Building Android with clang

Linux Plumbers Conference 2014,
LLVM Microconference

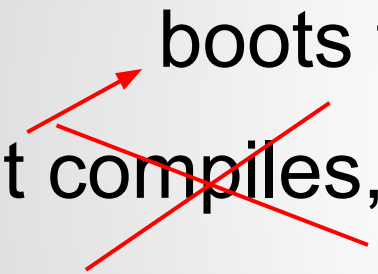
Bernhard “Bero” Rosenkränzer, Linaro
bero@linaro.org

Quick status update for the impatient

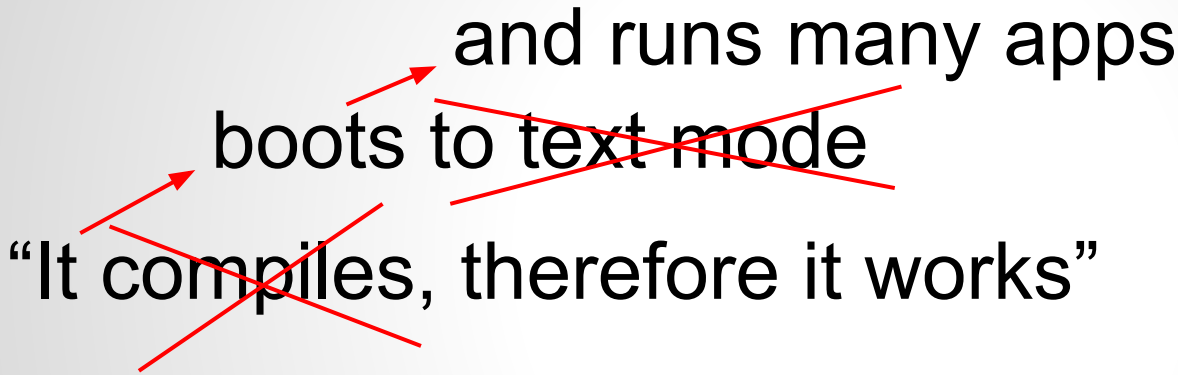
“It compiles, therefore it works”

(A dangerous method of detecting bugs - might be patented by Microsoft QA dept.)

Quick status update for the impatient



Quick status update for the impatient



Compiles for Nexus 4, 5, 7 and 10.

4 is currently untested. 10 works great, 7 works

Patch submission status

Overall 112 patches submitted

81 accepted

27 waiting

4 abandoned in favor of better solutions

Script to apply all waiting patches:

git://android.git.linaro.org/aosp-patchsets.git

Quick performance check

clang-built AOSP is currently about 2.6% bigger than gcc-built AOSP.

Performance depends on what is being checked, but overall gcc is still ahead.

clang is around 20% faster at “make droidcore”.

Cheating twice...

We’re currently setting

```
LOCAL_CLANG := false
```

for /init and the GLESv1 and GLESv2 wrappers in frameworks/native/opengl/libs -- causing those bits to be compiled with gcc.

Cheating twice...

clang-built /init reboots the device before adb or other tools useful for debugging come up (even running clang-built init on an already built system causes a reboot - we’re likely triggering an error handler)

clang-built GLESv2 crashes the UI on startup.

Workaround for GLESv2 wrapper

The GLESv2 wrapper has a generic C version that works perfectly with clang (`#if USE_SLOW_BINDING`), and asm versions that don’t.

Unfortunately, adding overhead to any OpenGL call is not a good idea...

arm asm wrapper’s code

```
#define GET_TLS(reg) "mrc p15, 0, " #reg ", c13, c0, 3 \n"
#define CALL_GL_API(_api, ...)                                  \
     asm volatile(                                              \
       GET_TLS(r12)                                             \
       "ldr   r12, [r12, %[tls]] \n"                            \
       "cmp   r12, #0         \n"                               \
       "ldrne pc,  [r12, %[api]] \n"                                  \
       :                                                        \
       : [tls] "J"(TLS_SLOT_OPENGL_API*4),                      \
         [api] "J"(__builtin_offsetof(gl_hooks_t, gl._api))     \
       : "r12"                                                  \
     );
```

Sometimes clang is picky...

- “register” keyword usage in Chromium
- array subscripts of type “char” (hexdigit[‘0’] =...)
- undefined internal functions, undefined variables
- Use of GNU initializers instead of C99
- Conditions that can’t be true

Sometimes clang is picky...

- empty structs
- `asm("add w0, w0, #-1");` (converted to `sub w0, w0, #1` by gas, but not by clang)
- unused parameters

Sometimes clang is picky...

- Complains even about code that is about to be thrown away:

```
static void a();
void b() {
    if (false)
        a();
}
```

… and sometimes it finds real bugs

```
UCHAR a[X];
for(int i=0; i<X; i++)
    b = a ? tagCpe++ : tagSce++;
```

from MPEG TP decoder

… and sometimes it finds real bugs

```
char str[30];
snprintf(str, “%s”, x);
if(str == NULL)
    return ERROR;
```

from qcom camera HAL

… and sometimes it finds real bugs

```
void something(char n[30]) {
    if(!memcmp(buffer, n, sizeof(n))) {
        …
    }
}
```

from qcom bluetooth kernel module

… and sometimes it finds real bugs

```
class A {
    void *something() {
        if(this == NULL) return NULL;
        return something;
    }
}
```

from Binder

gcc extensions

AOSP used to use some gcc extensions not supported by clang:

- Nested functions
- __builtin_va_arg_pack
- variable-length arrays of non-POD types
- variable-length arrays in structs

… and 1 clang bug

There’s only 1 place in which we have to work around a clang bug:

```
char s[x] __attribute__((__aligned__
(PAGESIZE)));
```

http://llvm.org/bugs/show_bug.cgi?id=13007

/init and GLESv2 miscompiling may or may not be clang bugs.

Things that still need to be done

- Fix /init and GLES wrappers
- Investigate crashing apps
- Test other devices (esp. Aarch64, x86, MIPS)
- Set up daily builds so we detect new breakages and patches no longer applying quickly

Things that still need to be done

- Update clang (AOSP currently uses a pre-3.5 snapshot)
- Test different compiler options
- Build the kernel with clang too (currently using the prebuilt kernel)
- Investigate where clang based builds are much slower, optimize

Things that still need to be done

- Fix build failures with integrated as (right now, we’re forcing -no-integrated-as into the compiler flags)

What else?

What else can we do to help AOSP work with llvm/clang toolchains?