Oracle EDR InfiniBand Fabric is ideal for building and managing cloud network infrastructure. The fabric delivers the performance, security, agility, and scalability required to deploy business-critical workloads in a virtualized, multitenant environment. Oracle EDR InfiniBand Fabric enables enterprises to exploit cloud economics for their most demanding services.

Overview

Oracle EDR InfiniBand Fabric is engineered for the software-defined data center, delivering unprecedented performance and scale through a network infrastructure that is virtualized and secured for business-critical applications. Every server and storage system is connected to a virtualized, remote direct memory access (RDMA)-enabled, 100 Gb network. Software-defined networking (SDN) services allow any system to connect to any other system, SAN, or LAN at any site. The result is a fast, agile, and secure cloud infrastructure that allows application services to be rapidly deployed and to scale in capacity.

Oracle EDR InfiniBand Fabric offers an extensive network infrastructure portfolio for deploying clouds hosting business-critical workloads. Key advantages include:

- **Comprehensive software-defined networking and I/O.** Server I/O, networks, and network services are fully virtualized, enabling network resources for cloud tenants to be provisioned on demand.
- **Secured for enterprise multitenancy.** Though cloud tenants share the physical fabric, they are provisioned with private overlay networks and network services. The fabric's management and administrative resources are isolated from tenants.
- **Highest performance fabric available.** With 100 Gb/sec connections and sub-microsecond latency, enhanced data rate (EDR) InfiniBand is the ideal fabric for clouds hosting business-critical enterprise applications.
- **Scale with business demands.** Scale to hundreds of thousands of servers and storage systems distributed across multiple sites.
- **Seamless data center integration.** Integrate transparently with the existing data center LAN and SAN infrastructure.
- **Acceleration for Oracle software.** The fabric's server and storage interface is engineered with features to accelerate Oracle software built directly into the fabric silicon. These features include an application acceleration engine, along with InfiniBand enhancements to optimize the fabric for the messaging requirements of scalable, networked applications.

Fully Virtualized for Enterprise Clouds

With Oracle EDR InfiniBand Fabric, all aspects of cloud networking are virtualized, including networks, network devices, and host interfaces. All network connections are
defined by software, enabling any server to readily connect to any network, storage, or service. To accomplish this, the fabric offers a comprehensive set of network and I/O virtualization features:

- **Overlay networks.** The fabric incorporates overlay capabilities enabling isolated Ethernet networks to reside within the fabric. These networks operate at the full fabric bandwidth of 100 Gb/sec. Furthermore, the fabric supports InfiniBand, Ethernet, and IP isolation mechanisms such as partitions, VLANs, and subnets.
- **Virtual network services.** Overlay networks can be provisioned with virtualized network services appliances such as firewalls, VPNs, and load balancers.
- **Virtualized server I/O.** Virtual machines are presented with virtual InfiniBand, Ethernet, and Fibre Channel adapters. These virtual network adapters join the fabric through a virtual switch, which is managed and secured through the Oracle EDR InfiniBand Fabric’s management plane.

![Diagram of Oracle EDR InfiniBand Fabric](image)

**Figure 1. Virtualization within Oracle EDR InfiniBand Fabric**

**Highest Performance Converged Fabric Available**

Oracle EDR InfiniBand Fabric is the best-performing solution for enterprise clouds:

- **100 Gb converged fabric.** Delivers all I/O services for servers with a single network interface including network, storage, and interprocess communication.
- **Lowest latency.** InfiniBand provides the lowest latency available of any standard interconnect, eliminating network bottlenecks.
- **RDMA enabled.** InfiniBand supports RDMA, improving server and storage efficiency and enabling applications to run faster and to be deployed with fewer systems.

Enhanced Data Rate (EDR) InfiniBand is the highest performance server and storage interconnect available that is based upon open standards. With mechanisms such as reliable lossless guaranteed delivery and service differentiation, InfiniBand represents a significant opportunity for consolidation. A converged interconnect using InfiniBand can
consolidate complex IP networks within the data center and eliminate storage area networks (SANs), all without requiring changes to applications or storage.

Unlike traditional software-based transport protocol processing, InfiniBand provides hardware support for all of the services required to move data between hosts. By providing reliable end-to-end transport protocols in hardware and user-level RDMA capability, interconnected systems have more cycles available for processing, and scalable applications can require fewer numbers of systems. RDMA provides efficient and direct access to host or client memory without involving processor overhead. Because InfiniBand supports a broad range of upper-level protocols, it lends RDMA capabilities to protocols such as IP, iSCSI, NFS, and others. InfiniBand also provides quality of service (QoS) mechanisms that can help ensure application performance.

Open Standards Based

Oracle EDR InfiniBand Fabric’s hardware and software are based upon industry-standard InfiniBand and the OpenFabrics software stack. Oracle’s commitment to open standards, interfaces, and technologies are demonstrated in Oracle’s EDR InfiniBand Fabric. Oracle was a founding member of the InfiniBand Trade Association and has invested in InfiniBand technology since 1999. Oracle is a current Steering Committee Member of the IBTA and a member of the Board of Directors of the Open Fabrics Alliance.

Secured for Multitenant Environments

Oracle EDR InfiniBand Fabric is architected to deploy secure multitenant enterprise clouds. The fabric’s key security properties include:

- **Distributed security architecture.** Security features are engineered into every element of the fabric’s underlying components, including hardware, software, firmware, and management.

- **Network security services deployed to protect tenant domains.** Traditional network security devices such as firewalls and VPNs are virtualized and deployed within the fabric dynamically.

- **Isolated tenant network traffic.** Isolated private networks are provisioned for cloud tenants. Traffic isolation and data protection mechanisms ensure that tenant applications and data are not compromised.

- **Isolated administrative domains.** The fabric infrastructure creates isolated domains that establish traffic, fault, and administrative separation. Cloud tenants sharing the same physical infrastructure are secured from the network traffic and administrative actions of other tenants.

- **Isolated fabric management plane.** The fabric’s management and data planes are separated. All hardware and software components authenticate configuration and management actions, safeguarding the fabric against malicious users and processes.

- **Channel-based communication architecture.** InfiniBand’s queue pair structure and associated security keys provides private and secure communication channels within the fabric.
Oracle EDR InfiniBand Fabric combines the I/O, switching, network virtualization, and fabric management capabilities essential to deploying enterprise clouds.

Related Products
The fabric is comprised of the following products:

- Oracle Dual Port EDR InfiniBand Adapter
- Oracle InfiniBand Switch IS2-46
- Oracle InfiniBand Switch IS2-254
- Oracle Fabric Interconnect F2-12
- Oracle Fabric Manager
- Oracle SDN

Scale Cloud Capacity
Capacity and responsiveness requirements are unique to each enterprise cloud deployment. Oracle EDR InfiniBand Fabric enables clouds to scale both in capacity and across sites:

- **Connect hundreds of thousands of systems.** The fabric supports thousands of servers in a single InfiniBand subnet and hundreds of thousands of servers in a fabric.
- **Expand LAN and SAN capacity and connectivity as needed.** Adding a SAN or LAN connection to every server is as easy as connecting to the network and updating the server’s I/O profiles.
- **Connect to remote data centers.** The fabric supports long and extended range connectivity for geographic scaling. Fabrics at disparate data centers can be interconnected for added capacity or disaster recovery.

Solution Architecture
Oracle EDR InfiniBand Fabric is architected to maximize performance and scaling while minimizing the space, cabling, weight, and power required for cloud network infrastructure. The fabric is partitioned into distinct systems for server and storage fabric access, fabric scaling, and virtual fabric I/O. Key benefits of the architecture include:

- **Leaf-and-spine topology.** The fabric utilizes a flat, two-tier, leaf-and-spine network topology that eliminates the need for aggregation switching. The fabric delivers uniform bandwidth and latency to all nodes, which is critical to the performance of applications in cloud environments.
- **I/O distribution and scaling.** Gateways are employed to enable fabric-attached servers to connect to the data center LAN and SAN. Each of the fabric’s component systems includes Ethernet gateways to provide a base level of LAN connectivity. Virtual I/O systems can be attached to the fabric to scale I/O without limitations.
- **Unified fabric and I/O management.** Oracle Fabric Manager provides a comprehensive management platform for the fabric’s physical and virtual resources including server I/O, virtual networks, network services, and fabric I/O.
• **High-density optical interconnect.** The fabric employs an all-optical interconnect that increases reliability and reduces cable weight and volume. Furthermore, interswitch connections utilize 12x InfiniBand, reducing cabling by 67 percent.

Figure 3. Oracle EDR InfiniBand Fabric architecture

Switch and Virtualized I/O Systems

Oracle EDR InfiniBand Fabric’s systems share a common architecture. Each system incorporates both InfiniBand switching and Ethernet gateway functions to enable clouds of any size to be deployed and readily expanded. The systems also include an embedded management server, Ethernet management fabric, and an enclosure management subsystem. The Oracle EDR InfiniBand Fabric’s systems include:

• **Oracle InfiniBand Switch IS2-46.** The Oracle InfiniBand Switch IS2-46 provides access and management switching along with fabric I/O for servers connected to Oracle EDR InfiniBand Fabric.

• **Oracle InfiniBand Switch IS2-254.** As the spine switch for Oracle EDR InfiniBand Fabric, Oracle InfiniBand Switch IS2-254 provides fabric scaling and long-range extension across dark fiber.

• **Oracle Fabric Interconnect F2-12.** Oracle Fabric Interconnect F2-12 is a modular fabric I/O chassis for integrating enterprise clouds with data center network and storage infrastructure.

Server and Storage Interface

**Oracle Dual Port EDR InfiniBand Adapter**

A single adapter is utilized to provide all converged I/O services to servers and storage systems. Oracle Dual Port EDR InfiniBand Adapter provides acceleration, virtualization, and consolidation of application messaging and I/O services to servers connected to Oracle EDR InfiniBand Fabric.

Virtual Network Services

Network services are virtualized for rapid deployment and scaling within Oracle EDR InfiniBand Fabric. Virtual network services eliminate the need for proprietary fixed
functions that limit agility and create bottlenecks in the data center. Oracle EDR InfiniBand Fabric provides virtual network services through software-defined appliances:

- **Oracle SDN’s virtual network services.** The virtual network services capability of Oracle SDN provides the ability to deploy on-demand network services such as firewall, IP router, load balancer, virtual private network (VPN), and network address translation (NAT) services in a single virtual appliance.

- **Oracle F2 Network Services Module.** Supported in the fabric’s modular switching and I/O platforms, Oracle F2 Network Services Module contains two independent virtual appliances for hosting virtual network services.

**Fabric Management**

Oracle Fabric Manager, the management platform for Oracle EDR InfiniBand Fabric, is ideal for managing the network resources for multitenant enterprise clouds. Oracle Fabric Manager enables on-demand configuration and provisioning of server I/O, virtual networks, network services, and fabric I/O. Key cloud management features include:

- **Administrative domaining.** Fabric resources can be segregated into resource domains that are administered independently based upon roles and domain assignments. Administrative domaining enables the cloud administrator to allocate fabric resources to tenants. Tenant administrators only have access to the resources allocated to the tenant.

- **Role-based access control.** Oracle Fabric Manager preserves functional management roles within the data center, allowing server, network, and storage managers to maintain full control over their specific domains.

- **Scalability with templated I/O.** Templates define both the server I/O connections and the functional aspects of the connections, such as required bandwidth and availability. Templates can be applied to a server or group of servers to provision access to needed resources, making it just as easy to manage dozens or thousands of resources as it is to manage just one.

- **Real-time performance monitoring of fabric resources.** Oracle Fabric Manager’s integrated monitoring capability allows real-time performance analysis of network ports and virtual resources, enabling configuration and bandwidth issues to be rapidly identified and resolved nondisruptively.

- **Management of resources across sites.** Oracle Fabric Manager provides a single-point connectivity management across multiple sites, simplifying administration and disaster recovery for geographically distributed clouds.

![Figure 4. Oracle Fabric Manager](image-url)
### Key Fabric Functionality and Technical Specifications

#### Virtualization
- Converged Virtual I/O
  - Virtual InfiniBand HCA, Ethernet NICs, and Fibre Channel HBAs
  - Ethernet overlay networks over InfiniBand operating at EDR fabric speeds through Oracle SDN
  - Host interface supports both SR-IOV and paravirtualization; provides seamless hypervisor Open vSwitch support

- Overlay Networks
  - Up to 16 k isolated Ethernet L2 domains per InfiniBand subnet
  - Overlay networks operate at 100 Gb/sec
  - Overlay networks can span Ethernet gateways to the attached Ethernet L2 fabric

#### InfiniBand
- **Features**
  - InfiniBand EDR/FDR/ODR/DDR/SDR
  - MTU: 256, 512, 1,024, 2,048, 4,096, and 10 k byte MTUs
  - P_Keys: 272 per physical port
  - Virtual lanes: 8 data + 1 management

- **Protocols Supported**
  - RDMA, TCP/UDP, IPoIB, SDP
  - FCoIB, SRP, iSER, NFS RDMA
  - MPI
  - OpenFabrics user verbs
  - Oracle low-latency messaging protocols

- **Boot**
  - Boot over InfiniBand (IPoIB, iSCSI, SRP)
  - PXE boot (Ethernet gateway)

#### InfiniBand Routing Extensions
- Supports up to 64 k subnets
- Supports up to 64 M reachable hosts

#### InfiniBand Host Virtualization
- Supports up to 33 virtual HCA
- Supports one virtual switch per physical port
- 256 entry P_Key table can be divided equally among vHCAs

#### InfiniBand Enhancements
- Direct deposit: efficient inlining of data send operations
- SRQ and XRC
- Remote atomics
- Conditional RDMA
- Reliable multicast

#### Ethernet1 and IP over InfiniBand
- **Ethernet**
  - NICs per physical or virtual machine: Up to 32
  - Jumbo frames: supports jumbo frames up to 10 k
  - VLAN tagging and enforcement
  - MAC and VLAN classification of ingress packets
  - Serial Network Controller Sideband Interface (NC-SI)
  - Ethernet overlay networks operate at full EDR speeds for hosts connected by Oracle EDR InfiniBand Fabric

- **Offloads (Ethernet and IPoIB)**
  - Checksum offloads for IP, TCP, and UDP
  - Large segment offload (LSO)
  - Receive side scaling (RSS)
  - Header/payload split

- **Virtual NIC Resources (per vNIC)**
  - Ports: 2
  - Unique MAC address per vNIC
  - 4,096 VLANs per vNIC

#### Fibre Channel2 over InfiniBand
- **Fibre Channel**
  - Protocols: FC-AL, FCP (SCSI-FCP)
  - vHBAs per physical or virtual machine: Up to 8

- **Virtual HBA Resources (per vHBA)**
  - Ports: 2
  - Unique WWN per vHBA
  - LUN masking: 256 LUNs per storage target per vHBA

- **Boot**
  - SAN boot (via Fibre Channel gateway)

#### Security
- **Protocol Security Enhancements**
  - Ingress/egress L2 – L4 inspection and filtering: InfiniBand, Ethernet

- **Secure HCA**
  - Fabric management plane isolated from host processes and malicious users
- Anti-spoofing: InfiniBand, Ethernet
- Fabric management restricted to authenticated manager

**Cables and Transceivers**

**Supported Cables and Transceivers**

Oracle supplies InfiniBand cables and transceivers that are supported with Oracle EDR InfiniBand Fabric. For more information, see the Oracle EDR InfiniBand Fabric cable selection guide.

1. Ethernet gateway required for external LAN connectivity
2. Fibre Channel gateway required for external SAN connectivity
### SWITCH AND I/O VIRTUALIZATION SYSTEM HARDWARE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Oracle InfiniBand Switch IS2-46</th>
<th>Oracle InfiniBand Switch IS2-254</th>
<th>Oracle Fabric Interconnect F2-12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Function</strong></td>
<td>Leaf Switch</td>
<td>Spine Switch</td>
<td>Virtualized Fabric I/O and Network Services</td>
</tr>
<tr>
<td><strong>Architecture</strong></td>
<td>Fixed Switch</td>
<td>Modular Switch</td>
<td>Modular Platform</td>
</tr>
<tr>
<td></td>
<td>• Non-blocking InfiniBand switch</td>
<td>• Twelve+two 4x InfiniBand links (slots 1 – 4, 9 – 12)</td>
<td>• Two 4x InfiniBand links per slot</td>
</tr>
<tr>
<td></td>
<td>• Integrated Ethernet gateways</td>
<td>• Twenty-four+two 4x InfiniBand links (slots 5 – 8)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Integrated management switch</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Chassis Data Ports</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Twenty-four 4x InfiniBand ports</td>
<td>• Four 12x InfiniBand ports (three 4x each)</td>
<td>• Four 12x InfiniBand ports (three 4x each)</td>
</tr>
<tr>
<td></td>
<td>• Four 12x InfiniBand ports (3 4x each)</td>
<td>• 2 configurable ports: 4x InfiniBand or 10 GE/40 GE gateway</td>
<td>• 2 configurable ports: 4x InfiniBand or 10 GE/40 GE gateway</td>
</tr>
<tr>
<td></td>
<td>• Eight 10 Gb Ethernet ports</td>
<td>• Four 12x InfiniBand ports (three 4x each)</td>
<td>• Four 12x InfiniBand ports (three 4x each)</td>
</tr>
<tr>
<td></td>
<td>• 2 configurable ports: 4x InfiniBand or 40 GE gateway</td>
<td>• Four 12x InfiniBand ports (three 4x each)</td>
<td>• Four 12x InfiniBand ports (three 4x each)</td>
</tr>
<tr>
<td><strong>Maximum 4x InfiniBand Switch Ports</strong></td>
<td>38 ports</td>
<td>254 ports</td>
<td>14 ports</td>
</tr>
<tr>
<td><strong>Module Slots</strong></td>
<td>12 slots</td>
<td></td>
<td>12 slots</td>
</tr>
<tr>
<td></td>
<td>• Slot 1 prepopulated with Oracle’s 24-port EDR InfiniBand line module</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong># Switch Modules Supported</strong></td>
<td>• Up to 12</td>
<td>• None</td>
<td>• None</td>
</tr>
<tr>
<td><strong># Fabric I/O Modules Supported</strong></td>
<td>• Up to 7</td>
<td></td>
<td>• Up to 12</td>
</tr>
</tbody>
</table>

### SWITCH AND I/O MODULE HARDWARE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Oracle 24-port EDR InfiniBand Line Module</th>
<th>Oracle EDR InfiniBand Fabric Module</th>
<th>Oracle F2 Quad Port 10GBase-T Module</th>
<th>Oracle F2 10 Gb and 40 Gb Ethernet Module</th>
<th>Oracle F2 Dual Port 16 Gb Fibre Channel Module</th>
<th>Oracle F2 Network Services Module</th>
<th>Oracle F2 Long Range InfiniBand Module</th>
<th>Oracle F2 Long Range InfiniBand Module</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Function</strong></td>
<td>InfiniBand Switch</td>
<td>InfiniBand Switch</td>
<td>Ethernet Copper Connection</td>
<td>Ethernet Fiber Connection</td>
<td>Fibre Channel Connection</td>
<td>Fabric Resident Network Services</td>
<td>InfiniBand Range Extension</td>
<td>InfiniBand Range Extension</td>
</tr>
<tr>
<td><strong>Exposed Data Ports</strong></td>
<td>• Eight 12x InfiniBand ports (three 4x each)</td>
<td>• Four 12x InfiniBand ports (three 4x each)</td>
<td>• Four 10GBase-T ports</td>
<td>• 4 configurable ports: 40Gbase-XR or 4x10GBase-SR</td>
<td>• Two 16 Gb Fibre Channel ports</td>
<td>• Four 10GBase-XR ports</td>
<td>• Four 4x InfiniBand ports</td>
<td>• Four 4x InfiniBand ports</td>
</tr>
</tbody>
</table>

**CONTACT US**

For more information about Oracle EDR InfiniBand Fabric, visit oracle.com or call +1.800.ORACLE1 to speak to an Oracle representative.

**Integrated Cloud Applications & Platform Services**

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