An Oracle White Paper
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Garmin International Inc.
Oracle Exadata Database Machine
Technical Case Study

ORACLE

GARMIN

Contents

Executive Overview

Garmin designs, manufactures and markets global positioning system (GPS) navigation and communications equipment for the automobile/mobile, outdoor, fitness, marine and aviation markets. It is a leader in every market it serves. For market reach, Garmin has its primary company-owned distribution centers in the United States, the United Kingdom, Australia, and Taiwan. Garmin International is headquartered in Olathe, Kansas, with manufacturing facilities in the US and Taiwan.

Garmin has successfully deployed Oracle Exadata Database Machines for consolidating several mission-critical applications, including the E-Business Suite – covering order management, manufacturing and supply chain planning, and financials; and Garmin Connect – a widely successful application with over 1 billion logged miles, where thousands of customers around the world can track and analyze personal workout data. Garmin migrated and consolidated these applications from dedicated Sun SPARC and Intel SMP systems onto Exadata Database Machine. These applications have demonstrated improved performance compared to their previous systems:

- Garmin Connect enjoys sufficient system capacity for a workload that has more than tripled – one year ago, the rate of workout uploads to Garmin Connect was 1 million per week, now that rate is 1 million per day.

- Garmin has enjoyed a 20% to 50% performance gain in their Advanced Supply Chain Planning (ASCP) reporting cycles.

- Garmin's top 20 critical concurrent batch jobs now run on average 46% faster.

- Month-end related jobs now run on average 67% faster.

- Manufacturing resource planning (MRP) processes runs significantly faster. To quote Garmin, "Each day at 19:00 M-F we run the Garmin TSO/PMA Certification Set program. Before Exadata, the program took an average of 5 hours and 2 minutes to run. After Exadata, the program regularly takes 1 hour 25 minutes. By my calculations, that is a 475% improvement."

Along with the improved batch performance, online users enjoy consistent response times, noting especially how much faster the cursor moved between fields.

Garmin has also benefitted from Exadata's pre-configured Engineered Systems and support model, reflected by their experience of having new Exadata Database Machines installed and ready to load and test within 7 days of arriving on-site.

Garmin has utilized Oracle Maximum Availability Architecture (MAA) best practices for Exadata Database Machine to achieve their objectives for high availability (HA) and data protection. This is critical given the nature of the applications deployed in their Exadata environment – from their customer-facing Garmin Connect web site to their manufacturing and order fulfillment processing.

This technical case study describes Garmin's implementation of Exadata Database Machine.

Intended Audience

Readers of this paper are assumed to have experience with Oracle Database 11g technologies, familiarity with the Oracle Maximum Availability Architecture framework (MAA), and a general technical understanding of Oracle Exadata Database Machine. When referenced in this paper, in-depth background on these topics will be deferred, as they are covered in other documentation and technical white papers available on the Oracle Technology Network[1]. This paper will provide configuration details and benefits specific to the deployment being discussed. See the Appendix for a list of recommended technology white papers and acronyms used in this paper.

Introduction

With multiple commercial and retail distribution channels, Garmin needed to meet the demand for their products especially during the August through December timeframe – the ramp up for the Christmas season.

Garmin faced serious challenges with its previous architecture based upon mixed platforms:

- Legacy systems lacked fault tolerance – leading to difficulty meeting availability SLAs.
- Vertical SMP scaling was not projected to meet cost and performance objectives.
- Mixed platforms created re-work for implementation, leading to longer maintenance windows and higher costs.
- No standardization across legacy systems.
- Systems were expensive to purchase and difficult to deploy – long lead times and significant effort was required to acquire, build up, integrate, and deploy new systems.
- Hardware and software components from multiple vendors were complex to support. No one supplier was accountable at a system level.

Oracle Exadata Database Machine

Garmin needed to reduce its existing and long term costs based on growth of ERP and web applications, while improving quality of service for its mission critical applications, improving performance, scalability, and availability for both back-office and cloud-based processing. Garmin

[1] http://www.oracle.com/technetwork/database/exadata/index.html

chose Exadata Database Machine due to its superior performance and availability, and because it could fundamentally change their strategic IT focus away from building systems, to developing, consolidating, and supporting application services.

Using an Exadata system resulted in Garmin realizing the following advantages relative to their previous environment:

- Cost-effective horizontal scaling to achieve performance SLAs
- Integrated high availability features allowing availability SLAs to be met
- Cost reduction, both by consolidating workloads to fewer servers, and by migrating to the Engineered System solution.

Garmin Exadata Database Machine Deployment Architecture

At present, Garmin has two Exadata Database Machines. One hosts five production databases. The other hosts physical standby databases for their mission-critical applications, as well as test, development, and quality assurance databases for the five production environments. Production applications' databases deployed on Exadata Database Machine include:

- Garmin Connect, a customer-facing personal fitness web application with extreme availability requirements and rapidly growing disk requirements
- Orbit, an implementation of Oracle E-Business Suite 11i for order fulfillment, manufacturing, inventory and warehouse management, and financials
- PLAN, an implementation of Oracle E-Business Suite 11i and Demantra for Oracle Advanced Supply Chain Planning (ASCP)
- Hyperion 11.1.2, for analytic reporting during period-end close
- RubyTW, a custom Quest Shareplex application used for managing manufacturing processes for the Taiwan manufacturing facility

To support these applications, Garmin installed an Exadata Database Machine V2 Half Rack with high performance disk in production, and an Exadata Database Machine V2 Half Rack with high capacity disk for their physical standby, QA, test, and development environments. They expanded the physical memory of all Exadata Database Machine compute nodes to 144 GB using the available memory expansion kit.

Garmin's Connect application contains fitness and workout data along with waypoint data for distance traveled. The waypoints are stored as BLOBs in the Connect database. The popularity of this application is resulting in rapidly growing storage requirements. As the waypoint data ages, it is not accessed as often but must still be accessible. Garmin has implemented an Information Lifecycle Management (ILM) program, adding two stand-alone high-capacity Exadata Storage Servers configured as a separate ASM disk group for holding this aged data. This allows the high performance

disk to be used by the frequently-accessed data of all the production environments, while maintaining online access to the bulky, infrequently accessed waypoint data.

To accommodate the physical standby databases along with test and development databases, the half rack TEST Exadata Database Machine is configured with seven high capacity Exadata Storage Servers. Each storage server has twelve 2 TB High Capacity SAS disks. Garmin has chosen to run their test, development and project application databases on the TEST database machine that also hosts the physical standby databases of their production databases. Should any or all of the primary production databases be lost, they will fail over to their respective standby databases. At this time, Garmin will shut down any non-production application databases.

The two Exadata Database Machines are located in two separate buildings at Garmin headquarters. Each database machine is a separate isolated cluster, and the two are connected with a custom built high speed 10GE network. This custom network utilizes two dedicated Linux servers, each connecting to one of the two database machines via InfiniBand. These two Linux servers handle routing the traffic between the InfiniBand network and the custom 10GE network that runs between the two buildings. This allows for high transfer throughput for redo and archive logs to their physical standby databases enabling it to stay in sync should the primary database machine fail or be down for maintenance.

All application and mid-tier components connect over gigabit Ethernet to Exadata. This includes the 11i E-Business Suite concurrent managers for Orbit and PLAN. As Parallel Concurrent Processing is not implemented at this time, the concurrent manager is running on node 4 of their production Exadata Database Machine.

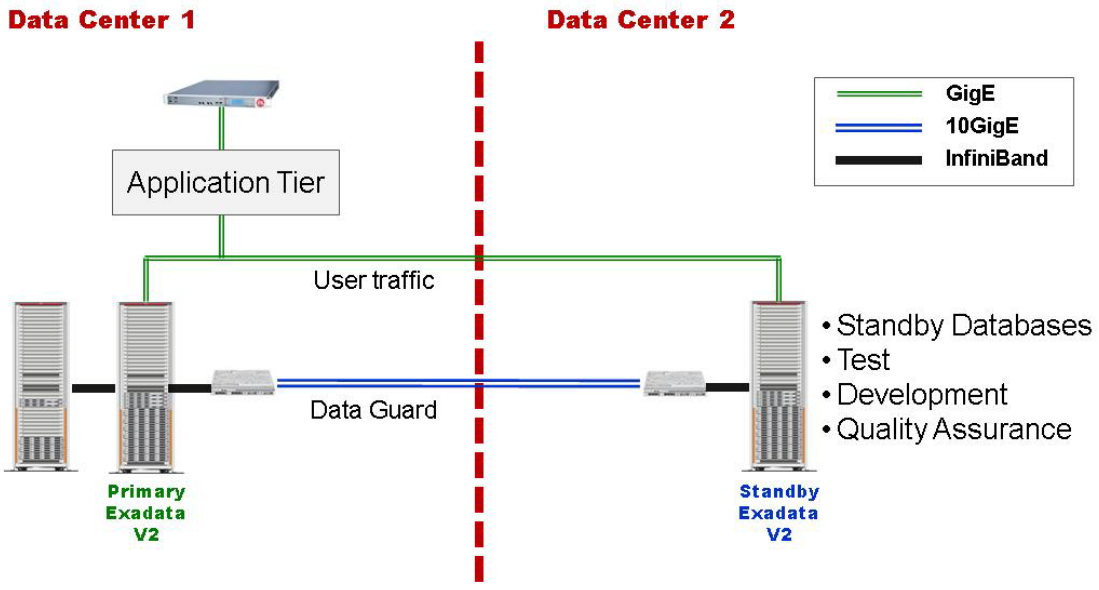

FIGURE 1 – EXADATA DATABASE MACHINE DEPLOYMENT ARCHITECTURE

Migration

Prior to migrating to Exadata Database Machine, Garmin's application databases were deployed on large dedicated SMP servers, spanning a mix of Sun Solaris and Linux Platforms using SAN storage. These various systems hosted mission-critical applications for customer web presence (Garmin Connect), order fulfillment, warehouse management, manufacturing, and financials. All of these applications were running on Oracle Database 10g Release 2.

It was important to migrate Garmin Connect to Exadata Database Machine with as little downtime as possible. To accomplish this, Garmin upgraded the Connect database from 10g Release 2 to 11g Release 2 (version 11.2.0.1) while it was still on their legacy system. They instantiated a physical standby on Exadata Database Machine, then performed a planned switchover to the physical standby database. This strategy enabled Garmin to migrate Garmin Connect to Exadata Database Machine with only minutes of downtime. Garmin followed best practices for Data Guard configuration found in the MAA paper, "Oracle Data Guard: Disaster Recovery for Exadata Database Machine[2]".

All other databases were migrated from their legacy environments to Oracle databases running on Exadata Storage Servers using Oracle Data Pump. The E-Business Suite application databases for Orbit and PLAN were upgraded from 10g Release 2 to 11g Release 2 (11.2.0.1) as part of the migration, guided by the MAA best practice paper, "Migrating Oracle E-Business Suite to Exadata Database Machine Using Oracle Data Pump.[3]"

[2] http://www.oracle.com/technetwork/database/features/availability/maa-wp-dr-dbm-130065.pdf

[3] http://www.oracle.com/technetwork/database/features/availability/maa-ebs-dbm-datapump-167285.pdf

Garmin Production Experience with Exadata

Prior to migrating to Exadata Database Machine, the following points were observed by Garmin:

- Gamin Connect was near maximum CPU capacity running on a single large SMP server.
- Garmin Connect was near maximum capacity for I/O (IOPS and throughput).
- Orbit was operating at high CPU usage and was nearing its maximum capacity.
- Orbit had reached its I/O capacity (IOPS and throughput).
- Weekly production backups led to noticeably poor performance every Tuesday

On Exadata Database Machine where Garmin Connect and Orbit are both running:

- Peak CPU usage across all nodes on the cluster was observed to be 50%.
- I/O utilization ranges between 15% with peaks up to 30%.
- Flash cache on Exadata Database Machine satisfies 93% of all physical I/O requests for Garmin Connect.
- Flash cache on Exadata Database Machine satisfies overall 70% of all physical I/O requests for Orbit.
- No more "Terrible Tuesday" – production backups are offloaded to the physical standby databases

Performance is also improved significantly in the following areas:

- Online users of OLTP E-Business Suite 11i applications experience consistent and stable performance.
- E-Business Suite Advanced Supply Chain Planning (ASCP) batch runs now complete 20% to 50% faster.
- Demantra Shipping and Booking History processes run 30% faster.
- Demantra ASCP upload processes now complete 60% faster.
- Several of the month-end batch jobs now run 67% faster.

The following table lists a few specific examples of performance improvements for critical business processes. The performance improvement is shown below as an X factor time faster.

TABLE 1. BUSINESS PROCESS PERFORMANCE COMPARISON

PROCESS NAME	PRE-EXADATA TIME (HH:MM:SS)	POST-EXADATA TIME (HH:MM:SS)	BY X TIMES FASTER
Critical Concurrent Jobs			
Communication for Receiving Event	00:35:54	00:00:20	107
Communication for Shipping Event	00:35:27	00:00:21	107
Report Set	01:11:43	00:00:44	96
Month End Processing			
Use Tax Liability Report	00:03:33	00:00:30	7
Aging - 4 Buckets Report	00:35:15	00:03:02	11
Detail Invoice Ship-To Report	07:31:53	03:24:01	2

- Substantial cost savings from consolidation – Garmin have now replaced 12 dedicated production servers by moving to Exadata Database Machine.

  Prior to Exadata, Garmin had no fault tolerant solutions in place for any of the applications. They now have an architecture in place to meet their SLA targets of 99.5% uptime for Orbit and PLAN (considering unplanned outages), and 99.5% uptime for Connect.

  - Orbit and PLAN E-Business Suite applications are now deployed on Oracle Real Application Clusters (Oracle RAC) increasing their availability compared to their non-Oracle RAC single SMP server.
  - Orbit and Connect both have reduced downtime for some planned maintenance activities by using Oracle RAC and Oracle Data Guard.

Scaling Garmin Connect

Garmin personal fitness devices allow their customers to record and analyze their performance during workouts – monitoring workout characteristics such as heart rate, distance, time, pace, elevation, etc., while recording waypoints marking geographic location of the workout. Customers can then upload their workout files to Garmin Connect, where the information is available for personal reporting and analysis as well as exploring – e.g., searching for activities and courses uploaded by other users or

searching by location. The Garmin Connect application has seen significant demand and growth, evidenced by large increases both in the number of users registered and the number of workouts uploaded by users.

Garmin Connect now benefits from the Exadata architecture by scaling CPU and memory with Oracle RAC and faster I/O with high bandwidth InfiniBand –making use of all available disks as well as the faster I/O provided by flash cache, reducing I/O latency for random reads.

One important and frequently used feature in Connect is the Connect Explore function, which provides functionality for searching activities and courses from other users as well as keyword searches of specific locations. Exercising this functionality results in a database query using GPS coordinates that must be serviced with low response times. To reduce the query response time, the table being queried was pinned into the Exadata Storage Server flash cache.

Prior to migrating to Exadata Database Machine, the Garmin Connect application experienced poor, erratic performance. After the migration, not only are they meeting their performance expectations they are able to support more than 2 times the number of users and achieve much higher transaction throughput. For example, prior to Exadata, Garmin Connect was peaking at 200,000 page visits per hour on Garmin Connect. After moving to Exadata, the Connect usage has grown to well over 750,000 page visits per hour with much more system capacity still available.

But even better performance could be gained… The Garmin Connect application is relatively COMMIT intensive, with a rate averaging above 85 user commits per second. With Oracle Database version 11.2.0.1 – the version available when the application was first migrated – Garmin Connect experienced the database wait event "log file sync" averaging around 17ms per commit. It was also observed that this wait event had other downstream impact such as causing buffer busy waits leading to some performance impact.

Smart Flash Logging is a feature introduced in the Exadata storage software release 11.2.2.4.0, which can be utilized with database version 11.2.0.2 and higher. Smart logging reduces redo log I/O write latency by performing parallel log writes to both flash logs – a small portion of the smart flash cache, and physical storage. The write to the flash log typically completes first, at which time control is returned to the application.

Garmin has since upgraded the Garmin Connect database to 11.2.0.3 and now takes advantage of Exadata Smart Flash Logging. Once Garmin Connect was upgraded to 11.2.0.3, log file sync went from an average of 17ms to 1.92ms per user commit due to smart logging. The buffer busy wait event disappeared from the top wait events allowing the application to scale even further.

One of the Garmin Connect DBAs noted, "Connect wouldn't be running today if it weren't for Exadata."

Garmin Using Exadata Database Machine for Database Consolidation

Consolidation of existing application databases involves two high-level tasks to be completed for a successful deployment:

- Planning for consolidation
- Managing the consolidated deployment

Planning for consolidation

When planning for consolidation, Garmin considered the following:

- High Availability SLA
- Planned maintenance windows
- Storage usage and expected growth
- Statistics on CPU, memory and I/O usage
- Workload behavior such as peak utilization, processing calendar – e.g., batch jobs for daily planning cycles, month-end close, and other required business processes
- Workload growth (new users, increase in transaction volumes, etc.)

As mentioned earlier, Garmin has successfully consolidated five application databases onto Exadata Database Machine. Garmin performed assessments for each of these application databases to determine their resource needs (CPU, memory, I/O) as they vary over the processing calendar and storage requirements. Expected growth was also factored into the planning process for future resource needs and storage growth.

Managing the consolidated deployment

Garmin utilized a number of strategies for managing their application databases consolidated on Exadata Database Machine – load distribution across Oracle RAC nodes, configuration adjustments, various load management tools, and Oracle Enterprise Manager suite.

Based on CPU and memory requirements, Garmin has decided where specific application database instances are to be placed on their production half rack Exadata Database Machine:

- Garmin Connect instances running on nodes 1 and 2
- Orbit instances running on all 4 nodes with the concurrent manger assigned to node 4
- PLAN instances running on nodes 3 and 4 with the concurrent manager assigned to node 3
- Hyperion instances running on nodes 3 and 4

- RubyTW instances running on nodes 1 and 2

Note that all databases are configured with Oracle RAC but not all are configured with Oracle Data Guard. See the following illustration for a graphical view of the layout.

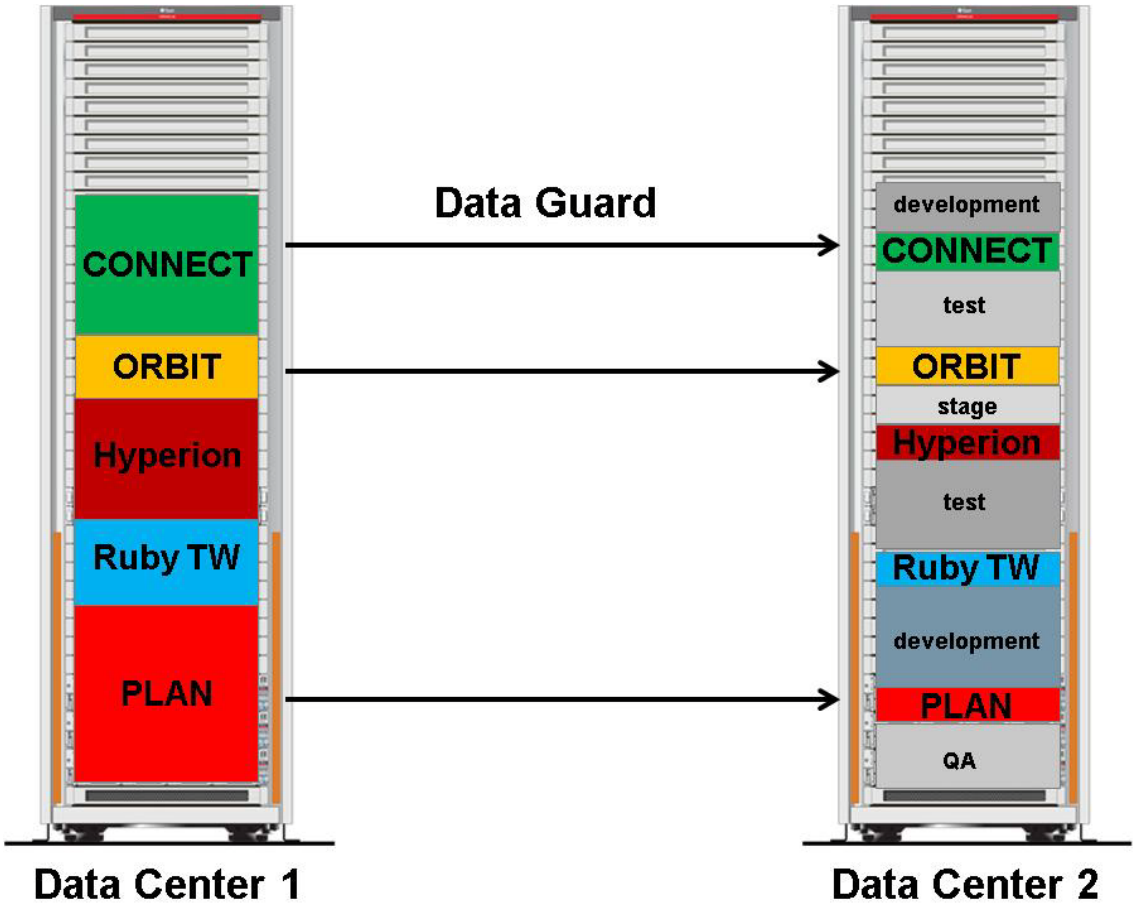

FIGURE 2 – GARMIN PRODUCTION CONSOLIDATE LAYOUT

To efficiently use memory – and avoid swapping – Garmin configured Linux hugepages on all compute nodes. Hugepages is a Linux OS kernel parameter that allows all processes that access the Oracle instance SGA to share the page tables. Linux hugepages are configured during installation but the ideal setting will vary based on application database requirements. For more information on configuring Linux hugepages, see My Oracle Support note 361323.1. For a script that will compute the recommended hugepage size, see My Oracle Support note 401749.1.

In addition to spreading instances and workload tasks across different Exadata Database Machine compute nodes, Garmin is using these tools to manage resources:

- Instance caging is being tested on Orbit to ensure sufficient CPU resources are available for Garmin Connect on node 1. For more information on instance caging, see "Database Instance Caging: A Simple Approach to Server Consolidation" white paper.[4]
- Exadata I/O Resource Manager (IORM) – only available on Exadata – is used to manage and priorities IO bandwidth for some reports that are run from Orbit.
- Garmin is in the process of implementing Database Resource Manager (DBRM) for managing both CPU and I/O resources for specific database services for each of their applications.

As application workload resource needs grow or change, and new applications are added, these tools are essential to managing the array of applications running at Garmin.

In addition, Oracle Enterprise Manager Grid Control is used to monitor and manage Garmin's Exadata systems. Oracle Enterprise Manager provides a complete view of Exadata, including:

- Oracle Database
- Database services
- Grid infrastructure: ASM storage manager and Oracle Clusterware
- Exadata storage cell
- All hardware components and operating environments present in the physical rack

To maintain overall health of the system, Garmin makes extensive use of the health check tool, exachk, to automate the collection and analysis of data regarding key software, hardware, and firmware versions and configuration best practices specific to Exadata Database Machine. The exachk output provides extensive review and crosscheck of an Exadata Database Machine installation, checking patch levels, reporting network or system faults, and validating a wide variety of configuration best practices. Garmin has followed the recommendations from the output of the exachk tool to ensure proper system configuration and smooth operations. For more information on exachk, refer to My Oracle Support note 1070954.1.

All test and development databases that support production as well as the physical standby databases have been consolidated onto their second (TEST/DEV) Exadata Database Machine Half Rack system.

Garmin Exadata Database Machine High Availability Configuration

One major benefit to Garmin's migration to Exadata Database Machine has been the availability of a robust toolkit to provide availability across a variety of scenarios for their mission critical applications.

[4] http://www.oracle.com/technetwork/database/focus-areas/performance/instance-caging-wp-166854.pdf

The following sections discuss implementation details for the major high availability components deployed in Garmin's Exadata Database Machine environments.

Configuration and use of Oracle RAC

All Garmin production databases on Exadata Database Machine have been deployed using Oracle RAC. Oracle RAC active-active clustering enables the cost-effective scale-out architecture and high availability sought by Garmin.

- Garmin's applications connect to Oracle using database services. Each database service is available on as many Oracle RAC nodes as needed to meet performance SLAs. Connect-time load balancing insures equal utilization of all nodes hosting a particular service.

  Some of Garmin's applications connect using Single Client Access Name (SCAN), which provides a level of abstraction between application clients and the physical configuration of the Oracle RAC database. For example, the Garmin Connect application uses SCAN to provide seamless connections across Oracle RAC instances, and to automatically reconnect should an Oracle RAC instance fail. Garmin has tested the reconnection time for Garmin Connect on Oracle RAC should one of the Oracle RAC instances fail, and have found that the reconnect time is 30 seconds. For more information on SCAN, see the overview white paper: Single Client Access Name (SCAN).[5]

  Oracle RAC also provides Garmin high availability during many types of planned maintenance. Oracle Grid Infrastructure and Oracle RAC rolling upgrades best practices enable certain maintenance (hardware, firmware and OS maintenance, one-off patches, critical patch updates) to be performed on one node at a time in a rolling fashion, while database services remain available on all other nodes of the Oracle RAC cluster. Here is how Garmin maintains availability during planned maintenance:

    - Disable the database service on node 1 and allow traffic to continue on node 2.
    - Once client traffic has been migrated from node 1 and new client requests are redirected elsewhere, its database home can be patched.
    - After patching, the instance is brought back up along with its services, and traffic is routed back to the patched node.
    - This process is repeated for the remaining nodes.

For more information on performing Grid Infrastructure and Oracle RAC patching in a rolling fashion, please see My Oracle Support note 244241.1.

[5] http://www.oracle.com/technetwork/database/clustering/overview/scan-129069.pdf

Configuration and use of Oracle Automatic Storage Management (ASM)

Garmin utilizes ASM, the integrated file system and volume manager used with Exadata Database Machine, to implement a cost-effective high-performance storage grid. Garmin has followed MAA Exadata Database Machine best practices for ASM.

- Garmin defined their DATA disk groups (user data) first when configuring their disk farm, which places these disk groups on outside edges of the disk for optimal performance. The RECO disk groups (recovery data) were defined next, placing them more to the inside of the disks, then finally the Database File System disk group (DBFS) was defined, placing it on the innermost portion of each disk.
- Garmin uses a 75/25 split of storage capacity between DATA and RECO disk groups respectively.
- Garmin has followed the MAA best practice to have all ASM disk groups span all storage cells to achieve the highest I/O performance for all applications. This does not include the two stand-alone Exadata storage cells used for the less active data for Garmin Connect – here, the disk group is defined across all the high capacity storage cells provisioned for the historical data.
- Exadata storage cells are patched in a rolling fashion (one cell at a time). Applying the patches on their TEST system enables all changes to be tested on the standby/QA/dev/test machine before applying them to the production system. Rolling them across the TEST database machine also provides a good test of the process while allowing some availability to be maintained on the dev, test, and QA environments.

  Garmin currently implements ASM normal redundancy (dual mirroring) for both DATA and RECO disk groups, as opposed to the MAA-recommended high redundancy (triple mirroring). To protect against prolonged downtime due to double partner disk failure, or partner disk failure during Exadata cell rolling upgrade, physical standby databases have been deployed for their mission critical applications and are available as a failover target.

Configuration and use of Data Guard

Garmin uses Oracle Data Guard physical standby databases to protect mission critical data, to provide high availability and disaster recovery in the event of database or site failure, and to provide availability during major planned maintenance events on the production machine.

MAA best practices were followed as documented in the technical white paper, "Oracle Data Guard: Disaster Recovery for Exadata Database Machine." [6]

[6] http://www.oracle.com/technetwork/database/features/availability/maa-wp-dr-dbm-130065.pdf

- All standby databases are configured using Oracle Data Guard Maximum Performance and asynchronous redo transport.
- Enables zero data loss switchovers from primary to standby for planned maintenance.
- Enables near-zero (single-digit seconds) data loss failover to a standby database should the primary unexpectedly become unavailable for any reason.
- Oracle Data Guard failover is used to rapidly transition production applications to a standby database during unplanned outages. A switchover for Garmin Connect is between 5 to 10 minutes which includes planned application services shutdown and restart. A Garmin Connect failover can be completed within 5 minutes.
- Garmin follows MAA Best Practices for corruption protection by implementing an Oracle Data Guard physical standby database including lost-write detection. Garmin is evaluating the use of Active Data Guard which would provide enhanced protection such as automatic block repair. For more details see the MAA technical white paper, "Preventing, Detecting, and Repairing Block Corruption: Oracle Database 11g." [7]

Configuration and use of Oracle Recovery Manager (RMAN)

Garmin utilizes a tape-based backup strategy. This offers Garmin the following advantages:

- Exadata storage and tape-based backups provide extremely fast backup and restore rates.
- Tape-only solutions isolate faults from Exadata Storage Servers.
- Exadata system capacity and bandwidth are maximized.
- Backups are isolated from production workload where a Data Guard physical standby is maintained.

Garmin uses the following practices for tape-based backups:

- Daily RMAN level 0 (full) backups of the database

  Garmin uses one of the nodes to perform backups and schedules the backups when other applications that are more I/O sensitive are not as active. The Recovery Manager (RMAN) is configured with 4 channels for the backup. Since moving to Exadata, their backup elapsed times have been reduced by 40%. The backup of the production PLAN database used to take 9 hours and now takes 4 hours.

[7] http://www.oracle.com/technetwork/database/focus-areas/availability/maa-datacorruption-bestpractices-396464.pdf

This one compute node is connected via InfiniBand to a NetBackup media server. This server is connected using fiber channel to a StorageTek SL8500 tape library with 24 LTO tape drives.

Garmin has plans to conduct daily incremental backups and perform a weekly full backup once per week, which is the MAA best practice. They will enable changed block tracking for the incremental backups.

- Offload RMAN backups to the standby database – mitigating "Terrible Tuesday"

  Prior to moving to Exadata, Garmin's backups were done directly from the production databases and would have a large impact on the production workload. These backups were performed on Tuesdays. Garmin coined the term "Terrible Tuesday" to describe the experience.

  Garmin now offloads many of their backups to their physical standby databases. With backups being offloaded to the standby, Tuesday is just another day.

- RMAN disk backups for TEST and QA, substantially reducing project life cycle time

  Garmin clones the standby databases for use by test, QA and other projects. The Exadata Database Machine has provided Garmin a much faster refresh time for these environments. Prior to Exadata, these refreshes would take as much as two weeks to complete. The refresh processes now take on average 8 hours for the largest project database. This is a huge time savings for Garmin as this reduces their project release life cycles.

For more information on backup best practices, see the technical white paper, "Backup and Recovery Performance and Best Practices for Exadata Cell and Oracle Exadata Database Machine Oracle Database Release 11.2.0.2." [8]

Challenges

Now that Garmin is running successfully on Exadata Database Machine, the ongoing challenges are driven by the growth of their business, which drives higher system usage and demand for higher availability from their user communities. Garmin will utilize the flexibility of Exadata Database Machine including IORM to manage the demanding growth.

Below are a few of the important challenges that must be met:

- Maintenance – a periodic planned maintenance program to keep current on Exadata Database Machines, database releases, and patch updates every 6 months.

  Garmin is successfully reducing the impact of maintenance windows for the consolidated applications by rolling the patches and upgrades using Oracle RAC and Oracle Data Guard Physical Standby. For the latest patch set and quarterly database patch for Exadata Database Machine (QDPE), please refer to My Oracle Support note 888828.1.

[8] http://www.oracle.com/technetwork/database/features/availability/maa-tech-wp-sundbm-backup-11202-183503.pdf

- Isolation – to prevent one application from impacting all others.

  This requires using mechanisms that protect critical application functions from being impacted by functions of another application. For example, a report performing an uncontrolled parallel smart scan could impact the I/O latency for applications performing OLTP transactions. Smart scans perform large I/O requests for higher I/O throughput, while OLTP performs small random I/O requests. Small write I/Os will experience high latency.

  There are a number of options available to manage this, but using I/O Resource Manager to govern smart scans or tuning some of the queries that really do not need to perform smart scans are options that should be considered first if smart scans will be executed in combination with OLTP applications.

- Monitoring – to quickly identify issues on this mission-critical frame and apply corrective measures as appropriate.

  It is important to be automatically alerted when specific thresholds have been exceeded over some period of time – excluding momentary spikes. These thresholds can be mapped to key performance indicators to aid in determining where the issue may be. To enhance their monitoring capabilities, Garmin is now planning to implement Oracle Enterprise Manager 12c.

- Testing – to ensure changes put into the consolidated environment will not have unexpected adverse effects

  In a consolidated environment, a complete test of a major change often must include testing the multiple workloads in tandem, to catch situations where a change in one area might cause an issue in another.

  It is also necessary to limit the test environment strictly so it uses only allocated resources, and does not expand to use more resources than will be available in production.

  These tests should cover both functionality and performance.

- Training -- Garmin was pleased with this "positive disruption" to their schedule, as they are now more confident in Garmin's ability to meet the business's service level requirements for these mission-critical applications.

Summary

Garmin is successfully deploying Exadata Database Machines to improve quality of service across the dimensions of performance, scalability, and high availability, while also reducing IT costs. In addition to cost, performance, and availability benefits, Garmin chose Exadata Database Machine because it fundamentally changes their strategic IT focus from building systems to developing, consolidating, and supporting application services critical to their business.

Appendix

An understanding of the following technology white papers and acronyms will provide the reader of this paper with a basic technical foundation.

Technical White Papers

- Oracle Exadata Database Machine: http://www.oracle.com/technetwork/database/exadata/exadata-technical-whitepaper-134575.pdf
- Oracle Real Application Clusters (RAC) 11g Release 2: http://www.oracle.com/technetwork/database/clustering/overview/twp-rac11gr2-134105.pdf
- Oracle Data Guard: Disaster Recovery for Exadata Database Machine http://www.oracle.com/technetwork/database/features/availability/maa-wp-dr-dbm-130065.pdf
- Deploying Oracle MAA with Exadata Database Machine: http://www.oracle.com/technetwork/database/features/availability/exadata-maa-131903.pdf

My Oracle Support Notes

- HugePages on Linux: What It Is... and What It Is Not... https://support.oracle.com/CSP/main/article?cmd=show&type=NOT&id=361323.1
- Shell Script to Calculate Values Recommended Linux HugePages / HugeTLB Configuration https://support.oracle.com/CSP/main/article?cmd=show&type=NOT&id=401749.1
- Oracle Exadata Database Machine exachk or HealthCheck https://support.oracle.com/CSP/main/article?cmd=show&type=NOT&id=1070954.1
- Rolling Patch - OPatch Support for RAC https://support.oracle.com/CSP/main/article?cmd=show&type=NOT&id=244241.1
- Oracle Patch Assurance - Data Guard Standby-First Patch Apply https://support.oracle.com/CSP/main/article?cmd=show&type=NOT&id=1265700.1
- Database Machine and Exadata Storage Server 11g Release 2 (11.2) Supported Versions https://support.oracle.com/CSP/main/article?cmd=show&type=NOT&id=888828.1

Acronyms

- Oracle RAC = Oracle Real Application Clusters
- ASM = Automatic Storage Management
- MAA = Maximum Availability Architecture
- SCAN = Single Client Access Name
- SLA = Service Level Agreement
- DBFS = Database File System

- ACO = Advanced Compression Option
- RMAN = Recovery Manager
- HA = High Availability
- IORM = IO Resource Manager
- DBRM = Database Resource Manager
- DR = Disaster Recovery
- RPO = Recovery Point Objective
- RTO = Recovery Time Objective
- FRA = Fast Recovery Area
- CRS = Cluster Ready Services
- ASR = Automated Service Request

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