Finding the Needle in a Big Data Haystack

Wolfgang Hoschek (@whoschek)
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About Wolfgang

- Software Engineer @ Cloudera Search Platform Team
- Previously CERN, Lawrence Berkeley National Laboratory, Skytide
- Very Large Scale Analytics Platforms, Distributed OLAP Servers, Search Servers, BI
- Committer on Apache Solr/Lucene, Flume, Lily HBase Indexer, Kite, Morphlines

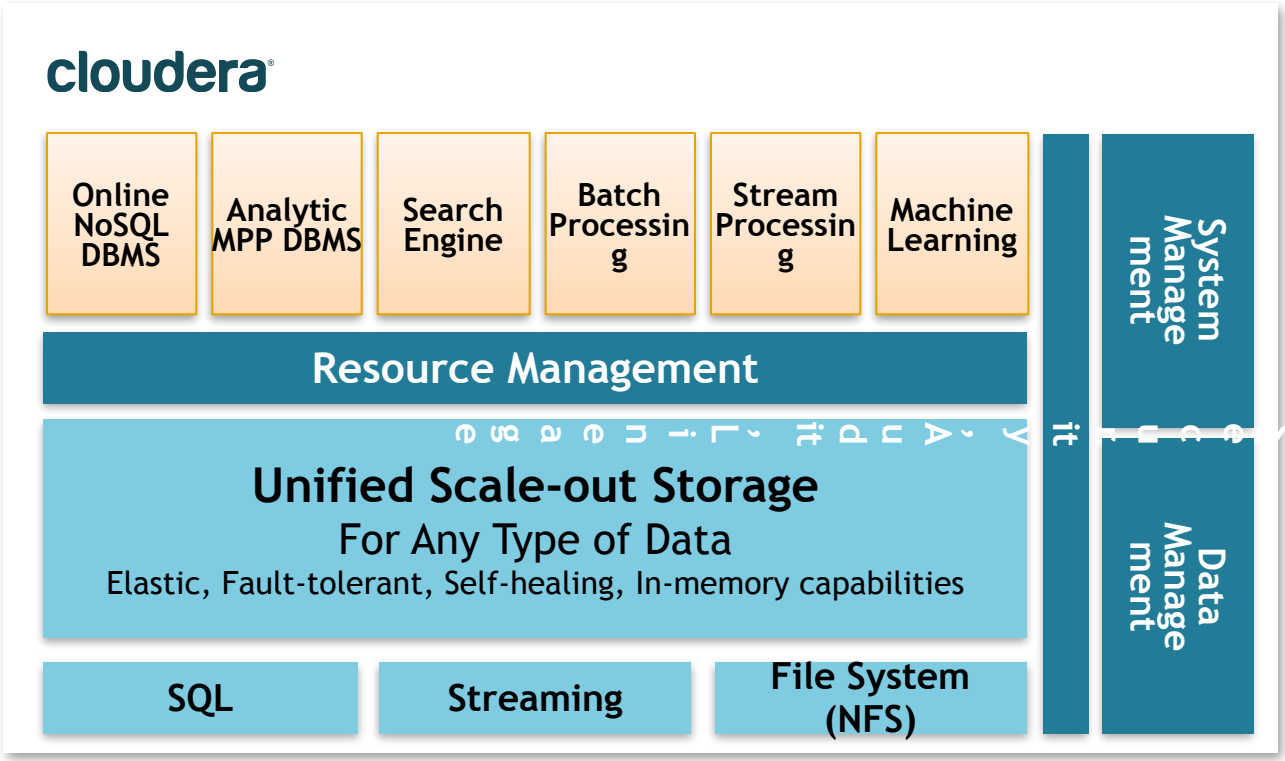
About Mark Miller

- Lucene / Solr committer.
- Previously, Core Engineering Manager at LucidWorks.
- Currently, Software Engineer at Cloudera.
- Co-creator of SolrCloud - Solr's distributed / clustering features.

Agenda

- Big Data and Search – setting the stage
- Cloudera Search's Architecture
- Near Real Time and Batch Use Cases
- Conclusion and Q&A

The Enterprise Data Hub



- Multiple processing frameworks
- One pool of data
- One set of system resources
- One management interface
- One security framework

Search Simplifies Interaction - to Everyone!

Explore

Navigate

Correlate

Experts know MapReduce. Savvy people know SQL.

Everyone knows Search!

What is Cloudera Search?

Interactive search for Hadoop

- Full-text and faceted navigation
- Batch, near real-time, and on-demand indexing

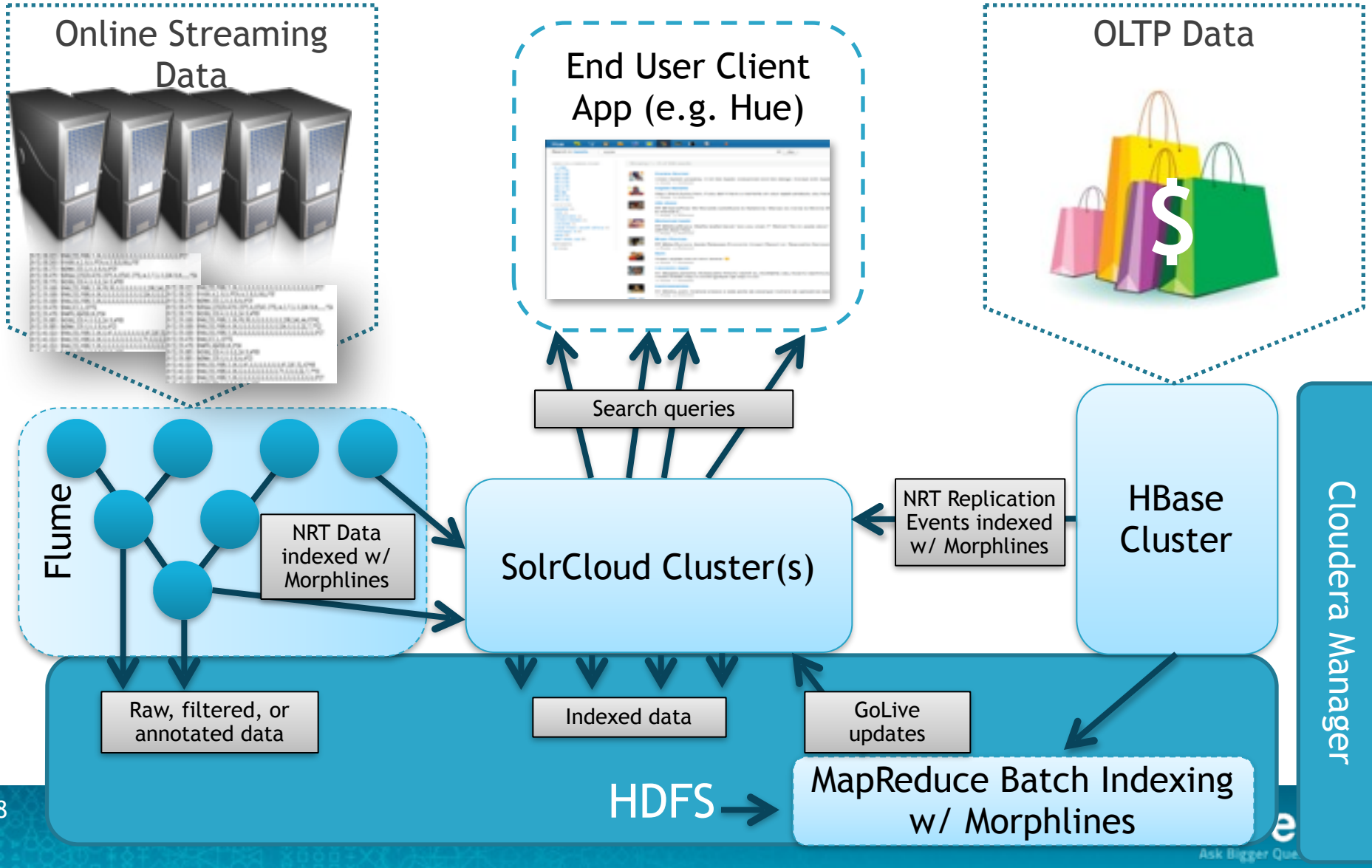
Apache Solr integrated with CDH

- Established, mature search with vibrant community
- Incorporated as part of the Hadoop ecosystem
  - Apache Flume, Apache HBase
  - Apache MapReduce, Kite Morphlines

Open Source

- 100% Apache, 100% Solr
- Standard Solr APIs

Cloudera Search Architecture Overview



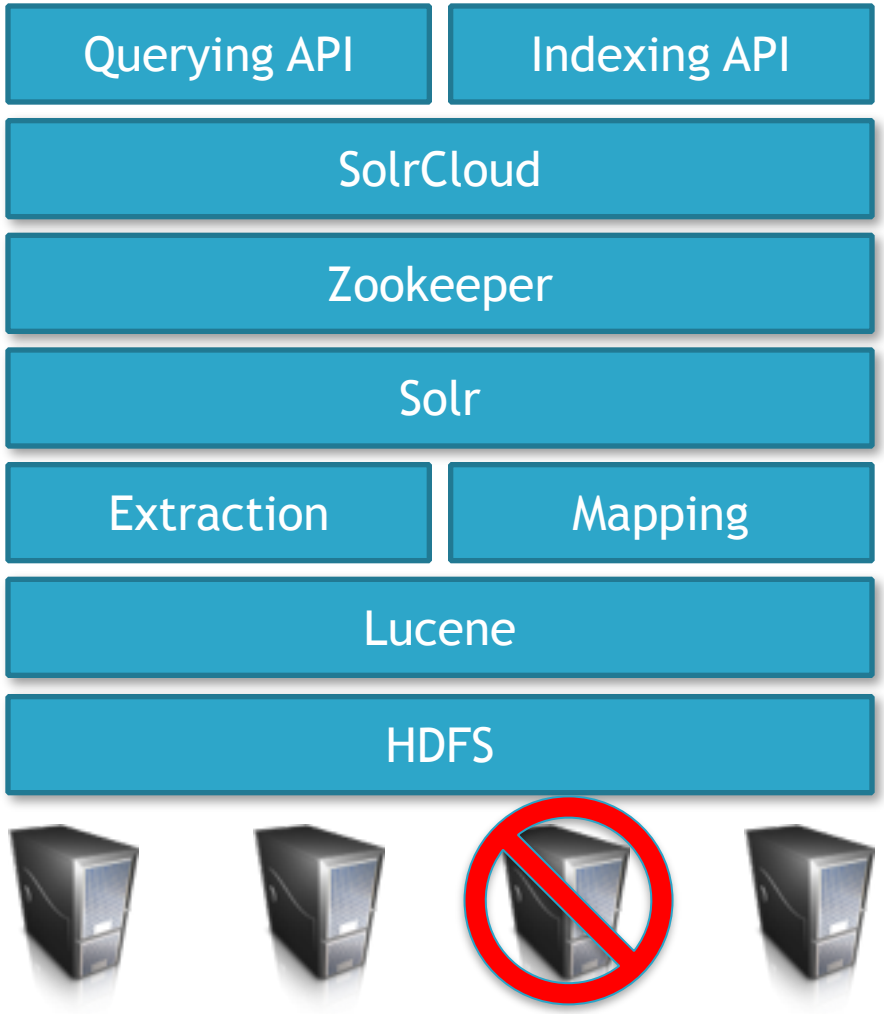
Challenges

- Scalable/Reliable Index Storage
- Near Real Time (NRT) indexing
- Scalable Batch Indexing
- Usability

Apache Lucene/Solr

- Lucene - full text search library
- Solr – search service on Lucene
- SolrCloud – distributed search
  - Partitioned and replicated inverted index
  - Low latency, scalable, reliable, HA, secure

Scalable and Robust Index Storage



Solr and HDFS

- Scalable, cost-efficient index storage
- Higher availability
- Search *and* process data in *one* platform

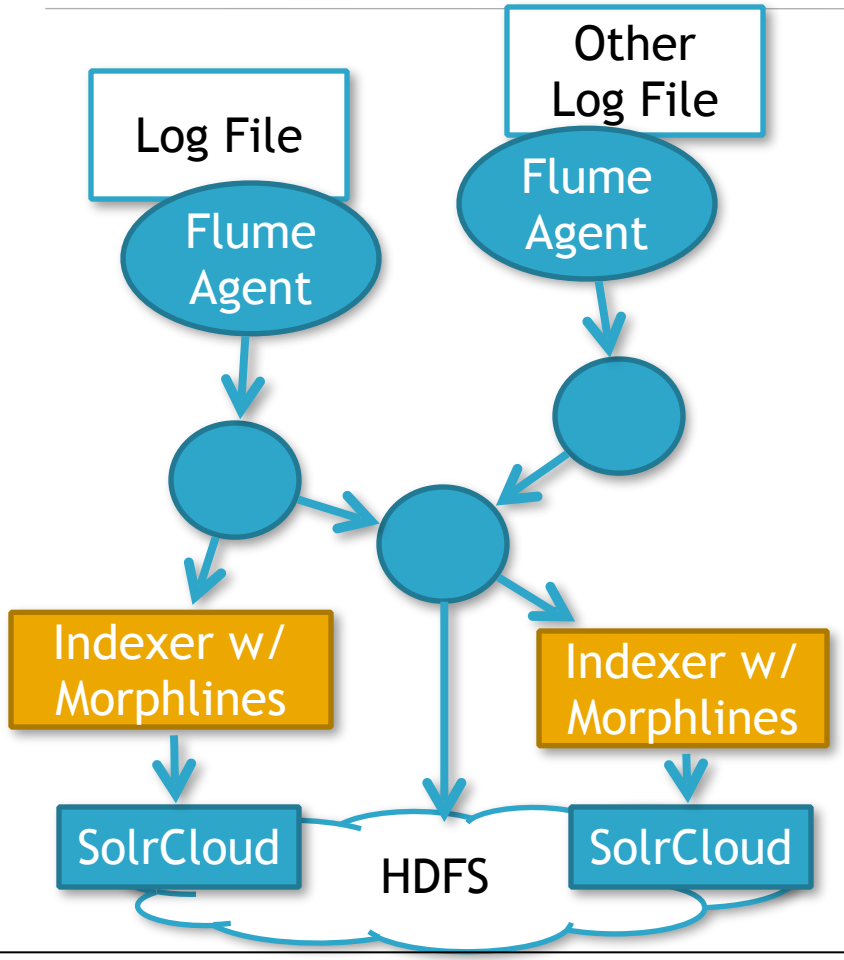
Integrate Solr/Lucene with HDFS

- Lucene Directory Abstraction
  - Implemented HDFSDirectory using HDFS client library
  - Read/Write index files directly to HDFS
- Solr DirectoryFactory Abstraction
  - HDFSDirectoryFactory plugs HDFSDirectory into Solr
  - Configuration – Solr and HDFS
- Solr HdfsTransactionLog
  - Puts transaction log into hdfs so that local file storage is not a concern and for replica failover on hdfs.

Auto Replica Failover

- When indexes are in HDFS, if a node goes down, you can start serving the index for the downed machine from a machine that is still up.
- Currently under development.
- Adds a level of failover and availability that is not available when storing indexes on the local filesystem.

Near Real Time Indexing with Apache Flume



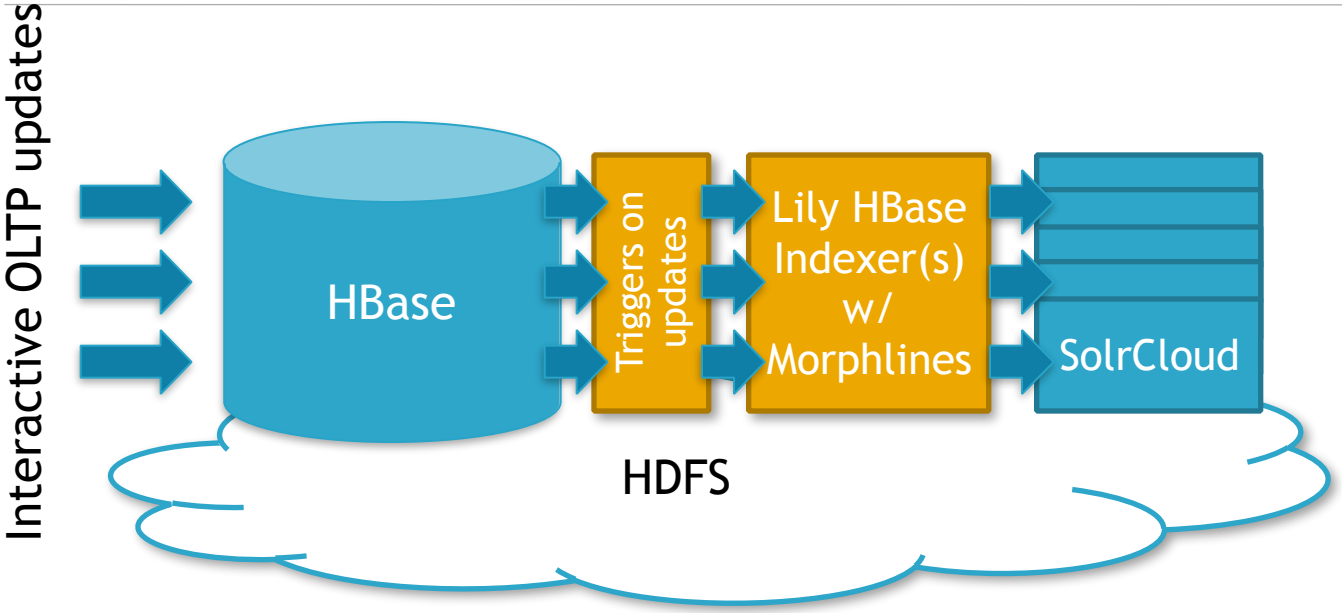
Solr and Flume

- Reliable streaming data ingestion at scale
- Indexing at data ingest
- Flexible ETL via Morphlines
- Packaged as “Flume Morphline Solr Sink”

Flume.conf

```
agent.sinks.solrSink.type = org.apache.flume.sink.solr.morphline.MorphlineSolrSink
agent.sinks.solrSink.morphlineFile = /etc/flume-ng/conf/morphline.conf
```

Searchable Real-Time Data
Indexing HBase



- Updates Solr index immediately on HBase cell update
- Non-intrusive, Flexible, Scalable, Reliable
- Partitioned and Replicated Indexing w/ Failover, HA

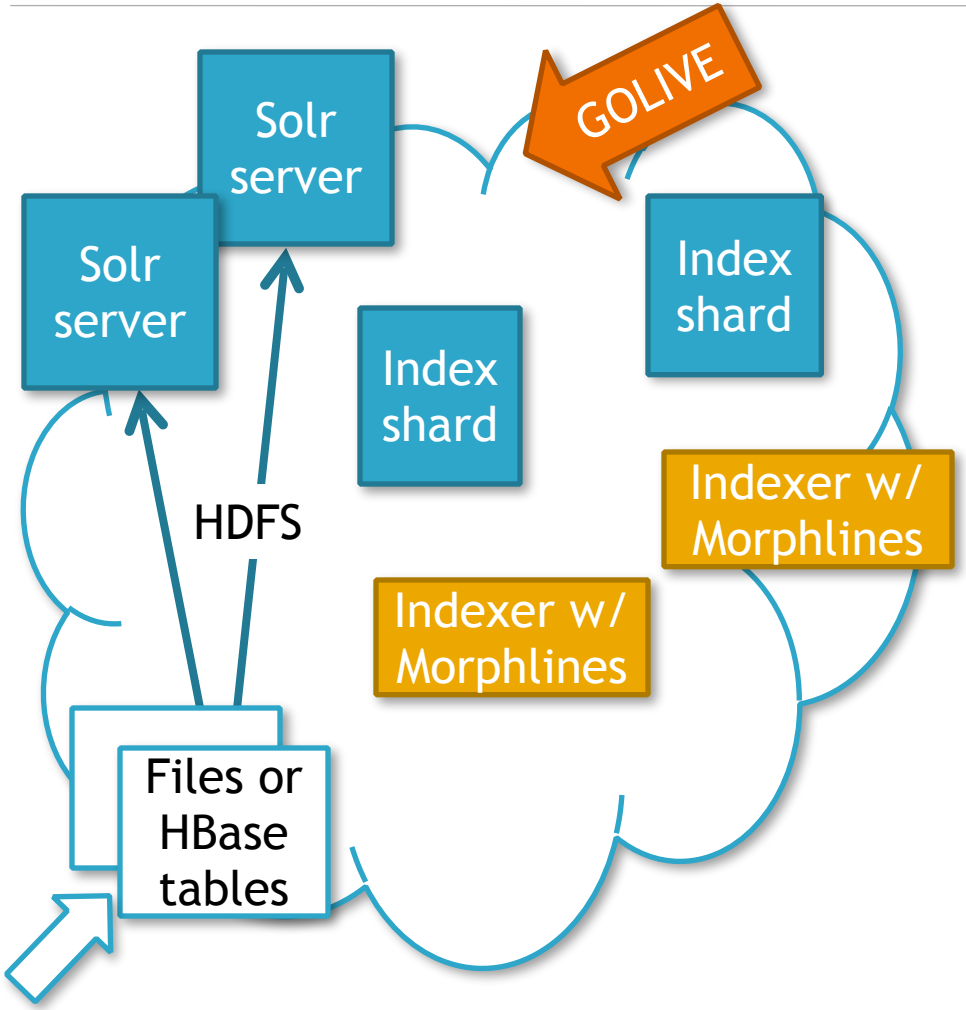
hbase-indexer.conf

```
<indexer table="myHBaseTable"
mapper="com.ngdata.hbaseindexer.morphline.MorphlineResultToSolrMapper">
  <param name="morphlineFile" value="/path/to/extractHBaseCell.conf"/>
```

Lily HBase Indexer

- Collaboration between NGData & Cloudera
  - NGData are creators of the Lily data management platform
- Lily HBase Indexer
  - Service which acts as a HBase replication listener
  - Replication updates trigger indexing of updates (rows/cells)
  - Integrates Kite Morphlines library for flexible ETL of rows/cells
  - ASL licensed on github http://github.com/ngdata/hbase-indexer

Scalable Batch ETL & Indexing

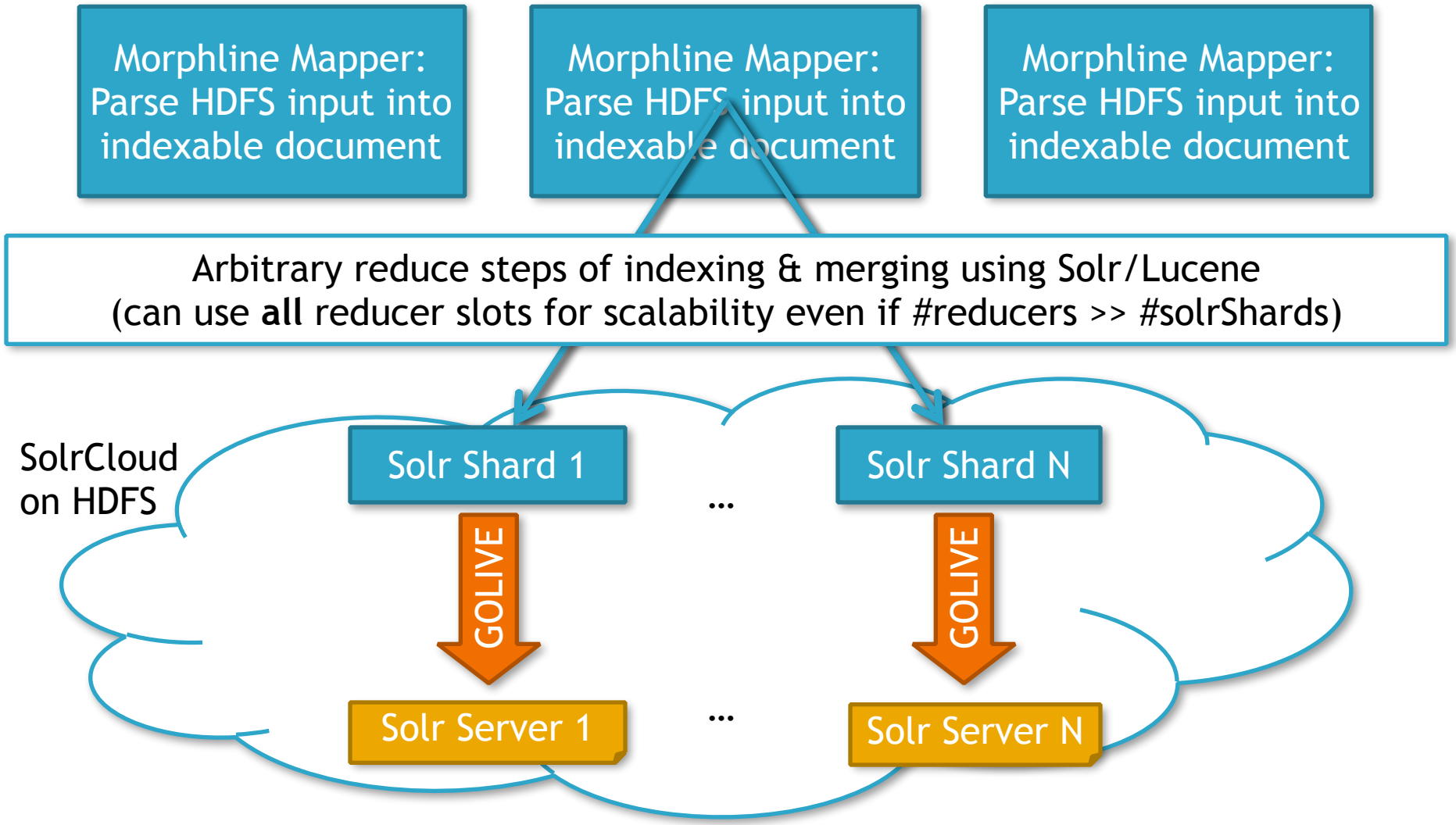


Solr and MapReduce

- Flexible, scalable, reliable batch indexing
- On-demand indexing, cost-efficient re-indexing
- Start serving new indices without downtime
- “MapReduceIndexerTool”
- “HBaseMapReduceIndexerTool”

```
hadoop ... MapReduceIndexerTool --morphline-file morphline.conf ...
```

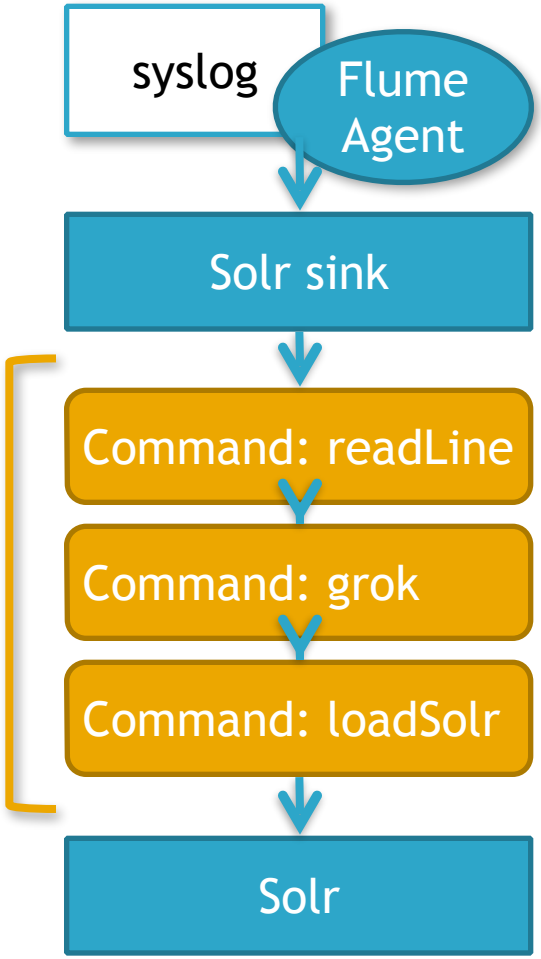
Scalable Batch Indexing



MapReduce Indexer

- MapReduce Job with two parts
  1) Scan HDFS (or HBase) for files to be indexed
  2) Mapper/Reducer indexing step
     - Mapper extracts content via Kite Morphlines
     - Reducer uses Lucene to index documents directly to HDFS
- "golive"
  - Cloudera created this to bridge the gap between NRT (low latency, expensive) and Batch (high latency, cheap at scale) indexing
  - Results of MR indexing operation are immediately merged into a live SolrCloud serving cluster
    - No downtime for users
    - No NRT expense
    - Linear scale out to the size of your MR cluster

Streaming ETL (Extract, Transform, Load)

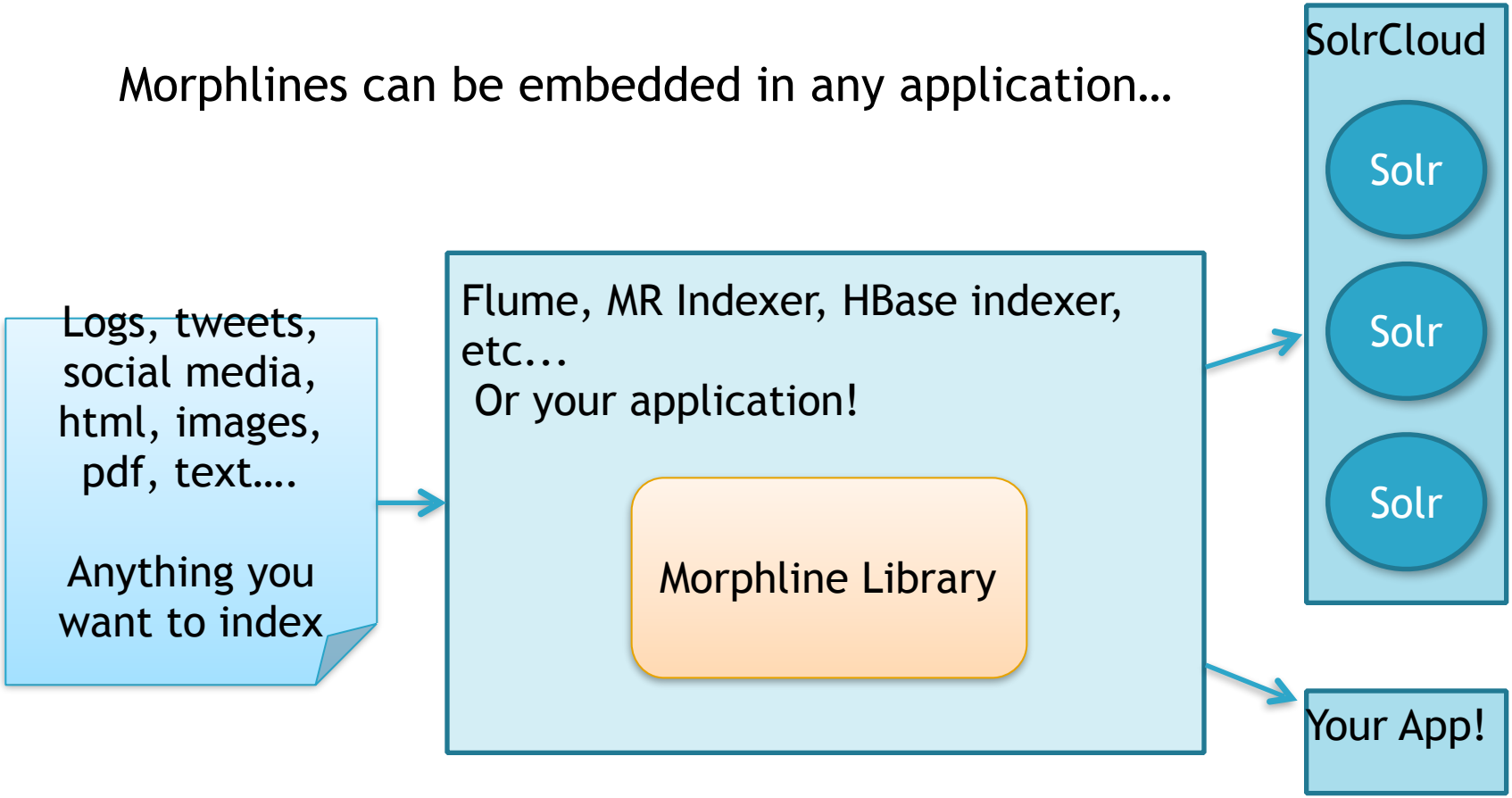


Kite Morphlines

- Consume any kind of data from any kind of data source, process and load into Solr, HDFS, HBase or anything else
- Simple and flexible data transformation
- Extensible set of transf. commands
- Reusable across multiple workloads
- For Batch & Near Real Time
- Configuration over coding
  - reduces time & skills
- ASL licensed on github https://github.com/kite-sdk/kite

Kite Morphlines Architecture

Morphlines can be embedded in any application…



Morphline Example – syslog with grok

```
morphlines : [
 {
   id : morphline1
   importCommands : [”org.kitesdk.**", "org.apache.solr.**"]
   commands : [
     { readLine {} }
     {
       grok {
         dictionaryFiles : [/tmp/grok-dictionaries]
         expressions : {
           message : """<%{POSINT:syslog_pri}>%{SYSLOGTIMESTAMP:syslog_timestamp} %
{SYSLOGHOST:syslog_hostname} %{DATA:syslog_program}(?:\[%{POSINT:syslog_pid}\])?: %
{GREEDYDATA:syslog_message}"""
         }
       }
     }
     { loadSolr {} }
   ]
 }
]
```

Example Input
<164>Feb 4 10:46:14 syslog sshd[607]: listening on 0.0.0.0 port 22
Output Record
syslog_pri:164
syslog_timestamp:Feb 4 10:46:14
syslog_hostname:syslog
syslog_program:sshd
syslog_pid:607
syslog_message:listening on 0.0.0.0 port 22.

Example: Indexing log4j w/ stacktraces

Record 1

```
juil. 25, 2012 10:49:40 AM hudson.triggers.SafeTimerTask run ok
```

Record 2

```
juil. 25, 2012 10:49:46 AM hudson.triggers.SafeTimerTask run failed
com.amazonaws.AmazonClientException: Unable to calculate a request signature
  at com.amazonaws.auth.AbstractAWSSigner.signAndBase64Encode(AbstractAWSSigner.java:71)
  at java.util.TimerThread.run(Timer.java:505)
Caused by: com.amazonaws.AmazonClientException: Unable to calculate a request signature
  at com.amazonaws.auth.AbstractAWSSigner.sign(AbstractAWSSigner.java:90)
  at com.amazonaws.auth.AbstractAWSSigner.signAndBase64Encode(AbstractAWSSigner.java:68)
  ... 14 more
Caused by: java.lang.IllegalArgumentException: Empty key
  at javax.crypto.spec.SecretKeySpec.<init>(SecretKeySpec.java:96)
  at com.amazonaws.auth.AbstractAWSSigner.sign(AbstractAWSSigner.java:87)
  ... 15 more
juil. 25, 2012 10:49:54 AM hudson.slaves.SlaveComputer tryReconnect
```

Record 3

Example: Indexing log4j w/ stacktraces

```
morphlines : [
  {
    id : morphline1
    importCommands : [”org.kitesdk.**", "org.apache.solr.**"]

    commands : [
      {
        readMultiLine {
          regex : "(^.+Exception: .+)|(^\\s+at .+)|(^\\s+... \\d+ more)|(^\\s*Caused by:.+)"
          what : previous
          charset : UTF-8
        }
      }
      { logDebug { format : "output record: {}", args : ["@{}"] } }
      { loadSolr {}
    ]
  }
]
```

Example: Escape to Java Code

```
morphlines : [
  {
    id : morphline1
    importCommands : [”org.kitesdk.**”]
    commands : [
      { java
        {
          code: """
            List tags = record.get("tags");
            if (!tags.contains("hello")) {
              return false;
            }
            tags.add("world");
            return child.process(record);
                """
        }
      }
    ]
  }
]
```

Current Morphline Command Library

- Supported Data Formats
  - Text: Single-line record, multi-line records, CSV, CLOB
  - Apache Avro, Parquet files
  - Apache Hadoop Sequence Files
  - Apache Hadoop RCFiles
  - JSON
  - XML, XPath, XQuery
  - Via Apache Tika: HTML, PDF, MS-Office, Images, Audio, Video, Email
  - HBase rows/cells
  - Via pluggable commands: Your custom data formats
- Regex based pattern matching and extraction
- Flexible log file analysis
- Integrate with and load data into Apache Solr
- Auto-detection of MIME types from binary data using Apache Tika

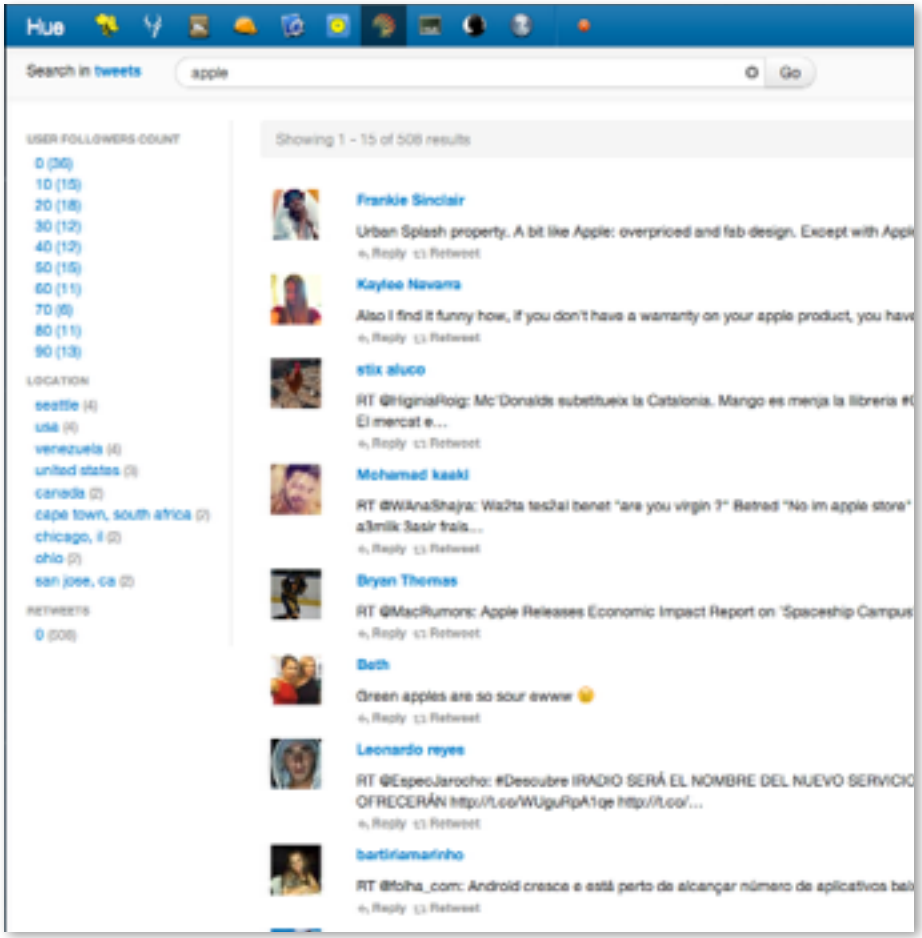
Current Morphline Command Library (cont'd)

- Scripting support for dynamic Java code
- Geolocation info for an IP address (Maxmind)
- Operations on fields for assignment and comparison
- Operations on fields with list and set semantics
- if-then-else conditionals
- A small rules engine (tryRules)
- String and timestamp conversions
- slf4j logging
- Yammer metrics and counters
- Decompression and unpacking of arbitrarily nested container file formats
- etc, etc

Morphline Performance and Scaling

- The runtime compiles morphline on the fly
- The runtime processes all commands of a given morphline in the same thread
- Piping a record from one command to another is fast
  - just a cheap Java method call
  - no queues, no handoffs among threads, no context switches, and no serialization between commands
- For scalability, deploy many morphline instances on a cluster in many Flume agents and MapReduce tasks

Simple, Customizable Search Interface



Hue

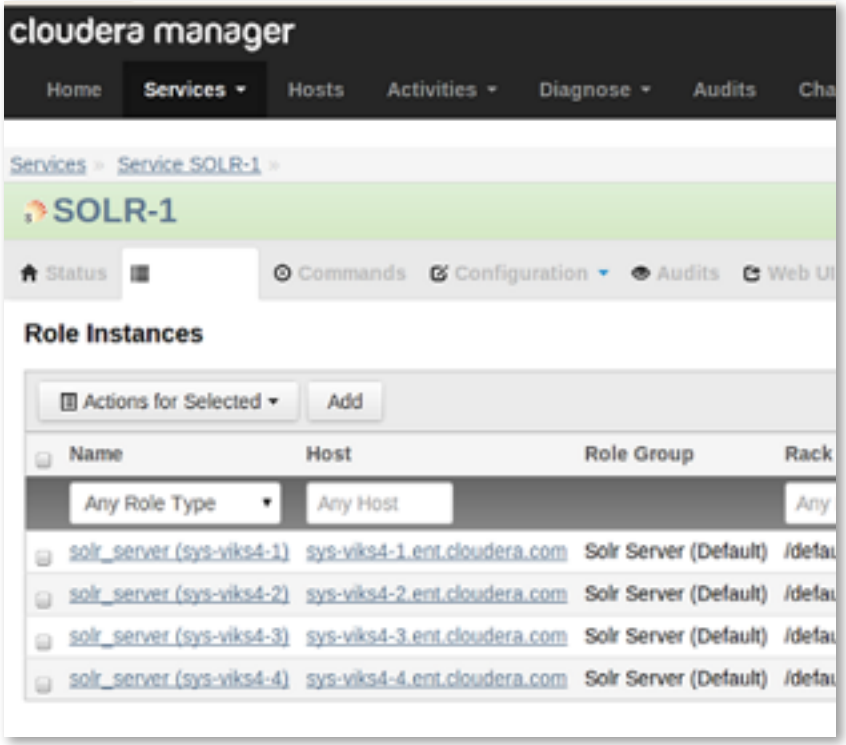
- Simple UI
- Navigated, faceted drill down
- Customizable display
- Full text search, standard Solr API and query language

Security

Cloudera Search + Sentry

- Cluster level access control
- Index level access control
- Document level access control
- Field level access control

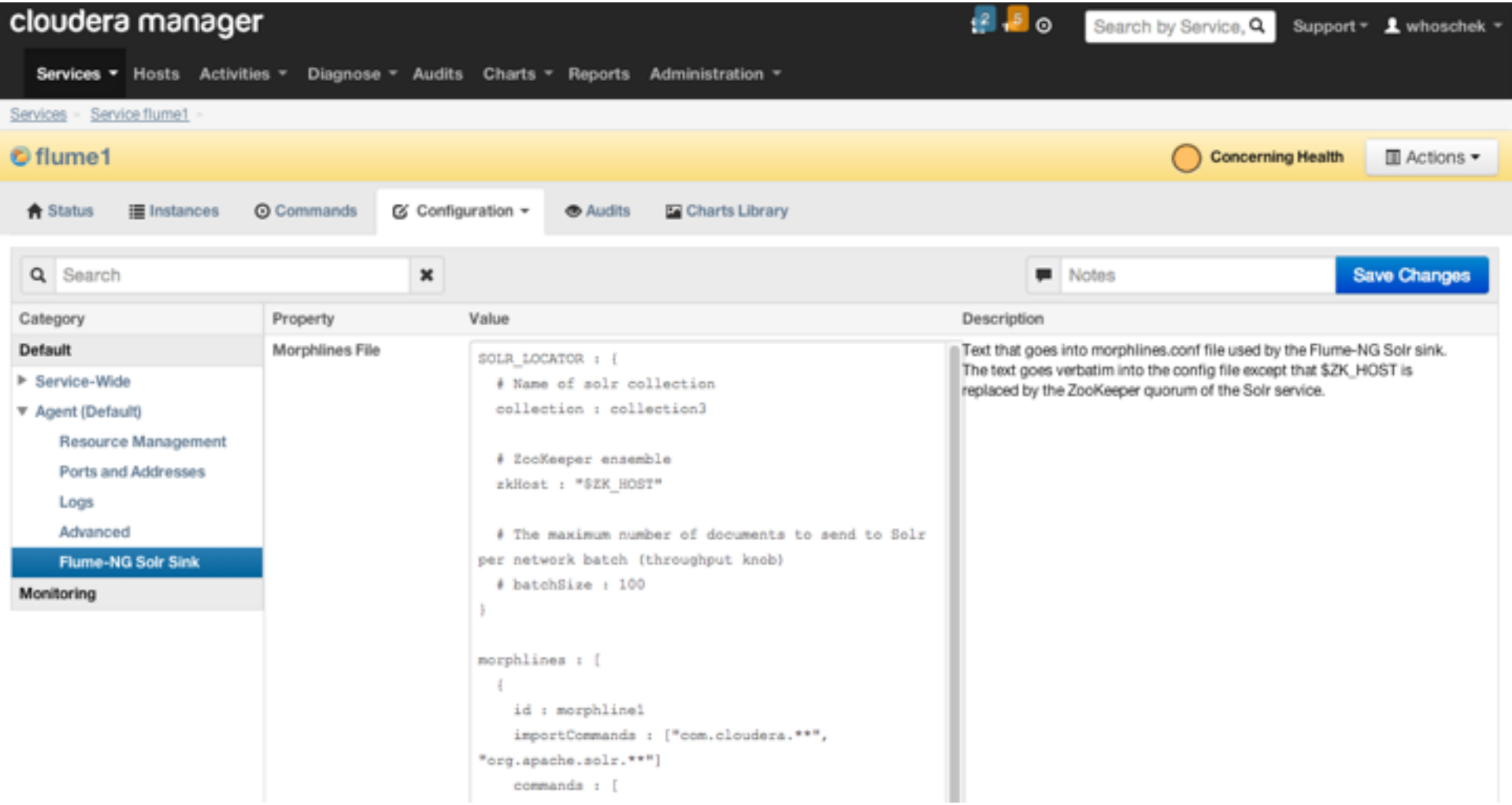
Simplified Management



Cloudera Manager

- Install, configure, deploy Solr services on the cluster
- Unified management and monitoring
- Resource management

Cloudera Manager Flume Morphline GUI



Conclusion and Getting Started

- Cloudera Search for CDH 4 & CDH5
  - Free Download
  - Extensive documentation
  - Send your questions and feedback to search-user@cloudera.org
  - Take the Search online training
- Get started with a Live Instance @ Cloudera Live
  - No download, no installation, no waiting!
- QuickStart VM also available