ORACLE OPEN WORLD

Oracle Autonomous Transaction Processing Overview and Roadmap

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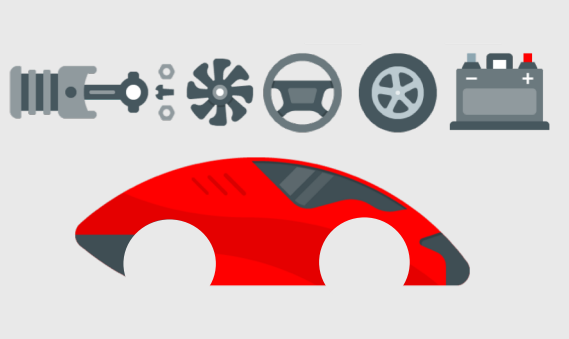
Database Systems Technologies

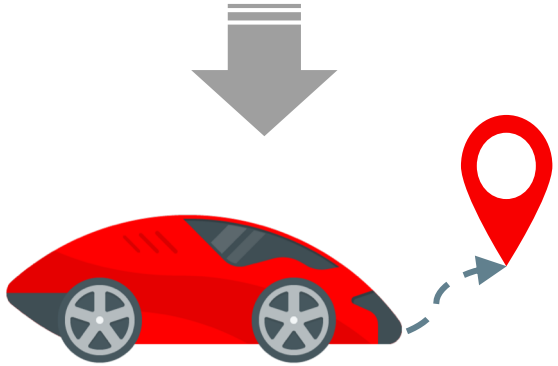
#thinkautonomous

Autonomous Database

- Traditionally each database deployment was unique
  - You are the DB builder, securer, repairer, tuner, and driver
  - Complex, labor intensive, poor economies-of-scale

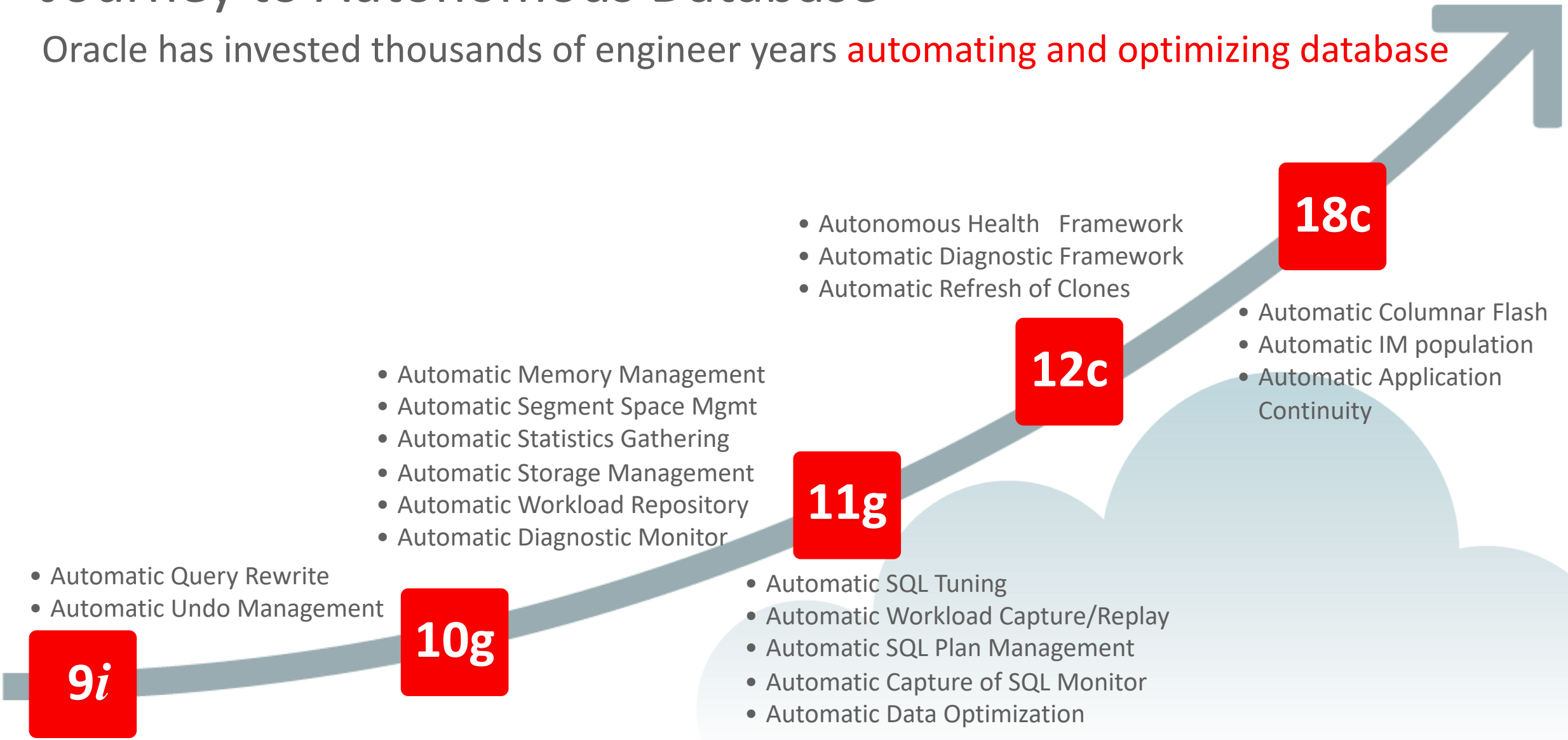


- **Autonomous Database** revolutionizes data management
  - The full database management lifecycle is completely automated
  - Even for ultra-mission critical databases with sensitive data
  - Enables you to innovate more, pay less, and ensure data safety



Journey to Autonomous Database

Oracle has invested thousands of engineer years automating and optimizing database



Journey to Autonomous Database

And thousands of engineer years automating and optimizing database infrastructure

2008

- Smart Scan
- Infiniband Scale-Out

- Database Aware Flash Cache
- Storage Indexes
- Hybrid Columnar Data

- IO Priorities
- Data Mining Offload
- Offload Decryption

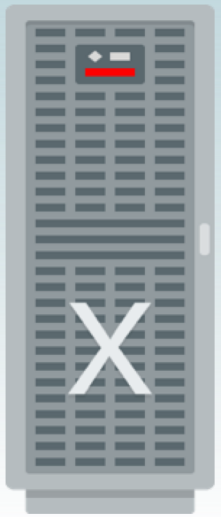
- Network Resource Mgmt
- Prioritized File Recovery

- Direct-to-wire Protocol
- JSON and XML offload
- Instant failure detection

- In-Memory Columnar in Flash
- Smart Fusion Block Transfer

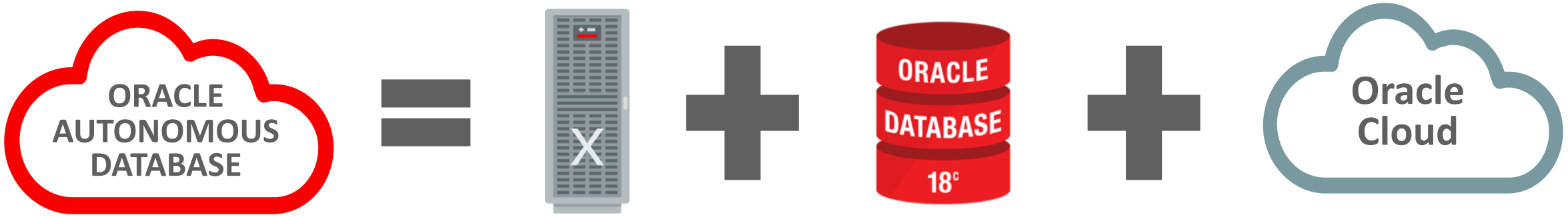
- Exadata Cloud Service

2018



Autonomous Completes the Journey

Brings Full Automation to Entire Database Lifecycle



Complete Infrastructure Automation

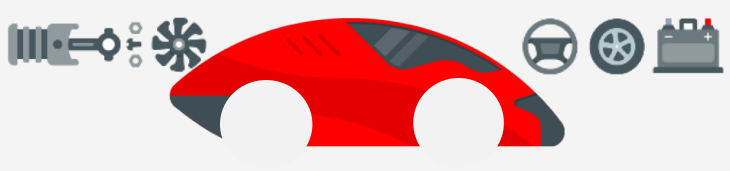
Complete Database Automation

Automated Data Center Operations and Machine Learning

World's First Autonomous Database

How It Works

Full Database Lifecycle is Automated



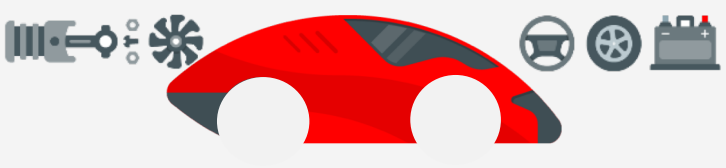
Provisioning

Rapidly creates **scalable mission critical** databases

Creates **Exadata**[+] Cloud Infrastructure, **RAC**[+] scale-out database, **Active Data Guard**[+] standby

[+] Unique to Oracle

Full Database Lifecycle is Automated



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Security

Protects from external and internal threats

Monitors threats, applies security **updates online**[+], stops admin snooping with **DB Vault**[+], **encrypts** all data

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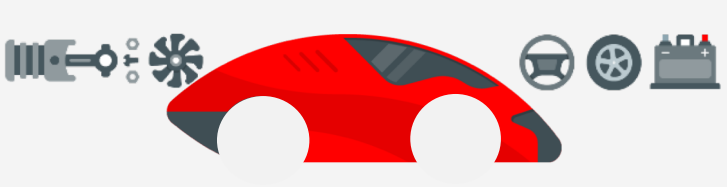

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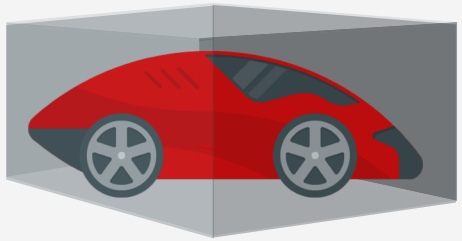
Management

Automates all infrastructure and database management

Performs **all OS and SYSDBA** operations, tunes settings, patches all software **online**[+], diagnoses **errors**[+]

[+] Unique to Oracle

Full Database Lifecycle is Automated



Protection

Recovers from any failure without downtime

Automates backup, restore, **application transparent**[+] failover in **scale-out cluster**[+] or to **active remote standby**[+]

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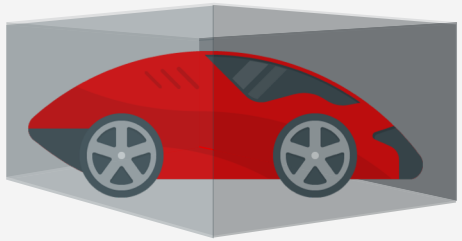

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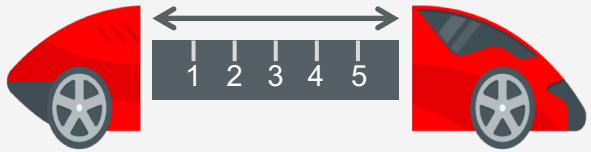

Scaling

Scales online for highest performance and lowest cost

Instant online elasticity[+] of **serverless** compute and storage enables **true pay-per-use**[+]

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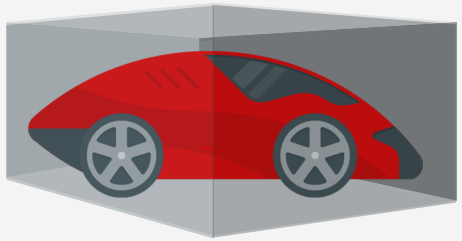
Full Database Lifecycle is Automated



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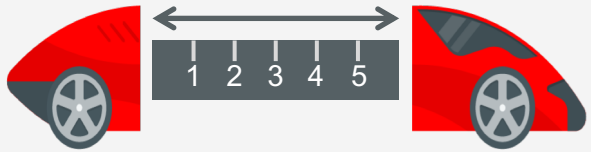

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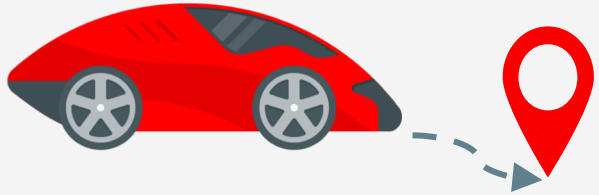


Optimization

Machine Learning optimizes database for each workload

Continuously optimizes memory, **data formats**, **indexes**[+], **parallelism**[+], and **plans**[+] for each workload

[+] Unique to Oracle

One Autonomous Database - Optimized by Workload

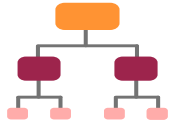
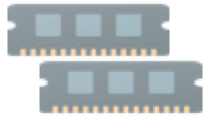
Autonomous Data Warehouse (ADW)

- Data Warehouse, Data Mart
- Data Lake, Machine Learning

Autonomous Transaction Processing (ATP)

- Transactions, Batch, Reporting, IoT
- Application Dev, Machine Learning

Autonomous Optimizations - Specialized by Workload

	ADW	ATP
	Columnar Format	Row Format
	Creates Data Summaries	Creates Indexes*
	Memory Speeds Joins, Aggs	Memory for Caching to Avoid IO
	Statistics updated in real-time while preventing plan regressions	

* Coming Soon in Oracle Database 19c

Continuous Optimization – Enabled by Machine Learning

- **SQL Plans** are like driving directions
  - Should adapt as data volume (traffic) changes
- **Indexes** are like roads and bridges
  - Should adapt if nature of the workload evolves
- Changes in data volume and SQL workload are continuously captured
- Machine Learning algorithm processes changes to find new optimal plans and indexes*
  - Improved driving directions, roads, bridges

* Coming soon

Machine Learning meets Mission Critical

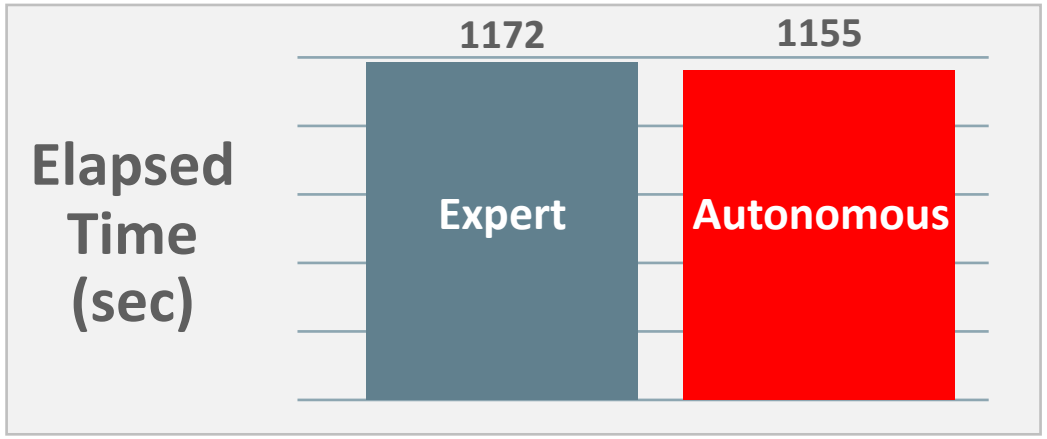
- New approach **avoids performance regressions**
  - Even for difficult cases where new plan or index helps 99 SQL statements and hurts 1
- Changes are first tested in background
- Then the benefit is validated on first execute of every changed SQL
  - If performance regresses, then old SQL plan is used

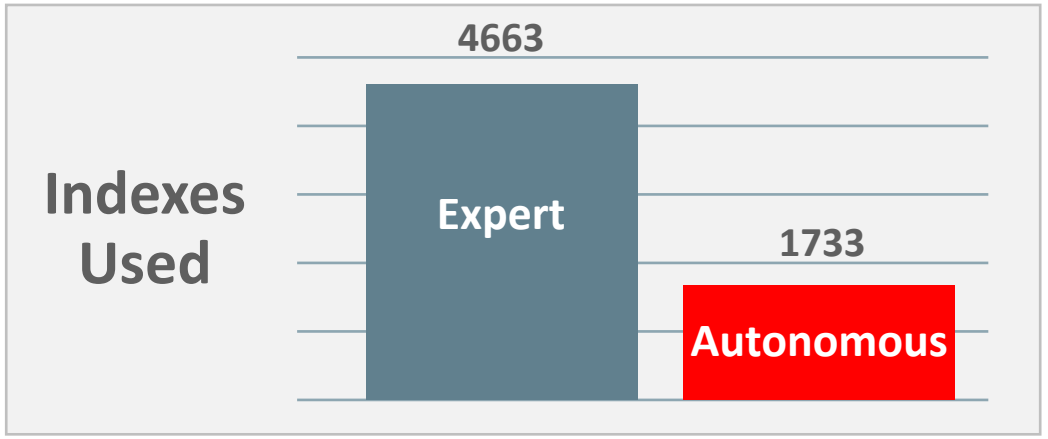
More Details Tomorrow at 4:45pm in session TRN3980
Test Drive Automatic Index Creation in Oracle Autonomous Database Cloud

* Coming soon

ATP In Action On Netsuite Workload

- Ran a complex Netsuite workload, and compared ATP to existing expert tuning
- **17,542** SQL statements, **1,852** tables, **8,151** indexes - years of tuning to create these indexes
  - Before running on ATP, all indexes and statistics were dropped



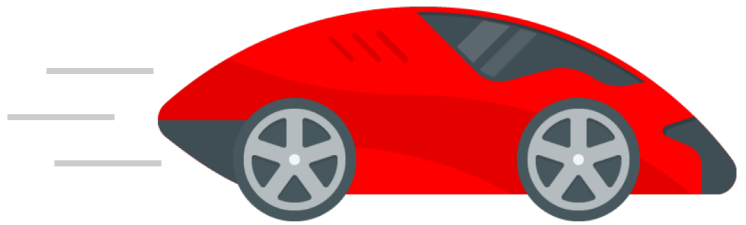


ATP achieved identical performance to expert manual tuning
ATP stays tuned as workload changes

Creation and Use

Autonomous Database Creation

- Database creation is super easy. Just select:
  - DB type - ATP or ADW
  - DB CPU count - really performance
  - DB storage size limit
  - DB region



- Performance resources allocated proportionally to number of CPUs chosen
  - Example – if a DB gets 15% of CPUs in Exadata system, then it gets 15% of memory
  - Same for IOs per second, Storage CPUs, Flash Cache

Pre-defined Services for Autonomous Transaction Processing

- Clients connect to pre-defined ”Services” using connect strings
- Different services defined for Transactions and Reporting/Batch
- Different services within TP and Batch control priority and parallelism

SERVICES NAME	RESOURCE MANAGEMENT SHARES	PARALELLISM
TPURGENT	12	MANUAL
TP	8	1
HIGH	4	CPU_COUNT
MEDIUM	2	4
LOW	1	1

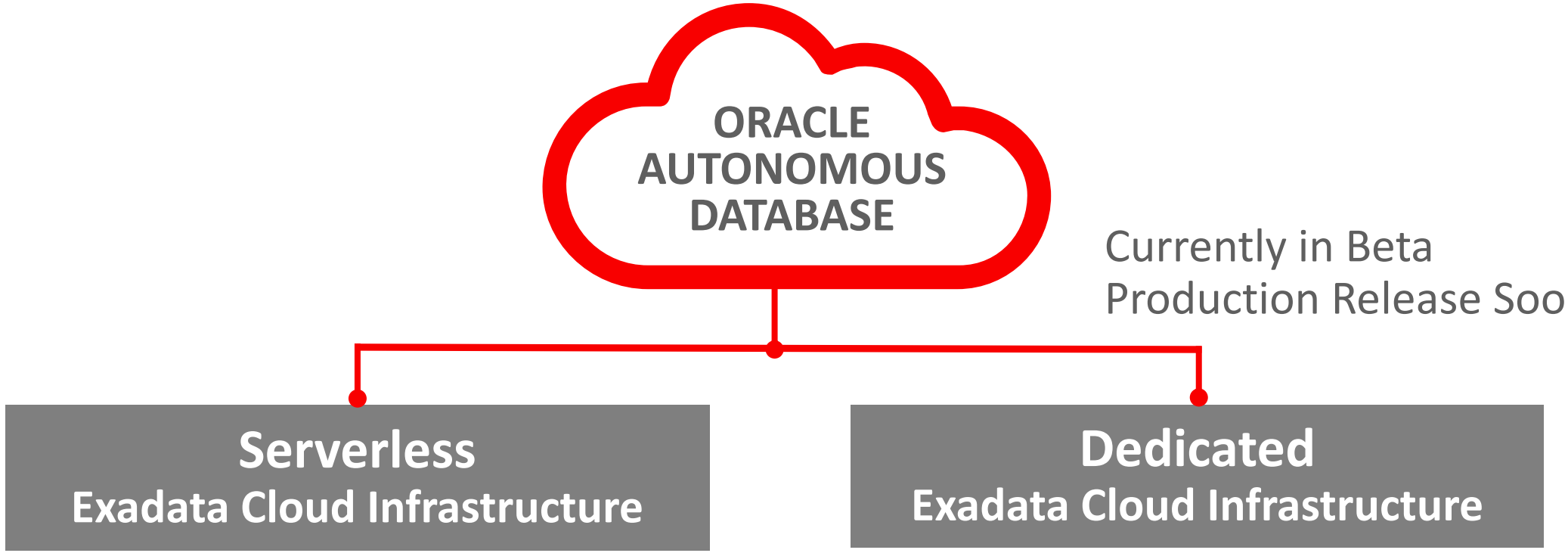
Use for Analytics, Reporting, and Batch on ADW and ATP

Autonomous DB Service – Interfaces

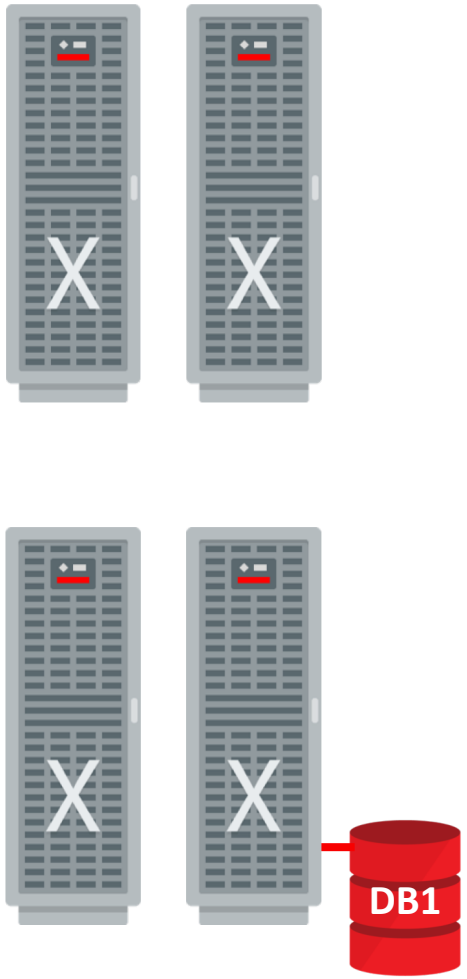
- Database actions are exposed through Cloud UI and REST APIs
  - Database create/terminate/backup/restore/stop/start
  - Change provisioned CPUs or storage
- Monitoring is available through the cloud service dashboard
  - Autonomous Database monitoring will also be possible with customer's existing Enterprise Manager Cloud Control (coming soon)
- Developers can use SQL Developer, or any other developer tool that supports standard Oracle database connections
- Using Oracle Rest Data Services (ORDS) developers can easily build Rest APIs for data and procedures in the database

Deployment Options

One Autonomous Database – Two Deployment Options



Serverless Exadata Cloud Infrastructure



- An ATP-S Database is placed on Exadata Cloud Infrastructure based on Region
- Oracle completely manages and controls all placement, patching, software versions, and isolation
- RAC cluster enables rolling upgrades and fast failover
- Low minimum size/cost - 1 OCPU and 1 TB of storage
- Low minimum time commitment – 1 hour

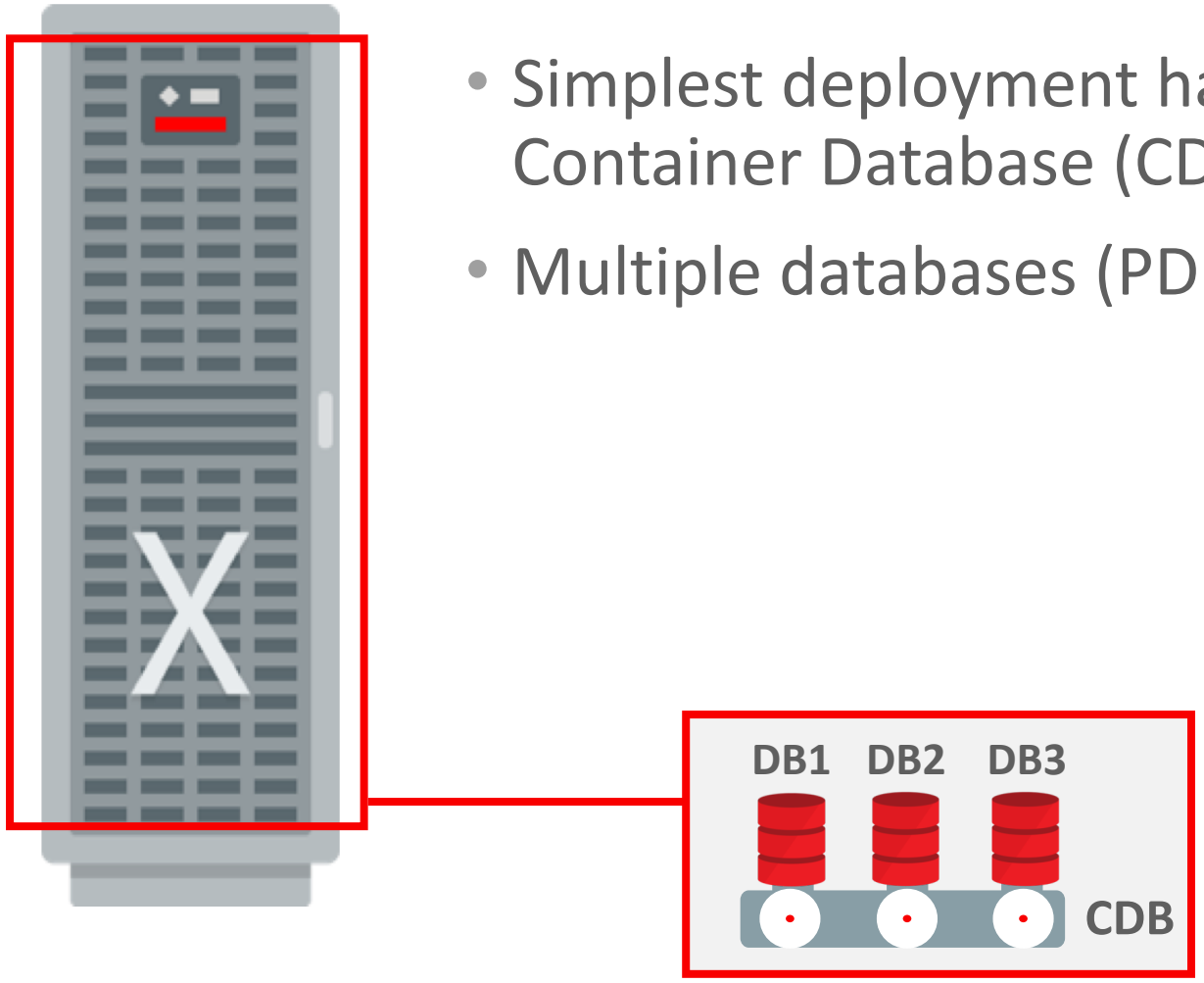
Dedicated Exadata Cloud Infrastructure

- Designed for **consolidation** of **mission critical** databases
- Dedicated provides complete **isolation** from other tenants
- Customer is assigned dedicated Quarter/Half/Full Exadata System within a customer chosen region and customer VCN
  - Minimum term for hardware is 1 month
  - Software billed per hour based on number of CPUs activated for provisioned databases

Dedicated Exadata Cloud Infrastructure

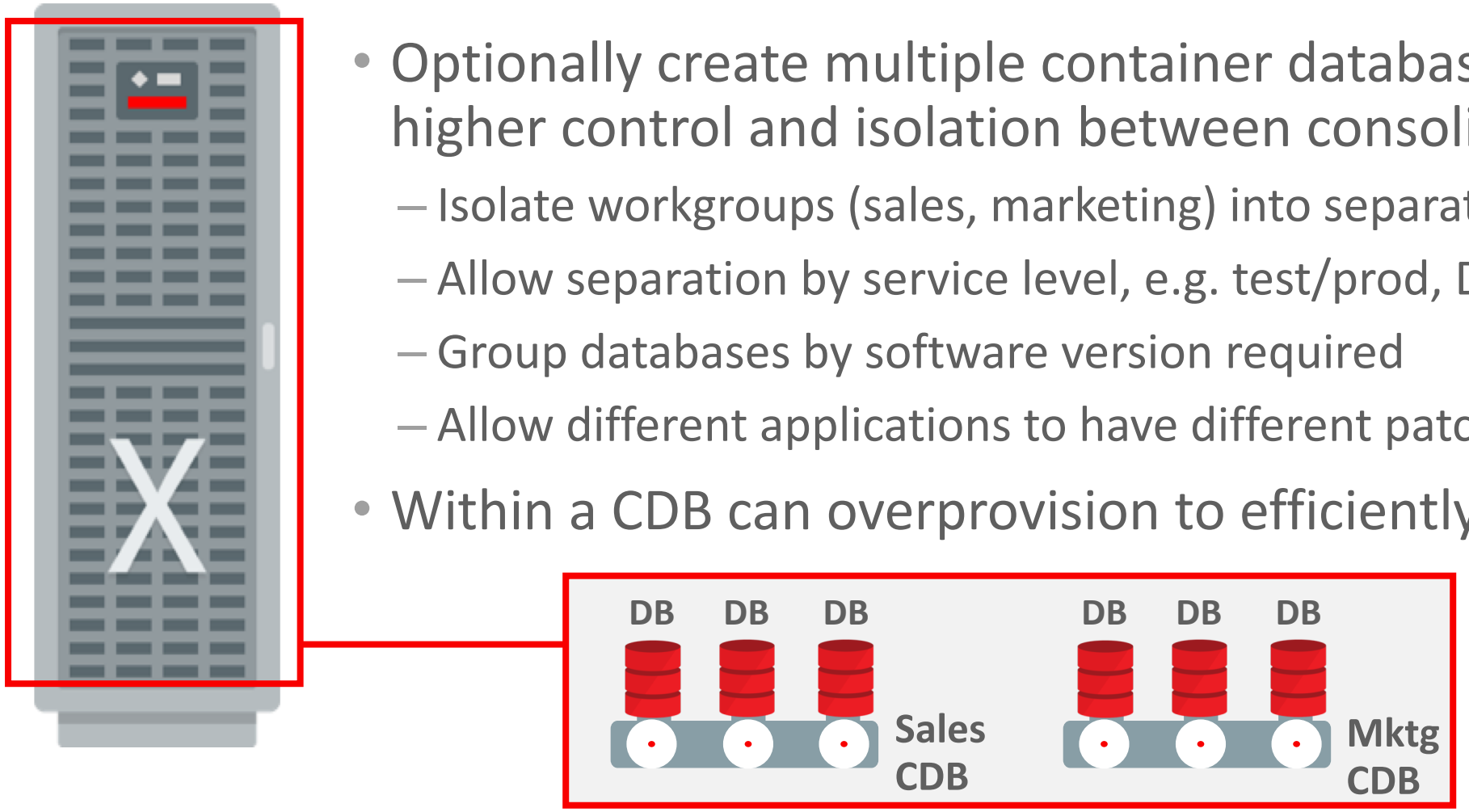
- Higher **Security** Isolation
  - No other tenants on system
- Higher **Performance** Isolation
  - No other tenants running on system
  - Control over density and overprovisioning
  - Guaranteed instant upsizing of resources within system
- Higher **Software Control**
  - Control within limits over software version and patching windows
  - Control over workloads allowed to run in database or system

Dedicated Simple Isolated Cloud in Public Cloud



- Simplest deployment has single cluster and single Container Database (CDB)
- Multiple databases (PDBs) can be created in the CDB

Dedicated Sophisticated Isolated Cloud in Public Cloud



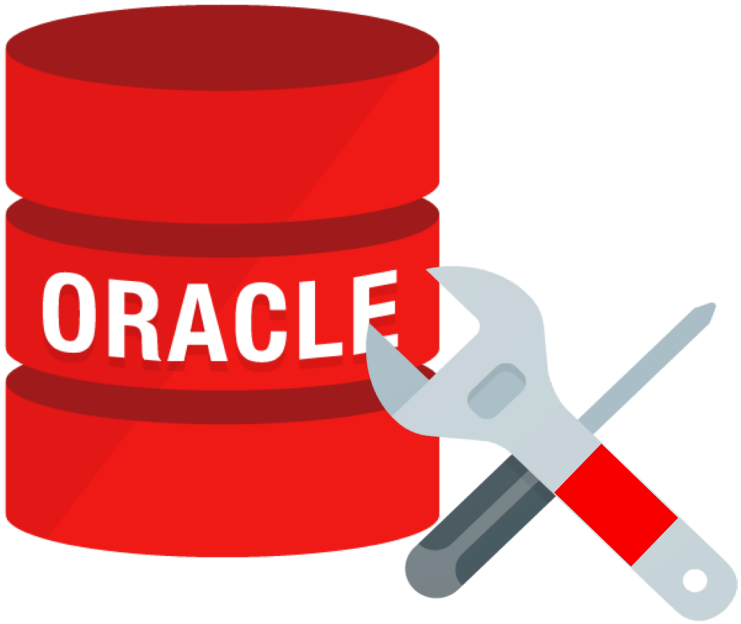
- Optionally create multiple container databases (CDBs) for higher control and isolation between consolidated databases
  - Isolate workgroups (sales, marketing) into separate CDBs
  - Allow separation by service level, e.g. test/prod, Data Guard or no
  - Group databases by software version required
  - Allow different applications to have different patching schedules
- Within a CDB can overprovision to efficiently share resources

Dedicated Infrastructure Fleet Administrator Role

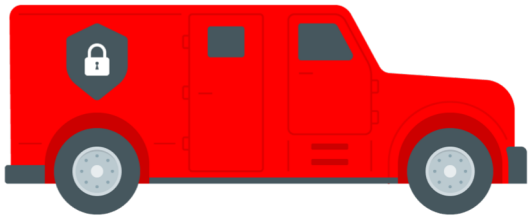
- Dedicated Systems are controlled by Fleet Administrator
- Fleet Admin allocates resources (infrequent) by selecting:
  - **Exadata Infrastructure** - number, size, region, VCN, License Model (BYOL) of systems
  - **Container DBs** – names, software versions, backup retention, Data Guard standby
- Chooses Cloud Compartment and tag for Resources
- Chooses timing and content of patches - within limits

ATP Operations:

Security



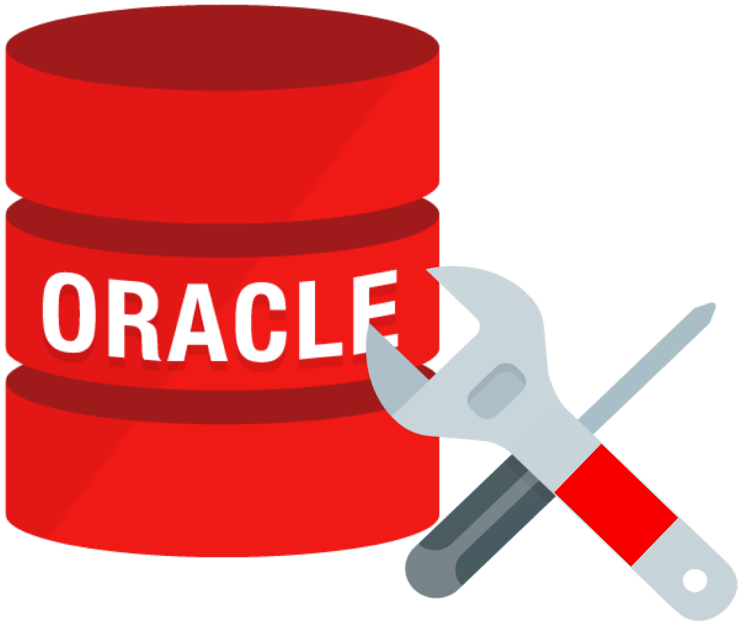
Security – Protection From External Attacks



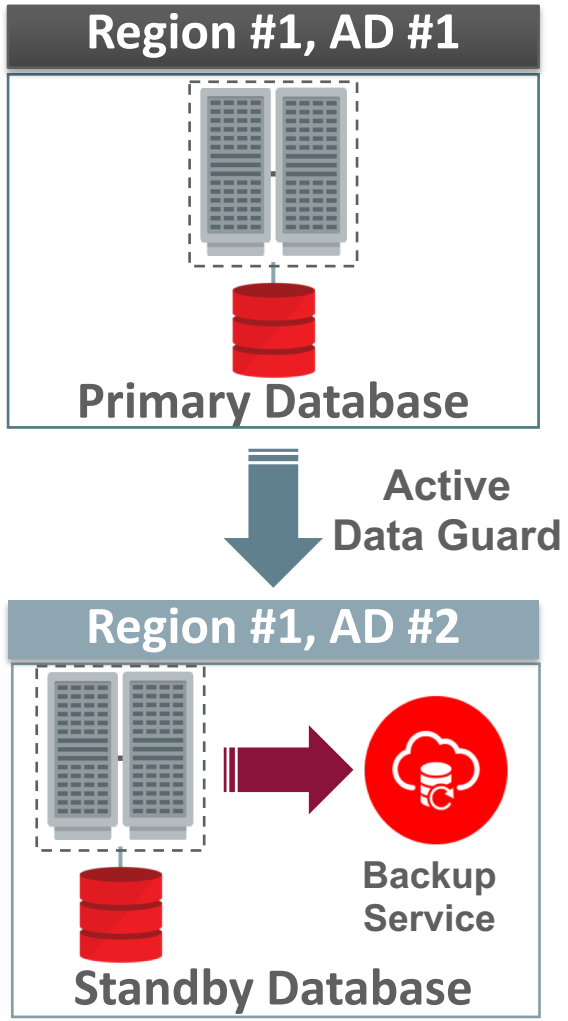
- No **login allowed to OS or CDB**, no Root or SysDBA, only login as PDBAdmin or DB user
  - No callouts to OS allowed. Prevents installing or modifying any software on system.
- Database clients can connect securely using TLS/wallet
- Databases run in customer private Virtual Cloud Network to prevent network access by other customers or hackers – Public IP not required (now in Dedicated, soon in Serverless)
- Secure Configuration deployed at all levels – OS, database, storage, etc.
- Oracle automatically applies updates with latest security patches
  - Quarterly, or off-cycle for high impact security vulnerability (details later)
- Native encryption prevents data access from outside the database

Dedicated Operations:

High Availability



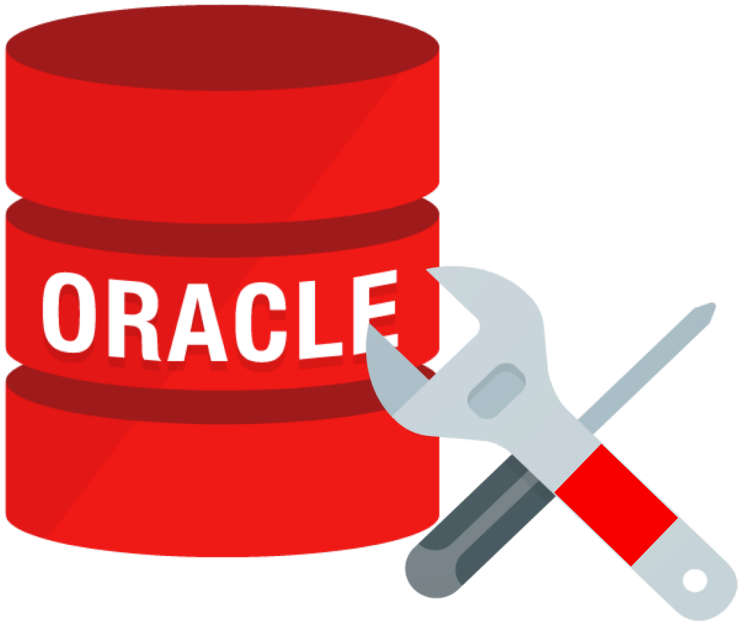
Availability Policies



- **High Availability** - Protection from hardware failures, software crashes, patches, updates
  - Uses RAC Database, redundant compute, networking, triple mirrored storage, and daily backup
- **Extreme Availability** – Adds protection from site outages and data corruptions
  - Uses Active Data Guard Standby. Available soon on ATP-Dedicated
  - Service Uptime SLA per Month: **99.995 NRX%** **(NRX = No Ridiculous Exclusions)**
  - 99.995% Uptime = at most 2m 12s of downtime per month
  - Goal is for application impact to be well **under 30 seconds** from any given availability event

Dedicated Operations:

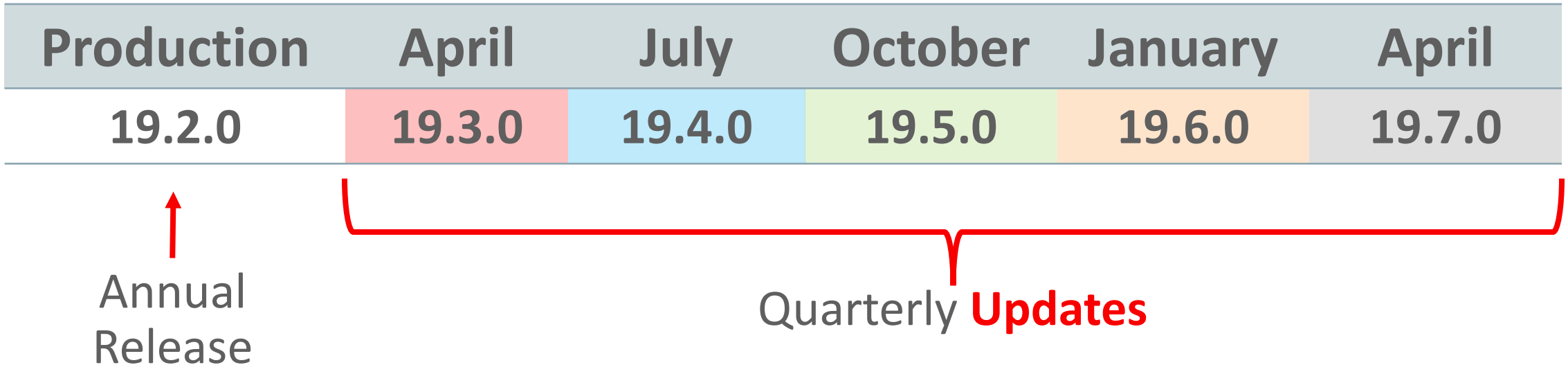
Patching And Upgrades



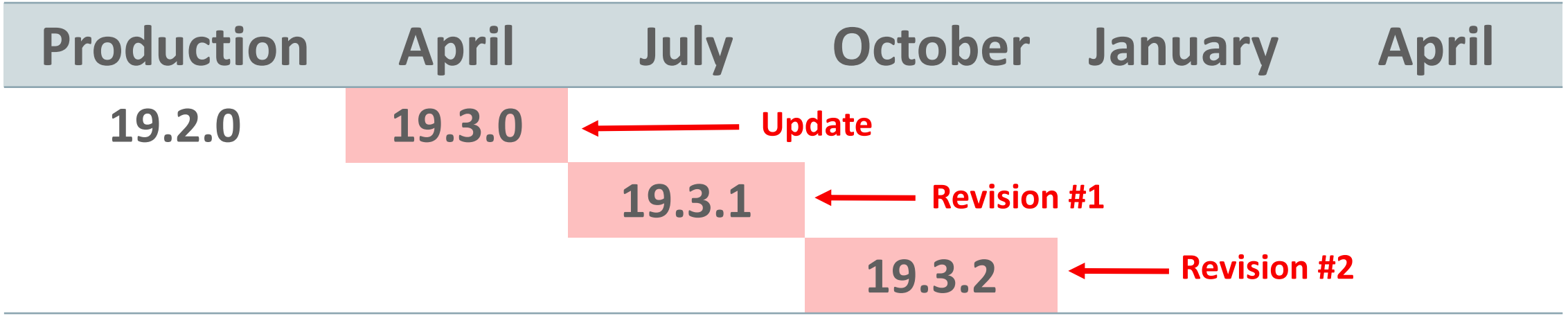
Review - New Annual Release Model and Motivation

- Huge Releases every few years – big bang of many features creates instability
  - Solution: Annual **Releases** – fewer changes, easier to test
- Want large patch bundles to avoid one-off patch proliferation
  - Solution: Quarterly **Updates** – include all important fixes
- However, bundling many fixes together increases risk of regression
  - Solution: Quarterly **Revisions** – only includes **security** and **regression** fixes

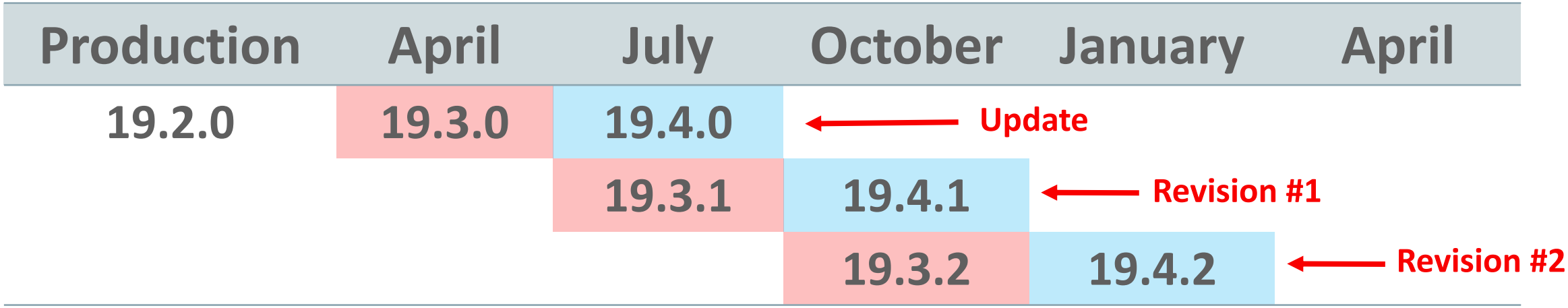
Quarterly Database **Updates**



Revisions



Updates and Revisions



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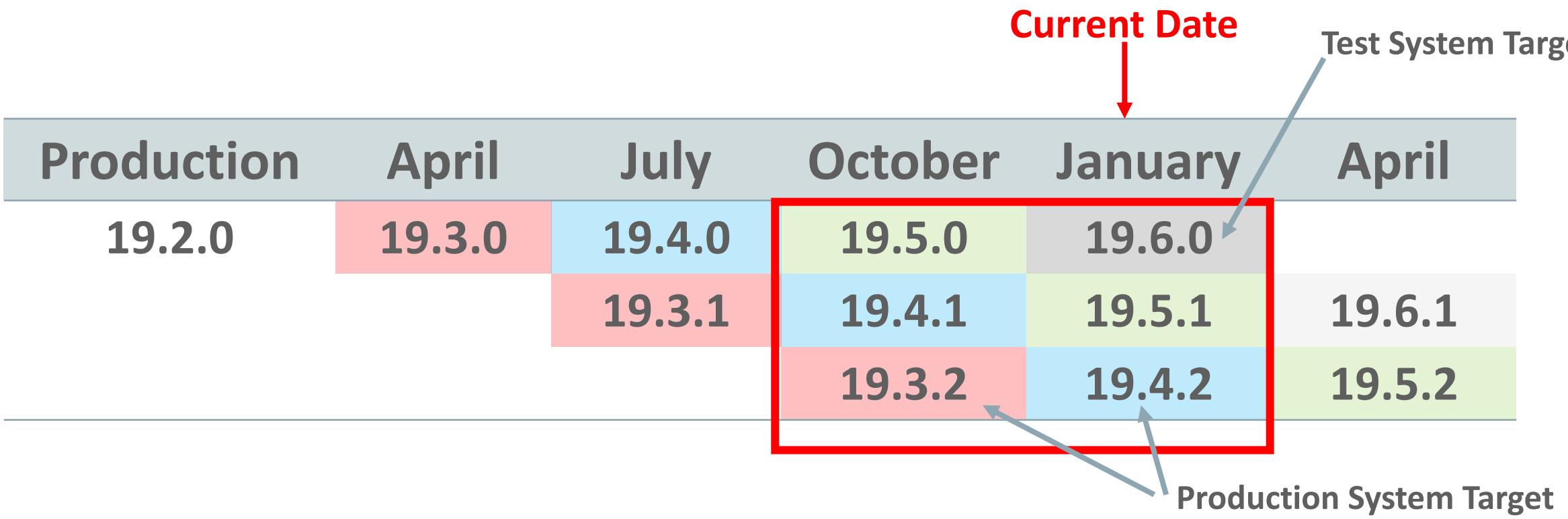
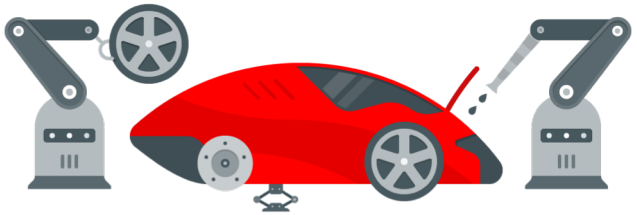


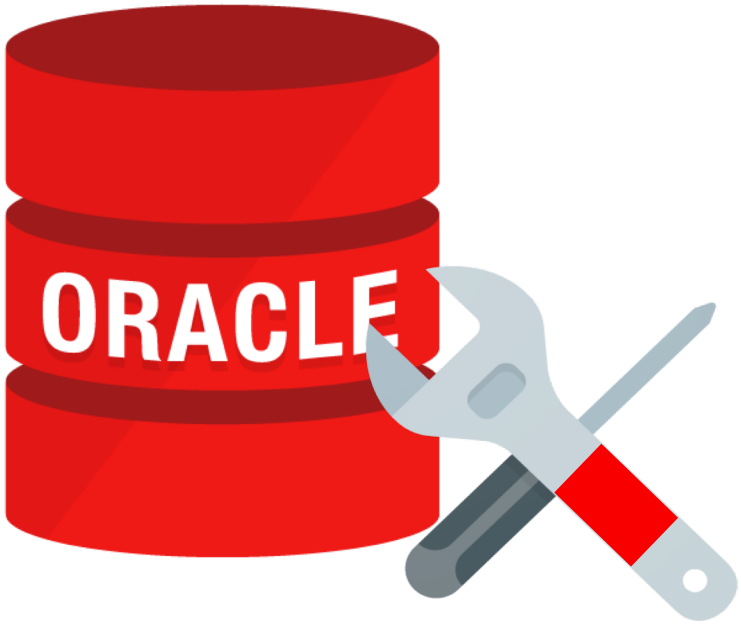
- ATP-D allows customers to patch to **current or previous** Update or Revision
- Allows customers to apply latest Update on test system, Revision on production

Patching on Dedicated



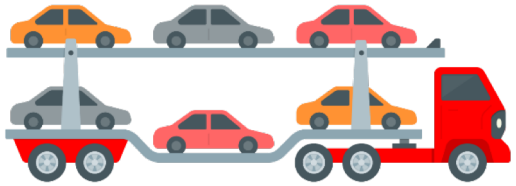
- Quarterly Patching of all components (on-demand for critical security issue)
  - Firmware, OS, Hypervisor, Clusterware, Database
  - Installs prebuilt Gold Image of patched database executables rather than directly applying patches
- Patching is **automatically scheduled**
  - Customer can adjust timing within a time range
- Patches applied rolling across RAC nodes and Exadata storage servers
  - Database is continuously available to application
  - Applications using Application Continuity best practices run without interruption

Autonomous Database:



Migration

Migration to Autonomous Database



- Autonomous Database is an Oracle Managed and Secure environment
- A physical database can't simply be migrated to autonomous because:
  - Database must be converted to PDB, upgraded to 19c, and encrypted
  - Any changes to Oracle shipped stored procedures or views must be found and reverted
  - All uses of CDB admin privileges must be removed
  - All legacy features that are not supported must be removed (e.g. legacy LOBs)
- Migration uses Data Pump to move database **data** into **new** Autonomous DB
  - GoldenGate replication can be used to keep database online during process
  - Has standard GoldenGate restrictions or rowids, nested tables, identity columns, etc.

Benefits

- Spend Less
  - Eliminate tedious, expensive, and unsafe manual database management
  - **Cut runtime costs up to 90%** with ultra-efficiency and pay-per-use
- Innovate more
  - Develop **new applications** faster with instant database provisioning and self-tuning
  - Refocus talent on business value
- Ensure data safety
  - Continuous online updates protect against **cyber-attacks**
  - Fault-tolerant solution – including maintenance

Think Autonomous – Revolutionize Your Data Management

Try it Now

2 TB Autonomous Database FREE for 3,300 Hours

https://cloud.oracle.com/try-autonomous-database

APPENDIX

Legacy Features Disallowed in ATP

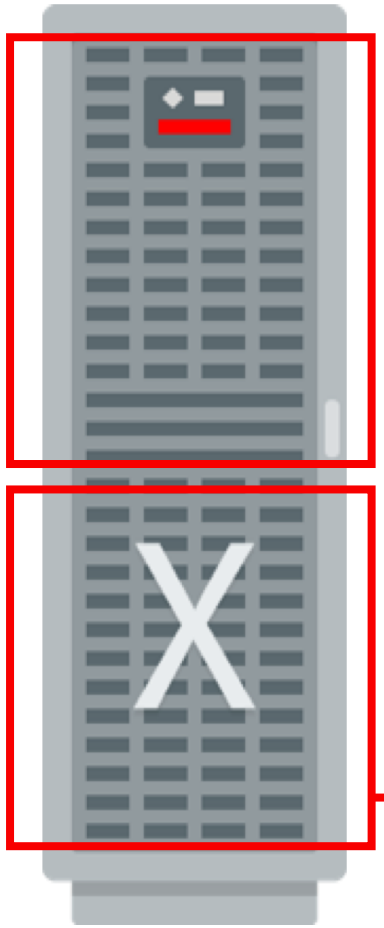
Legacy Feature	Replacement
Basic File LOBS	Secure Files LOBS
Dictionary Managed Tablespaces	Locally Managed Tablespaces
Manual Space Management	Automatic Space Management (ASSM)
Uniform Extent Allocation	Autoallocate
Manual Undo Segments	Undo Tablespace
DBMS_JOB	DBMS_SCHEDULER
DBMS_PIPE	Advanced Queuing
Non 8K Blocks	8K Blocks
Clustered Tables	Normal Tables
Index Organized Tables	Normal Tables
Tables that Disallow Row Movement	Row Movement Enabled

Restrictions – V1 Feature Limitations

- Java VM
- XML DB Repository
- Application Container
- Oracle Sharding
- LogMiner
- Golden Gate Capture
- Logical Standby except for patch/upgrade
- Real Application Testing
- OLAP
- Workspace Manager
- Transportable Tablespaces
- Oracle Multimedia
- Data Models

- Logical Standby and GoldenGate Related Restrictions **during migration or upgrade**:
  - Changes to tables with unsupported datatypes
    - Nested Tables, Identity Columns, Temporal Validity columns, PKREF, PKOID, SDO_RDF_TRIPLE_S
  - Reference and System Table Partitions
  - Edition Based Redefinition
  - Sharded queues
  - Various DBMS_* packages during rolling upgrade and migration

Database Creation is Almost Identical



- Database creation is almost identical between serverless and dedicated
  - Same screens and interfaces
- Main difference - when creating a database in Dedicated, customer chooses destination CDB for new database instead of Region