Druid lookups for high cardinality dimensions

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Agenda

- What’s druid
- Overview of druid segment file
- Why lookups
- Maha druid lookups architecture
- Salient features of maha druid lookups

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What's Druid?

- An open-source data store designed for sub-second OLAP queries
- Power analytic applications
- Real-time streaming ingestion
- Scalable
- Cost effective
- Highly available

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Data Roll-up

Timestamp	Dimensions			Metrics	
Timestamp	AdvertiserId	Gender	Country	Impressions	Clicks
2017-01-01T01:01:35Z	12345	Male	US	1	1
2017-01-01T01:02:18Z	12345	Male	US	1	0
2017-01-01T01:08:52Z	12345	Male	US	1	1
2017-01-01T01:13:45Z	12345	Female	US	1	0
2017-01-01T01:35:15Z	12345	Female	US	1	1

} Raw events

Timestamp	AdvertiserId	Gender	Country	Impressions	Clicks
2017-01-01T01:00:00Z	12345	Male	US	3	2
2017-01-01T01:00:00Z	12345	Female	US	2	1

} Immutable Segment file

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Druid req/resp

```
{
  "queryType": "groupBy",
  "dataSource": { "type": "table", "name": "sample_datasource" },
  "granularity": { "type": "all" },
  "dimensions": [
    { "type": "default", "dimension": "AdvertiserId", "outputName": "Advertiser ID" },
    { "type": "default", "dimension": "Gender", "outputName": "Gender" },
    { "type": "default", "dimension": "Country", "outputName": "Country" }
  ],
  "aggregations": [
    { "type": "longSum", "name": "Impressions", "fieldName": "Impressions" },
    { "type": "longSum", "name": "Clicks", "fieldName": "Clicks" }
  ],
  "intervals": [ "2017-01-01T00:00:00.000/2017-01-02T00:00:00.000" ]
}
```

```
[
 {
  "version" : "v1",
  "timestamp" : "2017-01-01T00:00:00.000Z",
  "event" : {
   "AdvertiserId" : 12345, "Gender" : "Male", "Country" : "US", "Impressions" : 3, "Clicks" : 2
  }
 },
 {
  "version" : "v1",
  "timestamp" : "2017-01-01T00:00:00.000Z",
  "event" : {
   "AdvertiserId" : 12345, "Gender" : "Female", "Country" : "US", "Impressions" : 2, "Clicks" : 1
  }
 }
]
```

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What about mutable dimension data ?

Timestamp	AdvertiserId	Gender	Country	Impressions	Clicks
2017-01-01T01:00:00Z	12345	Male	US	3	2
2017-01-01T01:00:00Z	12345	Female	US	2	1

Immutable segment file

AdvertiserId	Status
12345	ON
67890	ON

Mutable, how to support them ?

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Few options

1. Client side join
   - overhead
   - need to handle complicated logic like filtering
   - error prone
2. Use druid lookups

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What’s druid lookups?

- Dimension values are replaced with new values
- Two types
  - Map lookups, very small lookup that can be passed at query time
  - Globally cached lookups from local files or JDBC

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Limitations of default implementation

- Not suitable for high cardinality dimensions
- Most node types have to be loaded with lookups
- Limited to only one key column with a value column
- No real time updates
- Doesn’t generate monitoring metrics

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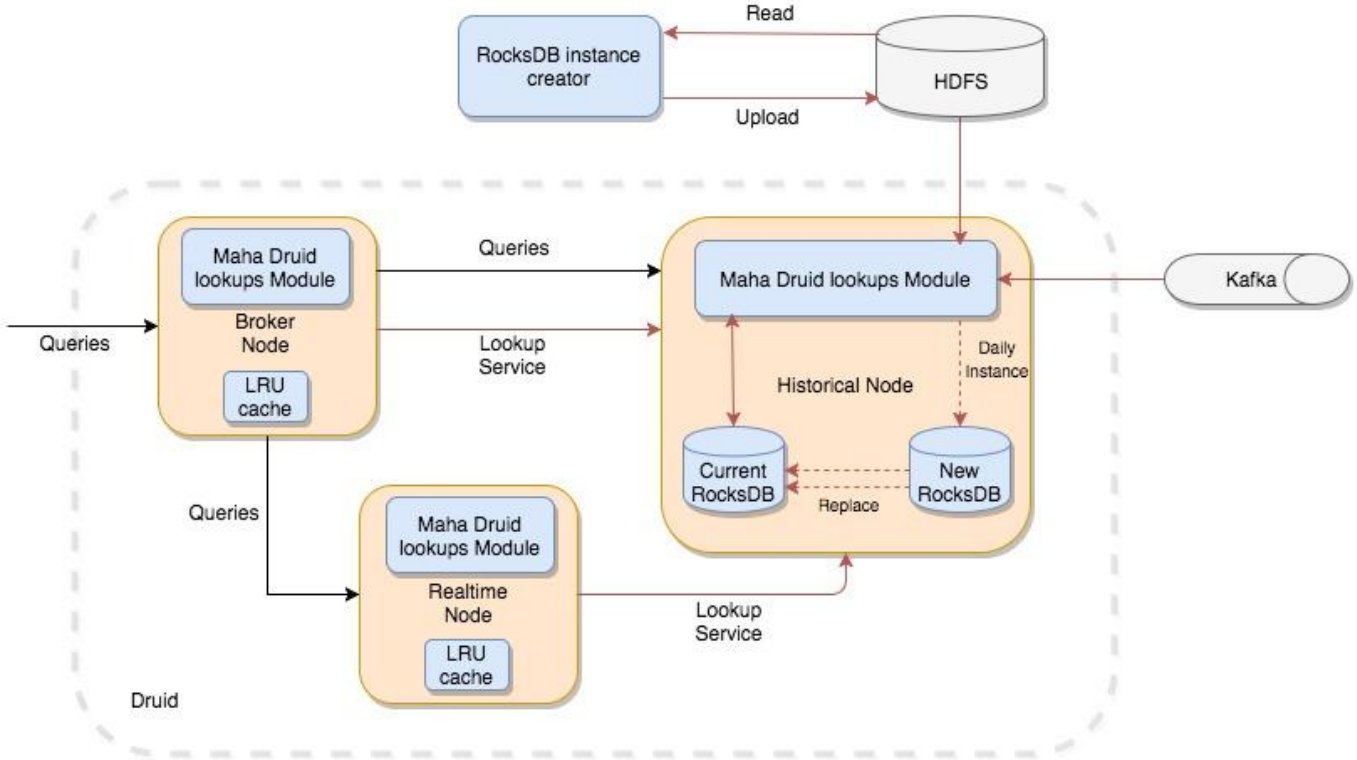
Introducing maha druid lookups

- Druid Extension open sourced under maha https://github.com/yahoo/maha/tree/master/druid-lookups
- Designed for high cardinality dimensions with sub-second updates
-

Architecture



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Salient features

- Designed for high cardinality dimensions used at Yahoo with > 120 million unique dimensional rows
- Supports multi-column lookups
- Real time update capability using Kafka
- Easily configurable

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Salient features

- Highly performant : < 25 ms difference between running the query on druid with lookups versus running the query on Oracle
- Uses RocksDB as an embeddable persistent key-value store for fast storage
- Support dynamic schema updates without druid deployments
- Lookup as a Service (LaaS) RESTful APIs
- Supports snapshotting
-

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Why RocksDB?

- Embeddable persistent key-value store for fast storage
- Highly performant
- Keys and values are just arbitrarily sized byte streams
- Optimized for fast storage such as flash drives and SSDs
- Easily configurable

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Dynamic Schema Support

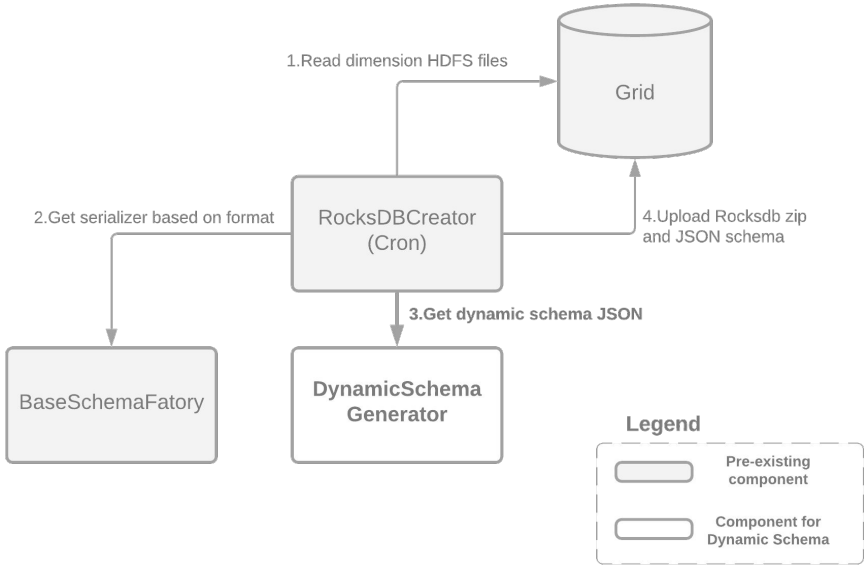

Diagram 1. RocksDB creation flow with JSON schema

Druid req/resp with lookup

```
{
  "queryType": "groupBy",
  "dataSource": { "type": "table", "name": "sample_datasource" },
  "granularity": { "type": "all" },
  "dimensions": [
    { "type": "default", "dimension": "AdvertiserId", "outputName": "Advertiser ID" },
    { "type": "default", "dimension": "Gender", "outputName": "Gender" },
    { "type": "default", "dimension": "Country", "outputName": "Country" },
    { "type": "extraction", "dimension": "AdvertiserId", "outputName": "Status",
      "extractionFn": { "type": "mahaRegisteredLookup", "lookup": "advertiser_lookup", "valueColumn": "status" }
    }
  ],
  "aggregations": [
    { "type": "longSum", "name": "Impressions", "fieldName": "Impressions" },
    { "type": "longSum", "name": "Clicks", "fieldName": "Clicks" }
  ],
  "intervals": [ "2017-01-01T00:00:00.000/2017-01-02T00:00:00.000" ]
}
```

```
[
  {
    "version" : "v1",
    "timestamp" : "2017-01-01T00:00:00.000Z",
    "event" : {
      "AdvertiserId" : 12345, "Gender" : "Male", "Country" : "US", "Status" : "ON", "Impressions" : 3, "Clicks" : 2
    }
  },
  {
    "version" : "v1",
    "timestamp" : "2017-01-01T00:00:00.000Z",
    "event" : {
      "AdvertiserId" : 12345, "Gender" : "Female", "Country" : "US", "Status" : "ON", "Impressions" : 2, "Clicks" : 1
    }
  }
]
```

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Integration with maha

- Out of the box support for querying
- Fallback option
- GroupBy query optimization while filtering on lookup column

Contributors

- Jay Yang
- Pranav Bhole
- Hiral Patel
- Pavan Arakere Badarinath

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Questions?

https://github.com/yahoo/maha

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