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HDB/HAWQ Integration with Hadoop

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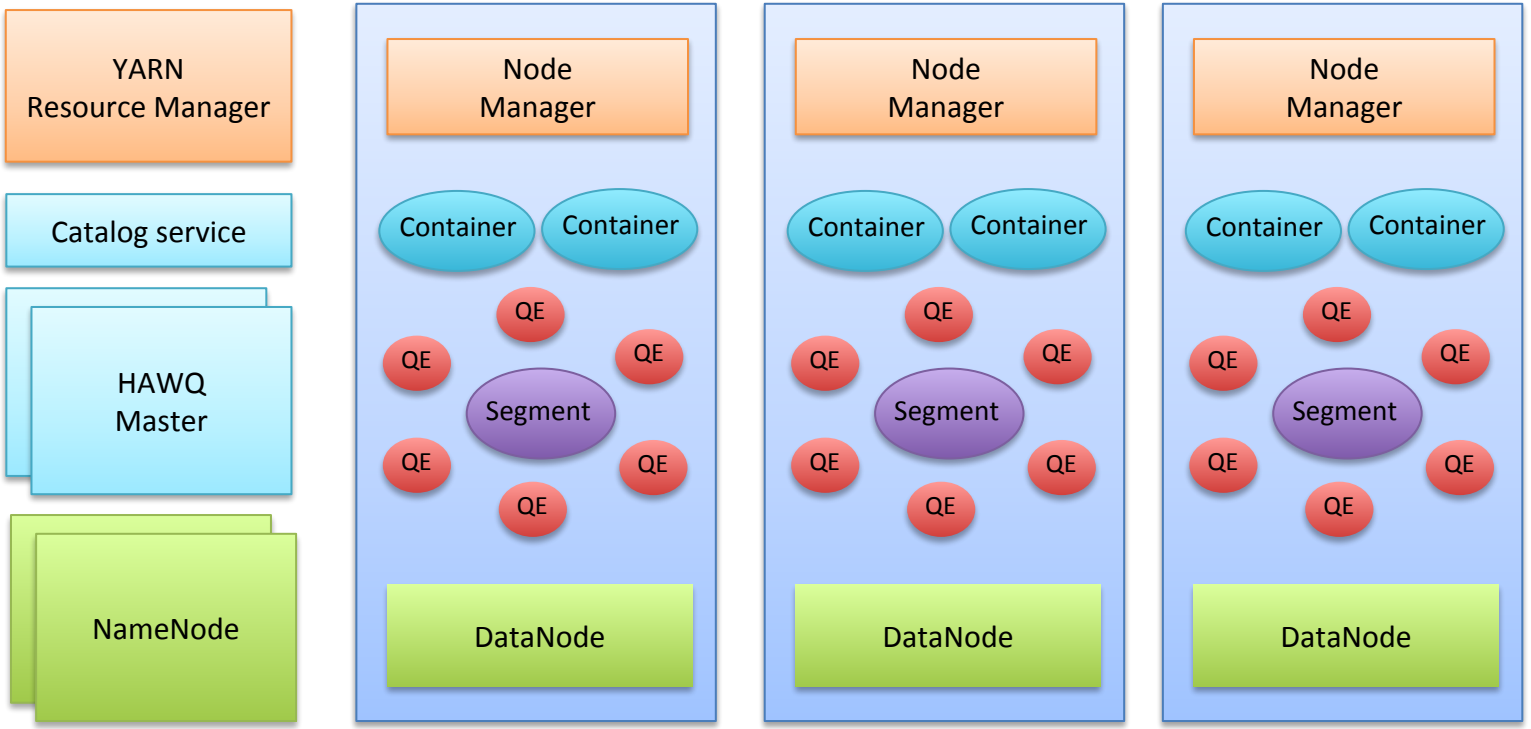
Agenda

- HDB/HAWQ Overview
- Storage Integration
- Resource Management Integration
- User Authorization Integration
- Future Work

HDB/HAWQ Overview

Architecture



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Components Interactive with Hadoop

- Storage
  - HDFS Catalog Cache vs. Libhdfs3
  - Parquet
  - PXF
  - InputFormat/OutputFormat
  - Hawq extract/register
- Resource Management
  - Standalone Resource Management vs Yarn Managed RM
  - LibYarn
- User Authorization
  - Ranger

Storage

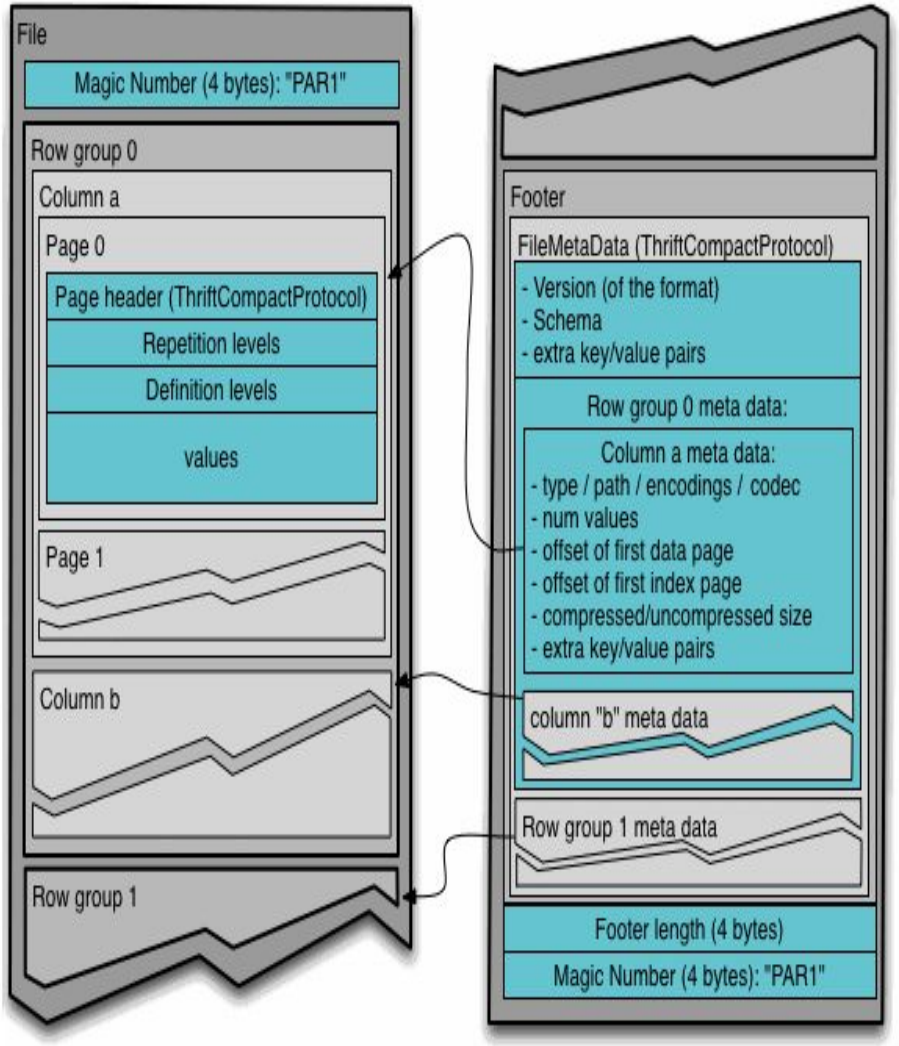
Data Access Layer

HDFS Catalog -- Cache

- HDB Metadata:
  - Catalog Table -> schema & hdfs file name
  - HDFS NameNode -> Block information for each hdfs file
- HAWQ master connects to HDFS Namenode to fetch block information of HDFS files
- The block information may be huge for large table -> performance downgrade if fetching every time
- HDFS Catalog Cache → Store previous block information & LRU Replacement Policy

HDFS Data -- Libhdfs3

- How to access data in HAWQ(C) from HDFS (Java)?
- Libhdfs
  - JNI based C language library
  - Users must deploy HDFS jars on every machine to use it
- Libhdfs3
  - native Hadoop RPC protocol and HDFS data transfer protocol
  - lightweight, small memory footprints
  - Easy to use and deploy



Parquet Storage

- HAWQ Design for Parquet
  - Do not change anything in open source Parquet format
  - Append to a file and add a new footer to file at the end of load/insert
  - Design point for Parquet is for large writes
- DDL
  - ***create table a(a int, b int)with(appendonly=true, orientation=parquet, compresstype=snappy);***

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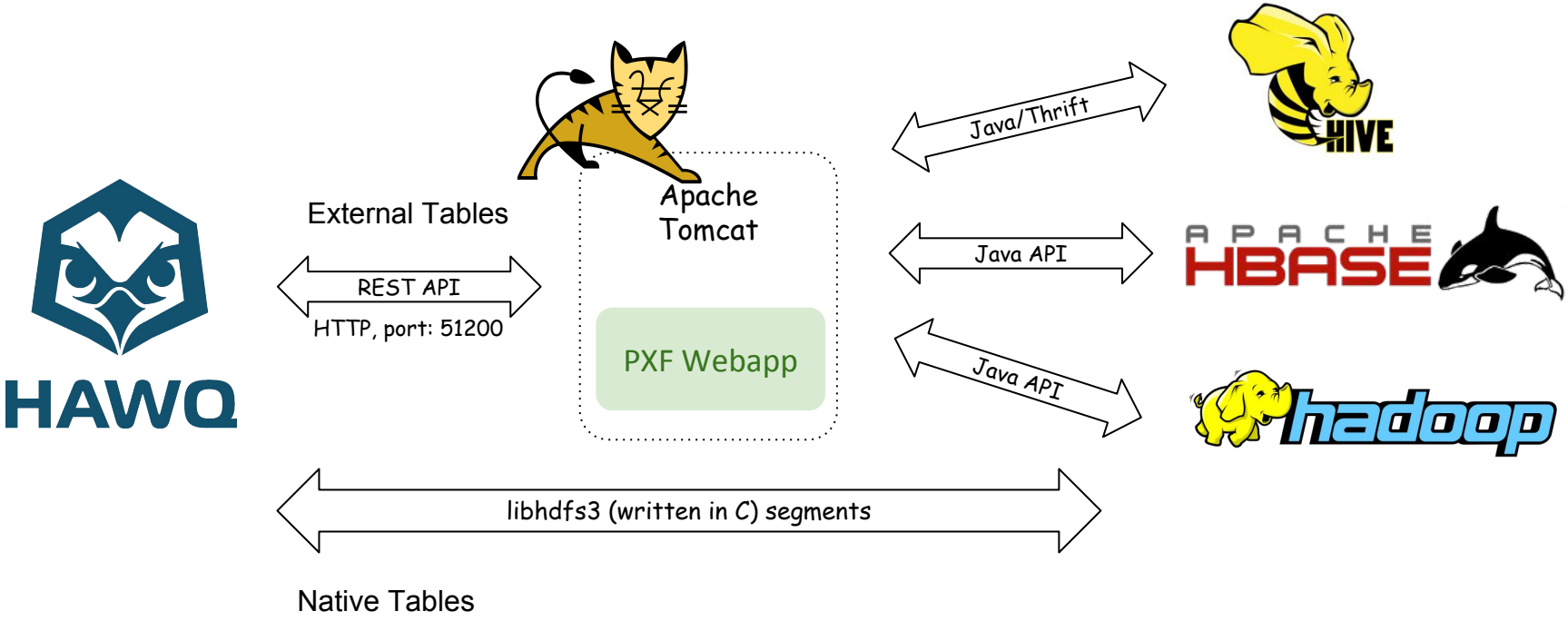
PXF Framework



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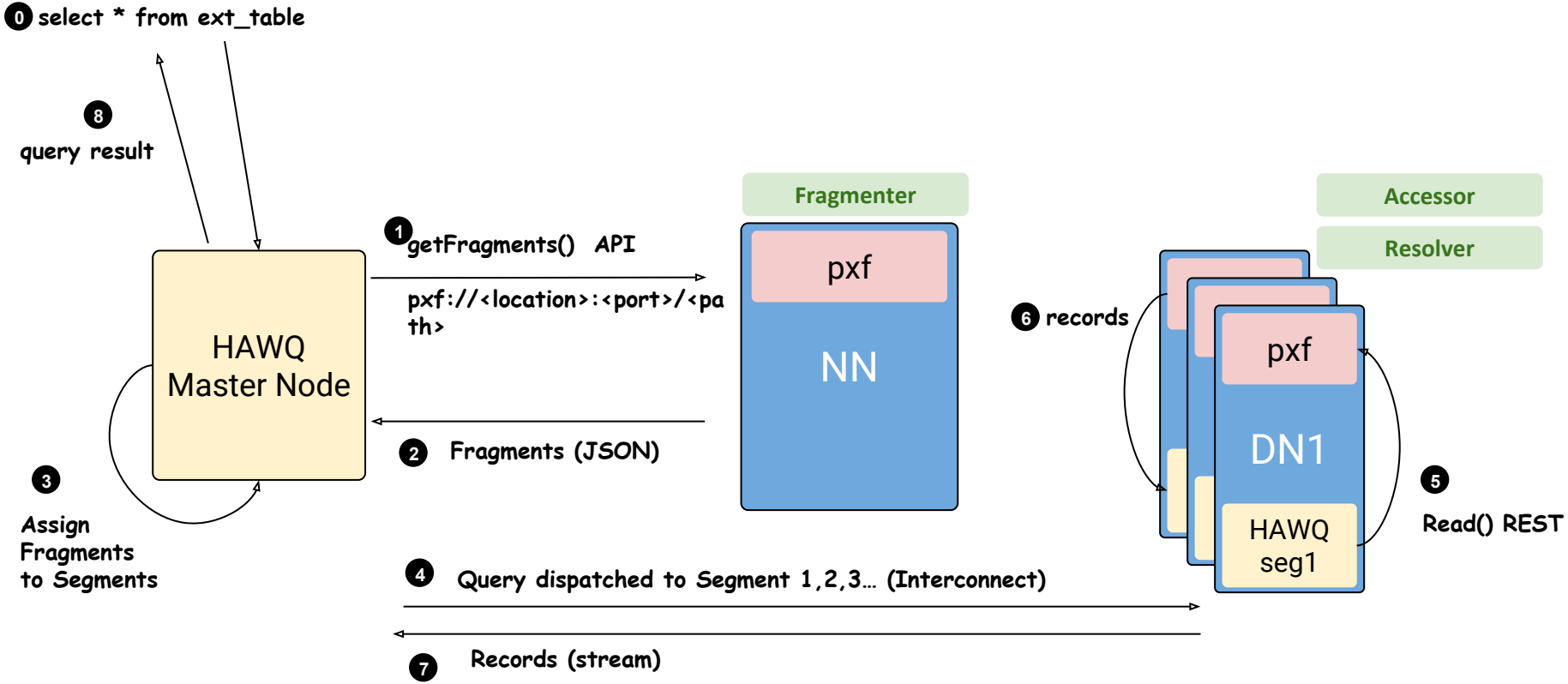
Architecture - Read Data Flow



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HAWQInputFormat/HAWQParquetOutputFormat

- Purpose
  - HAWQ can work align with other products in Hadoop eco-system
- HAWQInputFormat
  - Easy for others to read data generated in HAWQ
  - Get key as Void type, value as HAWQRecord type -> get each hawq record in HAWQRecord struct -> record.getInt(index)
  - Supports both AO table and Parquet table
- HAWQParquetOutputFormat
  - Extension to ParquetOutputFormat, specifying type to be HAWQRecord
  - Provides an interface setHAWQSchema for others to specify HAWQ schema
  - Other system can generate HAWQRecord, and thus can write the data

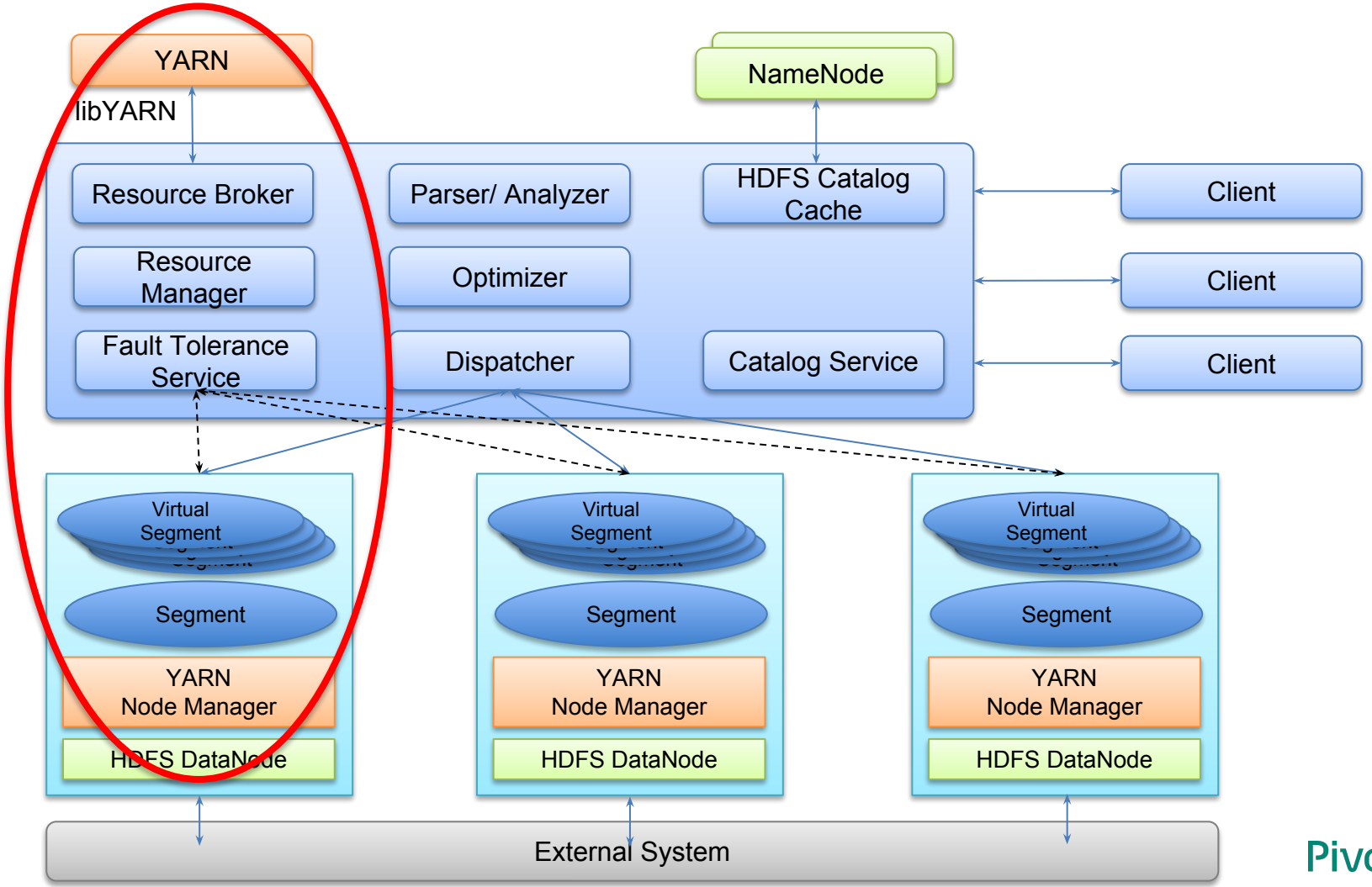
HAWQ Extract/HAWQ Register

- HAWQ Extract
  - Extract out metadata & HDFS file location for the table to yaml configuration file
  - Yaml configuration can be used by HAWQInputFormat
  - Usage *hawq extract [-h hostname] [-p port] [-U username] [-d database] [-o output_file] [-W] <tablename>*
- HAWQ Register
  - Register existing files on HDFS directly to HAWQ internal table
  - Scenario
    - Register other systems generated data
    - HAWQ cluster migration
  - Usage
    - *hawq register [-h <hostname>] [-p <port>] [-U <username>] -d <databasename> -f <hdfspath> <tablename>*
    - *hawq register [-h <hostname>] [-p <port>] [-U <username>] -d <databasename> -c <configFile> <tablename>*

Resource Management

HAWQ Resource Manager Highlights

- Hierarchical resource queues(DDL)
- Automatic Resource Allocation
- Resource Allocation policy at queue and statement level
- Global optimized resource allocation: HAWQ makes global optimized resource allocations across the cluster
- Pluggable global resource manager(two modes: None/YARN)
- Dynamic resource expansion/shrink and segment profiling
- High volume concurrent query execution & low resource allocation latency


YARN
libYARN
NameNode
Resource Broker
Parser/ Analyzer
HDFS Catalog Cache
Client
Resource Manager
Optimizer
Client
Fault Tolerance Service
Dispatcher
Catalog Service
Client
Virtual Segment
Segment
YARN Node Manager
HDFS DataNode
Virtual Segment
Segment
YARN Node Manager
HDFS DataNode
Virtual Segment
Segment
YARN Node Manager
HDFS DataNode
External System

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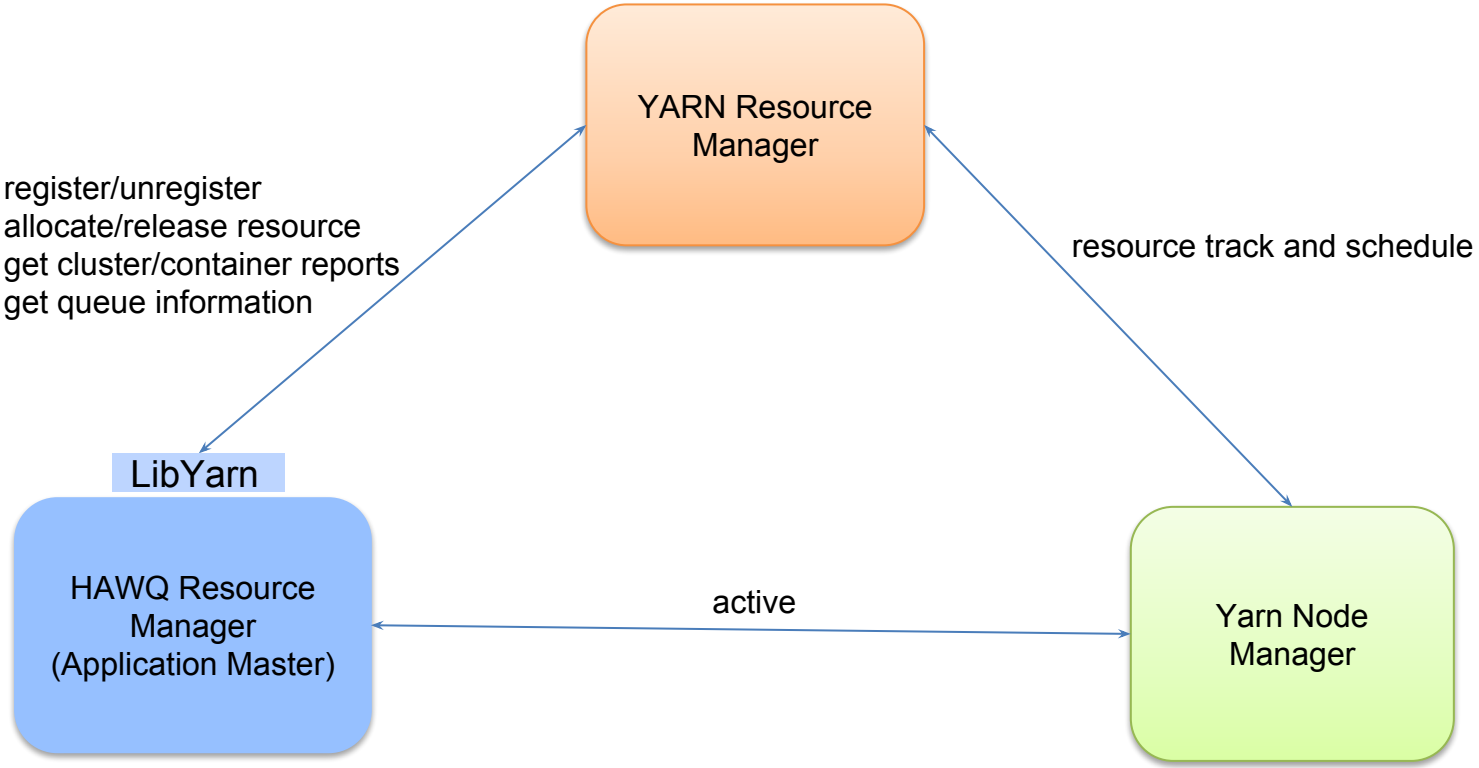
Interaction with Yarn



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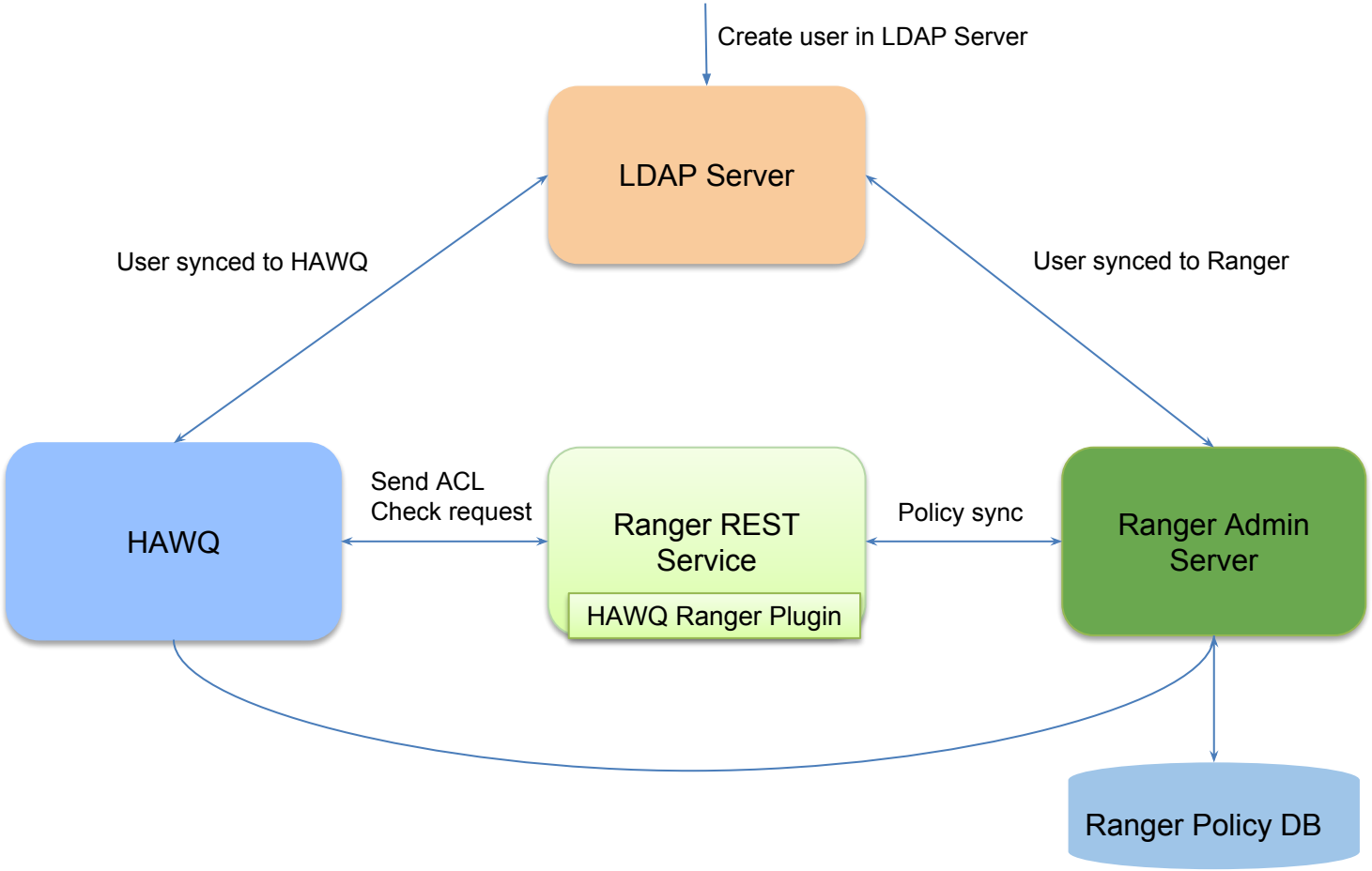
User Authorization

Background

- Ranger: A Global User Authorization Tool in Hadoop eco-system
  - Can support multiple systems such as HDFS, Hive, HBase, Knox, etc.
  - Provides a central UI for user to defining policies for different systems
  - Provide a base Java Plugin thus feasible for other products to define its own plugin to be controlled by Ranger
- HAWQ Current ACL
  - Implement through Grant/Revoke SQL Command
  - Current ACL is controlled by catalog table, which is stored in HAWQ master
- HAWQ needs to keep align with hadoop eco-systems, so we need integrate with Ranger ACL
  - Provide a GUC specifying whether enable ranger as ACL check
  - Once ranger is configured, move all the ACL check to Ranger side
  - Define all the policies in Ranger

HAWQ Ranger Integration



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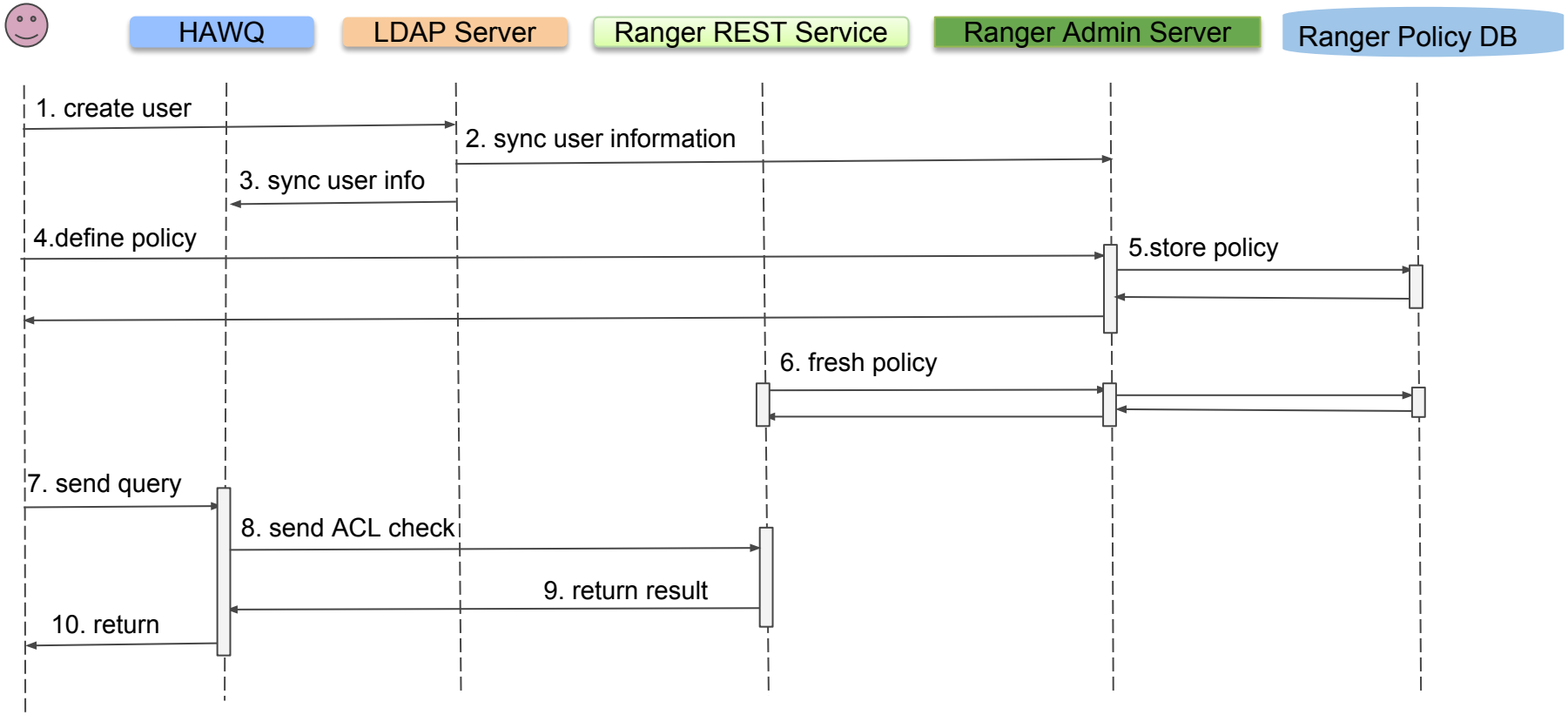
Workflow



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Components

- HAWQ Ranger Plugin
  - An extension to Ranger plugin, providing functions including
    - Register itself into Ranger Server
    - Sync Ranger defined policies to plugin itself
    - Lookup Service from Ranger Server to HAWQ
- Ranger Plugin Service
  - A RESTful Service which includes HAWQ Ranger Plugin
  - Provide API of checkPrivilege for HAWQ ACL
- HAWQ ACL
  - Encapsulate ACL check to a JSON Request, and send to RPS
    - Merge the ACL check inside one query as a single JSON Request
    - Request includes three parts information: requestor; resource; privileges

Future Work

TDE(Transparent Data Encryption) Support

- TDE: HDFS implements transparent, end-to-end encryption
  - Data is transparently encrypted and decrypted without requiring changes to user application code
  - Data can only be encrypted and decrypted by the client
  - HDFS never stores or has access to unencrypted data or unencrypted data encryption keys
- HAWQ Enhancement
  - Modify libhdfs3 to add support for TDE

Parquet 2.0 Support

- Parquet 2.0 Enhancement
  - Add more Converted Type: Enum, Decimal, Date, Timstamp
  - Add more statistics in DataPageHeader: including max/min/null count, distinct count
  - Add Dictionary Page
  - Add sorting column information in Rowgroup meta
  - …
- HAWQ Upgrade to Parquet 2.0 support
  - Bring performance improvement by leveraging statistics information
  - Become more compatible with other systems which have supported Parquet 2.0


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