Multi-Tenant Deployment
Oracle FLEXCUBE Universal Banking
Release 14.4.0.3.0
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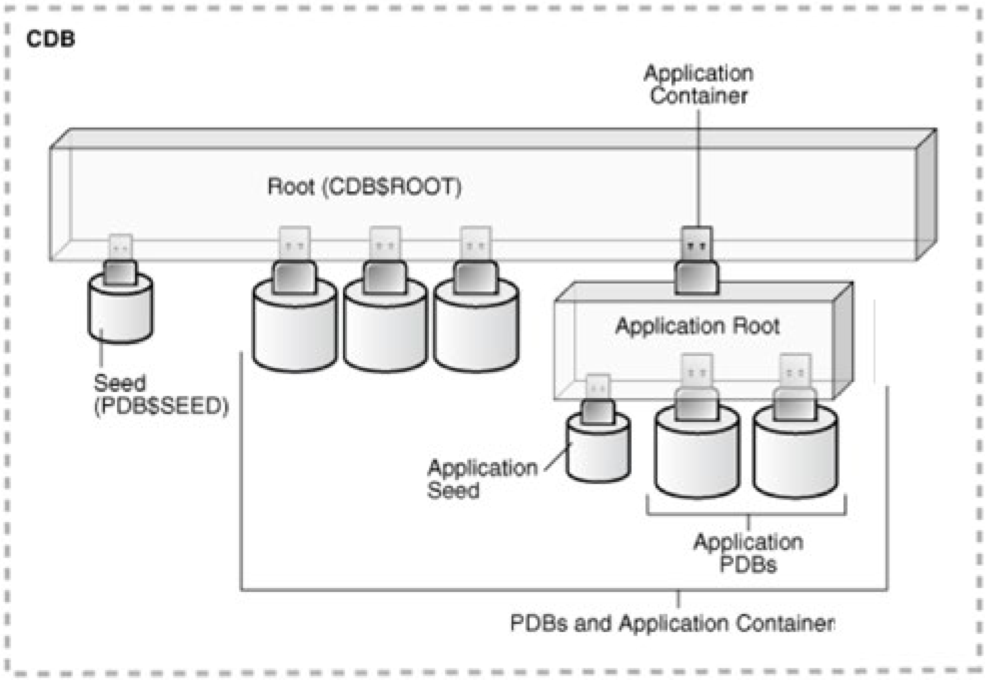
Multi-Tenant Architecture



1.1 Overview of the Multitenant Architecture

1.1.1 Container Database

The CDB is a collection of schemas, schema objects, and non-schema objects to which all PDBs belong.

Every CDB has one and only one root container named CDB$ROOT. The root stores the system metadata required to manage PDBs. All PDBs belong to the root. The system container is the CDB root and all PDBs that belong to this root.

The CDB root does not store user data. Oracle recommends that you do *not* add common objects to the root or modify Oracle-supplied schemas in the root. However, you can create common users and roles for database administration. A common user with the necessary privileges can switch between containers.

1.1.2 Application Root

Consider an application root as an application-specific root container. It serves as a repository for a master definition of an application back end, including common data and metadata. To create an application root, connect to the CDB root and specify the AS APPLICATION CONTAINER clause in a CREATE PLUGGABLE DATABASE statement.

1.1.3 Seed PDB

Unlike a standard PDB, a seed PDB is not intended to support an application. Rather, the seed is a *template* for the creation of PDBs that support applications. To accelerate creation of application PDBs within an application container, you can create an application seed. An application container contains either zero or one application seed.

1.1.4 Application PDB

An application PDB belongs to exactly one application container. Unlike PDBs plugged in to the CDB root, application PDBs can share a master application definition within an application container. For example, a user_details table in an application root might be a data-linked common object, which means it contains data accessible by all application PDBs plugged in to this root. PDBs that do not reside within the application container cannot access its application common objects.

1.2 Application Maintenance

Application maintenance refers to installing, uninstalling, upgrading, or patching an application.

Perform application installation, upgrade, and patching operations using an ALTER PLUGGABLE DATABASE APPLICATION statement.

The basic steps for application maintenance are as follows:

1. Log in to the application root.
2. Begin the operation with an ALTER PLUGGABLE DATABASE APPLICATION ... BEGIN statement in the application root.
3. Execute the application maintenance statements.
4. End the operation with an ALTER PLUGGABLE DATABASE APPLICATION ... END statement.

1.2.1 Application Installation

An application installation is the initial creation of a master application definition. A typical installation creates user accounts, tables, and PL/SQL packages.

To install the application, specify the following in the ALTER PLUGGABLE DATABASE APPLICATION statement:

- Name of the application
- Application version number

1.2.2 Application Upgrade

An application upgrade is a major change to an installed application.

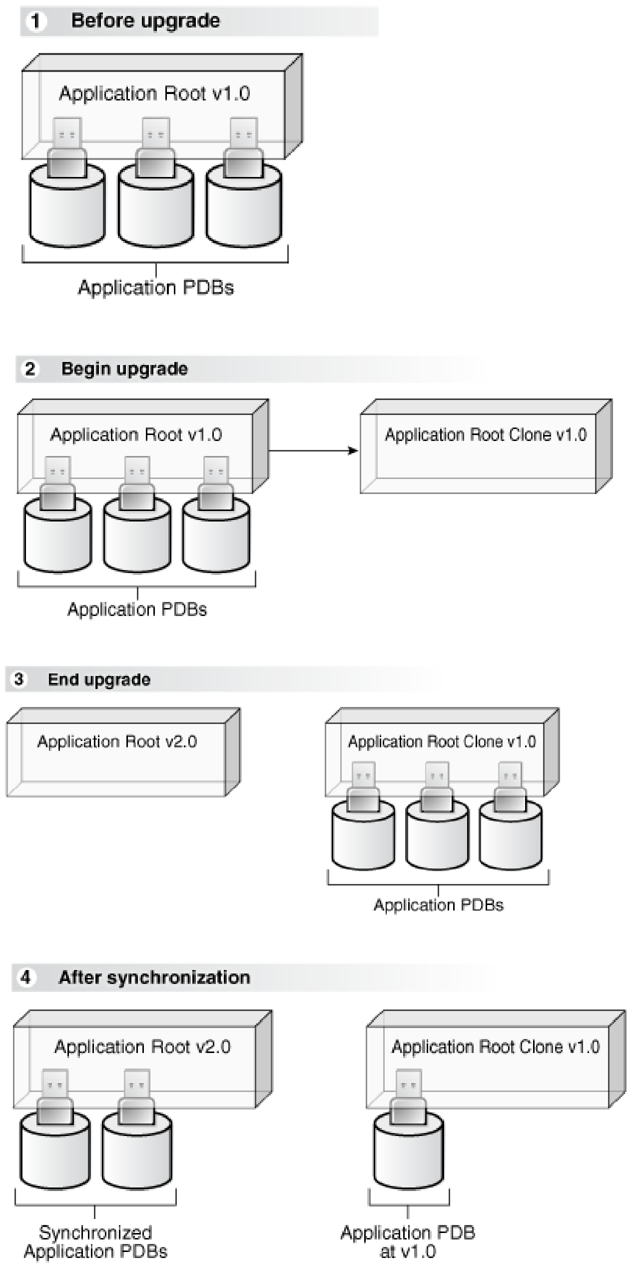
Typically, an upgrade changes the physical architecture of the application. For example, an upgrade might add new user accounts, tables, and packages, or alter the definitions of existing objects.

To upgrade the application, you must specify the following in the ALTER PLUGGABLE DATABASE APPLICATION statement:

- Name of the application
- Old application version number
- New application version number

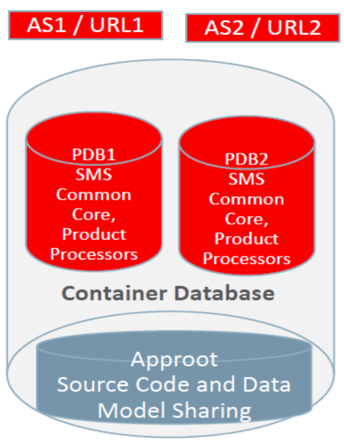
  During an application upgrade, the application remains available. To make this availability possible, Oracle Database clones the application root.

  The following figure gives an overview of the application upgrade process.


1 Before upgrade
Application Root v1.0
Application PDBs
2 Begin upgrade
Application Root v1.0
Application Root Clone v1.0
Application PDBs
3 End upgrade
Application Root v2.0
Application Root Clone v1.0
Application PDBs
4 After synchronization
Application Root v2.0
Application Root Clone v1.0
Synchronized Application PDBs
Application PDB at v1.0

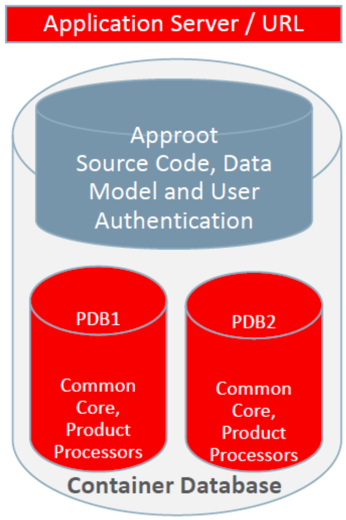
2.1 Shared Application

✓ In this model application would be deployed in an application container in 18C, Multiple front-end applications with URL is created per PDB.
• Application would be deployed in an Application Container
• Source code at Approot level shared with PDBs
• Data Model at Approot level shared with PDBs
• No sharing of data
• Multiple frontend application with URL per PDB (with common EAR file)



2.2 Shared Application and User Authentication

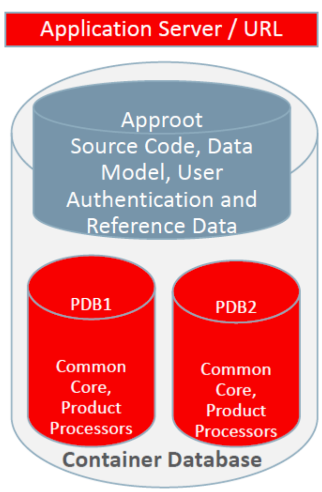
✓ In this model application would be deployed in an application container in 18C, Single front end application and an URL.
• Application would be deployed in an Application Container
• Source code at Approot level shared with PDBs
• Data Model at Approot level shared with PDBs
• Sharing of data related to User Authentication
• Single Frontend Application and Single URL



2.3 Shared Application with Shared Data - Default

✓ This would be using Application Container in 18C, Single front end application and an URL. Sharing of Entities from Approot to individual PDBs.

- Application would be deployed in an Application Container
- Source code at Approot level shared with PDBs
- Data Model at Approot level shared with PDBs
- Single Frontend Application and Single URL
- Sharing of Entities/data like
  - User Authentication, SMS Roles
  - Core Entities like Country, Currency, MIS Classes, UDFs
  - Chart of Account, Product, Account Class



2.4 Shared Application with Shared Data - Custom

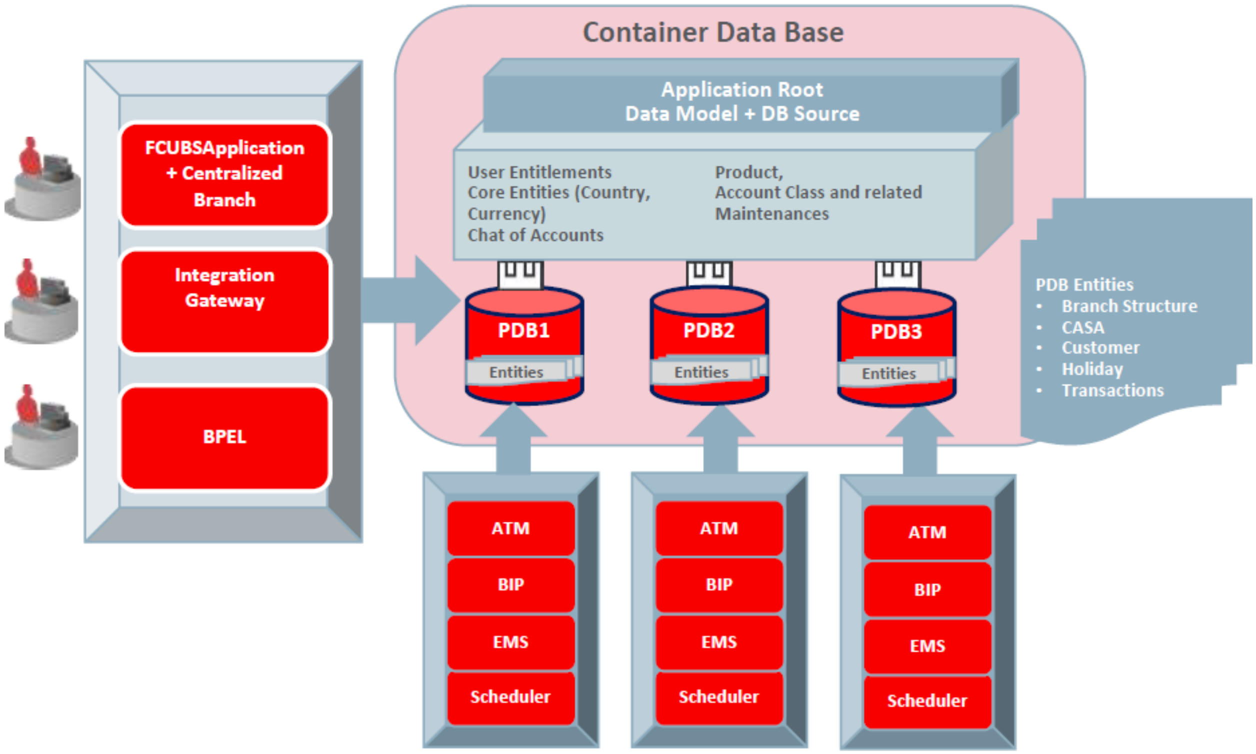
✓ This would be using Application Container in 18C, Single front end application and an URL. Sharing of Entities from Approot to individual PDBs.

- Application would be deployed in an Application Container
- Source code at Approot level shared with PDBs
- Data Model at Approot level shared with PDBs
- Single Frontend Application and Single URL
- Sharing of Entities/data like
  - User Authentication, SMS Roles

– Core Entities like Country, Currency, MIS Classes, UDFs
– Chart of Account, Product, Account Class

- User can opt-out the entities which are not required to be the candidates of approot and move to PDB.

Sample of components deployed in Shared Application and Shared Data model is given below:



Component Deployment Architecture

Application and Gateway will be common and single URL will be available for the application.
ATM, BIP, EMS, Scheduler has to be configured separately for each PDBs.

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3. Deployment and Installation Steps

As a pre-requisite, DB server has to be created with 18c database installed along with CDB setup.
Multi entity application root/PDB based application setup can be done by following below steps in sequential order, and detail of each steps explained as separate section subsequently.

1. Application Template PDB configuration
   a. Application Template PDB is a normal PDB created under CDB to install the required DB objects for a product processor. This PDB will have a common schema and is used as a template for creating Application root through cloning.
2. Application root and Application Seed configuration
   a. Application root
      i. Application root is an application-specific root container and repositories for an application back end DB objects.
      ii. Application root will be created through cloning from Application Template PDB.
   b. Application Seed
      i. Application seed is created to accelerate the creation of application PDBs within an application container.
      ii. Application seed will be created from Application root through cloning and used as template to create one or more Application PDBs.
3. Application Installation
      i. Application installation has to be done in the approot as version 1.0 with being user made explicit.
4. Application Root objects conversion
      i. All the DB objects loaded in Application root will be converted as DATA LINK or METADATA LINK.
5. Application Seed Sync with the Application Root
   a. Any changes deployed in Application Root will be available at Application PDB, if Application PDB sync with Application Root

Note: Application root should be synced with application seed always. It will help during the creation of new application PDBs. By this way the new application PDB created will have the all the patches applied.

6. Application PDB (entity) configuration from Application Seed
   a. Application PDB is an associated PDB under Application Root. Application PDB will be created by clone from Application Seed.
7. Day Zero Setup
   EAR Creation & Deployment
   - Co-Deployment – In case of Co-deployment all the product processor objects has to be loaded in the Application Template PDB, which will be cloned into Application Root and then subsequently cloned into Application Seed from Application Root inside an application container. Application Seed is used to accelerate the creation of application PDBs within an application container.
   - Stand-alone Deployment– In case of stand-alone deployment, application set up steps has to be followed separately. Installation of multiple product processors can be done inside the same CDB with separate Application containers which has the template PDB, Application Seed and Application PDBs of its own. Same set of installation can be done inside a different CDB.

Note: If .ear deployed in WebLogic server and SOA domain. RCU (Repository Configuration Utility) schemas should be created in a separate PDB. It should not be created within the application root container or in application PDBs.

3.1 Creation of Application Template

3.1.1 Purpose

Application Template PDB is a normal PDB created under CDB to install the required DB objects for a product processor. This PDB will have a common schema and is used as a template for creating Application root through cloning.

3.1.2 Steps to be followed

- Below steps to be followed to configure Application Template PDB
  - ✓ Application Template PDB Creation
  - ✓ Property File Creation pointing to Application Template PDB
  - ✓ Objects loading into the Application Template PDB.

3.1.2.1 Application Template PDB Creation

- User has to login into CDB as a sys user.
- Application Template PDB has to be created under the CDB.
- This Application Template PDB will be kept as a gold copy and recommended to not to use for any other purpose.
- Application Template PDB can have one common schema which will be cloned to create further databases.

  Below script will create the Application Template PDB with required grants under the CDB. DBA rights are required to perform this step.

  Application_Template_PDB_Creation.sql

  (**Refer the Attachment panel of this document to view the script**)

  Input sample for the script:

CDB Schema User Name	Sys
CDB Schema Password	Sys
CDB Host	1.1.1.1
CDB Port	1524
CDB Name	FC142CDB
DB Mounted Path	/scratch/db1800dat
Template PDB Name	Templatepdb
Common User Name	CMNUSER
Common User Password	CMNUSER

3.1.2.2 Property file creation with Application Template PDB

- Existing installer will be used for the property file creation
- Property file has to be created with Application Template PDB schema details.

  (Refer **FCUBS_Property_File_Creation.docx**)

3.1.2.3 Loading objects into the Application Template PDB

- Objects have to be loaded in the Application Template PDB using bat file [E.g.: SMSDBCompileRun.bat, ROFCDBCompileRun.bat] by silent installer for respective product processer.
- Application Template PDB schema should be checked for sanity with zero invalids.

3.2 Creation of Application Root and Application Seed

3.2.1 Purpose

- Application Root
    - An application root shares some characteristics with the CDB root, because it can contain common objects, and some characteristics with a PDB, because it is created with the CREATE PLUGGABLE DATABASE statement.
- Application Seed
    - After Application Root creation, Application Seed to be created by clone from Application Root. Application seed to be synched with Application Root, whenever there is DB objects deployed in Application Root. i.e., Application seed will have latest DB references of Application Root. Application seed will be used as template to create (entity) Application PDBs.
    - An optional application PDB that serves as a template for creating other PDBs within an application container

3.2.1.1 Application Root and Application Seed Creation

- Application Root

  Application Root will be created from Application Template PDB through clone. Application Root will hold all the DB objects as single source repository. Initially, the database sources will be copied Application Template PDB. On subsequent patch set upgrade, the database sources will be deployed in Application Root using upgrade mode.

- Application Seed

  After Application Root creation, Application Seed to be created by clone from Application Root. Application seed to be synched with Application Root, whenever there is DB objects deployed in Application Root. i.e., Application seed will have latest DB references of Application Root. Application seed will be used as template to create (entity) Application PDBs.

3.2.2 Steps to be followed

Below script will create the Application root and Application seed. DBA rights are required to perform this step.

Approot_AppSeed_Creation.sql

(**Refer the Attachment panel of this document to view the script**)

Input sample for the script:

CDB Schema User Name	Sys
CDB Schema Password	Sys
CDB Host	1.1.1.1
CDB Port	1524
CDB Name	FC142CBD
DB Mounted Path	/scratch/db1800dat
Template PDB Name	Templatepdb
Approot Name	Approot1
Pdb to app pdb path	C:\app_18c\client\user\product\18.0.0\client_1\rdbms\admin\pdb_to_appdb.sql
Common User Name	CMNUSER

3.3 Application Maintenance and PDB creation

3.3.1 Purpose

Application Maintenance:

- An application installation is the initial creation of a master application definition. A typical installation creates user accounts, tables, and PL/SQL packages.
- An application upgrade is a major change to an installed application. Typically, an upgrade changes the physical architecture of the application. For example, an upgrade might add new user accounts, tables, and packages, or alter the definitions of existing objects.

Creation of Application PDB:

- Application PDB (entity) to be created by clone from Application seed available under Application root. This is associated PDB under Application Root. Any DB sources changes deployed in Application Root, those changes to be synched with Application PDB, if required.
- Later if new Application PDB to be created, new Application PDB will be created by clone from Application seed. Since Application seed will hold latest DB sources by syncing with Application Root.

3.3.2 Steps for manual application setup

- Below steps to be followed to configure Application Root PDB
  - ✓ Application Installation
  - ✓ Application Root objects conversion
  - ✓ Application Seed Sync with the Application Root
  - ✓ Creation of Application PDB

3.3.2.1 Application Installation

Application installation has to be done in the approot as version 1.0 with being user made explicit.

This application name has to be used for further upgrade in case of object conversion and applying other patch set objects.

Below script will install the application in Application root. DBA rights are required to perform this step.

Application_Installation.sql

(**Refer the Attachment Panel of this document to view the script**)

Input sample for the script:

CDB Schema User Name	Sys
CDB Schema Password	Sys
CDB Host	1.1.1.1
CDB Port	1524
Application Root Name	Approot1
Common User Name	CMNUSER

3.3.2.2 Application Root objects conversion

- By default sharing type of all DB objects loaded in the Application Root will be none.
- A static table will hold the information of selected tables for which the sharing type is DATA LINK. Other tables will be treated as METADATA LINK
- Sharing of object types such as INDEX, LOB, TABLE PARTITION, SEQUENCE, JOB, MATERIALIZED VIEW and DYNAMIC PACKAGES will remain as NONE.
- All other object types such **as** SYNONYM, VIEW, TRIGGER FUNCTION, PROCEDURE, **and** PACKAGE would be converted as METADATA LINK.

Object Conversion

- With the above sharing type considerations, DB object types will be converted as DATA LINK and METADATA LINK as part of this application root object conversion step.
- User has to connect to Application Root as common user and then apply changes in upgrade mode with the same application name used in step 3.
- This step will be done from the installer and user will have 4 options to do the conversion as,
    - ➢ Shared Application
    - ➢ Shared Application and User Authentication
    - ➢ Shared Application and Shared Data – Default
    - ➢ Shared Application and Shared Data – Custom

Note:

Application root will be created through cloning from Application Template PDB which will have only the static data. Transaction or maintenance related data will not be available in the Application root.

Here all the function Ids will be available as PDB function ids.

Shared Application and User Authentication

SMS function ids will be available in Approot and the remaining all function ids will be available as PDB function ids.

Shared Application and Shared Data – Default

Identified list of entities will be available in approot and sharing of entities from Approot to individual PDBs is applicable in this model.

Shared Application and Shared Data – Custom

Identified list of entities will be available in approot and sharing of entities from Approot to individual PDBs is applicable in this model.

Additionally, User can opt-out the entities which are not required to be the candidates of approot and those function ids will be moved to PDB.

The application name and type of deployment will be stored in CSTB_PARAM table in approot.

PARAM_NAME	PARAM_VAL
MULTI_TENANT_APP_NAME	FCUBS
MULTI_TENANT_DEPLOYMENT_MODEL	SA (or) SAUA (or) SASDD (or) SASDC

Object conversion is a one-time activity and if it is tried again, system will validate based on the availability of cstb_param values.

3.3.2.3 Application Seed Sync with the Application Root

- In Application Root, post conversion of object type as DATA LINK and METADATA LINK, user need to sync Application Root with Application Seed.
- Post sync, characteristic of objects available in Application seed and Application PDBs will be same.
- Every patch set upgradation in Application Root,
  - User need to sync, Application Root with Application seed, to keep Application seed to hold the latest DB sources since Application seed will be used to create new PDBs further along.

Below Scripts can also be used to execute this step. This step can be performed from common user.

Approot_AppSeed_Sync.sql

(**Refer the Attachment panel of this document to view the script**)

Input sample for the script:

Approot Schema Username	CMNUSER
Approot Schema Password	CMNUSER
Approot Host	1.1.1.1
Approot Port	1524
Application Root Name	Approot1
Application Name	FCUBS

3.3.2.4 Creation of Application PDB

A PDB that is plugged in to an application container can be created from application seed through cloning.

Below script will be used to create Application PDB from Application Seed. DBA rights are required to perform this step.

Application_PDB_Creation.sql

(**Refer the Attachment panel of this document to view the script**)

Input sample for the script:

CDB Name	FC142CDB
CDB Schema User Name	Sys
CDB Schema Password	Sys
CDB HOST	1.1.1.1
CDB PORT	1522
CDB Mounted Path	/scratch/db1800dat/FC142CDB/templatePDB/users01.dbf
Application Root Name	FCAPPROOT
Application PDB Name	FCAPPPDB1

3.3.3 Steps for application setup when transaction data exists

- If the maintenance/ transaction data import has to be carried out in the Application root and Application PDBs, below steps has to be followed in the sequential order:

  - ✓ Creation of Application PDB
  - ✓ Application Installation
  - ✓ Application Root objects conversion
  - ✓ Application PDB Sync with the Application Root
  - ✓ Application Seed Sync with the Application Root

3.3.3.1 Creation of Application PDB

A PDB that is plugged in to an application container can be created from application seed through cloning.

Below script will be used to create Application PDB from Application Seed. DBA rights are required to perform this step.

Application_PDB_Creation.sql

Refer the Attachment panel of this document to view the script)

Input sample for the script:

CDB Name	FC142CDB

CDB Schema User Name	Sys
CDB Schema Password	Sys
CDB HOST	1.1.1.1
CDB PORT	1522
CDB Mounted Path	/scratch/db1800dat/
Application Root Name	FCAPPROOT
Application PDB Name	FCAPPPDB1

Note for Shared Application and User Authentication deployment model before object conversion:

SMS function ids will be available in Approot and the remaining all function ids will be available as PDB function ids.

1. Application root before object conversion will only have the static data.

2. If the data import has to be done to the application root schema, following steps 3 to 8 has to be carried out.

3. Triggers have to be disabled in the respective schemas before initiating the import.

4. Tables which are going to be available in the Application root as part of this model can be identified with the below query. (Total of around 21 tables)

```
SELECT DISTINCT a.object_name
 FROM cstm_approot_objects a
WHERE sharing = 'DL'
  AND UPPER(object_type) = 'TABLE'
  AND EXISTS (SELECT 1
        FROM user_objects b
       WHERE b.object_name = a.object_name
         AND b.object_type = 'TABLE')
  AND EXISTS (SELECT 1
        FROM cstm_approot_functions_menu c
       WHERE c.function_id = a.function_id
         AND c.modifiable = 'S');
```

5. The export data dump taken from the entities has to be imported into the application root schema only for these above set of tables.

6. For the PDB's, data from the entities can be directly imported into the respective application PDBs.

7. Once the import is completed, triggers have to be enabled again in the schemas.

8. After the data import, object conversion will be done from the installer.

Example:

If there are two entity schemas available for India and Japan region and we have two export dump taken for these schemas.

Step 1: Importing data into the Application root schema

Import the dump taken from India entity schema for the given list of tables followed by the import of dump from Japan entity schema for the same list of tables.

If the table is already present in the application root schema, action should be allowed to just append the table data.

```
impdp Approot_user/Approot_pwd@Approot_Schema
tables= < Tables from the above script>
content=DATA_ONLY
DIRECTORY=DUMP_FC144ENTITY1
DUMPFILE=FC144DEVPDB1_FULDUMP_210519.DMP
LOGFILE=FC144DEVPDB1_FULDUMP_APPROOT_260919_LOG.LOG
REMAP_SCHEMA=FC143ITR:FC14419CM1
REMAP_TABLESPACE=FC143ITR:FC14419CM1/USERS
DATA_OPTIONS=skip_constraint_errors
table_exists_action=append transform=OID:n

Note: Remap Tablespace recheck in target schema before providing.
```

Step 2: Importing data into the Application PDB schema

Once the first Application PDB is created from the application seed which will have only the data for static INCs, import the full dump taken from India entity schema

Similarly, for the second application PDB import the full dump taken from Japan entity schema

If the table is already present in the application PDB, action should be allowed to just append the table data.

```
impdp Approot_user/Approot_pwd@Approot_Schema
DIRECTORY=DUMP_FC144ENTITY1
DUMPFILE=FC144DEVPDB1_FULDUMP_210519.DMP
LOGFILE=FC144DEVPDB1_FULDUMP_PDB_260919_LOG.LOG
REMAP_SCHEMA=FC143ITR:FC14419CM1
REMAP_TABLESPACE=FC143ITR:FC14419CM1/USERS
DATA_OPTIONS=skip_constraint_errors
table_exists_action=append transform=OID:n

Note: Remap Tablespace recheck in target schema before providing.
```

Note for Shared Application and Shared Data – Default deployment model before object conversion:

Identified list of entities will be available in approot and sharing of entities from Approot to individual PDBs is applicable in this model.

1. Application root before object conversion will only have the static data.

2. If the data import has to be done to the application root/ schema, following steps 3 to 8 has to be carried out.

3. Triggers have to be disabled in the respective schemas before initiating the import.

4. Tables which are going to be available in the Application root as part of this model can be identified with the below query. (Total of around 464 tables)

```
SELECT DISTINCT a.object_name
 FROM cstm_approot_objects a
WHERE sharing = 'DL'
  AND UPPER(object_type) = 'TABLE'
  AND EXISTS (SELECT 1
        FROM user_objects b
       WHERE b.object_name = a.object_name
        AND b.object_type = 'TABLE')
  AND EXISTS (SELECT 1
        FROM cstm_approot_functions_menu c
       WHERE (c.function_id = a.function_id OR

           a.function_id IN ('STATIC', 'DYNAMIC')));
```

5. The export data dump taken from the entities has to be imported into the application root schema only for these above set of tables.

6. For the PDB's, data from the entities can be directly imported into the respective application PDBs.

7. Once the import is completed, triggers have to be enabled again in the schemas.

8. After the data import, object conversion will be done from the installer.

Example:

If there are two entity schemas available for India and Japan region and we have two export dump taken for these schemas.

Step 1: Importing data into the Application root schema

Import the dump taken from India entity schema for the given list of tables followed by the import of dump from Japan entity schema for the same list of tables.

If the table is already present in the application root schema, action should be allowed to just append the table data.

```
impdp Approot_user/Approot_pwd@Approot_Schema
tables= < Tables from the above script>
content=DATA_ONLY
DIRECTORY=DUMP_FC144ENTITY1
DUMPFILE=FC144DEVPDB1_FULDUMP_210519.DMP
LOGFILE=FC144DEVPDB1_FULDUMP_APPROOT_260919_LOG.LOG
REMAP_SCHEMA=FC143ITR:FC14419CM1
REMAP_TABLESPACE=FC143ITR:FC14419CM1
DATA_OPTIONS=skip_constraint_errors
table_exists_action=append transform=OID:n
```

Note: Remap Tablespace recheck in target schema before providing.

Step 2: Importing data into the Application PDB schema

Once the first Application PDB is created from the application seed which will have only the data for static INCs, import the full dump taken from India entity schema

Similarly, for the second application PDB import the full dump taken from Japan entity schema

If the table is already present in the application PDB, action should be allowed to just append the table data.

```
impdp Approot_user/Approot_pwd@Approot_Schema
DIRECTORY=DUMP_FC144ENTITY1
DUMPFILE=FC144DEVPDB1_FULDUMP_210519.DMP
LOGFILE=FC144DEVPDB1_FULDUMP_PDB_260919_LOG.LOG
REMAP_SCHEMA=FC143ITR:FC14419CM1
REMAP_TABLESPACE=FC143ITR:FC14419CM1
DATA_OPTIONS=skip_constraint_errors
table_exists_action=append transform=OID:n


Note: Remap Tablespace recheck in target schema before providing.
```

3.3.3.2 Application Installation

Application installation has to be done in the approot as version 1.0 with being user made explicit.

This application name has to be used for further upgrade in case of object conversion and applying other patch set objects.

Below script will install the application in Application root. DBA rights are required to perform this step.

Application_Installation.sql

(**Refer the Attachment Panel of this document to view the script**)

Input sample for the script:

CDB Schema User Name	Sys
CDB Schema Password	Sys
CDB Host	1.1.1.1
CDB Port	1524
Application Root Name	Approot1
Application Name	FCUBS
Common User Name	CMNUSER

3.3.3.3 Application Root objects conversion

- By default sharing type of all DB objects loaded in the Application Root will be none.

- A static table will hold the information of selected tables for which the sharing type is DATA LINK. Other tables will be treated as METADATA LINK
- Sharing of object types such as INDEX, LOB, TABLE PARTITION, SEQUENCE, JOB, MATERIALIZED VIEW and DYNAMIC PACKAGES will remain as NONE.
- All other object types such **as** SYNONYM, VIEW, TRIGGER FUNCTION, PROCEDURE, **and** PACKAGE would be converted as METADATA LINK.

Object Conversion

- With the above sharing type considerations, DB object types will be converted as DATA LINK and METADATA LINK as part of this application root object conversion step.
- User has to connect to Application Root as common user and then apply changes in upgrade mode with the same application name used in step 3.
- This step will be done from the installer and user will have 4 options to do the conversion as,
    - Shared Application
    - Shared Application and User Authentication
    - Shared Application and Shared Data – Default
    - Shared Application and Shared Data – Custom

Note:

Application root will be created through cloning from Application Template PDB which will have only the static data. Transaction or maintenance related data will not be available in the Application root.

Shared Application

Here all the function Ids will be available as PDB function ids.

Shared Application and User Authentication

SMS function ids will be available in Approot and the remaining all function ids will be available as PDB function ids.

Shared Application and Shared Data – Default

Identified list of entities will be available in approot and sharing of entities from Approot to individual PDBs is applicable in this model.

Shared Application and Shared Data – Custom

Identified list of entities will be available in approot and sharing of entities from Approot to individual PDBs is applicable in this model.

Additionally, User can opt-out the entities which are not required to be the candidates of approot and those function ids will be moved to PDB.

The application name and type of deployment will be stored in CSTB_PARAM table in approot.

PARAM_NAME	**PARAM_VAL**
MULTI_TENANT_APP_NAME	FCUBS
MULTI_TENANT_DEPLOYMENT_MODEL	SA (or) SAUA (or) SASDD (or) SASDC

Object conversion is a one-time activity and if ti is tried again, system will validate based on the availability of cstb_param values.

3.3.3.4 Application PDB Sync with the Application Root

- In Application Root, post conversion of object type as DATA LINK and METADATA LINK, user need to sync Application PDB with Application Root.
- Post sync, characteristic of objects available in Application root and Application PDBs will be the same.

Below Script can be used to execute this step. This step can be performed from common user.

Approot_PDB_Sync.sql

(**Refer the Attachment panel of this document to view the script**)

Input sample for the script:

PDB Schema Username	CMNUSER
PDB Schema Password	CMNUSER
PDB Host	1.1.1.1
PDB Port	1524
PDB Name	Approot1
Application Name	FCUBS

3.3.3.5 Application Seed Sync with the Application Root

- In Application Root, post conversion of object type as DATA LINK and METADATA LINK, user need to sync Application Root with Application Seed.
- Post sync, characteristic of objects available in Application seed and Application root will be same.
- On every patch set upgrade in Application Root, user need to sync the application root with application seed, to keep Application seed hold the latest DB sources since Application seed will be used to create new PDBs further along.

Below Scripts can also be used to execute this step. This step can be performed from common user.

Approot_AppSeed_Sync.sql

(**Refer the Attachment panel of this document to view the script**)

Input sample for the script:

Approot Schema Username	CMNUSER
Approot Schema Password	CMNUSER
Approot Host	1.1.1.1
Approot Port	1524
Approot Name	Approot1
Application Name	FCUBS

3.4 Day Zero Setup

- Existing Installer can be used to do day zero setup with configuration mode as 'Application Root' and by selecting the radio button 'Utilities'. This step has to be executed for every entity PDB separately.

  (Refer: **FCUBS_DB_Setup.docx**)

3.5 EAR Creation and Deployment

- Existing installer file ROFCEarRun.bat can be used to create EAR.
- EAR deployment has to be deployed manually from console. During EAR deployment, JNDI connectivity details to be maintained for every Application PDB. JNDI details of Application PDB will be captured during Day Zero Setup.

4.1 Approot Object Conversion: Shared Application

Kindly make sure all dynamic package exceptions should have an entry in "CSTM_APPROOT_OBJECTS" table.

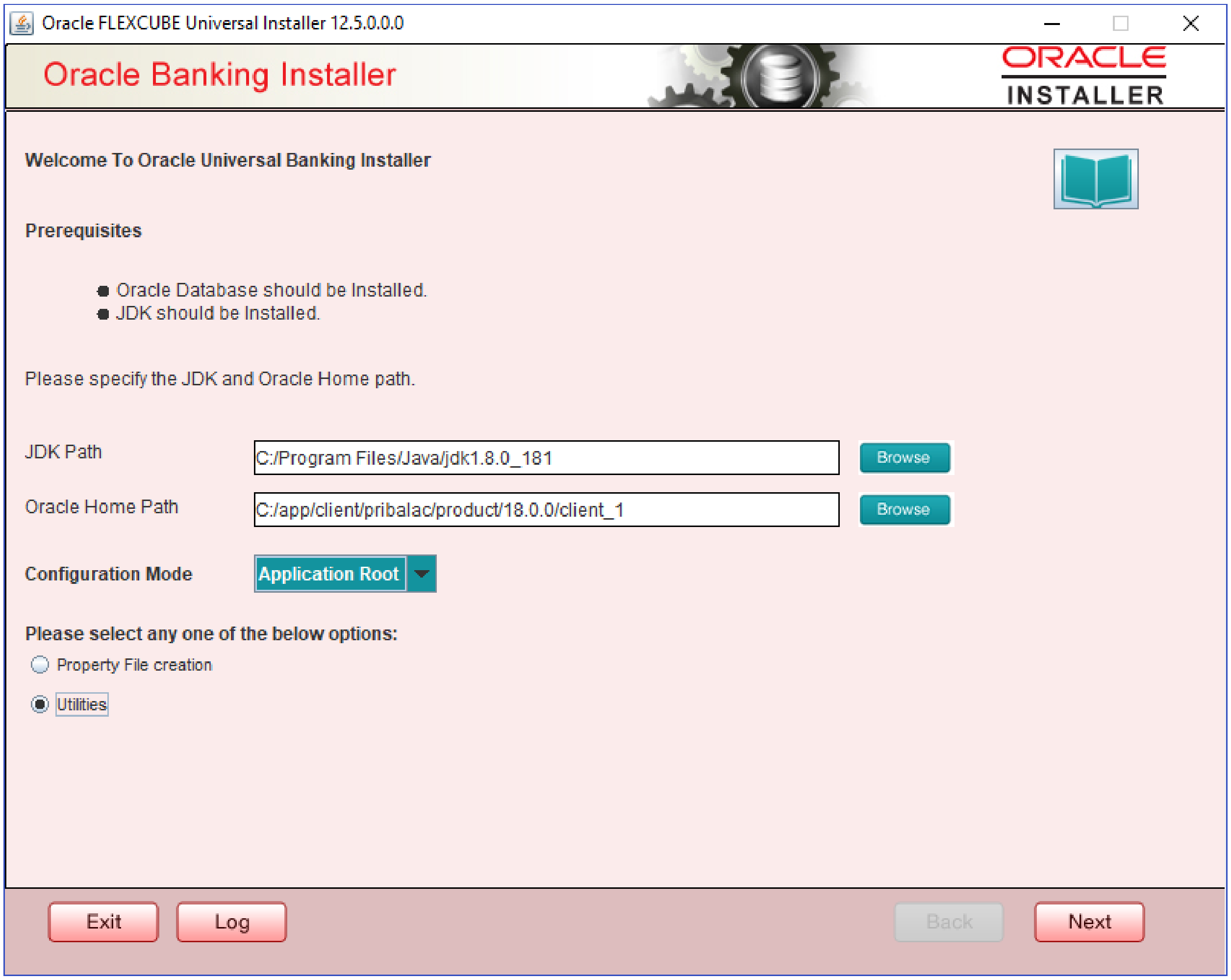
Example: Only package body will be considered as exception and package will be converted to METADATA link.

```
select * from cstm_approot_objects where object_name = 'CLPKS_MSG_SHELL';
```

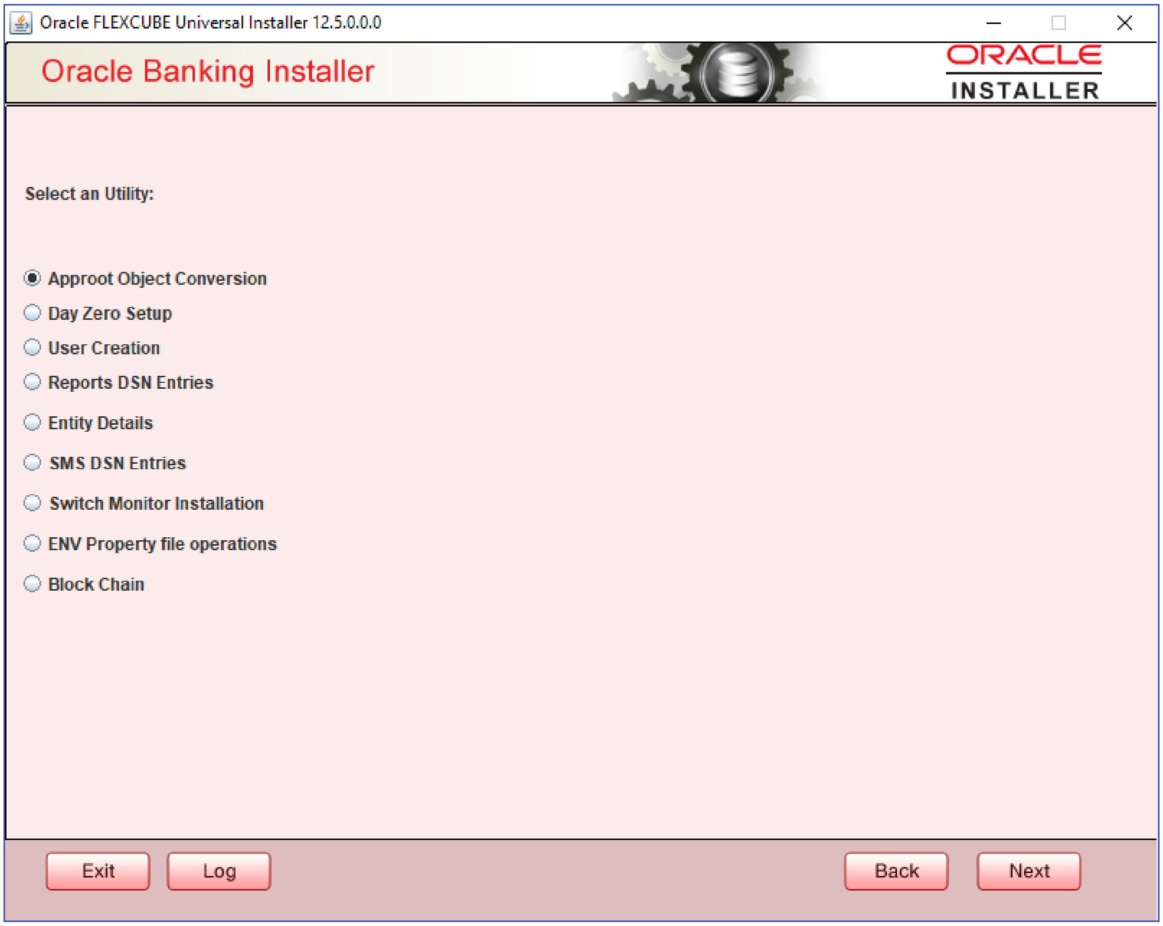
	FUNCTION_ID	OBJECT_NAME	OBJECT_TYPE	SHARING
1	DYNAMIC	CLPKS_MSG_SHELL	PACKAGE BODY	NONE

For multi-tenant deployment setup using the installer with deployment model as 'Shared Application', follow the steps given below.

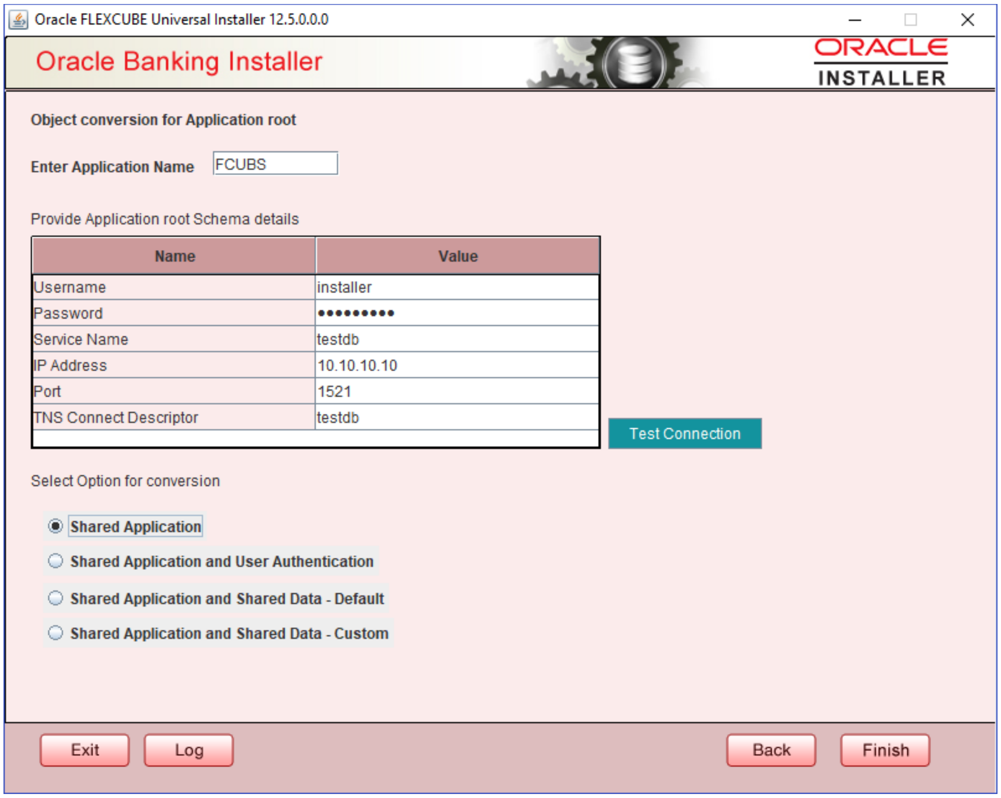
1. Double-click 'FCUBSInstaller.bat' batch file to launch Oracle FLEXCUBE Universal Installer. The following screen is displayed. Select Utilities option, configuration mode as "Application Root" and click 'Next' button.


Oracle FLEXCUBE Universal Installer 12.5.0.0.0
Oracle Banking Installer
ORACLE
INSTALLER
Welcome To Oracle Universal Banking Installer
Prerequisites
Oracle Database should be Installed.
JDK should be Installed.
Please specify the JDK and Oracle Home path.
JDK Path
C:/Program Files/Java/jdk1.8.0_181
Browse
Oracle Home Path
C:/app/client/pribalac/product/18.0.0/client_1
Browse
Configuration Mode
Application Root
Please select any one of the below options:
Property File creation
Utilities
Exit
Log
Back
Next

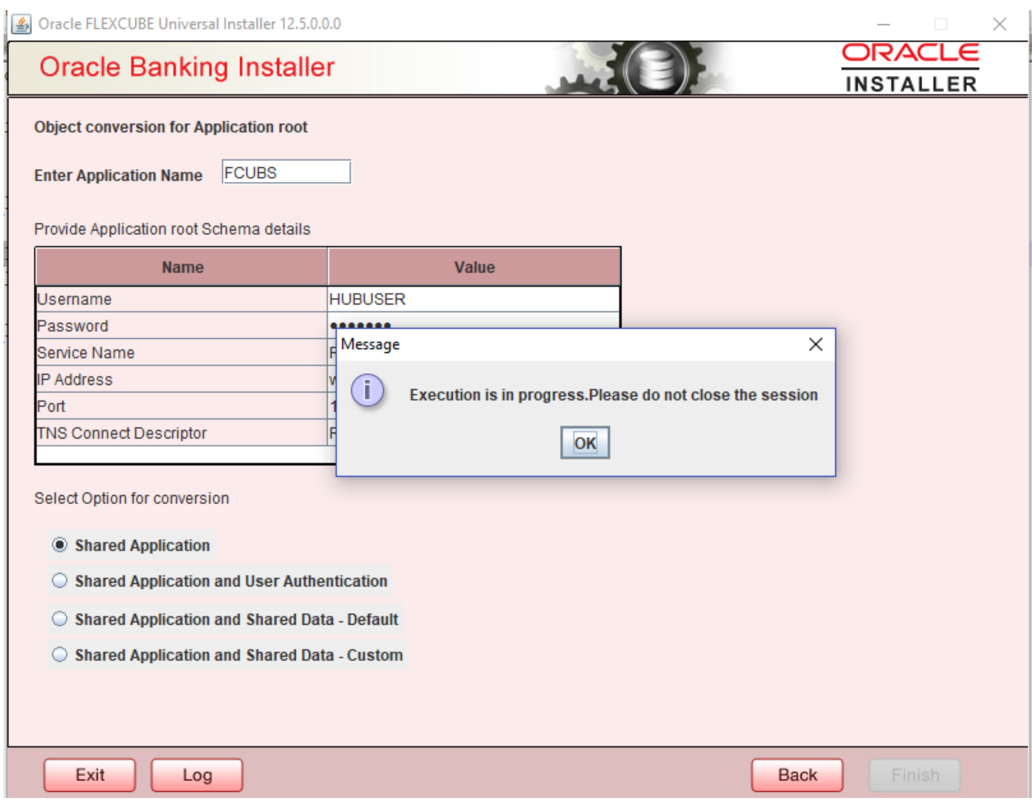
2. Select 'Approot object Conversion" in Utility Screen and click Next as shown below



3. In the Approot object conversion screen, enter Application name and the Application root schema details where the conversion has to be applied and click on 'Test Connection'.
4. Once the Connection is successful, 'Finish' button will be enabled.
5. User has to select the option '***Shared Application***' and click on the 'Finish' button to complete object conversion.



6. Execution will take few minutes and post completion, a dialog box displays ‘Compilation Success’ message in the front end.



7. This completes the setup and user can click on Exit to close the session.

4.2 Approot Object Conversion: Shared Application and User Authentication

Kindly make sure all dynamic package exceptions should have an entry in "CSTM_APPROOT_OBJECTS" table.

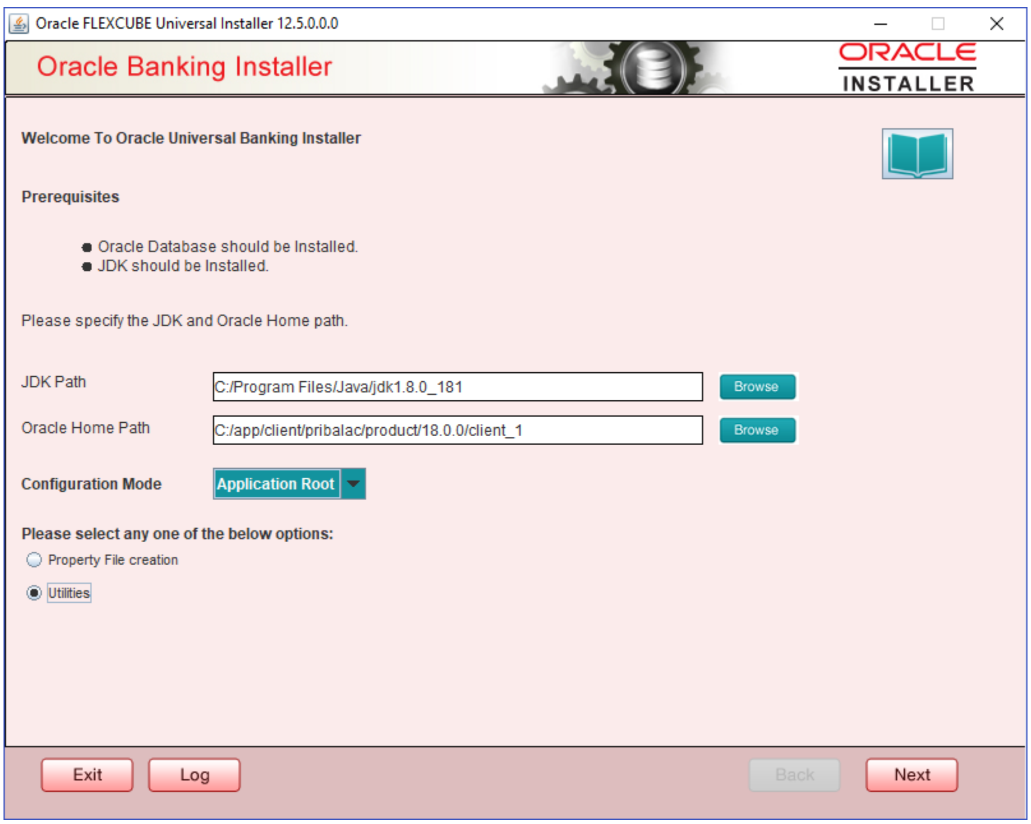
Example: Only package body will be considered as exception and package will be converted to METADATA link

```
select * from cstm_approot_objects where object_name = 'CLPKS_MSG_SHELL';
```

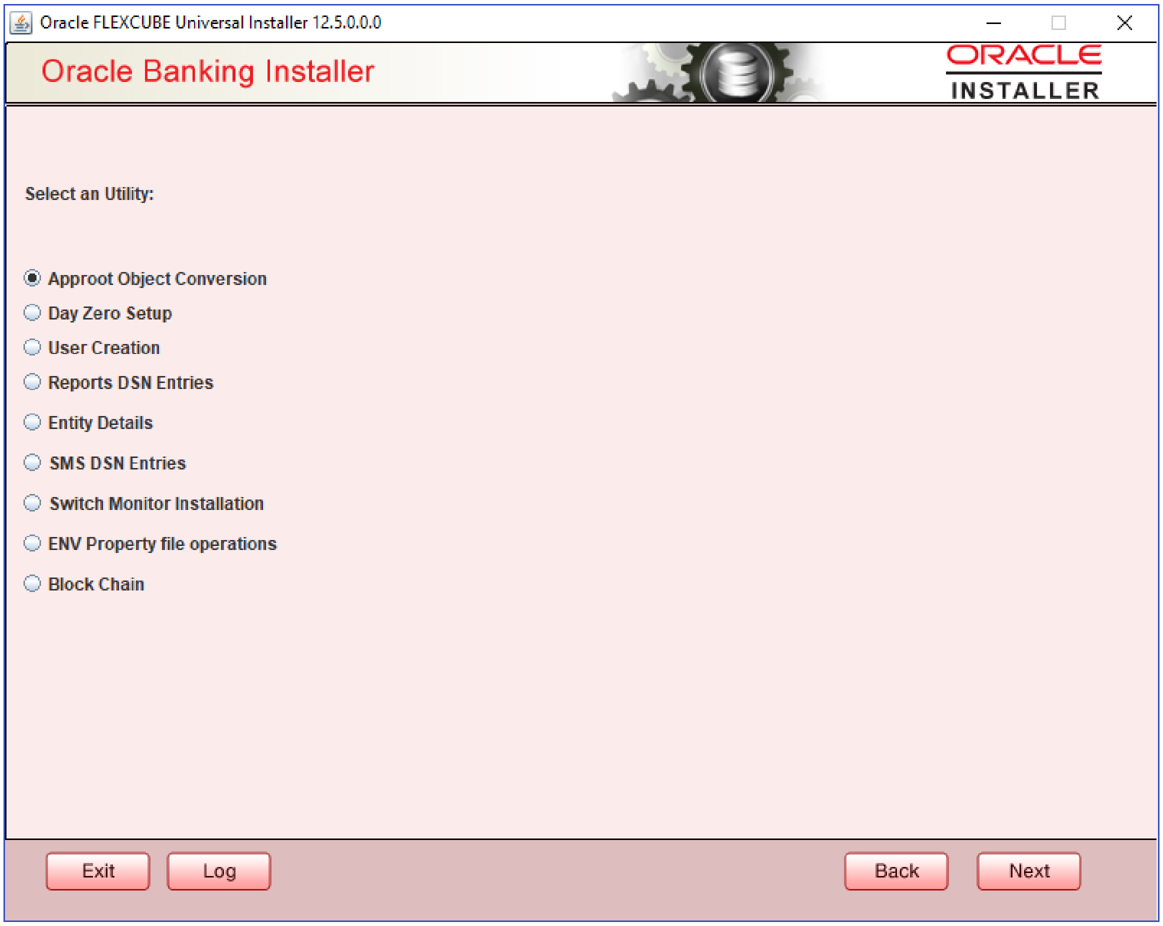
	FUNCTION_ID	OBJECT_NAME	OBJECT_TYPE	SHARING
1	DYNAMIC	CLPKS_MSG_SHELL	PACKAGE BODY	NONE

For multi-tenant deployment setup using the installer with deployment model as 'Shared Application and User Authentication', follow the steps given below.

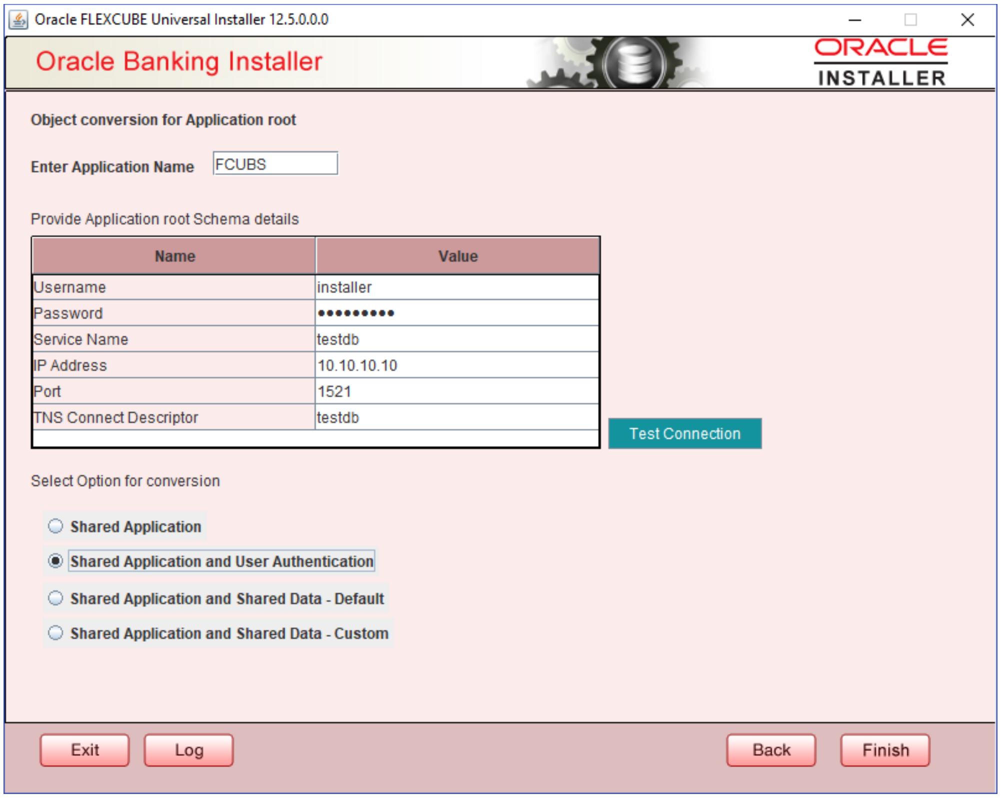
1. Double-click 'FCUBSInstaller.bat' batch file to launch Oracle FLEXCUBE Universal Installer. The following screen is displayed. Select Utilities option, configuration mode as "Application Root" and click 'Next' button.



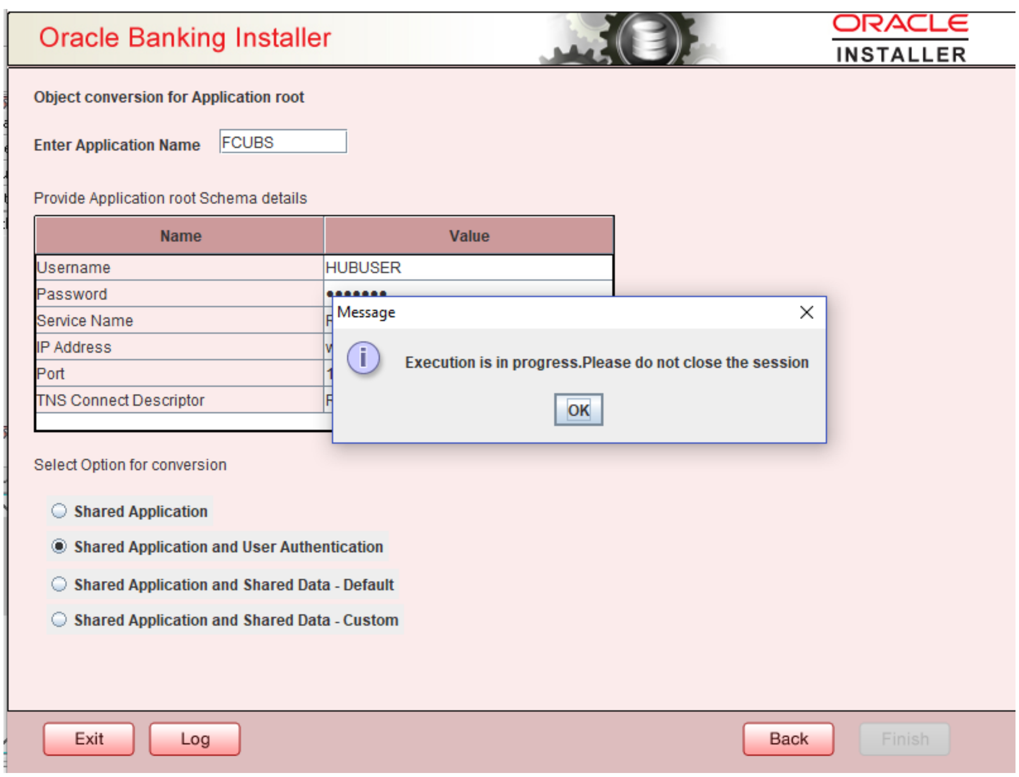
2. Select 'Approot object Conversion" in Utility Screen and click Next as shown below



3. In the Approot object conversion screen, enter Application name and the Application root schema details where the conversion has to be applied and click on ‘Test Connection’.
4. Once the Connection is successful, ‘Finish’ button will be enabled.
5. User has to select the option ‘**Shared Application and User Authentication’** and click on the ‘Finish’ button to complete object conversion.



6. Execution will take few minutes and post completion, a dialog box displays ‘Compilation Success’ message in the front end.



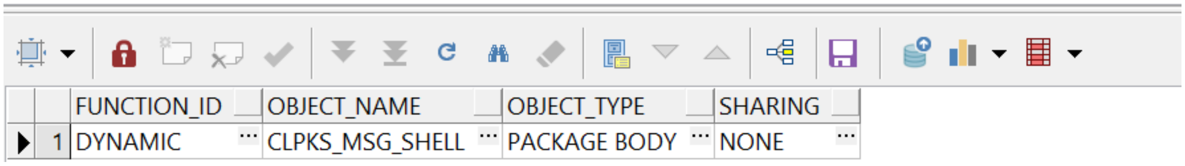
7. This completes the setup and user can click on Exit to close the session.

4.3 Approot Object Conversion: Shared Application and Shared Data – Default

Kindly make sure all dynamic package exceptions should have an entry in “CSTM_APPROOT_OBJECTS” table.

Example: Only package body will be considered as exception and package will be converted to METADATA link

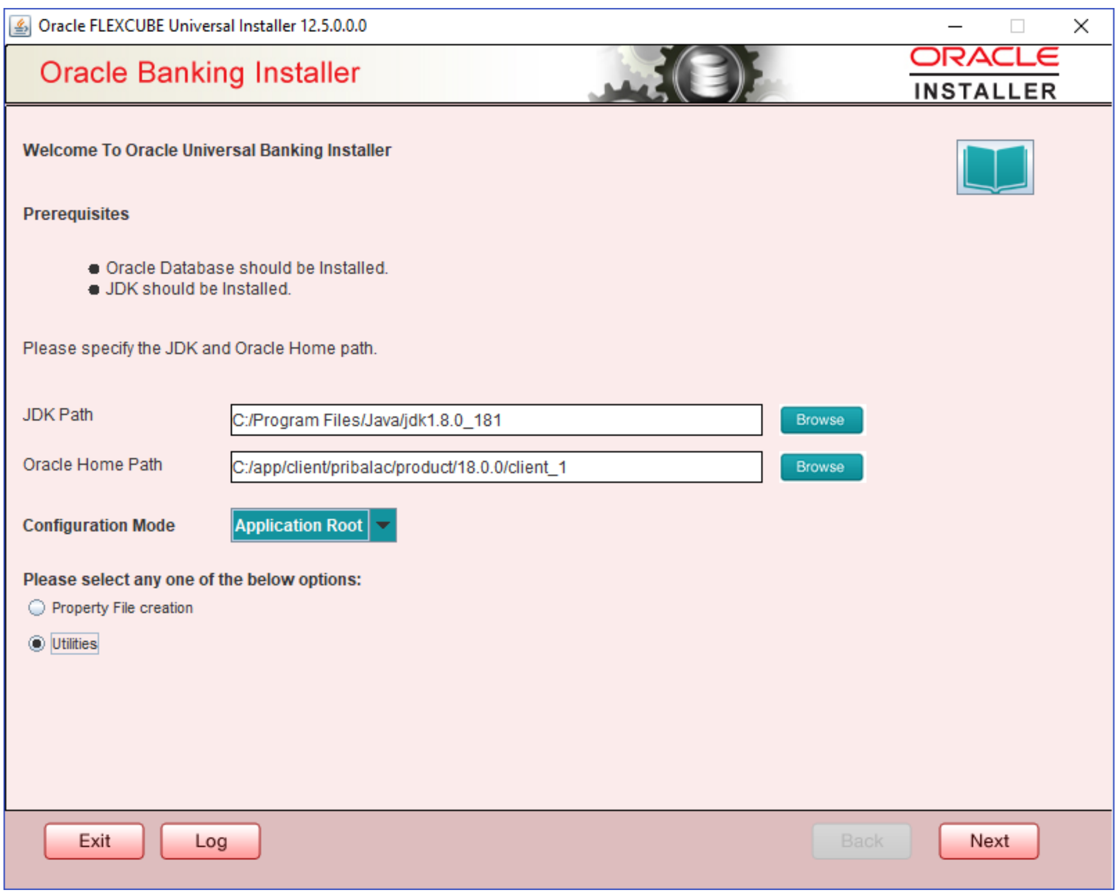
```
select * from cstm_approot_objects where object_name = 'CLPKS_MSG_SHELL';
```



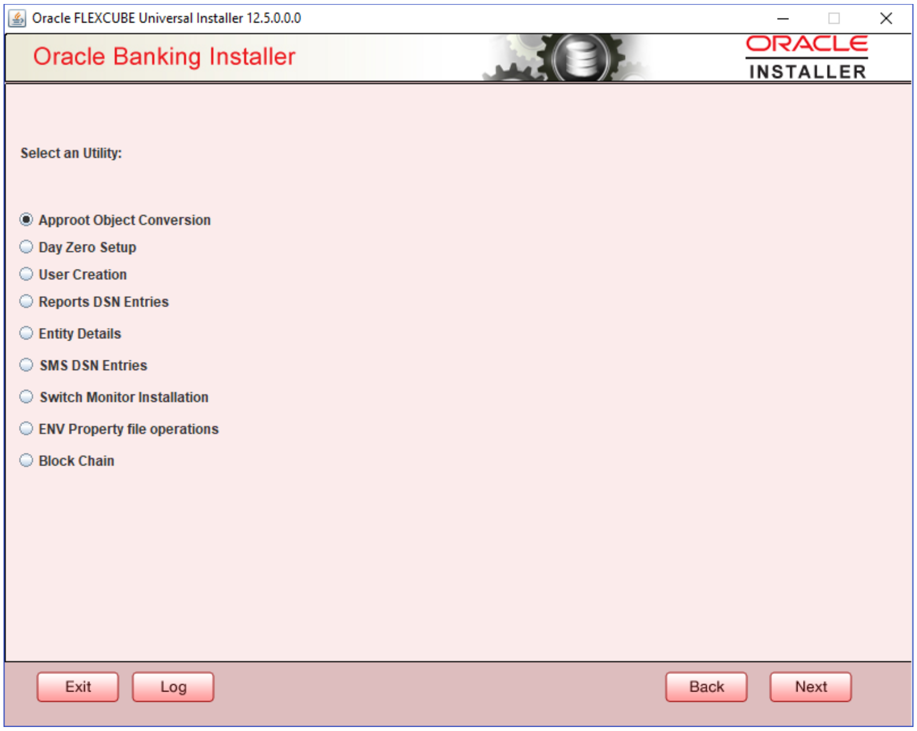
	FUNCTION_ID	OBJECT_NAME	OBJECT_TYPE	SHARING
1	DYNAMIC	CLPKS_MSG_SHELL	PACKAGE BODY	NONE

For multi-tenant deployment setup using the installer with deployment model as ‘Shared Application and Shared Data - Default’, follow the steps given below.

1. Double-click ‘FCUBSInstaller.bat’ batch file to launch Oracle FLEXCUBE Universal Installer. The following screen is displayed. Select Utilities option, configuration mode as “Application Root” and click ‘Next’ button.



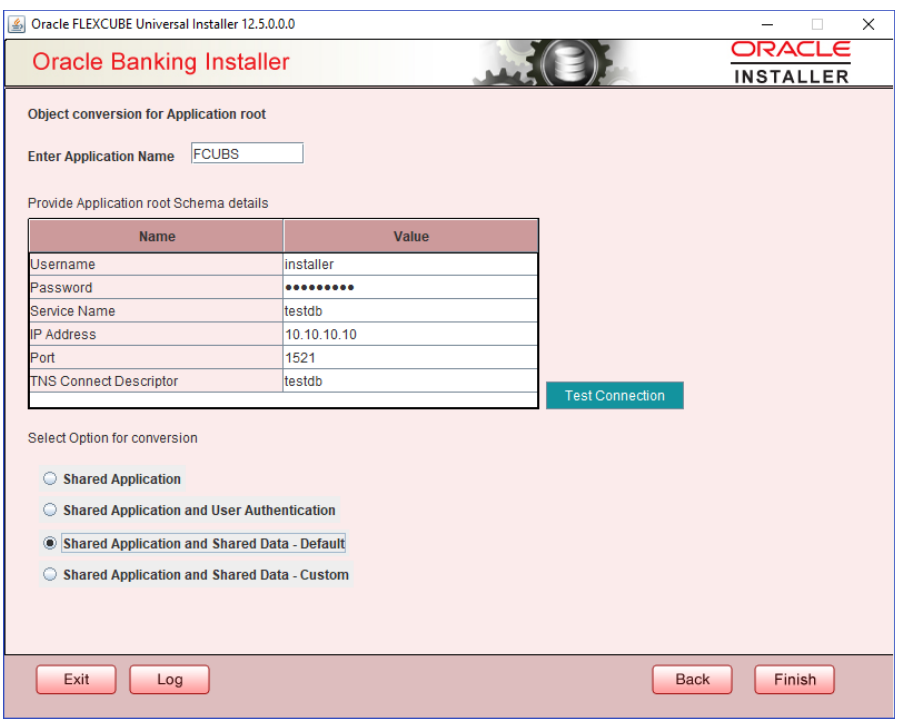
2. Select ‘Approot object Conversion’ in Utility Screen and click Next as shown below



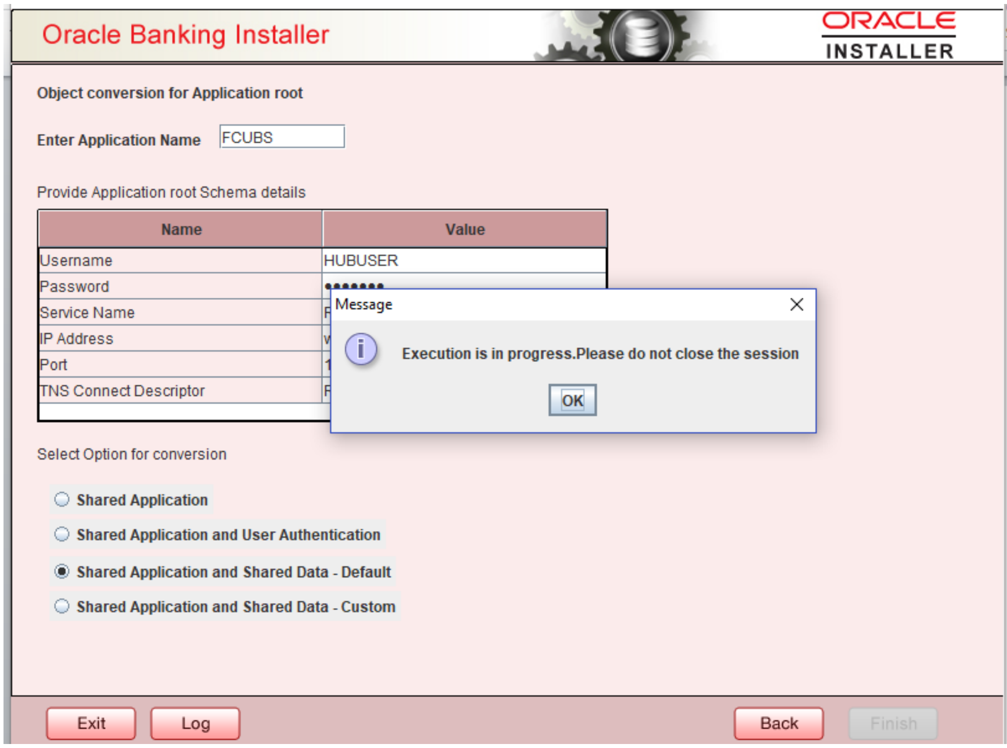
3. In the Approot object conversion screen, enter Application name and the Application root schema details where the conversion has to be applied and click on 'Test Connection'.

4. Once the Connection is successful, 'Finish' button will be enabled.

5. User has to select the option '**Shared Application and Shared Data - Default'** and click on the 'Finish' button to complete object conversion.



6. Execution will take few minutes and post completion, a dialog box displays ‘Compilation Success’ message in the front end.



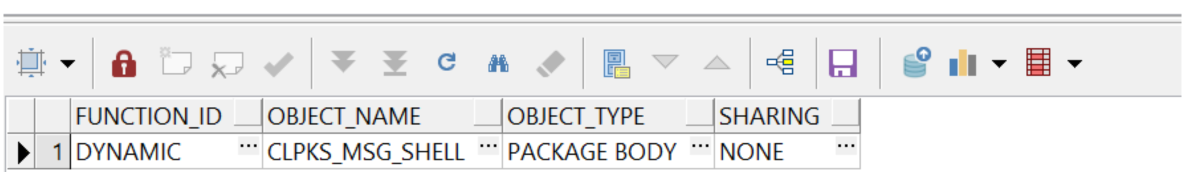
7. This completes the setup and user can click on Exit to close the session.

4.4 Approot Object Conversion: Shared Application and Shared Data – Custom

Kindly make sure all dynamic package exceptions should have an entry in “CSTM_APPROOT_OBJECTS” table.

Example: Only package body will be considered as exception and package will be converted to METADATA link

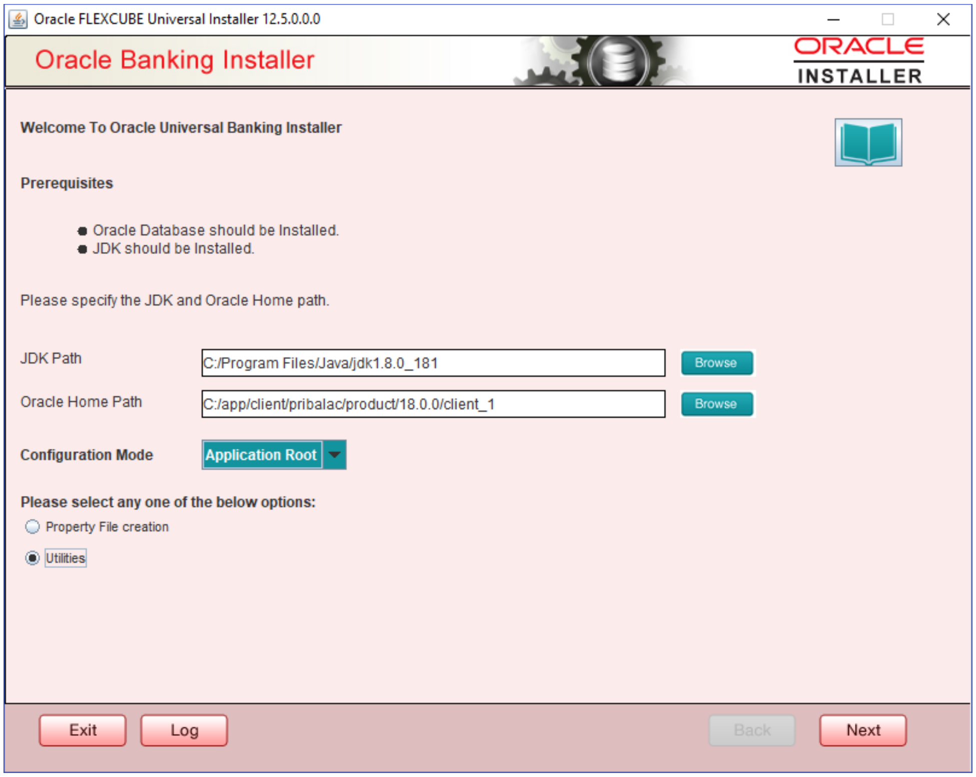
```
select * from cstm_approot_objects where object_name = 'CLPKS_MSG_SHELL';
```



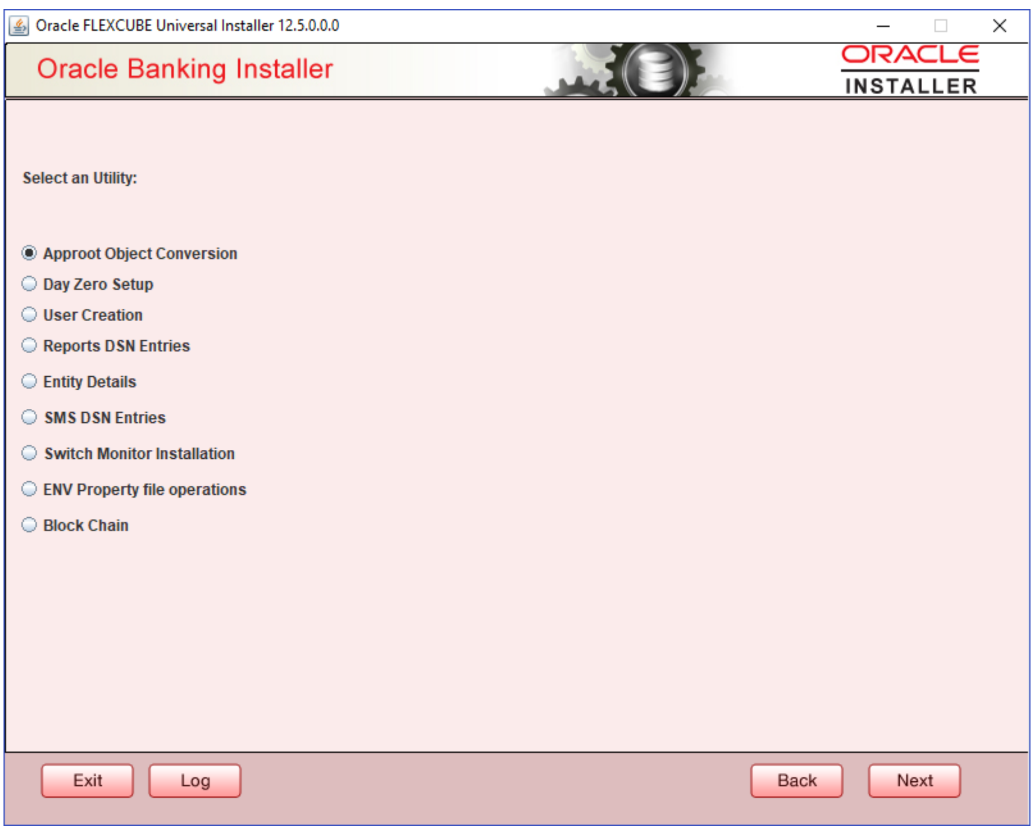
	FUNCTION_ID	OBJECT_NAME	OBJECT_TYPE	SHARING
1	DYNAMIC	CLPKS_MSG_SHELL	PACKAGE BODY	NONE

For multi-tenant deployment setup using the installer with deployment model as ‘Shared Application and Shared Data -Custom’, follow the steps given below.

1. Double-click ‘FCUBSInstaller.bat’ batch file to launch Oracle FLEXCUBE Universal Installer. The following screen is displayed. Select Utilities option, configuration mode as “Application Root” and click ‘Next’ button.



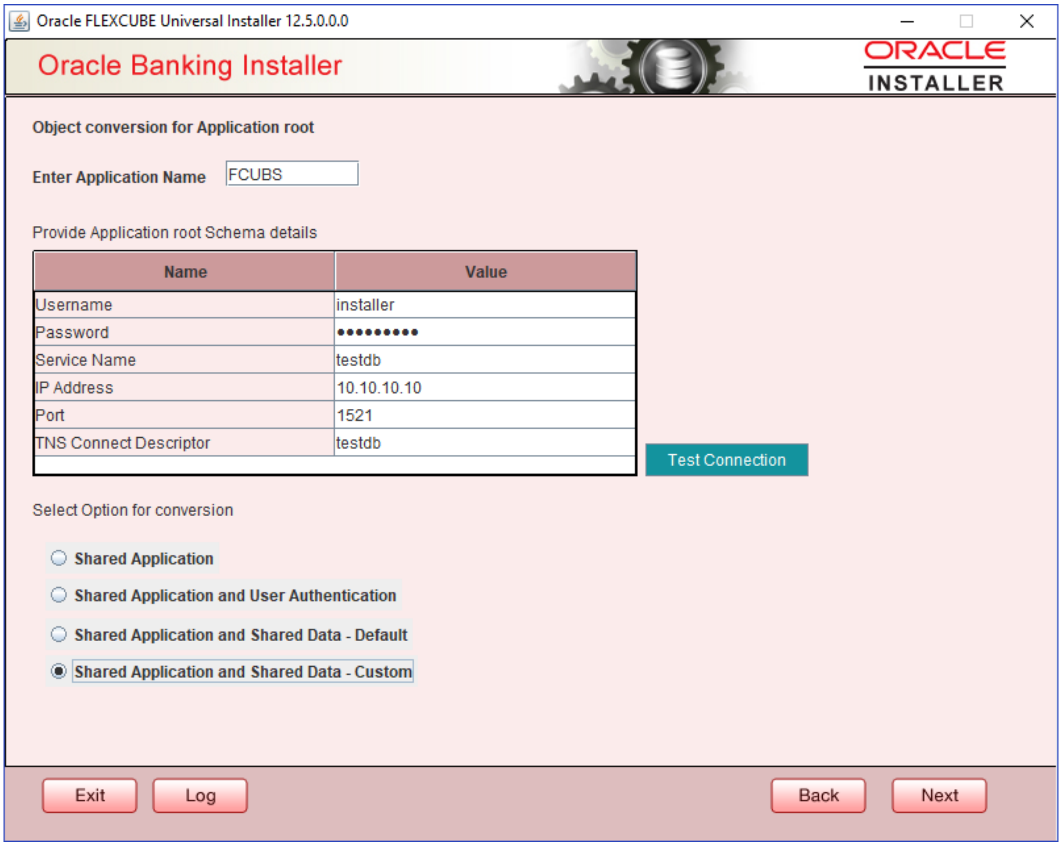
2. Select 'Approot object Conversion" in Utility Screen and click Next as shown below



3. In the Approot object conversion screen, enter Application name and the Application root schema details where the conversion has to be applied and click on 'Test Connection'.

4. Once the Connection is successful, ‘Next’ button will be enabled.

5. User has to select the option ‘**Shared Application & Shared Data - Custom’** and click on the ‘Next’ button to take through the steps of movement of function ids to PDB.



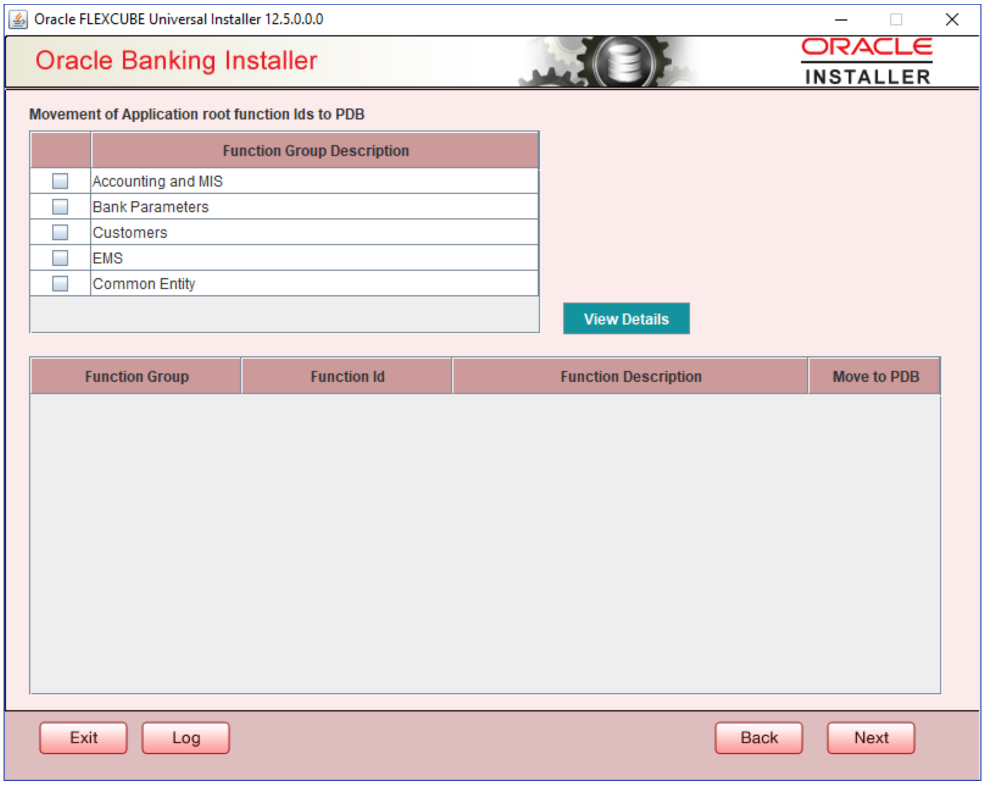
6. In the Next Screen, user can opt-out the entities which are not required to be the candidates of approot and those function ids will be moved to PDB.

7. There will be two multi blocks available.

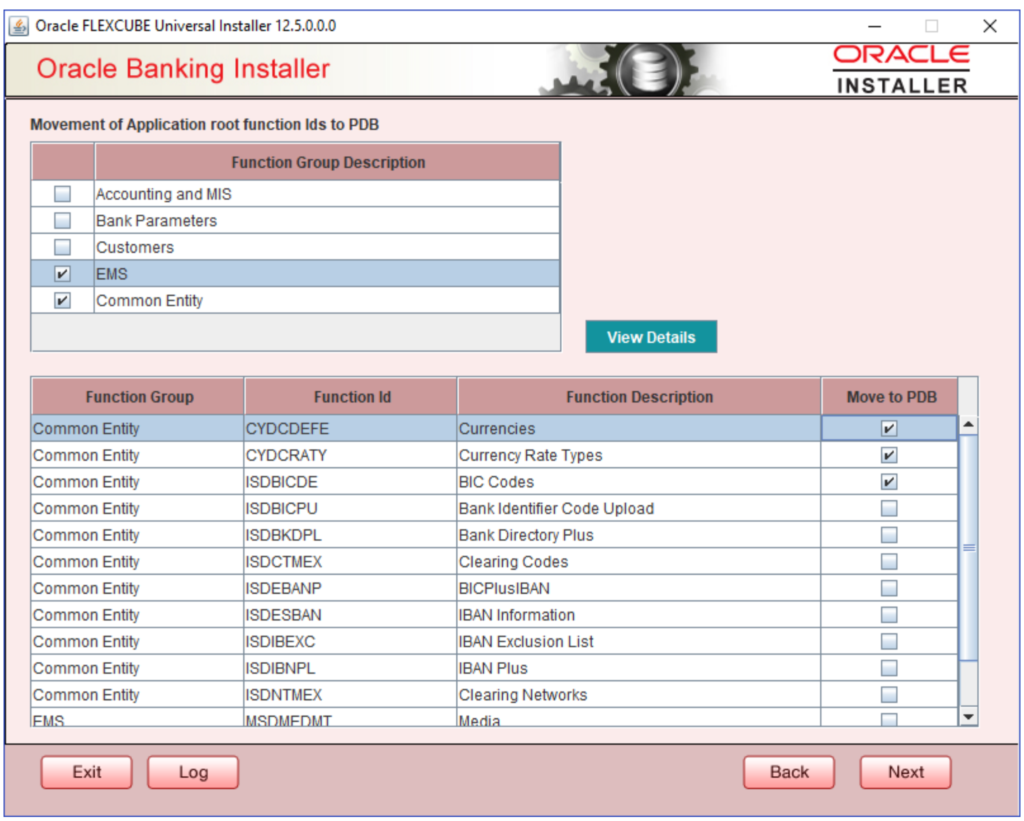
   a. First multi block will list the details of function groups which are the Approot candidates.

   b. Second multi block will list the function ids corresponding to each of the function group in the first block.

8. User can select more than one function group and the respective function ids will also be appended to the second multi block against the function group on click of ‘View Details’ button.

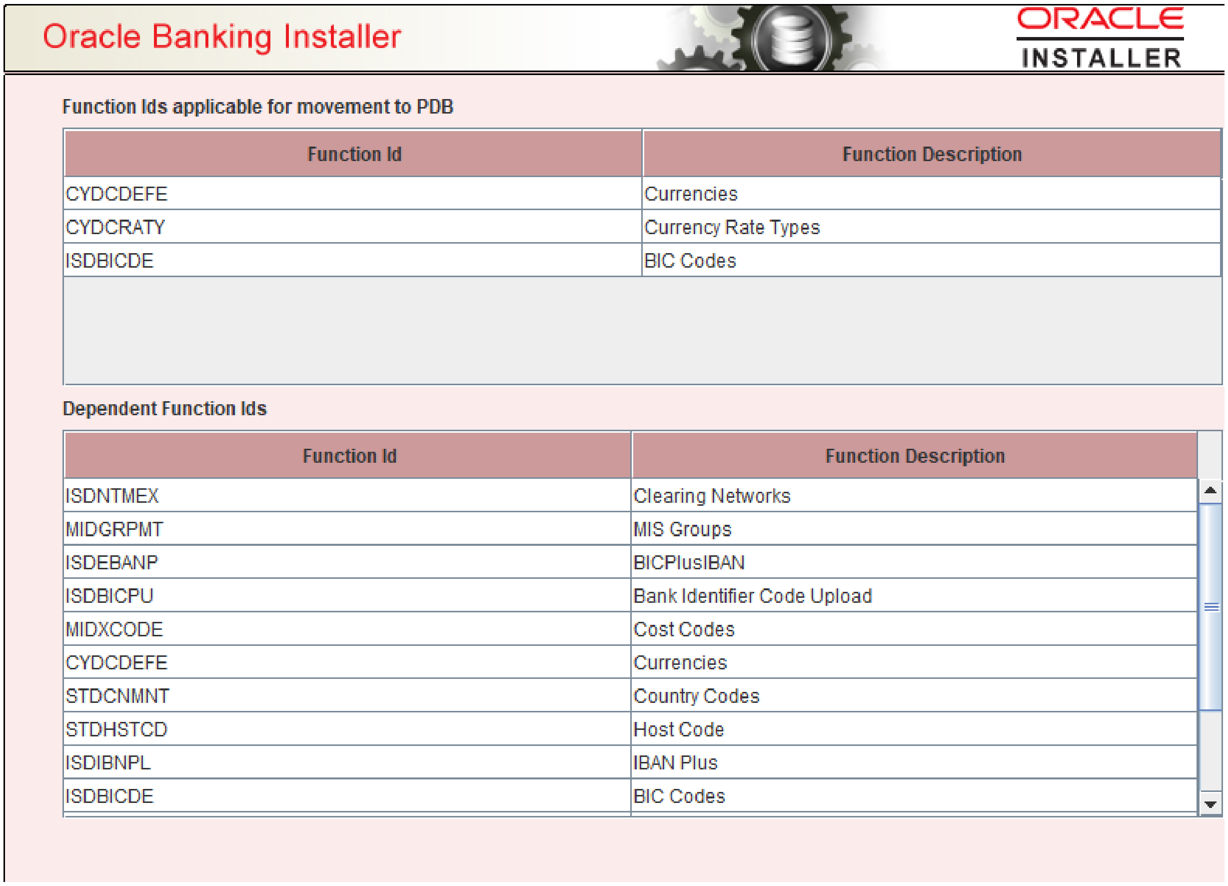


9. Second multi block will have the check box ‘Move to PDB’ against each function ID.



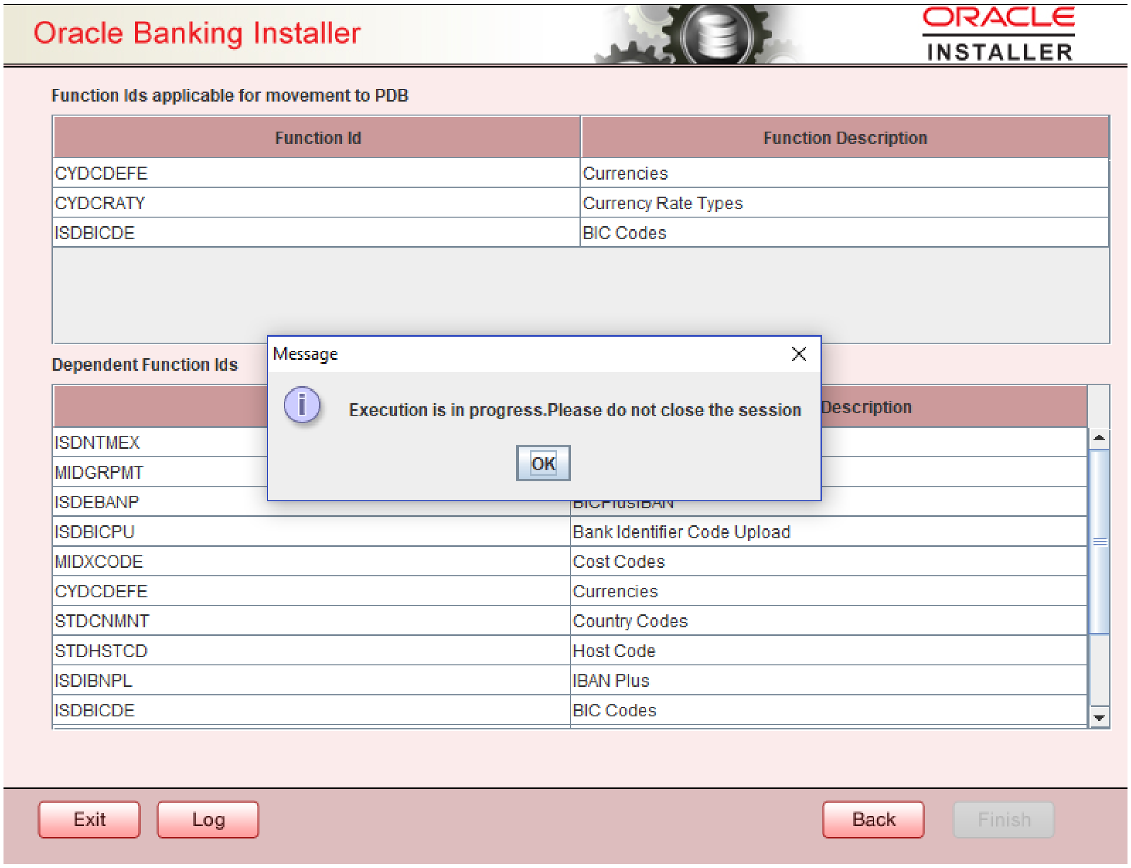
10. Once the selection is completed, ‘click on the Next button’ to move to the next screen where the complete list of function ids.

11. The dependent function ids of the selected functions opted to move to PDB will be listed in the below section



12. Object conversion can be completed by clicking on the Finish button.

13. Execution will take few minutes and post completion, a dialog box displays ‘Compilation Success’ message in the front end.



14. This completes the setup and user can click on Exit to close the session.

5. Mandatory step before PDB/SEED sync

Step1: Login into the Application Entity PDB/SEED as sys user

Step2: Create below attached function

fn_error_handler.fnc

Step3: Alter the DB Syncing error handling parameters

```
ALTER DATABASE PROPERTY SET SYNC_ERROR_HANDLER = 'sys.fn_error_handler';
```

✓ **Below are the errors handled during sync in Application PDB / Entity PDB.**

Oracle Docs		
Oracle Error	**Cause**	**Action**
ORA-24344	A sql/plsql compilation error occurred.	Return OCI_SUCCESS_WITH_INFO along with the error code
ORA-06512	Backtrace message as the stack is unwound by unhandled exceptions.	Fix the problem causing the exception or write an exception handler for this condition. Or you may need to contact your application administrator or DBA
ORA-65297	An operation was attempted that can only be performed outside an application action (install, uninstall, upgrade, or patch)	Perform the operation outside an application action.
ORA-65274	An operation was attempted that can only be performed in an application action (install, uninstall, upgrade, or patch).	Begin an application action.
ORA-00001	An UPDATE or INSERT statement attempted to insert a duplicate key. For Trusted Oracle configured in DBMS MAC mode, you may see this message if a duplicate entry exists at a different level	Either remove the unique restriction or do not insert the key
ORA-01430	An ALTER TABLE ADD statement specified the name of a column that is already in the table. All column names must be unique within a table.	Specify a unique name for the new column, then re-execute the statement

ORA-02264	The specified constraint name has to be unique.	Specify a unique constraint name for the constraint
ORA-01434	A DROP SYNONYM statement specified a synonym that does not exist. Existing synonym names may be listed by querying the data dictionary.	Specify the name of an existing synonym in the DROP SYNONYM statement.
ORA-00955	An attempt was made to create a database object (such as a table, view, cluster, index, or synonym) that already exists. A user's database objects must have distinct names.	Enter a unique name for the database object or modify or drop the existing object so it can be reused.
ORA-06550	Usually a PL/SQL compilation error.	None
ORA-04063	Cause: Attempt to execute a stored procedure or use a view that has errors. For stored procedures, the problem could be syntax errors or references to other, non-existent procedures. For views, the problem could be a reference in the view's defining query to a non-existent table. Can also be a table which has references to non-existent or inaccessible types.	Fix the errors and/or create referenced objects as necessary.

- **Significance of the application name**
  - The Application name provided at step 3 of the deployment will be used for any object modification like object conversion or patch-set application. Suggested name – FCUBS.
- **Roles for the Common user**
  - The common user should have DBA role while application install or upgrade. It can be revoked once the application maintenance is completed.
- **Can there be multiple Applications available in case of Co- deployment?**
  - It is recommended to have a single application as the Common core units can be released as part of any product processor and if the object can be linked to only one application.
  - Modification of the object belonging to one application cannot be modified in another application.
- **Day zero –set up in multi- tenant**
  - Day zero set up has be done for each of the PDBs created under the approot. The record insertion will be based on the sharing type of the object.
  - If the sharing is METADATA LINK, then the record for the table will be inserted into PDB schema and if the sharing is DATA LINK, record insertion happens in the approot schema for that table.
- **PDB creation possible errors**

Encountered the below error when the template PDB has read only schemas also available additionally.

```
ORA-65005: missing or invalid file name pattern for file -
/scratch/db1800dat/BRVCDB18C/SEEDFC142APPROOT/temp012018-01-08_16-05-42-077-PM.dbf
```

In such case, the FILE_NAME_CONVERT has to be provided with the full path till the temp file instead of the Approot and PDB path. Below link is referred to resolve this issue:

https://mosemp.us.oracle.com/epmos/faces/DocumentDisplay?_afrLoop=188548547043444&id=1910646.1&displayIndex=1&_afrWindowMode=0&_adf.ctrl-state=2mboo8is2_4

- **Sync failure with the PDB**
  - When synch with PDB fails, there is no definite solution available. Back up of the PDB can be taken before an upgrade and in case of synch failure; new PDB can be created and applied with the backup data.
  - Generally, for multi-tenant the recommendation is that objects will be compiled in a normal schema to check the sanity and to make sure the Invalids are zero. Once that is successful, the compilation will be done in Multi-tenant database.
- **Sync with PDB at different time**
  - Once the application upgrade is completed in approot, it can be synched up to the PDB. If the PDBs are not synched at the same time, there will be a mismatch between the front end and backend objects.
  - In such case when a single PDB is parked for synching afterwards, a separate front URL with backup EAR has to be created to point to the PDB schema.
- **During patch set deployment encountered below issues during sync into entity pdbs.**

```
ORA-21700: object does not exist or is marked for delete
```

ORA-44201: cursor needs to be reparsed

- Root cause can be traced in DBA_APP_ERRORS / DBA_ERRORS oracle table.
- Execute below command in Approot and Pdb. Consolidate list and create a sql file.

```
SELECT INVALIDOBJECT1
  FROM (SELECT 'alter ' || REFERENCED_TYPE || ' ' || REFERENCED_NAME ||
              ' compile;' INVALIDOBJECT1,
              1 INDX
         FROM USER_DEPENDENCIES
        WHERE NAME IN
              (SELECT object_name FROM user_objects WHERE status = 'INVALID')
          AND TYPE = 'PACKAGE'
          AND REFERENCED_TYPE IN ('PACKAGE', 'PACKAGE BODY')
          AND REFERENCED_NAME NOT IN ('STANDARD')
       UNION
       SELECT 'alter ' || OBJECT_TYPE || ' ' || OBJECT_NAME || ' compile;' INVALIDOBJECT1,
              2 INDX
         FROM USER_OBJECTS
        WHERE OBJECT_NAME IN
              (SELECT object_name FROM user_objects WHERE status = 'INVALID')
          AND OBJECT_TYPE IN ('PACKAGE')
       UNION
       SELECT 'alter package ' || OBJECT_NAME || ' compile body;' INVALIDOBJECT1,
              3 INDX
         FROM USER_OBJECTS
        WHERE status = 'INVALID'
          AND OBJECT_TYPE IN ('PACKAGE BODY'))
               ORDER BY INDX;
```

- Start the upgrade in approot.
- Drop the root cause objects.
- Create the root cause objects.
- Execute the sql file placed in a path.
- End upgrade
- Sync to Entity pdb.
- Verify the result using DBA_APP_ERRORS/ DBA_ERRORS/USER_OBJECTS status = ‘INVALID’.

7. Annexure

7.1 Default Approot Entities for Common Core

1. Core Entities/Maintenances
    a. Country Code
    b. Host Code & Timezone
    c. Currency
    d. Currency Rate types
    e. Language Code
    f. Rate Code Definition**

2. SMS Entities/Maintenances
    a. Entity Maintenance
    b. User Master (SSD)
    c. Role Master (SSD)
    d. Function Maintenance
    e. PII & Mask Maintenance
    f. SSO Parameters
    g. Hot Keys
    h. Customer Access group
    i. Department Maintenance

3. External Entities
    a. External Chart of Accounts
    b. External Transaction Codes
    c. External Credit Approval

4. MIS and UDF
    a. MIS Class & Codes
    b. MIS Group
    c. MIS Cost Codes
    d. MIS Pool
    e. UDF Definition
    f. UDF Function ID Mapping

5. Other Entities
    a. BIC Codes and related maintenances
    b. Process Definition
    c. Amount Text
    d. Media
    e. Gateway Multi-Entity Function Ids *
        i. Upload Source
        ii. External System
        iii. Amendment Maintenance

* New function IDs

** Islamic Entities wherever applicable

7.2 Default Approot Entities for FCUBS

1. Core Entities and Services
    a. Chart of Accounts
    b. Revaluation Setup
    c. Transaction Codes
    d. Currency Denominations
    e. Customer Categories, Prefixes, Groups, Ownership, Relation
    f. Issuer Codes
    g. Overrides

2. Subsystem and Classes
    a. Commission, Interest, Charge, Tax Scheme Class
    b. Status Codes
    c. ICCF Rule master *
    d. Tax Rule Master*
    e. Tax Categories, Tax Scheme, Tax Rate codes
    f. Product – UDF Mapping *
    g. Message Types, Media, Locations, SWIFT Tags

3. CASA and TD (Conventional and Islamic**)
    a. Account Class and Account Class Group
    b. Interest and Charge Rule and Product
    c. Interest and Charge SDEs
    d. Standing Instruction Product
    e. Structured Deposit Product
    f. PDC Product

4. Retail Lending (Conventional and Islamic**)
    a. Retail Lending Product and related Maintenances
    b. Leasing Product
    c. Mortgage Product
    d. Microfinance Product
    e. Collection Product

5. Teller
    a. Retail Teller Product
    b. Corporate Teller Product
    c. Utility Payment Product

6. Trade (Conventional and Islamic**)
    a. Letter of Credit Product and Related Maintenances
    b. Bills and Collection Product and Related Maintenances

7. Treasury (Conventional and Islamic**)
    a. Foreign Exchange Product and Related Maintenances
    b. Money Market Product and Related Maintenances
    c. Securities Repo Product and Related Maintenances
    d. Corporate Deposit Product and Related Maintenances
    e. Securities Product and Related Maintenances
    f. Derivatives Product and Related Maintenances

8. Other Modules (Conventional and Islamic**)
    a. Asset Management Fund Product
    b. Fixed Assets Product
    c. Expense Processing Product
    d. Intermediary Product
    e. Retail Bills Product

* New function IDs

** Islamic Entities wherever applicable

Multi-Tenant Deployment
[February] [2021]
Version 14.4.0.3.0

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