Embedded Streaming Media with GStreamer and BeagleBoard

Presented by Todd Fischer

todd.fischer (at) ridgerun.com

Agenda

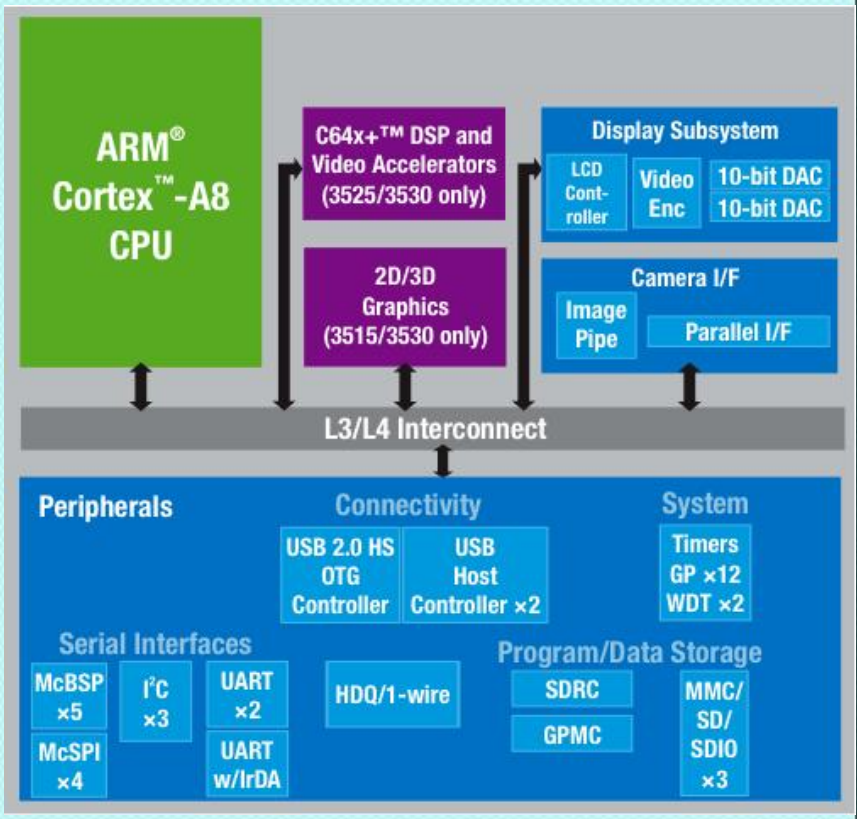
- BeagleBoard-XM multimedia features
- GStreamer concepts
- GStreamer hands on exercises
- DMAI and GStreamer
- Questions

What's New

- Performance
  - Tuning not as critical
- Streaming media not central to product
- HD – more power for higher resolution

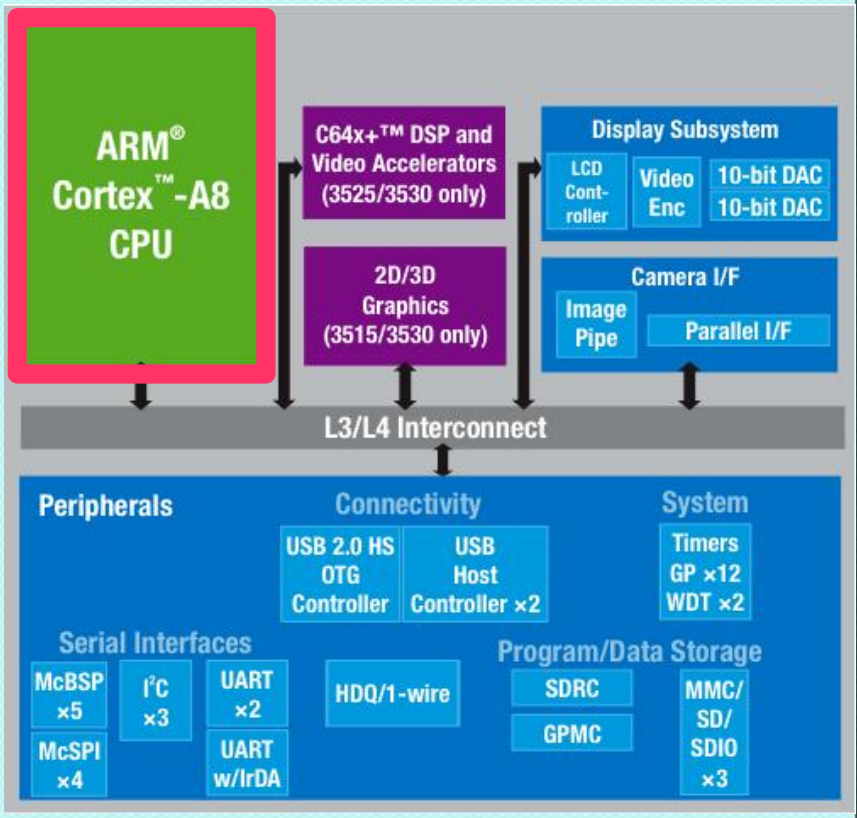
AM3730 Architecture

- Multimedia features:
  - Cortex A8 with Neon
  - C64x+ DSP
  - HD video accelerators
  - How to utilize the hardware features ?



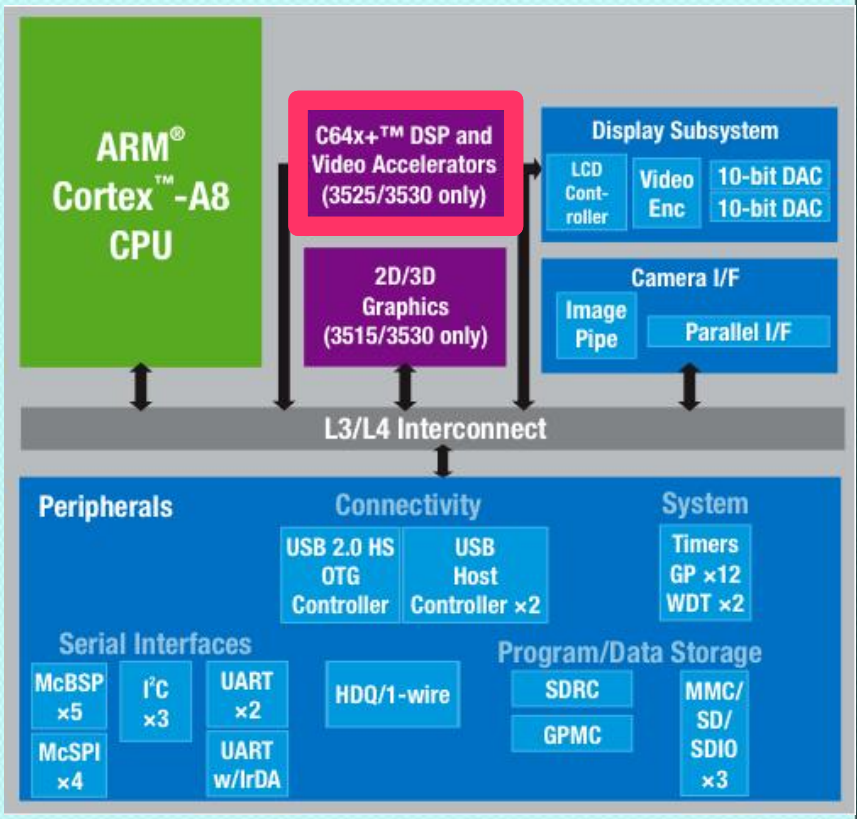
AM3730 Architecture

- Cortex A8
  - Neon
  - Super-scaler
  - Ghz clock



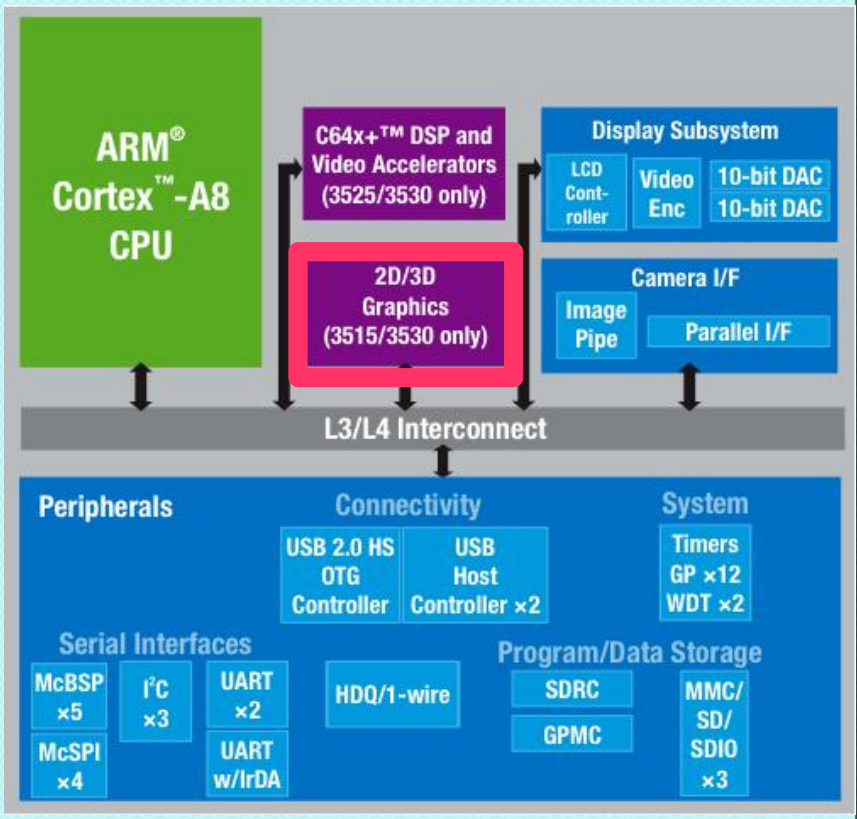
AM3730 Architecture

- C64+ DSP
  - HD video encode / decode



AM3730 Architecture

- Graphics Accelerator
  - Dedicated hardware
  - IVA – image, video audio accelerator
  - SGX accelerator
    - Supports OpenGLES



GStreamer

- Streaming media framework – audio and video
- Close to 200 plug-ins available
- Higher level than just input / filters / output
- Networking, audio/video mixed streams, auto data handling
- Various options utilizing hardware accelerators

GStreamer Overview

- Elements
  - Source, filters, sinks
- Bins and Pipelines
  - Containers, pipeline is the overall bin
- Pads
  - Element source / [illegible]

Caps

Capabilities organized by stream type with a set of properties

Plugin

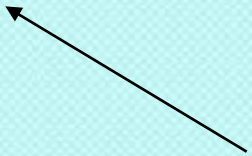
Collection of elements

Hands On Exercise 0

- Double click on GStreamer Class icon

- In terminal window, type

```
source ./s
```

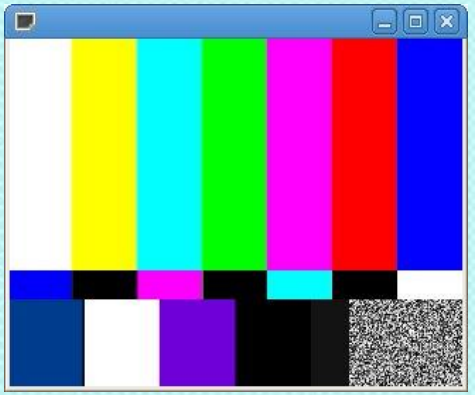


Need the period

Hands On Exercise 0

- Run video pipeline

  v1



- Actual command

  gst-launch videotestsrc ! ffmpegcolorspace ! xvimagesink

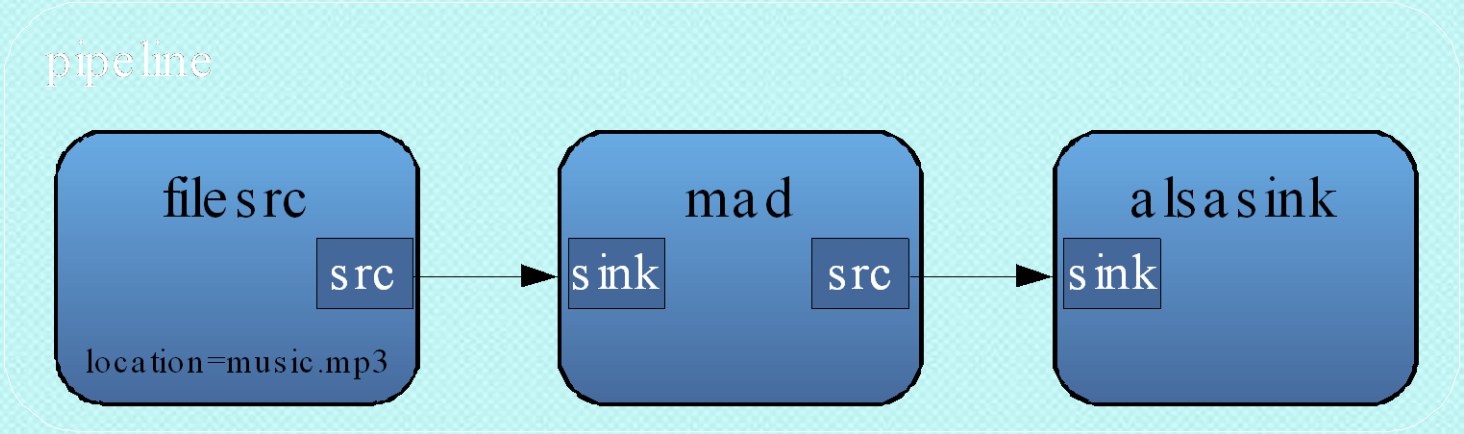
- See script contents

  cat v1

- There are lots of scripts

  ls

Simple MP3 Player



- Create dynamically using gst-launch

See script a0

- Source element reads from a file
- Filter element converts MP3 to PWM
- Sink element passes to ALSA output

Simple Audio Player Source Code

- Create pipeline, source, filter, sink
  - Set element properties
- Build into pipeline
  - Connect src and sink pads
- Setup pipeline event handler
  - End of stream
- Set pipeline state to play
- Run

See source a_gst.c

Keeping Plug-ins Organized

- Each known plug-in is added to registry
- Most aspects of plug-in are tracked in the registry
- Registry support run-in pipeline creation and dynamic filter selection
- Use gst-inspect to list plug-ins

Hands On Exercise 1

- Using gst-inspect, list
  - All plug-ins
  - All video plug-ins
  - Element properties for filesrc plug-in

Hands On Exercise 2

- GStreamer demultplexing pipelines
  - d5 – flash video
    - First demultiplex into audio and video

```
gst-launch filesrc location=sprc720.flv ! flvdemux name=demux
```

    - Second, process audio

```
demux.audio ! queue ! mad ! alsasink
```

    - Third, process video

```
demux.video ! queue ! ffdec_vp6f !  omapdmaifbsink
```

- Idea is the same
  - source data, filter data, send data to sink

GStreamer Daemon

- Separates audio / video streaming from controlling application
- Uses D-Bus messages to control pipeline
- Simplifies application development
  - No interaction with Gstreamer API
- Simplifies testing
  - Test app just sends D-Bus messages

Performance
Data Passing

- Minimize data copies
- Stream held in buffers with data, timestamp, other info
- When possible, buffer memory allocated by sink pad
- Use hardware when data copy is necessary

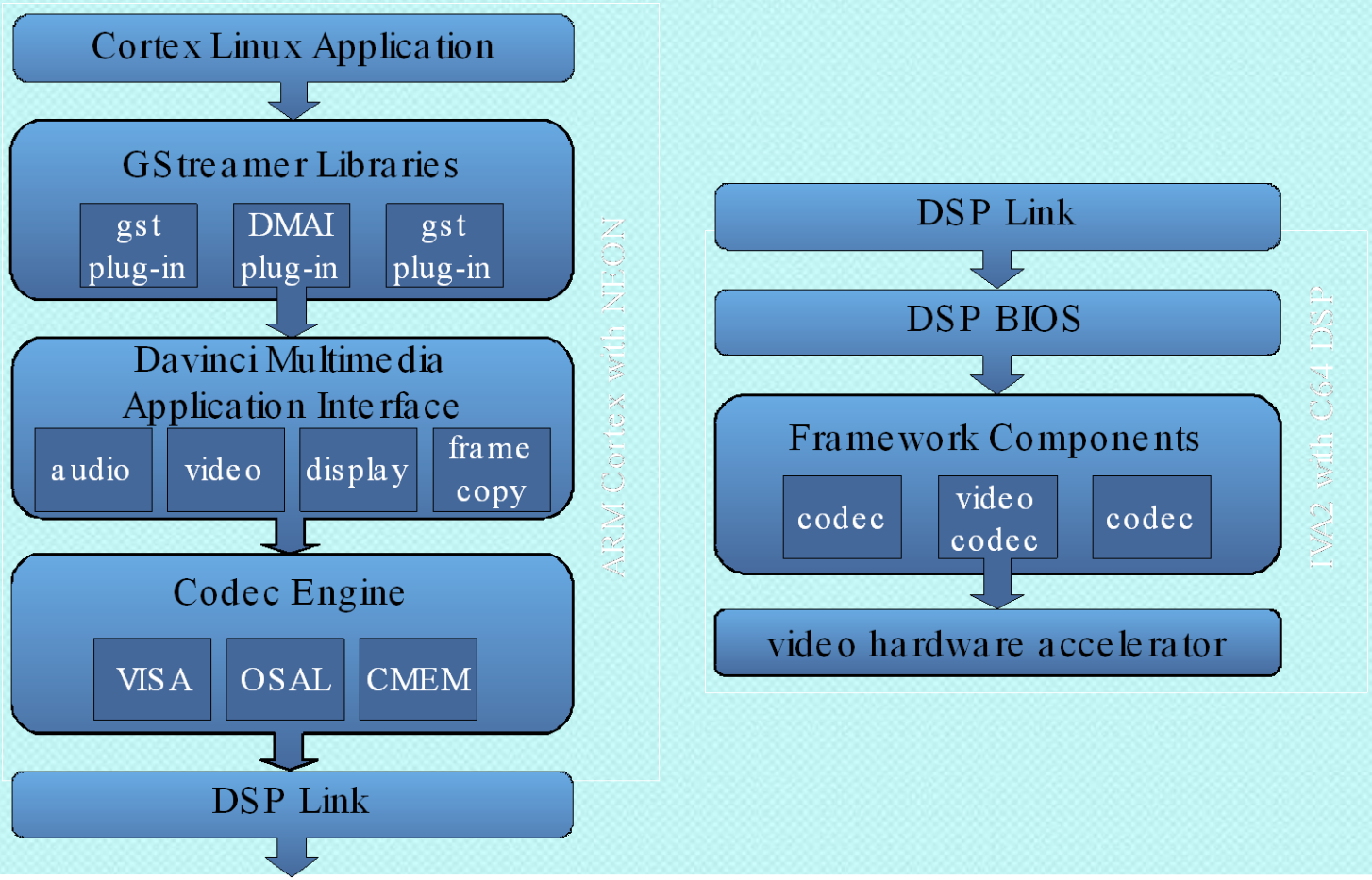
Performance
Data Transformation

- Cortex A8 compiler optimization
- NEON
  - Single Instruction Multiple Data
- C64+
  - Video accelerator
- DMA and other data movers

Performance Scheduling

- GStreamer elements may not be tuned for embedded use model
- Decoder may starve output device
  - Noticeable audio clicks
- Adjust buffering to pace entire pipeline
- Adjust thread priority

Davinci Multimedia Application Interface



DMAI and GStreamer

- Davinci Multimedia Application Interface
  - Exposes OMAP/Davinci hardware using high level of abstraction
    - Stream audio / video
    - Graphics display
    - Hardware optimized frame/data copy

Sitara Codec Engine

- Isolates users for audio/video codecs from those implementing the codecs
- Codec can run in several places without the calling application being aware
  - Cortex A8, NEON, C64, hardware accelerator
  - Uses DSPLink and DSPBios conventions to support DSP based algorithms dynamically

Convenience Video

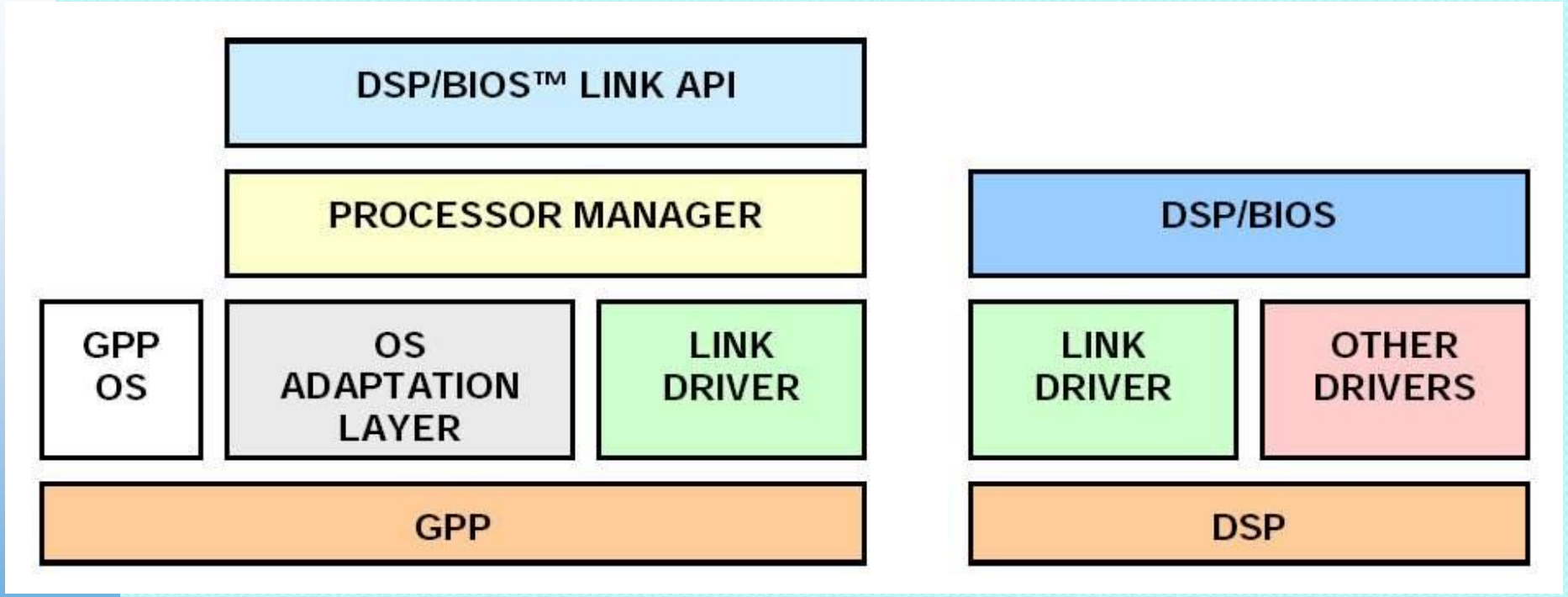
- The power of the AM3730
  - Streaming audio / video can be added to most any product
- Example: stream from DM365 Leopard Board 365

v4l2src ! dmaienc_mpeg4 ! rtpmp4vpay ! udpsink

BeagleBoard XM

udpsrc ! rtpmp4vdepay ! ffdec_mpeg4 ! omapdmaifbsink

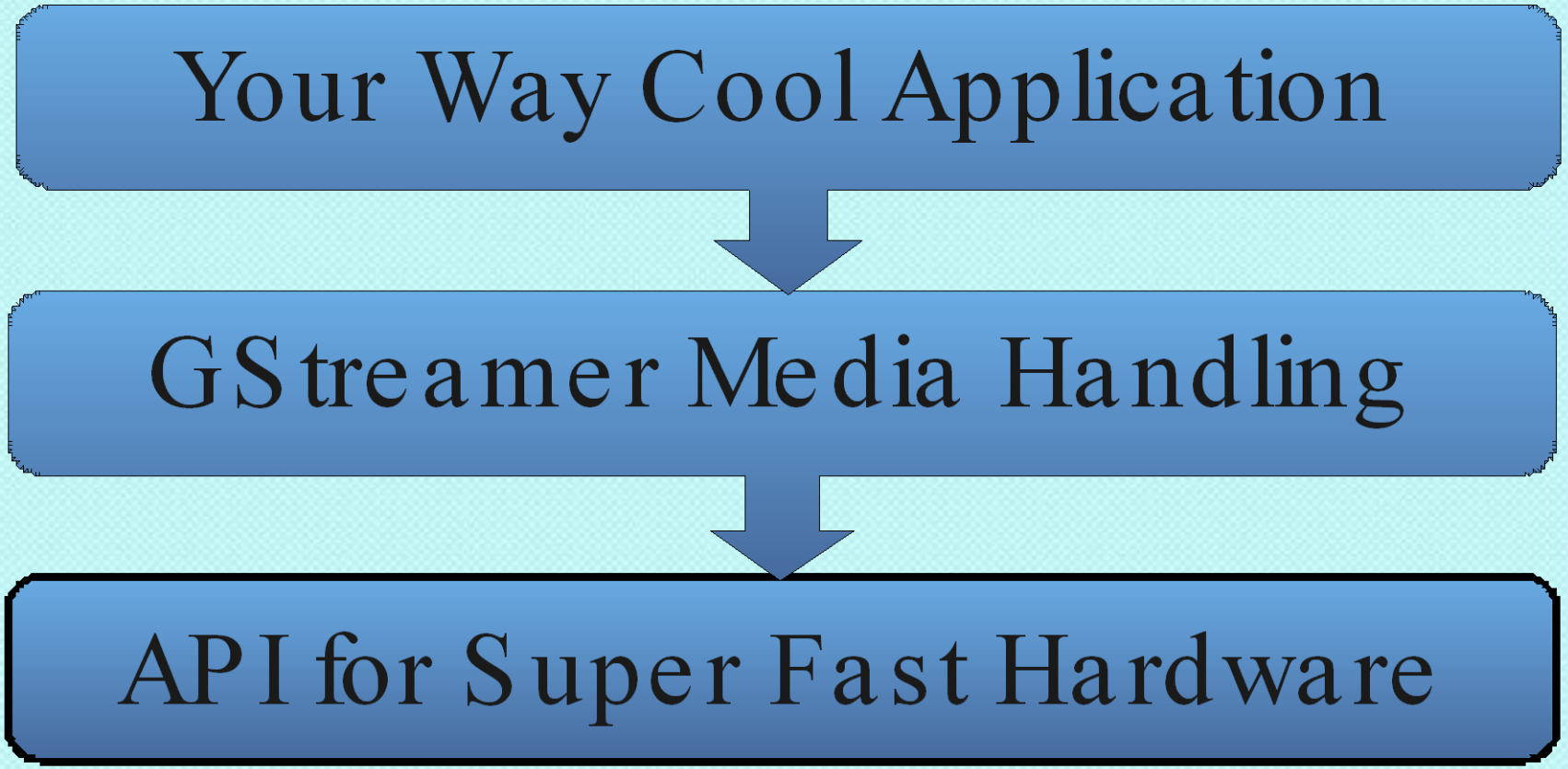
DSPLink



ARM9

C64

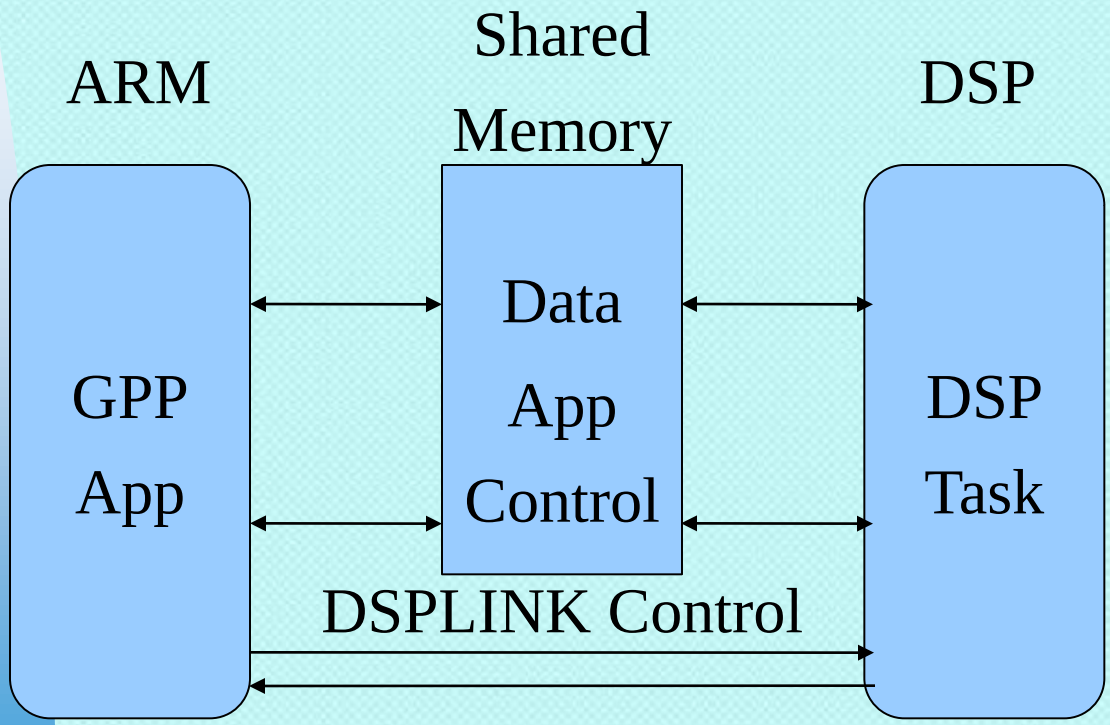
GStreamer in 3 Layers



Backup Slides

- DSPLink presentation

DSPLink
ARM / DSP Communication



See diagrams in DSPLINK Programmers Guide

DSPLink Communication Modules

- Notify
  - Low frequency communication
  - Small messages

MSGQ

- single reader
- multiple writers
- Variable size messages
- Fixed buffer size

MPLIST

- multiple readers
- multiple writers

rder
ssing

DSPLink Communication Modules

- CHNL
  - Single reader
  - Single writer
  - Fixed size buffers
  - Legacy SIO
  - Simplified buffer handling
- RingIO
  - Single reader
  - Single writer
  - Low reader/writer coupling
  - variable data creation/ consumption
  - Independent

DSPLINK Support Modules

- PROC
  - hardware setup
  - DSP code load and boot
  - ARM/DSP communication
  - DSP shutdown

POOL

Manage shared memory

Allocate / free

Address translation

Cache alignment