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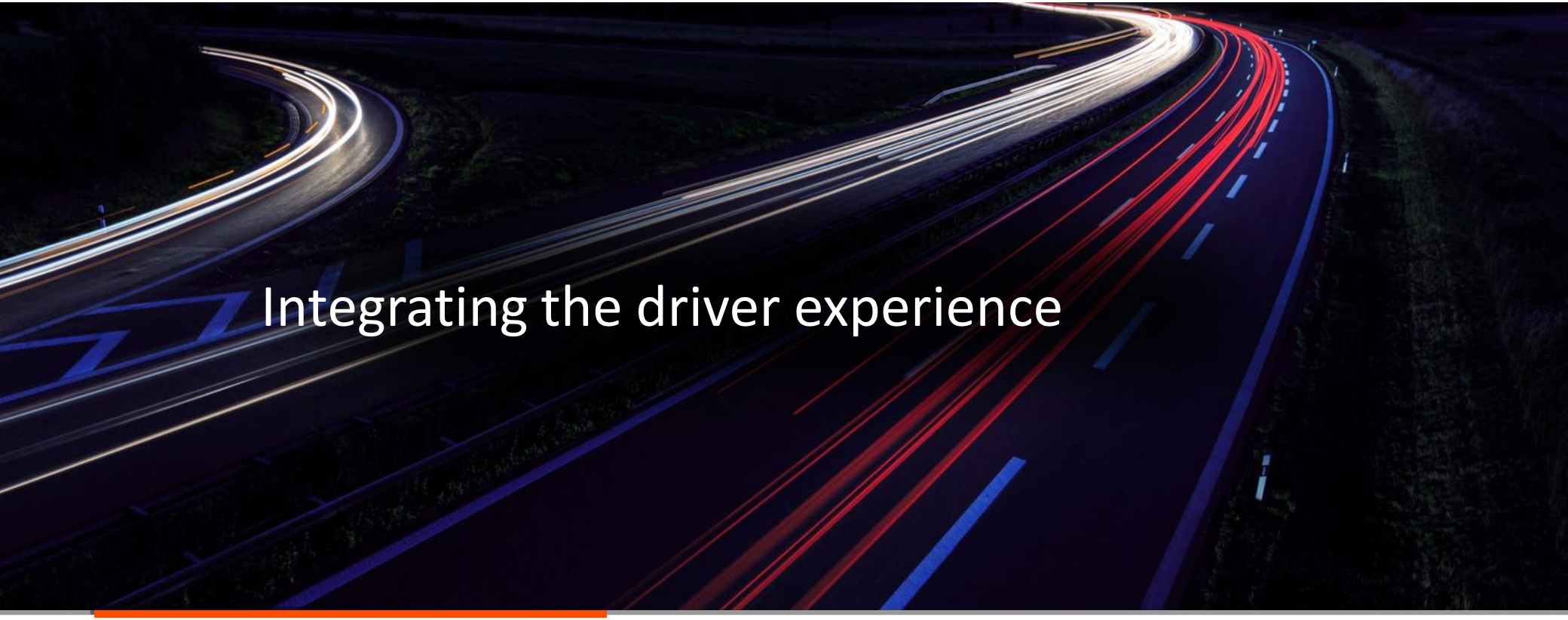

VIRTIO-VIDEO Concept

Genivi AMM Munich 2019

public

Virtual video streaming device concept

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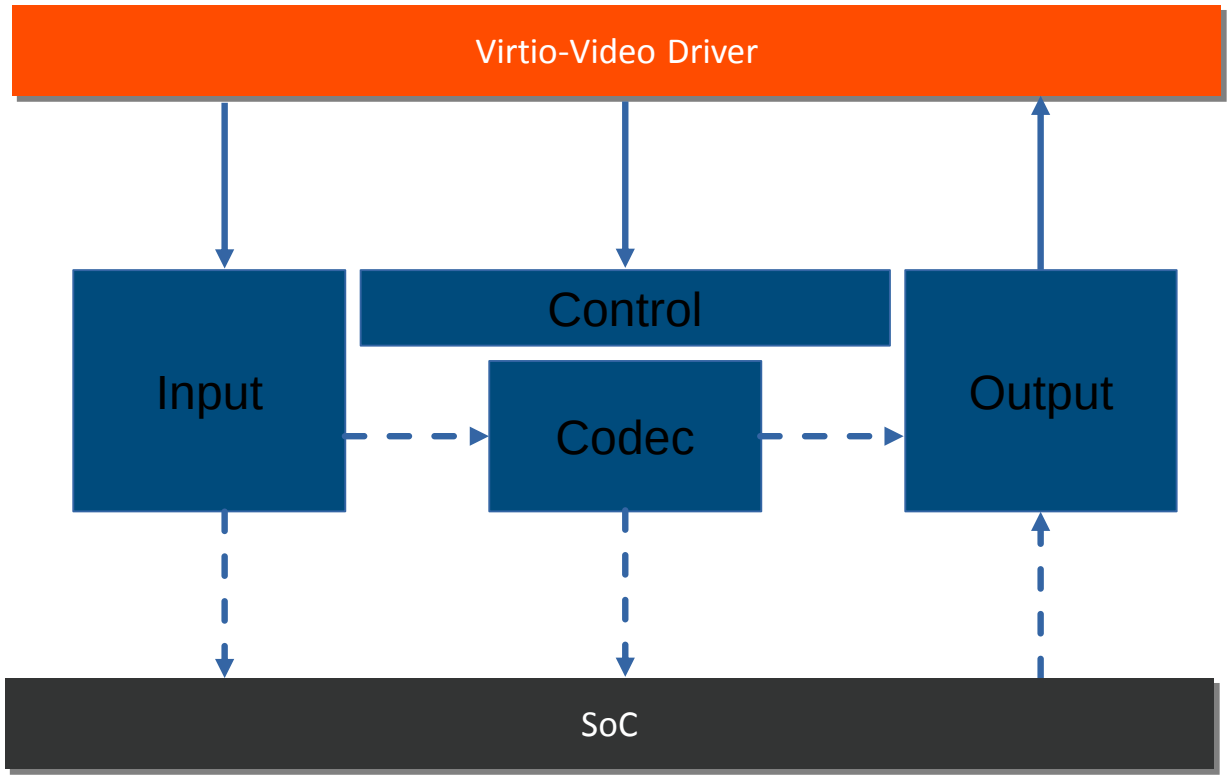
- Paravirtualised guests require video streaming devices, including video cameras, streaming capture and output devices, codec devices.
- Hardware video acceleration offloads the CPU, increases performance, and saves power.
- An abstract video streaming device that operates input and/or output data buffers is used to share video devices with several guests.
- Buffers are essentially scatter-gather lists used for DMA operations (similar to virtio-gpu).
- The buffers are used to organize data streams, e.g. from a camera (output stream) or from a decoder (input stream with decoded data and output stream with decoded frames).

Required functional

The virtio-video device performs operations on **video streams**

- Decoding
- Encoding
- Input/output
- Control



Codec device types

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Two codec device types exist:

- Stateful Video Codec*
  - Takes complete chunks of the bitstream and decodes them into raw video frames in display order. The decoder is expected not to require any additional information from the client to process these buffers.
  - A stateful video encoder takes raw video frames in display order and encodes them into a bitstream. It generates complete chunks of the bitstream, including all metadata, headers, etc. The resulting bitstream does not require any further post-processing by the client.
  - Performing software parsing, processing etc. of the stream in the driver in order to support this interface is strongly discouraged
- Stateless Video Codec*
  - Is a decoder that works without retaining any kind of state between processed frames. This means that each frame is decoded independently of any previous and future frames, and that the client is responsible for maintaining the decoding state and providing it to the decoder with each decoding request. This is in contrast to the stateful video decoder interface, where the hardware and driver maintain the decoding state and all the client has to do is to provide the raw encoded stream and dequeue decoded frames in display order.

* from the LKML: https://lkml.org/lkml/2019/1/24/246

Codec device types

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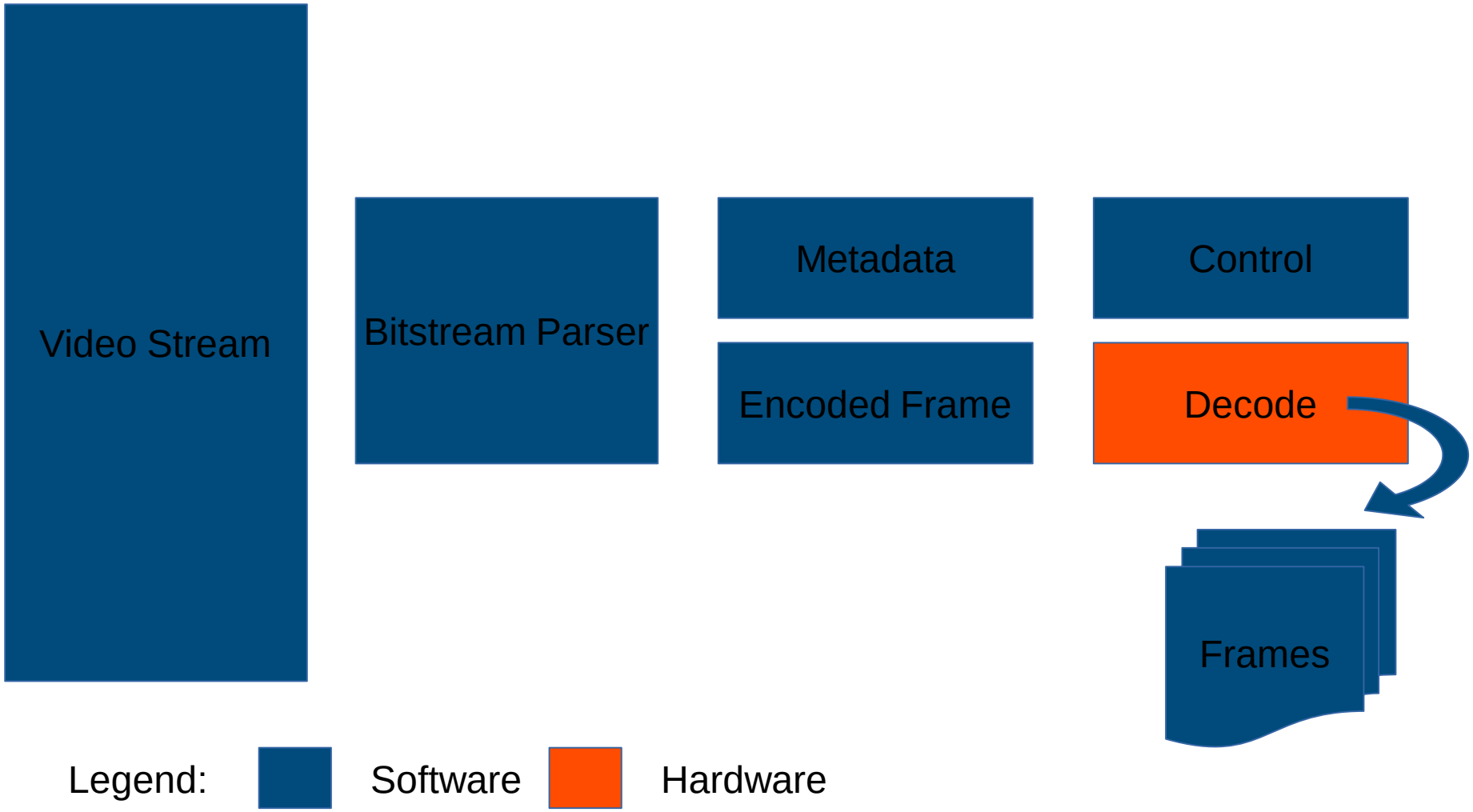
Stateless decoders



Codec device types

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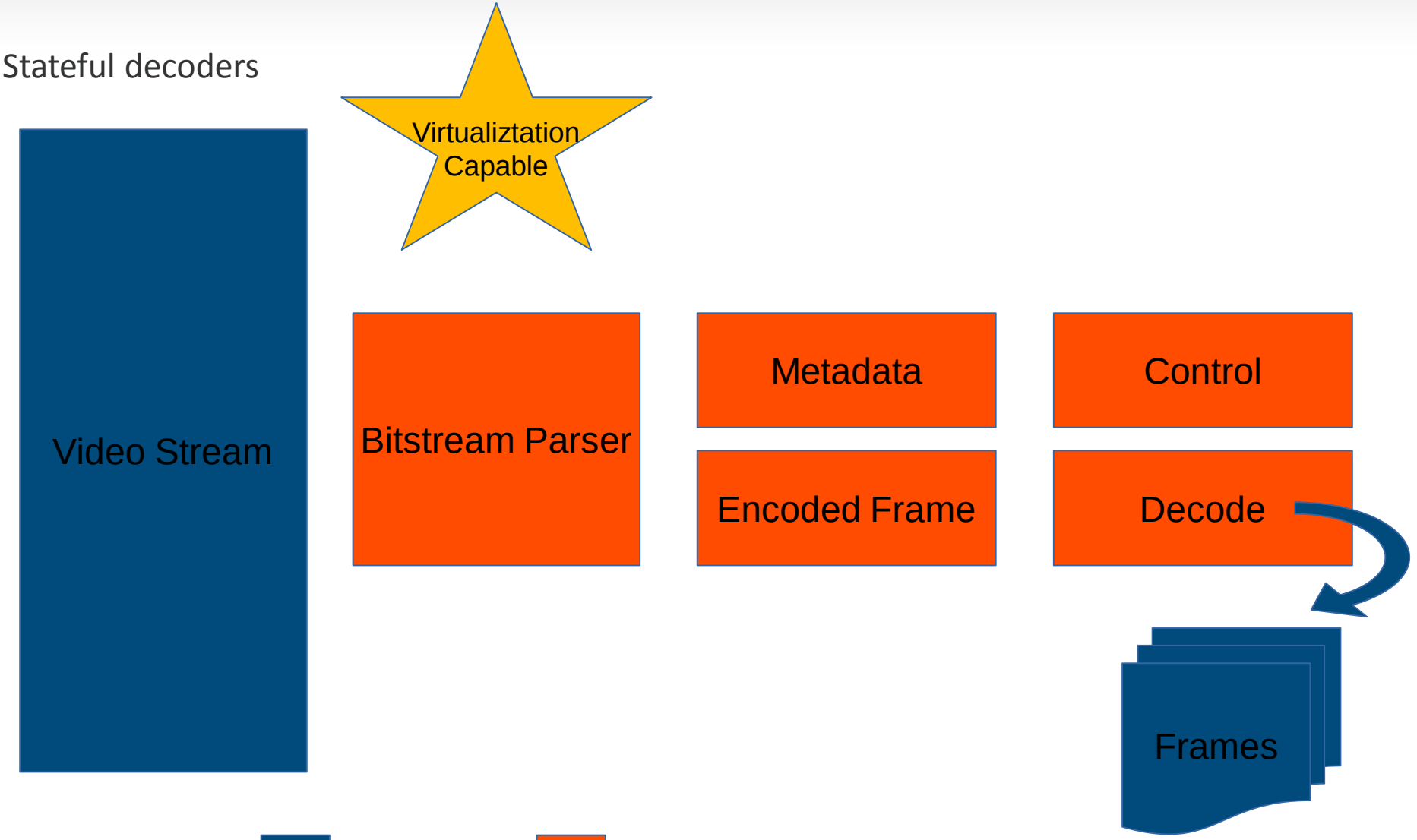
Stateful decoders



APIs to access video devices

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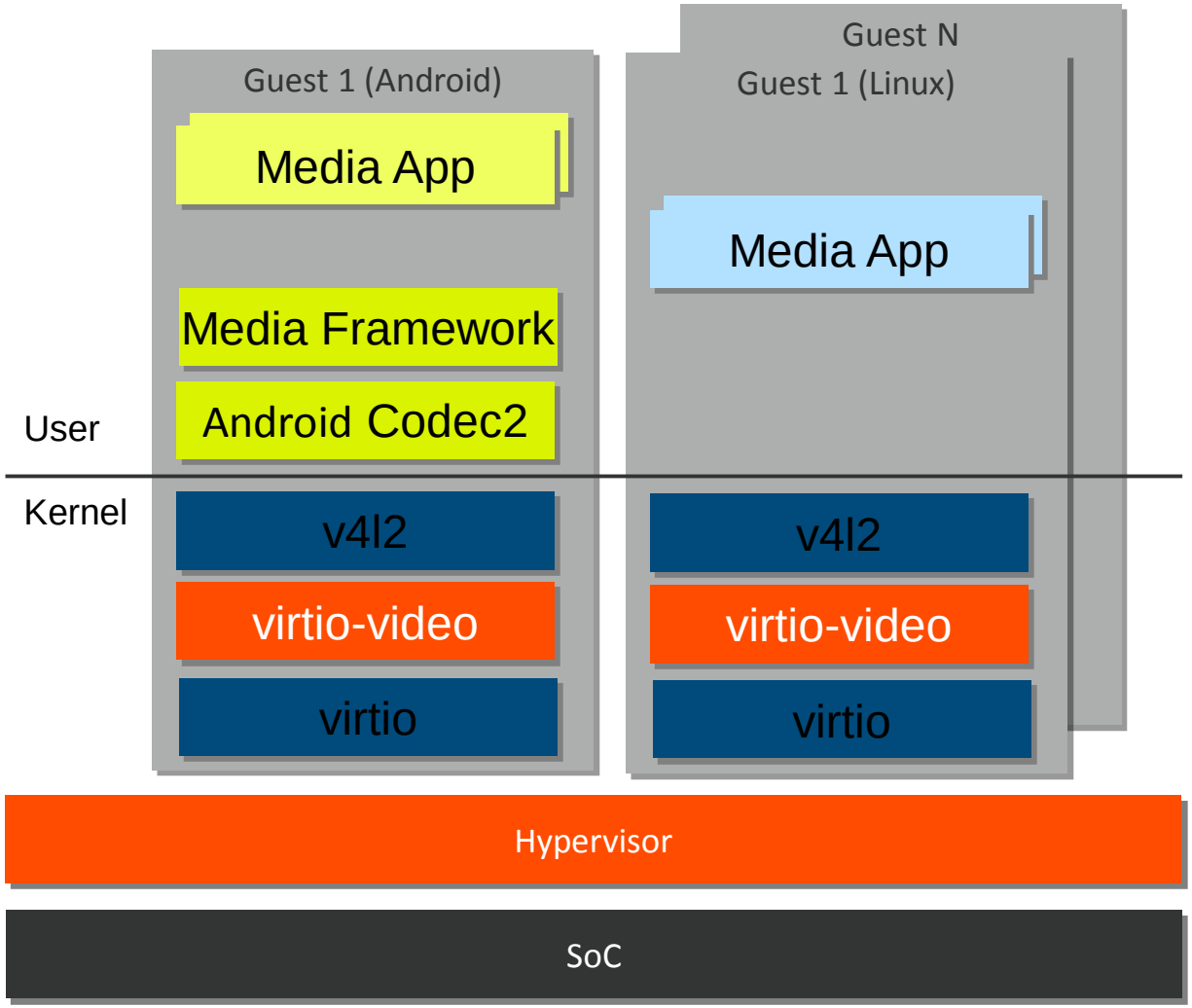
Several major APIs exist at the moment:

- OpenMAX
  - A royalty-free, cross-platform API that provides comprehensive streaming media codec and application portability.
- VA-API
  - Provides access to graphics hardware acceleration capabilities for video processing. It consists of a main library and driver-specific acceleration backends for each supported hardware vendor.
- V4L2
  - API that has been designed to control media devices in Linux. Supports the DMABUF framework, which provides a generic method for sharing buffers between multiple devices.

Implementation on Linux based systems



- V4l2 based driver
- Stateful interface
- Android integration via Codec2 HAL
- Supports:
  - Hardware video codec virtualization
  - Camera input
- Memory to Memory or device to device by use of dma-buffers
- Memory model same as virtio-gpu
- Virtio-gpu and video can share buffers

All of the above is only WIP so far!

Challenges

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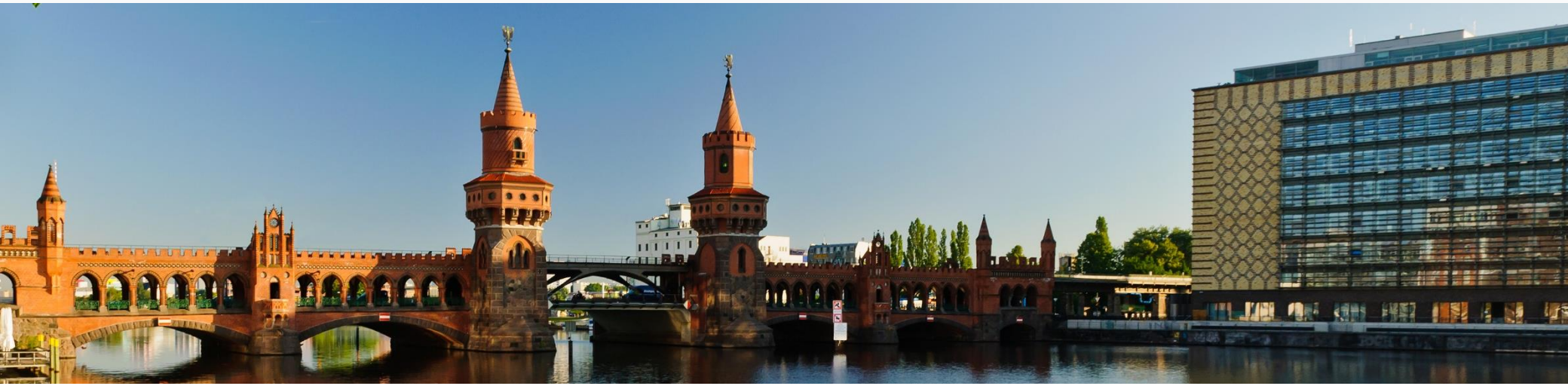
- Configuration
  - No APIs really make it possible to get all supported hardware features. Datasheet is the only source of reliable information.
  - Virtio device configuration layout can be very complex, especially for devices with many customizable controls.
- BSP versions
  - The media subsystem in the upstream kernel is evolving rapidly. E.g. the 4.14 kernel does not contain a definition of the H265/HEVC video format.
- Android integration
  - Currently OMX is ubiquitous. Codec2 is a new HAL.
  - No v4l2 based Codec2 solutions.



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