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# RMU Extract Secrets

## A database administrator tool

Ian Smith
Oracle Rdb Product Architect
Oracle Rdb Engineering
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# Remote Speaker Photo

**Ian Smith**

Rdb Product Architect, Oracle

# Program Agenda

1. Introduction to Extract
2. Special Purpose Scripting
3. Case Studies
4. Miscellaneous
5. Final Comments

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# Safe Harbor Statement

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# Introduction

## History and goals of RMU Extract

# Notes

- This isn’t a qualifier by qualifier description of RMU Extract
- However, I’ll present some highlights and qualifier combinations you may not have seen before
- Some background to Extract development

# Extract

- Based on original RDO_EXTRACT created during Rdb V1.1 training session in Sydney, Australia
- Enhanced as tool used for consulting and support
- New rewritten version became part of Rdb V4.0
- Under the RMU command but maintained as a separate image RMUEXTRACTnn.EXE

# What does it do?

- Metadata reader and formatter
- Database definitions are stored as BLR, MBLR and structures in the root file
- Extract reads various structures and creates SQL definitions

# BLR

- Binary Language Representation
- Syntax of pure query
  - Some SQL sematic information is discarded
- Often structured differently to either original RDO or SQL query
- Contained full procedural language a decade before SQL supported stored procedures
- SET FLAGS ‘BLR,NOPREFIX’

# Could be generated by either query

```
$ rdo @a
RDO> database filename sql$database
RDO>
RDO> for w in work_status
cont>    sorted by w.status_code
cont>    print w.status_name;
cont> end_for;
 STATUS_NAME
 INACTIVE
 ACTIVE
 ACTIVE
RDO>
RDO> finish
```

# Could be generated by either query

```
$ sql$ @b
SQL> attach 'filename sql$database';
SQL>
SQL> select status_name
cont> from work_status
cont> order by status_code
cont> ;
 STATUS_NAME
 INACTIVE
 ACTIVE
 ACTIVE
3 rows selected
SQL>
SQL> disconnect all;
```

Simple query to select a column, sort by a different column

# Example

```
(VERSION 4
 BLR$K_BEGIN
  BLR$K_MESSAGE 1 2
   DSC$K_DTYPE_T 1
   DSC$K_DTYPE_T 11
  BLR$K_MESSAGE 2 0
  BLR$K_FOR
   BLR$K_RSE  1
    BLR$K_RELATION WORK_STATUS 1
    BLR$K_SORT  1
    BLR$K_ASCENDING
     BLR$K_FIELD 1 STATUS_CODE
   BLR$K_END
   BLR$K_BEGIN
    BLR$K_SEND  1
     BLR$K_BEGIN
      BLR$K_ASSIGNMENT
       BLR$K_LITERAL
        DSC$K_DTYPE_T 1      "N"
       BLR$K_PARAMETER 1 0
```

Table name

Sorting column name

# Example

```
      BLR$K_ASSIGNMENT
         BLR$K_FIELD 1 STATUS_NAME
         BLR$K_PARAMETER 1 1
      BLR$K_END
   BLR$K_END
  BLR$K_SEND  1
   BLR$K_BEGIN
    BLR$K_ASSIGNMENT
      BLR$K_LITERAL
       DSC$K_DTYPE_T 1      "Y"
      BLR$K_PARAMETER 1 0
   BLR$K_END
 BLR$K_END
BLR$K_EOC)
```

Selected column name

BLR$ tags are byte codes, not keywords

# BLR decoder

- Contains a BLR decoder
- Can generate output syntax for RDO (if possible) and SQL (mostly possible)
- Restricted to the subset used by constraints, triggers, default values, computed by, automatic columns, views, and so on
- Due to complexity stored routines are extracted using the original SQL sources
  - Sometimes artifacts of source capture mean they require editing

# MBLR

- Metadata Binary Language Representation
- Language independent attribute and action definition
- Stored in Rdb$EXTENSION_PARAMETERS or Rdb$DATABASE_PARAMETERS special LIST OF BYTE VARYING columns
- SET FLAGS ‘MBLR,NOPREFIX’

# Example.

## MBLR definition with BLR fragment

```
SQL> set flags 'mblr,noprefix';
SQL> create domain creator_username varchar(31)
cont> default lower (current_user);
MBLR$K_VERSION_1     (This is a DEFINE)
  MBLR$K_FIELD_DEF  "CREATOR_USERNAME"
    MBLR$K_DESCRIPTOR
      DSC$K_DTYPE_VT 31
    MBLR$K_DEFAULT_VALUE  "18"
      BLR$K_VERSION4
        BLR$K_TRANSLATE "RDBVMS$LOWER"
          BLR$K_GET_INFO (10) RDB$K_INF_CURRENT_USER
  MBLR$K_FIELD_END
```

# Interface to other structures

- Rdb$DATABASE_INFO
  API interface to return database, cache, journal, storage area attributes
- Rdb$EXTENSION
  API interface to return formatted ACL (access control list), CSET (character set attributes), and so on
  - Note: must resolve ACL on remote system so that UIC's correctly mapped

# Generating CREATE INDEX

- Must read Rdb$INDICES and Rdb$INDEX_SEGMENTS tables
  - Provides columns and column attributes
  - **size is**, **mapping values**, **desc**, **asc**, …
- Must read Rdb$STORAGE_MAPS, and Rdb$STORAGE_MAP_AREAS tables
  - Provides **store** … **in** … **with limit of** clauses
- Rdb$EXTENSION_PARAMETERS (LoBV column)
  - Provides attributes such as **node size**, **percent fill**, etc
- Call RDB$DATABASE_INFO to get THRESHOLDS for the logical areas

# RMU Extract

- Original goals
  - Migration tool from RDO to SQL interface
  - Allow definitions to be converted to SQL scripts
  - Document existing databases
- Support all RDO and SQL objects
- See /LANGUAGE qualifier
- SQL language now far more complex than RDO so extract as RDO is severely limited

# Using Extract for special purposes

# Item

- Typically use /ITEM=ALL to get whole database
- ALL doesn’t mean ALL
- Many more keywords for Option

# Security and Audited Items

- PROTECTION (grant)
- REVOKE_ENTRY (revoke)
- SECURITY (auditing)
- LOAD
  - Creates a DCL script to unload a table
- UNLOAD
  - Creates a DCL script to load a table

# Security and Audited Items

- VERIFY
  - Creates a DCL script to verify the database (see RMU documentation)
- WORKLOAD
  - Creates DCL script that can be applied to a new database
  - Contains all the workload data from the source
  - Very useful when gathering workload data from production and experimenting in testing area

# Alter Database and Import

- ALTER_DATABASE
  - Generate the JOURNAL attributes and all the journal definitions
- IMPORT
  - Generate an **import database** statement
  - Use /Option keywords like FILENAME_ONLY
  - Use /Defaults to specify **allocation** and **snapshot_allocation**

# Annotation Options

- AUDIT
  - Requests that creation and alter timestamps be displayed with each object along with the creating username
- HEADER
  - Requests that a header be added to each section

# Case Study

- Part of the daily maintenance of the production system is to use
- RMU /Extract /Option=(Header,Audit) –
  /Item=(All,Protection,Security)
- Audit adds extra details for these objects
- Report contains current state of the database metadata

# Fine Tuning

# Header

- Header identifies section being extracted
- Also name of the source database and time stamp of the report
- Often considered noise
- Use NOHEADER option

# FILENAME_ONLY

- File file specification extracted
  - Database name
  - Storage Area Names
- If creating testing database scripts ask for FILENAME_ONLY

# Example

**$ rmu/extract/item=module/option=(noheader) personnel**

```
set verify;
set language ENGLISH;
set default date format 'SQL92';
set quoting rules 'SQL92';
set date format DATE 001, TIME 001;
attach 'filename $1$DGA170:[TEST.DATABASES]PERSONNEL.RDB';
-- no modules defined
```

# Example

**$ rmu/extract … /option=(noheader,filename_only) personnel**

```
set verify;
set language ENGLISH;
set default date format 'SQL92';
set quoting rules 'SQL92';
set date format DATE 001, TIME 001;
attach 'filename PERSONNEL';
-- no modules defined
```

# Example

**$ rmu/extract … /option=(nodomains,match:candidates%) …**

```
create table CANDIDATES (
   LAST_NAME
      CHAR (14),
   FIRST_NAME
      CHAR (10),
   MIDDLE_INITIAL
      CHAR (1),
   CANDIDATE_STATUS
      VARCHAR (255)
      constraint CANDIDATE_STATUS_1
         check((((CANDIDATE_STATUS is null)
            or (CANDIDATE_STATUS > '    '))
            or (CANDIDATE_STATUS = '    ')))
         not deferrable);
```

# Example

**$ rmu/extract/item=(table,noconstraint)/option=(…) personnel**

```
create table CANDIDATES (
    LAST_NAME
        CHAR (14),
    FIRST_NAME
        CHAR (10),
    MIDDLE_INITIAL
        CHAR (1),
    CANDIDATE_STATUS
        VARCHAR (255));

commit work;
```

Use noconstraint if you don't want them

# Tables

# Tables

- Generates the definitions as you would expect
- However, a table is rarely isolated
  - Indices
  - Storage Maps
  - Indices with **placement via index** clause
- Use GROUP_TABLE to create family grouping
- Also note the MATCH option used in this example
  - Support LIKE wildcard matching “_” and “%”
  - Don’t forget names are stored with trailing spaces

# Example

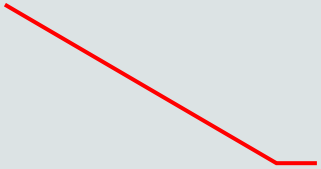
**$ rmu/extract/item=(table,storage,index) –**
**/option=(noheader,match=employees%,group_table) …**

```
create table EMPLOYEES (
    EMPLOYEE_ID ID_NUMBER,
    LAST_NAME LAST_NAME,
    FIRST_NAME FIRST_NAME,
    MIDDLE_INITIAL MIDDLE_INITIAL,
    ADDRESS_DATA_1 ADDRESS_DATA_1,
    ADDRESS_DATA_2 ADDRESS_DATA_2,
    CITY CITY,
    STATE STATE,
    POSTAL_CODE POSTAL_CODE,
    SEX SEX,
    BIRTHDAY STANDARD_DATE,
    STATUS_CODE STATUS_CODE);
```

# Example

## $ rmu/extract/item=(table,storage,index) – /option=(noheader,match=employees%,group_table) …

```
create unique index EMPLOYEES_HASH
    on EMPLOYEES (
    EMPLOYEE_ID)
    type is HASHED SCATTERED
    comment is
     ' hash index for employees'
    store
       using (EMPLOYEE_ID)
          in EMPIDS_LOW
             with limit of ('00200')
          in EMPIDS_MID
             with limit of ('00400')
          otherwise in EMPIDS_OVER;
```

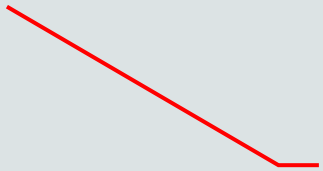


Then index used for placement

# Example

## $ rmu/extract/item=(table,storage,index) – /option=(noheader,match=employees%,group_table) …

```
create storage map EMPLOYEES_MAP
    for EMPLOYEES
    comment is
      ' employees partitioned by "00200" "00400"'
    placement via index EMPLOYEES_HASH
    store
       using (EMPLOYEE_ID)
          in EMPIDS_LOW
             with limit of ('00200')
          in EMPIDS_MID
             with limit of ('00400')
          otherwise in EMPIDS_OVER;
```



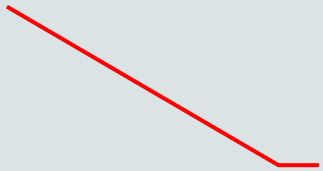
Then storage map for table

# Example

**$ rmu/extract/item=(table,storage,index) –**
**/option=(noheader,match=employees%,group_table) …**

```
create unique index EMP_EMPLOYEE_ID
      on EMPLOYEES (
      EMPLOYEE_ID
         asc)
      type is SORTED
      node size 430;

commit work;
```



All other indices

# Constraints

# Constraints

- Usually extracted as part of TABLE
- **primary key** and **not null** inline
- **check** and **foreign key** defined later using **alter table**

# Example

## $ rmu/extract/item=table/option=match:account% tp

```
create table "ACCOUNT" (
   ACCOUNT_NUMBER
      INTEGER
      default ACCOUNT_ID.nextval
      constraint ACCOUNT_PRIMARY_ACCOUNT_NUMBER
         primary key
         initially immediate not deferrable,
   FIRST_NAME
      VARCHAR (20),
   LAST_NAME
      VARCHAR (20),
   SEX
      CHAR (1),
   ACCOUNT_BALANCE MONEY);

alter table "ACCOUNT"
   add constraint ACCOUNT_CHECK1
      check(("ACCOUNT".ACCOUNT_BALANCE >= 20))
      initially immediate not deferrable;
```

Primary key inline

Check deferred

# Defer_Constraints option

- Extract will defer all the constraints

# Example

## $ rmu/extract … /option=(mat:account%,defer_constraints) …

```
create table "ACCOUNT" (
   ACCOUNT_NUMBER
      INTEGER
      default ACCOUNT_ID.nextval,
   FIRST_NAME
      VARCHAR (20),
   LAST_NAME
      VARCHAR (20),
   SEX
      CHAR (1),
   ACCOUNT_BALANCE MONEY);

alter table "ACCOUNT"
   add constraint ACCOUNT_CHECK1
      check(("ACCOUNT".ACCOUNT_BALANCE >= 20))
      initially immediate not deferrable
   alter column ACCOUNT_NUMBER
      constraint ACCOUNT_PRIMARY_ACCOUNT_NUMBER
         primary key
         initially immediate not deferrable;
```

# Case study

- Want script to define the table first
- Next load that table with data
- Then create the indices on that table
- Next need a script to add in constraints

# Example – create the table

## $ rmu/extract/item=(table,noconstraint)/option=(…,defer) tp

```
create table "ACCOUNT" (
   ACCOUNT_NUMBER
      INTEGER
      default ACCOUNT_ID.nextval,
   FIRST_NAME
      VARCHAR (20),
   LAST_NAME
      VARCHAR (20),
   SEX
      CHAR (1),
   ACCOUNT_BALANCE MONEY);

commit work;
```

# Example – load the table

**$ rmu/extract/item=load/option=(…,filename_only,noheader) tp**

```
$ RMU/LOAD -
                /TRANSACTION_TYPE=EXCLUSIVE -
                TP -
                "ACCOUNT" -
                ACCOUNT.UNL
$
$ EXIT
```

# Example – create the indices

**$ rmu/extract/item=index/opti=(mat:account%,group_table) tp**

```
set transaction read write reserving
   "ACCOUNT" for EXCLUSIVE WRITE;

create unique index ACCOUNT_PRIMARY_ACCOUNT_NUMBER
   on "ACCOUNT" (
   ACCOUNT_NUMBER
      asc)
   type is SORTED RANKED
   node size 430;

commit work;
```

group_table - the MATCH is on table name

# Example – now define the constraints

## $ rmu/extract/item=(notable,constraint)/option=(…,defer) tp

```
alter table "ACCOUNT"
   add constraint ACCOUNT_CHECK1
      check(("ACCOUNT".ACCOUNT_BALANCE >= 20))
      initially immediate not deferrable
   alter column ACCOUNT_NUMBER
      constraint ACCOUNT_PRIMARY_ACCOUNT_NUMBER
         primary key
         initially immediate not deferrable;

commit work;
```

# Miscellaneous

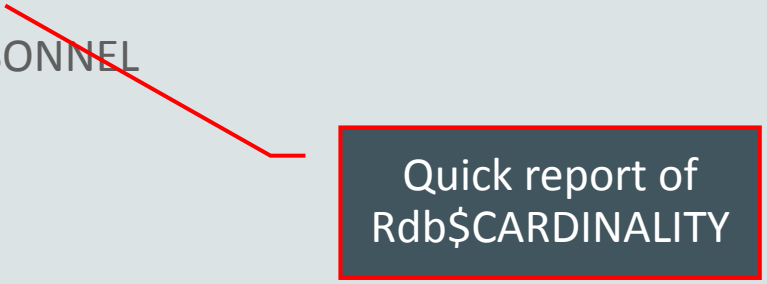
# What is PDL?

- Script language for retired product call Oracle EXPERT
- Generated volume script used for capacity planning
- PDL output might be useful today
- Item=Volume
- Option=Volume_Scan
- Option=Column_Volume

# Example

## $ rmu/extract/item=volume mf_personnel

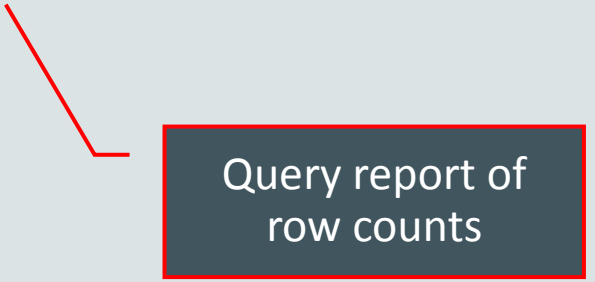
```
-- Volumes are approximate
Volume for schema MF_PERSONNEL
    Default volatility is 5;
    Table CANDIDATES all is 3;
    Table COLLEGES all is 16;
    Table DEGREES all is 165;
    Table DEPARTMENTS all is 26;
    Table EMPLOYEES all is 100;
    Table JOBS all is 15;
    Table JOB_HISTORY all is 274;
    Table RESUMES all is 0;
    Table SALARY_HISTORY all is 729;
    Table WORK_STATUS all is 3;
```



# Example

**$ rmu/extract/item=volume/option=volume_scan mf_personnel**

```
-- Volumes are derived from a full count of data
Volume for schema MF_PERSONNEL
   Default volatility is 5;
   Table CANDIDATES all is 3;
   Table COLLEGES all is 16;
   Table DEGREES all is 165;
   Table DEPARTMENTS all is 26;
   Table EMPLOYEES all is 100;
   Table JOBS all is 15;
   Table JOB_HISTORY all is 274;
   Table RESUMES all is 0;
   Table SALARY_HISTORY all is 729;
   Table WORK_STATUS all is 3;
```



# Example

**$ rmu/extract/item=volume/option=(column,volume_scan) …**

```
-- Volumes are derived from a full count of data
Volume for schema MF_PERSONNEL
   Default volatility is 5;
   Table CANDIDATES all is 3;
      List RESUME
         Cardinality IS 0;
   Table COLLEGES all is 16;
      Column COLLEGE_CODE all is 16;
   Table DEGREES all is 165;
      Column COLLEGE_CODE all is 13;
      Column EMPLOYEE_ID all is 99;
   Table DEPARTMENTS all is 26;
      Column DEPARTMENT_CODE all is 26;
…
```

Also collect index column uniqueness counts

# Order_By_Name

- When extracting definitions the default is to list them in the order they were created
- Use this option to sort names alphabetically
  - row cache, journal and storage area names
- Affects:
  - Database
  - Alter_Database
  - Import

# Example

**$ rmu/extract/item=database … /option=order_by_name**

```
create database …
    …
    create storage area DEPARTMENTS …
    create storage area EMPIDS_LOW …
    create storage area EMPIDS_MID …
    create storage area EMPIDS_OVER …
    create storage area EMP_INFO …
    create storage area JOBS …
    create storage area MF_PERS_SEGSTR …
    create storage area RDB$SYSTEM …
    create storage area SALARY_HISTORY …
…
;
```

# Omit_Disabled

- This option requests that disabled objects not be extracted
  - Indexes – **maintenance is disabled**
  - Constraints and Triggers - **disabled**
  - Users with **account is locked**
- Otherwise these objects are extracted with the disabling syntax

# Final Comments

# Oracle Usage

- Used in Rdb regression tests to generate scripts
  - For example, before and after scripts to check correct behavior
- Used by Support and Engineering groups to save time when handling customer databases
  - For example, generate SQL import scripts, or Load/Reload sequences for tests
  - Aside: also have a tool to generate IMPORT script directly from the interchange file (.rbr)
    - rmu/dump/export/option=import

# Continuing to develop

- We are always accepting enhancement requests for RMU Extract
- Recently added POSITION_COLUMN option to control behavior of Extract on tables changed with the BEFORE and AFTER column syntax

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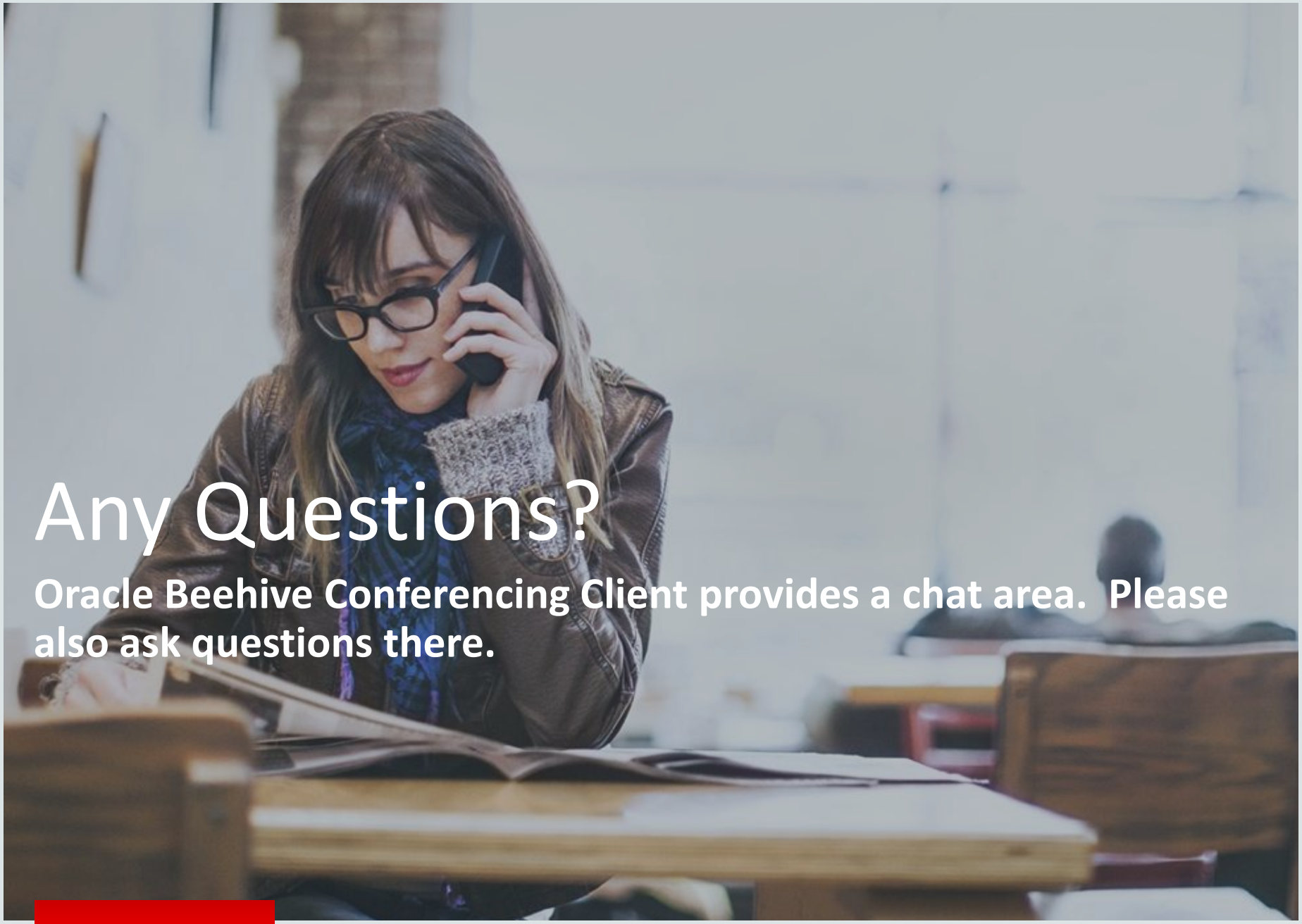

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