Standing on Shoulders of Giants: The Ampool Story

Milind Bhandarkar,
Founder & CEO, Ampool
About Me

- [http://www.linkedin.com/in/milindb](http://www.linkedin.com/in/milindb)
- Founding member of Apache Hadoop team at Yahoo [2005-2010]
- HDFS, MapReduce, Pig, YARN, HAWQ, Geode...
- Chief Architect at Greenplum Labs (2011-2013)
- Chief Scientist at Pivotal Software (2013-2015)
- Founder, CEO Ampool (2015-)
Recent History
2011: Greenplum Embraces Hadoop

- **GPMR**: Branded Version of MapR Distribution
- **June**: I join as Chief Architect, Greenplum Labs

- **GPHD**: Apache Hadoop + Facebook Patches (for HBase)
- **No Management tools**
- **Stop-Gap until Hadoop 2.0**
2012: GoH (Greenplum-on-Hadoop) Development

• Replace shared-nothing local storage with Shared HDFS storage
• GP-Fusion: Access other data-stores (e.g. HBase from GoH)

• UCS – Unified Catalog Service design
• First demoed at Hadoop Summit, San Jose 2012
2013: Pivotal HD Launched

- PHD 1.0 = Apache Hadoop 2.0 + HAWQ (GoH) + PXF (GP-Fusion) + ICM (Install-Config-Manager)
- Pivotal Data Team = Greenplum (A division of EMC) + Gemfire + Spring + RabbitMQ + Redis (vFabric from VMWare)
2014: Pivotal HD “Thesis” & Big Data Suite 2.0

- Brainstorming about future of Data
- Role of Data Services in “Pivotal One” = Cloud Foundry + Pivotal HD?
- Plans for “Next Five Years”?
- Open Source?
- December: I take leave of Absence from Pivotal
2015: All Pivotal Data Products Open Sourced

- Open Data Platform Announcement in February
- Gemfire (Apache Geode) Apache HAWQ, Apache MADlib, Greenplum (ASLv2)
- February: Ampool incorporated
- June: Ampool secures seed funding, Design, Product Spec
- August: Ampool Development starts
- September: Ampool joins ODPi
Why Did Ampool Join ODPI?

Commercial/ISV Solutions

- Multiple Hadoop distribution certifications required
- Duplicate efforts

ODPi Certification

- Single certification
- Multiple deployments

ODPi Core

- HDFS
- YARN
- MapReduce
- Ambari
Problem: Analytics pipelines are SLOW

Data Architect
Data Developers

Business Analysts
Data Scientists

Ingest → ETL → Analytics → App Use
Why?

File-based data exchange

Data Copies

Serialization overhead

Lack of Multi-tenancy

Ingest → ETL → Analytic

⚠️ File-based data exchange
⚠️ Data Copies
⚠️ Serialization overhead
⚠️ Lack of Multi-tenancy

Data Architect
Data Developers

Data Architects
Data Developers

Business Analysts
Data Scientists

User Data
}

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Need **FAST OBJECT ACCESS** across the pipeline...

Ingest → ETL → Analytics → App Use

ampool
... to improve PERFORMANCE

- Object-based data exchange
- No Data Copies
- End-to-end speedup
- Increased Concurrency

ampool

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Ampool Design Principles

Don’t reinvent the wheel
Best of Breed Compute & Storage
Respect boundaries
Augment & Empower the Ecosystem
Reduce Friction
Focus on data management in memory
Ampool Product
A **PLUGGABLE** distributed memory layer...

**ampool** Distributed, Memory-Centric, Data-Aware Object Store for Fast Analytics
For Unified Analytics

- 'Best of breed' compute engines
- Extensible Core with Polyglot Access
- Federated Persistence

Ampool: Distributed, Memory-Centric, Data-Aware Object Store for Fast Analytics

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Built on **PROVEN** In-memory Technology...

MASH (CLI Ext)

Kerberized

In-Memory Distributed Sys

Tunable Consistency

Pluggable Store Manager

Java API

APACHE GEODE

Mature Event Model

Function Pushdown

Key-Value Store

Native Interface

High Throughput

Table Store

Smart Data Tiering

Metadata/Catalog

Java API

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Apache Geode (Incubating)

- Incubating, but ROCK SOLID
- 1000+ Production Deployments
- Object Store, Cache (IMDG), ORM

- Session Store, Primary K-V Store
- Financial Services, Telecom, Manufacturing, Payroll Processing, Travel Industry
Apache Geode Scale

3TB Data in-memory

40K Transactions per second

17B Records in-memory

120K Concurrent users
36% of World Touches Apache Geode
Standing on Shoulders of Giants

- Thanks to All the Contributors!
Ampool Core
Terminology

- **Data Regions**
  - Flexible Tables
  - K-V Rows ...
  - Or, Typed-Tuples
  - Partitioned, with redundant copies...
  - Or, Replicated

- **Partitions (Buckets)**
  - Default=113
  - Hash-Based...
  - Or, Range-Based
    - [startKey-endKey]
  - 1 Primary, R Secondary, per Bucket
Key-Value Regions

- Create
- \( V = \text{Get}(K) \)
- \( \text{Put}(K, V) \)
- \( V[\ ] = \text{GetAll}(K[\ ]) \)
- \( \text{PutAll}(K[\ ], V[\ ]) \)
- Remove (K)

- (Object, Object)
- Distributed Hash Table
- Optimized for Low Latency (<1ms)
- Use for App Serving
Typed-Tuple Regions

- Create, Get, GetAll, Put, PutAll, Remove
- List<Columns[N]> Scan(startKey, endKey, ColumnNames [ ])
- Enables MVCC

- Versioned-Ordered...
- ...or, Unordered
- (byte [ ] key, Columns [N])
- Optimized for High-Throughput
- Used for Analytics
Persistence

- Eviction
  - LRU Policy
  - Max Rows per Region
  - Max Memory per Region
- Expiration
  - Time-to-live
- Local Store (Extended Memory)
- Shared Storage
  - Asynchronous
  - Sequential Writes/Reads
Advanced Features - Coprocessors

- Observer Co-processors
- Pre- & Post- Every Operation
- Triggers

- End-Point Co-processors
- Push Computations to Data
- Stored Procedures
Ampool Extensions
Datatorrent (Apache Apex)

- Yarn-Native Streaming Analytics
- 500+ Canned Streaming Operators
- Tunable Semantics (At-least once, At-most Once, Exactly-Once)

- Ampool In-Memory Synchronous Checkpointing
- Ampool Input/Output Operators
Cask Data Application Platform (CDAP)

- Batch pipelines with MR, Hive & Spark
- Common Dataset Abstraction (originally on HBase)
- Ampool Table Dataset Implementation
- End-to-end In-Memory Data Pipeline
Esgyn (Apache Trafodion)

- Full-Featured SQL Engine
  - Tandem Non-Stop SQL Server (HP Labs)
- Originally based on HBase & Hive ORC

- Hybrid Transactional & Analytical Processing (HTAP)
- In-Memory Standards-compliant SQL
Apache Hive & Apache Spark

- Ampool Storage Handler for Hive
- Create Table, .. Or
- .. Create External Table
- All Hive Types supported
  - Including Nested, Complex types

- Ampool RDD for K-V Table
- Ampool DataFrame for Typed-Tuples
- Hive-Spark Interoperability
Initial Performance
Faster than HBase on inserts (YCSB)
2-3x

Faster than HBase on Random Lookups (EsgynDB)
~4x

Faster than HBase on Scans (EsgynDB)
~6x

Faster than Alluxio (Tachyon) on Scans (Spark Reading Dataframes from Ampool)
Example Use Case & Demo
Ad Performance: An Illustrative Analytics Use-Case

Users
- View Content
- Have Interests
- Served Ads

Publishers
- Add Content
- Update Interests

Advertisers
- Create Ads
- Update Interests
- Ad Performance

ACME Corp
- Serve Ads/Content
- Capture Events
- Serve analytics
- Ad Server Infra/Logs

Data/Admin
- Monitor data flow
- service & infrastructure

Events
Ad Performance Analytics with Kafka, Esgyn & Ampool

Ad Server Logs → Kafka → Esgyn → Ampool

Ad Performance
- Top Ads
- Top Camp.
- $ Revenue

Advertisers
Ad Analytics Pipeline: Detailed Data Flow

**Ingest**
- Data Generator (Java)
- Kafka
- Ad Server
- Content
- Ads
- Users
- U-C-A Updates
- Ad Server Logs

**Analytics**
- esgyn
  - Sys. mgmt.
  - Query plans
  - DB maint.
- Stream Ingest
- Ageing (Stored Proc.)
- Top Events (UDF)
- User-Ad (UDF)
- Cont-Ad (UDF)

**Ad-hoc Queries**
- Zeppelin
- Top Ads
- Top Camp.
- $ Revenue

**DB Manager**
- DB maint
- Query plans

**DB Manager**
- Sys. mgmt.

**User-Ad (UDF)**
- User-Ad
- Top Evts

**Ad Logs**
- Users
- Ads
- Content
- Con-Ad
- Top Evts

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Features Demonstrated

Real-time Streaming Ingest
External Tools Integration
Operational Analytics
Ad-Hoc Queries
Backup & Aging
Visualization
Monitoring