Apache Drill

YATIN SHARMA[1,*,+]

[1] School of Informatics and Computing, Bloomington, IN 47408, U.S.A.
[*] Corresponding authors: yatins@indiana.edu
[+] HID - S17-IR-2034

Paper-001, April 9, 2017

Apache Drill is a distributed SQL engine designed to enable users to explore and analyze data stored in non-relational datastores. It enables users to query the data using standard SQL and Business Intelligence(BI) tools without having to create schemas or transform data.

Keywords: Apache, Drill, DrillBit, NoSQL, Query

https://github.com/cloudmesh/sp17-i524/tree/master/paper1/S17-IR-2034/report.pdf

INTRODUCTION

Apache Drill[1], inspired by Google's Dremel System, is industry's first schema-free distributed SQL Engine which allows us to write SQL queries without having the need to define and maintain schemas or transform data. It automatically understands the structure of the data. It can integrate and combine from several data sources like Hive, Hbase, Mongodb, etc in a single query and export the data to any of the reporting tools like tableau[2], Excel, etc. Apache Drill can be used without the need of defining. It allows us to bypass schema maintenance tasks as well as Extract, Transform, Load (ETL) cycles and thus saves a lot time in data processing, which earlier consumed majority of projects time.

BENEFITS

Apache Drill allows us to conduct research on datasets without having to be an expert in everything. It is simple and straightforward to use and follows ANSI SQL standards, so there is no need for fresh learning. All we need is knowledge of SQL to get started. Additionally, Drill allows to couple various datasets with NoSQL[3] systems and provide direct access to keys of data which can then be used to query the data using Apache Drill whether it is stored in a file or NoSQL database. From a security perspective, Drill allows to create views for higher level access on the original data and give permission to others on these views. Drill comes with built in measures to protect and secure a database. It allows users to create a view and apply filesystem security to this view based upon their needs. Drill currently supports 3 layers of impersonation.

ARCHITECTURE

At the core, Drill consists of Daemon service called the Drillbit [4] which is responsible for accepting requests from clients, processing them, and returning the results to the client. The drillbit service can be run on any or all nodes of a cluster. It uses ZooKeeper[5] for all sort of communication in the clusters. ZooKeeper is responsible for cluster combination, cluster membership, leadership selection, etc. So, when a user submits a query, the ZooKeeper finds the Drillbit instance, also called foreman, which will eventually do the parsing, optimization, execution and data aggregation. All of this takes fraction of seconds to execute. Just like MapReduce, Drill uses data locality such that there is no need to bring data over the network and instead bring code to the data. It comes with a distributed SQL MPP engine to execute queries in parallel on a cluster.

Query Execution Flow

The SQL query submitted by Drill client, any JDBC/ODBC cliet or Rest Client, is accepted by a drillbit in a cluster. The drillbit that accepts the query becomes the driving Drillbit node, also called as a foreman, for this particular request. As a client application we can either submit to a drillbit or talk to the zookeeper which in turn will route this to an available drillbit. Once the query is received, it parses the query and tries to figure out the most optimal way to execute this query. Drill allows to do a variety of rule based as well as cost based optimization in addition to being aware of data locality while doing the query planning. Once the query plan is determined, Drill splits the query plan into a number of pieces called 'Query Plan Fragments'. The coordinated drillbit talks to the ZooKeeper and finds out what are the other drillbits that are available in the cluster. It then gets the location of the data and combines this information to determine the drillbits that can handle this Query Plan Fragments. It distributes the work to other drillbits in the cluster. Each Drillbit then does its own processing of the Query Plan Fragment and returns the result to the original drillbit(foreman) which then combines and returns the result to the client. As shown in the diagram below, Each of the drillbit, during the execution, would be interacting with the underlying Storage System like DFS, Hbase, MongoDB, etc.

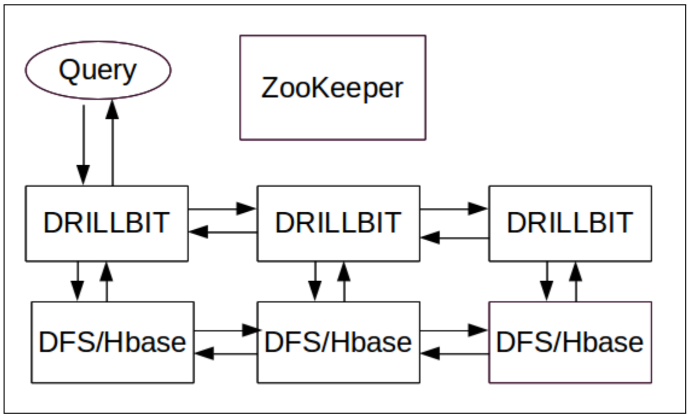

Fig. 1. Query Execution Workflow.

Figure 1. above describes the basic query execution workflow.Important thing to notice here is that each of the Drillbits are equal and there is no Master-Slave concept. So, the request from the client can go to any of of the drillbit depending upon its availability. It is also a completely scalable architecture that allows to add in more drillbits as and when required[6].

Columnar Execution

Drill is Columnar in storage as well as memory. It means that it does not have to materialize the data into row format and can perform all SQL operations like join, sorting, etc directly on columnar data without having to change the data. The benefit of this is that it not only boosts the performance but also saves the memory footprint that Drill has to occupy during query execution.

Vectorized Processing

Drill provides a vectorized execution engine to offer high memory and CPU efficiencies along with rapid performance for a wide variety of analytic queries. Instead of working on single records at any given time, Drill allows CPU to work on vectors, which are arrays of values from many different set of records in table. So, Drill works on more than one record at a time to achieve efficiency.

Optimistic/In-Memory

Drill is very optimistic in the sense it assumes that the chances of failure like hardware or node failure is very uncommon during the short execution of the query.So, it tries to execute as much as possible in memory without writing anything to disk for check-point and recovery purposes. Drill uses the traditional Pipe-line execution model in which all the tasks are executed in parallel and in different stages in different parts of the cluster.This enables Drill to achieve high speed performance in seconds.

Datastores Support

Drill is build for non-relation datastores like Hadoop, NoSQL, and cloud storage. Currently following datastores are supported:

- **Hadoop**: All Hadoop distributions (HDFS API 2.3+), including Apache Hadoop, MapR, CDH and Amazon EMR-for Data Ingestion
- **NoSQL**: MongoDB, HBase
- **Cloud storage**: Amazon S3, Google Cloud Storage, Azure Blog Storage, Swift

Client Support

Drill currently supports following clients:

- **BI tools** via the ODBC and JDBC drivers (eg, Tableau, Excel, MicroStrategy, Spotfire, QlikView, Business Objects)
- **Custom applications** via the REST API
- **Java and C applications** via the dedicated Java and C libraries

COMPARISON

Drill supports various non-relational datastores including Hadoop. However, Drill takes a different approach compared to popular SQL-on-Hadoop technologies like Hive and Impala. For example, it lets users directly query self-describing data (eg, JSON) without having to create and manage schemas.Moreover, Hive is a typical batch processing framework best suitable for long-running jobs, Drill on the other hand is suitable for short-running jobs like data exploration and BI. Unlike Hive, Drill is not limited to Hadoop. Drill can also query NoSQL databases (eg, MongoDB, HBase) and cloud storage (eg, Amazon S3, Google Cloud Storage, Azure Blob Storage, Swift).

GETTING STARTED

Step-by-step procedures to download, install and get started with Drill can be found on-line.[7]

CONCLUSION

Apache Drill allows us to use familiar querying language (SQL) against different data sources.It provides a single SQL interface for self service data exploration for structured and semi-structured data Source without any IT intervention. Drill also allows us to use familiar BI tools like Tableau and Excel for data exploration without any time-consuming/expensive programing and data definition. Apache Drill is making big data analytics more accessible to wider groups of people.

ACKNOWLEDGEMENTS

The author thanks Prof. Gregor von Laszewski for his technical guidance.

REFERENCES

[1] “Apache drill schema-free sql query engine for hadoop, nosql and cloud storage,” Web Page, online; accessed 23-Feb-2017. [Online]. Available: https://drill.apache.org/
[2] “Business intelligence and analytics | tableau software,” Web Page, online; accessed 15-March-2017. [Online]. Available: https://www.tableau.com/
[3] “Nosql databases explained | mongodb,” Web Page, online; accessed 15-March-2017. [Online]. Available: https://www.mongodb.com/nosql-explained
[4] “Architecture introduction - apache drill,” Web Page, online; accessed 23-Feb-2017. [Online]. Available: https://drill.apache.org/docs/architecture-introduction/
[5] “Apache zookeeper - home,” Web Page, online; accessed 15-March-2017. [Online]. Available: https://zookeeper.apache.org/

[6] “Drill query execution - apache drill,” Web Page, online; accessed 23-Feb-2017. [Online]. Available: https://drill.apache.org/docs/drill-query-execution/
[7] “Tutorials introduction - apache drill,” Web Page, online; accessed 23-Feb-2017. [Online]. Available: https://drill.apache.org/docs/tutorials-introduction/