Product Brief

Trafodion:
Transactional SQL on HBase

Enabling real-time distributed transaction processing on top of HBase

Introduction

Trafodion is an open source initiative from HP, incubated at HP Labs and HP-IT, to develop an enterprise-class SQL-on-HBase solution targeted for big data transactional or operational workloads. HP has developed transactional SQL technologies with more than 20 years of investment into database technology and solutions. Trafodion brings this core technology to the Hadoop ecosystem. The name 'Trafodion' (the Welsh word for transactions, pronounced '*Tra-vod-eee-on*':) was chosen specifically to emphasize the differentiation that Trafodion provides in closing a critical gap in the Hadoop ecosystem. To find out more about the origin and the name of the project, please visit **www.hp.com/go/trafodion.**

Target workloads

Hadoop workloads span from long-running batch mode to low-latency operational workloads as shown in the figure below. The three categories on the right side are analytic workloads and are regarded as well-suited for Hadoop and therefore have garnered the most attention. In contrast, the leftmost workload defined as "Operational" is a new class of workloads that encompasses OLTP workloads as well as transactions that include social and mobile data interactions and observations using a mixture of structured and semi-structured data.
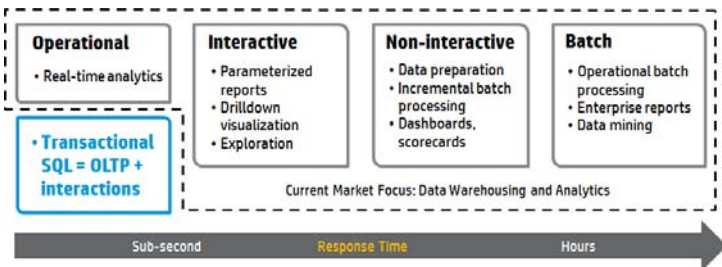
Traditionally, these workloads have been handled by relational databases. But, relational databases have scalability issues and do not provide schema flexibility required in certain cases. Hadoop addresses these limitations. Combined with Hadoop's perceived benefits of significantly reduced costs, there is growing interest and pressure to embrace these workloads in the Hadoop ecosystem.

As operational workloads represent business needs, they typically consist of a constant flow of transactions requiring low-latency response times for read/write access. Additionally, these workloads are characterized by:

- Data integrity with ACID-compliant protection
- High availability, concurrency and scalability
- Multi-structured data
- Rapidly evolving data requirements

Features

Currently, there is no existing open source SQL-on-HBase solution that adequately meets these requirements. Trafodion provides the following functionality to support transactional workloads in Hadoop:

- ACID-compliant distributed transaction protection over multiple SQL statements, tables and rows
- Rich, full-functioned ANSI SQL language support using ODBC/JDBC connectivity interfaces
- Performance improvements for transactional workloads by leveraging compile-time and run-time optimizations
- Support for large data sets using parallel-aware query optimizer

Trafodion intends to leverage the full capabilities of Hadoop ecosystem:

- Schema flexibility provided by HBase column family structures
- Snapshot capability with versioning support in Hadoop
- High Availability and Disaster Recovery support with replication and snapshotting capabilities

Benefits

Trafodion delivers a full-featured and optimized transactional SQL-on-HBase DBMS solution with full transactional data protection. These capabilities help overcome Hadoop's weaknesses in terms of supporting transactional workloads.

With Trafodion, customers gain the following benefits:

- Ability to leverage SQL expertise versus complex MapReduce programming
- Seamless support for existing transactional applications
- Ability to develop next generation highly scalable, real-time transaction processing applications
- Reduction in data latency for down-steam analytic workloads

And they also gain the following benefits inherent in Hadoop ecosystem:

- Reduced infrastructure costs
- Massive scalability and granular elasticity
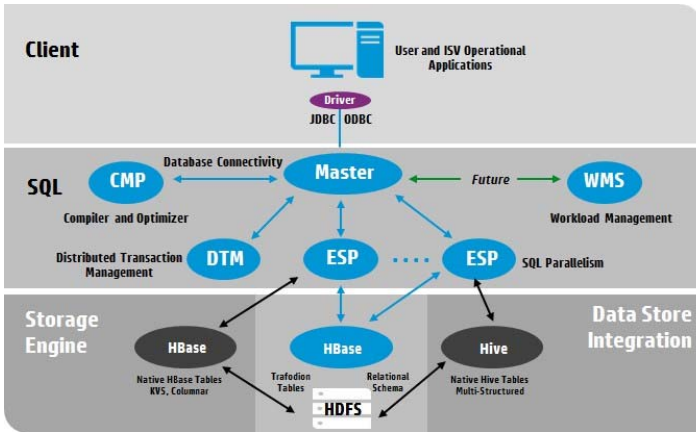- Improved data availability and disaster recovery protection

Trafodion: Transactional SQL on HBase

Architecture

The Trafodion software architecture consists of three distinct layers: the client layer, the SQL database services layer, and the storage engine layer as shown in the figure below.

The first layer is the **Client Services layer** where the application resides and accesses the Trafodion database via standard ODBC/JDBC interface using a Trafodion-supplied Windows or Linux client driver.

The second layer is the **SQL layer** where Trafodion provides a relational schema abstraction on top of HBase, encapsulating all of the services required for managing Trafodion database objects. These services include connection management, transaction management, optimized plan generation, and execution against Trafodion database objects. Trafodion features a mature query optimizer that can generate parallel query plans, eliminating the need for complex MapReduce programming development.

The third layer is the **Storage Engine layer** which consists of standard Hadoop services including HBase, HDFS, and Zookeeper. Trafodion database objects are stored in native Hadoop (HBase/HDFS) database structures. Trafodion handles the mapping of SQL requests into native HBase calls transparently on behalf of the application.

Key innovations

Trafodion's Distributed Transaction Management (DTM) component provides protection to transactions spanning multiple SQL statements, multiple tables, or multiple rows of a single table. Additionally, Trafodion DTM provides protection in a distributed cluster configuration across multiple HBase regions using an inherent two-phase commit protocol. DTM provides support for implicit (auto-commit) and explicit (BEGIN, COMMIT, ROLLBACK WORK) transaction control.

Trafodion provides many compile-time and run-time optimizations for varying transactional workloads ranging from singleton row accesses for OLTP-like transactions to highly complex SQL statements used for operational reporting purposes.

Example use case: OpenCart Application

As an example use case, OpenCart which is a free open source e-commerce platform, has been modified to execute SQL statements that interface with Trafodion instead of the default database (MySQL). This is a good application to demonstrate typical OLTP workload characteristics.
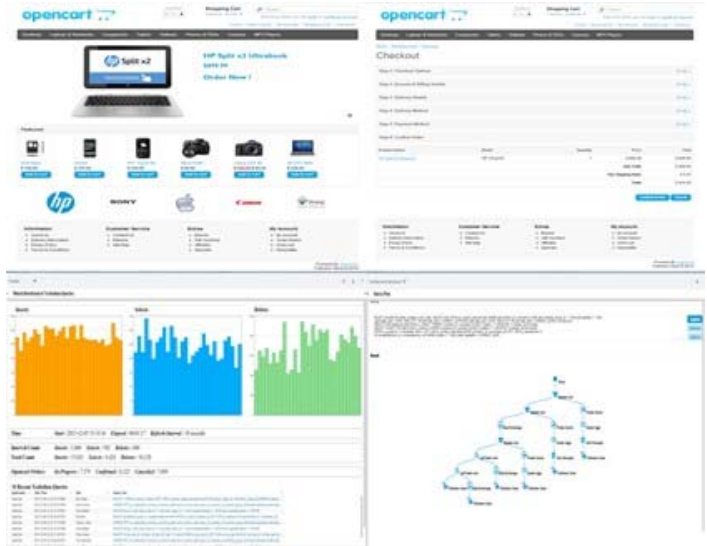
The top two figures show the changes to OpenCart to reflect the look of an HP shopping cart and the last two illustrate workload and query-level analysis using Trafodion Query Workbench.

Product availability

HP has launched Trafodion as an open source project and released the software under the Apache License, Version 2.0. Trafodion is now available to help you evaluate Trafodion's capabilities and begin proof of concept and prototyping efforts. The Trafodion documentation and download package consisting of the installer and the executable code are available at www.trafodion.org.

Learn more at
www.hp.com/go/trafodion

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