Architecting Real-Time Applications on SAP HANA Platform

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@rvenumbaka
Agenda

Introduction
In-Memory Computing: Why now?
What is SAP HANA Platform?
Architecting new applications on SAP HANA platform
Getting Started
SAP

R/3   ABAP   HANA
ERP   CRM    S/4HANA
SD, MM  BW     Business Objects
FI-CA Netweaver Ariba
          Sybase
          SuccessFactors
          Concur
THE cloud company powered by SAP HANA

- Platform
- Applications
- Network

86% of Global Fortune 500

98% of the 100 Most Valued Brands

44 M Cloud users

74% of the world transactions
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Introduction

**In-Memory Computing: Why now?**

What is SAP HANA Platform?

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Getting Started
Disk is too slow

Data Access Latency

- Core 1: 1.5 nanoseconds (L1 Cache)
- Core 1: 4 nanoseconds (L2 Cache)
- Core 1: 15 nanoseconds (L3 Cache)
- Core 1: 60 nanoseconds (Main Memory (DRAM))
- 1.5 nanoseconds
- 4 nanoseconds
- 15 nanoseconds
- 60 nanoseconds
- SSD: 200,000 nanoseconds
- Hard Disk: 10,000,000 nanoseconds

Disk is the Bottleneck

- CPU
- Memory
- Disk Storage
- Traditional Database

- DRAM is 125,000 times faster than disk
- DRAM is 10-80 times slower than on-chip caches
What does this mean to YOU and Software Architecture?

Architecture is developed based on current limitations and future requirements
Today’s reality… More data - Big Data, IoT

- Global middle class will reach 5 billion by 2030
- In 2015, Americans will spend 1.8 billion on mobile devices
- 200 trillion text messages received in the US every day
- 500 million Tweets sent per day
- 50 billion connected devices in 2020
Hardware Developments

20 years ago

MEMORY 1 GB x 6000
CPU 4 X 50 MHz x 1800

Today

MEMORY 6 TB
CPU 120 X 3.5 GHz

Near Future

MEMORY 48 TB
Cores 480
In-memory computing is a reality

<table>
<thead>
<tr>
<th>Year</th>
<th>Price / GB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>$6,328,125</td>
</tr>
<tr>
<td>1990</td>
<td>$103,880</td>
</tr>
<tr>
<td>2000</td>
<td>$1,107</td>
</tr>
<tr>
<td>2013</td>
<td>$5.50</td>
</tr>
</tbody>
</table>

Source: http://www.statisticbrain.com/average-historic-price-of-ram/
What if there is ONE platform….

…that can process transactions and analytics

…that can process all data types (structured, unstructured, documents, spatial, graph)?

…where all processing capabilities required to build an application are included?

…that is available in public/private cloud and on-premise?

How does this change the software architecture?
# SAP HANA Platform
The in-memory data management and application platform for all applications

**SAP HANA Platform**

<table>
<thead>
<tr>
<th>All Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAP, ISV and Custom Applications</td>
</tr>
<tr>
<td><strong>SAP HANA Platform</strong></td>
</tr>
<tr>
<td>Application Services</td>
</tr>
<tr>
<td>Database Services</td>
</tr>
<tr>
<td>Integration Services</td>
</tr>
<tr>
<td>All Data</td>
</tr>
</tbody>
</table>

**ONE open platform**

**OLTP + OLAP**

**ONE copy of the data**
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SAP HANA Platform – Database Services

Breakthrough innovations

- Turns data into real-time information
- No database tuning required for complex and ad hoc queries
- Run Transactions and Analytics together on one system and one copy of data
- Ready for Cloud, Hybrid, or On-premise deployment
- Not limited by the size of memory
In-Memory Columnar Store
Faster OLTP + OLAP processing on single copy of data

- ACID compliant
- High speed transactions support
- Aggregations on fly
- No indexes for fast access
- Process compressed data
- Optimized for multi-core parallel processing
- Single Instruction, Multiple Data (SIMD) processing support
Columnar Store

<table>
<thead>
<tr>
<th>Order</th>
<th>Country</th>
<th>Product</th>
<th>Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>456</td>
<td>France</td>
<td>corn</td>
<td>1000</td>
</tr>
<tr>
<td>457</td>
<td>Italy</td>
<td>wheat</td>
<td>900</td>
</tr>
<tr>
<td>458</td>
<td>Italy</td>
<td>corn</td>
<td>600</td>
</tr>
<tr>
<td>459</td>
<td>Spain</td>
<td>rice</td>
<td>800</td>
</tr>
</tbody>
</table>

Typical Database

```
SELECT Country, SUM(sales) FROM SalesOrders
WHERE Product = 'corn'
GROUP BY Country
```
Workload Analysis in OLTP & OLAP applications

Workload in enterprise applications are mainly read queries (OLTP 83%, OLAP 94%)

* Without Transaction-Maintained Aggregates
Columnar store to process transactions and queries
OLTP+OLAP on single copy of data

- Delta storage is optimized for transactions
- Delta storage is merged periodically with main storage
- No data duplication – Data kept either in delta storage or in main storage
SAP HANA Platform – Database Services
Comprehensive advanced data processing and analytics

### SAP HANA Platform

<table>
<thead>
<tr>
<th>Application Services</th>
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<tr>
<td>Database Services – Foundation and Processing Capabilities</td>
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<tr>
<td>Spatial</td>
</tr>
<tr>
<td>Search</td>
</tr>
<tr>
<td>Data Quality</td>
</tr>
</tbody>
</table>

Integration Services

- Run applications with dramatically different datatype characteristics in the same system
- Optimize streaming, graph, planning, and spatial applications on the same data
- Empower your business via built-in predictive analytics, business functions, and data quality
Build more logic inside the database

Eclipse Based IDE & Web IDE

Modeling tools to build application logic inside the database
• Views, Calculation Views, Stored Procedures, Decision Tables

Core Data Services (CDS)

SQL for spatial, search, text processing, predictive and graph

Built-in business function libraries for complex computations

60+ predictive libraries
Build more logic inside the database – Views – 1/3

Attribute View

Analytical View

Calculation View

Calculation View with Script

Currency Conversions
Build more logic inside the database – Views – 2/3
Purpose built engines to optimize execution

- SQL Optimizer
- Calculation Engine
- OLAP Engine
- Join Engine
- Column Store
- Calculations on Views
- Analytic Views
- Attribute Views
Build more logic inside the database – Views – 3/3

Graphical Calculation Views

- No SQL Script coding needed
- Includes Union, Join, Projection and Aggregation nodes
- Uses Analytic Views, Attribute Views, Calculation Views and tables
- Supports calculated columns
- Supports debugging
Build more logic inside the database – Core Data Services – 1/2
Entities & Associations

Custom-defined Type

```
type Amount {
    value : Decimal;
    currency : Association to Currency;
}
```

Entity

```
entity Address {
    streetAddress; zipCode; city; // snipped type defs
    kind : enum { home, business }
}
```

Association

```
entity Employee {
    addresses : Association[0..*] to Address;
    homeAddress = addresses[kind=home];
    salary : Amount;
}
```

Calculated Field

```
EmployeesInOrg as SELECT from Employee {
    ID, name, salary, orgunit {
        name,
        manager,
    },
    homeAddress
}
```

Structured Field

Query in CDS QL

```
```
Path expressions along Associations

```sql
SELECT c.id, c.name, a.zipCode FROM Customer c
JOIN $Customer2Address c2a ON c2a.customer = c.id
JOIN Address a ON c2a.address = a.id
AND a.type='deliveryAddr'
WHERE ...
```

XPath-like filter expressions in paths

```sql
SELECT name, addresses[type=deliveryAddr].city AS deliveryAddress,
addresses[type=invoiceAddr].city AS invoiceAddress FROM Customer ...
```

Nested projection clauses → structured result sets

```sql
SELECT id, name,
    deliveryAddress { streetAddress, zipCode, city }
FROM Customer WHERE ...
```
SAP HANA Platform – Application Services
Web server and database in one system reducing data movements

- Deliver consumer-grade User Experiences for any device, automatically
- Support for open development standards – HTML5, JSON, Java Script
- Built-in tools to develop, version-control, bundle, transport, and install applications
Beautiful User Experience on All Devices

- Model-View-Control (MVC) based JavaScript UI libraries to render client-side HTML5
- Based on OpenUI5 libraries
- 180+ UI controls and charts included
- Works with JSON, XML and OData models
SAP HANA Platform – Integration Services
Data from any source for a complete view of the business

- Access information stored in data silos while keeping the data in place
- Replicate and move any type of data in real-time to the cloud and on-premise when necessary
- Multiple access points from HANA to Hadoop data: thru Spark, Hive, HDFS and Map Reduce functions
- Run R applications directly from SAP HANA
SAP HANA: The Platform for all Applications
Comprehensive services to make information available to any application

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<tr>
<td>Web Server</td>
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<tr>
<td>OLTP + OLAP</td>
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<tr>
<td>Search</td>
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<tr>
<td>Dynamic Tiering</td>
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<table>
<thead>
<tr>
<th>Integration Services</th>
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</thead>
<tbody>
<tr>
<td>Smart Data Access</td>
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</table>

SAP HANA delivers results for business today

5,800+ SAP HANA customers

Forrester reports 37% cost savings using a single system for Analytics and Transactions

1,850+ SAP Business Suite and BW powered by SAP HANA customers

1,800+ startups from 57 countries innovating on SAP HANA

10,000 times faster reports

37+ SAP HANA Cloud Data Centers Worldwide (from SAP and IBM)
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Architecture changes with SAP HANA Platform – 1/2

UI Rendering

Middle Tier

Database

UI/App logic

Service logic

Data-centric logic

UI/Application Layer

(-> Client-side)

Application Services

Database Services

REST (OData)

SAP HANA Platform
Architecture changes with SAP HANA Platform – 2/2

**Push-down code** to database using views / CDS / SQL Script and consume through OData.

**Execute with built-in application services** to avoid multiple layers of buffering and to reduce data transfers.

**Use Insert-Only** to reduce time consuming updates and deletes and get change logs for free.
Big Data / IoT applications – Use SAP HANA platform as side car

Existing Applications

Application Server

Database

Big Data/ IoT Applications

SAP HANA Platform

<table>
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<tr>
<th>Text</th>
<th>Spatial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predictive</td>
<td>Graph</td>
</tr>
<tr>
<td>SDI/SDQ</td>
<td>Streaming</td>
</tr>
</tbody>
</table>

Warm data can be stored in the disk with Dynamic Tiering
Migrate data to SAP HANA platform

Build Insight to Action applications
Run all applications on SAP HANA Platform

No data duplicates | No data movement | No data latency | Simplified Landscape
All SAP applications run better on SAP HANA
SAP HANA is central to SAP strategy

- Every product from SAP already runs in / will soon be optimized for SAP HANA
- SAP HANA powers both on-premise and cloud applications
- SAP HANA enables managed private cloud (HEC) and SAP Platform-as-a-Service (HCP)
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Getting Started

Free Developer Instance

HANA Developer Edition on Azure

Microsoft Azure

HANA One on AWS

HANA Cloud Platform
Additional Information

Learn about SAP HANA

- SAP HANA Academy: [https://www.youtube.com/user/saphanaacademy](https://www.youtube.com/user/saphanaacademy)
- Free Massive Open Online Course (MOOC):
  - An Introduction to SAP HANA
  - Introduction to Software Development on SAP HANA


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