Best Practices for System Administration

LabKey User Conference and Workshop 2016

Brian Connolly
Senior Systems Engineer, LabKey Software

LabKey®

Agenda:

- Your hardware and environments
- Prerequisite software
- Overview of a LabKey Server installation
- Overview of the Admin Console
- Troubleshooting a LabKey Server
- Staging Servers
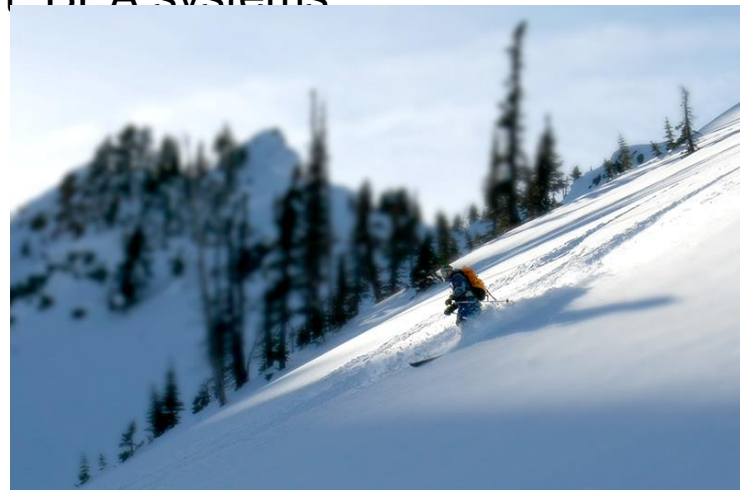- Monitoring and backups
- Q & A

Who am I

Senior Systems Engineer at LabKey

- What do I do at LabKey?
    - Run LabKey Servers at AWS and at Customer's sites
    - Help our Customers run LabKey Server

- Worked at LabKey for last 9 years
    - Previously worked at Microsoft, BEA systems UW and a few startups

Outside of LabKey I spend lots of time in the mountains

Your Hardware and Environments

Consider Your Starting Points, Pre-existing Systems

- Hardware (Physical or Virtual)
- Operating System
- Database(s)
- Using a Staging or Test Environment

Pre-requisite Software

- Oracle Java

- Apache Tomcat

- Database Software (PostgreSQL or MS SQL)

- Third Party Tools

Documented on our Support Technologies page at
https://www.labkey.org/wiki/home/Documentation/page.view?name=supported

Pre-requisite Software: Java

Recommended Version:
- 1.8.x - Latest Version
- Distribution to use: ServerJRE
- Download URL:
  http://www.oracle.com/technetwork/java/javase/downloads/index.html

Updates:
- Oracle releases Critical Patch Updates (CPU) once a quarter.
- Recommendation: *Always install updates during next maintenance window*

Pre-requisite Software: Tomcat

Recommended Version:

- Latest version of 7.0 or 8.0

Download URL:

- https://tomcat.apache.org/download-80.cgi
- Linux/Mac OSX: use "tar.gz" dist
- Windows: use "32-bit/64-bit Windows Service Installer"

Updates:

- Follow your standard patching policy

Pre-requisite Software: Tomcat

Configuration:
- Follow the guidelines in LabKey's documentation (#7 to #10)
  - https://www.labkey.org/wiki/home/Documentation/page.view?name=configTomcat
- server.xml: Use LabKey's sample configuration
  - https://github.com/LabKey/samples/tree/master/ops/config-examples
  - These are the configuration settings we use.
- Tomcat memory
  - Recommended: *Startup = 512MB | Max Size = 4096MB or greater*
  - https://www.labkey.org/wiki/home/Documentation/page.view?name=configWebappMemory

Configuration (continued)

- Windows Service Logon
  - Do not use Local System

Pre-requisite Software: PostgreSQL

Recommended Version: 9.5 or later

- Version 9.2, 9.3, 9.4 are still supported and regularly tested.

Download URL:

- http://www.postgresql.org/download/

Updates:

- Follow your standard patching policy
- LabKey will notify you if update contains critical hot-fix or security vulnerability

Configuration

- User and Privileges:
  - LabKey Server assumes that the user is a "superuser"
- Configuration Guidance (for "large" server)
  - Effective Cache Size: 75% of memory
  - Shared Buffers:
    - Linux: 25% of memory
    - Windows: 64MB to 512MB
  - Work mem: 20MB | Maintenance Work mem: 1024MB | Autovacuum Work mem: 512MB
  - Checkpoint Segments: 10
  - Checkpoint Timeout: 15
  - Random Page Cost: 1.4 | Join collapse limit: 10

Pre-requisite Software: MS SQL Server

- Recommended Version: SQL Server 2014
  - Versions 2008 and 2012 is supported and regularly tested
- Updates:
  - Follow your standard patching policy

Pre-requisite Software: MS SQL Database

Configuration

- User and Privileges:
  - LabKey Server assumes that the user is a member of the sysadmin role
  - Can be installed without user having sysadmin role.
    - DBA will create new database for LabKey Server
    - User requires db_owner role for database
    - After installation, DBA must manually install GROUP_CONCAT
      - https://www.labkey.org/wiki/home/Documentation/page.view?name=groupconcatinstall

Pre-requisite Software: Third Party Software

See https://www.labkey.org/wiki/home/Documentation/page.view?name=thirdPartyCode

LabKey Server Administration: Agenda

- Your hardware and environments
- Pre-requisite software
- **Overview of a LabKey Server installation**
- Overview of the Admin Console
- Troubleshooting a LabKey Server
- Staging Servers
- Monitoring and backups
- Q & A

Overview of LabKey Server Installation

Installation and Upgrade

- LabKey does not have *official* installation or upgrade scripts
- Sample scripts are available in our Samples repo
  - https://github.com/LabKey/samples/tree/master/ops

Overview of LabKey Server Installation

Important directories

- LabKey Server Installation Directory
- Site-Wide Fileroot
- Tomcat TMP directory

Overview of LabKey Server Installation

LabKey Server Install Directory: `(LABKEY_HOME)`
Contains LabKey Server Software

- `./modules`: LabKey modules installed here
- `./labkeywebapp`: all files used by web application
- `./pipeline-lib`: libraries
- `./bin`: compiled 3rd party tools
- `./files`: Site-Wide file root (default location)
- `./threadDumpRequest` & `./heapDumpRequest`:
- Optional:
  - `./externalModules`: put custom modules here
  - `./extraWebapp`: use this for splash pages or robots.txt, etc

We use `c:\labkey\labkey` (`/labkey/labkey`)

Overview of LabKey Server Installation

Site-Wide Fileroot:

- Contains
  - Default location for all files associated with every folder

- By default, located in Installation directory.
  - Location can be changed via the Files Admin Console

- Directory structure matches the folder layout of your LabKey Server
  - Example: if your "home" project has two sub-folders named bob and alice Sitewide Fileroot directory structure will be
    ```
    ./
    ./home
    ./home/bob
    ./home/alice
    ```

Overview of LabKey Server Installation

Tomcat TEMP directory:
- Contains
  - Temporary files such as report contents, thumbnails, etc
  - Default location of Full Text Search index

- Must be secured. Only admins and the user running the Tomcat server need access

- Location can be changed via TOMCAT service configuration tool
  - Default location is `TOMCAT_INSTALL_DIR/temp`
  - Recommend:
    - Do not use the default location (we use `c:\labkey\tomcat-tmp`)
    - Place on local disk (not on network storage)

Overview of LabKey Server Installation

LabKey Server configuration file: (`labkey.xml` file)
- Installed in `TOMCAT_INSTALL_DIR/conf/Catalina/locahost`

- What does it do? Tells the Tomcat server
  - How to connect to the LabKey database
  - Specifies location of the labkeywebapp directory
  - How to connect to the SMTP server
  - Sets various configuration parameters

Overview of LabKey Server Installation

LabKey Server configuration file: (continued)
- Security
  - This file contains passwords and sensitive information
  - Secure this file!

- Documentation at
  https://www.labkey.org/wiki/home/Documentation/page.view?name=cpasxml

Overview of LabKey Server Installation

LabKey Server configuration file: Important settings

- Context Path:
  - Default is `labkey`:
    - This means your URL will be something like
      http://host.example.org/labkey
  - Controlled by name of the file
  - If you want your URL to be http://host.example.org
    - change name of file to ROOT.xml

LabKey Server configuration file: Important settings

```
<Context docBase="@@appDocBase@@" debug="0" reloadable="true"
crossContext="true">
```

- docBase: is the location of labkeywebapp directory.

Overview of LabKey Server Installation - Postgres

LabKey Server configuration file: Important settings

Database Configuration:
```
<Resource name="jdbc/pgDataSource" auth="Container"
        type="javax.sql.DataSource"
        username="USERNAME"
        password="PASSWORD"
        driverClassName="org.postgresql.Driver"
        url="jdbc:postgresql://localhost:5432/test"
        maxActive="20"
        maxIdle="10"
        accessToUnderlyingConnectionAllowed="true"/>
```

Overview of LabKey Server Installation - MS SQL

LabKey Server configuration file: Important settings

Database Configuration:

```
<Resource name="jdbc/mssqlDataSource" auth="Container"
        type="javax.sql.DataSource"
        username="USERNAME"
        password="PASSWORD"
        driverClassName="net.sourceforge.jtds.jdbc.Driver"
        url="jdbc:jtds:sqlserver://localhost:1433/DATABASE_NAME"
        maxActive="20"
        maxIdle="10"
        accessToUnderlyingConnectionAllowed="true"
        validationQuery="SELECT 1"/>
```

Overview of LabKey Server Installation

LabKey Server configuration file: Important settings

SMTP Configuration:

```
<Resource name="mail/Session" auth="Container"
        type="javax.mail.Session"
        mail.smtp.host="@@smtpHost@@"
        mail.smtp.user="@@smtpUser@@"
        mail.smtp.port="@@smtpPort@@"/>
```

- Configuration supports TLS and other options
  - https://www.labkey.org/wiki/home/Documentation/page.view?name=cpasxml

Overview of LabKey Server Installation

LabKey Server configuration file: Important settings

```
<!-- Encryption key for encrypted property store -->
<Parameter name="MasterEncryptionKey" value="@@masterEncryptionKey@@" />
```

- Master Encryption Key:
  - This key is used to encrypt credentials used to access remote services
  - Store this key in safe place
  - If using a Staging server: key must be same on staging and production

Overview of LabKey Server Installation

LabKey Server **Installation** has two steps:

1. Install the binary distribution files

2. Install the LabKey database schema

Overview of LabKey Server Installation

Step 1: Install the binary distribution files

- What happens during this step:
  a. Files from distribution are copied to LabKey Installation directory
  b. LabKey Web Service is started

Overview of LabKey Server Installation

Step 2: Install the LabKey database schema

- What happens during this step:
  a. LabKey Web Server starts up
  b. Attempts to connect to database instance
     - If database does not exist, then creates it
     - If database exists, but is empty goes to next step
  c. Installs labkey and core schemas
  d. Asks the installer to create the first user account
     - This account will be member of Site Admin group
  e. Installs all other schemas in database

Overview of LabKey Server Installation

LabKey Server **Upgrade** has two steps:

1. Install the binary distribution files

2. Upgrade the LabKey database schema

(upgrades are a little more involved)

Overview of LabKey Server Installation

Step 1: Install the binary distribution files

- What happens during this step:
  - a. LabKey Web Server service is stopped
  - b. Files from the distribution directory are copied to LabKey installation directory
  - c. LabKey Web Server service is started

How is this done:

- Using `upgrade-windows-manual.bat` script
  - *use `upgrade-windows-manual.sh` for linux*

Step 2: Upgrade the LabKey database schema

- What happens during this step:
    a. LabKey Web Server Server starts up
    b. Connects to database instance
    c. Compares version of newly installed files with information in the database **

** Version information is stored both in the database and in the files/software on disk)

Overview of LabKey Server Installation

Step 2: Schema upgrade not required

- Two scenarios where this can happen:
  a. If the software is not newer than the database
  b. If the software is newer than the database, but no database changes are required.

Overview of LabKey Server Installation

Step 2: Schema upgrade is required

- This occurs if the software is newer than the database and database changes are required.

- So what happens :
  a. Web server will only allow Site Admins to login while the upgrade is running
  b. After upgrade is finished all users are allowed to login

Overview of LabKey Server Installation

Typical workflow for installer/upgrader:

1. Run upgrade script
   a. Review messages printed to screen for errors
   b. *Note: LabKey Web Server is started at end of script*
2. Open `labkey.log` and verify the server has started
3. Open browser and login
   a. If required, perform database upgrade

Overview of LabKey Server Installation

Typical workflow for installer/upgrader: (cont.)

4. When upgrade is complete:
   a. Review `labkey.log` and verify their were no errors
   b. Open `Admin Console` and verify version of LabKey Server running
   c. Start acceptance testing.

LabKey Server Administration: Agenda

- Your hardware and environments

- Pre-requisite software

- Overview of a LabKey Server installation

- **Overview of the Admin Console**

- Troubleshooting a LabKey Server

- Staging servers

- Monitoring and backups

- Q & A

Overview of Admin Console

The LabKey Server Admin Console contains lots of good information.

- Management pages for server
- Version: LabKey, JAVA, PostgreSQL, TOMCAT
- Diagnostic Info: Links to log files, Memory usage, etc
- Audit logs

Let me give you run-down….

LabKey Server Administration: Agenda

- Your hardware and environments
- Pre-requisite software
- Overview of a LabKey Server installation
- Overview of the Admin Console
- **Troubleshooting a LabKey Server**
- Staging Servers
- Monitoring and backups
- Q & A

Troubleshooting a LabKey Server

LabKey Server writes lots of log files. Here is an overview.

Troubleshooting a LabKey Server

Log files are located in CATALINA_HOME/logs

- `labkey.log`: 99% of the important logs are here
    - Contains debug,informational, warning and error
    - File is rotated when reaches 10MB.
    - Four previous versions retained
- `labkey-errors.log`: Same as `labkey.log` but only ERROR messages
    - File is rotated with each server restart
    - Four previous versions retained
- `catalina.YYYY-MM-DD.log`: (or `catalina.out`)
    - Contains TOMCAT specific logs
    - New file is created daily (as long as activity) and retained forever

Troubleshooting a LabKey Server

For the expert:

- `localhost_access_log.*:`
  - Contains access logs (ie info about each request to the server)
  - Contains URL, referrer, user account making requesting, etc
  - New file is created daily (as long as activity) and retained forever

- `commons-daemon.*.log:`
  - Contains logs from the Windows Service. If service does not start, look here.
  - New file is created daily (as long as activity) and retained forever

Log Files: ETLs

When an ETL runs a log file is created.

- ETL is run as Pipeline Job
- ETL log file is referred to as pipeline job log file
- Contains informational and error messages
- If the ETL fails look in this log for errors or other debug info.

Troubleshooting a LabKey Server

Heap and thread dumps:

- HeapDump:
  - What: "Dumps" contents of memory to a file
  - How: "touch" file
    `LABKEY_HOME\heapDumpRequest`
  - Where: File is written to `LABKEY_HOME`

- ThreadDump:
  - What: "Dumps" running threads to labkey.log file
  - How: "touch" file
    `LABKEY_HOME\threadDumpRequest`
  - Where: File is written to `LABKEY_HOME`

LabKey Server Administration: Agenda

- Your hardware and environments
- Pre-requisite software
- Overview of a LabKey Server installation
- Overview of the Admin Console
- Troubleshooting a LabKey Server
- **Staging Servers**
- Monitoring and backups
- Q & A

Staging and Test Environments

Guidance for setting up a Staging Server

- Change the Server GUID
- Write a SQL script to automatically change Site Settings and Look & Feel

Full documentation at
https://www.labkey.org/wiki/home/Documentation/page.view?name=stagingServerTips

My design for building a Staging Env.
- Create exact duplicate of Production Server
  - Same OS and version of pre-req software
    - Tomcat, PostgreSQL/MSSQL, JAVA
    - Other software your server may use (ie R, python)
  - Same configuration
    - FileRoots, Tomcat TMP directories in same file locations
    - HTTPS (if configured on Prod)
- Change some settings
  - Set Server GUID
  - Set Master Encryption Key to be same as Prod
  - Change name of LabKey Database
    - ie. if Prod is `labkey`, then use `labkey-staging`

My design for building a Staging Env. (cont)

- Data Periodically "refreshed" from Production
  - When Production is to be upgraded
    - 1. Data in Staging Env will be wiped
    - 2. Data in Production Env will be copy to Staging

Staging Env: Using the design (High-Level)

1. **On Production Env.**
   - Backup the "Data" in Prod Env
   - The "Data" is stored in the LabKey Database and in SiteWide FileRoot
     - (and any other FileRoots you may be using)

2. **On Staging Env.**
   - Shutdown LabKey Server
   - Refresh Database and FileRoot "Data"
   - Change Look and Feel (and other settings)
   - Start LabKey Server
   - Test

Staging Env: Using the design (Details)

On Production Env.
- Backup of the LabKey Database options
  - Full Backup: Write to file and copy to Staging Env.
  - Other methods are available.

- Backup of FileRoot(s) options
  - Full: "zip" up files to archive and copy to Staging Env.
  - Incremental: Use a tool like Rsync to transfer files directly to Staging Env.

Staging Env: Using the design (Details)

On Staging Env.
- Shutdown LabKey Server
- Restore of the LabKey Database options
  - Full Backup:
    i. Drop existing LabKey Database
    ii. Restore Production Backup
    iii. [*Best Practice: Use different name for LabKey Database on Staging*]
  - Other methods are available.
- Change Look and Feel/Site Settings
  - See https://www.labkey.org/wiki/home/Documentation/page.view?name=stagingServerTips

Staging Env: Using the design (Details)

On Staging Env.
- Restore of FileRoot(s) options
    - Full:
        i. "unzip" files to archive into proper directories
        ii. Ensure OS permission of restored files is correct
    - Incremental:
        i. Ensure OS permission of copied files are correct

Now you are ready to test
- New LabKey Server release
- OS patches
- Tomcat, PostgreSQL, JAVA etc upgrades

Monitoring and Backups

Tell me about your plans for

- Monitoring

- Backups

Monitoring and Backups

Monitoring: What to monitor

- Tomcat: Up/Down
- Disk space on `FileRoot`, `PipelineRoot`, `Tomcat TMP` dir
- Database: Up/Down
- CPU/Memory usage
- Other…

Monitoring and Backups

Backup: Important to backup

- Files:
  - FileRoot (Site-wide and all custom)
  - PipelineRoot(if used)
  - Tomcat TMP directory
  - LabKey, Tomcat, database log files
  - System Files (Operating System, software, etc)
- Database

Questions?

Questions?