

Mike GANGLER
Fred DENIS

Migrate Any Database Workload to the Cloud : Challenge Accepted

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Information about Mike Gangler

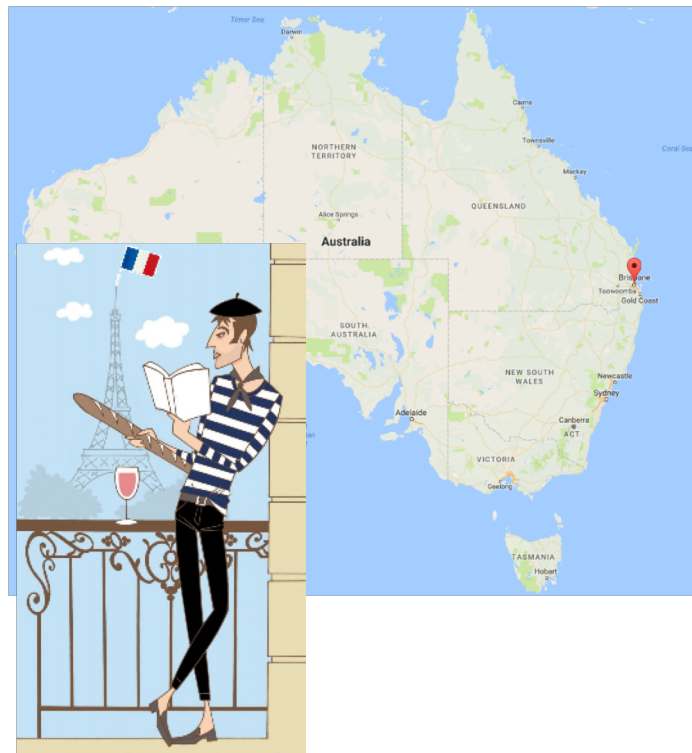


- **Oracle ACE**
- DBA for over 30 years, working with Oracle since version 4
- Team Lead and Senior Database Specialist at Secure-24
- Public Speaker: Oracle OpenWorld, IOUG Collaborate, MOUS, UKOUG, RMOUG, ODTUG, GLOC
- Currently serving on the board of the Michigan Oracle User Summit (mous.us) and 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

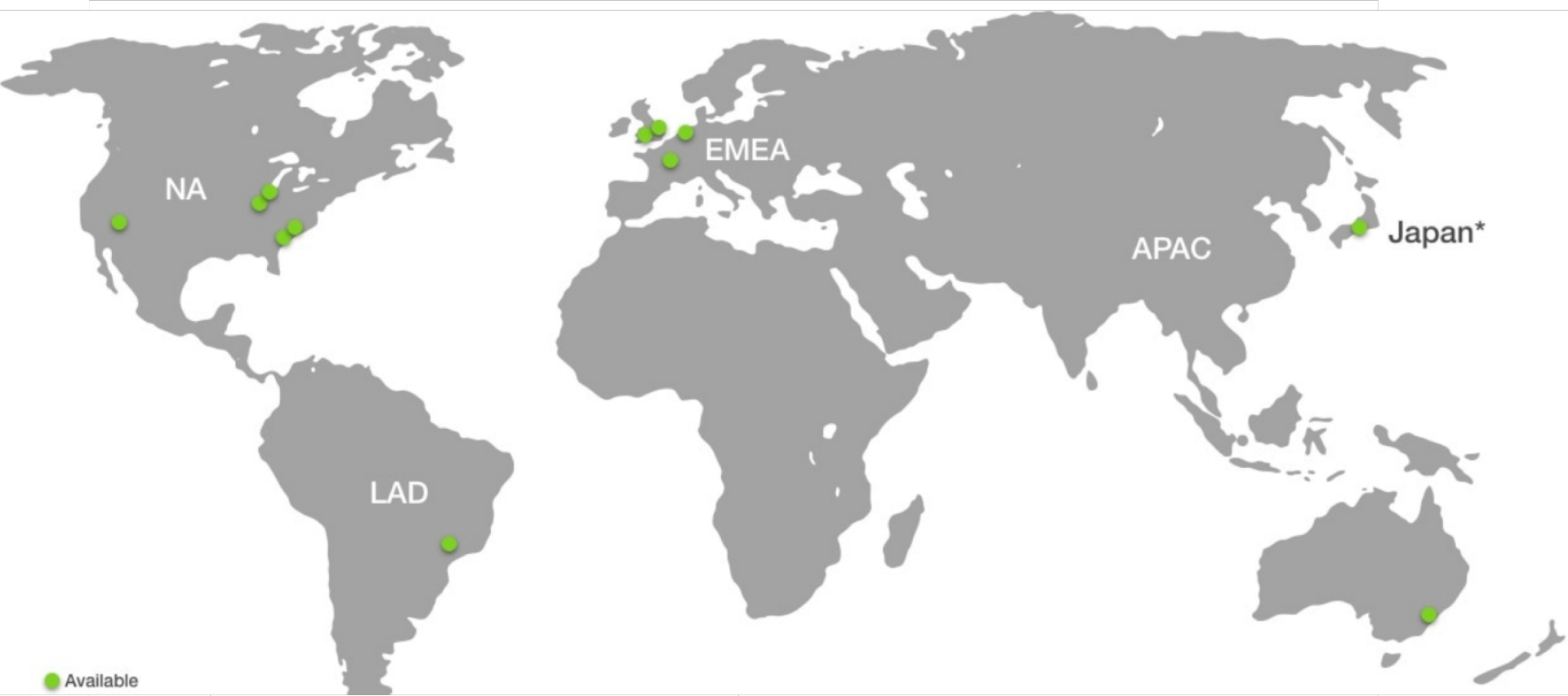


Who I am ?

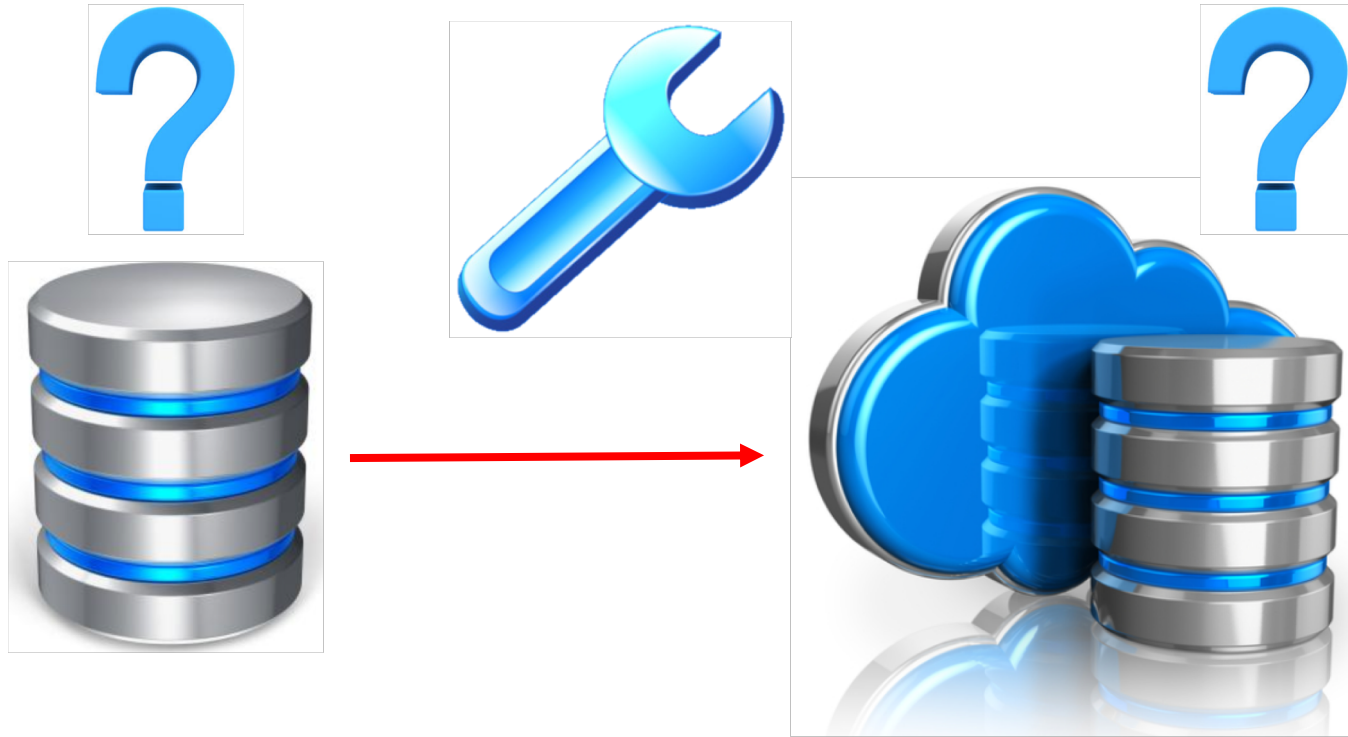
- Fred DENIS
- From Brisbane, Australia
- Oracle DBA at Pythian
- unknowndba.blogspot.com
- Google for “pythian blog denis”



Overview of the Clouds



So you want to move to the Cloud ?





Network based transfer

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Network based transfer tools

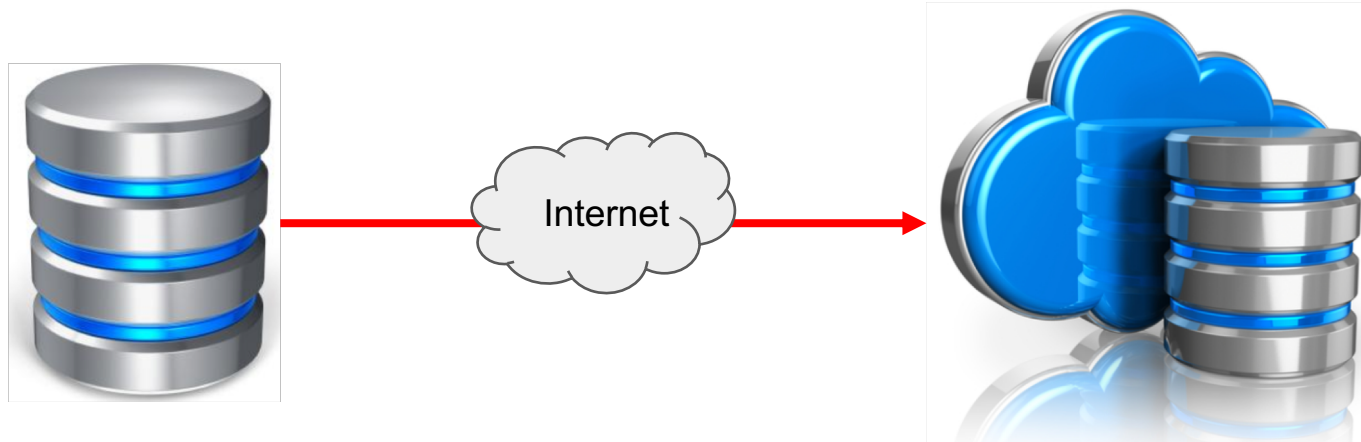
- Using the CLI

```
oci os object put -ns mynamespace -bn mybucket --name myfile.txt --file . . .
```



Network based transfer -- IPSec

- IPSec stands for *Internet Protocol Security*
- It is a VPN protocol known to have a strong encryption
- You cannot ensure your network transfer speed as you will be using the Internet to reach the Cloud

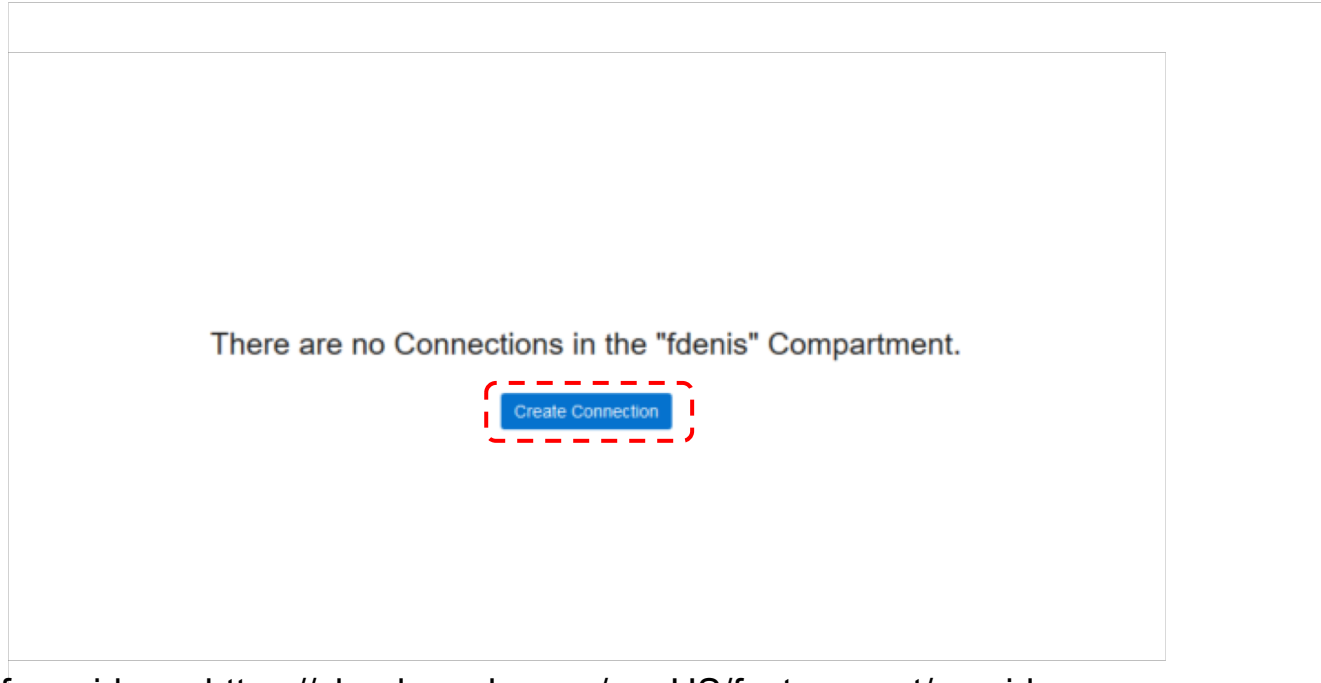


Network based transfer -- Fast Connect (1)

Private connectivity across your premises and your Virtual Cloud Network (VCN)

Product	Pay as You Go (Port Hour)	Monthly Flex (Port Hour)	Includes
FastConnect 1 Gbps	\$0.2125	\$0.2125	No separate charges for inbound or outbound data transfer
FastConnect 10 Gbps	\$1.275	\$1.275	No separate charges for inbound or outbound data transfer

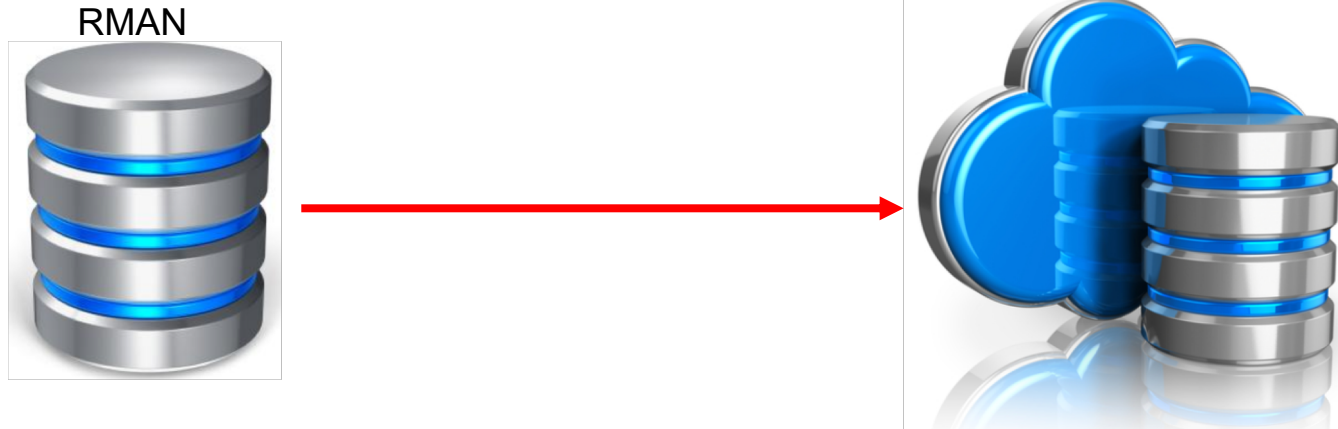
Network based transfer -- Fast Connect (2)



List of providers : https://cloud.oracle.com/en_US/fastconnect/providers

Using Backup Cloud Service (1)

- Backup Cloud Service allows you to directly backup your database(s) from your premises to the Cloud



Using Backup Cloud Service (2)

What you need :

- A supported OS / Database versions

System	Supported Versions
Oracle Database*	<p>Enterprise Edition: 10g Release 2 (10.2.0.5) and later</p> <p>Standard Edition (SE, SE1, SE2): 10g Release 2 (10.2.0.5), 11g Release 1 (11.1.0.7), 11g Release 2 (11.2.0.3 and 11.2.0.4), and later</p> <p>* Unsupported Oracle Database versions are in deprecated mode. See My Oracle Support Doc ID 1640149.1 at http://support.oracle.com for the latest support matrix.</p>
Operating system (64 bits)	Linux, Solaris x86-64, SPARC, Windows, AIX, HP-UX, zLinux

Using Backup Cloud Service (3)

What you need :

- Storage capacity

Buckets *in* fdenis *Compartment*

Create Bucket



[MyBucket](#)

Created: Tue, 11 Sep 2018 00:49:55 GMT

Using Backup Cloud Service (4)

What you need :

- JDK 1.7 on the source system (the one you plan to install the Oracle Database Cloud Backup Module)

```
[oracle@server ~]$ java -version  
java version "1.8.0_161"  
Java(TM) SE Runtime Environment (build 1.8.0_161-b12)  
Java HotSpot(TM) 64-Bit Server VM (build 25.161-b12, mixed mode)  
[oracle@server ~]$
```

Using Backup Cloud Service (5)

What you need :

- If using Standard Edition, patch 18339044 is needed to do encrypted backups as described in note 1640149.1 - Oracle Database Backup Service - FAQ

[Patch 18339044](#) 'CANNOT DO BACKUPS WITH ORACLE PUBLIC CLOUD SBT
LIBRARY IN STANDARD EDITION

Using Backup Cloud Service (6)

What you need :

- [Install the backup cloud module](#)
- Configure RMAN to backup to the Cloud

```
RMAN> CONFIGURE CHANNEL DEVICE TYPE sbt  
PARMS='SBT_LIBRARY=location-of-the-SBT-library-for-Database-Cloud-Backup-Module,  
SBT_PARMS=(OPC_PFILE=location-of-the-configuration file)';
```

- Configure controlfile autobackup

```
RMAN> CONFIGURE CONTROLFILE AUTOBACKUP ON;
```


Using Backup Cloud Service (7)

What you need :

- **Configure Backup encryption (backups must be encrypted to be sent to the Cloud)**

`KBHS-01602: backup piece xxxxxxxxxxxx is not encrypted`

- **Password encryption**

`SET ENCRYPTION ON IDENTIFIED BY password ONLY`

- **Transparent Encryption of Backups**

`Need to create a software keystore (wallet)`

- **Dual Mode Encryption of Backups**

`Need of the keystore or the password`

Using Storage Gateway

- Storage Gateway has been released on September 24th 2018
- Mount a NFS (NFSv4) on your on-premises system to an Object Storage bucket
- Excellent to move or archive data to the cloud or for disaster recovery purpose
- Can be used to move from OCI-classic to OCI
- Maximum of 100 million files per file system; recommended to have no more than 5 FS per Storage Gateway
- Multiple Storage Gateway instances cannot run against the same Object Storage Bucket
- Storage Gateway is Free

Network bottleneck

	Approximate Data Upload Time*				
Dataset Size	10 Mbps	100 Mbps	1 Gbps	10 Gbps	Data Transfer Service
10 TB	92 Days	9 Days	22 Hours	2 Hours	1 Week
100 TB	1,018 Days	101 Days	10 Days	24 Hours	1 Week
500 TB	5,092 Days	509 Days	50 Days	5 Days	1 Week
1 PB	10,185 Days	1,018 Days	101 Days	10 Days	2 Weeks



Non network based transfer

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Using Data Transfer (1)

1/ Data Transfer Appliance

- Loan 150 TB appliances from Oracle for 30 days
- Oracle pays for the shipping to your premises, you pay to send it back
- Only available for US and EU customers
- Service is free

Using Data Transfer (2)

2/ Data Transfer Disk

- You buy your own hard drives and ship them to Oracle
- Oracle ships them back to you after you are done with the copy of your data to your Cloud Storage
- Service is free

Using Data Transfer (3)

3/ Data Transfer [Disk|Appliance] -- How to proceed

Create Transfer Job [help](#) [cancel](#)

Create a transfer job to start the data transfer process. Select the bucket that you want to upload your data to.

JOB NAME

UPLOAD BUCKET

TRANSFER DEVICE TYPE

DISK APPLIANCE

Create Transfer Job



Ravello

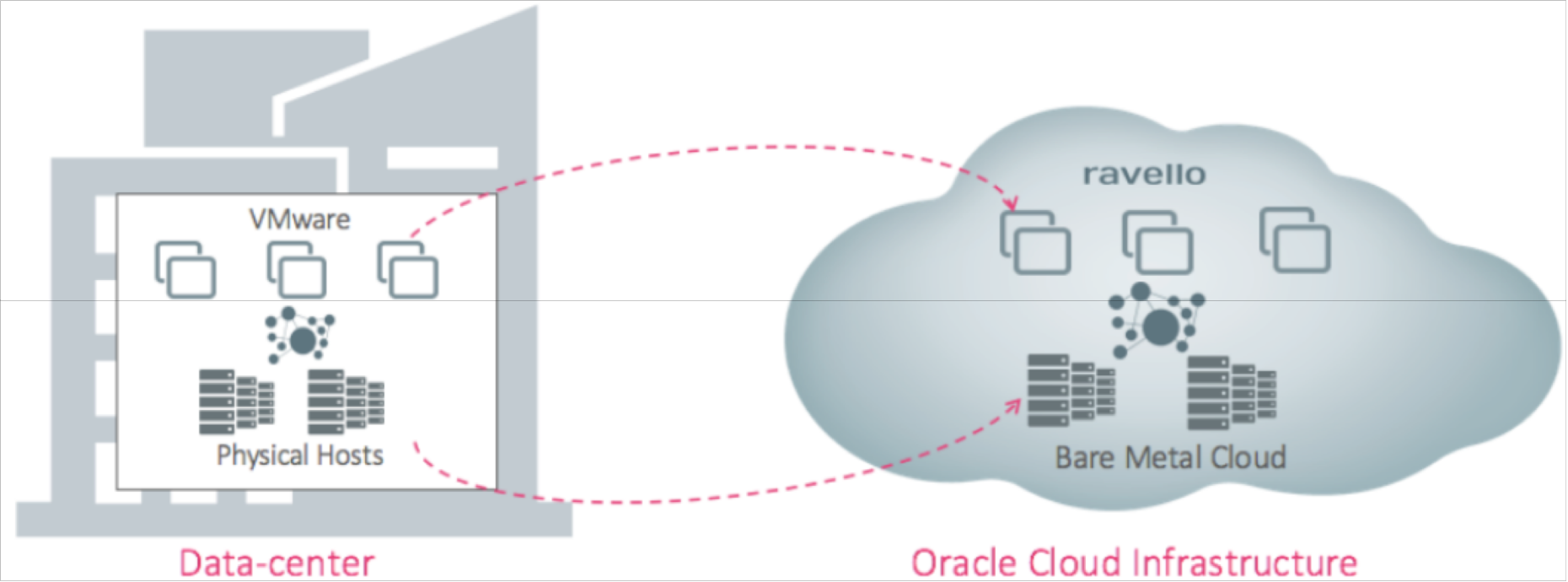
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Ravello

- Ravello systems has developed the HVX hypervisor to superseded ESX and then run applications in public Clouds where ESX is not supported
- Ravello has been bought by Oracle in 2016
- Ravello is a Cloud Service allowing to run the VMWare and KVM servers in the Clouds
- Ravello enables complex applications to run on public clouds exactly as those applications run in the datacenter: Everything about the VMs stays the same - the same operating system, paravirtualized drivers, application settings, network settings, VMware tools etc.
- The largest VM that can be deployed on Ravello on Oracle Cloud Infrastructure can have 32 vCPUs and 200 GB of memory.

Ravello



Ravello

- Install the Ravello VM Import Tool
- Import the VM(s) images
- Create an application
- Drag and drop the VMs you want to deploy in the canvas
- Publish the application



Which way to go with my database(s) ?

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Today's Discussion

Case Study.

Today's presentation will cover ways to upgrade and move databases to the Oracle Cloud with little or no downtime. This will look at the tools used to get the data to the cloud.

Overview of Process

- Basics of Migration Projects
- Migration Strategies
- Questions

Migration Planning Basics

- Which Migration Methods / tools should I choose ?
- Important factors
 - Source/target version – Cloud - Linux
 - Source/target platform – Cloud – 11.2.0. 4 or Greater
 - Downtime requirements
 - Network Speeds – Cant be understated – Cloud – Fastconnect
 - Database Architecture – Desire to adopt new features

Migration - Evaluation Phase

- **What is your Source ?**
 - Exadata
 - Oracle Engineered Systems
 - Physical Machine
 - VM Ware ? (destination has to be Ravello)

- **What is your Destination ?**
 - Oracle Cloud -Exadata
 - Oracle OCI (Instance)
 - Oracle Database Cloud Service

Migration – Oracle Cloud Service

Oracle Database Cloud Service

QuickStarts Welcome! Identity Domain

Instances Activity SSH Access

As of Oct 23, 2018 3:05:25 PM UTC

Summary	9	4	30 GB	2,767 GB	9
	Instances	OCPUs	Memory	Storage	Public IPs

Instances

Search by instance name or tags

	HROUG	Status: Instance Stopped	Submitted On: Oct 18, 2018 1:36:13 PM UTC	OCPUs: 1*
		Version: 18.0.0.0		Memory: 7.5 GB*
		Edition: Enterprise Edition		Storage: 170 GB

	db122-test	Version: 12.2.0.1	Created On: Oct 14, 2018 8:26:22 PM UTC	OCPUs: 1
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Migration – Oracle Cloud Service – P2

Apps Secure-24 Massachusetts To... ASM List of halls and w... Log On Facebook - Log In... Roadside America... Other Bookmar

ORACLE Cloud My Services Dashboard Users ? MJ

Create Instance

Cancel Instance Details Confirm Next >

Instance

Provide basic service instance information.

* Instance Name ?

Description ?

Notification Email ?

Region ?

Tags + ?

License Type

- My organization already owns Oracle Database software licenses. Bring my existing database software license to the Oracle Database Cloud Service.
- Subscribe to a new Oracle Database software license and the Oracle Database Cloud Service.

Learn about how [Bring Your Own License](#) (BYOL) works.

* Software Release ?

* Software Edition ?

* Database Type ?

Migration – OCI Database

The screenshot shows the Oracle Cloud Infrastructure (OCI) console interface. At the top, there is a navigation bar with the Oracle logo and 'Cloud Infrastructure' text. A search bar is present on the right side of the navigation bar. Below the navigation bar, the main content area is divided into a left sidebar and a main panel. The sidebar contains a 'MENU' icon, a 'Bare Metal, VM, and Exadata' section, and a 'DB Systems' section which is currently selected. Under 'DB Systems', there is a link for 'Standalone Backups'. Below the sidebar, there is a 'List Scope' section and a 'COMPARTMENT' dropdown menu currently set to 'Mike_Gangler-V1'. A message at the bottom of the sidebar reads 'Don't see what you're looking for?' with an information icon. The main panel displays the title 'DB Systems in Mike_Gangler-V1 Compartment' and a status 'No DB System'. A blue button labeled 'Launch DB System' is visible at the top of the main panel. Below this, a large message states 'There are no DB Systems in the "Mike_Gangler-V1" Compartment.' with another blue 'Launch DB System' button centered below it.

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MENU ORACLE Cloud Infrastructure Search us-ashburn-1 ?

Bare Metal, VM, and Exadata

DB Systems

Standalone Backups

List Scope

COMPARTMENT

Mike_Gangler-V1

Don't see what you're looking for? ⓘ

DB Systems in Mike_Gangler-V1 Compartment

No DB System

Launch DB System

There are no DB Systems in the "Mike_Gangler-V1" Compartment.

Launch DB System

Migration – OCI Database – P1

The screenshot shows the Oracle Cloud Infrastructure (OCI) console interface. At the top, there is a navigation bar with the Oracle logo and 'Cloud Infrastructure' text. Below this, the main content area is titled 'DB Systems in Mike_Gangler-V1 Compartment'. A message states 'There are no DB Systems in the "Mike_Gangler-V1" Compartment.' and a 'Launch DB System' button is visible. The left sidebar contains navigation options like 'Bare Metal, VM, and Exadata', 'DB Systems', and 'Standalone Backups'. The bottom left corner has a search bar and a help icon.

Apps Secure-24 Massachusetts To... ASM List of halls and w... Log On Facebook - Log In... Roadside America... Other Bookmar

MENU ORACLE Cloud Infrastructure Search us-ashburn-1 ?

Bare Metal, VM, and Exadata DB Systems in Mike_Gangler-V1 No DB System

DB Systems Standalone Backups

List Scope

COMPARTMENT Mike_Gangler-V1

Don't see what you're looking for? ?

Launch DB System

There are no DB Systems in the "Mike_Gangler-V1" Compartment.

Launch DB System

Migration – OCI Database – P2

Launch DB System [help](#) [cancel](#)

If the Virtual Cloud Network or Subnet is in a different Compartment than the DB System, enable Compartment selection for those resources: [Click here](#).

DB System Information

DISPLAY NAME
mikeg-test7

AVAILABILITY DOMAIN
HDGG:US-ASHBURN-AD-1

SHAPE TYPE
 VIRTUAL MACHINE BARE METAL MACHINE

SHAPE
VM.Standard2.1

TOTAL NODE COUNT
1

ORACLE DATABASE SOFTWARE EDITION
Enterprise Edition

Background text: Bare Metal, VM, and Exadata; DB Systems; Standalone Backups; List Scope; COMPARTMENT: Mike_Gangler-V1; Don't see what you're looking for? (i); No DB System; V1" Compartment.

Migration – OCI Database – P3

The screenshot displays the Oracle Cloud Infrastructure console interface. The top navigation bar includes the Oracle logo and 'Cloud Infrastructure'. The left sidebar contains a 'MENU' and a 'COMPARTMENT' dropdown menu set to 'Mike_Gangler-V1'. The main content area is titled 'Database Information' and contains the following configuration fields:

- DATABASE NAME:** testmjb
- DATABASE VERSION:** 12.2.0.1
- PDB NAME (Optional):** testpdb1
- DATABASE ADMIN PASSWORD:** [Redacted]
- CONFIRM DATABASE ADMIN PASSWORD:** [Redacted]

Below the password fields, there is a red warning message: "Password must be 9 to 30 characters and contain at least 2 uppercase, 2 lowercase, 2 special, and 2 numeric characters. The special characters must be _, #, or -." Below that, a green confirmation message states: "Confirmation must match password above." There is also a checked checkbox for "AUTOMATIC BACKUP" with an information icon. A note below it reads: "Configure the service to automatically back up this database to Oracle Cloud Infrastructure Object Storage." At the bottom, an orange warning box contains the text: "Important: All prerequisites for backing up to Oracle Cloud Infrastructure Object Storage must be met for automatic backups to".

Migration Strategies

Migration / Tools and Options (3rd Party Options)

- ❖ Logical Replication (Golden Gate)
- ❖ Physical Replication (Dbvisit)
- ❖ VM Ware Tools – P2V

Migration Strategies

Migration / Tools and Options (Oracle Provided)

- ❖ Dataguard – Enterprise Edition Only
- ❖ Transportable tablespace (TTS)
- ❖ Data Pump
- ❖ RMAN1 / RMAN0



Migration - DataGuard

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Migration - Using DataGuard

When to Use Data Guard Migration

- ✓ Minimal Downtime Migration
- ✓ Source can be 11.2.0.4+
- ✓ Physical Copy of the database
- ✓ Must have Enterprise Edition

Migration - Using DataGuard

When Not to Use Data Guard Migration (Limitations)

- ✓ When you need to upgrade (Cant use for Direct Upgrade)
- ✓ Have Cross-Endian (i.e. Windows / AIX to Linux)
- ✓ Only Works with Oracle Enterprise Edition
- ✓ Option to use "DBVIST" if you have Standard Edition - www.dbvisit.com

Migration - Using DataGuard

Example process - Same as Non-cloud (Pre-cutover)

- Perform Full Rman backup or Level 0 backup
- Note – Can backup to Oracle Cloud – Saves on additional storage
- Copy source to Destination (Non Oracle Cloud)
- Perform RMAN Restore
- Apply Redo logs and setup standby database

Migration - Using DataGuard

Example process - Same as Non-cloud

At Cutover (Most databases < 1 hour)

- Apply redo logs,
 - switch databases to Primary mode
 - Plug into cloud database
-
- Note - (If Destination is cloud) - Oracle Database Cloud Instance



Migration - DataPump

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Migration - Using Data Pump

When to Use Data Pump Migration

- ✓ Good for Different Endian Formats (i.e. Unix – linux)
- ✓ Source Version Can be 10G and Later
- ✓ Migration from non-CDB to PDB
- ✓ Changes to Database structure
- ✓ Upgrade to later versions possible
- ✓ Logical Replication of Data Only

Migration - Using Data Pump

When NOT to Use Data Pump Migration

- ✓ Time Issues with larger Databases
- ✓ High or inconsistent Network latency
- ✓ Missing objects (i.e. like Synonyms, database links)
Depends on level of data pump.
- ✓ Slow process – Due to Moving data Multiple times
- ✓ Logical Replication of Data

Migration - Using Data Pump

Example process (Cutover)

- ✓ Create cloud / database instance (PDB if necessary)
- ✓ Export Source data using expdp
- ✓ Copy dump files to New database
- ✓ Import using impdp into destination



Migration - RMAN backup / restore

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Migration - Using Backup/Restore

When to Use Backup / Restore Migration

- ✓ Same Endian Format
- ✓ Source Version Can be 11G and Later
- ✓ No Database structure Changes
- ✓ No Direct Oracle Upgrade
- ✓ Physical Replication of Data

Migration - Using Backup/Restore

When NOT to Use Backup/Restore Migration

- ✓ Shorter downtime allowed
- ✓ High or inconsistent Network latency
- ✓ Not tolerant to Slow process – Due to Moving data Multiple times



Migration - Logical Replication

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Migration - Using Logical Replication

When to Use Logical Replication Migration *Third Party Products (Golden Gate)*

- ✓ Different Cross-endian possible
- ✓ Source version can be version 8i and later
- ✓ Possible to Migrate from non-CDB to PDB
- ✓ Changes to database structure possible
- ✓ Minimal downtime migration Upgrade to new version possible

Migration - Using Logical Replication

When NOT to Use Logical Replication Migration

- ✓ Financial Constraints
- ✓ If Data Types not compatible with 3rd party products
- ✓ High or inconsistent Network latency

Migration - Using GoldenGate

Example process (Cutover)

- ✓ Perform RMAN Backup (Full or Level0)
- ✓ Copy Source data to Destination
**Not required if restoring directly from Source
- ✓ Restore / Instantiate New database from backup

Migration - Using GoldenGate

Example process (Pre-Cutover)

- ✓ Create Cloud or Database instance at Destination
- ✓ Migrate data to Destination via RMAN Backup, Transportable tablespaces (TTS) or Data pump
- ✓ Instantiate / Synchronize new Database on Destination

Day of Cutover :

- ✓ Switch / point application Users to new database
- ✓ Minimal Downtime Required



Migration - Transportable Tablespaces

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Migration - Transportable Tablespaces (TTS)

When to Use TTS Migration

- ✓ Need to move to a different Endian
- ✓ Source version *8i* and later (same OS) or *10g* and later cross-endian
- ✓ If you need to Migrate from non-CDB to PDB
- ✓ No changes to database structure
- ✓ Need to Upgrade to later version
- ✓ Applications that are tablespace isolated(i.e. Hyperion)

Migration - Using TTS Migration

When NOT to Use TTS Migration

- ✓ High or inconsistent Network latency
- ✓ Adverse to moving data multiple times
- ✓ If you need to change Data Structures
- ✓ Many Application / Schema Users

Migration - Using Incremental TTS

Example process (Pre-Cutover)

- Pre-Create Database instance and PDB (If Necessary)
- Export users
- Export tablespace metadata
- Export application metadata

Migration - Using Incremental TTS

Day of Cutover :

- Move data files and metadata to Destination Database
- RMAN CONVERT data files if needed
- Import users
- Import tablespace metadata
- Import application metadata
- Switch / point application Users to new database
- Minimal Downtime Required



Migration - 12c PDB cloning

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Migration - Using 12C PDB Cloning

When to Use 12C PDB Cloning

- ✓ Source version can be version 12.1 and 12.2
- ✓ Source and Destination must be PDB
- ✓ No Database structure Changes
- ✓ Time Constraints at cutover
- ✓ Minimal downtime with hot clone

Migration - Using 12C PDB Cloning

When Not to Use Oracle 12c PDB Cloning Migrations

- ✓ Different Cross-endian possible
- ✓ Source Oracle version < 12.1 or 12.2
- ✓ Non-Container database
- ✓ database structure possible

Migration - Using 12c PDB Cloning

Migration Process

- Using DBMS_FILE_TRANSFER Create Destination database (Pre-cutover).
 - Create dblink from Destination to Source database
 - Clone PDB via DBLINK
 - Upgrade if moving to new Version
- ✓ 12.2 will be using Hot Clone – 12.1 doesn't use Hot Cloning

Migration - Using 12c PDB Cloning

Other Options –for the PDB Migration Process

- Plug / Unplug PDB's
 - Cloning PDB's (Can use non-CDB's)
- ✓ 12.2 will be using Hot Clone – 12.1 doesn't use Hot Cloning



Migration - RMAN1 / RMAN0

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Migration - Using RMAN1/RMAN0

When to Use RMAN1 / RMAN0 Migration

- ✓ Same Endian Format
- ✓ Source Version Can be 10G and Later
- ✓ No Database structure Changes
- ✓ No Direct Oracle Upgrade
- ✓ Short upgrade window
- ✓ Oracle Database using Standard Editions

Migration - Using RMAN1/RMAN0

When NOT to Use Backup/Restore Migration

- ✓ High or inconsistent Network latency
- ✓ Storage issues (Need space for RMAN1 backups)

Migration - Using RMAN0/RMAN1

Example process (Cutover)

- ✓ Perform RMAN0 Backup (Level0)
- ✓ Copy Source data to Destination
- ✓ Restore Database without optimizing
- ✓ Apply Daily RMAN1 Backups to Restored database until cutover.



Migration - Comparisons



Migration – Options - Zero or Near-Zero Downtime

- Dataguard

- RMAN1/RMAN0

- PDB Clone

- Golden Gate – Logical Replication

Migration Basics

Summary: Choose the Right Migration Method

	Backup/ Restore	Data Guard	PDB Unplug/ Plug	PDB Clone	Non-CDB Clone	Data Pump	Transportable Tablespaces	Full Transportable export/import	GoldenGate Cloud Service
Source Version	11.2.0.4, 12.1.0.2, 12.2.0.1	11.2.0.4, 12.1.0.2, 12.2.0.1	12.1.0.2, 12.2.0.1	12.1.0.2, 12.2.0.1	12.1.0.2, 12.2.0.1	10g and later	8i and later	11.2.0.3 and later	8i and later
Upgrade Allowed			✓	✓		✓	✓	✓	✓
Cross- Endian						✓	✓	✓	✓
Structural Changes						✓			✓
PDB Source			✓	✓					
Minimal Downtime		✓		✓ (12.2 only)					✓

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References

A huge thanks to the following blogs and websites:

<https://mikedietchde.com/>

<https://kyuoracleblog.wordpress.com/>

<https://events.rainfocus.com/catalog/oracle/oow17/catalogoow17?showEnrolled=false>

Questions



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