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# LAND TECHNOLOGY SOLUTIONS (LTS) PROJECT

MAST Deployment Guide (v 2.2)

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Prepared by:

SSG-Advisors, LLC

1 Mill Street, Suite 201  
Burlington, VT 05401  
Phone: (802) 735-1169  
Fax: (866) 595-9620

2000 P Street, Suite 401  
Washington, DC 20036  
Phone: (202) 548-7107

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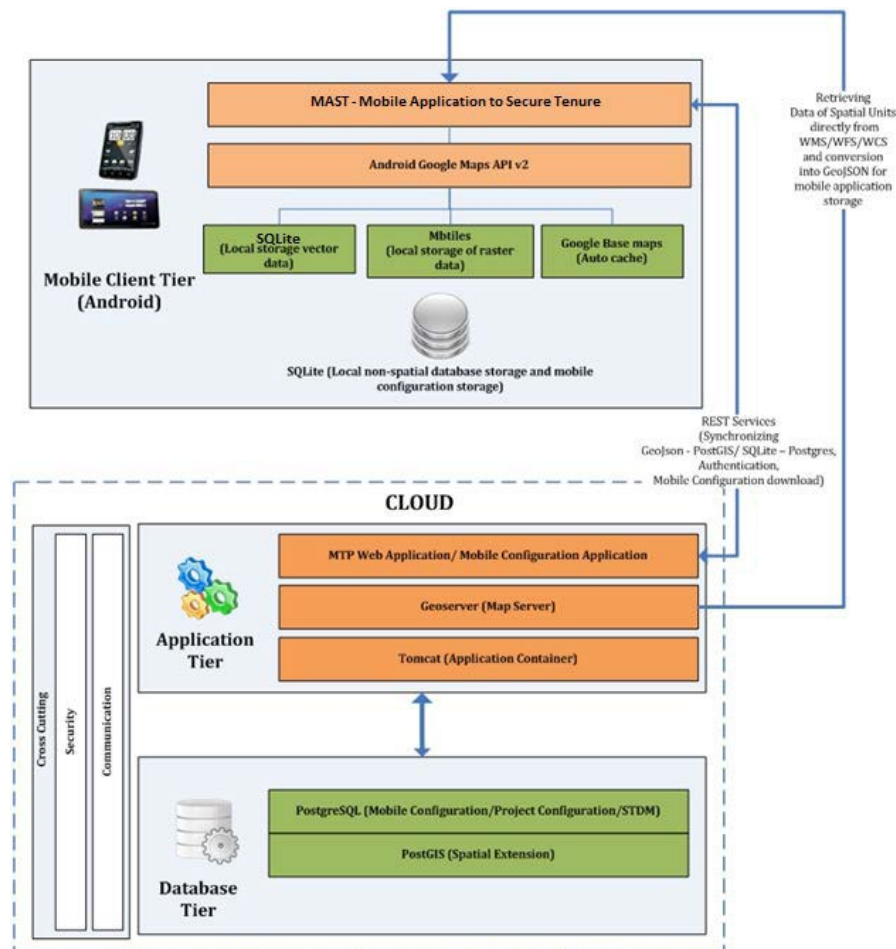
# ACRONYMS & ABBREVIATIONS

LTS	Land Technology Solutions
MAST	Mobile Applications to Secure Tenure
ME&L	Monitoring, Evaluation and Learning
ERC	USAID Evaluation, Research and Communication (ERC) project
USAID	United States Agency for International Development
USAID/E3/LU	USAID's Bureau for Economic Growth, Education and Environment, Office of Land and Urban

# I. INTRODUCTION

This document is a guide to setting up a MAST server and mobile application instance from scratch. It is designed to be used in conjunction with the MAST Implementation Guide and serves as a technical manual for all the technology components that underlie the MAST platform. The intended audience is software developers, systems administrators, and other technical specialists.

It is assumed that the user has reasonable familiarity with Linux servers, Java applications, databases, and Android applications. Working knowledge of git and other tools will also be necessary. This guide makes extensive use of the Linux command line and assumes that the user has a Linux development environment available for use, though a Windows or OSX computer can certainly be used with some modifications.



**Figure I – MAST infrastructure**

A complete deployment of MAST requires, at a minimum, a server and enough Android devices to meet the project's needs. The server can be a physical server or a cloud server, and this guide provides information for both use cases. Android devices may be mobile phones or tablets, but should run Android

4+ and have an onboard GPS unit with sufficient accuracy to map land parcels. For improved accuracy, it is recommended that you use an external GPS unit connected to the mobile device via Bluetooth or USB.

# 2. MAST Data Management Infrastructure

## 2.1 HOSTING

Before beginning MAST deployment, first consider what type of server hosting you will be using. MAST can either be run on a cloud server, like Amazon Web Services (AWS), or on a local, physical server. Either option is viable, and the decision rests on the purpose, environment, and longevity of the project.

A cloud server is appropriate for a MAST instance that is large in scale (regional or national) and that requires consistent server uptime and availability, but does not have a physical environment that would allow these needs to be fulfilled by a local server, i.e. lacks reliable datacenters, electricity, or connectivity. Cloud servers ensure infrastructure reliability for a reasonable monthly fee, but do require an internet connection to reach. Costs tend to be reasonable, but the ability to pay them does require a consistent cash flow. Although cloud servers don't require infrastructure maintenance, they are still servers and require system administration knowledge to set up and maintain.

A local server is appropriate for two cases: when MAST is only going to be utilized in a single office or location, or if there are high quality data centers available locally. In the first case, MAST can be installed on a single computer (even a laptop) and accessed only via a local network. Advantages are the low cost and low complexity, at the expense of flexibility and reach. It also requires a qualified local technician, or a preconfigured machine sent to the location. Configuration will be somewhat different than the cloud server. In the second case, configuration will be identical to that of a cloud server, but will require a database and significant infrastructure support, in addition to overall systems support. This type of solution is only likely to be viable in instances where data sovereignty is paramount and funding is sufficient to pay for high levels of support. Cost may be high.

### Amazon Web Services

This guide largely discusses hosting in terms of AWS, though any other hosting service could be used. Simply find a similar server configuration to those suggested below.

MAST can run on relatively small servers, as small as t2.large. However, for large deployments, m4.large and above are recommended. While day to day operations don't require significant resources, serving large amounts of imagery and executing topology checks can be CPU-intensive. It is also recommended that the MAST database run on a separate Amazon Relational Database Service (RDS) server. This makes database management and backup very easy. Since storage is relatively cheap on AWS, elect for 100 GB minimum on each server. SSD is preferable for performance reasons. If you wish to use a smaller server size, such as a t2-tier server, regular application function will likely be sufficient, but topology check runs may be significantly hampered and cause performance issues, and memory management may become an issue.

For a local server, select hardware with a similar profile to the AWS server above. A minimum of 4 GB of RAM, 200 GB of storage, and a modern, multicore processor are recommended. If there will be a very small number of users with minimal concurrency, most consumer laptops will run MAST, though performance may not be optimal.



## 2.2 SERVER SETUP AND PREREQUISITES

### AWS Configuration

This guide assumes that the server is running Ubuntu 16.04. This is a long-term support version that is supported with free images from Amazon. Any other Linux distribution will function just as well; simply use your package manager of choice and substitute directory paths with the correct ones.

When configuring your AWS server, make sure that these ports are open via security settings.

- 22 (SSH): limit this to your own IP
- 5432 (PostgreSQL): for the database server if you wish to directly connect a database management client; limit this to your own IP
- 80 (HTTP): for the application server; open this to all IPs that should have access to MAST, or leave open to all
- 443 (HTTPS): for the application server, if using SSL

At the time of this writing, MAST does not support SSL out of the box.

### OS and package installation

Before proceeding, update your apt packages and lists:

```
$ sudo apt-get update
$ sudo apt-get upgrade
```

Install Java JDK 8 using the webupd8 installer:

```
$ sudo add-apt-repository ppa:webupd8team/java
$ sudo apt-get update
$ sudo apt-get install oracle-java8-installer
```

Install PostgreSQL and PostGIS extensions, if you are using a single server for application and database. If you are using Amazon RDS or equivalent, you will not need to do this, but will need to [configure your RDS database to work with PostGIS](#).

```
$ sudo apt install postgresql postgresql-contrib postgis
```

There are no apt packages for Tomcat, so first browse to the Apache Tomcat 8 download page at <https://tomcat.apache.org/download-80.cgi> and copy the link for the tar.gz archive link. At the time of this writing, it is <https://www-eu.apache.org/dist/tomcat/tomcat-8/v8.5.38/bin/apache-tomcat-8.5.38.tar.gz>. Then download the package and unzip it to the **/opt** folder:

```
$ wget https://www-eu.apache.org/dist/tomcat/tomcat-8/v8.5.38/bin/apache-tomcat-8.5.38.tar.gz
$ sudo tar xzvf apache-tomcat-8.5.38.tar.gz -C /opt
```

Files will be unzipped into **apache-tomcat-8.5.38** folder. Rename it to **tomcat**.

```
$ sudo mv /opt/apache-tomcat-8.5.38/ /opt/tomcat
```

Download and install GeoServer for serving map layers. GeoServer will be deployed to the Tomcat server and therefore we need the WAR package. For this guide, the latest 2.15.0 is used.

```
$ wget  
'http://sourceforge.net/projects/geoserver/files/GeoServer/2.15.0/geoserver-2.15.0-war.zip/download'
```

Rename downloaded file to **geoserver.zip** and unzip it to **geoserver** folder.

```
$ mv download geoserver.zip  
$ unzip geoserver.zip -d geoserver
```

Now the **geoserver** folder contains different files and folders. We need to copy geoserver.war into our Tomcat folder under the web applications subfolder - **/opt/tomcat/webapps**.

```
$ sudo cp geoserver/geoserver.war /opt/tomcat/webapps
```

Once the Tomcat server is started, geoserver.war will be expanded into the **geoserver** folder and deployed as a web application.

In order to connect to the MAST database, download appropriate JDBC drivers for PostgreSQL and PostGIS and put them into the **/opt/tomcat/lib** folder. The following lines use the latest versions as of this writing but you may check [here for postgres](#) and [here for postgis](#) driver updates. For this guide, since we installed Java 8 or higher, use version 4.2.

```
$ sudo wget https://jdbc.postgresql.org/download/postgresql-42.2.5.jar -P /opt/tomcat/lib/  
$ sudo wget http://central.maven.org/maven2/net/postgis/postgis-jdbc/2.3.0/postgis-jdbc-2.3.0.jar -P /opt/tomcat/lib/
```

## Configuration

### Configure PostgreSQL password

First, run the psql utility using postgres account and change and then change the password. If you used Amazon RDS, you've already done this during the setup process and will not need to repeat the process now.

```
$ sudo -u postgres psql  
postgres=# \password postgres
```

Remember this password, as it will be used to access the database in the future.

### Configure Tomcat

First, open your **.bashrc** file for editing using your favorite editor.

```
$ vim ~/.bashrc
```

And add the following lines (assuming Java 8 is installed):

```
JAVA_HOME=/usr/lib/jvm/java-8-oracle  
CATALINA_HOME=/opt/tomcat
```

Create or edit **setenv.sh** file in the Tomcat folder under **/opt/tomcat/bin** with the editor of your choice and set the following content:

```
CATALINA_OPTS="$CATALINA_OPTS -Dfile.encoding=UTF8 -Duser.timezone=UTC -  
server -d64 -XX:NewSize=700m -XX:MaxNewSize=700m -Xms1024m -Xmx2048m -  
XX:MaxPermSize=1024m -XX:+UseParNewGC -XX:+UseConcMarkSweepGC -  
XX:+CMSParallelRemarkEnabled -XX:SurvivorRatio=20 -XX:ParallelGCThreads=8"
```

This line sets different options for your Tomcat. The most important ones are **-Xms** (sets minimum allocated memory) and **-Xmx** (sets maximum allocated memory). Make sure that you have enough RAM for the configured values.

Make sure that the file is executable:

```
sudo chmod ug+x /opt/tomcat/bin/setenv.sh
```

Add the following resource reference to **/opt/tomcat/conf/context.xml** inside the **Context** tags, i.e. before **</Context>**:

```
<ResourceLink global="jdbc/mast" name="jdbc/mast"  
type="javax.sql.DataSource"/>
```

Add the following lines, configuring MAST database connection, to **/opt/tomcat/conf/server.xml** file inside the **GlobalNamingResources** tags, i.e. right before closing **</GlobalNamingResources>** tag, swapping out the host, database name, username and password strings for the correct ones. Please make sure that the database is not created yet and remember database name, configured in this setting. This name has to be used at the next steps when creating database.

```
<Resource type="javax.sql.DataSource"
name="jdbc/mast"
factory="org.apache.tomcat.jdbc.pool.DataSourceFactory"
driverClassName="org.postgresql.Driver"
url="jdbc:postgresql://host:5432/dbname"
username="username"
password="password"
testWhileIdle="true"
testOnBorrow="true"
testOnReturn="false"
validationQuery="SELECT 1"
validationInterval="30000"
timeBetweenEvictionRunsMillis="5000"
maxActive="100"
minIdle="10"
maxWait="10000"
initialSize="10"
removeAbandonedTimeout="60"
removeAbandoned="true"
logAbandoned="true"
minEvictableIdleTimeMillis="30000"
jmxEnabled="true"
jdbcInterceptors="org.apache.tomcat.jdbc.pool.interceptor.ConnectionState;
org.apache.tomcat.jdbc.pool.interceptor.StatementFinalizer;
org.apache.tomcat.jdbc.pool.interceptor.SlowQueryReportJmx(threshold=10000)
"
/>
```

## 2.3 APPLICATION AND DATABASE DEPLOYMENT

### Initialize Database

Fetch a copy of the latest scripts from the GitHub repository:

```
$ git clone https://github.com/MASTUSAID/DB-SCRIPTS.git
```

If you don't have Git installed, you can download the database creation script directly:

```
$ wget https://raw.githubusercontent.com/MASTUSAID/DB-SCRIPTS/master/create_database.sql
```

Login to your postgres server and create a new database. Your connection string will vary depending on your server choice.

```
$ sudo -u postgres psql
postgres=# CREATE DATABASE mast;
```

If you are using RDS, you will have to enable PostGIS support by manually adding several extensions. Follow the instructions in [Amazon's documentation for RDS here](#). You should end up with several new topology schemas.

Restore the database schema and data downloaded from the GitHub repository:

```
postgres=# \c mast
postgres=# \i create_database.sql
```

You may need to specify full path to the **create\_database.sql** file if it's not in the current folder. If you have no errors, check to ensure that the database has been populated.

### Install the DMI Application

You can either clone and compile MAST-DMI application from the GitHub (<https://github.com/MASTUSAID/MAST-DMI>) or download a compiled version from releases (<https://github.com/MASTUSAID/MAST-DMI/releases/>). Check for the latest release and download **mast.war** from the assets list. At the time of writing this guide, the latest release is 3.1.

```
$ wget https://github.com/MASTUSAID/MAST-DMI/releases/download/3.1/mast.war
```

If you are planning to do further development of MAST or explore the code, clone and open the project in your favorite Java IDE, supporting Maven.

Before building the application, you may wish to further configure some items, such as reports. MAST reports are configured using Jasper Reports, and all templates can be found under **/src/main/resources/reports** folder. Detailed use of the Jasper report editor is outside the scope of this document, but details and help can be found online at <http://community.jaspersoft.com/documentation>.

Once you have the WAR file available, copy it to the Tomcat **webapps** folder.

```
$ sudo cp mast.war /opt/tomcat/webapps/
```

## Start the Server

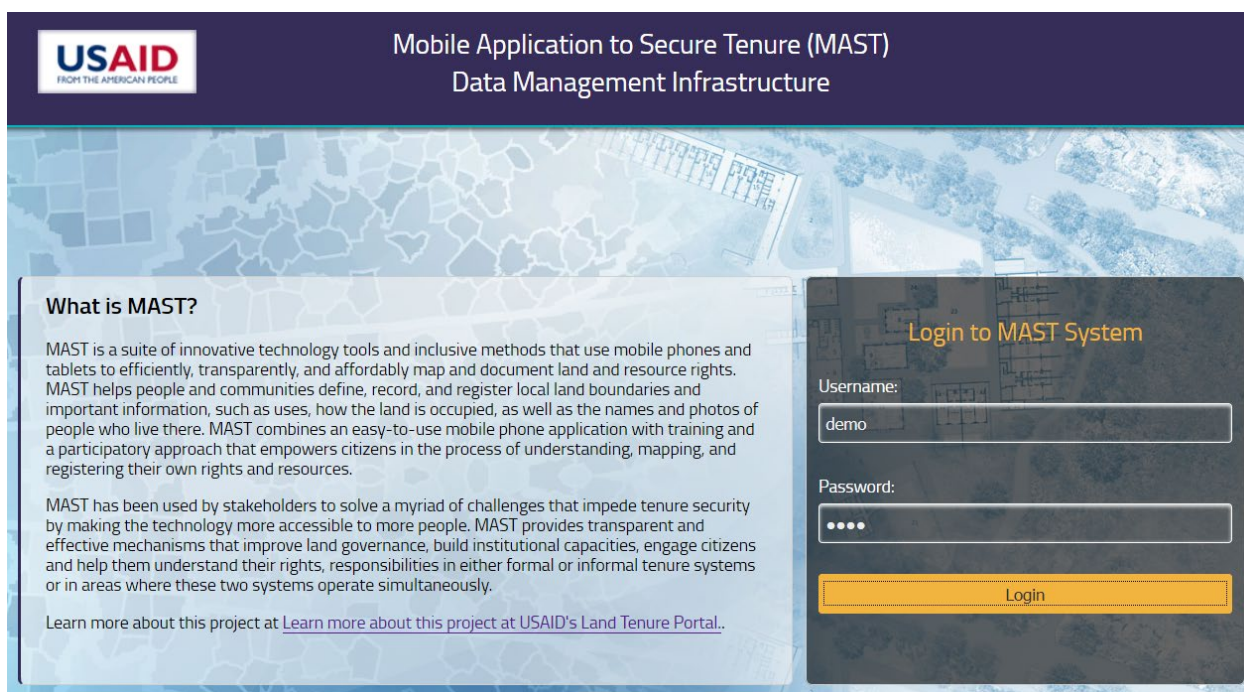
Finally, start your Tomcat server by using the following command:

```
$ sudo /opt/tomcat/bin/startup.sh
```

If you choose, you may also install Tomcat as a systemd service, though this is outside the scope of this guide.

Wait a few moments (e.g. 1-2 minutes) and check that the application has been deployed by going to **http://[your\_server\_IP]:8080/mast**. If you are testing from the local machine, use **localhost** instead of IP address. Please, note that if you didn't configure the HTTP port for Tomcat, it will use 8080 by default. This can be changed in the **server.xml** configuration file.

If components were properly installed and configured, you should see this login screen.



**Figure 2 – Login screen**

By default, a new database is created with user **demo** and password **demo**. This user has full administration rights, so you use it for initial setup and configuration of your own projects (refer to the user guide for more details). It's highly recommended that you change this password to something secure and disable/delete demo user in your production. There is also one project configured for your reference and tests.

## 2.4 GEOSERVER CONFIGURATION

GeoServer is used by MAST DMI for displaying various map layers. You can publish and link to DMI any type of layers, but there are a few important ones, which must be configured in GeoServer in order for the DMI to function properly. They include land parcels layer, resources layers and area of interest layer.

Before starting GeoServer configuration, open your browser and type in the IP address of your Tomcat server with '/geoserver' at the end:

**http://localhost:8080/geoserver/**

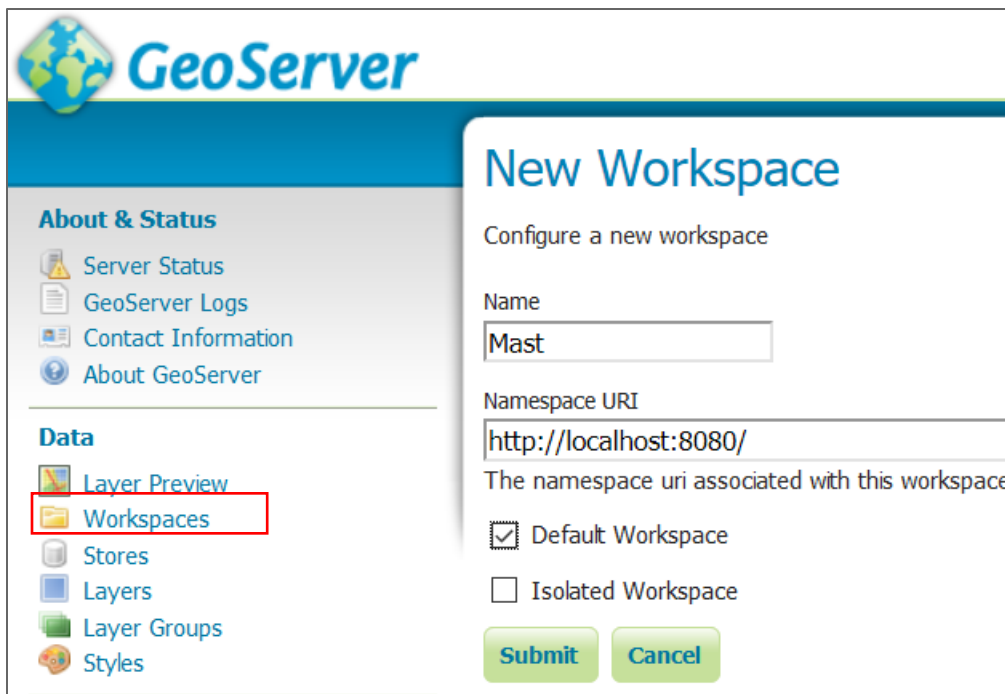
In this example we use localhost, but you can replace it with your IP address.

By default GeoServer has the username **admin** with password **geoserver**. Use these for accessing GeoServer, but it's highly recommended that you change this password to something more secure.

### Create namespace

First, we have to create the mast namespace, where all further data stores, layers and styles will be configured. Follow the steps below:

1. Login into GeoServer.
2. Click **Workspaces** in the left menu.
3. Click **Add new workspace** link.
4. Enter the following values:
  - a. Name = Mast
  - b. Namespace = http://localhost:8080/ (change localhost to IP address of Tomcat server if you want to access DMI from the network).
  - c. Tick **Default Workspace**
5. Click **Submit button**



The screenshot shows the GeoServer web interface. On the left, a sidebar contains two main sections: 'About & Status' and 'Data'. Under 'Data', the 'Workspaces' link is highlighted with a red rectangular box. The main content area displays the 'New Workspace' configuration form. It includes a title 'New Workspace', a subtitle 'Configure a new workspace', and two input fields: 'Name' (containing 'Mast') and 'Namespace URI' (containing 'http://localhost:8080/'). Below these fields is a descriptive text: 'The namespace uri associated with this workspace'. There are two checkboxes: 'Default Workspace' (checked) and 'Isolated Workspace' (unchecked). At the bottom right, there are two buttons: 'Submit' and 'Cancel'.

**Figure 3 – Mast workspace**

## Enable anonymous access

In newer GeoServer versions, anonymous “write” access is turned off and therefore you won’t be able to do spatial editing from the MAST DMI. Make sure that anonymous “write” access is enabled by following the steps below:

1. Click on the **Data** option under **Security** main menu.
2. In the list of rules, check if **ROLE\_ANONYMOUS** is present for **\*.\*.w** rule.

**Data Security**

Manage data security: edit, add and remove access rules

[+ Add new rule](#)

[- Remove Selected\(s\)](#)

<< < 1 > >> Results 1 to 2 (out of 2 items)

<input type="checkbox"/> Rule path	Roles
<input type="checkbox"/> *.*.r	*
<input type="checkbox"/> *.*.w	GROUP_ADMIN,ADMIN

<< < 1 > >> Results 1 to 2 (out of 2 items)

3. If anonymous role is missing, click on the **\*.\*.w** rule.
4. On the next screen select **ROLE\_ANONYMOUS** in the available roles and click add button “=>” to add it into Selected Roles.

**Roles**

Grant access to any role

☐

Available Roles		Selected Roles
ROLE_AUTHENTICATED	<a href="#">=&gt;</a>	GROUP_ADMIN
	<a href="#">&lt;=</a>	Admin
		ROLE_ANONYMOUS

[+ Add a new role](#)

[Save](#) [Cancel](#)

5. Click Save button.

## Publish parcels layer



For displaying land parcels on the map control in DMI, they have to be published on GeoServer first. If you initialized the MAST database from the script in this GitHub account, it already has settings to read the core Geoserver layers from localhost. If you are testing your server from a different computer, these layers' IP address has to be changed in the database. See the **Adjust layers URL** section for more details.

Start publishing the parcels layers by creating new a data store:

1. Click **Stores** in the main menu.
2. Click **Add new store**.
3. Click on **PostGIS** vector data source.
4. Enter the following parameters:
  - a. Workspace = Mast
  - b. Data Source Name = MastDB
  - c. Host = localhost (or IP address if your database on the different server)
  - d. Port: 5432
  - e. Database = mast
  - f. User = postgres
  - g. Password = [your\_postgres\_password]
  - h. Expose primary keys = yes (ticked)
5. Click **Save** button

**GeoServer**

**About & Status**

- Server Status
- GeoServer Logs
- Contact Information
- About GeoServer

**Data**

- Layer Preview
- Workspaces
- Stores**
- Layers
- Layer Groups
- Styles

**Services**

- WCS
- WFS
- WMTS
- WMS

**Settings**

- Global
- Image Processing
- Raster Access

**Tile Caching**

- Tile Layers
- Caching Defaults
- Gridsets
- Disk Quota
- BlobStores

**Security**

- Settings

## New Vector Data Source

Add a new vector data source

PostGIS  
PostGIS Database

### Basic Store Info

Workspace \*

Mast

Data Source Name \*

MastDB

Description

☒ Enabled

### Connection Parameters

host \*

localhost

port \*

5432

database

mast

schema

public

user \*

postgres

passwd

.....

Namespace \*

http://localhost:8080

☒ Expose primary keys

**Figure 4 – New store**

If all parameters are provided correctly, you will see the next screen with the list of tables, available in the database. If you have any issues, see the Known Issues section for more details regarding PostgreSQL drivers in GeoServer.

Go through the listed tables and find **la\_spatialunit\_land**. Click **Publish** link against this table. Alternatively you can go through **Layers** menu and select **Add a new layer** option. Make sure the following parameters are set for the land parcels layer:

- 1) Name = la\_spatialunit\_land
- 2) Title = Land Parcels
- 3) Native SRS = EPSG:4326
- 4) Declared SRS = EPSG:4326
- 5) Click **Compute from SRS bounds** to calculate bounding box. You can use **Compute from data** if you have already some data.
- 6) Click **Compute from native bounds** to set **Lat/Lon Bounding Box**
- 7) Click **Save** button



**Figure 5 – Parcels layer properties**

After successful saving, it will appear in the list of layers (under **Layers** menu).

### **Publish area of interest layer**

Area of interest area layer is used for displaying designated areas, which can be further assigned to specific para-surveyor for limiting his area of field surveys. Since we have already created MAST database source, we simply need to publish a new layer. Follow these steps below:

1. Click **Layers** menu.
2. Click **Add a new layer** link.
3. Select **Mast:MastDB** data source.
4. Look for **la\_spatialunit\_aoi** table and click **Publish**.
5. Provide the following values:
  - a. Name = la\_spatialunit\_aoi
  - b. Title = AOI
  - c. Native SRS = EPSG:4326
  - d. Declared SRS = EPSG:4326
  - e. Click **Compute from SRS bounds** to calculate bounding box. You can use **Compute from data** if you have already some data.
  - f. Click **Compute from native bounds** to set **Lat/Lon Bounding Box**
6. Click **Save** button

### Publish resource (land) layer

MAST allows the capture of various resource types in the field. They can be in the form of a polygon, line or point. Follow these steps below to publish polygon resources:

1. Click **Layers** menu.
2. Click **Add a new layer** link.
3. Select **Mast:MastDB** data source.
4. Look for **la\_spatialunit\_resource\_land** table and click **Publish**.
5. Provide the following values:
  - a. Name = la\_spatialunit\_resource\_land
  - b. Title = Resource Land
  - c. Native SRS = EPSG:4326
  - d. Declared SRS = EPSG:4326
  - e. Click **Compute from SRS bounds** to calculate bounding box. You can use **Compute from data** if you have already some data.
  - f. Click **Compute from native bounds** to set **Lat/Lon Bounding Box**
6. Click **Save** button

### Publish resource (line) layer

To publish line resources, follow these steps below:

1. Click **Layers** menu.
2. Click **Add a new layer** link.
3. Select **Mast:MastDB** data source.
4. Look for **la\_spatialunit\_resource\_line** table and click **Publish** link against this table.
5. Provide the following values:
  - a. Name = la\_spatialunit\_resource\_line
  - b. Title = Resource Lines
  - c. Native SRS = EPSG:4326
  - d. Declared SRS = EPSG:4326
  - e. Click **Compute from SRS bounds** link to calculate bounding box. You can use **Compute from data** link if you have already some data.
  - f. Click **Compute from native bounds** link to set **Lat/Lon Bounding Box**

6. Click **Save** button

### Publish resource (point) layer

For publishing point resources, follow these steps below:

1. Click **Layers** menu.
2. Click **Add a new layer** link.
3. Select **Mast:MastDB** data source.
4. Look for **la\_spatialunit\_resource\_point** table and click **Publish** link against this table.
5. Provide the following values:
  - a. Name = la\_spatialunit\_resource\_point
  - b. Title = Resource Points
  - c. Native SRS = EPSG:4326
  - d. Declared SRS = EPSG:4326
  - e. Click **Compute from SRS bounds** link to calculate bounding box. You can use **Compute from data** link if you have already some data.
  - f. Click **Compute from native bounds** link to set **Lat/Lon Bounding Box**
6. Click **Save** button

### Publish vertices layer

Vertices layer is used for showing land parcel vertices, when producing various print outs (e.g. land certificate). Follow these steps below:

1. Click **Layers** menu.
2. Click **Add a new layer** link.
3. Select **Mast:MastDB** data source.
4. Look for **vertexlabel** table and click **Publish**.
5. Provide the following values:
  - a. Name = vertexlabel
  - b. Title = vertexlabel
  - c. Native SRS = EPSG:4326
  - d. Declared SRS = EPSG:4326
  - e. Click **Compute from SRS bounds** to calculate bounding box. You can use **Compute from data** if you have already some data.
  - f. Click **Compute from native bounds** to set **Lat/Lon Bounding Box**
6. Switch to **Publishing** tab and select **point** style in the **Default Style** dropdown box.
7. Click **Save** button

### Adjust layers URL

The default MAST database comes with predefined list of layers, configured for http://localhost:8080 address. If you have a different port number or are planning to test MAST from the network using real IP address of the server, you need to update the layers in the **la\_spatialsource\_layer** table. Simply run the following query on your MAST database:

```
update la_spatialsource_layer set location =  
'http://your_ip_address:port_number/geoserver/wfs?';
```

Change “your\_ip\_address” and “port\_number” to appropriate values, according to your configuration. In Ubuntu, using the psql client:

```
$ sudo -u postgres psql
postgres=# \c mast
mast=# update la_spatialsource_layer set location =
'http://your_ip_address:port_number/geoserver/wfs?';
```

## 2.4 KNOWN ISSUES

### Java

When installing Tomcat on Windows system using Java 8, there may be an issue with starting the MAST DMI application. In the log files of Tomcat you will find the following error:

*Property 'passwordEncoder' threw exception; nested exception is  
org.jasypt.exceptions.EncryptionOperationNotPossibleException*

In order to resolve this, download Java 7 Cryptography Extensions from the following link:

<http://www.oracle.com/technetwork/java/javase/downloads/jce-7-download-432124.html>

Extract and copy over downloaded files into your JRE installation folder under **lib/security**. They have to be placed in the jre folder according to your JAVA\_HOME configuration.

### GeoServer JDBC driver for PostgreSQL

GeoServer comes with a PostgreSQL JDBC driver, but sometimes it may not match your database version. Since we are deploying JDBC driver into Tomcat libraries, you can try and delete this driver from the GeoServer folder. Geoserver folder is created under Tomcat **webapps** folder after you start your Tomcat for the first time. Go to the GeoServer's lib folder (e.g. /opt/tomcat/webapps/geoserver/WEB-INF/lib) and delete the **postgresql** file (e.g. postgresql-42.1.1.jar).

After deleting the file, you will need to restart your Tomcat. Make sure to give it some time (30 seconds or so) before starting Tomcat again.

```
$ sudo /opt/tomcat/bin/shutdown.sh
$ sudo /opt/tomcat/bin/startup.sh
```

# 3. MAST Mobile Application

## 3.1 APK SETUP

The easiest way to get started with MAST mobile application is to download it from the latest releases on GitHub. Check <https://github.com/MASTUSAID/MAST-MOBILE/releases/> and look for the latest release. Download **mast.apk** from the assets list, copy to your Android mobile device and run for installation. At the time of writing this guide, the latest release is 3.1, available at <https://github.com/MASTUSAID/MAST-MOBILE/releases/download/3.1/mast.apk>.

## 3.2 FRESH COMPILATION

### IDE setup

First, download and install Android Studio from <https://developer.android.com/studio/index.html>. During setup, you will be prompted to download any versions of the Android SDK that you wish to use. For the purposes of MAST, download the SDK for Android 6.0 Nougat (API level 23).

If you wish to test the application before building, create an Android Virtual Device to ensure your install works properly. Click *Tools > Android > AVD Manager*, and click the *Create Virtual Device* button. Choose a phone and SDK level to emulate, such as the Pixel with the latest Android version. Before clicking *Finish*, click on *Show Advanced Settings*. Under *Memory and Storage*, ensure that the SD card is set to *Studio-Managed* and is at least 200 MB.

### Configure, Compile, and deploy application

To build the application package, first fetch the source code from GitHub:

```
$ git clone https://github.com/MASTUSAID/MAST-MOBILE.git
```

If you are using Android Studio version greater than 2.2.3, open the gradle.build file and ensure that the following value is set for the gradle version:

```
dependencies {  
    classpath 'com.android.tools.build:gradle:2.3.3'  
}
```

To build the application package (APK file), select *Build > Generate Signed APK*. Android Studio will request that you create a signed keystore and key file to use to sign the application, if you have not already. Follow the onscreen instructions. Further information is available [online](#).

Once you have the final APK, transfer a copy to each device that you plan on using. To install the application, use a file browser application to open and run the APK. Note that you will have to ensure that the devices are set to run applications from alternative sources (i.e. not the Google store), by going to the devices security settings. The exact location of the setting varies from device to device.

## 3.2 KNOWN ISSUES

### Google Maps API Key

When compiling the MAST-MOBILE project, the Google Maps API key may not be working and it will require replacement with a new key. Open **AndroidManifest.xml** file and replace value for the following setting:

```
<meta-data
    android:name="com.google.android.maps.v2.API_KEY"
    android:value="MAPS_API_KEY" />
```

Put new key instead of **MAPS\_API\_KEY** value.



U.S. Agency for International Development

1300 Pennsylvania Avenue, NW

Washington, DC 20523

Tel: (202) 712-0000

Fax: (202) 216-3524

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