Towards a universal buffer allocator for Linux

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a.k.a Resurrecting the Unix Device Memory Allocator

https://www.x.org/wiki/Events/XDC2016/Program/Unix_Device_Memory_Allocation.pdf

James Jones, XDC 2016

a.k.a It’s been a mess for 15 years, I wish someone else would fix the problem

- **Buffer allocation**: How does an application allocate image buffers shareable by multiple producers and consumers with optimal performance ?
- **Format negotiation**: How does an application decide on the optimal format (pixel format, modifiers, stride, …) for the images stored on those buffers ?
- **Cache management**: How do we ensure correctness and performance ?

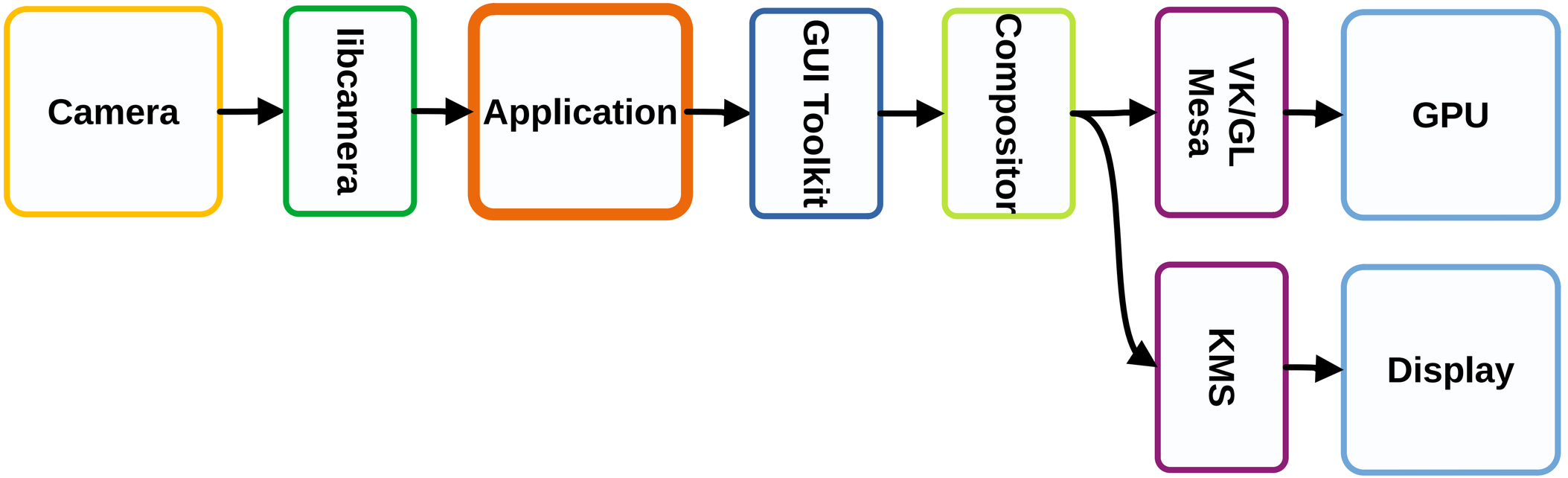
For the purpose of this high-level discussion, the words “Buffers”, “Buffer Objects”, “Frame Buffers” and “Surfaces” are used interchangeably. These concepts are more precisely defined in different kernel areas and userspace frameworks (with different meanings of course).

Problem Statement

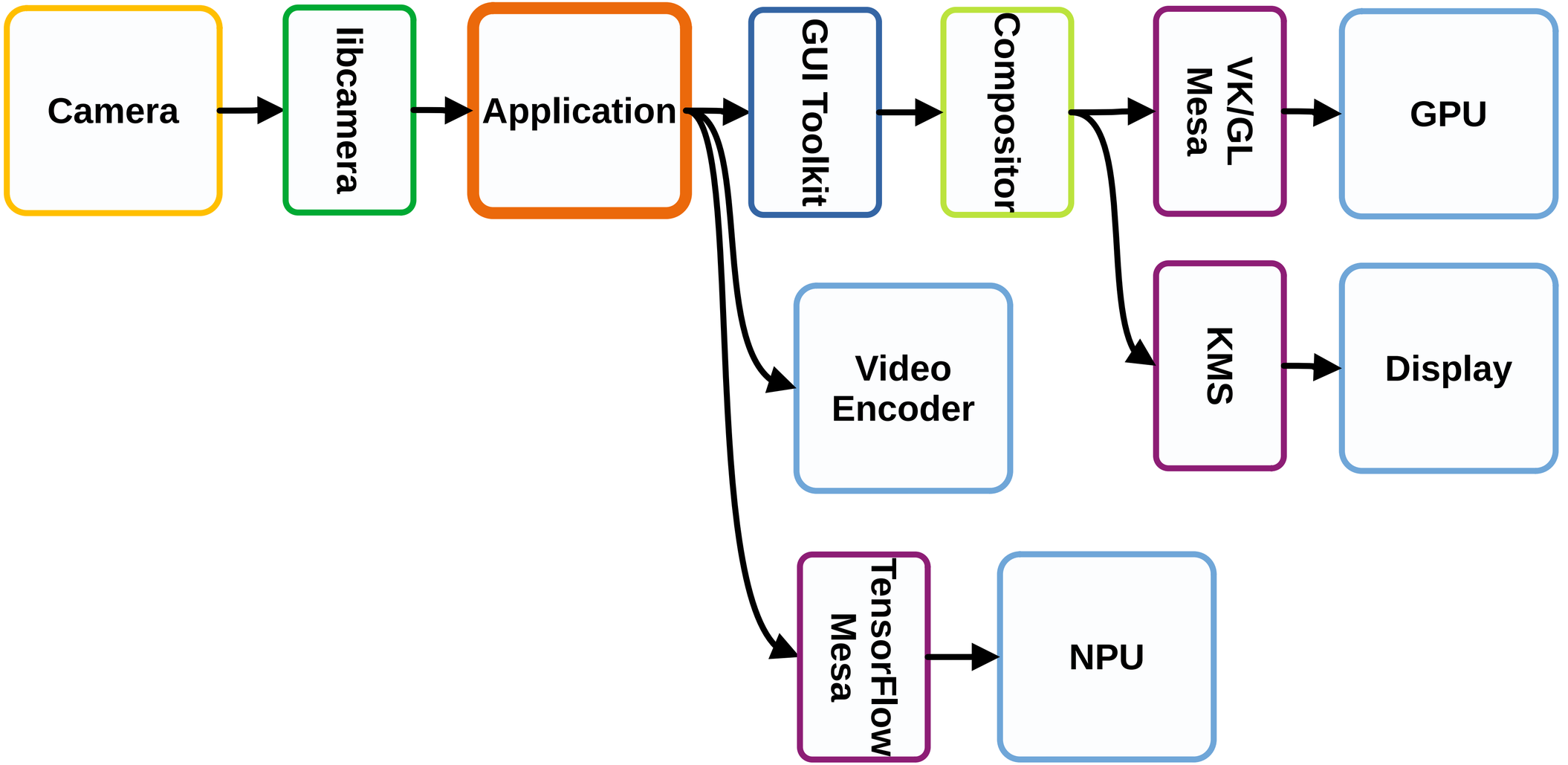
- **Synchronization**: Fence support is there, but not used everywhere (e.g. missing from V4L2).

(Mostly) Solved Problems

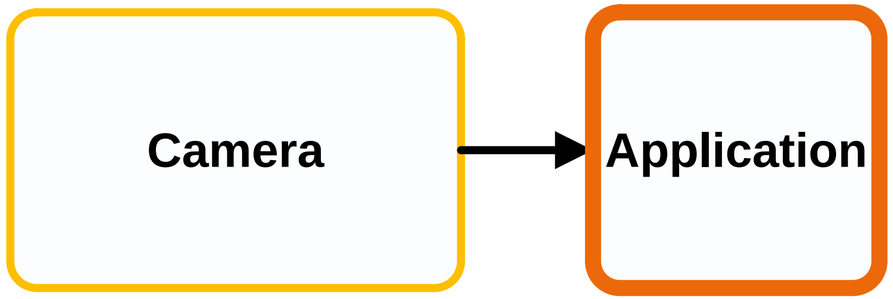
Use Cases


Camera
libcamera
Application
GUI Toolkit
Compositor
VK/GL
Mesa
GPU
KMS
Display

Use Cases


Camera
libcamera
Application
GUI Toolkit
Compositor
VK/GL Mesa
GPU
Video Encoder
KMS
Display
TensorFlow Mesa
NPU

Use Cases



Use Cases

- Multiple allocation APIs offered by the kernel
  - DRM (driver-specific)
  - V4L2 (generic, driver-specific backend)
  - DMA heaps (user-selectable backend)
  - UDMABUF
  - ...
- Based on standard or driver-specific IOCTLs
- APIs focus on the needs of the device they cater for

Kernel Buffer Allocation APIs

- GBM (Mesa) & mini-gbm (Chrome OS)
- Gralloc (Android)
- EGLStream (Khronos)
- Vulkan (Khronos)

Some Relevant Prior Art in Userspace

What’s next ?

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This is the point where someone in the audience volunteers to design and implement a solution...

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… right ?

- Who has an interest in seeing this fixed ?
- What parts of the problem space have the highest priority ?
- Who can contribute ?

There will be a workshop tomorrow at 11:00 on this topic (https://indico.freedesktop.org/event/6/contributions/395/)

What’s Next ?

Merci