CON4758: Next-Generation Scale: How T-Mobile Uses Oracle TimesTen In-Memory Database

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Principal Engineer, T-Mobile US
Agenda

• Introducing TimesTen
  - Sam

• T-Mobile’s Customer Information Caching Journey
  Pradeep and Magesh

• Questions - All
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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.

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How do you **build** a service?

- Books say …
  - Three tier model
    - Web servers interact with users
    - Application servers implement business logic
    - Database remembers everything
- Simple!
How does your service perform?
How do you **scale** your service?

- Hyperscale applications are harder
- Adding more web servers: easy
- Adding more app servers: easy
- How about a much bigger database?
How is your response time?

- Every request goes over the network
- Twice
- Networks are slow
How do you **cache** data?

- **Great!**
  - Take some load off the database
  - Reduce network traffic
  - Improve response time

- **Not great!**
  - Two sets of code to access the same data?
  - Two different data models?
  - How do you keep the cache up to date?

- **Would be Awesome:**
  - A readable cache that looks like the database
How do you **capture** data?

- Some applications have high ingest rates
- Must capture data persistently
- Even if the database is down
- Even if the data is *bursty*
- Would be awesome:
  - A writable cache that looks like the database
Oracle TimesTen In-Memory Database

- **Relational Database**
  - Pure in-memory
  - ACID compliant
  - Standard SQL and PL/SQL
  - Entire database in DRAM

- **Extremely Fast**
  - Microseconds response time
  - Hundreds of millions of transactions per second throughput
  - Transparent scale out to dozens of hosts

- **Fully Persistent**
  - Database and transaction logs persisted to flash / disk

- **Highly Available**
  - Active – standby and multi-master replication
  - Parallel replication for very high throughput
  - High Availability and Disaster Recovery
  - K-safety

Used by thousands of companies around the world for over 20 years

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How do you use TimesTen?

*With the same skills you already have*

- TimesTen is a database
- Full transaction semantics
- Standard database APIs
- SQL
- PL/SQL
- Oracle compatible datatypes
- Sophisticated ability to sync data to/from Oracle Database (optional)
TimesTen as the database of record

- Example: Prepaid mobile billing

- *TimesTen runs more than a billion mobile phones around the world*

- Ultra high transaction volume
  - Every phone call
  - Every text message

- Very low response times
TimesTen as a writable cache

- Example: Realtime fraud detection
- Post office scans every envelope in real time
  - Looking for fraudulently photocopied stamps
- Huge transaction volumes
  - Over a million per second at peak
- Ultra short response time
  - Reroute letter *while it’s still in the sorting machine*
- Data ultimately sent to Oracle Database for long-term storage
TimesTen as a read only cache

- Example: eBay
  - Cache of all user data
  - Capable of 140 billion queries per day

- Example: T-Mobile
Agenda

- Introducing TimesTen
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- Questions - All
T-Mobile
Customer Information - Caching Journey

PACE Powered by TimesTen

Pradeep Rathnala Sr Manager, Customer Information

Magesh Kumar Janarthanan Principal Engineer

PRODUCT & TECHNOLOGY Customer Information Domain
ABOUT T-MOBILE

- T-Mobile US is the third largest wireless carrier in the United States. T-Mobile US provides wireless voice and data services in the United States, Puerto Rico and the U.S. Virgin Islands under the T-Mobile and Metro by T-Mobile brands.
- As America’s Un-carrier, T-Mobile US, Inc. is redefining the way consumers and businesses buy wireless services through leading product and service innovation.
- NASDAQ traded public company – TMUS
- Based in Bellevue, Washington

Q2 2019 Highlights:

- 1.8M total net adds – 25th consecutive quarter with more than 1 million net adds
- Record-low branded postpaid phone churn of 0.78% in Q1 2019, down 17 bps YoY
UN-CARRIER MOVES

SIMPLE CHOICE & MOBILE WITHOUT BORDERS
MARCH 2013

SIMPLE GLOBAL
OCTOBER 2013

LIFETIME COVERAGE GUARANTEE
JUNE 2014

Wi-Fi UNLEASHED
SEPTEMBER 2014

UN-CARRIER FOR BUSINESS
MARCH 2015

#GETTHANKED
JUNE 2016

TAXES & FEES INCLUDED
JANUARY 2017

TEAM OF EXPERTS
AUGUST 2018

JUMP! & JUMP! ON DEMAND
JULY 2013

CARRIER FREEDOM
JANUARY 2014

MUSIC FREEDOM
JUNE 2014

DATA STASH
DECEMBER 2014

BINGE ON
NOVEMBER 2015

T-MOBILE ONE
AUGUST 2016

NETFLIX ON US
SEPTEMBER 2017
WE REPRESENT..

Oracle Product Components:
- Oracle Siebel UCM
- Oracle TimesTen
- Oracle Enterprise DQ
- Oracle Watchlist Screening
- Oracle Database
- Oracle Data Integrator
- Oracle Goldengate
- Oracle Active Data Guard

Customer Information Domain

Customer Hub

Oracle Product Components:
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Part of Products & Technology responsible for:
- Customer & Prospect Lifecycle Management
- Customer Experience
- Credit, Fraud, Risk & Compliance
- Preferences

Domain Facts

<table>
<thead>
<tr>
<th>Subscribers</th>
<th>Prospects</th>
<th>Lookup Calls per Day</th>
<th>Avg SLA</th>
<th>Inbound Events Per Day</th>
<th>Commits /Day</th>
<th>Capability APIs</th>
<th>Database Size</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>112 MM</td>
<td>380 MM</td>
<td>10.2 MM</td>
<td>50 - 800 Milli sec</td>
<td>5.2 MM</td>
<td>400 MM</td>
<td>150 +</td>
<td>30 TB</td>
<td>99.996%</td>
</tr>
</tbody>
</table>

Lookup Calls per Day: 10.2 MM
Avg SLA: 50 - 800 Milli sec
Inbound Events Per Day: 5.2 MM
Commits /Day: 400 MM
Capability APIs: 150 +
Database Size: 30 TB
Availability: 99.996%

Part of Products & Technology responsible for:
- Customer & Prospect Lifecycle Management
- Customer Experience
- Credit, Fraud, Risk & Compliance
- Preferences
OUR PROBLEM STATEMENT

We were challenged with:

- SLA consistency amidst growing customer base
- Lack of application-level cache for COTS
- Need for in-memory data caching for microservice architectures
- Increased number of API consumers for customer data
- Interface to modernized customer experience platform in web and social channels
- Necessity to support critical-experience APIs
- Handling high concurrency
- Database hotspots
Our Cache Journey

- **RDBMS Options**
- **NoSQL Options**
- **Research Products in Market**

**Product Identification**
- Cloud Assessment (AWS)
- Load tests
- Proof of Concept
- Use Case Evaluation

**Evaluation**
- Hardware Specification
- Recommendations
- Sizing
- Product RoadMap

**Product Team Review**
- Production Readiness Review
- Testing (Functional + Performance)
- Monitoring/Alerts & Dashboard
- High Availability
- NPE / Production Build
- Setup & Configurations

**Implementation**
- Setup & Configurations
- Implementation

**Realization**
- Faster time to market
- Customer Experience
- Exceptional Performance

**Assessment**
- Hardware Requirements
- License Assessment
- Product Support
- Success Stories
- Published Benchmarks

**Comparison**
- Response Time
- Stability
- Compatibility with our product stack
- Cost (Implementation + Ops)

**Procurement**
- Business Justification
- Funding
- Domain Roadmap alignment

*Dates*
- **April 2019**
- **Sept 2019**
OUR SOLUTION

On-Prem Cloud Platform

API Gateway

PACE
Read / Write Cache

Partners
Retail
Web
Care
Walmart
Costco

Consumers / Channels
Retail
SIVR
Social Media

Sources
Billing
Comm...
Credit
Finance
Order
TFB

Event Framework
JMS
Kafka
RabbitMQ

Transaction CRM

T-Mobile
TEAM of EXPERTS

T-Mobile
MONEY

Oracle

T-Mobile Confidential
WHY TIMESSEN?

- Extreme read/write speed/performance (Microseconds Response Time)
- Failover and high availability
- Supports transactional data cache
- Supports reference data cache
- Support for relational data model
- Data replication
- Cloud native
- Available client frameworks for quick development
- Configurable retention policies
- Native primary data source (oracle DB) compatibility
**TimesTen Specification**

**H/W Specification :**
HP Dl560 Gen10 8180M @2.5 GHz, 112 Core
4TB PCIe NVMe
4TB DDR4 DRAM

**GRID1**
- Active
- Failover

**GRID2**
- Active
- Failover

**GRID1**
- StandBy

**GRID2**
- StandBy

**FAST Facts**

- **23** Cache Groups
- **1.1 Billion** Cached Records
- **1.3TB** Active Cache Size
- **10.2 MM** Requests /Day
- **21MM** Load Speed Per Second
- **99.96 %** Cache Hit Ratio

An illustrative high Available environment IDD.
Capability Benchmarks

API SLA

- CustomerBridging: 20X
- BillPaymentKiosk: 28X
- Accountautopay: 22X
- Customereligibilitycheck: 5X
- TEXconnectedcustomerassign...: 24X
- TEXAssignmentlookup: 24X
- BankCustomerProfile: 40X
- CustomerPrescreen: 20X

Response Time (Millisec)

Without TimesTen

With TimesTen
REALIZED BENEFITS

FAST RESPONSE TIME
5 - 50x IMPROVEMENT

ALWAYS ON
SEAMLESS SWITCHOVER

HIGH THROUGHPUT
STABLE UP TO 5x LOADS
NEXT STEPS

- Migrate to ScaleOut based on readiness of Application Cache feature. Working with Product Team to the rollout of Application Cache in ScaleOut
  - Scalability Benefits
- Implement Use cases to Integrate GraphQL with TimesTen. Working with Product team for release of adapter for Node.js
LET’S TALK
TimesTen Sessions This Week

• CON4759: Oracle Data Caching: An eBay perspective
  Moscone South
  Room 152C
  11:15 Wednesday

• Come see us at the Demogrounds!
  Moscone South
  Booth ODB-015
Oracle TimesTen

The World’s Fastest OLTP Database