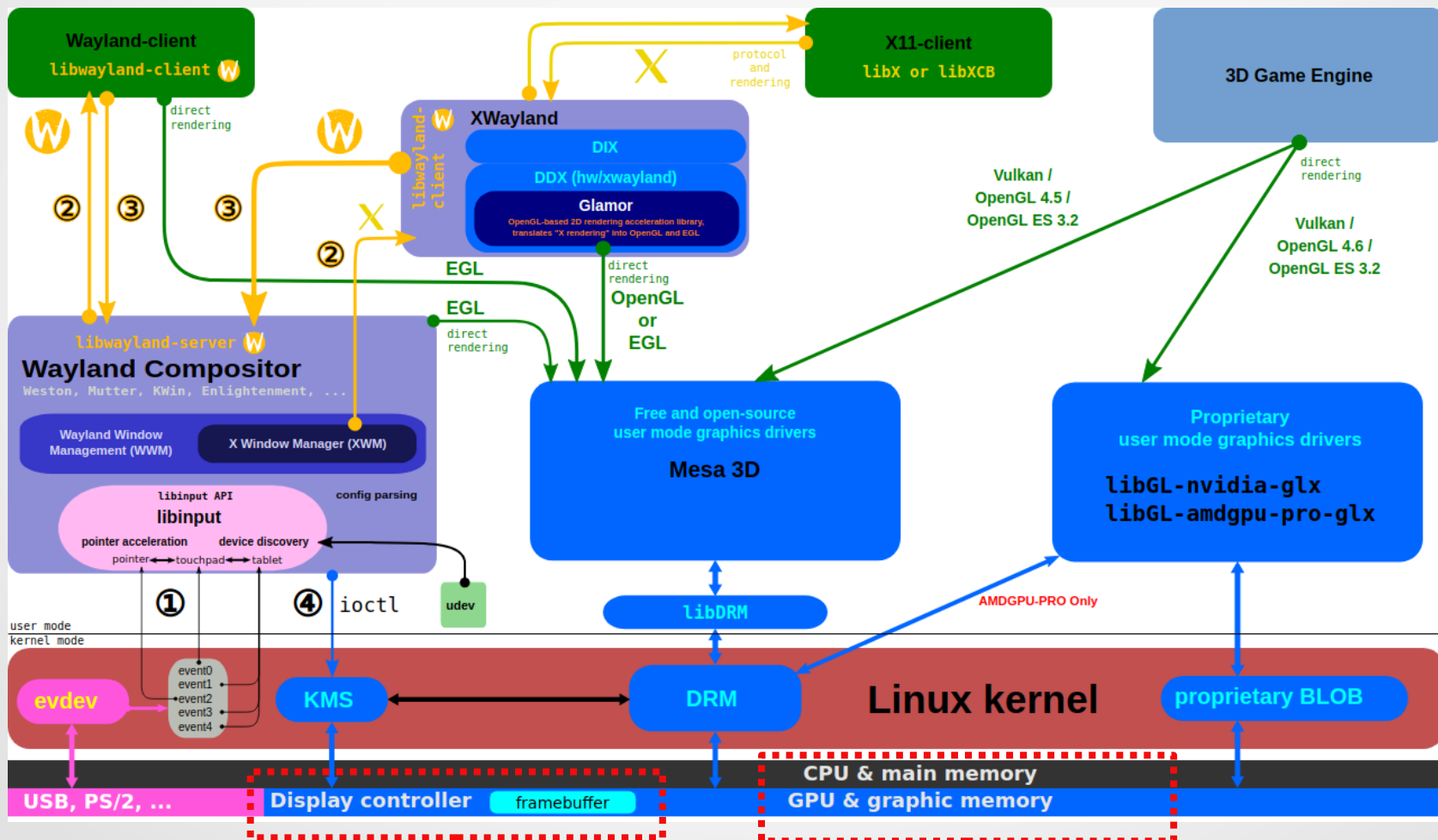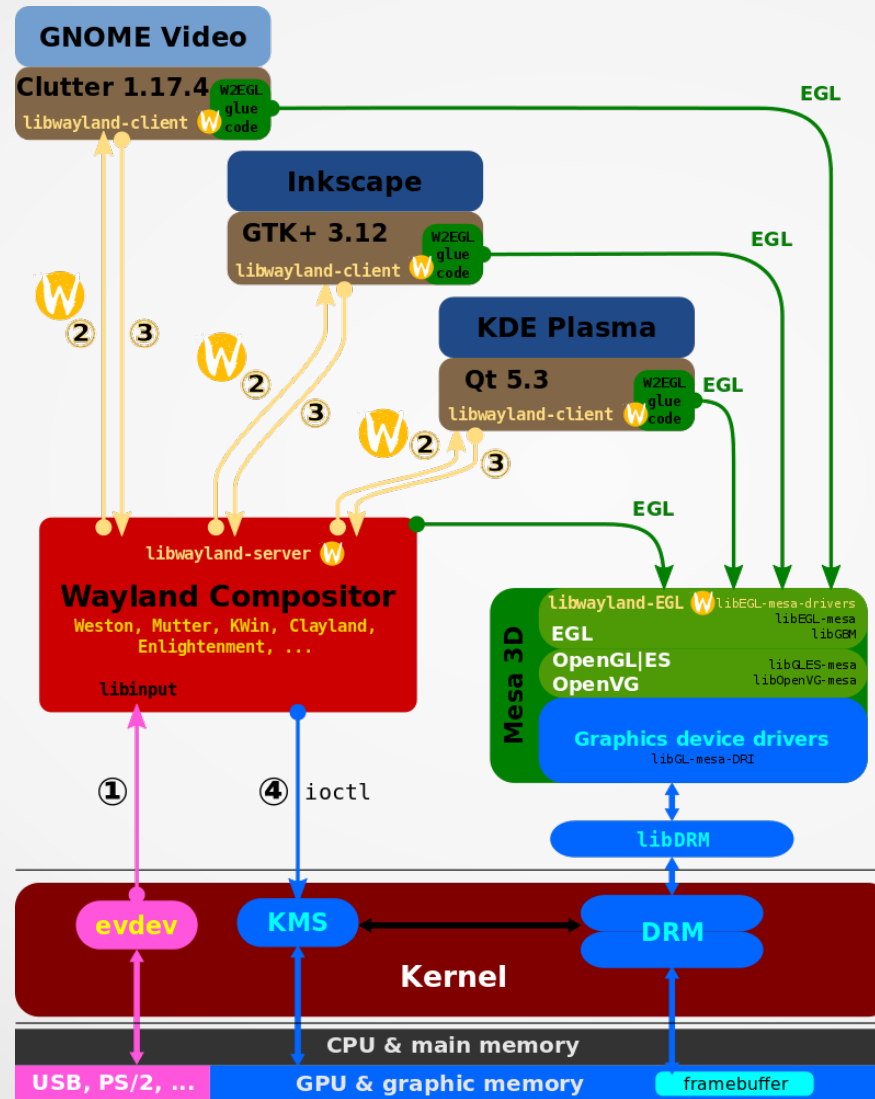# Linux Display Subsystem

X Server and Wayland Compositor

https://upload.wikimedia.org/wikipedia/commons/2/2d/The_Linux_Graphics_Stack_and_glamor.svg

Wayland Display Server and EGL

GTK and Gnome

- ## GTK
  - GTK (formerly GTK+) is a free and open-source cross-platform widget toolkit for creating graphical user interfaces (GUIs).
  -

- ## GNOME
  - GNOME is the default desktop environment of many major Linux distributions

  - originally an acronym for GNU Network Object Model Environment

  - free and open-source desktop environment for Linux and other Unix-like[10] operating systems

https://en.wikipedia.org/wiki/GNOME

https://en.wikipedia.org/wiki/GTK

OpenGL and EGL

- EGL
  - EGL Native Platform Graphics Interface is an interface portable layer for graphics resource management.

  - works between rendering APIs such as OpenGL ES or OpenVG and the underlying native platform window system

- OpenGL
  - OpenGL (Open Graphics Library) is a cross-language, cross-platform application programming interface (API) for rendering 2D and 3D vector graphics

- Mesa
  - Mesa, also called Mesa3D and The Mesa 3D Graphics Library
  - it is an open source implementation of OpenGL, Vulkan, and other graphics API specifications
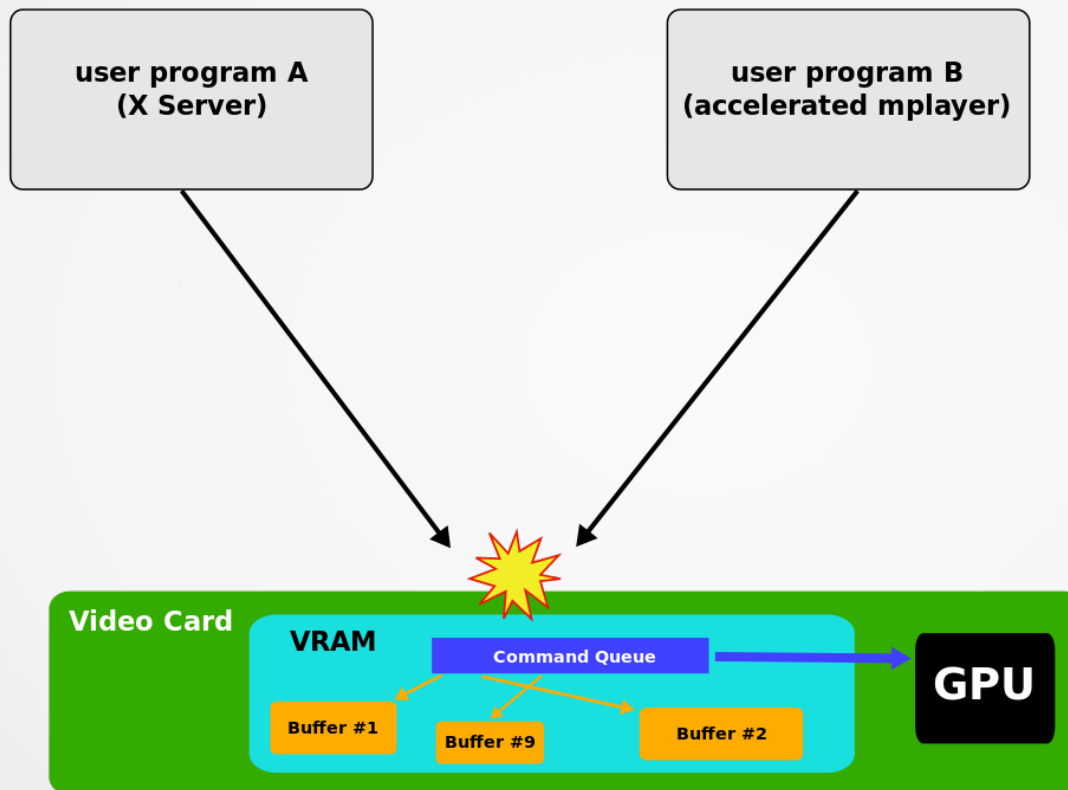
Direct Rendering Manager (DRM)

- Direct Rendering Manager
    - Management of buffers and free space within that memory.
    - Solve Frame buffer driver cannot be used GPU and multi-user process.

- DRM consists of
    - libdrm
        - libdrm provides a user space library for accessing the DRM

    - KMS : Kernel Mode Setting
        - Change resolution and depth

    - DRI : Direct Rendering Infrastructure
        - Interfaces to access hardware directly

    - GEM : Graphics Execution Manager
        - Buffer management
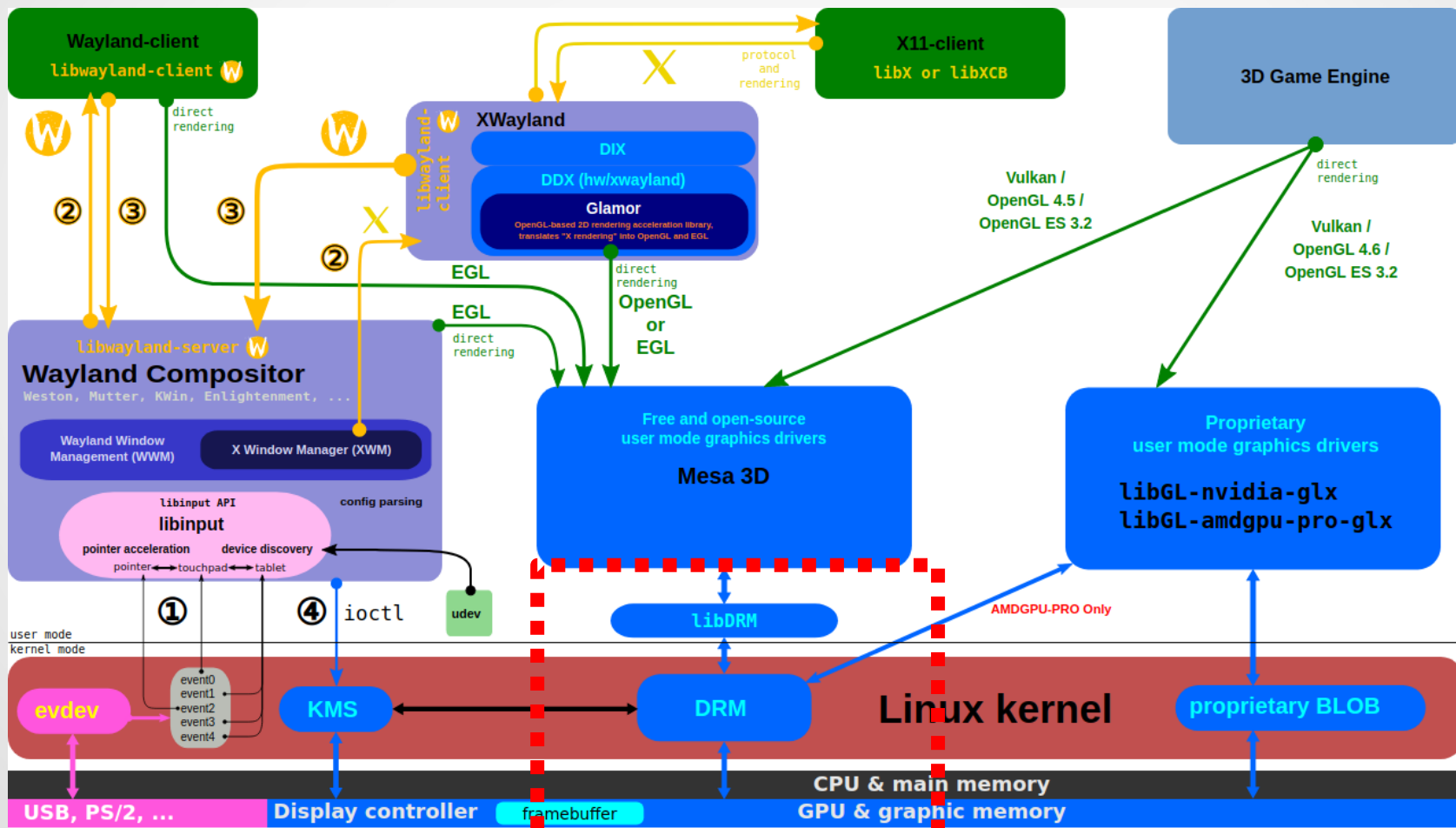
    - DRM Driver in kernel side
        - Access hardware

Direct Rendering Manager (DRM)

If no use DRM

user program A
(X Server)

user program B
(accelerated mplayer)

Video Card

VRAM

Command Queue

GPU

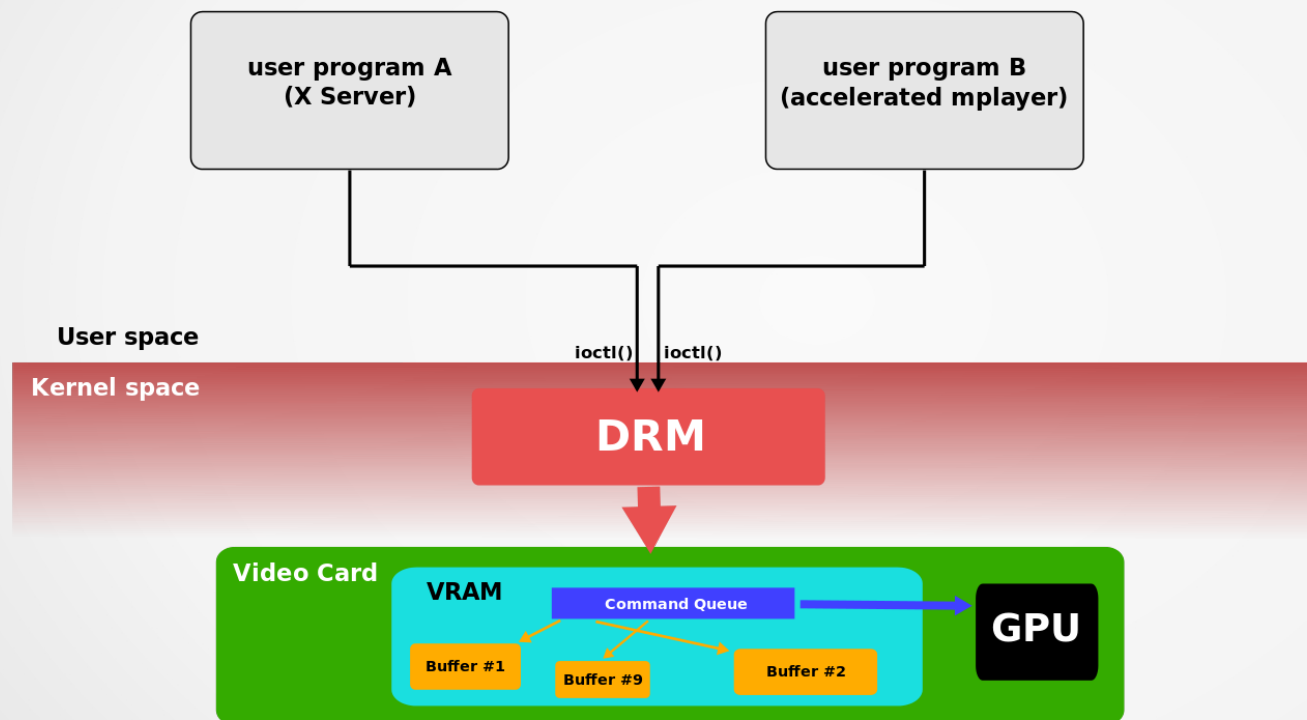Buffer #1

Buffer #9

Buffer #2

Direct Rendering Manager (DRM)

https://upload.wikimedia.org/wikipedia/commons/2/2d/The_Linux_Graphics_Stack_and_glamor.svg
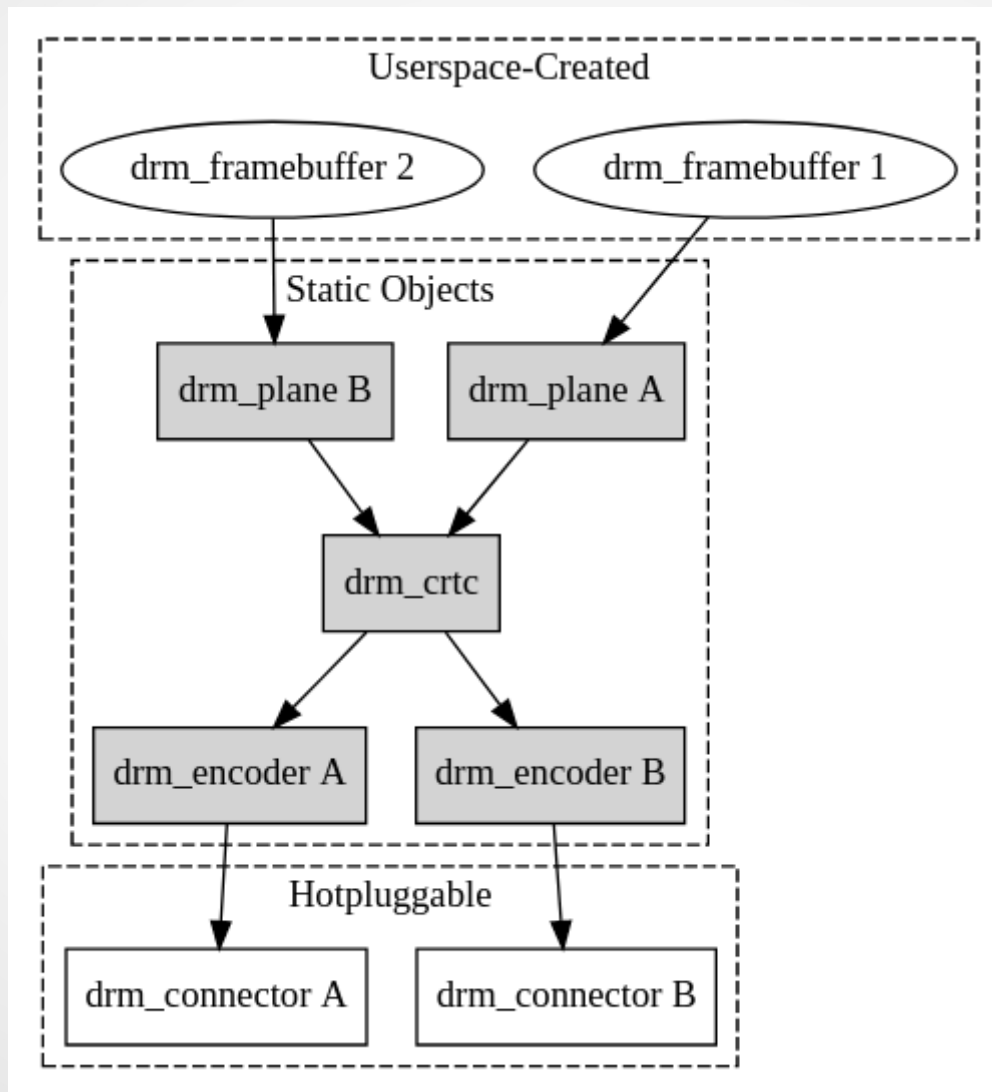
Direct Rendering Manager (DRM)

Use DRM

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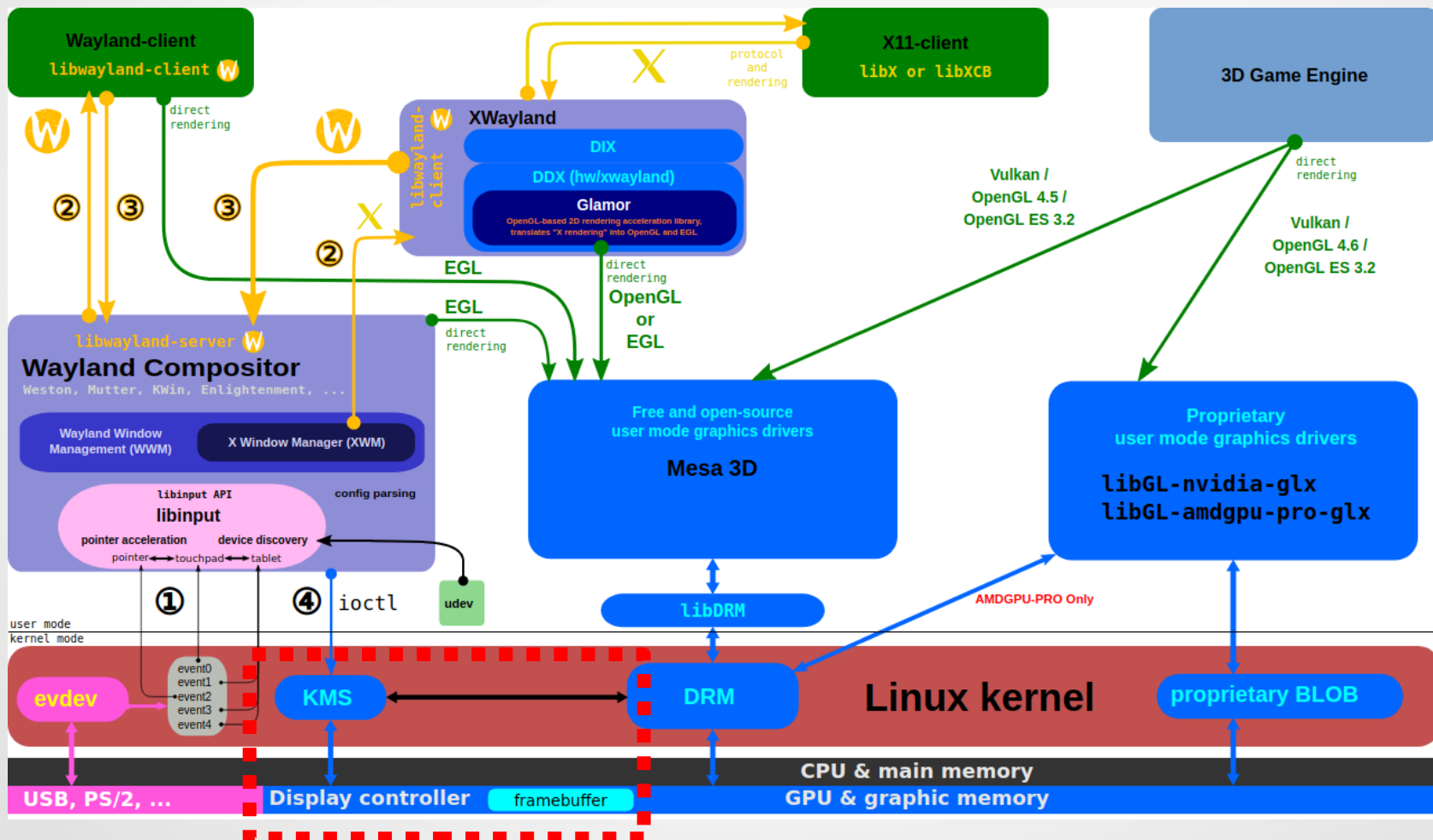
9

Kernel Mode Setting (KMS)

- KMS device model
  - CRTCs
  - Connectors
  - Encoders
  - Planes

- Kernel Mode Setting
  - screen resolution
  - color depth and
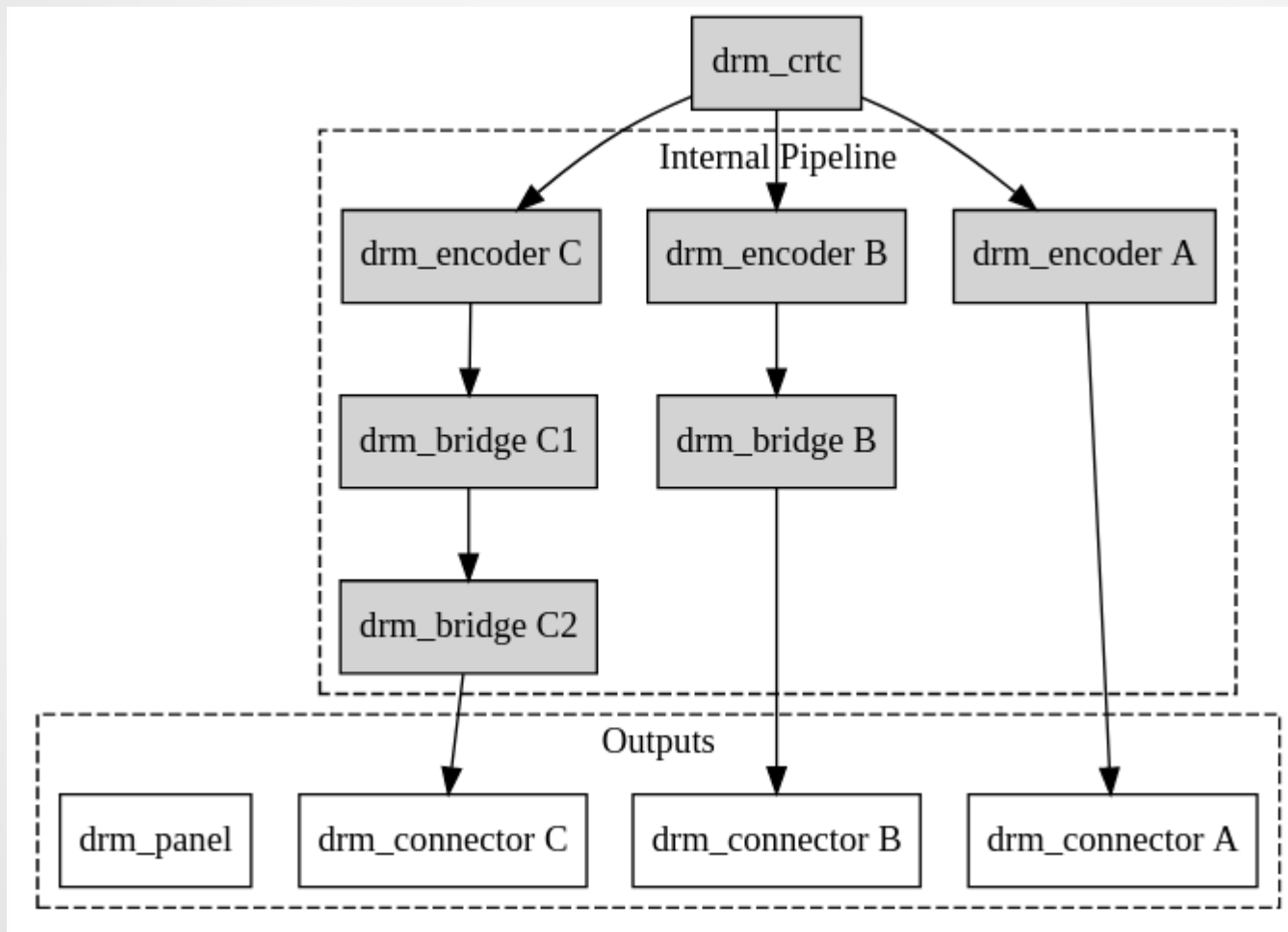 - refresh rate

Kernel Mode Setting (KMS)

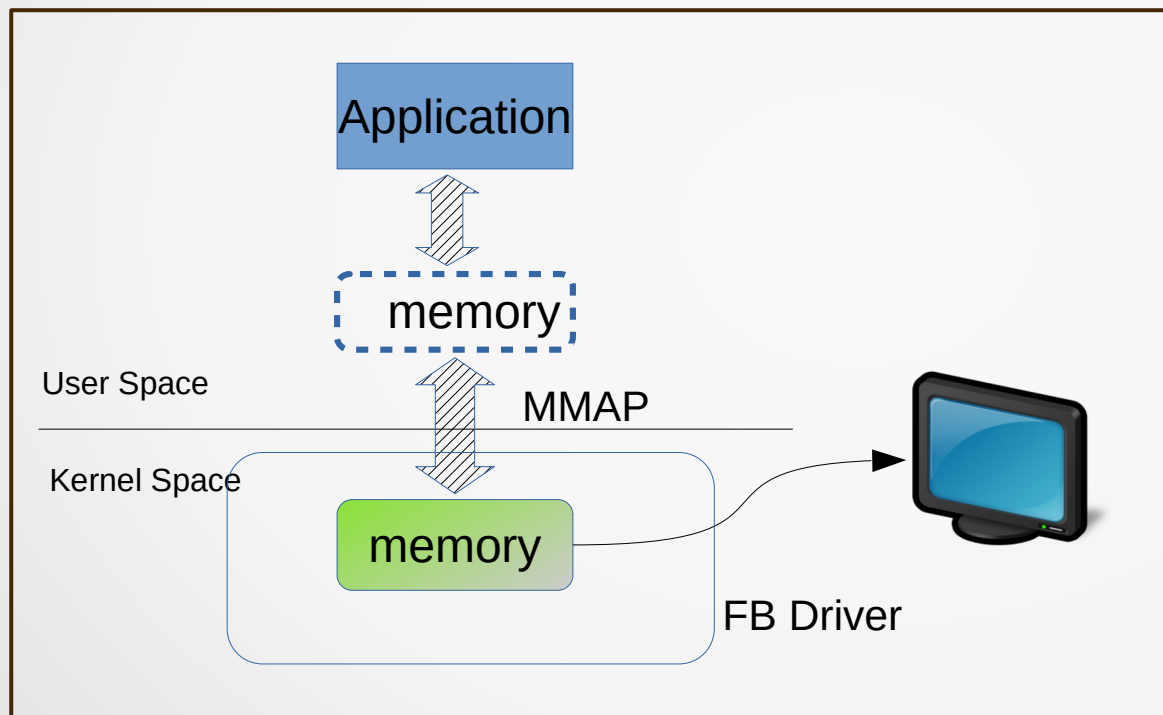https://www.kernel.org/doc/html/v4.15/gpu/drm-kms.html

Kernel Mode Setting (KMS)

https://upload.wikimedia.org/wikipedia/commons/2/2d/The_Linux_Graphics_Stack_and_glamor.svg

Kernel Mode Setting (KMS)

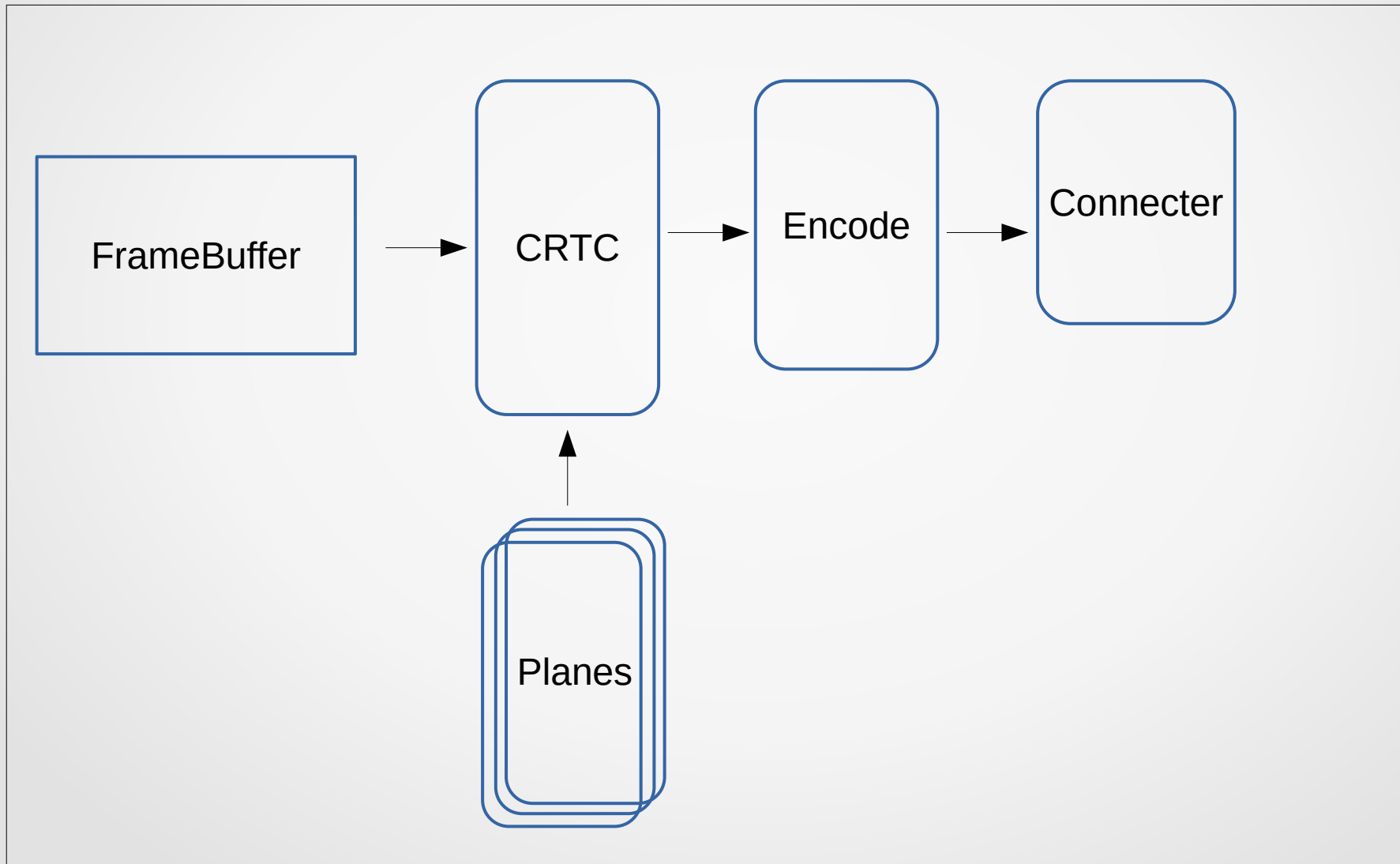https://www.kernel.org/doc/html/v4.15/gpu/drm-kms.html

Video Frame Buffer

- The frame buffer device provides an abstraction for the graphics hardware.

Kernel Mode Setting (KMS)

LCD Parameters

- VBPD : vertical back porch

- VFBD : vertical front porch

- VSPW : vertical sync pulse width

- HBPD : horizontal back porch

- HFPD : horizontal front porth

- HSPW : horizontal sync pulse width

LCD Display Parameters
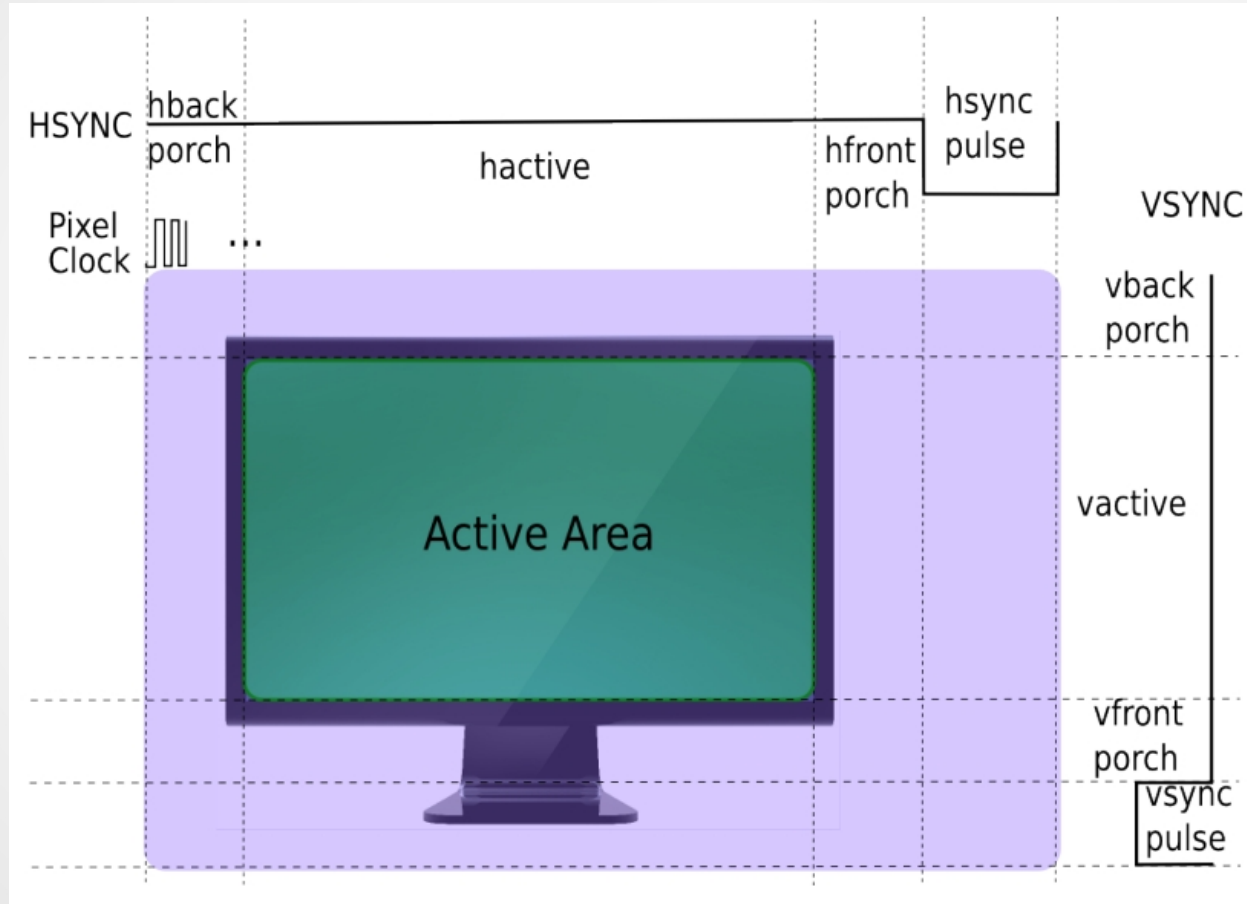
- Dotclock

  - The video hardware draws pixels on the display speed

```
dotclock = (X-resolution + left margin +
            right Margin + HSYNC length) *
            (Y-resolution + upper margin +
            lower margin + VSYNC length) * refresh rate


pixclock = 1/dotclock
```

LCD Display Parameters
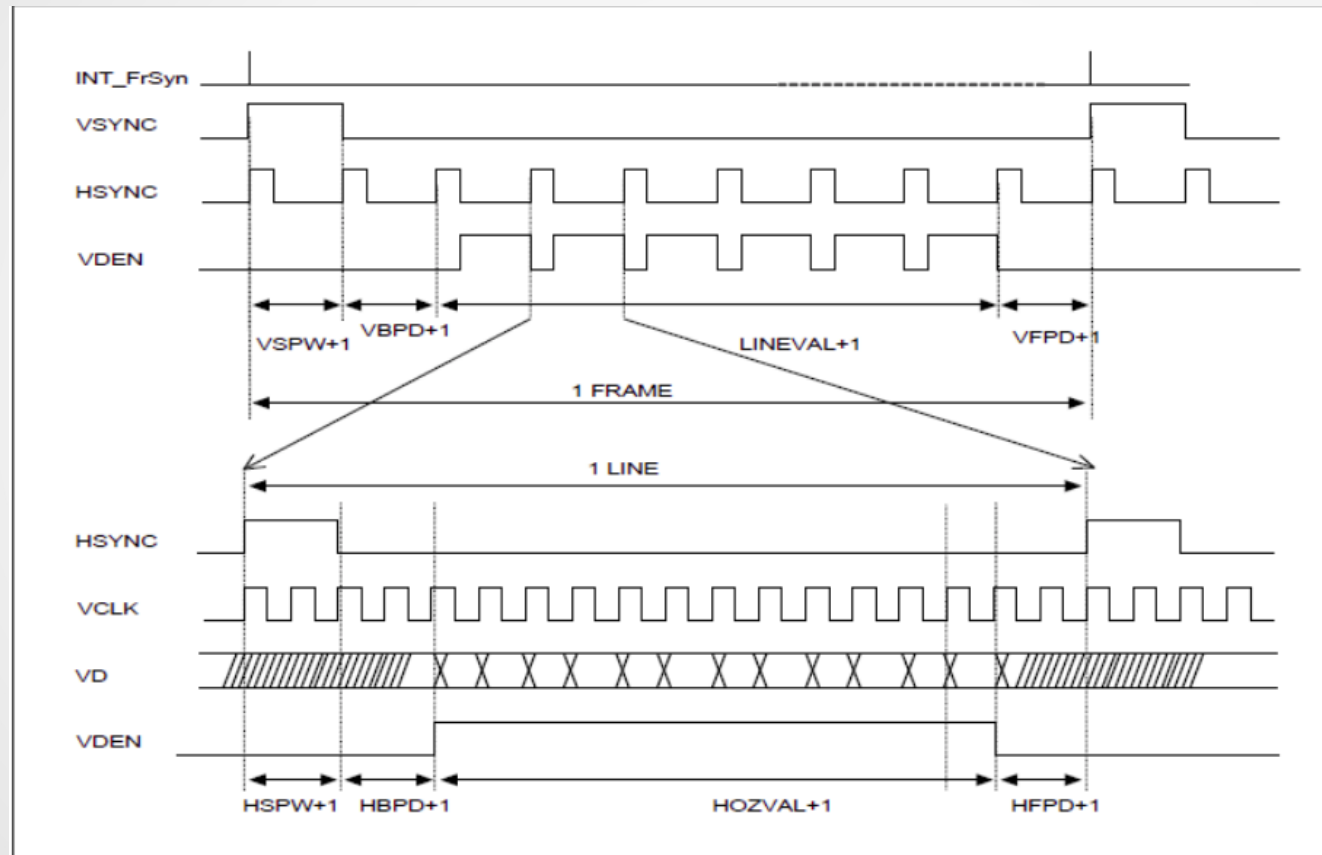
LCD Display Parameters

LCD Display Parameters

LCD Display Parameter

Figure 3. 2 Vertical input timing diagram.
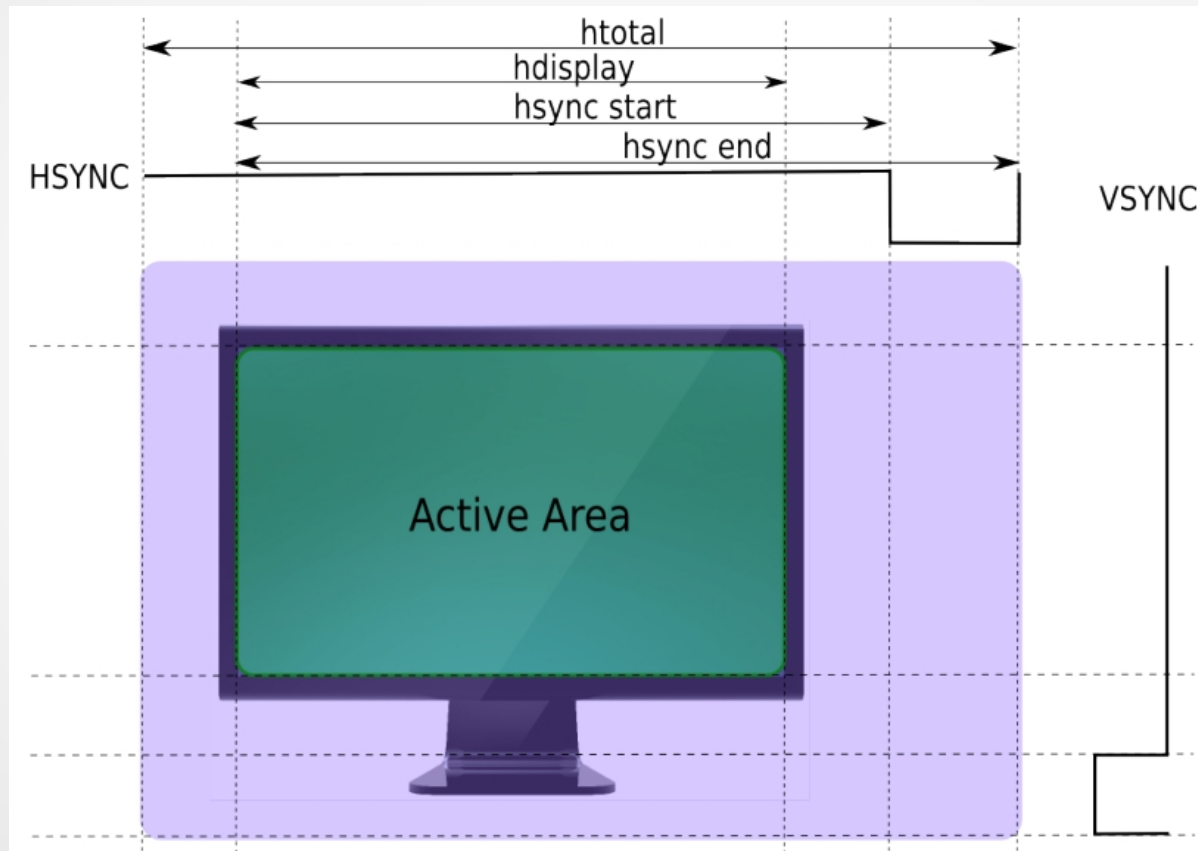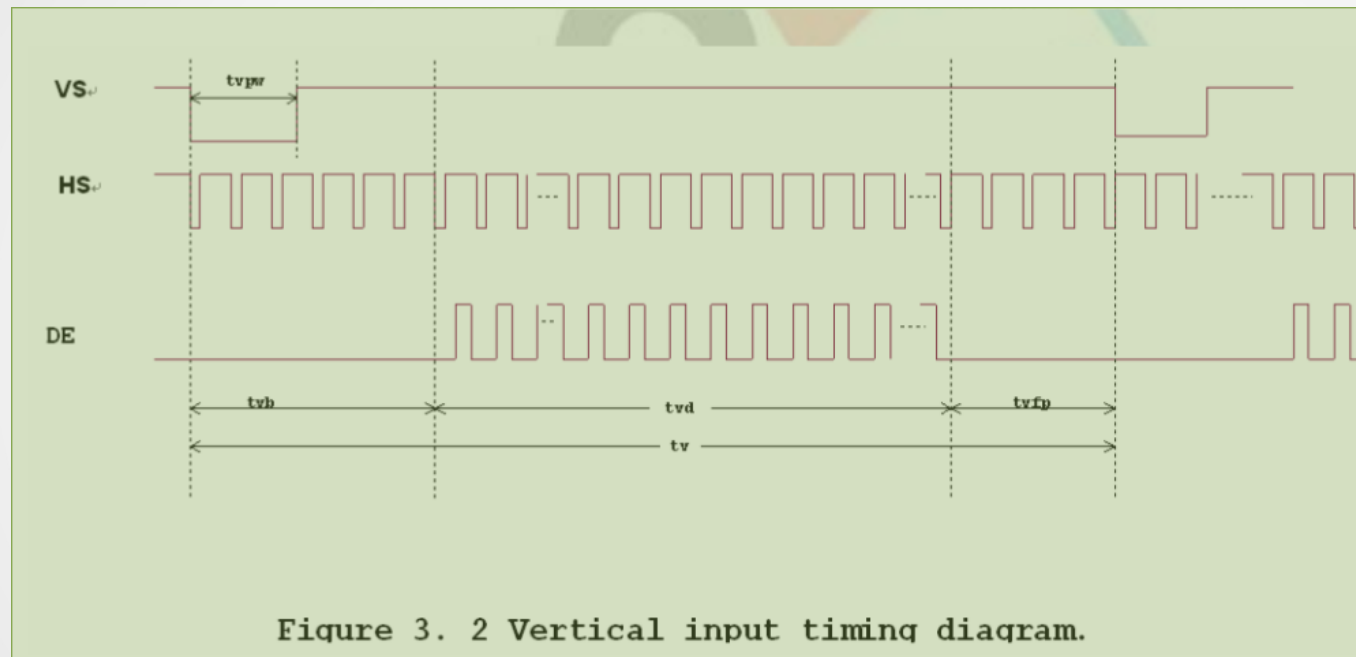
LCD Display Parameter

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Horizontal Display Area	thd	-	800	-	DCLK	
DCLK Frequency	fclk	26.4	33.3	46.8	MHz	
One Horizontal Line	th	862	1056	1200	DCLK	
HS pulse width	thpw	1	-	40	DCLK	
HS Blanking	thb	46	46	46	DCLK	
HS Front Porch	thfp	16	210	354	DCLK	

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Vertical Display Area	tvd	-	480	-	TH	
VS period time	tv	510	525	650	TH	
VS pulse width	tvpw	1	-	20	TH	
VS Blanking	tvb	23	23	23	TH	
VS Front Porch	tvfp	7	22	147	TH	

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Vertical Display Area	tvd	-	480	-	TH	
VS period time	tv	510	525	650	TH	
VS pulse width	tvpw	1	-	20	TH	
VS Blanking	tvb	23	23	23	TH	
VS Front Porch	tvfp	7	22	147	TH	