Cloud Adjacent Databases Facilitate Migration to Cloud

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Agenda

1. Cloud migration challenges
2. How can Cloud Adjacent Databases help?
3. What is Oracle TimesTen In-Memory Database?
4. TimesTen as a Cloud Adjacent Database
5. Example use cases
6. Summary
7. Q & A
Terminology

• Multi Cloud environment
  – An application, system, or service is deployed across, or uses resources from, multiple independent clouds

• Hybrid environment
  – An application is deployed on, or uses resources from, both on-premises and cloud environments

• Edge computing
  – A distributed computing paradigm where compute resources, including storage, are brought closer to the location where they are needed. The opposite of Cloud computing. *(paraphrased from Wikipedia)*
Cloud migration challenges

- Many challenges with migrating applications from on-premises to the Cloud
  - Architecture
  - Performance; network bandwidth and latency
  - Approach; piece-meal, all-at-once, hybrid

- Typical round-trip network latencies
  - Within a data centre: sub millisecond
  - Outside world to/from a Cloud: 10s of milliseconds

- Heavily database dependent applications and latency sensitive applications are often the most challenging
  - If apps and database are not co-located, performance will suffer
  - During migration (and maybe afterwards) co-location is not always possible => hybrid environment
  - A hybrid environment may be needed long term (or even forever)
Cloud Migration

On premises

Migration

Cloud
What are Cloud Adjacent Databases?

• A simple notion
  – Put a (lightweight) database ‘close’ to the application (in terms of network latency)
  – Containing the key data needed by the application
  – Synchronise this ‘local’ data with the main database asynchronously (in the background)

• Which
  – Reduces network latency for application access to its data
  – Offloads work from the main database

• Leading to
  – Faster and more predictable application responsiveness
  – Improved reliability

• A concrete example of edge computing / edge databases
Hybrid without Cloud Adjacent Databases

Min request latency: \((2 \times A) + (2 \times B)\)
Hybrid with Cloud Adjacent Databases

Min request latency: \((2 \times A) + (2 \times C)\)  

\(C << B\)
Multi Cloud without Cloud Adjacent Databases
Multi Cloud with Cloud Adjacent Databases

AppA — CADB1 — Internet — CADB2 — AppB — CADB3

DB1
DB2
DBA
DBB
Characteristics of a Cloud Adjacent Database

• Lightweight, easy to deploy and easy manage
  – Little or no DBA oversight required

• Highly compatible with central database
  – SQL, APIs, transactions, ...

• Good performance
  – To maximise the performance benefits

• Persistent and recoverable, maybe highly-available
  – To protect data
  – To offer increased resilience
Oracle In-Memory Database Technologies

**Application-Tier**

- **TimesTen In-Memory Database**
  - Latency Critical OLTP applications
  - **Microsecond** response time
  - Standalone or Cache for Oracle Database

**Database-Tier**

- **Database In-Memory**
  - Dual Format In-Memory Database
  - **Billions of Rows/sec** analytic data processing
  - **2-3x** Faster Mixed Workloads

**Storage-Tier**

- **In-Memory on Exadata Storage**
  - In-memory column format on Exadata Flash Cache
  - **5-10x** faster smart scan in storage
  - **15x** increase in total columnar capacity
Oracle TimesTen In-Memory Database

Multiple Deployment Options

**TimesTen Classic**

1. Standalone / Replicated Relational IMDB
   - Low latency applications
   - ISV/OEM Embedded solutions

2. Cache for Oracle Database
   - Accelerate Oracle Database applications
   - HA option via Replication

*Microsecond response time, millions of TPS*

**TimesTen Scaleout**

3. Distributed Relational IMDB
   - High throughout and storage capacity
   - Transparent data distribution
   - Elastic scalability
   - Fault tolerant

*Millissecond response time, hundreds of millions of TPS*
TimesTen Classic

Relational Database
- Pure in-memory
- ACID compliant
- Standard SQL, PL/SQL, APIs
- Entire database in RAM

Persistent and Recoverable
- Database and Transaction logs persisted on local disk or flash storage
- Automatic recovery after failure

Extremely Fast
- Microseconds response time
- Very high throughput

Highly Available
- Active-Standby and multi-master replication
- Very high performance parallel replication
- HA and Disaster Recovery
Performance – Response Time
Low Latency - **Microseconds** Response Time

TPTBM Read and Update
E5-2699 v4 @ 2.20GHz
2 socket, 22 cores/socket,
2 threads/core
TimesTen 11.2.2.8.0
(100M rows, 17GB data)
TimesTen Application-Tier Database Cache
For Oracle Database

- Cache subset of Oracle Database tables in TimesTen for better response time
  - With full persistence to local storage
- Read-write caching
  - Transaction execution and persistence in TimesTen
- Read-only caching
  - Transactions executed in Oracle Database
- Same architecture as TimesTen Classic
  - Supports cache tables and native TimesTen tables
- HA and fault tolerance in the application-tier
- Highly compatible with Oracle database
  - SQL, PL/SQL, APIs, ...

Telco Services
Financial Services

eCommerce, Personalization

Real-Time Analytics – Dashboard, Scorecard
Data Mart

Application

Oracle TimesTen

Application

Oracle TimesTen

Application

Oracle TimesTen

Oracle Database
Flexible Cache Group Configurations

• Cache Group describes the Oracle Database tables to cache
  – All or subset of rows and columns
  – Defined using SQL
    CREATE CACHE GROUP PremierUsers
    FROM OE.CUSTOMER ( NAME VARCHAR2(100) NOT NULL,
    ADDR VARCHAR2(100)
    )
    WHERE OE.CUSTOMER.ORDER > 500;

• Cache tables are regular tables in TimesTen
  – Queries/joins, insert/update/delete
TimesTen Scaleout

Shared nothing distributed IMDB built on proven TimesTen technology

- For High-Velocity **Extreme OLTP** applications
  - IOT, trading, fraud detection, mobile, click stream, billing, orders, etc.

- **Cutting-Edge Design**
  - Pure In-Memory, Full SQL, Full ACID Transactions
    - Scale-out shared nothing architecture
    - Multiple data copies for HA (K-safety)
      - All copies active for read/writes
    - Global secondary indexes
  - Complex SQL and Parallel SQL for reporting and batch

- **Centralized management and administration**
YCSB Workload B (95% Read 5% Update): **38 Million TPS**

### YCSB version 0.15.0
- 1KB record (100-byte x 10 Fields)
- 100M records / Replica Set
- Uniform Distribution

### TimesTen Scaleout
- 1 to 16 replica sets
- 2 synchronous replicas per replica set

### Oracle Cloud Infrastructure
- 32 * BM.DenseIO2.52
TimesTen as a Cloud Adjacent Database

• TimesTen Classic/Cache is a great fit as a Cloud Adjacent Database
  – Lightweight, simple to deploy and manage
    • No DBA required
  – Standard SQL, PL/SQL, APIs
  – Persistent and recoverable, HA

• High performance
  – True in-memory architecture optimised for low latency
  – High performance high-availability

• Data synchronisation
  – If backend DB is Oracle, use built in caching features for ‘out of the box’ data sync
  – APIs such as XLA (log mining & event notification) enable ‘roll your own’ data sync
Example use case #1: Navigation, traffic alerts, parking info

• Large Japanese automotive manufacturer

• Need to
  – Capture real-time information from vehicle sensors and systems
  – Process and enhance data
  – Share with other apps & vehicles
  – Push new/updated data to vehicles

• Must haves
  – Acceptable performance
  – High resiliency
Example Use Case #1: High Level Architecture

Cloud Data Centre

Internet

Roadside Interaction System

TimesTen IMDB

AppC

AppD

AppA

AppB

DB

App

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Cloud Data Centre

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Roadside Interaction System

TimesTen IMDB

AppC

AppD

AppA

AppB

DB

App
Example Use Case #1: Data Flows

- Vehicles interact with a ‘nearby’ RIS to exchange data
  - GPS derived data (position, speed, heading)
  - Any other sensor data required by application(s)

- Roadside Interaction System
  - Filters, summarises, aggregates, analyses
  - Syncs some of this data with central (Cloud hosted) database

- Central (Cloud hosted) database and apps
  - Main data repository and processing centre
  - Has the ‘bigger picture’ – performs higher level processing
  - Sends required data back to vehicles via RIS
Example use case # 2: Cache for Oracle ATP Cloud Service

• ATP Cloud Service offers incredible performance
• But it is still a cloud service
  – High network latency if used in hybrid deployments
  – May be impacted by network issues
• Deploy TimesTen Cache as an on-premises CADB to improve hybrid deployments
• Deploy a TimesTen Cache Service for fully cloud based deployments
Example use case # 2: Cache for Oracle ATP Cloud Service
Example use case # 2: Cache for Oracle ATP Cloud Service

Cloud DC 1

Oracle ATP Cloud Service

Cloud DC 2
Summary

• Migration to Cloud can present risks
  – Maintaining performance and reliability is often one of them
  – Particularly for hybrid deployments

• Cloud Adjacent Databases can help with this for some applications
  – Better performance and reliability
  – More complex architecture

• In-memory databases are often ideal as Cloud Adjacent Databases
  – Data volumes are typically low to medium
  – Lightweight footprint with little or no administration required
  – Excellent performance on low cost hardware

• Data synchronisation is a key aspect
  – Cloud Adjacent Databases usually needs to sync some data with a central database
  – Data sync needs to be flexible, fast and reliable
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