COLLABORA

GStreamer for Tiny Devices

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Open First

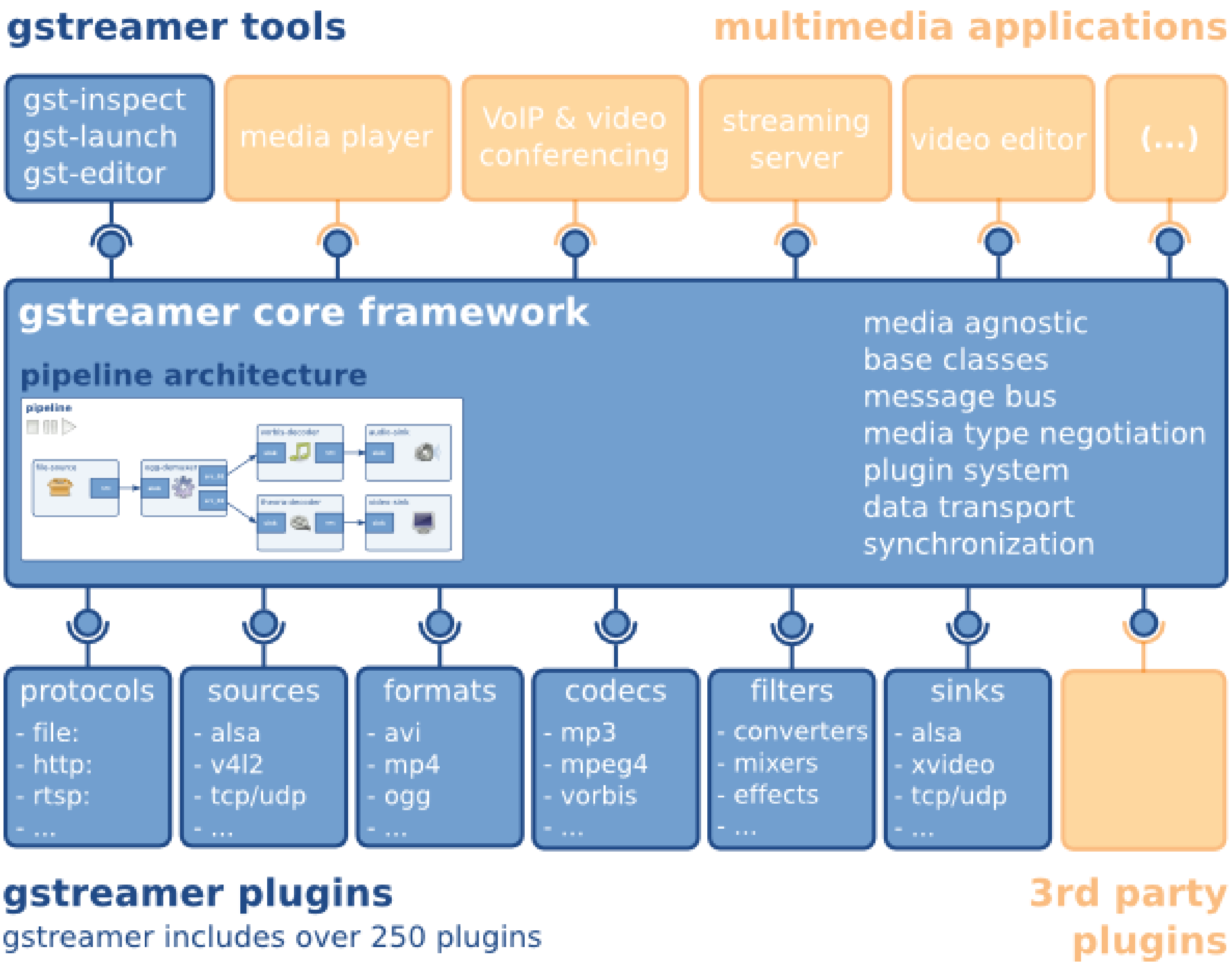
Who am I ?

- 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



gstreamer tools

multimedia applications

gst-inspect
gst-launch
gst-editor

media player

VoIP & video conferencing

streaming server

video editor

(...)

gstreamer core framework

pipeline architecture

media agnostic
base classes
message bus
media type negotiation
plugin system
data transport
synchronization

protocols
- file:
- http:
- rtsp:
- ...

sources
- alsa
- v4l2
- tcp/udp
- ...

formats
- avi
- mp4
- ogg
- ...

codecs
- mp3
- mpeg4
- vorbis
- ...

filters
- converters
- mixers
- effects
- ...

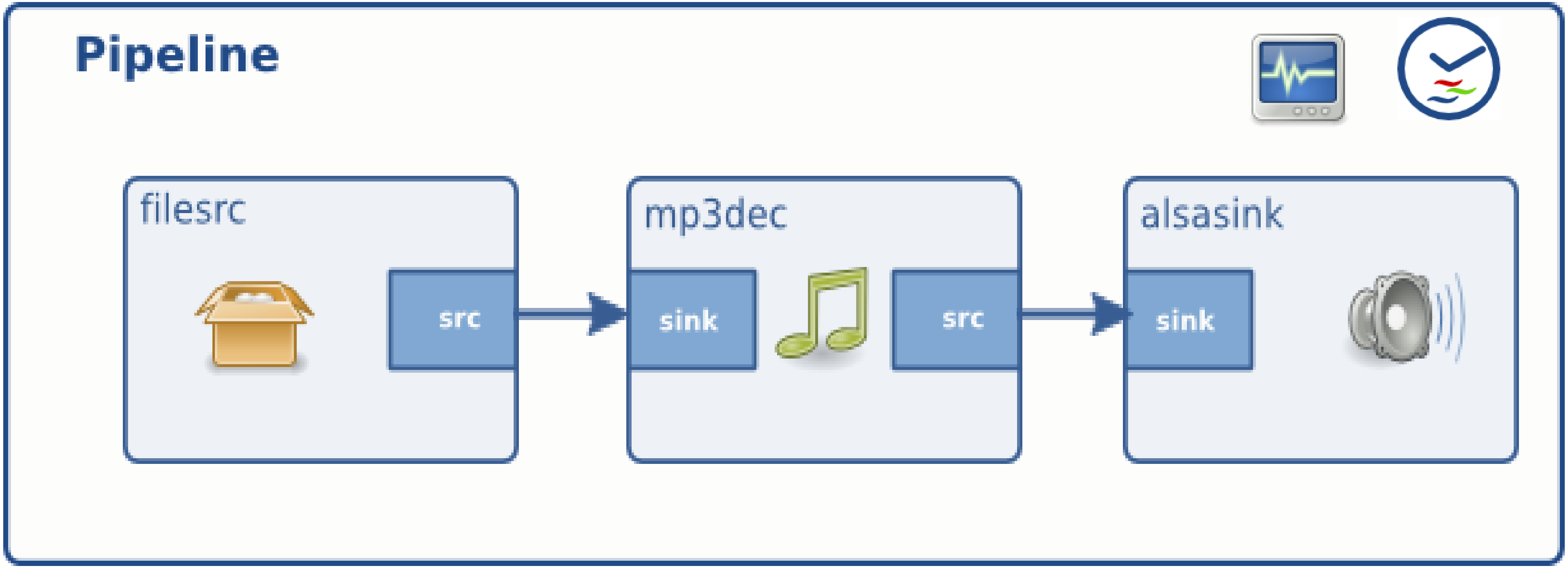
sinks
- alsa
- xvideo
- tcp/udp
- ...

gstreamer plugins

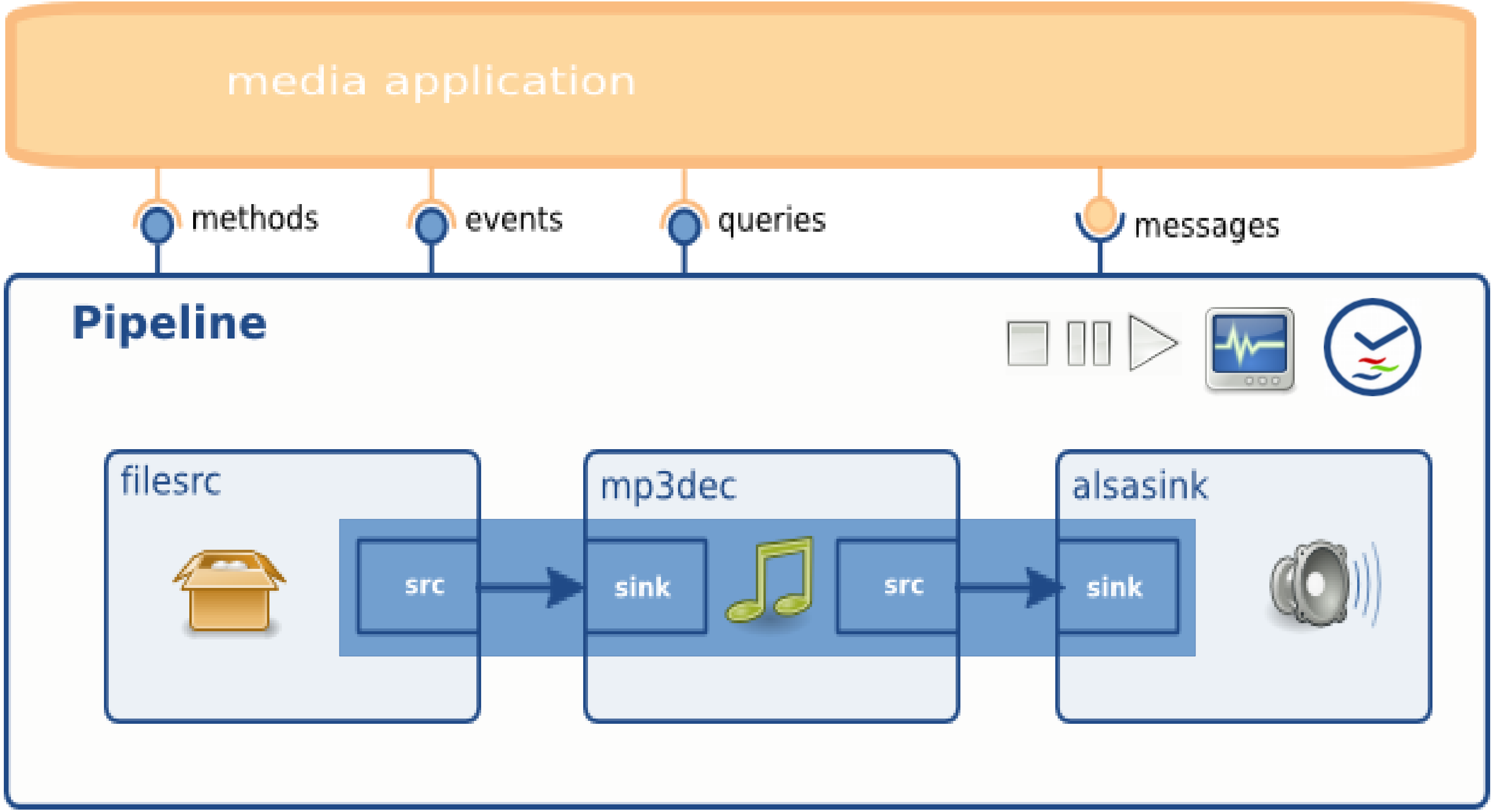
gstreamer includes over 250 plugins

3rd party plugins

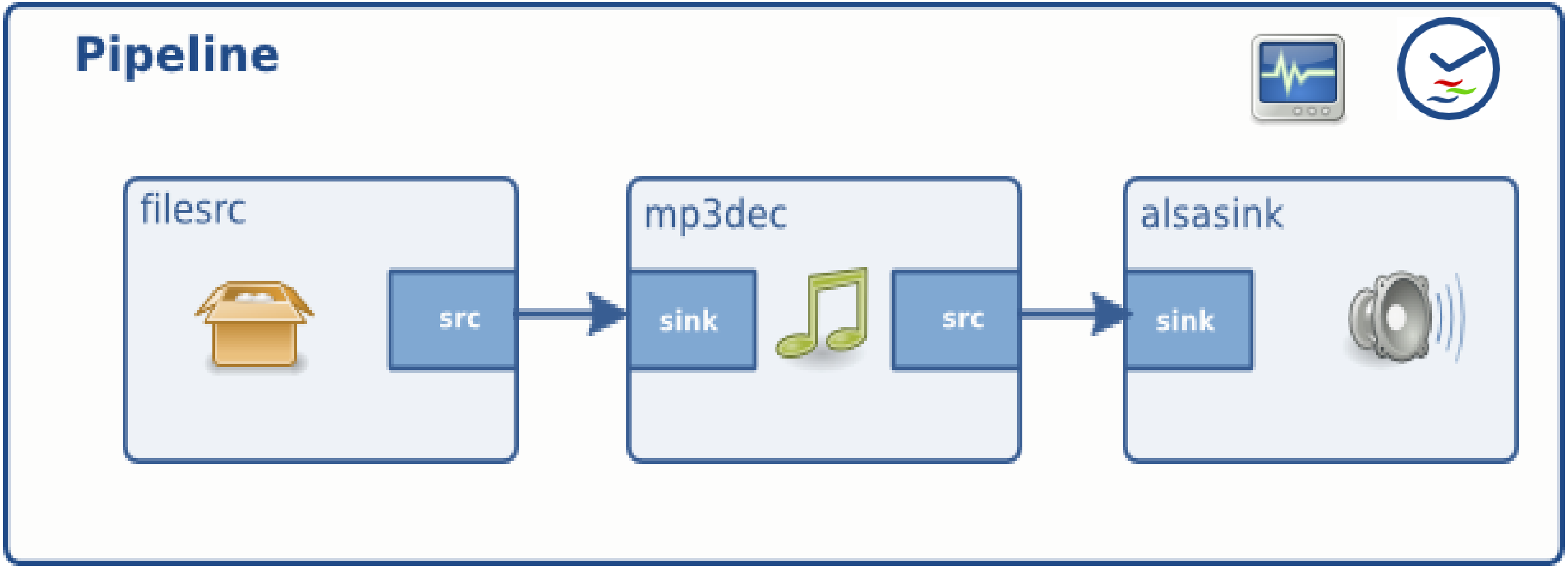
Pipelines!



GStreamer in Applications



Pipelines!



GStreamer: Perfect for embedded!

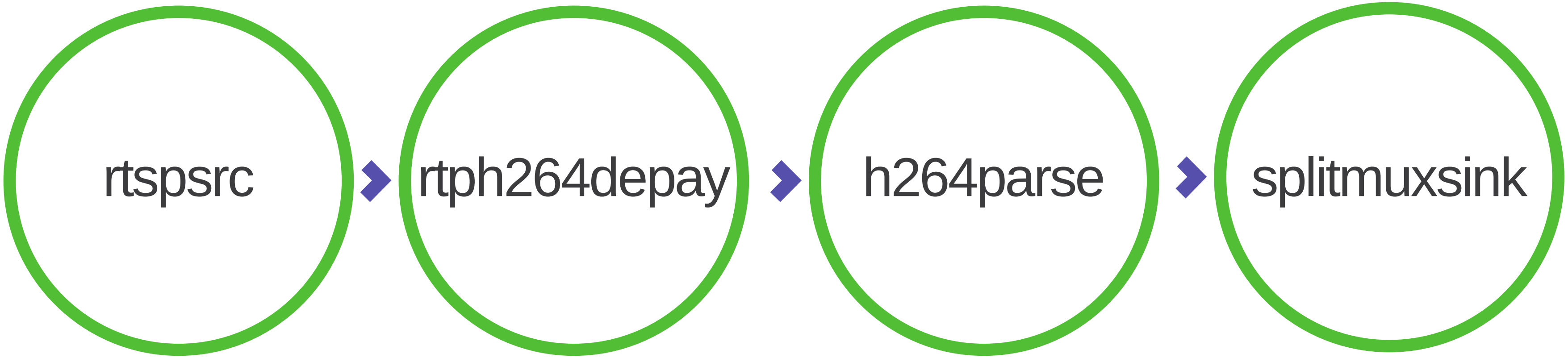
- Complete Zero-Copy toolkit
  - Full negotiation
  - Buffer lifetime
  - Synchronization
- Loads and loads of hardware enabled plugins
- Very fast prototyping

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



Example: A RTSP to MP4 file segments

- Prototype on PC:

```
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

287 MB

Version 0.1: A shell script with gst-launch-1.0

- Strip it
  - 17 MB of dynamic libraries

17 MB

Version 1: A C program

```
#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);

  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/pkg
config

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

17 MB

Static Build?

- Using libtool
  - `libtool -static-libtool-libs`
  - `pkg-config --static`

- 7.5 MB binary
- Stripped: 1.5 MB static binary

1.5 MB

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

1.7 MB

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

17 MB

Statically build plugins

- Declare functions like

  ```
  GST_PLUGIN_STATIC_DECLARE (coreelements);
  ```

- Register plugins
  - After `gst_init()`
  - `GST_PLUGIN_STATIC_REGISTER (coreelements);`

Statically build plugins

- Link with

```
-L/home/ocrete/collabora/cerbero/build/dist/li
nux_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

4.7 MB

Ask the compiler for HELLPPP !

- Compile with -Os
- Disappointing, it hasn't improved!
  - Stripped Binary: 4.7 MB

4.7 MB

Strip functions that are not used

- Build with:

```
-ffunction-sections -fdata-sections
```

- Link with:

```
-Wl,--gc-sections
```

- Stripped Binary : 4 MB

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

3.8 MB

Cheating time: Compressed binary

- Using upx

```
upx --best program
```

- Compress down to 2 MB

2 MB

More steps

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

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Thank you!