
GLOC
Great Lakes Oracle Conference
To CDB or not to CDB,
That is the question ?
Multitenant option
explained...
Presented by Mike Gangler
Secure-24
May 16- 4:15 – 5:15
LL02
MAY 16 & 17, 2018
CLEVELAND PUBLIC AUDITORIUM, CLEVELAND, OHIO
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Secure-24 Company Overview

Highlights

- Founded 2001 in Southfield, MI
- 600+ employees, < 8% turnover
- 87% First Tier Resolution and 98% Customer Satisfaction
- Ranked one of ComputerWorld's 100 Best Places to Work in IT for 5 years running

Scale

- Trusted by clients with total annual revenues exceeding US $1Trillion
- 16 consecutive years of double digit growth
- 200+ global customers
- 20+ global industries

Innovation

- Academy Model
- Highly automated
- All FLASH storage
- SLAs through the application layer
- Customer portal provides transparency
- 8% annual investment in R&D

Oracle Focus

- Certified Oracle Platinum Partner
- 240+ Oracle client environments
- Investment in advanced technology

Corporate Direction

- Build the leading IT Services company in United States
- Five Pillars: Quality, Customer Service, Security, Process and Automation
- Continue strong organic growth
- Support international expansion

Secure-24 has 17 years of experience delivering managed IT operations, application hosting, and support services to enterprises worldwide. We manage SAP, Microsoft, Oracle, and other mission critical applications across all industries.

Information about Mike Gangler

- **Oracle ACE**
- DBA for over 30 years, working with Oracle since version 4
- Team Lead and Senior Database Specialist at Secure-24
- Public Speaker: Oracle OpenWorld, IOUG Collaborate, MOUS, UKOUG, RMOUG, ODTUG, GLOC
- Currently serving on the board of the Michigan Oracle User Summit (mous.us) and SEMOP (www.semop.org)
- Charter member of the Board of Directors for the International Oracle Users Group (IOUG) – www.ioug.org
- Follow me on my Blog http://mjgangler.wordpress.com
- twitter! @mjgangler

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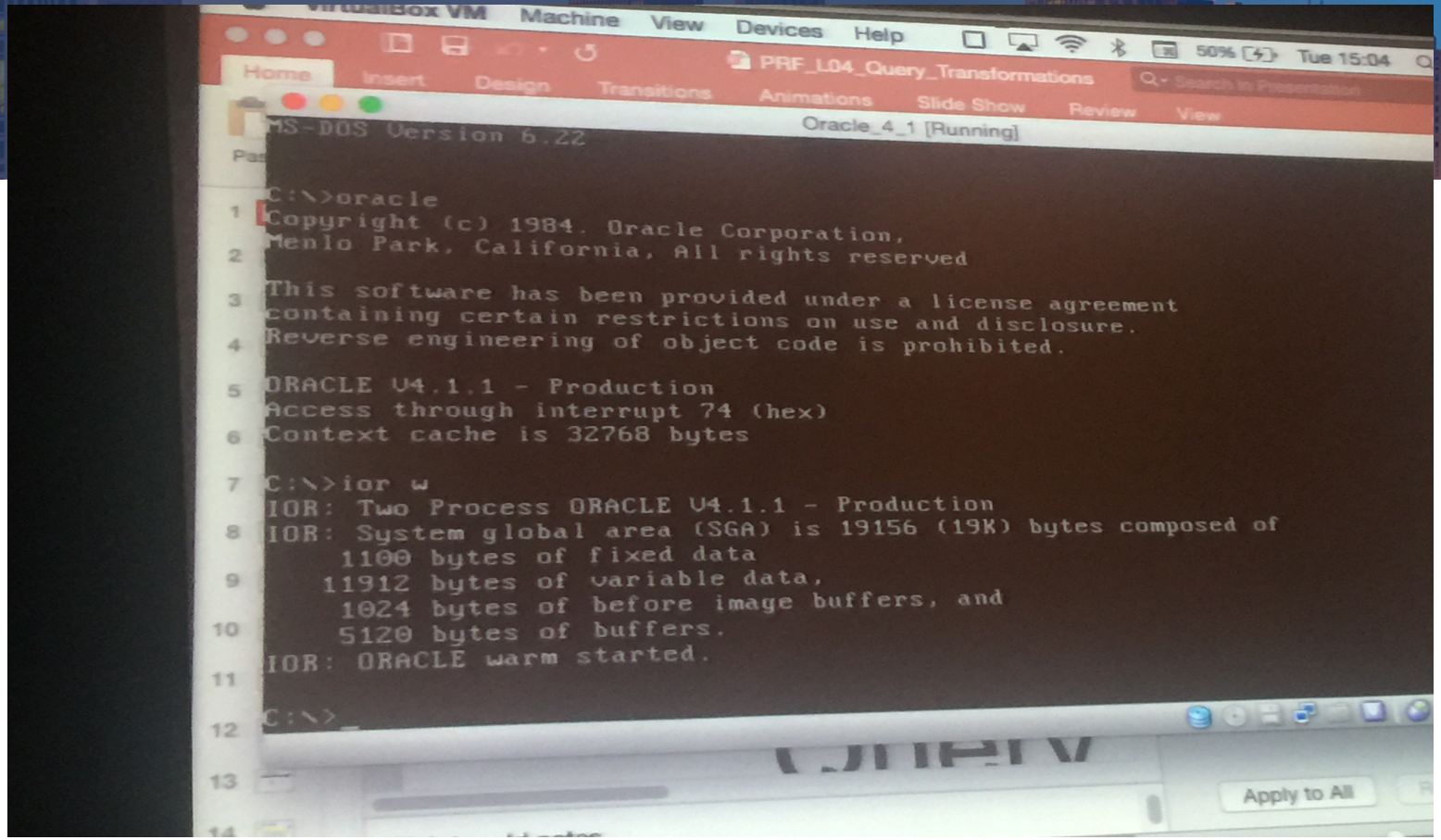

Oracle Version 4

Today's Discussion

This presentation demonstrate advantages, disadvantages, cost implications and a Total Cost of ownership of using CDBs with both Multitenant and default license.

This session will discuss the tips, tricks and solutions that provided the ability to overcome the challenges of new technology when failure isn't an option.

The information learned from this presentation will help you navigate the difficult world of using Multitenant Container (CDB's).

Todays Agenda

- What is a CDB
- Components of CDB
- TCO and Cost Factor
- CDB / PDB - Options / Tools
- CDB / PDB - Security – Dev-OPS
- Summary

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- CDB / PDB - Security Options
- CDB / PDB - DEV /Ops

What is a CDB ?

- The multitenant architecture enables an **Oracle database** Instance to function as a multitenant **container database** (CDB).
  - In another words – You can have many databases per container (CDB)
    - CDB = Container Database includes zero, one, or many customer created Pluggable **Databases** (PDBs)
    - PDB = Pluggable Database – Customer created Database - Can only belong to 1 CDB

Agenda

- What is a CDB?
- Components of CDB
- How does a CDB work ?
- TCO and Cost Factor
- CDB / PDB - Options / Tools
- CDB / PDB - Security Options
- CDB / PDB - DEV /Ops

Components of a Container Database (CDB)

- Every CDB has the following Components:
  - Exactly one root (CDB$ROOT)
    - which has the data dictionary views for the root and all pluggable databases.
  - Exactly one **seed PDB** **(PDB$SEED)**

    The seed PDB is a system-supplied template that the CDB can use to create new PDBs..
    - You cannot add or modify objects in PDB$SEED.
      - **NOTE – This is not backed up in a CDB FULL BACKUP**
  - Zero or more user-created PDBs within a CDB
    - A PDB is an application database(s)
    - The maximum number of PDB in one CDB is “252 pluggable databases”. (4096 - 12.2)
    - Each pluggable database has “CON_ID” which is a unique container identification
      - **NOTE - No PDBs exist at creation of the CDB. You add PDBs based on your business requirements.**

Components of a Container Database (CDB)

Other Characteristics :

- Each PDB will have the following tablespaces: **SYSTEM, SYSAUX**. **TEMP** tablespace can be “optionally” created under a PDB, otherwise PDB will use the TEMP tablespace for the root container.

- All pluggable databases use a common **UNDO** tablespace under root CDB.
  - With 12.2 – each PDB has its own UNDO tablespace

Components of a Container Database (CDB)

User Characteristics :

- Using SYS to access root CDB, the DBA can stop/start CDB instance.
- You can use Sys – To stop/start PDB instance
- A different PDB administrator User manages each PDB.

Components of a Container Database (CDB)

Other User Characteristics :

- A **common user** exists across a CDB with a single identity. In this example, common user SYS can manage the root and every PDB.
  - A common user is a database user known in every container.
  - CDB Common User = C##<USER> - Default
  - alter system set **common_user_prefix=''** scope=spfile;
- A PDB contains:
  - Local Users – PDB only
  - Common Users – for all pdbs

Components of a Container Database (CDB)

Other Characteristics :

- In 12c **Character Set** is set at CDB level, and will be applied to all associated PDB.
  - In 12.2 – Each PDB can be it's a Different Character Set (Must be a subset of the CDB)

- There is a centralized (common) CDB alert log, so all error/informative messages for each PDB are being written to one common alert log and set of trace files.

Components of a Container Database (CDB)

Security Characteristics

- Security –at Database Level (PDB) Versus Schema
- Better “data isolation”
- freedom of using public synonyms, provisioning, and portability.

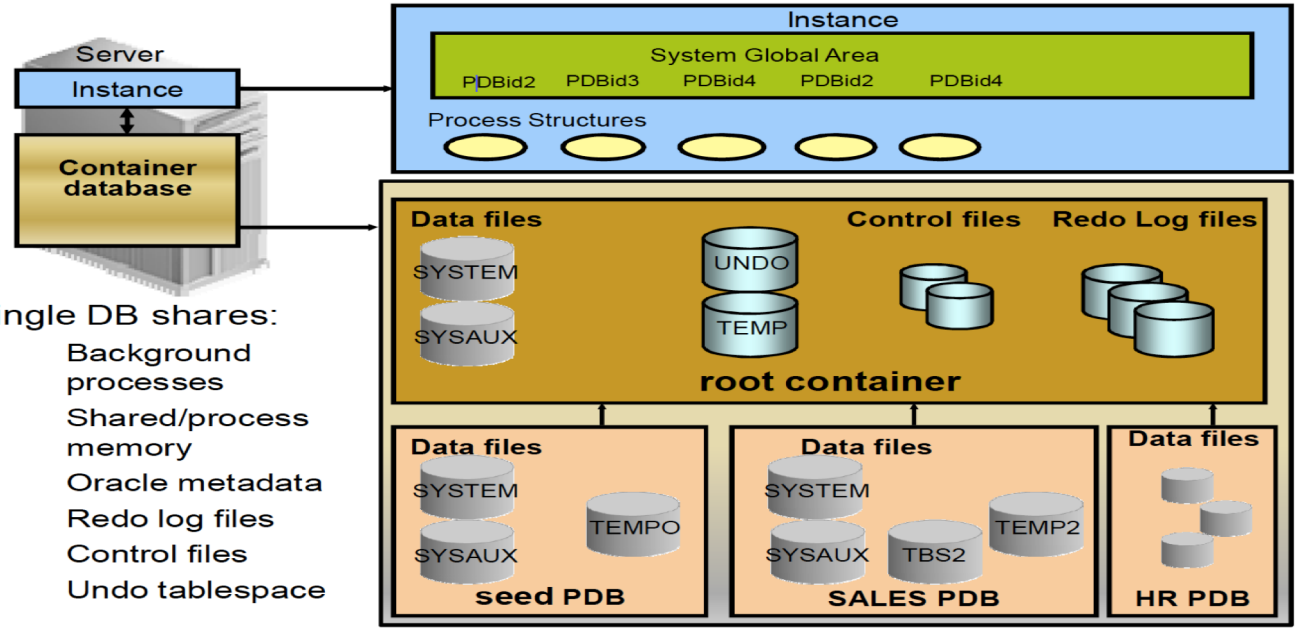
Components of a Container Database (CDB)

CDB Versus PDB

CDB LEVEL
Oracle Software
SGA
Background Process
Data Guard
Some Parameters (isModifiable='FALSE'
Control files, Redo
(S)Pfile, Password File

PDB LEVEL
Point in-Time Recover
Some Parameters (isPDB_Modifiable='TRUE')
Undo Tablespace (12cR2)
Character Set (12cR2)
Flashback Database (12cR2)

Container Database Architecture



Single DB shares:

- Background processes
- Shared/process memory
- Oracle metadata
- Redo log files
- Control files
- Undo tablespace

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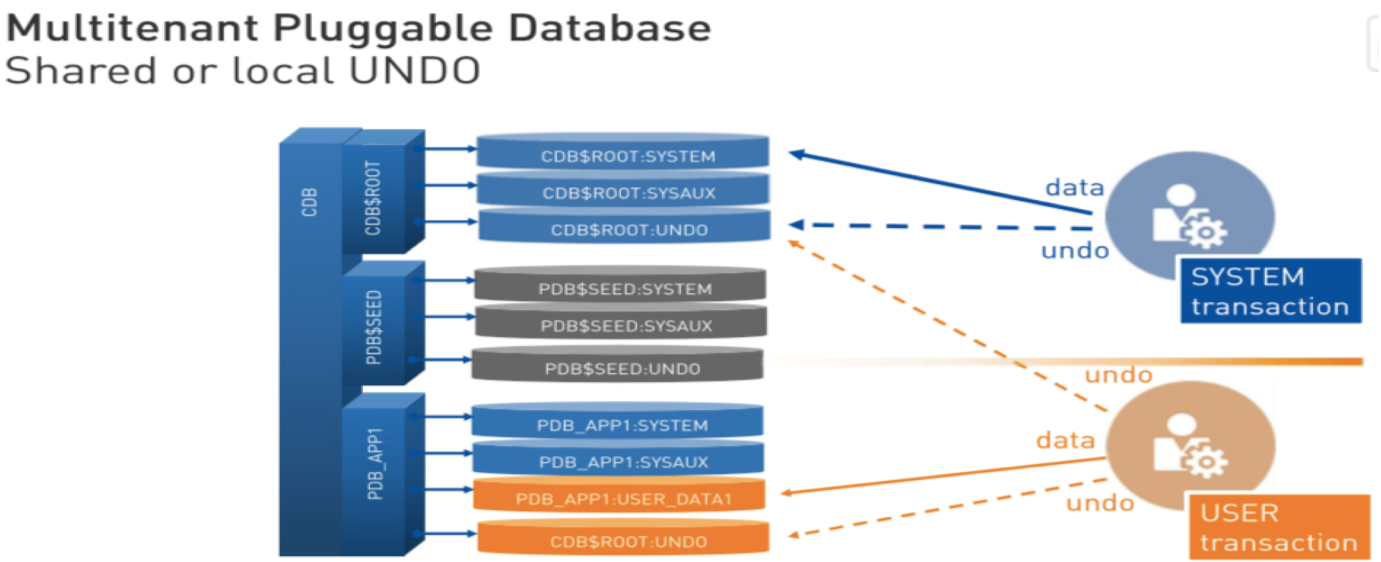
Components of a Container Database (CDB)



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Agenda

- What is a CDB?
- Components of CDB
- **TCO and Cost Factor**
- CDB / PDB - Options / Tools
- CDB / PDB - Security Options
- CDB / PDB - DEV /Ops

TCO / Cost Factors

- Cost / TCO Presumptions:
  - Using Oracle Global Pricing List (Retail)
  - 4 database Instances per Machine
  - 8 PDB’s Per CDB Instance
  - 8 CPU’s Per Database Machine
  - 64 GB Memory Per Machine (Depends on Sizes of instance SGA)

TCO / Cost Factors (NOTE RETAIL COSTS)

- Oracle Enterprise Edition License Per CPU = $47,500
- Oracle Multitenant License Per CPU = $17,500
- Database Machine – 8 CPU – 1 database Instances
  - Oracle Database Cost – without CDB - $380,000
  - Oracle Database Cost – With CDB - $520,000

TCO / Cost Factors (Using Previous Options)

- Database Machine – 8 CPU – Database Instance Costs
  - Per Database Machine Cost – **without Multitenant** - $380,000
    - $47,500 * 8 = $380,000 (1 Non-CDB Database Instance)
    - ***** NOTE – Each CDB – Contains 1 PDB's/Applications
  - Per Database Machine Instance Cost – With Multitenant - $520,000
    - $65,000 * 8 CPU's = $520,000 ('X' CDB Database Instance)
    - ***** NOTE – S24 Standard = CDB – Contains 8 (max) PDB's/Applications
    - Sharing Background processes
    - Per Database is better

TCO / Cost Factors (Using Previous Options)

- Database Costs – (Per Machine)
  - **Break Even results = 1.36 database Instance**
  - If # of PDB's / Applications Required < 2
    - DO NOT Purchase Multitenant Option
    - X (CDB) Database Instances and 1 PDB (DEFAULT)
    - $380K Total Cost (Non Multitenant)
  - Cost of Multitenant for Same
    - X Database Instances
    - $520,000 Total Cost (Multitenant)

Agenda

- What is a CDB?
- Components of CDB
- TCO and Cost Factor
- CDB / PDB - Options / Tools
- CDB / PDB - Security Options
- CDB / PDB - DEV /Ops

CDB / PDB - Options / Tools – Data Guard

- Data guard Options
  - Data guard Backups at a CDB Level
    - Reduced DBA efforts
    - PDB's automatically get backed up
    - RMAN> Backup Database
  - Data guard Backups at a PDB level
    - Backup pluggable database only
    - RMAN> Backup Pluggable Database PDB1

CDB / PDB - Options / Tools - Data Guard

- Data guard Recovery Options
  - Data guard Recovery Backups at a CDB Level
    - Create New Empty CDB (PDB$SEED Doesn't get backed up)
    - RMAN> Recover Database
  - Data guard Recovery at a PDB level
    - RMAN> Alter pluggable database PDB1 close;
    - RMAN> restore pluggable database PDB1;
    - RMAN> recover pluggable database PDB1;
    - RMAN> alter pluggable database PDB1 open resetlogs;

CDB / PDB - Options / Tools – Plug/Unplug Options

- Unplug / Plug PDB's Options
  - Moving databases/PDBS much easier to other CDB's
    - CDB1>alter database PDB1 unplug into 'XML FILE'
    - CDB2>Connect to new CDB
    - CDB2>Create pluggable database using 'XML File'

CDB / PDB - Options / Tools – Fast Cloning

- Fast Cloning
  - Cloning databases/PDB's
    - Within Same CDB
      - CDB1> create pluggable database PDB2 from PDB1;
    - From another CDB
      - RCDB> create database link connection to Destination Database (RLINK)
      - LCDB > create pluggable database PDB1 from RLINK@HOST_NAME
  - In 12.1 – Need to set source PDB in Read Only Mode
  - In 12.2 – Can have PDB in open Mode (Hot Clone)

CDB / PDB - Options / Tools - Clone PDB's

- Cloning PDB's
  - SQL> create pluggable database pdb2 from pdb1
    - > file_name_convert=('PDB1','PDB2')
- No Need for expdp Because cloning automatically moves System metadata
- No need for read-only because redo and undo can be applied.
  - In 12.1 – undo is shared so PDB MUST be in read-only mode
- Can also be cloned through DB Link

CDB / PDB - Options / Tools - Clone PDB's (Cont.)

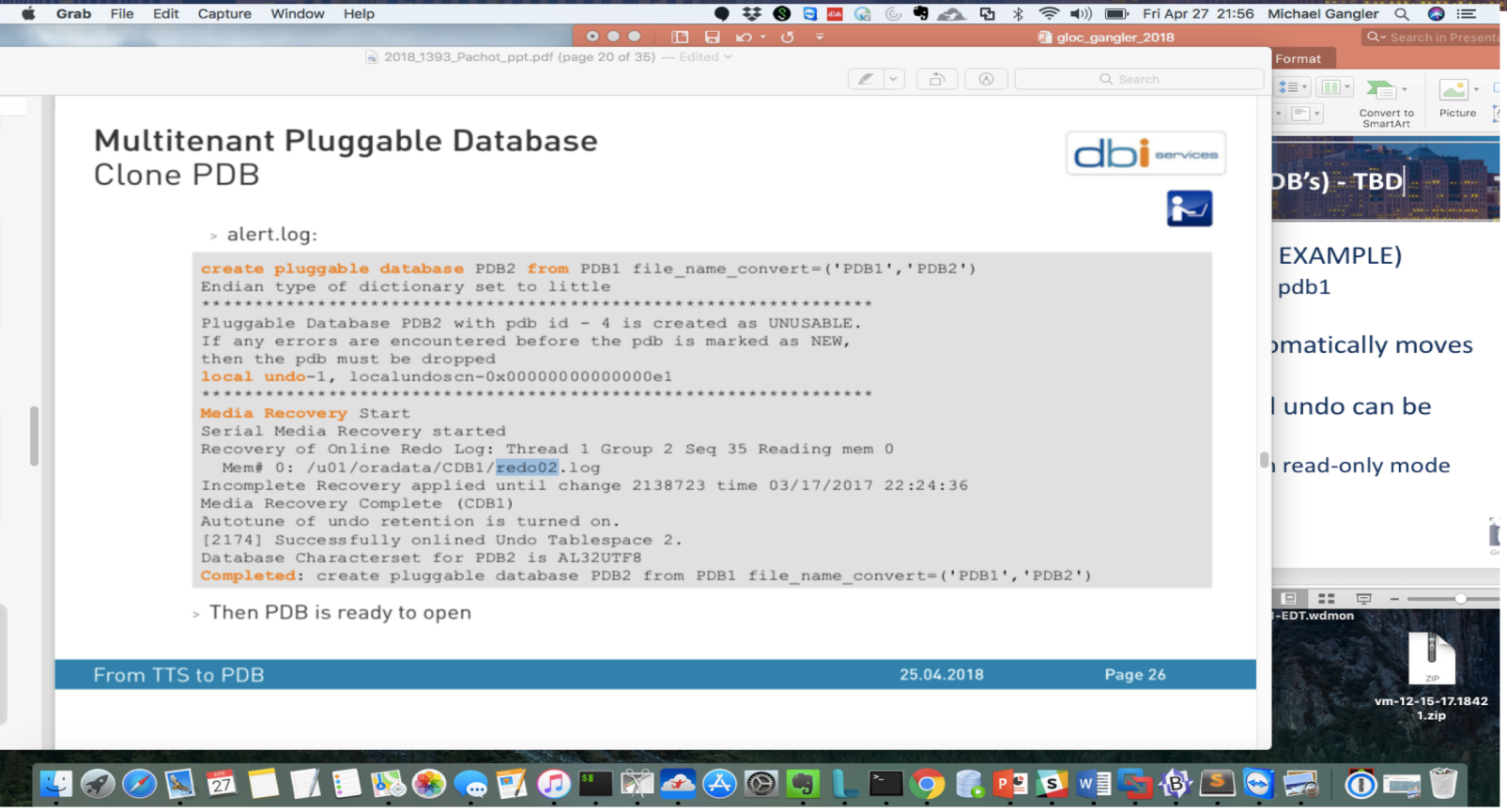
- Cloning PDB's from another PDB (SHOW EXAMPLE)
  - SQL> create pluggable database pdb2 from pdb1
    - > file_name_convert=('PDB1','PDB2')
- No Need for expdp Because cloning automatically moves System metadata
- No need for read-only because redo and undo can be applied.
  - In 12.1 – undo is shared so PDB MUST be in read-only mode
- Can also be cloned through DB Link

CDB / PDB - Options / Tools - Clone PDB's (Cont)

- Local clones are PDB's in the same CDB
- You Can Also clone from Remote Clone
  - Using DBLINK
  - Using XML
- Need user with "SYSOPER" or Create Pluggable database
- Create database link CDB1 connect to C##DBA identified by password using 'tnsnames-pdb'
- Create pluggable database pdb2 from pdb 1@CDB1 file_name_convert=('CDB1/PDB1','CDB2'/'PDB2')

- !!! Cloning from 12.1 requires patch 18633374: COPYING ACROSS REMOTE SERVERS
- Point #2 – Source must be in read only

CDB / PDB - Options / Tools - Clone PDB's - ALERT LOG



Grab File Edit Capture Window Help — Fri Apr 27 21:56 Michael Gangler

gloc_gangler_2018

2018_1393_Pachot_ppt.pdf (page 20 of 35) — Edited

Multitenant Pluggable Database
Clone PDB

dbi services

- alert.log:

```
create pluggable database PDB2 from PDB1 file_name_convert=('PDB1','PDB2')
Endian type of dictionary set to little
****************************************************************
Pluggable Database PDB2 with pdb id - 4 is created as UNUSABLE.
If any errors are encountered before the pdb is marked as NEW,
then the pdb must be dropped
local undo-1, localundoscn-0x0000000000000e1
****************************************************************
Media Recovery Start
Serial Media Recovery started
Recovery of Online Redo Log: Thread 1 Group 2 Seq 35 Reading mem 0
  Mem# 0: /u01/oradata/CDB1/redo02.log
Incomplete Recovery applied until change 2138723 time 03/17/2017 22:24:36
Media Recovery Complete (CDB1)
Autotune of undo retention is turned on.
[2174] Successfully onlined Undo Tablespace 2.
Database Characterset for PDB2 is AL32UTF8
Completed: create pluggable database PDB2 from PDB1 file_name_convert=('PDB1','PDB2')
```

- Then PDB is ready to open

From TTS to PDB 25.04.2018 Page 26

Format

Convert to SmartArt | Picture

DB's) - TBD

EXAMPLE)
pdb1

omatically moves

l undo can be

read-only mode

-EDT.wdmon

vm-12-15-17.1842
1.zip

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CDB / PDB - Options / Tools – Refreshable PDB's (12.2)

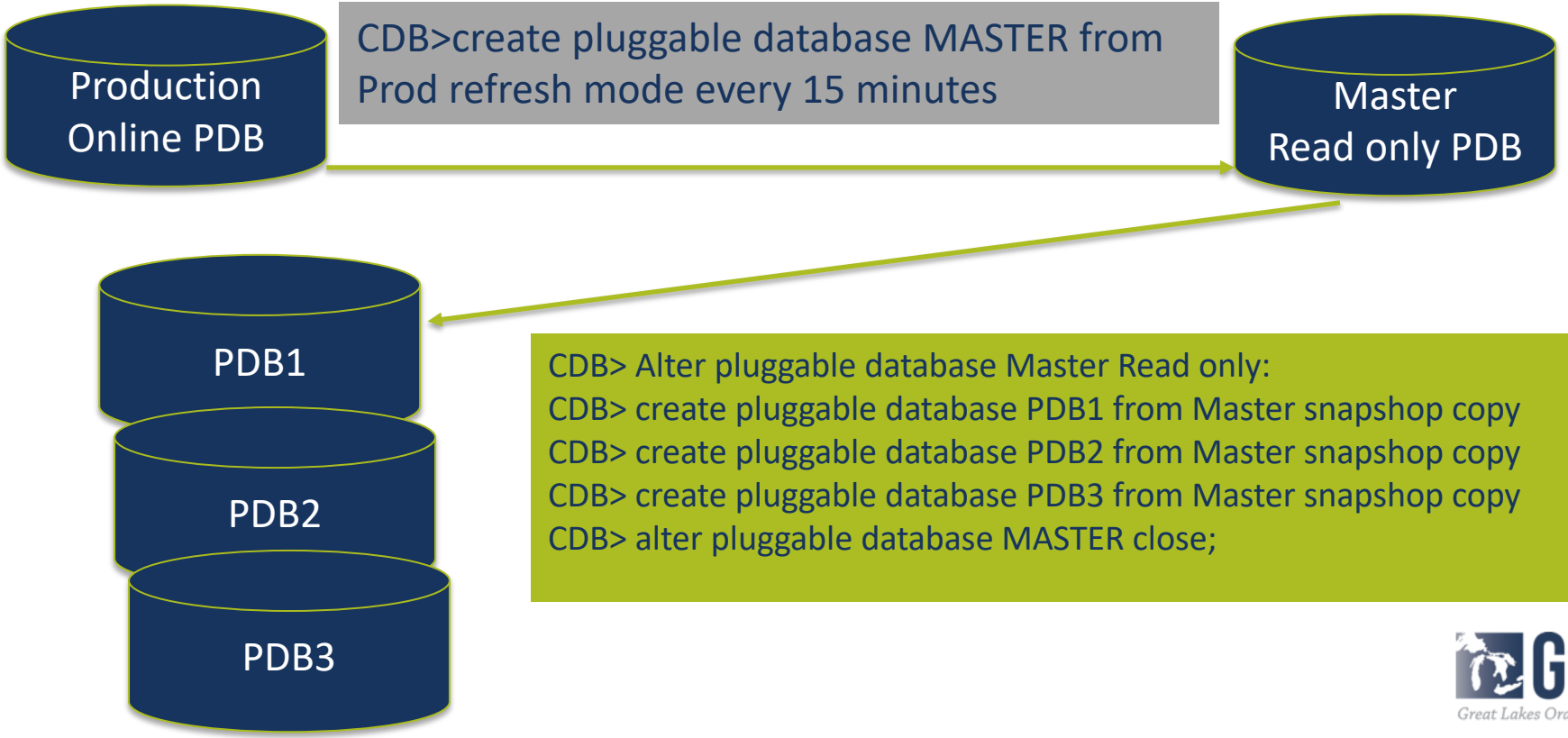
- Refreshable PDB's allows more ability to perform up-to-date refreshes, and great for Dev/Ops type Enviroments:
- Steps to set this up :
  - Step 1 – take a full clone on the source PDB – No Downtime required for Hot Cloning
  - Step 2 – Refresh the "Refreshable" PDB by applying redo logs (Either on Demand or by Schedule)
- The Refreshable PDB should in Read-Only Mode
- NOTE – This is not a replacement of Data Guard

CDB / PDB - Options / Tools – Refreshable PDB's (12.2)

- Cloning ONLINE –
  - Source PDB Doesn't have to be Read Only
  - Redo Apply on the Destination PDB
  - Default Refreshable mode is manual
- Automated Refreshing
  - Every N minutes
  - If Source PDB is not available, - Alternative location to find archive logs can be set with REMOTE_RECOVERY_FILE_DEST instance parameter.

```
CDB> Create pluggable database refresh_pdb from prd_pdb@host
CDB >> Refresh mode every 30 Minutes;
```

CDB / PDB - Options / Tools – Refreshable PDB's (12.2)



CDB / PDB - Options / Tools – Upgrades

- Upgrade Whole CDB
  - You an Upgrade and Apply a patch at CDB-Level (All at one)
  - https://mikedietrichde.com/2014/08/06/upgrade-pdbs-everything-at-once-full-cdb-upgrade/
- Upgrade Individuals PDB
  - Unplug/Plug PDB's into the upgraded CDB (NEW) – One at a time
  - https://mikedietrichde.com/2014/08/05/upgrade-pdbs-one-at-a-time-unplugplug/

CDB / PDB - Options / Tools – Managing Resources

- How Do you manage the “Noisy Neighbor”
  - PDB-Level Resource Plan
    - You can specify how much resources per Consumer Groups
    - Prioritize resources between competing Sessions
  - CDB-LEVEL Resource Plan
    - Specifies how much resources allocated to PDB’s
    - Prioritizes Resources between Competing PDB’s

CDB / PDB - Options / Tools – Managing Resources

- CDB Level
  - CPU Shares
  - CPU Utilization Limit
  - CPU_COUNT (12.2)
  - Tables – “DBA_CDB_RSRC_PLAN” and ”DBA_CDB_RSRC_PLAN_DIRECTIVE”

PLUGGABLE Database	CPU Shares	Guaranteed CPU	CPU LImit
PDB_ERP	2	3/4 = 75%	100 %
PDB_DWH	1	1 / 4 = 25%	60 %

CDB / PDB - Options / Tools – Managing Resources

- PDB LEVEL Memory Resource Management
  - Oracle 12.2 ONLY
  - Memory Parameters – PDB Level
    - SGA_TARGET
    - DB_CACHE_SIZE
    - DB_SHARED_POOL_SIZE
    - PGA_AGGREGATE_LIMIT
    - PGA_AGGREGATE_TARGET
    - SGA_MIN_SIZE (NEW)

CDB / PDB - Options / Tools – Managing Resources

- PDB LEVEL Memory Resource Management – Part 2
  - Oracle 12.2 ONLY
  - NEW Parameters – PDB Level
    - MAX_IOPS – Limits the number of I/O operations Per Second
    - MAX_MBPS – Limits Megabytes for I/O operations per Second
    - Default: 0 (No Limit)
  - If Oracle Waits Due to I/O Limit “Resmgr: I/O rate Limit” – Wait Event
  - Can’t be set in a NON-PDB

CDB / PDB - Options / Tools – Maintenance Tasks

- ENABLE_AUTOMATIC_MAINTENANCE_PDB Parameter
  - Default = TRUE
  - Can be used to enable/disable running Maint. Tasks
  - PDB or CDB
- AUTOTASK_MAX_ACTIVE_PDBS - Parameter
    - Maximum number of PDB's that can schedule the maintenance task
    - CDB Only
    - DEFAULT – (2 PDB's and CDB root can run tasks at the same time)
- Both Parameters introduced in 12cR2

CDB / PDB - Options / Tools – AWR (12.1)

- AWR Snapshots – CDB Level Only
- AWR data reside in CDB$ROOT container
  - AWR data retention
  - Snapshot Schedule
  - Manual Snapshots
  - Purging Snapshot data
- UnPlugged PDB Does Not Contain AWR Information

CDB / PDB - Options / Tools – AWR (12.2)

- AWR Snapshots – CDB or PDB Level
- AWR Snapshots – Default – SYSAUX tablespace – Each PDB
- AWR Reports at a PDB or CDB Level
- AWR Management operations can be at either CDB or PDB
- New Parameter – AWR_PDB_AUTOFLUSH_ENABLED
  - Enables automatic AWR Snapshot for PDB's
  - Default = FALSE
  - Can Be at CDB or PDB Level