A New Generation of Data Transfer Tools for Hadoop: Sqoop 2

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Who Are We?

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  - Apache Sqoop Committer
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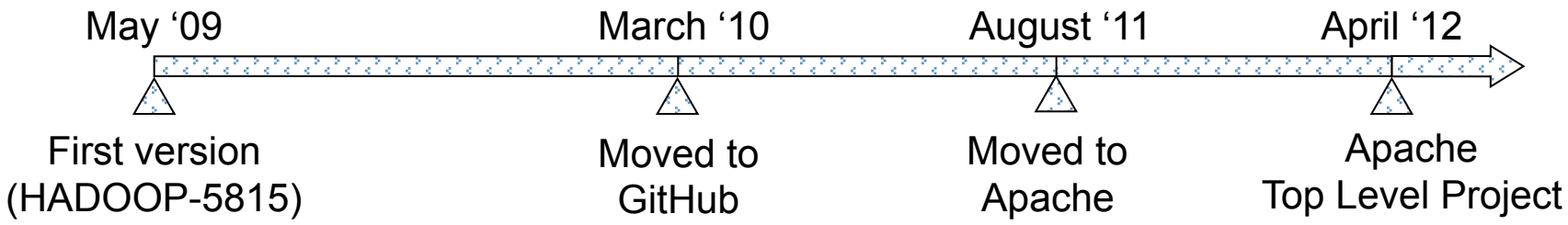
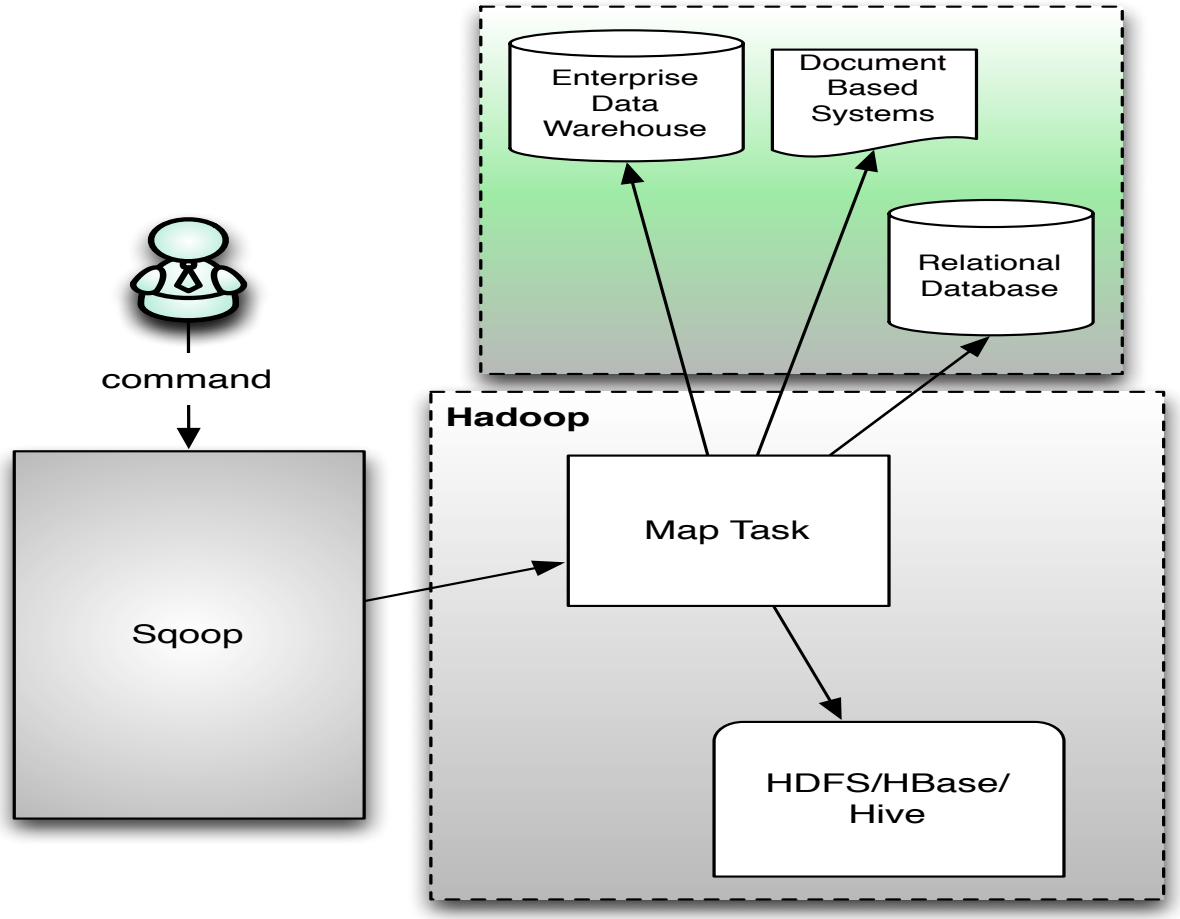
  - Apache Sqoop Committer
  - Support Manager, Cloudera

What is Sqoop?

- Bulk data transfer tool
  - Import/Export from/to relational databases, enterprise data warehouses, and NoSQL systems
  - Populate tables in HDFS, Hive, and HBase
  - Integrate with Oozie as an action
  - Support plugins via connector based architecture



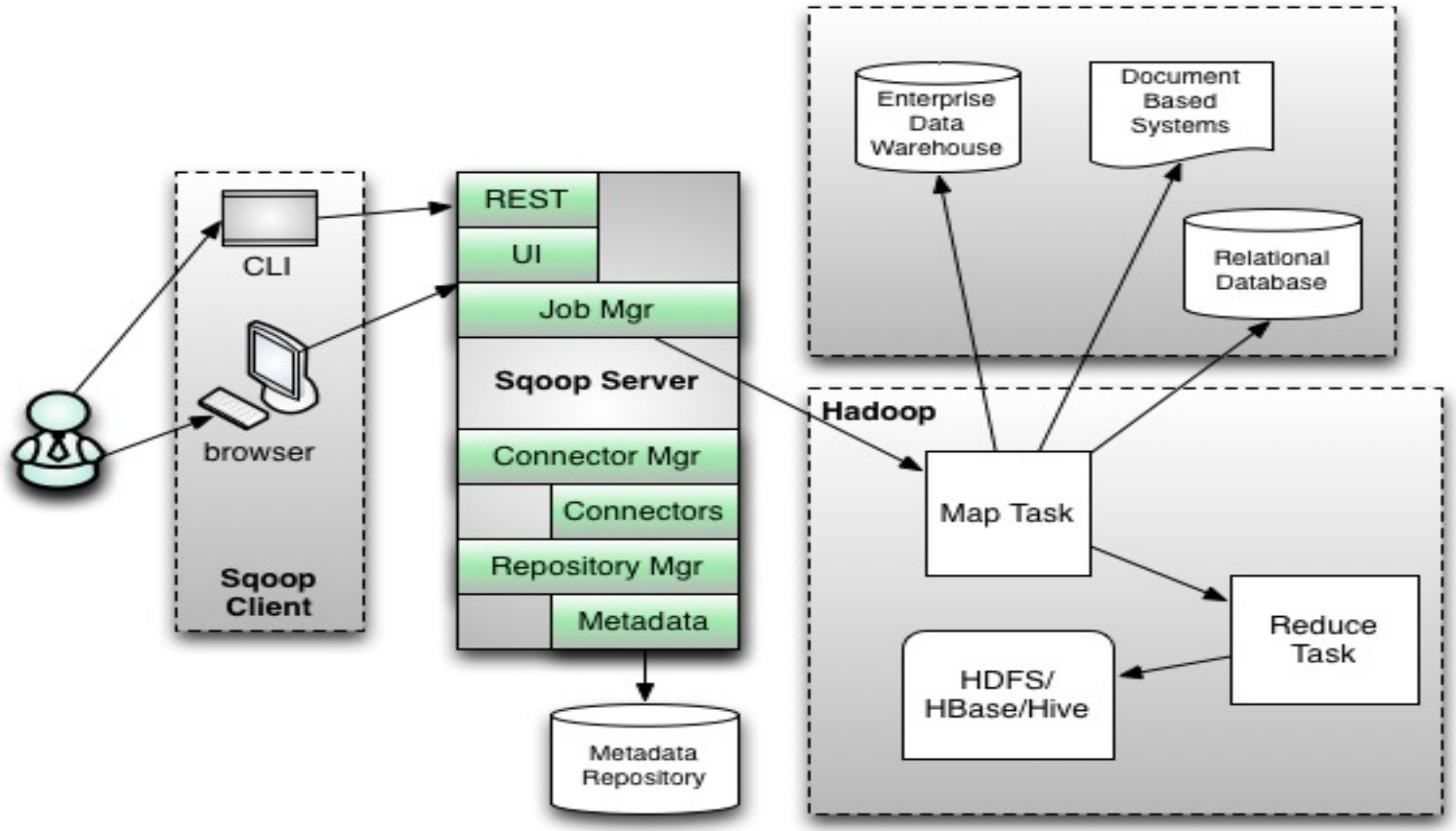
Sqoop 1 Architecture



Sqoop 1 Challenges

- Cryptic, contextual command line arguments
- Tight coupling between data transfer and output format
- Security concerns with openly shared credentials
- Not easy to manage installation/configuration
- Connectors are forced to follow JDBC model

Sqoop 2 Architecture



Sqoop 2 Themes

- Ease of Use
- Ease of Extension
- Security

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Ease of Use

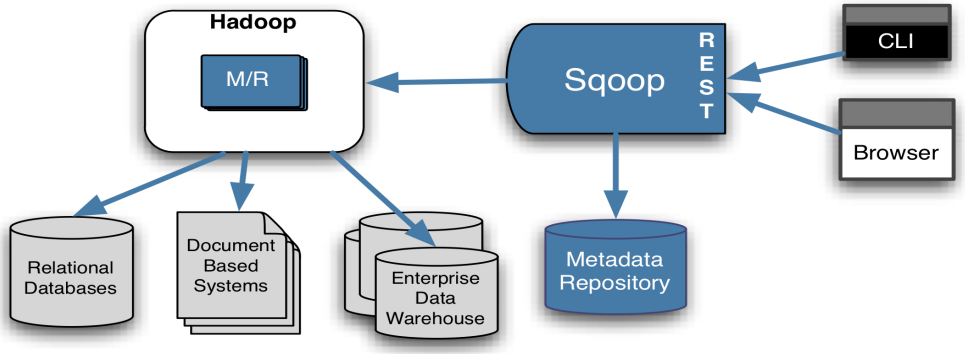
Sqoop 1	Sqoop 2
Client-only Architecture	Client/Server Architecture
CLI based	CLI + Web based
Client access to Hive, HBase	Server access to Hive, HBase
Oozie and Sqoop tightly coupled	Oozie finds REST API

Sqoop 1: Client-side Tool

- Client-side installation + configuration
  - Connectors are installed/configured locally
  - Local requires root privileges
  - JDBC drivers are needed locally
  - Database connectivity is needed locally

Sqoop 2: Sqoop as a Service

- Server-side installation + configuration
  - Connectors are installed/configured in one place
  - Managed by administrator and run by operator
  - JDBC drivers are needed in one place
  - Database connectivity is needed on the server



Client Interface

- Sqoop 1 client interface:
  - Command line interface (CLI) based
  - Can be automated via scripting

- Sqoop 2 client interface:
  - CLI based (in either interactive or script mode)
  - Web based (remotely accessible)
  - REST API is exposed for external tool integration

Sqoop 1: Service Level Integration

- Hive, HBase
  - Require local installation
- Oozie
  - von Neumann(esque) integration:
    - Package Sqoop as an action
    - Then run Sqoop from node machines, causing one MR job to be dependent on another MR job
    - Error-prone, difficult to debug

Sqoop 2: Service Level Integration

- Hive, HBase
  - Server-side integration
- Oozie
  - REST API integration

Ease of Use

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Ease of Extension

Sqoop 1	Sqoop 2
Connector forced to follow JDBC model	Connector given free rein
Connectors must implement functionality	Connectors benefit from common framework of functionality
Connector selection is implicit	Connector selection is explicit

Sqoop 1: Implementing Connectors

- Connectors are forced to follow JDBC model
  - Connectors are limited/required to use common JDBC vocabulary (URL, database, table, etc)
- Connectors must implement all Sqoop functionality they want to support
  - New functionality may not be available for previously implemented connectors

Sqoop 2: Implementing Connectors

- Connectors are not restricted to JDBC model
  - Connectors can define own domain
- Common functionality are abstracted out of connectors
  - Connectors are only responsible for data transfer
  - Common Reduce phase implements data transformation and system integration
  - Connectors can benefit from future development of common functionality

Different Options, Different Results

Which is running MySQL?

```
$ sqoop import --connect jdbc:mysql://localhost/db \
--username foo --table TEST
```

```
$ sqoop import --connect jdbc:mysql://localhost/db \
--driver com.mysql.jdbc.Driver --username foo --table TEST
```

- Different options may lead to unpredictable results
  - Sqoop 2 requires explicit selection of a connector, thus disambiguating the process

Sqoop 1: Using Connectors

- Choice of connector is implicit
  - In a simple case, based on the URL in --connect string to access the database
  - Specification of different options can lead to different connector selection
  - Error-prone but good for power users

Sqoop 1: Using Connectors

- Require knowledge of database idiosyncrasies
  - e.g. Couchbase does not need to specify a table name, which is required, causing --table to get overloaded as backfill or dump operation
  - e.g. --null-string representation is not supported by all connectors
- Functionality is limited to what the implicitly chosen connector supports

Sqoop 2: Using Connectors

- Users make explicit connector choice
  - Less error-prone, more predictable
- Users need not be aware of the functionality of all connectors
  - Couchbase users need not care that other connectors use tables

Sqoop 2: Using Connectors

- Common functionality is available to all connectors
  - Connectors need not worry about common downstream functionality, such as transformation into various formats and integration with other systems

Ease of Extension

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Sqoop 2 Themes

- Ease of Use
- Ease of Extension
- Security

Security

Sqoop 1	Sqoop 2
Support only for Hadoop security	Support for Hadoop security and role-based access control to external systems
High risk of abusing access to external systems	Reduced risk of abusing access to external systems
No resource management policy	Resource management policy

Sqoop 1: Security

- Inherit/Propagate Kerberos principal for the jobs it launches
- Access to files on HDFS can be controlled via HDFS security
- Limited support (user/password) for secure access to external systems

Sqoop 2: Security

- Inherit/Propagate Kerberos principal for the jobs it launches
- Access to files on HDFS can be controlled via HDFS security
- Support for secure access to external systems via role-based access to connection objects
  - Administrators create/edit/delete connections
  - Operators use connections

Sqoop 1: External System Access

- Every invocation requires necessary credentials to access external systems (e.g. relational database)
  - Workaround: create a user with limited access in lieu of giving out password
    - Does not scale
    - Permission granularity is hard to obtain
- Hard to prevent misuse once credentials are given

Sqoop 2: External System Access

- Connections are enabled as first-class objects
  - Connections encompass credentials
  - Connections are created once and then used many times for various import/export jobs
  - Connections are created by administrator and used by operator
    - Safeguard credential access from end users
- Connections can be restricted in scope based on operation (import/export)
  - Operators cannot abuse credentials

Sqoop 1: Resource Management

- No explicit resource management policy
  - Users specify the number of map jobs to run
  - Cannot throttle load on external systems

Sqoop 2: Resource Management

- Connections allow specification of resource management policy
  - Administrators can limit the total number of physical connections open at one time
  - Connections can also be disabled

Security

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Support only for Hadoop security	Support for Hadoop security and role-based access control to external systems
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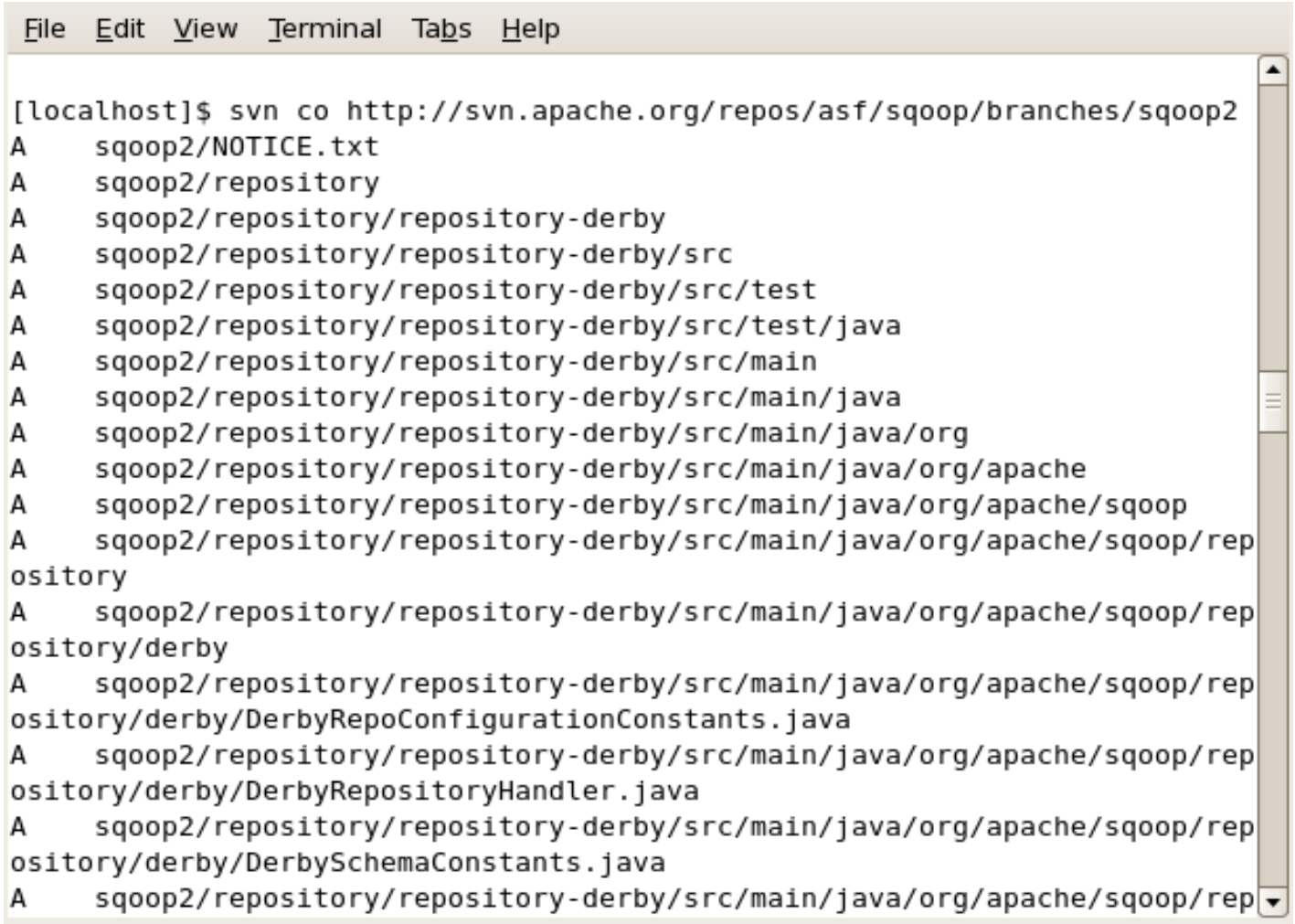
Demo Screenshots



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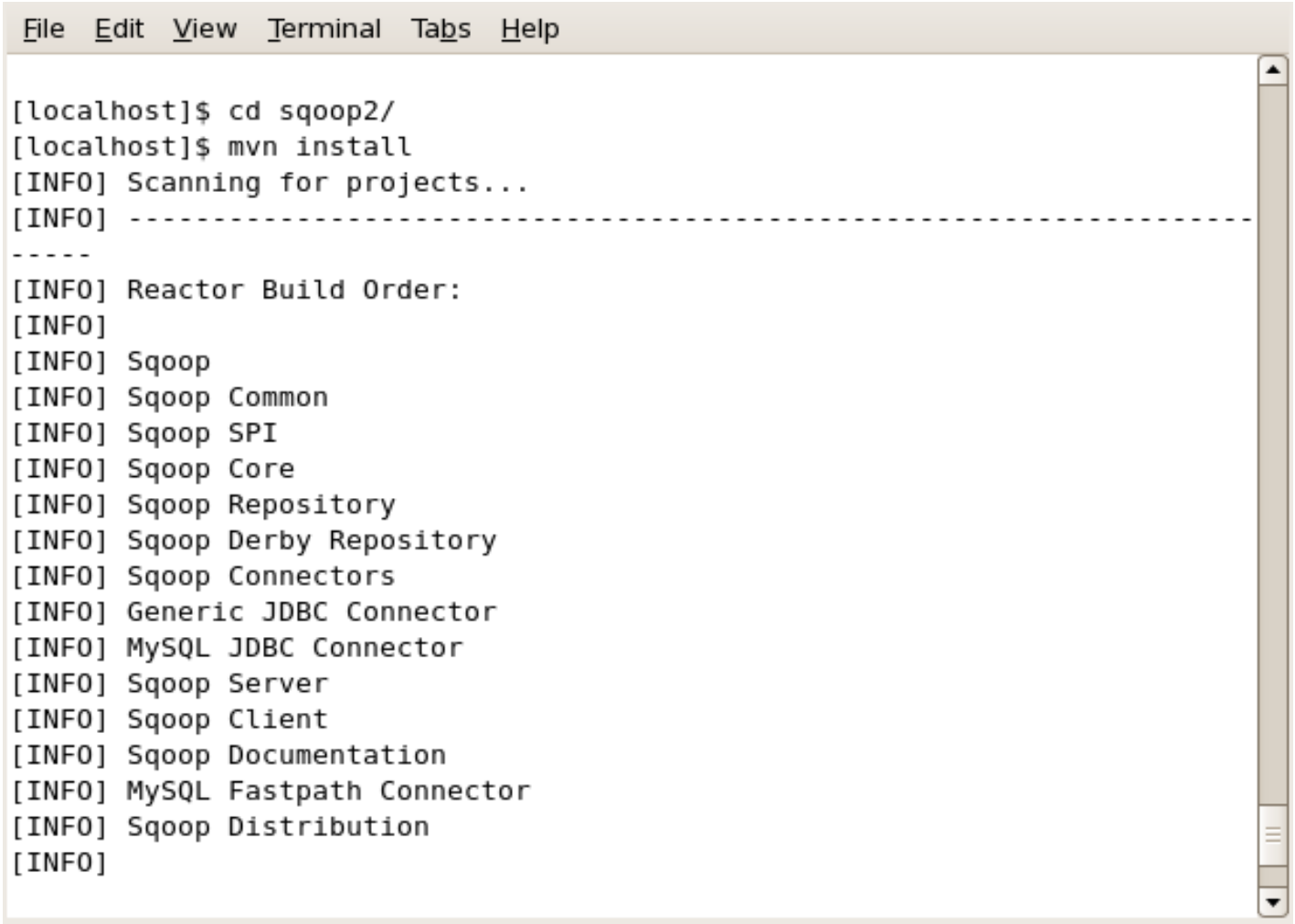

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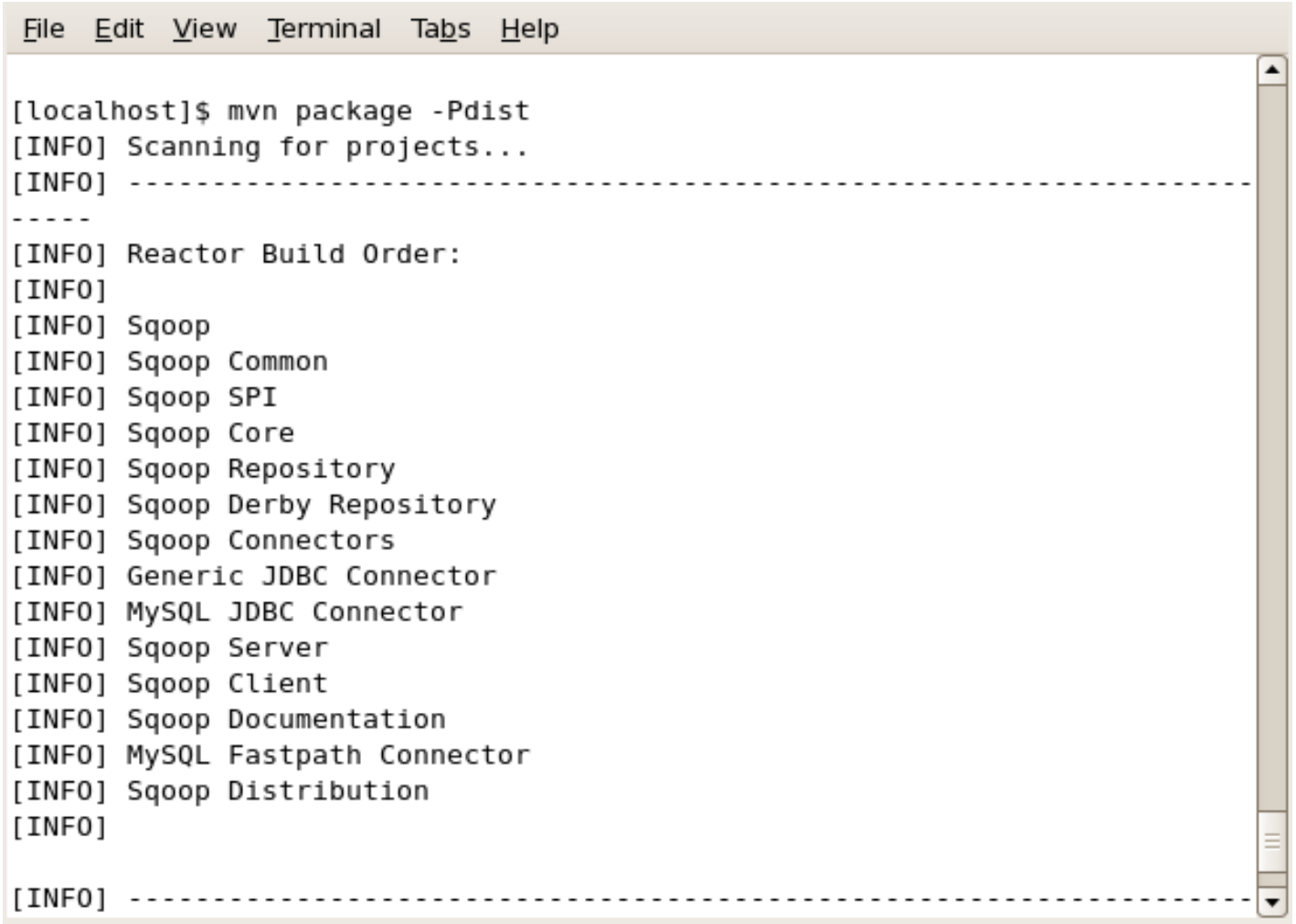

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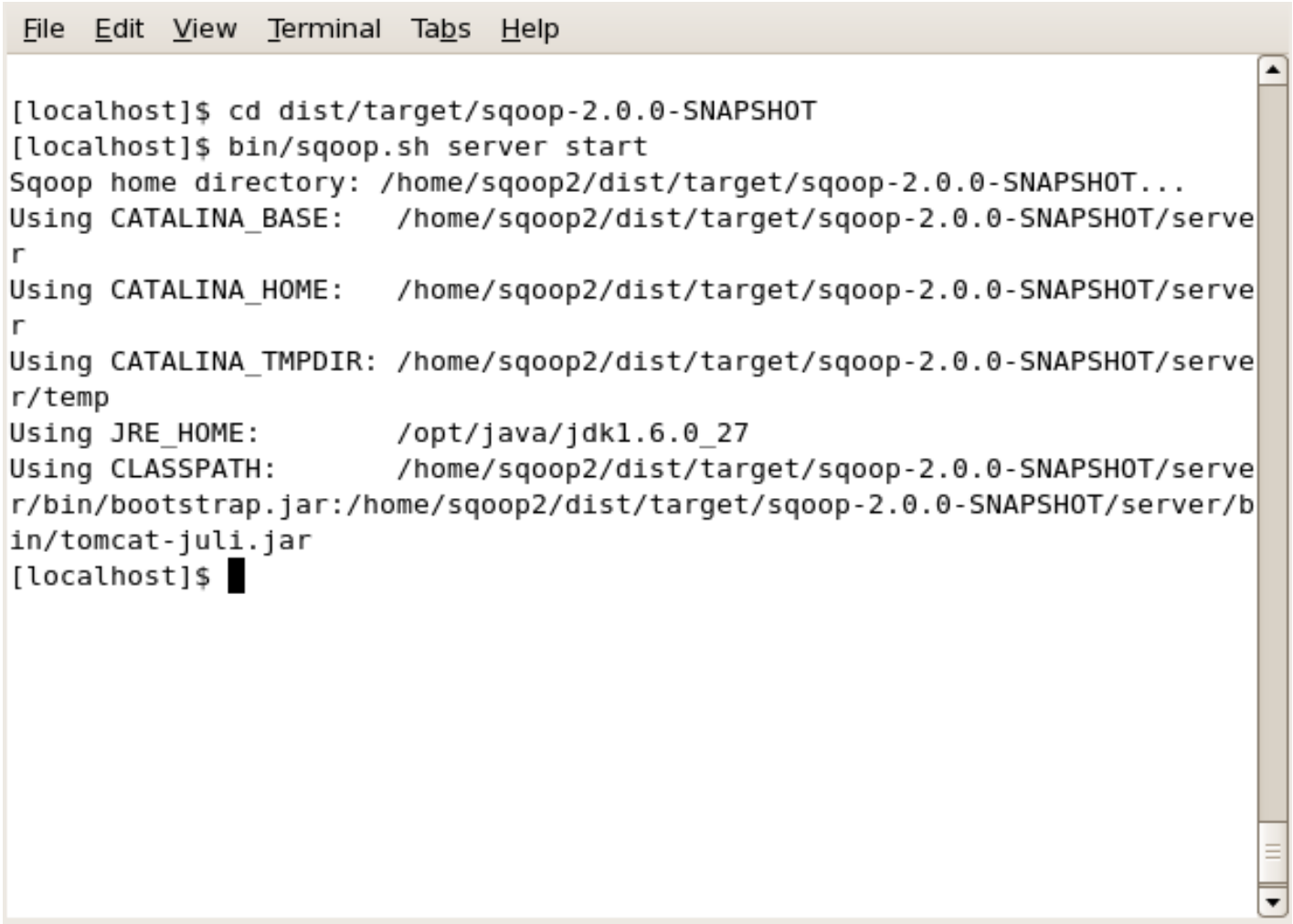

Demo Screenshots

File Edit View Terminal Tabs Help

```
[localhost]$ bin/sqoop.sh client
Sqoop home directory: /home/sqoop2/dist/target/sqoop-2.0.0-SNAPSHOT...
Jun 8, 2012 10:42:22 PM java.util.prefs.FileSystemPreferences$2 run
INFO: Created user preferences directory.
Sqoop Shell: Type 'help' or '\h' for help.

sqoop:000> show version
Usage: show version
-a,--all         Display all versions
-c,--client      Display client version
-p,--protocol    Display protocol version
-s,--server      Display server version

sqoop:000> show version --all
Server version:
  Sqoop 2.0.0-SNAPSHOT revision 1346742
  Compiled by root on Fri Jun  8 22:38:45 PDT 2012
Client version:
  Sqoop 2.0.0-SNAPSHOT revision 1346742
  Compiled by root on Fri Jun  8 22:38:45 PDT 2012
Protocol version:
  [1]
```

Takeaway

Sqoop 2 Highights:

- Ease of Use: Sqoop as a Service
- Ease of Extension: Connectors benefit from shared functionality
- Security: Connections as first-class objects and role-based security

Current Status: work-in-progress

- Sqoop2 Development:
  http://issues.apache.org/jira/browse/SQOOP-365
- Sqoop2 Blog Post:
  http://blogs.apache.org/sqoop/entry/apache_sqoop_highlights_of_sqoop
- Sqoop2 Design:
  http://cwiki.apache.org/confluence/display/SQOOP/Sqoop+2

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- Sqoop2 Quickstart:
  http://cwiki.apache.org/confluence/display/SQOOP/Sqoop2+Quickstart
- Sqoop2 Resource Layout:
  http://cwiki.apache.org/confluence/display/SQOOP/Sqoop2+-+Resource+Layout
- Sqoop2 Feature Requests:
  http://cwiki.apache.org/confluence/display/SQOOP/Sqoop2+Feature+Requests

SQOOP WANT YOU