Design of Vhost-pci

- designing a new virtio device for inter-VM communication

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Agenda

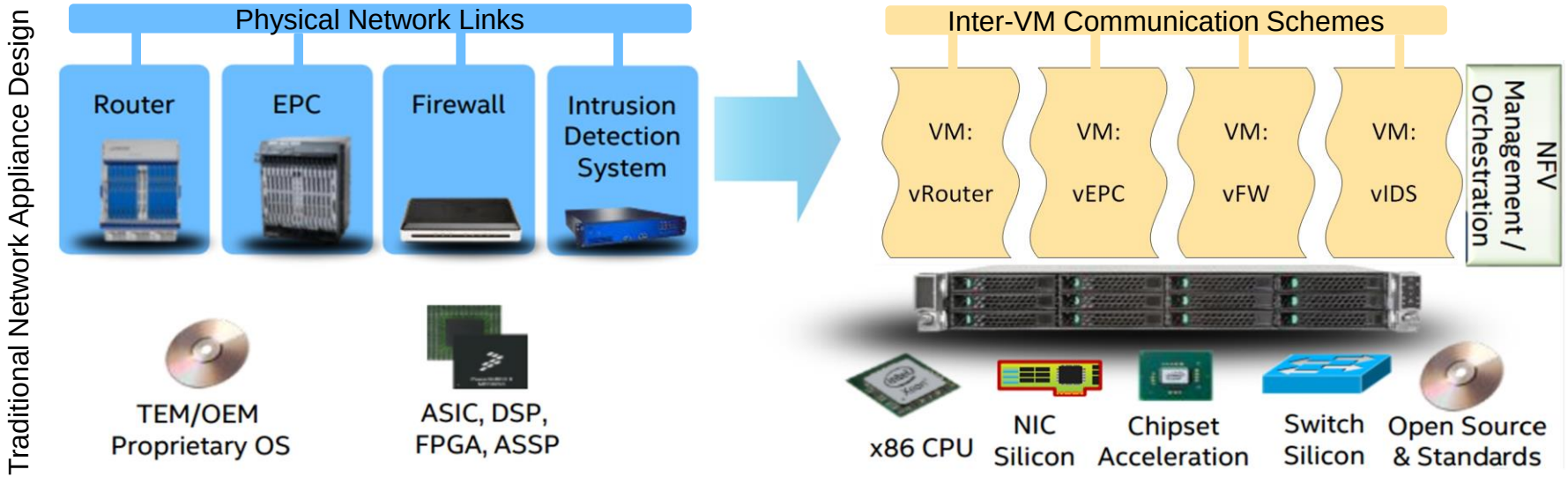
Part 1: Usage and Motivation

Part 2: Design Details

Part 3: Current Status

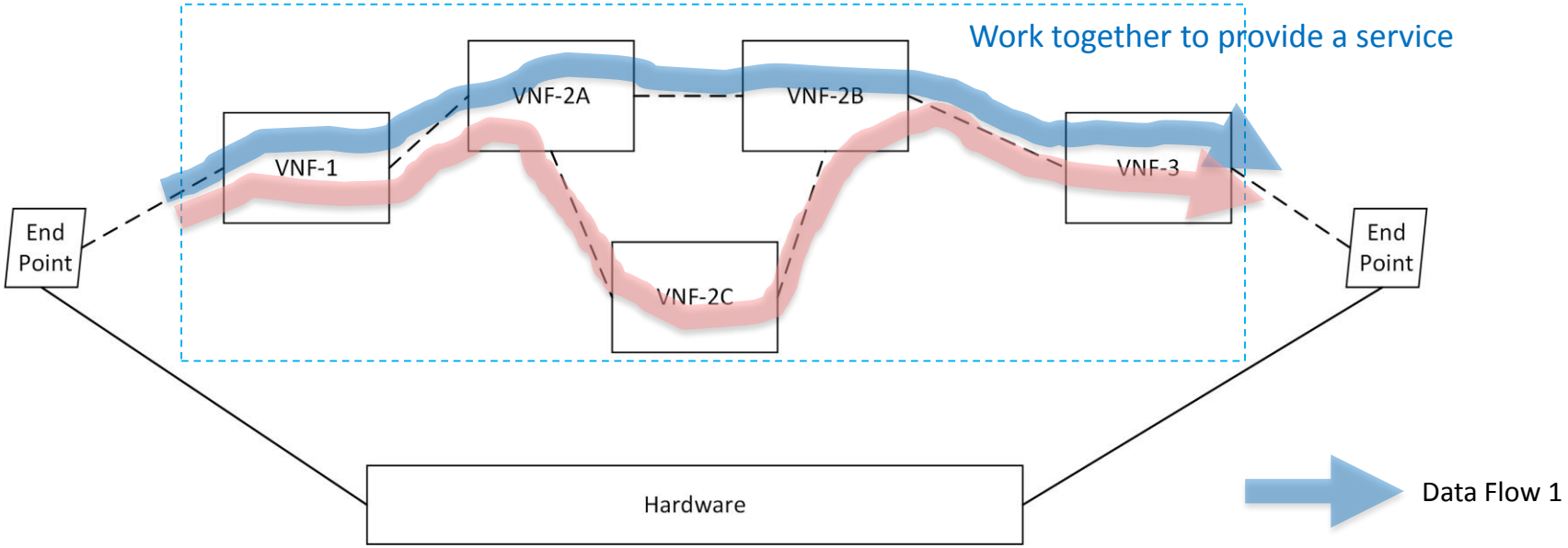
Part 1:
Usage and Motivation

Transformation of Network Appliances



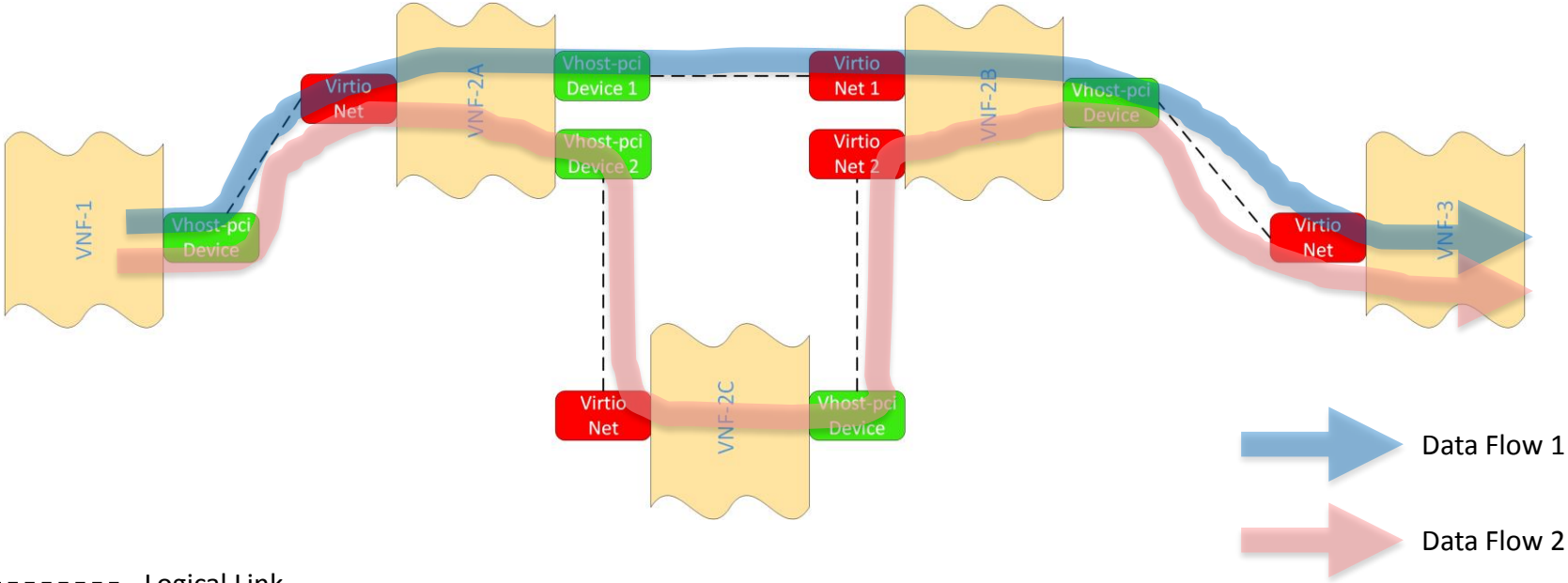
Network Appliances to Virtual Network Functions(VNF):
transformation relies on high performance inter-VM communication schemes

Virtual Network Function Forwarding Graph



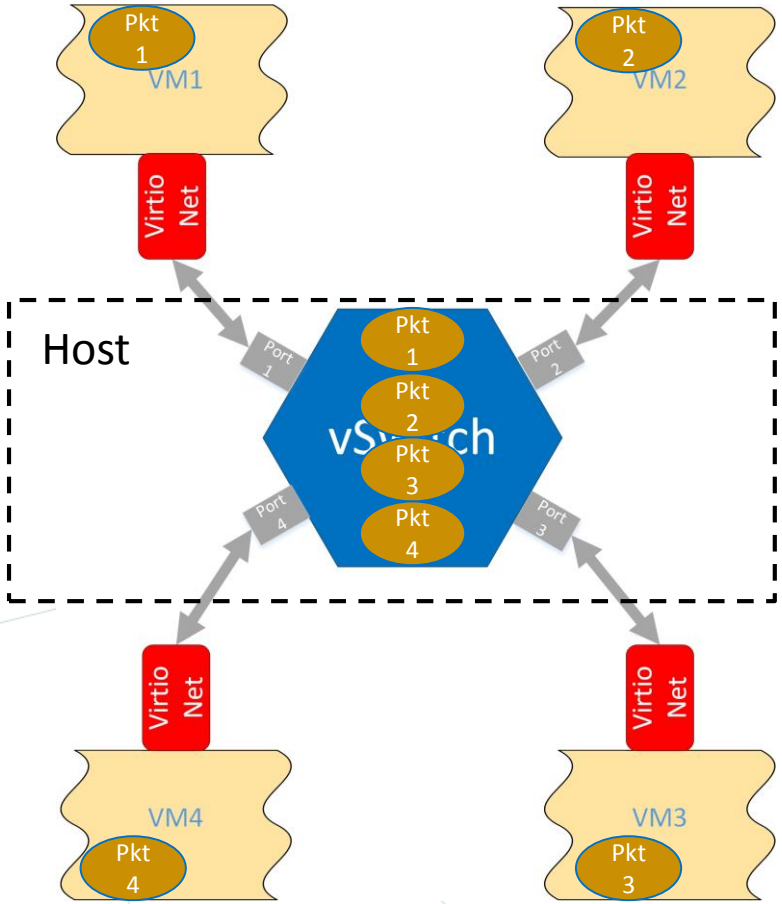
Ref: ETSI, "Architectural Framework", 2013
http://www.etsi.org/deliver/etsi_gs/nfv/001_099/002/01.01.01_60/gs_nfv002v010101p.pdf

VNF Forwarding with Vhost-pci



Existing Inter-VM Network Packet Transmission

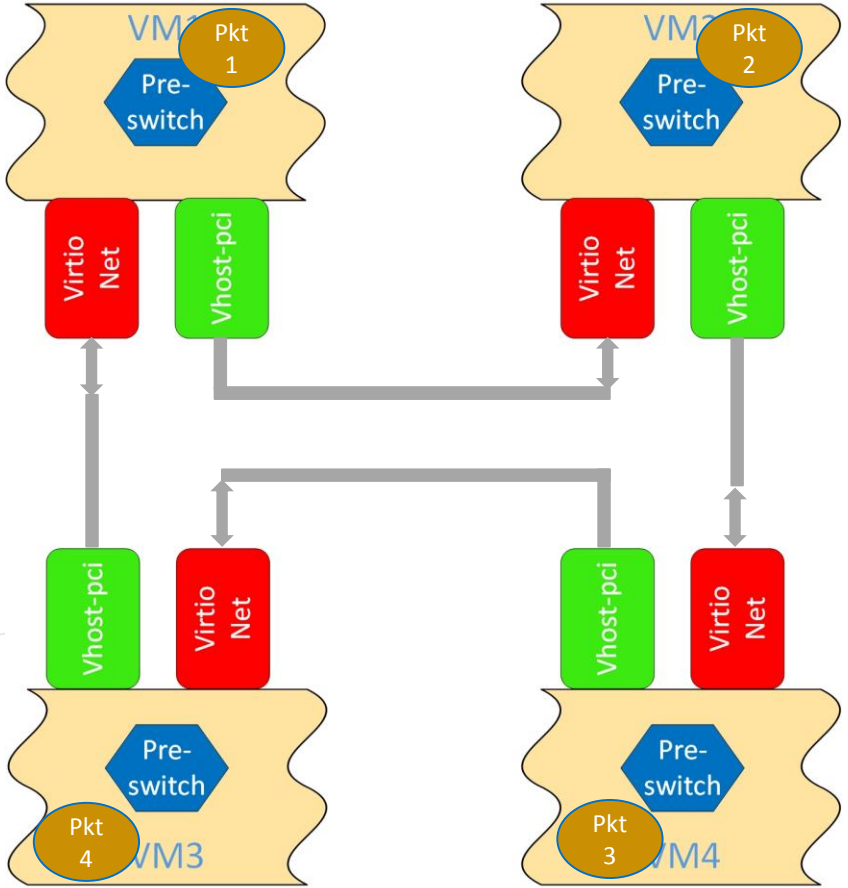
- Long Code Path: packets are transmitted from one VM to another via an intermediary
- Packets, streamed out of VMs, are bumper-to-bumper in the central vSwitch



Vhost-pci for Inter-VM Network Packet Transmission

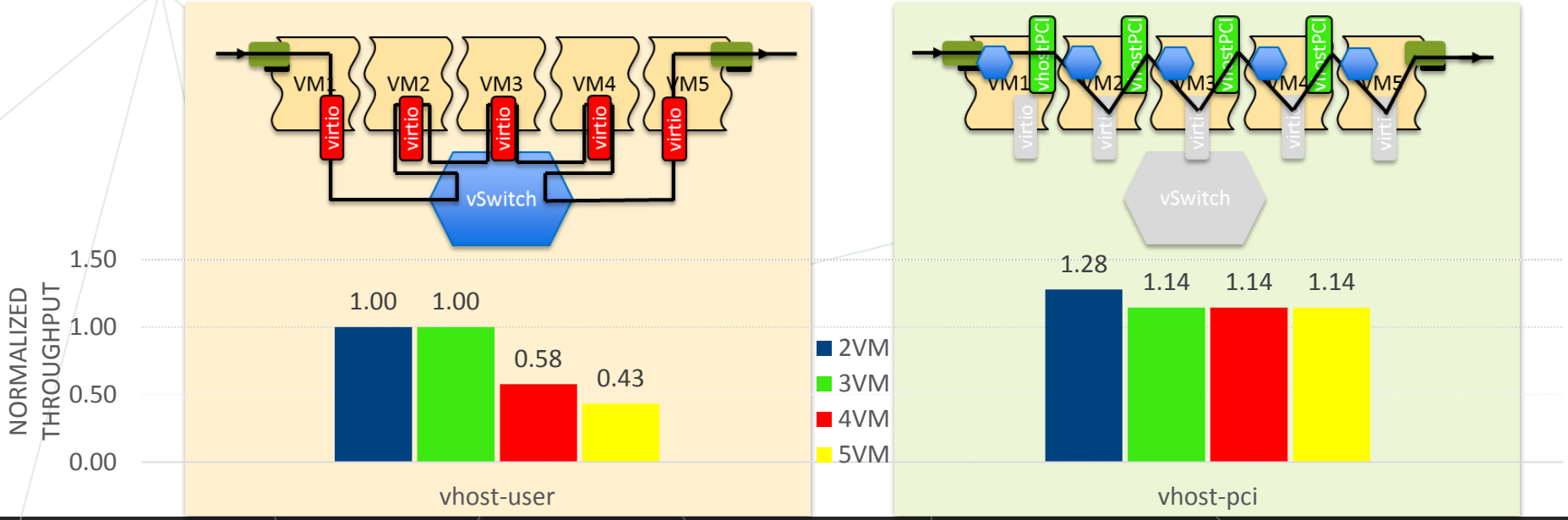
Advantages:

- Short Code Path: packets are transmitted from one VM directly to another VM
- Better scalability



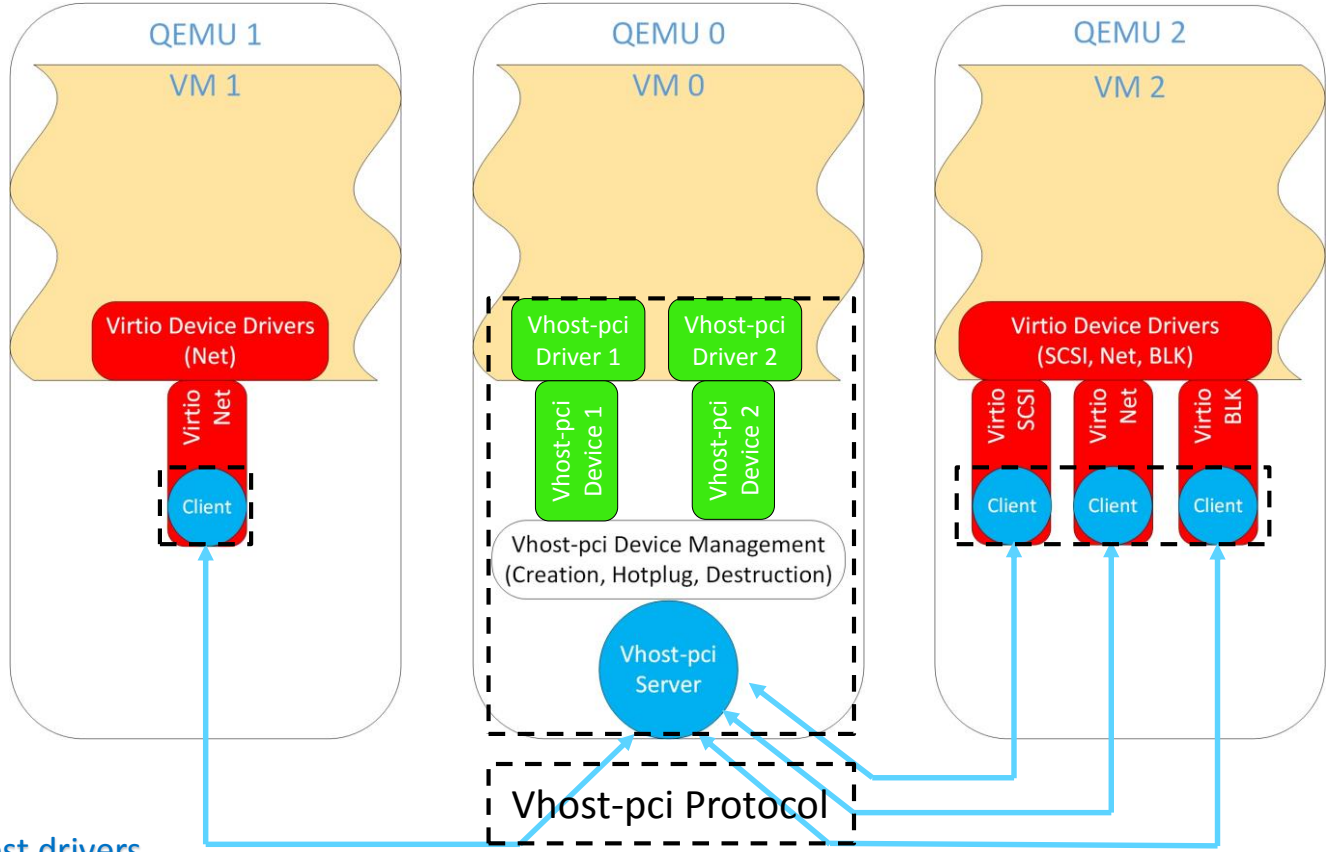
Micro-benchmarking Results

VSPERF / Chain of 2 to 5 VM
- RFC2544 via ext. packet generator DPDK Pktgen
- OVS DPDK on two cores (default)
- VM setup: one pinned vCPU, 2GB RAM (hugepages)
- pCPU: Intel(R) Xeon(R) E5-2698 v3 @ 2.30GHz



Part 2:
Design Details

Vhost-pci Design



Frontend Device/Driver

Backend Device/Driver

QEMU Socket Server/Client

Socket Connection

New Component

No change needed to in-guest drivers for virtio devices

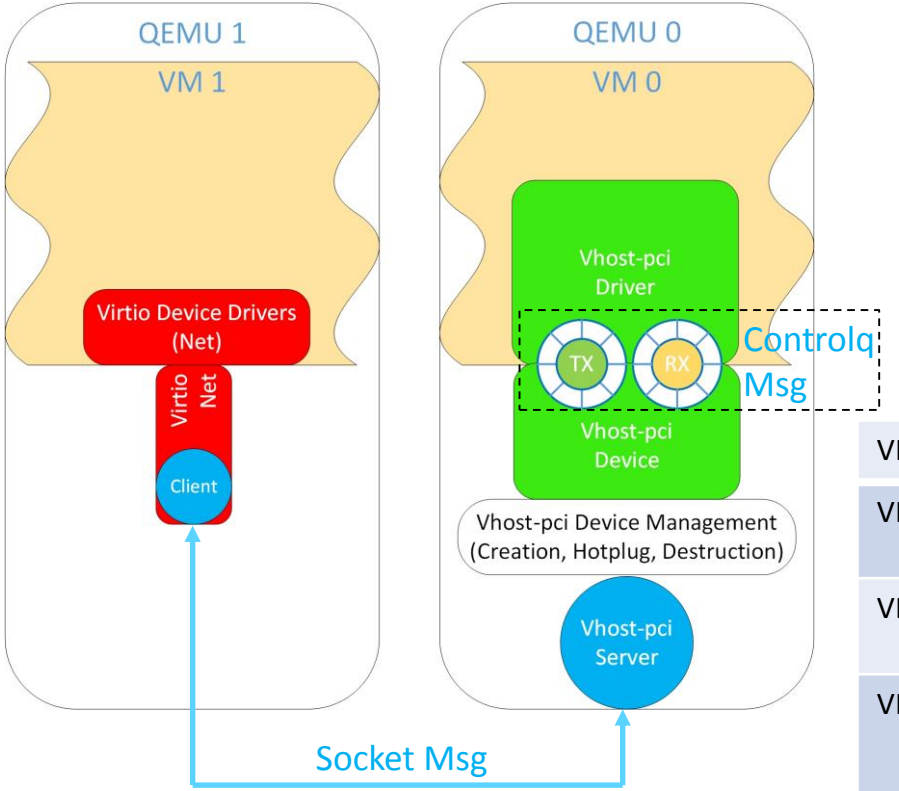
Vhost-pci Server

- To use the vhost-pci based inter-VM communication mechanism, a VM's QEMU needs to create a vhost-pci server
- Creates a vhost-pci-server by adding the following QEMU booting commands:
  - -chardev socket,id=vhost-pci-server-xyz,server,wait=off,connections=32,path=/opt/vhost-pci-server-xyz
  - -vhost-pci-server socket,chardev=vhost-pci-server-xyz

Vhost-pci Client

- To use a vhost-pci device on another VM as a backend, the originating virtio device supplies a vhost-pci client which connects to the remote vhost-pci server
- Create a virtio device with a vhost-pci client using the following commands:
  - -chardev socket,id=vp-client1,path=/opt/vhost-pci-server-xyz
  - -device virtio-net-pci,mac=52:54:00:00:00:01,vhost-pci-client=vp-client1
- The client communicates to the server using the vhost-pci protocol to set up the inter-VM communication channel

Vhost-PCI Protocol

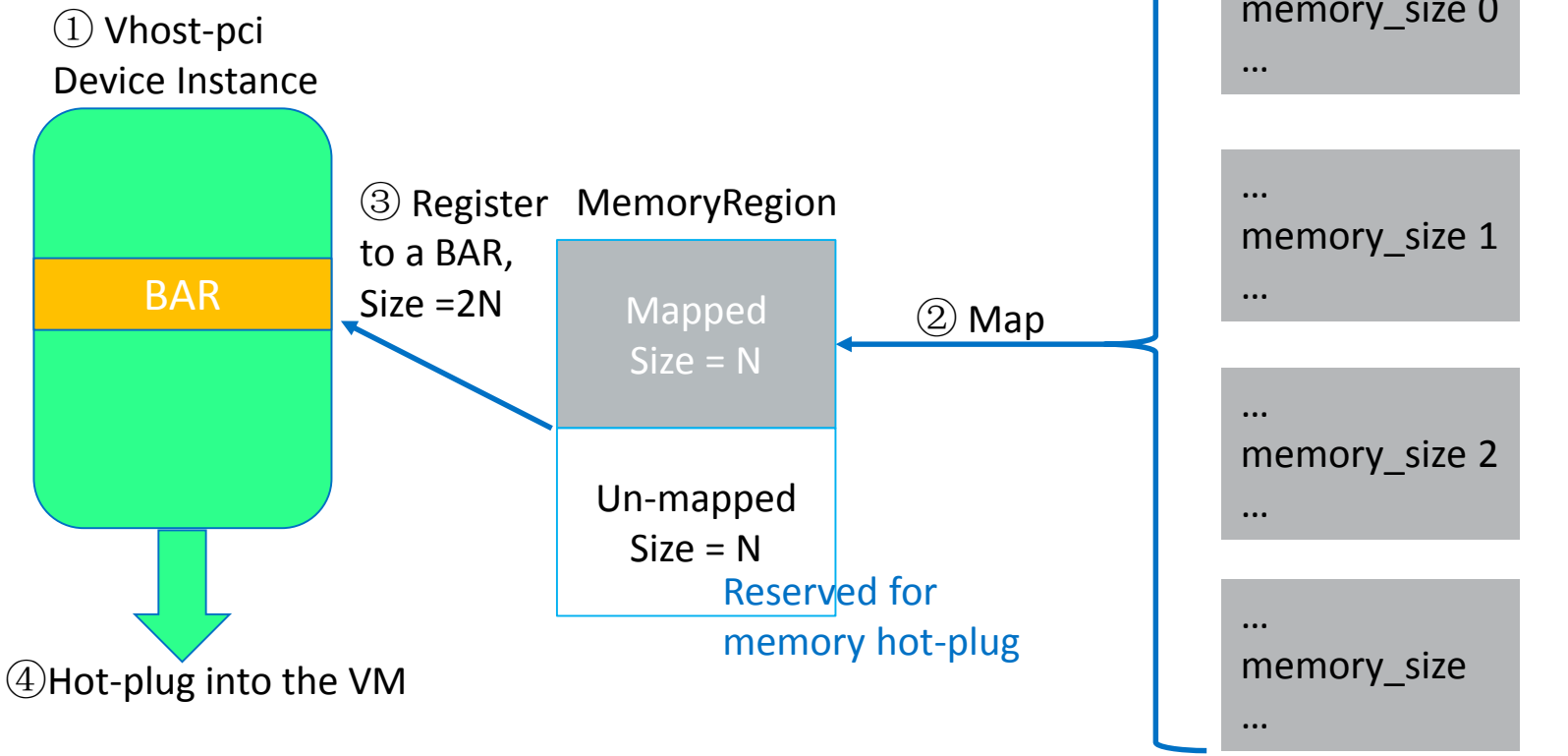


Protocol Msg

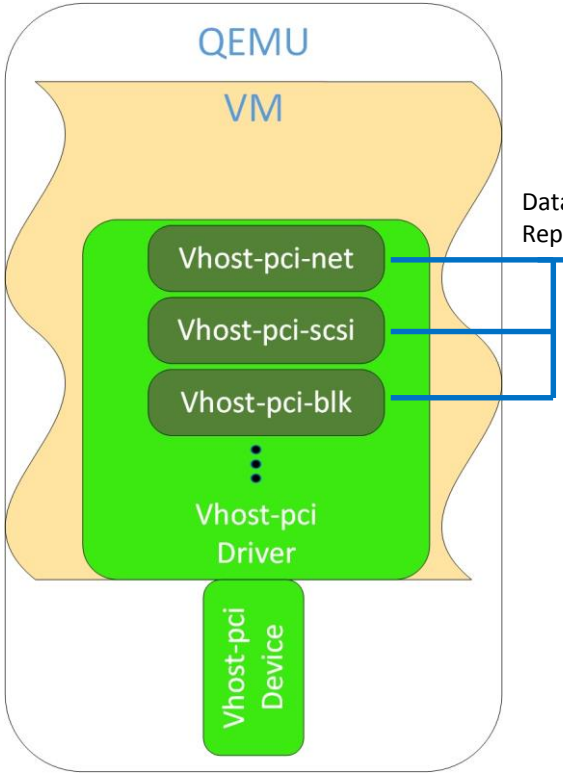
VHOST_PCI_GET_UUID	Identifies a frontend VM
VHOST_PCI_GET_MEMORY_INFO	Used to map the entire frontend VM's memory
VHOST_PCI_GET_DEVICE_INFO	Frontend device info (device type, vring addr etc)
VHOST_PCI_GET_FEATURE_BITS	Feature bits of the frontend device to be negotiated with the vhost-pci device and driver

Vhost-pci Device Management

Device Creation



Vhost-pci Driver



Data Structure Representation

struct vhost_pci_info:

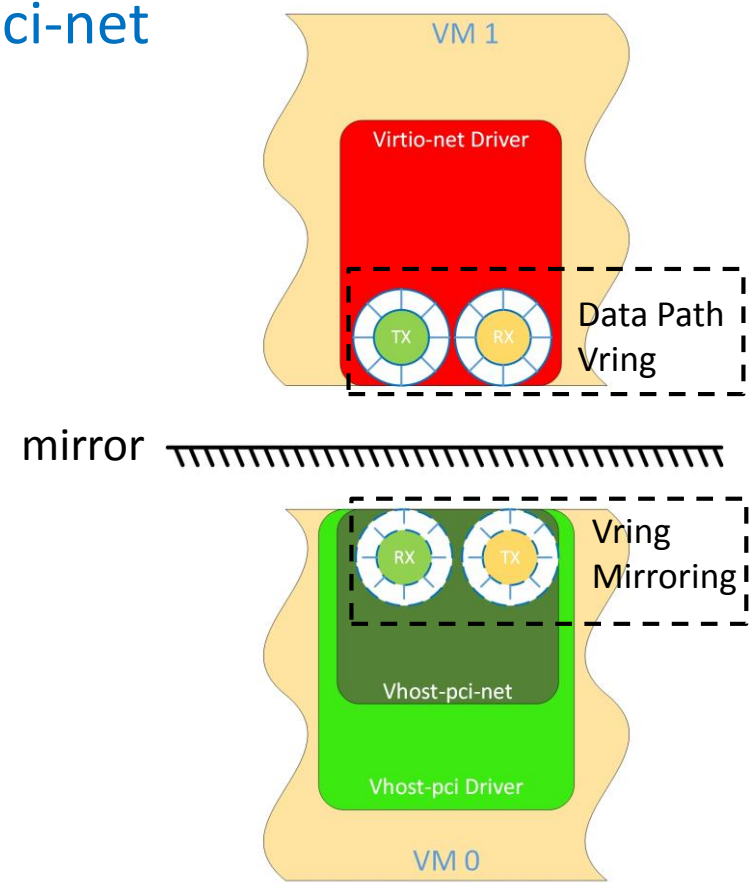
- struct vhost_pci_dev[MAX_NUM];

struct vhost_pci_dev:

- u32 device_type;
- u64 device_id;
- void *dev;

Pointer to the device specific structure
e.g. dev = net_device

Vhost-pci-net



- vhost-pci-net shares vrings created by the originating virtio-net device
- TX ring from originating device becomes RX ring at mirrored device, and vice versa
- Copying packets in and out of originating device rings is the responsibility of vhost-pci-net

Part 3:
Current Status

Current Status

- Initial PoC completed, summary of results presented
- Design RFC v2 has been sent out to KVM/QEMU mailing list (https://lists.gnu.org/archive/html/qemu-devel/2016-06/msg05359.html)
- Patches implementing RFC v2 design are work in progress

End of Presentation

Thank you!