Immersion: The Challenge for Commodity Gaming

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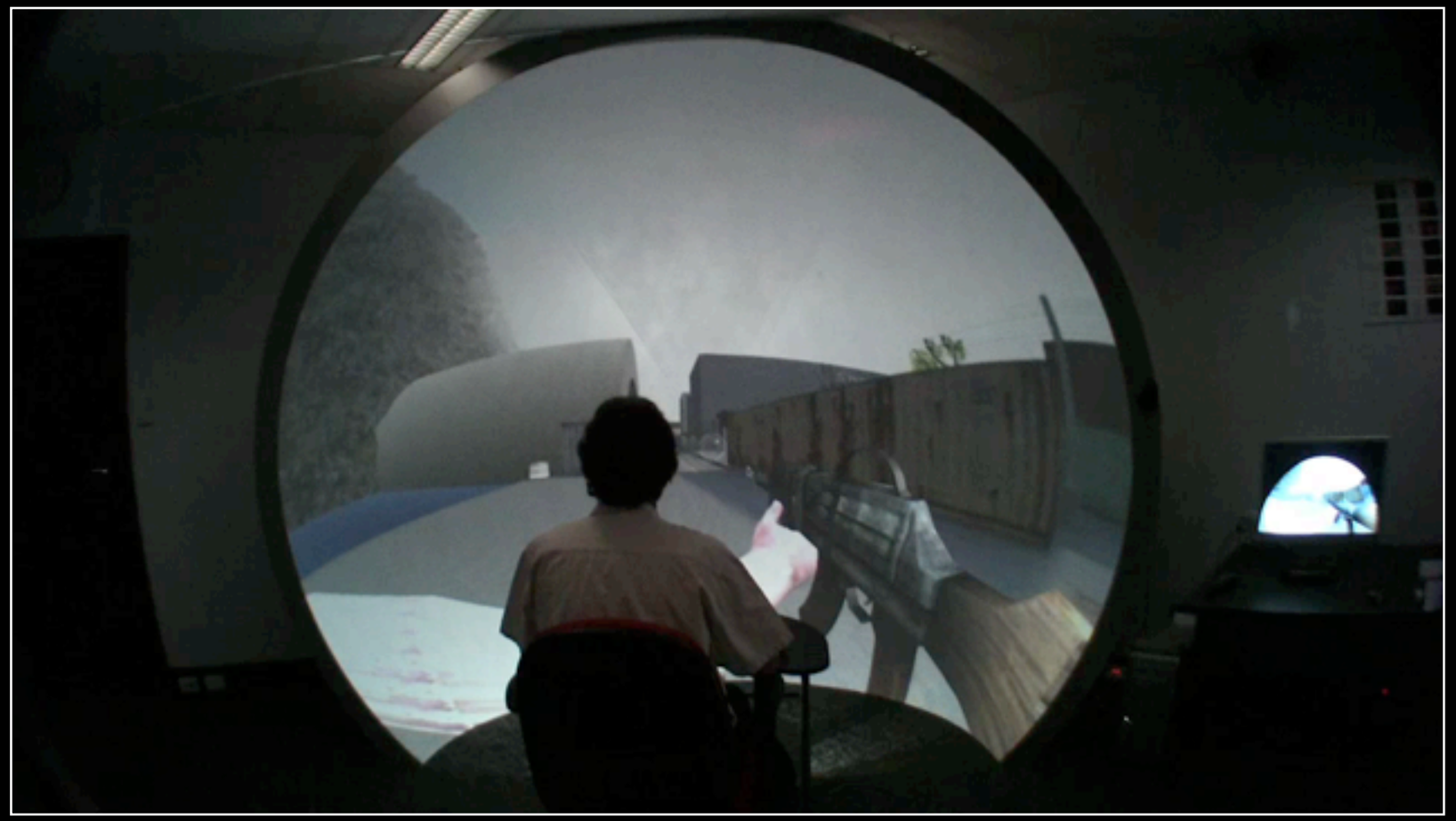
Introduction

- Sense of immersion, of "being there" is greatly enhanced when all or a significant portion of the human visual field is engaged.
- A key requirement for virtual reality is the virtual environment filling the viewers field of view, none of the real world impinges.
- Often referred to as "removing the frame", the frame around almost all digital display devices.
- Importance accepted in commercial/military simulators.
  Almost universally unsupported in the gaming industry!
- Compared with stereoscopic 3D which is widely supported in the gaming industry.
  I claim
  1. Stereoscopy is rarely engaged with in gaming except for initial novelty
  2. It doesn't offer a gaming advantage and has significant disadvantages

Prior user testing and motivation

- 2010: Comparison of monoscopic - stereoscopy - and immersion in a FPS.
- Players in immersive environment performed better despite slightly lower frame rates and lower resolution imagery than monoscopic and stereoscopic display.
- Peripheral vision evolved for early detection of danger.
- Players universally preferred the immersive environment.



Prior user testing and motivation

- 2010: Comparison of monoscopic - stereoscopy - immersion in a non-aggressive game.
- Used standard demo scene for Unity. Players asked to simply explore.
- Players in immersive environment reported more discoveries than in monoscopic and stereoscopic. Also travelled further, did less backtracking indicating higher environment awareness.
- Players universally preferred the immersive environment.

Multiple displays

- The high use by gamers of multiple displays would suggest they appreciate the effect and benefits.
- Noting however that multiple displays are still a long way from filling the human FOV.

Example: Liquid Galaxy

- Googles Liquid Galaxy is one exception.
- Example that generic support for a range of immersive displays is possible.
- Also illustrates the possibility of generic support for distributed (cluster based) rendering of realtime graphics.

Example: jDome

- Even doing it wrong can be compelling enough!

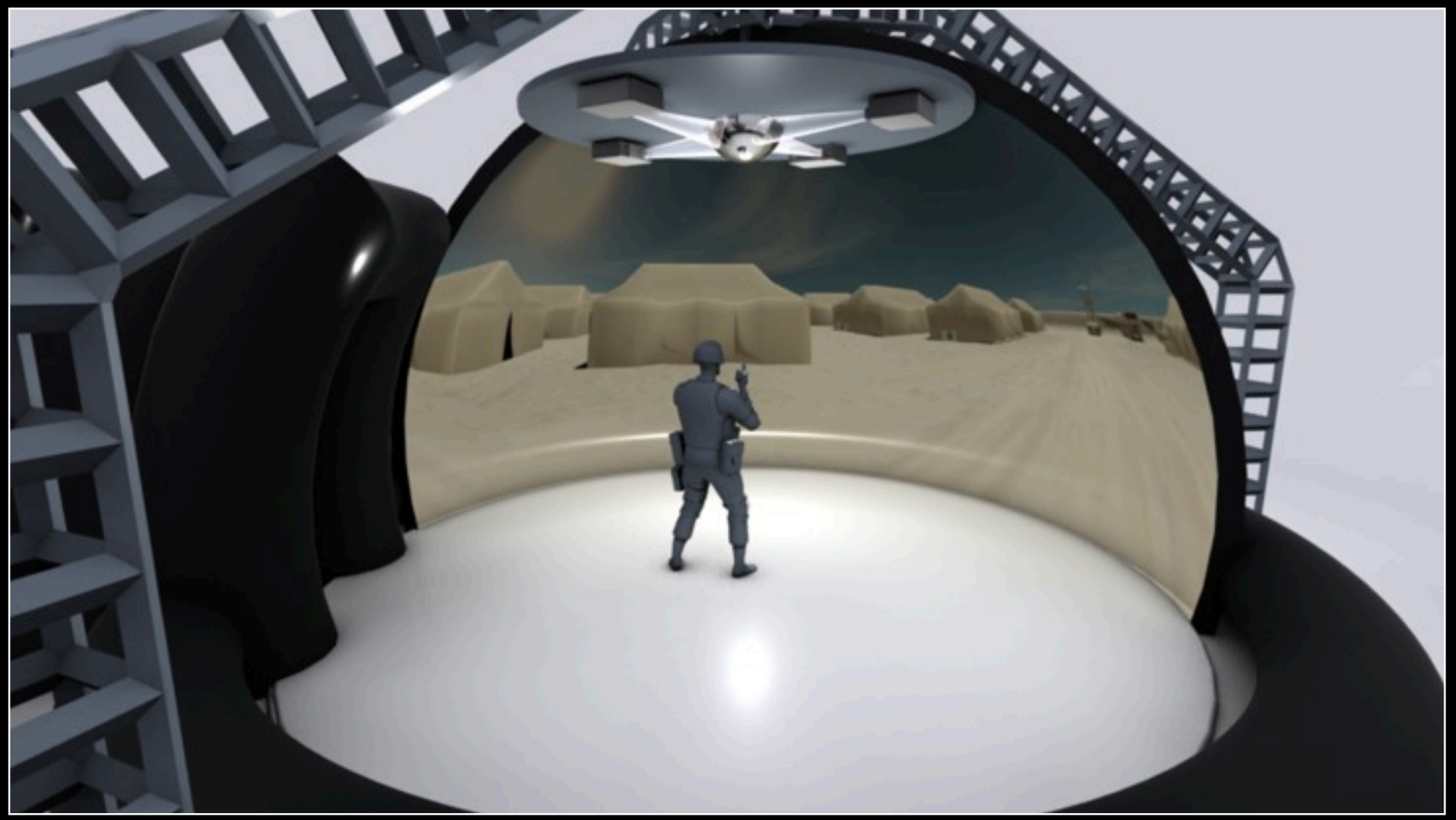
- The jDome simply uses very wide angle perspective camera and rear projects onto a dome.

- The imagery in the far field is greatly distorted and is not conveying the correct imagery.

- Has the advantage of using unmodified games.

Simulators

- In simulators the value of immersive displays is well established.
- Use the phrase: “Situational awareness”.



Why not?

- Why are there not products that more fully utilise the human visuals system?

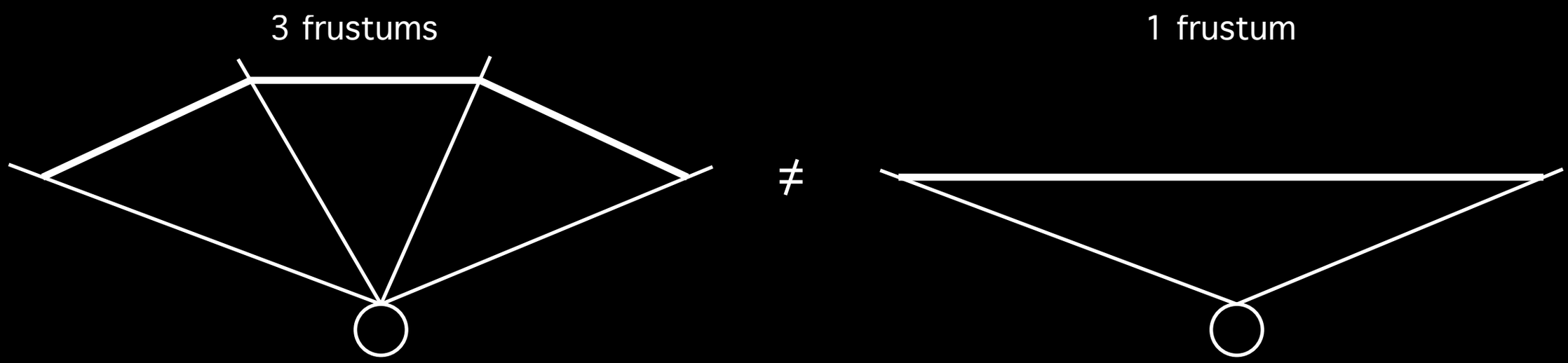
- Economics? Space?

- Unlike stereoscopy there is lack of experience of immersive displays.
  Digital planetariums being one of the few examples.

- It is technically more challenging for developers?

Why is it difficult?

- The current hardware accelerated realtime graphics APIs only support two projections: orthographic and perspective.
- A wide field of view (> 100 degrees say) cannot be (efficiently) generated from a single perspective projection.
- In the past graphics performance for multiple pass rendering was problematic.
- Capturing/intercepting graphics calls is more complicated than the stereoscopic case.
- Multipass rendering (multiple camera frustums) is necessary.
- Views generated are user/screen position dependent. Even for the simplest three panel display the three correct frustums depend on the viewer position and the panel orientation.



Why is it difficult?

- There are potentially a wide range of display configurations.
  [Could buy the viewing hardware as part of the game]

- Compared to stereoscopy where the underlying technology may be different but one still creates the same stereo pairs.

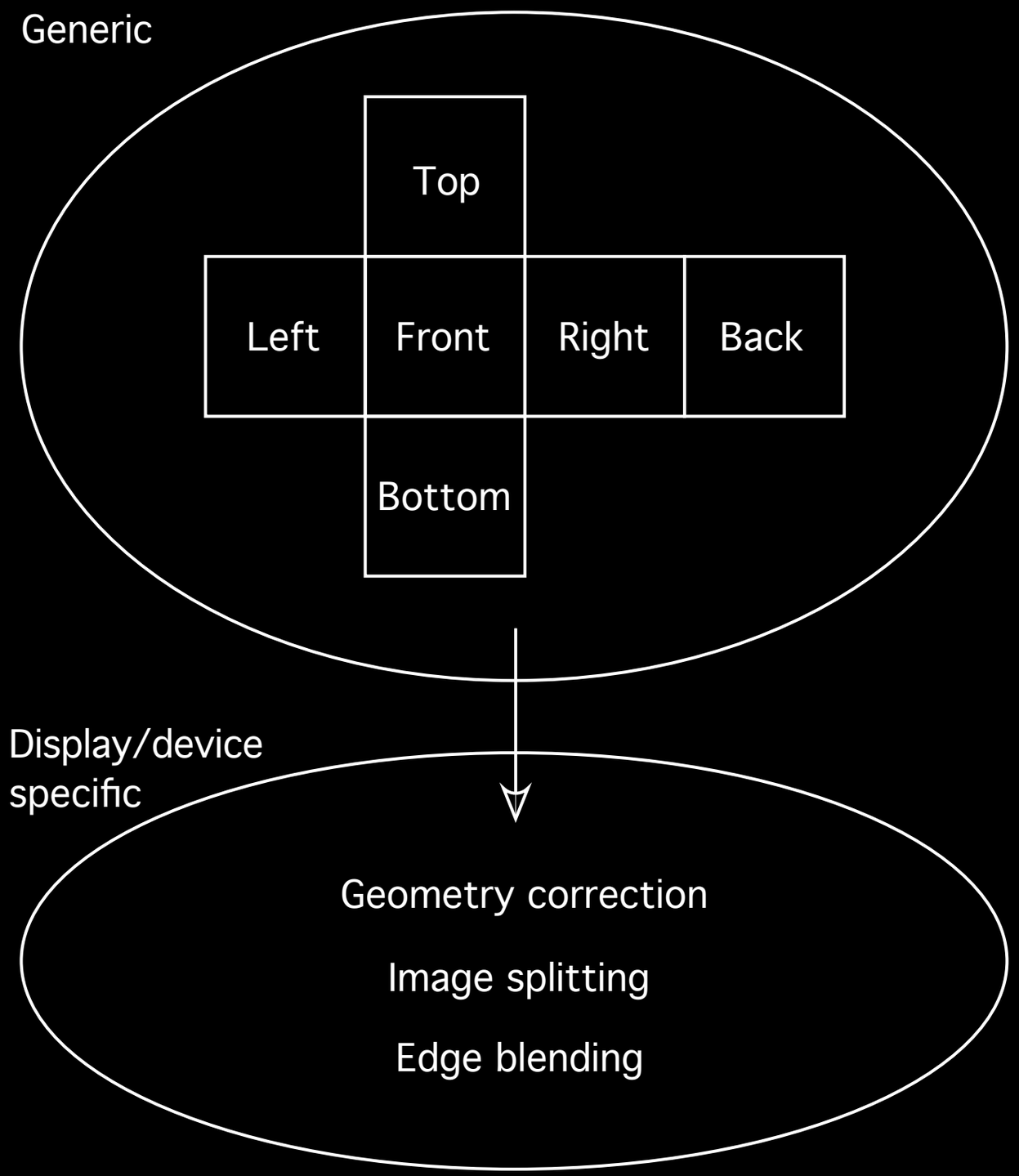
- Creating custom pipeline and parameters for each display geometry would be an overwhelming burden on game developers.

- Depending on the display one needs to handle some or all of the following:
  - Image splitting
  - Geometry correction
  - Edge blending

Solution

- Separate the field of view requirements from the display geometry requirements.
- As a minimum the game needs to at least support the generation of sufficient visual information.
- Only then can hardware manufacturers have the chance of converting that to meet the specifics of the display.

... It then becomes a matter of standards, how the hardware and device specific manufacturers access the image data through a plugin mechanism, for example.



Creating sufficient image data

- All surround displays can be supported by capturing 6 perspective views.
- Many can be supported with fewer.
- Stereoscopic versions need a second set of cube views, one from each eye position.
- Once the visual field of view is captured the rest is just image processing.
- The game engine doesn't need to concern itself with viewer position with respect to screen surfaces, that is taken care of by the image warping phase.

Example: Hemispherical dome

- Most hemispherical dome displays require 4 cube faces.
- Examples include the iDome and current digital planetariums.

Example: Hemispherical dome

Games responsibility

Display providers responsibility

Example: Tiled panels

Games responsibility

Display providers responsibility

Example: Cylindrical display

Left Right

Data projector 1 Data projector 2 Data projector 3

Summary

- Immersion via peripheral vision is a key element for performance and engagement.
- Propose a solution for game engine developers who intent to support immersive displays.
- Tested / implemented to date in Unity3D, Blender, Quest3D.
- Effort is split between game engine developer and hardware supplier.
  - Game engine needs to create the imagery.
  - Hardware specific components is only image mapping.