



# TcpGPS for Android



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## Introduction

TcpGPS is an Android application (available both for mobile phones and tablets) that allows the user to carry out field work on measurements of farms, roads, crops, etc., in a simple way.

In addition, after carrying out the survey or importing a file of measured points, it is possible to proceed to the staking out of these points, offering tools for quick and easy location of these points on the ground.

Finally, the data obtained can be exported to a range of different formats (TXT, GML, KML, etc.) and synchronised with Google Drive to make them instantly available on any other platform.

## Preparation of the project

The first time the application is started, the user will be prompted to specify the project they want to use. There are three available:

- **Last project:** Select the last project that was used.
- **Select project:** Allows you to choose a previously created project to continue editing.
- **New project:** A new empty project is created.

Once the project is ready, it will be loaded and the application will open in **Survey** mode.

## Workspace

Figure 1 shows an image of the workspace as presented at startup. The following parts are distinguished (indicated by numbers in the image):

1. **Map:** The map is the main working element, since it is where the points and information about them are displayed.
2. **Map menu:** Various different options for working with the map are displayed in the map menu, such as accessing the layers presented in the map, zoom extension, GPS tracking, and map mode.
3. **Working menu:** Options for carrying out work with regard to surveying, staking out, points, etc. are displayed in this menu, depending on the section being accessed.
4. **Navigation menu:** Options to browse through the different sections of the application are displayed in this menu, such as surveying, staking out, or project.

5. **Communications toolbar:** Information regarding the GPS and Bluetooth status.
6. **Options menu:** Set of options related to the current section.

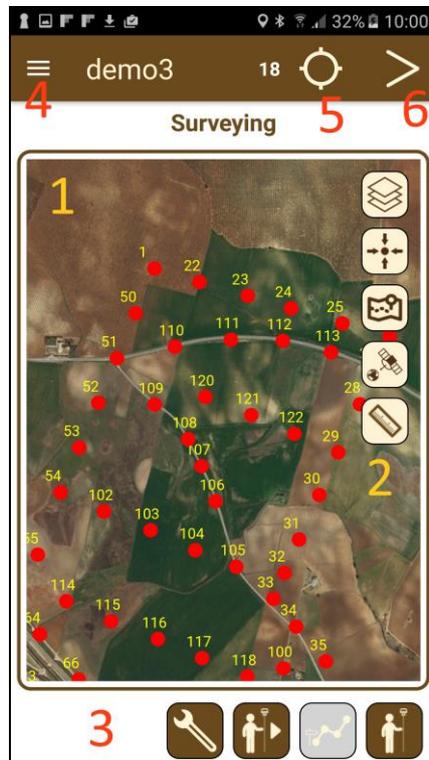


Figure 1. Workspace

Each of these parts will be described below, and the information and elements that are presented in will be shown in each section.

## Project options

The **Project** submenu can be found on the side menu, which allows you to choose one of the following options:

- **Information:** Project properties such as name, author, coordinate system, etc.
- **New project:** Allows a new project to be created.
- **Open:** Allows you to choose another project to work on.

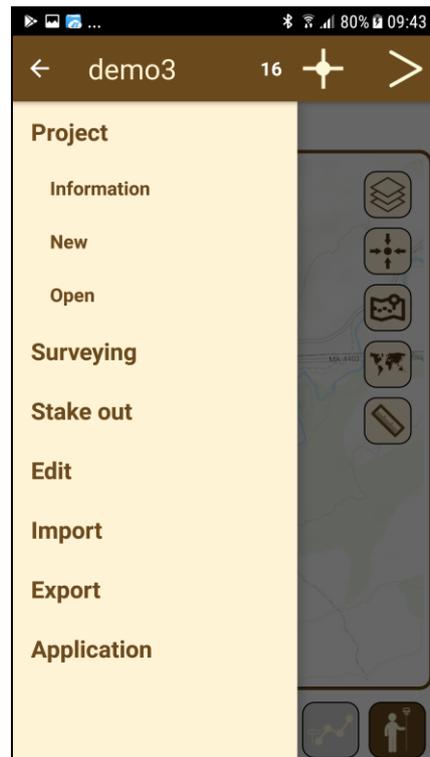


Figure 2. Project menu

## Configuring the workspace

The **Settings** option can be found in the **Application** submenu. This option leads to the **Settings** section, where a set of parameters for the workspace is available (Figure 3). These options are described in the table below:

<b>Surveying and Staking Out</b>	
<i>Item categories</i>	Item categories to be taken into account for GPS data
<i>Minimum Number of Satellites</i>	Minimum number of satellites for obtaining GPS data
<i>Height of the Antenna</i>	Default antenna height to be used during the project
<b>Continuous Surveying</b>	
<i>Interval</i>	Allows you to select from options for continuous surveying by time, gradient, or distance
<b>Staking Out</b>	
<i>Staking Out Mode</i>	Staking out mode used (north, movement, or most recent point staked out)
<i>Horizontal Tolerance</i>	Horizontal tolerance to take the point as having been reached
<i>Vertical Tolerance</i>	Vertical tolerance to take the point as having been reached
<i>Distance Target Mode</i>	Distance at which to change to target mode

<i>Next Point</i>	Automatic stepping to the next point to be staked out according to the number of the point or by proximity to the current one
<b>Application</b>	
<i>Orientation</i>	Allows to choose the screen orientation (portrait or landscape).
<i>Activate log</i>	Allows the activation of the logger for generating log files of the current session.

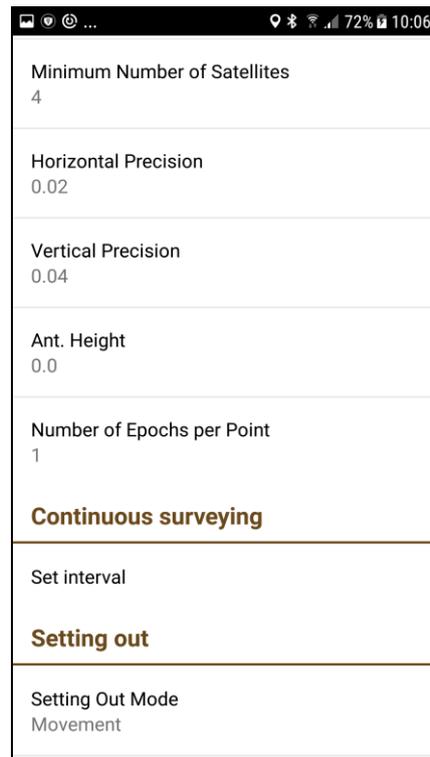


Figure 3. Settings section

## GPS connection

TcpGPS allows you to use two data sources: the device's internal GPS, if it has one, or an external GPS connected via Bluetooth.

In **Application > Communications** section are available the needed options for selecting and configuring the different types of GPS receivers.

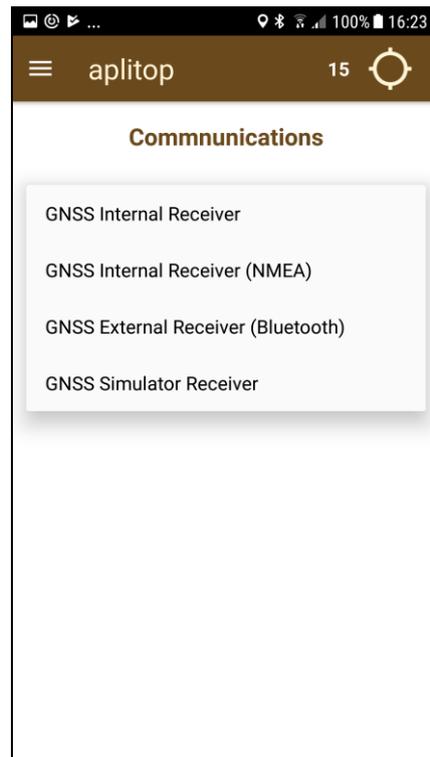


Figure 4. Selection of the receiver

### Connection to the internal GPS

In this case, only the device's GPS must be enabled. The application will automatically connect to it and receive the data. Also, the internal GPS with NMEA output can be selected if the device provides this feature.

### Connection to an external GPS

In this case, the Bluetooth connection of the device must be enabled to establish communication with the external GPS (which must also be compatible with this type of connection).

The application saves the connection information for the last GPS used, but if it is the first time you are connecting or you want to connect to a different GPS, you must open the connection screen. To do this, simply press the Bluetooth icon on the

**communications toolbar**  . This will take you to a screen like the one shown in Figure 4.

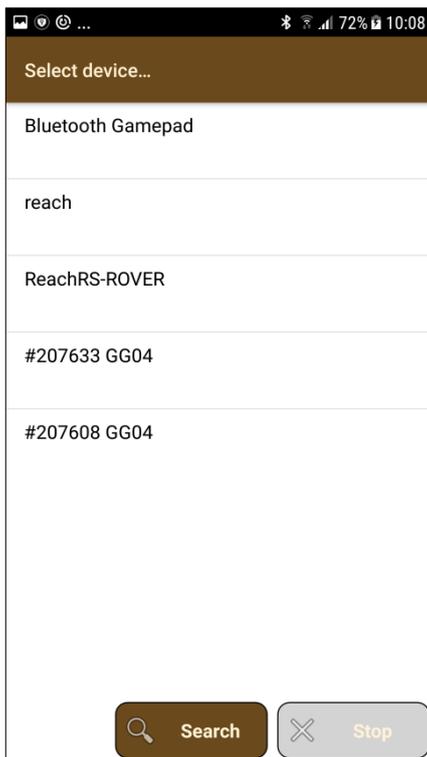


Figure 5. Connection screen with an external GPS

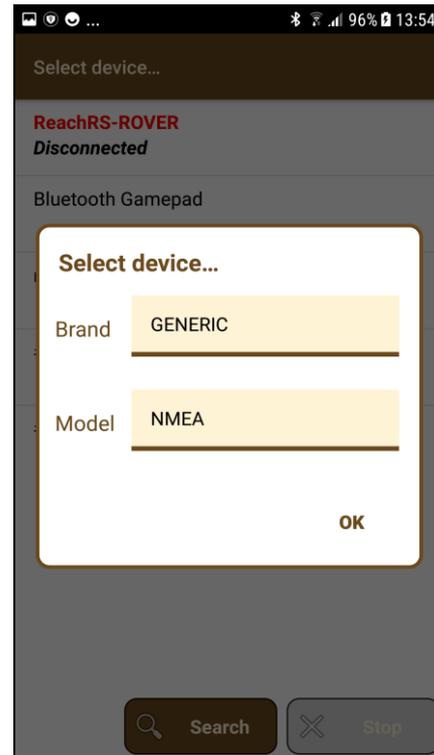


Figure 6. Selection of the GNSS device model

In this screen, you have the option to search for nearby devices or select one from the list. Once the device is selected, the possibility to set up the brand and model of the receiver is displayed (Figure 6). For the models in the list, a basic configuration is sent from the application to start working with the device. If a more specific configuration is needed or the receiver used is not in the list, the *GENERIC* option allows the connection with the GNSS receiver (it must be configured before connecting).

### NTRIP client configuration

When the connection with an external GNSS receiver is selected, it is allowed to use the mobile device as a NTRIP client for sending corrections got by an Internet stream to the receiver.

Figure 7 shows the options for the NTRIP client configuration:

- **Caster:** Selection or creation of the connection to a new NTRIP service provider. Name, IP address, port, user and password will be required for accessing.
- **Mount point:** A NTRIP caster could have available different data streams to provide the information. A list of streams available for the current caster is displayed in the spinner for selecting.
- **Latitude/Longitude:** Reference for corrections. It can be taken using the internal GPS pressing the **GPS** button.

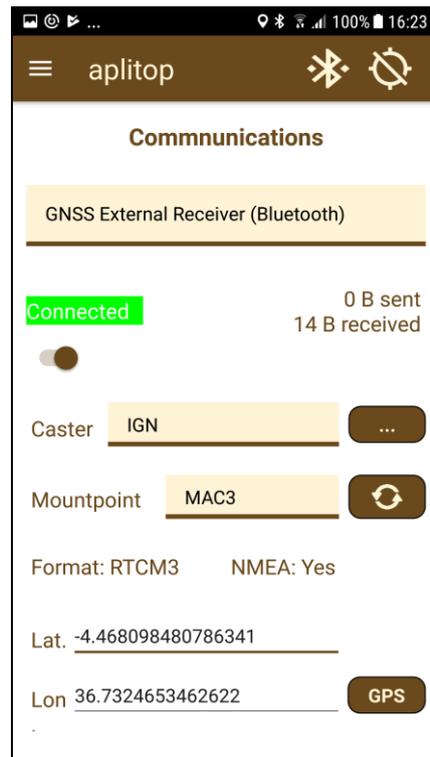


Figure 7. NTRIP client configuration

Once the NTRIP client is configured, by pressing the switch button the connected is requested. If everything goes well, **Connected** message will be shown on green background and the reception of the information from the stream and the sending of it to the receiver will be shown as received/sent bytes.

### GPS status

It is possible to consult the GPS status by opening the **GPS status** section, pressing on the GPS icon in the **communications toolbar** <sup>1</sup>.

In this section, you can find information on both GPS (Figure 8) and available satellites (Figure 9). The arrows in the **options menu** can be used to navigate between one view and another.

<sup>1</sup> The icon for this access changes according to the type of position the GPS currently has.

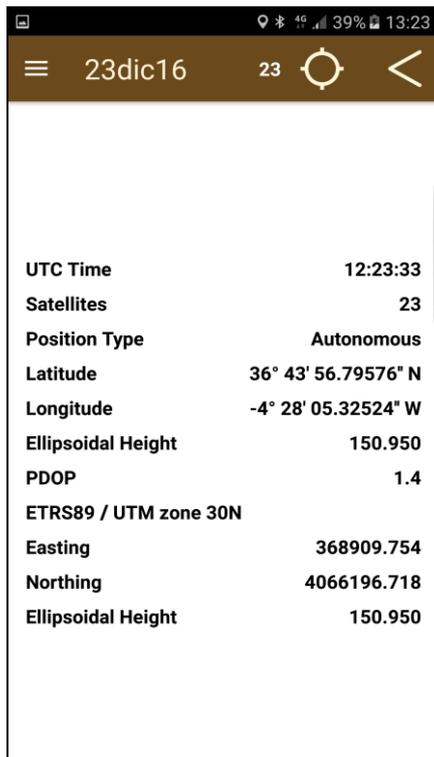


Figure 8. GPS status

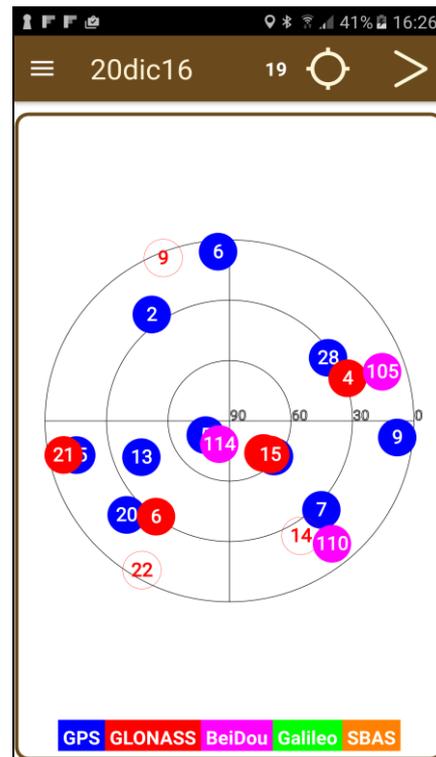


Figure 9. Satellite constellation

## Surveying

This is the first screen that appears for the user when they enter the application. Two modes are available: **map mode** (Figure 10) and **numerical mode** (Figure 11).

The user can take points using either of the two methods available:

- **Spot measurement**  : Allows you to take a point at any time. This will be disabled when using **continuous measurement**.
- **Continuous measurement**  : It allows you to take a series of consecutive points according to three criteria:
  - **Continuous measurement by time interval**: A time interval is defined for the next point to be taken.
  - **Continuous measurement by distance**: A distance is defined after which the next point will be taken.
  - **Continuous measurement by gradient interval**: A difference in level is defined after which the next point will be taken.

These criteria can be adjusted in the *Continuous measurement* section in the workspace settings (Figure 12).

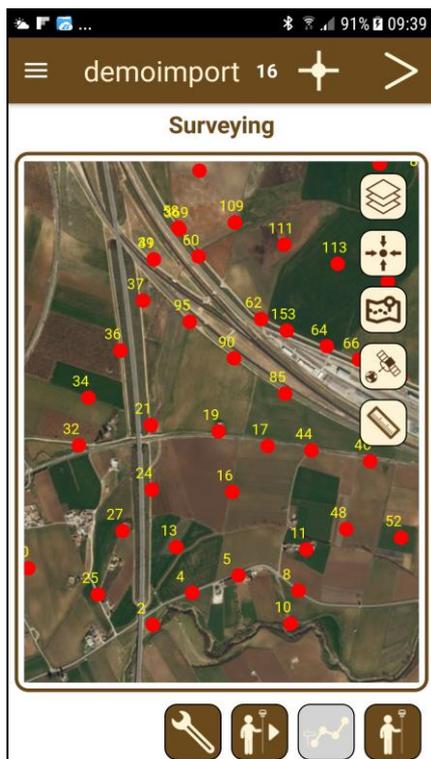


Figure 10. Surveying map mode

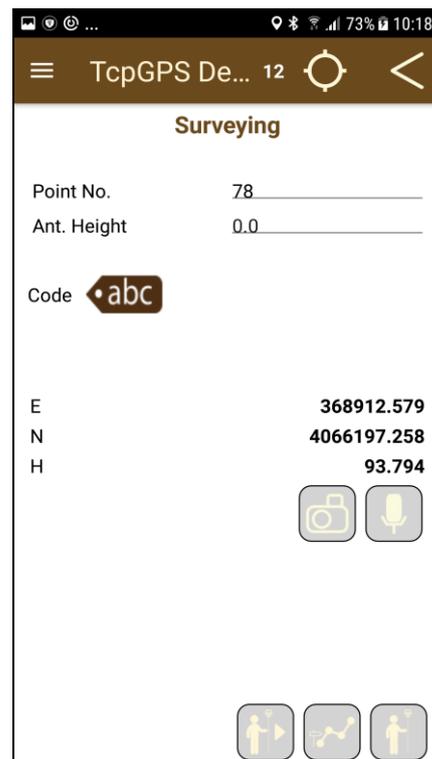


Figure 11. Numerical surveying mode

Finally, there is the option to **begin**  / **end**  a line. If you have chosen a line code for the point, this button will be activated to indicate when to begin or end a line. If surveying is started with this type of code, it will start automatically and can be finished at any time and a new one started.

Several parameters associated with the points taken can be configured from the numerical surveying screen:

- **Point number:** Number of the next point to be taken. This number will be increased by one each time as consecutive points are measured, starting with the point provided.
- **Height of the antenna:** The height of the antenna at the moment the point was gathered. By default, the value defined in the **Settings** will appear, but if you need to change this to a specific point or points, it is possible to define a new one here (this does not change the default value).
- **Code:** A code that will be associated to the point, which can be selected from a predefined list or a new code created.

The **numerical surveying** screen also displays the numerical information of the current GPS position.

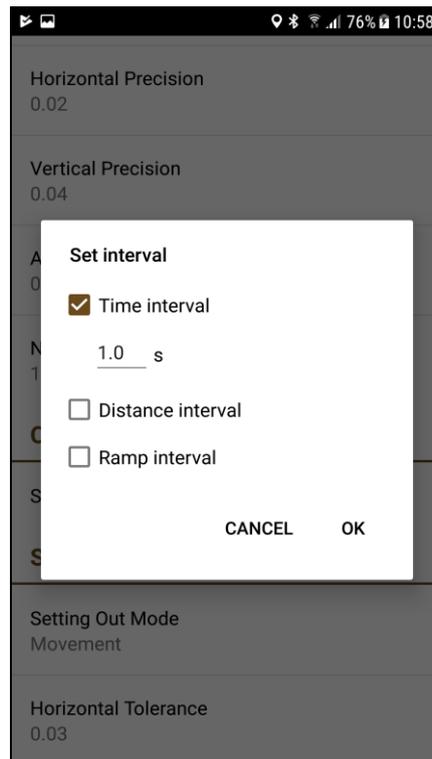


Figure 12. Setting the interval for continuous surveying

In this mode, the map has additional functionality: **distance measurement**. When you

push the button , you will be told to choose the first point. Once this has been selected, a second point will be requested. After these steps, information about the distance between the two points will be displayed (Figure 13): *2D distance* (not taking the height into account), *3D distance*, and the *difference in height*.

Other map mode functions (also available in **staking out**) are:

- **Map type** : Allows the type of map displayed to be changed.
- **Zoom extension** : Allows the map to be centred on the area defined by the points gathered during the course of the project.
- **GPS tracking** : Enables or disables GPS tracking, which consists of making the map move to the position where the GPS is located if it is not in the work area defined in the application.

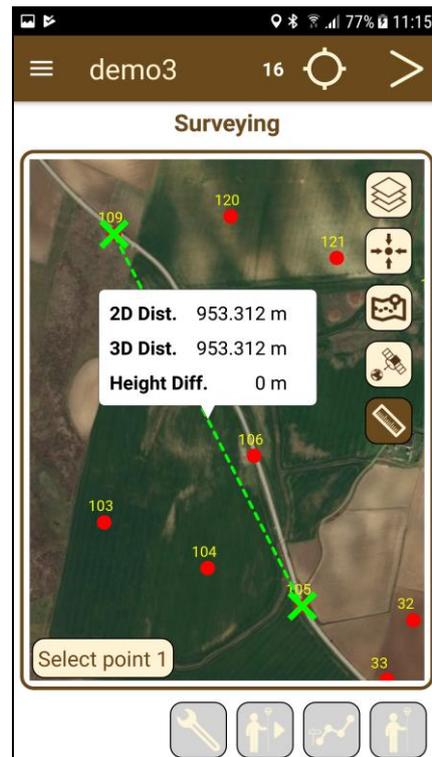


Figure 13. Measuring the distance between two points

## Surveying tools



Pressing the tools button  displays a dialog box where you can find a set of tools to work with the points gathered. These tools correspond to the calculation of new points by means of the intersection of geometric elements (Figures 14 to 16). There are three types of intersection:

- **Line-Line Intersection:** The point where two lines drawn between four selected points of the project cross is calculated. If the lines are parallel there will be no intersection point.
- **Line-Circle Intersection:** In this case, there may be no solution if the line and the circle are separate; there may be only one solution if the line is tangential to the circle; or there may be two solutions if the line crosses the circle, in which case one of the two possible points can be chosen.
- **Circle-Circle Intersection:** This case is similar to the previous one, and there may be no, one, or two solutions.

In order to complete an intersection, simply follow the instructions at the bottom of the map.

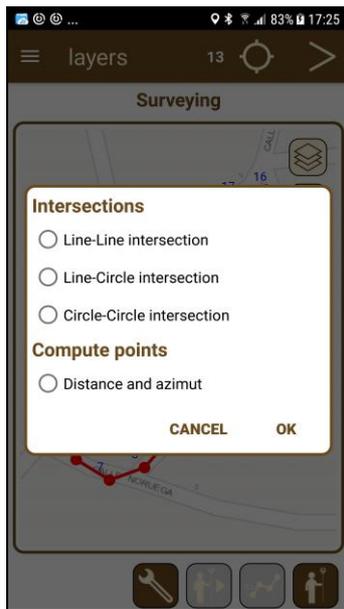


Figure 14. Surveying tools dialog box

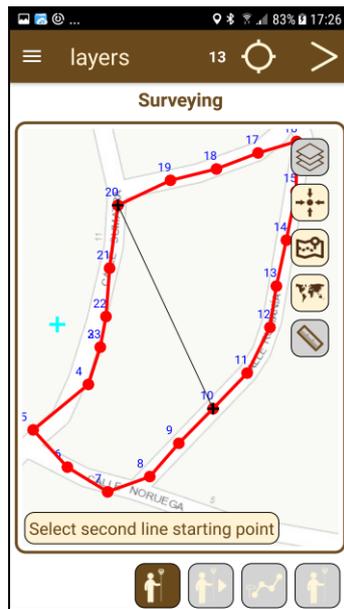


Figure 15. Selection of points for the intersection

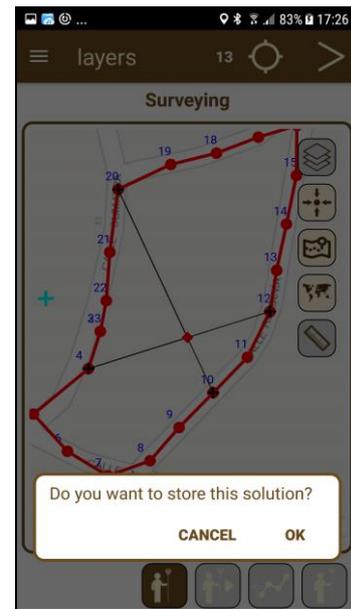


Figure 16. Confirmation of the intersection solution

## Layer management

In the TcpGPS maps (both when surveying and staking out) a division into layers is carried out that are organised according to their nature (Figure 17). The following types of layers exist:

- **Points Layers:** These layers divide the set of work points into different subsets separated by their code. When a new project is created, a layer of **points** is automatically created that will contain all the points that do not have a code.
- **Base Map layer:** This layer is created automatically when a new project is created and is unique.
- **DXF layer:** This layer contains a DXF map imported from a file with the same extension.
- **Shape layer:** This layer contains a SHAPE map imported from a **.shp**<sup>2</sup> file
- **WMS layer:** This layer allows a **WMS** service to be configured that will be displayed on the map.

<sup>2</sup> As well as the **.shp** extension, the associated **.prj**, **.shx**, and **.dbf** files must be present.

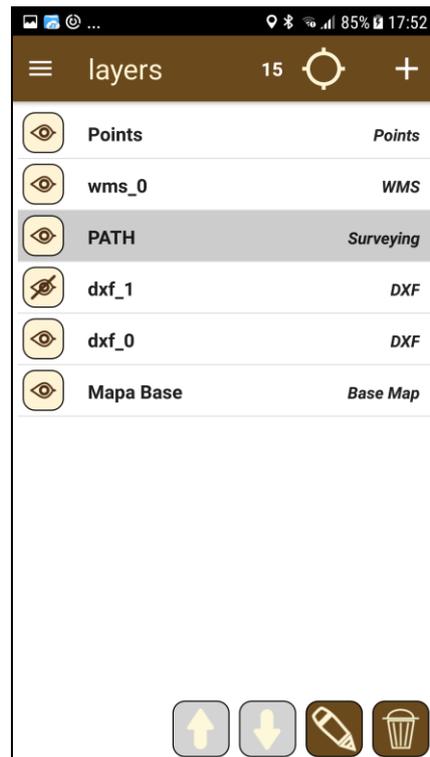


Figure 17. Layer manager

The following commands can be executed on each of these layers:

- **Sort layers:** You can change the order of one layer with respect to another using the buttons to **raise**  or **lower**  the layer in the stack of layers.
- **Edit the layer** : The settings window of the selected layer type is displayed.
- **Delete layer** : Deletes the project layer.
- **Display the layer** : Enables or disables the display of the layer on the map.

### Editing the Points layer

The layer called **Points**, as was mentioned previously, is a special layer designed to contain those points that do not have a specific code. However, some of the properties shown here also affect the other points gathered.

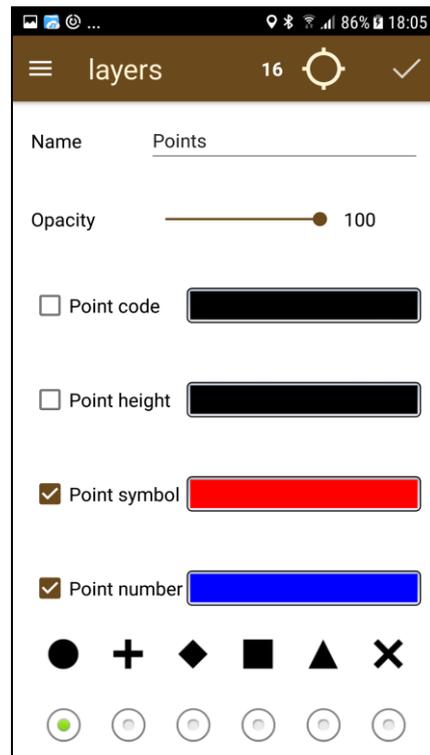


Figure 18. Editing the Points layer

On the editing screen of this layer (Figure 18), you can configure different properties applied to the points to be gathered:

- **Name:** Although by default this layer is called Points, this name can be changed at any time.
- **Opacity:** Level of transparency of the points.
- **Point code:** This shows that the code to which each point belongs appears next to it on the map; the display colour can be selected.
- **Height of the point:** This shows that the height of each point appears next to it on the map; the display colour can be selected.
- **Point symbol:** This shows whether or not a symbol is selected to mark the location of the point on the map and its colour. In addition, when you have finished editing, its shape can also be defined.
- **Number of the point:** This shows whether or not a number is selected to appear on the map next to the point and its colour.

### Editing the Map layer

This layer, like the **Points** layer, is a special layer that is created when a new project is created. Its purpose is to manage the base map that will be presented in the workspace. The properties that you can define here are (Figure 19):



Figure 19. Editing the Base Map

- **Name:** Although the default name is *Base Map*, it is possible to change it.
- **Opacity:** Level of map transparency.
- **Map type:** There are three types of map that can be displayed: *street*, *topographical*, and *satellite*. The map type can also be changed in one of the **map menu** options in the workspace.

### Editing the shape layer

A **shape** layer manages a file of this type to be displayed in the workspace (Figure 20). In order to be able to load these types of files, it is necessary to have four different file types in the same folder:

- **.shp:** This is the SHAPE file with the information to be displayed.
- **.shx:** This is the associated index file.
- **.prj:** Projection file indicating the system on which the map was made.
- **.dbf:** Database with information associated with the points and geometries of the map.

The properties to be defined for this layer are:

- **Layer name.**
- **Opacity:** Level of transparency of the layer.
- **Colour:** Colour for lines and dots on the map.

- **File:** File to be displayed.

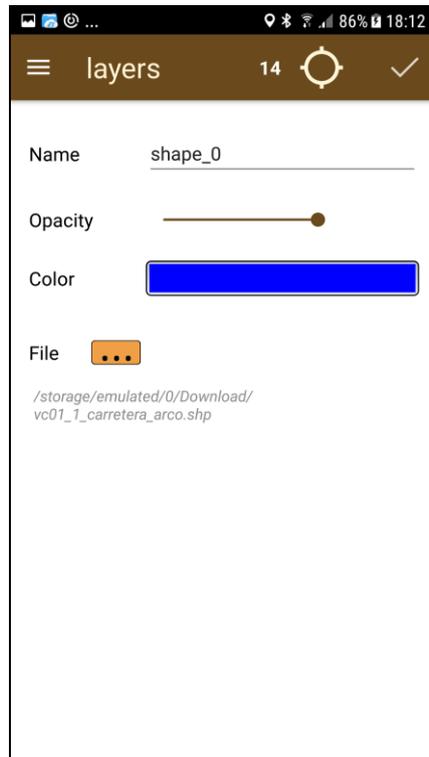


Figure 20. Shape layer editing screen

### Editing the DXF layer

A **DXF** layer (Figure 21) manages a file of this type to be displayed in the workspace.

The properties to be defined for this layer are:

- **Layer name.**
- **Opacity:** Level of transparency of the layer.
- **File:** File to be displayed.

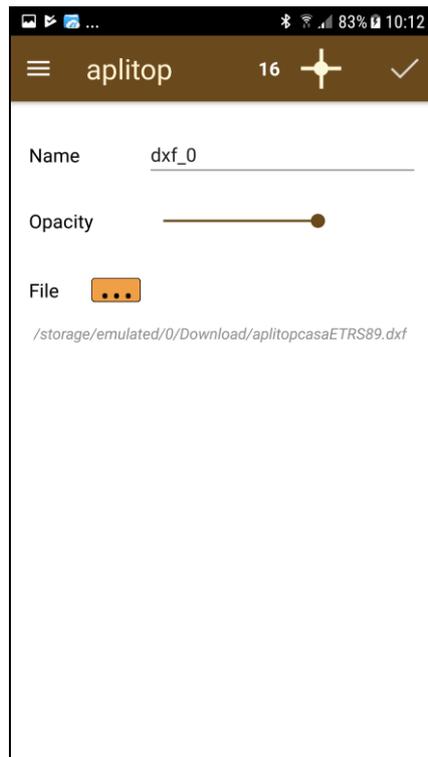


Figure 21. Editing a DXF layer

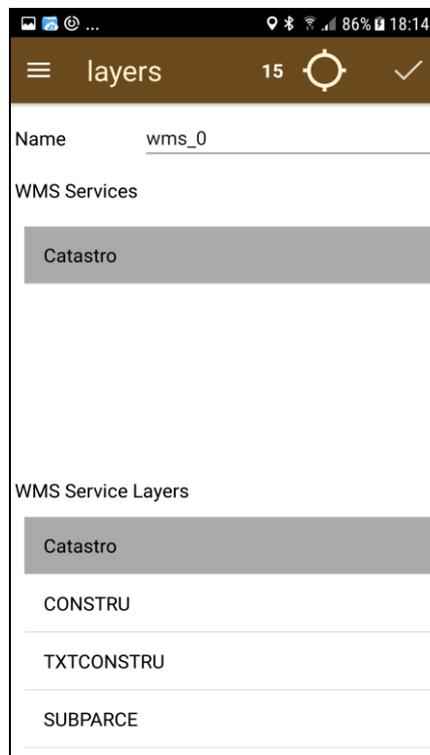


Figure 22. WMS layer editing screen

## Editing the WMS layer

A **WMS** layer (Figure 22) manages the connection to a service of this type in order to load the related information in the workspace.

When the settings or editing screens are opened for this layer, a list of available WMS services will appear. When one of these services is selected, the layers that make up this service will appear in the list below the previous one, providing the option whether to display them or not.

## Staking Out

In the side menu, the **Staking out** submenu can be found, which gives the option to choose between two modes, depending on whether you wish to do **staking out of points** (Figure 23) or **staking out of lines** (Figure 24).

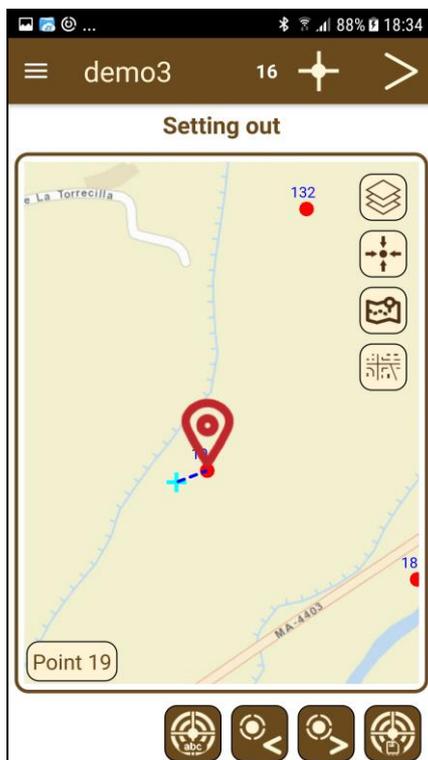


Figure 23. Staking out of points

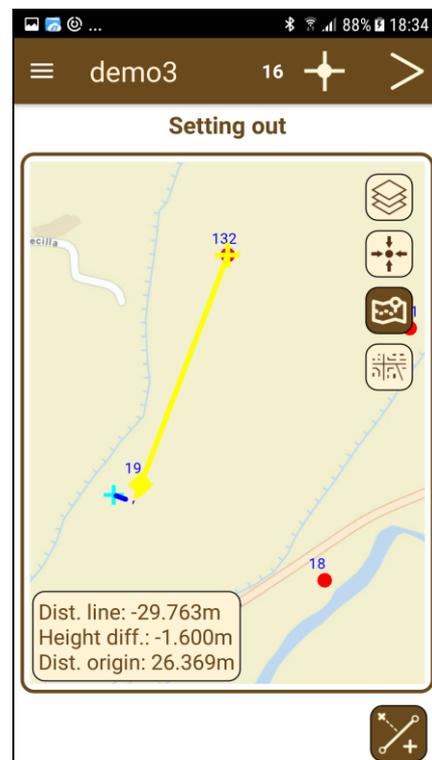


Figure 24. Staking out of lines

## Staking out of points

In this section, individual points are staked out. To make the job easier, TcpGPS incorporates various modes for staking out:

- **Map mode (Figure 23):** In this mode, a map is displayed showing the points and the current GPS location. You can select the point to be staked out simply by clicking on it. A sign indicating the point and a line between the current position

and the point will be sufficient to move towards it in the correct direction. The map is always oriented to the north, unless the reference is set to track motion, in which case it will be oriented in whatever direction the user is currently moving.

- **Numerical mode (Figure 25):** In this mode, arrows will indicate where the user should go: left, right, forwards, backwards, up, or down. This mode is available for tablet versions and mobile devices that do not have a magnetometer or accelerometer.
- **Compass mode (Figure 26):** The direction in which the point is located with respect to north is displayed in this mode. In order to use it, the device must have a magnetometer. It is recommended for locating far-away points.
- **Target mode (Figure 27):** In this mode, the direction in which the point is located relative to the GPS position will be shown, taking into account the reference used. This mode is recommended for fine localisation.

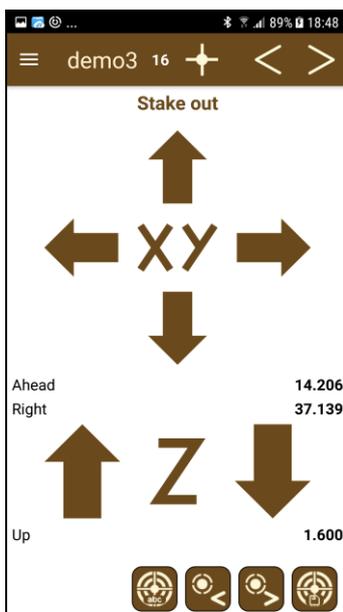


Figure 25. Numerical staking out mode

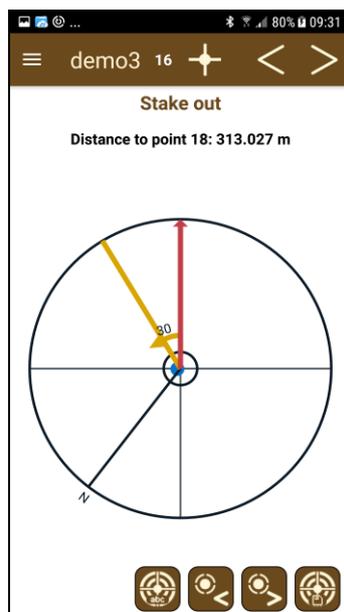


Figure 26. Compass staking out mode

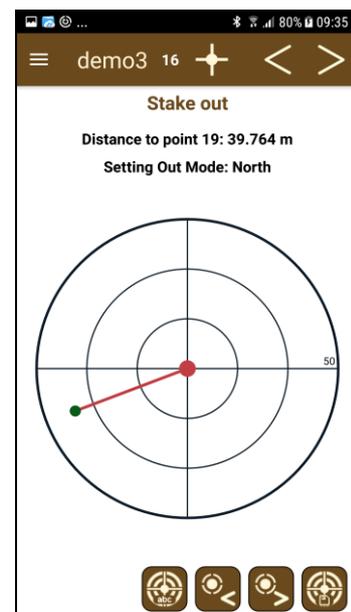


Figure 27. Target staking out mode

The following options are provided for working with **staking out of points**:

- **Staked out point** : Saves the point staked out in the database by recording the current GPS data.

- **Next**  / **previous**  **point**: They allow you to select the point to be staked out by scrolling through the list of points according to their numerical order.
- **Select code** : Allows you to select a specific set of points according to their code. Another option is associated with this one to allow you to return to the full list of points .

### Staking out of lines

In this section, work is done on the staking out of a line (Figure 24), which will be the one established between two selected points. Once the two points have been selected, a line will join them together on the map and information will be displayed about the **distance to the line**, the **distance to the origin** (this being taken to be the first point selected), and the **difference in height** to the current point where the GPS is

located. If you want to stake out another line, just press the button .

### Working with the data

Once the surveying data has been gathered and/or the staking out work performed on them, a range of tools are available in order to be able to work with the data.

#### Importing points

It is possible to import points previously gathered on other platforms or from other projects made with TcpGPS using **.txt** or **.pun** files. The format of the points in these files must be:

```
<point number> <X> <Y> <Z> <point code>
```

#### Exporting points

Points gathered in TcpGPS can be exported to the following formats: **KML**, **TXT**, **DXF**, and **GML**.

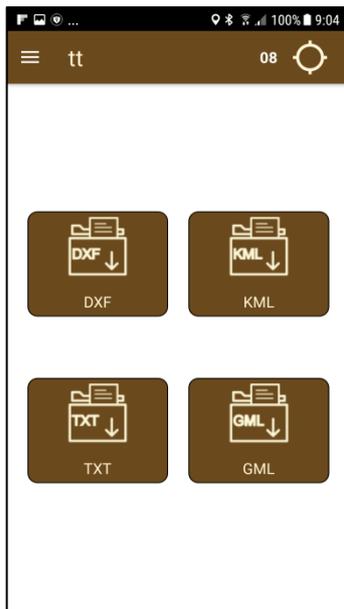


Figure 28. Point export menu



Figure 29. Export to GML format dialog box

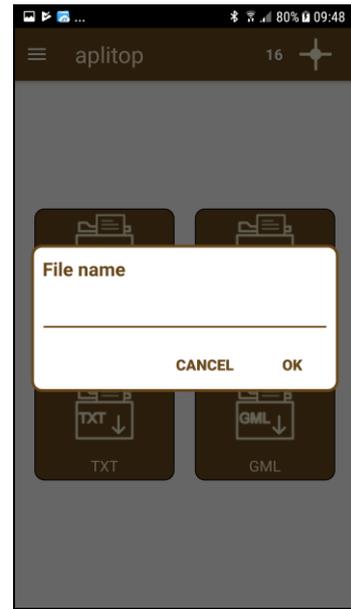


Figure 30. Export to TXT, DXF and KML formats dialog box

Figures 25, 26, and 27 show the menu for exporting points and the dialog boxes used to define exporting in various formats.

### Synchronising data with Google Drive

When you start the TcpGPS application on Android, you are prompted to select one of the Google accounts you have configured. This allows the user to synchronise the project with their Google Drive account to store the data and images gathered during the project.

When the application is synchronised for the very first time, it will create a folder called *TcpGPS* in the root folder of the user's Google Drive account. Each project that is synchronised with Google Drive will create a folder inside it bearing the name of the project. This folder will contain the data in a **.txt** text file with the same name as the project and the images gathered associated with the points.

### Editing points

Points gathered using TcpGPS are stored in the database associated with the project. The stored data can be viewed in the **List of points** in the **Edit** section (Figure 28).

The properties of each point are classified in three different lists, selectable from the

drop-down menu marked with the icon  :

- **Basic data:** General information of the point as it was gathered, also taking into account the coordinate system used.
- **Raw data:** Complete information on the point for later processing.
- **Staking out:** Information for points that have been staked out. The last staking out performed on a point is only shown if it has been done several times.

On these lists, you can search for specific points by their number or by their code,

options are available in the drop-down menu identified by the icon



No.	Code	Ant.	X	Y
1		0.000	348269.111	41035
2		0.000	347088.485	41008
17		0.000	347684.000	41007
18		0.000	347543.000	41006
19		0.000	347343.000	41007
22		0.000	348456.000	41034
23		0.000	348656.650	41033
24		0.000	348835.739	41033
25		0.000	349049.709	41032
26		0.000	349245.753	41032
27		0.000	349182.793	41030
28		0.000	349115.718	41029

Figure31. List of points

It is also possible to select a point from any list and select from a range actions to perform on it:

- **Go to map** : This takes the user to the surveying section by centring the view on the selected point.
- **Go to staking out** : This takes the user to the staking out section with the selected point ready to start the operation.
- **Edit the point** : This takes the user to the **Details of the point** section, from where information about the point can be viewed.

### Details of the point

This provides detailed information about the point, not only with respect to its numerical data, but also making it possible to associated multimedia information such as photos and voice notes with it.

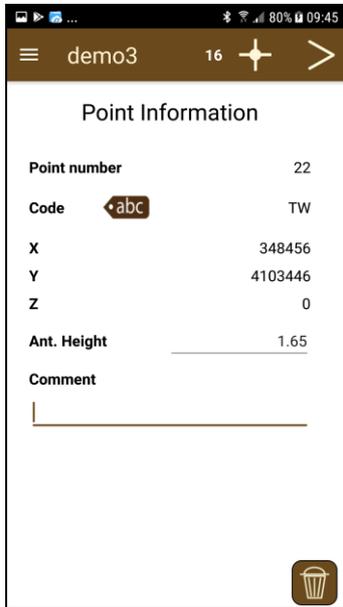


Figure 32. Basic point information

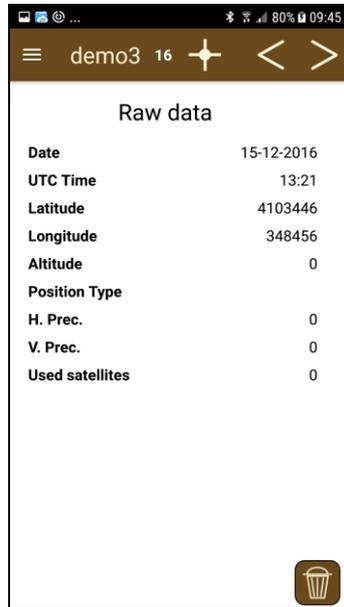


Figure 33. Raw point data



Figure 34. Information and multimedia data associated with the point

### Annex A. Directory structure

In the mobile device where the TcpGPS application is executed, a directory structure will be created in the main memory of the device, which has the following structure:

TcpGPS

```

|_ projects
    |_ <project 1>
        |_ img
        |_ snd
    |_ <project 2>
        |_ img
        |_ snd
    ...

```