In-Memory Computing SUMMIT EUROPE 2019

# 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

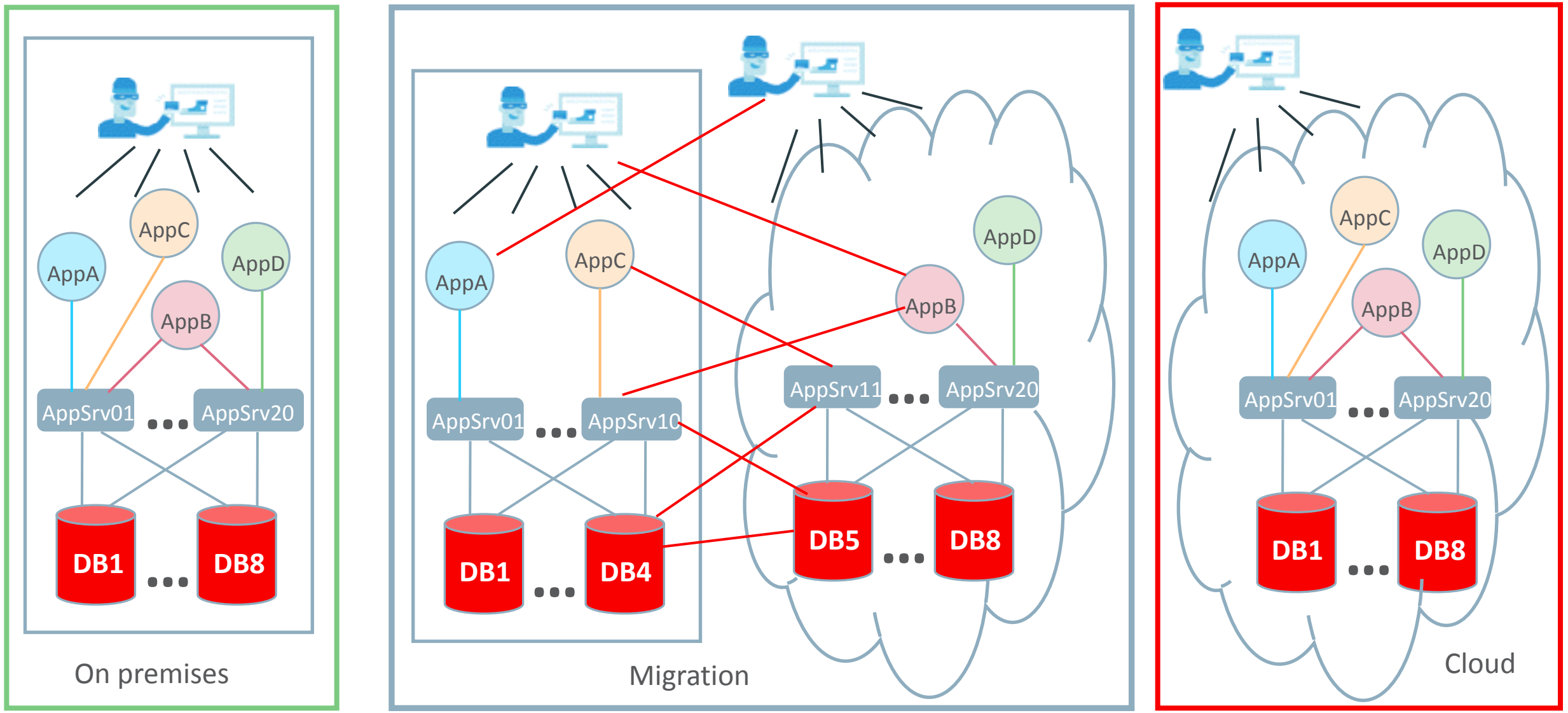
# Terminology

- 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

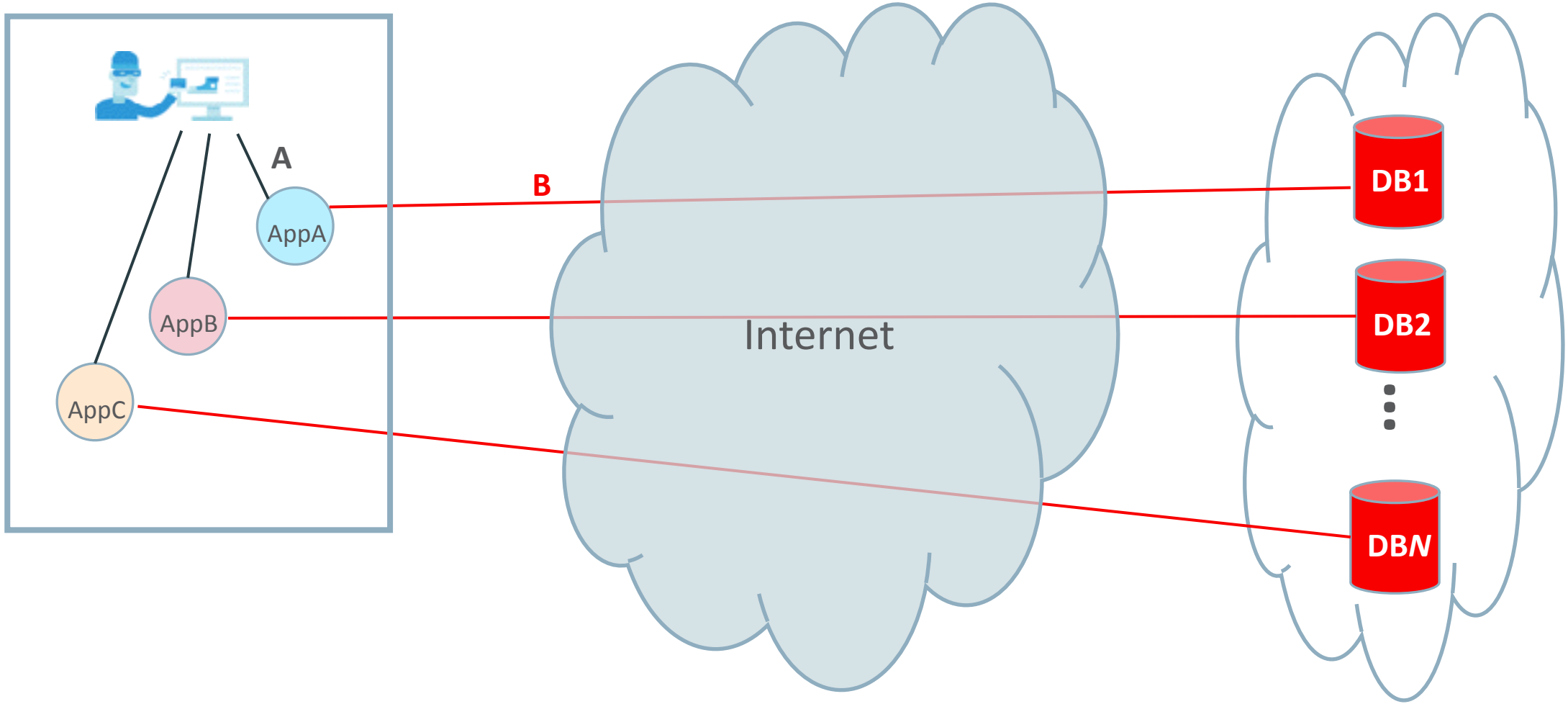


# What are Cloud Adjacent Databases?

- 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

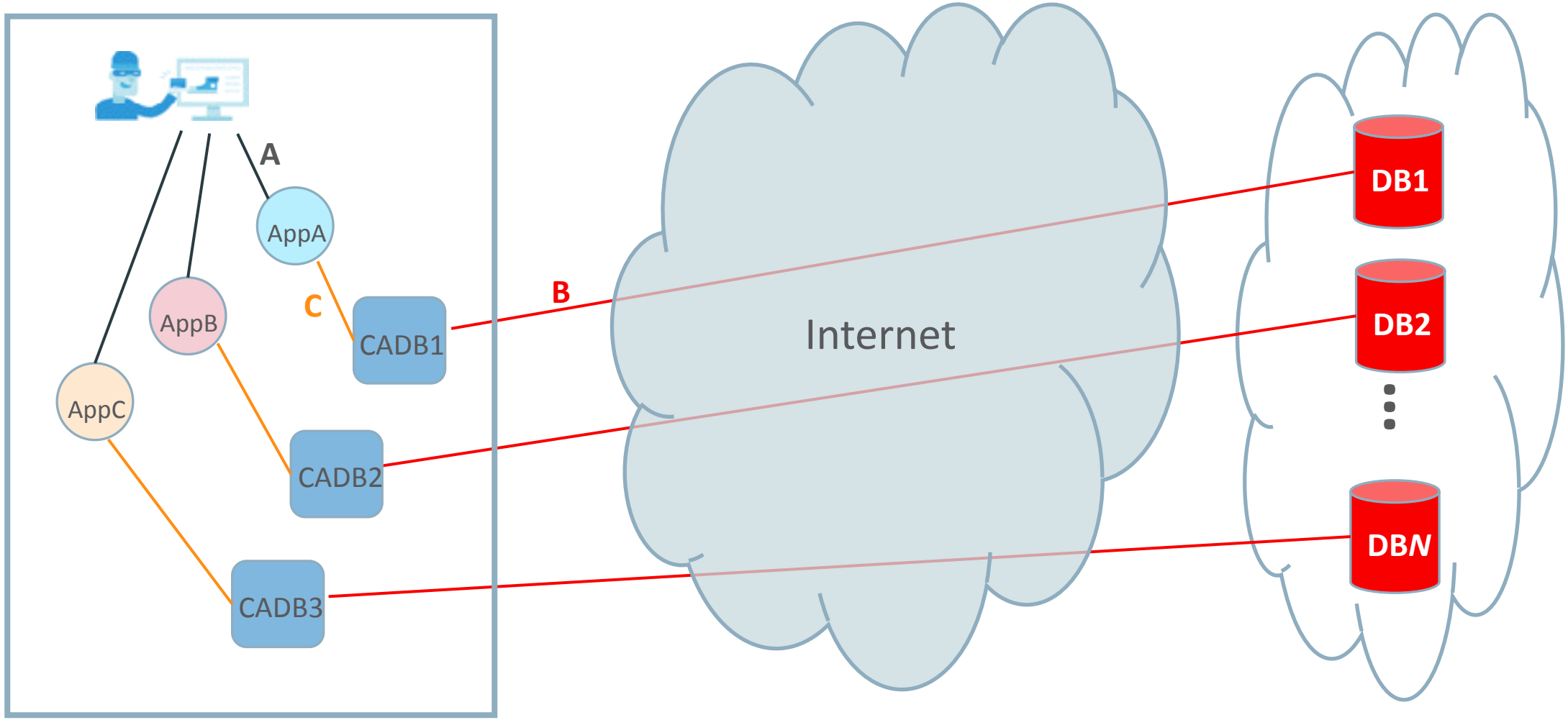
 

# Hybrid without Cloud Adjacent Databases



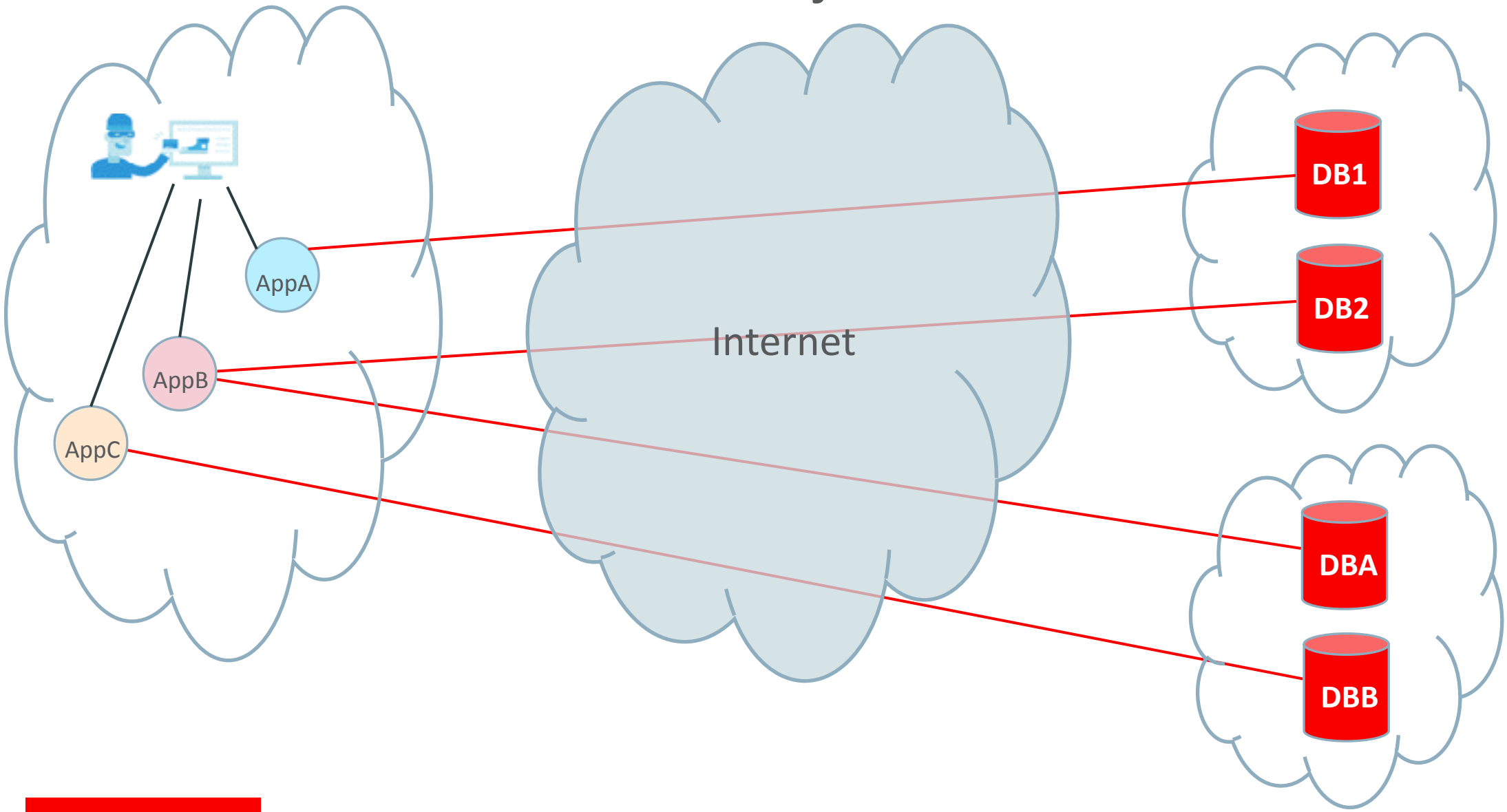

Min request latency: (2 * A) + (2 * B)

# Hybrid with Cloud Adjacent Databases

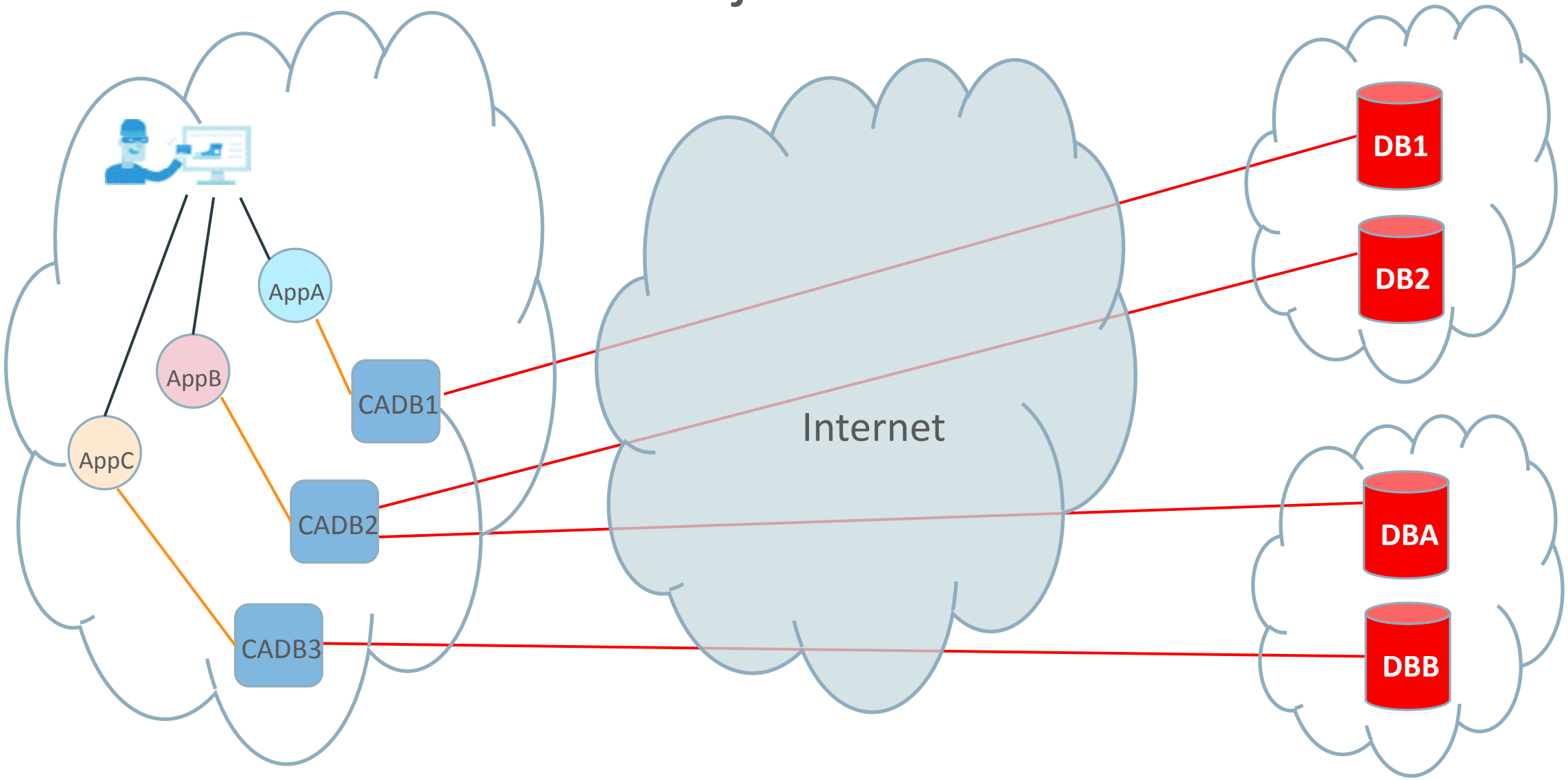



Min request latency: (2 * A) + (2 * C)  **C <<< B**

# Multi Cloud without Cloud Adjacent Databases



# Multi Cloud with Cloud Adjacent Databases



# Characteristics of a Cloud Adjacent Database

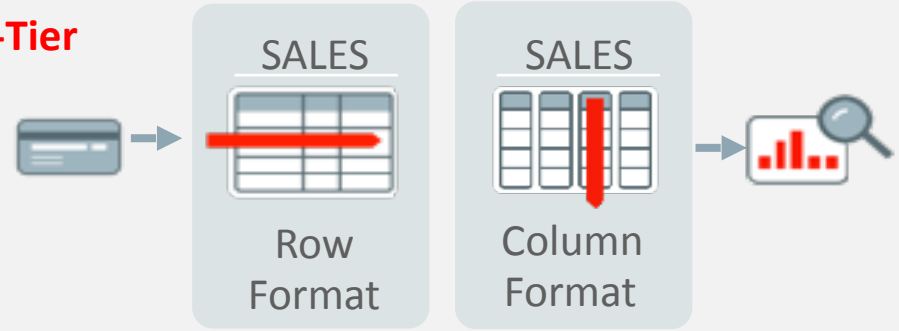
- Lightweight, easy to deploy and easy manage
  - Little or no DBA oversight required
- Highly compatible with central database
  - SQL, APIs, transactions, …
- Good performance
  - To maximise the performance benefits
- Persistent and recoverable, maybe highly-available
  - To protect data
  - To offer increased resilience

# Oracle In-Memory Database Technologies

**Application-Tier**

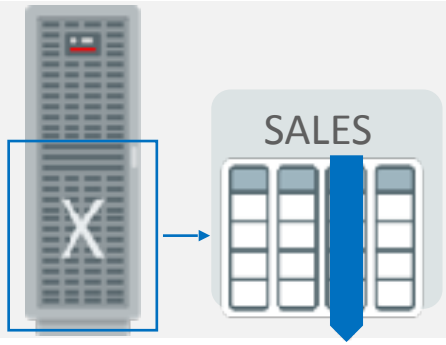

- **TimesTen In-Memory Database**
  - Latency Critical OLTP applications
  - **Microsecond** response time
  - Standalone or Cache for Oracle Database

**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

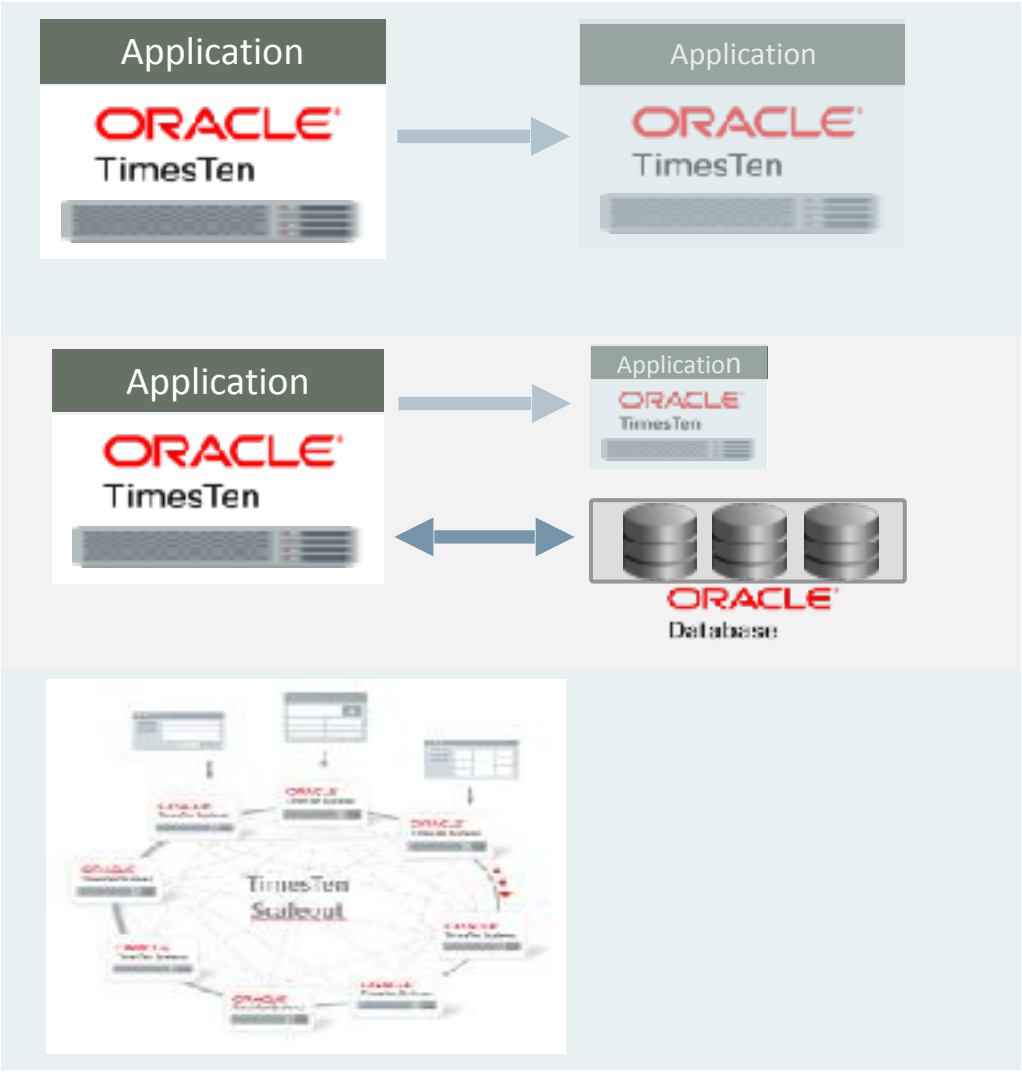
1. Standalone / Replicated Relational IMDB
   - Low latency applications
   - ISV/OEM Embedded solutions
2. Cache for Oracle Database
   - Accelerate Oracle Database applications
   - HA option via Replication

***Microsecond response time, millions of TPS***

### TimesTen Scaleout

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

***Millisecond 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

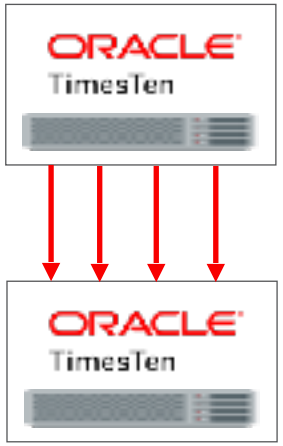
## Persistent and Recoverable

- 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

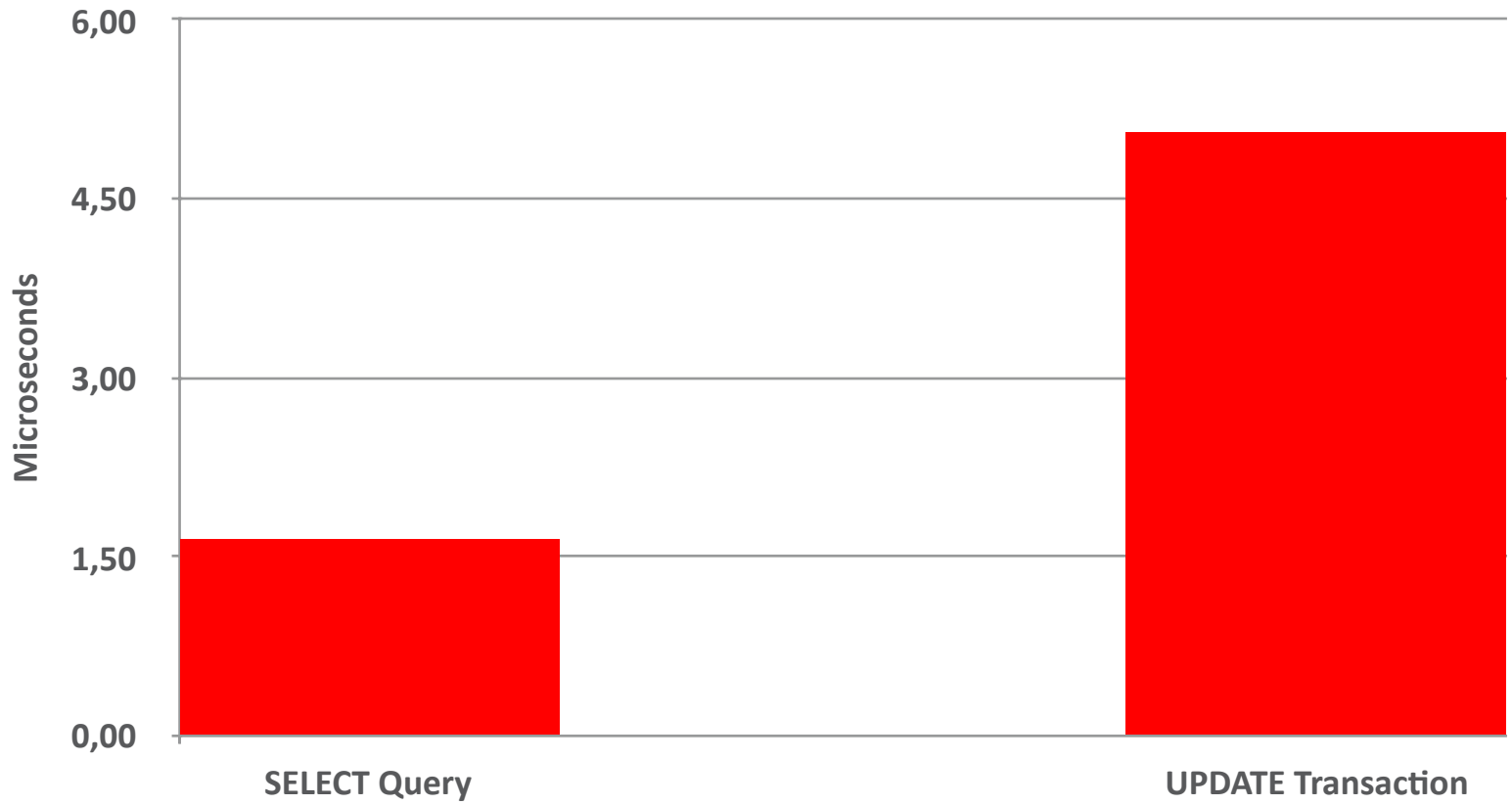



- Active-Standby and multi-master replication
- Very high performance parallel replication
- HA and Disaster Recovery

# Performance – Response Time

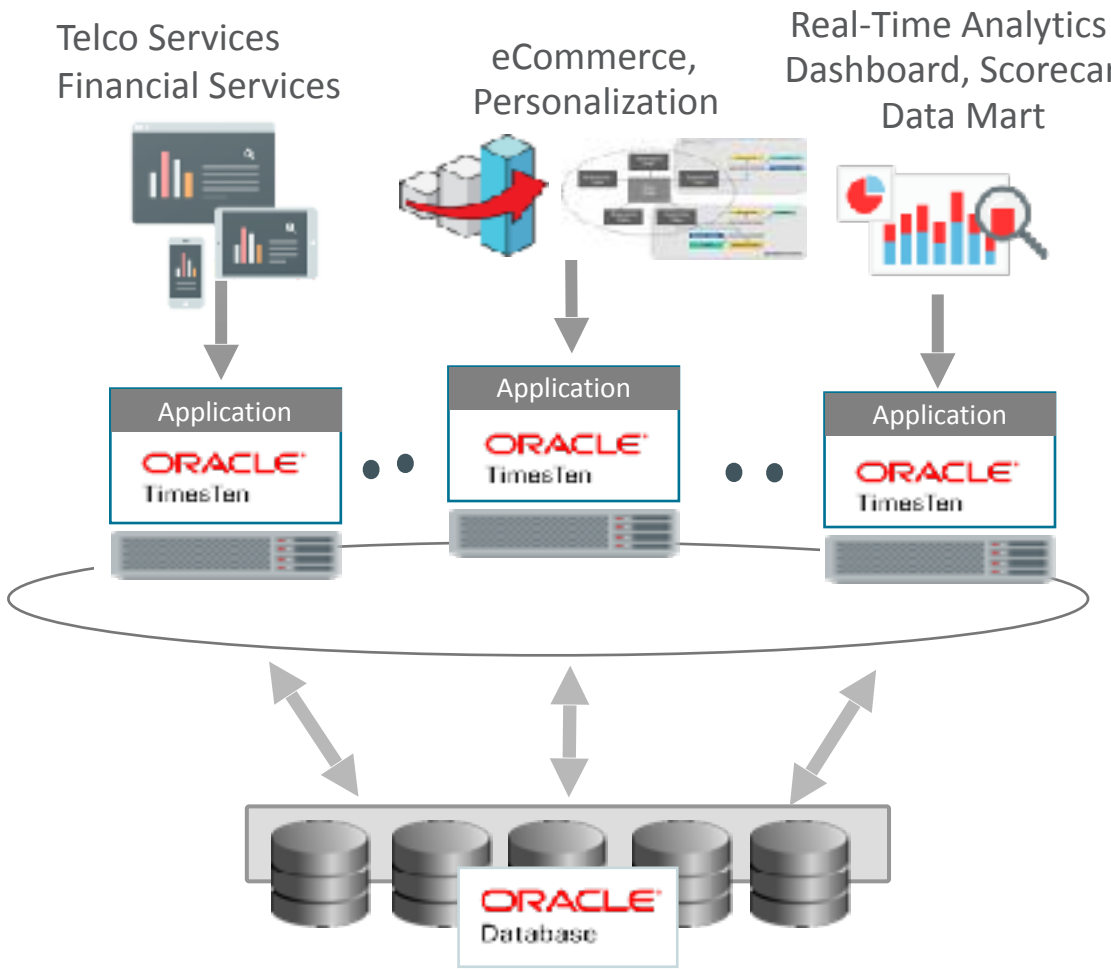
## Low Latency - **Microseconds** Response Time

**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)**



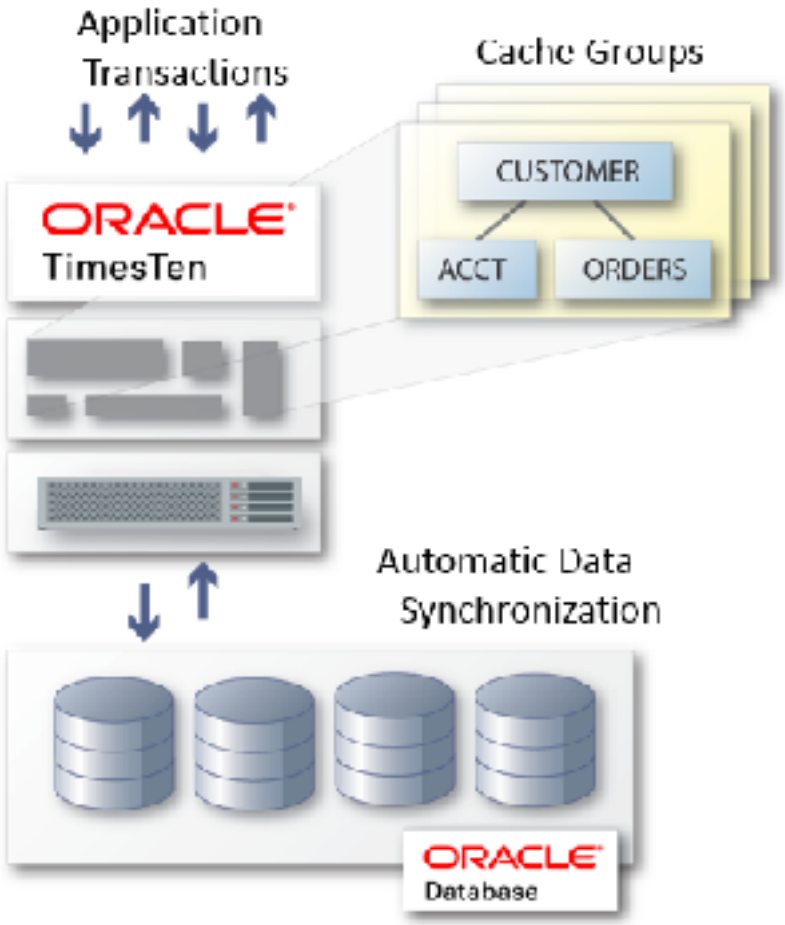
# TimesTen Application-Tier Database Cache

## 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, …

# Flexible Cache Group Configurations



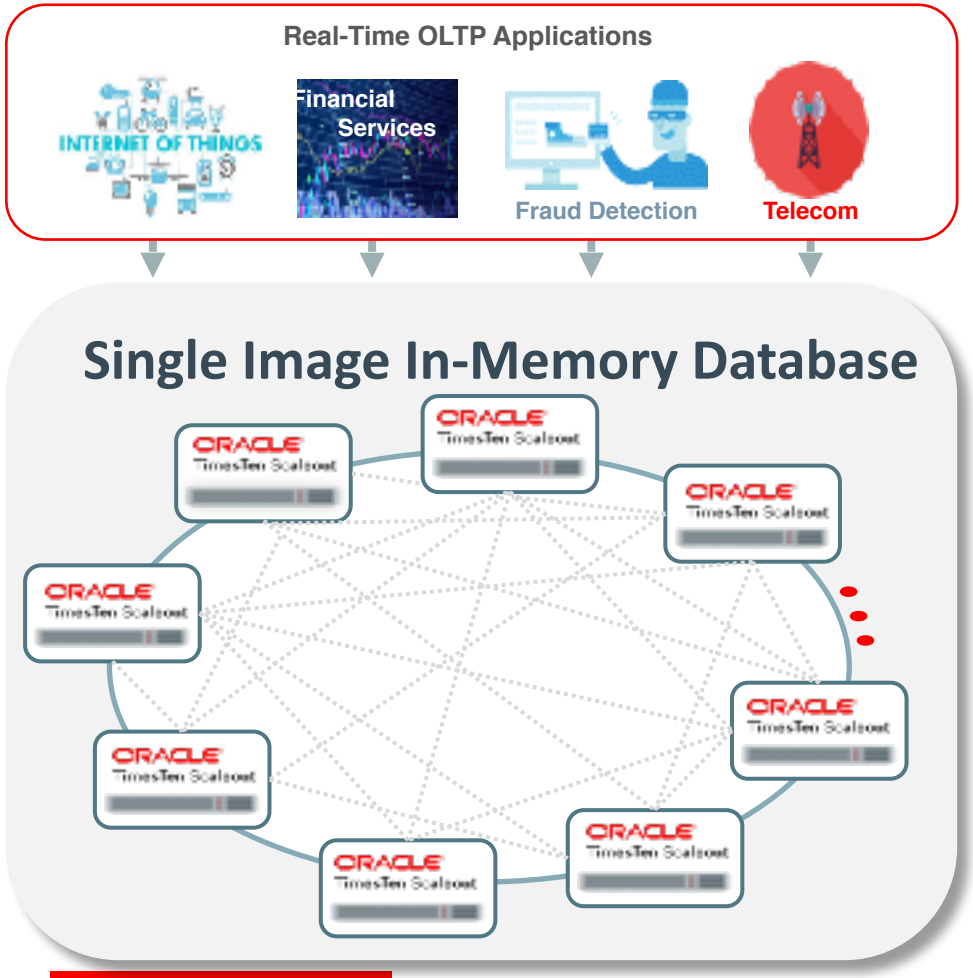

- Cache Group describes the Oracle Database tables to cache
  - All or subset of rows and columns
  - Defined using SQL

```
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

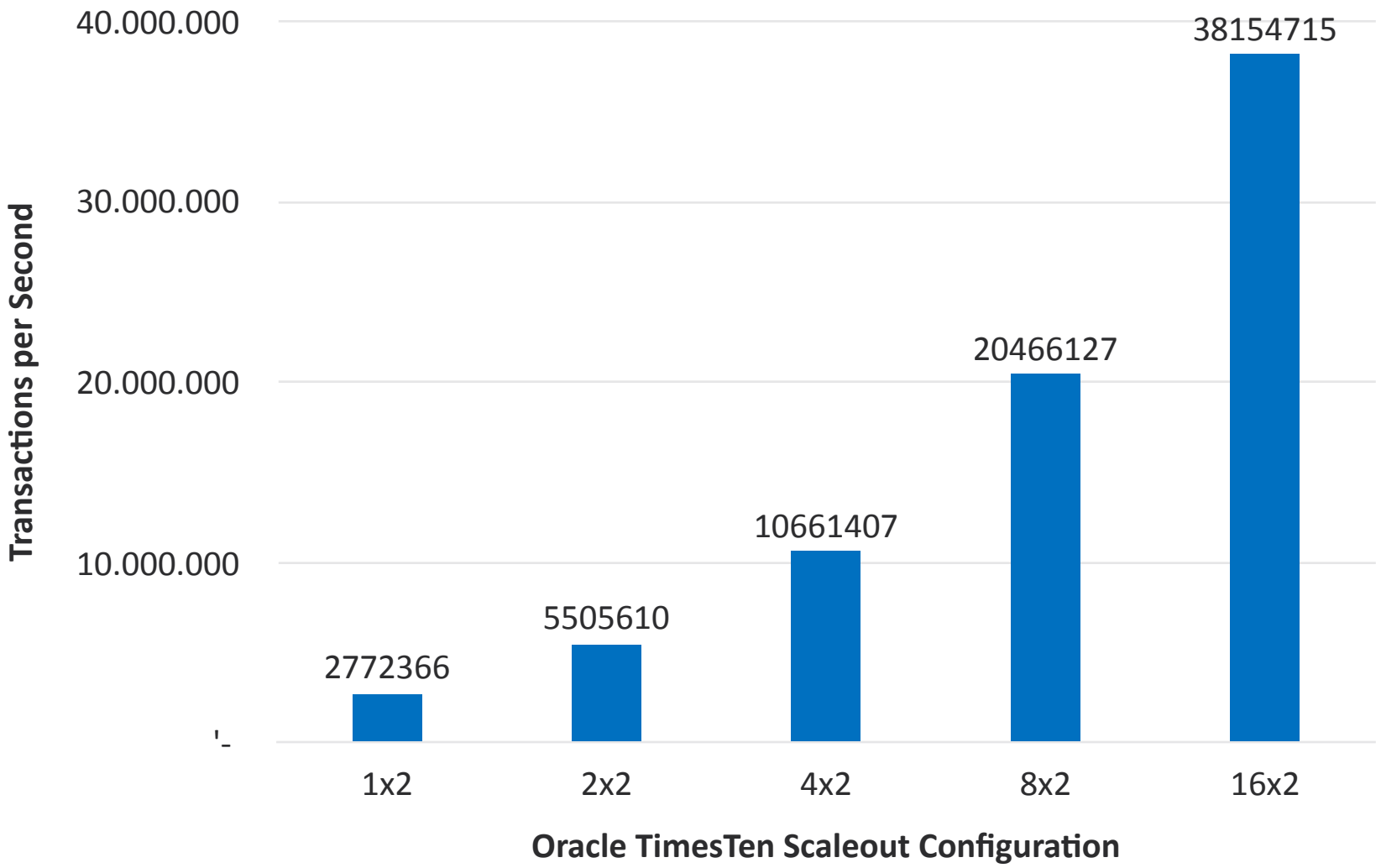
# TimesTen Scaleout

## 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

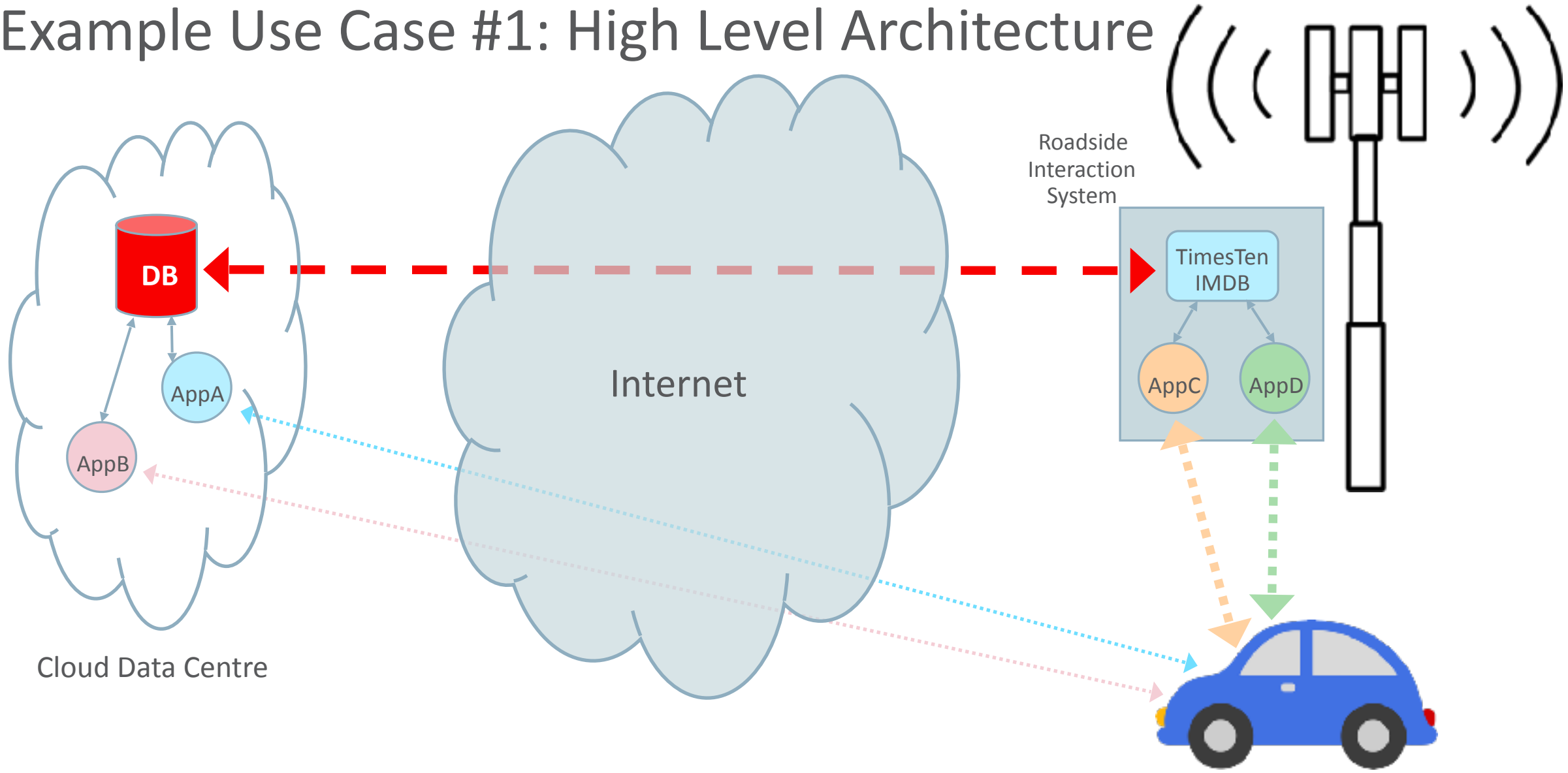
 

# Example use case #1: Navigation, traffic alerts, parking info

- 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



# 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



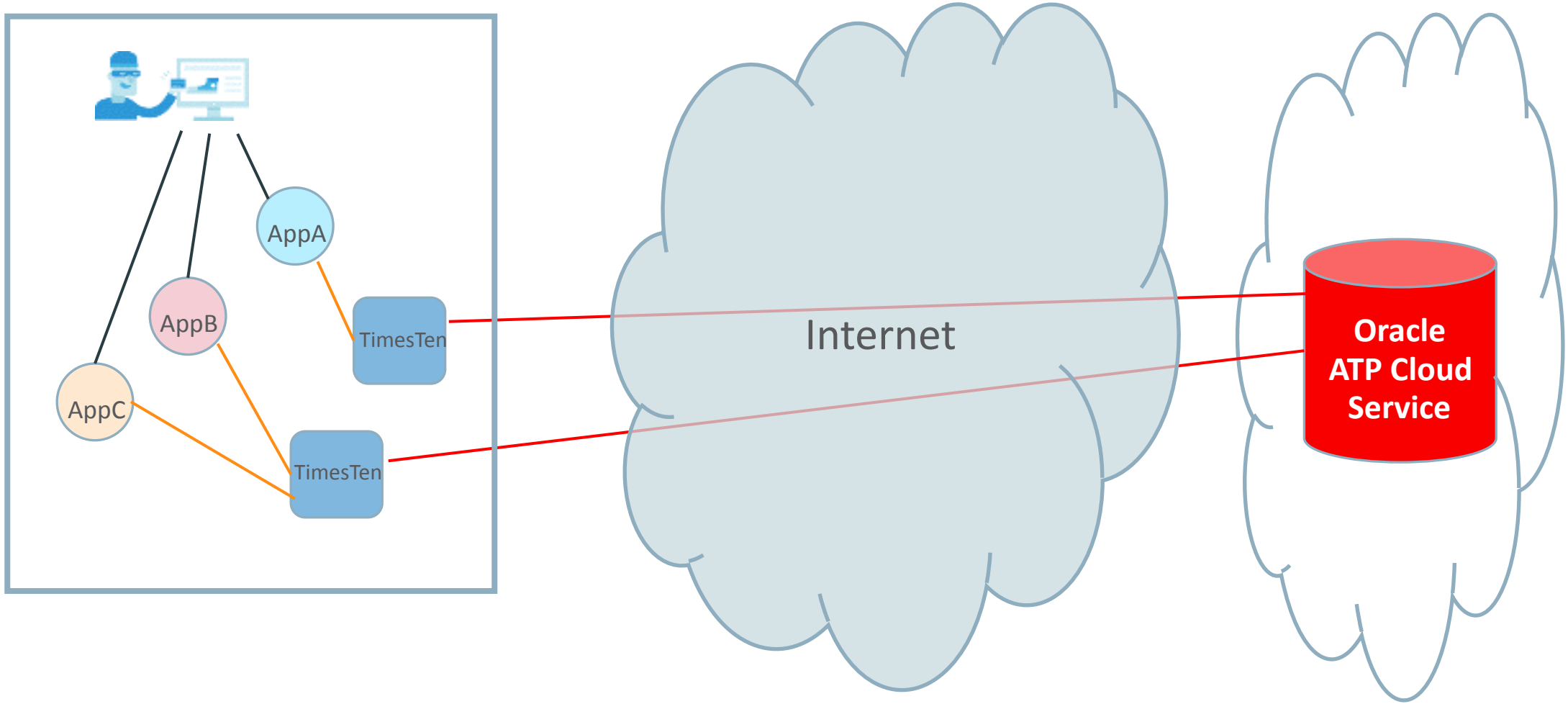
 

# Example use case # 2: Cache for Oracle ATP Cloud Service

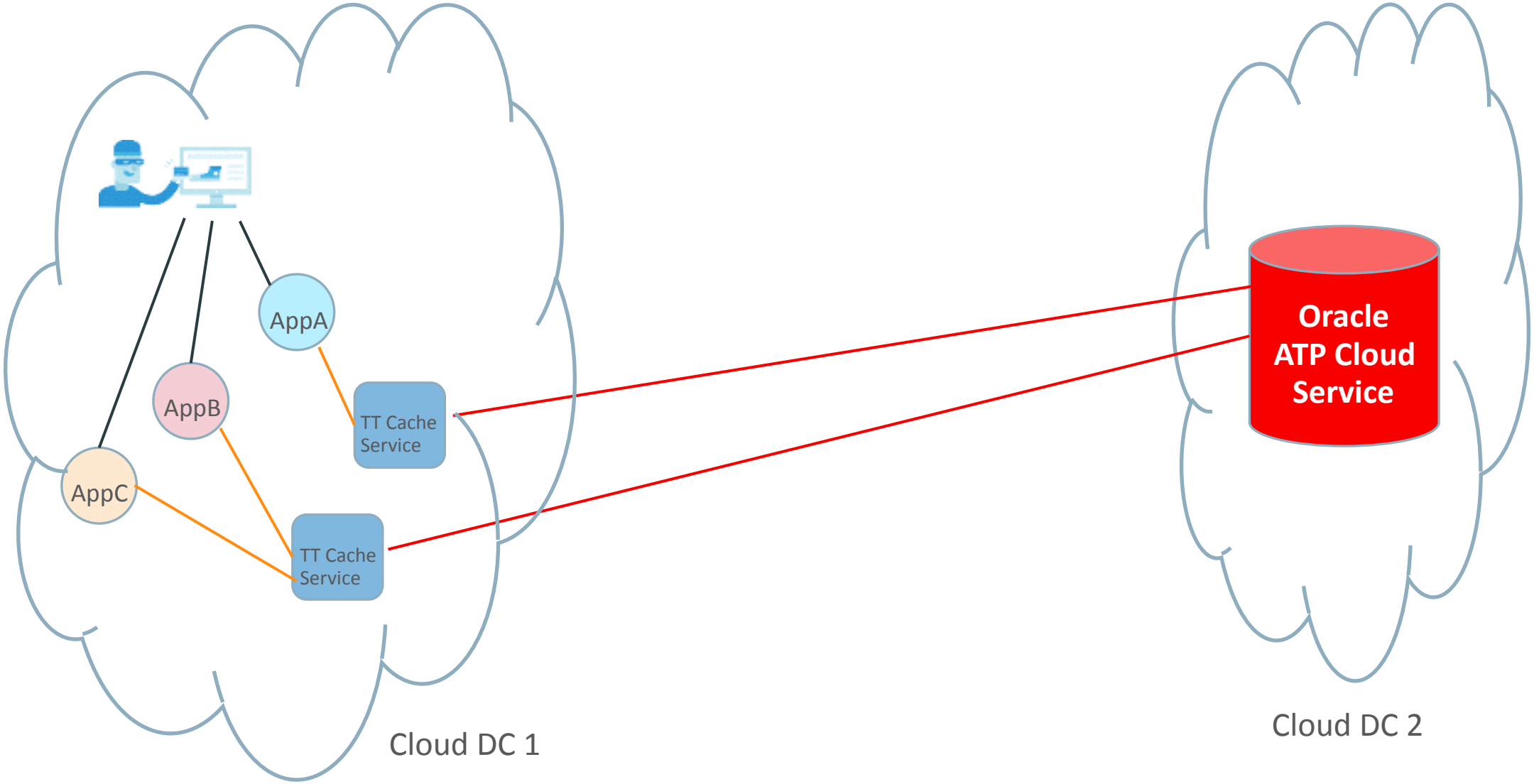
- ATP Cloud Service offers incredible performance
- But it is still a cloud service
  - High network latency if used in hybrid deployments
  - May be impacted by network issues
- Deploy TimesTen Cache as an on-premises CADB to improve hybrid deployments
- Deploy a TimesTen Cache Service for fully cloud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

# Example use case # 2: Cache for Oracle ATP Cloud Service



# Example use case # 2: Cache for Oracle ATP Cloud Service



# 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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