

Building Chromium on an embedded platform using Ozone-Wayland

```
static void  
properties(GObjectClass  
*gobject_class)  
{  
    mSpec *pspec;
```

```
attribute */  
uint64  
CODE,  
ode.",  
ode",  
0,  
64,  
/*  
/  
E
```

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- Open Source experts and consultants
- 14 years of experience
- Important contributions to:
 - Client-side web technologies: WebKit, Blink/Chromium, Servo
 - Graphics: Wayland, Mesa
 - Compilers: V8, JavaScriptCore, Guile
 - Multimedia: GStreamer, Grilo
 - ...



Introduction

Ingredients

- Renesas R-Car M2 Porter
- Recipes to build a Weston image
- Meta-browser recipes to build Chromium
- Computing power
- Patience!



Layers

- Poky
- meta-openembedded
- meta-linaro
- meta-renesas
- meta-browser

```
BBLAYERS ?= " \  
  ${TOPDIR}/../poky/meta \  
  ${TOPDIR}/../poky/meta-yocto \  
  ${TOPDIR}/../poky/meta-yocto-bsp \  
  ${TOPDIR}/../meta-renesas/meta-rcar-gen2 \  
  ${TOPDIR}/../meta-renesas \  
  ${TOPDIR}/../meta-openembedded/meta-oe \  
  ${TOPDIR}/../meta-openembedded/meta-multimedia \  
  ${TOPDIR}/../meta-linaro/meta-linaro-toolchain \  
  ${TOPDIR}/../meta-browser \  
"
```



local.conf

- Use local-wayland.conf file for porter board
- Add Chromium to the list of software in the image
 - `IMAGE_INSTALL_append = " chromium"`

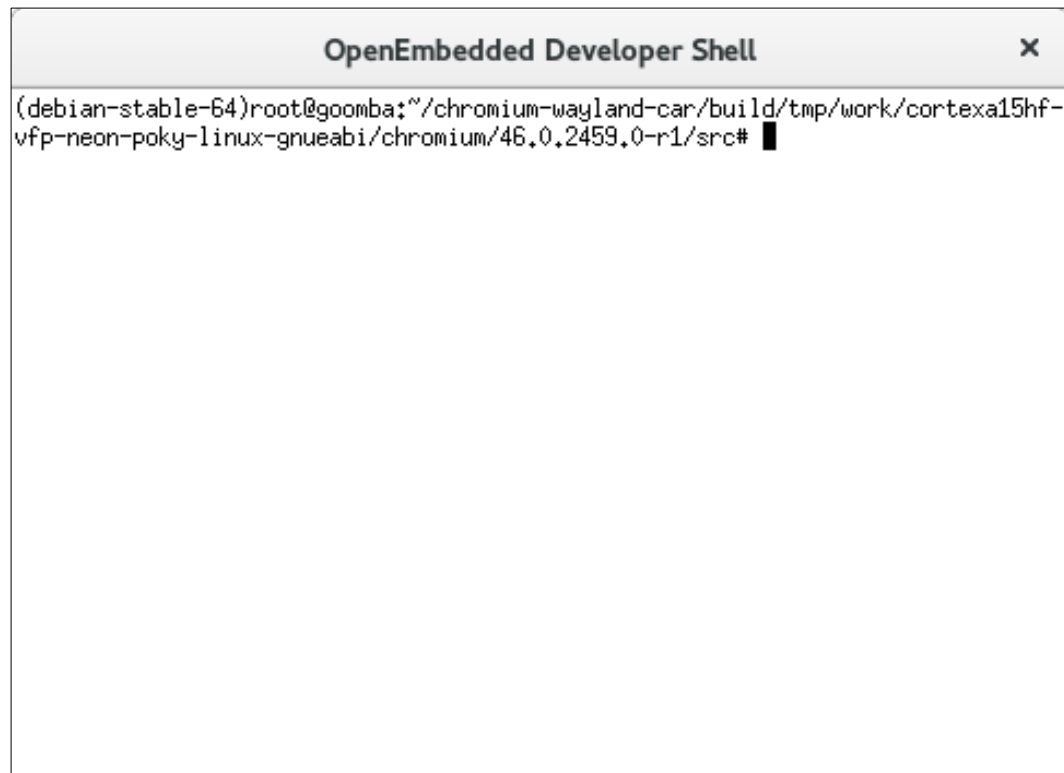
Our tools

Devshell

- devshell opens a shell where all the OE variables and recipe defines are set.
- you need the xterm package around
- depending on your environment, you may need `export DISPLAY=:0.0`

Devshell: usage

- `bitbake -c devshell <package name>`



The screenshot shows a terminal window titled "OpenEmbedded Developer Shell" with a close button (X) in the top right corner. The terminal content displays the prompt `(debian-stable-64)root@goomba:~/chromium-wayland-car/build/tmp/work/cortexa15hf-vfp-neon-poky-linux-gnueabi/chromium/46.0.2459.0-r1/src#` followed by a cursor.

gdbserver

- Allows to debug a piece of software that is running on a remote machine
- Very useful for development on embedded
 - gdb difficult or impossible to run there
 - Memory, processing power, disk space constraints
 - 30 minutes to load chromium symbols in the porter!

gdbserver: requirements

- Gdbserver available in the image for the target board
 - Add to local.conf:
 - `IMAGE_INSTALL_append = " ... gdbserver"`
- On the build/host machine:
 - `apt-get install gdb-multiarch`

gdbserver: usage

- On the target:

- `$ gdbserver 0.0.0.0:15000 <program>`
- `$ gdbserver --attach 0.0.0.0:15000 <pid>`

- On the build/host machine:

- `$ cd ${YOCTOBUILDIR}`
- `$ gdb-multiarch tmp/work/cortexa15hf-vfp-neon-poky-linux-gnueabi/<module>/image/<path-to-exec>`
- `(gdb) set sysroot tmp/sysroots/porter`
- `(gdb) set arch armv5`
- `(gdb) target remote ${ip.address.of.board}:15000`
- `(gdb) run | continue`

Chromium --gpu-startup-dialog

- Multi-process architecture
 - Great for user experience and security
 - Extra difficulty to debug
- Flag --gpu-startup-dialog to debug the GPU process

--gpu-startup-dialog: usage

- On the target:

- `$ google-chrome --gpu-startup-dialog`
Gpu (816) paused waiting for debugger to attach. Send SIGUSR1 to unpause.
- `$ gdbserver --attach 0.0.0.0:15000 816`

- On the build/host machine:

- `$ cd ${YOCTOBUILDIR}`
- `$ gdb-multiarch tmp/work/cortexa15hf-vfp-neon-poky-linux-gnueabi/chromium/46.0.2459.0-r0/src/out/Release/chrome`
- `(gdb) set sysroot tmp/sysroots/porter`
- `(gdb) set arch armv5`
- `(gdb) target remote 192.168.10.135:15000`
- `(gdb) signal SIGUSR1`

Getting in trouble...
and out of it

Missing gnome-keyring

- Error:

```
| No package 'gnome-keyring-1' found
| gyp: Call to 'pkg-config --cflags gnome-keyring-1'
| returned exit status 1.
| WARNING: exit code 1 from a shell command.
| ERROR: Function failed: do_configure (log file is
| located at .../log.do_configure.17258)
ERROR: Task 5 (.../chromium_46.0.2459.0.bb,
do_configure) failed with exit code '1'
```


Missing gnome-keyring

- Workaround: add to local.conf:
 - `IMAGE_INSTALL_append = " chromium libgnome-keyring"`
- Solution: check dependencies in Chromium recipe:
 - In `chromium_40.0.2214.91.bb`:

```
DESCRIPTION = "Chromium browser"  
DEPENDS += "libgnome-keyring"  
include chromium.inc
```
 - In `chromium.inc`:

```
DEPENDS = "xz-native pciutils pulseaudio cairo nss zlib-  
native libav cups ninja-native gconf libexif pango  
libdrm"
```
 - Wrong include, libgnome-keyring dependency gets overwritten!

Missing gnome-keyring

- **Patch:** Include chromium.inc before appending to DEPENDS

```
--- a/recipes-browser/chromium/chromium_40.0.2214.91.bb
+++ b/recipes-browser/chromium/chromium_40.0.2214.91.bb
@@ -16,9 +16,9 @@
 #      * CHROMIUM_WAYLAND_DEPENDS
 #      * CHROMIUM_WAYLAND_GYP_DEFINES
```

```
+include chromium.inc
DESCRIPTION = "Chromium browser"
DEPENDS += "libgnome-keyring"
-include chromium.inc
SRC_URI = "\
.../chromium-browser-official/${P}.tar.xz \
file://include.gypi \
```



Missing gnome-keyring

- New error:

```
ERROR: Nothing PROVIDES 'libgnome-keyring' (but
.../chromium_40.0.2214.91.bb DEPENDS on or otherwise
requires it)
```

```
NOTE: Runtime target 'chromium' is unbuildable,
removing...
```

```
Missing or unbuildable dependency chain was:
['chromium', 'libgnome-keyring']
```

```
ERROR: Required build target 'core-image-weston' has
no buildable providers.
```

```
Missing or unbuildable dependency chain was:
['core-image-weston', 'chromium', 'libgnome-keyring']
```

Missing gnome-keyring

- How to get libgnome-keyring?

```
$ find -name libgnome-keyring*  
  
./meta-openembedded/meta-gnome/recipes-  
gnome/gnome-keyring/libgnome-keyring_2.32.0.bb
```

- Solution: add meta-gnome layer:

```
BBLAYERS ?= " \  
  ${TOPDIR}/../poky/meta \  
  ${TOPDIR}/../poky/meta-yocto \  
  ${TOPDIR}/../poky/meta-yocto-bsp \  
  ${TOPDIR}/../meta-renesas/meta-rcar-gen2 \  
  ${TOPDIR}/../meta-renesas \  
  ${TOPDIR}/../meta-openembedded/meta-oe \  
  ${TOPDIR}/../meta-openembedded/meta-multimedia \  
  ${TOPDIR}/../meta-linaro/meta-linaro-toolchain \  
  ${TOPDIR}/../meta-browser \  
  ${TOPDIR}/../meta-openembedded/meta-gnome \  
"
```



Problem building libglu

- Error:

```
| ../tmp/sysroots/x86_64-linux/usr/libexec/  
| cortexal5hf-vfp-neon-poky-linux-gnueabi/gcc/  
| arm-poky-linux-gnueabi/4.8.3/ld: cannot find -lGL  
| collect2: error: ld returned 1 exit status  
| Makefile:1041: recipe for target 'libGLU.la' failed  
| make: *** [libGLU.la] Error 1  
| ERROR: oe_runmake failed  
| WARNING: exit code 1 from a shell command.  
| ERROR: Function failed: do_compile (log file is  
| located at ../log.do_compile.27132)
```

Problem building libglu

- Cause: libglu, required by dependencies, depends on full GL, which is not available in the device.

- Dependency chain when X11 is enabled:

- chromium → libav → libsdl → libglu → GL

```
$ cat ./meta/recipes-multimedia/libav/libav.inc
```

```
...
```

```
PACKAGECONFIG[x11] = "--enable-x11grab,--disable-x11grab,virtual/libx11 libxfixes libxext xproto virtual/libsdl"
```

- Workaround: add to local.conf:

- DISTRO_FEATURES_remove = " x11"

Problem building libglu

- Solution: patch recipe, glu was not really necessary to build libSDL

```
--- a/meta/recipes-graphics/libSDL/libSDL_1.2.15.bb
+++ b/meta/recipes-graphics/libSDL/libSDL_1.2.15.bb
@@ -13,7 +13,7 @@ LIC_FILES_CHKSUM = "file://COPYING;md5=27818cd7fd83877a8e3ef82b82
PROVIDES = "virtual/libSDL"

DEPENDS = "${@base_contains('DISTRO_FEATURES', 'directfb', 'directfb', '', d)} \
- ${@base_contains('DISTRO_FEATURES', 'opengl', 'virtual/libgl libglu', '', d)} \
+ ${@base_contains('DISTRO_FEATURES', 'opengl', 'virtual/libgl', '', d)} \
  ${@base_contains('DISTRO_FEATURES', 'x11', 'virtual/libx11 libxext libxrandr libx
tslib"
```

Problem building libglu

- Proper patch is already upstream

```
commit 0e5a9114f58828058595d773e5b97771c88f7be8
Author: Robert Yang <liezhi.yang@windriver.com>
Date: Tue Sep 15 19:28:46 2015 -0700
```

```
libSDL: depends on libglu when both x11 and opengl
```

```
The libglu requires both opengl (depends on
virtual/libgl) and x11
(needs libGL.so which is provided by mesa when x11 in
DISTRO_FEATURES),
so let libSDL depends on libglu when both x11 and
opengl in
DISTRO_FEATURES.
```



Missing includes in v8

- Error:

```
| FAILED: g++ -MMD -MF obj.host/v8/src/base/v8_libbase.bits.o.d  
| -D... -W... -f... -pipe -m32 -O3 -std=gnu++11  
| -I../..v8 -Igen --param=ssp-buffer-size=4 -pthread  
| -c ../..v8/src/base/bits.cc  
| -o obj.host/v8/src/base/v8_libbase.bits.o  
| In file included from /usr/include/bits/errno.h:24:0,  
|  
|     ...  
|     from ../..v8/src/base/bits.cc:5:  
| /usr/include/linux/errno.h:1:23: fatal error: asm/errno.h:  
| No such file or directory  
| #include <asm/errno.h>  
|     ^  
| compilation terminated.  
| ninja: build stopped: subcommand failed.  
| WARNING: exit code 1 from a shell command.  
| ERROR: Function failed: do_compile (log file is located at  
| ../log.do_compile.25688)
```



Missing includes in v8

- Check what is happening with devshell:

- `$ bitbake -c devshell chromium`

- `# whereis g++`

```
g++: /usr/bin/g++
```

- `# env`

```
CPP=arm-poky-linux-gnueabi-gcc -E -sysroot=.../build/tmp/sysroots/porter -march=armv7-a  
-mthumb-interwork -mfloat-abi=hard -mcpu=neon -mtune=cortex-a15
```

```
PATH=.../build/tmp/sysroots/x86_64-linux/usr/bin/python-
```

```
native:.../poky/scripts:.../build/tmp/sysroots/x86_64-linux/usr/bin/cortexa15hf-vfp-neon-  
poky-linux-
```

```
gnueabi:.../build/tmp/sysroots/porter/usr/bin/crossscripts:.../build/tmp/sysroots/x86_64-  
linux/usr/sbin:.../build/tmp/sysroots/x86_64-linux/usr/bin:.../build/tmp/sysroots/x86_64-  
linux/sbin:.../build/tmp/sysroots/x86_64-
```

```
linux/bin:.../poky/scripts:.../poky/bitbake/bin:/usr/local/bin:/usr/bin:/bin:/usr/local/games  
:/usr/games
```

```
CXX=arm-poky-linux-gnueabi-g++ -march=armv7-a -mthumb-interwork -mfloat-abi=hard -mcpu=neon  
-mtune=cortex-a15 -sysroot=.../build/tmp/sysroots/porter
```

```
CC=arm-poky-linux-gnueabi-gcc -march=armv7-a -mthumb-interwork -mfloat-abi=hard -mcpu=neon  
-mtune=cortex-a15 -sysroot=.../build/tmp/sysroots/porter
```

- `# whereis arm-poky-linux-gnueabi-g++`

```
arm-poky-linux-gnueabi-g++: .../build/tmp/sysroots/x86_64-linux/usr/bin/cortexa15hf-vfp-neon-  
poky-linux-gnueabi/arm-poky-linux-gnueabi-g++
```



Missing includes in v8

- Problem: wrong compiler being used
 - Calling `g++` instead of `$CXX`
 - `$CXX` points to `arm-poky-linux-gnueabi-g++` inside the `sysroot`
 - `g++` is the system compiler
- Workaround:
 - `apt-get install gcc-multilib g++-multilib`
- Proper solution would be fixing the recipe!

Cannot open libGLv2.so

- Error:

```
[display.cc (117)] Failed to load GLES  
library: libGLv2.so.2: cannot open shared  
object file: no such file or directory
```

- Check contents in `/usr/lib`

- `libGLv2.so` is there, symlinks with version numbers are not

- Workaround: manually add a symlink

```
cd /usr/lib
```

```
ln -s libGLv2.so libGLv2.so.2
```

Cannot open libGLv2.so

- Solution: patch recipe

```
--- a/meta-r-car-gen2/recipes-graphics/gles-module/gles-user-module.bb
+++ b/meta-r-car-gen2/recipes-graphics/gles-module/gles-user-module.bb
@@ -65,7 +65,10 @@ do_install() {
     ${D}/${sysconfdir}/powervr.ini
     fi
 fi
-}
+
+ # Fix symlink
+ cd ${D}/usr/lib && ln -s libGLv2.so libGLv2.so.2
+}

PACKAGES = "\
    ${PN} \
```

Error in egl.c

- Error:

```
egl.c:228: eglQueryString: Assertion `ret != ((void *)0)' failed.
```

- Check code flow with the debugger

- Set breakpoint at `egl.c:228`

```
224     ret = _eglQueryString(dpy, name);
225
226 #ifdef WANT_WAYLAND
227     if (name == EGL_EXTENSIONS) {
228         assert(ret != NULL);
229         ...
```

- Check backtrace to know where we are: [libegl](#)

Error in egl.c

- Solution: replace the assert with a softer `if` sentence
 - Check solution with original developers, **share upstream**

```
--- a/egl.c
+++ b/egl.c
@@ -224,8 +223,7 @@ const char *eglQueryString(EGLDisplay dpy, EGLint name)
     ret = _eglQueryString(dpy, name);

#ifdef WANT_WAYLAND
-     if (name == EGL_EXTENSIONS) {
-         assert(ret != NULL);
+     if (ret && name == EGL_EXTENSIONS) {

         if (!_eglextstr) {
             _eglextstr = calloc(1, strlen(ret) + strlen(EGL_WL_EXTI
```



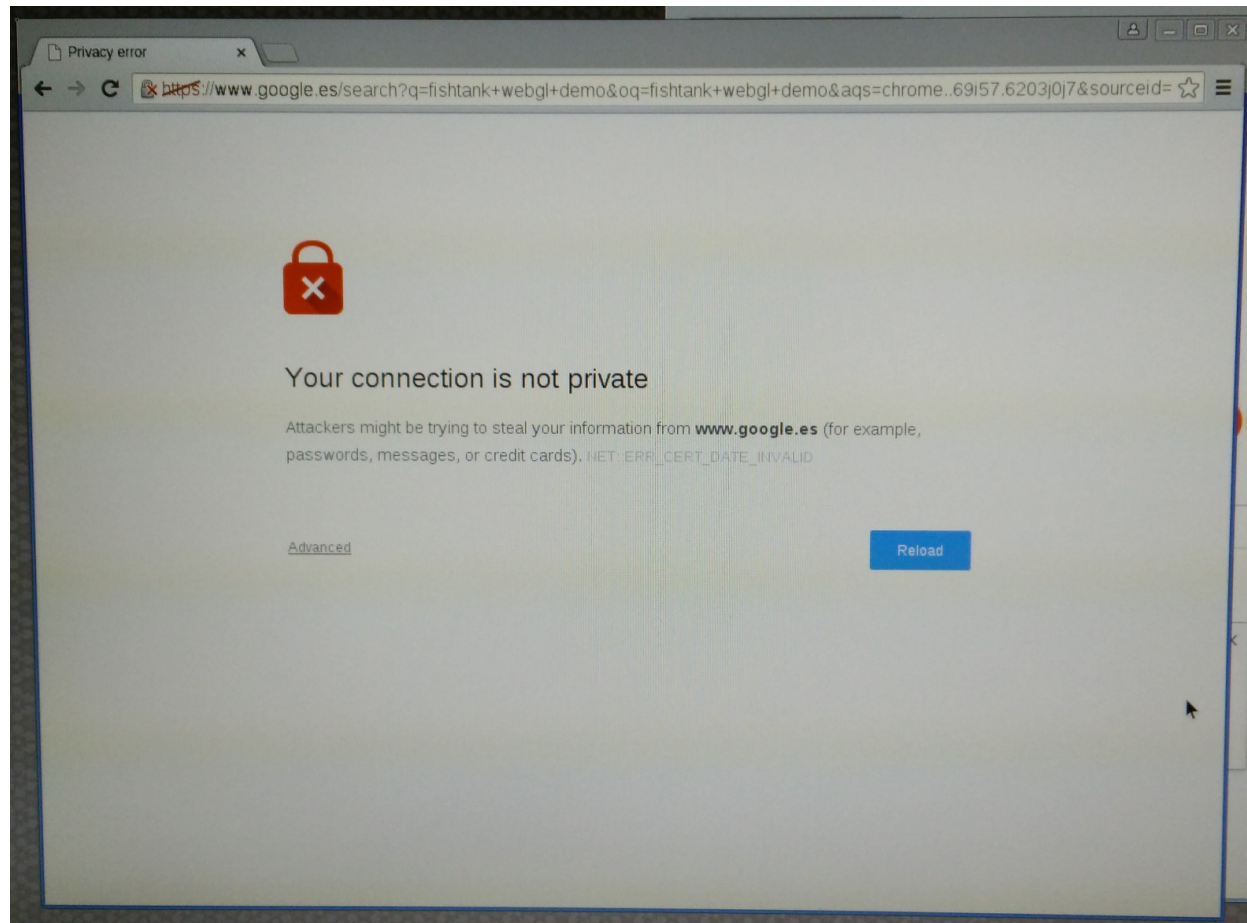
Error in egl.c

- Solution: replace the assert with a softer `if` sentence
 - Modify libegl recipe:

```
--- a/meta-rcar-gen2/recipes-graphics/wayland/libegl.bb
+++ b/meta-rcar-gen2/recipes-graphics/wayland/libegl.bb
@@ -5,7 +5,7 @@ LIC_FILES_CHKSUM = "file://egl.c;beginline=5;endline=15;md5=36
COMPATIBLE_MACHINE = "(r8a7790|r8a7791|r8a7793|r8a7794)"

PROVIDES = "${@base_contains("DISTRO_FEATURES", "wayland", "virtual/egl", "",
-SRCREV = "ee4bce93878d02a144ae6ebfba1eff28fe9b4442"
+SRCREV = "02b559098042a0aeb9ac63eece547868a140fa46"
```


Missing certificates



Missing certificates

- Solution: add ca-certificates package to the image
 - `IMAGE_INSTALL_append = " chromium ca-certificates"`

Finally, it's working!



Summary

Contributions upstream

- Contributions to meta-browser
 - [4b27058](#) chromium: Include chromium.inc before appending to DEPENDS
 - [6ae140b](#) chromium: Rework the evaluation of the Wayland feature.
 - [65d7e9f](#) chromium: Clean the definitions of some ozone-wayland variables.
 - [556b41a](#) chromium: Allow to build in Debug mode.

Contributions upstream

- Contributions to libegl
 - [ce7caca](#) Don't assert when eglQueryString() returns null.
- Contributions to meta-renesas
 - rcar-gen2: libegl: Update SRCREV.
 - rcar-gen2: gles-user-module: Add symlink for the GLESv2 library.

Contributions upstream

- Contributions to Ozone-Wayland
 - [a12c78e](#) Add support for receiving drag data from external processes
 - [5b0b336](#) Add an error message when running with software rendering
 - [3bc3655](#) tools/jhbuild: moduleset requires the full path
 - [b0988bb](#) WindowManagerWayland: guard against invalid window handles
 - Some additional commits and more under development now

What's next

- Build on top of meta-ivi
- Run on the GENIVI Demo Platform
- Continue with the development of Ozone-Wayland

Thank you!

