Display Virtualization with KVM for Automotive Systems

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RENESAS


IDEAS
ON BOARD

“In computing, virtualization refers to the act of creating a virtual [...] version of something.”

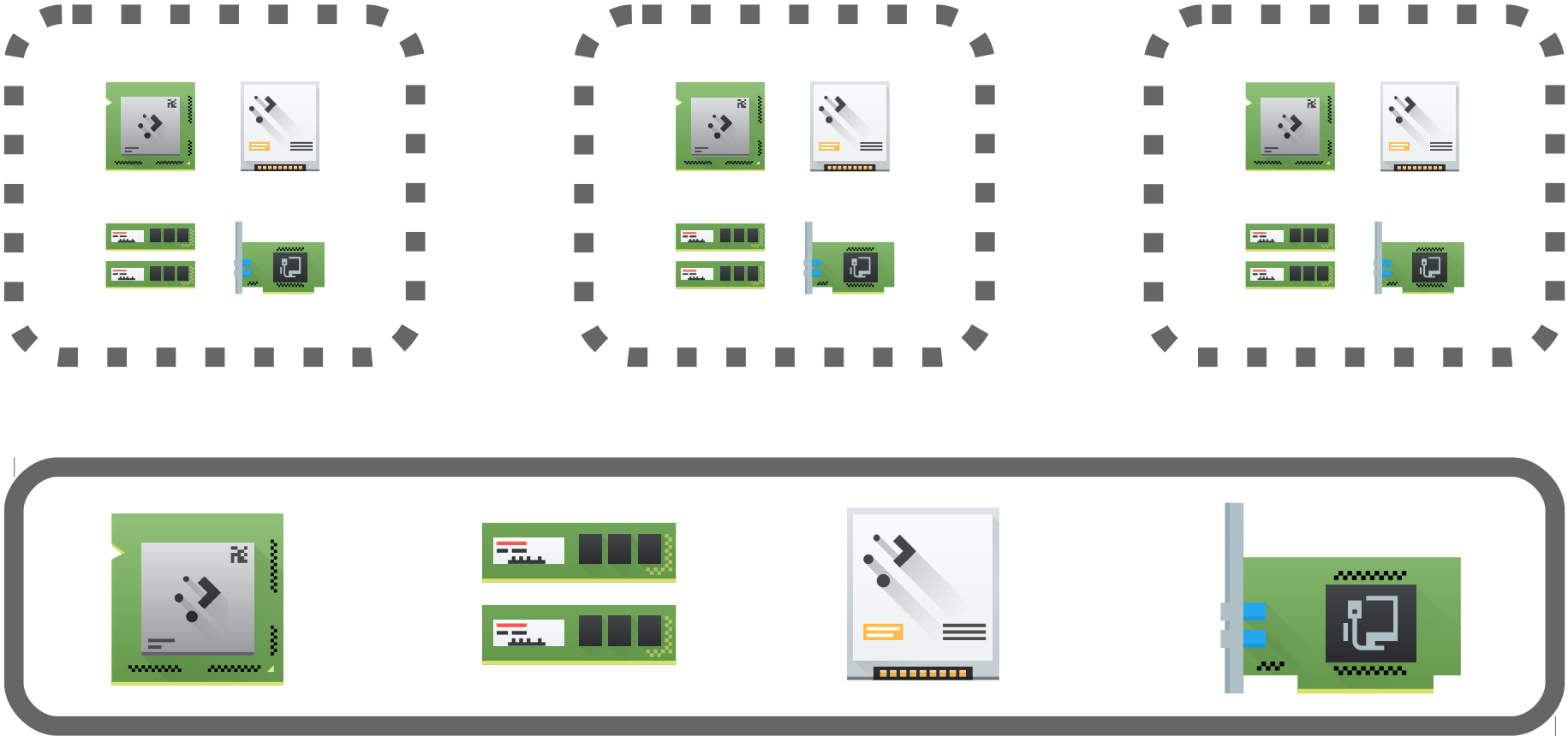
https://en.wikipedia.org/wiki/Virtualization

Virtualization

Emulation

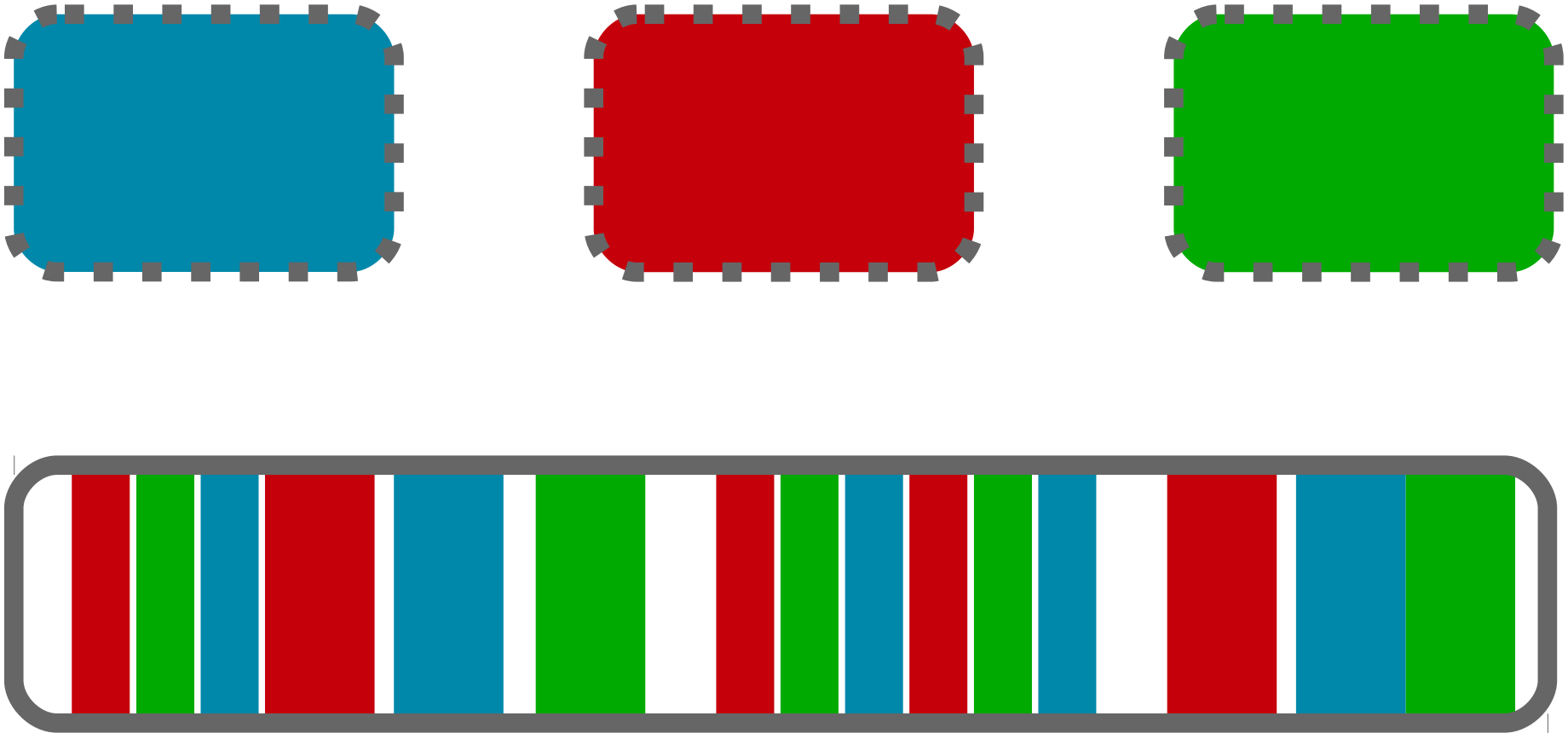
Simulation

Virtualization

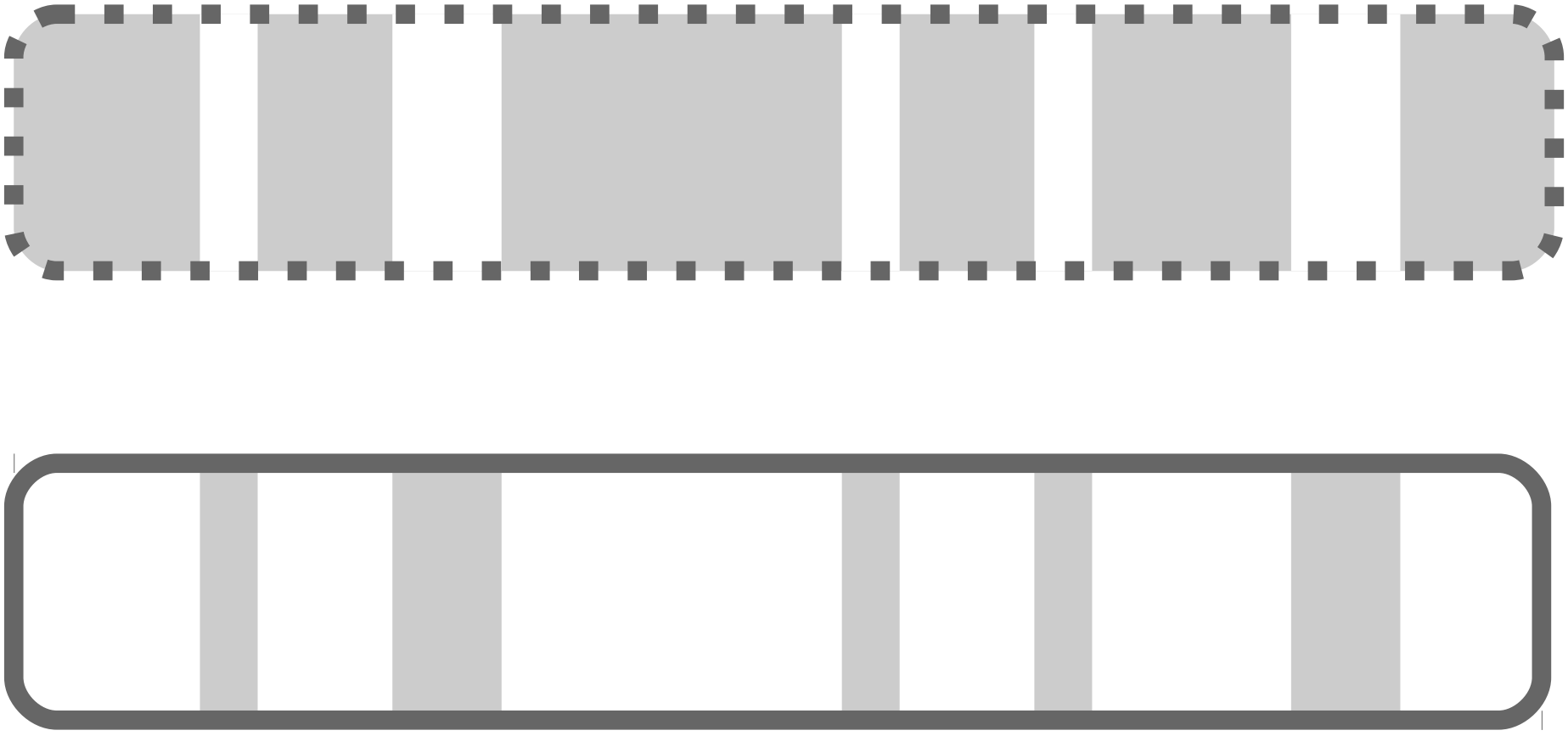


IDEAS ON BOARD

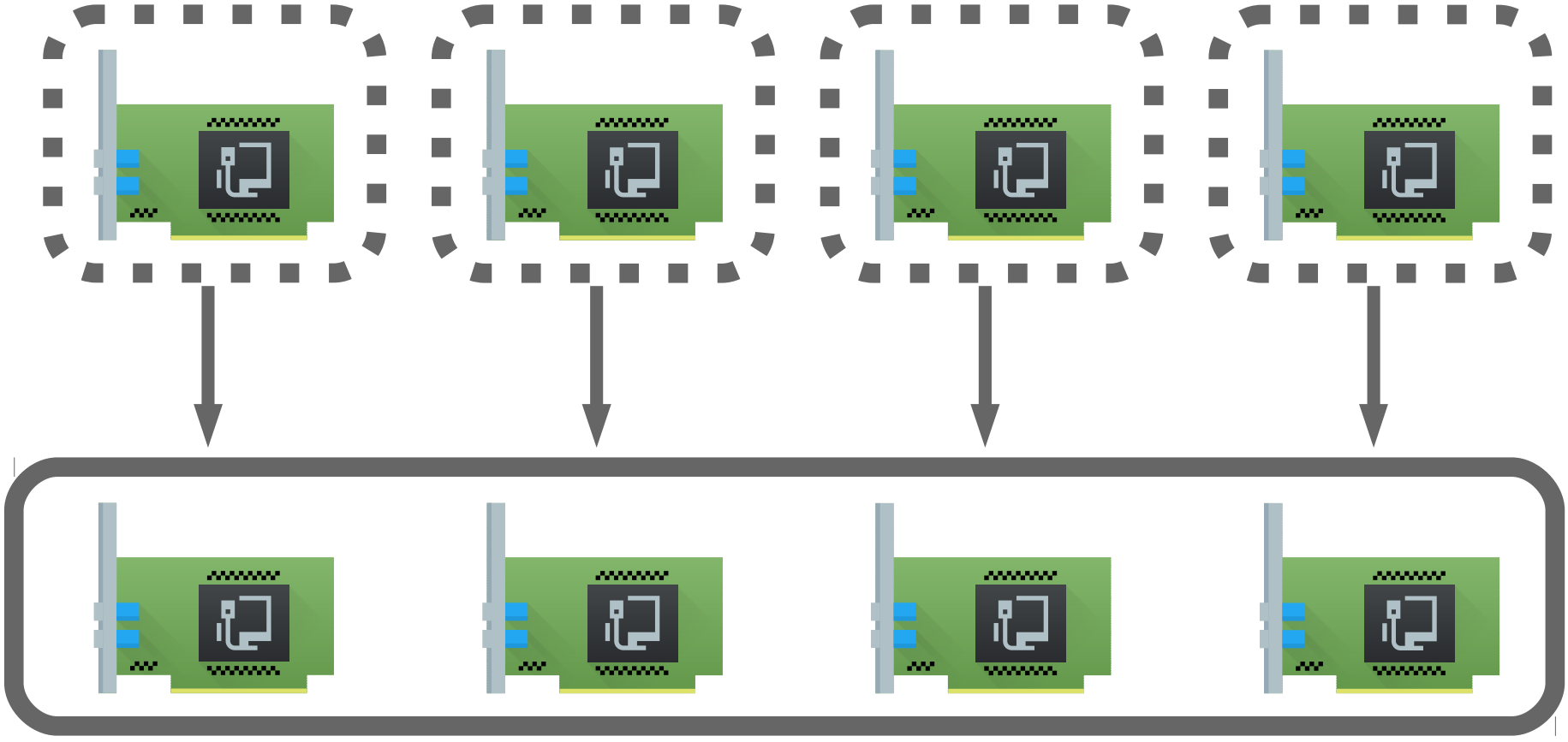
Virtualization



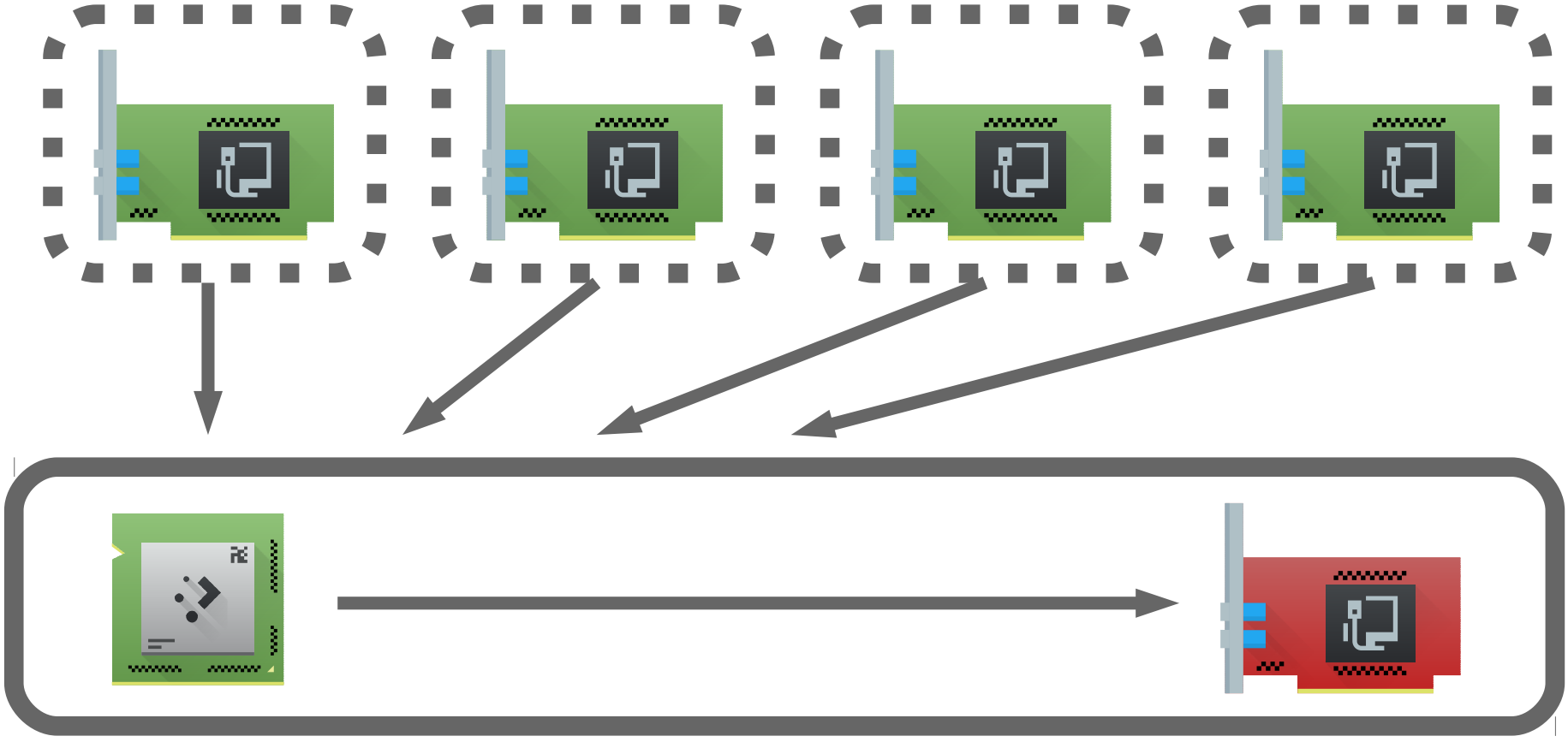
Virtualization – Memory



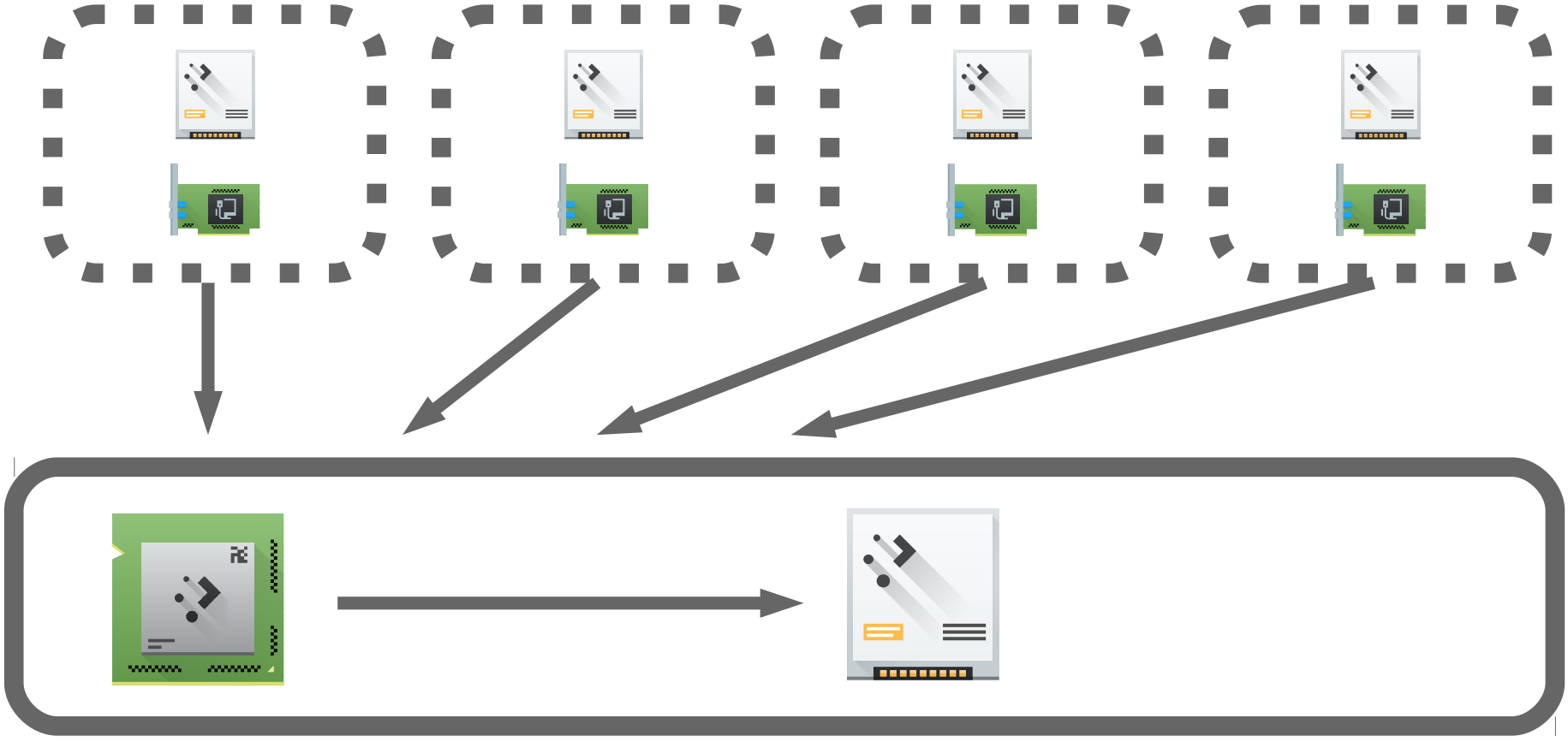
Virtualization – CPU



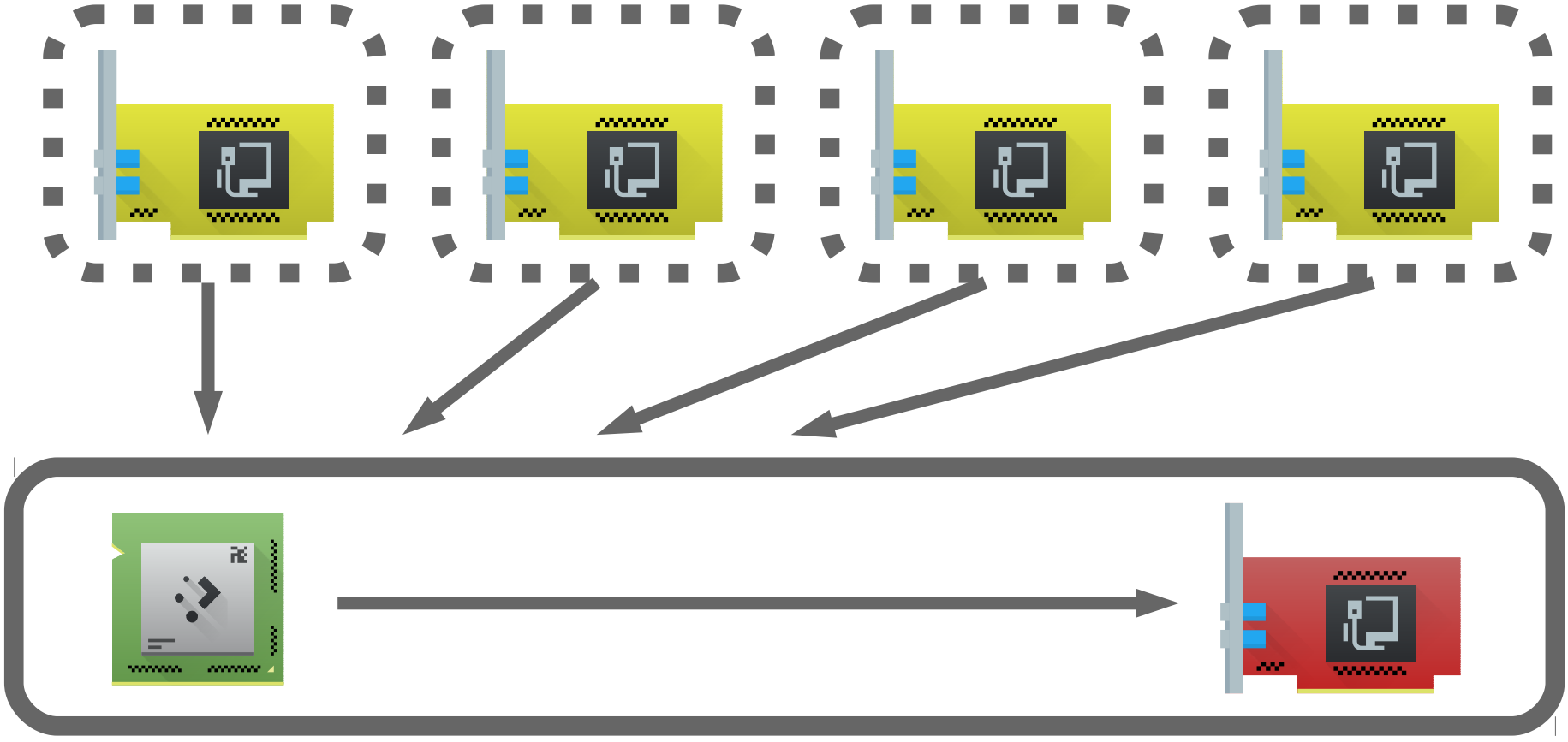
Virtualization – I/O – Passthrough



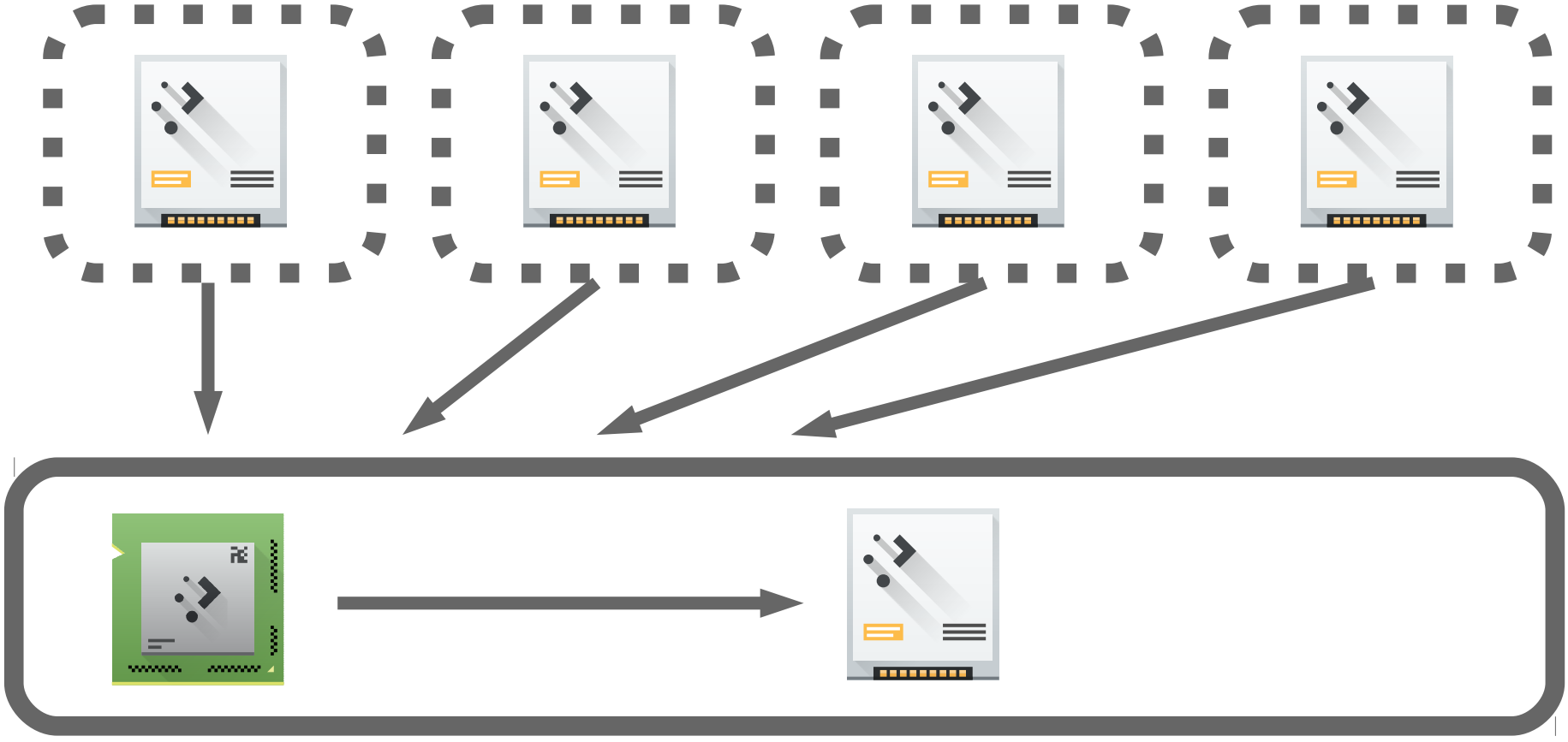
Virtualization – I/O – Emulation



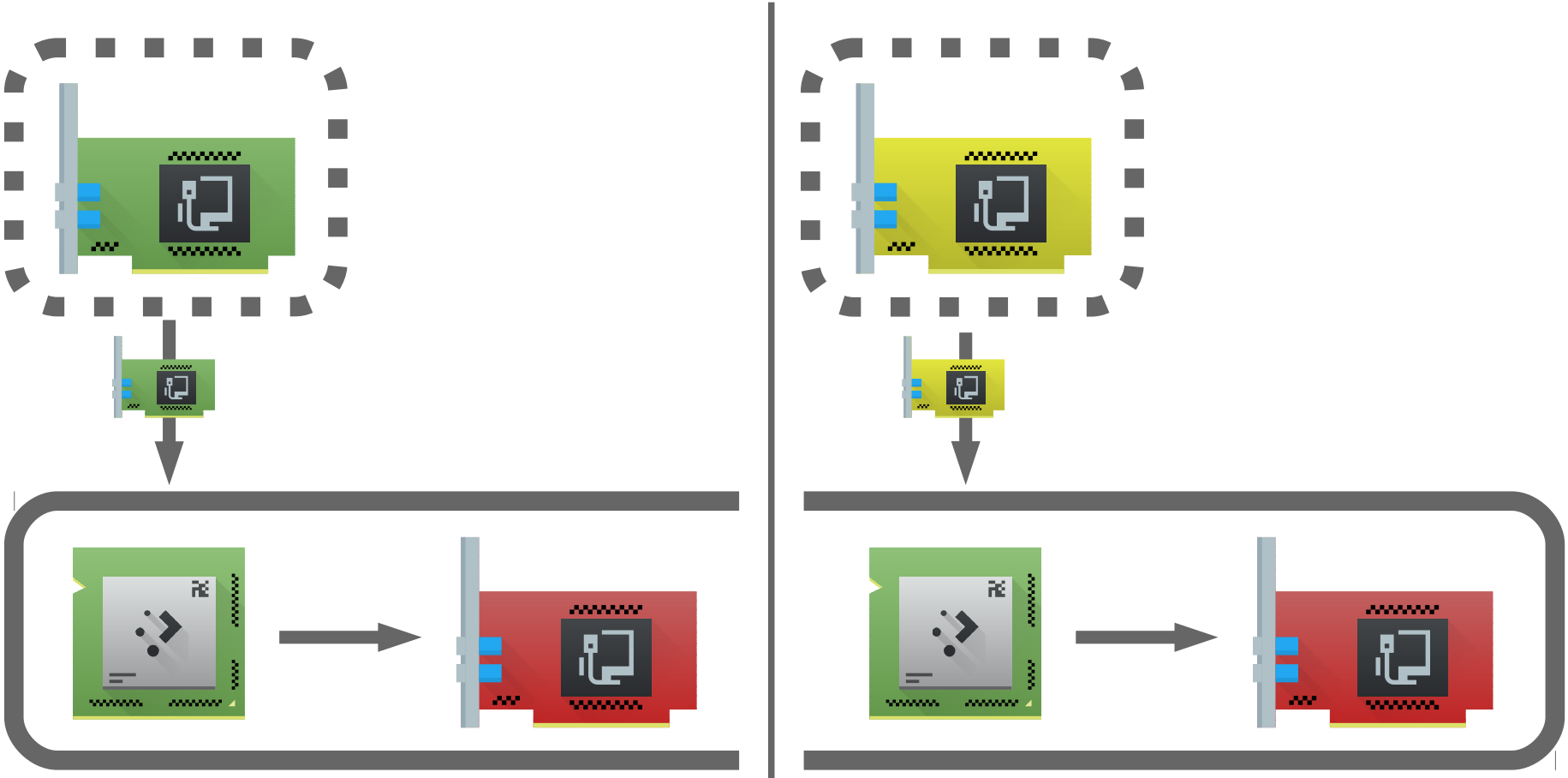
Virtualization – Disk - Emulation



Virtualization – I/O – Para-virtualization



Virtualization – Disk - Para-virtualization



Virtio

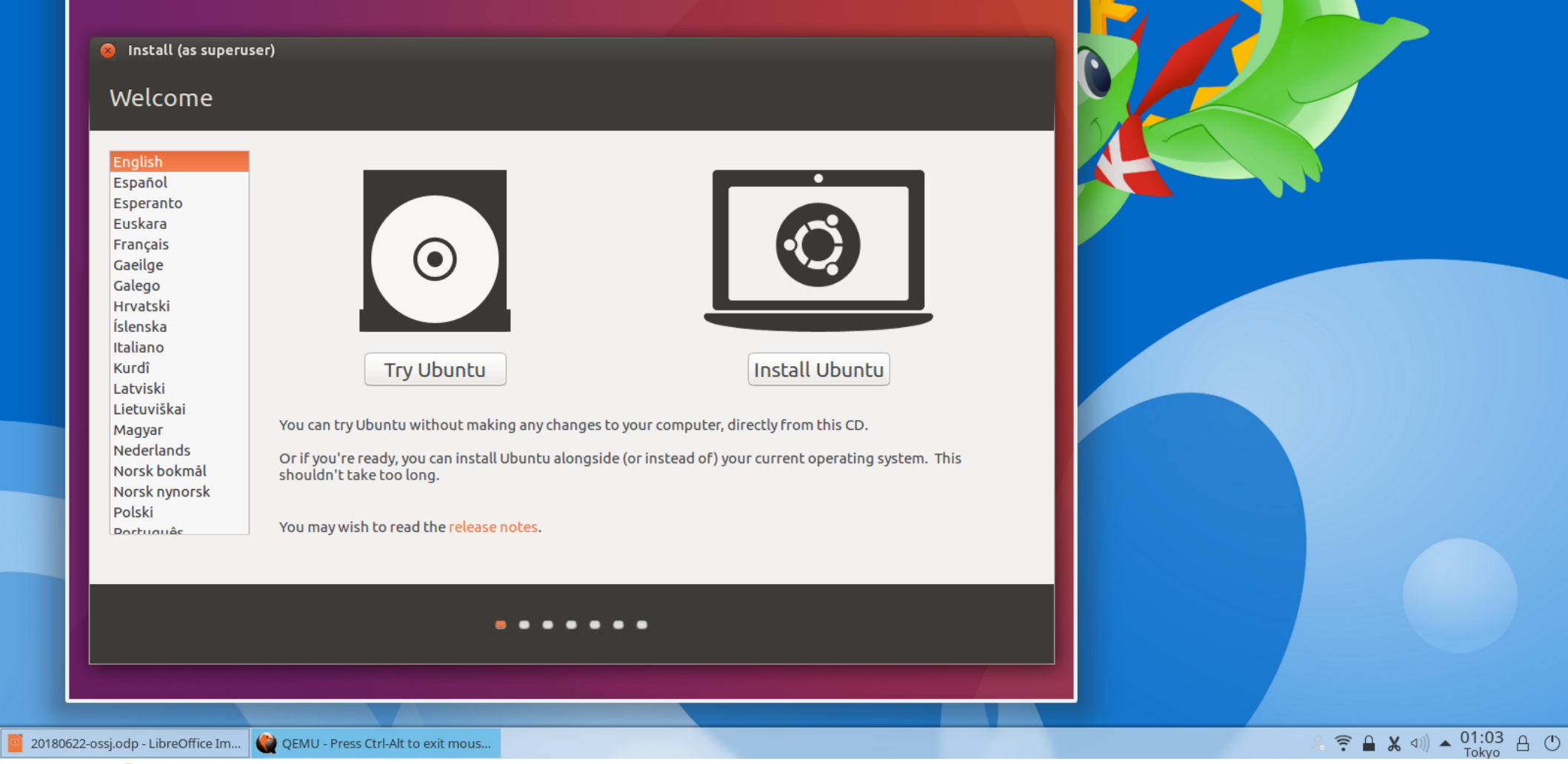




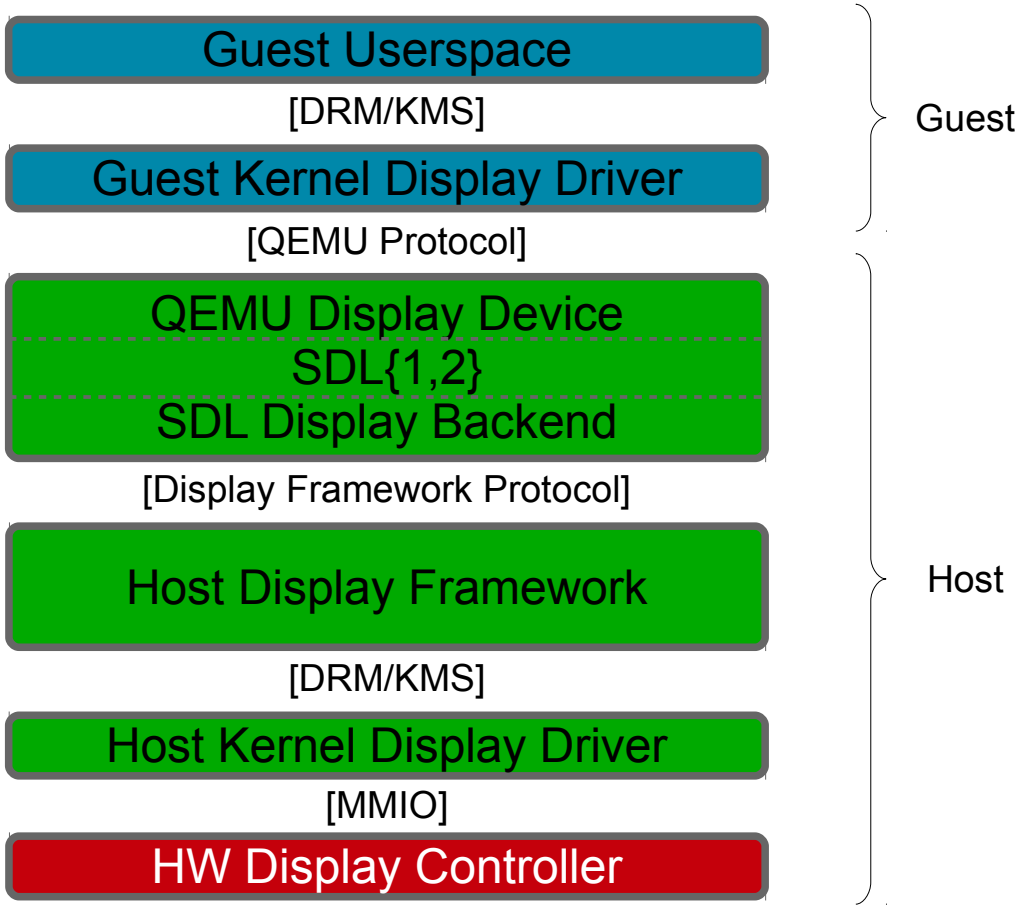

+ Entropy, sockets, SCSI, ...

IDEAS ON BOARD

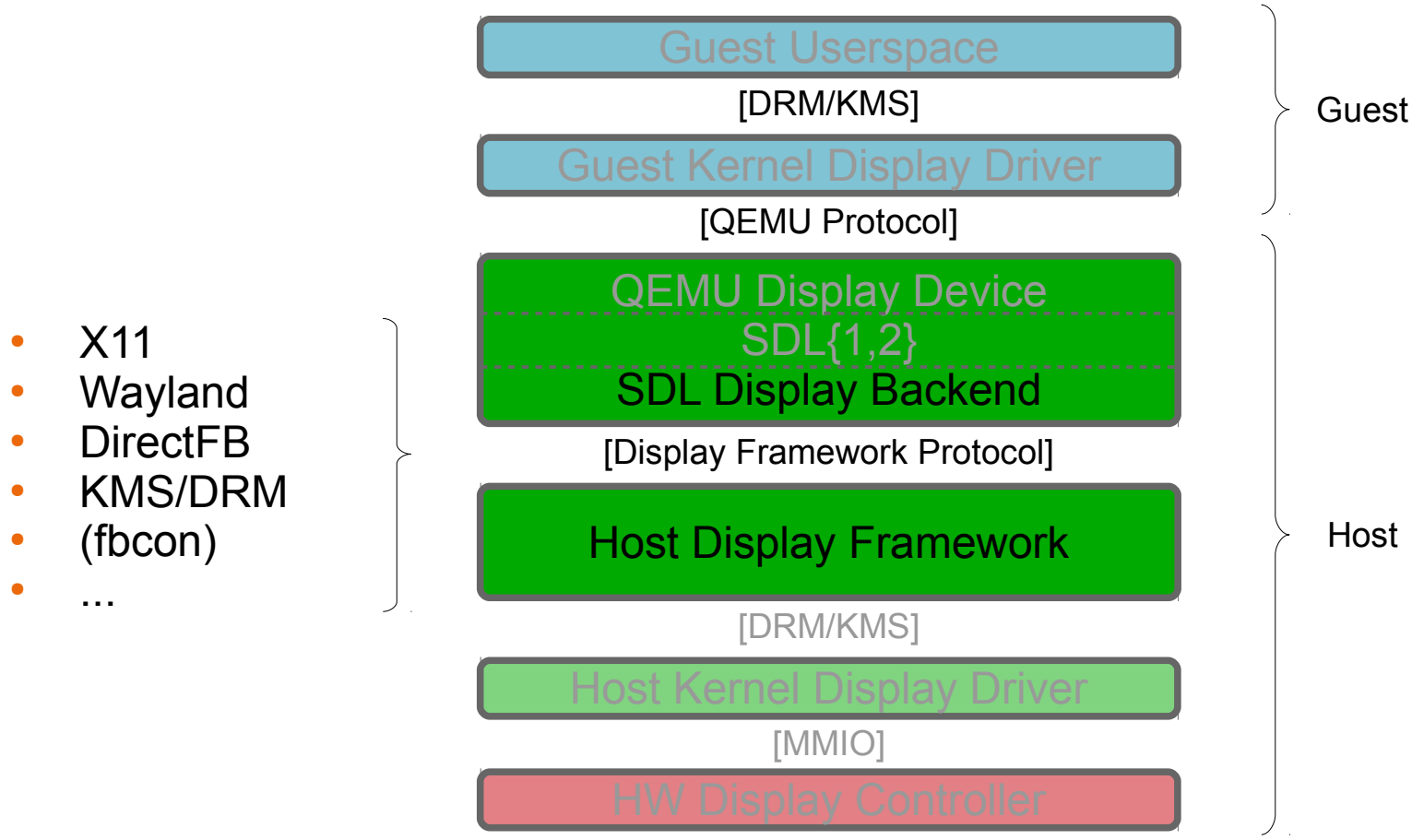
Virtio



Display Virtualization



Display Virtualization – QEMU

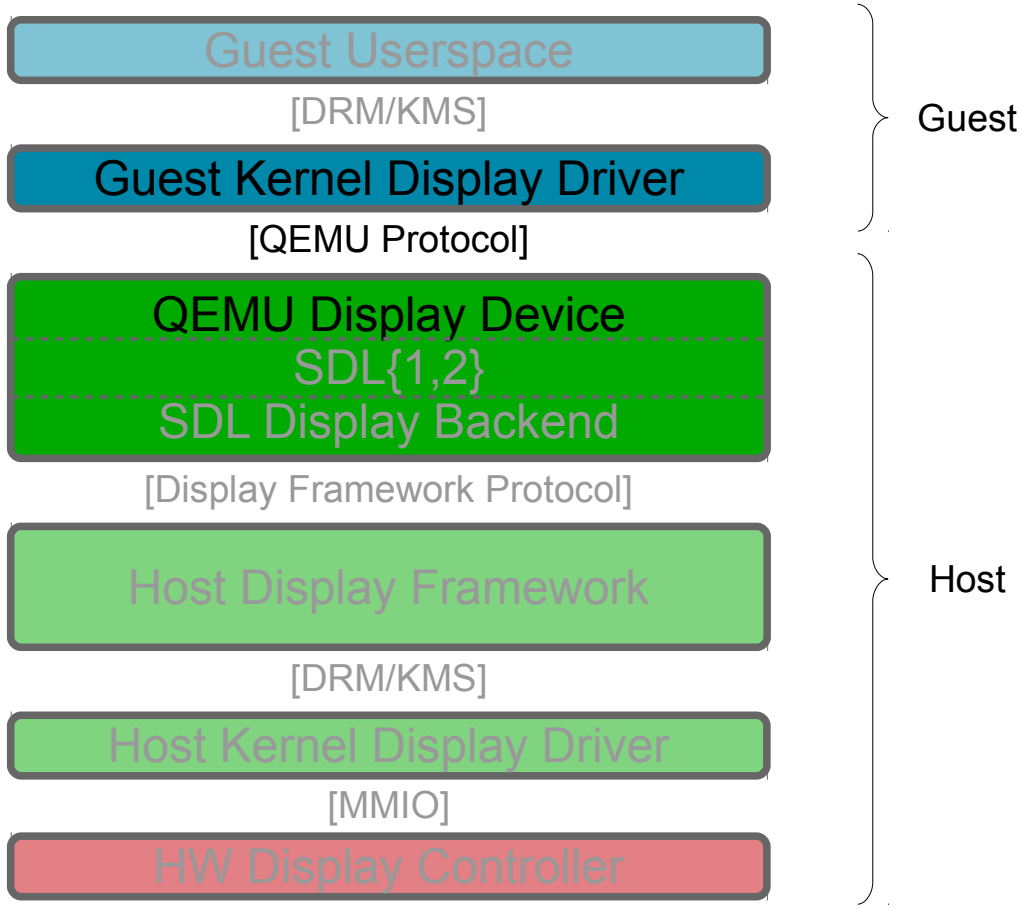


Display Virtualization – QEMU

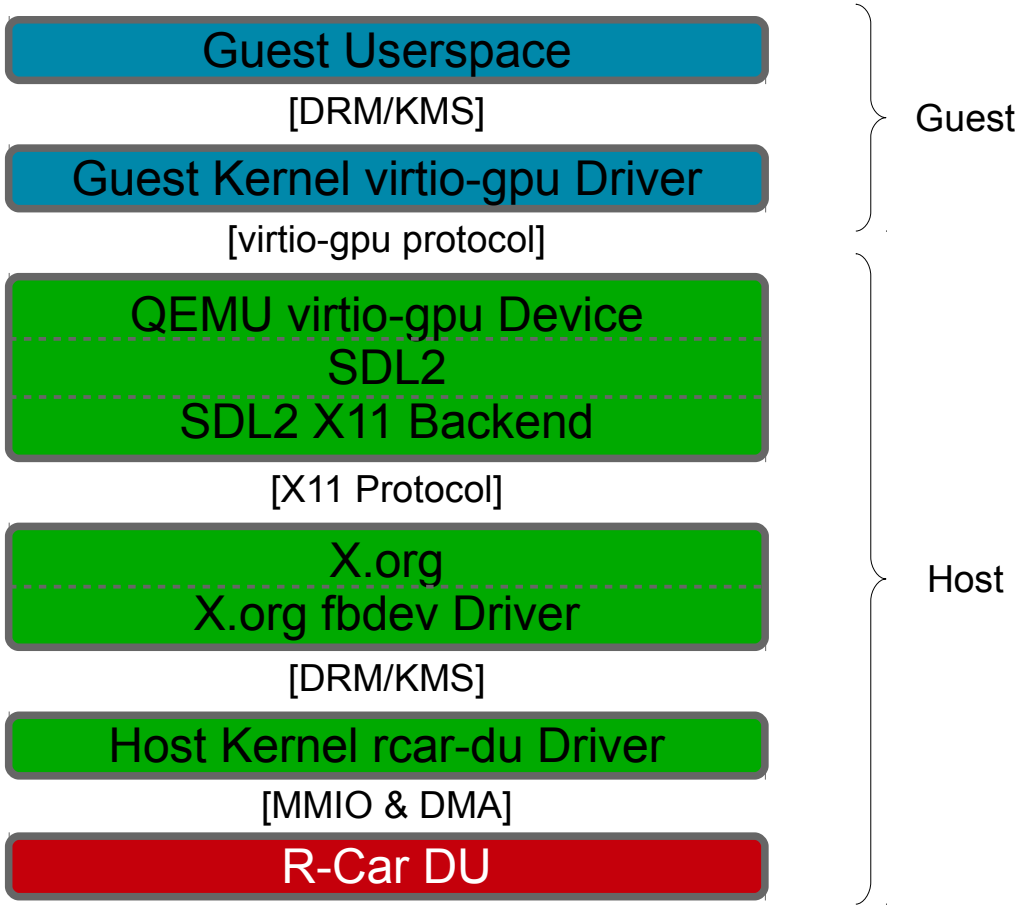
- cirrus
- pl110
- qxl
- xlnx.v-dp
- ...

- vga
- virtio-gpu
- xenfb
- vmware-vga

- omap-dss
- omap-lcdc
- ...



Display Virtualization – QEMU



H3 DU Virtualization – virtio-gpu

~5 fps

> hw > display > virtio-gpu.c

```
static void virtio_gpu_simple_process_cmd(VirtIOGPU *g,
                                          struct virtio_gpu_ctrl_command *cmd)
{
    ...
    switch (cmd->cmd_hdr.type) {
    case VIRTIO_GPU_CMD_RESOURCE_CREATE_2D:
        virtio_gpu_resource_create_2d(g, cmd);
        break;
    case VIRTIO_GPU_CMD_RESOURCE_ATTACH_BACKING:
        virtio_gpu_resource_attach_backing(g, cmd);
        break;
    case VIRTIO_GPU_CMD_TRANSFER_TO_HOST_2D:
        virtio_gpu_transfer_to_host_2d(g, cmd);
        break;
        ...
    }
    ...
}
```

H3 DU Virtualization – virtio-gpu

> hw > display > virtio-gpu.c

```
static void virtio_gpu_resource_attach_backing(VirtIOGPU *g,
                                               struct virtio_gpu_ctrl_command *cmd)
{
    struct virtio_gpu_simple_resource *res;

    ...
    res = virtio_gpu_find_resource(g, ab.resource_id);
    ...
    ret = virtio_gpu_create_mapping_iov(&ab, cmd, &res->addrs, &res->iov);
    ...
}
```

> hw > display > virtio-gpu.c

```
static void virtio_gpu_transfer_to_host_2d(VirtIOGPU *g,
                                           struct virtio_gpu_ctrl_command *cmd)
{
        ...
        void *img_data = pixman_image_get_data(res->image);

        for (h = 0; h < t2d.r.height; h++) {
            src_offset = t2d.offset + stride * h;
            dst_offset = (t2d.r.y + h) * stride + (t2d.r.x * bpp);

            iov_to_buf(res->iov, res->iov_cnt, src_offset,
                       (uint8_t *)img_data
                       + dst_offset, t2d.r.width * bpp);
        }
        ...
}
```

H3 DU Virtualization – virtio-gpu

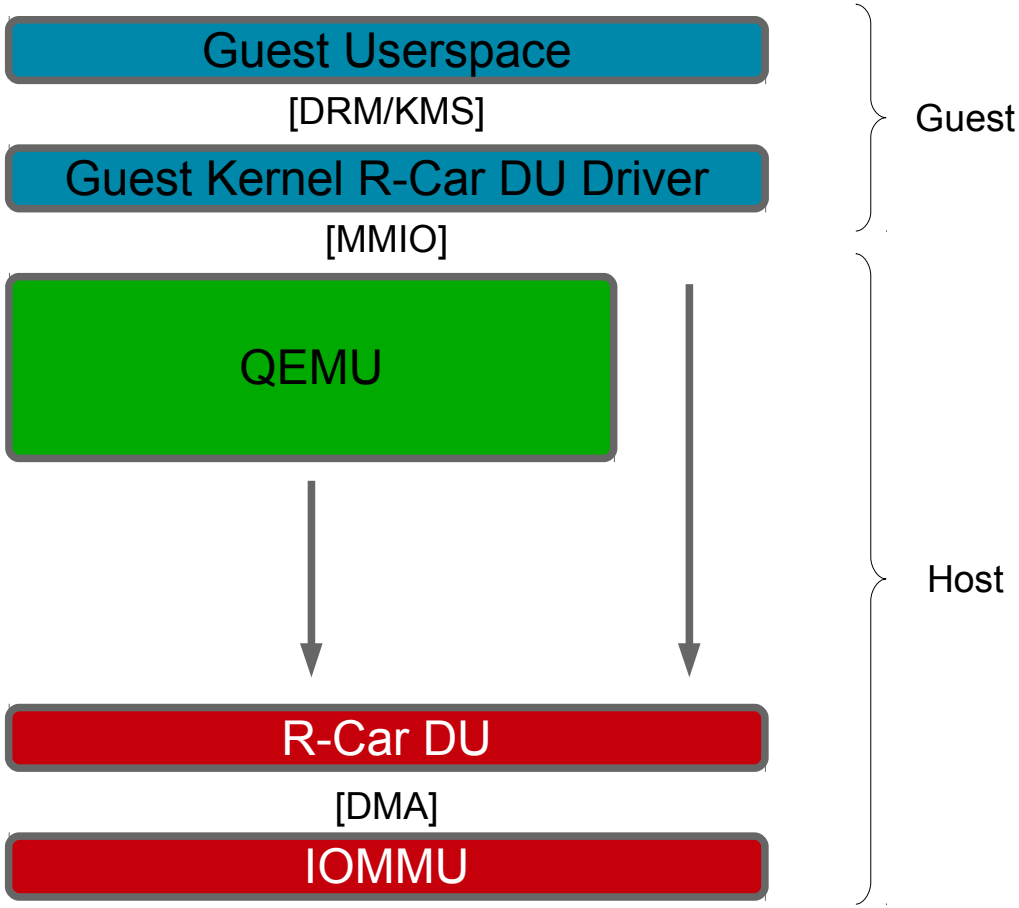
> include > qemu > iov.h

```
static inline size_t
iov_to_buf(const struct iovec *iov, const unsigned int iov_cnt,
           size_t offset, void *buf, size_t bytes)
{
    if (__builtin_constant_p(bytes) && iov_cnt &&
        offset <= iov[0].iov_len && bytes <= iov[0].iov_len - offset) {
        memcpy(buf, iov[0].iov_base + offset, bytes);
        return bytes;
    } else {
        return iov_to_buf_full(iov, iov_cnt, offset, buf, bytes);
    }
}
```

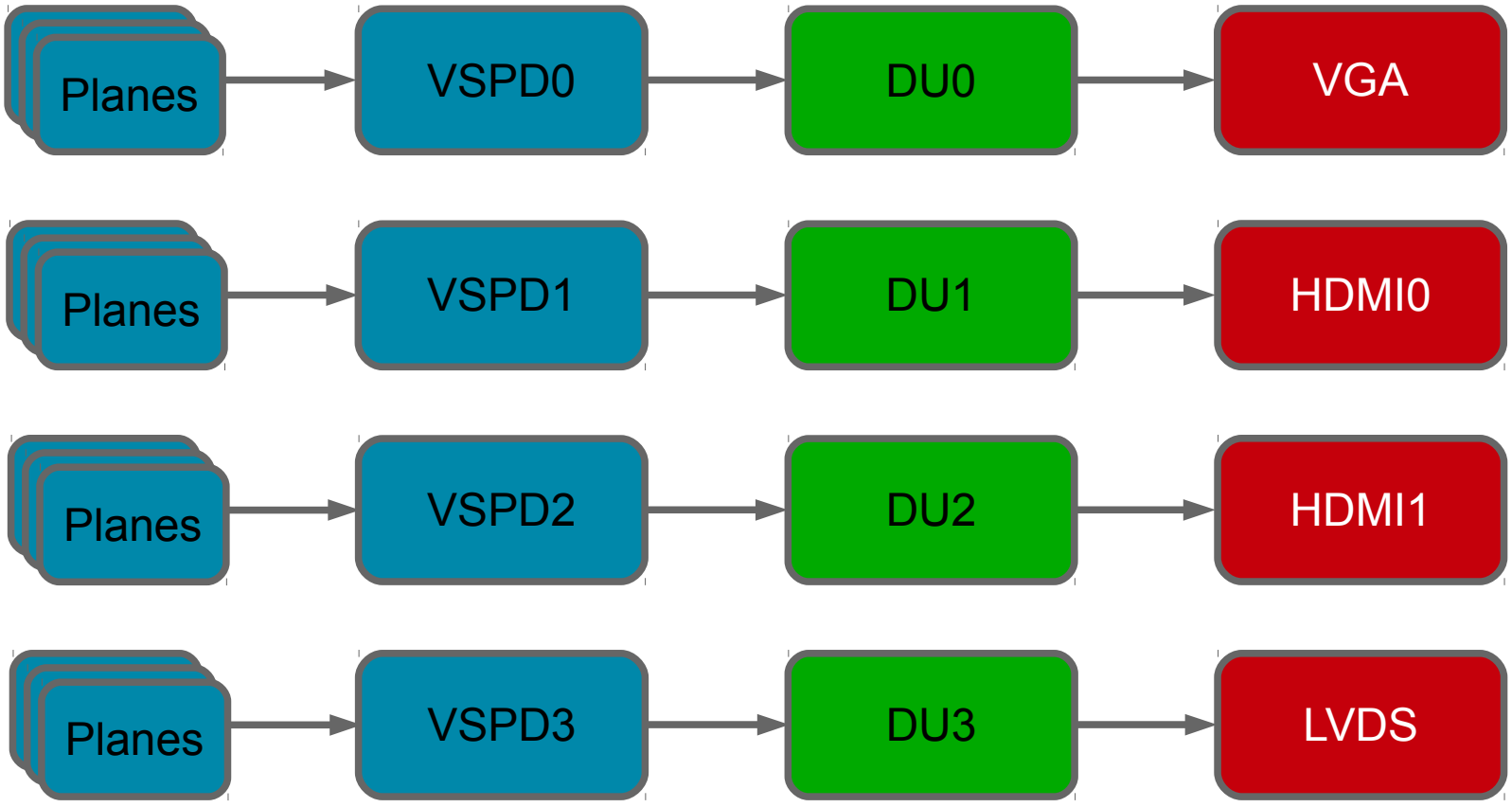
memcpy()

4.35 **KVM_SET_USER_MEMORY_REGION**

```
Capability: KVM_CAP_USER_MEM
Architectures: all
Type: vm ioctl
Parameters: struct kvm_userspace_memory_region (in)
Returns: 0 on success, -1 on error
...
This ioctl allows the user to create or modify a guest
physical memory slot. When changing an existing slot,
it may be moved in the guest physical memory space, or
its flags may be modified. It may not be resized.
Slots may not overlap in guest physical address space.
```

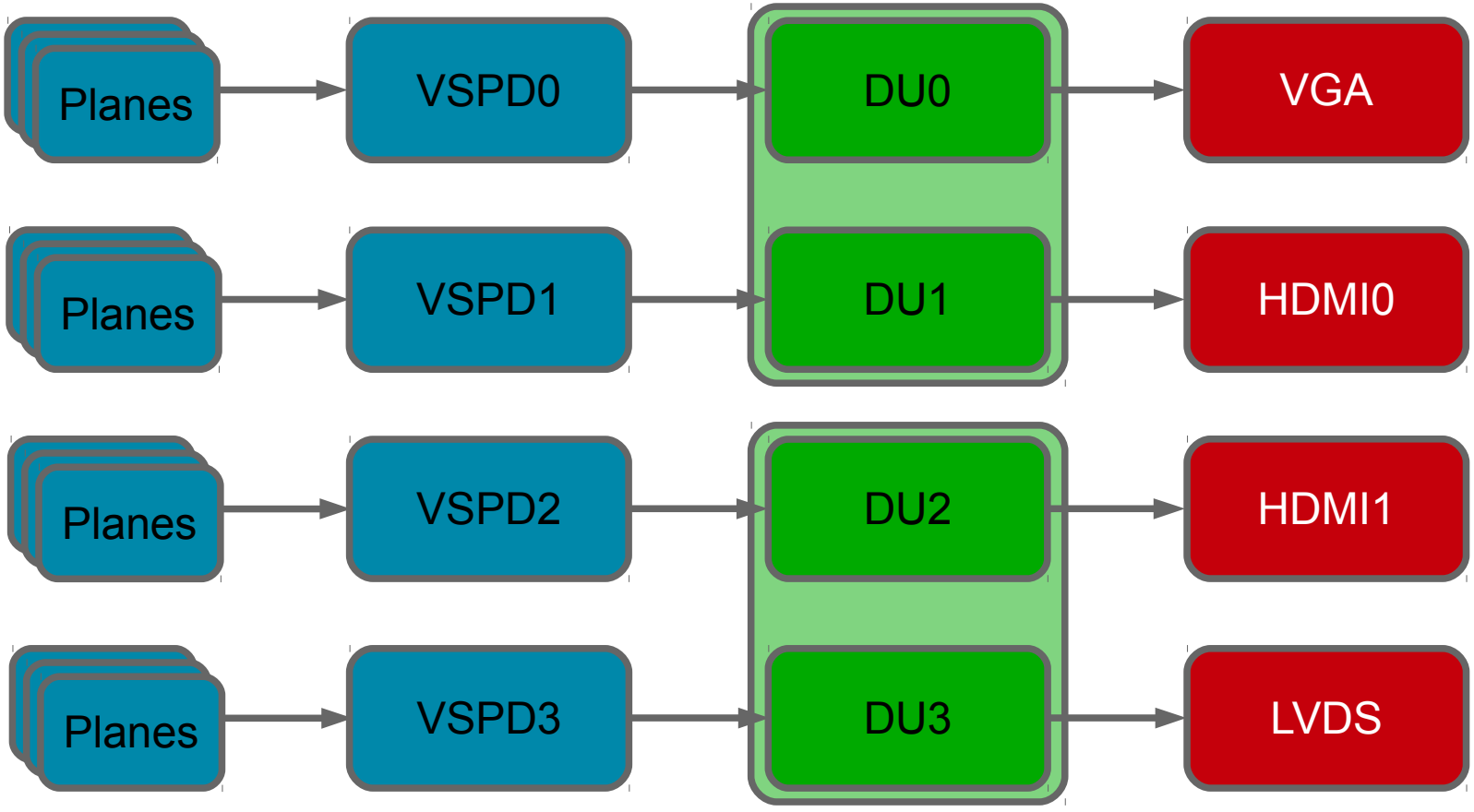


H3 DU Virtualization – Pass-through



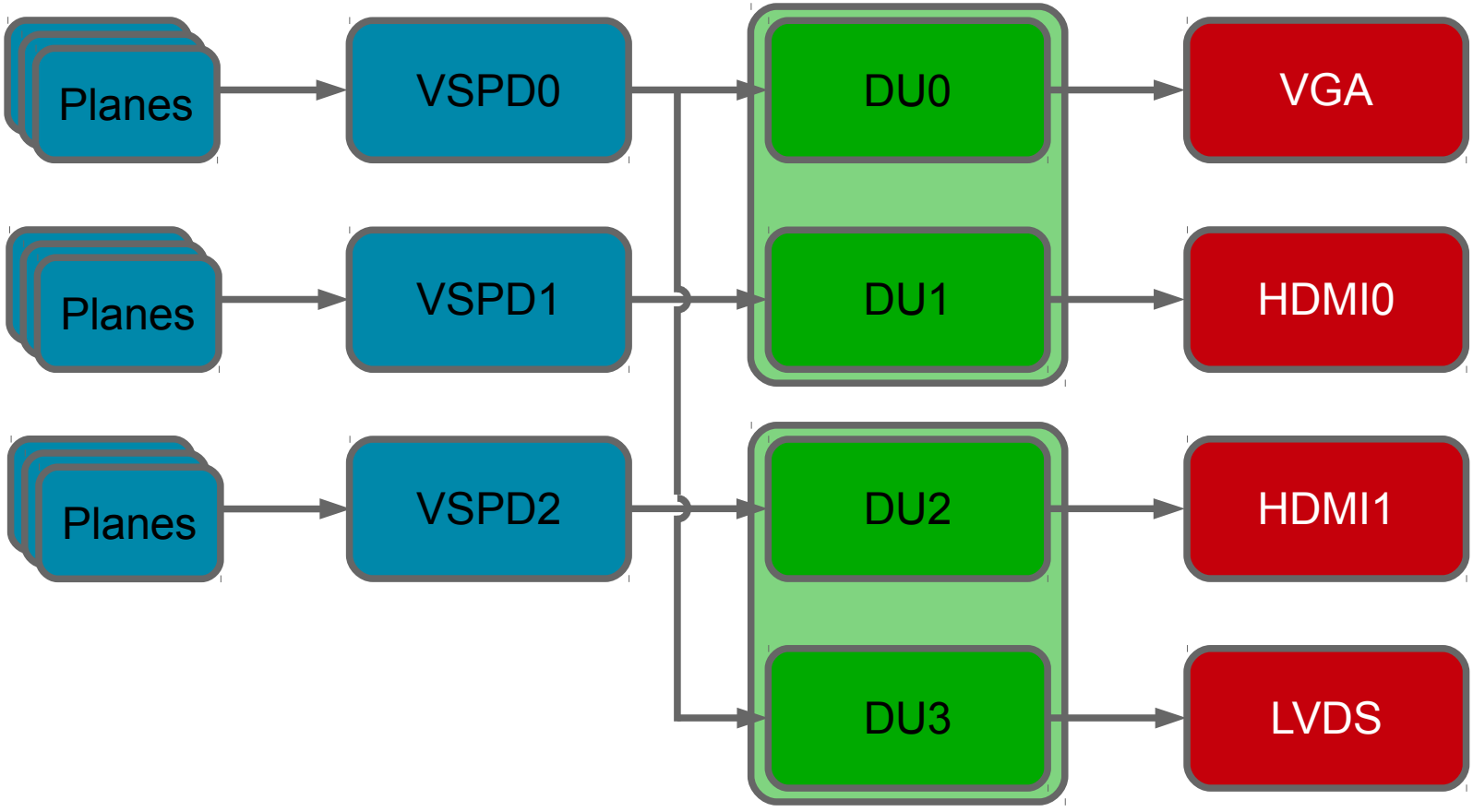
IDEAS ON BOARD

R-Car H3 DU



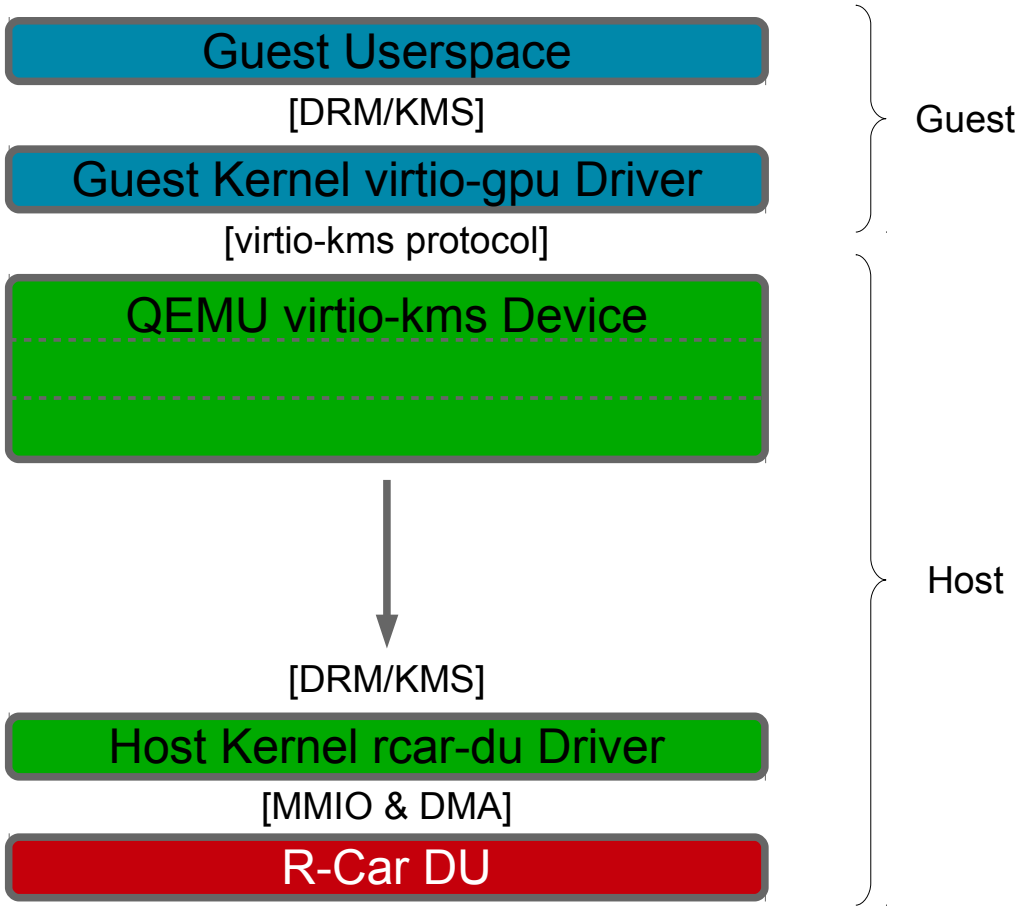
IDEAS ON BOARD

R-Car H3 DU

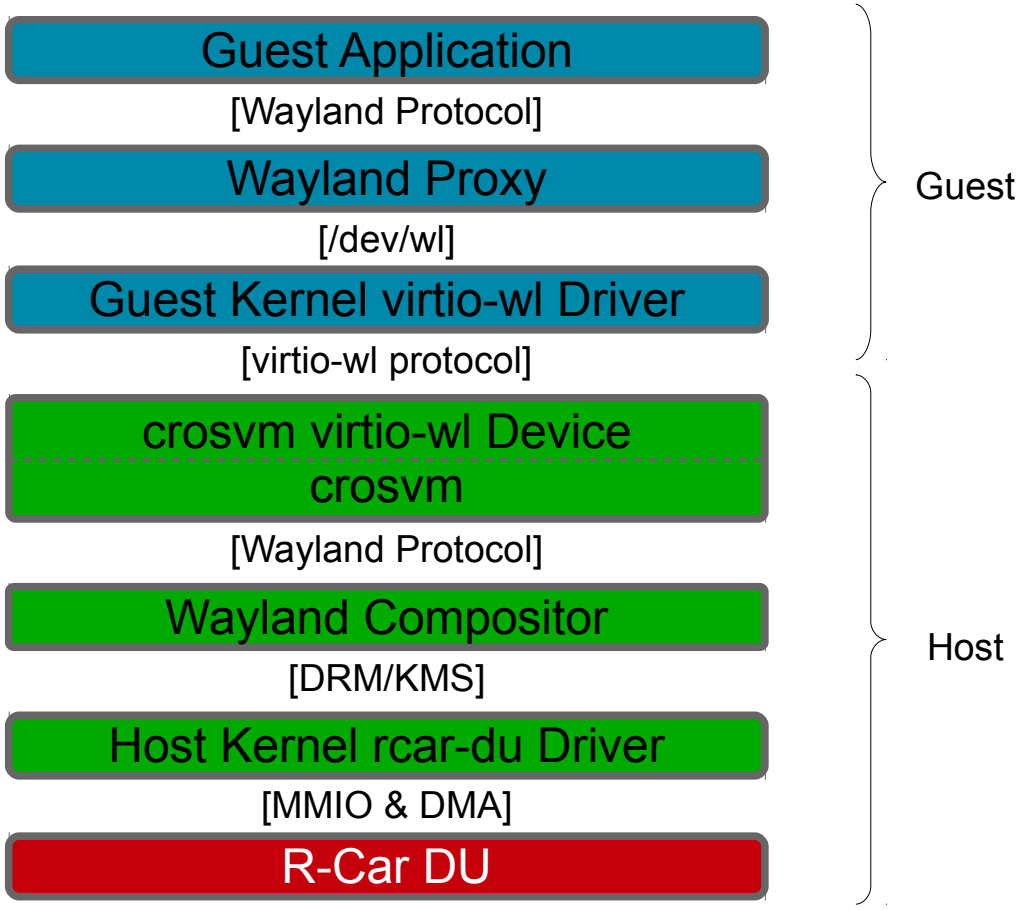


IDEAS ON BOARD

R-Car H3 DU



Display Virtualization – virtio-kms



Display Virtualization – virtio-wl

- https://wiki.automotivelinux.org/eg-virt
- https://github.com/oasis-tcs/virtio-spec
- https://events.static.linuxfound.org/sites/events/files/slides/An%20Introduction%20to%20PCI%20Device%20Assignment%20with%20VFIO%20-%20Williamson%20-%202016-08-30_0.pdf
- http://www.linux-kvm.org/images/5/59/02x03-Neo_Jia_and_Kirti_Wankhede-vGPU_on_KVM-A_VFIO_based_Framework.pdf
- https://www.spinics.net/lists/dri-devel/msg164583.html
- https://www.elinux.org/R-Car/Virtualization

Resources

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Contact

ご清聴
ありがとう
ございました！

IDEAS ON BOARD