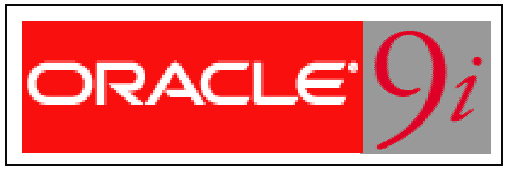



# User Management and Database Security

"nets THE REVOLUTION"

# Oracle database security management



- Controlling access to data ( authorization )
- Authenticating users
- Ensuring data integrity
- Auditing user's actions
- Managing enterprise security

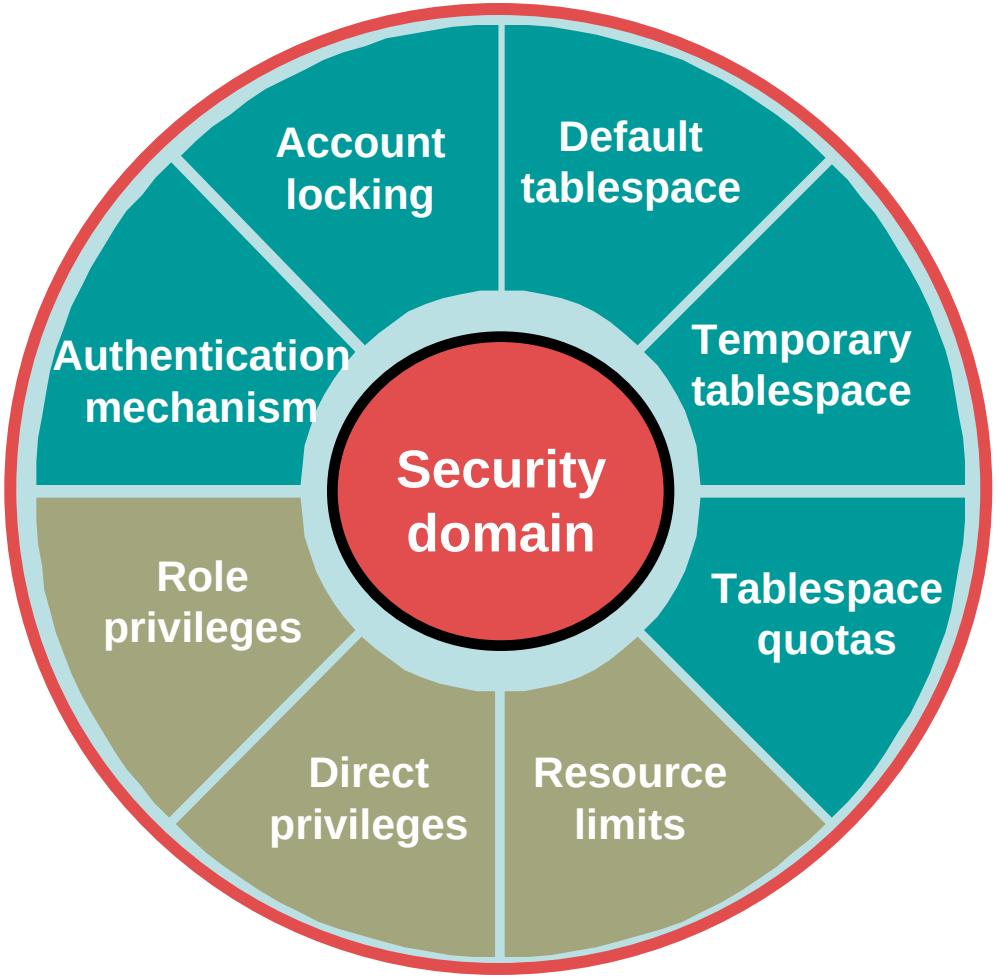
# Managing Users



- Creating new database users
- Altering and dropping existing database users
- Monitoring information about existing users

# Users and Security






- DBA defines users who can access db
- Security domain defines the settings that apply to users

# Database Schema



- **Schema: named collection of objects like tables, views, procedures, etc.**
- **When a user is created a schema with same name is created**
- **Hence username and schema name used interchangeably**
- **Some of the objects a user can own**

# Checklist for Creating Users (Developers not end users)



- Choose a username and authentication mechanism.
- Identify tablespaces in which the user needs to store objects.
- Decide on quotas for each  tablespace.
- Assign default tablespace and temporary tablespace.
- Create a user.
- Grant privileges and roles to the user.
- If no default tablespace is assign to the user the System tablespace becomes the default for that user.

# Creating a New User: Server Authentication



- Set the initial password:
- Expires at login forcing user to change password

```
CREATE USER anil
IDENTIFIED BY panil
DEFAULT TABLESPACE data01
TEMPORARY TABLESPACE temp
QUOTA 15m ON data01
PASSWORD EXPIRE;
```

# Creating a New User: Operating System Authentication



- Use OS_AUTHENT_PREFIX (in parameter file)
- Example: O/S User = user15

| OS_AUTHENT_ PREFIX | Database User | Remote Login Possible |
|---|---|---|
| OS_ | OS_USER15 | No |
| empty string " " | USER15 | No |
| OPS$ (default) | OPS$USER15 (default) | Yes |

# Creating a New User: Operating System Authentication (contd.)



- E.g., An OS user tikekarr;
- Use IDENTIFIED EXTERNALLY clause with create user
- Also exists as a database user
- Oracle will not validate
- To use sql*plus say
  - Sqlplus /

# Creating a New User: Guidelines



- Choose a standard password initially; use O/S authentication sparingly.
- Use the EXPIRE keyword to force users to reset their passwords.
- Always assign temporary tablespace.
- Restrict quotas to few users; use QUOTA UNLIMITED with caution.
- Educate users:
  - To connect
  - To change password

# Controlling Account Lock and Password



```
ALTER USER anil
IDENTIFIED BY hisgrandpa
PASSWORD EXPIRE;
```

```
ALTER USER anil
IDENTIFIED BY hisgrandpa
ACCOUNT LOCK | UNLOCK;
```

# Changing User Quota on Tablespace



- To get a user out of system (fired/resigned):
  - Use password expiration
  - Lock account
  - Alter password
  - Change profile
  - Export/import user schema elsewhere

```
ALTER USER anil
QUOTA 0 ON data01;
```

# Dropping a User



- **Use the CASCADE clause if the schema contains objects.**

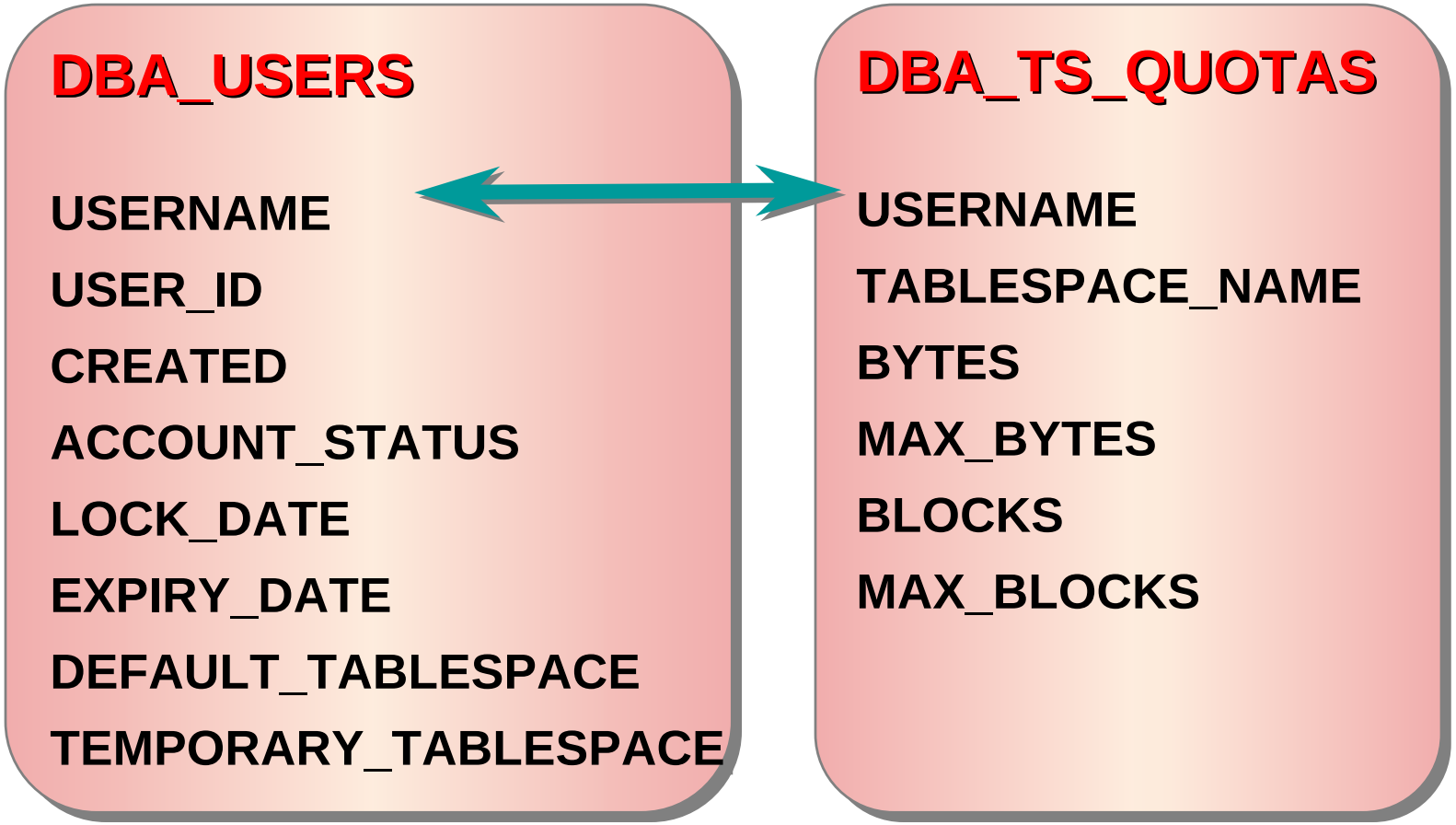
```
DROP USER anil;
```

```
DROP USER anil CASCADE;
```

- **User currently connected cannot be dropped**

# Monitoring Users





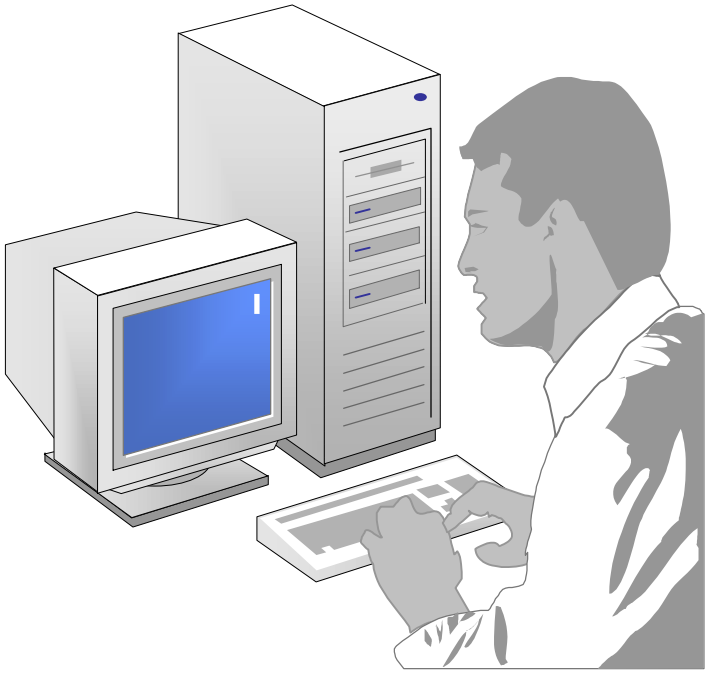
# Monitoring Users (contd.)



- Select tablespace_name, blocks, max_blocks, bytes, max_bytes From dba_ts_quota Where username = 'SCOTT';
- -1 in MAX_BLOCKS or MAX_BYTES indicates unlimited quota
- Select username, account_status, temporary_tablespace From dba_users;
- Lists all users, their account status and temp. ts

# Exercise III Managing Users

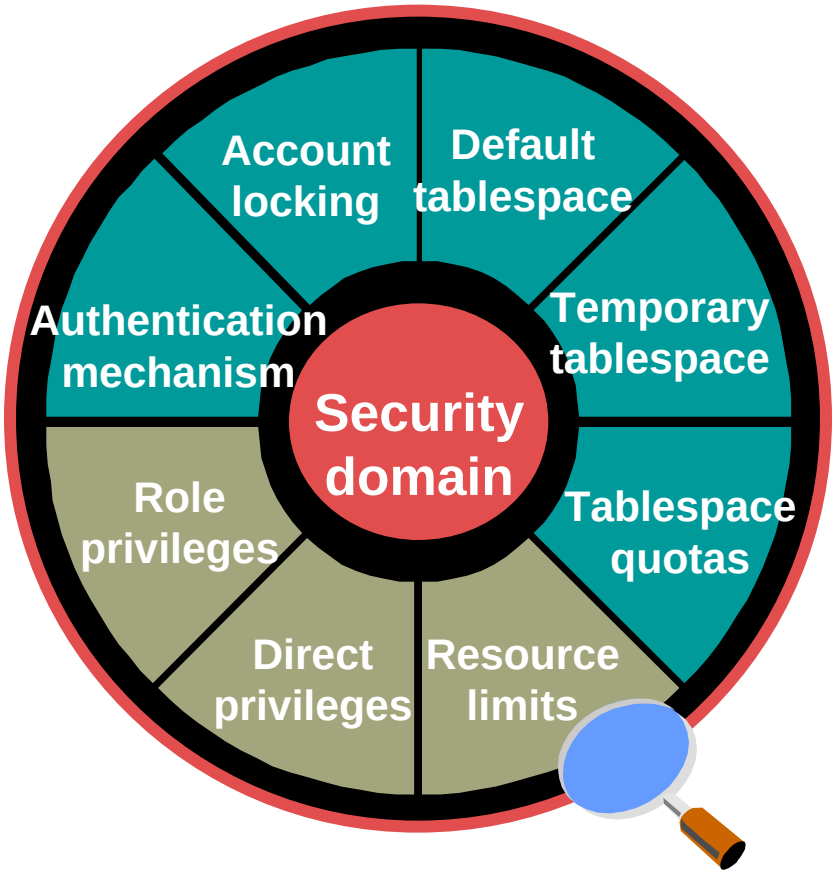




# Profiles



- Are named sets of resource and password limits
- Are assigned to users by the CREATE/ALTER USER command
- Can be enabled or disabled
- Can relate to the DEFAULT profile
- Can limit system resources on session or call level



# Managing Resources with Profiles



1. Create profiles.

2. Assign profiles to the user.

3. Enable resource limits.

# Creating a Profile: Resource Limit



```
CREATE PROFILE developer_prof LIMIT
SESSIONS_PER_USER 2
CPU_PER_SESSION 10000
IDLE_TIME 60
CONNECT_TIME 480;
```

# Setting Resource Limits at Session Level



| Resource | Description |
|---|---|
| CPU_PER_SESSION | Total CPU time measured in hundredths of seconds |
| SESSIONS_PER_USER | Number of concurrent sessions allowed for each username |
| CONNECT_TIME | Elapsed connect time measured in minutes |
| IDLE_TIME | Periods of inactive time measured in minutes |
| LOGICAL_READS_PER_SESSION | Number of data blocks (physical and logical reads) |
| PRIVATE_SGA | Private space in the SGA measured in bytes (for MTS only) |

# Setting Resources at Call Level



| Resource | Description |
|---|---|
| CPU_PER_CALL | CPU time per call in hundredths of seconds |
| LOGICAL_READS_PER_CALL | Number of data blocks |

# Resource Parameter



- **Composite_limit**
  - **A composite limit is a sum of several of the resource parameters, measured in service units.**
  - **These resources are weighted by their importance.**
  - **Oracle takes into account four parameters to compute a weighted composite_limit:**
    - **Cpu_per_session**
    - **Connect_time**
    - **Logical_reads_per_session**
    - **Private_sga.**
  - **You can set a weight for these four parameter by using the alter resource cost statement.**

# Assigning Profiles to a User



```
CREATE USER user3 IDENTIFIED BY user3
DEFAULT TABLESPACE data01
TEMPORARY TABLESPACE temp
QUOTA unlimited ON data01
PROFILE developer_prof;
```

```
ALTER USER scott
PROFILE developer_prof;
```

# Enabling Resource Limits



- Set the initialization parameter RESOURCE_LIMIT to TRUE
  - or
- Enforce the resource limits by enabling the parameter with the ALTER SYSTEM command

```
ALTER SYSTEM SET RESOURCE_LIMIT=TRUE;
```

# Altering a Profile



```
ALTER PROFILE default LIMIT
SESSIONS_PER_USER 5
CPU_PER_CALL 3600
IDLE_TIME 30;
```

# Dropping a Profile

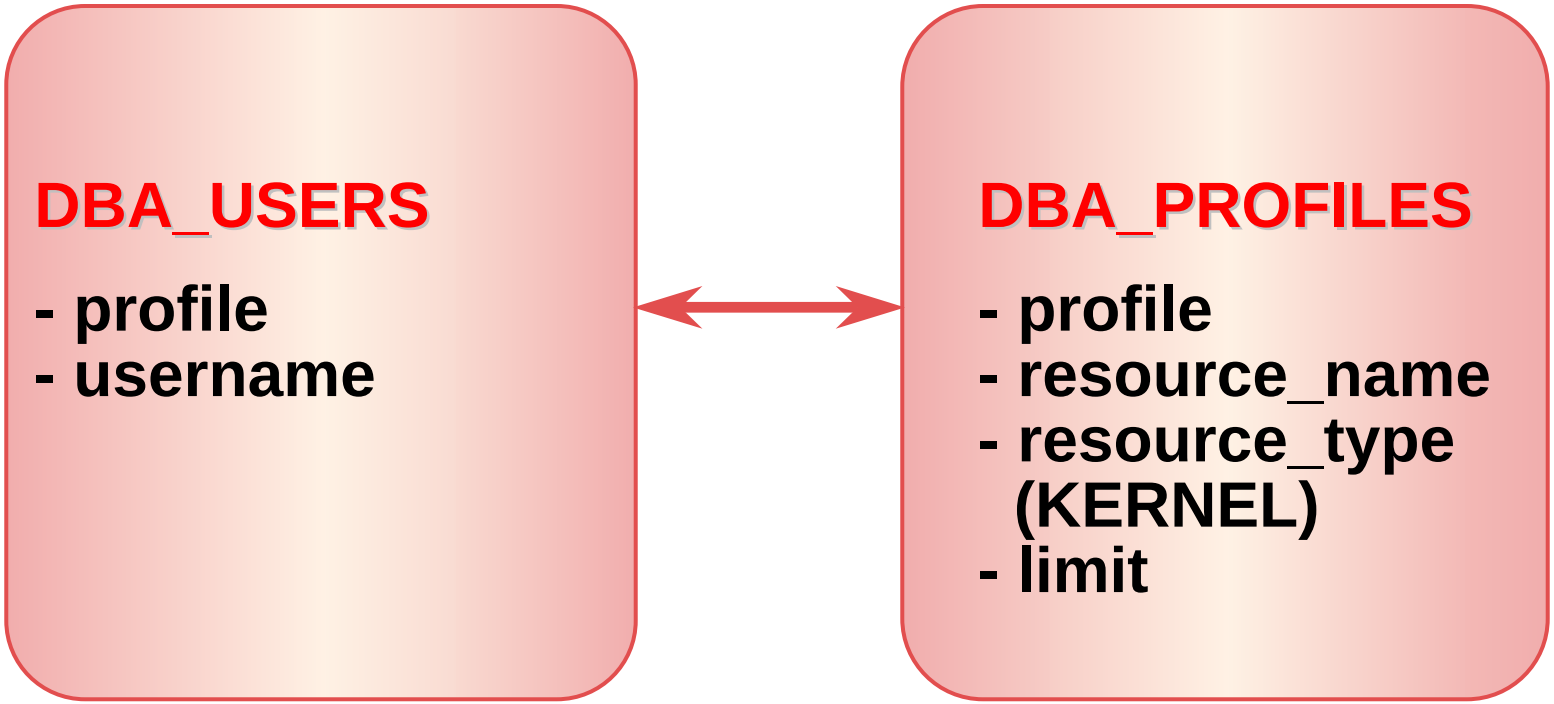


```
DROP PROFILE developer_prof;
```

```
DROP PROFILE developer_prof CASCADE;
```

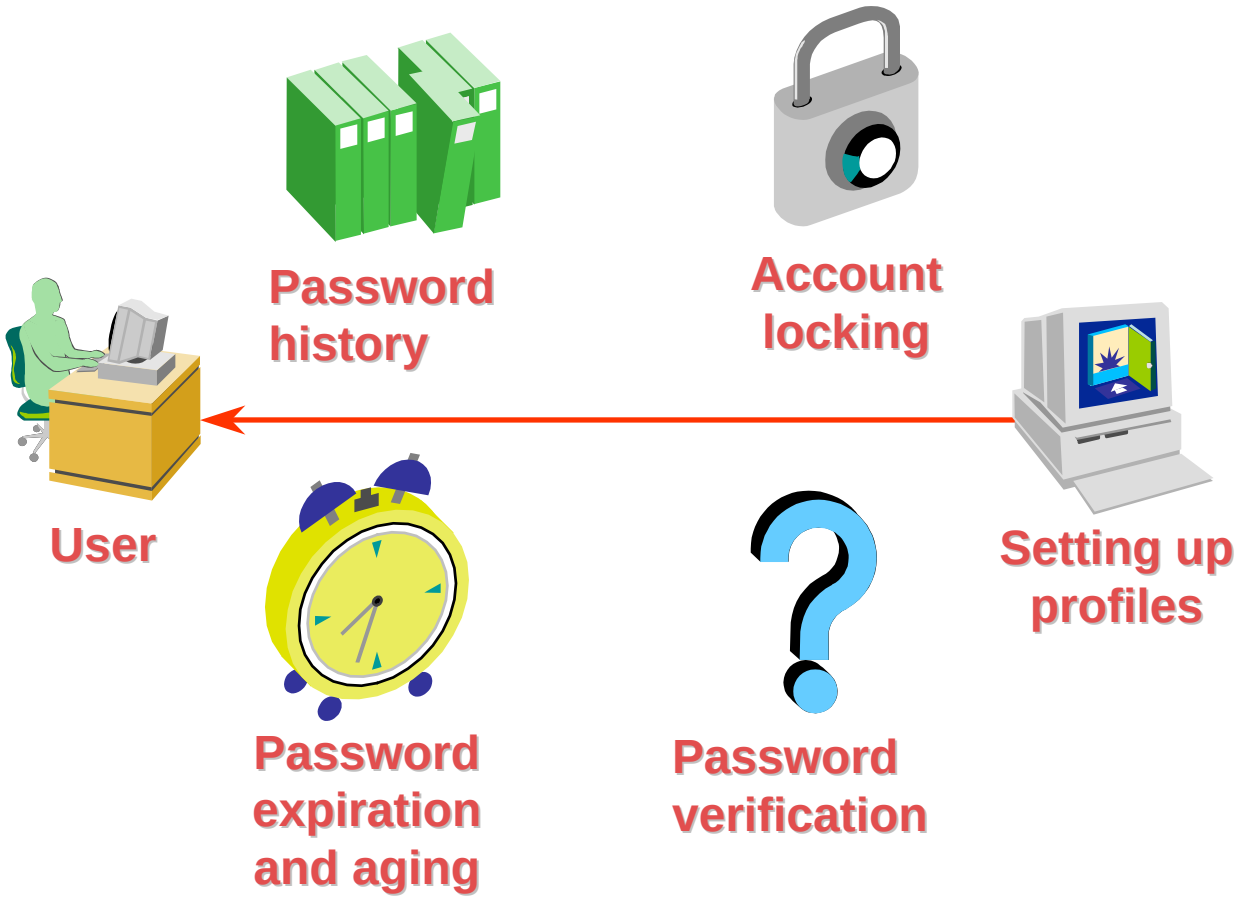
# Viewing Resource Limits





# Password Management





# Enabling Password Management



- Set up password management by using profiles and assigning them to users.
- Lock, unlock, and expire accounts using the CREATE USER or ALTER USER command.
- Password limits are always enforced, even if RESOURCE_LIMIT for an instance is set to FALSE.

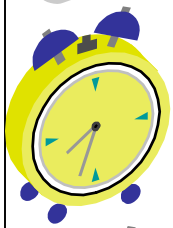
# Creating a Profile: Password Settings

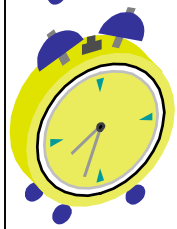


```
CREATE PROFILE grace_5 LIMIT
  FAILED_LOGIN_ATTEMPTS 3
  PASSWORD_LIFE_TIME 30
  PASSWORD_REUSE_TIME 30
  PASSWORD_VERIFY_FUNCTION verify_function
  PASSWORD_GRACE_TIME 5;
```

# Password Settings



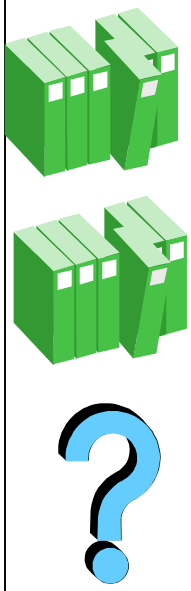




| Parameter | Description |
|---|---|
| FAILED_LOGIN_ATTEMPTS | Number of failed login attempts before lockout of the account |
| PASSWORD_LOCK_TIME | Number of days for which the account remains locked upon password expiration |
| PASSWORD_LIFE_TIME | Lifetime of the password in days after which the password expires |
| PASSWORD_GRACE_TIME | Grace period in days for changing the password after the first successful login after the password has expired |

# Password Settings (contd.)





| Parameter | Description |
|---|---|
| PASSWORD_REUSE_TIME | Number of days before a password can be reused |
| PASSWORD_REUSE_MAX | Maximum number of times a password can be reused |
| PASSWORD_VERIFY_FUNCTION | PL/SQL function that makes a password complexity check before a password is assigned |

# User- Provided Password Function



- **Function must be created in the SYS schema and must have the following specification:**

```
function_name(
    userid_parameter IN VARCHAR2(30),
    password_parameter IN VARCHAR2(30),
    old_password_parameter IN VARCHAR2(30))
RETURN BOOLEAN
```

# Password Verification Function VERIFY_FUNCTION



- Minimum length is four characters
- Password should not be equal to username
- Password should have at least one alpha, one numeric, and one special character
- Password should differ from the previous password by at least three letters

Password verification

# Viewing Password Information



- DBA_USERS
  - profile
  - username
  - account_status
  - lock_date
  - expiry_date
- DBA_PROFILES
  - profile
  - resource_name
  - resource_type (PASSWORD)
  - limit

# Resource Management Problem for Production Database



- Batch job's are taking up most of the available resources, which is hurting other, more critical jobs that need to run at the same time.
- Excessive loads at peak times are causing critical processes to run for an unacceptably long period of time.
- You schedule large jobs and really can't predict when they might be launched.
- Some users are using an excessive amount of CPU, causing you to kill their session abruptly.
- Some users are using a very high degree of parallelism in their operations, which is hurting the performance of the system as a whole.
- You want to prioritize jobs according to some scheme, but you can't do so using operating system resources.

# With Oracle's Database Resource Manager, a database administrator can:



- Guarantee certain users a minimum amount of processing resources regardless of the load on the system and the number of users
- Distribute available processing resources by allocating percentages of CPU time to different users and applications.
  - In a data warehouse, a higher percentage may be given to ROLAP (relational on-line analytical processing) applications than to batch jobs.
- Limit the degree of parallelism of any operation performed by members of a group of users
- Create an active session pool.
  - This pool consists of a specified maximum number of user sessions allowed to be concurrently active within a group of users.

# With Oracle's Database Resource Manager, a database administrator can: (contd.)



- Allow automatic switching of users from one group to another group based on administrator-defined criteria.
  - If a member of a particular group of users creates a session that runs for longer than a specified amount of time, that session can be automatically switched to another group of users with different resource requirements.
- Prevent the execution of operations that are estimated to run for a longer time than a predefined limit
- Create an undo pool.
  - This pool consists of the amount of undo space that can be consumed in by a group of users.
- Configure an instance to use a particular method of allocating resources.
  - You can dynamically change the method, for example, from a daytime setup to a nighttime setup, without having to shut down and restart the instance.

# Database Resource Manager Overview



- Resources are allocated to users according to a resource plan specified by the database administrator.
- The following terms are used in specifying a resource plan:
- A resource plan
  - specifies how the resources are to be distributed among various users (resource consumer groups).
- Resource consumer groups
  - allow the administrator to group user sessions together by resource requirements. Resource consumer groups are different from user roles; one database user can have different sessions assigned to different resource consumer groups.
- Resource allocation methods
  - determine what policy to use when allocating for any particular resource. Resource allocation methods are used by resource plans and resource consumer groups.

# Database Resource Manager Overview (contd.)



- **Resource plan directives**
  - **are a means of assigning consumer groups to particular plans and partitioning resources among consumer groups by specifying parameters for each resource allocation method.**
- **The Database Resource Manager also allows for creation of plans within plans, called subplans.**
- **Subplans allow further subdivision of resources among different users of an application.**
- **Levels provide a mechanism to specify distribution of unused resources among available users. Up to eight levels of resource allocation can be specified.**

# Using the Database Resource Manager



- **A DBA can manage the Database Resource Manager through executing procedures in the Oracle-supplied DBMS_RESOURCE_MANAGER package.**

- **Sequence of actions need to take to start using the Database Resource Manager**
  - **Create a pending area.**
  - **Create a consumer group.**
  - **Create a resource plan.**
  - **Create a plan directive.**
  - **Validate the pending area.**
  - **Submit the pending area.**

# Creating a Pending Area



- Before you can modify an old plan or create a new plan, you need to activate or create a pending area using the Database Resource Manager package.
- All resource plans created will be stored in the data dictionary.

```
SQL> execute dbms_resource_manager.create_pending_area;
PL/SQL procedure successfully completed.
```

```
SQL> execute dbms_resource_manager.clear_pending_area;
PL/SQL procedure successfully completed.
```

# Creating Consumer Groups



- Once the pending area is active, create the consumer groups to which users are allocated.
- You can assign users initially to one group, and you can later switch them to other groups if necessary.

```
SQL> execute dbms_resource_manager.create_pending_area;
PL/SQL procedure successfully completed.
SQL> execute dbms_resource_manager.create_consumer_group
        (consumer_group => 'local',comment => 'local councils');
PL/SQL procedure successfully completed.
SQL> execute dbms_resource_manager.create_consumer_group
        (consumer_group => 'regional',comment => 'regional');
PL/SQL procedure successfully completed.
SQL> execute dbms_resource_manager.create_consumer_group
        (consumer_group => 'national',comment => 'national office');
PL/SQL procedure successfully completed.
```

# Checking what groups exist in your database



- **Use DBA_RSRC_CONSUMER_GROUPS view for information relating to what groups currently exist in your database.**

```
SQL> SELECT consumer_group, status FROM
dba_rscr_consumer_groups;
```

# Default groups in Oracle Database



- Other_groups
  - This isn't really a group, because you can't assign users to it.
  - When a resource plan is active, other_groups is the catchall term for all sessions that don't belong to this active resource plan.
- Default_consumer_groups
  - If you don't assign users to any group, they will, by default, become members of the default group.
- Sys_group and low_group
  - These are part of the default system_plan that exists in every database.
  - Oracle supplies three plans for each database
    - SYSTEM_PLAN : Plan to give system sessions priority.
    - INTERNAL_QUIESCE : Plan to internally quiesce system.
    - INTERNAL_PLAN : Plan to give system sessions priority

# Validate & submit pending area



- Once you create the groups, you can then validate your pending area.
- Once the changes are accepted as being correct, you can submit the changes through the Database Resource Manager.

```
SQL> execute dbms_resource_manager.validate_pending_area;
PL/SQL procedure successfully completed.
SQL> execute dbms_resource_manager.submit_pending_area;
PL/SQL procedure successfully completed.

SQL> select consumer_group, status from
dba_rsrc_consumer_groups;
```

# Assigning users to consumer groups



- First grant the users privileges to switch their groups using *dbms_resource_manager_privs.grant_switch_consumer_group* procedure.
- Use *dbms_resource_manager_privs.set_initial_consumer_group* procedure to switch.

```
SQL> execute dbms_resource_manager_privs.grant_switch_
        consumer_group ('anil','local',TRUE);
PL/SQL procedure successfully completed.
SQL> execute dbms_resource_manager.set_inital_
        consumer_group('anil','local');
PL/SQL procedure successfully completed.
```

```
Verify Consumer Group Membership of Users
SQL> select username, initial_rsrc_consumer_group from dba_users;
```

# Create Resource Plans and Plan Directives



- **Creating Resource Plans**
  - **Resource plans enable you to set limits on resource use by specifying limits on four variables: CPU, active session pool, degree of parallelism, and the order in which queued sessions will execute.**
  - **Currently, for all four parameters, only the default levels and methods provided by Oracle can be used.**

```
SQL> execute dbms_resource_manager.create_pending_area;
PL/SQL procedure successfully completed.
SQL> execute dbms_resource_manager.create_plan ( plan =>
        'membership_plan', comment => 'New Membership
Recruitment');
PL/SQL procedure successfully completed.
```

# Create Resource Plans and Plan Directives (contd.)



- **Creating a Plan Directive**
  - **The plan directive assigns 70 percent of the available CPU at the first level to the local group and the rest, 30 percent, to the regional group.**
  - **It allocates 100 percent of the CPU at the second level to the national group.**
  - **In addition to the preceding three groups, you need to add a plan directive for the default other_groups for the Database Resource Manager to accept your plan directives.**
- **If you don't include a resource directive for other_groups, Oracle won't let you use your directives for the other groups if the plan directives is for a primary or top plan.**

# Create Resource Plans and Plan Directives (contd.)



```
SQL> execute dbms_resource_manager.create_plan_directive
      (plan => ‘membership_plan’, GROUP_OR_SUBPLAN =>
      ‘local’, COMMENT => ‘LOCAL GROUP’, CPU_P1 => 70);

SQL> execute dbms_resource_manager.create_plan_directive
      (plan => ‘membership_plan’, GROUP_OR_SUBPLAN =>
      ‘REGIONAL’, COMMENT => ‘regional group’, CPU_P1 => 30);

SQL> execute dbms_resource_manager.create_plan_directive
      (plan => ‘membership_plan’, GROUP_OR_SUBPLAN =>
      ‘national’, COMMENT => ‘NATIONAL GROUP’, CPU_P2 => 100);

SQL> execute dbms_resource_manager.create_plan_directive
       (plan => 'membership_plan', GROUP_OR_SUBPLAN =>
      'OTHER_GROUPS', comment => 'Default plan',CPU_P3 => 100);
```

# Create Resource Plans and Plan Directives (contd.)



- You can now validate and submit your new top-level plan, membership_plan.
- Determining the status of the Resource Plans from dba_rsrc_plan_directives

```
SQL> execute dbms_resource_manager.validate_pending_area;
PL/SQL procedure successfully completed.
SQL> execute dbms_resource_manager.submit_pending_area;
PL/SQL procedure successfully completed.

SQL> select plan, group_or_subplan, cpu_p1, cpu_p2,cpu_p3, status
from dba_rsrc_plan_directives;
```

# Enabling the Database Resource Manager



- Oracle will not automatically enforce the resource plans.
- Explicitly activate the Database Resource Manager, either by specifying the initialization parameter resource_manager_plan in the init.ora file or by using the alter system command.
- Query V$RSRC_CONSUMER_GROUP to see what resource usage among the consumers groups looks like.

```
SQL> alter system set resource_manager_plan=MEMBERSHIP_PLAN;
System altered.

SQL select * from v$rsrc_plan;

SQL> select name, active_sessions, cpu_wait_time,
consumed_cpu_time,
        current_undo_consumption from v$rsrc_consumer_group;
```

# Managing Privileges



- **Two types of privileges:**
  - **SYSTEM: enables users to perform particular actions in the database**
    - **create, alter, drop, etc.**
  - **OBJECT: enables users to access and manipulate a specific object**
    - **select, update, insert, exec, etc.**

# System Privileges



- There are about 126 system privileges.
- The ANY-keyword in the privileges signifies that users have the privilege in every schema.
- The GRANT command adds a privilege to a user or a group of users.
- The REVOKE command deletes the privileges.
- Users with ANY privilege can access data dictionary tables

# System Privileges: Examples



| Category | Examples |
|---|---|
| INDEX | CREATE ANY INDEX, ALTER ANY INDEX<br>DROP ANY INDEX |
| TABLE | CREATE TABLE (includes dropping privilege, create index)<br>CREATE ANY TABLE, ALTER ANY TABLE<br>DROP ANY TABLE (need this for truncating)<br>SELECT ANY TABLE, UPDATE ANY TABLE<br>DELETE ANY TABLE |
| SESSION | CREATE SESSION (need this to do anything)<br>ALTER SESSION<br>RESTRICTED SESSION(when db in restricted mode) |
| TABLESPACE | CREATE TABLESPACE<br>ALTER TABLESPACE<br>DROP TABLESPACE<br>UNLIMITED TABLESPACE |

# Granting System Privileges



```
GRANT CREATE SESSION, CREATE TABLE TO user1;
```

```
GRANT CREATE SESSION TO scott
WITH ADMIN OPTION; (enables scott to grant the privilege
or role to other users or roles)
```

# SYSDBA and SYSOPER Privileges



| Category | Examples |
|---|---|
| SYSOPER | STARTUP<br>SHUTDOWN<br>ALTER DATABASE OPEN \| MOUNT<br>ALTER DATABASE BACKUP CONTROLFILE<br>ALTER TABLESPACE BEGIN/END BACKUP<br>RECOVER DATABASE,<br>ALTER DATABASE ARCHIVELOG<br>RESTRICTED SESSION |
| SYSDBA | SYSOPER privileges WITH ADMIN OPTION<br>CREATE DATABASE<br>RECOVER DATABASE UNTIL<br><br>(any operation on db or objects in db) |

user SYSTEM not as powerful as SYS

# SYSDBA and SYSOPER Privileges (contd.)



- **User SYS:**
  - **Owner of data dictionary, can make changes**
  - **Granted SYSOPER and SYSDBA roles**
  - **Can start and shutdown database**

- **User STSTEM:**
  - **Not granted SYSOPER and SYSDBA roles**
  - **Cannot start/shutdown database**
  - **Cannot modify data dictionary**
  - **Safer to be SYSTEM than SYS**

# Password File Authentication



- Create the password file and set the REMOTE_LOGIN_PASSWORDFILE parameter.
- Set REMOTE_LOGIN_ PASSWORD_FILE=EXCLUSIVE.
- Grant SYSOPER and SYSDBA privileges to users.
- Query V$PWFILE_USERS to verify the password file members.

# Displaying System Privileges



- Select * from dba_sys_privs;
- Select * from session_privs; (current session)

**Database Level**

**DBA_SYS_PRIVS**

- GRANTEE
- PRIVILEGE
- ADMIN OPTION

**Session Level**

**SESSION_PRIVS**

- PRIVILEGE

# System Privilege Restrictions



- O7_DICTIONARY_ACCESSIBILITY = TRUE
  - Reverts to Oracle7 behavior
  - Removes the restrictions on system privileges with the ANY keyword
  - Defaults to TRUE

# Revoking System Privileges



**REVOKE CREATE TABLE FROM user1;**

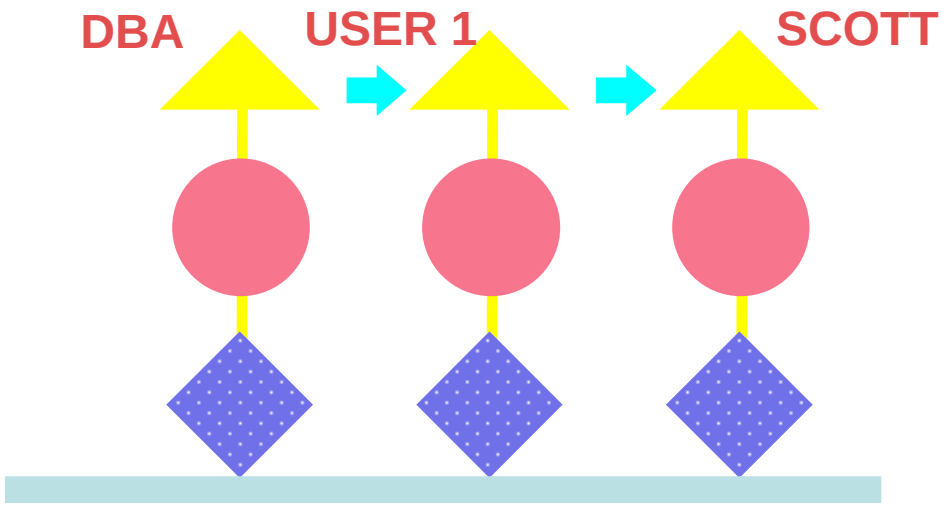
**(can REVOKE privileges granted with GRANT command)**

**REVOKE CREATE SESSION FROM scott;**

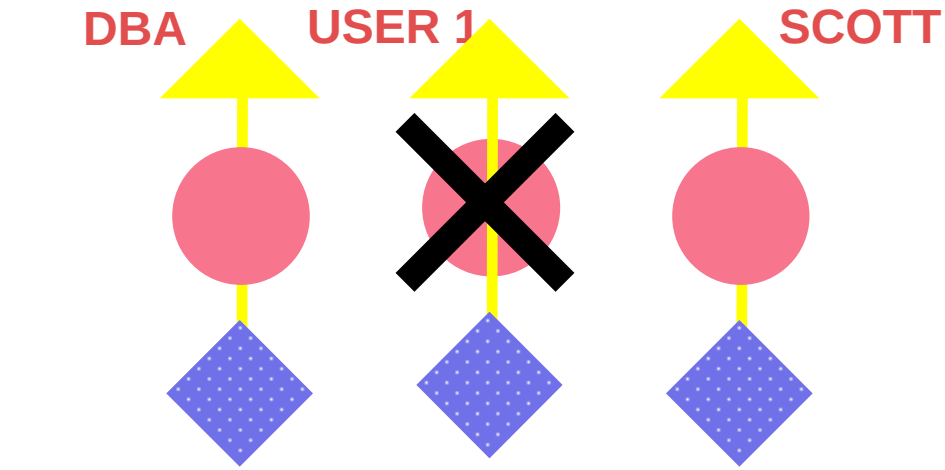
# Revoking System Privileges Using WITH ADMIN OPTION



GRANT



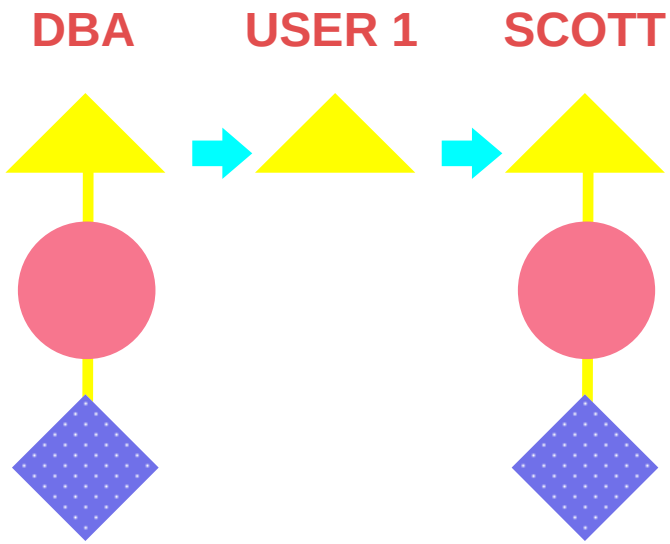

REVOKE (doesn't cascade)



# Revoking System Privileges Using WITH ADMIN OPTION (contd.)



## RESULT



# Object Privileges



| Object priv. | Table | View | Sequence | Procedure |
|---|---|---|---|---|
| ALTER | √ | | √ | |
| DELETE | √ | √ | | |
| EXECUTE | | | | √ |
| INDEX | √ | | | |
| INSERT | √ | √ | | |
| REFERENCES | √ | | | |
| SELECT | √ | √ | √ | |
| UPDATE | √ | √ | | |

# Granting Object Privileges



```
GRANT EXECUTE ON dbms_pipe TO public;
```

```
GRANT UPDATE(ename,sal) ON emp TO user1
WITH GRANT OPTION;
```

**Column (field) level grants**

# Displaying Object Privileges



**DBA_TAB_PRIVS**

GRANTEE
OWNER
TABLE_NAME
GRANTOR
PRIVILEGE
GRANTABLE

Object privileges

**DBA_COL_PRIVS**

GRANTEE
OWNER
TABLE_NAME
COLUMN_NAME
GRANTOR
PRIVILEGE
GRANTABLE

Col specific privileges

# Revoking Object Privileges

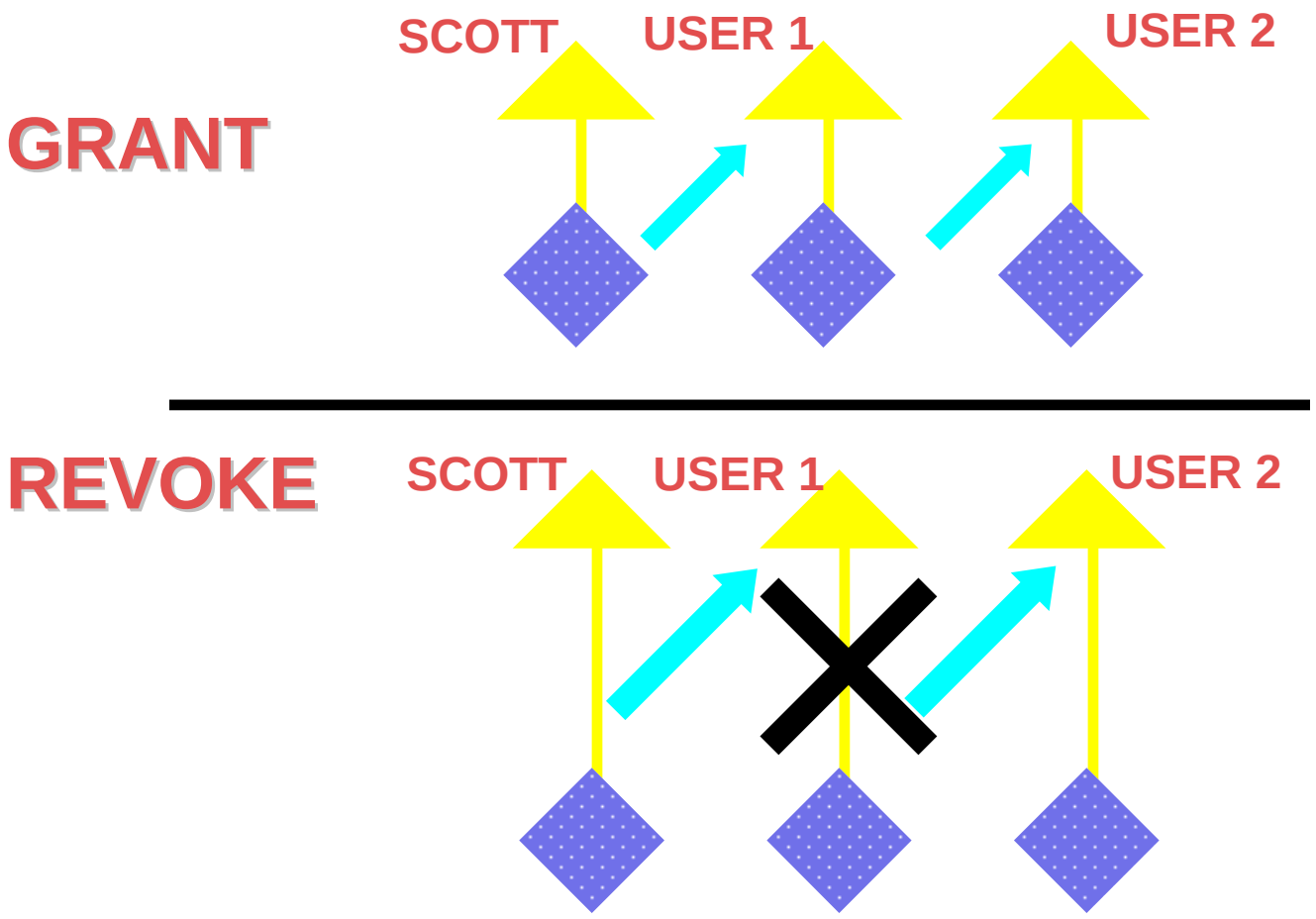


- Select * from dba_tab_privs where grantee = ‘SCOTT’;
- Select * from dba_col_privs;

```
REVOKE execute ON dbms_pipe FROM scott;
```

# Revoking Object Privileges Using WITH GRANT OPTION

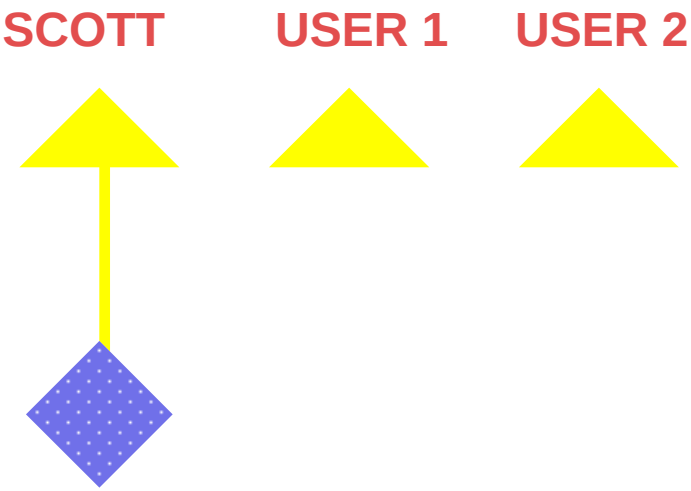




# Revoking Object Privileges Using WITH GRANT OPTION (contd.)



## RESULT




**Summary: revoking object privileges will cascade**

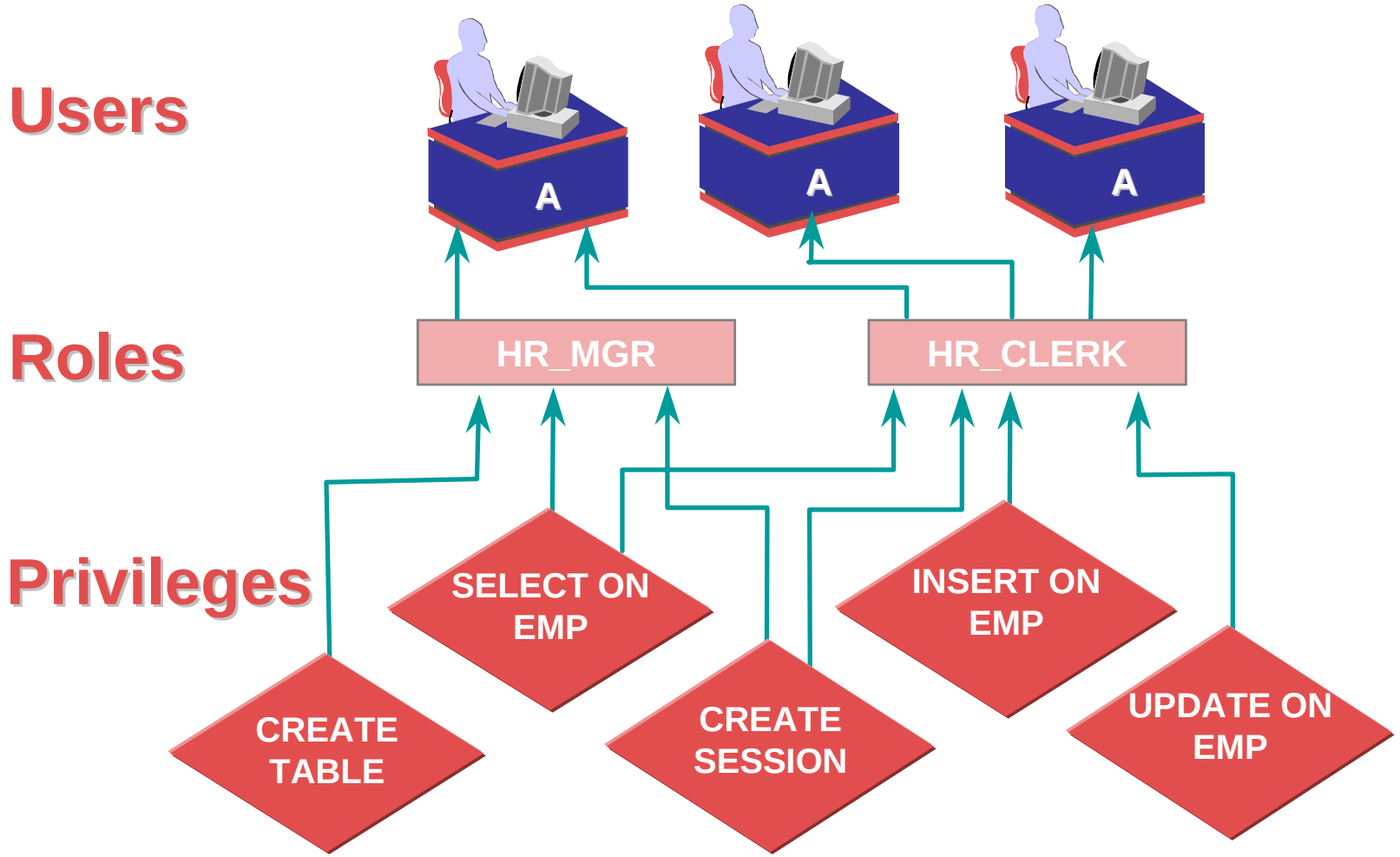
# Roles



- **Role: named groups of related privileges**
  - **Granted/revoked with same commands as for privileges**
  - **Maybe granted to user or role (except itself)**
  - **Can consist of object and system privileges**
  - **May be enabled/disabled**
  - **Can require password to enable**
  - **Not owned by anyone**

# Roles (contd.)





# Benefits of Roles



- Reduced granting of privileges
- Dynamic privilege management
- Selective availability of privileges
- Granted through the OS
- No cascading revokes
- Improved performance

# Creating Roles



```
CREATE ROLE sales_clerk;
```

```
CREATE ROLE hr_clerk
IDENTIFIED BY bonus;
```

```
CREATE ROLE hr_manager
IDENTIFIED EXTERNALLY;
```

# Using Predefined Roles



| Role Name | Description |
|---|---|
| CONNECT | These two roles are provided for backward compatibility. |
| RESOURCE | |
| DBA | All system privileges WITH ADMIN OPTION |
| EXP_FULL_DATABASE | Privileges to export the DB |
| IMP_FULL_DATABASE | Privileges to import the DB |
| DELETE_CATALOG_ROLE | DELETE privileges on DD tables |
| EXECUTE_CATALOG_ROLE | EXECUTE privilege on DD packages |
| SELECT_CATALOG_ROLE | SELECT privilege on DD tables |

# Modifying Roles



```
ALTER ROLE sales_clerk
 IDENTIFIED BY commission;
```

```
ALTER ROLE hr_clerk
IDENTIFIED EXTERNALLY;
```

```
ALTER ROLE hr_manager
NOT IDENTIFIED;
```

# Assigning Roles



```
GRANT sales_clerk TO scott;
```

```
GRANT hr_clerk,
TO hr_manager;
```

```
GRANT hr_manager TO scott
WITH ADMIN OPTION;
```

# Assigning Privileges to Roles



```
GRANT create table, create any index TO hr_clerk;
```

```
GRANT create_session TO hr_manager;
```

# Enabling and Disabling Roles



- Disable a role to temporarily revoke the role from a user.
- Enable a role to temporarily grant it.
- The SET ROLE command enables and disables roles.
- Default roles are enabled for a user at login.
- A password may be required to enable a role.

# Enabling and Disabling Roles: Examples



```
SET ROLE sales_clerk IDENTIFIED BY
commission;
```

Enable: this is how users would activate their role

```
SET ROLE ALL EXCEPT sales_clerk;
```

```
SET ROLE NONE;
```

Disable all roles for current session

# Removing Roles from Users



```
REVOKE sales_clerk FROM scott;
```

```
REVOKE hr_manager FROM PUBLIC;
```

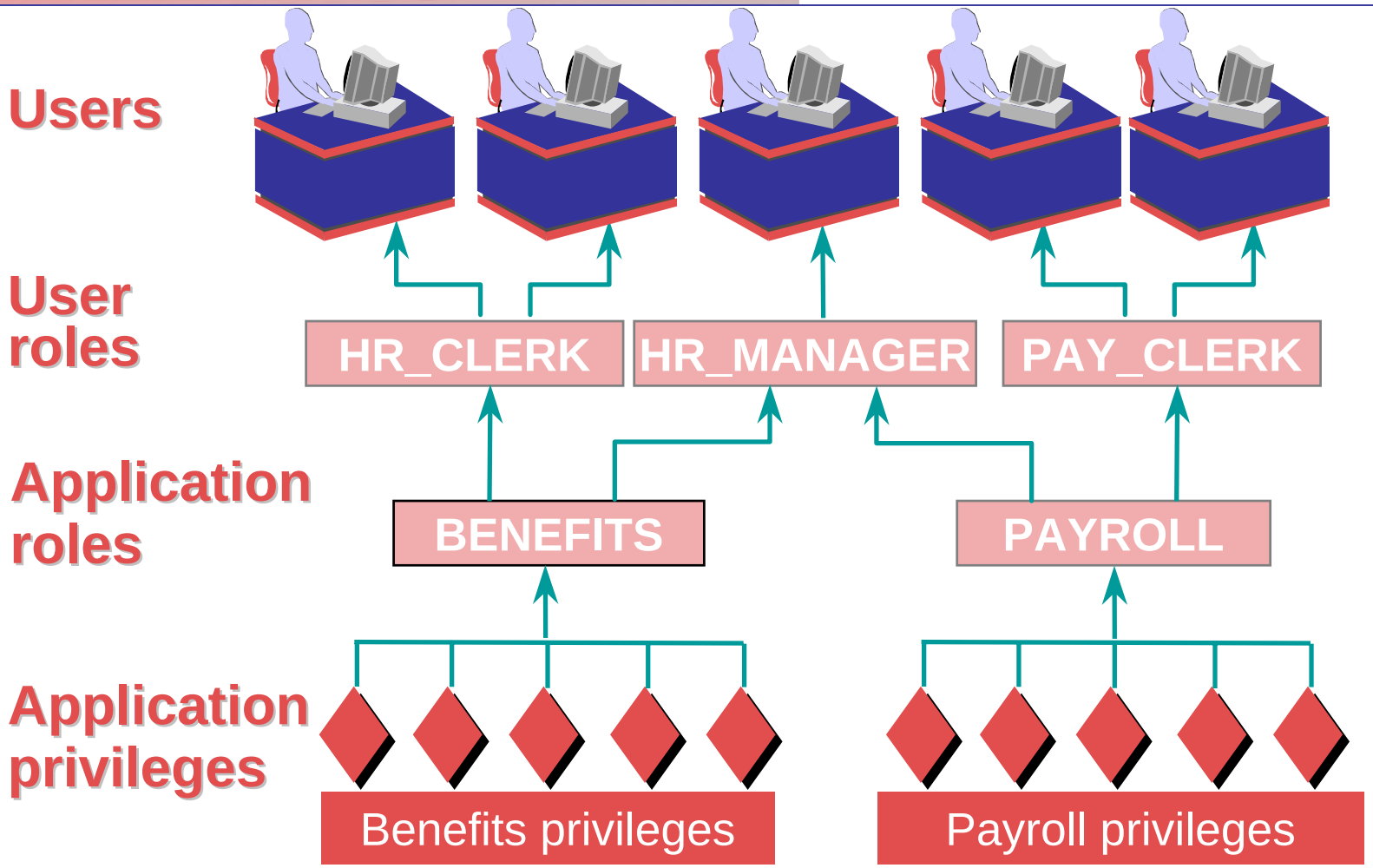
# Removing Roles



```
DROP ROLE hr_manager;
```

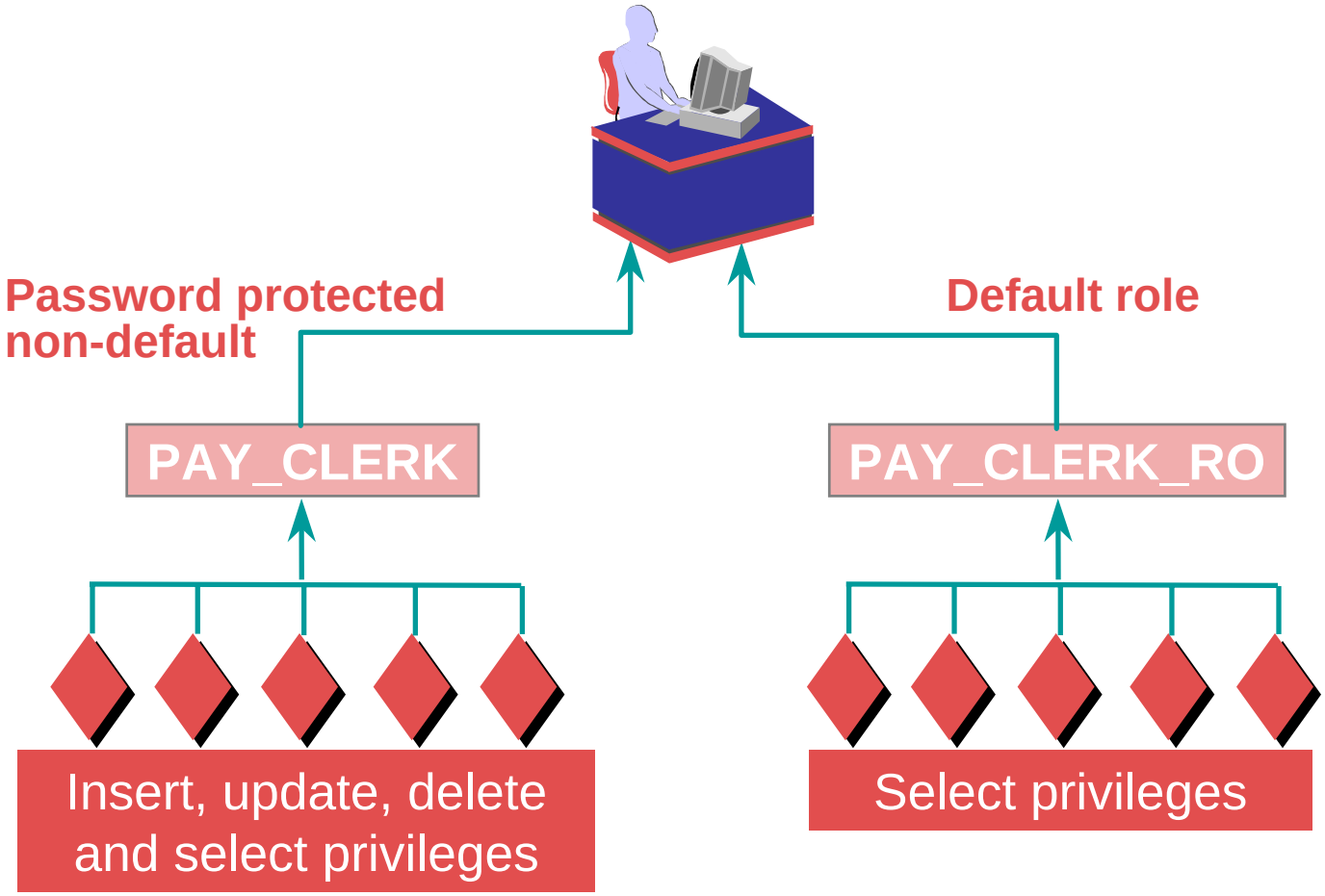
# Guidelines for Creating Roles





# Guidelines for using Passwords and Default Roles





# PUBLIC



- **The PUBLIC User Group and Roles**
  - **To give a certain privilege or role to all the users in the database, simple grant this privilege/role to the user group PUBLIC, which exists in every database by default.**

- **Using Secure Application Roles**
  - **Secure application roles in Oracle9i are roles that are implemented through a package.**

# Displaying Role Information

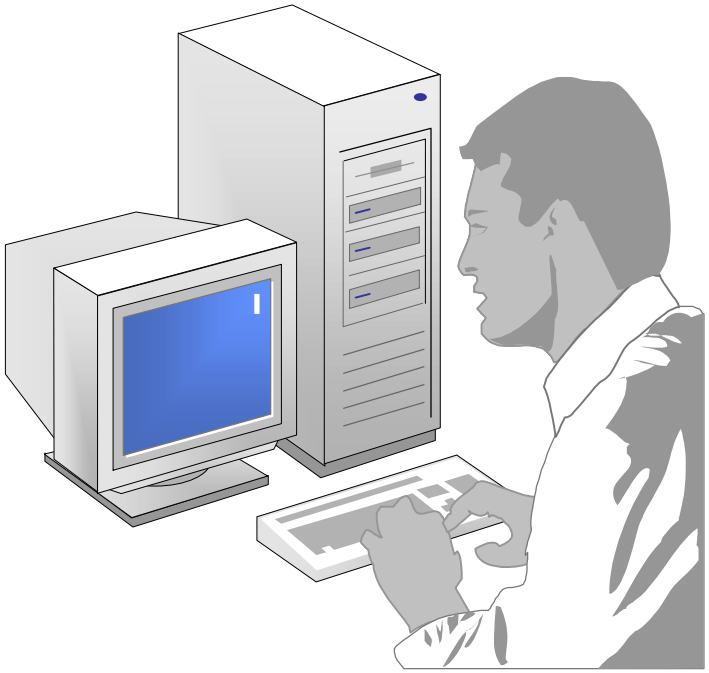


| Role View | Description |
|---|---|
| DBA_ROLES | All roles which exist in the database |
| DBA_ROLE_PRIVS | Roles granted to users and roles |
| ROLE_ROLE_PRIVS | Roles which are granted to roles |
| DBA_SYS_PRIVS | System privileges granted to users and roles |
| ROLE_SYS_PRIVS | System privileges granted to roles |
| ROLE_TAB_PRIVS | Table privileges granted to roles |
| SESSION_ROLES | Roles which the user currently has enabled. |

```
Select role, password_required from dba_roles;
```

# *Exercise IV Managing user roles & privileges*





# Fine-grained Data Security



- Oracle9i database provides a lower level security of data using fine-grained data security techniques.
- You can allow all users to access a central table such as payroll table, but transparent to the users you can institute security policies that limit access of an individual user to only those rows in a table.
- Oracle uses two main concepts to enforce fine-grained security within database:
  - An application context.
  - A fine-grained access control policy.
- Oracle uses the term Virtual Private Database to refer to the implementation of the fine-grained access control policies through application contexts.

# Auditing Categories



- **Auditing privileged operations**
  - **Always audited**
  - **Startup, shutdown, and SYSDBA or SYSOPER connections**
- **Database auditing**
  - **Enabled by DBA**
  - **Cannot record column values**
- **Value-based or application auditing**
  - **Implemented through code**
  - **Can record column values**
  - **Used to track changes to tables**

# System-level Triggers



- **Database start-up triggers :**
  - **These triggers are used to execute code that you want to execute immediately after database start-up.**
- **Logon triggers:**
  - **Provide you with information regarding the logon times of a user, along with details about the user's session.**
- **Logoff triggers:**
  - **Similar to the logon triggers, but they execute right before the user's session logs off.**
- **DDL triggers:**
  - **To capture all database object changes with these triggers.**
- **Server error triggers:**
  - **Capture all major PL/SQL code errors into a special table.**

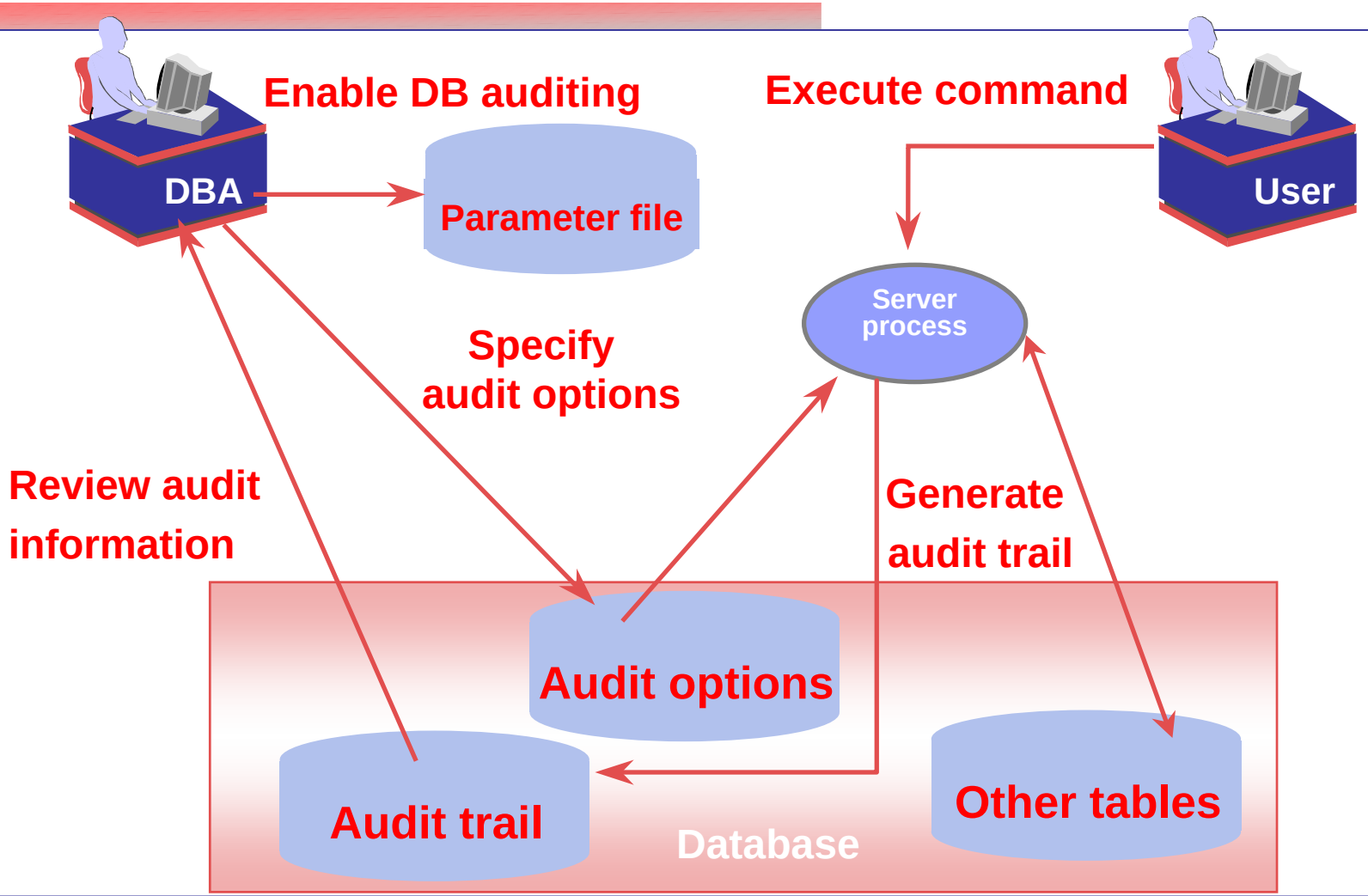
# Value-Based Auditing: An Example



```
CREATE    TRIGGER scott.auditemployee
  AFTER INSERT OR DELETE OR UPDATE
  ON scott.emp
  FOR EACH ROW
BEGIN
  INSERT INTO scott.audit_employee
    VALUES (    :OLD.empno, :OLD.name,…,
                              :NEW.empno, :NEW.name,…,
                            USER, SYSDATE);
END;
```

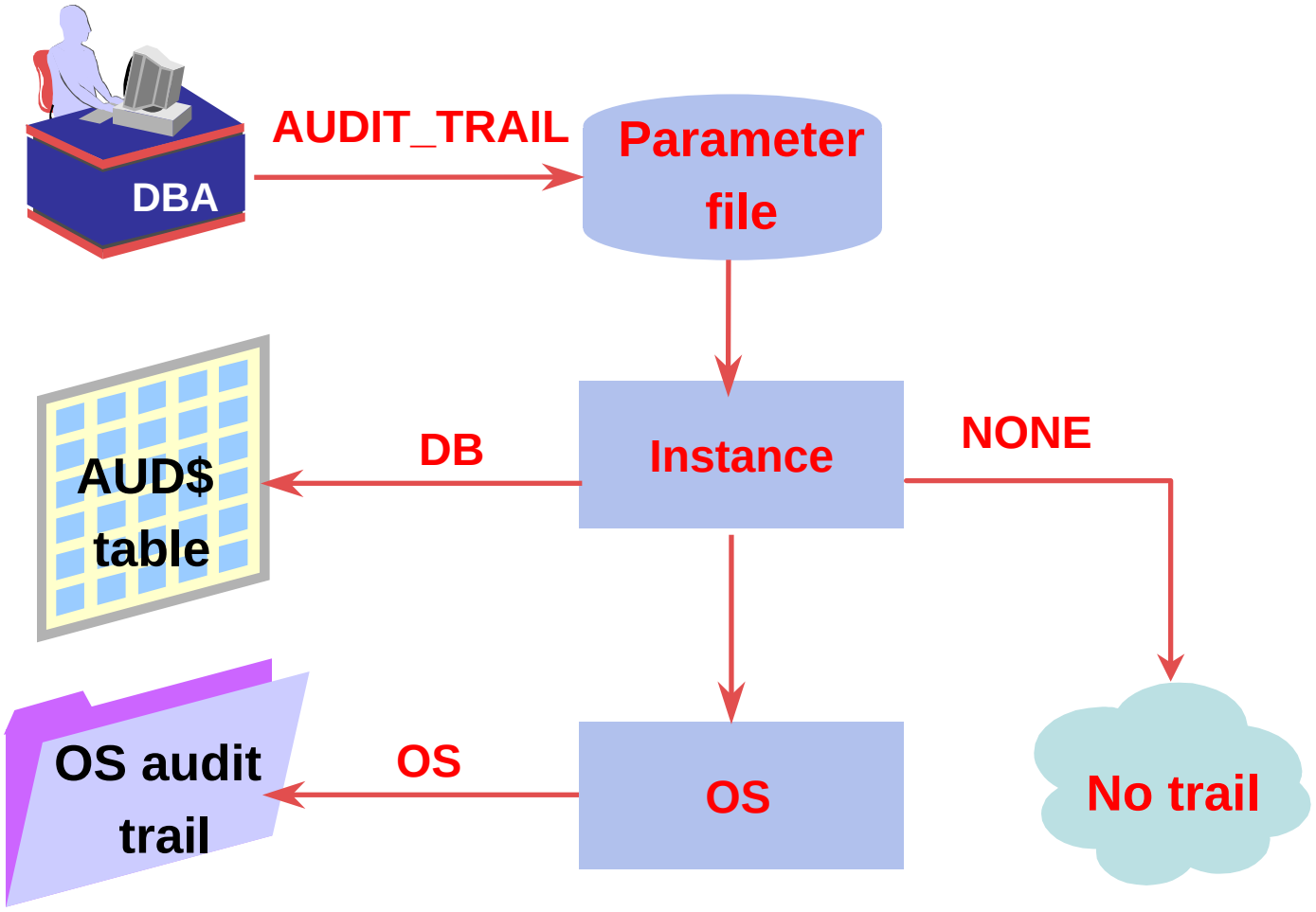
# Database Auditing





# Enabling Database Auditing





# Enabling Auditing Options



- **Statement auditing**

```
AUDIT user;
```

- **Privilege auditing**

```
AUDIT select any table
        BY scott BY ACCESS;
```

- **Schema object auditing**

```
AUDIT LOCK ON scott.emp
BY ACCESS WHENEVER SUCCESSFUL;
```

# Auditing Schema Objects



| Object / Option | Table | View | Seq-uence | Stored Pro-gram | Snap-shot |
|---|---|---|---|---|---|
| ALTER | X | | X | | X |
| AUDIT | X | X | X | X | X |
| COMMENT | X | X | | | X |
| DELETE | X | X | | | X |
| EXECUTE | | | | X | |
| GRANT | X | X | X | X | X |
| INDEX | X | | | | X |
| INSERT | X | X | | | X |
| LOCK | X | X | | | X |
| READ | | | | | |
| RENAME | X | X | | | X |
| SELECT | X | X | X | X | X |
| UPDATE | X | X | | | X |

# Viewing Auditing Options



| Data Dictionary View | Description |
|---|---|
| ALL_DEF_AUDIT_OPTS | Default audit options |
| DBA_STMT_AUDIT_OPTS | Statement auditing options |
| DBA_PRIV_AUDIT_OPTS | Privilege auditing options |
| DBA_OBJ_AUDIT_OPTS | Schema object auditing options |

# Disabling Auditing Options



```
NOAUDIT user WHENEVER SUCCESSFUL;
```

```
NOAUDIT create table BY scott;
```

```
NOAUDIT LOCK ON emp;
```

# The Audit Trail



- Stores the records generated by statement, privilege, and object auditing
- The audit records are stored in the SYS.AUD$ data dictionary table or in the OS audit trail
- Each record in the audit trail includes:
  - The user who executed the statement
  - The command issued (action code)
  - Any system or object privilege used
  - The objects referenced in the statement
  - The date and time the statement was issued

# Oracle Default Auditing



- When you don't specify any type of logging, by default Oracle will log three types of database actions under all circumstances.
- The auditing actions and the audit records are written to the default $ORACLE_HOME/rdbms/audit directory.
  - Connections as SYSOPER or SYSDBA.
  - Database start-up
  - Database shutdown

# Viewing Auditing Results



| Audit Trail View | Description |
|---|---|
| DBA_AUDIT_TRAIL | All audit trail entries |
| DBA_AUDIT_EXISTS | Records for AUDIT EXISTS/NOT EXISTS |
| DBA_AUDIT_OBJECT | Records concerning schema objects |
| DBA_AUDIT_SESSION | All connect and disconnect entries |
| DBA_AUDIT_STATEMENT | Statement auditing records |

# Auditing Guidelines



- **Focus auditing**
  - **Object auditing, where possible**
  - **Only specific users**
  - **By session**
  - **Successful or unsuccessful**
- **Maintain the audit trail**
  - **Monitor the growth of the audit trail**
  - **Protect the audit trail from unauthorized access**
  - **Cleaning OS audit files**

# The Password File



- Use orapwd to create the password file.
- The remote_login_passwordfile initialization parameter.
- None
  - No password file is used.
  - This is the default, and it permits only operating system-authenticated users to perform DBA task.
- Shared
  - Creates a shared password file with a single user: SYS.
  - Any user who wants to perform privileged tasks has to log in as SYS.
- Exclusive
  - Uses a password file.
  - Any user can be granted the SYSDBA and SYSOPER privileges, and when the user SYS does so, the user is automatically added to the password file.

# Encrypted Passwords



- By default, Oracle user passwords aren't encrypted, which leaves them vulnerable to unauthorized usage.
- ora_encrypt_login=true (client)
- dblink_encrypt_login=true (server)
- Oracle will always encrypt a password when it's sending it across a network.

# Authentication Methods



- External Authentication
- Proxy Authentication
- Centralized User Authorization using LDAP

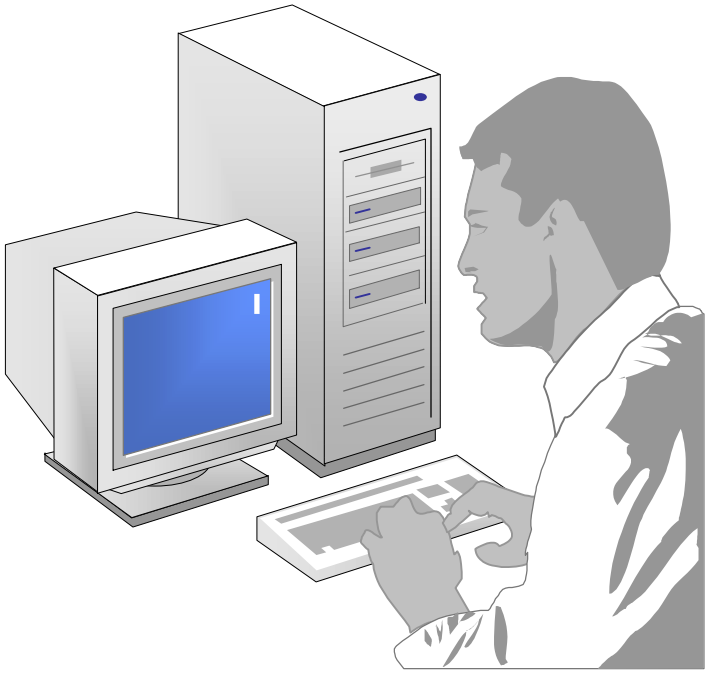
# Database Security Do's Don'ts

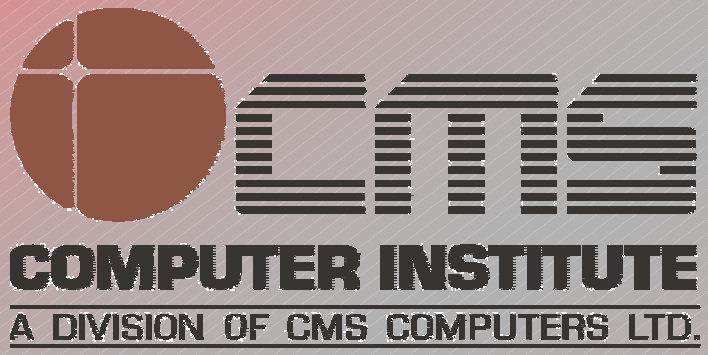


- User Accounts default lock except SYS and SYSTEM.
- Passwords, don't hard-code
- Operating System Authentication
- Audit your Database
- Grant Privileges Appropriately.
- Set appropriate Permissions.
- Safeguard the Network and the Listener.
- Keep Up-to-Date  for latest news about new security vulnerabilities and the patches to overcome them..
- Use Oracle's Advanced Security Feature.
- Take Care of Application Security.

# Exercise V Auditing the database Usage








**Design & Published by:**

**CMS Institute, Design & Development Centre, CMS House, Plot No. 91, Street No.7,**

**MIDC, Marol, Andheri (E), Mumbai –400093, Tel: 91-22-28216511, 28329198**

**Email: courseware.inst@cmail.cms.co.in**

**www.cmsinstitute.co.in**