

The logo for Oracle Open World 2017 is presented on a red, three-dimensional rectangular block. The text 'ORACLE' is in white, 'OPEN' is in black, and 'WORLD' is in white, all in a bold, sans-serif font. The year '2017' is positioned at the bottom right of the block in a red, semi-transparent font. The block is set against a background of abstract, geometric shapes in shades of blue and grey, creating a modern, architectural feel.

**ORACLE  
OPEN  
WORLD  
2017**

Brent Skillings  
Oracle Enterprise Cloud Architect

# Topics

- Oracle's Cloud
  - Vision
  - Cloud Updates
- Database Technology
  - Oracle 18c / “Autonomous Database”
  - Exadata X7
- Security

# Oracle Cloud: Infrastructure Vision

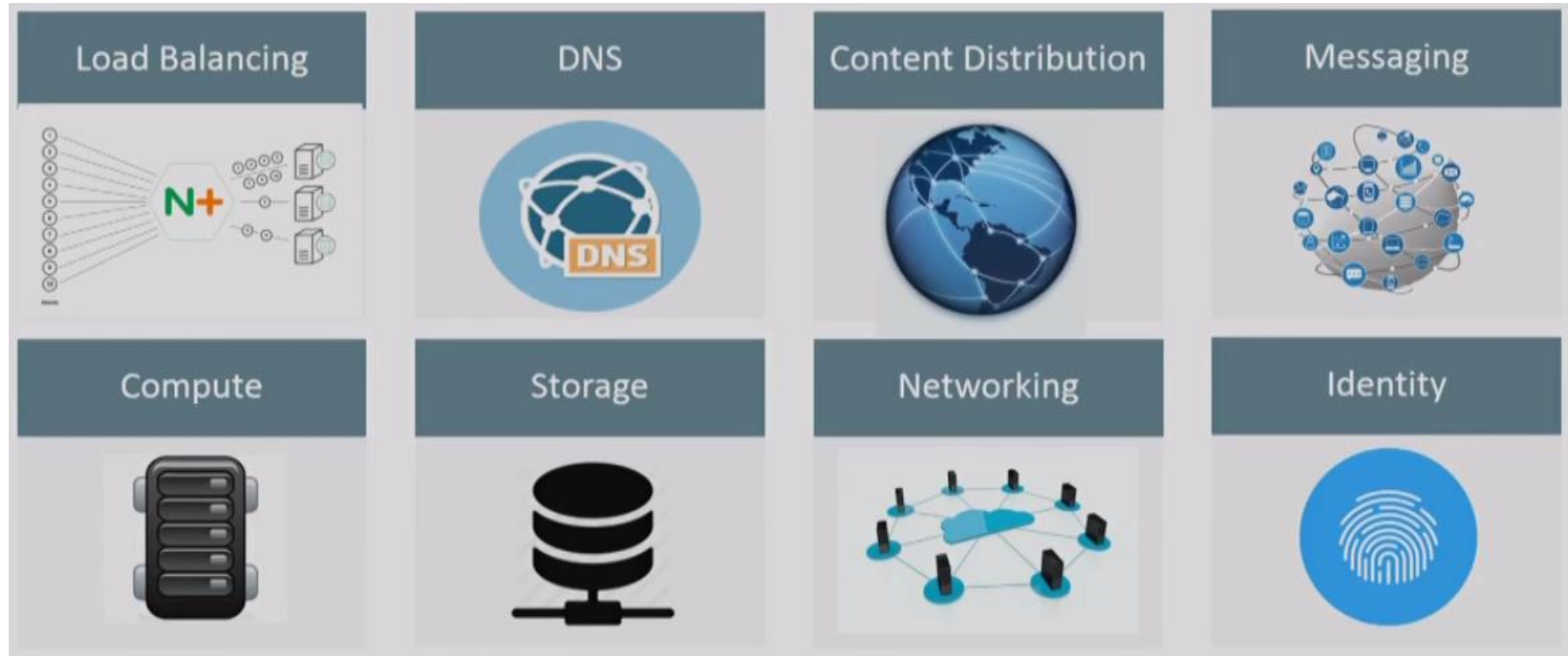


Infrastructure as **CODE**

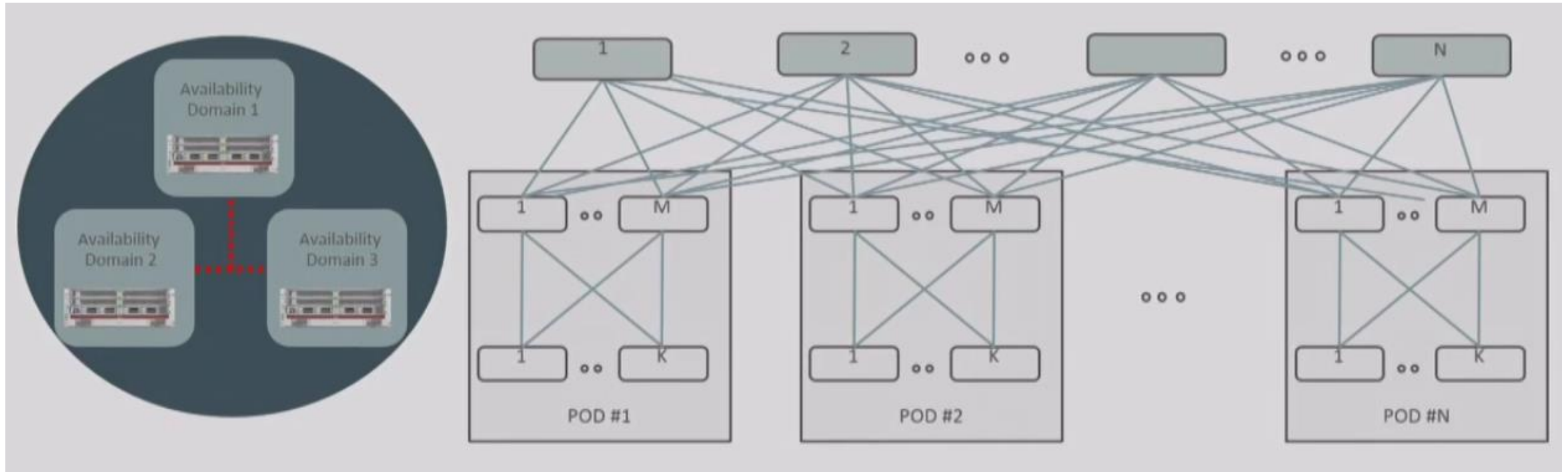
# Oracle Cloud: Regions



# Oracle Cloud: Infrastructure-as-a-Service



# Oracle Cloud: Infrastructure-as-a-Service



Flat Horizontally Scaled, Non Over-subscribed Network

# Oracle Cloud: Infrastructure-as-a-Service

Docker Containers

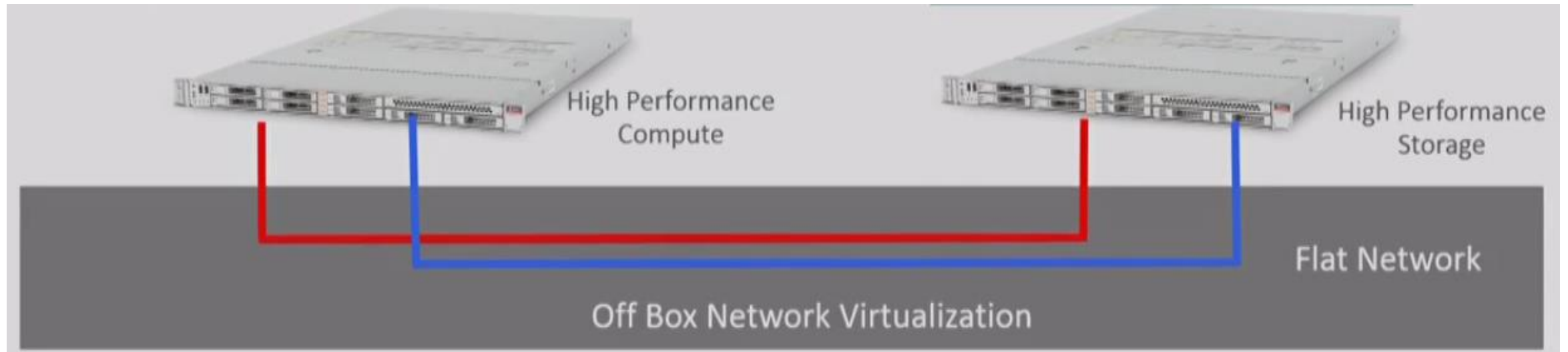
Hypervisors

Hypervisors

File System

Block Storage

Object Storage



# Oracle Cloud: **Infrastructure-as-a-Service**



## **High Performance Compute Systems**

**Intel X5 & X6 with 32-44 Cores per Server**

Standard: Non-NVME SSD, 256 GB RAM

High I/O: 13.2 TB NVMe SSD, 512 GB RAM

Dense I/O: 28.8 TB NVMe SSD, 1024 GB RAM



## **High Performance Storage Systems**

Local NVMe: 28.8 TB/Server, 1 Millions IOPs

Block Storage: 1 TB Per Volume, 1000 IOPS per Volume,  
30,000 IOPs Per Server

Object Storage – High Performance with Strong Consistency

# Oracle Cloud: Infrastructure-as-a-Service

ORACLE Cloud My Services

Compartment: Finance

Larry Ellison

Database Services Activity SSH Access

Summary

- 2 nodes
- 8 OCPUs
- 30 GB memory
- 370 GB storage
- 2 public IPs

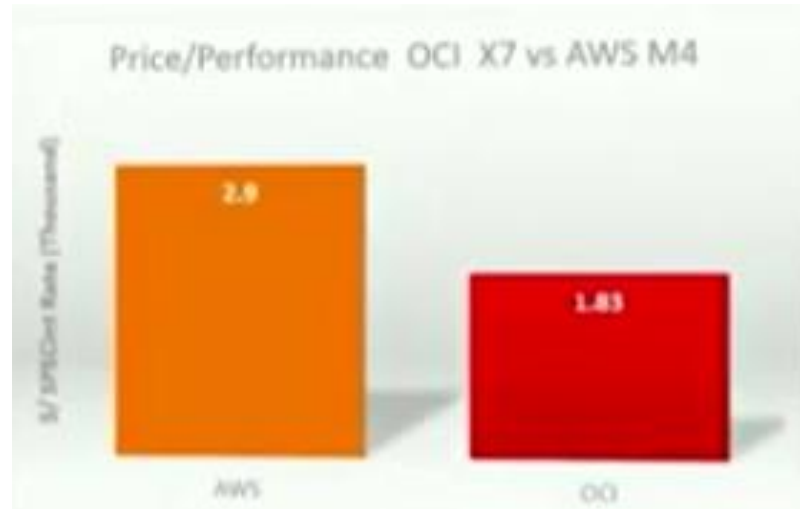
Cluster: NexGen\_Cluster

Category: All Show: All Create Service

Service Name	Version	Edition	OCPUs	Memory	Storage	Public IP	Data Guard	Created On
NEXGEN_DB1	12.1.0.2	Extreme Performance Edition	4	15 GB	185 GB	129.152.159.140	Enabled	Sept 14, 2016
NEXGEN_DB2	12.1.0.2	Extreme Performance Edition	4	15 GB	185 GB	129.152.159.142	Enabled	Sept 14, 2016

# Oracle Cloud: Fastest and Cheapest Compute

## Comparison of Specint\_rate



25% Cheaper per core

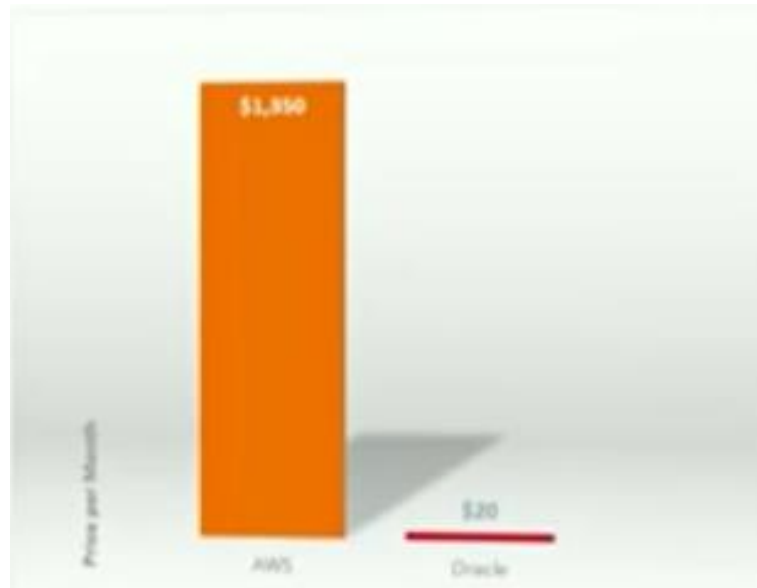
62% More cores per system

15% Better SPECint\_rate per core

54% Better Price Performance per instance

# Oracle Cloud: Fastest and Cheapest Compute

## Comparison of Specint\_rate



3-68X Lower cost based on  
Number of IOPS

25% Better Performance

4-100X Better Price Performance

# Oracle Cloud: Platform Vision

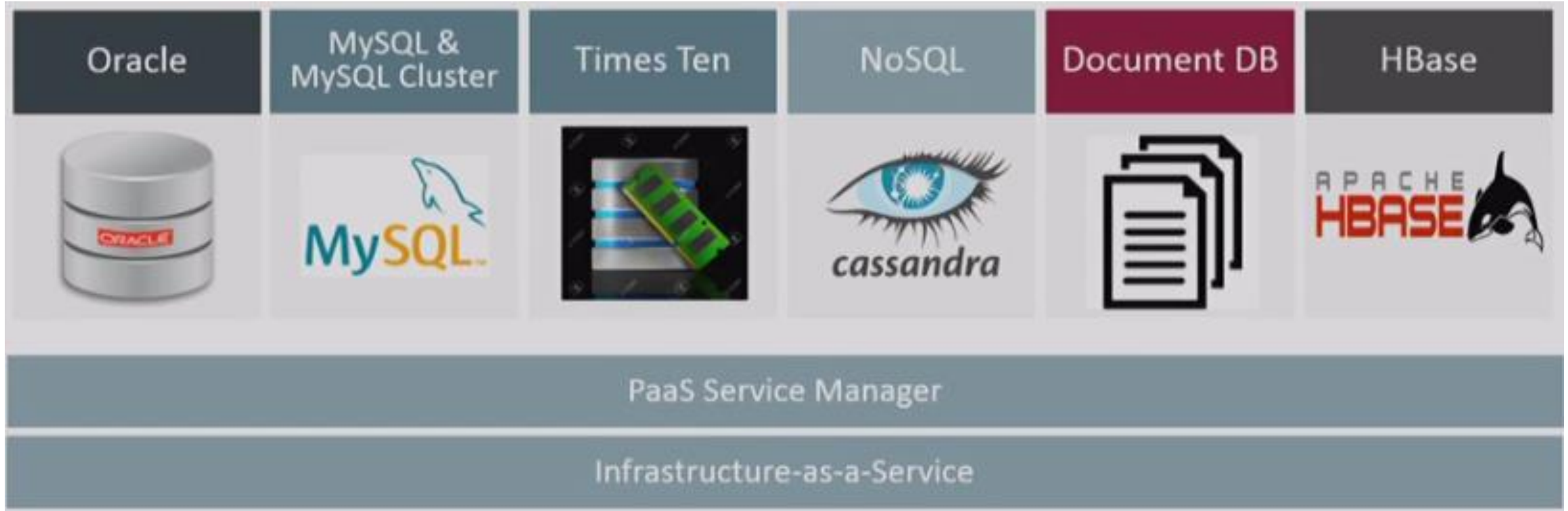


Platform Software as **Autonomous Services**

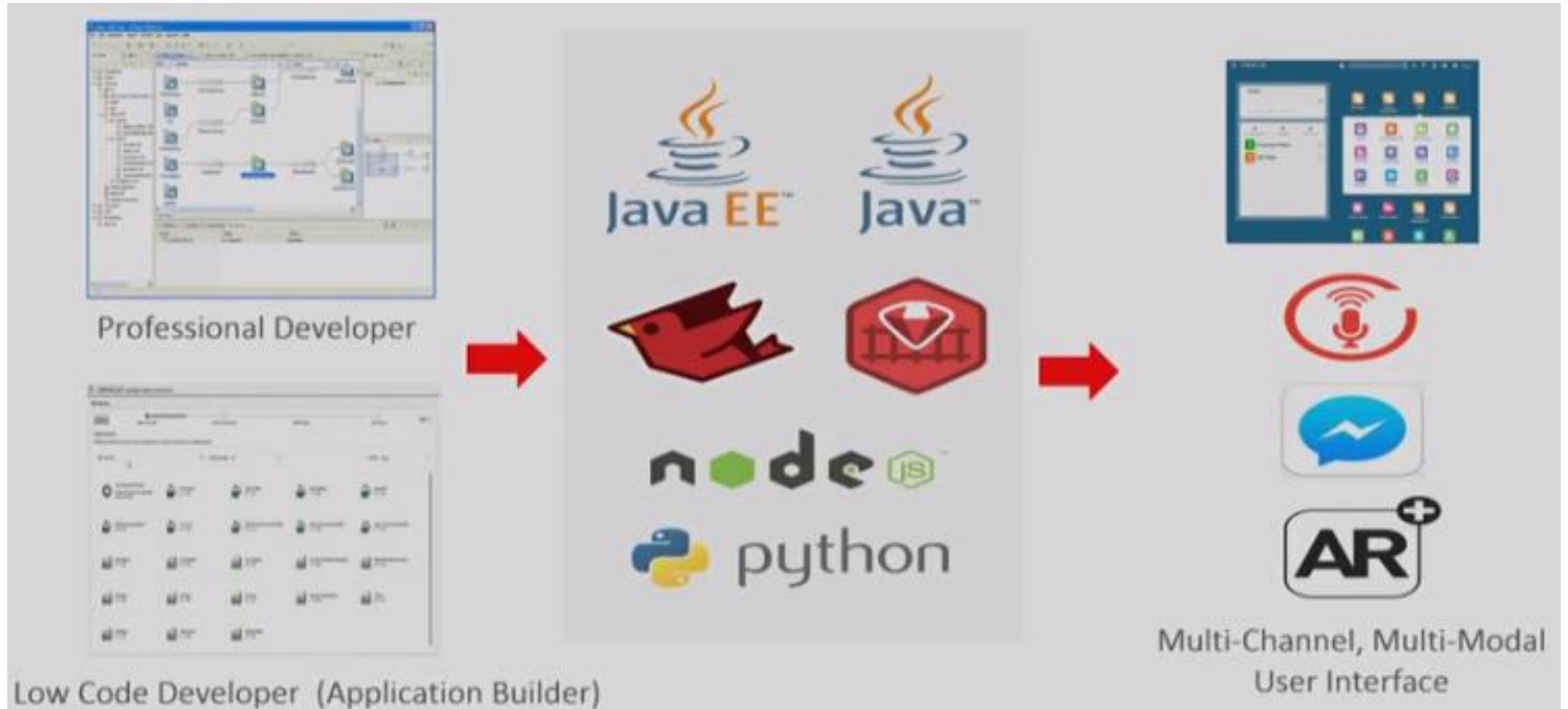
# Oracle Cloud: Platform-as-a-Service



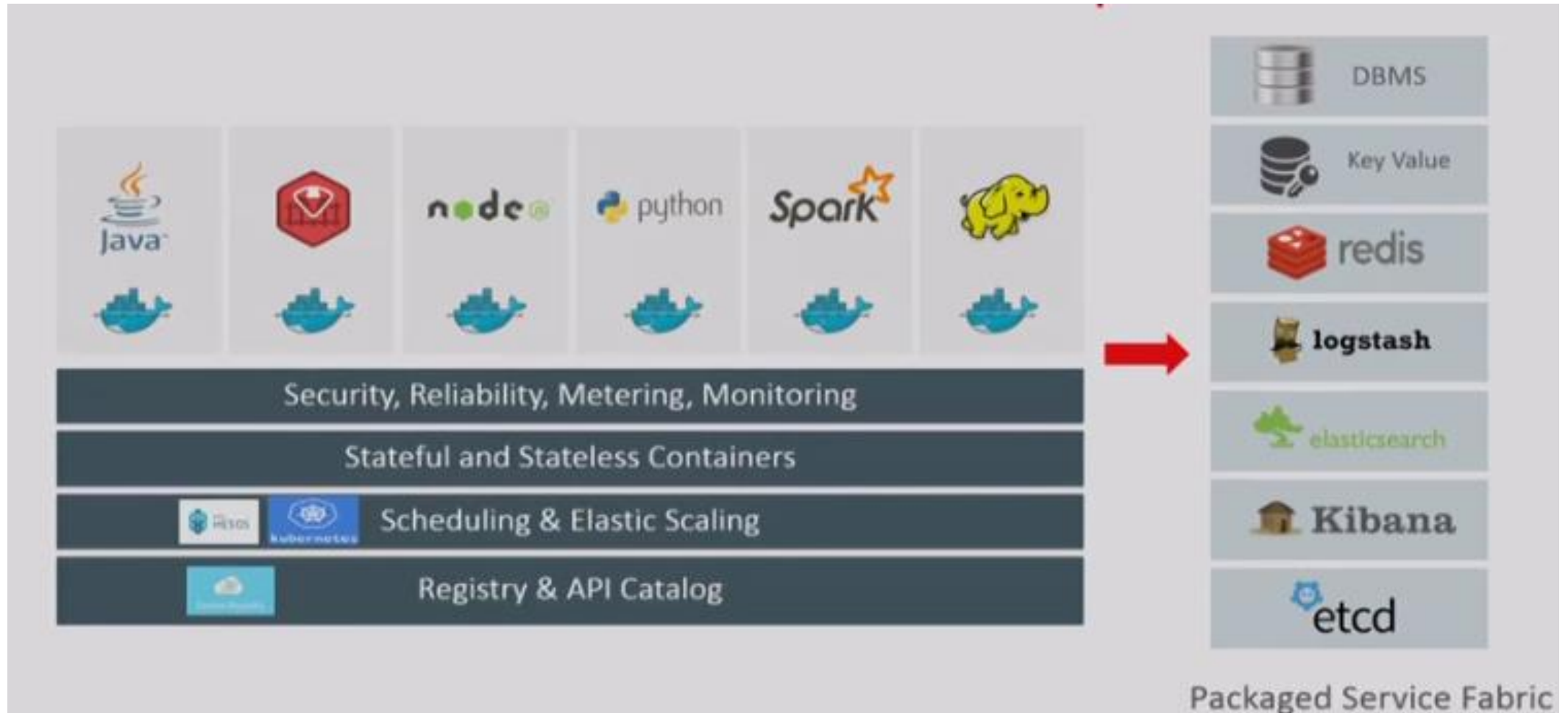
# Oracle Cloud: PaaS Data Management



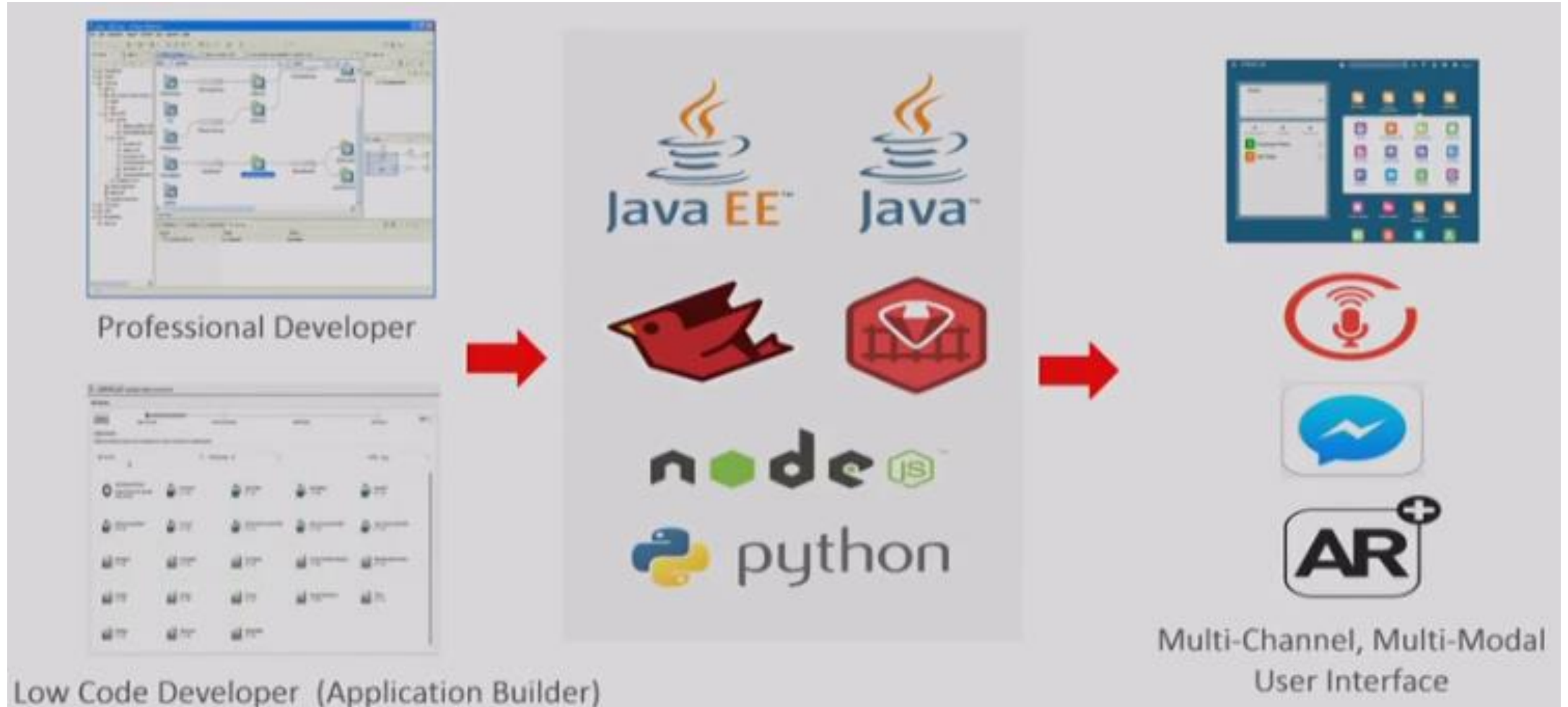
# Oracle Cloud: PaaS Application Development



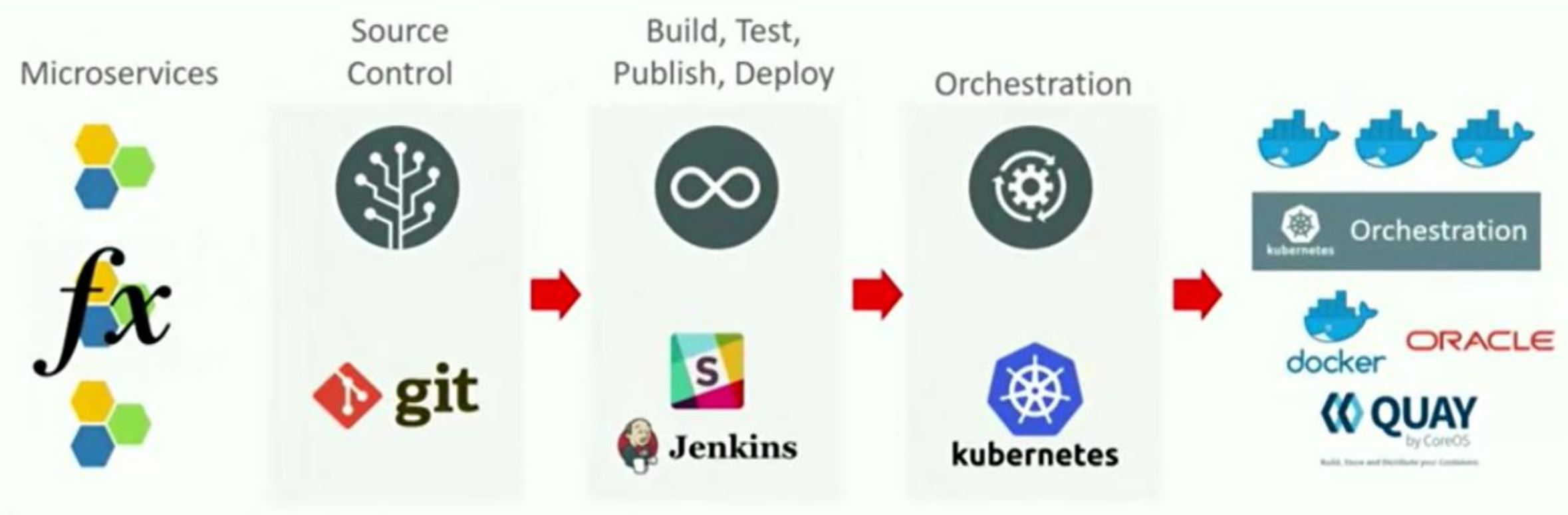
# Oracle Cloud: PaaS Application Development



# Oracle Cloud: PaaS Application Development



# Oracle Cloud: PaaS Micro-Services / Containers



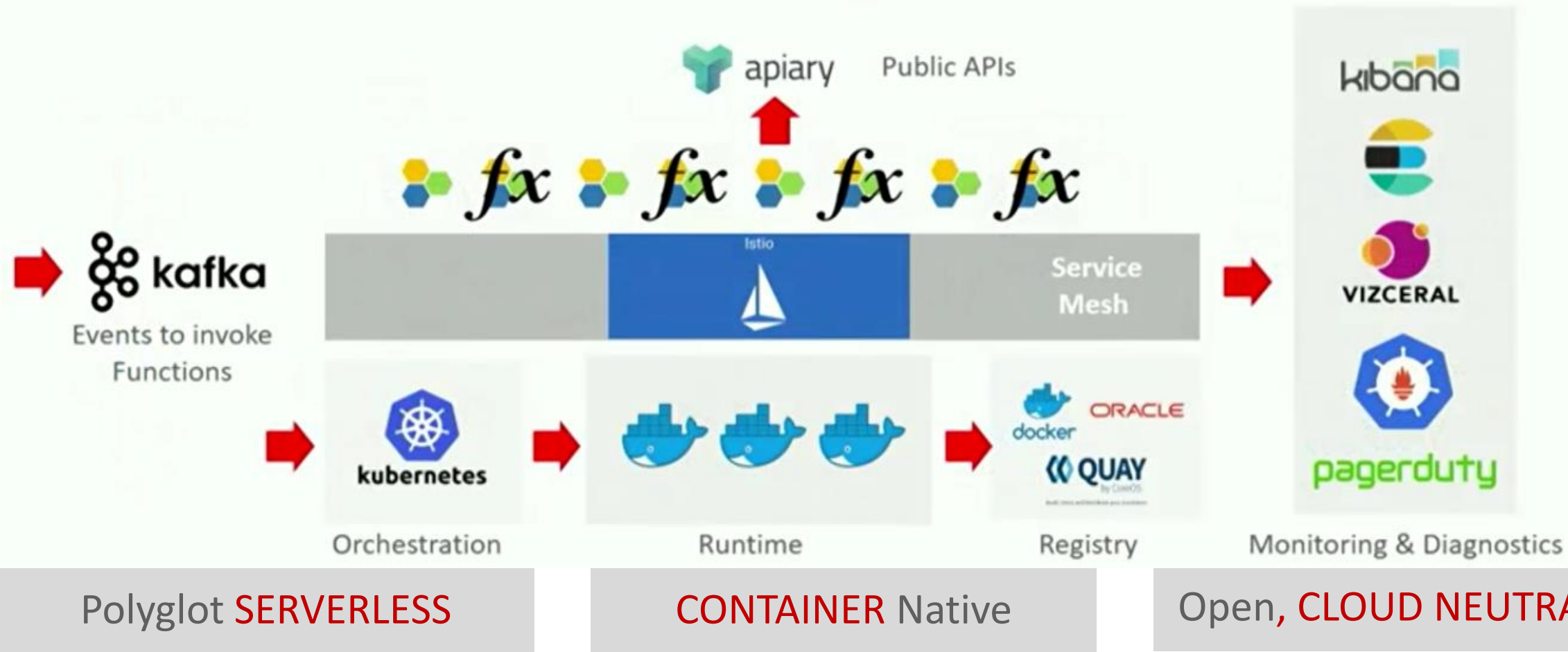
DevOps for **MICROSERVICES**

**CONTAINER** Native

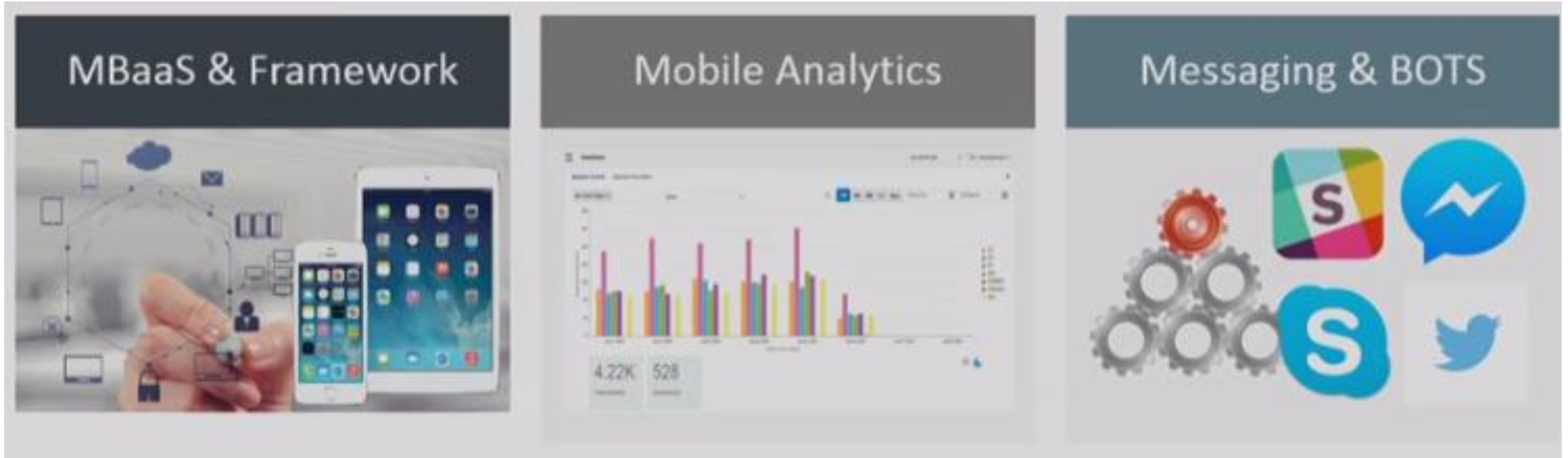
Open, **CLOUD NEUTRAL**



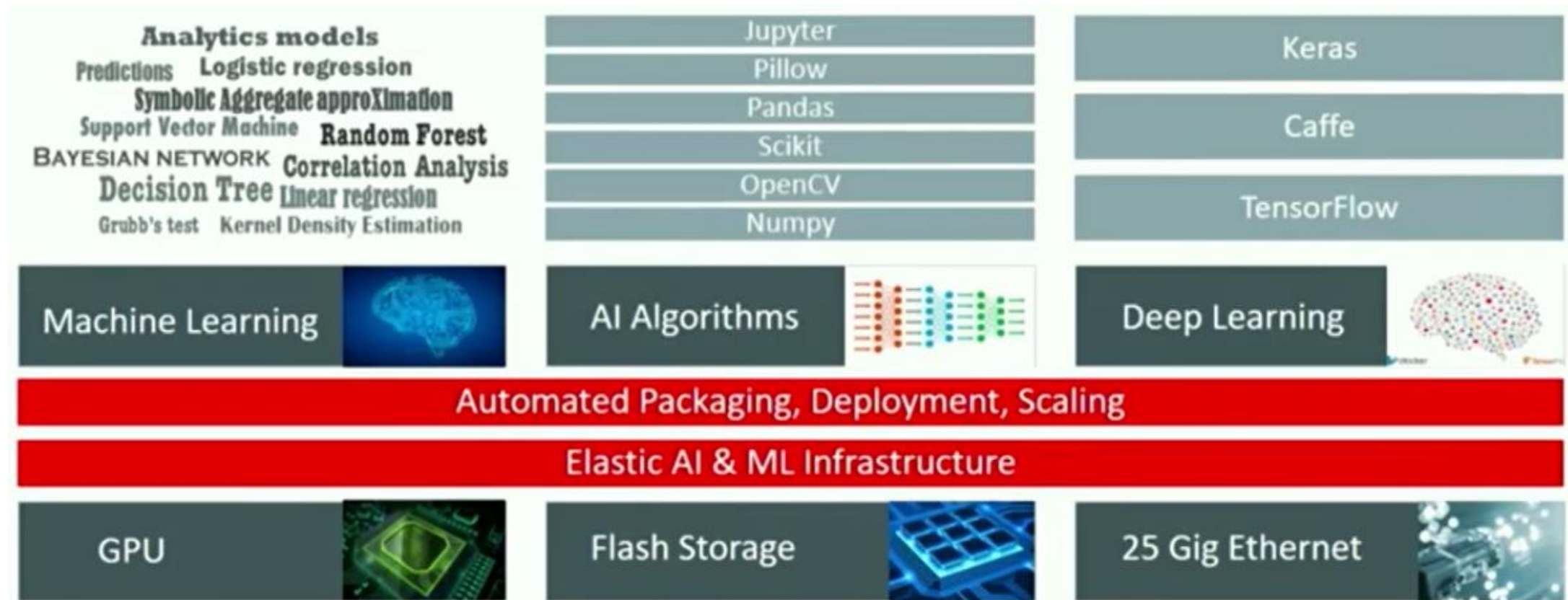
# Oracle Cloud: PaaS Polyglot Serverless



# Oracle Cloud: PaaS Mobile Development



# Oracle Cloud: PaaS AI & Machine Learning



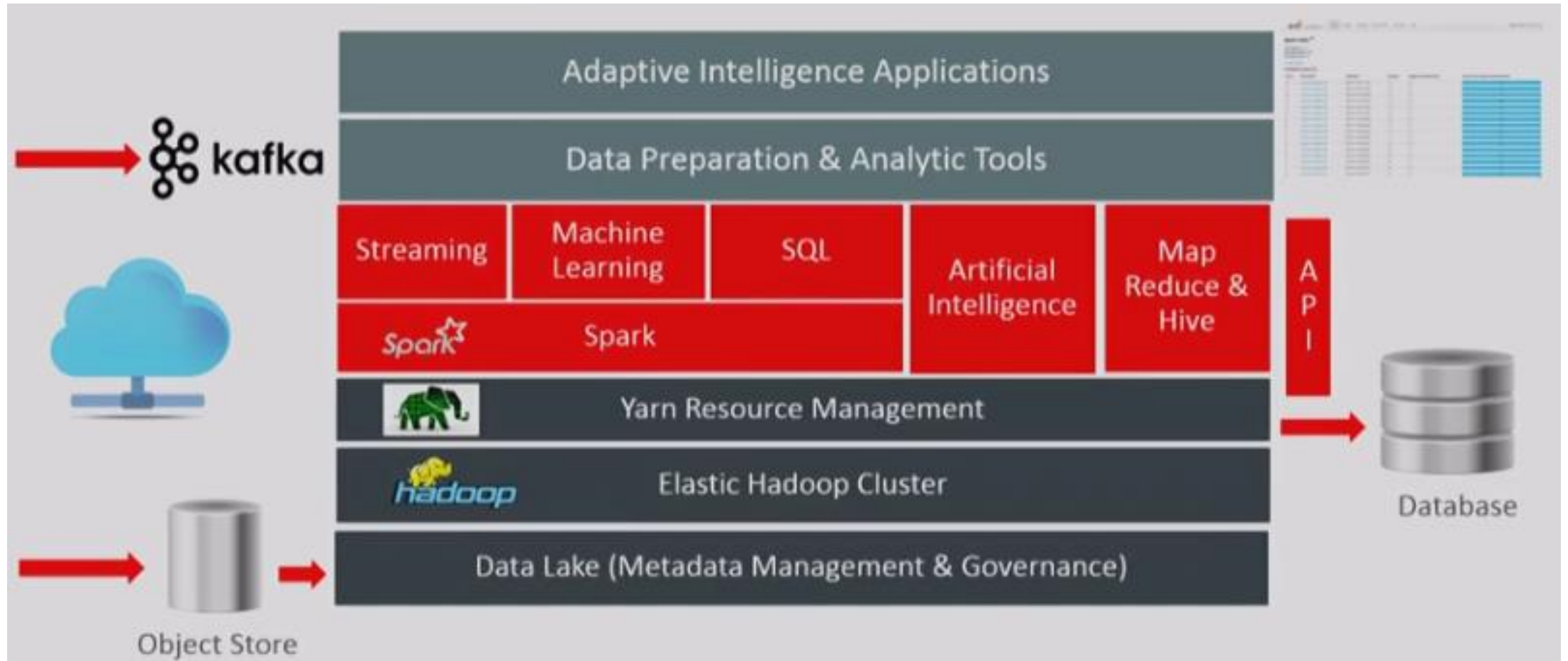
Experiment with **DATA SETS & AI/ML ALGORITHMS**

# Machine Learning

## Computers learn from patterns in the Data and Make Predictions

- Machine learning relies on large amounts of accurate training data
  - Higher volumes of accurate data increases learning
  - Increased learning/training means more accurate predictions
- **Anomaly Detection**: Separate normal from abnormal patterns in the data
  - Detect a cancer cell from normal cells
  - Detect the CFO logging on from a computer in the Ukraine.

# Oracle Cloud: PaaS Big Data & Analytics



# Oracle Cloud: **Software-as-a-Service**



Only **COMPLETE SAAS SUITE**

# Oracle Cloud: Customer Experience (CX)



# Oracle Database 18 aka...the “Autonomous” Database

Hey...What happened to  
13,14,15,16 and 17 ???



# “Autonomous Database”

- Automated Database can instantly patch itself while running
- No delay waiting for Human process or downtime window
- Lots of other benefits from Database Automation

# Database Professionals: Evolution of Skill Set

**Problem: More data management tasks than humans to do the work**

## Less time on Administration

- Less time on infrastructure
- Less time on patching, upgrades
- Less time on ensuring availability
- Less time on tuning



## More time on Innovation

- More time on database design
- More time on data analytics
- More time on data policies
- More time on securing data

# Database Administrator Must Ensure End-to-End Service Levels

- Focus on optimizing how applications and databases work together:
  - Define good data model, and good SQL
  - Avoid row at a time processing, and repeated logins/parsing
  - Understand where time is being spent
  - Understand tradeoffs in parallelism, plans, indexes, partitions, etc.
  - Ensure that **sensitive data is kept secure end-to-end**
  - **Beware what an application asks for – the database will do exactly that**
- Need new skills in Cloud Systems, Cloud Networking, Cloud Storage
  - DBA sizes, monitors, ensures full stack works as expected
- Database Administrator will gain more control
  - Will be in charge of, and in control of, end-to-end service levels

# Oracle 18c Autonomous Database

## Total Automation Based on Machine Learning

- **No Human Labor:** Eliminate 100% of the human labor to manage the database
- Database automatically provisions, upgrades, patches, tunes itself while running
  - **Automated real-time security patching** with no downtime window required
- **No Human Error:** SLA Guaranteed 99.995% reliability and availability
  - Minimize costly planned plus unplanned downtime to less than 30 minutes per year
- No Human Performance Tuning: Consumes less compute and storage than at Amazon
  - **We guarantee your Amazon bill is cut in half. Lower labor costs is even bigger savings.**

# Oracle 18c Autonomous Database

## Lots of New OLTP and Data Warehouse Features

### OLTP

- 4x faster in-memory OLTP Access
- 5x faster RAC for higher contention OLTP loads
- 2x faster streaming ingest for IOT workloads
- Zero impact grid infrastructure patching
- PDB cloud provisioning automation
- NVRAM ready row store, column store, SQL

### Analytics

- 2x faster in-memory column store
- 100x faster in-memory analytics for external data
- 100x faster approximate query processing
- Query and Load directly from Oracle Object store
- Active Data Guard for data warehouse loads
- New machine learning algorithms

# Oracle 18c Autonomous Database

## No Human Labor – No Human Error

- **Fully Automated Database Provisioning and Management**
  - Even for mission critical scale-out clusters with Data Center disaster protection
  - User defines policies, then system automatically manages itself
  - Automatic provisioning, backup, upgrades, patching, tuning, etc. while running
  - No human administration means **no administrator errors or malicious behavior**

# Oracle 18c Autonomous Database

## Continuous Adaptive Performance Tuning

- **Fully Automated Performance Tuning**
  - Automatic optimization: Indexing, caching, statistics, parallelism, etc.
  - Continuous tuning to adapt to data volume increases and data distribution changes
  - Consumes less computer resources than human tuned system

# Oracle 18c Autonomous Database

## Dynamic Elastic Hardware Allocation

- **Fully Automated Hardware Resource Elasticity**
  - Increase expand/shrink compute and storage without downtime
  - Minimizes cost by delaying resource allocation until time needed
  - No overpaying for partially used fixed configurations

# Oracle 18c Autonomous Database

## Non-stop Availability: Fault tolerant plus On-line Recovery and Upgrades

- System Failure or Scaling
  - Regional Outage or DB Corruption
  - Patches (Upgrades)
  - Major Release Upgrades
  - Table/Index/Schema Changes
  - User Error
- Exadata, RAC, ASM
  - Active Data Guard
  - RAC Rolling Upgrade
  - Transient Logical Standby
  - Online and Edition Based Redefinition
  - Flashback transaction, table or database

# Oracle Autonomous Services for Every Database Workload

**More Automation and Lower BYOL PaaS Prices: Middleware, Analytics...**

- Autonomous **Data Warehouse** Cloud Service
- Autonomous **OLTP Database** Cloud Service
- Autonomous **Express** Database Cloud Service
- Autonomous **NoSQL** Database Cloud Service

# Autonomous Database for Data Warehouses

Available: **December 2017**

- **Automated**
  - Automatically provision, upgrade, patch, tune while running
  - Eliminates human labor and human error
- **Efficient**
  - Minimize Hardware Resource Consumption
  - Guaranteed half the cost of Amazon
- **Reliable**
  - Guaranteed 99.995% availability
  - Guaranteed 100x better availability than Amazon

# Autonomous Database for OLTP

Available: **June 2018**

- **Automated: upgrade, patch, tune...while running**
  - Handles OLTP and Mixed workloads
  - Provision **Mission Critical** with High-Performance 99.995% availability configuration
  - Provision **Low Cost** for non-critical workloads or Test/Dev with single server config
- **Efficient: Consume fewer computer resources**
  - Running faster on Exadata infrastructure consumes less compute time
  - Data Compression consumes less storage
  - Instant scaling of compute or storage only when needed with no downtime
- **Reliable: 99.995% availability**

# Exadata X7

Continued Tradition of  
State-of-the-Art Hardware



# Exadata Cloud, Your Way

100% Compatible, No Application Changes, Consistent Cloud Experience

## Private Cloud

Exadata Database Machine



Customer Data Center

Purchased

Customer Managed

## Cloud at Customer

Exadata Cloud at Customer



Customer Data Center

Subscription

Oracle Managed

## Public Cloud

Exadata Public Cloud Service

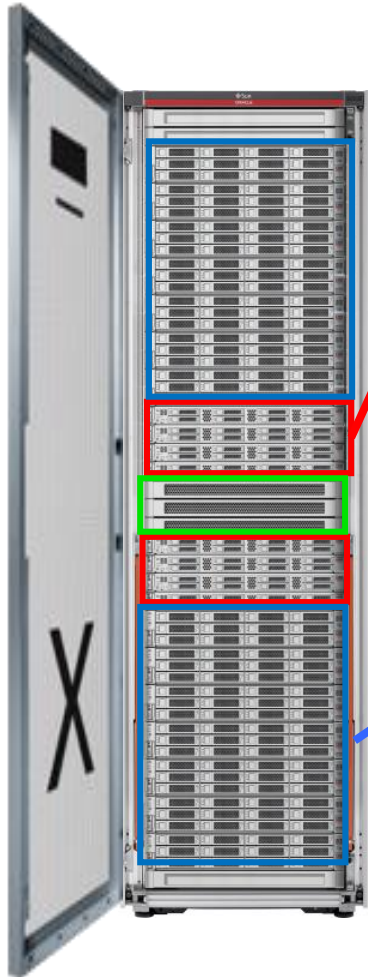


Oracle Cloud

Subscription

Oracle Managed

# Exadata X7 Hardware (changes in red)



- **Scale-Out 2-Socket Database Servers**

- 20% to 40% faster CPUs – latest 24 core Intel Skylake
- 150% faster Ethernet – 25 GigE client connectivity
- 50% more DRAM capacity and throughput

- **Ultra-Fast Unified InfiniBand Internal Fabric**

- **Scale-Out Intelligent 2-Socket Storage Servers**

- Intel 10 core Skylake CPUs offload database processing
- 25% more disk capacity - 10TB Helium Disk Drives
- 100% more flash capacity - 6.4 TB Hot swappable NVMe Flash

Database Server



High-Capacity (HC) Storage



Extreme Flash (EF) Storage



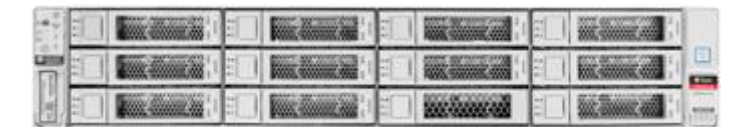
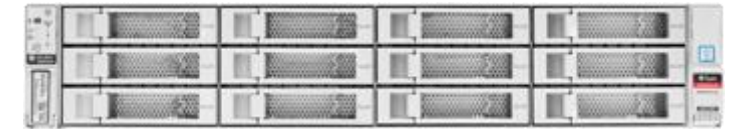
# Exadata X7 Database Servers - Details

- X7-2 Database Servers
  - 48 Cores, 2 x **Twenty-four-Core Intel® Xeon® 8160** Processors
  - **384 GB (12 x 32GB)** – Expandable to 1.5 TB
  - **25 Gigabit Ethernet** for client connectivity
- X7-8 Database Servers
  - 48 Cores, 8 x **Twenty-four-Core Intel® Xeon® 8160** Processors
  - **3 TB (48 x 64GB)** – Expandable to **6 TB**
  - **25 Gigabit Ethernet** for client connectivity
  - **2 x 6.4 TB 2.5-inch Flash Accelerator F640 PCIe Drives (Hot-Pluggable)**



# Exadata X7 Storage Servers - Details

- X7-2 Extreme Flash (EF) Storage Server
  - **2 x Ten-Core Intel® Xeon® 4114** Processors, **192 GB** DRAM
  - **Hot Plug 8 x 6.4TB PCIe rear-mounted flash cards**
  - Capacity increases to **51.2TB**
  - **2x 150 GB M.2 Drives performing Boot and Rescue Functions**
- X7-2 High Capacity (HC) Storage Server
  - **2 x Ten-Core Intel® Xeon® 4114** Processors, **192 GB** DRAM
  - **Hot Plug 4 x 6.4TB PCIe rear-mounted flash cards**
  - **12 x 10 TB** 7.2K RPM High Capacity SAS (hot-swap) – 3.5” disk size
  - **2x 150 GB M.2 Drives performing Boot and Rescue Functions (hot bootable)**



# Faster Client Connectivity with More Choices

- State-of-the-art **25 Gigabit Ethernet** connectivity from database servers to clients
- Optional dual port **25 Gigabit Ethernet** fiber card

Or

- Optional quad port 10 Gigabit Ethernet copper card
- All ports can be configured using OEDA
- New management switch



Subnet 2

Name : **Client**  Enable LACP

Subnet Mask : 255.255.255.0

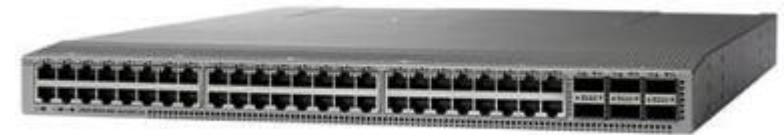
Gateway :

Client Network Format :  RJ45/SFP28 Combined on Motherboard  SFP28 PCI 2 Port Card  RJ45 PCI 4 Port Card

10 Gbit  25 Gbit  10 Gbit  25 Gbit

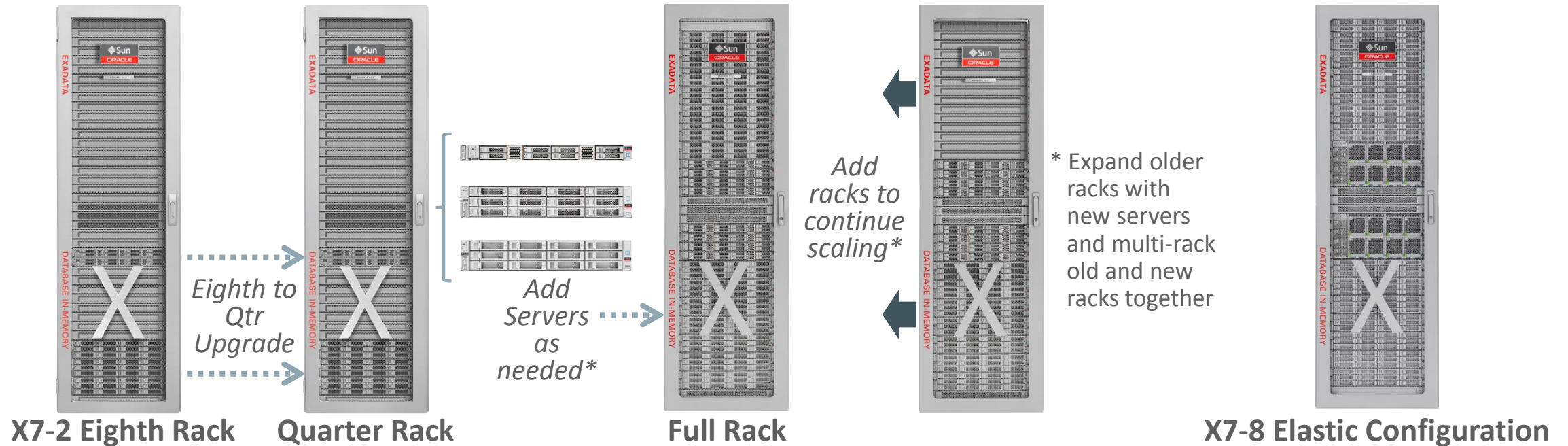
# Exadata X7: Biggest Change in Exadata in Many Years

- Intel® Xeon® Processor Scalable Family **Skylake**
- **50% more** memory **channels** and **faster** memory
- **50% more** default memory, **memory expansion in factory**
- **150% faster 25Gb/sec Ethernet**, more connectivity options
- **100% more capacity, faster, hot swappable** NVME PCIe Flash
- New **M.2 hot swappable** boot drives
- New Ethernet management switch
- **25% larger** Disk Drives & **new disk controller HBA**



# Scalable Configurations Right-Size Your Investment

## Elastic Hardware Configurations



## Capacity-on-Demand Software Licensing

- Enable compute cores as needed, subject to minimums
- License Oracle software for enabled cores only



\* 14 cores minimum per DB server (max 48 cores)

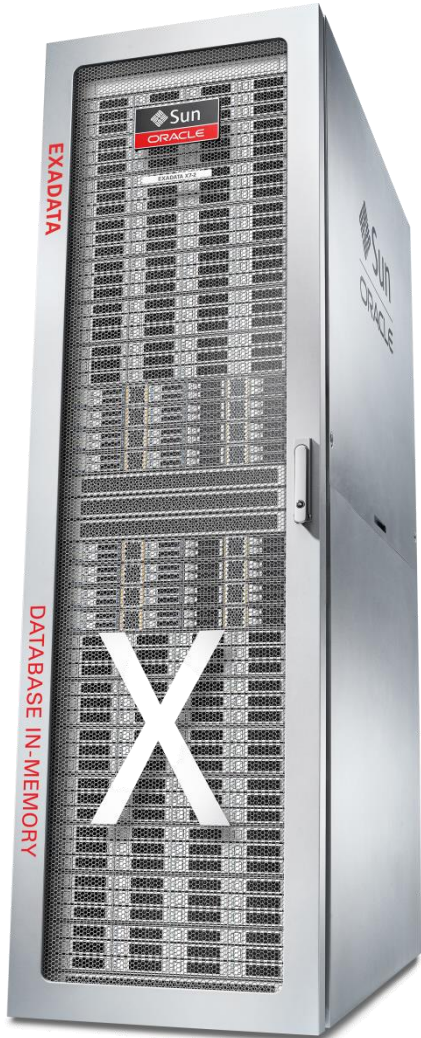
\* 8 cores minimum per Eighth Rack DB server (max 24 cores)

# Breakthrough Database Performance

Exadata X7  
Full Rack\*



Read	<b>5.97 million</b> IO/sec	<b>350</b> GB/sec
Write	<b>5.4 million</b> IO/sec	n/a
IO Latency	<b>250</b> microseconds	n/a



\*Exadata Rack with 10 DB servers and 12 Extreme Flash storage servers

# Exadata X7-2 and X7-8 Performance Improvements vs X6

- **350 GB/sec** IO Throughput
  - 17% more (vs Exadata X6)
- **5.97 Million** OLTP Read IOPs
  - 50% more IOPs (vs Exadata X6) under 250usec = 3.5M
- **40%** CPU improvement for Analytics
- **20%** CPU improvement for OLTP
  - 40% on X7-8
- Dramatically faster than leading all-flash arrays

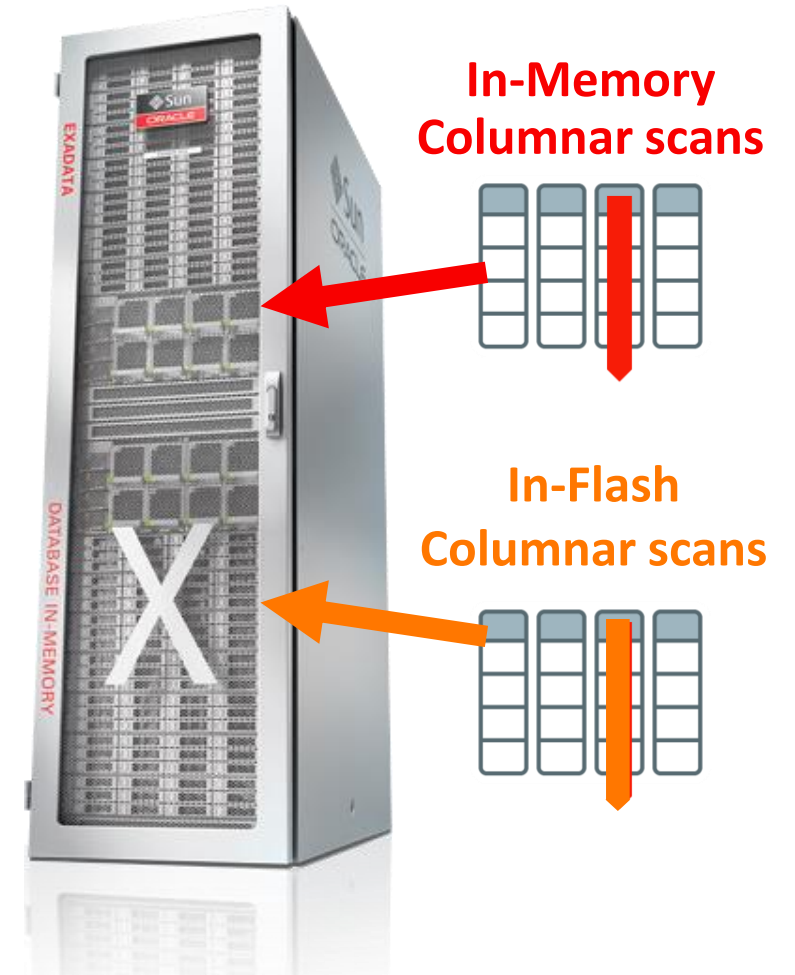


Each rack has up to:

- **1.7 PB Disk**
- **720 TB NVMe Flash**

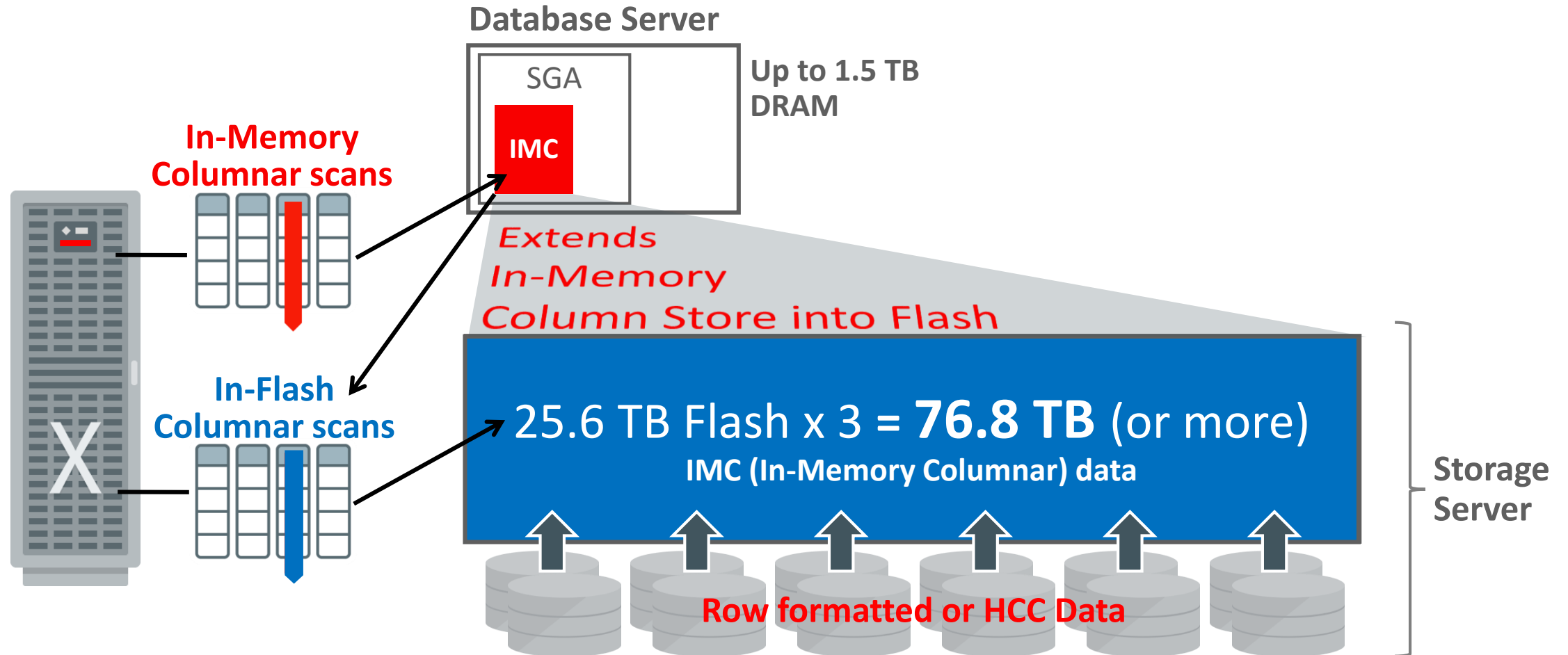
# Analytics: Exadata Brings In-Memory Analytics to Storage

- Exadata automatically transforms table data into In-Memory DB columnar formats in Exadata Flash cache
  - Enables fast vector processing for storage server queries
- Faster decompression speed than Hybrid Columnar Compression
- **Additional compression for OLTP compressed or uncompressed tables in flash – new in 18.1**
- Enables dictionary lookup and avoids processing unnecessary rows
- Smart Scan results sent back to database in In Memory Columnar format
  - Reduces Database node CPU utilization
- **Uniquely** optimizes next generation Flash as memory



# Analytics: In-Memory Columnar Formats in Flash Cache

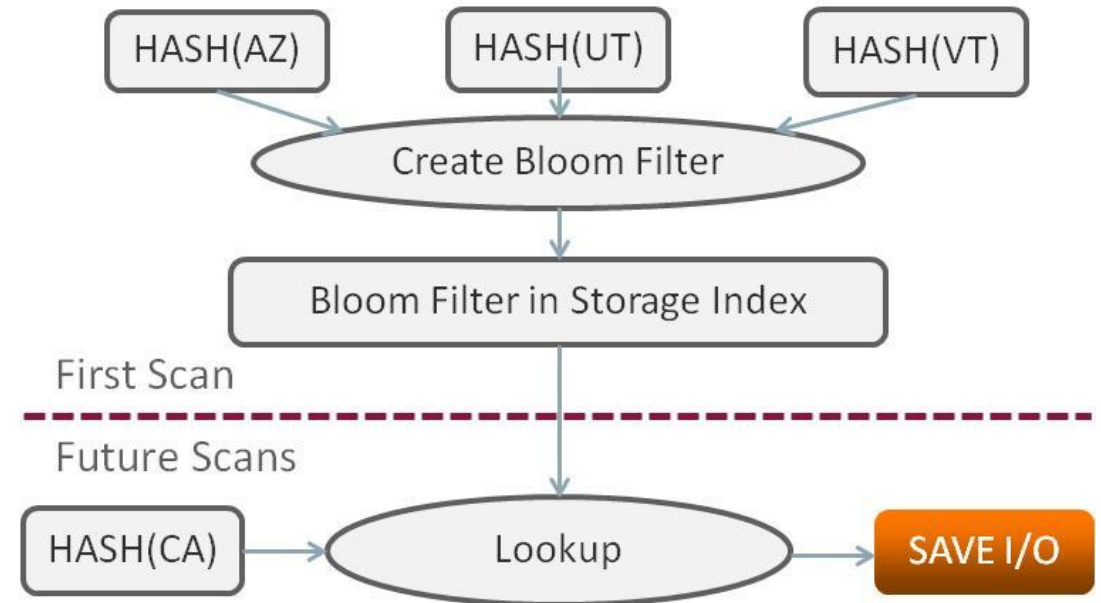
3 - 4x Overall Analytics Performance Improvement



# Analytics: Automatic Storage Index Set Membership

- Storage Index help skip unnecessary IOs
  - Currently contains up to 8 columns of min/max summary
  - Created automatically and kept in memory
- What about queries with low cardinality columns?  
`select name, address from travels  
where origin='Sierra Leone' and dest='CA'`
- Traditional min/max not good enough
- Database gathers stats and find that column has less than 400 distinct values
- Database requests storage to compute bloom filter
- Storage will compute distinct values and create a bloom filter
- Smart Scans check value 'CA' against bloom filter and saves performing I/O
- Supports Database 12.1.0.2 and Database 12.2.0.1

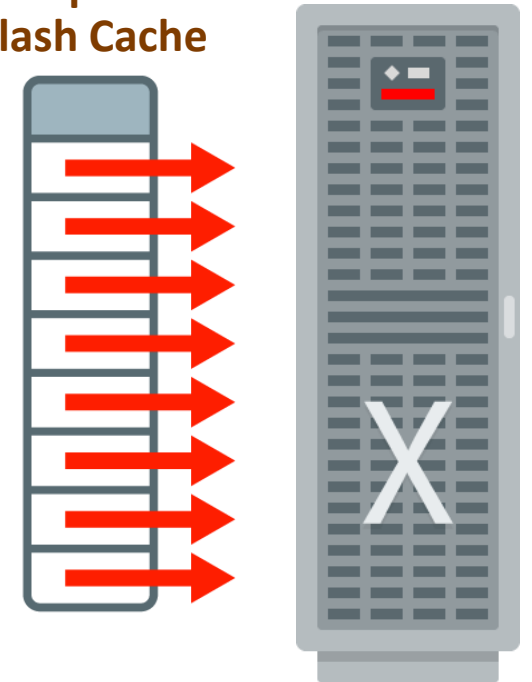
ORIGIN	DEST	NAME	ADDRESS
Sierra Leone	AZ	Alice	...
Sierra Leone	UT	Bob	...
Sierra Leone	VT	John	...



# Analytics: Automatic Write Bursts and Temp IO in Flash Cache

- Write throughput of four flash cards has become greater than the write throughput of 12-disks
- When database write throughput exceeds throughput of disks, Smart Flash Cache intelligently caches writes
- When queries write a lot of temp IO, Smart Flash Cache intelligently caches temp IO
  - Writes to flash for temp spill reduces elapsed time
  - Reads from flash for temp reduces elapsed time further
- Smart Flash Cache prioritizes OLTP data and does not remove hot OLTP lines from the cache
- Smart flash wear management for large writes
- Supports Database 11.2.0.4, 12.1.0.2 and 12.2.0.1

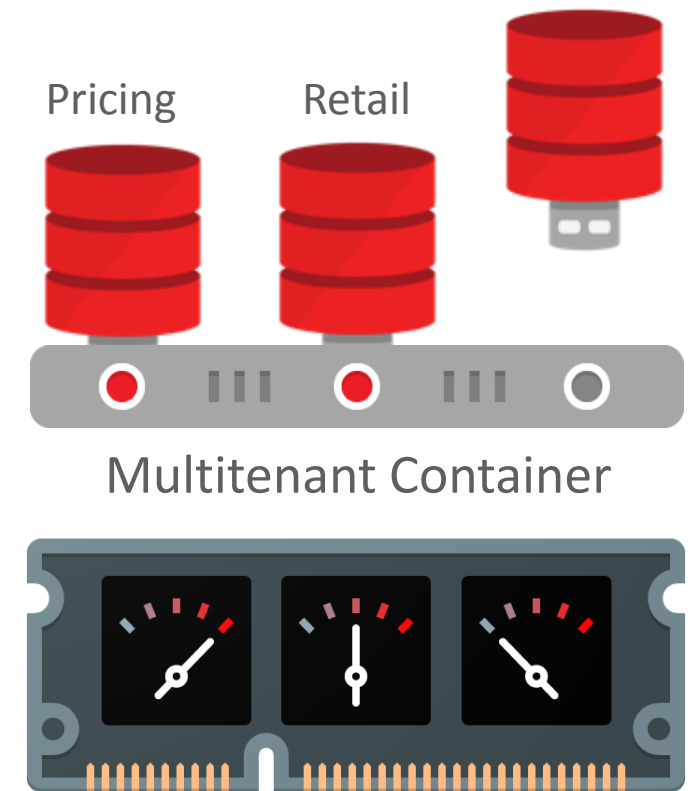
## Write Bursts and Temp IO in Flash Cache



Accelerates Large Joins and Sorts and Large Data Loads

# Exadata Consolidation: Up To 4,000 Pluggable Databases

- Exadata offers unique end-to-end resource management and consolidation capabilities
- Multitenant Option now allows greater than 252 Pluggable Databases within a single Oracle Multitenant Container Database
  - Up to thousands
- **Exclusively available on Exadata, SuperCluster and DB PaaS**



# Exadata Hierarchical Snapshots

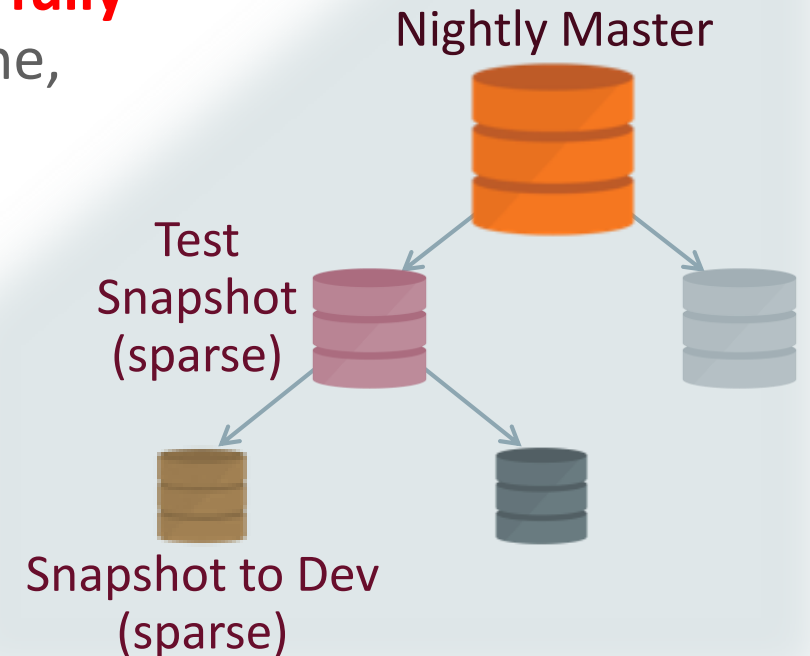
Develop, Test and Deploy on Exadata for Exadata – Full Lifecycle Value

- Why Exadata Snapshots

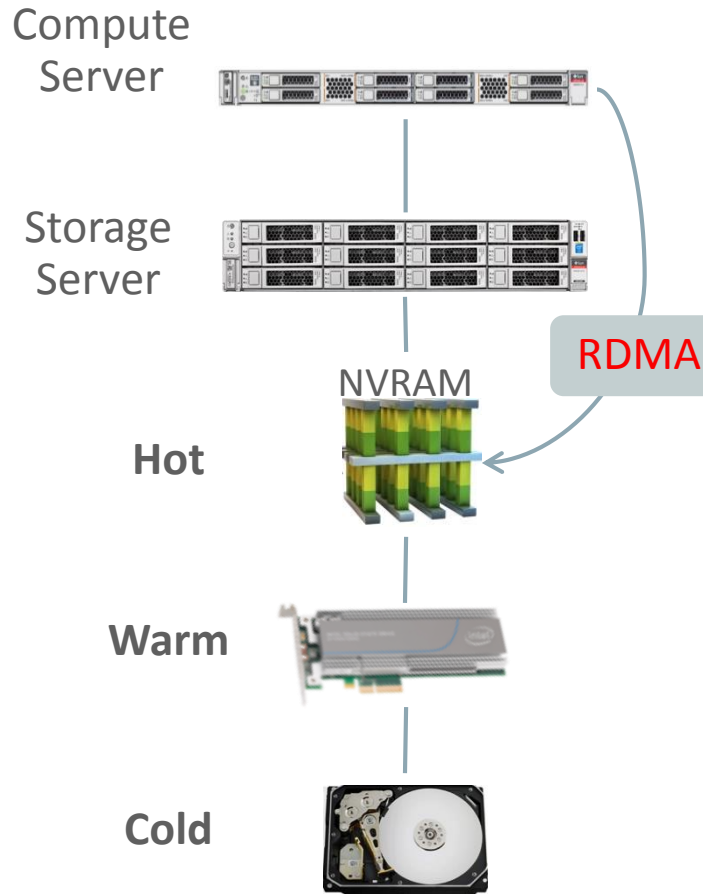
- Ideal for space-efficient read-only or read-write snapshots of an Oracle database that you can use for development, testing, etc.
- Used by developers and testers who need to validate a **fully functional Exadata environment** (e.g. Smart Flash Cache, Smart Scan, HCC)

- Hierarchical Snapshots (example)

- Development releases nightly database build
- Tester creates a snapshot and finds a bug
- Tester creates a snapshot of her snapshot
- Provides the new copy to development for analysis



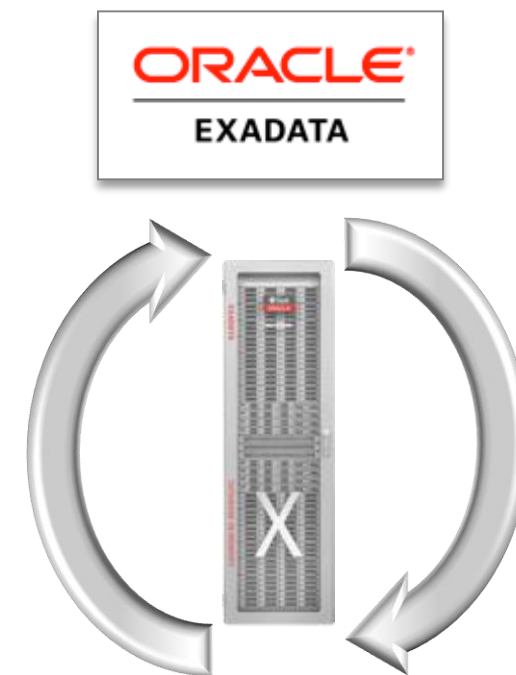
# Preview: Non-Volatile Memory Cache in Exadata Storage



- Exadata Storage Servers will add Non-Volatile memory cache in front of Flash memory – Intel 3D X-Point
- **RDMA** enables order of magnitude faster remote access of stored data
  - Direct access to NVRAM gives **20x lower latency** than Flash
- NVRAM used as a **cache** effectively increases its capacity by 10x vs using NVRAM directly as expensive storage
  - Cost-effective to run multi-TB databases completely in memory
- Expensive NVRAM shared across servers for lower cost
- NVRAM mirrored across storage servers for fault-tolerance

# Manageability: Automated Cloud Scale Software Upgrade

- New Upgrade Process in 18.1
  - Point the Storage Server to the Software Store
  - Storage Server downloads new software in the background
  - User schedules time of software upgrade
  - Storage Servers automatically upgrade in rolling fashion online
- Benefits
  - Simpler and faster Cloud and On-Premises upgrades
  - Just need to schedule time of upgrade
  - One software repository for hundreds of machines
- Existing upgrade process continues to work



ORACLE®

# Oracle Security

*Oracle Management Security Cloud*



**SECURITY**  
**Inside-Out**

# ORACLE DATABASE SECURITY CONTROLS

## PREVENTIVE

Encryption & Redaction

Masking & Subsetting

DBA & Operational Controls

## DETECTIVE

Activity Monitoring

Database Firewall

Auditing & Reporting

## ADMINISTRATIVE

Key Management

Privilege & Data Discovery

Configuration Management

ORACLE®



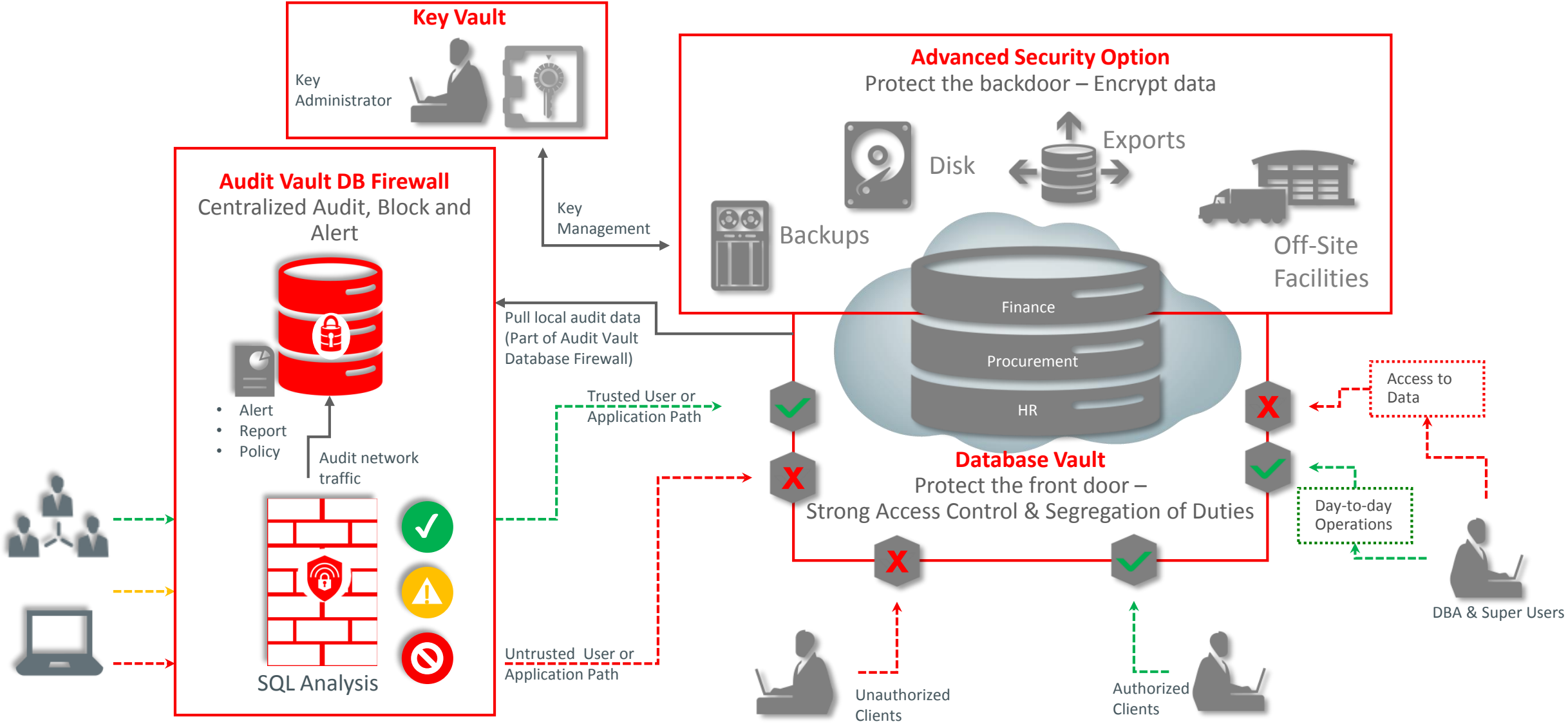
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# Oracle – Protect the data / Enforce Defense in Depth Strategy



# Database Autonomy & Highly Automated Cyber Security

- Database Autonomy: Fully automated 100% “self-driving” database
- Automated Cyber Defense: Detect & remediate attacks in real-time
- They work together:
  - **Discover attack**: Real time ML log processing detects security anomaly in data
  - **Remediate**: Database automatically patches itself while running

**Lots of other benefits come from Total Database Automation**

# Oracle 18c – “Autonomous Database” Can Secure Itself

- Automated Protection from **external attacks**
  - Automatically applies latest security updates online
    - Quarterly, or off-cycle for high impact security vulnerability
  - Native encryption prevents data access from outside the database
    - Allows keys to be managed by customer’s existing Security Module (HSM)
    - Will interface with Database Aware Key Management Cloud Service
- Automated Protection from malicious **internal users**
  - Database Vault prevents administrators from seeing user data
  - Data Masking finds and conceals sensitive data from testers
- Oracle staff is locked out - well defined “break glass” procedure, with customer approval, for Oracle Operations to access system

# Huge Amounts of Computer System Data in Event Logs

## Enable New Database and Security Applications for Machine Learning

- Logs of Event Logs
  - Infrastructure logs: Network, Server, Storage, VM, OS
  - Platform logs: Database, Java, Analytics, etc.
  - Application logs: ERP, CX, HCM, Custom, etc.
- Event Log Training Data Enables New Machine Learning Applications
  - Security: Detect and connect anomalous events: Login from Ukraine and unique SQL
  - Database: Classify normal query patterns and automatically tune database

# Oracle Management Cloud – Security & Network



# Oracle Management Cloud – Security Monitoring and Analytics Security Operations Center (SOC) solution with **built-in intelligence**

- **Intelligent monitoring** of security events, user behavior & SQL
  - Continuous ML, and other algorithmic pipelines to detect anomalies early in kill chain
- **Investigate using Log Analytics** for internal & external threat vectors
  - Understand attack chains across any application for forensics or prevention
- **Automatically remediate** to reduce exposure
  - Continually harden systems in response to a threat or weakness



# Oracle Management Cloud – Configuration & Compliance

## Continuous Compliance Across Hybrid Cloud Estate

- Maintain industry and regulatory compliance (STIG, GDPR, etc.)
- Enforce company-specific compliance across hybrid clouds
- ML driven configuration drift management

**Why is this important?**  
**One word....Equifax**



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