Lecture 2
Oracle Database 12c/18c Architecture Part 2

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http://www.iidba.co.il/author/cimid/
http://www.sqlserver.co.il/?cat=940
3rd Israeli Conference on Software Architecture
http://www.iltam.org/sw-arch2016/arch2016_page#OpenSource
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https://www.youtube.com/watch?v=x4hGjYGbfkc
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SqlSaturday Israel 2016:
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http://www.sqlsaturday.com/623/Sessions/Detail
SqlSaturday Israel 2018:
Reference and Credits

Oracle Open World 2017 session catalog

Run SQL with Oracle Live SQL

Oracle Database 12c Release 2 Help Center
Agenda

- Oracle Client/Server Architecture
- Database and Instance
- Real Application Cluster (RAC)
- Major background processes
- Checkpoint Process (CKPT)
- Database Writer Process (DBWN)
- Log Writer Process (LGWR)
- Online Redo Logs (ORLs)
- Connections and Sessions
- Oracle Database 12c Multitenant architecture
- What is the cloud
- Oracle Database as A service
Oracle Client/Server Architecture

• Client (not the user): application that communicates either through a middle-tier (middleware) application or directly with Oracle server
• Middle tier: Homegrown LOB, Oracle Fusion Applications/Middleware
  – HTTP(S) Web server
• Oracle Database is the “back end” storage tier
  – Although the platform is capable of declarative/procedural logic
• Oracle Exadata Database Machine ,Oracle Exalytics
Database and Instance

- Process and memory structures together are called an **instance**;

- **Database**: Storage structure. Set of physical files (Data files, Control files, Redo Log files) saved on the disk that store information.

- Instance and Database are called an **Oracle server**.

- One instance communicates with one DB.

- If the machine goes down for some reason, DB will be unavailable. Solution: **Real Application Clusters (RAC)**.
Real Application Cluster (RAC)

• More than one instance communicates to a single database and shared storage: **Active Active Cluster**

• Each instance has separate sets of background processes, SGAs, RAM, CPU and Disk.

• Oracle manages the connection load balancing and failover automatically.

• Nodes always communicating with themselves so they won't step on each other's changes.
Database and Instance

**Database**
- Set of files, located on disk, that store data. These files can exist independently of a database instance.

**Database instance**
- Set of memory structures that manage database files. Instance consists of a shared memory area, called the system global area (SGA), and a set of background processes.
- An instance can exist independently of database files.
- For each user connection to the instance, a **client process** runs the application. Each client process is associated with its own **server process**. Server process has its own private session memory, known as the program global area (PGA).
Oracle Instance

- A database instance is a set of memory structures that manage database files.
- When an instance is started, Oracle Database allocates a memory area called the **system global area (SGA)** and starts one or more **background processes**.

**SGA** serves various purpose:
- Maintaining internal data structures that many processes and threads access Concurrently.
- Caching data blocks read from disk
- Buffering redo data before writing it to the online redo log files
- Storing SQL execution plans
Oracle Database 12c Architecture:

Major background processes

- **DBWn**: Database writer writes dirty modified blocks from DB buffer cache to the data files.
- **CKPT**: Checkpoint process writes checkpoint information: checkpoint position, SCN to control files and data file headers, location in online redo log to begin recovery, and so on.
- **LGWR**: The log writer writes redo information from the log buffer to the online redo logs.
- **ARCn**: The archiver copies the content of online redo logs to archive redo log files.
Oracle Database 12c Architecture

major background processes

- **PMON:** *Process Monitor* cleans up abnormally terminated database connections and also automatically registers a database instance with the listener process.
- **LREG:** Orchestrates the net listener
- **SMON:** *System Monitor* performs system level clean-up operations, including instance recovery in the event of a failed instance, coalescing free space, and cleaning up temporary space.
- **DBWn:** *Database Writer* writes blocks from the database buffer cache to the data files.
- **LGWR:** *log writer* writes redo information from the log buffer to the online redo logs every 3 seconds.
- **CKPT:** *Checkpoint process* writes checkpoint information to the control files and data file headers.
- **ARCn:** *Archiver* copies the content of online redo logs to archive redo log files.
- **RVWR:** The recovery writer maintains before images of blocks in the fast recovery area.
- **MMON:** *Manageability monitor process* gathers automatic workload repository statistics.
- **RECO:** *Recoverer process* automatically resolves failed distributed transactions.
Checkpoint Process (CKPT)

- **Mandatory Background Processes**
  - Updates the control file and data file headers with checkpoint information and signals DBW to write blocks to disk.
  - **Checkpoint information** includes the checkpoint position, SCN, location in online redo log to begin recovery, and so on
  - CKPT does not write data blocks to data files or redo blocks to online redo log files
  - System change number (SCN) is Oracle's clock - every time we commit, the clock increments. The SCN just marks a consistent point in time in the database.

- A checkpoint is the act of writing dirty modified blocks from the buffer cache to disk.

- DB ALWAYS has transactions going on. SMON and many other background processes are always doing work, the database (unless it is opened read only) is always doing transactions.
Database Writer Process (DBWn)

- Write modified *(dirty)* buffer in database buffer cache to disk
- **Asynchronously** while performing other process to advance checkpoint.
Log Writer Process (LGWR)

Writes the redo log buffer to a redo log file on disk writes

- When user commit a transaction
- When the redo log buffer is one-third full
- Before a DBWn process writes modified buffers to disk
- Every 3 seconds
Online Redo Logs (ORLs)

- Crucial to the Oracle database
- Transaction logs for DB
- Two types of redo log files: *online* and *archived*
- Used for recovery purposes in the event of an instance or media failure.
Online Redo Log Switches

- log writer is the background process responsible for writing transaction information from redo log buffer (in the SGA) to the online redo log files (on disk).
- Log writer flushes the contents of the redo log buffer when any of the following are true:
  - A COMMIT is issued.
  - A log switch occurs.
  - Three seconds go by.
  - Redo log buffer is one-third full.
  - Redo log buffer fills to one megabyte.
Reuse of Online Redo Log

- **At time 1**, Block A is read from Data File AA into the buffer cache and modified.
- **At time 2** the redo-change vector information (how the block changed) is written to the log buffer.
- **At time 3** the log-writer process writes the Block A change-vector information to online redo log 1.
- **At time 4** a log switch occurs, and online redo log 2 becomes the current online redo log.
Redo Stream

- **Oracle normally only writes change vectors to the redo stream**
Logging and Archiving

LGWR

Group 1

Group 2

Group 3

ARCH

Arch 1

Arch 2

Arch 3

Arch 4

Arch 5

Arch 6

Redo Log Files

Archive Log Files
Connections and Sessions

• A database **connection** is a physical communication pathway between a client process and a database instance.
• A database session is a logical entity in the database instance memory that represents the state of a current user login to a database.
• Session lasts from the time the user is authenticated by the database until the time the user disconnects or exits the database application.
• A single connection can have 0, 1, or more sessions established on it.
• The sessions are independent: a commit in one session does not affect transactions in other sessions.
How Many Databases on One Server?

- **Architecture with one server per database**
  - Profitable for the hardware vendor but in many environments isn’t an economical use of resources.
How Many Databases on One Server?

- **Multiple databases sharing one set of Oracle binaries on a server**
  - If you have enough memory, CPU, and disk resources consider creating multiple databases on one server.
  - You can create a new installation of the Oracle binaries for each database or have multiple databases share one set of Oracle binaries.
  - If you have requirements for different versions of Oracle binaries, you must have multiple Oracle homes.
How Many Databases on One Server?

- **One database used by multiple applications and users**
  - If you don’t have the CPU, memory, or disk resources to create multiple databases on one server
  - To save Oracle License because it is usually per cpu core.
  - Be careful not to use public synonyms, because there may be collisions between applications.
  - It’s typical to create different schemas and tablespaces to be used by different applications in such environments.
Oracle Database 12c Multitenant architecture

- A major architectural change.
- One SGA
- One set of background processes
- One root container
- DBs in the container database are called pluggable databases.
  - Self-contained Oracle database
- Multiple pluggable databases
  - Up to 4096 PDBs (12cR2)
- DBs overhead will be shared by all the databases in the container database.
Benefits of the Multitenant Architecture for Database Consolidation

- Cost reduction
- Easier management and monitoring of the physical database
- Separation of data and code
- Secure separation of administrative duties
- Ease of performance tuning
- Support for Oracle Database Resource Manager
- Fewer database patches and upgrades
What is the cloud

**Defined “as a Service”**

**IaaS**
- Compute
- Storage
- Network

**PaaS**
- Data
- BI
- Java
- Mobile
- IoT

**SaaS**
- HCM
- ERP
- CRM
- PLM

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**Oracle Database Cloud – Summary of Services**

**Oracle Database Cloud Service**
- Full-featured dedicated single-node/RAC database
- **Primary Use Case**: Dev, test and deployment of existing apps

**Oracle Exadata Cloud Service**
- Highest-performing and most-available database platform
- **Primary Use Case**: Mission-critical applications and high density database consolidation

**Oracle Database Schema Service**
- Fully managed Database Schema as a service for app dev with APEX, SQL Developer, Java Cloud and RESTful Web Services
- **Primary Use Case**: Development and deployment of departmental applications

**Oracle Database Backup Service**
- Capacity on demand eliminates storage hardware planning
- Transparent management, redundancy and highly available
- **Primary Use Case**: Enterprise data security protection and privacy

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- 100% compatibility with on-premises
- Fully automated or managed backups, patching and tooling
- Simple to move locations or create a hybrid cloud
- Simple provisioning in a few clicks
Oracle Database as a Service
Automated Infrastructure and Database Administration

Robust automation reduces administrative time and promotes standardization improving manageability and availability