

Using a modern high-accuracy GPS for orienteering fieldwork

Metadata

This document describes how to set up a modern extremely accurate GPS Receiver connected to an Android phone using MapRun6 to display your location on your basemap while in the field, even under canopy, to aid in fieldwork of orienteering maps ~~or hiding treasure~~. Thanks for assistance and input to:

- Cap'n Geoff Peck, creator of most of Queensland's O maps, embracer of GPS technology.
- Peg-leg Peter Effenev, father of MapRun6 and its predecessors.
- Dread Peter Mousley, a little-known Mexican.

This document was created by and is maintained by Mark "Aaargh" Roberts; contact me at mark@markroberts.id.au.

You can find the latest version of this document here:

<http://www.markroberts.id.au/Wordpress/wp-content/uploads/GPSForFieldwork.pdf>

Your suggestions and corrections are extremely welcome, but first please look at the latest version as above.

Geoff, Mark and Peter E are all ~~privateers~~ orienteers who compete in M60+ in South East Queensland.

Summary

- Buy a \$460 GPS Receiver with separate antenna, a \$200 Android phone and a \$40 power bank.
- Attach the antenna to a hat and package the GPS in your backpack.
- Install a Bluetooth app and MapRun6 on an Android phone.
- Export your map from OCAD to KMZ, upload to the MapRun server, download to your phone.
- A little ~~black cross~~ red dot shows where you are on your map on the phone.
- You can record waypoints which (along with your track) can be exported and used in OCAD.

Assumptions

- You (or perhaps a trusted fellow privateer) are using OCAD to create a new map.
- You are in bushland and need help with precise positioning for point features under canopy.
- You may wish to record precise waypoints and tracks.
- You are making something like an orienteering map which records terrain, vegetation and (eg) rock detail and needs to be accurate in their relationships (this is very hard work without a GPS.)
- Your basemap is precisely georeferenced, which probably means that it was created from LIDAR. This approach is not useful when your basemap was drawn by a pirate using eyeology in 1963.

More Material to add to this Document

- U-Center & USB Driver for U-Center.
- Stop the screen switching off while viewing MapRun6.
- Attach the phone to your fieldwork board.
- Spot when B-G disconnects.
- Screen shot showing track.
- Alternative antennae.

GPS Receiver

We are using a package purchased from [ardusimple.com](https://www.ardusimple.com); when I bought mine in May 2021 it cost \$469 including shipment from Europe and remarkably arrived in 5 days.

<https://www.ardusimple.com/product/simplertk2blite-bt-case-kit/>

There are some other antenna options which we don't know much about; they possibly work even better.

In the box is the main unit with power cable and the antenna with 5m long cable.



The Main Unit is not waterproof; it is meant to be carried in your pocket or backpack.

Mounting the Antenna

The antenna is waterproof; it works best if it is horizontal, has a metal backplane underneath it, and is not in the shadow of your body.

You could mount it on a pole sticking up from your backpack, but that's very dodgy when scrambling through the bush. Geoff recommends attaching it to a tin-lid on the top of a pirate Bunnings hat. Here is mine attached to an ugly baseball cap. I tried a regular cap, but the bulk of the tin lid meant it no longer fitted my head properly:



The purpose of the tin lid backplane is to prevent reflections from the ground being picked up. The cable is really a tiny wave-guide (think coax from a TV antenna) so be very careful not to put a kink in it. The antenna is waterproof.

The cable is 5m long, so you will need to carefully stash the unrequired portion of it into the baggie you will see later. Be sure to leave enough cable free to allow you to put your backpack down on the ground while the cap is on your head.

Powering the Receiver

The package contains a USB cable for power, so you also need some sort of USB battery pack / power bank. Get a high capacity unit with two outputs so that you can also power your phone if need be.

This one cost \$33 including delivery from eBay, has a claimed capacity of 50,000mAh which is 25x my older unit, and weighs 195g with the cable:



Make yourself a Google account

This solves a number of problems:

- Access to Google's PlayStore.
- Allowing you to email your track and waypoints to your PC from your phone.

Buy an Android Phone

Geoff says it's very easy to break or lose your regular phone while using it for fieldwork in the bush. I suggest that you purchase a cheap phone dedicated for this purpose. If you are an iPhone user you have no choice. Keep the phone in your pocket, and take it out only when you need it.

- Android only – iPhone is too hard technically, and losing one is even harder.
- Bluetooth-capable.
- Not too old – MapRun6 requires Android 5.0 Lollipop (2014)
- Decent battery.
- Perhaps protect the phone with a weatherproof cover; brightly coloured will help you find it when dropped.
- A cable to power it from the power bank in your backpack if need be.
- Second-hand is fine so \$200 is plenty. I bought mine from the phone mender hole-in-the-wall at the shopping centre.

Phone Settings

Your Phone or Android version may differ from mine (Samsung Galaxy S8.) You will need WiFi on to install two apps, then off for use in the field.

- Go to **Phone Settings** – each of the following starts here.
- Under **Connections / WiFi** connect to your WiFi and select Auto Reconnect. Consider setting up a connection to the hotspot on your phone for use in the field.
- (When in the field) Under **Connections**, switch to *Flight Mode**** then turn *Bluetooth*** on (has to be in this order.)
- Under **About Phone / Software information**, find *Build number* and tap it 7 times (yes really, Jim Lad) to enable Developer Options.
- Go to **Developer Options / Select mock location app** and select *Bluetooth GNSS*.
- Under **Sounds and Vibration** switch off everything in sight to save power.
- Under **Display** change *Brightness* to Maximum for outdoors use.
- Under **Lock Screen** switch on *Always On Display*.
- Under **Lock Screen / App shortcuts** select MapRun6 and Bluetooth GNSS.
- Under **Device Care / Battery / MapRun6 & Bluetooth GNSS*** switch off *Put app to sleep*.
- Under **Display / Screen Timeout** set it to maximum (10 minutes.)
- Under **Apps / three dot menu top right / Special Access / Optimise Battery Usage** switch from *Apps not optimised* to *All*, find MapRun6 and Bluetooth GNSS and switch them off. See dontkillmyapp.com for more options.
- If your phone has *SmartStay*, switch it on so it will stay on while you are looking at it.

Some of these Phone settings are repeated elsewhere in this document.

*If you can't see both, change *Usage by Apps* to 1 week

**Did you know that it's named after Harald Bluetooth? He sounds like a pirate but he was the Scandinavian king ~~who invented orienteering~~.

***Sometimes a phone which isn't set to Flight Mode will also use some sort of mysterious location setting mechanism, override the feed from the GPS, and show your location leaping about every few seconds.

Android Usage

If you are an iPhone user, some Android conventions will be mysterious and lead you to tearing your hair out or making the designer walk the plank.

- You will need a Google logon to access apps in the PlayStore (not vital, but easier)
- It will connect to your Gmail and calendar without asking and nag you about cities you need to raze.
- Power Up and Power Down by pressing and holding the physical button on the right.
- Close the opening screen to get to the apps by swiping anywhere left to right.
- Select from the running apps by pressing the **III** on-screen button* at bottom left.
- Search for an app by pressing the **III** on-screen button* then use the search at the top.
- Find a recently used app pressing the **III** on-screen button* then look down the bottom.
- “Go Back” by tapping the < or triangle on-screen button at bottom right.
- “Close” by tapping the square on-screen button at centre bottom.
- Install a new app using the PlayStore app.

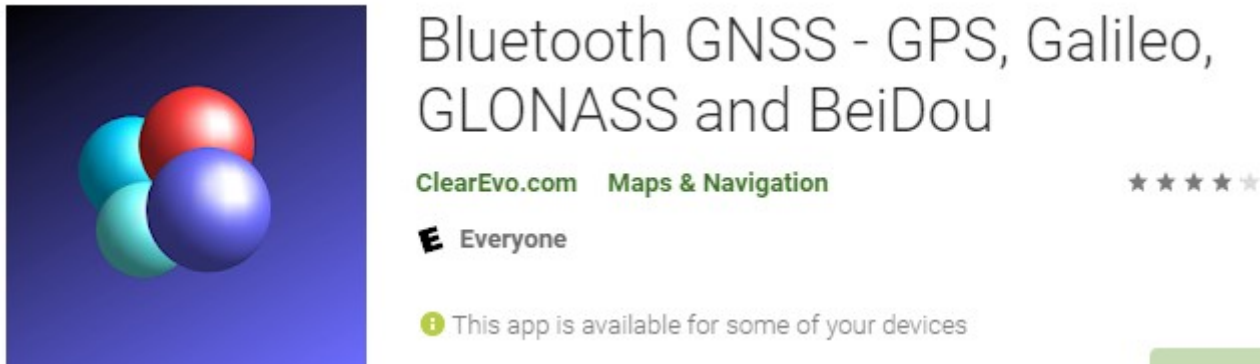


*Your version may not have this button. Peter says:

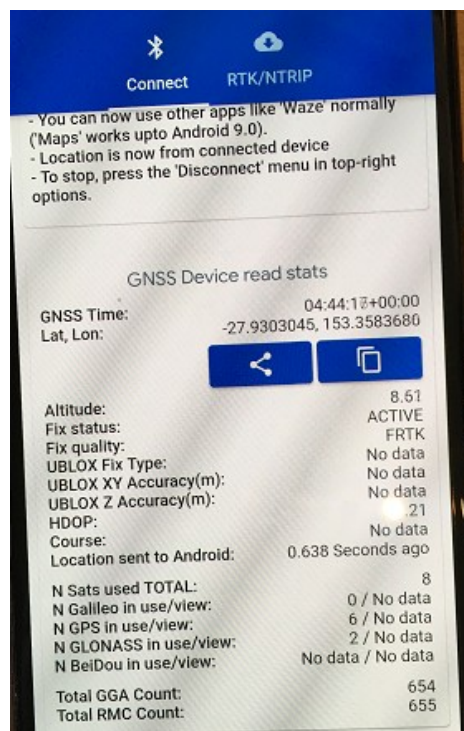
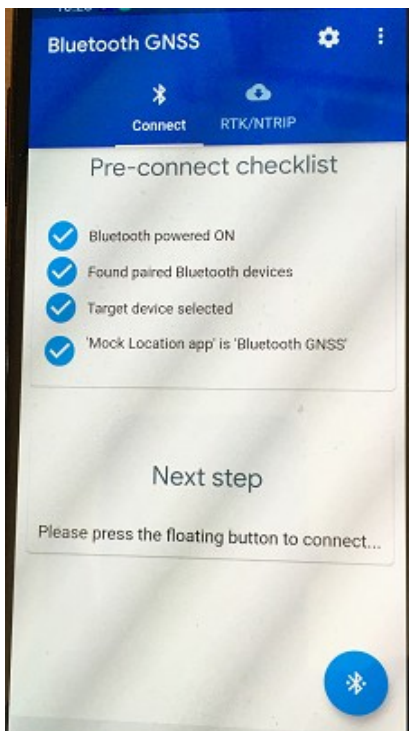
There are typically three buttons: a triangle (go back) a circle (home) and a square (menu)

Install the Bluetooth App on your Phone

MapRun6 can handle a Bluetooth GPS connection, but Geoff recommends using a free specialised phone app for this purpose. It's called *Bluetooth GNSS – GPS, Galileo, GLONASS and BeiDou*.



- Install the app from PlayStore on your phone, allowing any permissions it asks for.
- Go to **Phone Settings / Connections**, switch to *Flight Mode* then turn Bluetooth on.
- Go to **Phone Settings / About Phone / Software information / Build number** and tap it 7 times (yes really, Jim Lad) to enable Developer Options.
- Go to **Phone Settings / Developer Options / Select mock location app** and select *Bluetooth GNSS*.
- Plug power into your GPS unit
- Fire up the app; you will need to select the GPS device, and now should have four blue ticks visible as below left:



- Press the blue Bluetooth button at bottom right to connect to the GPS unit and see the stats display as above right.

Install the MapRun6 App on your Phone



You need an app to display your location on your map on your phone: Peter Effeney's MapRun6. A variety of earlier versions exist, eg MapRunF, but there is no reason to consider using them unless you have an ancient phone. For more information go to maprunners.weebly.com

Peter has collaborated with Captain Geoff to add a number of features to MapRun to make it useful for fieldwork; he says that the Check Sites function is the best and easiest method to show your location in the field.

- Install MapRun6 from the PlayStore, allowing any permissions it asks for.
- Tap on the **Name** button and enter many details including some which don't seem relevant.
- Tap on the **Options and Settings** button.
- **GPS Input should be *Phone GPS (std) and Suppl* – (NOT Bluetooth).** (This is the default setting.)

(Further settings are needed AFTER you have selected an Event/Map.)

Generate a KMZ of the Map on your PC

KMZ is one of the file formats used by Google Earth, originally called Keyhole, which explains the K. A .KMZ file is in fact a .ZIP file containing other files. You can look inside by renaming one from *whatever.kmz* to *whatever.zip* and opening it in Windows or whatever backward OS you use. You will find something like this:

Data > __ParadiseLost > COMPLETED > ParkwoodArundel > Arundel.zip

Name	Type	Cor
files	File folder	
doc.kml	KML	

and in *files* are the image tiles:

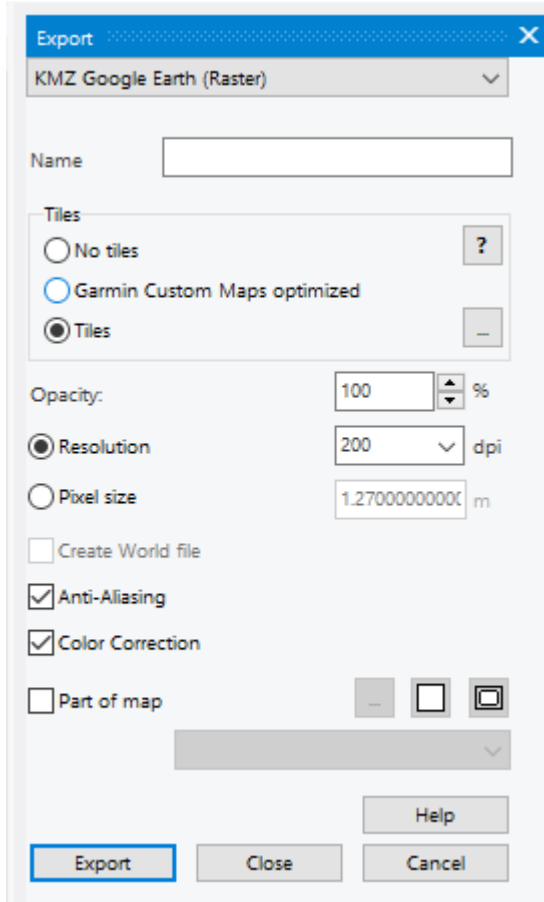
Data > __ParadiseLost > COMPLETED > ParkwoodArundel > Arundel.zip > files

Name	Type	Compressed size
tile_0_0.jpg	JPG File	64 KB
tile_0_1.jpg	JPG File	68 KB
tile_0_2.jpg	JPG File	20 KB
tile_0_3.jpg	JPG File	40 KB
tile_0_4.jpg	JPG File	8 KB
tile_1_0.jpg	JPG File	104 KB
tile_1_1.jpg	JPG File	222 KB
tile_1_2.inn	JPG File	165 KB

The doc.kml file holds the metadata:

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- Generator: OCAD 2020.5.10.3415 -->
<kml xmlns="http://www.opengis.net/kml/2.2">
  <Folder>
    <name>Arundel</name>
    <GroundOverlay>
      <name>tile_0_0.jpg</name>
      <drawOrder>75</drawOrder>
      <Icon>
        <href>files/tile_0_0.jpg</href>
        <viewBoundScale>0.75</viewBoundScale>
      </Icon>
      <color>FFffffff</color>
      <LatLonBox>
        <north>-27.942660475</north>
        <south>-27.948529964</south>
        <east>153.347126248</east>
        <west>153.340516753</west>
        <rotation>-10.840687687</rotation>
      </LatLonBox>
    </GroundOverlay>
  </Folder>
</kml>
```

- Open OCAD, load your map
- Select File / Export and make these settings



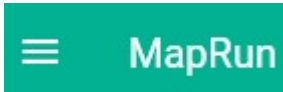
You may want 300 dpi instead of 200dpi, which makes the files twice as heavy – but that shouldn't matter.

Upload your KMZ to the MapRun Server from your PC

You don't need a logon with MapRun for this step.

This isn't the only way to get the map into your phone but it's probably the simplest.

- Go to console.maprun.net on your PC
- Click on the burger menu at top left



- Choose *Setup Check Sites*
- Enter an *Event/Map Name*
- Enter an *Expiry Date* – this is limited to 100 days from today
- Enter *Name and Email*
- Click on *Choose Map File(KMZ)* and select your KMZ
- Click on *Add The Event*
- If your KMZ is >2MB it will warn you about something doesn't matter
- It will give you a 6 digit CheckSites Code to identify the file: WRITE IT DOWN NOW

This CheckSites Code is necessary to see the map, so it is private to you.

Download your KMZ to MapRun6 on your Phone

The original purpose of CheckSites was control site checking to aid course setters.

Do this at home for access to WiFi or use a hotspot on your regular phone:

- Switch on WiFi on your phone.
- Fire up MapRun6.
- Tap the round burger button at bottom right.
- Tap on **CheckSites** near the bottom of the list.
- Enter the CheckSites Code you wrote down earlier; the KMZ will be downloaded to your phone.
- Switch off WiFi.

The following settings have to be entered for each new event (map) that you select:

- On MapRun6 home screen tap on *Options and Settings* and scroll down
- Switch on **Display Orienteering Map Overlay**.
- Switch on **Display present location**.
- Optionally switch on **Display track**.
- Optionally switch on **Display location pins** if you want to record waypoints.

Viewing your Map (and your Location) on your Phone

You don't need WiFi for this; in fact you need WiFi to be off:

- Go to **Phone Settings / Connections**, switch to *Flight Mode* then turn *Bluetooth* on (in this order.)
- Open MapRun6.
- We will assume you have already loaded the Map and selected it in CheckSites.
- Tap on the *Go to Start* button.

It will now display your map with the view positioned at its centre. If you are physically on the map, you will need to move the view to your location by tapping on the tiny bombsight icon at bottom left. The red dot shows where you are, and if Display Track is switched on, your track will also appear.

When you have finished, tap on the Home icon at top left. It will show you a scary message about ending your run (not very relevant to CheckSites), but note that your track and waypoints are still saved.

Accessing your Track and Waypoints

In MapRun6 when you are back at home:

- In **Settings / Connections** switch on WiFi and connect
- Go to the home screen (icon at top left.)
- Tap on *Show Results* button near the bottom.
- Select the result file.
- Tap on the burger menu icon at top right.
- Tap on *Email Track*.
- It will default the sender to the Google logon set up in your phone.
- It will default the recipient to the email address you entered in MapRun6 under *Name*.
- (If WiFi isn't on and available and connected it will silently put this email in the Outbox. Start the Gmail app to see it.)
- What you receive is a .GPX file containing your track and your waypoints.

Real Time Kinematic Positioning (RTK) – Bonus feature

https://en.wikipedia.org/wiki/Real-time_kinematic_positioning

Disclaimer – this gives centimetre accuracy which you just don't need, and requires WiFi which can cause problems.

RTK is an option if you have phone coverage, which is relatively unlikely for the kind of bushland where you need super-accurate GPS. RTK uses information transmitted from a nearby base station to (in ideal circumstances) make your new GPS accurate to centimetres.

If you have purchased a dedicated Android phone, it presumably has no SIM; I activated the WiFi hotspot on my regular iPhone and connected it to that.

You need a logon for the data supplier. Go to auscors.ga.gov.au and register; within a minute you will receive an email that looks like this:

Thank you for registering for the AUSCORS Ntrip Broadcaster.

Your account details are:

Username: nmarkroberts
Password: [REDACTED]

In order to get connected you will need the following information:

Hostname: auscors.ga.gov.au
Port: 2101

Now go in to the Bluetooth GNSS app, tap on the RTK/NTRIP tab, and enter those details. It will ask you to select a stream source from a long list; it seems you just have to plough through the list to find your local stream.

Big Fat Problem with this – you need to switch on WiFi which potentially causes the issue described earlier where the location bounces about.

Recording Waypoints

This is an entirely optional feature because you are presumably making annotations on a map as you go.

- In MapRun6, tap the location pin icon at top right of the screen:



- Enter a waypoint note

You may find that you use waypoints or look at the phone very frequently, so you need your phone in your hands at all times; it is best to attach it to your map board.

The Whole Package

I happened to have a weatherproof container which is meant to attach to the top tube of your bicycle or to your belt and hold your phone, wallet etc; you can poke the antenna cable through a gland, intended for an earphone cable. You don't need access to any of this once you are up and running, so it can sit in your backpack.

My Accusat EPIRB emergency locator beacon (\$229) also fits in there, so that's its new home.



Summary of costs

GPS Receiver package \$469

Power pack \$33

Ugly baseball cap \$priceless

Android phone \$220 second hand

Total \$722

Summary of weight

Power pack and USB power cable 195g

Galaxy G8 phone 168g

Antenna and cable 200g?

More Ideas

- Get a USB charger for your car's cigarette lighter output just in case



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