How to Build an Open Source Embedded Video Playback System

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Embedded Video Playback System
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Embedded Video Playback System

By LG 전자 - 세계 명화가 LG 스마트 TV 속으로, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=17450806
Agenda

- Features
- Status Quo
- Open source
- Future Work
Features

- Interactive GUI
- Preview of multiple videos
- Fullscreen playback of one video
- OpenGL acceleration for GUI
System Architecture

H264 Video → Video Decoding → GUI → Display

Driver

OpenGL Driver

i.MX6

Chips&Media
Coda 960

Vivante
GC 3000
Status Quo

- Vendor supplied board support package
- Linux kernel and userspace
- Patches for vendor selected Linux version (e.g., 3.14.52 / 4.1.15)
- Binary blob drivers for GPU and video decoding
- Obstacles for debugging and maintenance

What can we achieve using open source software from upstream?
User Interface: QML

- Declarative user interface specification and programming language
- Graphics acceleration via OpenGL
- Demo application 150 lines of QML code
- Interface to video decoding 200 lines of C++ code
Compositing: etnaviv

- Reverse-engineered driver for Vivante GPUs
- Available upstream in Mesa (since 17.0) and Linux (since 4.5)
- etnaviv implements OpenGL → Usable from Qt 5
- Video frames can be composited in hardware
Video Pipeline: Gstreamer

- No solution in upstream Gstreamer, yet
- Custom sink “gst-video-item”
- Zero-copy from Gstreamer to QML
- Pipeline auto-plugging with playbin

```
filesrc
*demux
h264parse
<h264dec>
gst-video-item
```
Decoding: CODA Driver

- Linux driver available in mainline (VIDEO_CODA)
- V4L2 mem2mem device → /dev/videoX
- Gstreamer v4l2videoXdec element
- i.MX6 hardware customizations → drivers about to be mainlined
- Unfortunately still closed source firmware
System Architecture

H264 Video → gstreamer → Qt → Display

V4L2 CODA

mesa etnaviv

i.MX6

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Vivante GC 3000

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Future Work

- Upstream solution for GStreamer to etnaviv interface (gst-video-item)
- Other compositors for UI, e.g., Wayland compositor
- Adaptive streaming for dynamic adjustment of video quality
Conclusion

- Binary blob drivers → issues with maintenance and debugging
- User interface → etnaviv and QML
- Video decoding → Gstreamer and V4L2
- Future work → Wayland, adaptive streaming

Embedded video playback does not require blob drivers
Thank You!

- GStreamer - https://gstreamer.freedesktop.org
- mesa - http://www.mesa3d.org
- QML - https://www.qt.io/qt-quick