Porting Tizen-IVI 3.0 to an ARM based SoC Platform

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Current State of Affairs

- **Intel architecture (x86) system**
  - Tizen IVI 2.0alpha, Tizen IVI 3.0
- **ARM architecture based system**
  - Tizen IVI 2.0alpha (ivi-panda)

Test Platform

- **Renesas R-Car Gen2 series platform**
- **R-Car M2**
  - ARM Cortex A15 x2
- **R-Car H2**
  - ARM Cortex A15 x4, + ARM Cortex A7 x4 (option)
- **Graphics System**
  - 3D - Imagination Technologies PowerVR series
  - Display Unit
- **On board IP**
  - H/W video decode/encode
  - image processing

Agenda

- **Objective**
- **Methodology**
- **Porting Tasks**
  - Weston/Wayland Integration
  - WebKit Integration
  - GStreamer Integration

Objective

- **Tizen IVI 3.0 on R-Car M2/H2**

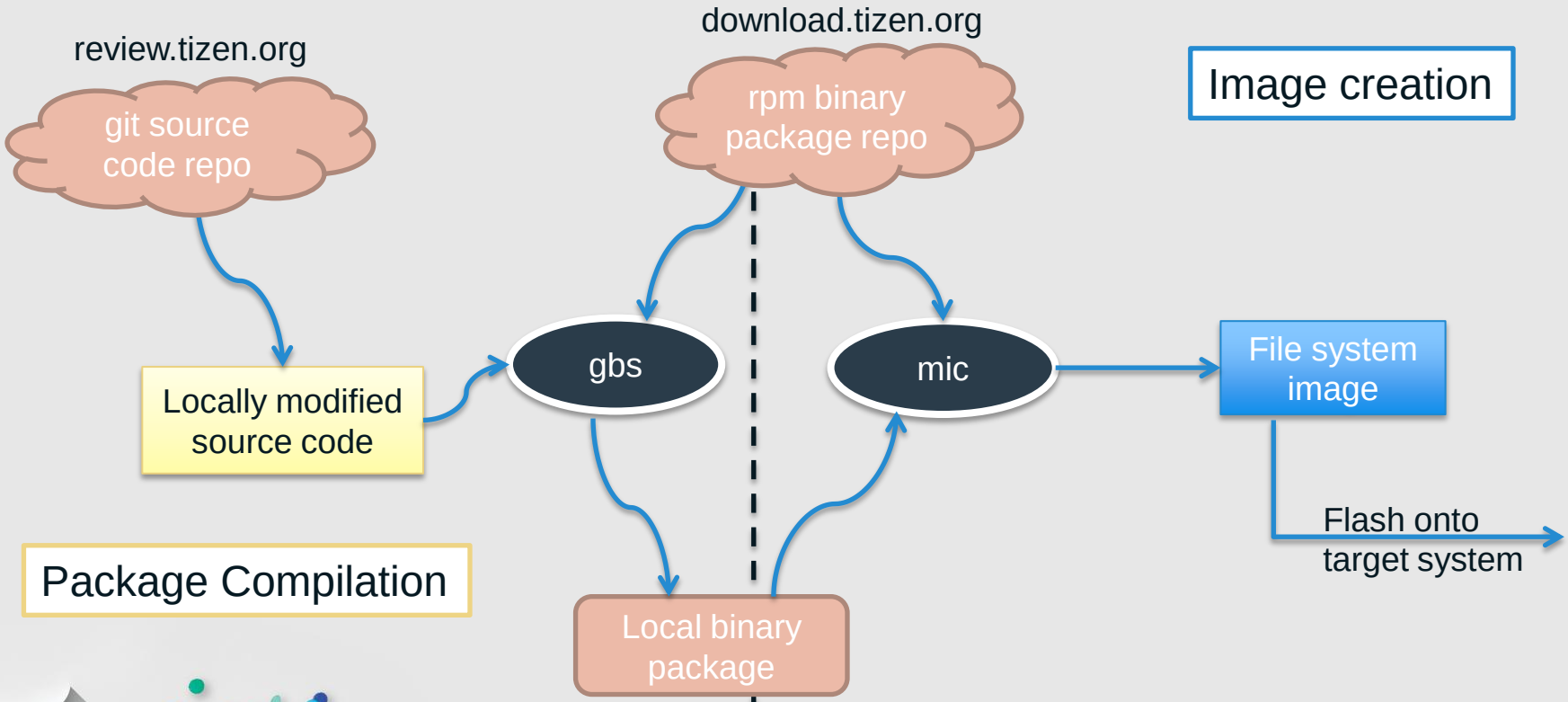
1. **Standard Native Applications**
   - Terminal program
   - Open GL/ES applications
2. **Web**
   - Browser and web applications
3. **Multimedia**
   - Video playback (1080p @ 30fps)

Methodology

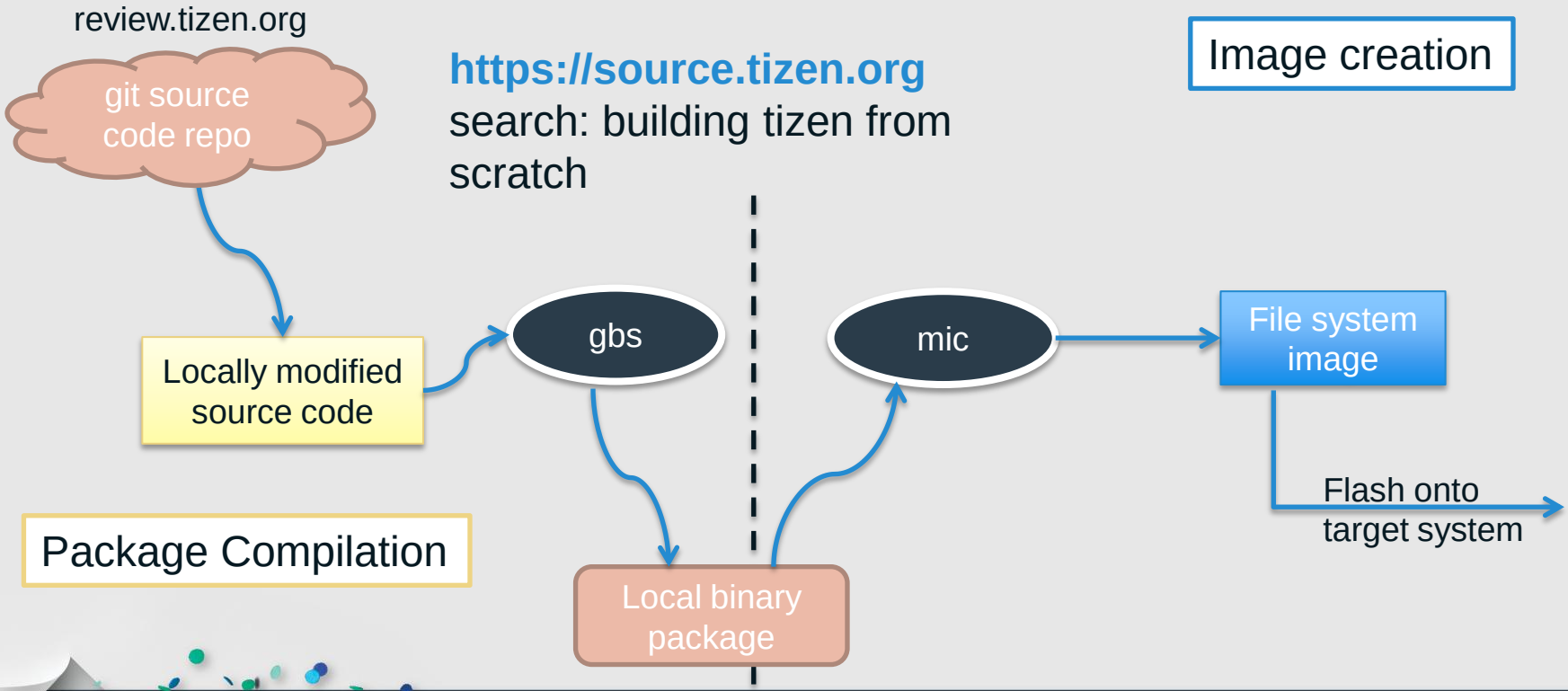
- **Tizen IVI 3.0 milestone releases we used:**
  - M2-Sep (released Oct 11, 2013)
  - M2-EOY (released Jan 15, 2014)
  - M2-March2014 (released April 11, 2014)
- **Non-hardware dependant packages**
  - Rebuild for ARM instruction set
- **Hardware dependant packages**
  - Replace with R-Car M2/H2 versions

Getting Source Code and Workflow

Using Upstream Repos



Full local build



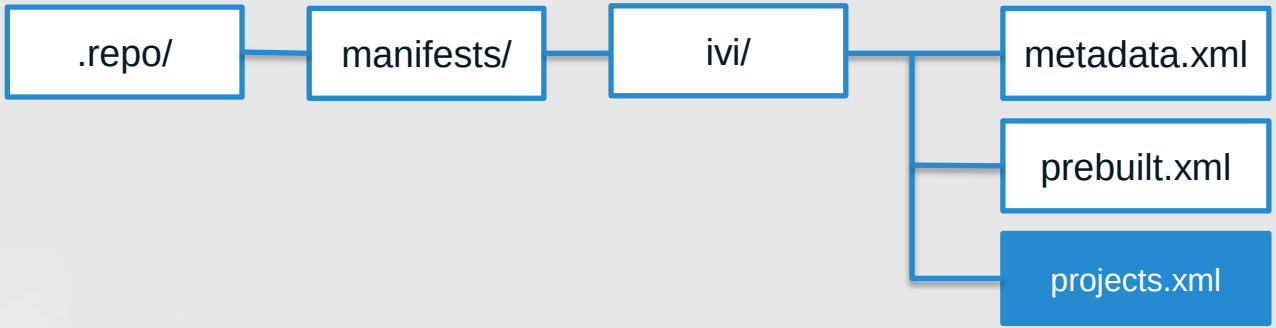
Source Code and Build Preparation

- **Get source code**

```
$ repo init -u review.tizen.org:scm/manifest -b tizen -m ivi.xml
```

- **Overwrite `projects.xml` with milestone manifest file**

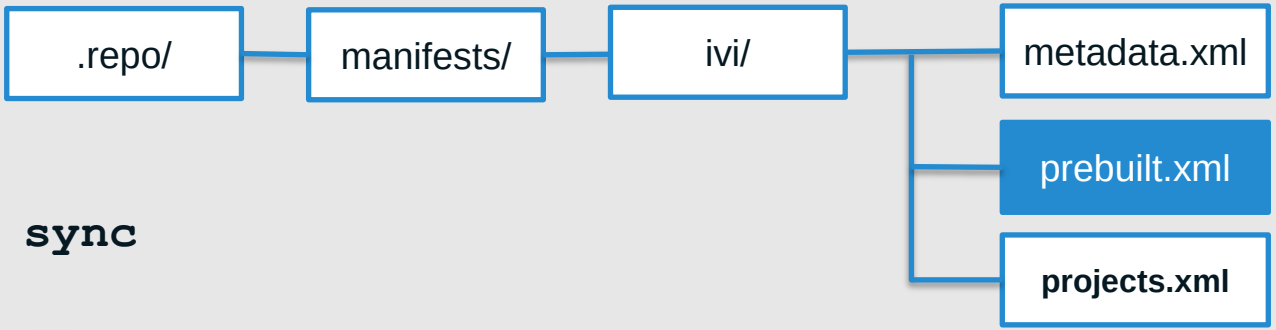
  http://download.tizen.org/${RELEASE_PATH}/builddata/manifest/



Build Preparation (cont.)

- Use prebuilt ARM toolchain from Tizen mobile branch

```
-<project name="pre-built/toolchain-arm" ... revision="tizen-ivi"/>
+<project name="pre-built/toolchian-arm" ... revision="tizen"/>
```




```
$ repo sync
```

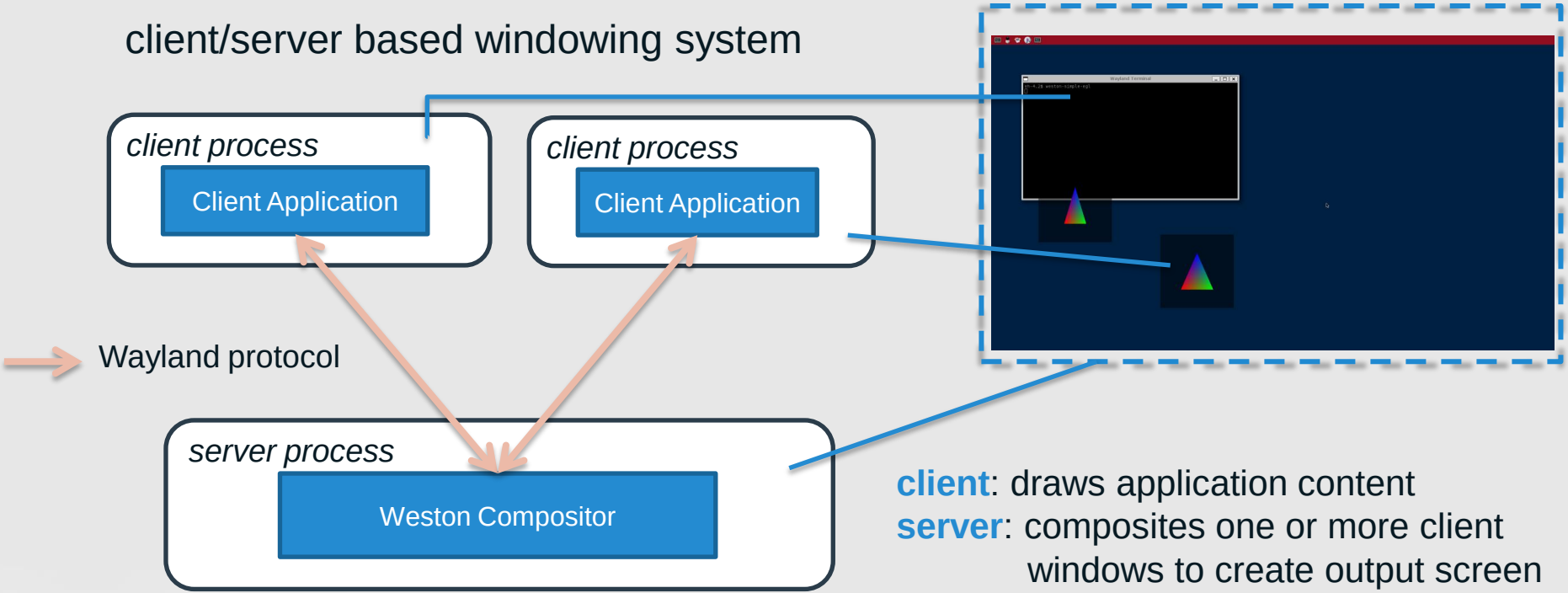
Porting Tasks

- **Recompile packages (roughly 800)**
- **Wayland/Weston (windows system) backend**
  - Use PowerVR driver instead of Mesa
- **Web Applications**
  - Implement WaylandBufferManager
- **Multimedia Acceleration Video Playback**
  - 0 – copy video stream processing

Replacing the Mesa driver for Wayland/Weston

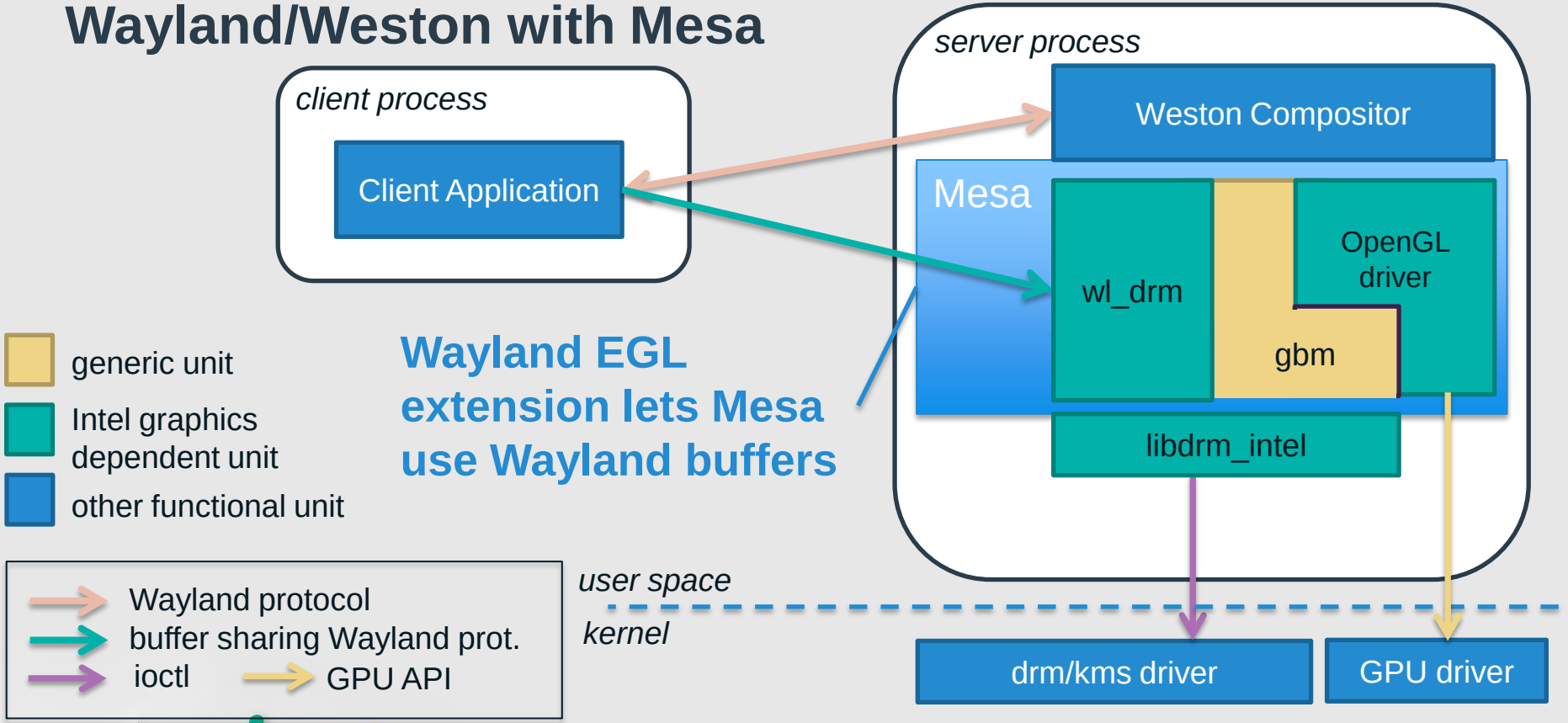
Wayland/Weston Overview

client/server based windowing system

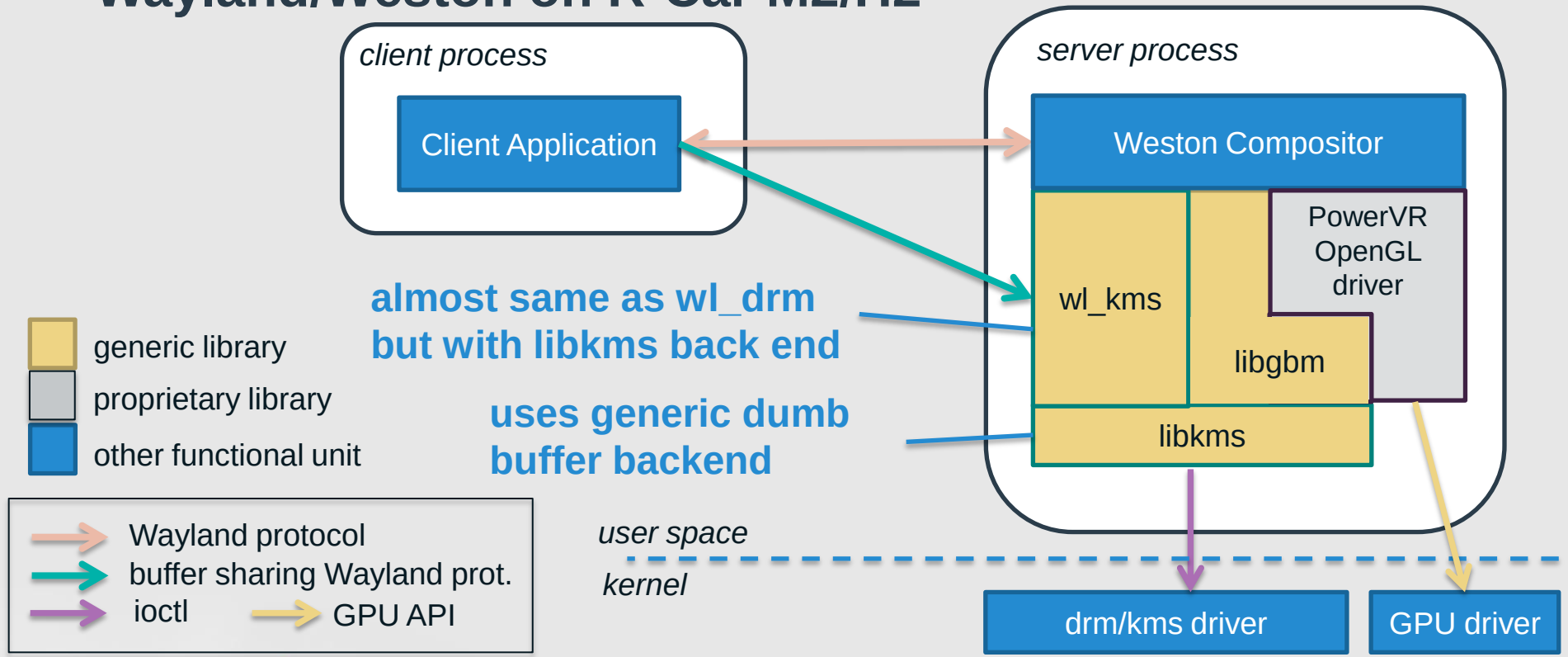


client: draws application content
server: composites one or more client windows to create output screen

Wayland/Weston with Mesa



Wayland/Weston on R-Car M2/H2



Replacing Mesa

Replacement libraries must

- Implement EGL_WL_bind_wayland_display EGL extension

  http://cgit.freedesktop.org/mesa/mesa/tree/docs/specs/WL_bind_wayland_display.spec
- Provide
  - libgbm – Access to dri/drm device
  - libdrm/libkms – for access to memory buffers (we use DUMB buffers)
  - buffer sharing interface – (similar to Mesa wl_drm)
- libgbm backend should match buffer sharing interface

Replacing Mesa on Tizen

1. remove mesa library

```
$ rm -r platform/upstream/mesa
```

2. edit build.conf (build settings file)

```
-%define with_mesa=1
...
+Substitute: pkgconfig(gl)
+Substitute: mesa-devel pkgconfig(gles20)
...
 Macros
-%with_mesa=1
```

3. build the system

```
$ gbs build -A armv7l
```

(for full build command line see http://source.tizen.org "building Tizen from scratch")

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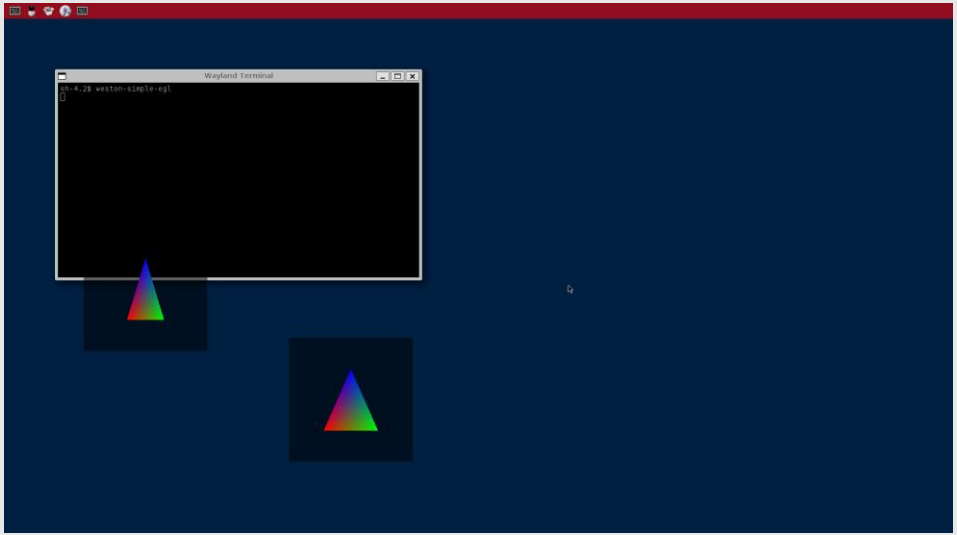
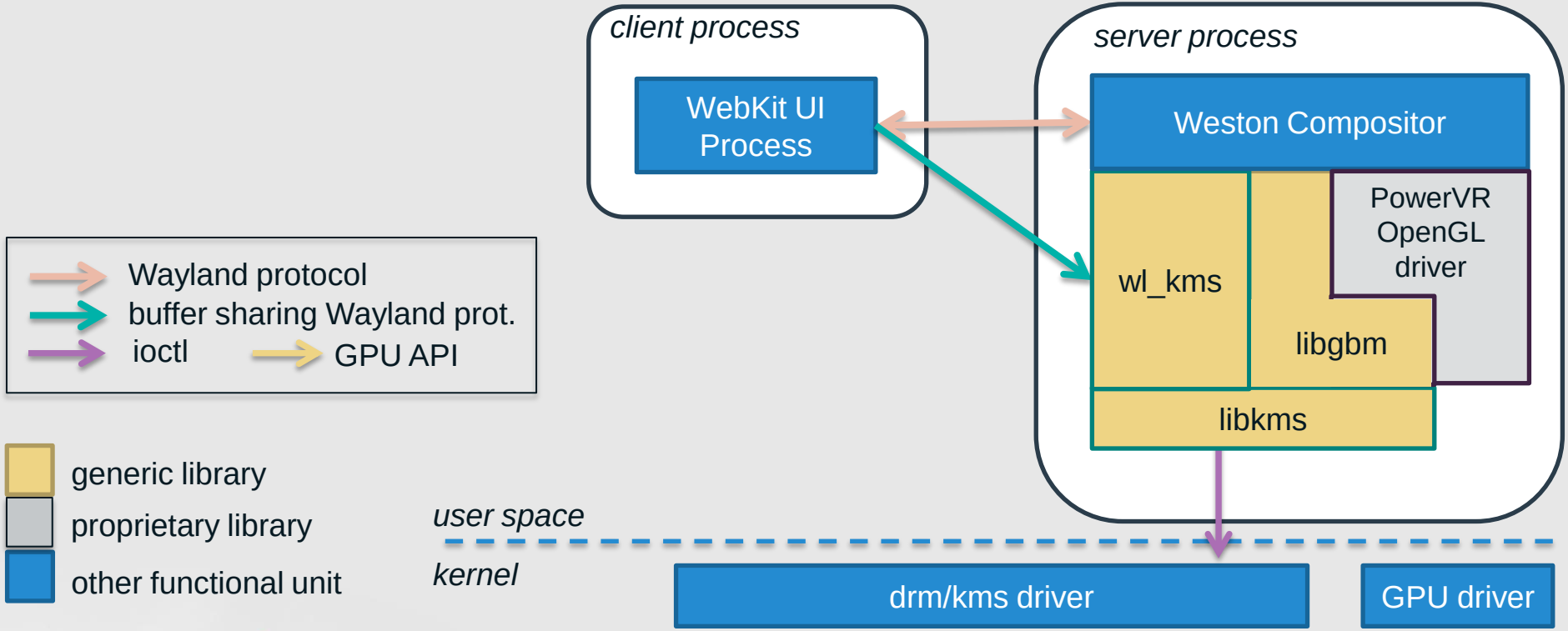
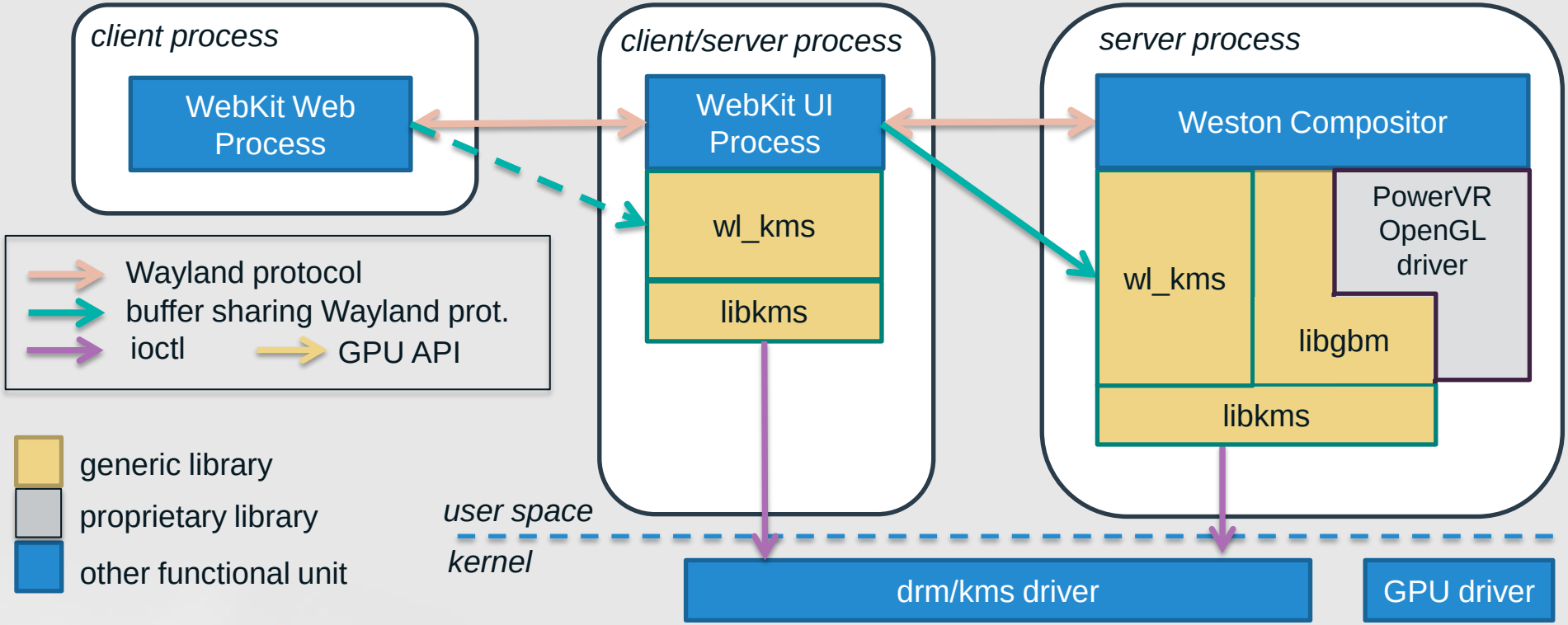


Webkit2 and WaylandBufferManager

Simple client-server configuration



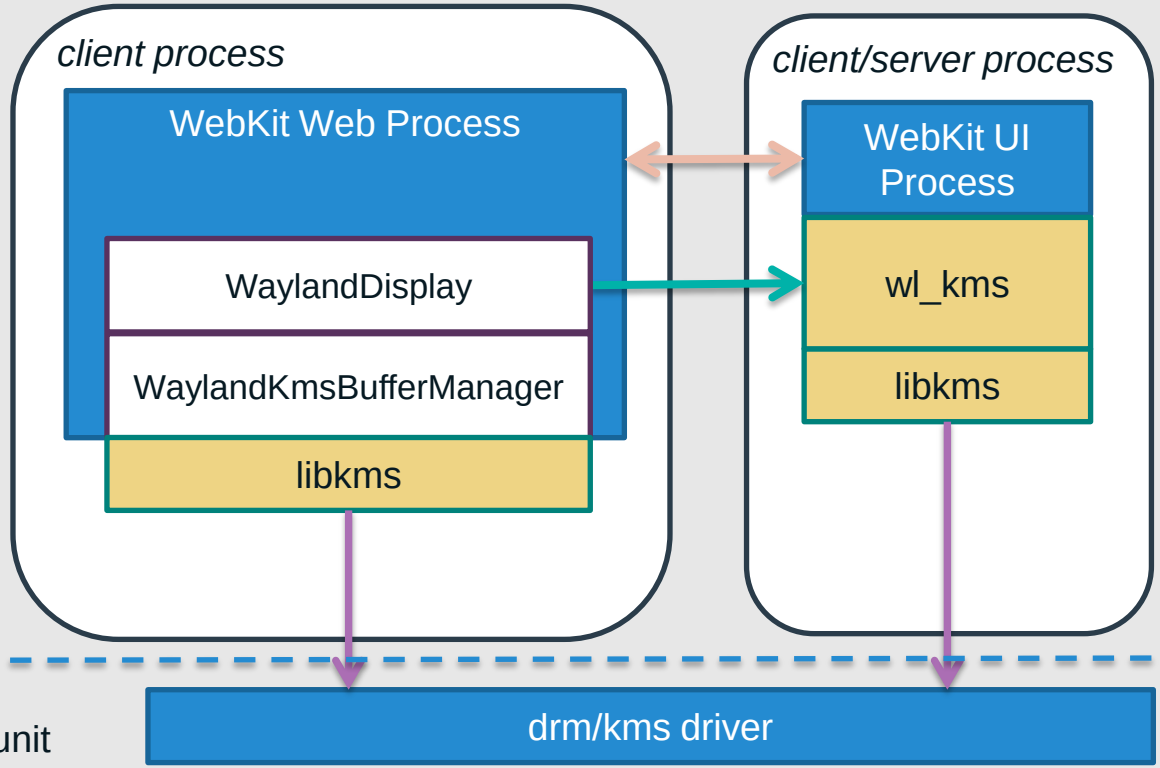
Webkit2 client-client/server-server configuration



Webkit2 Buffer Allocation

WaylandDisplay (class):
Update to use wl_kms instead of wl_drm

WaylandKmsBufferManager (class):
Implementation of WaylandBufferManager interface



Wayland protocol
buffer sharing Wayland prot.
ioctl

generic library
other functional unit

WaylandBufferManager Interface

- **Interface for allocating/locking shareable buffers (e.g.. kms_bo)**
  - allocateBO returns `handleId`.
  - `*handle` is pointer to shareable fd (ie. flinked fd, or DMABuf handle)
  - `query` to get buffer virtual address

```
class WaylandBufferManager {
    allocateBO(w, h, stride, size, align, *handle);
    lockSurface(handleId);
    unlockSurface(handleId);
    freeBO(handleId);
    query(handleId, **addr);
}
```

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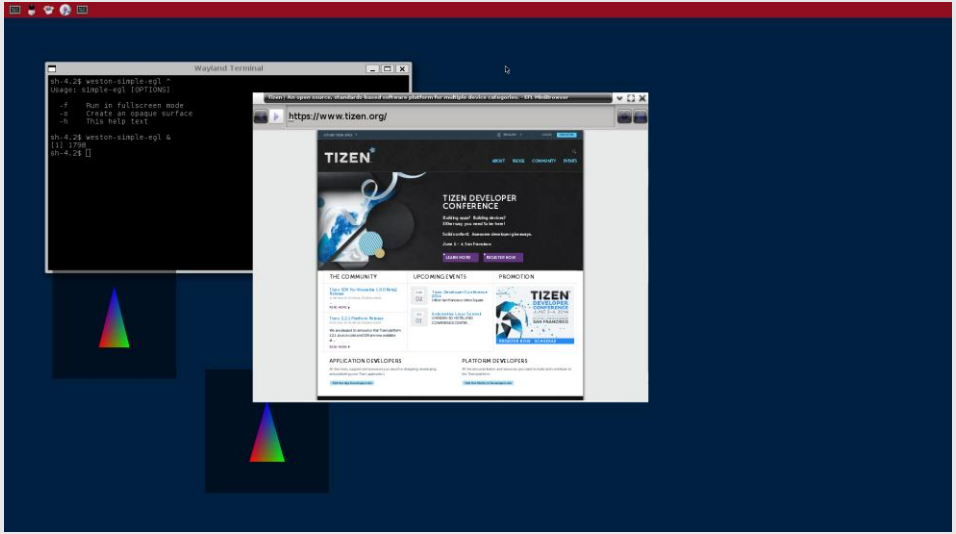
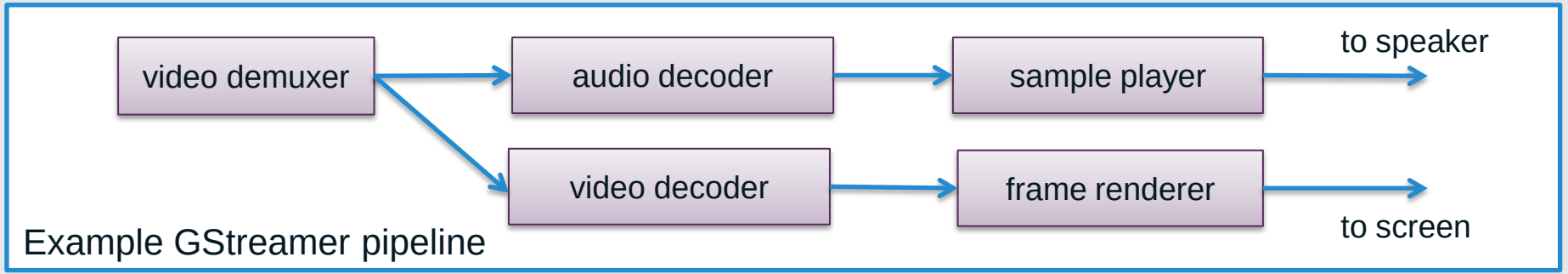


Using GStreamer with Tizen IVI 3.0

GStreamer

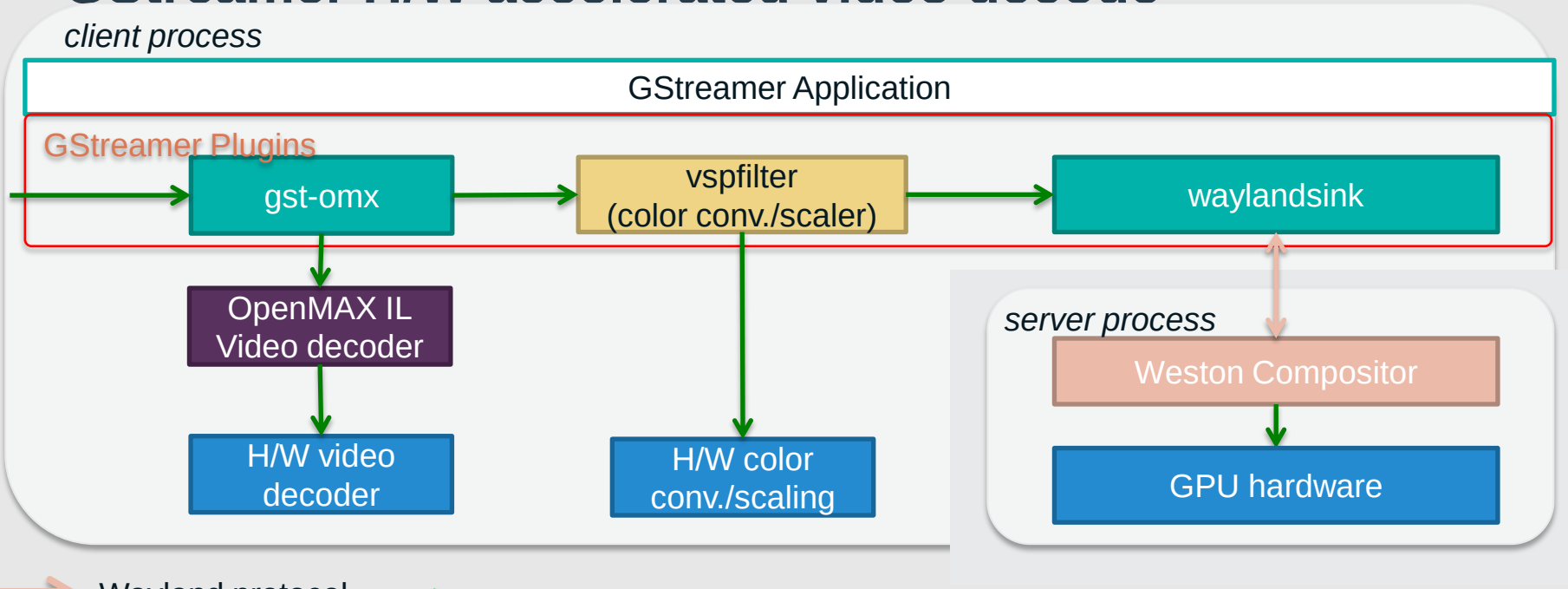
- **Encode, decode, capture and display multimedia data**
- **Make a pipeline of components to do what you want**



Video Decode on R-Car M2/H2 on Tizen IVI 3.0

- **Audio pipeline**
  - Software decode for now
- **Video decode**
  - Use gst-omx to bridge GStreamer to OpenMAX IL component
- **Color conversion/scaling**
  - Use hardware accelerated color conversion/scaling module
- **Display**
  - Use waylandsink to display via Weston compositor

GStreamer H/W accelerated video decode



Wayland protocol

API call

full custom

as-is upstream component

customized component

Reneas proprietary library

Waylandsink customization

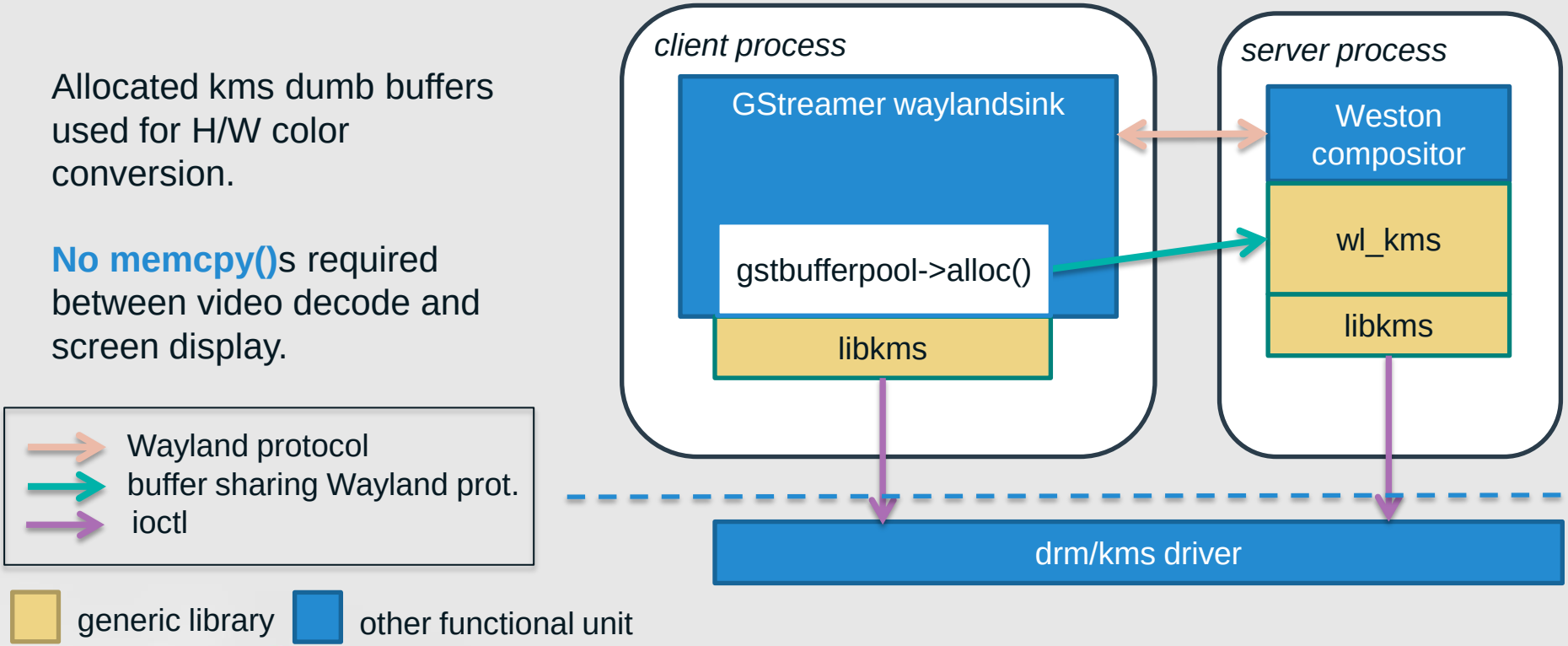
- **H/W color conversion requires physically contiguous buffers**
  - Waylandsink allocates non-contiguous shared memory buffers
  - Need to add extra memcpy()s into pipeline.

- **Buffers allocated from kms bo are physically contiguous (on our system)**
  - Use the same method as with WebKit to allocate and share graphics buffers

Waylandsink customized for libkms usage

Allocated kms dumb buffers used for H/W color conversion.

No memcpy()s required between video decode and screen display.



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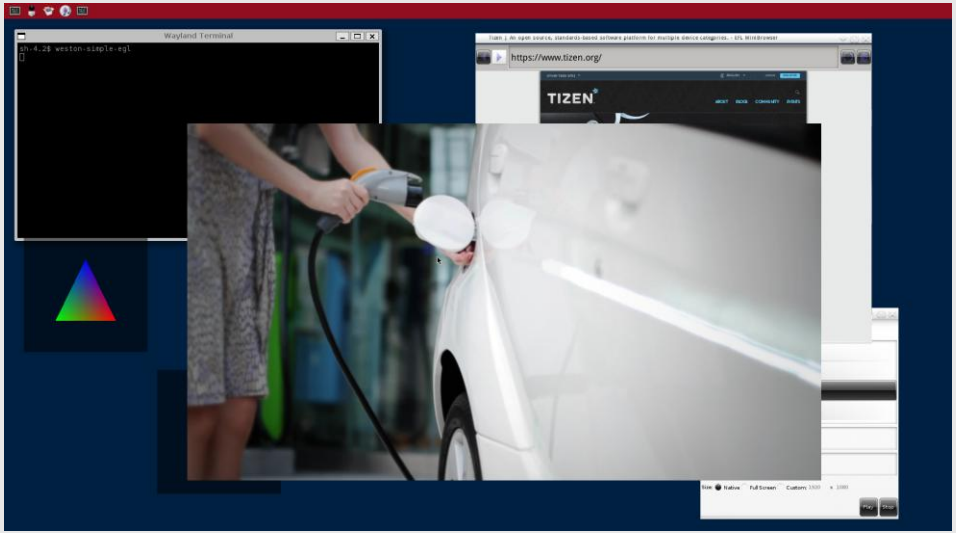

What we learned - review

- **Building**
  - Use mainifest.xml from milestone release on donwload.tizen.org
  - Use mobile toolchain for ARM
- **Weston/Wayland**
  - Need support for EGL_WL_bind_wayland_display in Open GL/ES driver
  - Can use libkms dumb buffers
- **WebKit**
  - Implement WaylandBufferManager; update WaylandDisplay
- **Multimedia playback**
  - Use libkms and Wayland buffer sharing to implement 0-copy processing with physically contiguous memory buffers

Thank you.

Questions?

Links

- **Building Tizen from scratch**
  - https://source.tizen.org/documentation/developer-guide/all-one-instructions/creating-tizen-images-scratch-one-page
- **EGL_WL_bind_wayland_display EGL extension**
  - http://cgit.freedesktop.org/mesa/mesa/tree/docs/specs/WL_bind_wayland_display.spec
- **Renesas R-Car series platforms**
  - http://am.renesas.com/applications/automotive/cis/cis_highend/


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