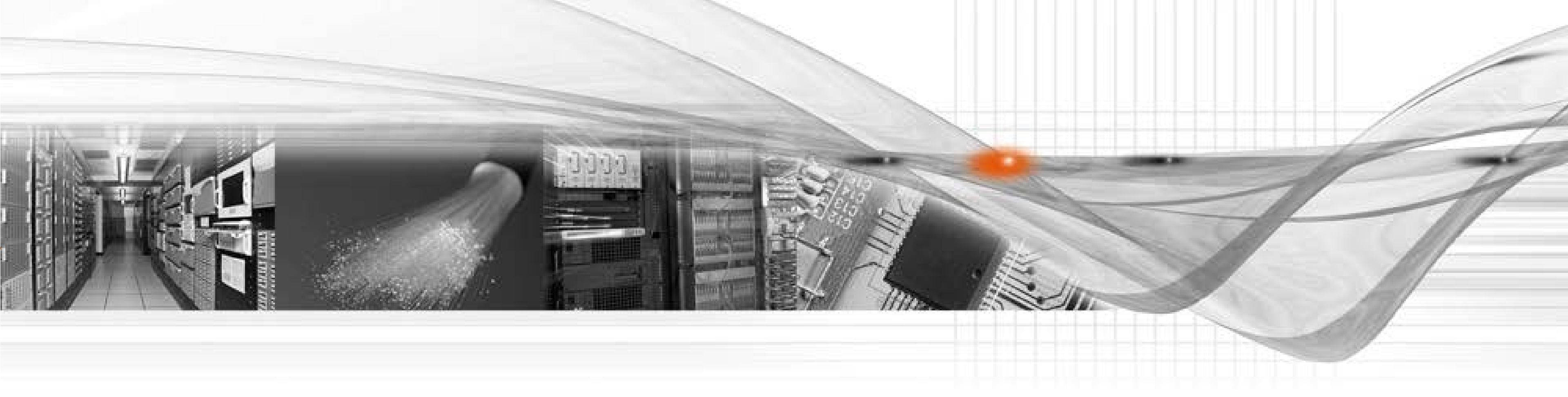
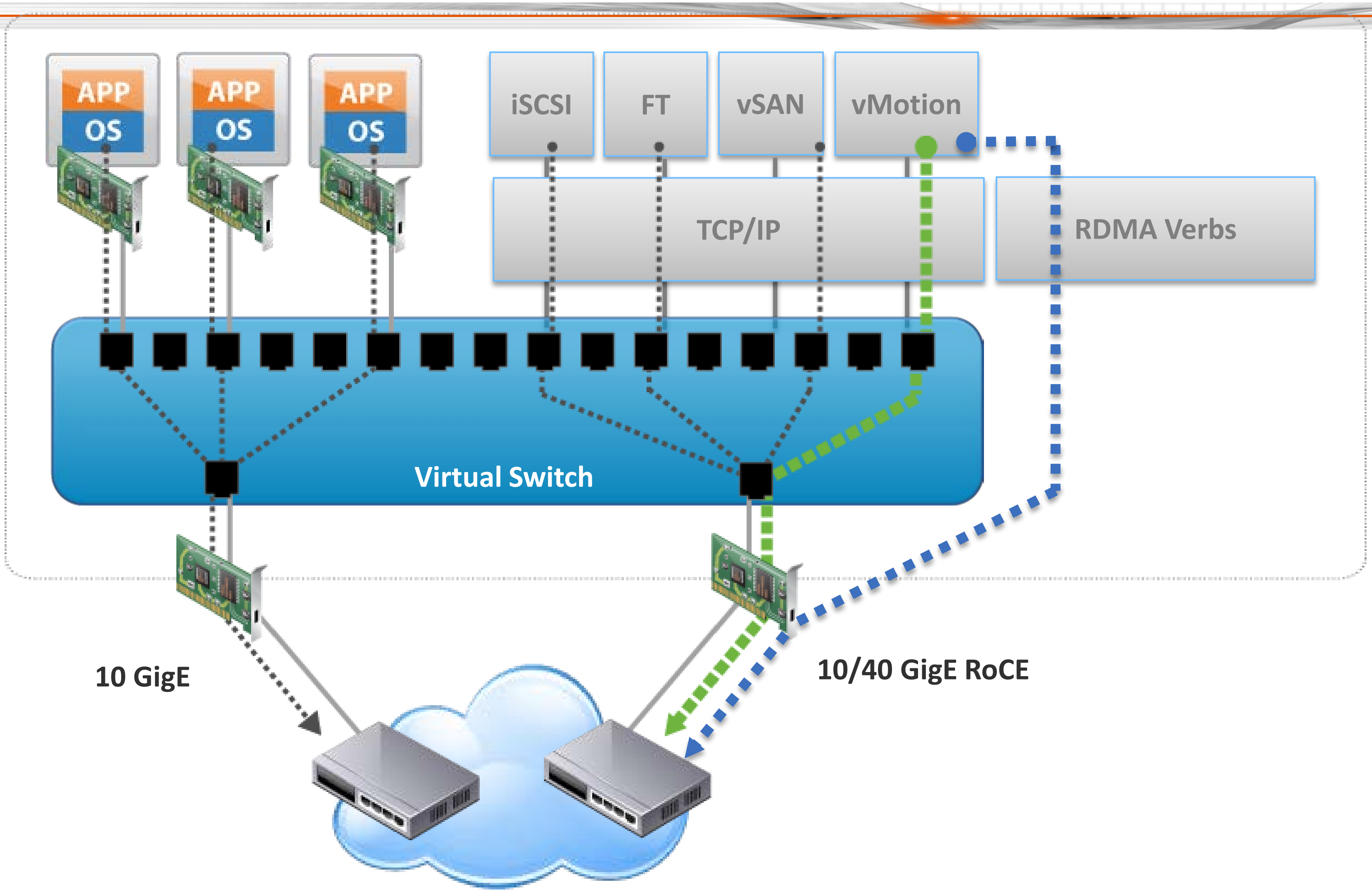


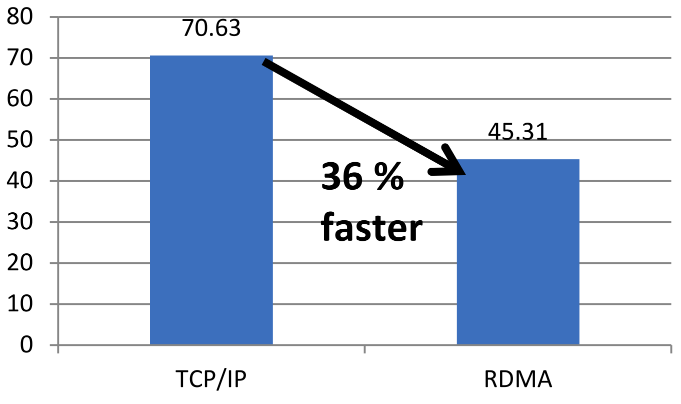
RDMA In Virtual Environments (v1.0)

Aaron Blasius, ESXi Product Manager
Bhavesh Davda, Office of CTO
VMware

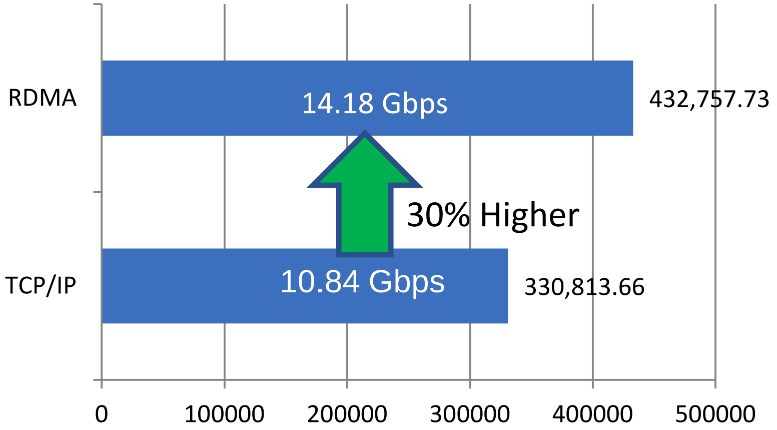
RDMA for hypervisor services



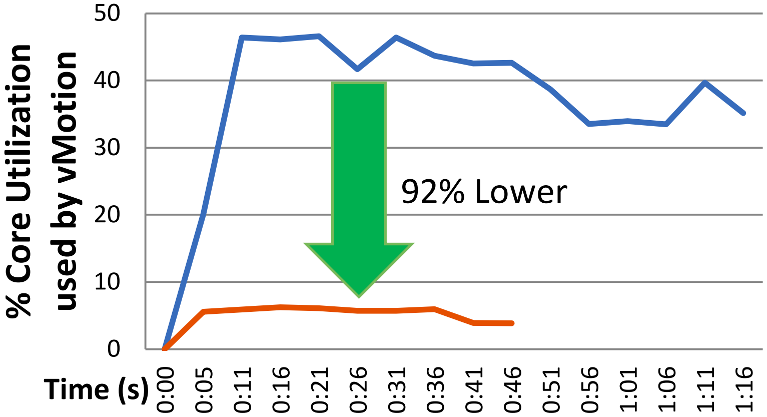
vMotion/RDMA Performance



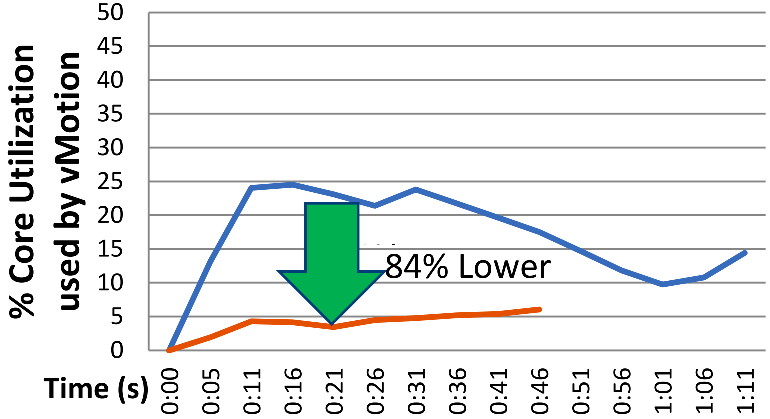
Total vMotion Time (seconds)



Precopy bandwidth (Pages/sec)



Destination CPU Utilization



Source CPU Utilization

Hypervisor level RDMA Requirements

- Integrate OFED Kernel Space Mid-Layer and Provider components into ESXi hypervisor
- Add RDMA Verbs support for hypervisor services: vMotion, FT, vSAN, vRDMA, iSCSI
- Create RDMA Device layer for hardware drivers to plug into
- Work in progress

Options to offer RDMA to vSphere Virtual Machines

- Full-function VM DirectPath (passthrough) **≥ ESXi 4.0**
- SR-IOV VF VM DirectPath (passthrough) **≥ ESXi 5.1**
- SoftRoCE over 10GbE in VM DirectPath mode
- SoftRoCE over paravirtual Ethernet vNIC over 10GbE uplink
- SoftRoCE over paravirtual Ethernet vNIC between VMs

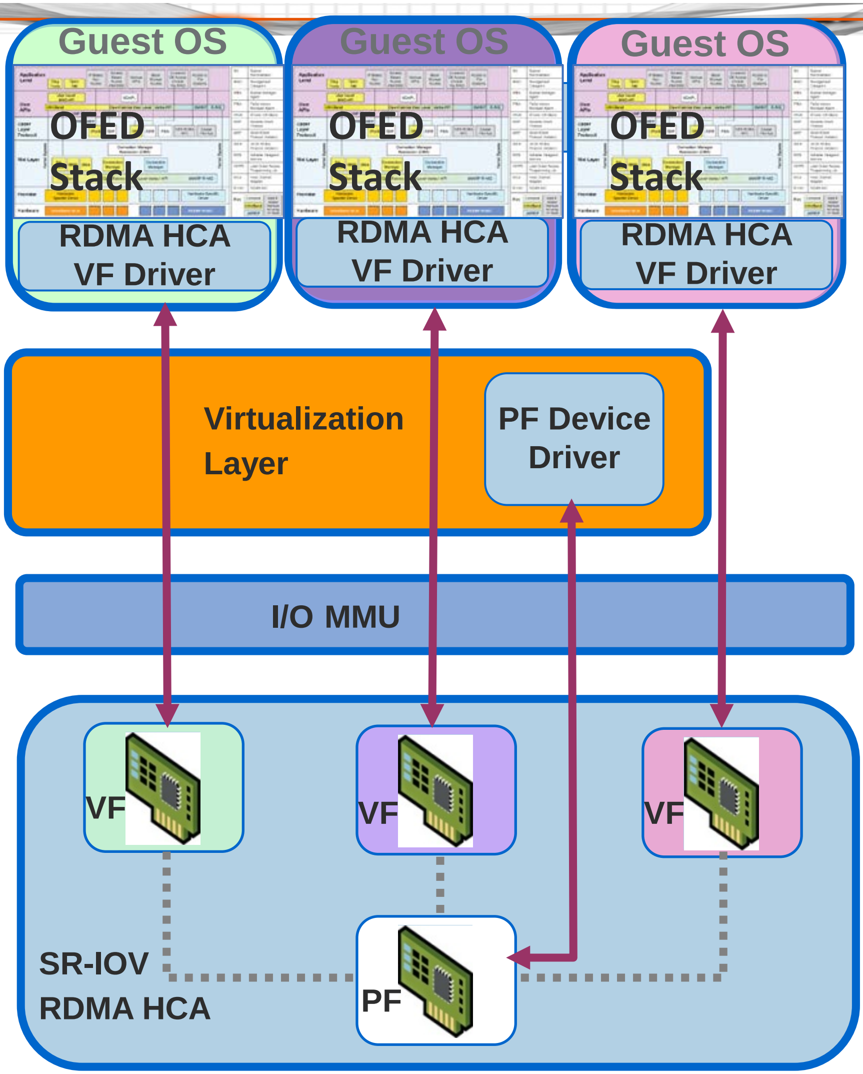
NOT RECOMMENDED

- Paravirtual RDMA HCA (vRDMA) offered to VM

Prototyping/Future

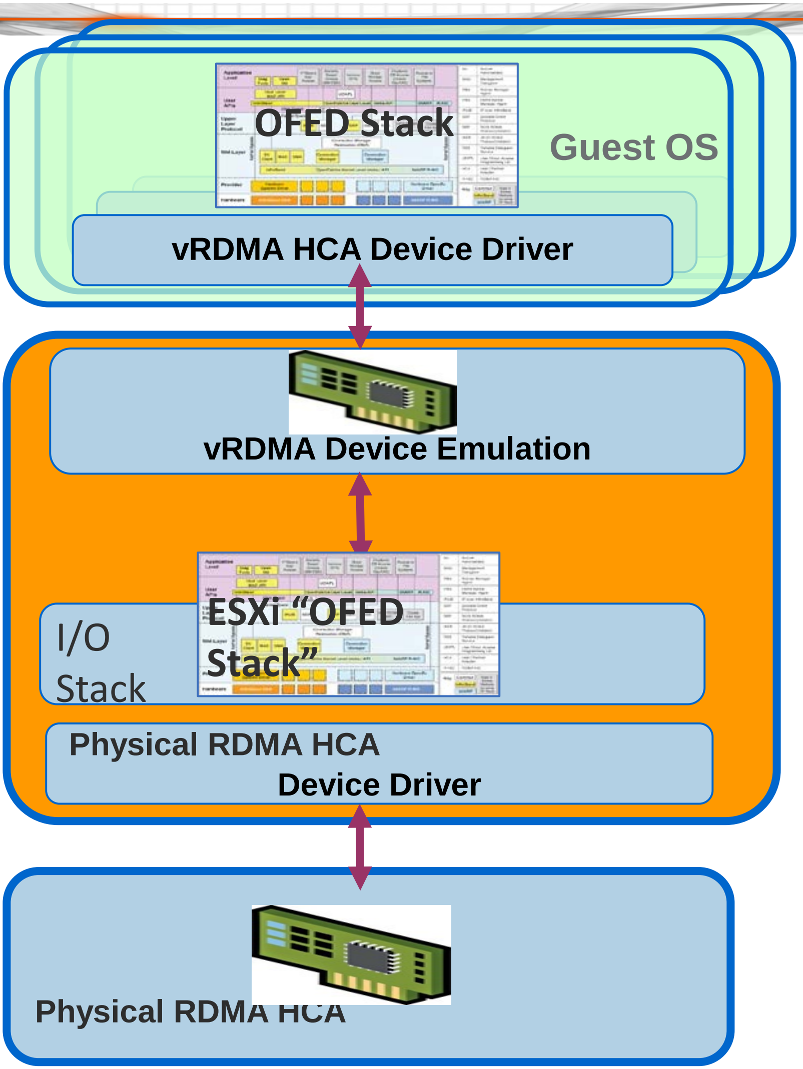
SR-IOV VF VM DirectPath

- Single-Root IO Virtualization (SR-IOV): PCI-SIG standard
- Physical (IB/RoCE/iWARP) HCA can be shared between VMs or by the ESXi hypervisor
  - Virtual Functions direct assigned to VMs
  - Physical Function controlled by hypervisor
- Still VM DirectPath, which is incompatible with many important vSphere features



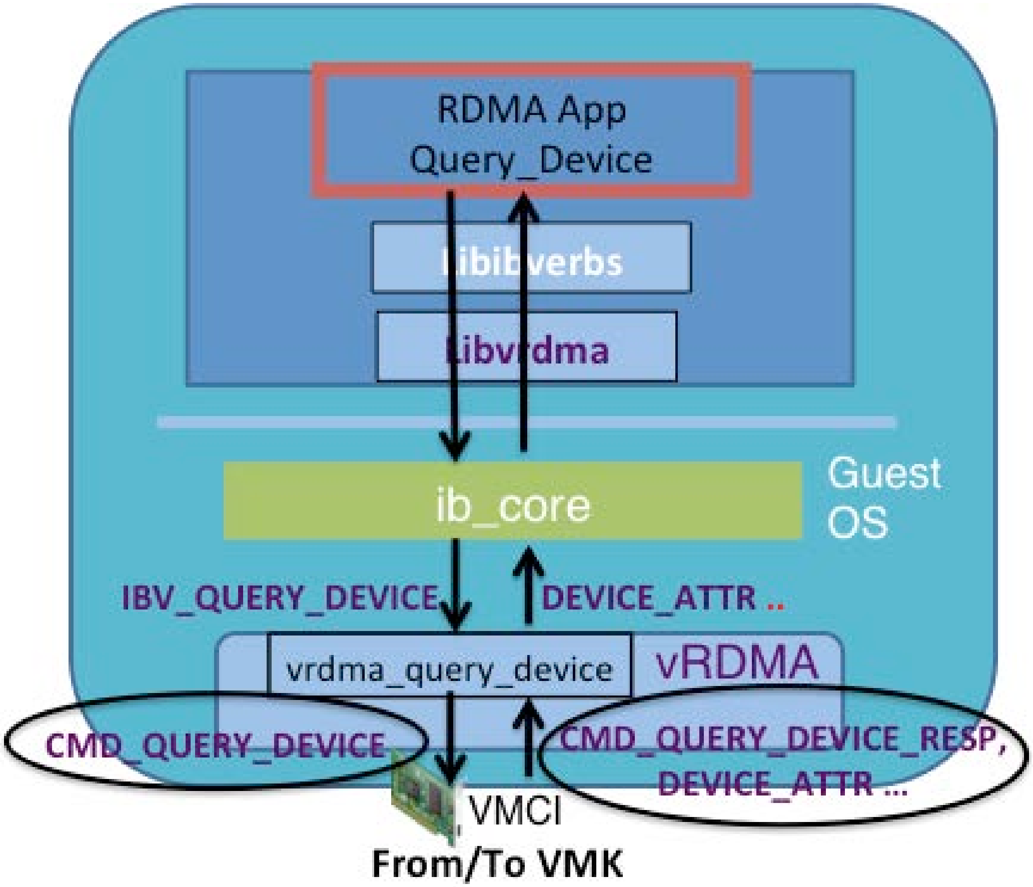
Paravirtual RDMA HCA (vRDMA) offered to VM

- New paravirtualized device exposed to Virtual Machine
  - Implements "Verbs" interface
- Device emulated in ESXi hypervisor
  - Translates Verbs from Guest to Verbs to ESXi "OFED Stack"
  - Guest physical memory regions mapped to ESXi and passed down to physical RDMA HCA
  - Zero-copy DMA directly from/to guest physical memory
  - Completions/interrupts "proxied" by emulation
- "Holy Grail" of RDMA options for vSphere VMs



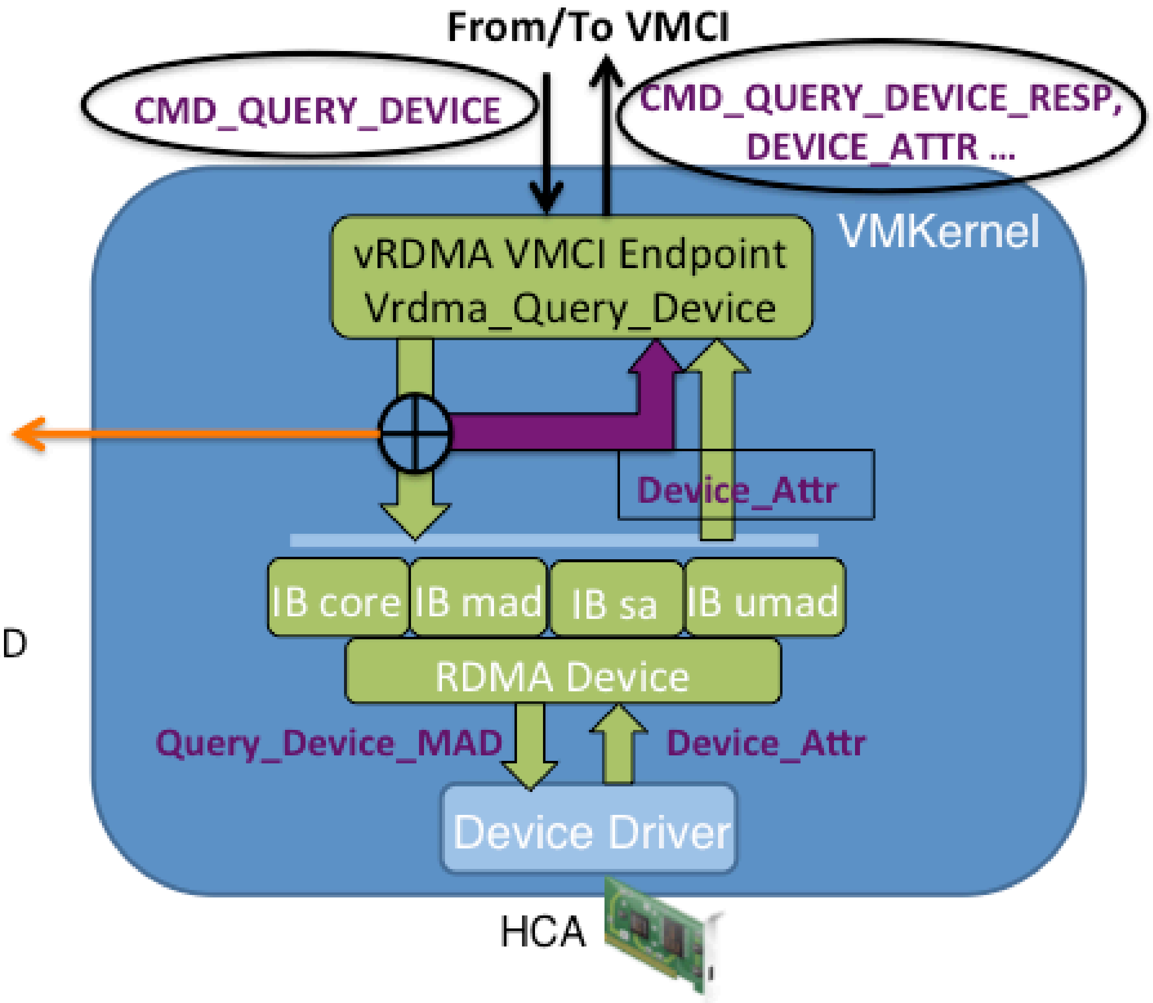
Guest Kernel vRDMA Driver

- Registers kernel verbs functionality with ib_core framework
- Re-uses response structures from ib_user_verbs.h

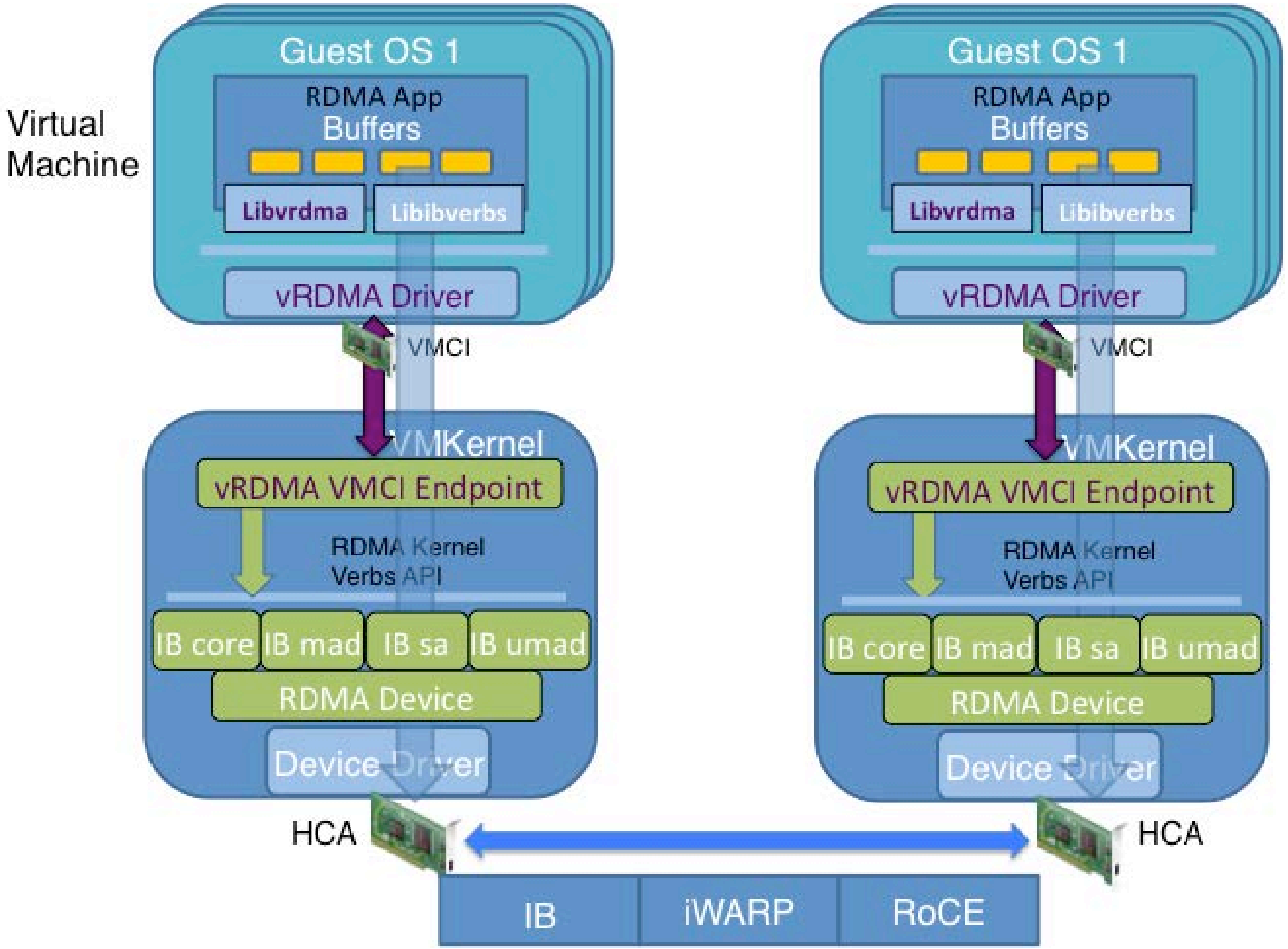


ESXi VMkernel vRDMA Backend

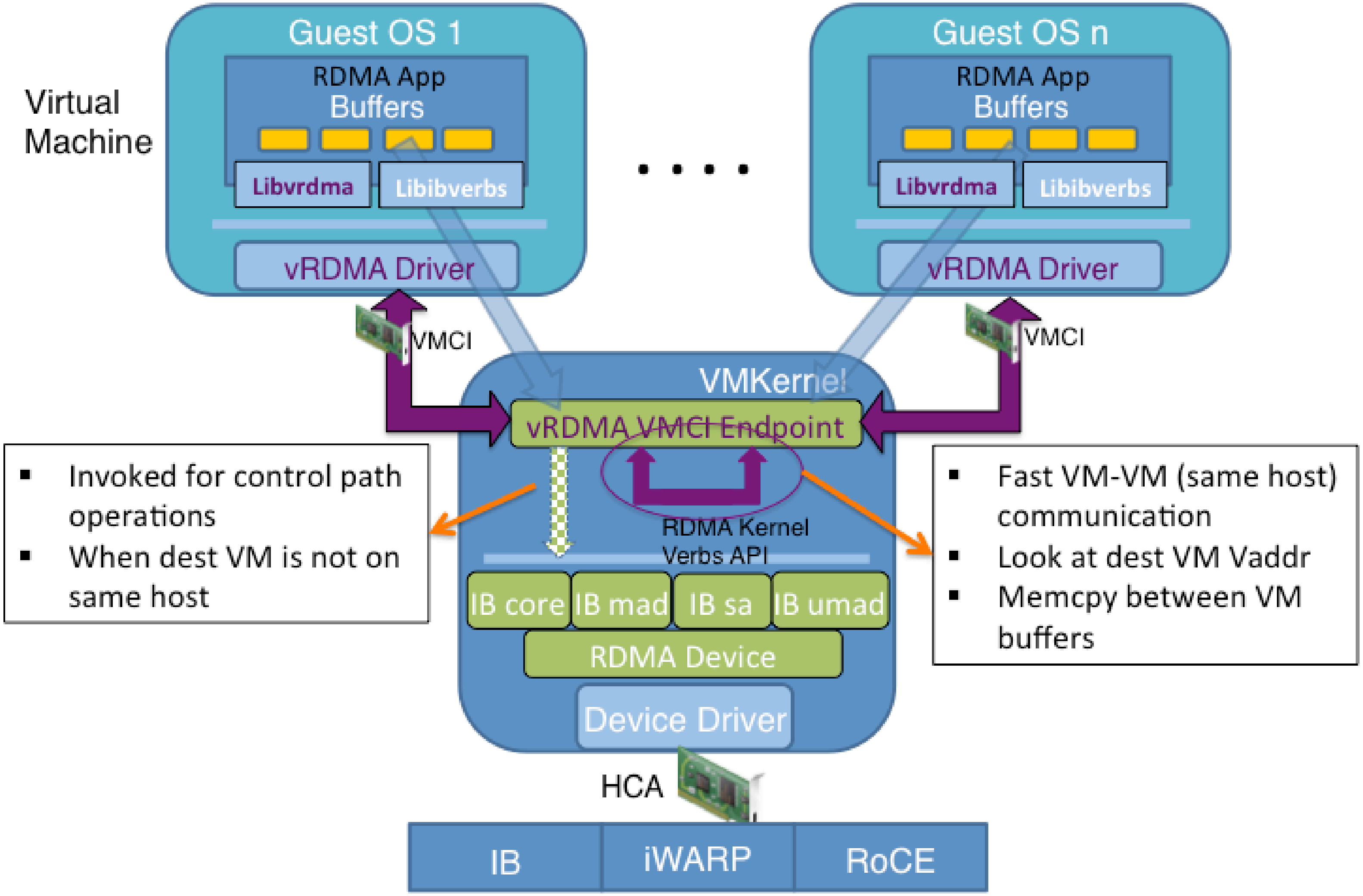
- vRDMA can return cached/dummy Device_Attr
- No need to send Query_Device_MAD everytime



vRDMA: VMs On Different Hosts



vRDMA: VMs On The Same Host



- Invoked for control path operations
- When dest VM is not on same host

- Fast VM-VM (same host) communication
- Look at dest VM Vaddr
- Memcpy between VM buffers

vRDMA Prototype Status

- Prototyped by intern in CTO office in summer ‘12
- MAD Verbs functional
- Data path Verbs work-in-progress
- Estimated performance
  - 5 µs HRT for RDMA Write with polling completion
  - Back-of-envelope estimate based on VM-exit overheads and VMCI performance benchmarks

RDMA Use Cases

- Traditional Enterprise
- HPC
- Big Data
- Storage
- Messaging
- Other Scale Out Applications
- What’s your preferred method for obtaining device drivers?
  - Linux distribution OFED
  - Hardware vendor OFED

RDMA Adoption Trend

- What % of your organization’s applications leverage RDMA today?
- What % by 2016?
- Is RDMA driving your hardware purchasing decisions?
- Are any of your RDMA-based applications stateful?

Moving the enterprise to virtual RDMA

- Do you want to run RDMA-based applications in a VM?
- Would you use a virtual RDMA device in a VM?
  - vMotion, HA, Snapshots, DRS
- What is your tolerance for latency overhead?

Aaron Blasius

ablasius@vmware.com

Thank You

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