Continuous Database Patching at scale

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Agenda

1. Introduction
2. PayPal's Scale
3. Patching Methods & Techniques @ PayPal
4. Near zero downtime patching
5. Q & A

Currently Senior Database Engineer @ PayPal with 15+ years of experience with Oracle Technologies

Oracle Golden Gate SME

Development of Scalable and Highly Available database applications for Large scale banking and financial applications

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About PayPal

Two decades ago, our founders invented payment technology to make buying and selling faster, secure, and easier; and put economic power where it belongs: **In the hands of people**

Our 400+ Million consumers can accept payments in > 100 currencies and interact with 20M+ Merchants across 200 markets

Thousands of PayPal team members provide support to our customers in over 20 languages

We are a trusted part of people's financial lives and a partner to merchants in 200+ markets around the world

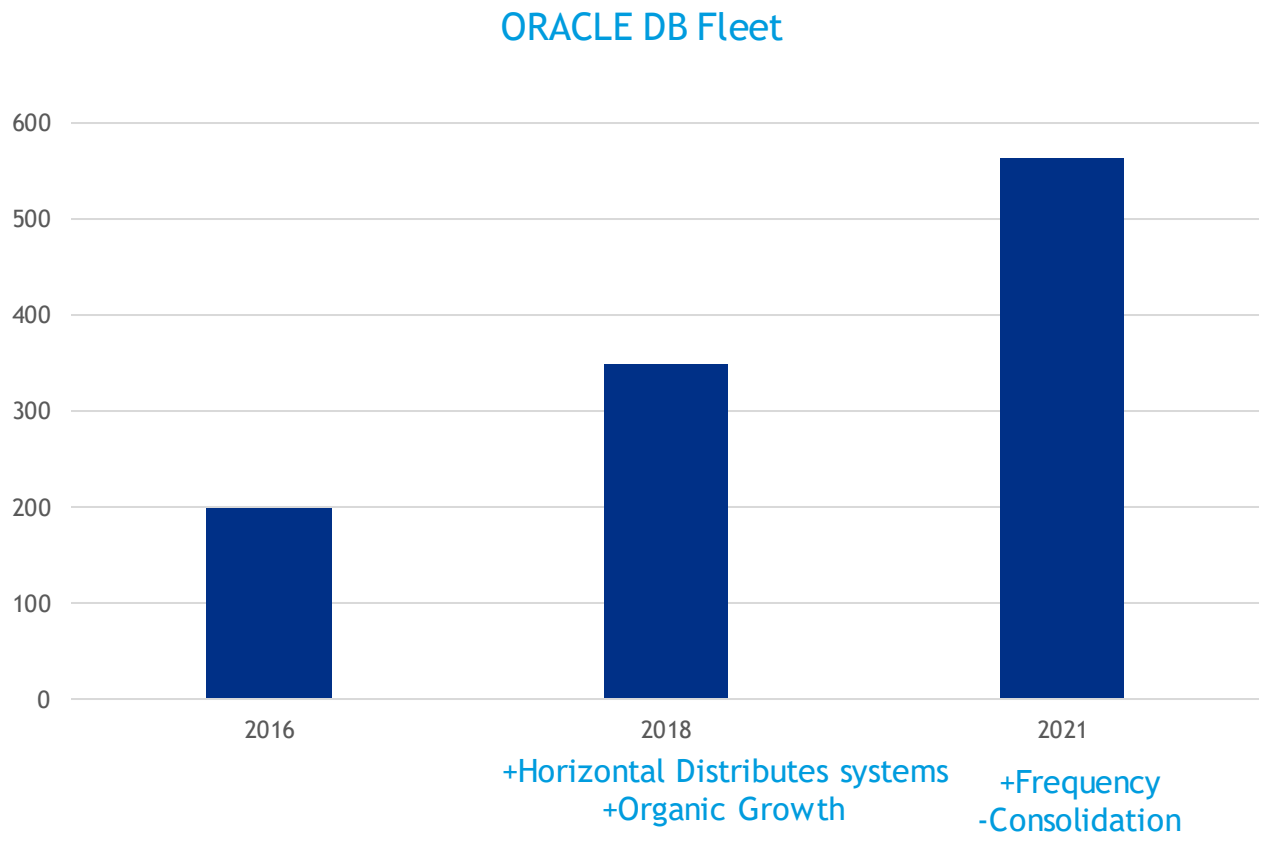
Database Infrastructure & Storage Footprint

6M+
Execs/Sec

750+
ORACLE Instances

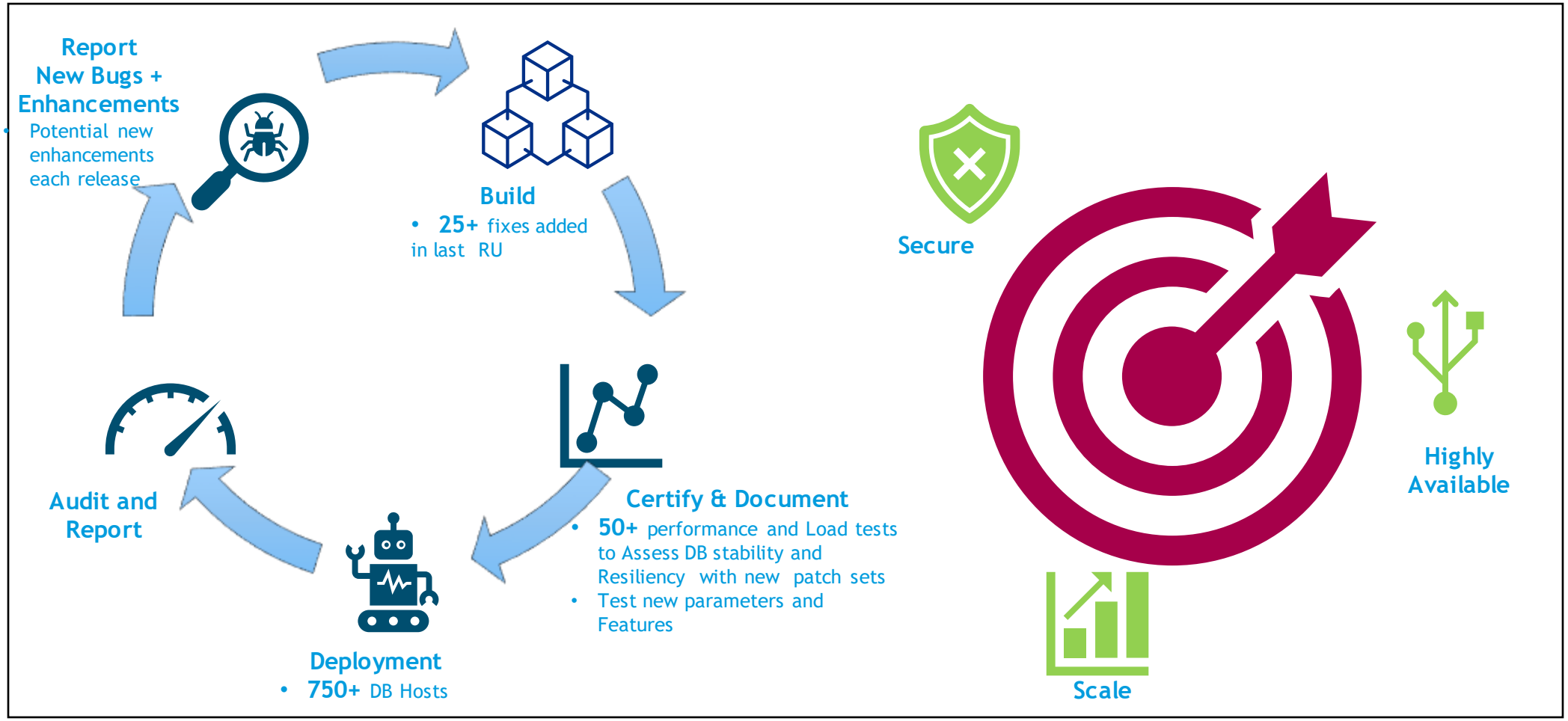
32% Y-o-Y
DB Storage Growth

90+ PB
Total DB Storage

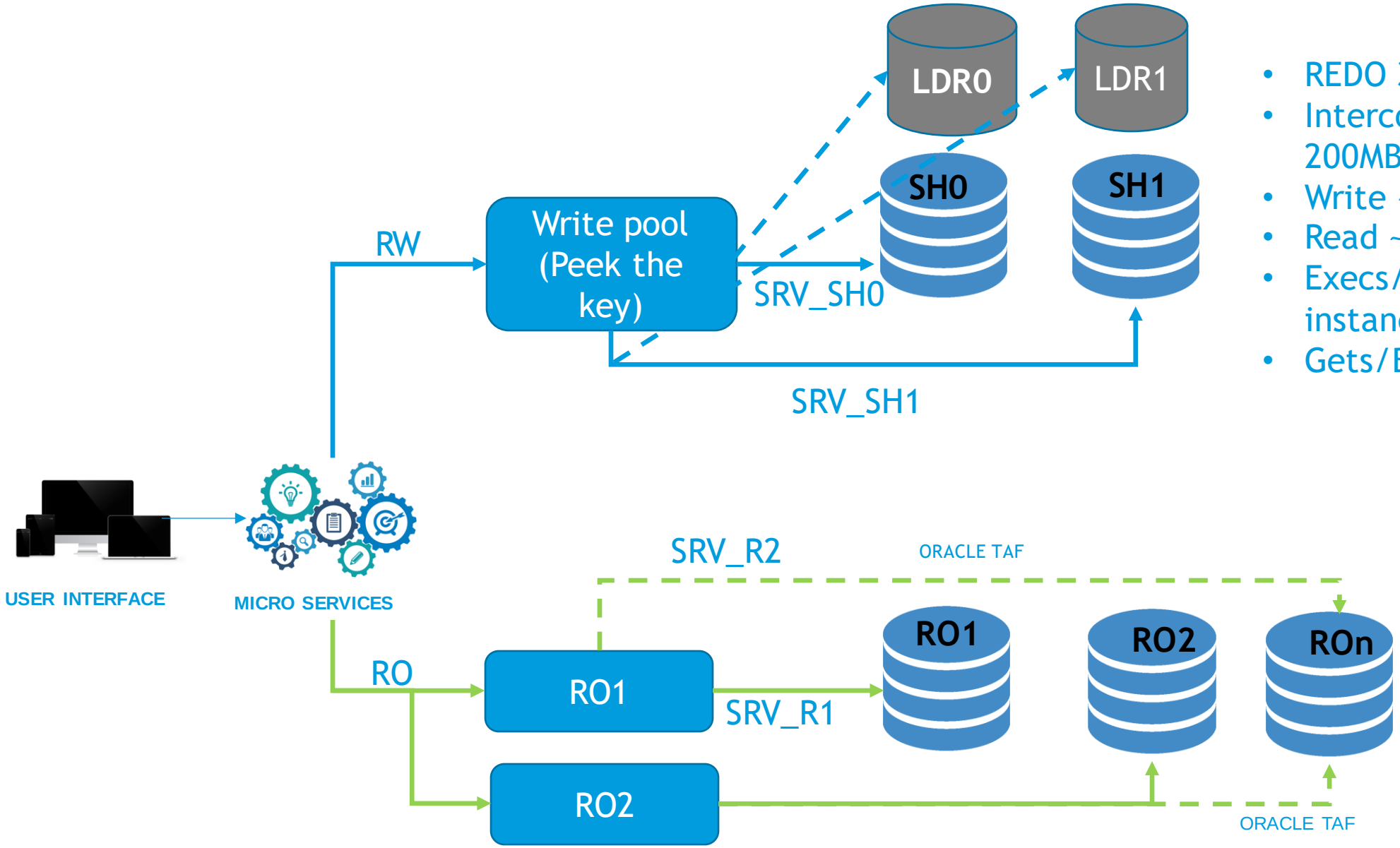


PayPal

Software Lifecycle

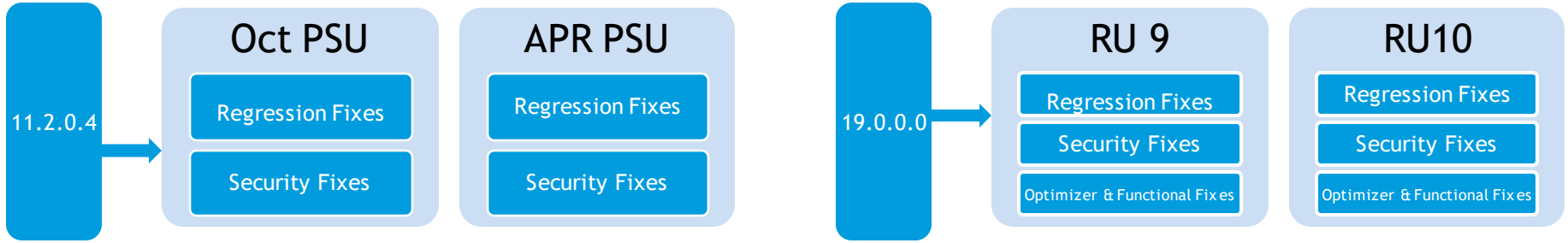


Database Deployment Patterns



- REDO 300MBPS
- Interconnect 200MBytesPs
- Write ~ 50K IOPs/ 5GBPs
- Read ~ 50K IOPs/ 5GBPs
- Execs/s ~100k per instance
- Gets/Block changes ~ 5m

Patching cycle

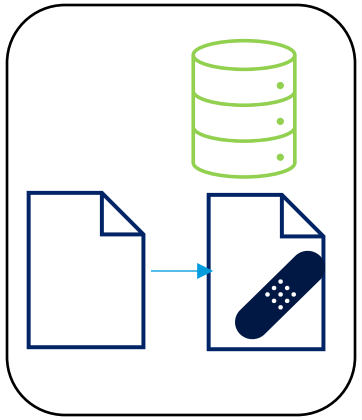


	Jan 18	Apr	Jul	Oct	Jan 19	Apr	Jul	Oct
RU	18.1.0	18.2.0	18.3.0	18.4.0	18.5.0	18.6.0	18.7.0	18.8.0
RUR #1			18.2.1	18.3.1	18.4.1	18.5.1	18.6.1	18.7.1
RUR #2				18.2.2	18.3.2	18.4.2	18.5.2	18.6.2
RU					19.1.0	19.2.0	19.3.0	19.4.0
RUR#1							19.2.1	19.3.1
RUR #2								19.2.2

Patching Methods

Method	Type	Pros	Cons
Opatch OPatchauto	In place	• One-off patches	• Outage
Opatchauto/gridsetup	Out of place	• Automated patching for less conflicting patches	• New Homes • Local • Conflicting patches • Vendor Dependency
FPP	Out of place	• Centralized • Comprehensive • Limited online GI patching	• Lack of control &Env awareness • New homes • Agent based targets • Complex GI + RDBMS • Authentication limitations for non-clients
Custom methods (custom clone + switch)	Custom Out of place (Gold Images)	• Control • ORACLE +PayPal env awareness • Same Home • Centralized and scalable • Limited online GI patching	• Development and maintenance

In place patching



Out of place patching

Patching with Opatch/Opatchauto tools

In place (Same Home)

opatchauto apply <Patch_Location>

Out of Place (New Home)

opatchauto apply ${PATCH_HOME} -outofplace

Or

${ORACLE_HOME}/OPatch/opatchauto apply ${PATCH_HOME} -prepare-clone
${ORACLE_HOME}/OPatch/opatchauto apply ${PATCH_HOME} -switch-clone

```
<System patch location - directory>
|_____ Readme.txt (or) Readme.html
       bundle.xml
       automation
               |_____ apply_automation.xml
       |_____ rollback_automation.xml
       Sub-patch1
                |_____ etc/config/inventory.xml
                |_____ etc/config/actions.xml
                |_____ files/Subpatch1 'payload'
       Sub-patch2
                |_____ etc/config/inventory.xml
                |_____ etc/config/actions.xml
                |_____ files/Subpatch1 'payload'
```

System patch format

```
--------------------------------Patching Failed----------------------------------
Command execution failed during patching in home: /x/home/oracle/product/19.0.0.0, host: sjnexadb03.
Command failed:  /x/home/oracle/product/19.0.0.0/OPatch/opatchauto  apply /x/home/oracle/patches_080421/32545008 -oh /x/home/oracle/product/19.0.0.0 -target_type rac_database -binary -invPtrLoc /x/home/grid/19.0.0.0/oraInst.loc -jre /x/home/grid/19.0.0.0/O
Patch/jre -persistresult /x/home/oracle/product/19.0.0.0/opatchautocfg/db/sessioninfo/sessionresult_analyze_sjnexadb03_rac_2.ser -analyze -online -force_conflict -prepare_home
Command failure output:
==Following patches FAILED in analysis for apply:

Patch: /x/home/oracle/patches_080421/32545008/32545013
Log: /x/home/oracle/product/19.0.0.0/cfgtoollogs/opatchauto/core/opatch/opatch2021-08-11_08-19-58AM_1.log
Reason: Failed during Analysis: CheckConflictAgainstOracleHome Failed, [ Prerequisite Status: FAILED, Prerequisite output:
The details are:
Reason -
Superset Patch 32545013 has
Subset Patch 31281355 which has overlay patches [30576112,29791916,30931981,29351786,31377487,29657973,28406374,31664150,29997937,31648120,30684902,31604197,31142377,30321076] and these overlay patches conflict with Superset Patch

OPatch recommends any one of the following actions
  - Please rebuild the superset patch to make ...

After fixing the cause of failure Run opatchauto resume

]
OPATCHAUTO-68061: The orchestration engine failed.
OPATCHAUTO-68061: The orchestration engine failed with return code 1
OPATCHAUTO-68061: Check the log for more details.
OPatchAuto failed.
```

Patching with gridsetup tool

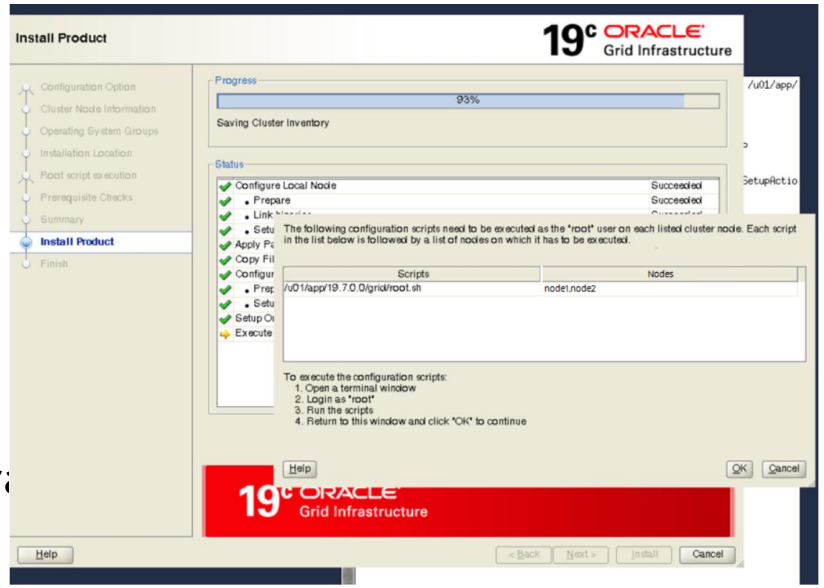
- Download Base goldimage from OTN and Apply RU

  /{Extracted Base goldimage}/gridSetup.sh -ApplyRU <RU_Number>

{OR}

- Apply patches on test server and creategoldimage
  - Apply patches using opatch/opatchauto
  - gridSetup.sh -createGoldImage

    -destinationLocation /x/home/oracle/ -silent -exclFiles .patch_stora



- Extract and switch to new goldimage on target system
  - Extract new goldimage to new_home
  - {new_home}/gridSetup.sh -silent –switchgridhome
  - When prompted run root.sh

root.sh -transparent –nodriverupdate can be used for online switch for some patches. OS kernel modules such as ACFS are not updated but will continue to run the pre-patch version. Effective with rootcrs.sh –updateosfiles &CRS restart or subsequent reboot with OS kernel update

Patching with FPP(RHP)

```
Performs Rapid Home Provisioning operations and manages Rapid Home Provisioning Servers and Clients.

Usage:
        rhpctl add                  Adds a resource, type or other entity.
        rhpctl addnode              Adds nodes or instances of specific resources.
        rhpctl addpdb               Adds a pluggable database to the specified multitenant container database.
        rhpctl allow                Allows access to the image, series or image type.
        rhpctl collect              Collects backup of operating system configuration for the cluster.
        rhpctl compare              Compares operating system configurations for the specified cluster.
        rhpctl delete               Deletes a resource, type or other entity.
        rhpctl deleteimage          Deletes an image from a series.
        rhpctl deletenode           Deletes nodes or instances of specific resources.
        rhpctl deletepdb            Removes a pluggable database from the specified multitenant container database.
        rhpctl deploy               Deploys OS image for the cluster.
        rhpctl disable              Disables the scheduled daily backup of operating system configuration for the cluster.
        rhpctl disallow             Disallows access to the image, series or image type.
        rhpctl discover             Validates and discovers parameters to generate a response file.
        rhpctl enable               Enables the scheduled daily backup of operating system configuration for the cluster.
        rhpctl export               Exports data from the repository to a client or server data file.
        rhpctl grant                Grants a role to a client user.
        rhpctl import               Creates a new image from the specified path.
        rhpctl insertimage          Inserts a new image into a series.
        rhpctl instantiate          Requests images from another server.
        rhpctl modify               Modifies a resource, type or other entity.
        rhpctl move                 Moves a resource from a source path to a destination path.
        rhpctl movepdb              Moves a pluggable database from the specified source multitenant container database to the specified destination multitenant container database.
        rhpctl promote              Promotes an image.
        rhpctl query                Gets information of a resource, type or other entity.
        rhpctl recover              Recovers a node after its failure.
        rhpctl register             Registers an image, user or server.
        rhpctl replicate            Replicate image from server to a specified client.
        rhpctl revoke               Revokes a role of a client user.
        rhpctl subscribe            Subscribes the specified user to an image series.
        rhpctl uninstantiate        Stops updates for previously requested images from another server.
        rhpctl unregister           Unregisters an image, user or server.
        rhpctl unsubscribe          Unsubscribes the specified user to an image series.
        rhpctl upgrade              Upgrades a resource.
        rhpctl verify               Validates and creates or completes a response file.
        rhpctl zdtupgrade           Performs zero downtime upgrade of a database.
```

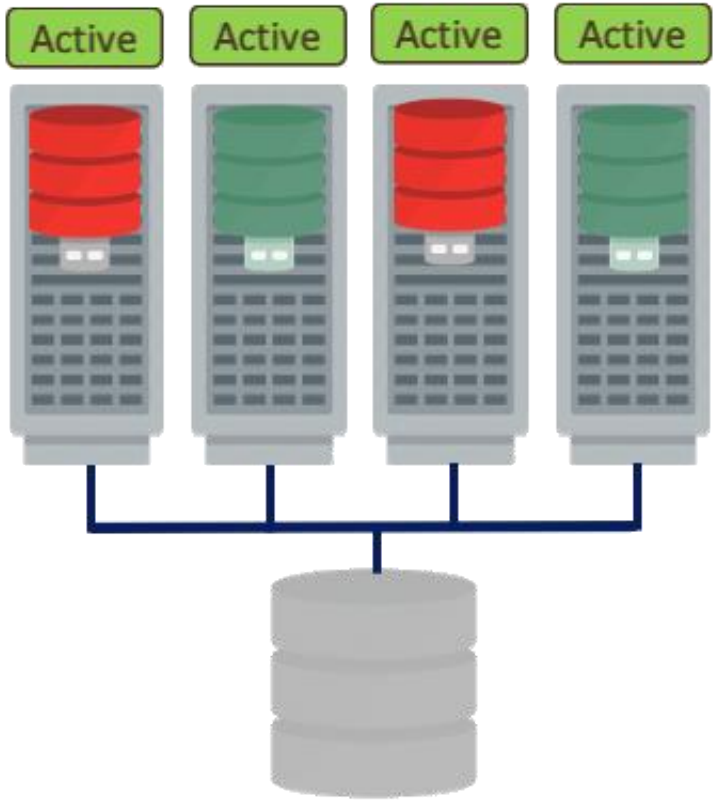
Custom Patching with full goldimage

- Apply patches on test server and create full goldimage
  - Apply patches using opatch/opatchauto
  - tar cpf <tarball> <Home_location> --exclude= .patch_storage/

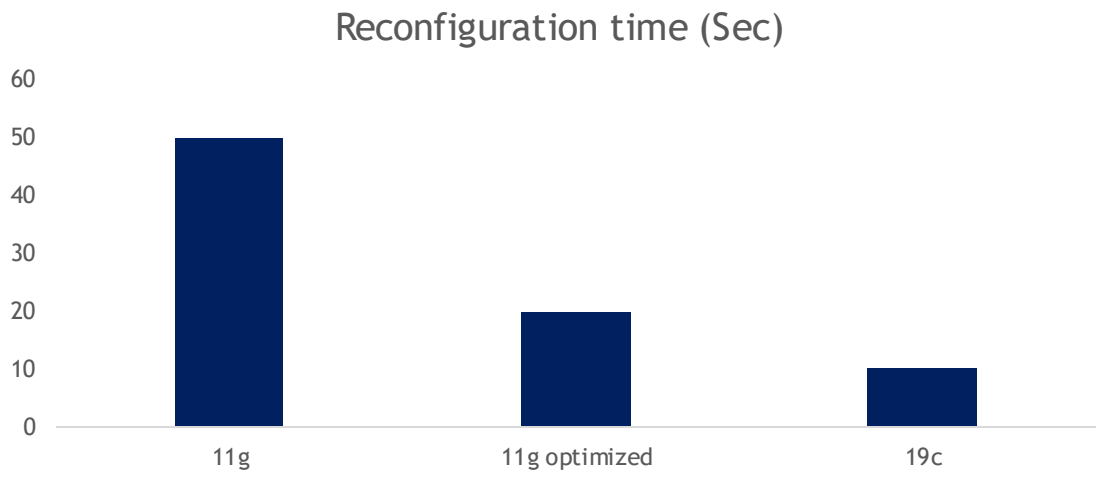
- Extract and switch to new goldimage on target system
  - Extract goldimage to new home on target
  - Custom clone with copying configuration files from current home (Example: crs dbs cdata gpnp log network/admin but retaining crs/lib, crs/install/*.pl etc..)
  - Relink Binaries
  - Switch to new home with rootcrs.sh –prepatch and rootcrs.sh –postpatch utilities

RAC rolling patching with minimum downtime

RAC Rolling Patching



Minimal Instance start/stop reconfiguration impact



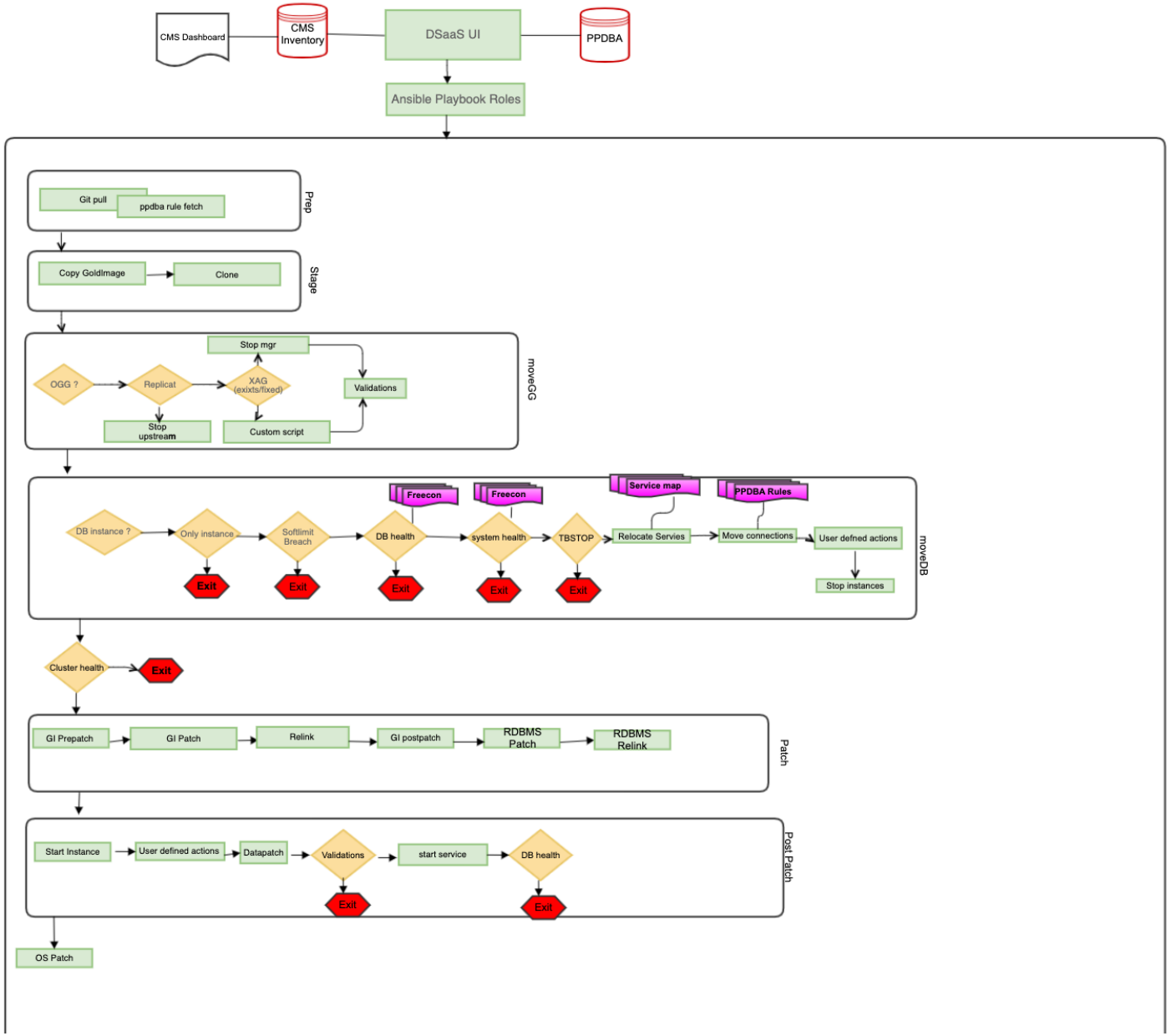
With NO DRM

- DBMS_CACHEUTIL to grab affinity
- Shrink Buffer Cache
- Increase LMS Processes

***Your Mileage varies depending on your Architecture and configuration

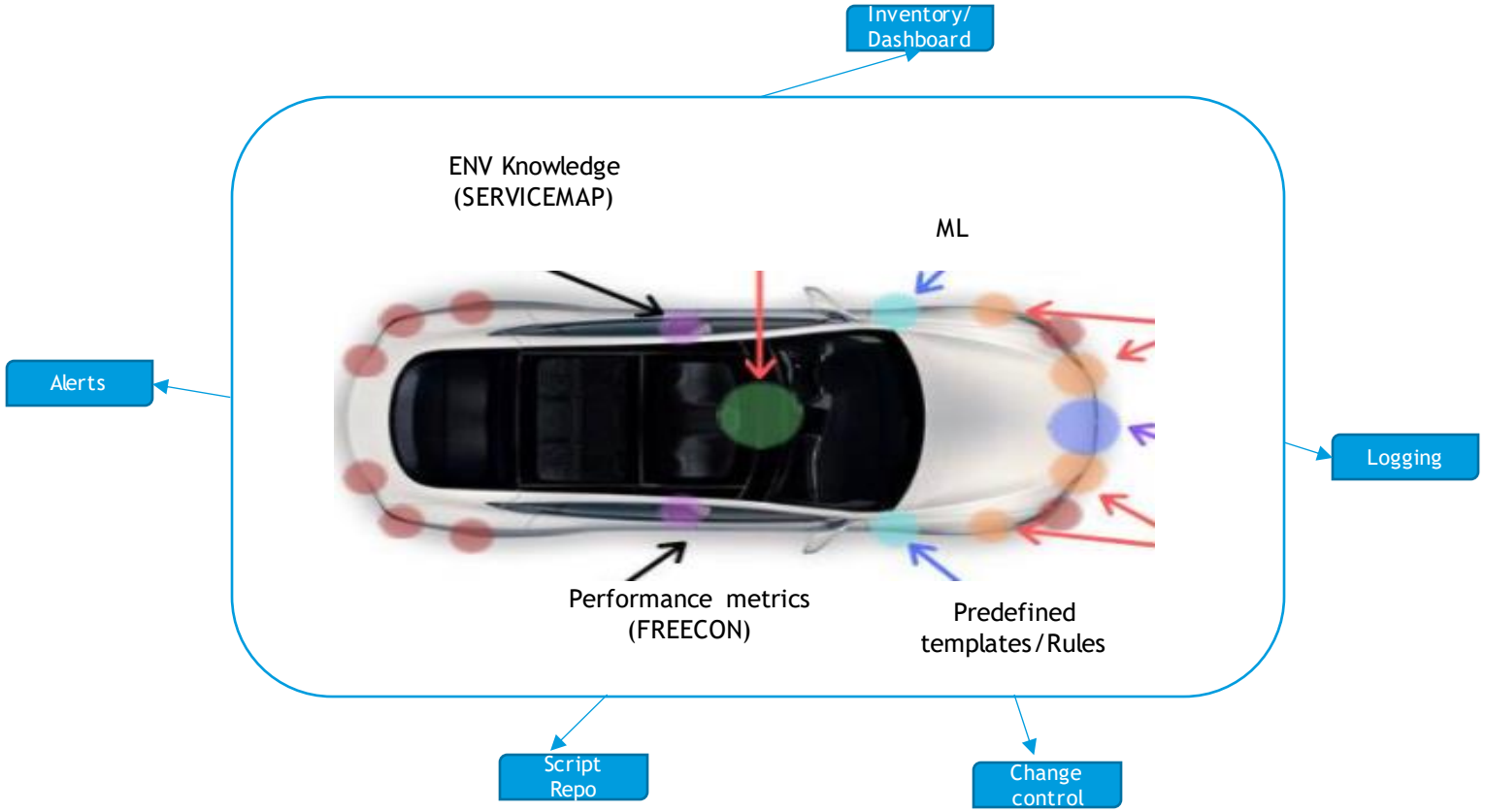
Patching at Scale


```
  - {role: host_readiness}
  - {role: install_scripts}
  - {role: stg_GI_img}
  - {role: clone_GI_img}
  - {role: copy_RDBMS_img}
  - {role: clone_RDBMS_img}
  - {role: capture_prepatch_info}
  - {role: move_OGG}
  - {role: relocate_DBservices}
  - {role: drain_connections}
  - {role: stop_DB_instances}
  - {role: switch_GI_home}
  - {role: switch_RDBMS_home}
  - {role: start_instances}
  - {role: start_services}
  - {role: post_patch_scripts}
  - {role: update_cms}
  - {role: post_patch_healthcheck}
```



Patching at Scale

- Platform/Product Agnostic
- Fact Driven Intelligence
- Scalable
- Idempotent
- Easy onboarding
- Architecture awareness

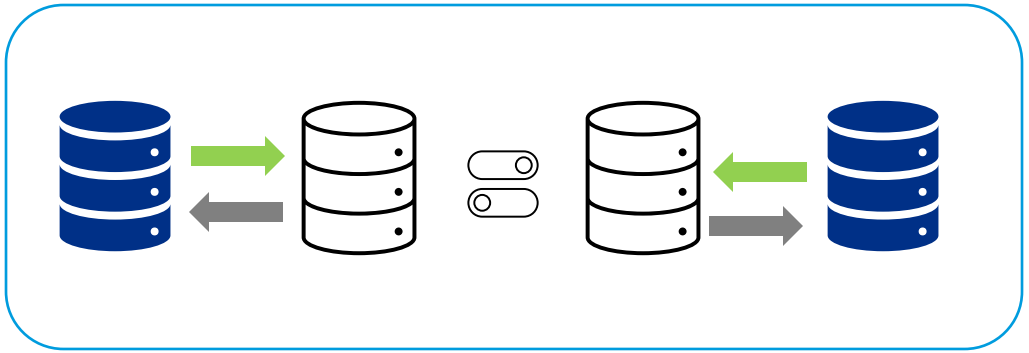



```
Time            Gets    PhyR   Sent   #SQL #Parse Writes  #BrBW  Load  %CPU   %IO   Log  Log  #PQ  #ACT  Blkd  Blkr   Redo  LFPW DBFS SqlRsp #Conn #Act,Cur %Not #ORA  #DB #ASM
              (blk)   (blk)   (MB)  Execs  Calls  (blk)        Avg  Util  Wait   In  Out Sess  Sess  Sess        (blk)  (ms) (ms) Tm(ms)  Sess LogGroup Arch  Err Alrt Alrt
------------ ------ ------ ------ ------ ------ ------ ------ ----- ----- ----- ---- ---- ----- ----- ----- ------ ----- ---- ------ ----- -------- ---- ---- ---- ----
08-12 06:20:21 18.3m  79.4k  691.2     1m   1.1k  24.1k     42  32.3  19.9   1.9   12   11    0    42     0     0 171.2k    .2   .6     .2  7.2k 1/10,3
08-12 06:20:31 17.8m    60k    645 933.9k    919  19.1k     30  31.1  20.3   1.7   16   12    0    30     0     0 148.5k    .2   .6     .2  7.2k 1/10,3           0    0
08-12 06:20:41 16.6m    58k  584.2 888.3k    500  17.5k     19  31.2  18.6   1.7    6    0    0    33     0     0 139.6k    .2   .6     .2  7.2k 1/10,3           0    0
08-12 06:20:51 19.1m  61.4k  661.8 977.3k    649  20.8k     15  32.1  19.9   1.6   14    9    0    30     0     0 166.5k    .2   .6     .2  7.2k 1/10,3
08-12 06:21:01 18.3m  65.1k  589.7 880.7k    523  21.5k     37  32.8  21.3   1.9   15    9    0    32     0     0 137.5k    .2   .6     .2  7.2k 1/10,3
08-12 06:21:11 18.6m  78.1k  610.3   994k   4.3k  22.3k     37  35.4  22.6   2.1   31   21    0    40     0     0 132.2k    .2   .5     .2  7.2k 1/10,3
08-12 06:21:21 17.7m  63.3k  632.3   966k    785  26.3k     20  35.5  21.2   2.1   11   11    0    33     0     0 136.7k    .2   .6     .2  7.2k 1/10,3
08-12 06:21:31 20.5m  60.9k  708.3     1m    856  26.9k     20  34.2  20.7   1.7   25   17    1    34     0     0 155.3k    .2   .6     .2  7.2k 1/10,3
08-12 06:21:41 17.6m  57.1k  628.9 947.6k    716  18.9k     21  34.4  18.9   1.6   14   10    0    46     0     0 130.5k    .2   .6     .2  7.2k 1/10,3
08-12 06:21:51   17m  61.2k  599.8 894.7k    598  19.9k     31  34.7  18.8   1.8   17   10    0    32     0     0 142.6k    .2   .6     .2  7.2k 1/10,3
08-12 06:22:01   18m  64.2k  583.1 876.8k    746  21.2k     20  34.8  19.8   1.8   20   11    0    36     0     0 129.9k    .2   .6     .2  7.2k 1/10,3
08-12 06:22:11 19.7m  66.9k  668.2     1m   1.4k  20.2k     35  35.5  20.4   1.7   18   17    0    33     0     0 176.5k    .2   .6     .2  7.2k 1/10,3
08-12 06:22:21 19.2m  58.8k  625.7 936.4k   1.2k  20.7k     29  35.3  19.1   1.6   12    7    0    37     0     0 147.7k    .2   .6     .2  7.2k 1/10,3
08-12 06:22:31 17.4m  55.7k  601.3 900.5k   1.2k  21.6k     27  35.1  18.2   1.5   14    7    0    28     0     0 137.5k    .2   .6     .2  7.2k 1/10,3
08-12 06:22:41 19.1m  61.6k  579.3 885.3k   1.4k    17k     15  34.8  19.1   1.8   15   12    0    35     0     0 143.3k    .2   .6     .2  7.2k 1/10,3
08-12 06:22:51 20.8m  63.1k  654.9     1m     1k  21.2k     22  34.7  19.4   1.6   13    9    0    34     0     0 154.9k    .2   .6     .2  7.2k 1/10,3
08-12 06:23:01 16.9m  55.9k  618.4 916.6k    682  19.3k     25  33.5  19.5   1.6   16    8    0    36     0     0 144.9k    .2   .6     .2  7.2k 2/10,4    11    0    0
08-12 06:23:11 16.8m  57.1k  626.7 935.4k   1.2k  18.5k     35    34  20.4   1.8   17   15    0    42     0     0 133.6k    .2   .7     .2  7.2k 2/10,4           0    0
08-12 06:23:21 19.4m  73.9k  694.1     1m     1k  20.5k     34  33.3  19.2   1.9   15   12    0    32     0     0 144.2k    .2   .6     .2  7.2k 2/10,4
08-12 06:23:31 18.5m  65.4k  612.4 916.2k    695  23.8k     23  32.3  18.4   1.8   17   10    0    37     0     0 138.6k    .2   .6     .2  7.2k 2/10,4           0    0
08-12 06:23:41 17.7m  63.3k  589.9 899.2k   1.2k  18.9k     36  33.7  19.7     2   12   10    0    30     0     0 158.3k    .2   .7     .2  7.2k 2/10,4
```

Near Zero downtime Golden Gate based cutovers

DB Cutover Automation

- Switch DB services
- Drain Connections
- Validate Lag
- Sequences Synchronization
- Target Database Validations
- Open Target Database



< 30 Sec cutovers

Q & A

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