GStreamer for Tiny Devices

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Who am I?

- GStreamer at Collabora since 2007
- Started with VVoIP: Telepathy & Farstream
- Helps our customers use GStreamer
  - Many embedded projects
A Tiny Device?

- Flash Storage
- Slow CPU
- Little RAM
Overview of GStreamer
Pipelines!
GStreamer in Applications
Pipelines!
GStreamer: Perfect for embedded!

• Complete Zero-Copy toolkit
  - Full negotiation
  - Buffer lifetime
  - Synchronization
• Loads and loads of hardware enabled plugins
• Very fast prototyping
Example: A Security Camera

- 16 MB Flash
- 1 GB RAM
- RTSP Server
- ARMv7
Example: A RTSP to MP4 file segments

- Captures 2s clips from RTSP server

rtspsrc ➤ rtph264depay ➤ h264parse ➤ splitmuxsink
Example: A RTSP to MP4 file segments

- Prototype on PC:

```bash
gst-launch-1.0 rtspsrc location=rtsp://... ! rtph264depay ! h264parse ! splitmuxsink location=file_template_%05d.mp4
```
Version 0: A shell script with gst-launch-1.0

- Complete GStreamer build
  - 287 MB for total build
  - 82 MB of dynamic libraries
Version 0.1: A shell script with gst-launch-1.0

- Strip it
  - 17 MB of dynamic libraries
#include <gst/gst.h>
#include <unistd.h>

int main (int argc, char **argv)
{
    GstElement *pipeline;
    GError *error = NULL;

    gst_init (&argc, &argv);

    pipeline = gst_parse_launch("rtspsrc location=rtsp://127.0.0.1:8554/test ! rtph264depay ! h264parse ! splitmuxsink max-size-time=2 location=video%05d.mp4", &error);
    if (!pipeline)
        g_error("Error: %s", error->message);
    if (!pipeline)
        g_error("Error: %s", error->message);

    gst_element_set_state(pipeline, GST_STATE_PLAYING);
    pause();
    gst_element_set_state(pipeline, GST_STATE_NULL);

    return 0;
}
Version 1: A C program (Makefile)

SYSROOT=/home/ocrete/collabora/cerbero/toolchain/sysroot-glibc-linaro-2.25-2017.08-arm-linux-gnueabihf

CC=/home/ocrete/collabora/cerbero/toolchain/gcc-linaro-7.1.1-2017.08-i686_arm-linux-gnueabihf/bin/arm-linux-gnueabihf-gcc

PKG_CONFIG_PATH=/home/ocrete/collabora/cerbero/build/dist/linux_armv7/lib/pkgconfig

program: program.c Makefile
    libtool link --tag=CC $(CC) `PKG_CONFIG_PATH=$(PKG_CONFIG_PATH) pkg-config --libs --cflags gstreamer-1.0` program.c -o program
Version 1: A C program

- Binary: 13K
  - Stripped: 5.5K
- Plus 17 MB in libraries
- Total: 17 MB
Static Build?

- Using libtool
  - `libtool --static-libtool-libs`
  - `pkg-config --static`
- 7.5 MB binary
- Stripped: 1.5 MB static binary
Try on device

• Put on Flash, run it:

  ** (program:14806): ERROR **: Error: no element "rtspsrc"

• Missing all the plugins!
Copy plugins

• All ? 17MB ....

• Only relevant?!
  - GST_DEBUG=GST_PLUGIN_LOADING:4

• Total 1.7 MB in plugins once stripped
Try on device again

(program:23211): GStreamer-WARNING **: Failed to load plugin '/lib/gstreamer-1.0/libgstudp.so': libgstnet-1.0.so.0: cannot open shared object file: No such file or directory

- Plugins are not static!
  - Need to re-add libraries
  - Back to 17 MB
Statically build plugins

• Declare functions like

```c
GST_PLUGIN_STATIC_DECLARE (coreelements);
```

• Register plugins
  - After `gst_init()`
  - `GST_PLUGIN_STATIC_STATIC_REGISTER (coreelements);`
Statically build plugins

• Link with

-L/home/ocrete/collabora/cerbero/build/dist/linux_armv7/lib/gstreamer-1.0 -lgstcoreelements -lgstisomp4 -lgstvideoparsersbad -lgstrtp -lgstrtsp -lgstrtpmanager -lgstudp
Statically build plugins

- Real static binary is 28 MB
- Stripped to 4.7 MB
- Really working on device
Ask the compiler for HELLPPPP!

- Compile with -Os
- Disappointing, it hasn't improved!
  - Stripped Binary: 4.7 MB
Strip functions that are not used

- Build with:
  -ffunction-sections -fdata-sections
- Link with:
  -Wl,--gc-sections

- Stripped Binary: 4 MB
Dig into!

- Find which .o files contribute to the sink
- Used
  - objdump
  - Python script
- Tool: Bloaty McBloatface
  - Did not work for me
Butcher GLib

- GLib has internal plugins
- Always registered
- Not used, but bot garbage collected
- Butcher them out
Butcher GLib

- Removed
  - GSettings
  - GDBus
  - AppInfo
  - Gapplication
  - Notifications

https://people.collabora.com/~tester/Butcher-glib-remove-gdbus-gapplication-desktopap.patch
Butcher GLib

- Stripped binary down to 3.8 MB
Cheating time: Compressed binary

• Using upx

  upx --best program

• Compress down to 2 MB
More steps

- Remove UTF-8 tables in GLib
- Dig into exact linked code
Thank you!