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Virtual RDMA devices

ANNUAL INTERNATIONAL OPENFABRICS SOFTWARE DEVELOPERS' WORKSHOP

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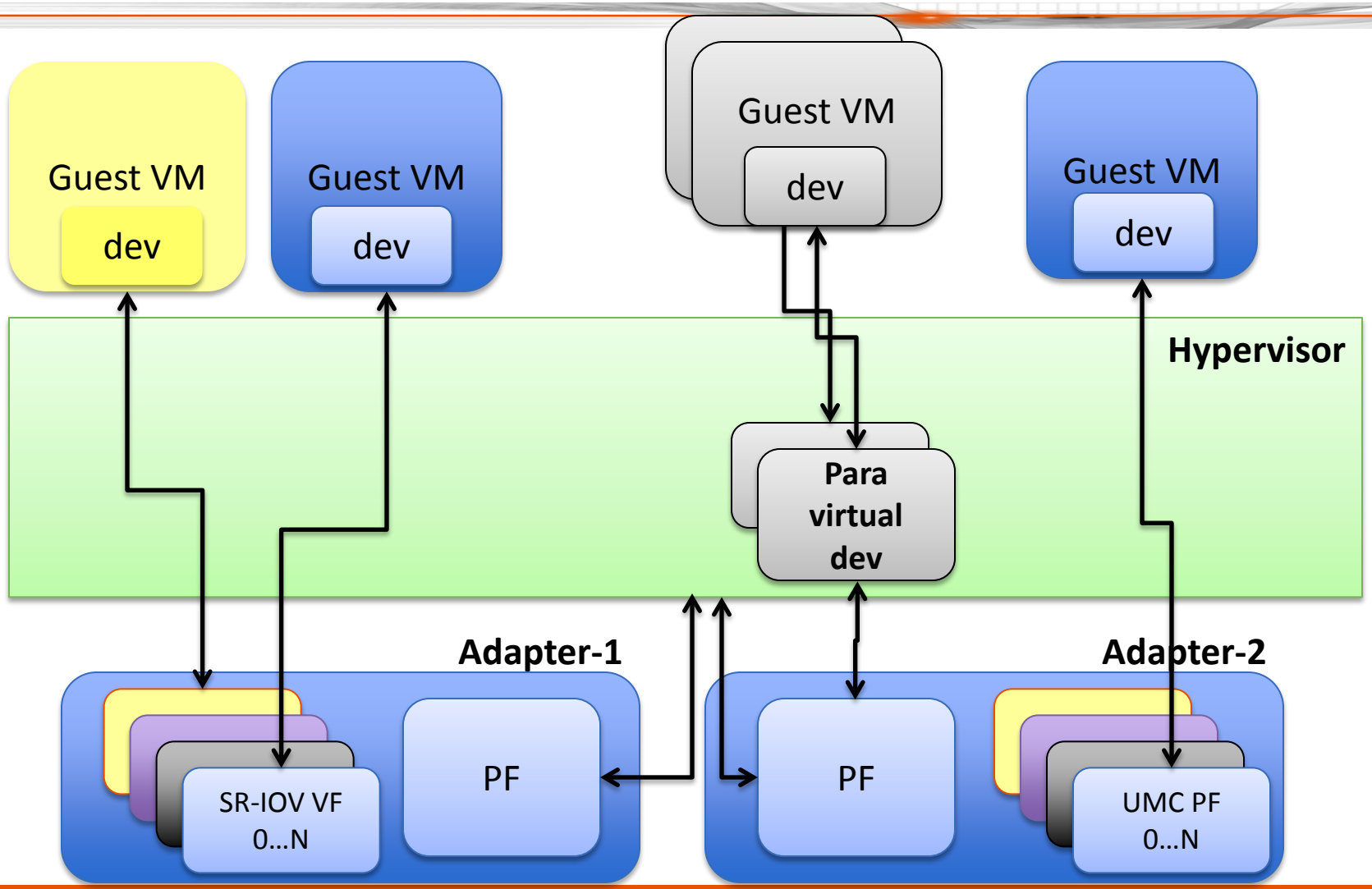
Overview

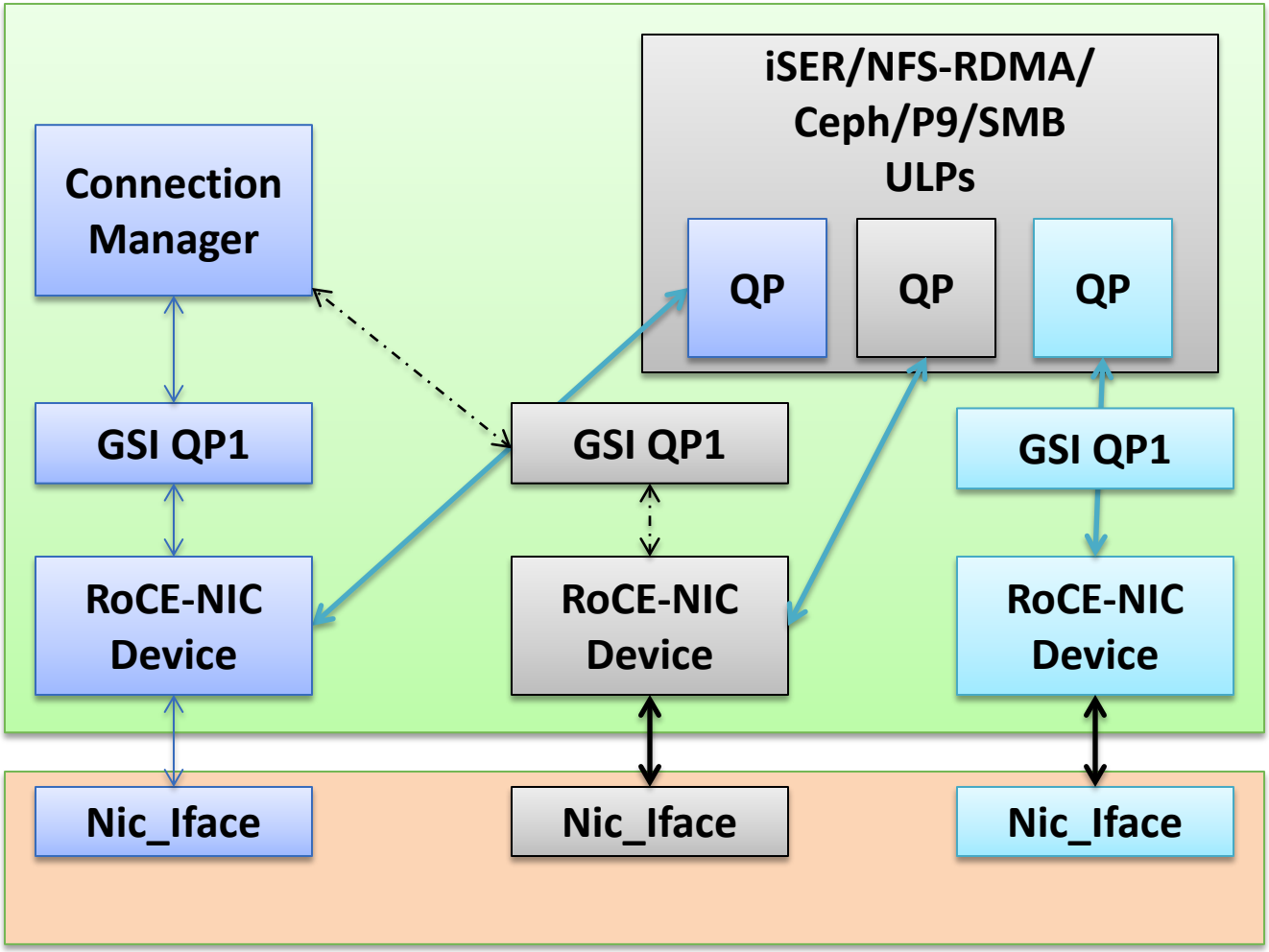
- Virtual devices
  - SR-IOV devices
  - Mapped physical devices to guest VM (Multi Channel)
  - Para virtualized devices
  - Software based virtual devices

  - Virtual device mapped to physical device

Overview


Guest VM
dev
Guest VM
dev
Guest VM
dev
Guest VM
dev
Hypervisor
Para
virtual
dev
Adapter-1
Adapter-2
SR-IOV VF
0…N
PF
PF
UMC PF
0…N

Overview of RoCE/NIC Interfaces (Dedicated QP1)



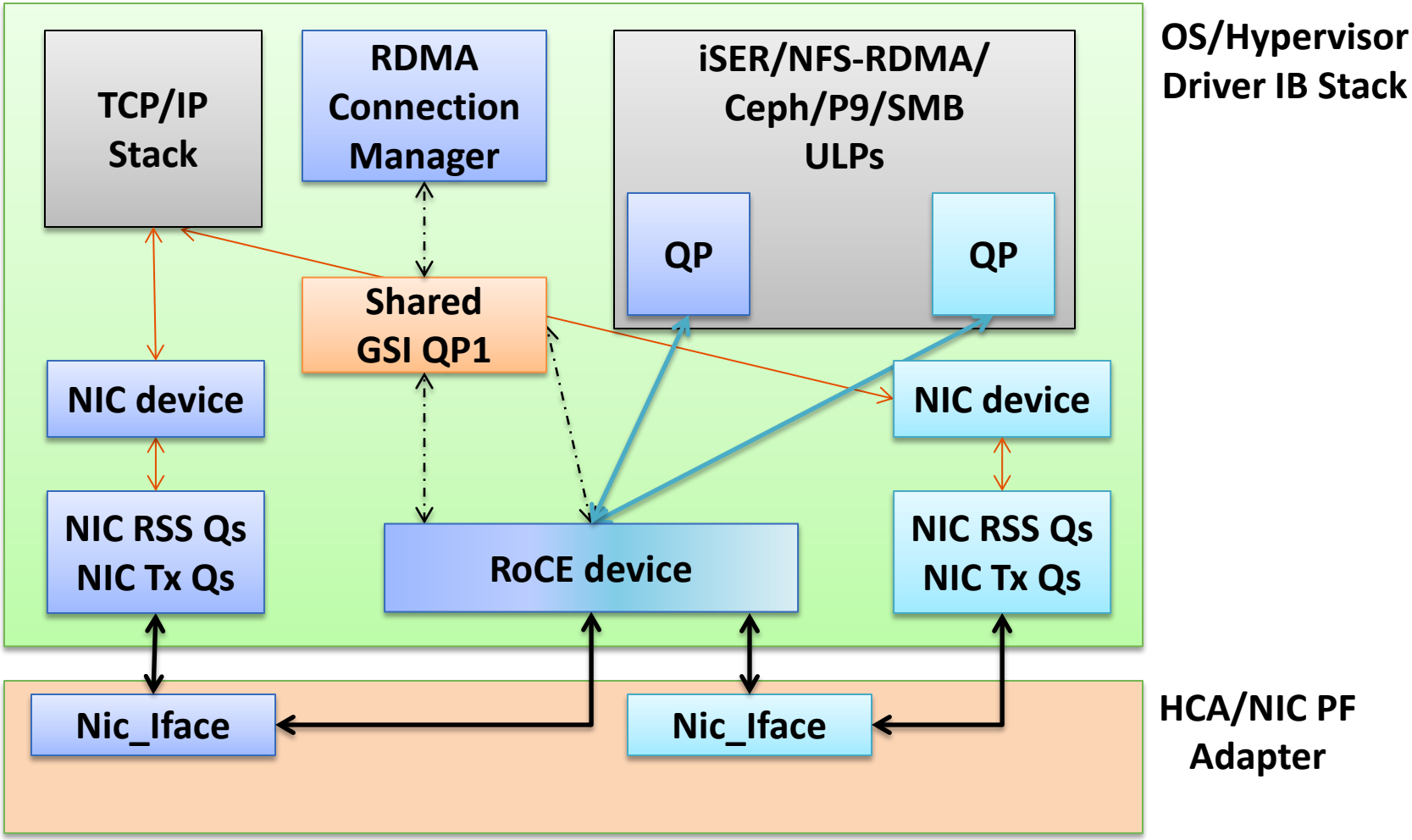
Multiple RoCE/NIC partitions using interfaces

- NIC driver can create one or more adapter specific *Nic_Iface* each having unique attributes such as MAC address and/or vlan.
- Each such *Nic_Iface* translates to adapter interface object at OS/Hypervisor level.
- One or more such interfaces can be created per PF.
- Each *Nic_Iface* can host NIC RSS RQs.
- NIC traffic continues to operate based on the existing *Nic_Iface* object including RSS support.

RoCE QP to Interface binding

- RoCE QPs are attached to one of the *Nic_Iface* object during QP state transition.
- RoCE QP can be reused without destroying and recreated to bind to different *Nic_Iface*.
- Supports accelerated (extensions) QP state transitions to make QP usable for data traffic per *Nic_Iface*.
- Every interface can host GSI QP1 based on the *Nic_Iface* adapter interface object.
- QP1 need to scale with each adapter interface object. There is better option that that.

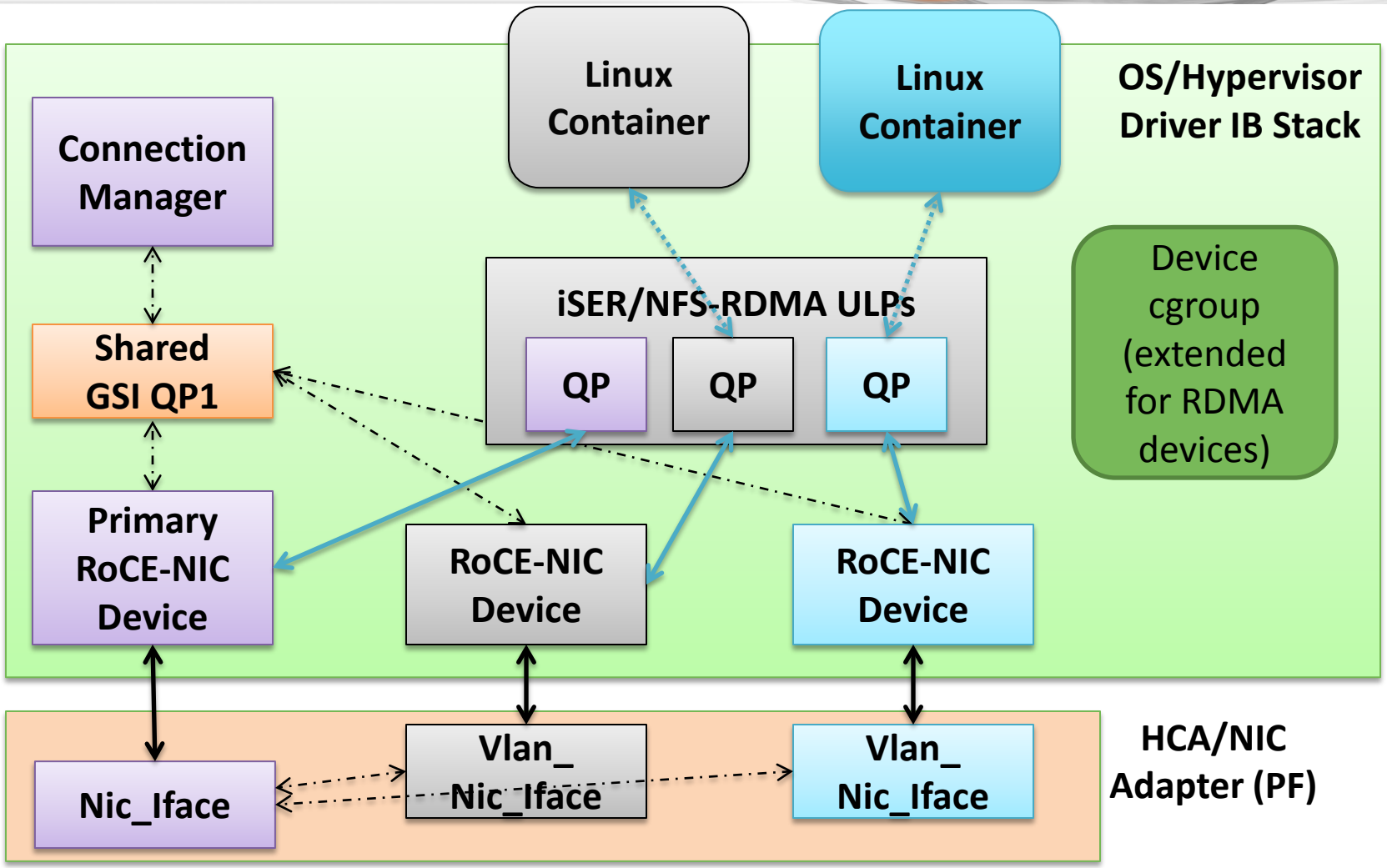
Shared QP1 across multiple NIC interfaces



Shared QP1 across multiple interfaces

- One GSI QP1 per port shared among multiple *Nic_Iface*.
- Scales well as number of interfaces grows.
- Filters QP1 packets on *Nic_Iface* basis.
- RoCE device driver connection manager performs connection establishment, filtering for the right *Nic_Iface* object.
- GSI QP1 accepts packets RoCEv1 and RoCEv2 packets
- Adapter parses QP1 packets and informs v1/v2 to connection manager stack reducing the need to parse the packets in host software driver.
- Connection manager supports RoCEv1 and RoCEv2 connections on per QP basis.

Linux vrdma overview



Virtual RDMA devices

- Multiple virtual RDMA devices are mapped to single physical ibdev RDMA device
- Each virtual RDMA device is mapped to single *netdev* structure
- Virtual device and physical device bound to same physical netdev during creation time
- Virtual device uses the resource of the physical devices (MR, PD, SRQ, QP)
- Network device movement from network namespaces destroys the virtual RDMA devices
- Network namespace destroys virtual rdma devices

Role of cgroup vs virtual rdma device

- Each virtual device can be provisioned for their own resources (orthogonal to cgroups)
- Device cgroup is extended for resource limitation of user space applications across multiple rdma devices
- Virtual devices provides resource provisioning for kernel consumers and their resources which are not directly bound to user processes, created/destroyed from threads, work_queues, connection management event handlers.

New ibverbs Linux APIs

- Binding creates the virtual rdma device (libibverbs)
  - *ibv_create_virtual_ibdev(struct ib_device *pdev,*
    *char *netdev_name,*
    *char *new_ibdev_name);*
  - *ibv_destroy_virtual_ibdev(char *virtual_ibdev_name);*
- Configuration
  - *int ibv_provision_resources(struct ib_device *vdev,*
    *struct ib_resource_config *resources);*
  - Resources provisioning can be changed dynamically, provided it doesn't have consume all of them.
- Device flag to indicate virtual or physical flag
  - *Ib_get_device_type(struct ib_device *dev);*
- New APIs for vendor drivers
  - *Ib_register_vdevice(struct ib_device *vdevice);*
  - *Ib_unregister_vdevice(struct ib_device *vdevice);*

Isolation and performance

- Application Isolation
  - via ib_ucontext
- Virtual device object itself isolates itself in kernel space from other devices
- Performance
  - Same as physical device as every resource is mapped to physical device resource
- No need to carve out or over provision resources per VF and/or PF at device level, including MSI-X vectors, GIDs etc.
- Isolation checks for VFs at adapter level can be skipped bring simplicity to deployment and configuration management at adapter level.

Challenges and future extensions

- GSI QP1 extension
  - Single QP1 to multiplex for virtual devices
- GID isolation
  - Proxy GIDs for physical devices, to be omitted during connection establishment.
- Interrupt moderation

- Single virtual device for multiple RDMA devices
- More higher level operations than just pure SEND/WRITE/READs
- Virtual devices can be made usable beyond containers to other hypervisor modes.

Thank You

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