

ORACLE EXADATA STORAGE EXPANSION RACK X4-2

FEATURES AND FACTS

FEATURES

- Grow the storage capacity of Oracle Exadata Database Machines and Oracle SuperCluster
- Includes from 4 to 18 Oracle Exadata Storage Servers
- Mirrored usable capacity of up to 387 TB per rack before compression
- Up to 216 CPU cores dedicated to SQL processing in storage
- Up to 57.6 TB of Exadata Smart Flash Cache
- Connected directly to Exadata Database Machines X4-2 and X3-8 and SuperCluster via 40 Gb/second InfiniBand
- Hybrid Columnar Compression often delivers 10X-15X compression ratios
- Complete redundancy for high availability

FACTS

- Uncompressed I/O bandwidth of up to 130 GB/second per rack from SQL
- 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 6 Petabytes of user data can be stored in a rack using the included Hybrid Columnar Compression
- Scale the configuration by connecting up to 18 Exadata Database Machines and Exadata Storage Expansion Racks without external switches. Larger configurations can be built with additional InfiniBand switches

The Oracle Exadata Database Machine and the Oracle SuperCluster 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 or a SuperCluster. A natural extension of the Exadata Database Machine and the SuperCluster, the Exadata Storage Expansion Rack can be used to satisfy the Big Data requirements of the largest mission critical databases.

Engineered System For Fast Deployment of All Your Databases

The Exadata Database Machine and SuperCluster are easy to deploy systems that include all the hardware needed for running the Oracle Database. The database servers, storage servers and network are pre-configured, pre-tuned, and pre-tested by Oracle experts, eliminating the weeks of effort that is typically required to deploy a high performance system. Extensive end-to-end testing ensures all components work seamlessly together and there are no performance bottlenecks or single points of failure that can affect the complete system. The Exadata Storage Expansion Rack takes this to the next level.

Extreme Performance and Capacity

The Exadata Storage Expansion Rack enables you to grow the Exadata storage capacity and bandwidth of any Exadata Database Machine or SuperCluster. It is designed for database deployments that require very large amounts of data including: historical or archive data, backups, documents, images, XML, LOBs, etc. Available in Full Rack, Half Rack and Quarter Rack sizes, it connects to the Exadata Database Machine or SuperCluster using the integrated InfiniBand fabric. The expansion rack is extremely simple to configure as there are no LUNs or mount points to set up. Storage is configured and added to a database online with a few simple commands.



Extreme System Scalability and Growth

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

RELATED PRODUCTS AND SERVICES

RELATED PRODUCTS

- Oracle Exadata Database Machine X3-8
- Oracle Exadata Database Machine X4-2
- Oracle Exadata Storage Server X4-2
- Oracle SuperCluster
- Oracle Database 11g and 12c
- Real Application Clusters
- Partitioning
- Advanced Compression
- Advanced Security
- Active Data Guard
- GoldenGate
- Real Application Testing
- OLAP
- Advanced Analytics
- Business Intelligence
- Enterprise Manager
- Oracle Linux
- Oracle Solaris

RELATED SERVICES

The following services are available from Oracle:

- Advanced Customer Services
- Oracle Premier Support for Systems
- Oracle Infrastructure as a Service On-Premise (IaaS)
- Oracle Platinum Services
- Oracle PlatinumPlus Services
- Consulting Services
- Oracle University courses

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 1.2 TB High Performance disks or 4 TB High Capacity 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 and the SuperCluster 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 18 Exadata Database Machine racks and Exadata Storage Expansion Racks can be easily connected via InfiniBand cables and internal switches. An 18 rack Exadata configuration has a raw disk capacity of up to 15,360 TB and 3,840 CPU cores dedicated to SQL processing. Larger configurations can be built with additional InfiniBand switches.

As new Exadata Storage Expansion Racks are connected to an Exadata Database Machine or a SuperCluster, the storage capacity and performance of the system grows. 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, SuperCluster 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.

Extreme Performance by Offloading Data Intensive Processing

As data volumes grow exponentially, conventional storage arrays struggle to quickly transfer data from disk and flash to database servers at a rate that keeps the CPUs busy. Modern servers with many CPUs can consume data at many tens to hundreds of gigabytes a second. This is far faster than conventional architectures that use storage arrays can deliver data through their storage heads and the storage network.

The scale-out architecture of the Exadata Database Machine and the SuperCluster not only provides high performance and scalability, it also includes a unique technology that **offloads data intensive SQL operations into the Oracle Exadata Storage Servers**. By pushing SQL processing to the Exadata Storage Servers, data filtering and processing occurs immediately and in parallel across all storage servers as data is read from disk and flash. **Only the rows and columns that are directly relevant to a query are sent to the database servers.**

For example, if a query is executed to identify the customers who placed sales orders over \$1000 in the month of March, an Exadata system will: offload the scanning of the table to the Exadata storage; filter out all sales orders that are less than \$1000; filter out sales orders not in March; and extract just the relevant

customer names. The result is that the data transferred to the database servers is reduced by orders of magnitude. This greatly accelerates query execution, eliminates bottlenecks, and significantly reduces the CPU usage of the database servers.

Each Exadata Storage Server has two Intel® Xeon® processors that are used for database offload. A full rack Exadata Database Machine has a total of 168 processor cores in the storage servers that can be used to offload the database servers. The CPUs in Exadata Storage Servers do not replace database CPUs. Instead they accelerate data intensive workloads similar to how graphics cards accelerate image intensive workloads.

Optimizing Storage Use and I/O Through Compression

The Exadata Storage Server provides a very advanced compression capability called **Hybrid Columnar Compression (HCC) that provides dramatic reductions in storage for large databases**. Hybrid Columnar Compression enables the highest levels of data compression and provides tremendous cost-savings and performance improvements due to reduced I/O, especially for analytic workloads. Storage savings is data dependent and often ranges from 5x to 20x. Typical storage savings is an industry leading 10x. On conventional systems, enabling high data compression has the drawback of reducing performance. Because the Exadata Database Machine is able to offload decompression overhead into large numbers of processors in Exadata storage, most analytics workloads run faster using Hybrid Columnar Compression than they do without it. Hybrid Columnar Compression delivers the compression and analytic performance benefits of column storage while avoiding the dramatic slowdown that pure columnar stores experience for drilldown operations (single row access).

Two modes of Hybrid Columnar Compression are available. **Query optimized compression** mode is suitable for read intensive workloads such as Data Warehouses and provides large storage savings while providing enhanced analytic performance. **Archive compression** mode provides the highest degree of compression and is targeted at seldom accessed data that is kept online.

On OLTP systems, Hybrid Columnar Compression can be used to compress older, less active data while newer, more active and update intensive data can be compressed using Advanced Row Compression. Oracle Database 12c provides the ability to change the type of compression used by individual table partitions online, even if there are global indexes on the table to ensure seamless tiering across different compression types as data ages and becomes less active.

Extreme Performance from Exadata Smart Flash Cache

Exadata systems use the latest **PCI flash technology** rather than flash disks. PCI flash delivers ultra-high performance by placing flash memory directly on the high speed PCI bus rather than behind slow disk controllers and directors. Each Exadata Storage Server includes 4 PCI flash cards with a total raw capacity of 3.2 TB of flash memory. A Full Rack Exadata Storage Expansion Rack includes 72 PCI flash cards providing 57.6 TB of flash memory.



Sun Flash Accelerator F80 PCIe Card

Exadata flash can be used directly as flash disks, but it is almost always configured as a flash cache in front of disk since caching provides flash level performance for much more data than fits directly into flash.

The **Exadata Smart Flash Cache** automatically caches frequently accessed data in PCI flash while keeping infrequently accessed data on disk drives. This provides the performance of flash with the capacity and low cost of disk. The Exadata Smart Flash Cache understands database workloads and knows when to avoid caching data that the database will rarely access or is too big to fit in the cache. For example, Exadata understands when I/Os are run for backup purposes, for table scans, and for storing temporary results that will be quickly deleted. In addition to automatic caching, administrators can optionally provide SQL directives to ensure that specific tables, indexes, or partitions are always retained in flash. Tables can be retained in flash without the need to move the table to different tablespaces, files or LUNs as is often required with traditional storage.

Exadata's Smart Flash Cache is designed to deliver flash-level IO rates, throughput, and response times for data that is many times larger than the physical flash capacity in the machine by automatically moving active data that is experiencing heavy IO activity into flash, while leaving cold data that sees infrequent IO activity on disk. It is common for hit rates in the Exadata Smart Flash Cache to be over 90%, or even 98% in real-world database workloads even though flash capacity is more than 10 times smaller than disk capacity. Such high flash cache hit rates mean that Exadata Smart Flash Cache provides an **effective flash capacity** that is often 10 times larger than the physical flash cache. For example, a full rack Exadata Storage Expansion X4-2 often has an effective flash capacity of 576 TB.

On top of the capacity benefits provided by smart caching, **Exadata Smart Flash Cache Compression** dynamically increases the capacity of the flash cache by transparently compressing user data as it is loaded into the flash cache. This allows much more data to be kept in flash memory, and further decreases the need to access data on disk drives. The compression and decompression operations are completely transparent to the application and database. Exadata Smart Flash Cache Compression leverages hardware acceleration to deliver **zero performance overhead for compression and decompression**, even when running at rates of millions of I/Os per second or 100s of Gigabytes per second.

Flash Cache Compression benefits vary based on the compressibility of the user data. Tables that are uncompressed will see the largest benefits. Indexes will also typically compress very well. Exadata Smart Flash Cache Compression will also

provide significant flash cache space expansion on top of the benefits already provided by Advanced Row and Basic table compression. OLTP applications will often see the overall logical size of the flash cache double even if they use Advanced Row Compression. Tables that use Hybrid Columnar Compression or LOB Compression will see minimal additional compression since these are already very highly compressed formats. With Flash Cache Compression turned on, a full rack Exadata Storage Expansion X4-2 provides up to 115 TB of logical flash cache capacity (before database level compression is factored in).

Flash performance is often limited and bottlenecked by traditional storage architectures. In contrast, Exadata uses a combination of scale-out storage, InfiniBand networking, database offload, and PCI flash to deliver extremely high performance rates from flash. A single full rack Exadata Storage Expansion X4-2 achieves up to **130 GB per second of data scan bandwidth**, and up to **3.42 Million random 8K read I/O operations per second (IOPS)** when running database workloads. This performance is orders of magnitude faster than traditional database architectures. It is important to note that these are real-world end-to-end performance figures measured running SQL workloads with realistic IO sizes inside a single rack Exadata system. They are not component level measurements based on low level IO tools.

The Exadata Smart Flash cache also caches database block writes. Write caching eliminates disk bottlenecks in large scale OLTP and batch workloads. The flash write capacity of a single full rack Exadata Storage Expansion X4-2 exceeds **2.52 Million 8K write I/Os per second**. The Exadata write cache is transparent, persistent, and fully redundant. The I/O performance of the Exadata Smart Flash Cache is comparable to dozens of enterprise disk arrays with thousands of disk drives.

To further accelerate OLTP workloads, the Exadata Smart Flash Cache also implements a special algorithm to reduce the latency of log write I/Os called **Exadata Smart Flash Logging**. The time to commit user transactions or perform critical updates is very sensitive to the latency of log writes. Smart Flash Logging takes advantage of the flash memory in Exadata storage combined with the high speed RAM memory in the Exadata disk controllers to greatly reduce the latency of log writes and avoid the latency spikes that frequently occur in other flash solutions. The Exadata Smart Flash Logging algorithms are unique to Exadata.

Exadata uses only enterprise grade flash that is designed by the flash manufacturer to have high endurance. Exadata is designed for mission critical workloads and therefore does not use consumer grade flash that can potentially experience performance degradations or fail unexpectedly after a few years of usage. The enterprise grade flash chips used in Exadata X4 have an expected endurance of 10 years or more for typical database workloads.

The automatic data tiering between RAM, flash and disk implemented in Exadata provides tremendous advantages over other flash-based solutions. When third-party flash cards or flash disks are used directly in database servers, the data placed in flash is only available on that server since local flash cannot be shared between

servers. This precludes the use of RAC and limits the database deployment to the size of a single server handicapping performance, scalability, availability, and consolidation of databases. Any component failure, like a flash card, in a single server can lead to a loss of database access. Local flash lacks the intelligent flash caching and Hybrid Columnar Compression provided in Exadata and is much more complex to administer.

Real world experience has shown that server local flash cards and flash disks can become crippled without completely failing leading to database hangs, poor performance, or even corruptions. Flash products have been seen to intermittently hang, exhibit periodic poor performance, or lose data during power cycles, and these failures often do not trigger errors or alerts that would cause the flash product to be taken offline. Worse, these issues can cause hangs inside the Operating System causing full node hangs or crashes. Exadata software automatically detects and bypasses poorly performing or crippled flash. When an unusual condition is detected, Exadata will automatically route I/O operations to alternate storage servers.

Many storage vendors have recognized that the architecture of their traditional storage arrays inherently bottleneck the performance of flash and therefore have developed new flash-only arrays. These flash-only arrays deliver higher performance than traditional arrays but give up the cost advantages of smart tiering of data between disk and flash. Therefore the overall size of data that benefits from flash is limited to the size of expensive flash. Exadata smart flash caching often provides flash level performance for data that is 10 times larger than physical flash since it automatically keeps active data that is experiencing heavy IO activity in flash while leaving cold data that sees infrequent IO activity on low-cost disk. Database and Flash Cache Compression further extend the capacity of Exadata flash. Third party flash arrays will also not benefit from Exadata Hybrid Columnar Compression.

Exadata not only delivers much more capacity than flash-only arrays, it also delivers better performance. Flash-only storage arrays cannot match the throughput of Exadata's integrated and optimized architecture with full InfiniBand based scale-out, fast PCI flash, offload of data intensive operations to storage, and algorithms that are specifically optimized for database.

Enterprise-Class Security with Extreme Performance

Exadata Database Machine is the world's most secure database machine. Building on the high security capabilities in the Oracle Database, **Exadata moves decryption processing from database server software into the Exadata Storage Server hardware.** Exadata storage leverages hardware decryption and compression together to provide the highest performance secure databases. **Encryption occurs after the data is compressed so that the cost of decryption is decreased by the degree of compression.** By leveraging both technologies, Exadata is able to query fully encrypted and compressed databases with near zero overhead at hundreds of gigabytes of user data per second.

The Exadata system is designed and delivered as an integrated whole, and not a

collection of components. In traditional database deployments, the customer takes on all the integration tasks for the system – including the task of ensuring the security of each individual software and hardware component, and ensuring that security is maintained across the full product stack. **Oracle delivers full stack security in the Exadata Database Machine.**

Exadata security has been probed and evaluated by hundreds of leading banks, telecoms, and governments worldwide. The security findings of all these evaluations have been incorporated into the Exadata standard configuration, making it a highly secure database system.

Extreme Backup & Recovery Speed

On example of the Big Data strengths of the Exadata Storage Expansion Rack is when used as a destination for Exadata Database Machine or SuperCluster 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 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 or SuperCluster.

Mission Critical High Availability

The Exadata Storage Expansion Rack is engineered to provide the highest levels of availability. **All types of failures are protected against** including simple failures such as disk, server, or network, as well as complex site failures and human errors. Each Exadata Storage Expansion Rack has **completely redundant hardware** including redundant InfiniBand networking, redundant Power Distribution Units (PDU), redundant power supplies and storage servers. Oracle RAC protects against database server failure. ASM provides data mirroring to protect against disk or storage server failures. Oracle RMAN provides extremely fast and efficient backups to disk or tape. Oracle's Flashback technology allows backing out user errors at the database, table or even row level. Using Oracle Data Guard, a second Exadata Database Machine can be configured to maintain a real-time copy of the database at a remote site to provide full protection against site failures and disasters.

Because of its industry leading availability, the Exadata Database Machine and the Exadata Storage Expansion Rack have been deployed by leading companies for their most critical applications including interbank fund transfers, online securities trading, real-time call tracking, and web-based retailing. Mission Critical availability is not restricted to OLTP workloads; it also applies to warehousing and analytics workloads.

Highest Level of Service

Oracle offers a complete set of support services for the Exadata family of products including: 24x7 hardware service, system monitoring, software installation and

configuration among other standard and custom offerings.

Of particular value is **Oracle Platinum Services** which is available exclusively for Oracle's Engineered Systems. Platinum Services provides fault monitoring, faster response times, and expedited escalation to development. With Platinum Services, fault monitoring, software maintenance, and patching is performed remotely by Oracle engineers. Platinum Services provides a higher level of support than has ever been available before for all software and hardware within an Engineered System including the Oracle Database. Platinum Services is provided free of charge to Exadata customers.

IT Agility

Exadata is a complete system for running databases including storage, servers, and internal networks. Management of a traditional database system is typically spread across the management teams of each of the components such as the database team, the storage team, and the system administration team. In contrast, an **Exadata system is typically managed by a single Database Machine Administration team**. Database Machine Administrators have full control of all resources in the Exadata Database Machine including storage resources. New database deployments and configuration changes can be implemented by the Database Machine Administrators without coordination across different component management teams that are often overloaded and have differing priorities. Database Machine Administrators can focus on application and business specific enhancements rather than coordinating across component teams, or tuning and triaging of low level configuration issues.

Dramatically Lower Costs

Because of the extreme performance, high storage capacity, and unique compression capabilities delivered by the Exadata Database Machine, workloads that would require very large traditional hardware systems can be run on much smaller Exadata systems. The hardware needed for an application deployed on an Exadata system is often reduced 10X compared to a traditional system.

Exadata provides a huge RAM, flash and disk footprint for large data sets. Raw storage on an Exadata full rack exceeds 670 TB and Hybrid Columnar Compression often expands storage and memory capacity 10X. By intelligently moving active data across storage and memory tiers, Exadata simultaneously delivers the highest performance and the lowest cost.

Exadata has the unique ability to consolidate many databases supporting multiple workloads in a single cloud platform. High-end OLTP, analytics, batch, reporting, and backups can all run simultaneously within and across databases with extreme performance. **The extreme performance and capacity of Exadata enables very large numbers of databases and workloads to be consolidated on Exadata.** Consolidating databases on Exadata reduces system hardware cost, software cost, and greatly reduces ongoing operations cost.

The uniformity of Exadata Database Machine configurations results in large cost savings. **Exadata standardizes not just technologies, but also integration,**

testing, hardening, tuning, and support. Customers deploy Exadata systems much faster and with a lot less labor than traditional systems. Low level tuning, integration, and maintenance is reduced or eliminated. Because all Exadata users run a configuration that is identical to thousands of other users, and is identical to Oracle's internal configurations, it is far less likely that issues will be encountered, and issue resolution is quicker and simpler reducing both operations cost and downtime cost.

Exadata Business Benefits

Beyond the operational benefits of extreme performance, availability, and security at low cost, Exadata also directly benefits the business.

Exadata accelerates time to market for new business applications since the time needed for system configuration, tuning, and testing is largely eliminated. Deployment times are reduced from months to days, and the risk of unexpected system level issues after go-live is greatly reduced. When a new application is deployed, it is common for unanticipated application usage patterns to create performance issues. Exadata's huge I/O, network, and compute throughput can absorb spikes created by unanticipated workloads without slowing response times of mission critical workloads. Overall Exadata speeds application deployment and reduces risk allowing businesses to innovate faster.

Exadata's extreme performance and large memory and flash capacity enhances employee productivity and customer satisfaction by greatly improving user response times. **Users spend more time doing useful work, and less time waiting** for the system to respond.

Exadata's extreme performance does not just improve business efficiency, it also **enables business users to make smarter decisions, discover growth opportunities, and reduce costs.** Users can analyze data in real-time, explore different possibilities, and perform rapid iteration to find better solutions. Exadata enables:

- Real-time business data analysis
- Faster financial closes
- Better planning and budgeting
- More effective and faster projections

Conclusion

Exadata delivers a fully integrated database platform with the latest hardware technologies and unique software to deliver extreme performance, availability, and security. This coupled with cost savings, ease of management, and enhanced supportability result in greater business agility and efficiency. Given what can be achieved with Exadata, it is no surprise it is the new global standard for running the Oracle Database.

Exadata Storage Expansion Rack X4-2 Key Capacity and Performance Metrics						
	Full Rack		Half Rack		Quarter Rack	
Maximum SQL flash bandwidth ²	130 GB/s		65 GB/s		29 GB/s	
Maximum SQL flash read IOPS ³	3,420,000		1,710,000		760,000	
Maximum SQL flash write IOPS ⁴	2,520,000		1,260,000		560,000	
Flash data capacity (raw) ⁵	57.6 TB		28.8 TB		12.8 TB	
Effective Flash cache capacity ⁷	Up to 576 TB		Up to 288 TB		Up to 128 TB	
	HC ¹ Disks	HP ¹ Disks	HC ¹ Disks	HP ¹ Disks	HC ¹ Disks	HP ¹ Disks
Maximum SQL disk bandwidth ²	26 GB/s	30 GB/s	13 GB/s	15 GB/s	6 GB/s	7 GB/s
Maximum SQL disk IOPS ³	42,000	64,000	21,000	32,000	9,500	14,400
Disk data capacity (raw) ⁵	864 TB	258 TB	432 TB	129 TB	192 TB	57 TB
Disk data capacity (usable) ⁶	387 TB	116 TB	194 TB	58 TB	85 TB	25 TB
Maximum full backup rate	27 TB/hour		13.5 TB/hour		6 TB/hour	
Actual system performance varies by application.						
¹ HP = High Performance; HC = High Capacity						
² Bandwidth is peak physical scan bandwidth achieved running SQL, assuming no database compression. Effective user data bandwidth is higher when database compression is used.						
³ Based on 8K IO requests running SQL. Note that the IO size greatly affects Flash IOPS. Others quote IOPS based on smaller IOs and are not relevant for databases.						
⁴ Based on 8K IO requests running SQL. Flash write I/Os measured at the storage servers after ASM mirroring, which issues multiple storage IOs to maintain redundancy.						
⁵ Raw capacity is measured in standard disk drive terminology with 1 GB = 1 billion bytes. Usable capacity is measured using normal powers of 2 space terminology with 1 TB = 1024 * 1024 * 1024 * 1024 bytes.						
⁶ 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 in the normal redundancy case.						
⁷ Effective Flash Capacity is larger than the physical flash capacity and takes into account the high flash hit ratios due to Exadata's intelligent flash caching algorithms, and the size of the underlying disk storage. It is the size of data files that often can be stored in Exadata and be accessed at the speed of flash memory.						

Exadata Storage Expansion Rack X4-2 Hardware		
Full Rack	Half Rack	Quarter Rack
18 x Exadata Storage Servers X4-2: <ul style="list-style-type: none"> • 216 CPU cores for SQL processing • 72 PCI flash cards with 57.6 TB (raw) Exadata Smart Flash Cache • 216 x 1.2 TB 10,000 RPM High Performance disks or 216 x 4 TB 7,200 RPM High Capacity disks 	9 x Exadata Storage Servers X4-2: <ul style="list-style-type: none"> • 108 CPU cores for SQL processing • 36 PCI flash cards with 28.8 TB (raw) Exadata Smart Flash Cache • 108 x 1.2 TB 10,000 RPM High Performance disks or 108 x 4 TB 7,200 RPM High Capacity disks 	4 x Exadata Storage Servers X4-2: <ul style="list-style-type: none"> • 48 CPU cores for SQL processing • 16 PCI flash cards with 12.8 TB (raw) Exadata Smart Flash Cache • 48 x 1.2 TB 10,000 RPM High Performance disks or 48 x 4 TB 7,200 RPM High Capacity disks
3 x 36 port QDR (40 Gb/sec) InfiniBand Switches		2 x 36 port QDR (40 Gb/sec) InfiniBand Switches
Additional Hardware Components: <ul style="list-style-type: none"> • 42U Rack • Ethernet switch for administrative connectivity to servers in the Database Machine • 2 x Redundant Power Distributions Units (PDUs) 		
Included Spare Parts Kit Contains: <ul style="list-style-type: none"> • 1 x 1.2 TB High Performance disk or 1 x 4 TB High Capacity disk • 1 x 800 GB PCI flash card 		
Exadata Storage Expansion Rack X4-2 Connectivity and Upgrades		
Connection to Exadata Database Machine	Half Rack to Full Rack Upgrade	Quarter Rack to Half Rack Upgrade
Connect any combination of up to 18 Exadata Database Machine racks or Exadata Storage Expansion Racks via the InfiniBand fabric. Larger configurations can be built with external InfiniBand switches. Connected racks can be any combination of V2, X2, X3, or X4 generation hardware.	Upgradability: Field upgrade from Half Rack to Full Rack Additional Hardware Components Included With The Upgrade: <ul style="list-style-type: none"> • 9 x Exadata Storage Servers X4-2 with 12 x 1.2 TB 10,000 RPM High Performance disks or 12 x 4 TB 7,200 RPM High Capacity disks • InfiniBand and Ethernet cables to connect all the components 	Upgradability: Field upgrade from Quarter Rack to Half Rack Additional Hardware Components Included With The Upgrade: <ul style="list-style-type: none"> • 5 x Exadata Storage Servers X4-2 with 12 x 1.2 TB 10,000 RPM High Performance disks or 12 x 4 TB 7,200 RPM High Capacity disks • 1 x 36 port QDR (40 Gb/sec) InfiniBand switch • InfiniBand and Ethernet cables to connect all the components
Upgrade Support Services: <ul style="list-style-type: none"> • Hardware installation and software configuration 		

Exadata Storage Expansion Rack X4-2 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 includes 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 Infrastructure as a Service On-Premise (IaaS)
- Oracle Platinum Services
- Oracle PlatinumPlus Services
- Business Critical Service for Systems
- Oracle Exadata Start-Up Pack
- System Upgrade Support Services including hardware installation and software configuration
- Oracle Auto Service Request (ASR)

Exadata Storage Expansion Rack X4-2 Environmental Specifications			
	Full Rack	Half Rack	Quarter Rack
Height	78.66" - 1998 mm		
Width	23.62" – 600 mm		
Depth	47.24" – 1200 mm		
Weight	Weight: 1,817 lbs. (824.2 kgs)	Weight: 1,131 lbs. (513.0kgs)	Weight: 764 lbs. (346.5 kgs)
Acoustic noise (operating)	8.2 B	7.9 B	7.6 B
Environmentals With High Capacity Disk			
Maximum power usage	8.9 kW (9.1 kVA)	5.1 kW (5.2 kVA)	2.6 kW (2.7 kVA)
Typical power usage ¹	6.2 kW (6.3 kVA)	3.6 kW (3.7 kV)	1.9 kW (2.0 kVA)
Cooling at maximum usage	30,400 BTU/hour 32,100 kJ/hour)	17,400 BTU/hour (18,400 kJ/hour)	8,900 BTU/hour 9,400 kJ/hour)
Cooling at typical usage	21,200 BTU/hour 22,400 kJ/hour)	12,300 BTU/hour 13,000 kJ/hour)	6,500 BTU/hour 6,900 kJ/hour)
Airflow at maximum usage ²	1,410 CFM	810 CFM	410 CFM
Airflow at typical usage ²	980 CFM	570 CFM	300 CFM
Environmentals With High Performance Disk			
Maximum power usage	10.0 kW (10.2 kVA)	5.6 kW (5.7 kVA)	2.8 kW (2.9 kVA)
Typical power usage ¹	7.0 kW (7.1 kVA)	4.0 kW (4.1 kVA)	1.9 kW (2.0 kVA)
Cooling at maximum usage	34,100 BTU/hour (36,000 kJ/hour)	19,100 BTU/ hour (20,150 kJ/ hour)	9,500 BTU/ hour (10,000 kJ/ hour)
Cooling at typical usage	23,900 BTU/hour (25,200 kJ/hour)	13,650 BTU/ hour (14,400 kJ/ hour)	6,700 BTU/ hour (7,000 kJ/ hour)
Airflow at maximum usage ²	1,600 CFM	900 CFM	440 CFM
Airflow at typical usage ²	1,100 CFM	650 CFM	310 CFM
Operating temperature/humidity: 5 °C to 32 °C (41 °F to 89.6 °F), 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 ³			
<ul style="list-style-type: none"> • Safety: UL/CSA 60950-1, EN 60950-1, IEC 60950-1 CB Scheme with all country differences • RFI/EMI: EN55022, EN61000-3-11, EN61000-3-12 • Immunity: EN 55024 • Emissions and Immunity: EN300 386 			
Certifications ³			
<ul style="list-style-type: none"> • North America (NRTL), European Union (EU), International CB Scheme, BSMI (Taiwan), C-Tick (Australia), CCC (PRC), MSIP (Korea), CU EAC (Customs Union), VCCI (Japan) 			
European Union Directives ³			
<ul style="list-style-type: none"> • 2006/95/EC Low Voltage Directive, 2004/108/EC EMC Directive, 2011/65/EU RoHS Directive, 2012/19/EU WEEE Directive 			
¹ Typical power usage varies by application load.			
² Airflow must be front-to-back.			
³ All standards and certifications referenced are to the latest official version at the time that the data sheet was written. Other country regulations/certifications may apply. 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 Software Features (Partial List)	
<ul style="list-style-type: none"> • Smart Scan Technology • Smart Flash Cache • Smart Flash Logging • Flash Cache Compression • IO and Network Resource Management • Storage Index • Hybrid Columnar Compression • Smart Scans of Data Mining model scoring 	
High-Availability Features	
<ul style="list-style-type: none"> • 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	
<ul style="list-style-type: none"> • Oracle Embedded Integrated Lights Out Manager (ILOM) • Oracle Enterprise Manager 12c Oracle 	

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.



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