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Ethernet over InfiniBand

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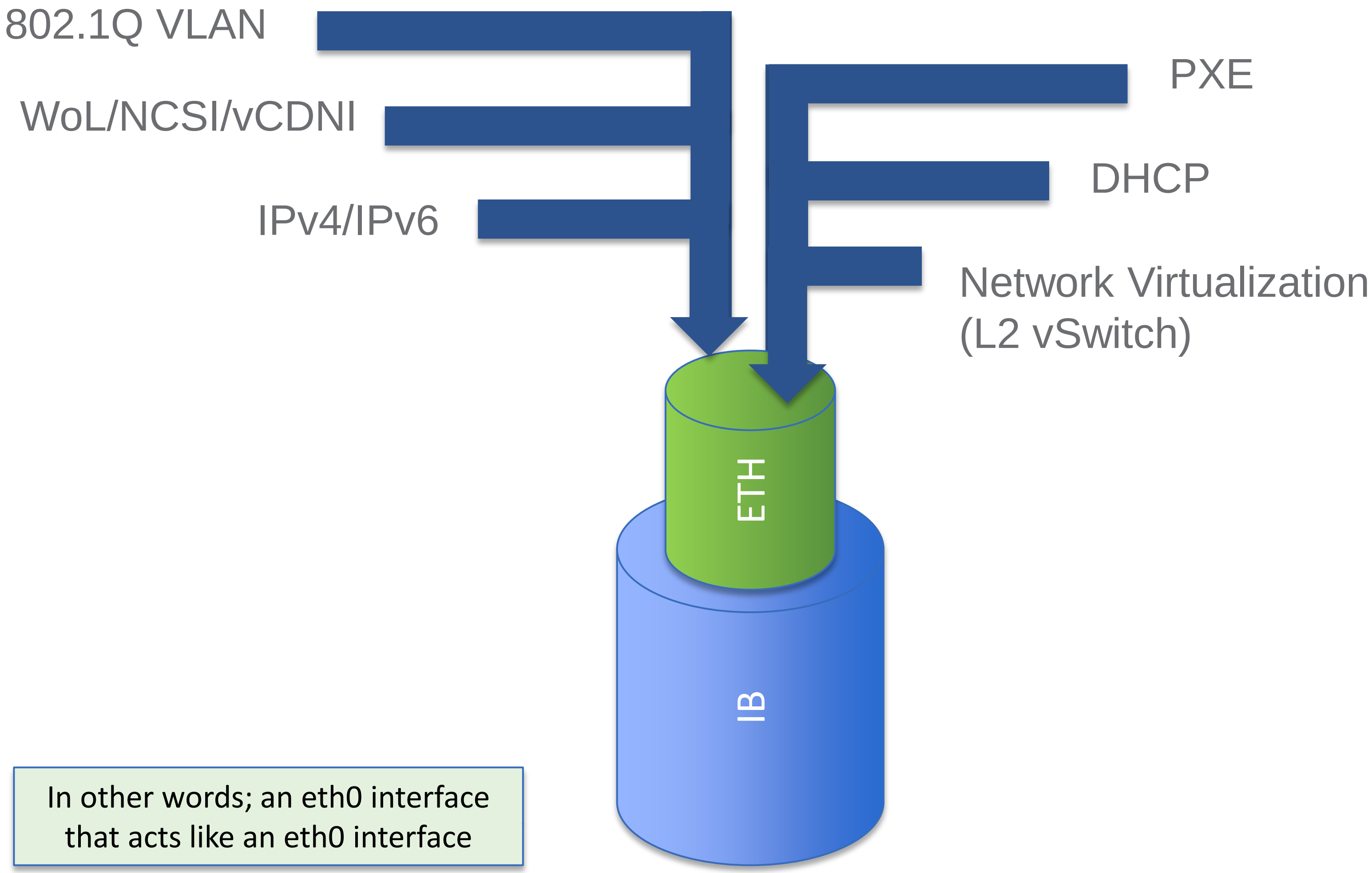
April 2013

Goal



In other words; an eth0 interface that acts like an eth0 interface

Goal

- Seamless Support for Ethernet Services over InfiniBand Network
  - IP and non-IP Applications
  - Virtualization (vSwitch)
  - 802.1Q
- Seamless Ethernet Management
  - DHCP, PXE, etc.
  - Load Balancing & High Availability
    - Unmodified Bonding/Teaming driver support
- Protocol may be distributed
  - Doesn’t rely on central software/hardware manager
- Simple bridging between EoIB and Ethernet

What’s New

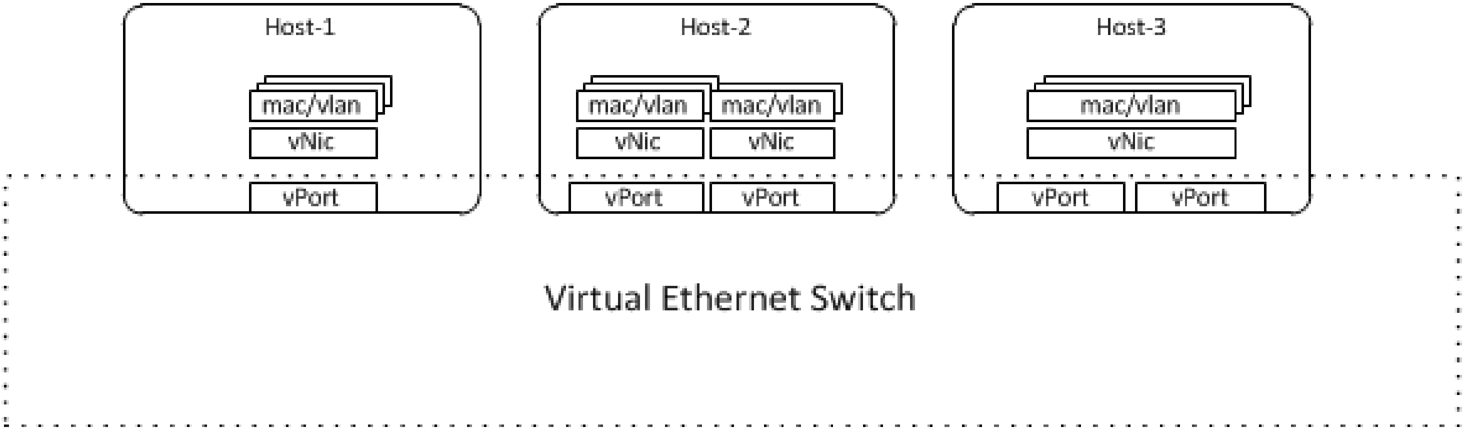
	Ethernet	EoIB	IPoIB
Ethernet Header	➢Present	➢Present	➢Not Present
Compatibility with L2-based apps	➢Seamless	➢Seamless	➢Not Supported ➢Needs special handling when using eIPoIB
MAC Setting	➢Any	➢Any	➢Limited: based on QPN and GID
MAC Length	➢6 bytes	➢6 bytes	➢20 bytes
Migration	➢Transparent to the netdev driver	➢Transparent to the netdev driver	➢Requires special handling
MTU	➢9K	➢Limited by IB mtu: 4K (in UD)	➢Limited by IB mtu: 4K (in UD)
VLAN ID	➢Any	➢Any	➢IPoIB: Not Supported ➢eIPoIB: Mapped to PKEY (1..128 only, cannot exceed PKEY range)

Model

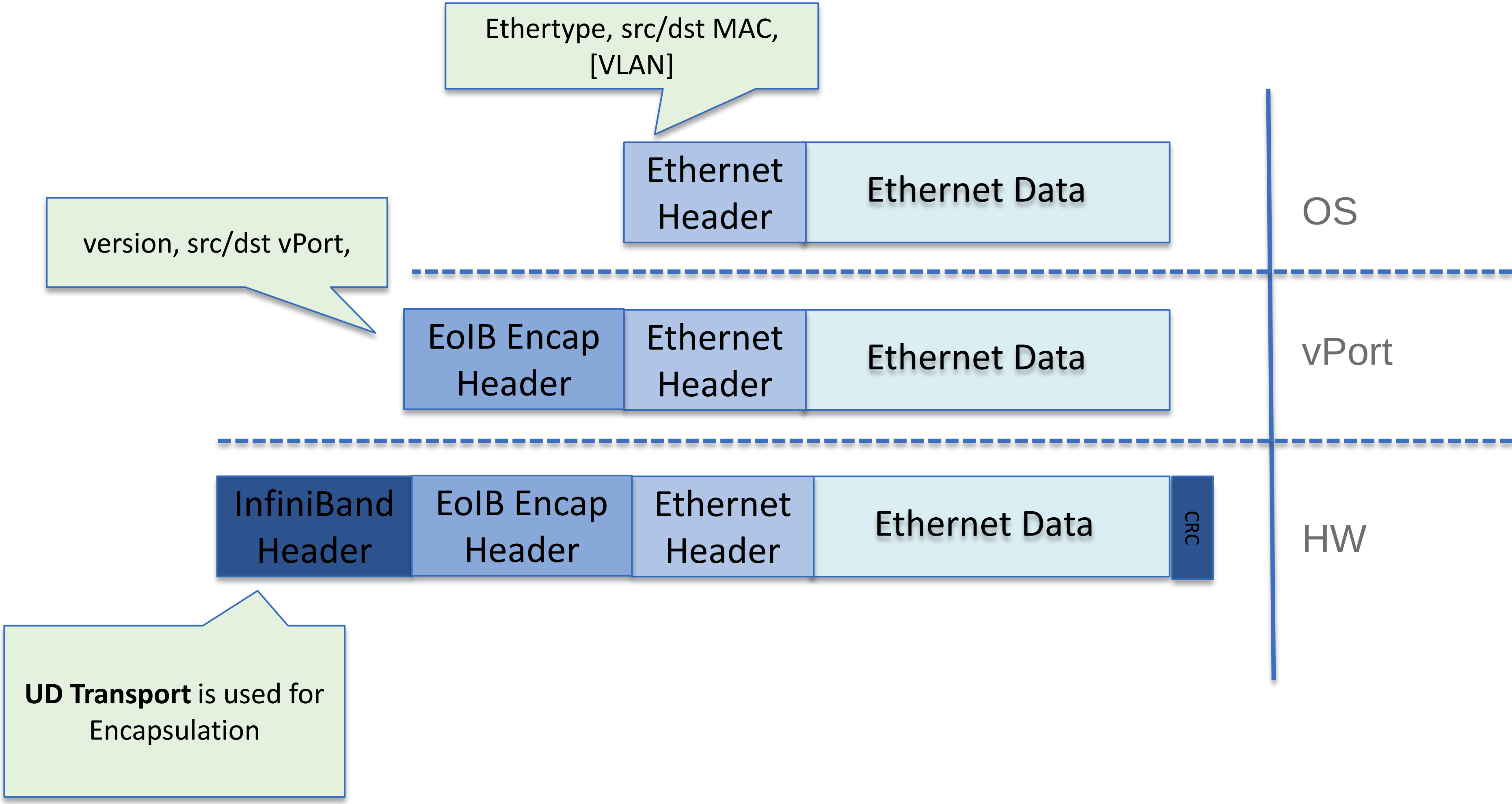
- **Ethernet Overlay Network on top of InfiniBand Underlying Network (UD Transport)**
- InfiniBand Network as a “giant” Virtual Ethernet Switch (VES)
- End points may have one or more Virtual Ports (vPort) connected to the VES
- A Virtual NIC (vNIC) represents the Ethernet Interface within the end-point, connected directly to the vPort
- A Gateway (GW) can be implemented the same way as a host with multiple pNIC/vNIC instances

Model

- VES is distributed; each vPort holds a Forwarding Database (FDB) table.
- Optionally, a VES manager can be used to push the FDB table to the end points
- A Gateway (GW) can be implemented the same as a host with multiple pNIC/vNIC instances



Packet Format



UD Transport is used for Encapsulation

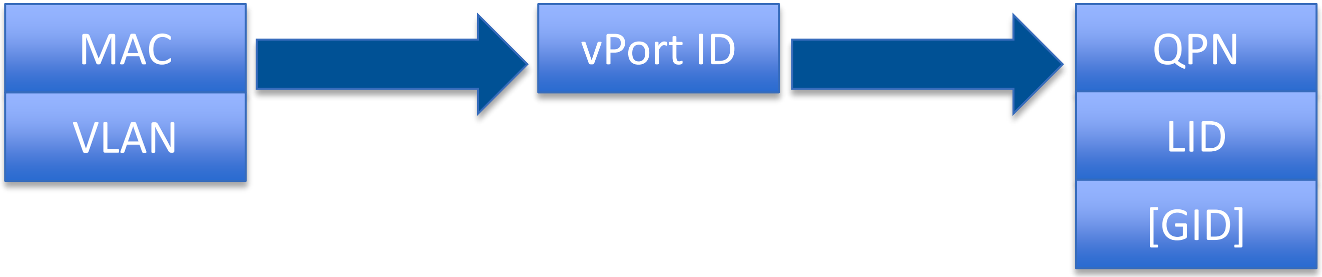
Address Resolution

- What’s New:
  - Ethernet Link Layer (MAC) is decoupled from the underlying InfiniBand network
    - Allows using any MAC address; a must for virtualization models where the hypervisor is responsible for VM’s MAC setting
  - EoIB is decoupled from ARP/NDP protocols
    - No dependency on the OS address resolution and Control Plane
    - Allows EoIB to have its own Control Plane and carry information/notifications not available in ARP/NDP
  - Learning

Address Resolution

- How it works:
  - Each end-point holds a Forwarding Database (FDB) table
  - The FDB is used to map the Ethernet packet based on MAC/VLAN to the corresponding InfiniBand Address Handle
  - FDB is updated based on ingress traffic learning as well as EoIB Control Plane
  - If mapping is missing, the packet is flooded (distributed mode)
    - Similar to VXLAN approach

- Egress Packet Flow:



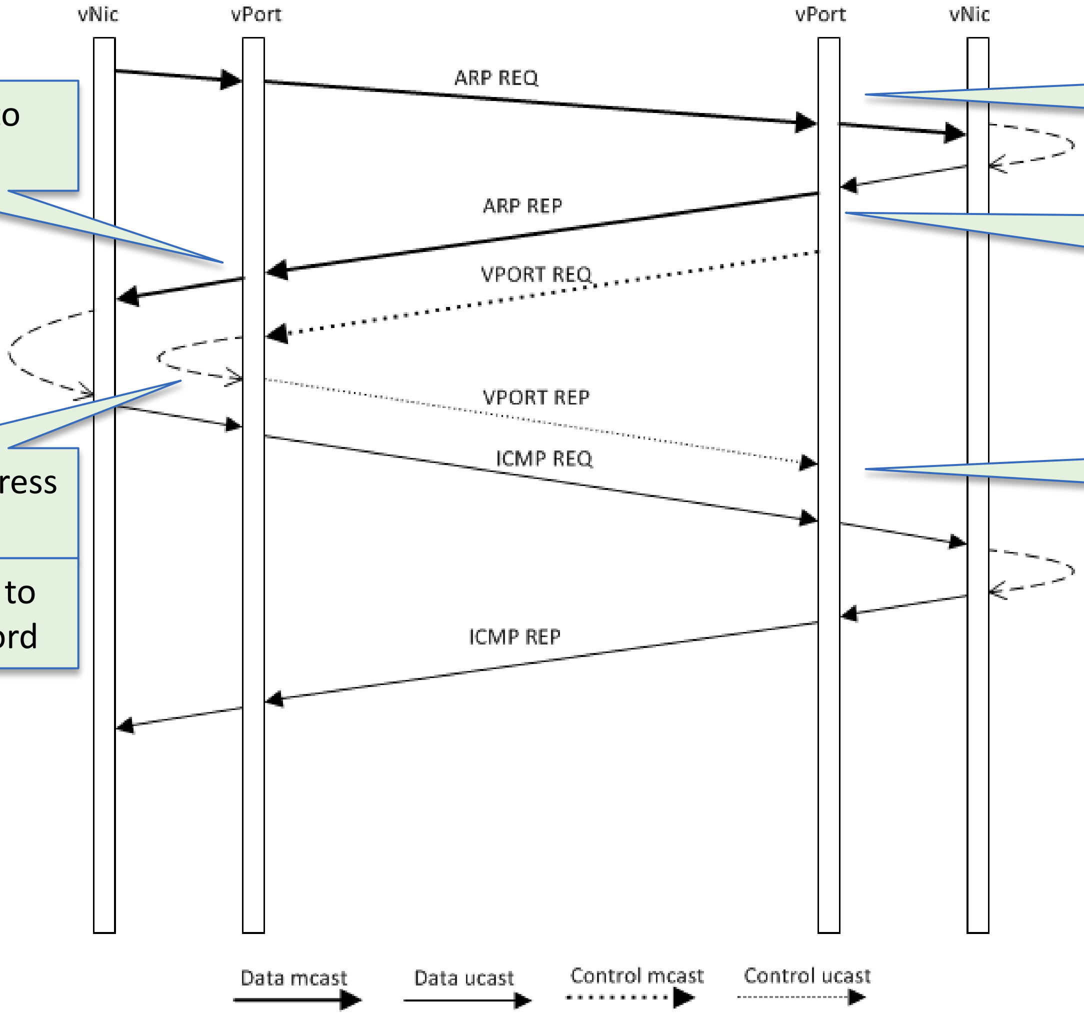
FDB

- Construction:
  - Learn incoming traffic to map MAC/VLAN to a vPort
    - Same approach as physical Switch learning
  - Use EoIB Control Plane (vPort Request/Reply) to map vPort to IB Address
  - SA query is sent out to get the PathRecord based on the IB Address
- Scheme

Overlay Address		Underlying Address	Physical Address		
MAC	VLAN	vPort ID	QPN	LID	[GID]
			QPN	LID	[GID]
MAC	VLAN	vPort ID	QPN	LID	[GID]
MAC	VLAN	vPort ID	QPN	LID	[GID]

For Link Aggregation

Ping Example



Learn MAC/VLAN to vPort mapping

Learn vPort to IB address mapping

SA Query is issued* to obtain the PathRecord

Learn MAC/VLAN to vPort mapping

FDB is incomplete; flooding is used (in distributed mode)

Learn vPort to IB address mapping

SA Query is issued* to obtain the PathRecord

* Not shown in the diagram

Thank You

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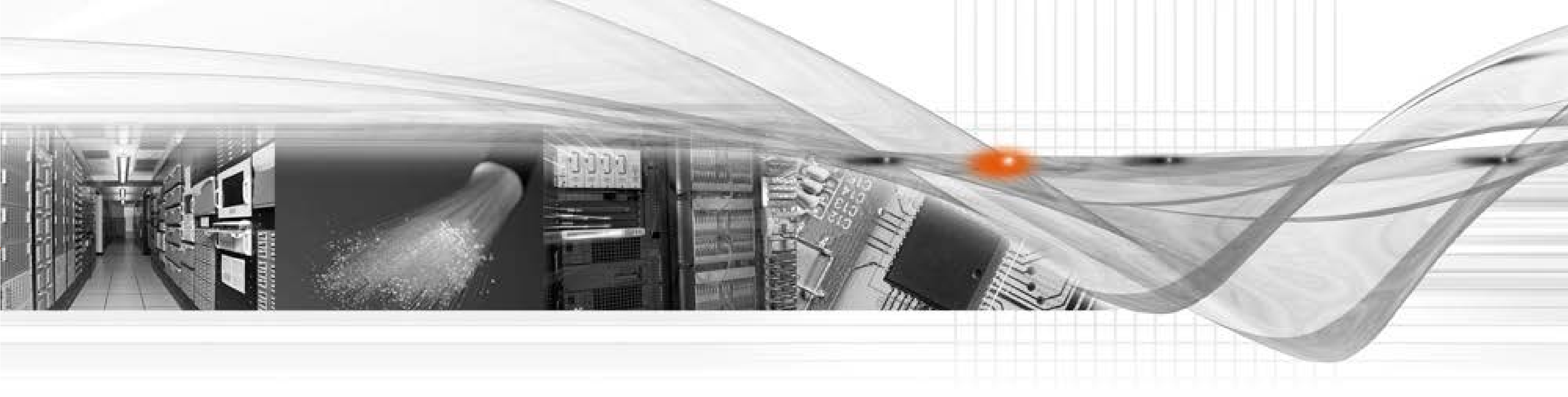
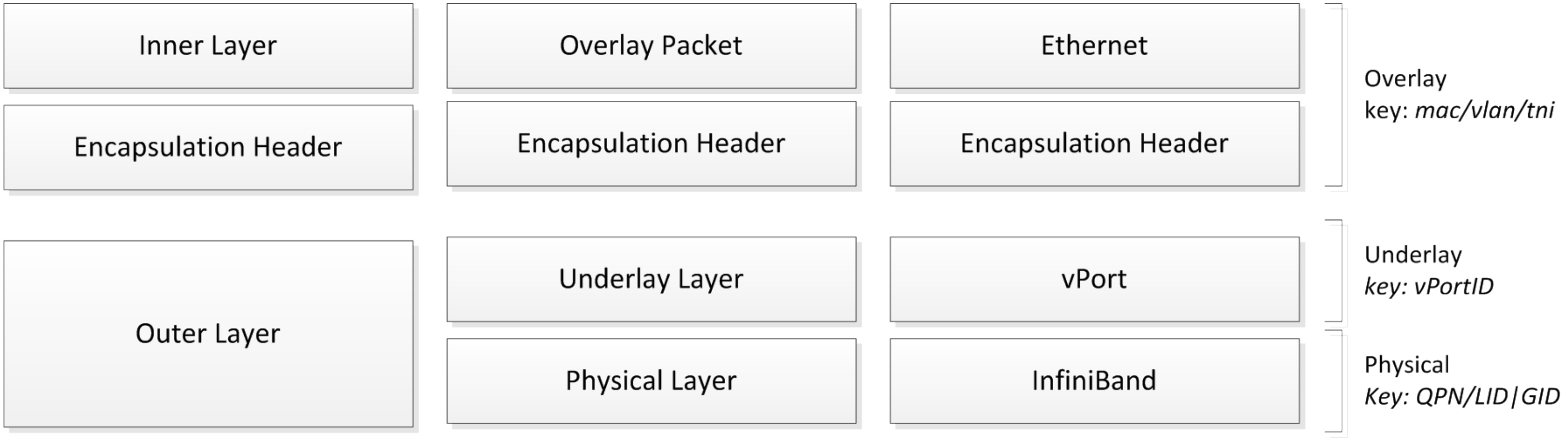


Backup

Layers



Inner Layer

Encapsulation Header

Outer Layer

Overlay Packet

Encapsulation Header

Underlay Layer

Physical Layer

Ethernet

Encapsulation Header

vPort

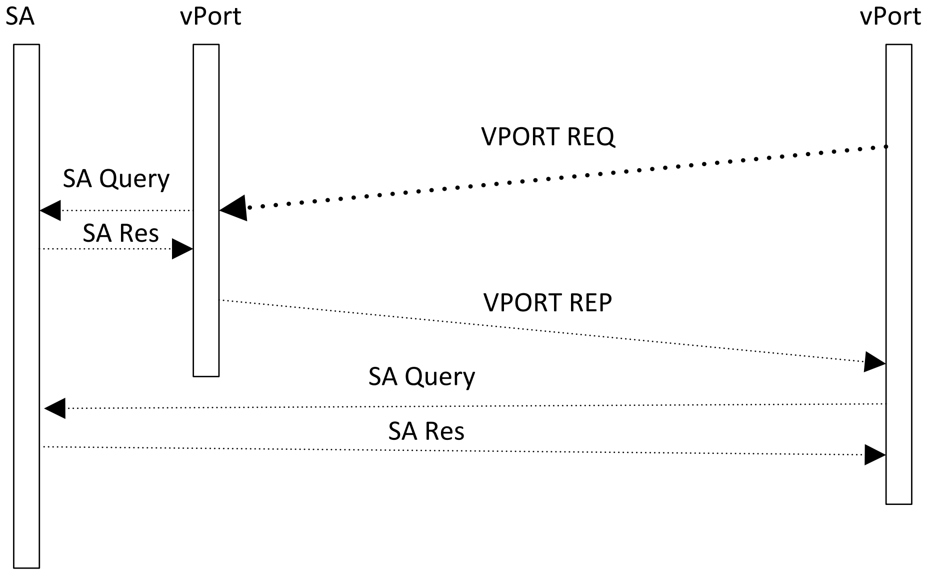
InfiniBand

Overlay
key: *mac/vlan/tni*

Underlay
key: vPortID

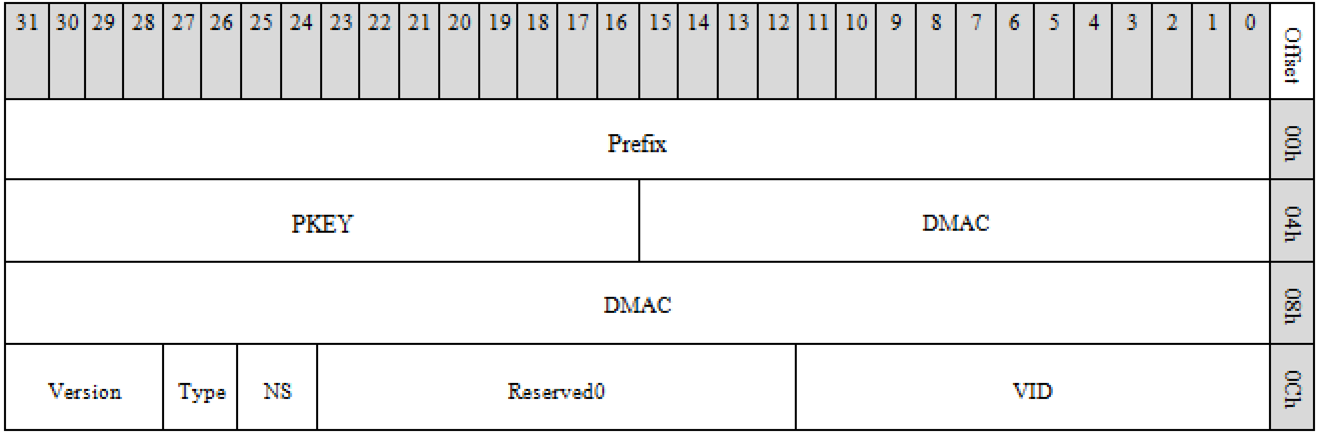
Physical
Key: QPN/LID|GID

SA Query


SA
vPort
vPort
VPORT REQ
SA Query
SA Res
VPORT REP
SA Query
SA Res

Multicast

Table 19: Multicast GID Layout



31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Offset
Prefix																																00h
PKEY																DMAC																04h
DMAC																																08h
Version				Type		NS		Reserved0												VID												0Ch

VES Instances

- Each PKEY defines a VES instance
- VES can serve multiple VLANs
  - VLAN and PKEY are decoupled
  - The administrator can limit the use of specific VLAN group for each VES instance for higher security