

# Insiders Guide to Oracle Autonomous Database

**Maria Colgan**

**Master Product Manager**

**Mission Critical Database Technologies**

**June 2019**



## Safe Harbor Statement

The preceding is intended to outline our general product direction. It is intended for information purposes only, and may not be incorporated into any contract. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions. The development, release, timing and pricing of any features or functionality described for Oracle's products may change and remains at the sole discretion of Oracle Corporation.

# The first fully Autonomous Database in the industry



## Self-Driving

Automates all database and infrastructure management, monitoring, tuning



## Self-Securing

Protects from both external attacks and malicious internal users

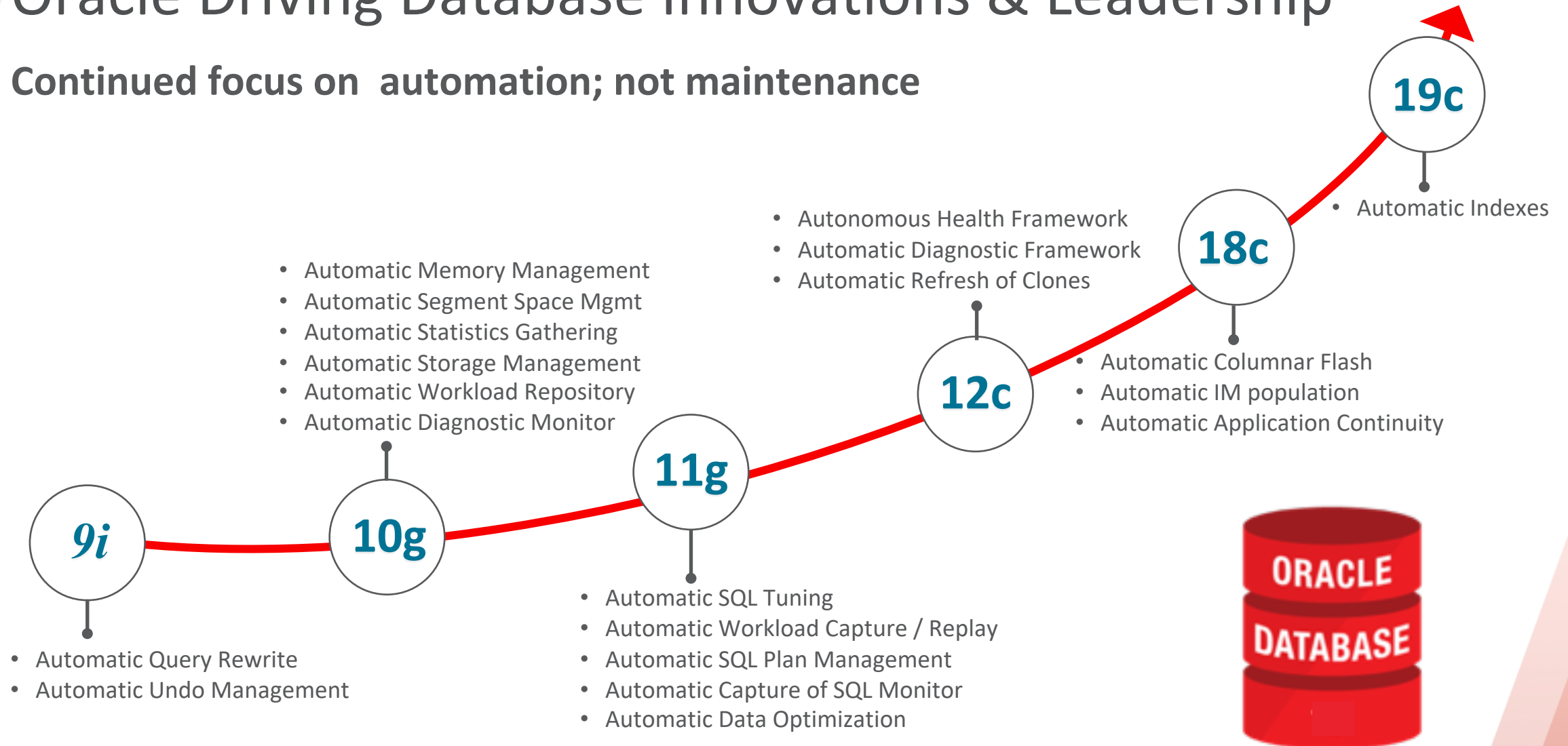


## Self-Repairing

Protects from all downtime including planned maintenance

# Oracle Driving Database Innovations & Leadership

Continued focus on automation; not maintenance



# Automating and Optimizing Database Infrastructure

**Engineered Systems provide a differentiated platform to build upon**

- 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

- Exadata Cloud Service
- In-Memory Columnar in Flash
- Smart Fusion Block Transfer

**2018**

**2008**



# Autonomous Completes the Journey

Full automation of database lifecycle enabled with machine learning



Autonomous Database

=



Complete Infrastructure Automation

+



Complete Database Automation

+



Automated Data Center Operations

# Autonomous Database **Machine Learning**

Diagnostics, recovery and optimizations for each layer of the deployment stack

## Database Infrastructure



Detection and recovery of failed/sick server, storage or switch/link

## Database Operations



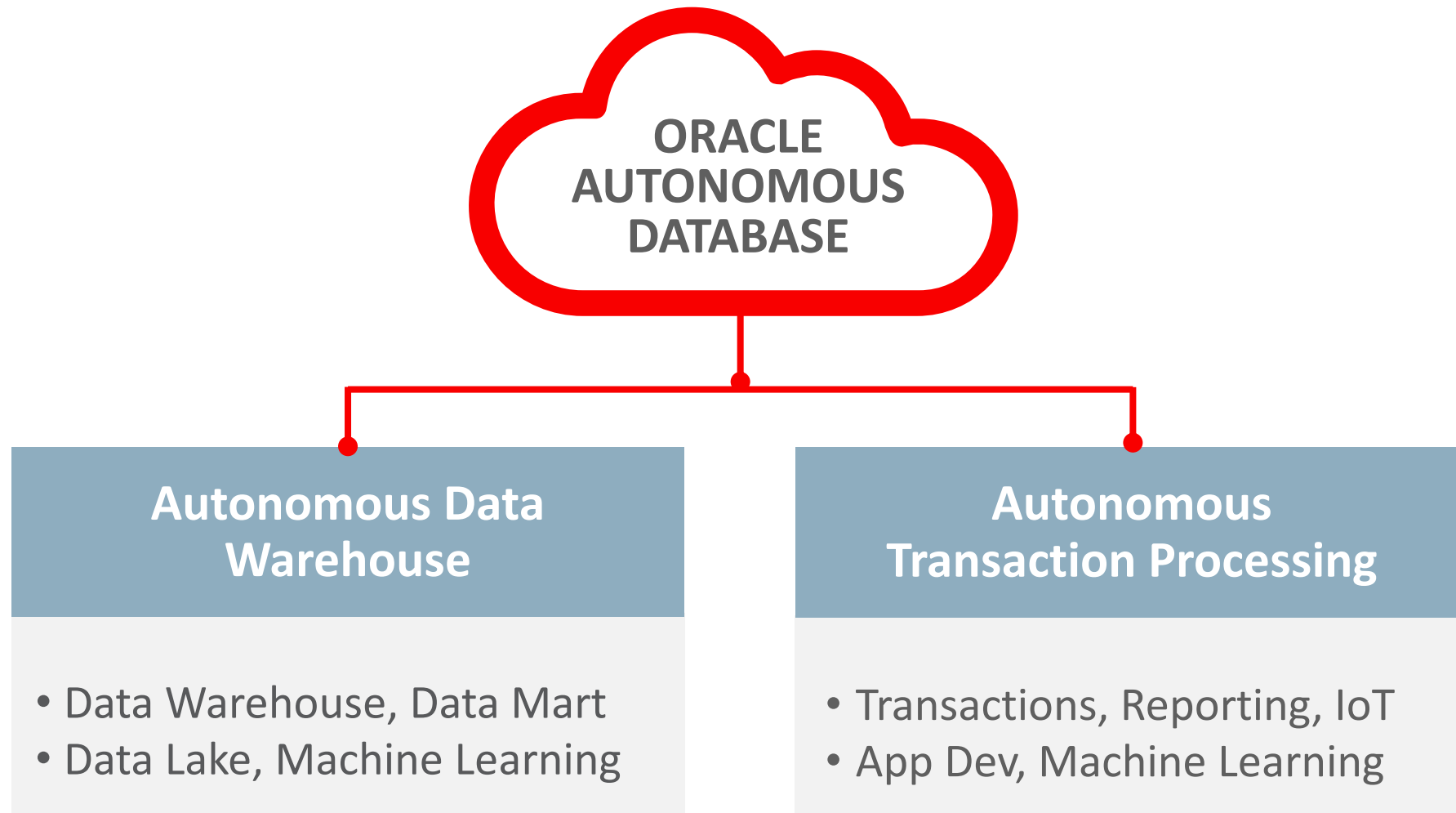
Hang Management  
Anomaly Detection  
Bug Identification and Prioritization

## Workload Optimizations



Query Optimizer  
Real-time statistics  
Automatic Indexing

# One Autonomous Database - Optimized by Workload



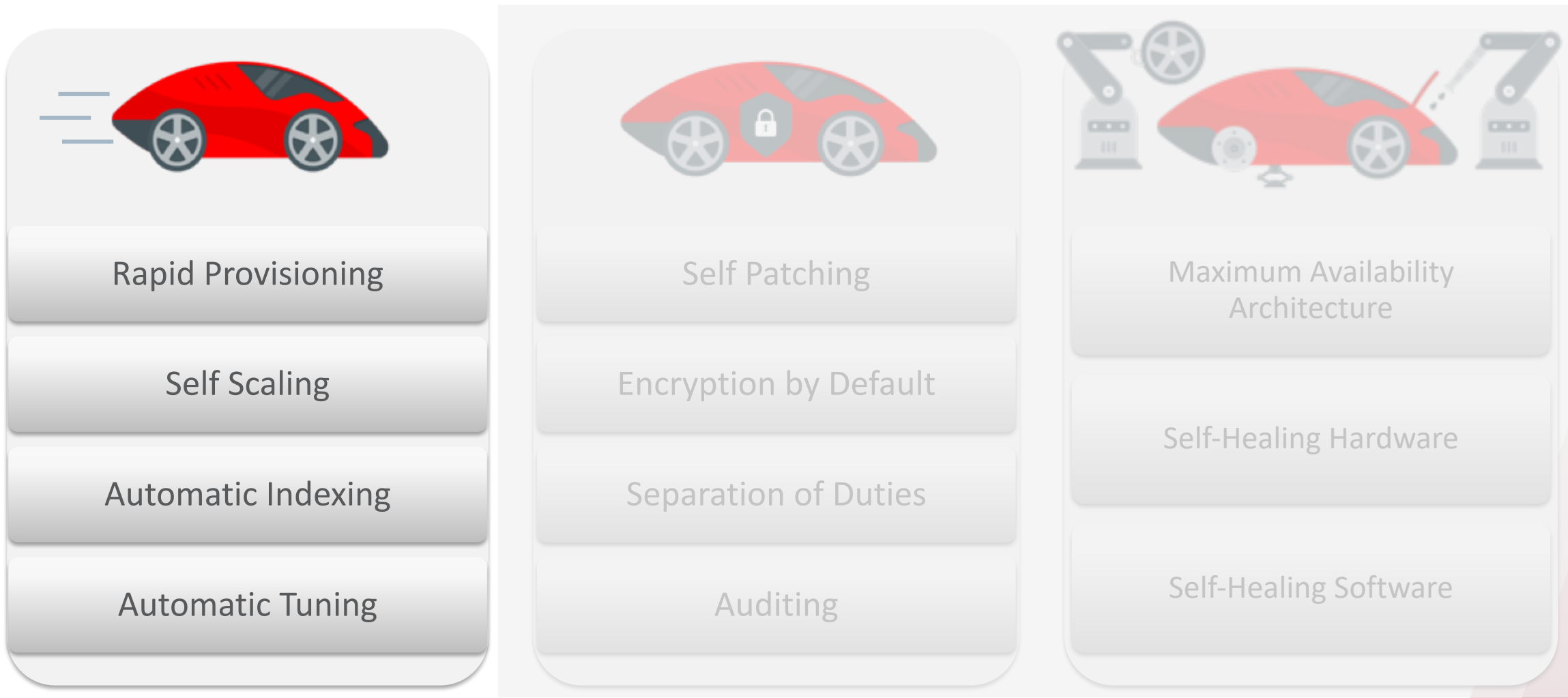




How does it work?

# A Look Under the Hood

## Key Capabilities of **Self-driving**, Self-Securing, Self-Repairing



# Under the hood of Self-Driving



## BENEFITS

- Creates mission critical scale-out database in minutes
- Automates all monitoring, management and tuning eliminating database maintenance drudgery
- Allows Customers to focus on business goals not on technology
- Full compatibility enables simple database migration

## ORACLE TECHNOLOGY

Provisions Exadata Cloud Infrastructure,  
Creates RAC scale-out DB,  
Active Data Guard\* standby

## AUTONOMOUS DATABASE CAPABILITIES

Rapid Provisioning

Automatic Tuning

Self Scaling

Automatic Indexing

Cloning

\* Coming soon in ATP-Dedicated

# Self-Driving | Rapid Provisioning

- Database creation is quick and easy - answer 6 simple question:
  1. DB **region**
  2. DB **type** - ATP or ADW
  3. DB **name**
  4. DB **CPU** count - really performance
  5. DB **storage** size limit
  6. Admin **Password**
- Exadata Cloud Infrastructure instantly provisioned with Oracle RAC Database
  - Easy migration as it's the same database as you have on-premises today
- Performance resources allocated proportionally to number of CPUs chosen

# Self-Driving | Automatic Tuning

## Autonomous Data Warehouse

## Autonomous Transaction Processing



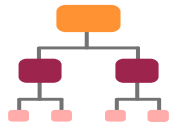
Optimizes Complex SQL

Optimizes Response Time



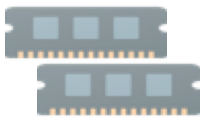
Columnar Format

Row Format



Creates Data Summaries

Creates Indexes



Memory Speeds Joins, Aggs

Memory for Caching Avoid IO



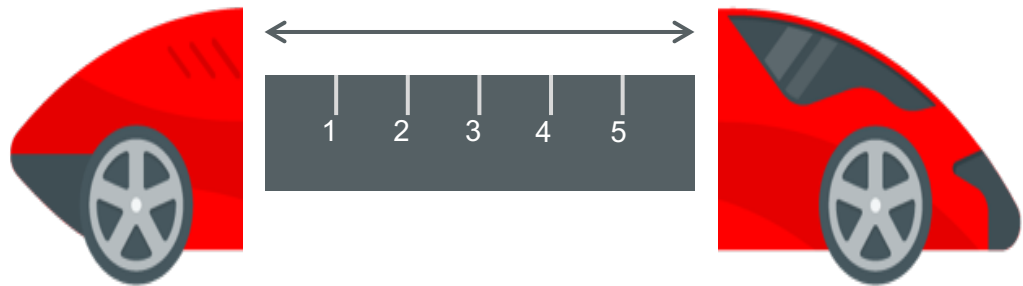
Statistics updated in real-time while preventing plan regressions

# Self-Driving | Automatic Tuning

## Pre-defined Services for Autonomous Database

SERVICES NAME	LOCATION	PARALLELISM	RESOURCE MANAGEMENT PLAN SHARES	CONCURRENT QUERIES BEFORE QUEUING BEGINS
TPURGENT	ATP ONLY	MANUAL	12	100 X CPU_COUNT
TP	ATP ONLY	1	8	100 X CPU_COUNT
HIGH	ADW & ATP	CPU_COUNT	4	3 QUERIES
MEDIUM	ADW & ATP	4	2	1.25 X CPU_COUNT
LOW	ADW & ATP	1	1	100 X CPU_COUNT

# Self-Driving | Elastic Scaling



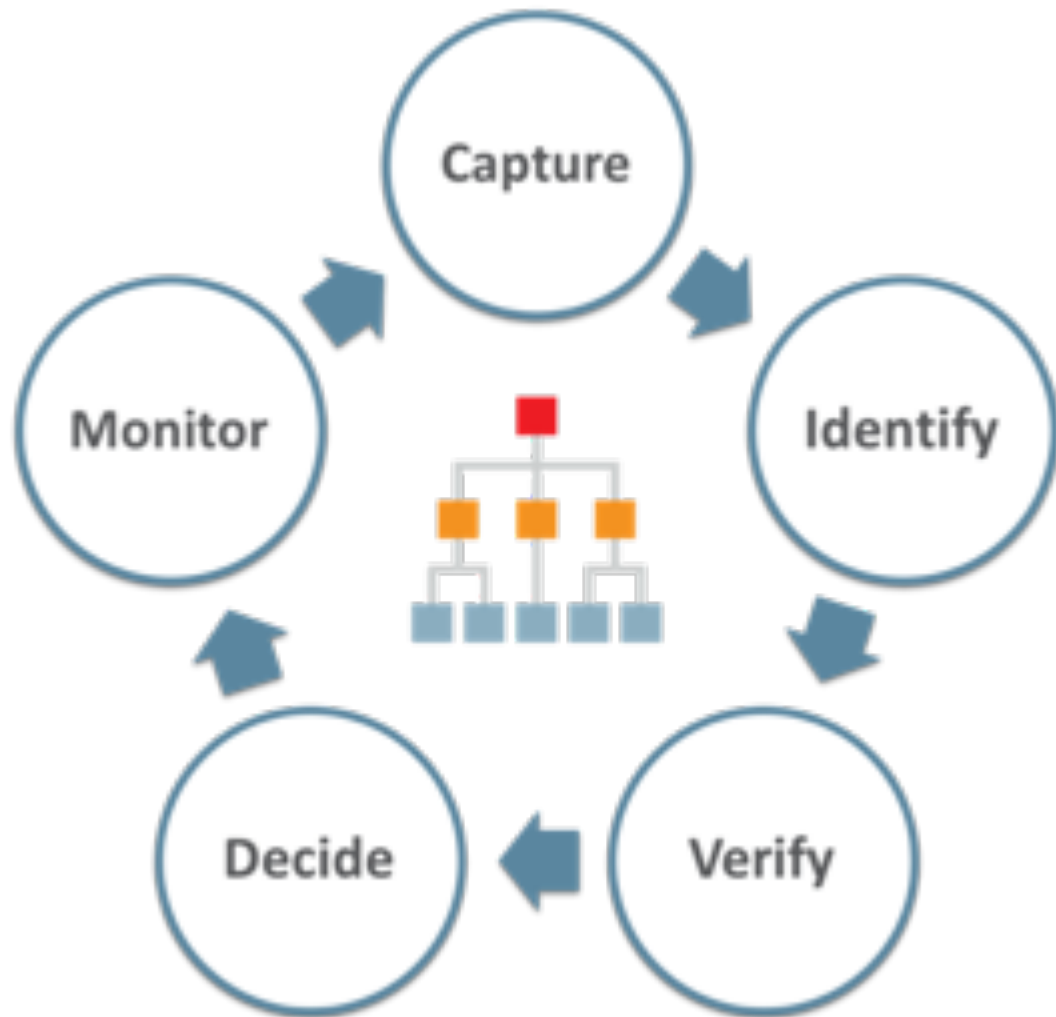
Instant scaling online for highest performance and lowest cost

Scale compute or storage completely independent of one another

All scaling operation occur online – while the application continuous to run

Scaling actions are exposed through Cloud UI and REST APIs

# Self-Driving | Automatic Indexing



An **expert system** that implements indexes based on what a skilled performance engineer would do

**Reinforcement Learning** allows it to learn from its own actions as all candidate indexes are **validated** before being **implementing**

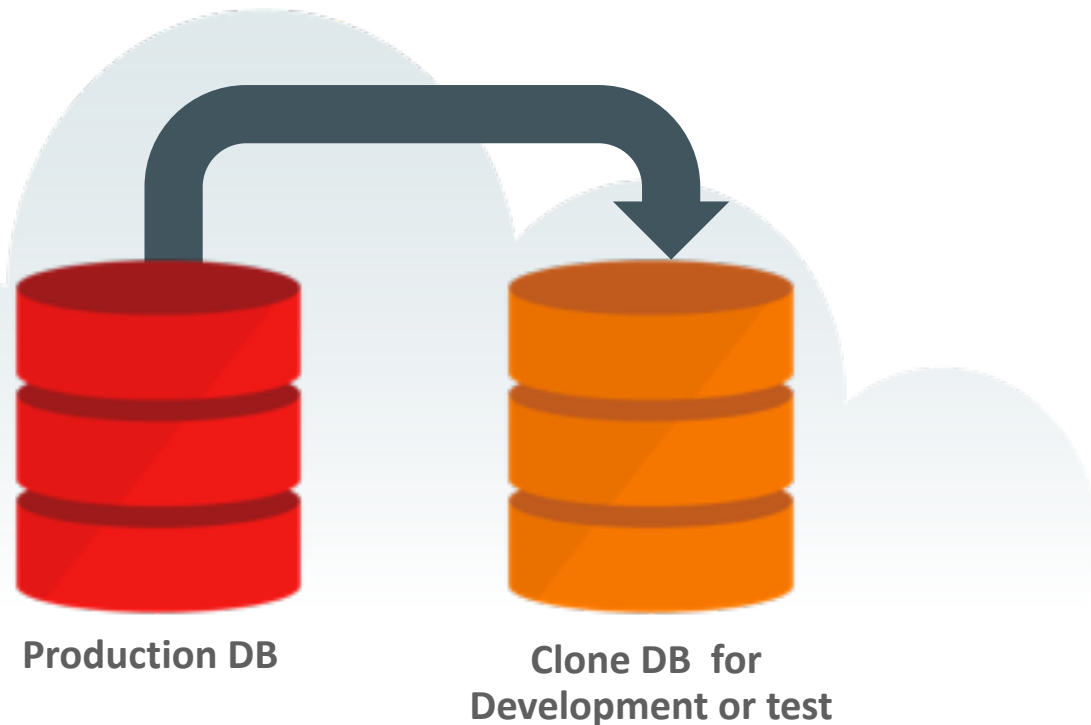
The entire process is fully automatic

Transparency is equally important as sophisticated automation

All tuning activities are auditable



# Self-Driving | Cloning



Two types of clone can be created:

- A full database clone
- A metadata clone (Schema but no data)

Easy and fast as user only has to decide:

1. **Compartment** for the clone
2. **Name** of the clone
3. **CPU** and **storage**
4. New ADMIN **password**

ML Worksheets and AWR data don't get cloned

# A Look Under the Hood

## Key Capabilities of Self-driving, **Self-Securing**, Self-Repairing



Rapid Provisioning

Self Scaling

Automatic Indexing

Automatic Tuning

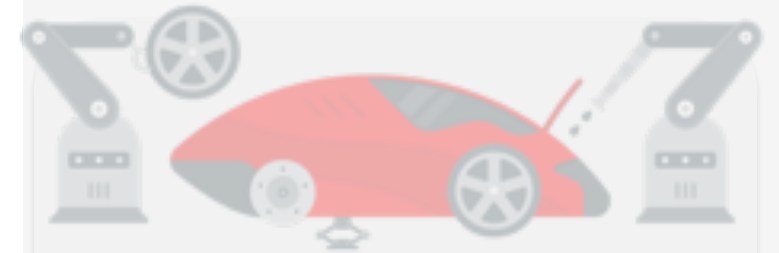


Self Patching

Encryption by Default

Separation of Duties

Auditing



Maximum Availability  
Architecture

Self-Healing Hardware

Self-Healing Software



# Under the hood of Self-Securing

## BENEFITS

- Secure configuration with full database encryption
- Protects from both external and malicious internal threats
- Automatically applies security updates online
- Sensitive data hidden from Oracle or customer admins

## ORACLE TECHNOLOGY

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

## AUTONOMOUS DATABASE CAPABILITIES

Encryption by Default

Self Patching

Separation of Duties

Auditing

\* Coming soon in ATP-Dedicated

# Self-Securing | Encryption by Default

## Encryption for Data at Rest



- Automatically configured – all application data is encrypted within the database
- Database Backups are also encrypted

## Encryption for Data in Motion



- Automatically configured – all network access is encrypted to and from the database
- Choice of two methods
  - Oracle Native Network Encryption
  - Transport Layer Security (TLS) v1.2 (default)
- Oracle client credentials can be downloaded via encrypted wallet files

# Self-Securing | Self Patching

## **Automatic Patching of all components (on-demand for critical security issue)**

- Firmware, OS, Hypervisor, Clusterware, Database

## **Patches applied in a rolling fashion across RAC nodes and Exadata storage servers**

- Database is continuously available to application
- Applications using Application Continuity best practices, run without interruption

## **Patching is automatically scheduled**

- Customer can adjust patching window within a time range on Dedicated deployments\*

# Self-Securing | Separation of Duties

## Security Managed by Oracle

---



- Network security and monitoring
- OS and platform security
- Database patches and upgrades
- Administrative separation of duties
- Data encryption by default

## Security Managed by the Customer

---



- Ongoing security assessments
- Users & Privileges
- Sensitive data discovery
- Data protection
- Activity auditing

But Remember, In the Cloud... Security Is a **Shared** Responsibility

# Self-Securing | Auditing

**Autonomous Database leverages Oracle Unified Audit to capture security-relevant activity**

- Login failures
- Changes to users, including creation of new accounts, grants of privileges or roles
- Changes to database structures, including tables, procedures, and synonyms

**Customers have access to all of the audit data via the UNIFIED\_AUDIT\_TRAIL view**

**The DBMS\_FGA package can be used to add more polices**



# A Look Under the Hood

## Key Capabilities of Self-driving, Self-Securing, **Self-Repairing**



Rapid Provisioning

Self Scaling

Automatic Indexing

Automatic Tuning



Self Patching

Encryption by Default

Separation of Duties

Auditing



Maximum Availability  
Architecture

Self-Healing Hardware

Self-Healing Software





# Under the hood of Self-Repairing

## BENEFITS

- **Recovers** automatically from any failure and protects automatically from all downtime
- **99.995%** uptime including maintenance, guaranteed\*
- Applied Machine learning techniques respond in real-time

## ORACLE TECHNOLOGY

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

## AUTONOMOUS DATABASE CAPABILITIES

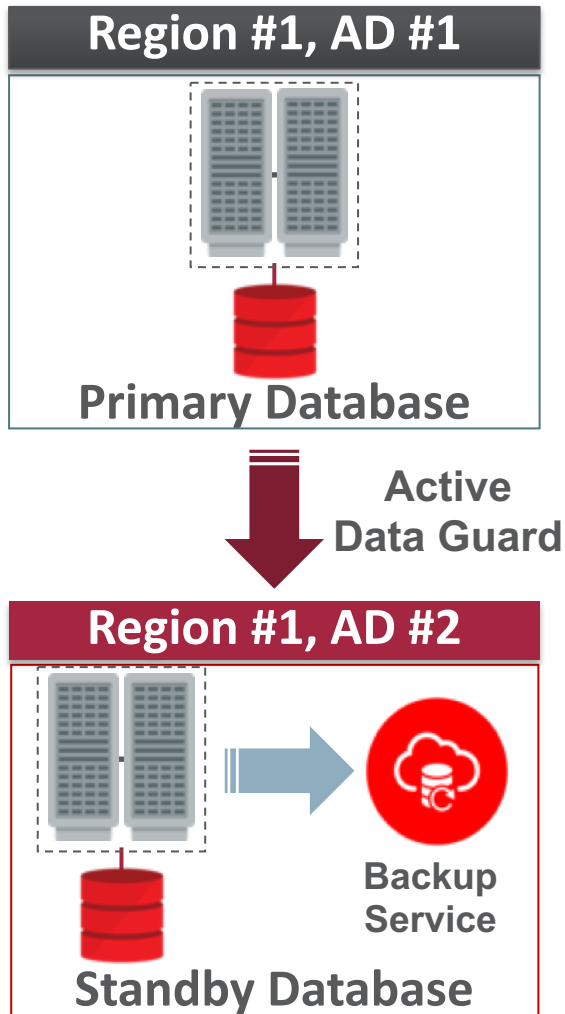
Maximum Availability Architecture

Self Healing Hardware

Self Healing Software

\* Coming soon in ATP Dedicated

# Self-Repairing | Maximum Availability Architecture



**High Availability** - Protection from hardware failures, software crashes, patches, updates

Uses RAC Database, redundant compute, networking, triple mirrored storage, and daily backup

**Disaster Recovery\*** – 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

\* Coming soon in ATP-Dedicated

# Self-Repairing | Self-Healing Hardware

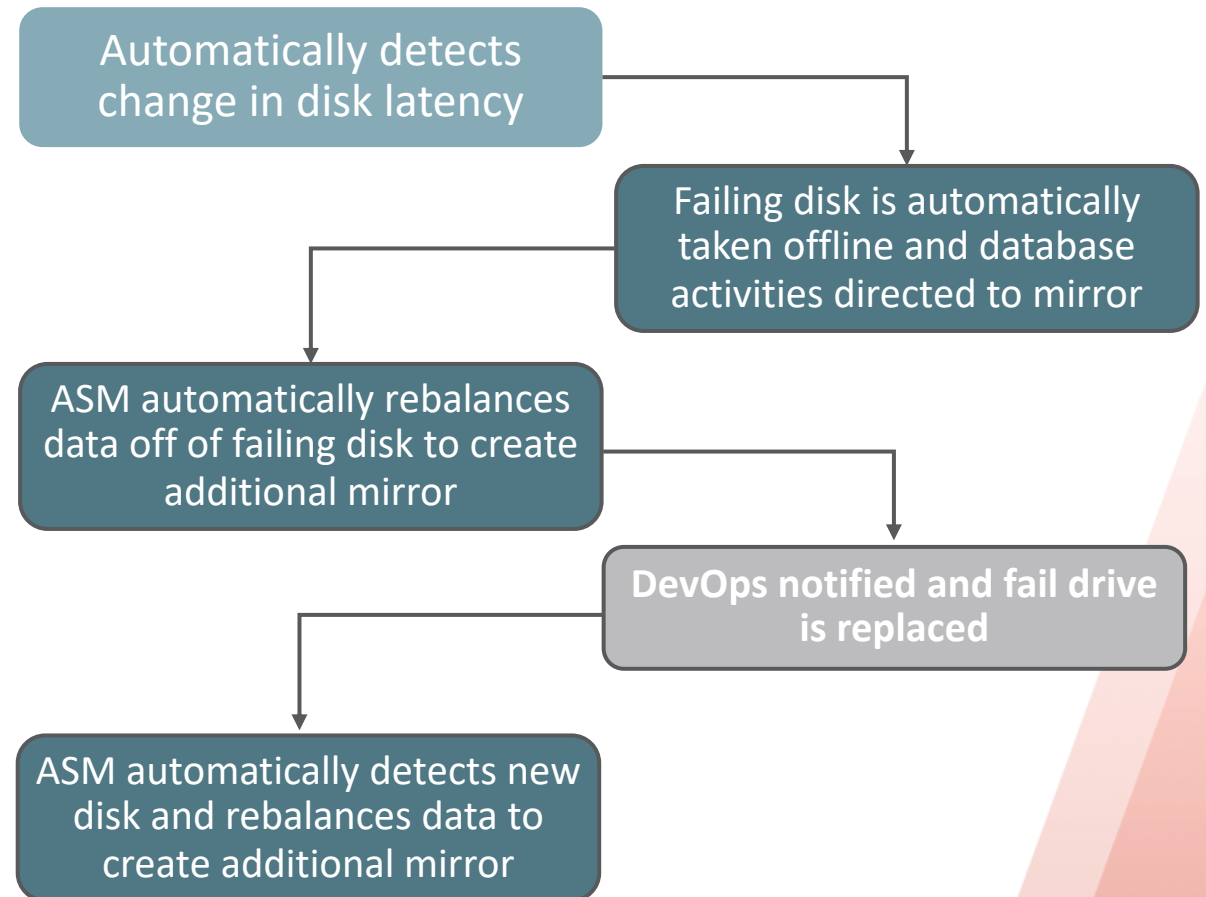
Database Infrastructure for Autonomous is provided by Exadata

Exadata Provides advanced predictive failure capabilities

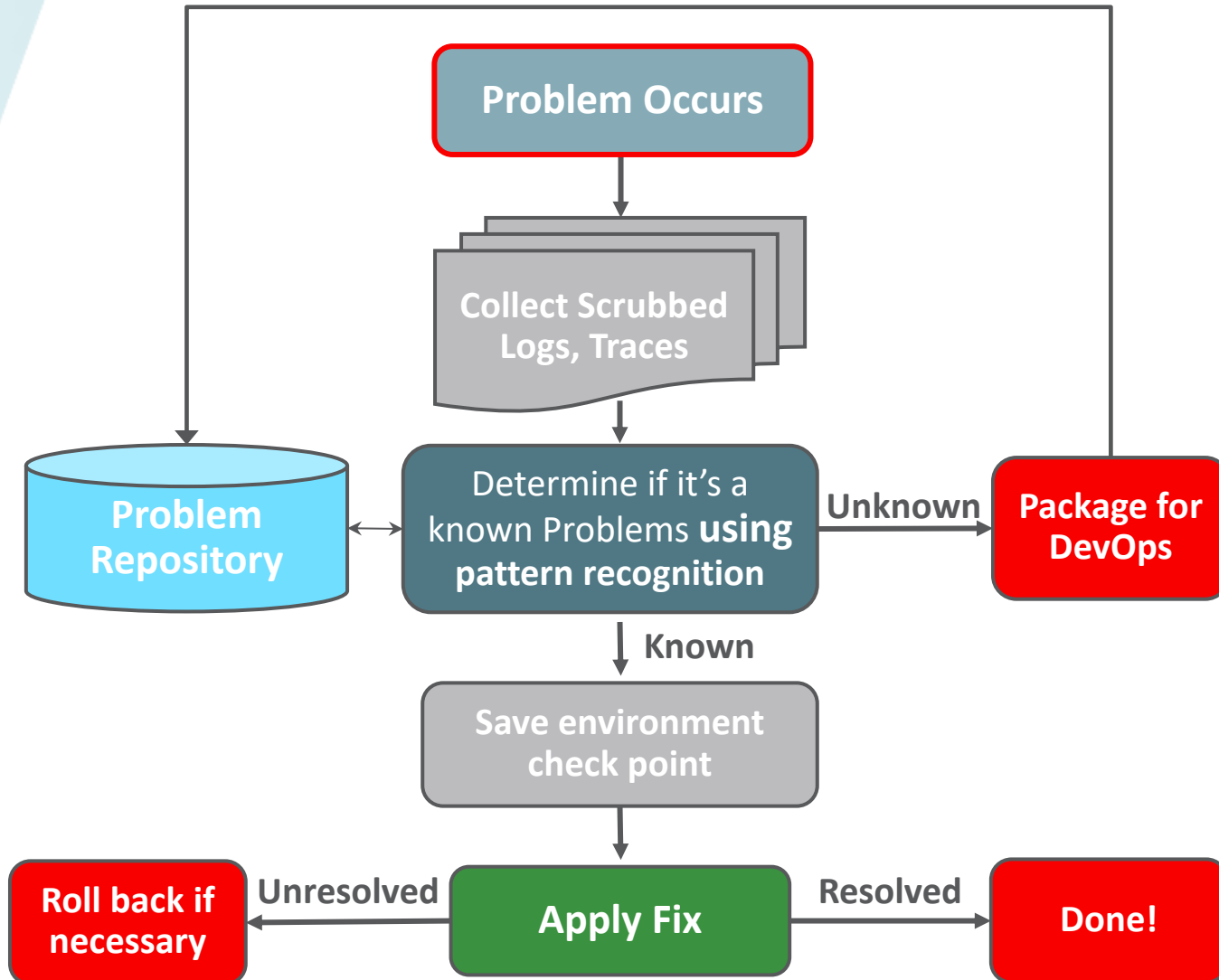
**Unique** detection of server failures without a long timeout avoids system hangs

**Unique** sub-second redirection of IOs around sick devices avoid database hangs

Continuously monitors for sick devices



# Self-Repairing | Self-Healing Software



## Automatically detect problems/issues:

1. Collect diagnostics info to establish an **anomaly timeline** or **signature**
2. Use **Pattern Recognition** to determine if it's a known problems
3. **If known problem**
  - a. Explain what will be done to fix
  - b. Save environment checkpoint
  - c. Apply Fix and do root cause analysis
  - d. Roll back fix if required
4. **If a new problem**
  - a. Package up all diagnostic information
  - b. Hand off to DevOps

# Summary | Autonomous Database Making your life easier

## Spend Less

- Eliminate tedious, expensive, and unsafe manual database management

## Innovate more

- Develop **new applications** faster with instant database provisioning and self-tuning
- Allows you to focus on business rather than technology

## Ensure data safety

- Continuous online updates protect against **cyber-attacks**
- Fault-tolerant solution – including maintenance

