



# Faster than Fast—Oracle Introduces Exadata X9M Portfolio

*Why Oracle's New Exadata, ExaC@C, and ZDLRA X9M Innovations Topple the Competition While Giving Customers up to 80% More Performance at the Same Price*

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# Introduction

## Oracle Debuts New Exadata, ExaC@C, and ZDLRA X9M Solutions that Solve the Topmost Customer Database Problems

Database (DB) customers must deal with frequently recurring problems due to major underlying issues that require innovative breakthroughs to resolve. These underlying issues include low IOPS (Input Output Operations Per Second) which reduce application performance when data workloads increase, high latency that slows transactions reducing productivity and customer satisfaction, and low throughput that impedes the efficient processing of large amounts of data for analytics applications. Customers identify additional underlying issues such as low availability, little to no convergence of enterprise DB and infrastructure assets, lack of cloud identity preventing seamless movement between on-premises and public cloud resources, insufficient automation, and poor utilization efficiency directly driving up DB costs, resulting in ever more problems that require attention. In sum, the scaling of DB size and performance is a topmost concern across the entire DB ecosystem.

In our evaluation of Oracle's new Exadata X9M portfolio, it is clear the company's vision directly addresses the underlying issues that cause database administrators and IT decision makers to lose sleep: the constant battling of DB problems. The Exadata X9M portfolio is an unbeatable value prop, providing extreme performance, lowest cost, and is available everywhere. The platform delivers what we see as best-in-class DB hardware. It scales-out elastically and provides DB-optimized computing, networking, and storage capabilities. The Exadata portfolio also offers DB-aware system software, which uses specific algorithms designed to vastly improve the execution of OLTP (Online Transaction Processing), OLAP (Online Analytical Processing), and DB workload consolidation. We also note that automated management is applied across the entire portfolio to reduce typical DB administration or even eliminate manual management completely. Lastly, we'll note that these capabilities are identically assimilated throughout all on-premises, Exadata Cloud@Customer (ExaC@C), and Oracle Cloud Infrastructure (OCI) Exadata offerings.

Following our evaluation, we view the Oracle Exadata portfolio as well-suited for fulfilling the workload demands of enterprises, including the mission critical, high-volume DBs of Fortune Global 100 organizations. These workloads include scaling petabyte warehouses, assuring ultra-fast OLTP, complex business applications (e.g., SAP, Oracle Siebel, E-Business Suite, etc.), and massive DB consolidation.

The new Exadata X9M portfolio which includes Oracle Exadata Database Machine X9M, ExaC@C X9M, and Zero Data Loss Recovery Appliance X9M can easily meet the topmost concerns and demands of DB customers globally. In examining the new Exadata X9M portfolio proposition, we analyze the following elements:

- Exadata Architecture and Software: Key to Performance and Latency Breakthroughs
- Exadata X9M: Delivering Throughput and Efficiency Advances Exadata X9M: Increasing Consolidation and Cost Benefits
- ExaC@C X9M: Meeting the Need for Data Sovereignty with a Cloud Database Service
- Autonomous Database on ExaC@C X9M: Lowering Costs with a Self-driving Database
- Recovery Appliance X9M: Strengthening Oracle Database Protection



## Exadata Database Machine X8M vs X9M – At-a-Glance Comparison

Server Type	Eighth Rack (2x Database + 3x Storage)		Quarter Rack (2x Database + 3x Storage)		Half Rack (4x Database + 7x Storage)		Full Rack (8x Database + 14x Storage)	
	X8M	X9M	X8M	X9M	X8M	X9M	X8M	X9M
Max # of Cores	48	64	96	128	192	256	384	512
RAM (GB) per DB Server /Total all Servers	384 / 768	384 / 768 1024 / 2048	384 / 768	512 / 1024 1024 / 2048 2048 / 4096	384 / 1536	512 / 2048 1024 / 4096 2048 / 8192	384 / 3072	512 / 4096 1024 / 8192 2048 / 16384
Maximum # VMs per Server	12	12	12	12	12	12	12	12
Persistent Memory (TB)	4.5	2.3	4.5	4.5	10.5	10.5	21	21
Total Usable Capacity (TB)	HC 74	96	149	192	349	449	698	898
	EF 22	-	44	44	103	103	206	206
Flash (TB)	HC 38	38	76	76	179	179	358	358
	EF 76	-	153	153	358	358	716	716

Information in red indicates Exadata Cloud@Customer X9M changes

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## Executive Summary

- Oracle's new Exadata X9M solution delivers substantial improvements over the Exadata X8M and can give customers an enduring competitive edge. Oracle Exadata X9M directly addresses growing IT and DB decision maker demands for accelerating analytics and increasing DB consolidation through the support of Intel Ice Lake 32-core CPUs in DB servers that deliver 33% more cores for parallel analytics and 64% more memory bandwidth.
- Exadata X9M enhancements prioritize increasing scale and consolidation efficiency. High Capacity and Extended Storage Servers now provide 28% more storage capacity by using 18TB disks instead of 14TB disks at the same price to keep up with expanding database sizes.
- Oracle has ensured that all Exadata X9M enhancements are uniformly applied to its Exadata Cloud@Customer (ExaC@C) X9M solution, fulfilling organizations' growing demands for cloud benefits for databases and workloads that they cannot move to the public cloud due to sovereignty laws, industry regulations, organizational policies, security policies, network latency, or complexity of migrating interdependent databases and applications to a new environment.
- By running Autonomous Database (ADB) on ExaC@C X9M, with the solution providing dedicated, secure resources, fully automated management, and cost-conscious automatic scaling of DB consumption pricing, Oracle notably broadens the Exadata X9M solution's addressable market.
- Additional enhancements to ExaC@C X9M incorporate backup to Oracle's Zero Data Loss Recovery Appliance (Recovery Appliance), which protect and archive data in customer DCs and Autonomous Data Guard, which enables a new service with streamlined setup and management.

# Exadata Architecture and Software: Key to Performance and Latency Breakthroughs

A review of Oracle's Exadata architecture and software approach provides the foundation for discerning why Oracle's new Exadata X9M solution delivers substantial improvements over the Exadata X8M and can give customers an enduring competitive edge. For starters, Oracle's Exadata Smart Scan technology has been enhanced to efficiently support more complex queries in the most demanding workloads. Smart Scan now shares metadata across storage servers to increase parallel query execution, substantially improving DB scalability in data-intensive environments. Factor in faster decryption algorithms for all Exadata storage server generations and smarter management using enhanced DB alerting and faster software updates, and the DB fundamentals are in place for significant Exadata X9M IOPS and throughput improvements while maintaining the eye-catching <19 microsecond SQL read latency of the previous generation X8M solutions.

Exadata X9M supports the latest Intel Ice Lake 32-core CPUs (Central Processing Units) that enable 33% more cores for OLTP in comparison to Exadata X8M. PCIe 4.0 dual-port active-active 100Gb RoCE (Remote Direct Memory Access over Converged Ethernet) and up to 2TB of memory per DB server allow customers to increase the impact of OLTP caching, key ingredients that enable Exadata X9M to deliver up to 27.6M read IOPS per rack and scale DB performance as racks are added. When you sum all this up, each rack can support a mix of up to 1,216 DB cores, 38TB memory, 3.8 PB Raw Disk, 920 TB NVMe (Non-Volatile Memory express) Flash, and 27 TB Intel Optane PMem (Persistent Memory) so organizations can create configurations that cost-effectively meet their current needs as well as adapt and grow to meet changing requirements.

From our perspective, the combined Exadata X9M capabilities deliver unprecedented OLTP DB performance and cost compared to Exadata X8M. These breakthrough metrics include:

- **72% more IOPS:** Enabling new transactional and hybrid DB use cases.
- **42% lower costs per IOPs:** Making Exadata capabilities more affordable for many organizations.
- **33% more pooled resources:** Increasing consolidation rates and resource utilization efficiency.

We see the combined advances in IOPS, costs, and resourcing pooling efficiency as vital to powering the DB innovations that are key to removing the underlying causes of DB problems customers face, as well as providing Oracle with the portfolio differentiation needed to expand the Exadata X9M solution's market share against both cloud on-premises and conventional on-premises vendors. Exadata is also a data warehousing powerhouse and rival Snowflake has no on-premises data warehouse offering for example, which means even more opportunities to win new business for Oracle with the X9M generation.

# Exadata X9M: Delivering Throughput and Efficiency Advances

In today's data center and cloud environments, accelerating analytics and increasing consolidation are top priorities for IT and DB decision makers. Oracle Exadata X9M directly addresses these demands through the support of Intel Ice Lake 32-core CPUs in DB servers that deliver 33% more cores for parallel analytics and 64% more memory bandwidth. PCIe 4.0 flash cache in Exadata storage servers enable 80% faster throughput which combine with enhanced automatic columnarization of data using vector processing formats in flash cache to deliver over 1 TB/second of scan throughput for advanced analytics and in-database machine learning algorithms.

The Exadata X9M's use of two active 100 GB/sec RoCE networking connections on each DB and storage server increases throughput between them by 80%, significantly accelerating the accumulation of scan results generated on storage servers on the DB servers and any subsequent processing. Taken together, these new enhancements deliver what we see as significant net new benefits in the following areas compared to Exadata X8M:

- **87% higher throughput:** Enables new data-intensive use cases.
- **47% lower scan costs:** Brings Exadata capabilities to more customers.
- **Expanded, swifter pooled resources:** Enables improved real-time analytics inside OLTP applications.

When compared to Oracle Exadata X9M's scale out architecture with massive parallelism, legacy do-it-yourself infrastructures that connect DB servers to block storage devices over FibreChannel are severely limited in terms of the latency, IOPS, and throughput they can deliver. All raw data in these legacy environments must be shipped from the storage devices back to the DB servers for processing as opposed to Exadata's approach of initially processing the data where it resides – on the storage servers. We see Oracle Exadata X9M's integrated architecture with massive parallelism, rapid PCIe flash, and the offloading of data-intensive operations to storage as delivering the throughput and efficiency that organizations are looking for today to meet data-intensive analytical requirements.





# Exadata X9M: Increasing Consolidation and Cost Benefits

Exadata X9M enhancements also prioritize increasing scale and consolidation efficiency. High Capacity and Extended Storage Servers now provide 28% more storage capacity by using 18TB disks instead of 14TB disks at the same price to keep up with expanding database sizes and enable more databases to be consolidated on an Exadata single system. The previously mentioned 33% increase in database server CPU cores and memory coupled with the use of all-flash storage in those servers support more VMs per DB server which also increases the level of database consolidation that customers can achieve. Also, Oracle Database's converged DB capabilities allow customers to run any mix of OLTP, analytics, graph, spatial, and machine learning databases on the same system, further increasing the impact of DB consolidation.

By combining these features, it's obvious that Oracle is endeavoring to dramatically improve the cost effectiveness of its DB machine proposition. These cost improvements compared to Exadata X8M include:

- **42% less cost for OLTP IOPS & 47% less cost for analytics scans.**
- **More work per DB CPU:** Reduces infrastructure size and license costs.
- **Broader pooled resources:** Increases DB and infrastructure consolidation resulting in lower operational costs.

By using Exadata X9M, organizations achieve definitive DB consolidation gains, avoiding the operational risks and costs of managing and securing information on multiple platforms.



# ExaC@C X9M: Meeting the Need for Data Sovereignty with a Cloud Database Service in Customer Data Centers

Oracle has ensured that all Exadata X9M enhancements are uniformly applied to its Exadata Cloud@Customer (ExaC@C) X9M solution, fulfilling organizations' growing demands for cloud benefits for DBs and workloads that they cannot move to the public cloud due to sovereignty laws, industry regulations, organizational policies, security policies, network latency, or complexity of migrating interdependent databases and applications to a new environment. As an Oracle-managed service, Oracle Cloud operators access ExaC@C for maintenance. To further meet tight regulations in industries such as financial services, Oracle provides operator access control that allows IT organizations to control when Oracle Cloud operators can access systems, for how long, and what they can do while there with real-time session monitoring, logging, and session termination capabilities.

With Exadata Cloud@Customer X9M, organizations can, at any time and without taking the databases offline, increase the amount of DB server resources that they consume to meet peak daily or seasonal requirements or reduce them to control costs. This significantly reduces cloud consumption costs because IT teams no longer need to overprovision resources to meet peak demands for applications that cannot permit up to 30 minutes of downtime every time an underlying compute shape is changed.

The Exadata Cloud@Customer X9M enhancements axiomatically include Intel Ice Lake 32-core CPUs in DB servers, Intel Ice Lake 24-core CPUs in storage servers, 28% more storage capacity (compared to ExaC@C X8M), 1.5TB DRAM per DB server, and the same <19 microseconds latency with PMem and RoCE. We like the fact that these enhanced capabilities are all available at the same time as Exadata X9M, while maintaining the same price as the ExaC@C X8M offering.

As a result, customers gain immediate benefits in relation to ExaC@C X8M, such as up to 22.4M IOPS (an 87% boost), 540 GB/sec throughput (80% more), and 992 vCPUs worth of database compute (24% more). We view these capabilities as providing clear differentiation of the ExaC@C X9M solution in relation to AWS Outposts with RDS (Relational Database Service). For example, Oracle's minimum SQL read latency is <19 microseconds while RDS on AWS Outposts is a much lengthier 1,000 microseconds, giving Oracle a fifty-fold advantage when accessing data. The ExaC@C solution delivers 540 GB/S maximum throughput while RDS on AWS Output is limited to only 28.5 GB/S, yielding Oracle an eighteen-fold throughput edge. Moreover, Oracle's ExaC@C supports online scaling with no application downtime, no downtime for maintenance and upgrades, and application-transparent DB acceleration with PMem, whereas the RDS on AWS Output solution lacks all these functions and, as a result, is orders of magnitude slower.

Whereas Oracle Exadata Cloud@Customer is a strategic offering for Oracle, it's not clear that other on-premises cloud offerings such as AWS Outposts and Azure Stack are more than a checkbox for those vendors.

In further examining the area of DB functionality, we observe that Oracle ExaC@C X9M offers SQL offload to up to 576 cores in intelligent storage servers. In contrast, AWS Outposts with RDS offers no intelligent storage capabilities and only limited operator access control. Moreover, we surmise



RDS on AWS Outposts supports only MySQL, PostgreSQL, and SQL Server functions, but does not for Redshift, Aurora, DynamoDB, Document DB (Mongo DB), Keyspaces (Cassandra), Neptune (Graph), and Timestream (Time series) – or Oracle Database, whereas Oracle Database’s converged database capabilities meets these customer needs.

Oracle ExaC@C X9M fulfills the top priority demands of customers who require and decide to implement public cloud infrastructure with managed cloud database services in their data centers. These customer fulfillment benefits compared to ExaC@C X8M include:

- **Up to 80% faster throughput and 87% higher IOPS:** The dual improvements can run any database workload faster or reduce costs of running those workloads by up to 47%.
- **Elastic storage expansion:** Up to 45% lower infrastructure costs for data-intensive workloads.
- **Operator Access Control:** Increases security in regulated settings.

Oracle Exadata Cloud@Customer X9M allows organizations to deploy industry-leading database performance in their data centers, enabling them to run applications faster while lowering costs and maintaining full control of their data to meet data sovereignty and security requirements. We see Oracle ExaC@C X9M attaining clear competitive differentiation against AWS RDS on AWS Outposts across key performance and capabilities categories, further enhancing the complete Exadata proposition.



## Autonomous Database on ExaC@C X9M: Lowering Costs with a Self-driving Database

It appears that Oracle is further broadening the addressable market of the Exadata X9M portfolio by running Autonomous Database (ADB) on ExaC@C X9M, with the solution providing dedicated, secure resources, fully automated management, and cost-conscious automatic scaling of DB consumption pricing. The Autonomous DB capabilities encompass Oracle's Autonomous Transaction Processing and Autonomous Data Warehouse cloud services and provide machine learning based automatic scaling, tuning, patching, and securing of the database along with AutoML enhanced analytics and other Autonomous-only capabilities.

This is particularly important for organizations looking to adopt Autonomous Database, as the comprehensive set of autonomous capabilities assures customers that maximum performance is attainable, full data sovereignty is safeguarded, and the built-in auto-scaling of DB consumption reduces the cost of running databases in all scenarios.





# Recovery Appliance X9M Enhancements: Strengthening Oracle Database Protection

Additional enhancements to ExaC@C X9M incorporate backup to Oracle's Zero Data Loss Recovery Appliance (Recovery Appliance), which protect and archive data in customer DCs and Autonomous Data Guard, which enables a new service with streamlined setup and management. In addition, Oracle DB Shared Server provides the Use Shared Server feature for legacy apps to reduce connection counts and customer managed keys with OKV single instance that simplifies encryption key management.

In addition, Oracle's next generation Recovery Appliance X9M delivers a 30% increase in backup capacity by replacing the 14 TB drives found in ZDLRA X8M systems with 18TB drives, allowing organizations to protect more DBs with longer retention periods with a "Base rack" configuration providing 207TB of physical capacity, 2PB effective backups, and 15TB/hour restore rates. A "Full rack" configuration supports more than 1 PB physical capacity, 13 PB of effective backups, and a 24TB/hour restore rate. Recovery Appliance X9M also lowers the solution's entry price by up to 50% for Base rack configurations resulting in substantially lower per-Terabyte cost for protected databases since all configurations are created by starting with the Base rack. This new entry price expands the addressable market for Recovery Appliance to medium and smaller-sized organizations

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## Conclusion and Recommendations

In summary, we believe the new Exadata X9M integrated solution delivers higher performance and a broader range of capabilities across all Oracle DB workloads than anything else in the market that runs on-premises—be it a cloud on-premises or a typical server, ensuring that customers gain significantly more value. In the area of performance, Exadata X9M provides the <19 microsecond latency, increased OLTP IOPS, accelerated analytics throughput—orders of magnitude faster than AWS Outposts and Azure Stack—and enhanced Smart Scan capabilities that DB and IT decision makers prioritize.

For enhanced software requirements, customers can use Autonomous Database on ExaC@C X9M, operator access control, enhanced notifications, faster decryption, and faster updates, all of which are vital to meeting fast-evolving customer administration and security demands. Finally, the new solution lowers TCO by allowing customers to achieve higher levels of consolidation, use less infrastructure, reduce database license requirements, lower costs across key metrics, and achieve operational and consumption savings that are valued in all DC environments—all at the same price as the previous X8M generation. That’s significantly more bang for the customer’s buck.

The overall Exadata X9M proposition directly addresses the underlying issues that cause the most problems and disruption for DB customers. The Oracle X9M furnishes the scale-out hardware, DB-aware software intelligence, automated management capabilities, and architectural identity that make the new solution worthy of top consideration in the successful transformation of DB technology across all environments. Running Oracle Database on anything other than an X9M is the functional equivalent of trying to put a Tesla operating system in a Dodge Hellcat—it’ll operate in degraded mode and it’s far too advanced for the underlying, aging hardware to handle.

**DB Decision Makers Must Consider Oracle Exadata X9M.** DB decision makers must consider the new Oracle X9M solution, since it provides the superior architecture, enhanced software, and elastic scaling of DB resources that are essential to ensuring top performance and lowering TCO within any DB environment.

**DB and IT Decision Makers Considering AWS RDS on Outposts or Azure Stack Must Look at ExaC@C X9M.** DB decision makers should compare the complexity, costs, and lack of functionality and performance when considering RDS on AWS Outposts. We identify Oracle ExaC@C X9M as having a definite competitive edge especially in areas like minimum SQL read latency, maximum SQL throughput, and crucial areas of cloud database functionality such as supporting online scaling with no application downtime and avoiding downtime for maintenance and upgrades.

**Evaluate Autonomous Database on ExaC@C Credentials.** DB administrators and decision makers need to consider the ability to blend Autonomous Database, Exadata X9M, and OCI automation, security, and economics into one package by running Autonomous Database on ExaC@C X9M. This includes mitigating human errors with autonomous operations and providing comprehensive data sovereignty and low-latency application-tier connectivity in customer DCs. No other vendor can match this combination and Exadata is strategic for Oracle and a core enabler for their [substantial cloud progress](#).

# Important Information About This Paper

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