# GOALS

- **Virtual Ethernet networks over IB**
  - Communication between applications which are not IB-aware
  - Communication between IB-connected servers and Ethernet-connected servers
  - Connect to multiple physically isolated Ethernet networks using gateways
- **Security and isolation**
- **Fault tolerance**
- **High-performance**
  - Offloads on the servers, low-latency Ethernet gateway
- **Para-virtualized I/O, SR-IOV, and non-virtualized I/O**
- **Network services: firewall, load balancer, IP routing, VPN**
- **Software-defined**
  - Dynamic creation, removal, assignment, monitoring with a management tool
 - OpenStack support

SOLUTION

- **Implement virtual networks as overlay networks on IB**
- **Encapsulate Ethernet packets in IB messages**
  - Use the UD transport (RC an option)
  - Support a large MTU (10KB) on IB to accommodate jumbo Ethernet packets on UD
- **Map the broadcast domain of a virtual network to an IB multicast group**
- **Perform learning and aging in the server drivers and the gateway**
- **Ability to assign virtual networks to IB partitions**
- **Provide offloads in the HCA**
  - Checksum, large send, RSS/TSS, etc.
- **Security enforcement in the HCA**
  - Anti-spoofing, L2-L4 filtering

VIRTUAL NETWORK WITH NO UPLINK
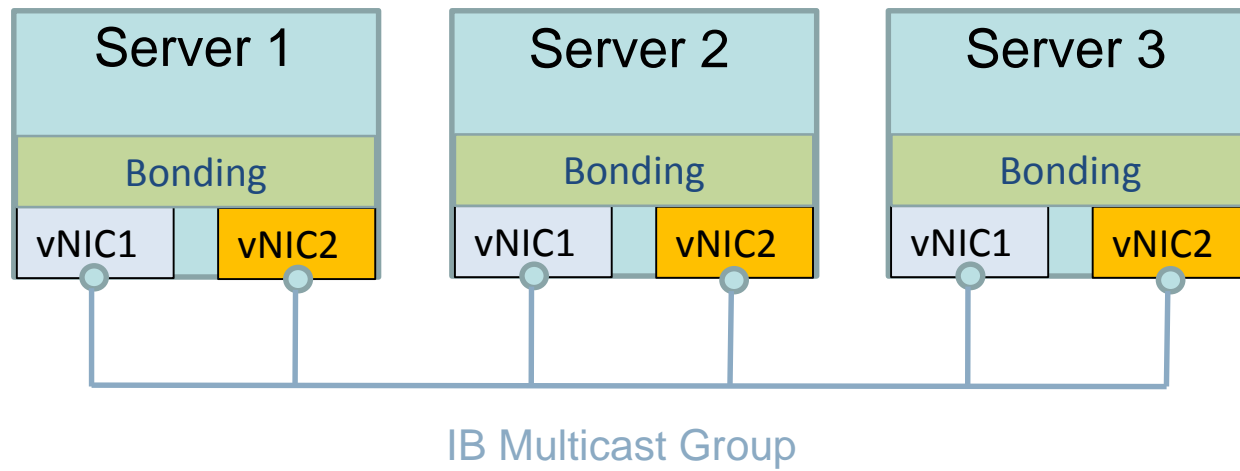
VIRTUAL NETWORK WITH AN UPLINK
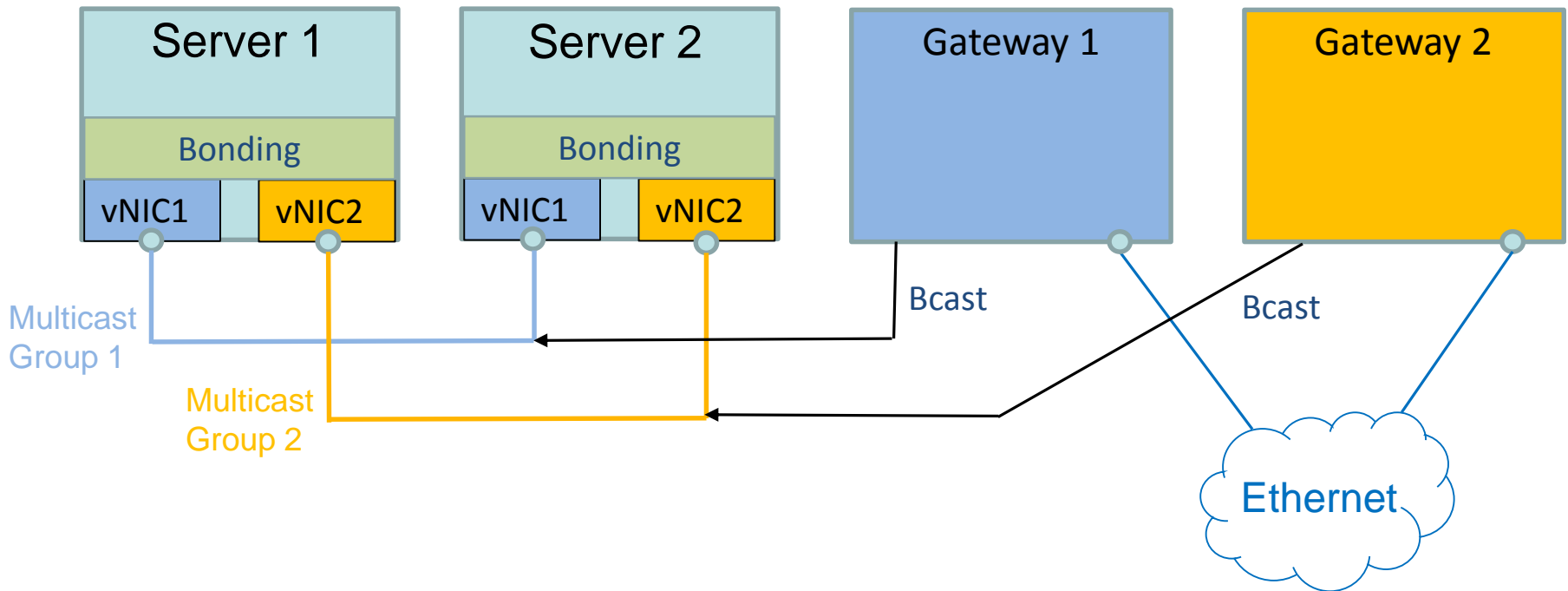
ADDRESS RESOLUTION

- **Server vNIC driver maintains a forwarding table (FT) to map destination MAC+VLAN to IB address handle of another server or gateway**
  - The FT is populated based on ingress traffic learning
  - Aging is applied to the FT
- **Similarly, the gateway maintains a forwarding table based on packets received from the servers**
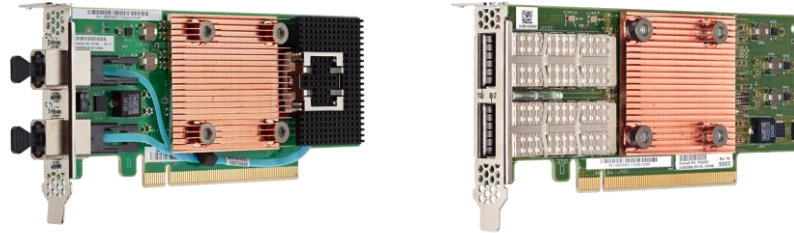
VIRTUAL NETWORK SERVICES

- **On-demand network services**
- **Multiple services – single virtual appliance**
- **High availability through VRRP**
- **Supported Network Services**
  - L3–L4 Firewall
  - Static and Dynamic NAT
  - L4 Load Balancing
  - IPSEC VPN
  - Static routing & gateway services

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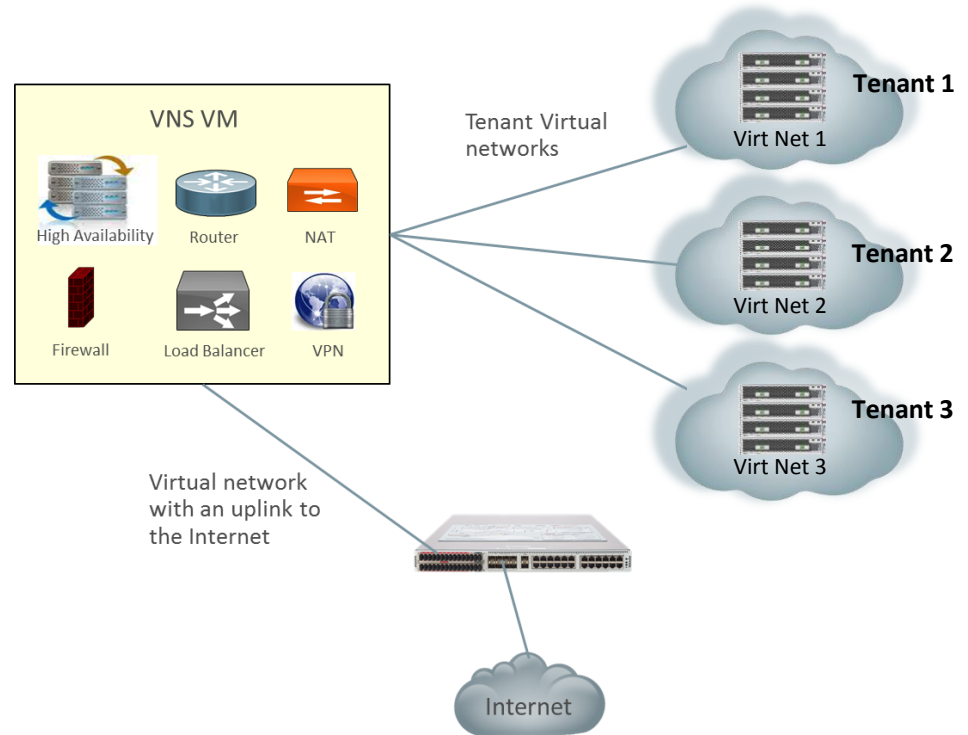
HARDWARE

HCA (EDR – 100Gbs)

Leaf switch (EDR) +
Ethernet gateway
2x40GE ports
8x10GE ports

Fabric Interconnect
12 I/O modules
Quad 40GE (16x10GE) QSFP
Quad 10GBaseT
Network Services Module

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FABRIC MANAGER

- **Manages physical and virtual network elements**
  - Switches and routers
  - Server network and storage interfaces
  - Network services
  - Virtual networks & Fabric I/O
- **Single console for fabric administration**
  - Provisioning & Orchestration
  - Server I/O, Network Services, and Virtual I/O Profiles
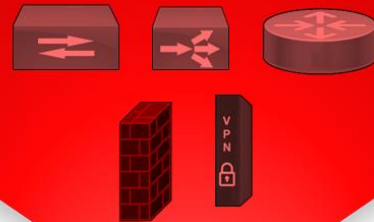 - Monitoring for Debug and diagnostics

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BUILDING BLOCKS OF SDN

Virtual Networks

Overlay isolated Ethernet networks upon the physical infrastructure

100G IB Fabric

Net 1 Net 2 Net 3

Virtual Network Services

Provision overlay networks with Virtual Network Services such as Firewalls, VPNs, and Load Balancers

VPN

Virtual Server I/O

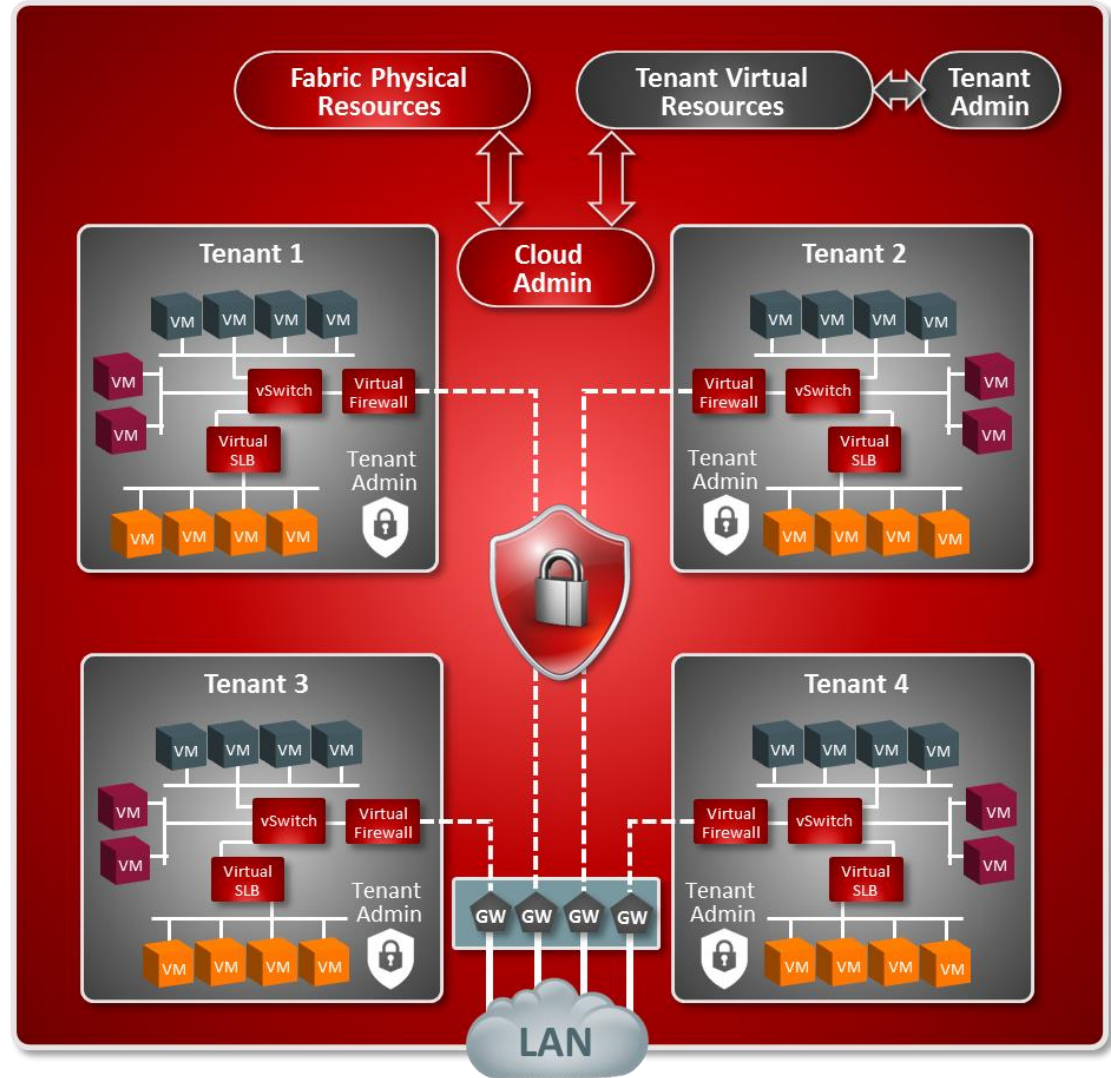Connect VMs to Virtual Networks with virtual InfiniBand, Ethernet, and Fibre Channel adapters

Virtual Machine

vNIC vHCA vHBA

Virtual Fabric I/O

Connect dynamically to multiple physically isolated LANs and SANs using gateways

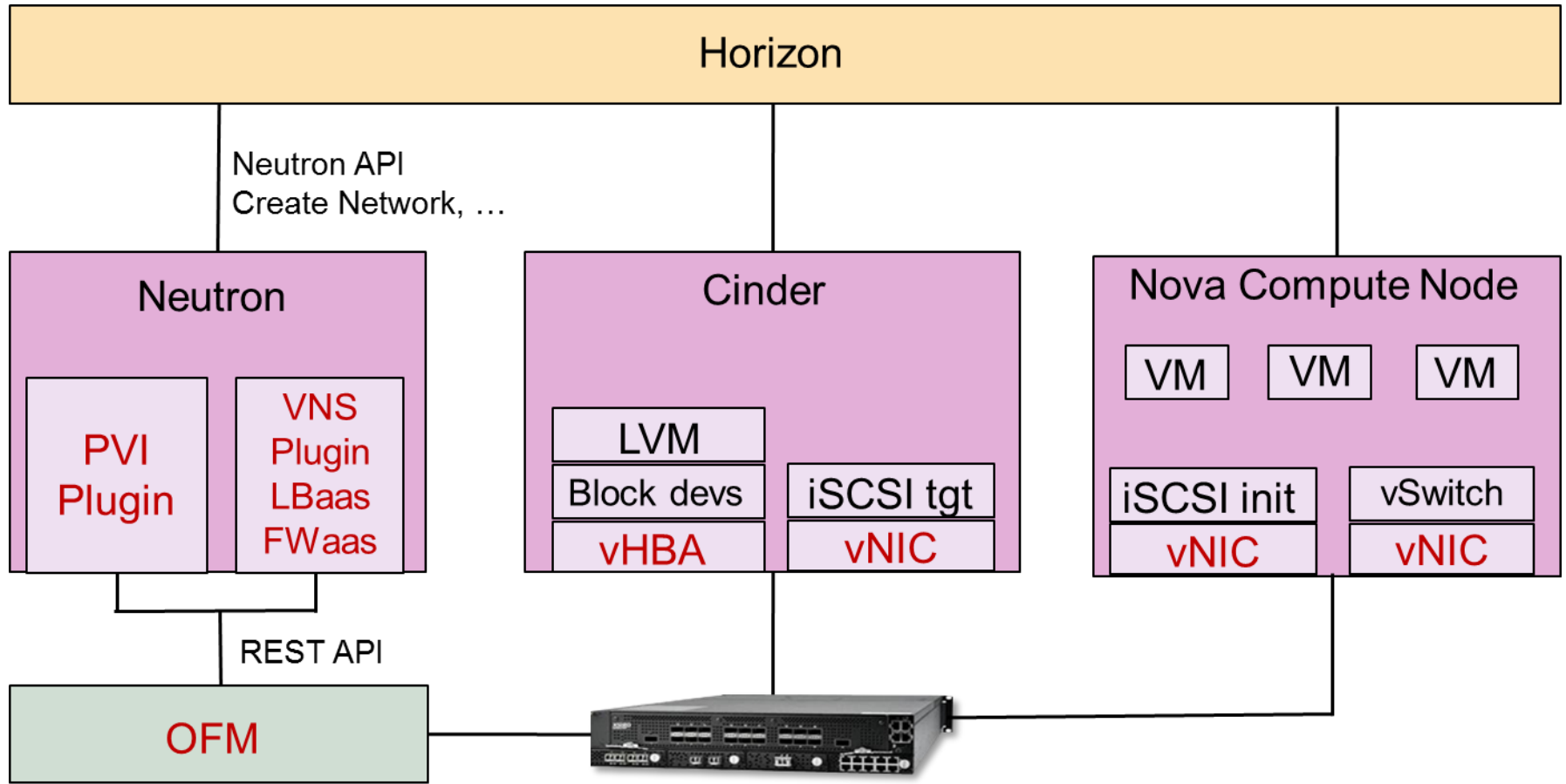Net 1 Net 2 Net 3

Gateways

GW GW GW

LAN SAN
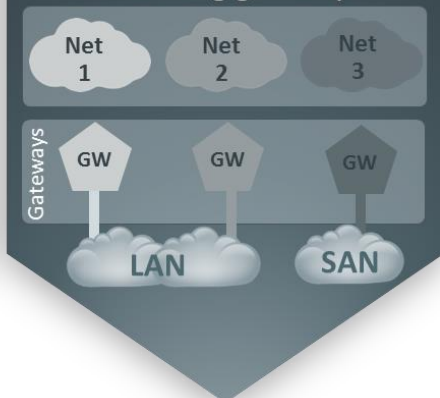
SECURE MULTI-TENANCY

- **Isolated tenant virtual networks**
- **Network security services protecting tenant domains**
  - Virtual firewalls and VPNs
- **Isolated administrative domains**
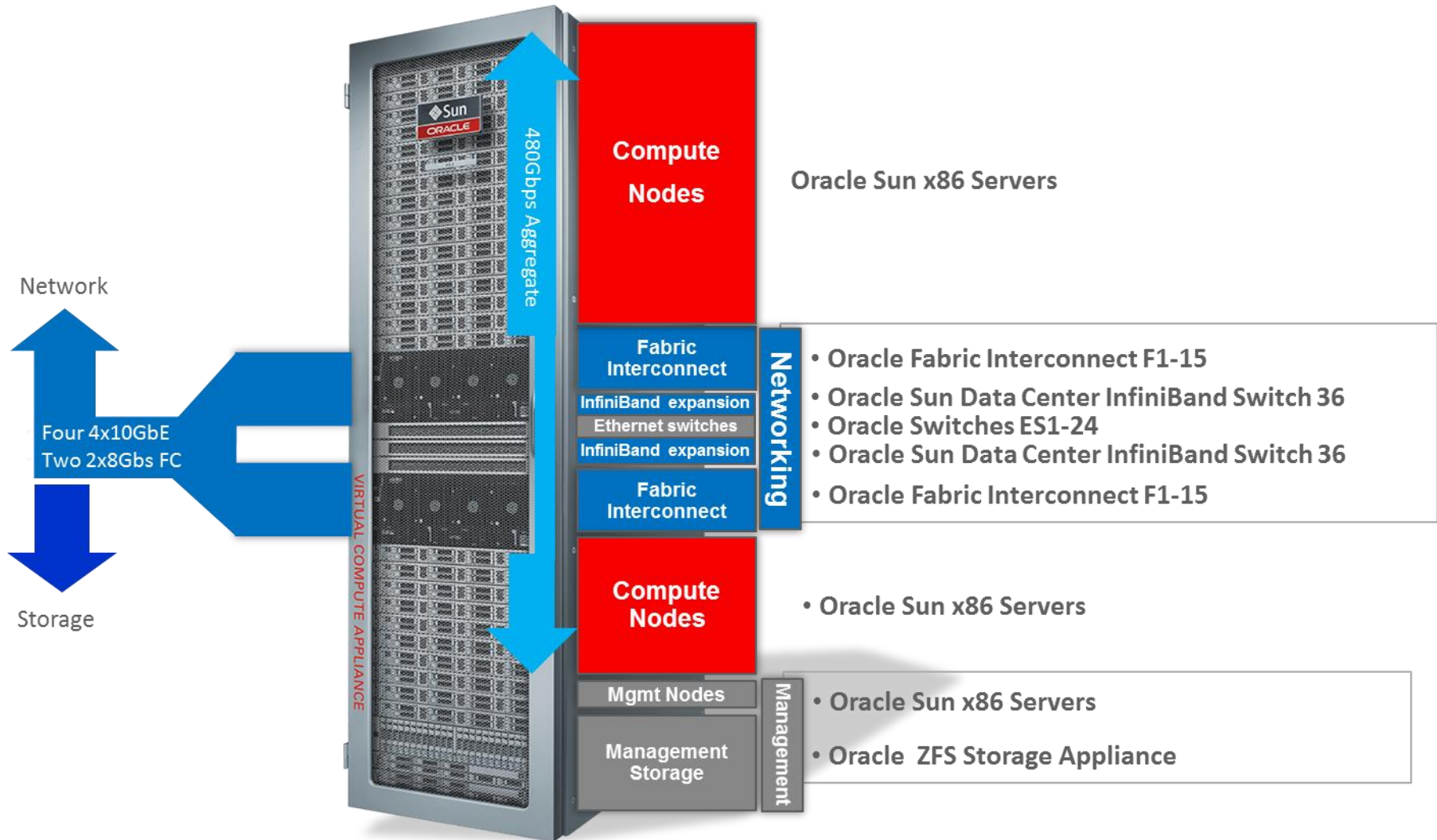 - Cloud tenants are secured from the administrative actions of other tenants

OPENSTACK SUPPORT

PRIVATE CLOUD APPLIANCE (PCA)
SDN over IB in an Engineered System

480Gbps Aggregate

VIRTUAL COMPUTE APPLIANCE

Network

Four 4x10GbE
Two 2x8Gbs FC

Storage

Compute Nodes — Oracle Sun x86 Servers

Fabric Interconnect

InfiniBand expansion
Ethernet switches
InfiniBand expansion

Fabric Interconnect

Networking
- Oracle Fabric Interconnect F1-15
- Oracle Sun Data Center InfiniBand Switch 36
- Oracle Switches ES1-24
- Oracle Sun Data Center InfiniBand Switch 36
- Oracle Fabric Interconnect F1-15

Compute Nodes
- Oracle Sun x86 Servers

Mgmt Nodes

Management Storage

Management
- Oracle Sun x86 Servers
- Oracle ZFS Storage Appliance

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THANK YOU

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