Exploring Oracle’s Engineered Systems

Creating differentiation in the integrated solutions market
Summary

Catalyst
The market in integrated, or converged, systems is becoming crowded as more and more vendors announce new offerings. Differentiation in this market is difficult to achieve as the integrated approach delivers broadly the same benefits: simplicity of use and deployment, workload-specific optimization, and better control over resources and ability to scale. However, Oracle has produced a range of systems that are unlike others in the integrated systems market, and the term "engineered systems" describes this differentiation extremely well.

Ovum view
Oracle’s Engineered Systems are mainly aimed at customers that have complex mission-critical environments and are seeking to both reduce costs and increase flexibility/agility in their data centers. One of the key differentiators of Oracle’s Engineered Systems is the inherent reliability, scalability, and performance that these systems deliver. These capabilities extend from the entry-level, eighth-rack solution (for Oracle Exadata and Oracle Exalogic systems) all the way up to the high-end, multi-rack solutions. While Oracle’s Engineered Systems are designed to address customers’ most pressing challenges in their data centers, central to Oracle’s Engineered Systems value proposition is the comprehensive support agreement that Oracle offers to customers. In fact it is Oracle’s combination of comprehensive Platinum Support, purpose-built software and hardware integrated systems that delivers the maximum business benefits to customers, enabling them to focus on innovating and on solving business-critical issues rather than spending all of their time solving IT issues.

Key messages
- Oracle’s strategy is to provide solutions that enable businesses to focus on business issues not IT issues.
- Enabling organizations to accelerate the deployment and simplify the management of private clouds is a key capability of Oracle Engineered Systems, particularly Oracle SuperCluster, Oracle Exadata, and Oracle Exalogic.
- Delivering flexibility and agility requires systems that are both specialized and easy to integrate in order to provide a holistic data center solution.
- Oracle Engineered Systems simplify the management of data and databases which are critical activities for enterprise customers.
- Software-defined environment enables organizations to deliver operational efficiency.

Recommendations for enterprises
Oracle’s Engineered Systems deliver a solution that is engineered for a particular purpose: to deliver reliability, performance, and scalability. Additionally, Oracle Engineered Systems are designed for specific workloads such as database, Big Data, and analytics, which makes these Engineered Systems different from the majority of the market. The market in converged or integrated solutions can be separated into three main sub-markets: low-end solutions designed for customers where limited scalability is needed and price is the primary driver for adoption; a general market where
solutions are being used as a replacement for existing systems, and where the workloads are not
critical to the organization, with the benefit to the customers deriving mainly from the consolidation of
resources; and high-end systems that deliver the ability to scale to multiple racks and run the most
mission-critical workloads. Ovum places Oracle’s solutions in the third category where performance,
cost, reliability, and scale are all equally important.

Oracle’s strategy is to provide solutions for
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Oracle currently has nine different products in its Engineered
Systems range

Oracle uses the term "Engineered System" to refer to its portfolio of converged/integrated systems.
The use of this distinctive naming to illustrate Oracle’s differentiation between its own Oracle
Engineered Systems and other converged systems is supported by deep integration between
hardware and software components, as well as by integration across software layers. This is only
possible because Oracle owns the full technology stack for each Engineered System. The term
Engineered Systems also conveys a sense of the systems’ capability for reliable service delivery with
minimum downtime.

Oracle has nine different products in its Engineered Systems range that cover general/multi-purpose
computing through to workload-specific. The Oracle portfolio includes Oracle Exadata Database
Machine, Oracle Exalogic Elastic Cloud, Oracle SuperCluster, Virtual Compute Appliance, Oracle
Database Appliance, Oracle Exalytics In-Memory Machine, Oracle Big Data Appliance, Oracle ZFS
Storage Appliance, and the Zero Data Loss Recovery Appliance.

One of the big new capabilities that Oracle has developed is the move away from using flash storage
to improve performance, and towards adding in-memory acceleration. This is currently only true for a
few of Oracle’s systems and is an optional capability. Ovum believes that this is an important
distinction for those workloads and use cases where performance is critical. This differentiates Oracle
from most of the competition; while some competitors are pre-integrating reference architectures from
off-the-shelf components, Oracle is developing new technologies that span the traditional technology
stack, including Oracle’s Hybrid Columnar Compression, Smart Flash Cache, Exabus, in-memory
application modules, in-memory database enhancements, and Software-in-Silicon technology. It is, in
fact, the essence of the distinction Oracle draws between "integrated" systems and "engineered"
systems. Oracle contends that its Engineered Systems products are not merely integrations of
pre-existing, standalone component products, but are designed (engineered) to be complete systems
at the outset, with deep cooperation between the engineering teams developing each of the
component products.
Oracle’s solutions support a wide variety of operating environments

Oracle’s Engineered Systems support a range of operating systems dependent on the particular model. For example, the product with the broadest coverage is the Oracle Virtual Compute Appliance, which is certified to support Microsoft Windows, Oracle Linux, Solaris x86, openSUSE, and Red Hat Linux. Oracle’s Engineered Systems are scalable from an eighth of a rack to 18 racks by simply adding cables to connect the racks. Oracle systems can also expand beyond 18 racks (this is true for systems that have a full rack size, such as Oracle Exadata, Oracle Exalogic, Oracle SuperCluster, etc., but not for systems that do not have a full rack size, such as Oracle Database Appliance and Oracle Exalytics) without a change in architecture by using additional InfiniBand switches from Oracle. This approach makes Oracle one of the easiest solutions to scale to very large deployments of 50 plus racks.

One of the biggest strengths of Oracle’s range of Engineered Systems is the ability for these systems to all be interconnected and managed through a single management tool, Oracle Enterprise Manager 12c. Ovum considers this a valuable capability that enables organizations to run a mixed infrastructure designed to meet workload requirements, yet manage the entire environment as a single estate. The other major strength of Oracle’s Engineered Systems is the quality of its Platinum Services support package. Oracle Platinum Services are provided to Engineered Systems customers at no extra charge with their standard Premier Support for Systems but provide an enhanced support level for the complete Oracle stack – server, storage, network, and database software – 24x7. Oracle remote fault monitoring is also provided with the following response times:

- 5 minute fault notification
- 15 minute restoration or escalation to development
- 30 minute joint debugging with development.

The other benefit that Oracle Platinum support provides is the fact that all patches are deployed/fixed by Oracle engineers. This high level of support is good news for CIOs who do not want to worry about IT support; today’s CIOs are focused on the service delivery to their customers and want their infrastructure to just work.

Speeding deployment and simplifying private cloud management are key for Oracle Engineering Systems

The growth in private cloud deployment needs organizations to deploy infrastructure that is flexible and rapid to deploy

The growth in demand to build private clouds by many IT departments has created a lot of misconceptions about what infrastructure is needed to support and deliver this capability. Oracle’s approach is to integrate and engineer the best-of-breed hardware and software into a centrally managed and serviced Oracle SuperCluster system. Oracle has two products in the range: Oracle SuperCluster T5-8 and Oracle SuperCluster M6-32. Both configurations combine SPARC T5 or M6
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servers, Oracle Solaris 11 (including Oracle Solaris Zones), Oracle Exadata Storage Servers, Sun ZFS Storage Appliance, InfiniBand technology, Oracle VM Server for SPARC, and Oracle Enterprise Manager 12c to manage it all, which provides the ideal platform to rapidly deploy and execute mission-critical application and database cloud services.

Effectively, Oracle SuperCluster T5-8 is either a half or full rack of pre-configured and installed hardware: each SPARC T5-8 half rack is configured with 4 x 16 core SPARC T5 processors (3.6GHz), 64 x 16GB of memory, 8 x 1.2TB 10,000 RPM disks, 4 x dual-port QDR InfiniBand adapter, and 4 x dual-port 10GbE.

The Oracle SuperCluster M6-32 has a maximum configuration of 32 x 12 core SPARC M6 processors (3.6GHz), 1024 x 32GB, for 32TB total memory, 32 x 1.2TB 10,000 RPM disks, 32 x 10GbE ports, 16 x I/O base cards, 16 x dual-port QDR InfiniBand adapter, and 4 x quad-port 1GbE, UTP. From an Exadata storage perspective, the Oracle SuperCluster M6-32 can be configured for either performance or capacity, depending on the workload characteristics. Each Oracle SuperCluster M6-32 has 9 x Exadata Storage Servers X4-2, each with either 12 x 1.2TB 10,000 RPM high-performance disks or 12 x 4TB 7,200 RPM high-capacity disks, 2 x six-core Intel Xeon E5-2630 v2 for SQL processing, and 4 x 800GB Exadata Smart Flash Cache.

It is integrated software that allows for high application availability and makes the SuperCluster a centrally managed platform using Oracle Enterprise Manager for delivering and managing infrastructure-as-a-service (IaaS). The scaling of Oracle SuperCluster offers flexibility with the T5-8 being available in either half- or full-rack configurations, while the M6-32 comes in configurations starting with 16 x 12 core SPARC M6 processors (3.6GHz), 512 x 16GB, for 8TB total memory, 16 x 1.2TB 10,000 RPM disks, 16 x 10GbE ports, 8 x I/O base cards, 8 x dual-port QDR InfiniBand adapter, and 2 x quad-port 1GbE, UTP and can be expanded in any combination of components to the maximum configuration.

Oracle has engineered and optimized their best-of-breed hardware and software in the Oracle SuperCluster range for high performance, including optimizations at the Exadata storage level, and Oracle and independent software vendor (ISV) enterprise applications.

Delivering flexibility and agility requires systems that are both specialized and easy to integrate

Engineered solutions are not a "one size fits all" solution

Oracle Exalogic Elastic Cloud and Oracle SuperCluster serve two different markets. Oracle SuperCluster is optimized to run Oracle Database 11gR2 or later and has the ability to support application tier software as well, by virtue of its extensive and mature virtualization technology set, which includes both Oracle VM for SPARC and Solaris Zones. Oracle Exalogic Elastic Cloud is workload specific, designed to run Java and non-Java workload in the mid-tier, particularly optimized for WebLogic Server, Oracle Coherence, Oracle Tuxedo, and Oracle Traffic Director, which are also supported on Oracle SuperCluster.

Oracle Exalogic Elastic Cloud is based on the Intel Xeon E5 processor and it can be implemented in a range of different size configurations ranging from a 96 core, 1TB entry-level solution (eighth-rack), through to a 720 core, 7.2TB (full-rack) configuration. Oracle Exalogic Elastic Cloud features a fully
integrated, enterprise-grade Oracle ZFS Storage Appliance. This is used as the primary shared storage for the system and is a fully redundant system that offers fault tolerance and is capable of on-site serving. The Oracle ZFS Storage appliance also has high-performance DIMM and flash memory designed to optimize read/write performance under the most demanding file-storage workloads. This degree of scalability means Oracle Exalogic meets the challenges of the current economic environment; organizations only want to size their compute requirements to current demand and do not want to purchase excess capacity. While the business wants to match capacity to demand it equally does not want new capacity to lag demand – typical physical capacity increases take three to six months. With Oracle Exalogic Elastic Cloud, organizations have a solution that enables rapid expansion, thereby addressing the two key requirements from business leaders: matching supply and demand and enabling growth at the same velocity as the business. The support provides the same peace of mind and quality of service for all the engineered solutions. In other words they are built to perform a task, and customers do not need to concern themselves about the inner workings and compatibility issues.

Solutions for "Big Data" require systems designed for performance

Oracle Big Data Appliance is designed for a wide range of different Big Data workloads including Hadoop and NoSQL processing. Ovum believes that the announcement of the new Oracle Big Data SQL represents an innovative solution from Oracle, it uses a new architecture for SQL on Hadoop which seamlessly integrates data in Hadoop and NoSQL with data in Oracle Database. The challenge for organizations is how to integrate different sets of data. The Oracle Big Data SQL solution uses two new approaches developed by Oracle to simplify this task: newly expanded External Tables and Smart Scan functionality on Hadoop.

The new external table types allow data in Hadoop and NoSQL to be exposed to Oracle Database users. The database administrators (DBAs) define these relationships once, and then the system automatically discovers Hive metadata including data location and data parsing requirements. Oracle’s Smart Scan technology works in conjunction with the external table types where data to the compute nodes is optimized through the use of local data scans that return only relevant columns and rows of data, and the application of SQL operators on JSON and XML at source. This reduces the performance penalties that are typically experienced as a consequence of excessive data movement.

Oracle Engineered Systems simplify the management of data and databases for enterprise customers

Specific workloads can be optimized on Engineered Systems, but it is important to note that Oracle SuperCluster contains the same Exadata Storage Servers that are used to build the Exadata configurations. Oracle SuperCluster is optimized for Oracle Database in exactly the same way, and to the same extent, as the Oracle Exadata configurations. The main differences are that Oracle SuperCluster provides a complete virtualization capability that allows customers to run applications in addition to Oracle Database. Other differences include the ability to add Fibre Channel HBAs and to do fully secure multi-tenant deployments (no kernel sharing).
Oracle Exadata Database Machine comprises two main products, X4-8 and X4-2, and a storage expansion solution designed specifically to cope with data growth, Oracle Exadata Storage Expansion Rack X4-2. Like all Oracle Engineered Systems it is a purpose-built solution that can be simply installed at a customer’s site and be used immediately. However, like the Oracle SuperCluster, Oracle Exadata Database Machine requires Oracle Database to be installed. In fact there is no difference between the two products in this regard if the customer is only running Oracle Database. (According to Oracle nearly 40% of Oracle SuperCluster customers are using it solely for Oracle Database, essentially running it as if it were a SPARC/Solaris Exadata.)

The Oracle Exalogic Elastic Cloud and Oracle Exadata Database Machine systems are very similar, in that they are delivered as a fully integrated hardware and software solution that includes everything needed to operate and manage the solution. The significant difference is that Oracle Exalogic Elastic Cloud simply needs an application to be installed, while Oracle Exadata Database Machine needs an application using the Oracle Database to be installed – such as those that execute on Oracle Exalogic Elastic Cloud – before it can perform any business function.

The model range provides customers with the ability to scale the solution to match database performance. The X4-2 extends from an eighth rack system with two database servers and three Oracle Exadata storage servers, to the full rack system with eight database servers and 14 Oracle Exadata storage servers. The X4-2 solutions can be easily upgraded and all are available with either 600GB high-performance disks or 3TB high-capacity disks. The X4-8 has the same performance, storage, and InfiniBand as Oracle Exadata X4-2, but uses large-scale 8-socket SMP servers instead of the 2-socket servers in Oracle Exadata X4-2. Each of the 8-socket servers in Oracle Exadata X4-8 has 120 processor cores, and 2-6TB of DRAM.

Flash storage has been expanded to 44TB in the full-rack X4-8 version. Oracle claims that this, combined with Exadata’s 10x Hybrid Columnar Compression, means customers can store 444TB of data in flash. Ovum believes that for the majority of customers this will result in significant performance improvements as there will be no longer be any need for the database to read data off slow disks. Oracle Exadata Database Machine can also now write to this large amount of flash memory, significantly improving online transaction processing (OLTP) performance. Similarly to Oracle Exalogic Elastic Cloud, full racks can be connected together using integrated InfiniBand fabric to form even larger configurations.

### Delivering data reliability and protection is a key capability of Oracle Zero Data Loss Recovery Appliance

Oracle Zero Data Loss Recovery Appliance comes with a base configuration of two compute servers and three storage servers connected using InfiniBand. This configuration is scalable in a rack up to a maximum of 14 storage servers, which provides 224TB of capacity or 2.2PB of virtual full backups. Oracle’s design brief for the Oracle Zero Data Loss Recovery Appliance was to reduce backup-related processing on production database systems to the absolute minimum. Oracle delivers this by transmitting only the changed data, using an incremental-forever backup architecture and two innovative technologies, Delta Push and Delta Store.
**Delta Push**

Delta Push effectively sends unique changes from all the protected databases, and is commonly referred to as "incremental forever" backups. Oracle has included specific source-side data deduplication technology using the Oracle Database and the Recovery Manager (RMAN) backup tool.

**Delta Store**

On the storage side the Delta Store technology acts as the intelligence layer where incoming changes are validated, indexed, and compressed. These changed blocks are the foundation of Virtual Full Database Backups, which are space-efficient, pointer-based representations of physical full backups as of the point-in-time of an incremental backup. Ovum understands that the benefit for customers is that these virtual full backups deliver a 10x capacity improvement over traditional full backups.

Oracle enables these Zero Data Loss Recovery Appliances to be expanded and treated as a single Appliance by simply connecting full racks together using InfiniBand. Ovum believes that the stated maximum of 18 fully configured racks is sufficient for all commercial use cases – some academic research projects potentially require more capacity but are very much the exception.

**Software-defined environment enables organizations to deliver operational efficiency**

The Oracle Virtual Compute Appliance is a solution that is simple to install and scale and is designed to enable organizations to increase application deployment time through the use of virtualization technology. The base rack configuration of Oracle Virtual Compute Appliance X4-2 expands from two to 25 nodes, each node is 2 Intel 8-core Xeon processors with 256GB of RAM, 2 x 1.2TB HDDS, 1 dual-port QDR InfiniBand HCE, 1GbE BASE-T management port, and fully redundant power supply. In addition to the controller nodes each Oracle Virtual Compute Appliance includes Oracle ZFS Storage ZS3-ES, 4 x QDR InfiniBand ports (one active and one passive per storage head), 292GB solid state disk write cache, 18TB serial-attached SCSI (SAS) disks, and 2GbE management ports. The networking infrastructure is delivered by Oracle Virtual Networking, which consists of 2 x Oracle Fabric Interconnect F1-15 model with 15 I/O module slots each with 20 Non-blocking QDR InfiniBand server ports, 4 quad-port 10GbE modules, and 2 dual-port 8Gb Fibre Channel modules (Oracle states that Fibre Channel is included, but not supported, in the initial release).

According to Oracle customer feedback, the Oracle Virtual Compute Appliance takes less than one hour to unpack and install to be ready to deploy virtual machines to. These virtual machines can be built using the Oracle VM templates and Assembly Builder, which accelerates the process of building and deploying virtual machines. Organizations can use other tools to build virtual machines, but the Oracle tools are designed for the Oracle Virtual Compute Appliance. Another feature that is worthy of calling out is the ability to add any storage to the Oracle Virtual Compute Appliance; by default it comes with Oracle ZFS, but can support many third-party storage solutions. One of the most significant capabilities is Oracle Software-Defined Networking (SDN), which dynamically connects servers to networks and storage. Oracle SDN eliminates the physical storage and networking cards found in servers and replaces them with virtual network interface cards (vNICs) and virtual host bus adapters (vHBAs). These virtual components enable IT administrators to change and deploy configurations dynamically on the fly. Applications and operating systems see these virtual resources exactly as they would see their physical counterparts.
Appendix

Methodology

The process for information gathering used in writing this report involved

- detailed briefings with the vendors
- additional independent research into the solutions
- peer review of the report.

Further reading

Exploring the Suitability of Converged Infrastructure Solutions for Enterprises, IT0022-000164
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