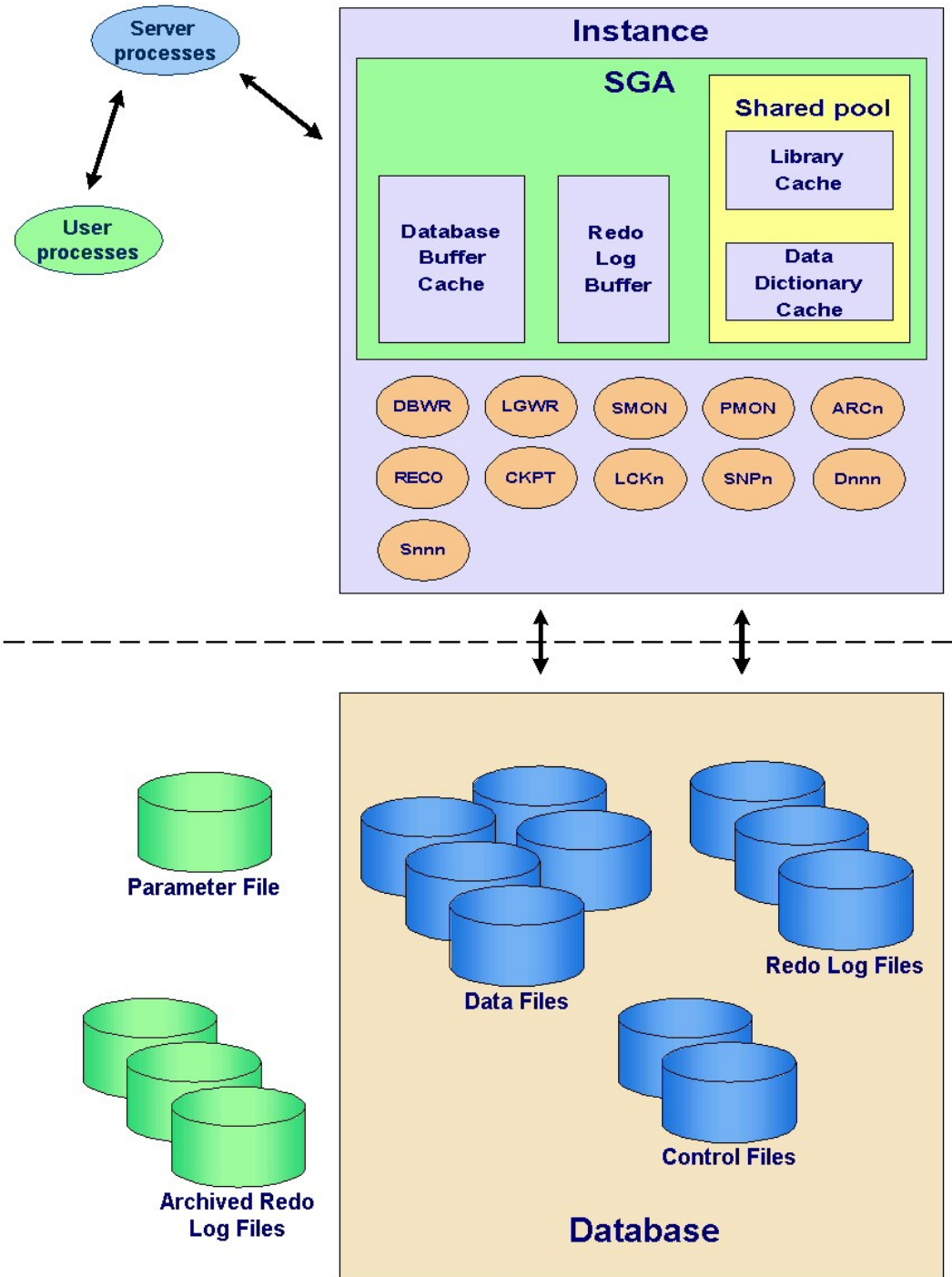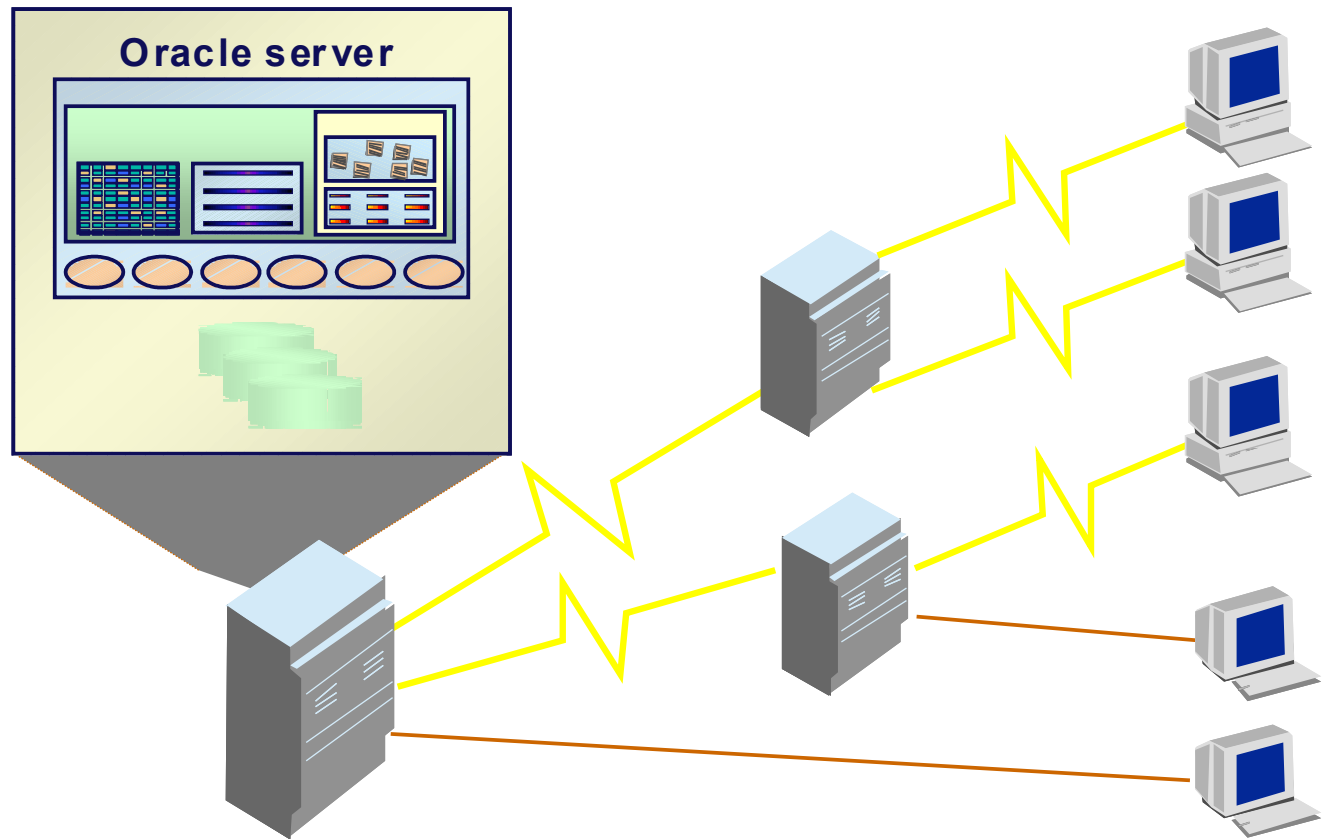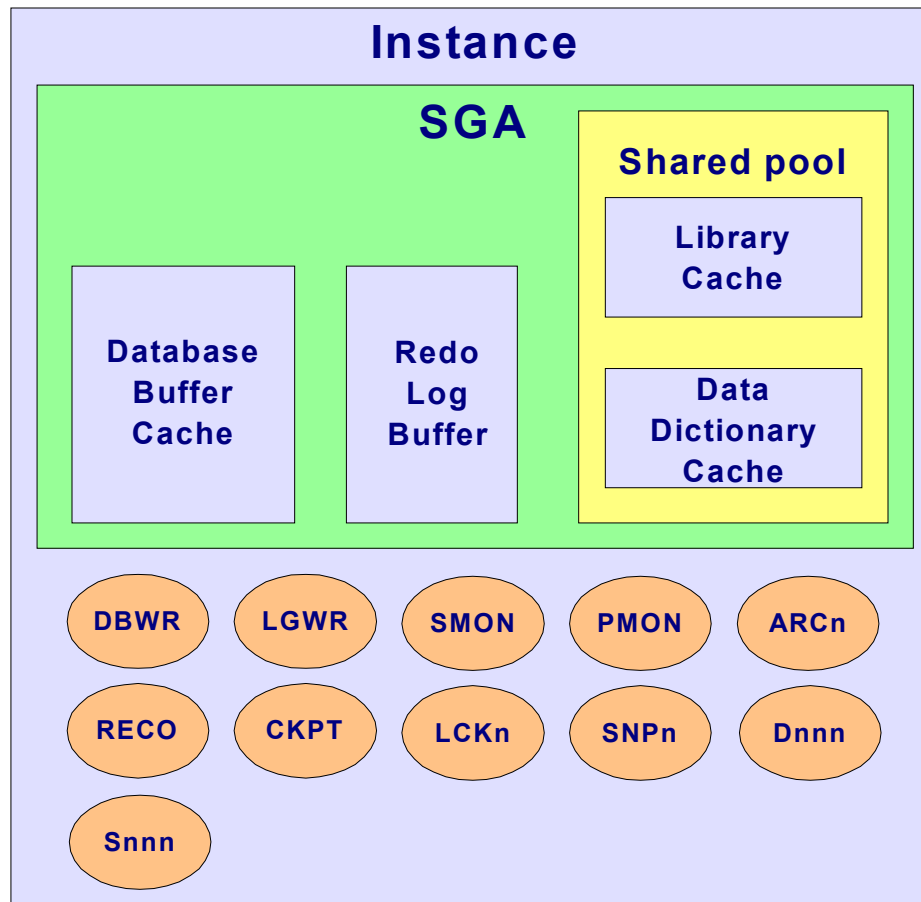# Oracle Architecture

Overview

Oracle Architecture
The Oracle Server

Oracle Architecture
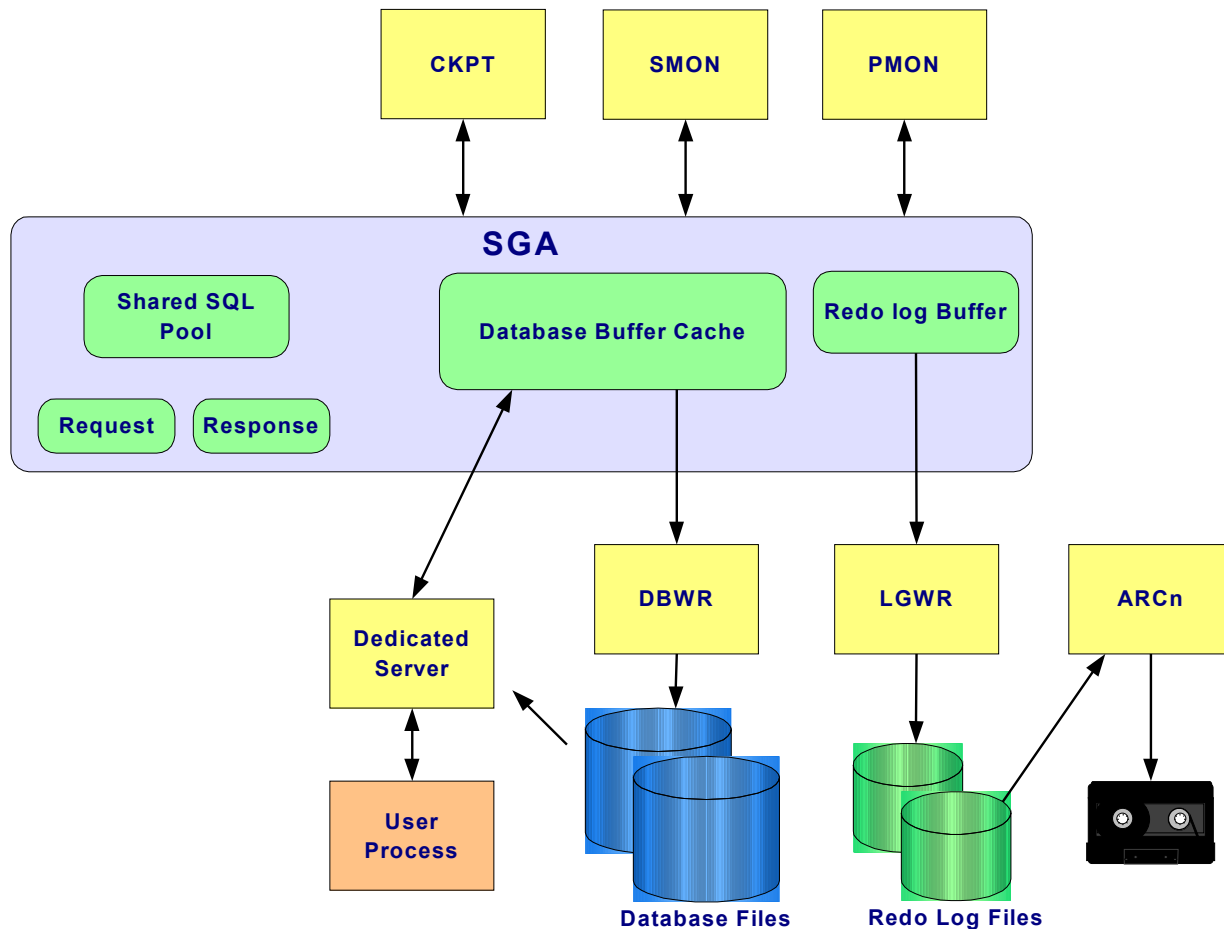## Instance Architecture

Oracle Architecture
Instance

- An Oracle instance:
    - Is a means to access an Oracle database
    - Always opens one and only one database
- Consists of:
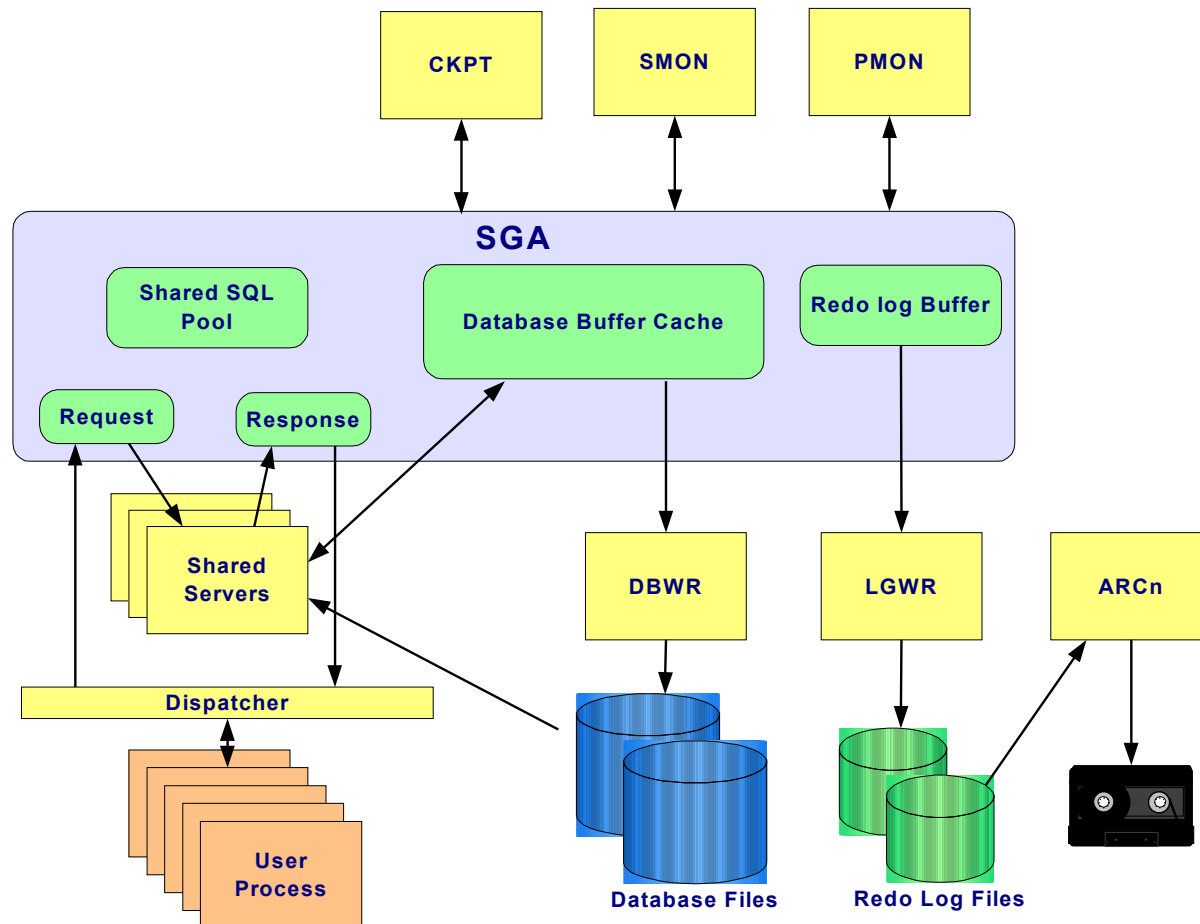   - Internal memory structures
    - Processes

Oracle Architecture
Interaction with the Database (Dedicated Server)

Oracle Architecture
Interaction with the Database (Shared Server)

Oracle Architecture
Internal Memory Structures SGA

System or 'shared' Global Area (SGA)

- Database buffer cache
- Redo log buffer
- Shared pool
- Request & response queues (shared server)

Oracle Architecture
Database buffer cache

- Used to hold data blocks read from datafiles by server processes

- Contains 'dirty' or modified blocks and 'clean' or unused or unchanged bocks

- 'Dirty' and 'clean' blocks are managed in lists called the dirty list and the LRU

- Free space is created by DBWR writing out 'dirty' blocks or aging out blocks from the LRU

- Size is managed by the parameter DB_BLOCK_BUFFERS

Oracle Architecture
Least Recently Used (LRU)

- LRU and the database buffer cache
  - Every time a data block is read from disk it is placed in the database buffer cache at the head of the LRU list
  - If a block is already in the cache and it is read again it is moved to the head of the list
  - Data not used frequently is 'aged' out of the cache while frequently used data remains

Oracle Architecture
Redo Log Buffer

- A circular buffer that contains redo entries
  - Redo entries reflect changes made to the database
- Redo entries take up contiguous, sequential space in the buffer
- Data stored in the redo log buffer is periodically written to the online redo log files
- Size is managed by the parameter LOG_BUFFER
  - Default is 4 times the maximum data block size for the operating system

Oracle Architecture
Shared Pool

- Consists of multiple smaller memory areas
  - Library cache
    - Shared SQL area
      - Contains parsed SQL and execution plans for statements already run against the database
    - Procedure and package storage
  - Dictionary cache
    - Names of all tables and views in the database
    - Names and datatypes of columns in the database tables
    - Privileges of all users
- Managed via an LRU algorithm
- Size determined by the parameter SHARED_POOL_SIZE

Oracle Architecture
Least Recently Used (LRU)

- LRU and the shared pool
  - Every time a SQL statement is parsed it is placed in the shared pool for reuse
  - If a SQL statement is already in the shared pool it will not re-parse but it is placed at the head of the LRU
  - SQL statements not used frequently are 'aged' out of the shared pool while frequently used statements remain
  - A SQL statement may be artificially retained at the head of the LRU by 'pinning' the statement

Oracle Architecture
Internal Memory Structures PGA

Program or 'process' Global Area (PGA)
- – Used for a single process
- – Not shareable with other processes
- – Writable only by the server process
- – Allocated when a process is created and deallocated when a process is terminated
- – Contains:
  - Sort area – Used for any sorts required by SQL processing
  - Session information – Includes user privileges
  - Cursor state – Indicates stage of SQL processing
  - Stack space – Contains session variables

Oracle Architecture
Background Processes - DBWR

- Writes contents of database buffers to datafiles
- Primary job is to keep the database buffer 'clean'
- Writes least recently used (LRU) 'dirty' buffers to disk first
- Writes to datafiles in optimal batch writes
- Only process that writes directly to datafiles
- Mandatory process

Oracle Architecture
Background Processes - DBWR

- DBWR writes to disk when:
  - A server process cannot find a clean reusable buffer
  - A timeout occurs (3 sec)
  - A checkpoint occurs
  - DBWR cannot write out 'dirty' buffers before they have been written to the online redo log files

Oracle Architecture
Commit Command

The SQL command **COMMIT** allows users to save transactions that have been made against a database. This functionality is available for any **UPDATE, INSERT, or DELETE** transaction; it is not available for changes to database objects (such as **ALTER TABLE** commands)

Oracle Architecture
Background Processes - LGWR

- Writes contents of redo log buffers to online redo log files
- Primary job is to keep the redo log buffer 'clean'
- Writes out redo log buffer blocks sequentially to the redo log files
- May write multiple redo entries per write during high utilization periods
- Mandatory process

Oracle Architecture
Background Processes - LGWR

- LGWR writes to disk when:
  - A transaction is COMMITED
  - A timeout occurs (3 sec)
  - The redo log buffer is 1/3 full
  - There is more than 1 megabyte of redo entries
  - Before DBWR writes out 'dirty' blocks to datafiles

Oracle Architecture
Background Processes - SMON

- Performs automatic instance recovery

- Reclaims space used by temporary segments no longer in use

- Merges contiguous areas of free space in the datafiles (if PCTINCREASE > 0)

- SMON 'wakes up' regularly to check whether it is needed or it may be called directly

- Mandatory process

Oracle Architecture
Background Processes - SMON

- SMON recovers transactions marked as DEAD within the instance during instance recovery
  - All non committed work will be rolled back by SMON in the event of server failure
  - SMON makes multiple passes through DEAD transactions and only applies a specified number of undo records per pass, this prevents short transactions having to wait for long transactions to recover
- SMON primarily cleans up server-side failures

Oracle Architecture
Background Processes - PMON

- Performs automatic process recovery
  - Cleans up abnormally terminated connections
  - Rolls back non committed transactions
  - Releases resources held by abnormally terminated transactions
- Restarts failed shared server and dispatcher processes
- PMON 'wakes up' regularly to check whether it is needed or it may be called directly
- Mandatory process

Oracle Architecture
Background Processes - PMON

- Detects both user and server aborted database processes

- Automatically resolves aborted processes
  - PMON rolls back the current transaction of the aborted process
  - Releases resources used by the process
  - If the process is a background process the instance most likely cannot continue and will be shut down

- PMON primarily cleans up client-side failures

Oracle Architecture
Background Processes - CKPT

- Forces all modified data in the SGA to be written to datafile
  - Occurs whether or not the data has been committed
  - CKPT does not actually write out buffer data only DBWR can write to the datafiles
- Updates the datafile headers
  - This ensures all datafiles are synchronized
- Helps reduce the amount of time needed to perform instance recovery
- Frequency can be adjusted with parameters

Oracle Architecture
Background Processes - ARCH

- Automatically copies online redo log files to designated storage once they have become full

Oracle Architecture
Server Processes

- Services a single user process in the dedicated server configuration or many user processes in the shared server configuration

- Use an exclusive PGA

- Include the Oracle Program Interface (OPI)

- Process calls generated by the client

- Return results to the client in the dedicated server configuration or to the dispatcher in the shared server configuration
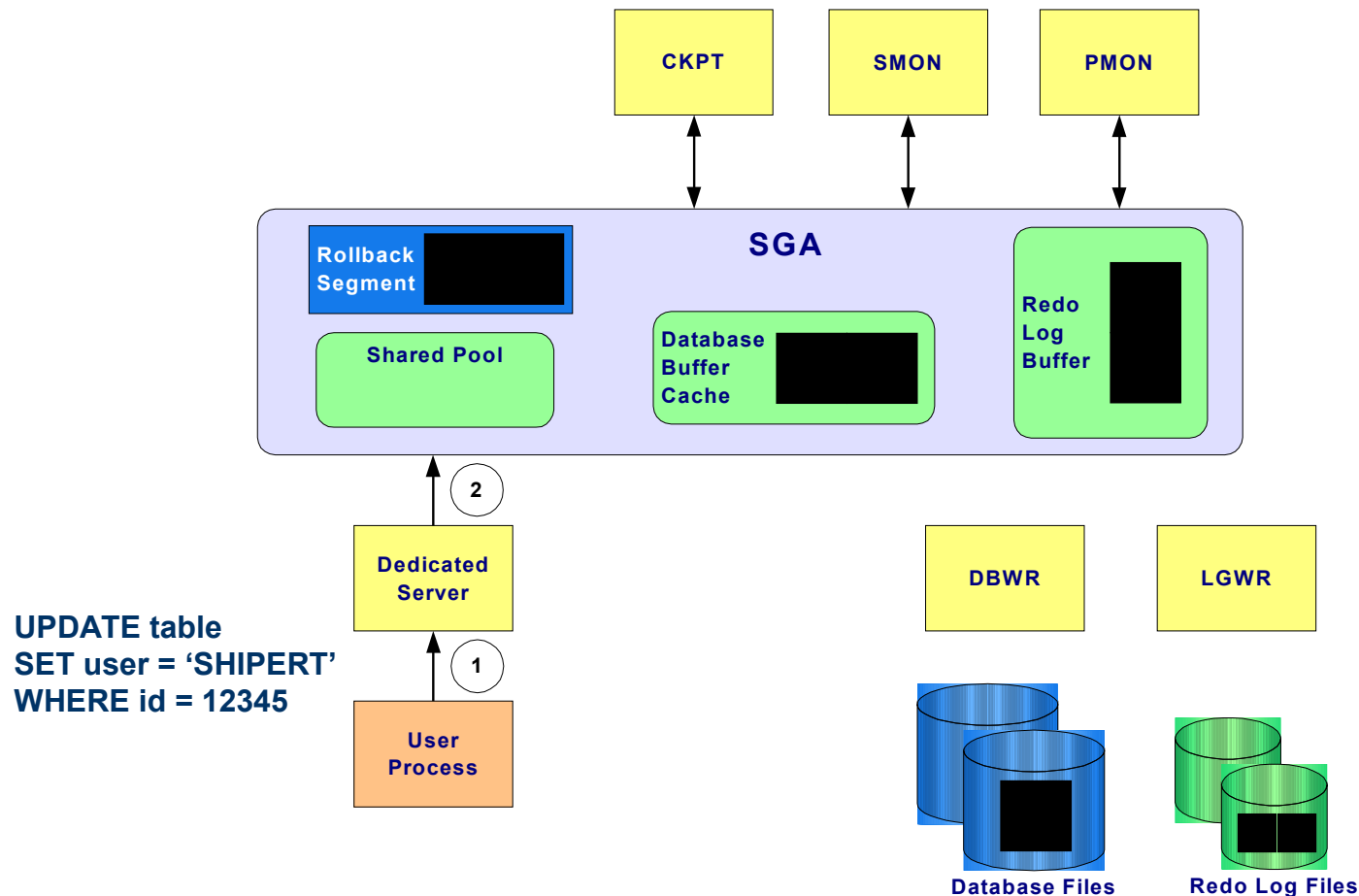
Oracle Architecture
User Processes

- Run on the client machine
- Are spawned when a tool or an application is invoked
  - SQL*Plus, Server Manager, Oracle Enterprise Manager, Developer/2000
  - Custom applications
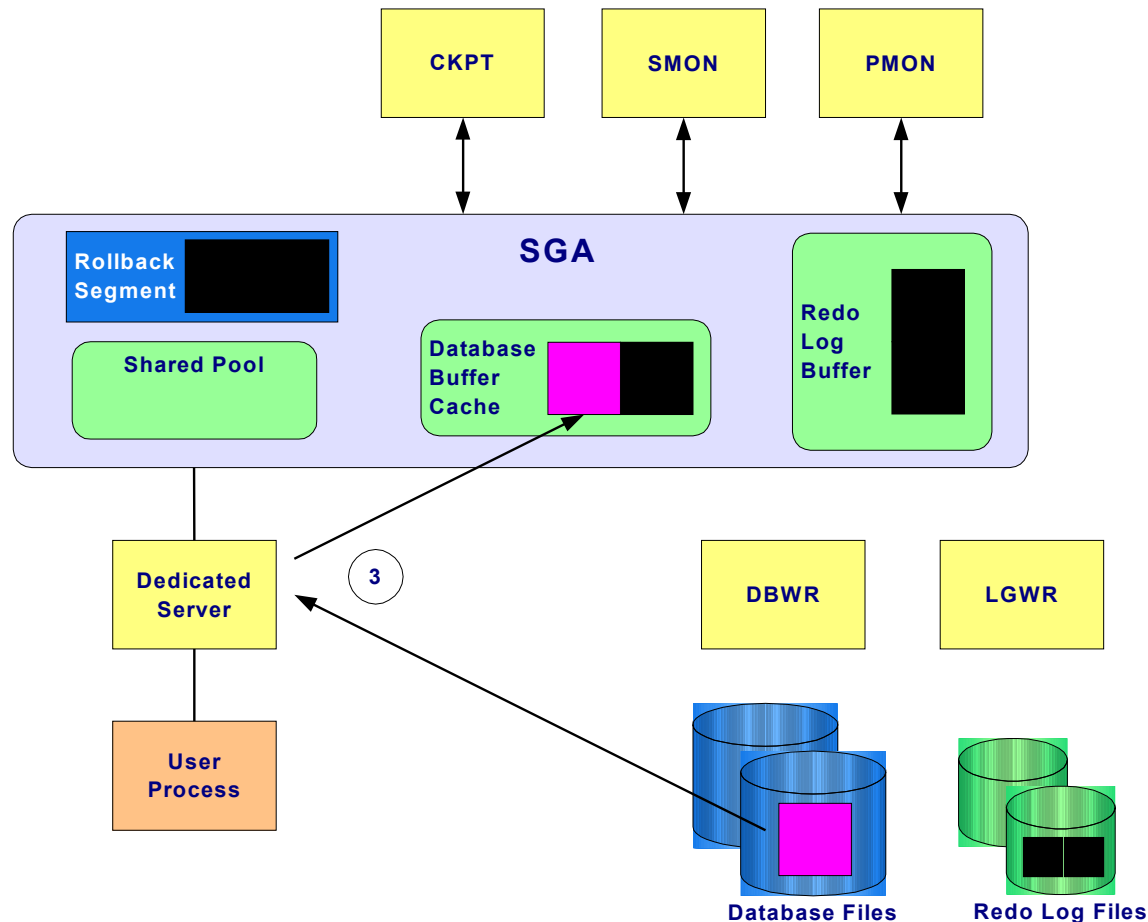- Include the User Program Interface (UPI)
- Generate calls to the Oracle server
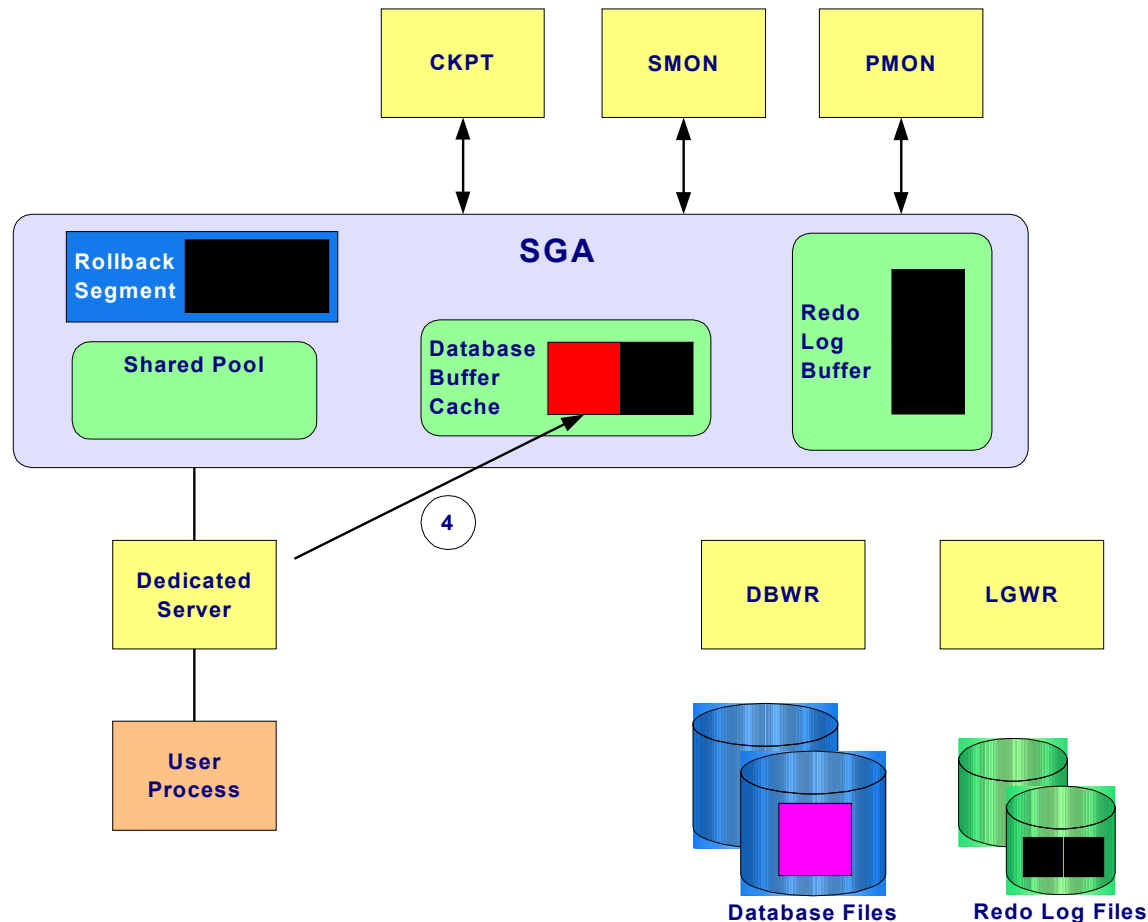
Oracle Architecture
Transaction Example - Update

CKPT

SMON

PMON

SGA

Rollback Segment

Redo Log Buffer

Shared Pool

Database Buffer Cache

2

Dedicated Server

UPDATE table
SET user = 'SHIPERT'
WHERE id = 12345

1

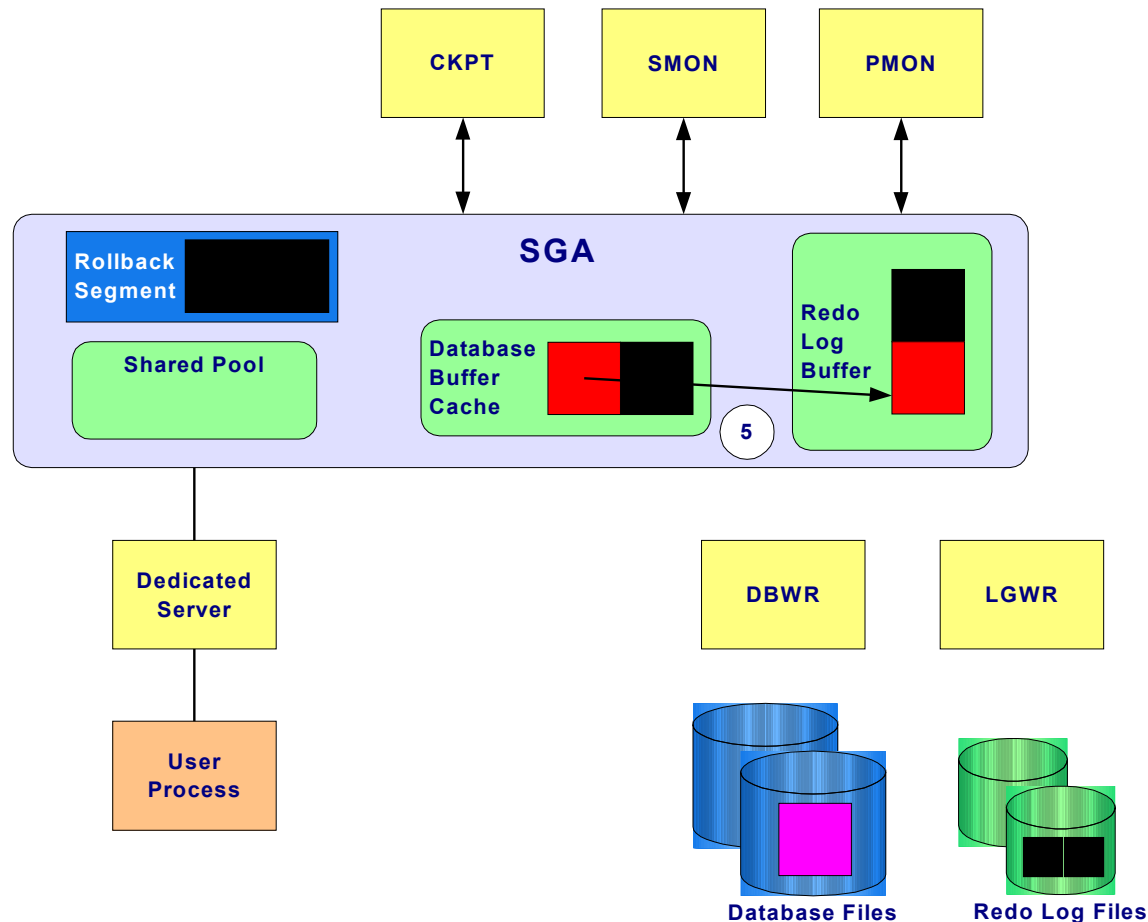User Process

DBWR

LGWR

Database Files

Redo Log Files

Oracle Architecture
Transaction Example - Update

Oracle Architecture
Transaction Example - Update

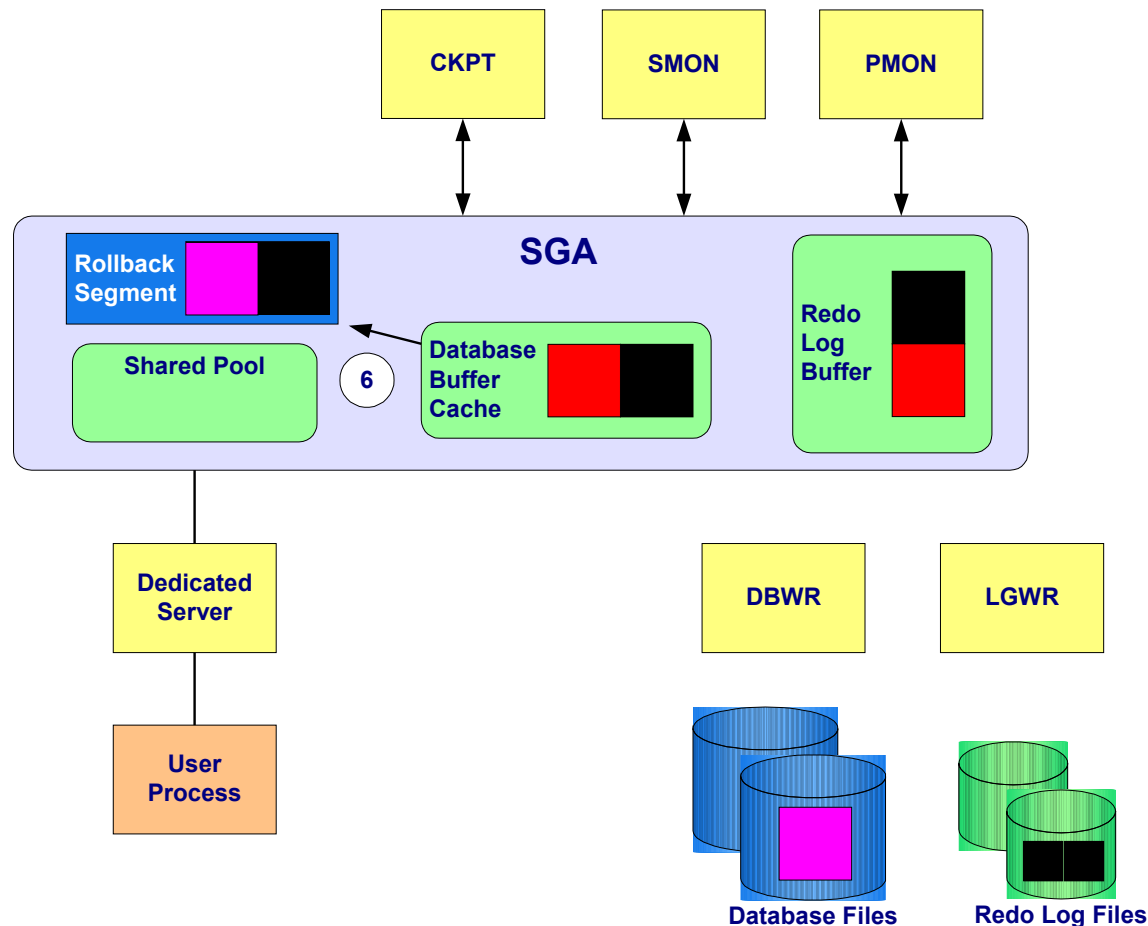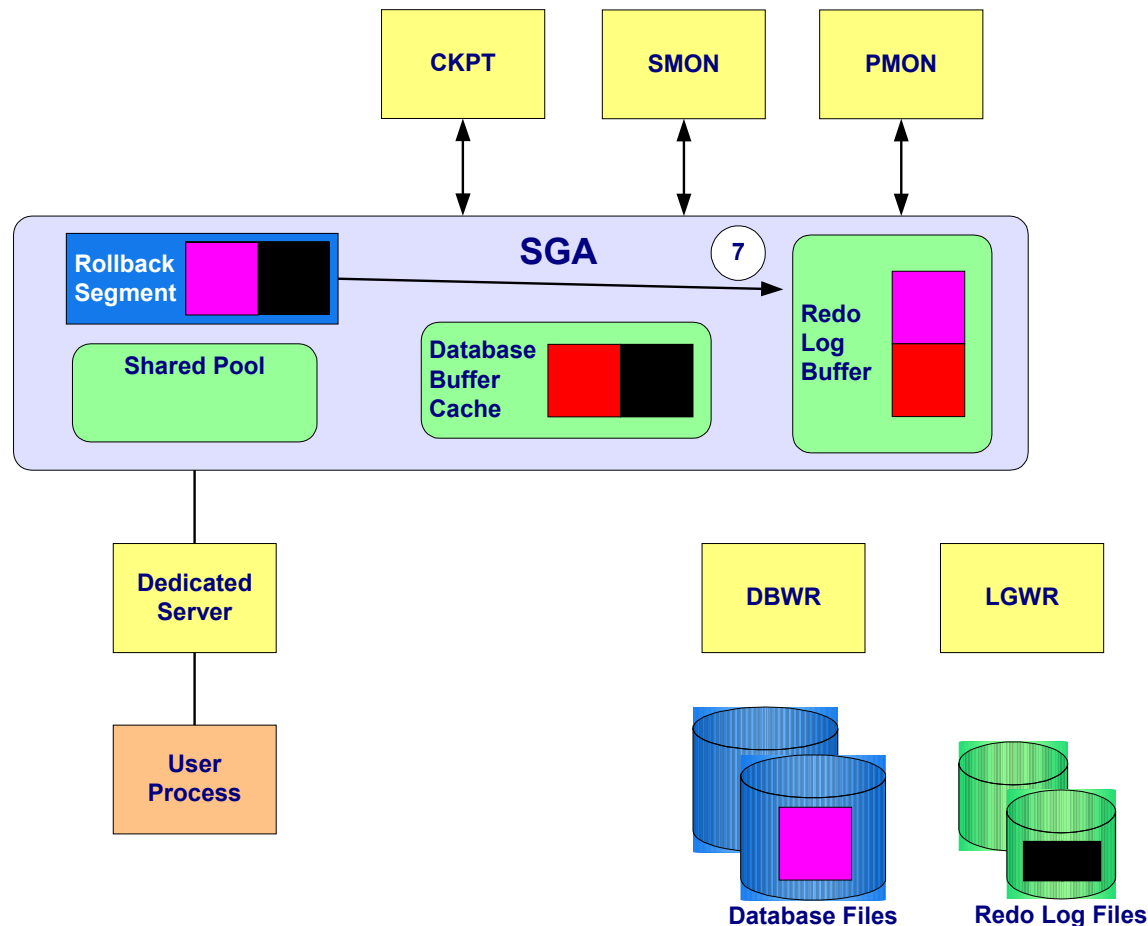# Oracle Architecture
Transaction Example - Update
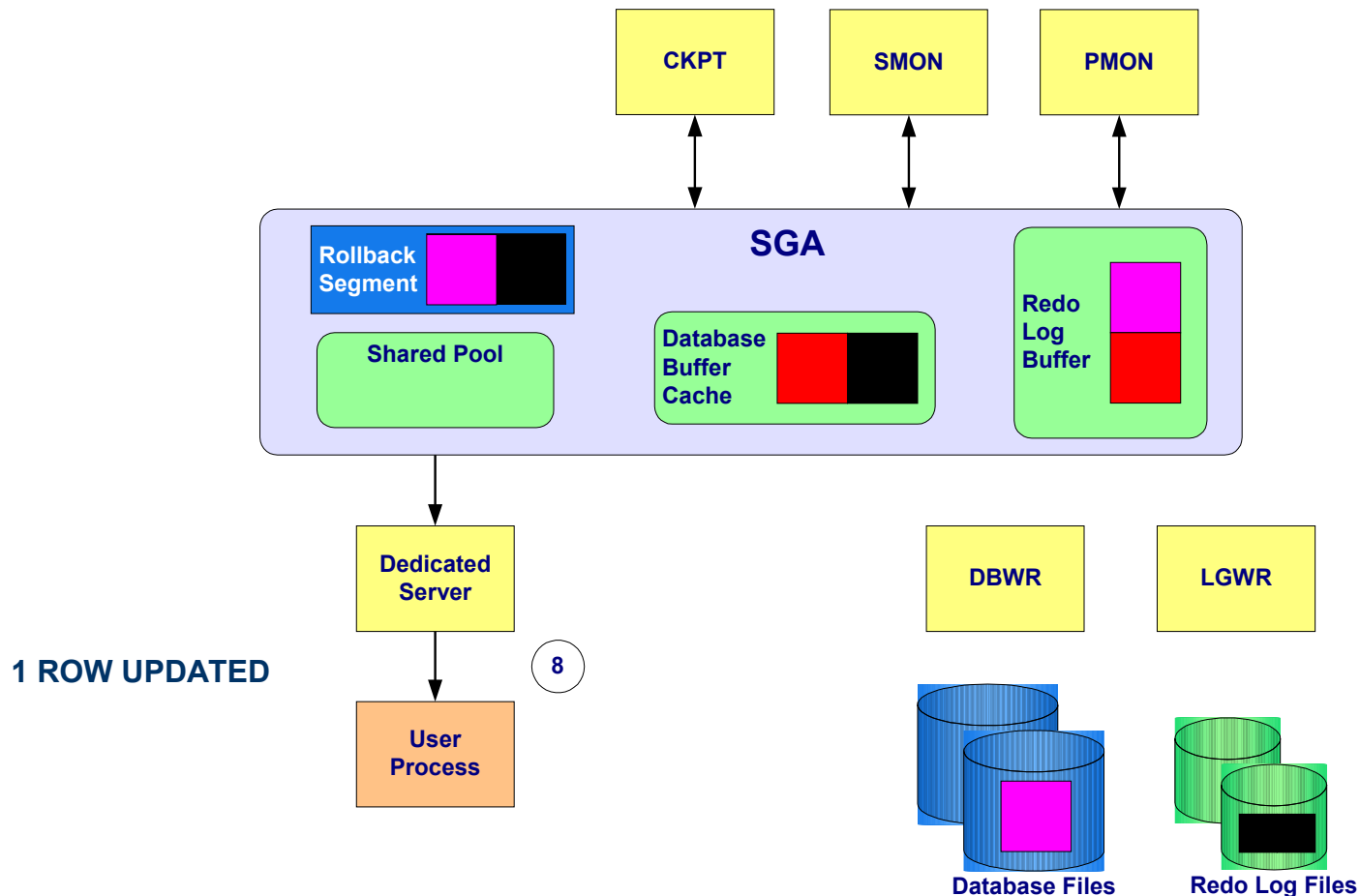
Oracle Architecture
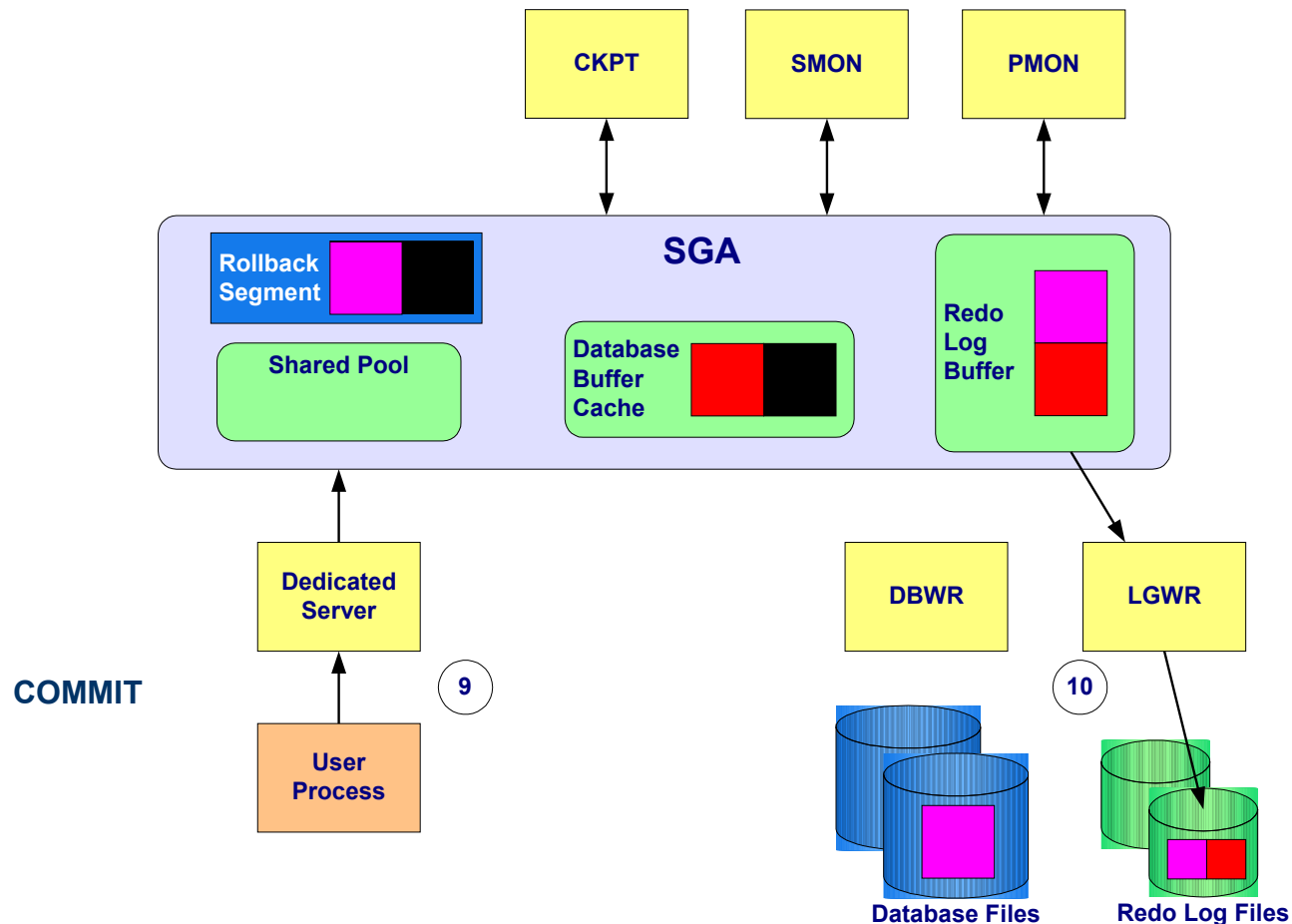## Transaction Example - Update

Oracle Architecture
Transaction Example - Update

Oracle Architecture
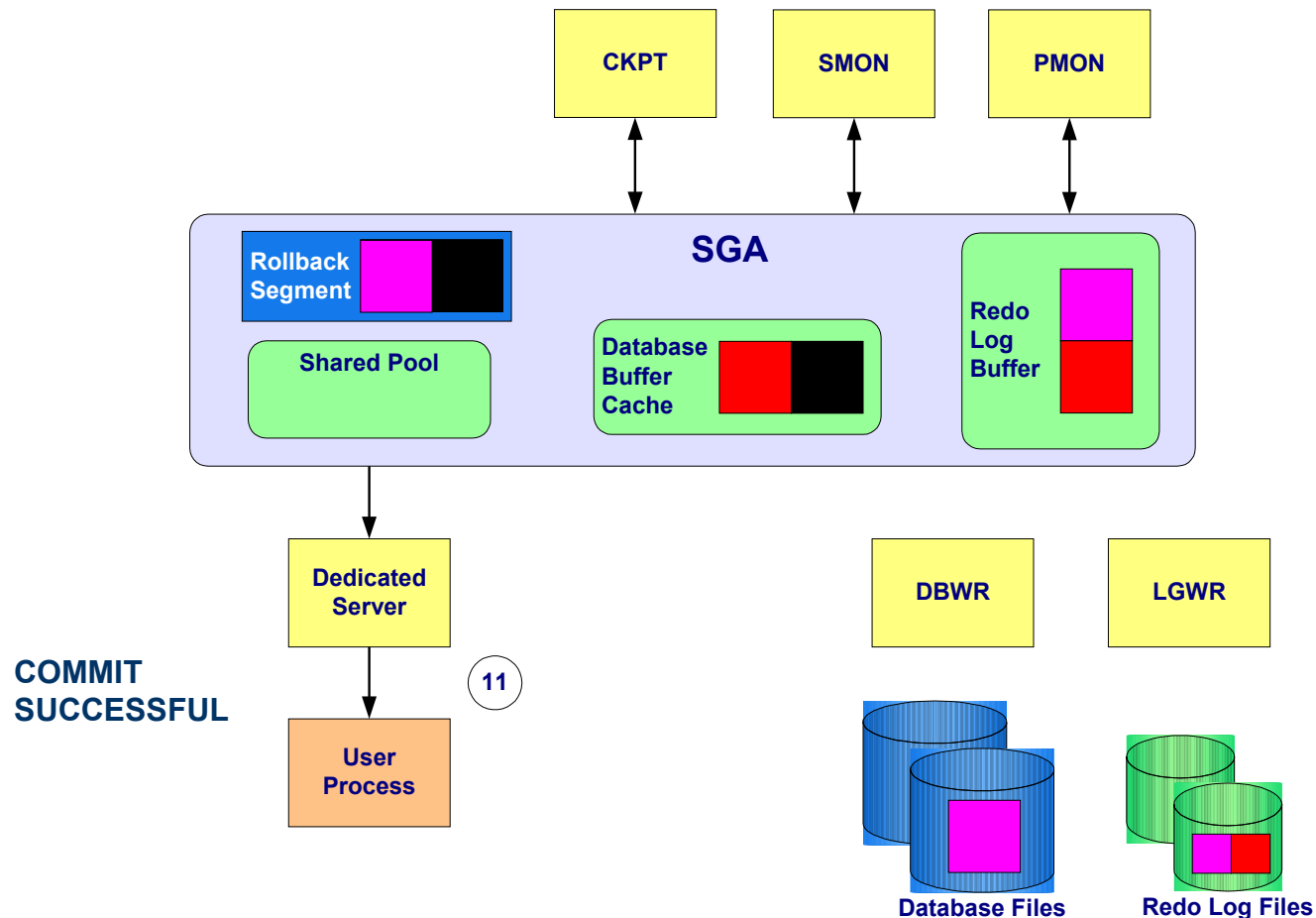## Transaction Example - Update

CKPT

SMON

PMON

SGA

Rollback Segment

Shared Pool

Database Buffer Cache

Redo Log Buffer

Dedicated Server

DBWR

LGWR

1 ROW UPDATED

8

User Process

Database Files

Redo Log Files

Oracle Architecture
Transaction Example - Update

CKPT

SMON

PMON

SGA

Rollback Segment

Redo Log Buffer

Shared Pool

Database Buffer Cache

Dedicated Server

DBWR

LGWR

COMMIT

9

10

User Process

Database Files

Redo Log Files

Oracle Architecture
Transaction Example - Update

Oracle Architecture
Transaction Example - Update