Oracle Cloud Infrastructure
Highlights & Value Add

RB Hooks, III

Vice President, Cloud Infrastructure and Solutions
Oracle National Security Group

Safe harbor statement

The following 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.

OCI Highlights

"In order to make a true enterprise grade cloud we had to rethink todays approach to clouds. The result was our Gen 2 architecture."

"It is designed completely different from our competitor's Gen 1 clouds. Gen 2 provides better performance, better SLAs, better security, it's more open with no lock-in, and   all at lower costs."

Larry Ellison
Executive Chairman & CTO
Oracle
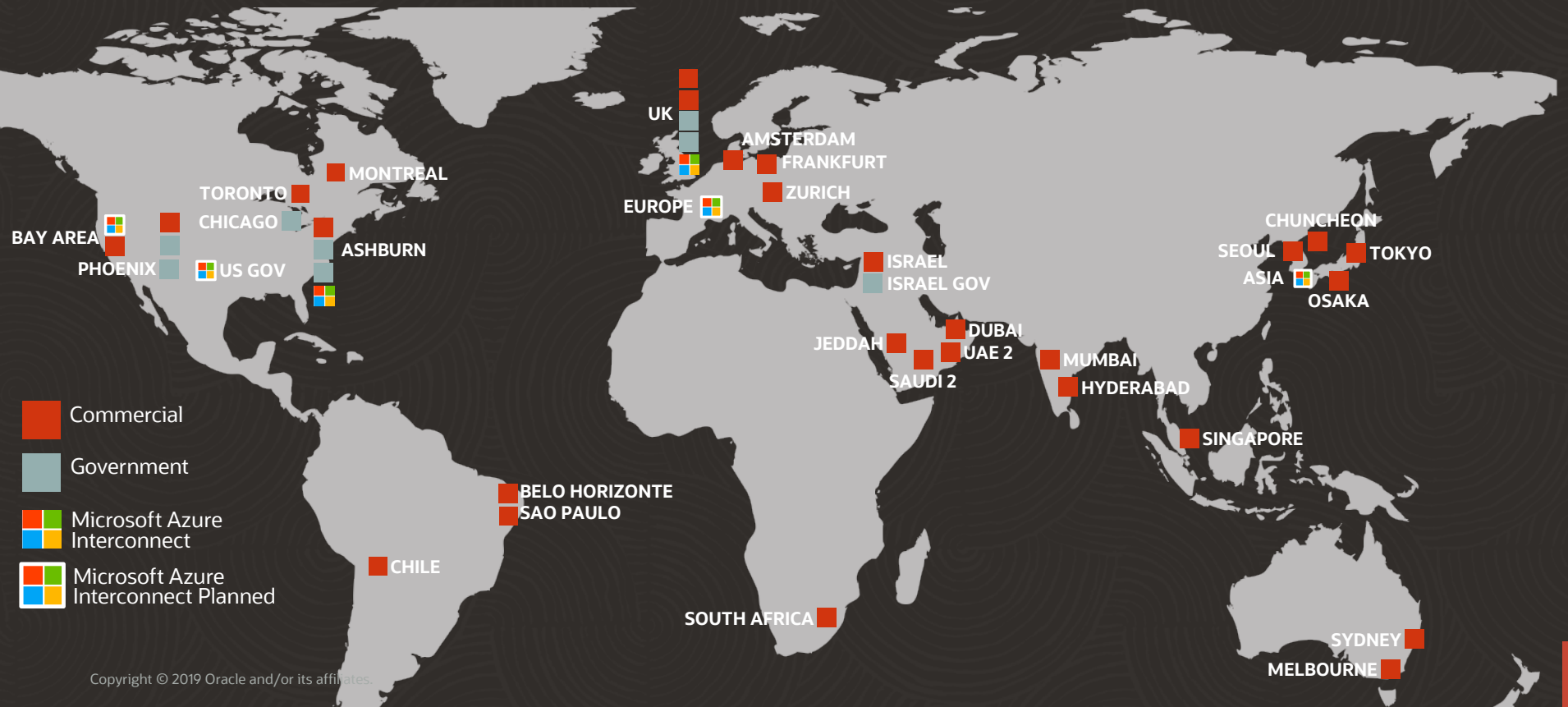
Oracle Cloud Infrastructure Global Footprint
Today: 16 Hyper-Scale Regions

LONDON
FRANKFURT
ZURICH
TORONTO
CHICAGO
ASHBURN, VA
PHOENIX
SEOUL
TOKYO
MUMBAI
SAO PAULO
SYDNEY

Commercial

Government

Microsoft Azure Interconnect

Oracle Cloud Infrastructure Global Footprint

Next Year: 36 Oracle Regions vs 25 AWS Regions

Commercial
Government
Microsoft Azure Interconnect
Microsoft Azure Interconnect Planned

UK
AMSTERDAM
FRANKFURT
ZURICH
EUROPE
MONTREAL
TORONTO
CHICAGO
ASHBURN
BAY AREA
PHOENIX
US GOV
CHUNCHEON
SEOUL
TOKYO
ASIA
OSAKA
ISRAEL
ISRAEL GOV
DUBAI
JEDDAH
UAE 2
MUMBAI
SAUDI 2
HYDERABAD
SINGAPORE
BELO HORIZONTE
SAO PAULO
CHILE
SOUTH AFRICA
SYDNEY
MELBOURNE

Copyright © 2019 Oracle and/or its affiliates.

Oracle Cloud Government Regions

FedRAMP Moderate

Two regions online and IL2 authorized, FedRAMP Moderate Authorized

DoD IL 5 Authorized

Two regions finished and audited, authorization imminent for FedRAMP High

Top Secret/SCI-SAP, Secret

Two Oracle National Security Regions (ONSR) (S&TS/SCI) in final development, planned authorization in 9 months

Oracle Cloud is Holistic (IaaS, PaaS, and SaaS)

Open and Pre-integrated to reduce complexity

SaaS | Supply Chain | ERP / EPM | Modern HR | Marketing | Sales | Service | Commerce | Industry

PaaS | Data Management | Agile DevOps | Enterprise Integration | Data Integration | Analytics & ML | Security | Content | IOT | Block Chain
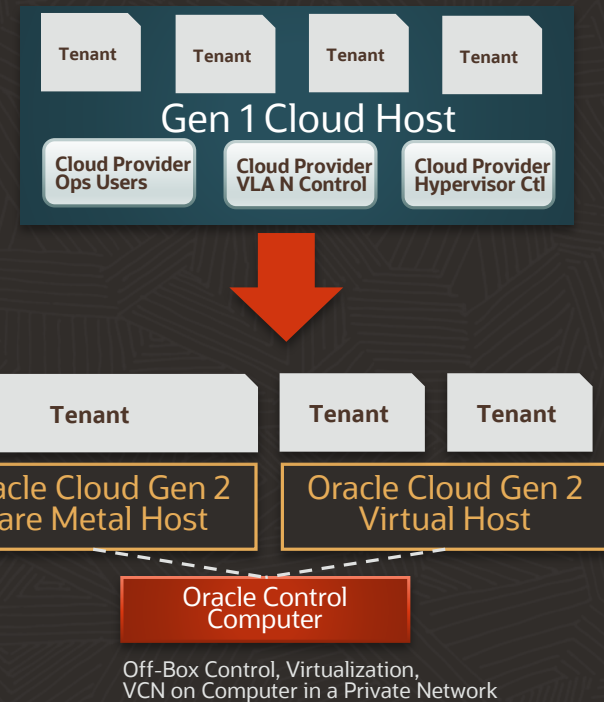
IaaS | Compute | Networking | Storage | Edge

Oracle Cloud Design Overview – Gen 2

- Open, Hybrid, Cloud Native, True Lift and Shift
- Extremely flat CLOS network delivers high performance
  - Network topology similar to Telco/5G specs
  - No over provisioning
- Off-Box Control and Virtualization provides:
  - No Oracle access to tenant machines
  - Provides new levels of tenant isolation and security
- Bare Metal Nodes allow total customer control
  - Use own OS, Lockdowns, Hypervisor, Encryption, IPs
- HPC/RDMA networks deliver low latency

Tenant	Tenant	Tenant	Tenant

Gen 1 Cloud Host

Cloud Provider Ops Users	Cloud Provider VLA N Control	Cloud Provider Hypervisor Ctl

Tenant	Tenant	Tenant

Oracle Cloud Gen 2 Bare Metal Host	Oracle Cloud Gen 2 Virtual Host

Oracle Control Computer

Off-Box Control, Virtualization,
VCN on Computer in a Private Network

Complete Cloud Infrastructure Services

Compute

Up to 64 CPU cores, 8 GPUs, 768 GB RAM, 51 TB local NVMe SSD, 5M IOPS, AMD and Intel processors

Bare metal/VM, CPUs/GPUs, HPC

Storage

Predictable IOPS Block Storage for up to 98% less, storage for whole lifecycle

NVMe, Block, File, Object, Archive

Autonomous Database

Fast provisioning. Automatic tuning, patching, securing. 99.995% availability.

Transactions, Data Warehouse

Security

Integrated security services to protect data and to control and monitor access

IAM, Audit, KMS, CASB

Complete Cloud Infrastructure Services

Containers

Fully managed, certified Kubernetes service with Docker containers

Containers and Kubernetes

Networking

Isolated networks with reserved IPs, security lists, firewalls, lowest cost private connectivity

VNC, LBaaS, FastConnect, VPN

Database

Millions of TPS; Full RAC and Active Data Guard support

Bare metal, VMs, Exadata

Edge

Global DNS, application protection, bot management, DDoS protection, email delivery

DNS, WAF, DDoS, Email

Complete Cloud Infrastructure Services

Migration

Move on-prem environments to the cloud with full hardware performance

Migrate Apps, KVM

OCI at Customer

Subscription-priced cloud infrastructure, database managed by Oracle

Exadata on-premises

Data Movement

Software NAS gateway, data ingest service with full chain of custody (HDD or appliance)

Storage appliance, Data Transfer

Governance

Logical separation and tagging of resources for simplified management

IAM, Tagging, Cost Management

Oracle Cloud Platform Services

- Open Source and Open Standards based services

- Higher order services provide rapid low/no code setup
  - Ease of Use empowers larger talent pool
  - Faster time-to-mission impact
  - Easy Scale Up/Down

- Autonomous Service Options
  - Self Tune
  - Self Heal (Patch)
  - Self Manage (Backup/Recovery/Upgrade)

- Pay for what you use subscription-based pricing with BYOL option

13   © 2019 Oracle
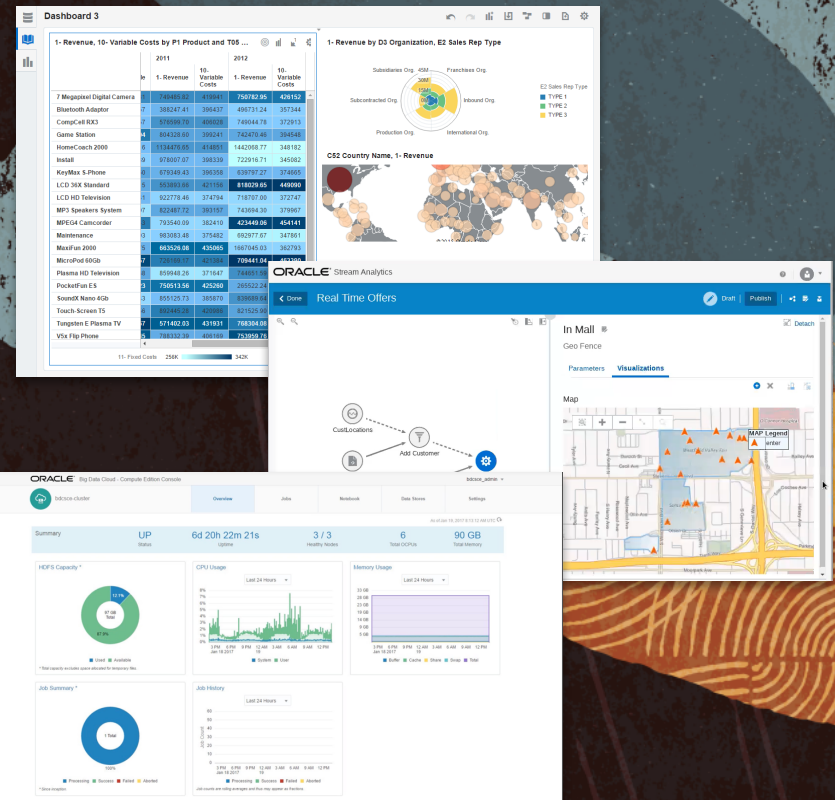
Oracle Cloud Platform Services

Data Services
Autonomous Data Warehouse
Autonomous Transaction DB
Exadata Service
Database Service
Data Integration Service
Data Catalog Service
Data Migration Service
Streaming (Kafka) Service
NoSQL DB Service
Data Safe

DevOps and Integration
Agile Developer Service
Container Service
Container Pipeline Service
Application Integration Service
Process Management Service
Block Chain Service
API Management Service
Java Service
Mobile Service
Digital Assistant Chatbot Service

Analytics
Oracle Analytics Service
Stream Analytics Service
IOT Service
Data Science Service
Big Data Service

Enterprise Services
Identity Management Service
CASB Service
Enterprise Management Service
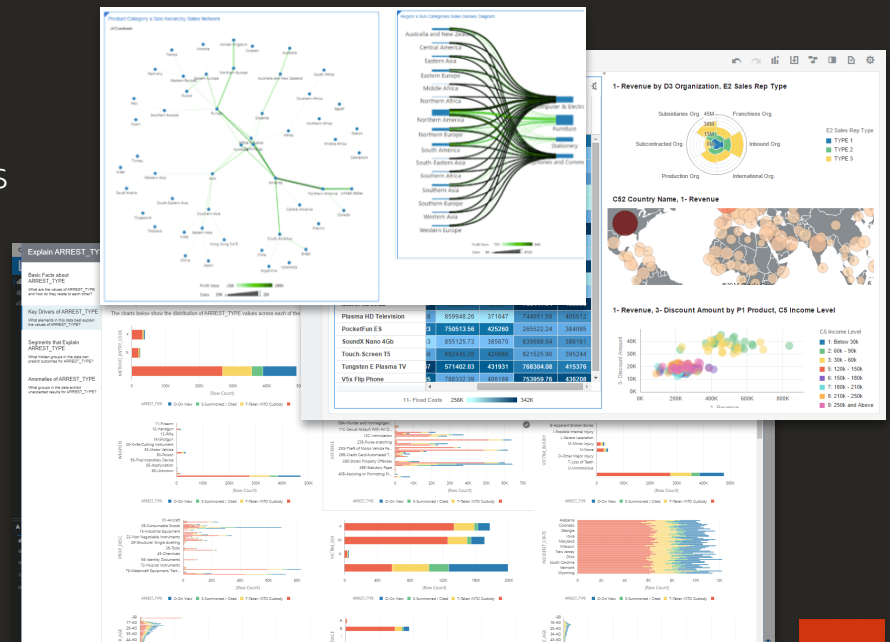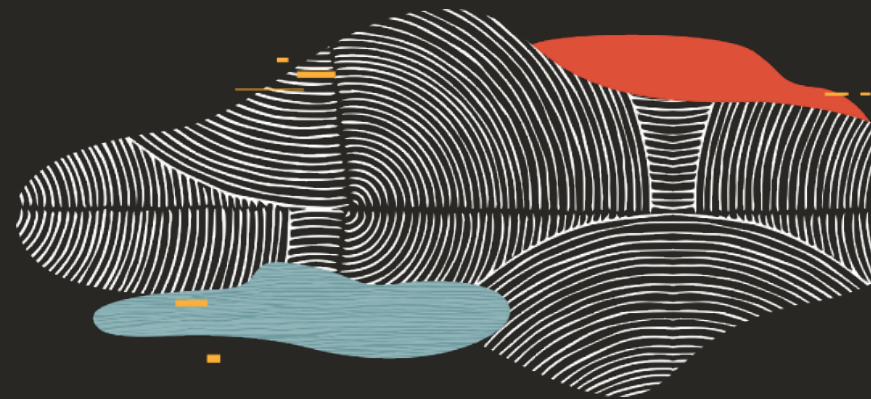Content and Experience Service
Email Delivery Service

Oracle Cloud Data Services

- Open Source, SQL, Big Data, and NoSQL Services

- Oracle Autonomous database services natively run on OCI
  - Up to 268 TB of capacity and millions of IOPS per instance
  - Auto Healing, Auto Tuning, Auto Patching, Auto HA

- Provides high performance data services for extreme IOPS
  - Run Bare Metal, VMs, and Exadata

- Oracle Cloud provides migration provisioning and management tools for data services

- Extremely low cost ingress/egress fees
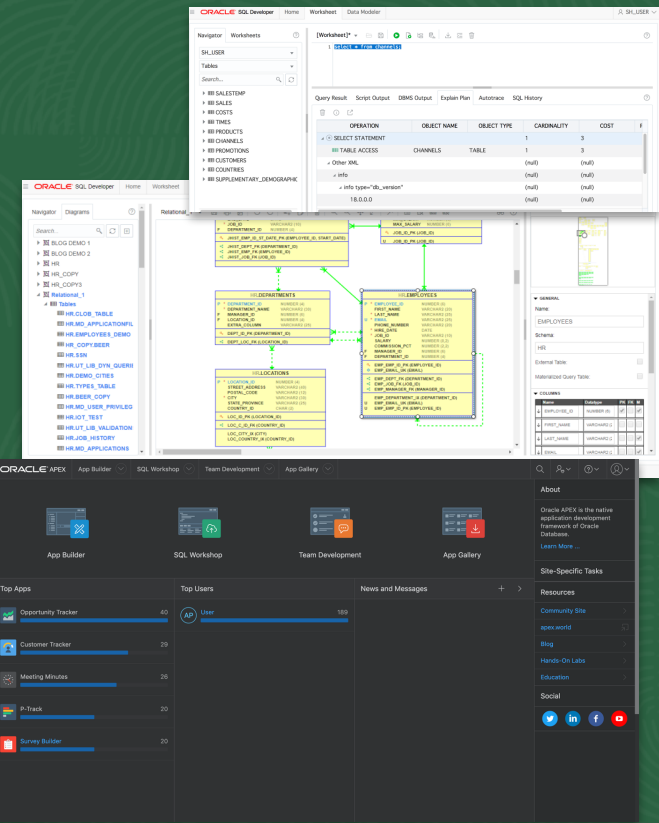
Oracle Cloud Analytic Services

- Oracle Cloud provides a suite of machine learning/AI, Big Data, Advanced Analytics, Data Integration, Data Science, Data Lake, and Data Cataloging services

- Access and process data across other cloud vendors, object storage, files, or commercial and open source databases

- Services designed for the role of data scientists and analysts

- Extensive data discovery and visualization features

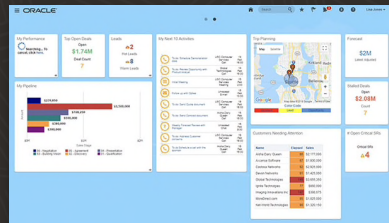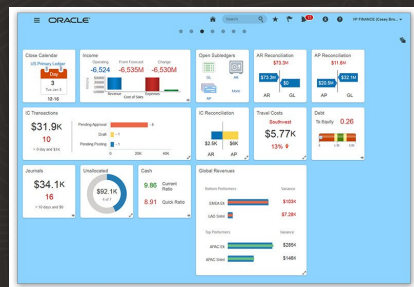- Supports notebooks, Python, R, and SQL

Oracle Enterprise Software Services (SaaS)

Customer Experience
Service
Engagement
Sales
Marketing
Configure, Price and Quote
Commerce
Call Center
Help Desk
CRM Analytics

HCM
Human Resources
Talent Management
Workforce Rewards
Workforce Management
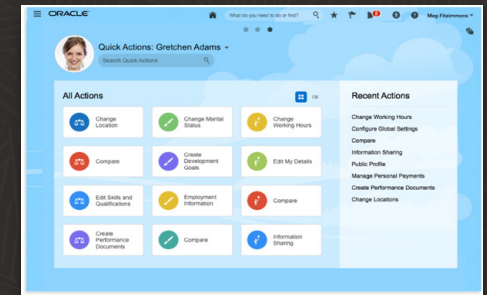Work Life Solutions
HCM Analytics
Recruiting

Financials and ERP
Financials
Accounting Hub
Project Financial Management
Project Management
Risk Management
Procurement and Contracts
ERP Analytics
Enterprise Planning and Budgeting
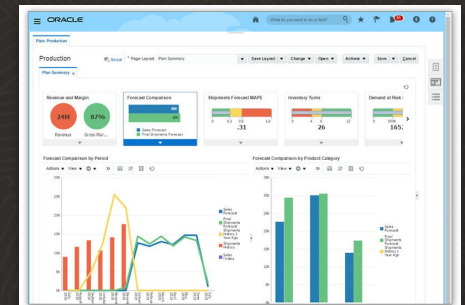Financial Consolidation and Close
Account Reconciliation

Supply Chain Management
Inventory Management
Logistics
Maintenance
Manufacturing
Order Management
Procurement
Product Lifecycle Management
Supply Chain Planning
SCM Analytics

Exadata Cloud: Choice of Deployment Models

Flexible Subscription Model

Cloud Automation

Network Isolation

Cloud Security and Hardening

Oracle-Managed Exadata Infrastructure

Exadata Cloud at Customer (ExaCC)
TS/SCI Available

In Customer Data Centers

Exadata Cloud Service (ExaCS)

In Oracle Cloud

OCI Value Adds
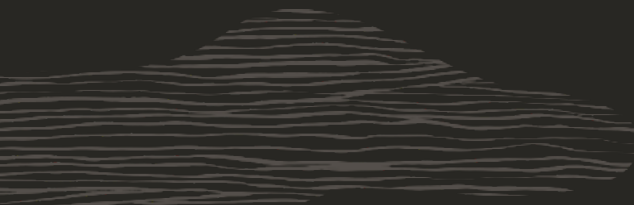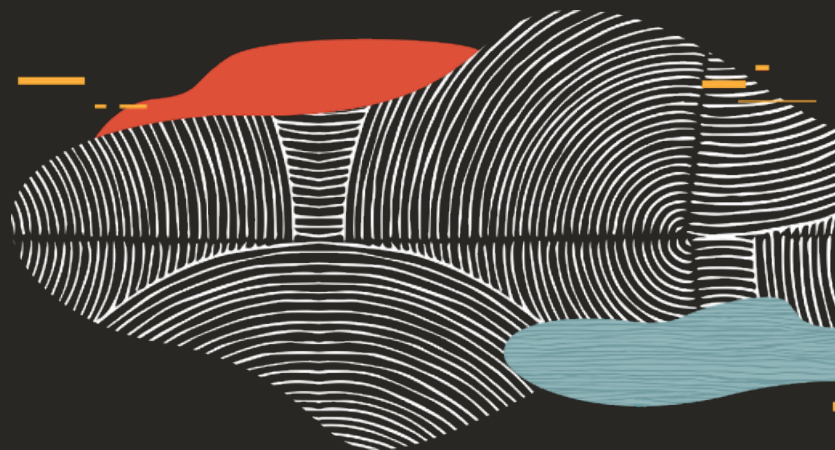
Oracle Cloud Key Differentiators

Open > Performance > Security > Superior Economics

Oracle Cloud Key Differentiators Overview

— Open and Pre-integrated to reduce complexity

Open Platform to enable hybrid cloud development and cloud mobility

- Built for non-proprietary Open Source and Industry-wide Open Standards for cloud DevSecOps

Natively Secure to eliminate known and future attack vectors

- Off-box non-X86 network and virtualization management with secure wipe of non-volatile devices

Built for Performance to broaden the range of addressable IT challenges

- Large Bare-Metal server instances and Exadata with ultra-low-latency, high-bandwidth network

Lower Cost to better rationalize Cloud Native, Migration and Lift & Shift deployments

- OCI instances are ~ ½ the price of commercial AWS instances & data egress charges are ~ 1/13 the price

Oracle's Commitment to Cloud Native Open Source

Leadership role in Open Source communities

THE LINUX FOUNDATION

CLOUD NATIVE COMPUTING FOUNDATION

OPENAPI INITIATIVE

HYPERLEDGER

kubernetes

ECLIPSE FOUNDATION

MySQL

Bringing Open Source software to OCI platform

Terraform

kubernetes

OPENSHIFT by Red Hat

CHEF

ANSIBLE

docker

Contributing back to Open Source software

fn

OpenJDK

GraphPipe

smith   crashcart   railcar

kubernetes — Oracle Cloud provides a CNCF Native Kubernetes Managed Service and a Container CI/CD Pipeline Service for deployment

Positive Excerpts of Oracle Cloud Open Native Services

THENEWSTACK

Oracle Cloud Native Framework Promises 'Bi-Directional ' Cloud Portability

Forbes

"Oracle Cloud Native Framework is a bold move. I believe this is a credible play to displace Red Hat OpenShift with a modern and completely cloud-native software stack."

PR Newswire

Oracle Arms Developers with the Most Comprehensive Cloud Native Framework

DEV CLASS

"Oracle crashed the party at KubeCon today, promising to free developers from vendor lock-in with what it claims is the "most comprehensive cloud native framework."

siliconANGLE

Oracle Pitches New Serverless Computing Options for Developers

Forbes

Oracle's Open Approach to Cloud Native Software

Highest and Most Consistent Storage Performance

Raw I/O performance outruns the competition

StorageReview

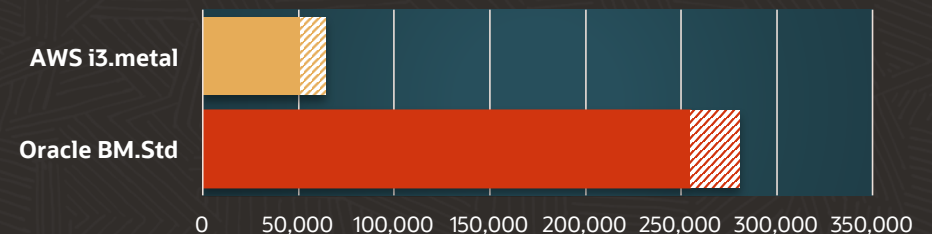Independent testing demonstrates **2-5X performance advantage** over AWS

Advantages driven by **bigger available configurations**, **faster network**, no resource oversubscription

Oracle Cloud has these benefits **across all workloads** including Oracle Database as well as non-Oracle workloads

Oracle is **the only cloud vendor** with a service level agreement **that covers performance, manageability and availability**

Oracle Database workload: Block Storage IOPS
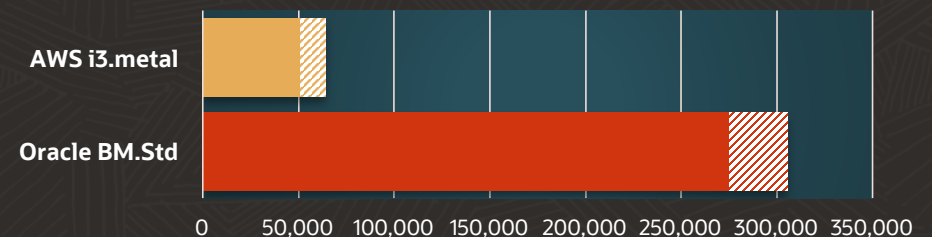
AWS i3.metal	
Oracle BM.Std	

0   50,000   100,000   150,000   200,000   250,000   300,000   350,000

MS SQL workload: Block Storage IOPS

AWS i3.metal	
Oracle BM.Std	

0   50,000   100,000   150,000   200,000   250,000   300,000   350,000

www.storagereview.com/oracle_cloud_infrastructure_compute_bare_metal_instances_review
www.storagereview.com/amazon_ec2_i3metal_review

Better, more consistent storage performance than other clouds

2-5x performance advantage over AWS

- Oracle Database
- Microsoft SQL
- VDI
- Mixed workloads
- Hadoop
- HPC (computational fluid dynamics)
- AI/ML

Backed by performance SLAs

Block Storage IOPS

300000	
250000	
200000	
150000	
100000	
50000	
0	

AWS i3.metal | Oracle BM.Std

% Usable IOPS

100%	
90%	
80%	
70%	
60%	
50%	
40%	
30%	
20%	
10%	
0%	

AWS | Oracle

www.storagereview.com/oracle_cloud_infrastructure_compute_bare_metal_instances_review
www.storagereview.com/amazon_ec2_i3metal_review
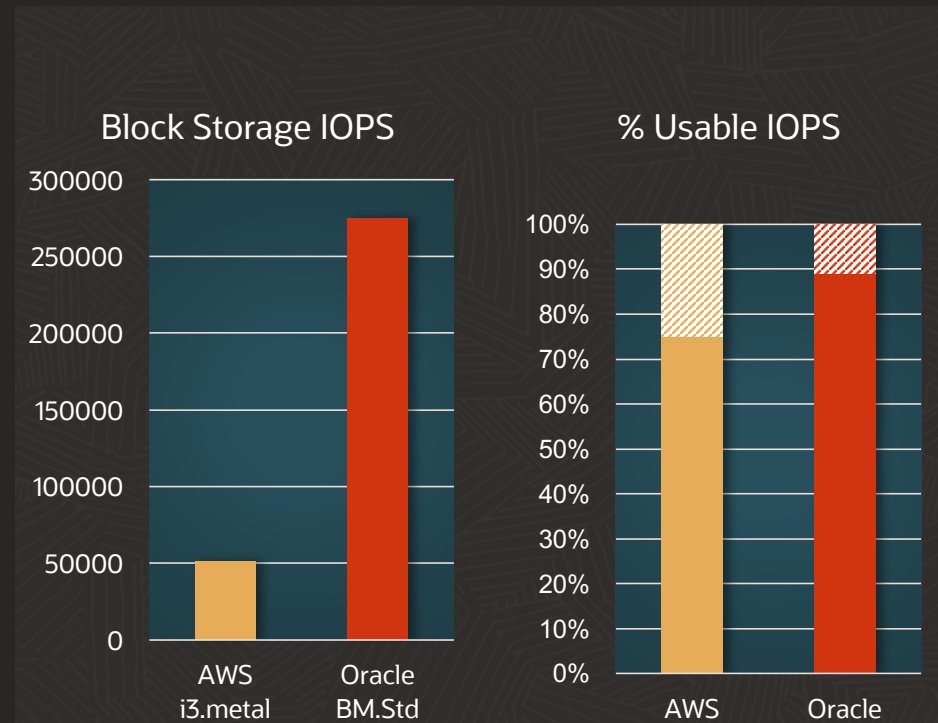
Oracle Cloud Infrastructure Cluster Networking

Cloud-first network for ultra low latency and high bandwidth
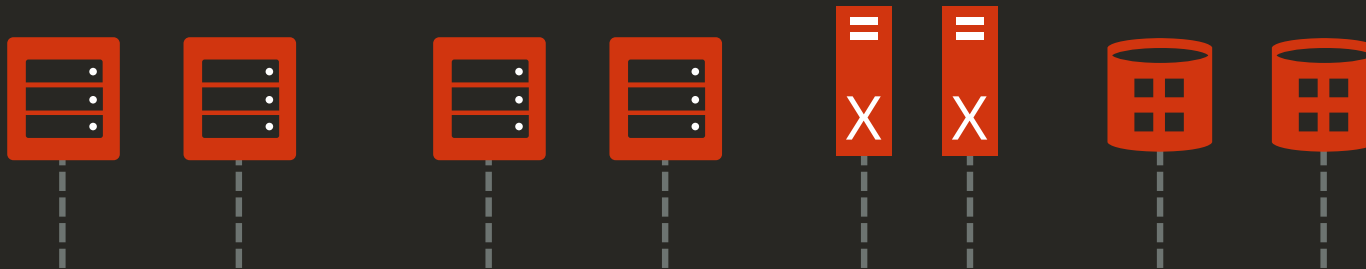
1.5 µs latency, 100Gb/s   **Clustered RDMA Network**

For high performance workloads (HPC, Database, Big Data, AI) including the hardest product development workloads like CFD, Crash Simulations, Reservoir Modelling, DNA Sequencing

- **Bare Metal RDMA**
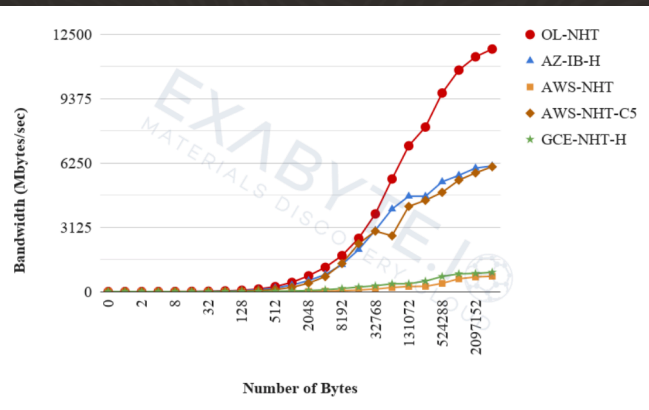 - For the hardest product development workloads such as CFD, Crash Simulations, Reservoir Modelling, DNA Sequencing

- **Ultra low latency and high bandwidth**
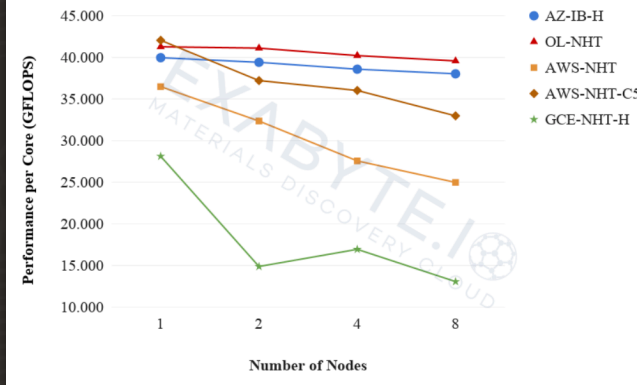 - For HPC, Databases, Big Data, and AI workloads
  - Cluster 1,000's of cores on RDMA
  - Supports MPI including IntelMPI and OpenMPI

Third Party Cloud Performance Testing

"Our findings demonstrate that Oracle Cloud outperforms other cloud vendors"
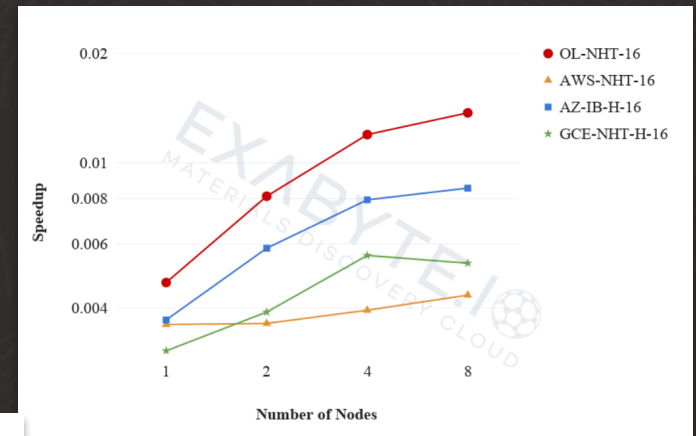
Benchmarking Test: AWS, Microsoft, Oracle, and Google

https://blog.exabyte.io/cloud-hpc-2018-12-google-cloud-42f6de60464d

Industry First end-to-end Cloud Warranty

	ORACLE®	AWS	Azure	GCP
AVAILABILITY	Covered	Covered	Covered	Covered
PERFORMANCE	Covered	Not Covered	Not Covered	Not Covered
MANAGEABILITY	Covered	Not Covered	Not Covered	Not Covered

"We were seeing 75% utilization and 60X performance improvements over other cloud providers."

Navindra Yadav
Founder
Cisco Tetration

Oracle is the only CSP that Builds, Uses, and Sells their own servers

- Hardened and secure supply chain

- Specific out of band secure hardware trust provides control of hardware components and secure wipe

- Provides secure Bare Metal host isolation

- Built for on-prem and public cloud scale and performance

- Secure ILOM & TPM

- Better testing, certifications, and SLAs for our Cloud

- Cloud Engineers and HW Engineers work together to innovate on Gen 2 Oracle Cloud
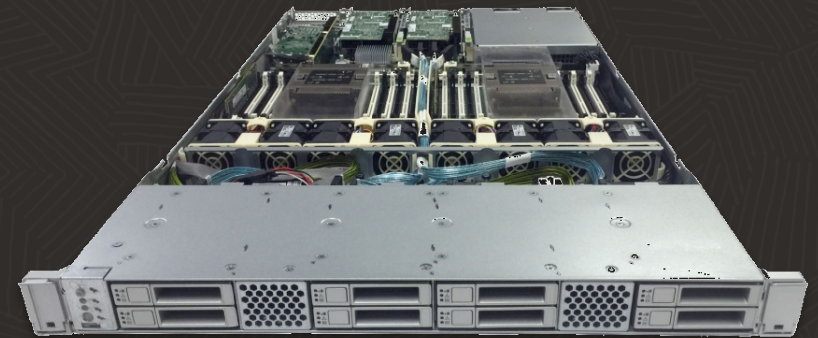
Security Focused Design and Supply Chain

Oracle Cloud is Built Using Oracle hardware for a Reason

Open and Pre-integrated to reduce complexity
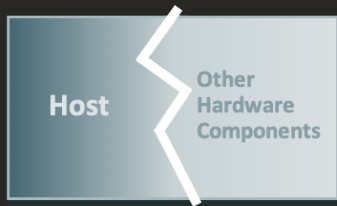
Hardware-Based Host Isolation

ensures tenants on host cannot gain access to non-tenant hardware components such as service processor and BIOS flash storage

Secure Wipe of Service Processor and BIOS firmware

uses special hardware to remotely wipe foundational firmware (BIOS and Service Processor) after each tenant use or whenever security is compromised

Fine-grained Disable of Unused Hardware Components

use special hardware to remotely disable unused PCIe slots, USB ports, on-board NICs, and more

Powerful Human Readable Policy Engine Enforces Separation

Tenancy = TS/SCI

Users
User1
User2

Groups
NSA-Y3
SOCOM

Instances
Instance1
Instance2

Dynamic Groups
Shared HPC
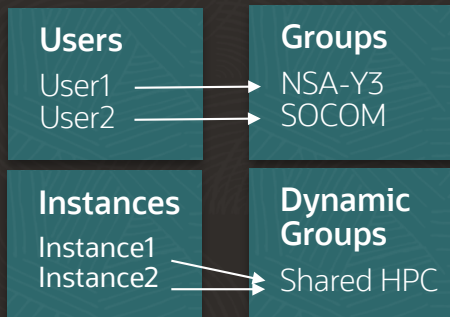
Policies

PolicyA: allow group **NSA-Y3** to manage all-resources in compartment **Program-A**

PolicyB1: allow group **SOCOM** to manage all-resources in compartment **Program-B**

PolicyB2: allow dynamic-group **Shared-HPC** to use buckets in compartment **Program-B**

Compartment = Program A

PolicyA

Object Storage Buckets

VCN

Compartment = Program B

PolicyB1

Compute Instances

Block Volumes

Load Balancers

Object Storage Buckets

PolicyB2

Oracle Cloud Costs Less

"If you want better SLAs, better security and better performance you have to be willing to spend less" -Larry Ellison

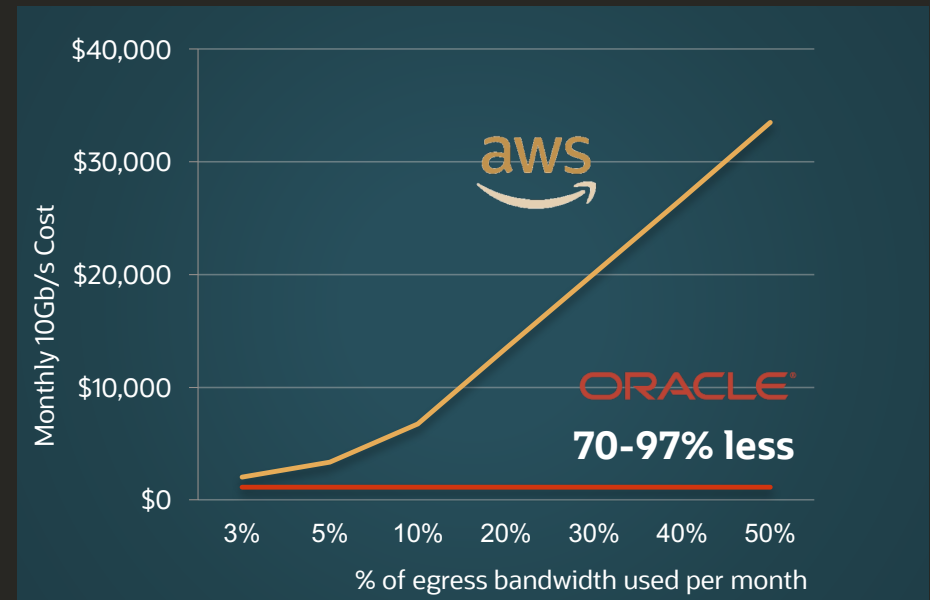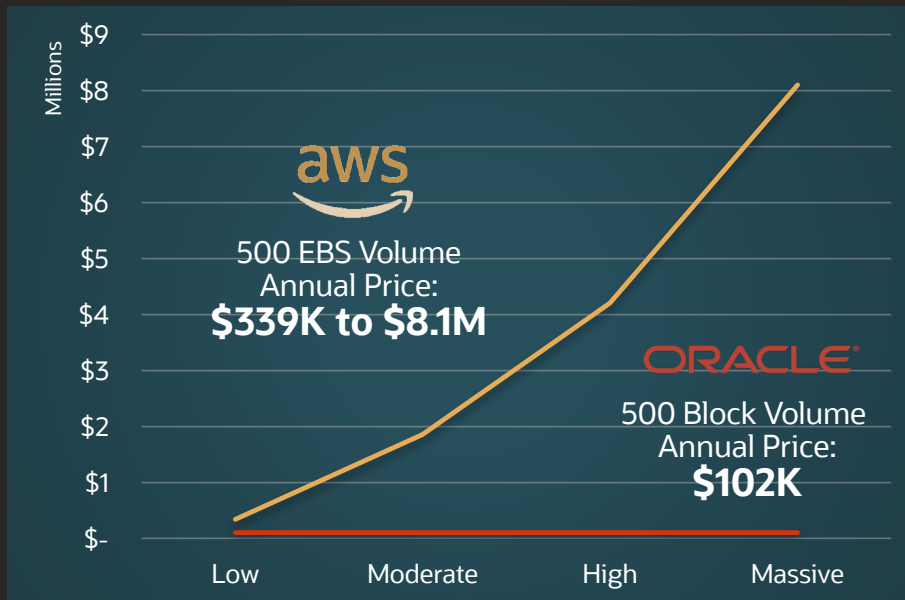|	ORACLE	AWS	Azure	GCP
Standard Virtual Machine Instances ($/OCPU/Hour)	$0.0638	+52%	+52%	+46%
DenseIO Virtual Machine Instances ($/OCPU/Hour)	$0.1275	+18%	+48%	+20%
Bare Metal Standard ($/OCPU/Hour)	$0.0638	+34%	N/A	N/A
Bare Metal Dense IO ($/OCPU/Hour)	$0.1275	-25%*	N/A	N/A
GPU Instances ($/GPU/Hour)	$2.25	+26%	+26%	+4%
Block Storage: Massive Perf (annual cost, 400GB 20K IOPS)	$204	+7,900%	+2,900%	+400%
Data Archive ($/GB/Month)	$0.0026	+35%	-30%	+63%
File Storage ($/GB/Month)	$0.425	+86%	+29%	+79%
Internet Data Egress (50TB/Month)	$340	+1,300%	+1,300%	+1,300%
Private Line Network (1 Gbps, 100TB Data, Monthly)	$155	+2,100%	+3,700%	+1,500%

▮ = Lowest Cost

*Oracle DenseIO bare metal has 44% more cores and 3.4X local SSD capacity vs AWS i3.metal

*Based on published Price List

Pay less for guaranteed performance and connectivity

aws

500 EBS Volume
Annual Price:
$339K to $8.1M

ORACLE®

500 Block Volume
Annual Price:
$102K

Millions

$9			
$8			
$7			
$6			
$5			
$4			
$3			
$2			
$1			
$-	Low	Moderate	High	Massive

Oracle doesn't charge for storage performance, and **guarantees** it. AWS charges $0.065 for every IOP and **doesn't guarantee** performance.

aws

ORACLE®

70-97% less

Monthly 10Gb/s Cost

$40,000
$30,000
$20,000
$10,000
$0

3% 5% 10% 20% 30% 40% 50%

% of egress bandwidth used per month

Oracle doesn't charge for dedicated connectivity (FastConnect) bandwidth. The more you use FastConnect, the more you save.

Oracle Cloud Costs Less

Example: 15 GB per CPU VM Instance
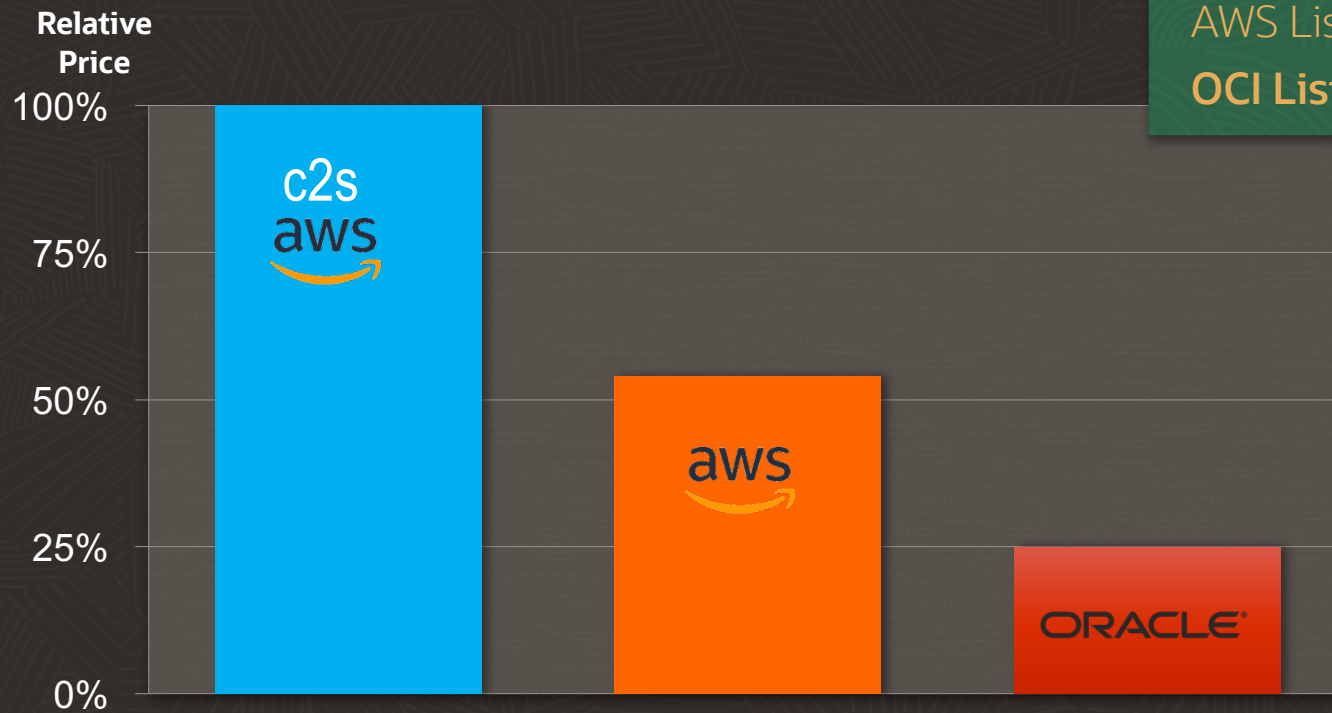
OCI List Price = ~ 1/2 AWS List Price
AWS List Price = ~ 1/2 AWS C2S Price
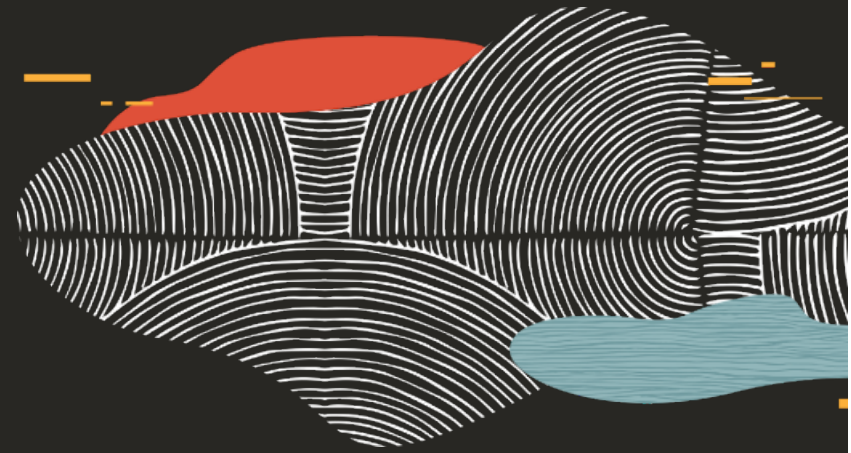**OCI List Price = ~ 1/4 AWS C2S Price**

Relative Price

100%

75%

c2s
aws

50%

aws

25%

ORACLE®

0%

How are we doing? A few of our customers:

New Cloud Announcements

Next Generation Cloud Enhancements

Next Gen Compute Platform

✓ **True Flexibility**

Pick exactly the number of cores you need

✓ **True Elasticity**
Autonomously scale cores up/down

✓ **True Availability**
Never go down even when auto-scaling cores

Next Gen Storage Platform

✓ **True Flexibility and Elasticity**
Pick starting amount of storage
Auto-scale up while running as needed

✓ **Performance On Demand**
Optimize between high-performance and low-cost

✓ **Always Available**
Zero downtime. Period.

Cluster Networking

Bare Metal RDMA Clusters Instances Supported:

✓ **Available Today:** HPC Instances: 36 cores, 3.7Ghz, 384GB
RAM, 6.7TB NVME, 100G RDMA

✓ **Coming Soon:** GPU Bare-Metal Instances: 8x GPUs, 2TB
RAM, 25TB NVME,
8x 100G RDMA

ORACLE

Data Catalog Cloud Service

OCI Data Catalog Vision
Self-service Data Discovery and Governance Solution

A single collaborative solution for data professionals *to collect, organize, find, access, enrich and activate technical, business and operational metadata* to support self-service data discovery and governance for trusted data assets in Oracle Cloud and beyond.
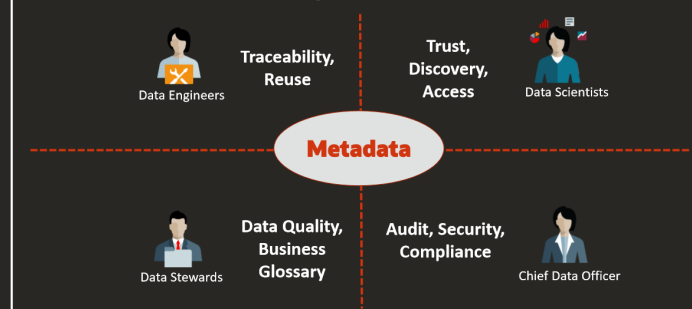
OCI Data Catalog Vision
Self-service Data Discovery and Governance Solution

Search & Discovery	Curation	Intelligence	Enterprise Class
• Metadata harvesting from on-prem and cloud systems • Semantic search, data profiling, lineage and impact analysis, data relationships	• Enterprise Business Glossary, Approval Workflows • Tagging, User annotations, social collaboration, ratings/comments, **associations and links**	• AI/ML based Recommendations • Auto-discovery, Auto-classification, Auto-association, Data Similarity	• OCI Native, REST APIs • Hive Metastore for OCI Obj Store, ADW etc. • Value added Integration with other OCI services

Metadata is the key!

- Data Engineers — Traceability, Reuse
- Data Scientists — Trust, Discovery, Access
- **Metadata**
- Data Stewards — Data Quality, Business Glossary
- Chief Data Officer — Audit, Security, Compliance

Key Data Catalog Concepts

- **Data Asset:** A source, provider, system or store containing data, e.g. a Database, an Object Store, a File or Document Store, a Message Queue, or an Application.
- **Data Entity:** A set of data in a Data Asset, normally representing a single type of data, e.g. a database table, a file, or several files representing a common set of data.
- **Data Attribute:** An attribute of a data entity describing an item of data, with a name and data type, e.g. a column in a database table or file.
- **Harvesting:** Process of collecting technical metadata from a data asset.
- **Glossary:** A collection of business concepts (typically by subject matter) in hierarchical form of Categories and Business Terms.

ORACLE + vmware®

The Partnership: Improving the experience of joint customers

- ✓ Oracle is developing a new product: Oracle Cloud VMware Solution
- ✓ Seamlessly migrate and extend VMware fleet to Oracle Cloud
- ✓ A familiar experience with full configurability and management
- ✓ Oracle joins VMware Cloud Provider Program
- ✓ Oracle Cloud VMware Solution will be sold by Oracle and Oracle partners
- ✓ Oracle will provide support for VMware on Oracle Cloud Infrastructure
- ✓ Oracle will also support Oracle Database and applications deployed on VMware

The Product: Oracle Cloud VMware Solution

- ✓ An Oracle product combining Oracle Cloud Infrastructure and VMware software
- ✓ A VMware Cloud Foundation certified solution
- ✓ Sold by Oracle and Oracle partners
- ✓ Supported by Oracle and VMware
- ✓ Monthly pricing, with a 1 year Universal Credits commitment required

VMware Software

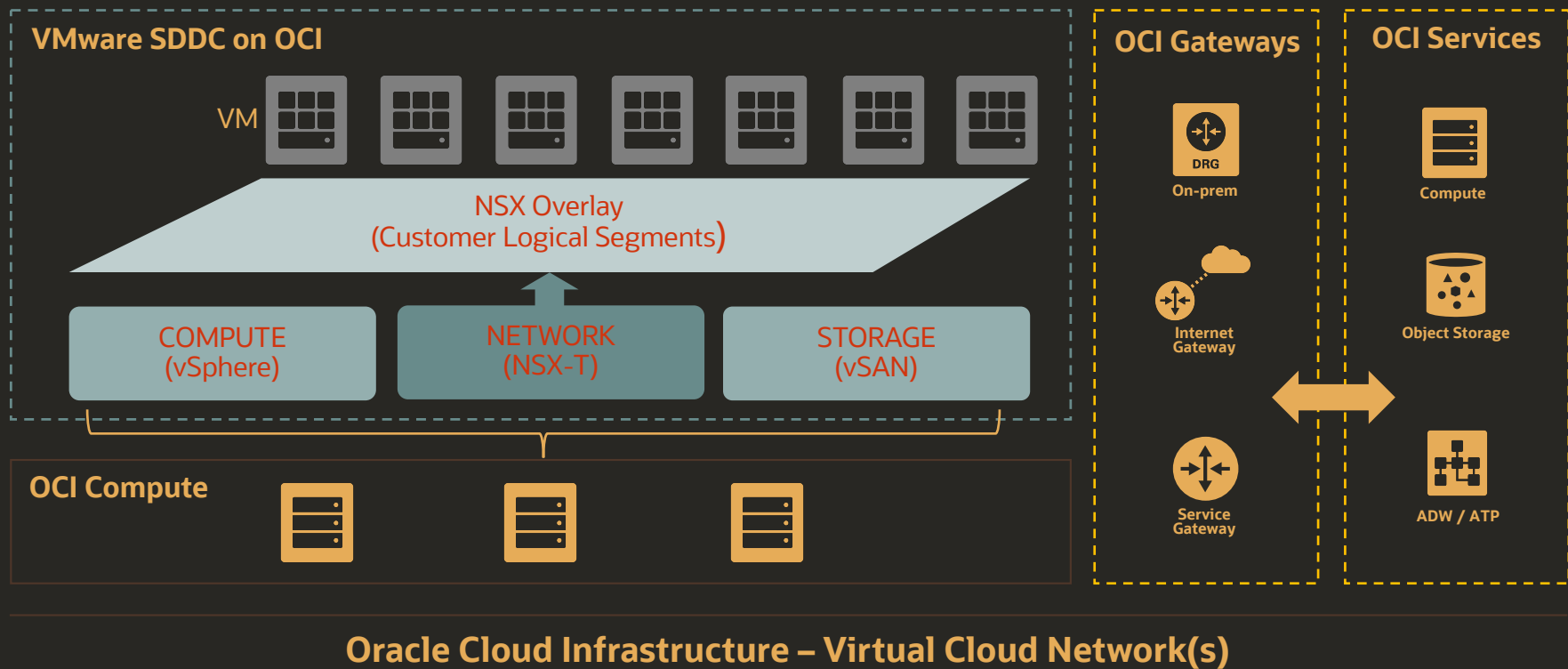A certified VMware Cloud Foundation environment with vSphere, vSAN, and NSX.

Oracle Infrastructure

An initial 3-server configuration, which you can bring up fast and expand at will

Integration Options

Connect your VMware to Oracle cloud services in the same datacenter. From Oracle Autonomous, DBaaS, to Exadata and more.

Diagram of Oracle Cloud VMware Solution

Benefits

Cloud Flexibility

Extend your VMware deployment to a hybrid cloud combining your datacenter and Oracle Cloud, or migrate VMs at your own pace to reduce your own infrastructure. Use Universal Credits for all.

Control

You control the software and hardware, with full administrative access to the entire stack of VMware software and the underlying bare metal cloud compute instances. Maintain your proven architectures and processes.

Manageability

Manage your Software Defined Data Center with a single pane of glass in the cloud or across a hybrid environment – vCenter

Extend and leverage with Oracle Cloud and Autonomous Services

Microsoft Azure + ORACLE

ORACLE + Microsoft
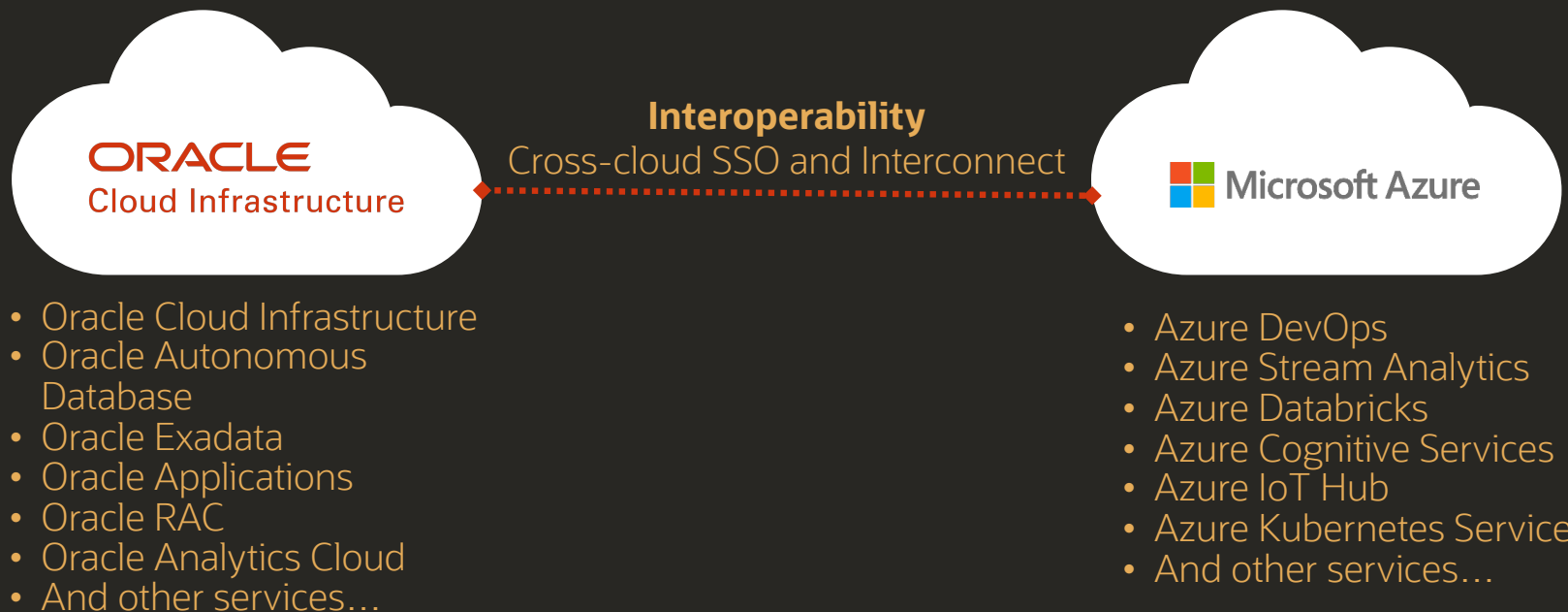
Interconnected Multi-Cloud Solutions for Enterprise

✓ Microsoft Azure and Oracle Cloud are <u>interconnected today</u>, so you can migrate and run mission-critical enterprise workloads across clouds

✓ <u>Unified identity and access</u> management via single sign-on with automated user provisioning to easily manage resources across clouds

✓ <u>Collaborative support</u> of custom and Oracle Applications on Azure with Oracle Database on Oracle Cloud – connect best-in-class services across clouds

Available Now: US East, London
Coming Soon: US West, Government, Asia, and Europe regions

Enterprise Cloud Interoperability Partnership

ORACLE
Cloud Infrastructure

Interoperability
Cross-cloud SSO and Interconnect

Microsoft Azure

- Oracle Cloud Infrastructure
- Oracle Autonomous Database
- Oracle Exadata
- Oracle Applications
- Oracle RAC
- Oracle Analytics Cloud
- And other services…

- Azure DevOps
- Azure Stream Analytics
- Azure Databricks
- Azure Cognitive Services
- Azure IoT Hub
- Azure Kubernetes Service
- And other services…

Resources to Learn the Oracle Cloud

- Always Free Cloud Tier is now available!
- Engineering Assisted Cloud Trials
- Free Government on-premise Technology & Training Sessions
- Free Lunch and Learn Sessions Onsite
- Free Hands on Cloud Certificate Training Workshops
- Visit our National Security Cloud Lab for Demos, Solution Design, and Prototyping

- Learn more: *cloud.oracle.com*

Confidential – © 2019 Oracle Internal/Restricted/Highly Restricted

Break