100%	100%	100%	100%	100%	100%	0%	100%	
_3.500: Create n Package	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	●	✓	
.500: ZLib Sanity c (-O0)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	
500: Ace C99 Test 2 -g)	✓	✓	✓	✓	✓	●	✓	✓	✓	✓	✓	✓	✓		✓	
500: Ace C++ Test 2 -g)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	
.500: Bullet 2.76 - , FMath	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	

- Engineers like to see green bots!
- Developed internally by one of our colleagues
- Each Column is a commit
- Each Row is a specific test run
- Layout is very dense, however Engineers are able to quickly find their commit and see how it is performing across all of the tests
- Each icon is a hyperlink to a detail page for that test run

TRACKING MERGE PAIN



P AND resolution = Unresolved ORDER BY "Comment Count" DESC

LLVM Builder added a comment - 16/Sep/15 1:36 PM

File: llvm/tools/clang/lib/CodeGen/CodeGenModule.cpp

File Hash: c558b48585d22b1005af9dd63fcc216bd4a73181

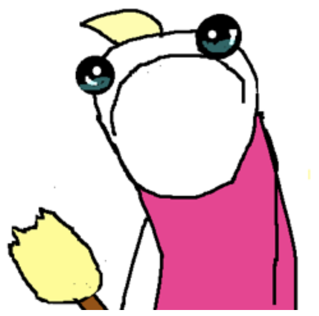
Bleeding_edge Commit Hash:36613f232493684280e9b0334178fccc7e6b5540

Opensource_test Commit Hash:c84e155a0a05fec0f7219051dce478a3627821fb

Diff Output:

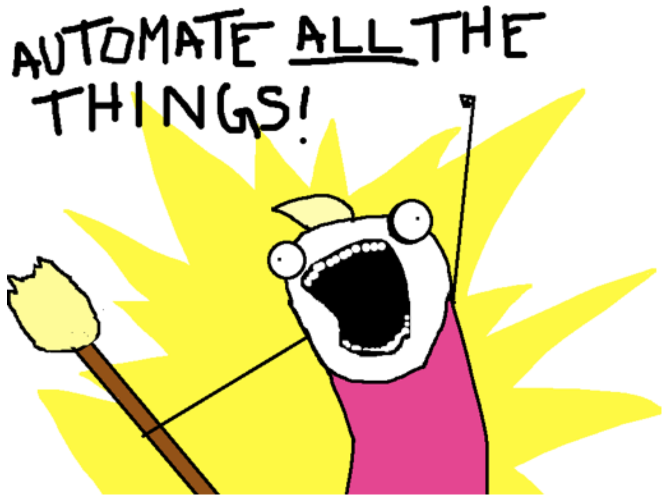
```
diff --cc llvm/tools/clang/lib/CodeGen/CodeGenModule.cpp
index 6484aad,34eb06d..0000000
--- a/llvm/tools/clang/lib/CodeGen/CodeGenModule.cpp
+++ b/llvm/tools/clang/lib/CodeGen/CodeGenModule.cpp
@@@ -69,1 -70,1 +70,5 @@@ static CGCXXABI *createCXXABI(CodeGenMo
++<<<<<<< HEAD
 +  case TargetCXXABI::PS4: // SCE_PRIVATE
++=======
+   case TargetCXXABI::WebAssembly:
++>>>>>>> opensource
```

- Our Merge Pain Tracker
- Developed internally as well
- Used to help keep track of conflicts we accumulate in between merges of our opensource and staging branches
- This assists us in surfacing the code which requires the most human attention and allows us to focus on getting that code upstream
- Over time we hope this tool will help us realize a healthy reduction in the amount of time it takes to resolve merge conflicts



Original content courtesy of http://hyperboleandahalf.blogspot.com/2010/06/this-is-why-ill-never-be-adult.html

- We have tools…we have process..
- Maybe we should just…



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- Automate all the things!
- Sounds like a good idea, right?
- As it turns out, that's not exactly true

UNINTENDED CONSEQUENCES

- Trick w/ automation is can’t allow automated processes to outpace the humans ability to keep up with it.
- Classic example is the “I Love Lucy” episode where Lucy & Ethel are working in the chocolate factory
- Conveyor goes crazy and chocolate ends up everywhere
- We wanted to avoid a similar scenario if we turned on 100% automated merging of llvm.org to staging and master without human intervention
- Paul would have pushed me out of the lifeboat
- Bots would turn red
- Engineers would be flooded with failure notifications
- and would eventually loose interest and bots would be forgotten about.
- Morale of the story, invest in infrastructure, automate as much as you can, but make sure your humans can keep up!

It is your turn!

- A little bit about us, what we do and how we got here
- Now it’s your turn
- How do you deal with merge pain?
- How much automation have you deployed?
- How do you deal with private branches?
- Comments, question stories?

THANK YOU!

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