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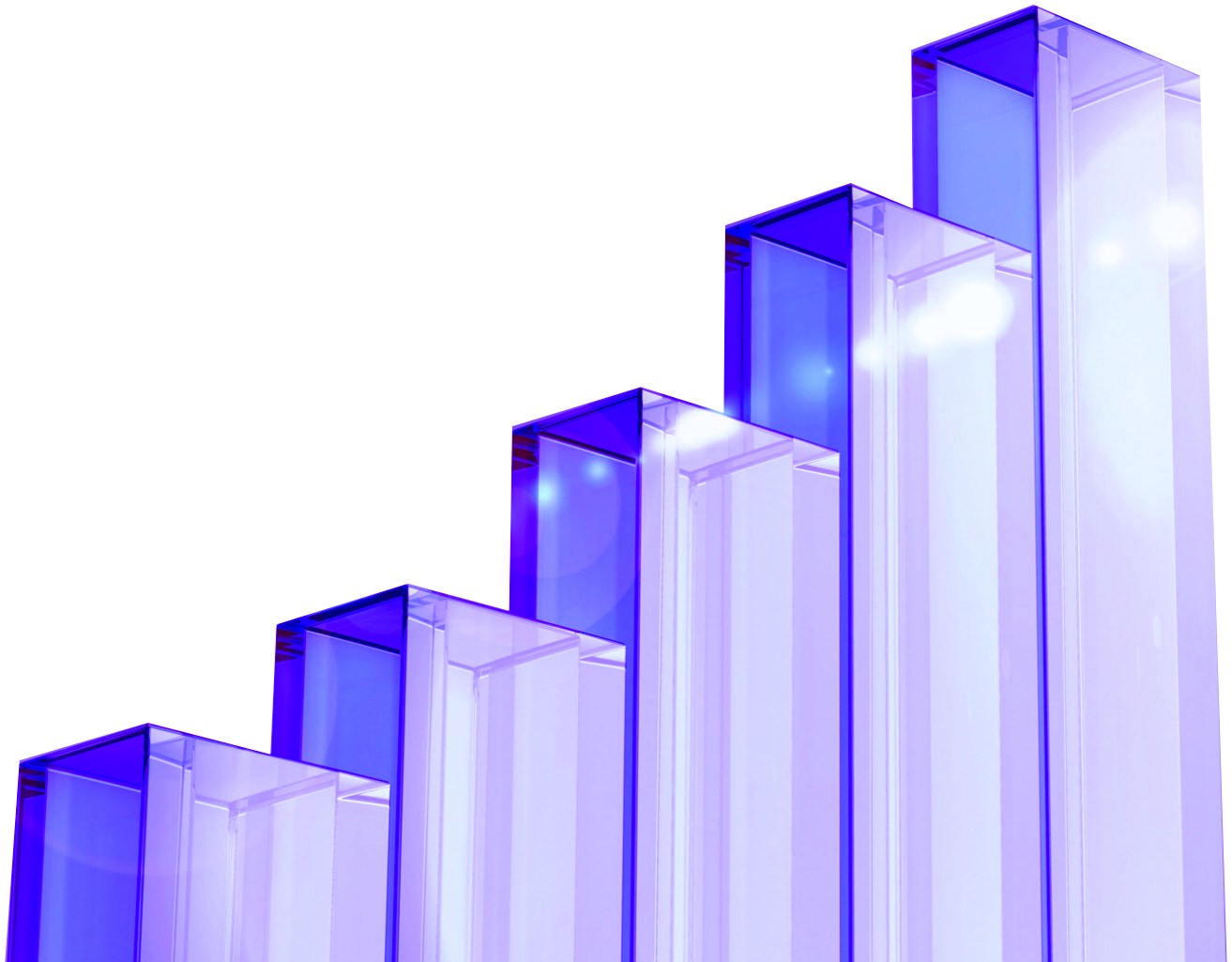
EXADATA AND AUTONOMOUS DATABASE IN THE CLOUD

Understanding the options



Oracle has been constantly improving its cloud technologies and bringing new capabilities to its powerful Exadata database platform on Oracle Cloud Infrastructure (OCI).

As a result, companies moving to the cloud have several Exadata-based options to consider.

The latest addition to this lineup is Autonomous Database Dedicated (ADB-D), a fully autonomous and isolated private database running on Oracle's cloud infrastructure. With this offering, companies can now choose from three cloud database options that use Exadata as a foundation—the **ADB-D; Autonomous Database Shared (ADB-S)**, where multiple users share the same cloud infrastructure; and the **Oracle Database Exadata Cloud Service (ExaCS)**, where Oracle owns and manages the infrastructure, and the customer company can access database features and operations.

While these options all rely on the Exadata platform, they differ in several key ways. For companies considering these platforms, the right choice will depend on matching the features and capabilities of the database to their specific needs and situation. As a result, understanding the differences between these options is an important first step in making a decision.

COMPARING THE THREE APPROACHES

All three of the Oracle Exadata-based options can run a variety of workloads.

The Autonomous Database, which automatically handles provisioning, security, updates, availability, performance, change management and error prevention, offers two pre-defined workloads—Autonomous Transaction Processing (ATP) and Autonomous Data Warehouse (ADW). The ExaCS offering can handle OLTP, data warehousing, OLAP and other workloads on a single platform in the cloud.

To understand how these offerings differ, it's useful to look at how they compare in terms of *deployment, scaling, management, high availability, backup and restore, functionality and licensing, and costs*.

Deployment

With ADB-D, companies need to first deploy the Autonomous Exadata Infrastructure. ADB-D then uses this to provide a dedicated, fully isolated Exadata infrastructure, with no shared processors, memory, network or storage. This approach uses a multitenant database architecture that makes it possible to create and manage multiple Autonomous Databases (the equivalent of pluggable databases) inside Autonomous Container Databases. Depending on the level of isolation required, companies can have separate containers for different types of workloads. That way, software updates and their applied versions are separate, as well as the workloads themselves. There is a maximum number of container databases allowed on a single ADB-D. Oracle may increase this number over time, so companies should always verify the upper limit before deployment.

Meanwhile, ADB-S deployment is relatively simple. With multiple users sharing common infrastructure resources, companies are responsible for specifying the CPUs and storage they require, but Oracle takes full responsibility for service operation.

With an ExaCS system, the primary consideration is choosing a rack size that fits the company's needs—a quarter, half or full rack, which vary in terms of CPU, memory and storage sizing.

All three deployment models take advantage of Oracle's generation 2 networking capabilities. For ADB-D and ExaCS, the database platform is deployed in a Virtual Cloud Network (VCN). Companies usually place the system in a private subnet with a private IP address from the VCN, while still having the option to place the system in a public subnet. Databases can also be accessed from a private network by provisioning a FastConnect or VPN Connect in OCI and routing traffic appropriately.

For ADB-S, the network configuration is slightly different. Companies can assign private endpoints for ADB-S that can then be accessed through their private VCN. They can also use a Service Gateway to access databases privately from the VCN so that traffic doesn't move across the Internet when private endpoints are not used. Databases can be accessed from the public Internet as well, if companies need to do so. Companies can limit connections by using Access Control Lists to specify approved IP addresses or CIDR blocks.

In general, setting up an ExaCS platform is the most complex of the three options, and that applies to the network setup as well. Client, management and backup subnets should be set up in the VCN, and specific rules should be established for managing traffic through security lists and network security groups, and for making sure traffic flows correctly, so that the service functions as intended.

Oracle Cloud Infrastructure Monitoring Service can be used to automatically log metrics from each service. Or, Oracle Management Cloud can provide a 360-degree view of these services. Companies can monitor health, capacity and performance by using these metrics, and create alarms and notifications to flag problems with the platform's health.

Scaling

Scaling with ADB-D is restricted by the size of the Exadata Infrastructure that has been deployed. The Autonomous Exadata Infrastructure quarter rack supports up to 92 OCPUs, while the half rack supports up to 200. ADB-D supports automatic OCPU scaling similar to ADB-S, up to three times of originally allocated OCPUs. In addition, hardware resources are automatically scaled proportionally to CPUs. Thus, if CPUs are scaled up by 20%, memory, IO, Flash, cache, etc. are scaled accordingly. Similar action needs to be taken with database parameters, such as the Oracle System Global Area (SGA) and Process Global Area (PGA) parameters.

For its part, ADB-S supports up to 128 OCPU cores and storage up to 128 TB. It can also provide automatic scaling, increasing the number of OCPUs by up to three times the originally allocated OCPUs, depending on the workload. Thus, if the ADB-S database is deployed with 8 CPUs, the maximum number of OCPUs is 24. Companies can scale ADB-S storage size without any impact on availability.

ExaCS can be deployed in a number of ways, with varying amounts of database nodes, storage and available CPU and memory. It supports manual scaling, allowing companies to scale CPUs within database nodes as long as all database nodes have the same number of CPUs assigned. If there is a need to scale to a different Exadata configuration—for example, from a quarter rack to a half rack—the database and data will need to be migrated to the new system.

Comparison of deployment features with Exadata X8 shapes

	CPUs	Storage	Scaling	Deployment	Supported DB versions (as of Q1 / 2020)
ADB-S	**128**	**128 TB**	**Auto-matic/ Manual**	**Minutes**	**19C**
ADB-D 1/4	**100**	**128 TB**	**Manual**	**Around 4h**	**19C**
ADB-D 1/2	**200**	**179 TB**	**Manual**	**Around 6h**	**19C**
ExaCS Base	**48**	**74 TB**	**Manual**	**Around 4h**	**11.2, 12.1, 12.2, 18C, 19C**
ExaCS 1/4	**100**	**149 TB**	**Manual**	**Around 4h**	**11.2, 12.1, 12.2, 18C, 19C**
ExaCS 1/2	**200**	**299 TB**	**Manual**	**Around 6h**	**11.2, 12.1, 12.2, 18C, 19C**
ExaCS Full	**400**	**598 TB**	**Manual**	**Around 8h**	**11.2, 12.1, 12.2, 18C, 19C**

Management

With ADB-S, companies have access to a single pluggable database, and there is no need for them to maintain the infrastructure—that is handled by Oracle. With ADB-D and ExaCS, companies will need to schedule or perform maintenance on some infrastructure components.

ADB-D gives companies more overall control of the system, but Oracle still performs infrastructure maintenance at least once per quarter, including complete operating system and Exadata Grid Infrastructure patching. Customers have control over the scheduling of the patching window in which maintenance is performed.

The maintenance of container databases can also be scheduled by the company. Here, there are two options: scheduling a Release Update, which includes the most current release update, or scheduling a Release Update Revision, which includes the latest release update and latest fixes. With both options, either current or previous versions can be chosen. In addition, companies can have multiple container databases in a single ADB-D, which will enable them to perform patching in different cycles—for example, in Test and Production.

With ADB-S, all maintenance updates and database patching activities are performed by Oracle on a pre-established schedule. Companies do not need to apply updates, and patching is done while the database stays online. This is made possible by an Autonomous Database clustered configuration, which enables rolling updates. These updates usually last no more than two hours.

The ExaCS differs from traditional on-premises Exadata in that Oracle handles all infrastructure patching. Companies have full control over virtual compute nodes (DomU), and they are responsible for managing the operating system, grid infrastructure and database software patching on these nodes. With ExaCS, companies should use the tools recommended by Oracle; the available tooling options can be found in an Oracle Exadata Cloud Service Patching document.

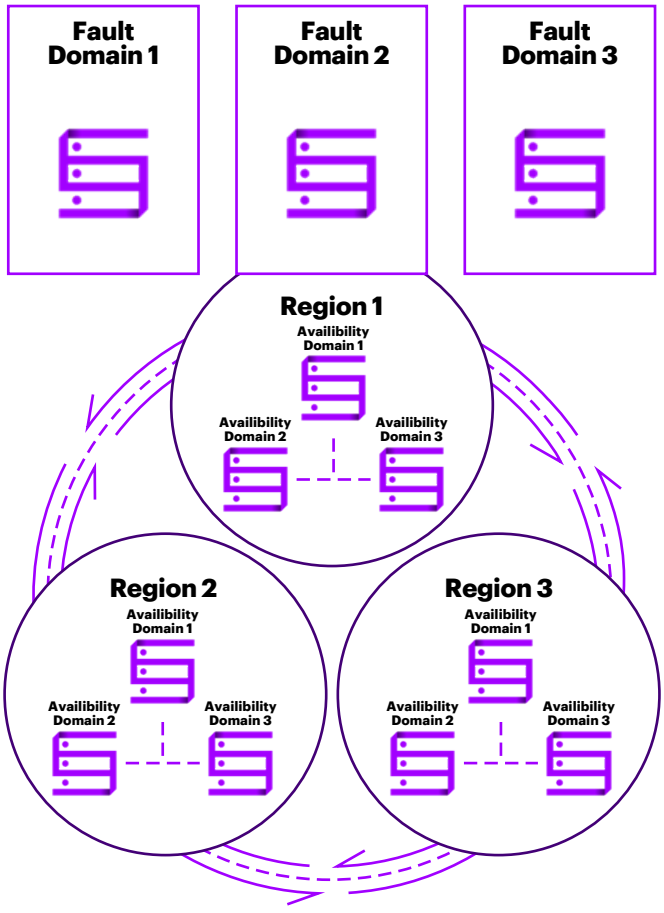
High Availability

Because all three of the database options discussed here rely on the Exadata infrastructure, they provide built-in redundancy. The Autonomous Database uses the high availability configuration in the Exadata Infrastructure as a default option (this can't be modified), which enables automatic failover when there is a failure.

ExaCS also relies on Exadata's built-in redundancy. In addition, it gives companies the option of using Oracle Data Guard to sync databases to either an Oracle Availability Domain or another Oracle Region, which provides further support for high availability. An Oracle Availability Domain is an isolated data center within an Oracle Region, which is a specific geographic area. A Region can include one or more Availability Domains to provide fault tolerance for companies.

Backup and Restore

Oracle emphasizes the strengths of OCI Regions, Availability Domains and Fault Domains in backup and restore activities, and companies should understand how this works. A Fault Domain groups hardware and infrastructure within an Availability Domain, allowing companies to distribute instances so that a failure within one Fault Domain doesn't affect other Fault Domains. There are always three Fault Domains within an Availability Domain.



Fault Domains, Availability Domains and Regions

Backups

All three platforms support the scheduling of automatic backups and the use of on-demand backups, with data being stored either locally or in Object Storage.

During Autonomous Database backups, the system stays operational, but some lifecycle actions cannot be executed, such as stopping the database. Backup retention is set to 60 days by default, but the retention period can be altered to 7, 15, or 30 days with ADB-D. However, with ADB-S it's locked at 60 days. Automatic backups include a weekly full backup and a daily incremental backup. Backup of archive logs is performed automatically every 15 minutes.

With the ExaCS platform, the backup retention period is chosen when automatic backups are being enabled. Retention periods are the same as they are with ADB-D—that is, 7, 15, 30, or 60 days. In addition, there is another tool for performing backups, "bkup_api," which can be used to back up databases to an Object Storage bucket or to a local disk Fast Recovery Area.

Restore

Restoring an Autonomous Database is a straightforward process that simply involves selecting the database from the available backups (within the defined retention period). If a company needs to perform a specific point-in-time restore, the system will decide which backup to use in order to provide the fastest restore.

ExaCS provides multiple restore options. Companies can choose to restore to the latest known good state, to a specific timestamp, or to a specific System Change Number. If the bkup_api tool has been used to create backups, Oracle Recovery Manager can be used to manually recover databases.

Functionality and Licensing

Autonomous Database now includes a number of capabilities that previously had to be licensed separately. In addition, existing database licenses can be leveraged with Autonomous Database platforms, which can help keep costs down.

Companies can now adjust some of the functionality in Autonomous Databases related to localization and SQL Optimizer, and much of the repetitive and manual work traditionally done by DBAs has been fully automated. System-, storage- and schema-level optimization is handled by the Autonomous Database, without human interaction. SQL Optimizer monitors new SQL statements and changes in the amount of data, allowing the system to change SQL plans when data volumes change.

If the system determines that an additional index might improve performance, it tests the index, and if appropriate, implements it and continues to monitor performance. If at some point the index is no longer needed, the system will automatically remove it.

With ExaCS, the approach is more traditional. Oracle offers a Bring Your Own License (BYOL) model, and while an Enterprise Edition - Extreme Performance License is required for full functionality, companies can use ExaCS with their existing licenses by limiting database features. The BYOL model also has the benefit of enabling companies to reuse older licenses if they eventually want to move from on-premises to cloud systems.

Comparing monthly costs of Exadata and Autonomous systems

There are two options when purchasing these database services—the "Pay as you Go" model and the "Monthly Flex" model. The figure below illustrates how these payment models compare across the three databases. This comparison looks at two ADB-S configurations—one with a 4 OCPU and 1TB configuration, and another one with a 4 OCPU and 128 TB configuration. It also looks at an ADB-D system with 4 OCPUs in a quarter rack configuration, and three variations of ExaCS.

Estimated monthly costs of running different ADB or Exadata systems.

For ADB-D pricing, it's important to remember that the required service is either Exadata quarter rack of half rack. This comes with base storage, and companies are billed for the base infrastructure and the amount of OCPUs used—an approach that is similar to the pricing for an ExaCS system. However, with ADB-D companies can run multiple autonomous databases on a single dedicated system.

For all the platforms, pricing is affected by the amount of cores being run, which means that a scaling event will have an impact on overall monthly cost. This relates to one of the key advantages of using cloud services—companies can scale services down during low workload periods hours to reduce costs, and scale them up during peak workload hours.

PUTTING IT ALL TOGETHER

Looking at all three of these Oracle database options, it is possible to develop some general recommendations about their use.

ADB-D will often be appropriate for companies that want to run their mission-critical systems in a secure isolation zone, on a highly available platform, and take advantage of Exadata performance. It will also be appealing to those looking for the benefits of automated database operations, but who also want to have more control over maintenance schedules, compared to the ADB-S option. And ADB-D can be a good fit for companies wanting to move critical workloads from on-premise systems to the cloud, consolidate operations, renew their IT architecture or rethink their database landscape. There are, however, still some limitations with ADB-D to consider: For example, there is currently no automated Disaster Recovery available, and several applications such as Oracle e-Business Suite, PeopleSoft and JD Edwards are not yet supported.

For its part, ADB-S will often be attractive to companies that want to move to the cloud quickly; do not want to maintain any infrastructure; and do not require full isolation or control over maintenance schedules for their workloads. With its flexible, isolated platform on a shared infrastructure, ADB-S can be useful for new projects, because it provides instant provisioning. And data scientists will be able to use ADB-S features such as machine learning to analyze and drive results, and easily scale the system to meet their changing needs.

Finally, the ExaCS platform, like ADB-D, offers dedicated performance and true isolation, and can handle mission-critical workloads. It can be an especially good option for companies wanting to consolidate multiple databases on a highly available system. In addition, ExaCS works with many traditional applications, such as Oracle e-Business Suite, PeopleSoft and JD Edwards, that are not yet supported on the Autonomous Database platform.

With these offerings, Oracle is providing a range of ways for companies to take advantage of Oracle Database and Oracle Exadata in the cloud. Companies should take time to understand the strengths of each approach. And they should continue to monitor Oracle's evolving offerings in this area, as it continues to leverage both autonomous operations and the cloud to help companies take full advantage of their data.

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