ORACLE EXADATA STORAGE EXPANSION RACK X2-2

FEATURES AND FACTS

FEATURES

- Grow the storage capacity of X2-2 and X2-8 Oracle Exadata Database Machines
- Includes from 4 to 18 Oracle Exadata Storage Servers
- Mirrored usable capacity of up to 194 TB per rack before compression
- Up to 216 CPU cores dedicated to SQL processing in storage
- Up to 6.75 TB of Exadata Smart Flash Cache
- Connected directly to Exadata Database Machines X2-2 and X2-8 via 40 Gb/second InfiniBand
- Scale-out storage architecture adds capacity, connectivity, flash, and processing in balanced fashion
- Uncompressed I/O bandwidth of up to 82 GB/second per rack
- Exadata Hybrid Columnar Compression delivers 10X-15X compression ratios
- Complete redundancy for high availability

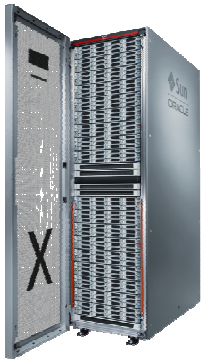
FACTS

- Engineered scale-out storage architecture pre-configured to easily expand system capacity and performance, online
- Simple upgrade to meet the needs of any size application
- Over 10 Petabytes of user data can be stored using the included Exadata Hybrid Columnar Compression
- Scale the configuration by connecting up to 8 Exadata Database Machines and Exadata Storage Expansion Racks by simply connecting via InfiniBand cables. Larger configurations can be built with additional InfiniBand

The Oracle Exadata Database Machine delivers extreme performance and scalability for all your database applications including Online Transaction Processing (OLTP), Data Warehousing (DW) and consolidation of mixed workloads. The Oracle Exadata Storage Expansion Rack is engineered to be the simplest, fastest and most robust way to add additional storage capacity to an Exadata Database Machine. A natural extension of the Exadata Database Machine, the Exadata Storage Expansion Rack can be used to satisfy the Big Data requirements of the largest mission critical databases.

Extreme Performance and Capacity for Online Transaction Processing, Data Warehousing and Consolidating Mixed Workloads

The Exadata Database Machine is an easy to deploy out of the box solution for hosting the Oracle Database. Ready to go day one much of the integration effort, cost and time of database deployment, has been eliminated. Whether its OLTP, DW or mixed workloads, a common deployment creates a tremendous opportunity for consolidation economies of scale in the data center. All this with breakthrough performance. The Exadata Storage Expansion Rack takes this to the next level.



The Exadata Storage Expansion Rack enables you to grow the Exadata storage capacity and bandwidth of any X2-2 and X2-8 Exadata Database Machine. It is designed for database deployments that require very large amounts of data including: historical or archive data; backups and archives of Exadata Database Machine data; documents, images, file and XML data, LOBs and other large unstructured data. The expansion rack is extremely simple to configure as there are no LUNs or mount points to configure. Storage is configured and added to a database with a few simple commands, completed in minutes.

The unique technology driving the performance advantages of the Exadata Database Machine is the Oracle Exadata Storage Server, and its software. By pushing database processing to the Exadata Storage Servers all the disks can operate in parallel reducing database server CPU consumption while using much less bandwidth to move data between storage and database servers. The Exadata Storage Expansion Rack is composed of standard Exadata Storage Servers and InfiniBand switches to seamlessly integrate with your Exadata Database Machine. The Exadata

RELATED PRODUCTS AND SERVICES

RELATED PRODUCTS

- Oracle Exadata Database Machine X2-8
- Oracle Exadata Database Machine X2-2
- Oracle Exadata Storage Server X2-2
- Oracle Database 11g
- Real Application Clusters
- Partitioning
- Advanced Compression
- Advanced Security
- Active Data Guard
- GoldenGate
- Real Application Testing
- OLAP
- Data Mining
- Business Intelligence
- Enterprise Manager
- Oracle Linux
- Oracle Solaris

RELATED SERVICES

The following services are available from Oracle:

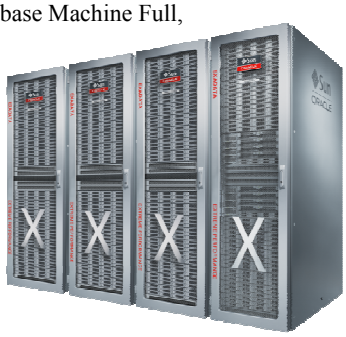
- Advanced Customer Services
- Consulting Services
- Oracle University courses

Storage Expansion Rack is a high-capacity, high-bandwidth, scale-out storage solution delivering up to 194 TB of uncompressed, and mirrored, usable capacity with a corresponding improvement in I/O bandwidth for your Exadata Database Machine deployment.

Extreme Scalability

Three versions of the Exadata Storage Expansion Rack are available. From the Full Rack configuration with 18 Exadata Storage Servers; to the Half Rack with 9 Exadata Storage Servers; to the Quarter Rack system with 4 Exadata Storage Servers; there is a configuration that fits any application. One version can be upgraded online to another ensuring a smooth upgrade path as processing requirements grow. All three versions of the expansion rack are delivered with the same 2 TB High Capacity SAS disks, and Exadata Smart Flash Cache, available in the Exadata Database Machine.

In addition to upgrading from a small to large Exadata Storage Expansion Rack, Oracle continues to use a building-block approach to connect the Exadata Storage Expansion Rack to the Exadata Database Machine using the integrated InfiniBand fabric to easily scale the system to any size. Exadata Storage Expansion Full, Half and Quarter Racks can be coupled to Exadata Database Machine Full, Half and Quarter Rack systems in almost any combination. Up to 8 Exadata Database Machine racks and Exadata Storage Expansion Racks can be easily connected via InfiniBand cables. An 8 rack configuration has a raw disk capacity of 3,360 TB and 1,680 CPU cores for SQL processing. Larger configurations can be built with additional InfiniBand switches.



On example of the Big Data strengths of the Exadata Storage Expansion Rack is when used as a destination for Exadata Database Machine backups. A full database backup can be created at up to 27 TB/hour when backing up uncompressed data that is being written to mirrored disk in an Exadata Storage Expansion Rack. It is capable of backing up hundreds of terabytes per hour when doing incremental database backups and petabytes per hour with incremental backups of Exadata Hybrid Columnar Compressed data. A disk backup on an Exadata Storage Expansion Rack is usable directly without loss of performance and without having to do a restore. This is a unique backup capability only available when backing up to an Exadata Storage Expansion Rack. It is by far the fastest and simplest way to backup and recover your Oracle Exadata Database Machine.

As new Exadata Storage Expansion Racks are connected to an Exadata Database Machine the storage capacity and performance of the system grow. The system can be run in single system image mode or logically partitioned for consolidation of multiple databases. Scaling out is easy with Exadata Database Machine and Exadata Storage Expansion Racks. Automatic Storage Management (ASM) dynamically and automatically balances the data across Exadata Storage Servers, online, evenly spreading the I/O load across the racks, fully utilizing all the hardware and easily

integrating the expansion rack into the configuration. The I/O Resource Manager can also be used to apportion I/O bandwidth to different databases and users of the system to deliver on business service level targets.

Enterprise Ready

Building on the high security capabilities in every Oracle Database, Exadata Database Machine and the Exadata Storage Expansion Rack provide the ability to query fully encrypted databases with near zero overhead at hundreds of gigabytes of user data per second. This is done by moving decryption processing from software into the Exadata Storage Server hardware.

The Exadata Storage Expansion Rack has complete redundancy built in to support the demands of mission critical applications. Each Exadata Storage Expansion Rack has redundant InfiniBand connectivity, redundant Power Distribution Units (PDU), and the servers all have hot-swappable disks, power supplies and fans for high availability. ASM provides disk mirroring (normal or triple mirrored) to protect against disk failures. Hot swappable components ensure the database can tolerate server and disk drive failure. In addition, data is mirrored across the Exadata Storage Servers to protect against loss of data and safeguard data accessibility.

Oracle Enterprise Manager is available to manage the software environment on the Exadata Database Machine and Exadata Storage Expansion Rack. A system monitoring plug-in for the Exadata Storage Server that delivers comprehensive availability, performance, and configuration information for the Exadata environment is available. Using Enterprise Manager, administrators can perform proactive monitoring and detailed configuration analysis of their Exadata Database Machine and Exadata Storage Expansion Rack.

Software from Oracle, Hardware from Sun

The Exadata Database Machine and Exadata Storage Expansion Rack build upon years of Oracle and Sun jointly solving customers' business and technical challenges. Integrated hardware and software technology, and related hardware support services, are provided in a unified fashion by Oracle. By combining leading, industry-standard servers and storage hardware from Sun with the intelligence built into the Oracle software, the Exadata Database Machine and Exadata Storage Expansion Rack delivers the industry's highest levels of performance, scalability, capacity and reliability, and is backed by Oracle Support.

Exadata Storage Expansion Rack X2-2 Key Capabilities		
Exadata Storage Expansion Full Rack	**Exadata Storage Expansion Half Rack**	**Exadata Storage Expansion Quarter Rack**
Up to 18 GB/second of uncompressed disk bandwidth [1]	Up to 9 GB/second of uncompressed disk bandwidth [1]	Up to 4 GB/second of uncompressed disk bandwidth [1]
Up to 82 GB/second of uncompressed Flash Cache data bandwidth [1]	Up to 41 GB/second of uncompressed Flash Cache data bandwidth [1]	Up to 18 GB/second of uncompressed Flash Cache data bandwidth [1]
Up to 32,000 Disk IOPS	Up to 16,000 Disk IOPS	Up to 7,200 Disk IOPS
Up to 1,900,000 Flash IOPS [2]	Up to 950,000 Flash IOPS [2]	Up to 425,000 Flash IOPS [2]
432 TB of raw disk data capacity [3]	216 TB of raw disk data capacity [3]	96 TB of raw disk data capacity [3]
Up to 194 TB of uncompressed usable capacity [4]	Up to 97 TB of uncompressed usable capacity [4]	Up to 42.5 TB of uncompressed usable capacity [4]
Up to 27 TB/hour full uncompressed backup to a mirrored destination	Up to 13.5 TB/hour full uncompressed backup to a mirrored destination	Up to 6 TB/hour full uncompressed backup to a mirrored destination

Actual system performance varies by application.

[1] Bandwidth is peak physical scan bandwidth achieved running SQL, assuming no data compression. Effective data bandwidth is higher when compression is used.

[2] Based on read IO requests of size 8K running SQL. Note that the IO size greatly affects Flash IOPS. Others quote IOPS based on 2K, 4K or smaller IOs and are not relevant for databases. Exadata Flash read IOPS are so high they are typically limited by database server CPU, not IO. This is especially true for the Storage Expansion Racks.

[3] For raw capacity, 1 GB = 1 billion bytes. Capacity calculated using normal space terminology of 1 TB = 1024 * 1024 * 1024 * 1024 bytes. Actual formatted capacity is less.

[4] Actual space available for a database after mirroring (ASM normal redundancy) while also providing adequate space (one disk on Quarter and Half Racks and two disks on a Full Rack) to reestablish the mirroring protection after a disk failure.

Exadata Storage Expansion Rack X2-2 Hardware		
Exadata Storage Expansion Full Rack	**Exadata Storage Expansion Half Rack**	**Exadata Storage Expansion Quarter Rack**
18 x Exadata Storage Servers X2-2 with 12 x 2 TB 7,200 RPM High Capacity SAS disks Includes: • 216 CPU cores for SQL processing • 6.75 TB Exadata Smart Flash Cache	9 x Exadata Storage Servers X2-2 with 12 x 2 TB 7,200 RPM High Capacity SAS disks Includes: • 108 CPU cores for SQL processing • 3.4 TB Exadata Smart Flash Cache	4 x Exadata Storage Servers X2-2 with 12 x 2 TB 7,200 RPM High Capacity SAS disks Includes: • 48 CPU cores for SQL processing • 1.5 TB Exadata Smart Flash Cache
3 x 36 port QDR (40 Gb/sec) InfiniBand Switches	3 x 36 port QDR (40 Gb/sec) InfiniBand Switches	2 x 36 port QDR (40 Gb/sec) InfiniBand Switches
Additional Hardware Components Included: • Ethernet switch for administration of the Storage Expansion Rack • Keyboard, Video or Visual Display Unit, Mouse (KVM) hardware for local administration • 2 x Redundant Power Distributions Units (PDUs) • 42U rack packaging Spares Kit Included: • 2 x 2 TB High Capacity SAS disks • 2 x 96 GB Exadata Smart Flash Cache cards • InfiniBand cables	Additional Hardware Components Included: • Ethernet switch for administration of the Storage Expansion Rack • Keyboard, Video or Visual Display Unit, Mouse (KVM) hardware for local administration • 2 x Redundant Power Distributions Units (PDUs) • 42U rack packaging Spares Kit Included: • 1 x 2 TB High Capacity SAS disk • 1 x 96 GB Exadata Smart Flash Cache card • InfiniBand cables	Additional Hardware Components Included: • Ethernet switch for administration of the Storage Expansion Rack • Keyboard, Video or Visual Display Unit, Mouse (KVM) hardware for local administration • 2 x Redundant Power Distributions Units (PDUs) • 42U rack packaging Spares Kit Included: • 1 x 2 TB High Capacity SAS disk • 1 x 96 GB Exadata Smart Flash Cache card • InfiniBand cables

Exadata Storage Expansion Rack X2-2 Support Services
• Hardware Warranty: 1 year with a 4 hour web/phone response during normal business hours (Mon-Fri 8AM-5PM), with 2 business day on-site response/Parts Exchange • Oracle Premier Support for Systems: Oracle Linux and Solaris support and 24x7 with 2 hour on-site hardware service response (subject to proximity to service center) • Oracle Premier Support for Operating Systems • Oracle Customer Data and Device Retention • System Installation Services • Software Configuration Services • Oracle Exadata Start-Up Pack • System Upgrade Support Services including hardware installation and software configuration • Oracle Auto Service Request (ASR)

Exadata Storage Expansion Rack X2-2 Connectivity and Upgrades		
Connection to Exadata Database Machine X2-2 and X2-8 Racks	**Exadata Storage Expansion Half Rack to Full Rack Upgrade**	**Exadata Storage Expansion Quarter Rack to Half Rack Upgrade**
Connect any combination of Exadata Database Machine Full or Half Racks to Exadata Storage Expansion Full or Half Racks via included InfiniBand fabric Connect a maximum of 1 Exadata Storage Expansion Quarter Rack to any Exadata Database Machine configuration (single or multi-rack) via included InfiniBand fabric Other configuration considerations: • Up to 8 racks can be connected without requiring additional InfiniBand switches • InfiniBand cables to connect 3 racks are included in the rack Spares Kit • Additional optical InfiniBand cables required when connecting 4 or more racks	Upgradability: Field upgrade from Half Rack to Full Rack Additional Hardware Components Included With The Upgrade: • 9 x Exadata Storage Servers X2-2 with 12 x 2 TB 7,200 RPM High Capacity SAS disks • InfiniBand and Ethernet cables to connect all the components • Upgrade to Full Rack Spares Kit	Upgradability: Field upgrade from Quarter Rack to Half Rack Additional Hardware Components Included With The Upgrade: • 5 x Exadata Storage Servers X2-2 with 12 x 2 TB 7,200 RPM High Capacity SAS disks • 1 x 36 port QDR (40 Gb/sec) InfiniBand switch • InfiniBand and Ethernet cables to connect all the components • Upgrade to Half Rack Spares Kit
Upgrade Support Services: • Hardware installation and software configuration	Upgrade Support Services: • Hardware installation and software configuration	Upgrade Support Services: • Hardware installation and software configuration

Exadata Storage Expansion Rack X2-2 Environmental Specifications		
Exadata Storage Expansion Full Rack	**Exadata Storage Expansion Half Rack**	**Exadata Storage Expansion Quarter Rack**
• Height: 42U, 78.66" - 1998 mm • Width: 23.62" – 600 mm • Depth: 47.24" – 1200 mm	• Height: 42U, 78.66" - 1998 mm • Width: 23.62" – 600 mm • Depth: 47.24" – 1200 mm	• Height: 42U, 78.66" - 1998 mm • Width: 23.62" – 600 mm • Depth: 47.24" – 1200 mm
Weight: 2,023 lbs. (917.6 kg)	Weight: 1,275 lbs. (578.3 kg)	Weight: 875 lbs. (396.8 kg)
Power • Maximum power usage: 12.6 kW (12.9 kVA) • Typical power usage (varies by application load): 8.8 kW (9.0 kVA)	Power • Maximum power usage: 6.9 kW (7.1 kVA) • Typical power usage (varies by application load): 4.8 kW (5.0 kVA)	Power • Maximum power usage: 3.4 kW (3.5 kVA) • Typical power usage (varies by application load): 2.4 kW (2.5 kVA)
Cooling • At maximum usage: 43,000 BTU/hour (45,400 kJ/hour) • At typical usage: 30,100 BTU/hour (31,800 kJ/hour)	Cooling • At maximum usage: 23,600 BTU/ hour (24,900 kJ/ hour) • At typical usage: 16,500 BTU/ hour (17,400 kJ/ hour)	Cooling • At maximum usage: 11,600 BTU/ hour (12,2500 kJ/ hour) • At typical usage: 8,100 BTU/ hour (8,600 kJ/ hour)
Airflow • At maximum usage: 1,980 CFM • At typical usage: 1,390 CFM • Airflow must be front-to-back	Airflow • At maximum usage: 1,090 CFM • At typical usage: 760 CFM • Airflow must be front-to-back	Airflow • At maximum usage: 530 CFM • At typical usage: 375 CFM • Airflow must be front-to-back
Acoustic noise: 8.3 B operating	Acoustic noise: 8.2 B operating	Acoustic noise: 8.1 B operating
Operating temperature/humidity: 5 ºC to 32 ºC (41 ºF to 89.6 ºF), 10% to 90% relative humidity, non-condensing Altitude Operating: Up to 3,048 m, max. ambient temperature is de-rated by 1° C per 300 m above 900 m		
Regulations [1] • Safety: UL 60950-1 2nd Ed, EN60950-1:2006 2nd Ed, CB Scheme with all country differences • RFI/EMI: FCC CFR 47 Part 15 Subpart B Class A, EN 55022:2006+A1:2007 Class A, EN 61000-3-11:2000, EN 61000-3-12:2005, ETSI EN 300 386 V1.4.1 (2008) • Immunity: EN 55024:1998+A1:2001:+A2:2003		
Certifications [1] • Safety: UL/cUL, CE, BSMI, GOST R, S-Mark, CSA C22.2 No. 60950-1-07 2nd Ed, CCC • EMC: CE, FCC, VCCI, ICES, KCC, GOST R, BSMI Class A, AS/NZ 3548, CCC • Other: Complies with WEEE Directive (2002/96/EC) and RoHS Directive (2002/95/EC)		
[1] In some cases, as applicable, regulatory and certification compliance were obtained at the component level.		

Oracle Database Software (sold separately)	
For storage servers	Oracle Exadata Storage Server Software Licenses are transferable from one system to another.
Exadata Storage Server Software Features	
• Smart Scan Technology • Smart Flash Cache • IO Resource Manager • Storage Index Technology • Hybrid Columnar Compression • Smart Scans of Data Mining model scoring	
High-Availability Features	
• Redundant power supplies and fans for all servers • Redundant InfiniBand switches • Redundant Power Distribution Units • Oracle Automatic Storage Management: All database files mirrored; disk failures do not interrupt query processing • Oracle Exadata Storage Server Software: storage server failures are tolerated • Backup is performed using Oracle Recovery Manager • Point in time restores are performed using Oracle Flashback Technologies	
Manageability Features	
• Oracle Embedded Integrated Lights Out Manager (ILOM) • Oracle Enterprise Manager Grid Control • Oracle Quality of Service Management (requires Oracle Database 11.2.0.2)	

Contact Us

For more information about the Oracle Database Machine, please visit oracle.com or call +1.800.ORACLE1 to speak to an Oracle representative.

Oracle is committed to developing practices and products that help protect the environment

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