Make Debian compiler agnostic

I CAN HAS
PROGRAMMING
LANGUAGE?

Current status :
All C, C++, Objective-C sources are being built with GCC for all supported Debian arches.

Gcc is THE FLOSS compiler for the last 25 years
Used for (pretty much) everywhere or anything

Why a new compiler ?

Because we can

No other reason ?

Because it is fun

Seriously :
Other compilers can find programming errors that gcc could not find

Code built by many compilers is more likely to be more strictly correct and more portable then code only built with gcc

Some compilers can have advantages on some archs (ex : clang on ARM)

As we were able to do with decoupling Linux from Debian with kFreeBSD and the HURD, we're aiming to decouple GCC in Debian.

LLVM/Clang

Started as an academic project
Versatile platform for compilation and virtual machine

Designed originally for the investigation of dynamic compilation techniques for static and dynamic languages

Sponsored by Apple since 2005 to replace GCC (GPL vs BSD)

Has now a strong and diverse community (academics, individuals and corporates)

Many universities/research centers are basing their research on LLVM

Clang

C, C++ & Objective-C compiler.
(no Fortran)
Based on LLVM

Default compiler for Mac OS X (Xcode)/iOS [1]
and FreeBSD [2]

Sources:
[1] https://developer.apple.com/technologies/tools/
[2] http://lists.freebsd.org/pipermail/freebsd-stable/2012-May/067486.html

Some advantages :

More recent base code (ie less legacy code)

Strong interest of material manufactors (ARM, MIPS, Nvidia, etc)

Supposed to be faster to build code than gcc

Accept the same arguments as gcc

Example

Full build of Scilab (doc, essential tests)

~24 minutes gcc

~22 minutes clang

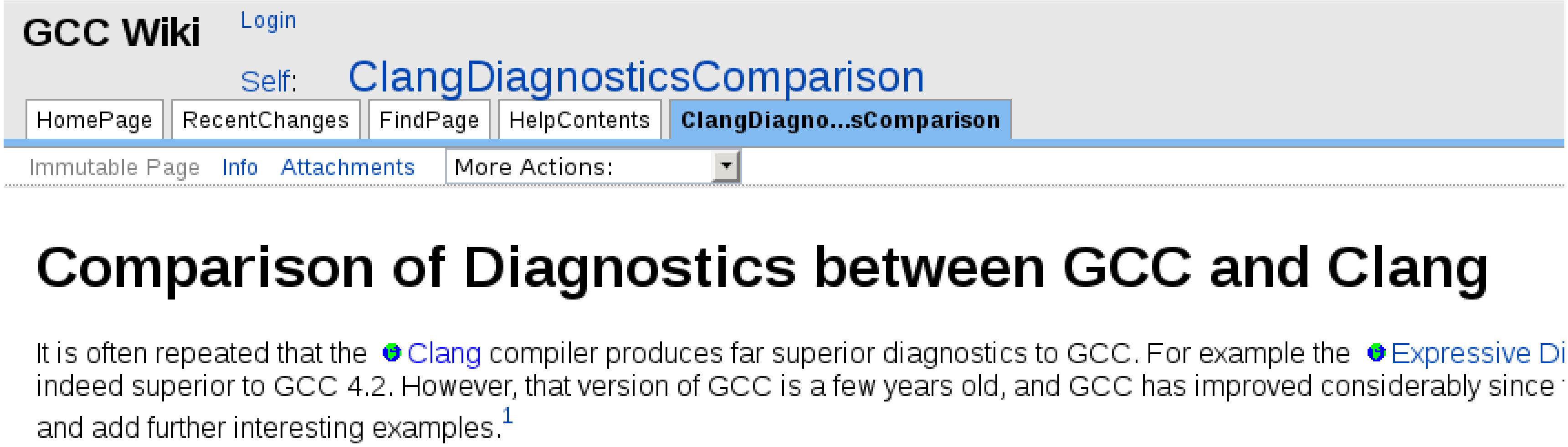
Some advantages (bis)
More intelligent detections

– foo.c --

```
int main() {
        unsigned int i = 0;
        return i < 0;
}
```

```
$ gcc -Wall -Werror foo.c ; echo $?
0
$ clang -Werror foo.c
foo.c:3:17: error: comparison of unsigned expression < 0 is always false
    [-Werror,-Wtautological-compare]
  return i < 0;
         ~ ^ ~
1 error generated.
```

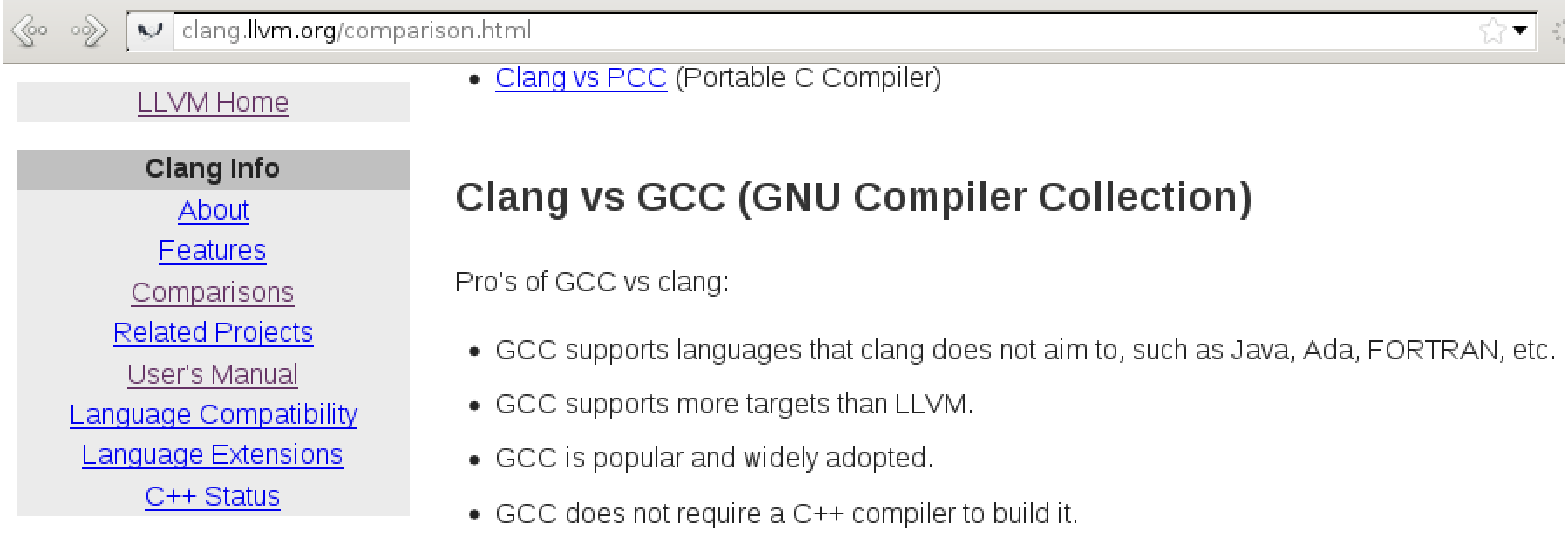
Side effect
=> Brings (friendly) competition in the free compiler world.



Comparison of Diagnostics between GCC and Clang

It is often repeated that the Clang compiler produces far superior diagnostics to GCC. For example the Expressive Di
indeed superior to GCC 4.2. However, that version of GCC is a few years old, and GCC has improved considerably since
and add further interesting examples.[1]

http://gcc.gnu.org/wiki/ClangDiagnosticsComparison



- Clang vs PCC (Portable C Compiler)

LLVM Home

Clang Info

About

Features

Comparisons

Related Projects

User's Manual

Language Compatibility

Language Extensions

C++ Status

Clang vs GCC (GNU Compiler Collection)

Pro's of GCC vs clang:

- GCC supports languages that clang does not aim to, such as Java, Ada, FORTRAN, etc.
- GCC supports more targets than LLVM.
- GCC is popular and widely adopted.
- GCC does not require a C++ compiler to build it.

http://clang.llvm.org/comparison.html#gcc

Rebuild of Debian using Clang

Crappy method :

```
VERSION=4.7
cd /usr/bin
rm g++-$VERSION gcc-$VERSION cpp-$VERSION
ln -s clang++ g++-$VERSION
ln -s clang gcc-$VERSION
ln -s clang cpp-$VERSION
cd -
```

Testing the rebuild of the package.

NOT the performances (build time or execution)
nor the execution of the binaries

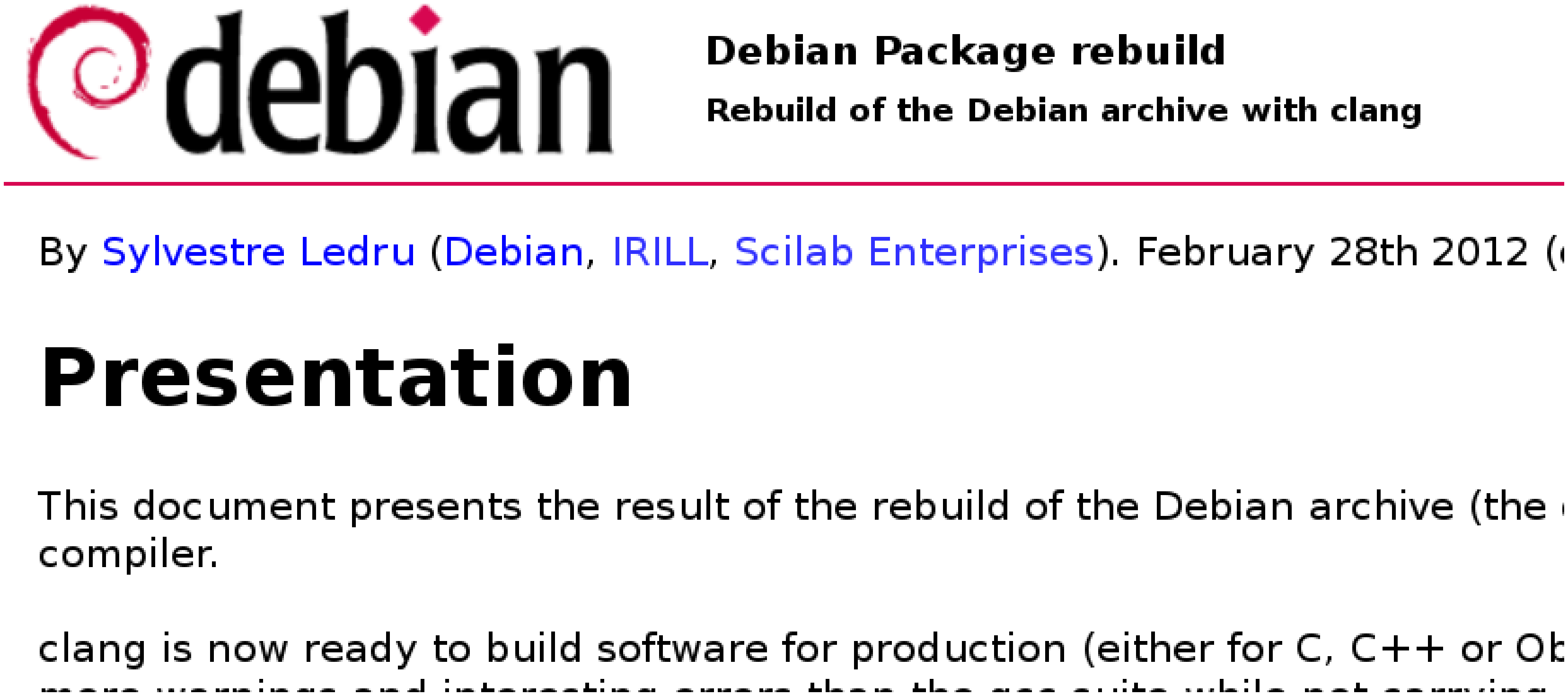
Rebuild with clang 3.0
February 28, 2012

15658 packages built : 1381 (8.8 %) failed.

Rebuild with clang 3.1
June 23, 2012

17710 packages built : 2137 (12.1 %) failed.

Full results published: http://clang.debian.net/



Debian Package rebuild

Rebuild of the Debian archive with clang

By Sylvestre Ledru (Debian, IRILL, Scilab Enterprises). February 28th 2012 (

Presentation

This document presents the result of the rebuild of the Debian archive (the
compiler.

clang is now ready to build software for production (either for C, C++ or Ob
more warnings and interesting errors than the gcc suite while not carrying

Done on the cloud-qa - EC2 (Amazon cloud)
Thanks to Lucas Nussbaum

Why these differences between 3.0 & 3.1?

-Werror & unused args
96 occurrences

Clang detects unused argument.

clang --param ssp-buffer-size=4
-Werror foo.c

And generates a normal warning …

Which becomes an error with -Werror

clang: error: argument unused during compilation: '--param ssp-buffer-size=4'

96 occurrences

Fixed in clang 3.2 rc1 :
http://llvm.org/bugs/show_bug.cgi?id=9673

Security check introduced in clang 3.1
20 occurences

```c
#include <stdio.h>
void foo(void) {
  char buffer[1024];
  sprintf(buffer, "%n", 2);
}
```

```
$ gcc -Werror -c foo.c && echo $?
0
$ clang -Werror -c foo.c && echo $?
foo.c:5:23: error: use of '%n' in
format string discouraged
      (potentially insecure) [-Werror,-
Wformat-security]
    sprintf(buffer, "%n", 2);
                      ~^
1 error generated.
```

Some of the most common errors

Unsupported options
48 occurrences

```
$ gcc -O9 foo.c && echo $?
0

$ clang -O9 foo.c
error: invalid value '9' in '-O9'
```

Different default behavior
132 occurrences

– noreturn.c –

```
int foo(void) {
  return;
}
```

```
$ gcc -c noreturn.c; echo $?
0
# -Wall shows it as warning
$ clang -c noreturn.c
noreturn.c:2:2: error: non-void
function 'foo' should return a value
      [-Wreturn-type]
        return;
        ^
1 error generated.
```

Different default behavior (bis)
17 occurrences

– returninvoid.c –

```
void foo(void) {
  return 42;
}
```

```
$ gcc -c returninvoid.c; echo $?

returninvoid.c: In function ‘foo’:

returninvoid.c:2:2: warning: ‘return’ with a value, in function returning void [enabled by default]

0

$ clang -c returninvoid.c

returninvoid.c:2:2: error: void function 'foo' should not return a value

      [-Wreturn-type]

        return 42;

        ^     ~~

1 error generated.
```

Different understanding of the C++ standard

```
– mailboxField.cpp –
class address {
protected:
    static int parseNext(int a);
};
class mailbox : public address {
    friend class mailboxField;
};
class mailboxField {
    void parse(int a)         {
            address::parseNext(a);
            // will work with:
            // mailbox::parseNext(a);
        }
};
```

```
$ g++ -c mailboxField.cpp && echo $?
0

$ clang++ -c mailboxField.cpp
mailboxField.cpp:17:22: error: 'parseNext' is a protected member of 'address'
        address::parseNext(a);
                 ^
mailboxField.cpp:4:16: note: declared protected here
   static int parseNext(int a);
              ^
```

References:
http://llvm.org/bugs/show_bug.cgi?id=6840
http://gcc.gnu.org/bugzilla/show_bug.cgi?id=52136

Different set of warnings with -Wall
Plenty of occurences

```
– plop.c –
void foo() {
     int a=1;
     if ((a == 1)) {
        return;
     }
}
```

```
$ gcc -Wall -Werror -c foo.cpp  && echo $?
0

$ clang -Wall -Werror -c foo.cpp
foo.cpp:3:13: error: equality comparison with extraneous parentheses
      [-Werror,-Wparentheses-equality]
    if ((a == 1)) {
         ~~^~~~
foo.cpp:3:13: note: remove extraneous parentheses around the comparison to
      silence this warning
    if ((a == 1)) {
        ~  ^   ~
foo.cpp:3:13: note: use '=' to turn this equality comparison into an assignment
    if ((a == 1)) {
           ^~
           =
1 error generated.
```

GCC Extensions which won't be supported 25 occurences

```
— foo.cpp —
#include <vector>
void foo() {
 int N=2;
 std::vector<int> best[2][N];
}
```

```
$ g++ -c foo.cpp; echo $?
0
$ clang++ -c foo.cpp
foo.cpp:4:29: error: variable length
array of non-POD element type
    'std::vector<int>'
  std::vector<int> best[2][N];
                           ^
1 error generated.
```

GCC accepts stuff which should not
34 occurences

– foo.cpp –

```
// Uncomment this line will fix the issue.

// template<typename Value_t>
//  void b(Value_t value)

template<typename Value_t>
void a(Value_t value) {

    b(value);

}


template<typename Value_t>
void b(Value_t value) {

}


void foo(int y) {

    a(y);

}
```

```
$ g++ -c foo.cpp; echo $?

0

$ clang++ -c foo.cpp

foo.cpp:6:5: error: call to function 'b' that is neither
visible in the template

      definition nor found by argument-dependent lookup

    b(value);

    ^

foo.cpp:15:5: note: in instantiation of function template
specialization

      'a<int>' requested here

    a(y);

    ^

foo.cpp:9:33: note: 'b' should be declared prior to the call site

template<typename Value_t> void b(Value_t value)

                                ^

1 error generated.
```

GSoC 2012 work

Objective:
Update the Debian infrastructure to allow a change of compiler

Student : Alexander Pashaliyski
Mentors : Paul Tagliamonte & me

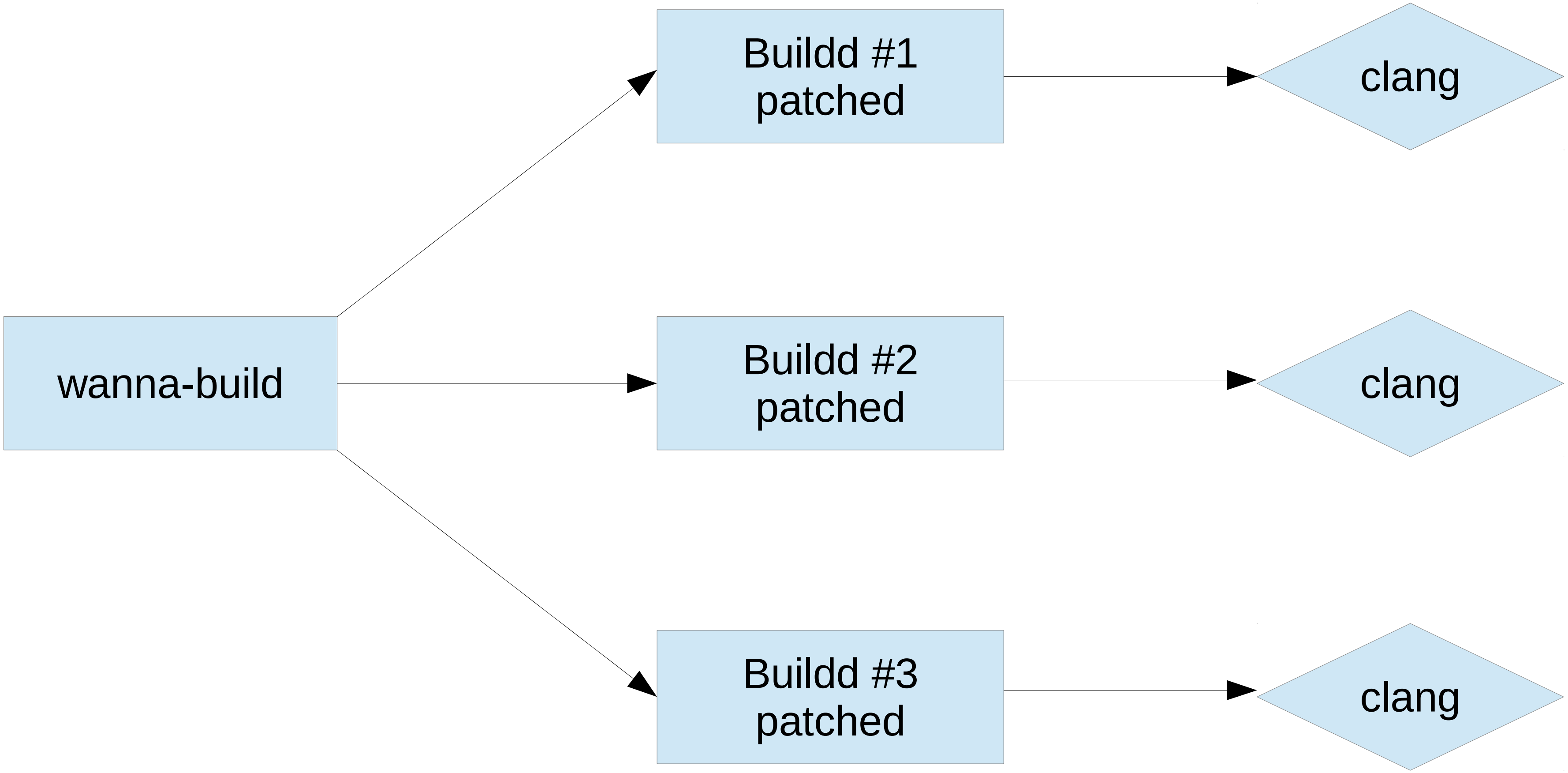
First output :

A tutorial/documentation for wanna-build setup

http://wiki.debian.org/DebianWannaBuildInfrastructureOnOneServer

http://wiki.debian.org/SetupBuildServiceForWanna-build

Setup a parallel infrastructure to the Debian build system



Hack the Debian tools to :

- Force dpkg to export CC=/usr/bin/cc, CXX=/usr/bin/c++ and OBJC=/usr/bin/objc
- Check for hardcoded CC=gcc in debian/rules
- Set the /usr/bin/{cc,c++,objc} alternatives to {clang, clang++}

- Call a hook to sbuild after the apt-get install of the build dependencies

- Fail the build on purpose when direct usage of gcc, g++ or cpp

Published on :

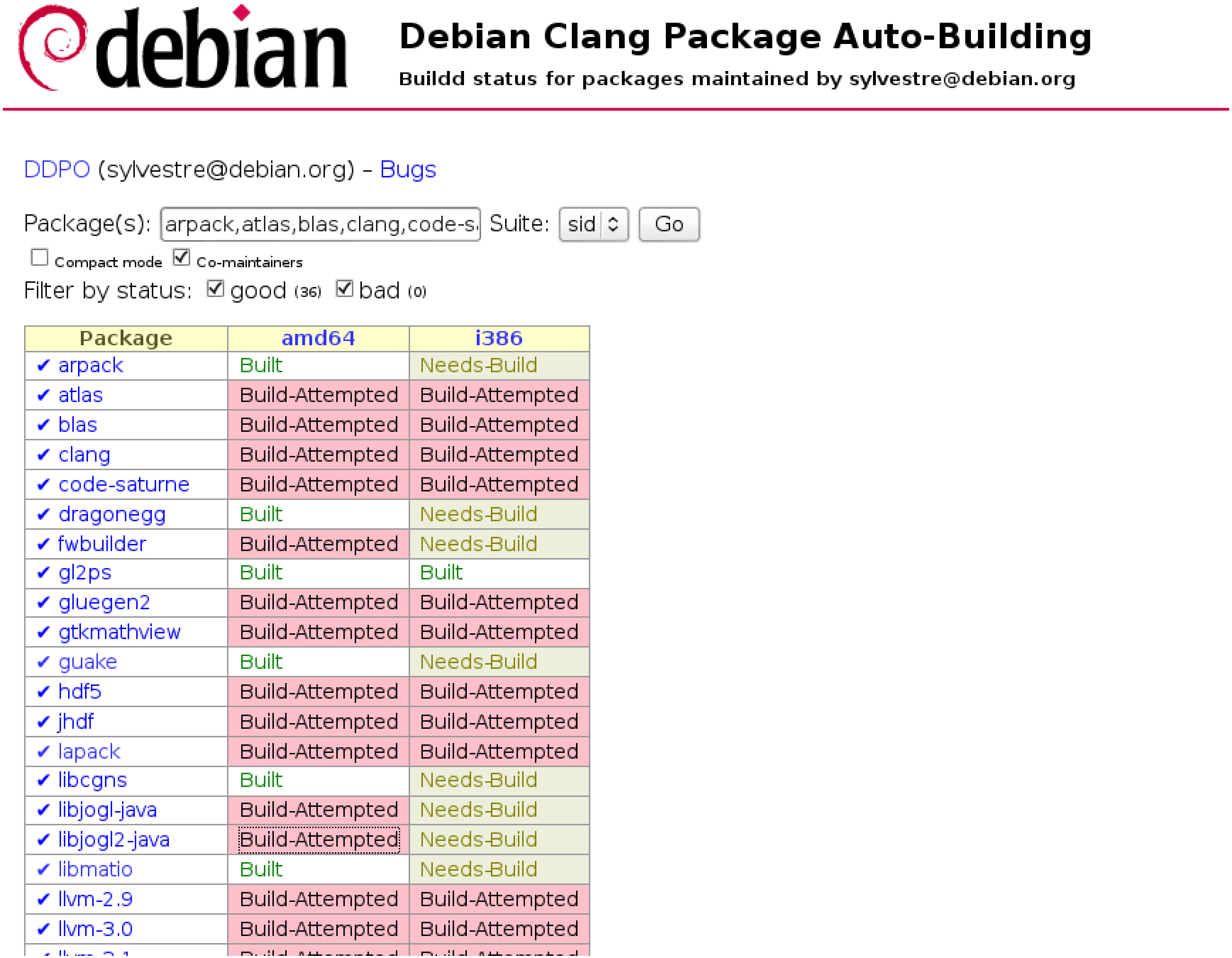
- https://github.com/sylvestre/debian-clang/

Results

http://buildd-clang.debian.net/

Publication of the build results of the packages using clang

Connected on the debian mirror (ie : updated packages)



Debian Clang Package Auto-Building

Buildd status for packages maintained by sylvestre@debian.org

DDPO (sylvestre@debian.org) - Bugs

Package(s): arpack,atlas,blas,clang,code-s Suite: sid Go

□ Compact mode ☑ Co-maintainers

Filter by status: ☑ good (36) ☑ bad (0)

Package	amd64	i386
✓ arpack	Built	Needs-Build
✓ atlas	Build-Attempted	Build-Attempted
✓ blas	Build-Attempted	Build-Attempted
✓ clang	Build-Attempted	Build-Attempted
✓ code-saturne	Build-Attempted	Build-Attempted
✓ dragonegg	Built	Needs-Build
✓ fwbuilder	Build-Attempted	Needs-Build
✓ gl2ps	Built	Built
✓ gluegen2	Build-Attempted	Build-Attempted
✓ gtkmathview	Build-Attempted	Build-Attempted
✓ guake	Built	Needs-Build
✓ hdf5	Build-Attempted	Build-Attempted
✓ jhdf	Build-Attempted	Build-Attempted
✓ lapack	Build-Attempted	Build-Attempted
✓ libcgns	Built	Needs-Build
✓ libjogl-java	Build-Attempted	Needs-Build
✓ libjogl2-java	Build-Attempted	Needs-Build
✓ libmatio	Built	Needs-Build
✓ llvm-2.9	Build-Attempted	Build-Attempted
✓ llvm-3.0	Build-Attempted	Build-Attempted
✓ llvm-3.1	Build-Attempted	Build-Attempted

Next steps

Update the debian policy to include something like :

Hardcoded usage of CC or CXX (for example, CC=gcc) should be avoid and documented if necessary.
Debian build tools must respect the CC and CXX variables if provided. If not, they shall default to /usr/bin/cc and /usr/bin/c++

See :
http://lists.debian.org/debian-devel/2012/08/msg00783.html

Add a lintian warning like

W: yourpackage: Hardcoded call to gcc/g++.
Use /usr/bin/cc or /usr/bin/c++ instead

Should be available as a new item in the PTS

Create a repository of packages built with Clang

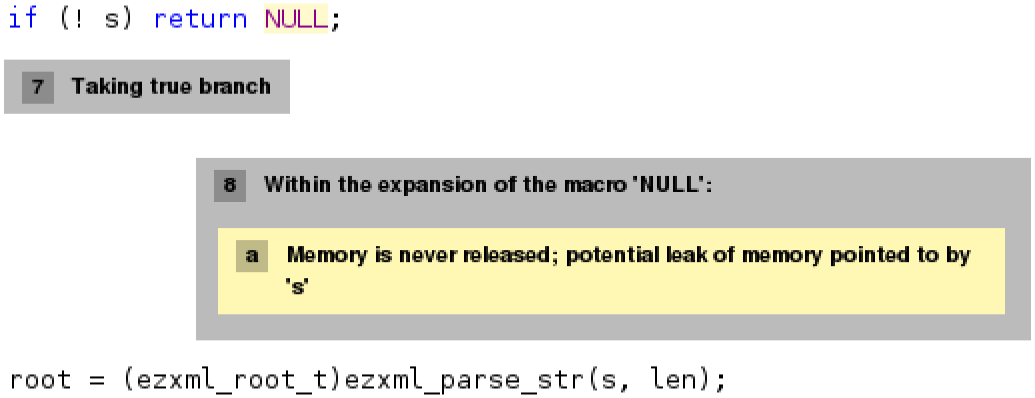
Future

Potential the rebuild of Debian with :

- clang+plugin. Ex : polly : cache-locality optimisation auto-parallelism and vectorization, etc

- address sanitizer (ASAN)

- scan-build : static C/C++ analyzer



```
if (! s) return NULL;
```

7 Taking true branch

8 Within the expansion of the macro 'NULL':

a Memory is never released; potential leak of memory pointed to by 's'

```
root = (ezxml_root_t)ezxml_parse_str(s, len);
```

- Intel compilers

Another GSoC project
Student : Andrej Belym
Mentor : Me

Packaging of
libc ++

libc++ is a new implementation of the C++ standard library, targeting C++0X.

libc++abi

libc++abi is a new implementation of low level support for a standard C++ library.

Clang++ is linking against libstdc++

Example :

```
– main.cpp –
#include <iostream>
using namespace std;
int main(){
      cout << " plop" << endl;
}

$ clang++ -o plop main.cpp
$ ldd plop|grep stdc
   libstdc++.so.6 => /usr/lib/x86_64-linux-gnu/libstdc++.so.6
(0x00007f4b50817000)
```

But Clang++ can link and run with libc++

Example :

```
– main.cpp –
#include <iostream>
using namespace std;
int main(){
      cout << " plop" << endl;
}

$ clang++ -stdlib=libc++ -o plop main.cpp
$ ldd plop|grep libc++
libc++.so.1 => /usr/lib/libc++.so.1 (0x00007ff0eaf1d000)
```

Initial upload in Debian in July
(new snapshot upload yesterday ;)

No official stable release yet

Packaging of **compiler-rt**

A C runtime library (equivalent to libgcc_s.so)

Any questions ? Remarks ?
Troll ? (+1)