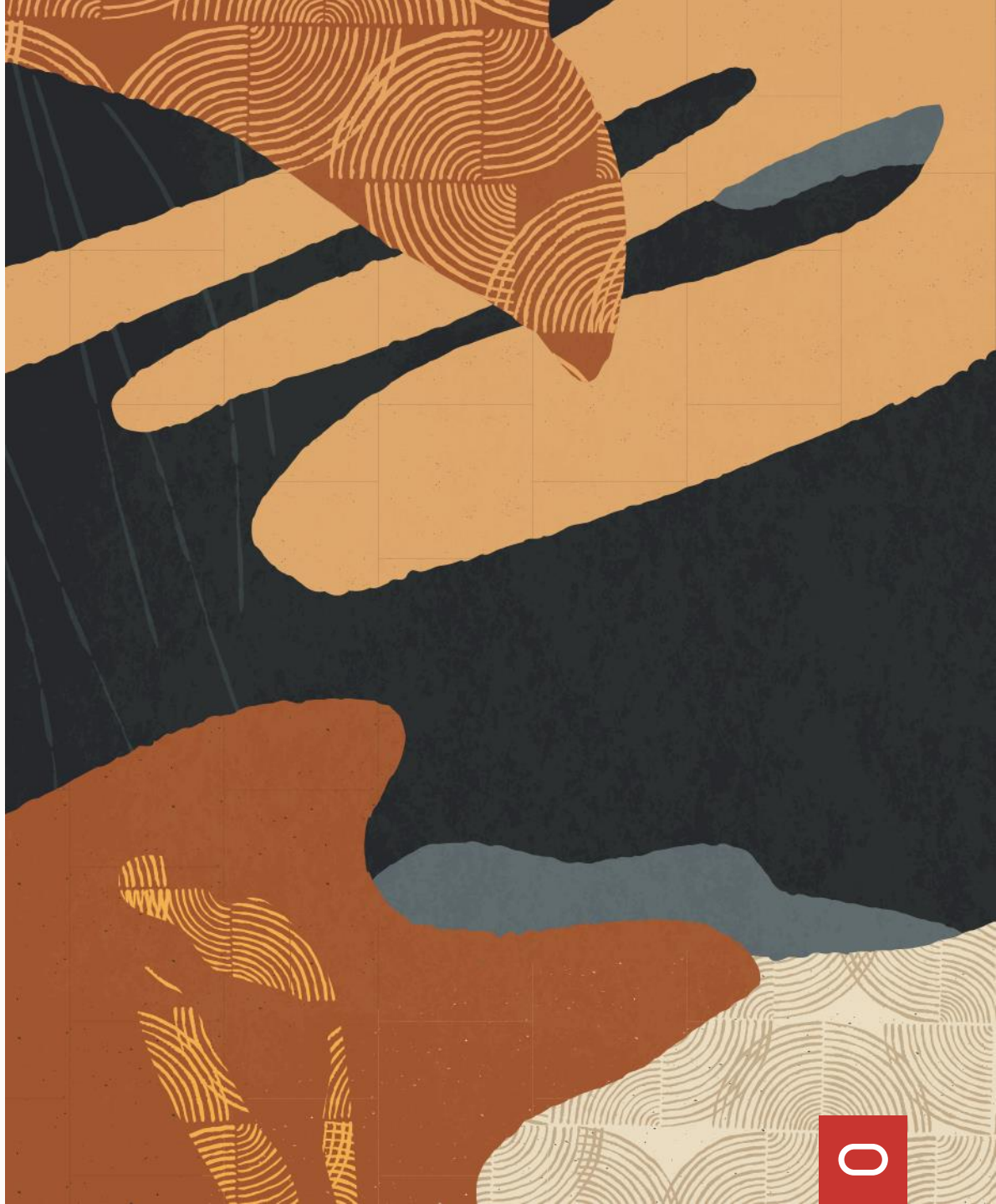
Point of view: Oracle DB and Enterprise DB

Review of solutions

Witold Świerzy

Oracle EMEA Data Domain Expert



Agenda

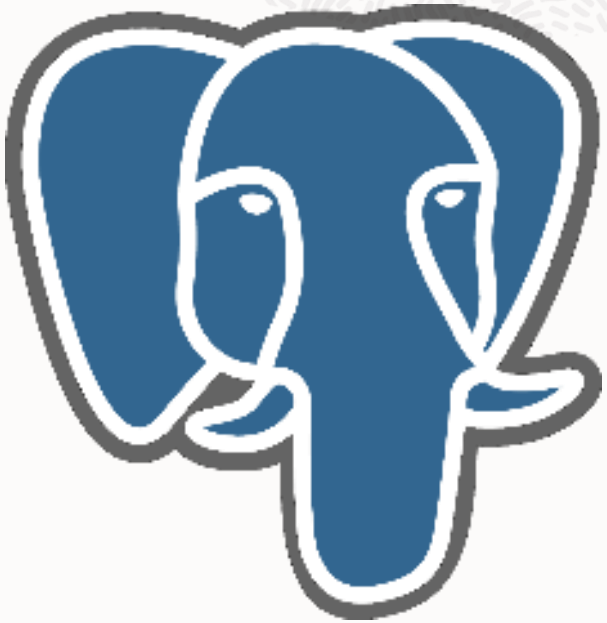
- Introduction
- Winning in Application Development area
- Winning in Database Maintenance area
- Summary

Introduction

Introduction

Short overview of PostgreSQL

- Marketed as “most advanced open-source **relational database**”
- Started in 1986 at UC Berkeley – POSTGRES project
- Free and open-source. Extensible
- Large PostgreSQL community
- Many PostgreSQL commercial versions
  - **EnterpriseDB**, Netezza/IBM, Greenplum, Postgres-XL, AgensGraph, Fujitsu, AWS Redshift,…



Introduction

Short overview of EnterpriseDB

- Founded in 2004. It is said to have ~500 employees and 4,000 customers.
- Private equity firm, Great Hill Partners, acquired EDB in June 2019.
- Acquired 2ndQuadrant, another PostgreSQL provider, in Sept 2020.
- Provides commercial support for PostgreSQL with additional enterprise features and some compatibility features with Oracle Database (the latter features are proprietary to EDB).

Introduction

Short overview of PostgreSQL and Enterprise DB

DB-ENGINES

Rank Jun 2022	Rank May 2022	Rank Jun 2021	DBMS	Database Model	Score Jun 2022	Score May 2022	Score Jun 2021
1.	1.	1.	Oracle	Relational, Multi-model	1287.74	+24.92	+16.80
2.	2.	2.	MySQL	Relational, Multi-model	1189.21	-12.89	-38.65
3.	3.	3.	Microsoft SQL Server	Relational, Multi-model	933.83	-7.37	-57.25
4.	4.	4.	PostgreSQL	Relational, Multi-model	620.84	+5.55	+52.32
5.	5.	5.	MongoDB	Document, Multi-model	480.73	+2.49	-7.49
6.	6.	↑ 7.	Redis	Key-value, Multi-model	175.31	-3.71	+10.06
7.	7.	↓ 6.	IBM Db2	Relational, Multi-model	159.19	-1.14	-7.85
8.	8.	8.	Elasticsearch	Search engine, Multi-model	156.00	-1.70	+1.29
9.	9.	↑ 10.	Microsoft Access	Relational	141.82	-1.62	+26.88
10.	10.	↓ 9.	SQLite	Relational	135.44	+0.70	+4.90
53.	53.	↑ 59.	EDB Postgres	Relational, Multi-model	3.02	-0.01	+0.83

Ranking based on

- **Mentions in Google search**
- **Google trends**
- **Relevance in social networks**
- **Job offering**
- **Number of professional networks**

Introduction

- We compare functionality of two Database Management Systems
  - **Oracle** and **Enterprise DB**

- Comparison covers two main areas

Application Development	Database Maintenance
• Database convergence • Available APIs • Low Code environments • Other development-related features	• Storage Architecture • Options and features related to database security • Backup and recovery options and tools • HA/DR solutions • Options and features related to database performance • Tools for database administration

Application Development

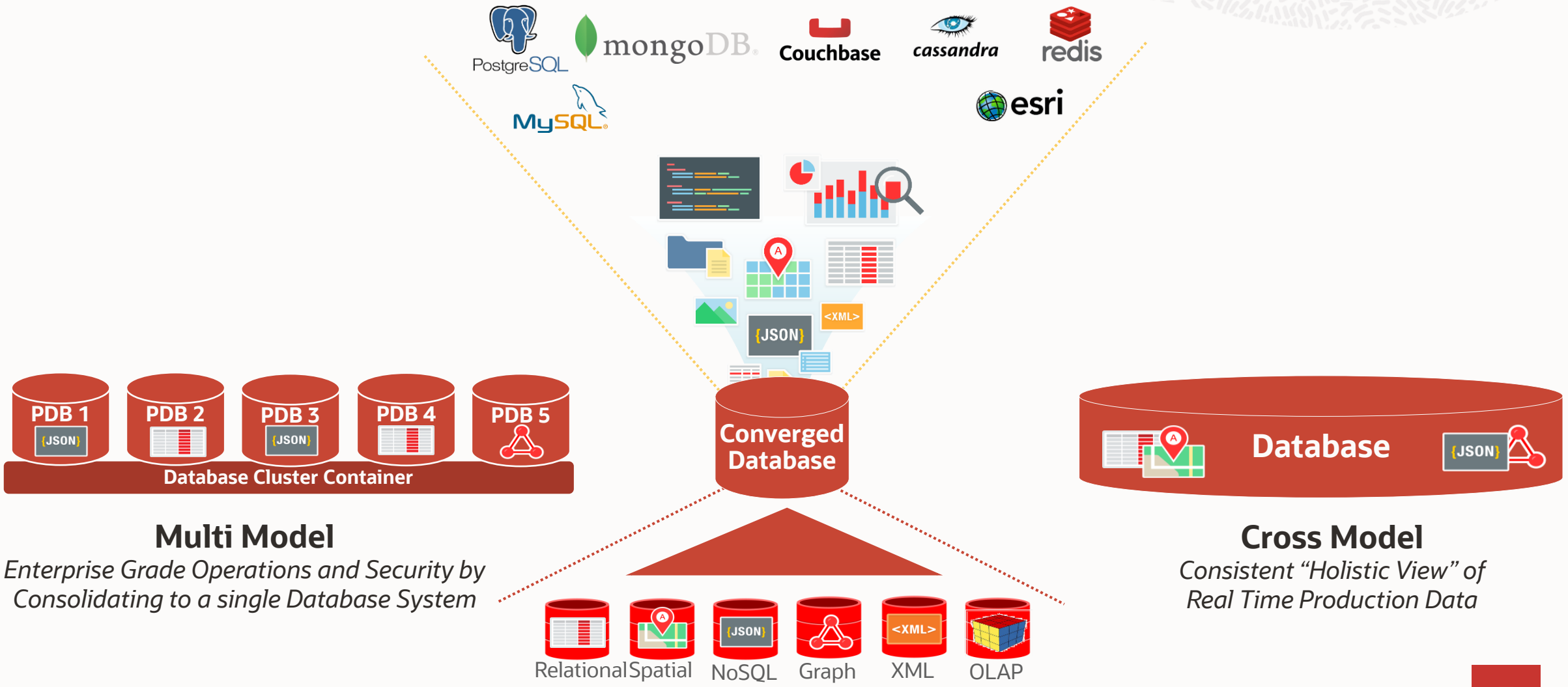
Application Development

Database convergence

- **EDB can store data in non-relational data models**
  - JSON
  - XML
  - Spatial
- **Does not support**
  - Multidimendional data
  - Property Graphs
  - Blockchain technologies
- **Does not provide specialized languages/APIs for non-relational data models**
  - SQL support only
- **Does not provide built-in ML solutions**
- **Spatial data model supported by PostGIS extension**
  - **Not installed by default**
- **Does not contain inegrated low-code environment**

Oracle Converged Database

Multi- and Cross-Model Database



Multi Model

Enterprise Grade Operations and Security by Consolidating to a single Database System

Cross Model

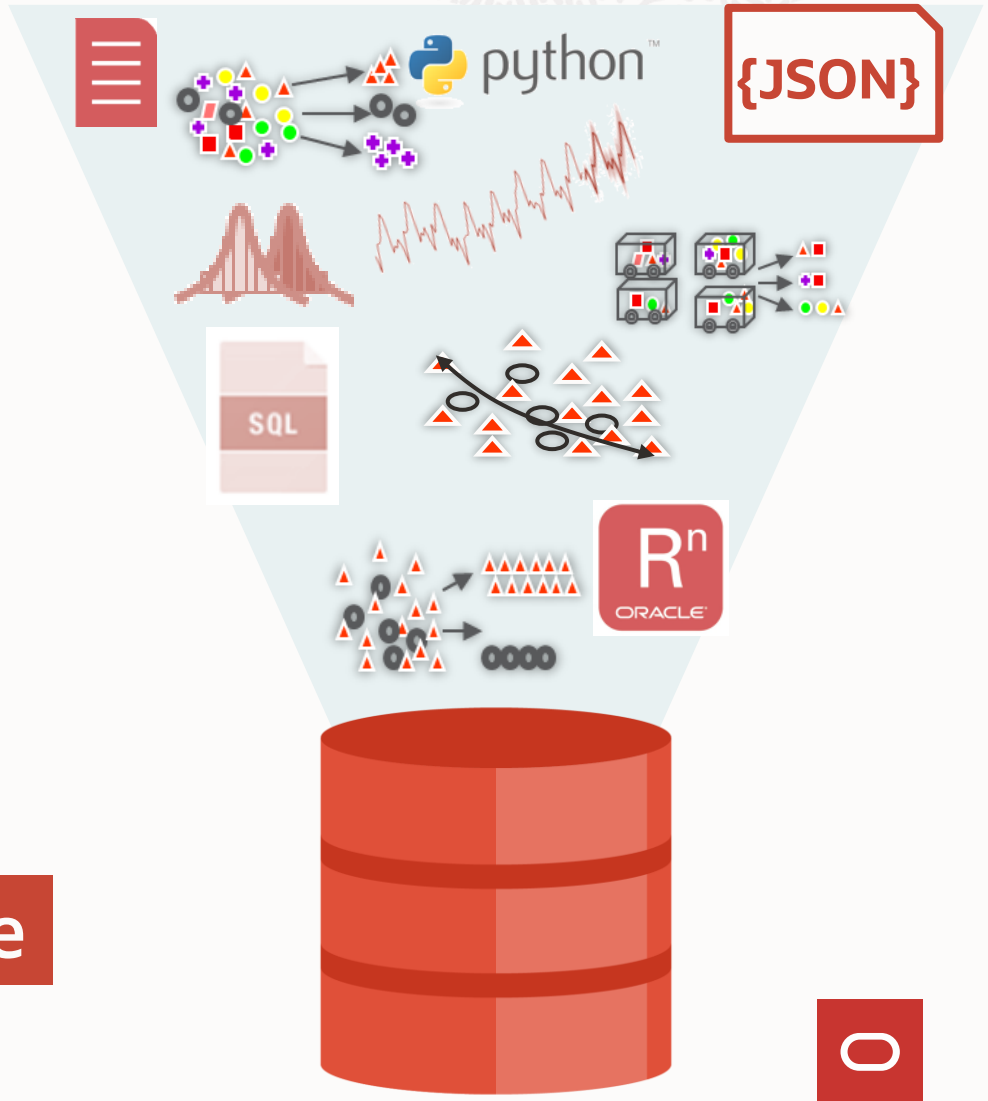
Consistent "Holistic View" of Real Time Production Data

Oracle Converged Database

Machine Learning integrated in Oracle Database

- **Machine learning models and algorithms run inside Oracle Database**
  - Data stays in-place
  - Massively parallel execution

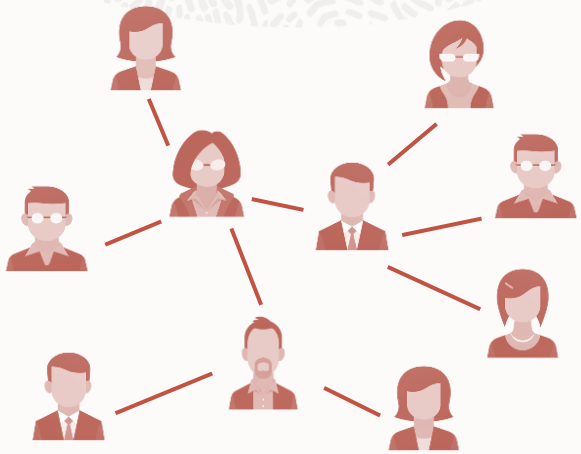
- **Flexible model building**
  - SQL, R or Python
  - Oracle Data Miner
  - Oracle AutoML
  - Over 30 in-database parallel ML algorithms including deep-learning



Oracle Makes Machine Learning Simple

Oracle Converged Database

Support for Graph Analytics



Oracle makes it simple to use Graph Analytics to discover:

- Influencers, dependencies, communities, ranking, customer 360, etc.

Over 50 in-memory parallel analytic graph functions

- Easy implementation with declarative SQL-like queries

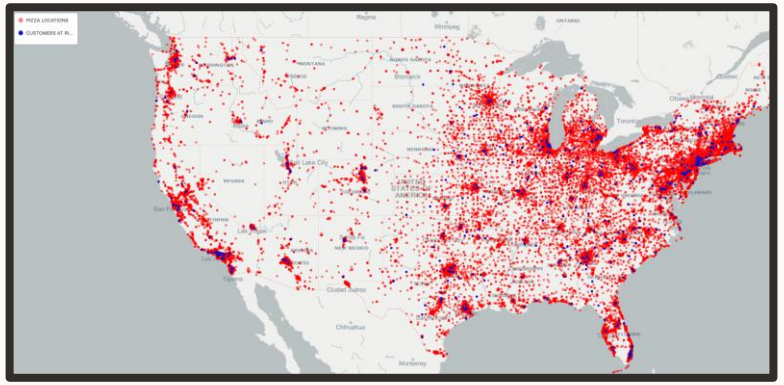
Oracle also provides an Open-Source Graph Query Language (PGQL)

PGQL allows users to specify graph patterns which are matched against vertices and edges in a graph

Previously a priced option, now **FREE** in all Oracle Database Editions

Oracle Converged Database

support for Data Driven Apps Create Value using Spatial Data



Oracle makes it simple to use location intelligence analytics and mapping services

- Compute distance between places, assets, people
- Analyze transportation, telecom, or utilities networks, sales territories, etc.

100s of in-database spatial operators and functions

- Over 60 spatial topology functions and procedures
- Over 125 Spatial Network functions and procedures

Previously a priced option, now **FREE** in all Oracle Database Editions

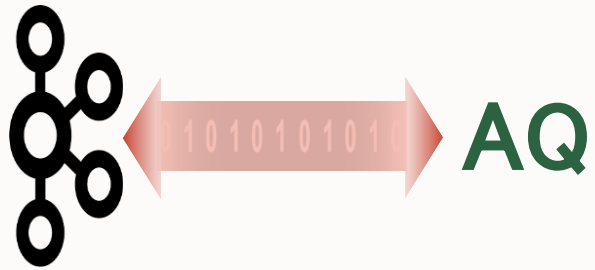
Oracle Converged Database

Support for Event Driven Architectures

Oracle makes it simple to implement event-driven apps

Oracle implements event streaming to and from Kafka

- Golden Gate replication can stream database changes into Kafka
- New: Oracle Database can query events from Kafka



Oracle Database Queues have supported events inside the DB for decades

- DB Queues provide ACID transactions and powerful SQL queries over events
- Confluent connector streams events between Kafka and DB Queues

More details related to licensing can be found here

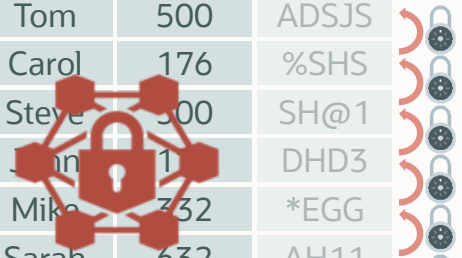
Oracle Converged Database

support for Data Driven Apps with Blockchain Data

```
CREATE Blockchain Table
       Trade_Ledger;
```

TRADE LEDGER

ID	User	Value	Hash
1	Tom	500	ADSJS
2	Carol	176	%SHS
3	Steve	300	SH@1
4	John	1	DHD3
5	Mike	332	*EGG
6	Sarah	632	AH11
7	Eve	25	LIO$
8	Prisha	850	SHS4



BLOCKCHAIN TABLE

Special blockchain tables

- Insert Only tables
- Inserted rows are cryptographically chained
- Chain can be verified and signed by participants

Simple to integrate into apps

- Look like standard tables with declarative SQL
- Full analytics and transactions on blockchain data

Use Cases

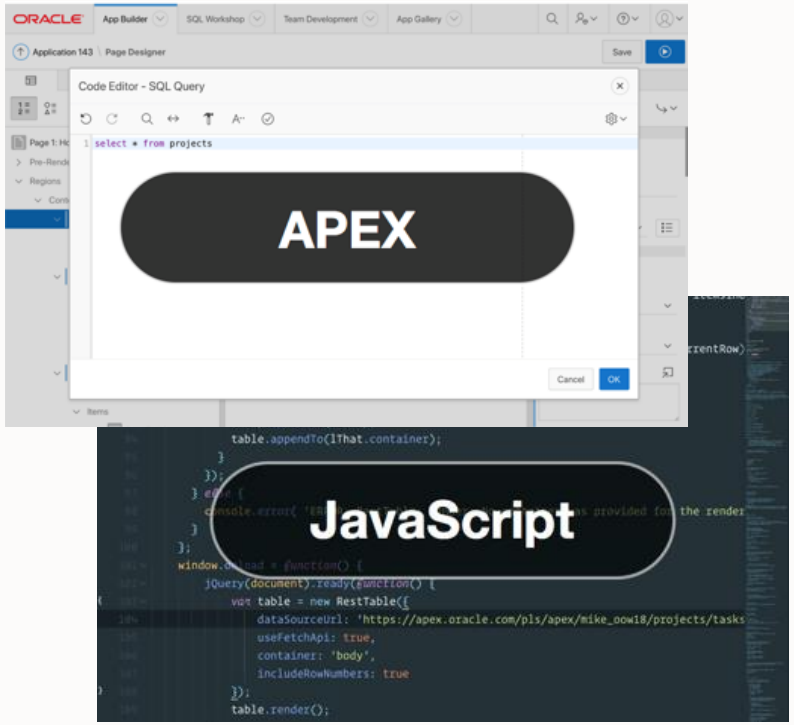
- Central unchangeable data such as measured values from IoT devices
- Compliance data for auditing reasons

More details related to licensing can be found here

Application Express (APEX)

Low-code environment for Oracle Converged Database

- **Low code** app dev platform
- Browser IDE automatically creates an App starting from a spreadsheet or a table
- SQL and REST friendly
- Deep integration with Oracle database
- Eliminates the complexity of Middle-tiers, connection management, state management, mapping database types to app types, scaling and HA
- Development of responsive and mobile apps
- 500K+ developer community
- **Oracle Named a 2022 Gartner® Peer Insights™ 'Voice of the Customer': Enterprise Low-Code Application Platforms**
    - **Details: here**



Application Express (APEX)

Low-code environment for Oracle Converged Database

Oracle makes it simple to create Low-Code Apps

Oracle APEX Low-Code IDE automatically creates an App starting from a spreadsheet or a table – data driven dev

Deep integration with the database eliminates the complexity of

- Middle-tiers, connection management, state management, mapping database types to app types, scaling, and HA

Create an enterprise App in hours – fastest time-to-value

Easily iterate the App to match evolving needs of business

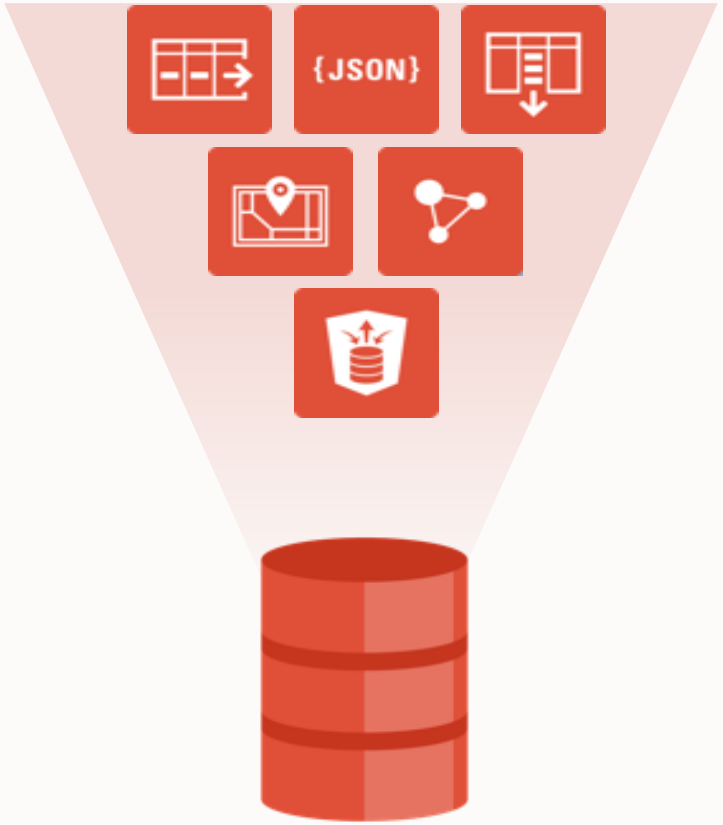
Application Development

APIs and languages

- **PostgreSQL provide libraries/connectors/drivers for many languages**
  - C/C++ CLI
  - ODBC, JDBC, .NET, Python
  - REST
- **EDB provide specialized language to build subprograms stored in a database**
  - PgPL/SQL for PostgreSQL can be considered as an equivalent for PL/SQL for Oracle Database
  - EDB Advanced Server provides also partial PL/SQL compatibility
  - Interpreted and not compiled language
  - Limited functionality
    - parallel execution, native compilation, ...

Oracle Converged Database

support for all modern Languages/Drivers/Tools/APIs



Languages

- C
- C++
- Java
- .Net
- JavaScript
- Python
- PHP
- R
- Go
- Rust
- Ruby
- Perl

Tools
Code Versioning

- SQL and PL/SQL
- SQL Developer, Data Modeler
- VS Code plugin
- SQLcl (modern sqlplus)
  - With *Advanced* Liquibase

Modern APIs

Collections API

- SODA drivers
- JSON results

Data As a Microservice with REST API

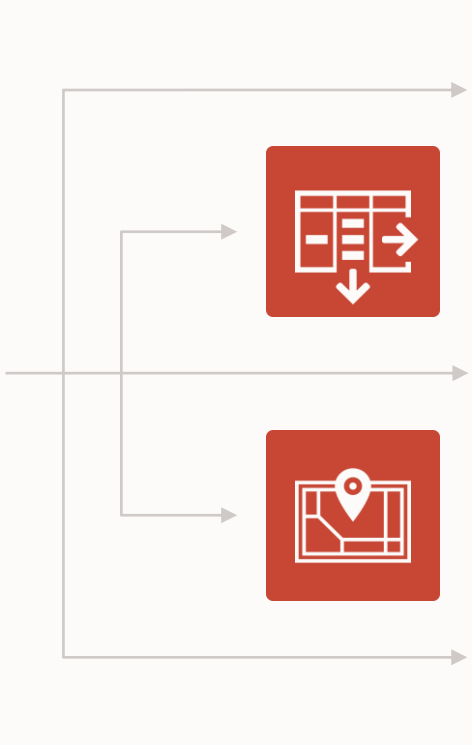
- JSON Data through HTTPS

Oracle Converged Database

Access data via SQL & REST or model-specific APIs: your choice

Cross-Model Data Access

SQL & REST
Relational, Graph,
Document, Spatial,
Temporal, multidimensional



Model-Specific Data Access

SODA
Pre-built REST APIs for JSON

PGQL
Property
Graph

SPARQL
RDF Graph

XQUERY

Developers can easily access multiple data models simultaneously via SQL, REST and APIs

Oracle Database - support for MongoDB

Develop and run MongoDB workloads in the Oracle Database

Modern document-centric development

- JSON Collections-based data model
- Rich clients – MongoDB API, REST and SODA based development API
- Native JSON storage with advanced indexes and optimized performance

... and proven enterprise functionality

- ACID Transactions
- SQL-based Reporting and Analytics (including scalable parallel execution)

... running on the Autonomous Database platform

- Availability
- Security
- Elasticity

Application Development

Other development-related features

- **Transaction processing**
  - EDB does not start transactions automatically
  - To start a transaction in EDB there is need to execute `BEGIN [TRANSACTION]` statement
  - Developer needs to remember about this fact during application development
- **Parallel processing**
  - **Oracle** supports parallel execution for queries, DML and DDL commands
    - Supported by RAC and Resource Manager
  - **EDB** supports parallel queries only

Database Maintenance

Other unique Oracle's options and features related to performance

Oracle's unique important performance-related features

- **Direct path load**
  - Dramatically increases performance of load operations
  - Supported in SQL*Loader, INSERT..SELECT and CTAS operations
  - Supports Parallel DML
- **NOLOGGING** mode for INSERT and CREATE INDEX statements
  - Increases performance of some SQL operations by eliminating redo log writes

Application Development

Other development-related features

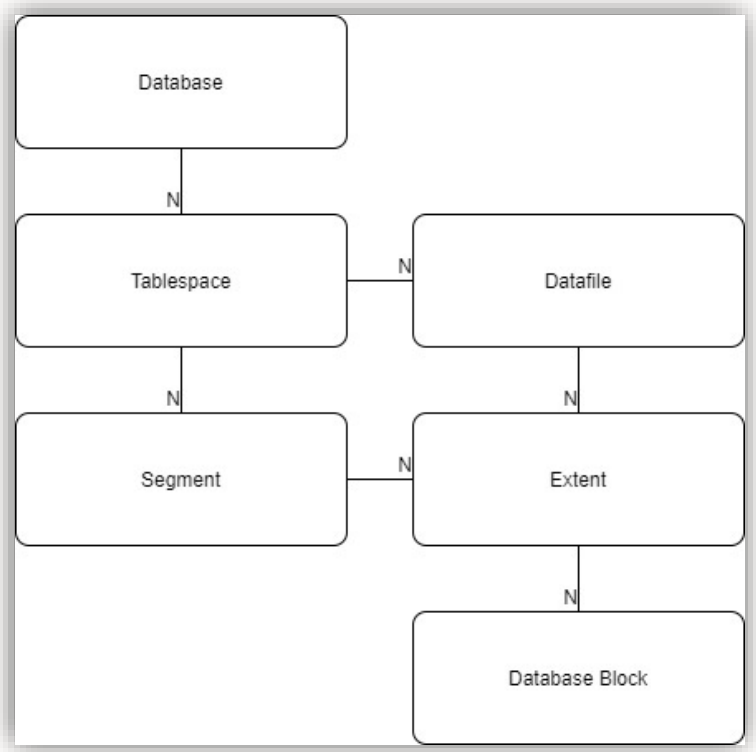
- **Materialized Views**
  - **EDB** treats materialized views as normal tables, with one exception: REFRESH command, which can be used to refresh a particular materialized view
  - Only complete refresh is implemented in Enterprise DB
  - There is no **query rewrite** feature implemented in Enterprise DB
  - No advisors, like Summary Advisor available in Enterprise DB
- And many more …

Database Maintenance

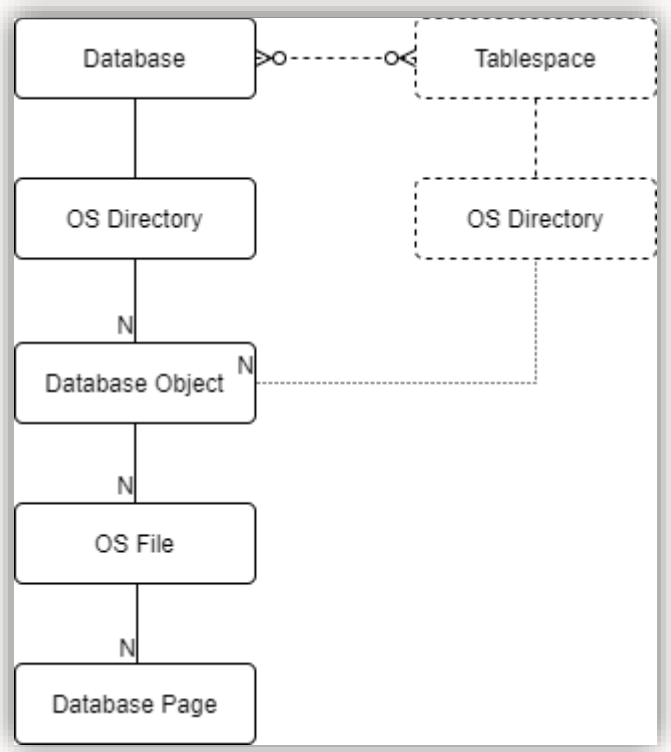
Database Maintenance

Storage Architecture Comparison

Oracle Database Storage Architecture



EnterpriseDB Storage Architecture



Database Maintenance

Storage Architecture Comparison

Oracle Database Storage Architecture

- Tablespaces are mandatory and consists of one or more datafiles.
- A single tablespace belongs to only one database, even in multitenant configuration.
- Datafiles contain extents belonging to multiple segments (tables, indexes, etc.).
- An extent is a specific number of contiguous data blocks
- Oracle database allows for using multiple block size at the same time (for different tablespaces).
- Default block size is configured at the database level and can be changed by setting appropriate configuration parameter DB_BLOCK_SIZE

EDB Database Storage Architecture

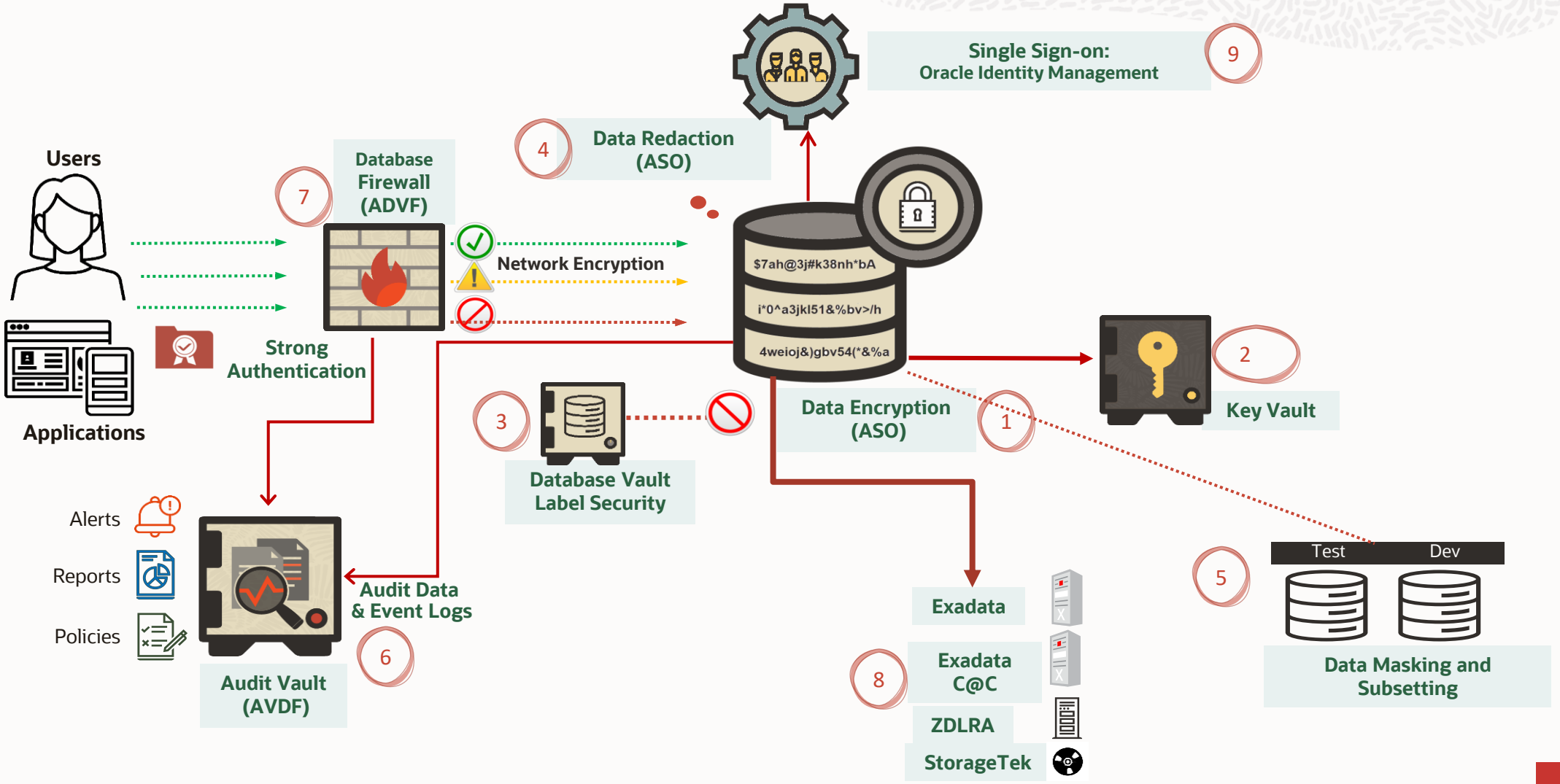
- Tablespaces are optional. By default PostgreSQL databases don’t use „tablespaces”.
- Tablespaces are, in fact, as well as databases, OS directories.
- Tablespaces are shared by all databases managed by a PostgreSQL instance.
- Every database object (table, index, etc) is stored in a separate set of datafiles (minum 1) in appropriate database or tablespace directory and consists of one or more database pages (blocks).
- PostgreSQL doesn’t support multiple database page sizes. Default page size is 8KB and its change requires recompilation

Database Maintenance

Database security

- **EDB** use similar to Oracle database privilege model
  - System and object privileges
- **EDB** provides auditing options similar to basic auditing in Oracle
  - Auditing of DML statements, using privileges and objects
  - Functionality similar to FGAC available in EDB Advanced Server
- **EDB** does not provide any data masking or VPD-related native solutions
- **EDB** does not provide any encryption keys management native solutions

Oracle's unique approach: Maximum Security Architecture



Database Maintenance

Database security

- **Oracle provides unique enterprise-level solutions:**
  - **Database Vault** to restrict access to application data by privileged users
  - **Virtual Private Database** to control access to subsets of the data
  - **Key Vault** to manage encryption keys
  - **Data Masking** to mask sensitive data
- **These features are crucial to build a fully protected system, which has to be aligned with organizational or law regulations (like GDPR)**

Database Maintenance

Backup and recovery options and tools

- **Oracle and EDB** provide tools to export the database into a flat file
  - Data Pump for Oracle database
  - pgdump, pgrestore, pgBackRest, Barman for EDB database

- **Oracle and EDB** provide features to perform the hot backup and full/point in time restoration
  - Archivelog and Recovery Manager for Oracle database
  - WAL archiving and pg_basebackup for PostgreSQL database

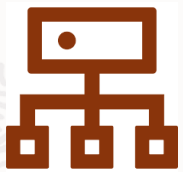
Database Maintenance

Backup and recovery options and tools

- **Oracle Recovery Manager automatizes and secures backup and restoration processes, providing features crucial for protecting an enterprise-scale database system against failures:**
  - Stores information about available backups
  - Automatically chooses the best backup for the restoring operation
  - Complete/incremental multilevel backups to reduce the resource consumption
  - Database/Tablespace/Datafile full or point-in-time recovery
  - Recovery at the database block level
  - Conversion of the data between different platforms
  - Block Change Tracing reduces backup time

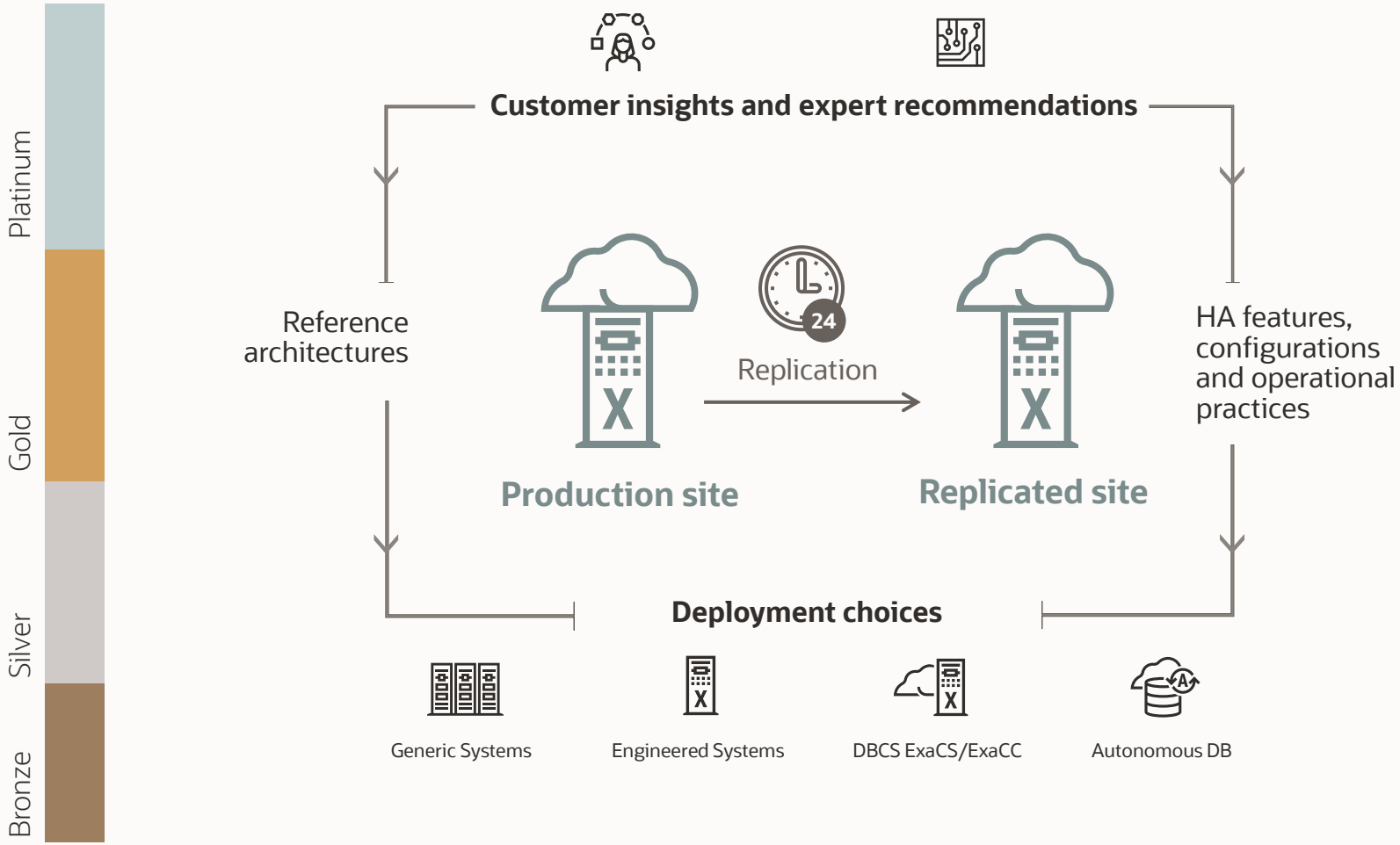
Database Maintenance

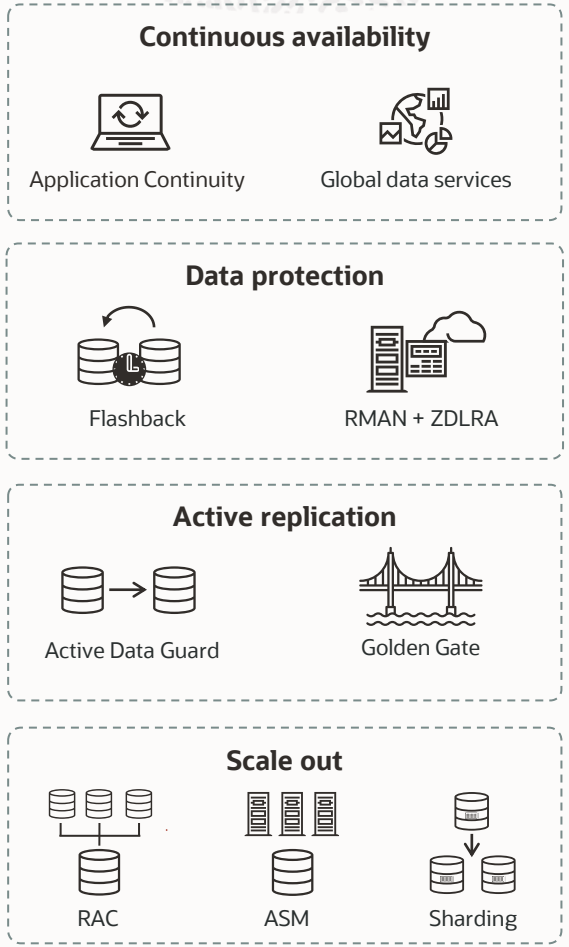
High Availability and Disaster Recovery



- **Enterprise DB** provide options to build share-nothing active-passive clusters **only**
  - No options comparable to
    - DML Redirection
    - Application Continuity
  - No transparent application failover/switchover solution
- **No active-active solutions available**
  - EDB does not implement sharding and RAC

Oracle's unique approach: Maximum Availability Architecture (MAA)





Database Maintenance

High Availability and Disaster Recovery

Oracle provides unique enterprise-level solutions

- **(Active) DataGuard** to build active-passive DR clusters
  - DML redirection allows for executing DML statements, being connected to a standby node
- **Oracle Real Application Clusters** allows for building highly-available and scalable active-active share-everything database clusters
  - **Almost linear growth of throughput** just by adding nodes
  - **Resource Manager** to manage the RAC resources consumption
  - **Parallel SQL** optimization integration
  - **Application Continuity** for automatic application failover
- **Oracle Sharding** allows for building highly-available and scalable active-active share-nothing database clusters
  - **Almost linear growth of throughput** just by adding nodes
  - **Replication and distribution** of the data
  - **Complexity transparent to applications**

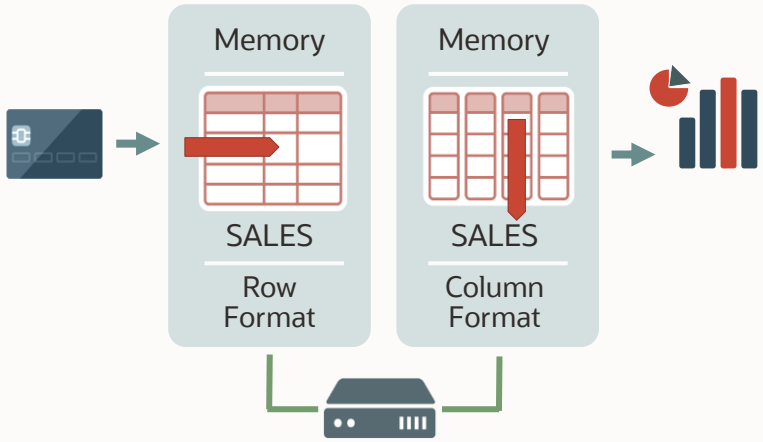
Database Maintenance

Options and features related to performance

- **Oracle and EDB** use cost-based SQL optimization
- **Oracle and Enterprise DB** provide ability to parallelize SQL stateme
  - Queries, DML and DDL in the Oracle database
  - Queries only in EDB
- **Oracle and EDB** implement tables and indexes partitioning
  - **Range, Hash and List** schemes
  - Used in partition prunning, partition wise joins
  - **Oracle** can use partitioned tables to parallelize DML operations
  - **Oracle** provides hybrid partitioning
  - **Oracle's Online Redefinition** allows for partition existing tables without a downtime
  - **EDB** supports **only local indexes**

Oracle's unique important performance-related features

Database In-Memory



Oracle makes it simple for Apps to provide instant data insights

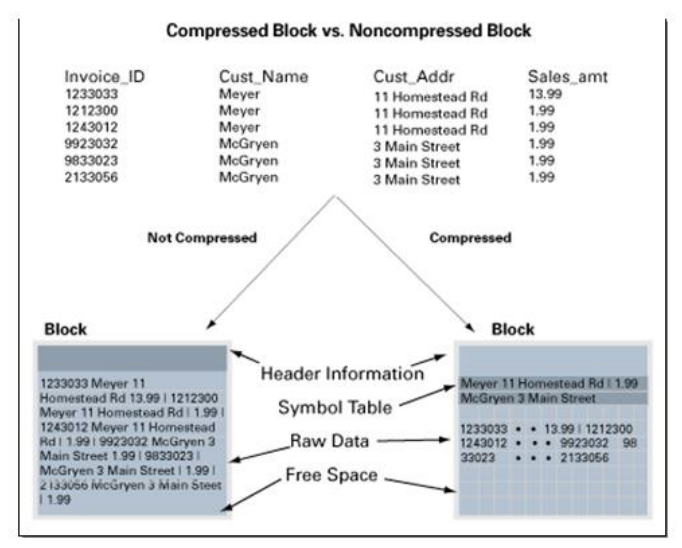
In-memory columnar formats and automatic parallel processing enable Analytics to transparently run 100x faster

No app changes needed - easy to deploy in Data Warehouse or OLTP database

More details related to licensing can be found here

Oracle's unique important performance-related features

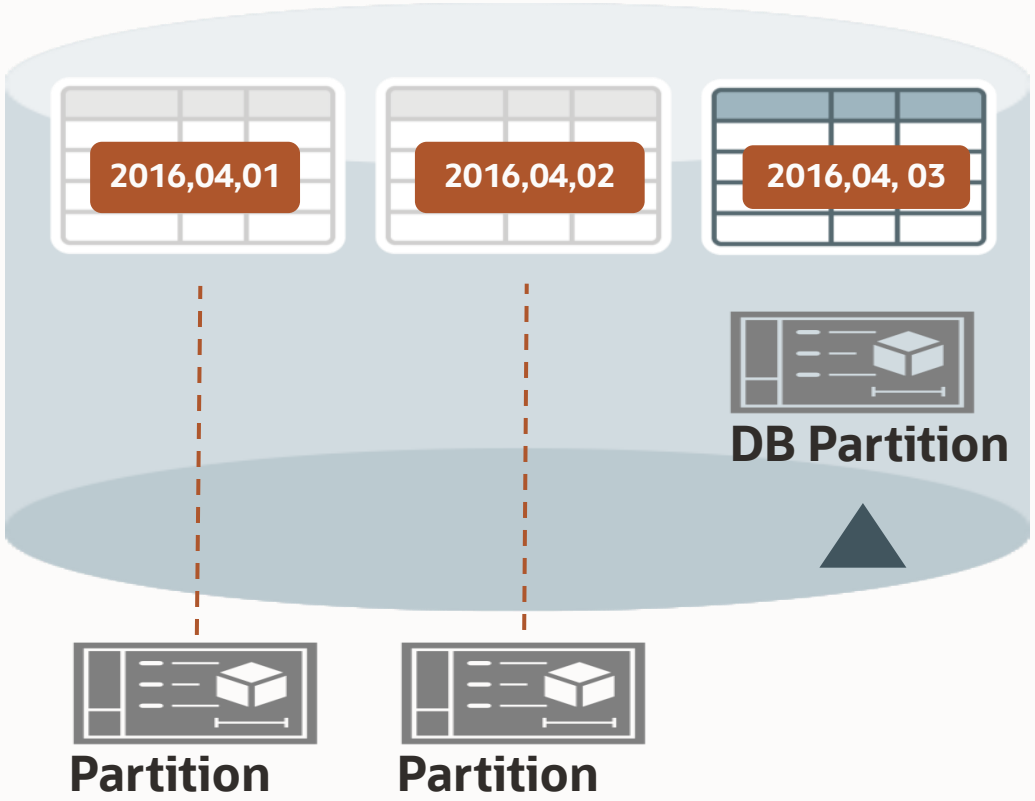
Advanced Compression



- ***Customers experience**: 2x to 4x compression ratios*
- Use for both OLTP and Data Warehouse applications
- Balances Good Compression Ratios and Performance
- Maintains compression across all DML operations and bulk load operations
- Data stays compressed in buffer cache for most queries
- Queries often faster due to fewer I/Os and more rows in buffer cache

Oracle's unique important performance-related features

Hybrid Partitioned Tables



- Combination of internal (database) and external partitions
- External resources are files on Linux, in Hadoop Distributed File System (HDFS), in Oracle Objectstore, AWS S3 or Azure
- Use Cases:
  - Move non-active partitions to external files
  - Use inexpensive storage options
  - No relocation of data required
  - Big Data Queries

More details related to licensing can be found here

Database Maintenance

Administration tools

- **PgAdmin for PostgreSQL**
  - Main tool used for database administration
  - Monitors performance of the database
  - Allows for executing SQL commands and PL/pgSQL programs
- **Postgres Enterprise Manager** (available only for EDB)
  - Built on top of PgAdmin
  - Allows for managing multiple PSQL databases and EDB advanced servers
- **Oracle Enterprise Manager**
  - Enteprise-level solution for database administrators
  - Used to monitor, diagnoze and manage multiple Oracle databases
  - Contains multiple advisors allowing for easier using and configuring advanced Oracle's features
  - Additional packs available
    - **Tuning and Diagnostic** packs for database performance tuning
    - **Database Lifecycle Management** pack for automating the processes required to manage the Oracle database lifecycle

Summary

Key Messages

Enterprise DB

- Marketed as”good enough” for most purposes
- **Has many limitations in all main areas**
  - Application Development
  - Security
  - Availability
  - Performance
  - Administration and development tools
- **These limitations cause the need to use external solutions**
  - Complex architecture
  - Complex and long application development process
  - **Increased TCO**
  - **Reduced ROI**

Summary

Key Messages

Oracle database

- Simplify App Development
- Simplify App Architecture

Oracle Converged Database is the only DBMS, which

- delivers the unified and holistic view of all the data
- Supports all paradigms of modern app developement

Oracle Maximum Security Architecture

- Protects data against threads
- Supports all the database options and features
- Crucial for most commerical use-cases

Oracle Maximum Availability Architecture

- Allows for building HA/DR systems
- Supports all the database options and features