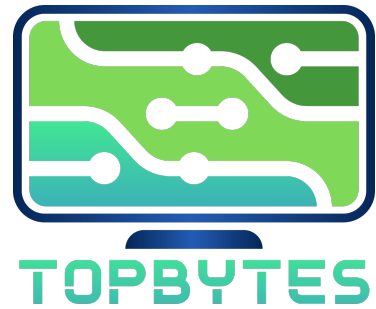




TopBytes SatTracker

<https://sattracker.topbytes.net>

Release 0.1.0

User Manual

Oct 22, 2026

SATTRACKER

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Welcome to the SatTracker user manual.

SatTracker is a standalone desktop amateur-satellite tracker from TopBytes Ltd. A 7-inch capacitive touchscreen driven by an ESP32-S3 shows a live world map of the satellites you follow — with their ground tracks and radio footprints — a 12-hour pass timeline, and a detail panel giving the selected satellite's azimuth, elevation and range, a sky plot of its next pass, and its **uplink and downlink frequencies corrected for Doppler shift** while it is overhead. It can alert you a few minutes before a satellite you care about makes a good pass.

SatTracker focuses on the satellites radio amateurs can actually work: FM repeaters such as SO-50, AO-91 and the ISS, linear transponders such as RS-44, FO-29 and AO-7, APRS digipeaters, and the geostationary QO-100.

It needs nothing more than a 2.4 GHz WiFi network and a USB-C power supply. Orbital data is downloaded automatically and all pass predictions are calculated on the device itself.

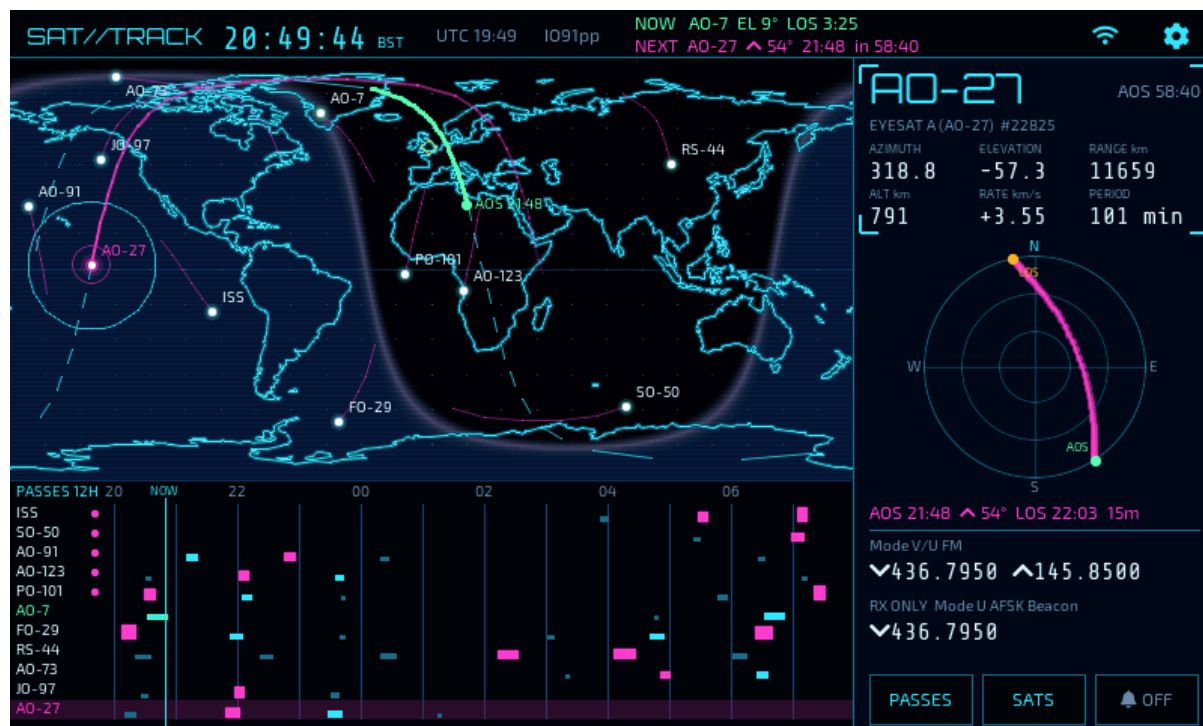


Fig. 1: The SatTracker main screen (NEON theme), with AO-27 selected and its track running to its next pass.

INTRODUCTION

1.1 What is SatTracker?

SatTracker is a desktop display that answers the three questions every satellite operator asks:

- **When** is the next usable pass of the satellite I want to work?
- **Where** should I point my antenna — where does it rise, how high does it get, and where does it set?
- **What frequency** do I transmit and listen on, right now, including Doppler shift?

It shows every satellite you are following on a world map, predicts all of their passes over your location for the next 24 hours, and gives you the details of whichever satellite you select — live, once a second.

SatTracker does not contain a radio. It tells you when, where and on what frequency; you work the pass with your own transceiver and antenna.

1.2 Key Features

1.2.1 World Map

- Equirectangular world map with coastlines and a live **day/night terminator**
- Up to **12 tracked satellites** with their names and a short trail
- The **selected** satellite shows its **footprint** — the area of the Earth from which it is above the horizon — its recent track, its future track as a dashed line, and the stretch of track where it will next be above *your* horizon, tagged with the acquisition time
- Your home location is marked on the map
- Tap a satellite to select it

1.2.2 Pass Prediction

- Full SGP4/SDP4 orbit model, calculated on the device — no internet service is needed to predict passes
- Next 24 hours of passes for every tracked satellite: acquisition of signal (AOS), time and elevation of closest approach (TCA), loss of signal (LOS), and the azimuths at each
- A **12-hour pass timeline** showing every satellite's passes at a glance, with good passes highlighted
- A sortable **upcoming-passes table**
- A polar **sky plot** of the selected satellite's next pass, with its live position during the pass
- Accuracy verified against the reference implementation to within about a second

1.2.3 Frequencies, Modes and Doppler

- Uplink and downlink frequencies, mode (FM, SSB/CW, AFSK, ...), CTCSS tone and inverting/non-inverting transponder type for each satellite
- Built-in data for 33 workable amateur satellites
- While a satellite is overhead the frequencies are **Doppler-corrected live**: the downlink shows where to listen, and the uplink shows where to transmit so that the satellite hears you on its nominal frequency

1.2.4 Pass Alerts

- Choose which satellites raise alerts
- Define a **good pass** by its maximum elevation (e.g. 30° or higher)
- An alert banner appears a configurable time before AOS (e.g. 10 minutes) and again at AOS, with the satellite's frequencies — and it wakes the screen if night mode has turned it off
- The top bar always shows what is above your horizon **now** (with the time until it sets) and the **next** good pass with a countdown to it

1.2.5 Two Display Themes

- **NEON** — a futuristic holographic HUD: deep-space background, cyan and magenta neon, glowing coast-lines and a comet-tail trail
- **OPS** — a hi-tech mission-control console: charcoal panels, crisp white and amber, a labelled latitude/longitude grid and five-minute ticks along the satellite track

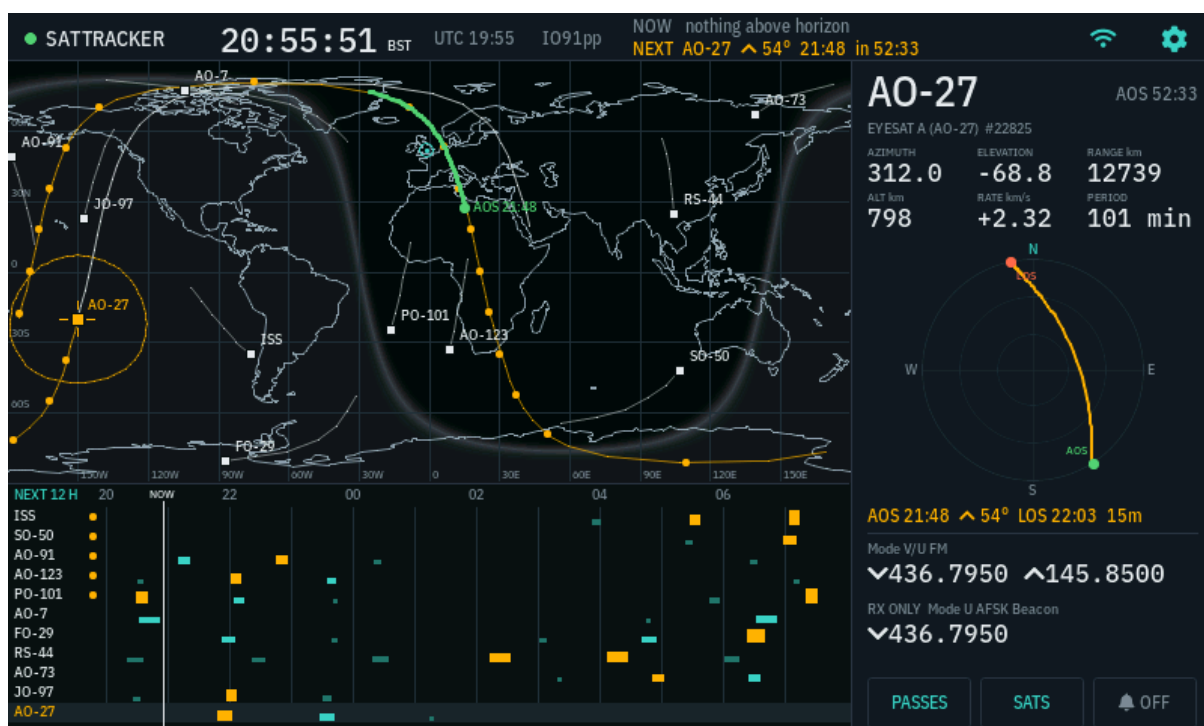
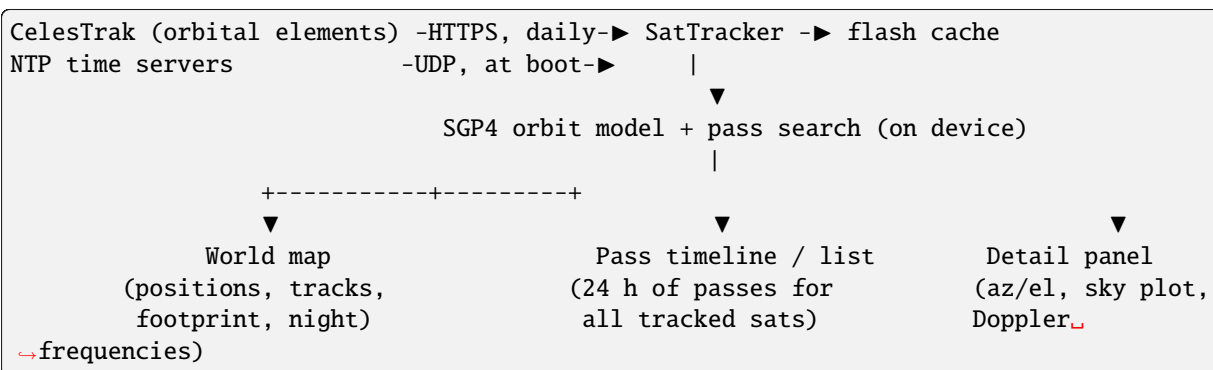


Fig. 1: The main screen in the OPS theme.

1.2.6 Connectivity and Updates

- 2.4 GHz WiFi, set up on the touchscreen or from a phone
- Up to 3 saved networks, joined automatically
- Clock synchronised over the internet (NTP) — accurate time is essential for satellite tracking
- Orbital data refreshed from CelesTrak every day and kept in flash memory, so the device keeps predicting through an internet outage
- Over-the-air firmware updates from TopBytes

1.3 How It Works



1. Once a day SatTracker downloads the current orbital elements (two-line element sets) for the amateur-radio satellites from CelesTrak and stores them in flash.
2. Every second it computes the position of each tracked satellite and its direction and distance from your home location.
3. In the background it searches the next 24 hours for passes over your location.
4. The display shows the results; alerts fire from the predicted passes.

1.4 Use Cases

- **Working FM satellites** — know which of SO-50, AO-91, AO-123, PO-101 and the ISS pass high over you today, and see the dial frequency to set as Doppler shifts.
- **Linear transponders** — see the passband for RS-44, FO-29, AO-7 or JO-97 and follow the Doppler-corrected passband centre during the pass.
- **Planning** — a glance at the timeline shows the best passes of the evening.
- **Not missing passes** — let the alert tell you ten minutes before a good one.
- **QO-100** — see the geostationary satellite's fixed azimuth and elevation from your location.
- **Shack display** — a striking always-on display of what is overhead.

1.5 System Requirements

1.5.1 Hardware

- SatTracker device
- USB-C power supply (5 V, 1 A minimum)

1.5.2 Network

- **2.4 GHz WiFi** (802.11 b/g/n). 5 GHz-only networks are **not** supported.
- Internet access for the time server, orbital data and firmware updates (outbound HTTPS on port 443, NTP on UDP port 123).

Once orbital data has been downloaded, pass prediction continues to work without an internet connection for several days. The clock must have been set from the internet since the device was last powered on.

1.6 Next Steps

- Set up your device in *Getting Started*
- Learn to read the screen in *Operation*
- Choose satellites, alerts and display options in *Configuration*

GETTING STARTED

This section walks you through the first-time setup of your SatTracker. Everything happens on the touchscreen — no laptop or phone is required, though a phone can be used for the access-point fallback if you prefer.

2.1 Unboxing and First Power-On

2.1.1 What's in the Box

Your SatTracker package should contain:

- SatTracker device
- USB-C power cable

2.1.2 Initial Power-Up

1. Connect the USB-C cable to the SatTracker's USB-C port
2. Connect the other end to a USB power source (5 V wall adapter, computer, or a quality power bank)
3. The 7-inch LCD lights up and the world map appears

Note: Use a quality 5 V USB-C power supply rated at 1 A or more. Insufficient power may cause boot loops or display instability.

2.2 First Boot Sequence

When SatTracker powers on for the first time:

1. **Display comes up:** the world map, pass timeline and detail panel are drawn. Satellite positions are shown straight away from the orbital data built into the firmware.
2. **Time warning:** until the clock has been set from the internet, the top bar shows **TIME NOT SYNCED** and no passes are predicted. Accurate time matters — a clock one second out puts a satellite seven kilometres out of place.
3. **WiFi setup:** if no network is saved, the on-screen **WiFi Setup** panel appears.

2.3 The On-Screen WiFi Setup

When no WiFi is configured, a full-screen **WiFi Setup** panel appears with two ways to get online:

WiFi Setup

No WiFi configured.

Option A - Join the hotspot "SatTracker Setup" **from** a phone/laptop, then **open** a browser to **set** up WiFi.

Option B - Scan **for** a network here on the screen:

[Scan **for** networks]

Most people use **Option B** and do everything on the screen.

2.3.1 Option B — Set Up WiFi on the Screen

1. Tap "Scan for networks"

The device scans for nearby 2.4 GHz networks and shows a **Select network** list. Each row shows the network name, a WiFi icon, and a padlock if the network is password-protected. The status line shows how many were found (e.g. 6 found, none found, or scan failed - tap Rescan).

Note: SatTracker does not support 5 GHz networks. Make sure your router has 2.4 GHz enabled.

2. Tap your network

Tap the name of your home or shack WiFi. If your network is hidden, tap **Other (enter manually)** to type the name yourself.

3. Enter the details

A setup panel opens with:

- **Network name (SSID)** — pre-filled if you picked it from the scan
- **Password** — tap the field and type your WiFi password on the on-screen keyboard
- **Add network** button to save
- **Cancel** button to back out

4. Tap "Add network"

The network is saved and the device begins connecting. Once connected, the setup panel closes.

2.3.2 Option A — Set Up WiFi From a Phone or Laptop

If you'd rather type on a real keyboard, use the access-point fallback:

1. On your phone or laptop, open WiFi settings and join the open network named SatTracker Setup.
2. A configuration page should open automatically (captive portal). If it doesn't, open a browser and go to <http://192.168.4.1>.
3. Enter your **WiFi network name** and **password** in the form and submit.
4. The page confirms:

Saved. SatTracker **is** connecting to your network. This hotspot will close.

5. The device joins your network and the setup hotspot shuts down.

Note: On some phones you may see a warning that "this network has no internet access." That's expected — the SatTracker Setup hotspot exists only for configuration.

Tip: If the device was previously running other TopBytes firmware (DXSpotter Pro or FlightRadar), the WiFi networks saved by that firmware are imported automatically on first boot, and this step is skipped.

2.4 After WiFi Connects

Once SatTracker is online it automatically:

- Sets its clock over NTP (pool.ntp.org / time.google.com). **TIME NOT SYNCED** disappears from the top bar.
- Predicts the next 24 hours of passes for your tracked satellites. The top bar shows **PREDICTING...** for about ten seconds, then the timeline fills in.
- Downloads the latest orbital elements from CelesTrak (about 30 seconds after coming online), then once a day.
- Checks the TopBytes update service for newer firmware.

2.5 Setting Your Home Location

All predictions are made for your **home location**. Out of the box this is a default in London; set your own so that pass times, azimuths and elevations are correct.

1. Tap the **gear** icon at the top-right of the screen, then tap **LOCATION**.
2. The location page shows your current home, e.g. HOME 51.6458, -0.7083 (I091pp).
3. Set it one of two ways:
 - **Maidenhead locator** — type a 4-, 6- or 8-character grid square (e.g. I091pp) and tap **Set grid**. Six characters is accurate to about 5 km, which is plenty for satellite work.
 - **Coordinates** — type your **latitude** (−90...90) and **longitude** (−180...180) in decimal degrees and tap **Set coords**.
4. Tap **Done**. The passes are recalculated for the new location within a few seconds.

Note: If you enter an invalid grid or out-of-range coordinates, the page shows an error (Invalid grid (e.g. I091wm) or Lat −90...90, Lon −180...180) and keeps your previous location.

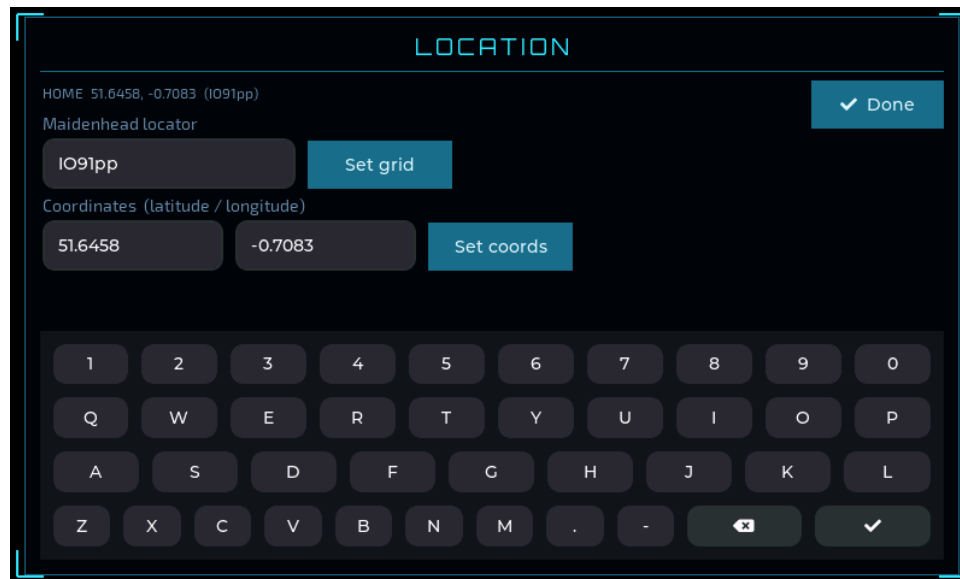


Fig. 1: Setting the home location by grid square or coordinates.

2.6 Setting Your Timezone

Pass times are shown in **local time**. Open **Settings** → **TIMEZONE**, scroll to your zone and tap **SET**. Daylight saving time is applied automatically. The big clock in the top bar shows local time with the zone (e.g. BST), and the smaller time beside it is UTC.

2.7 Verifying Successful Setup

You'll know setup was successful when:

- The big clock shows the correct local time, with the zone beside it, and the UTC time next to it is correct
- Your grid square is shown in the top bar
- The pass timeline shows coloured bars for upcoming passes
- The top bar shows **NOW** with any satellite that is up at the moment, and **NEXT** with the next good pass and a countdown

If the top bar still shows **TIME NOT SYNCED** after a few minutes, see [Troubleshooting](#).

2.8 What's Next?

Now your SatTracker is set up and running, you can:

- Learn to read every part of the screen in [Operation](#)
- Choose your satellites, alerts, theme and other options in [Configuration](#)
- Learn how predictions and Doppler work in [Advanced Features](#)
- If something isn't working, jump to [Troubleshooting](#)

OPERATION

This section explains every part of the SatTracker screen and how to use it while working satellites.

3.1 Screen Layout

The 800 × 480 display is divided into four areas:

```
+-----+
| TOP BAR: clock, UTC, grid square, now / next pass, WiFi, settings |
+-----+
|                               |                               |
|          WORLD MAP          |          DETAIL PANEL          |
| satellites, tracks, footprint, night side | selected satellite: |
|                               | az / el / range,              |
+-----+ sky plot,          |                               |
|          PASS TIMELINE          | frequencies                |
| next 12 hours, one row per satellite | [PASSES] [SATS] [bell] |
+-----+-----+
```

The display updates once a second.

3.2 The Top Bar

From left to right:

Title

SAT//TRACK (NEON) or SATTRACKER (OPS).

Clock

Local time in your chosen timezone, with the zone abbreviation (e.g. BST) beside it.

UTC

The current UTC time, as used by most satellite schedules and logs.

Grid square

Your home location as a 6-character Maidenhead locator.

Now and next

Two lines:

- **NOW** (green) — the tracked satellite that is above your horizon right now, its current elevation and the time until it sets, e.g. NOW AO-7 EL 12° LOS 3:24. If several are up, the highest is shown with +1, +2... for the others. nothing above horizon when none is up.
- **NEXT** — the next good pass (see [Pass Alerts](#)) that has not started yet, with its maximum elevation, local AOS time and countdown, e.g. NEXT ISS ▲ 88° 07:52 in 0:09.

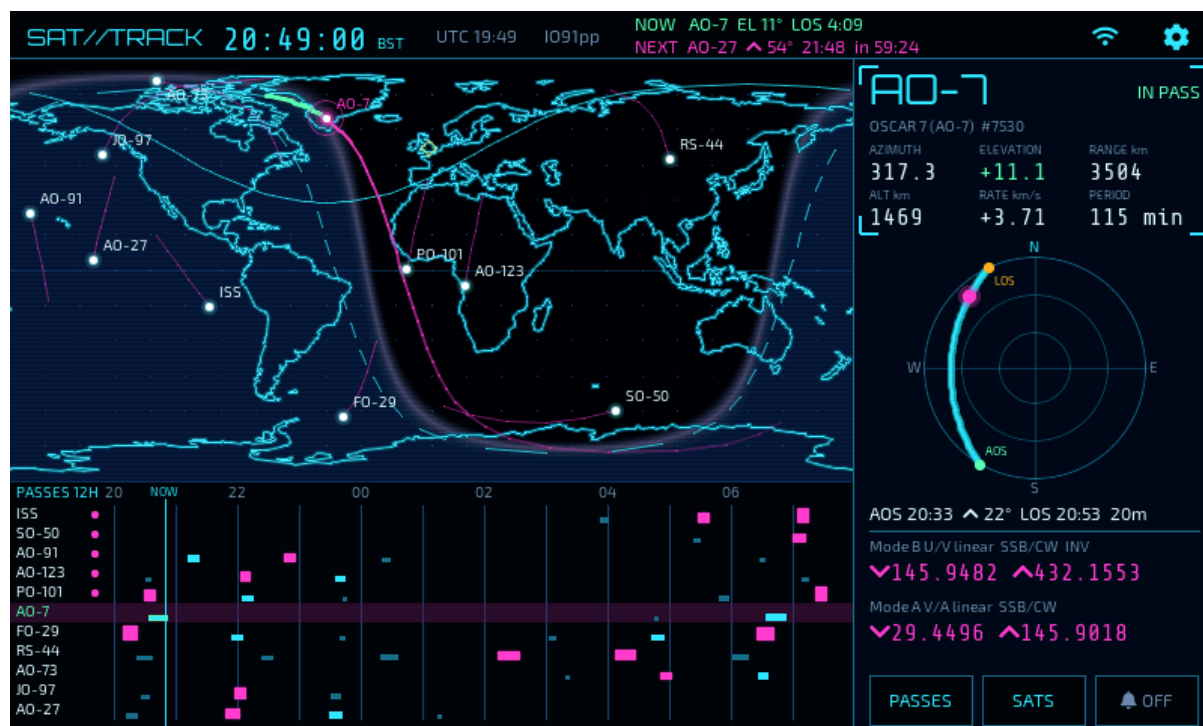


Fig. 1: The main screen while the selected satellite (AO-7) is making a pass. Daylight is over the Americas, night over Europe, Africa and Asia, with the grey line between.



Before predictions are available this area shows **TIME NOT SYNCED** (the clock has not been set from the internet yet) or **PREDICTING...** (the first prediction run is in progress).

WiFi status

The WiFi symbol when connected, AP while the setup hotspot is running, or a cross when not connected.

Settings

The gear icon opens the settings page (see [Configuration](#)).

3.3 The World Map

The map is a flat (equirectangular) projection of the whole Earth, north at the top.

Day, night and grey line

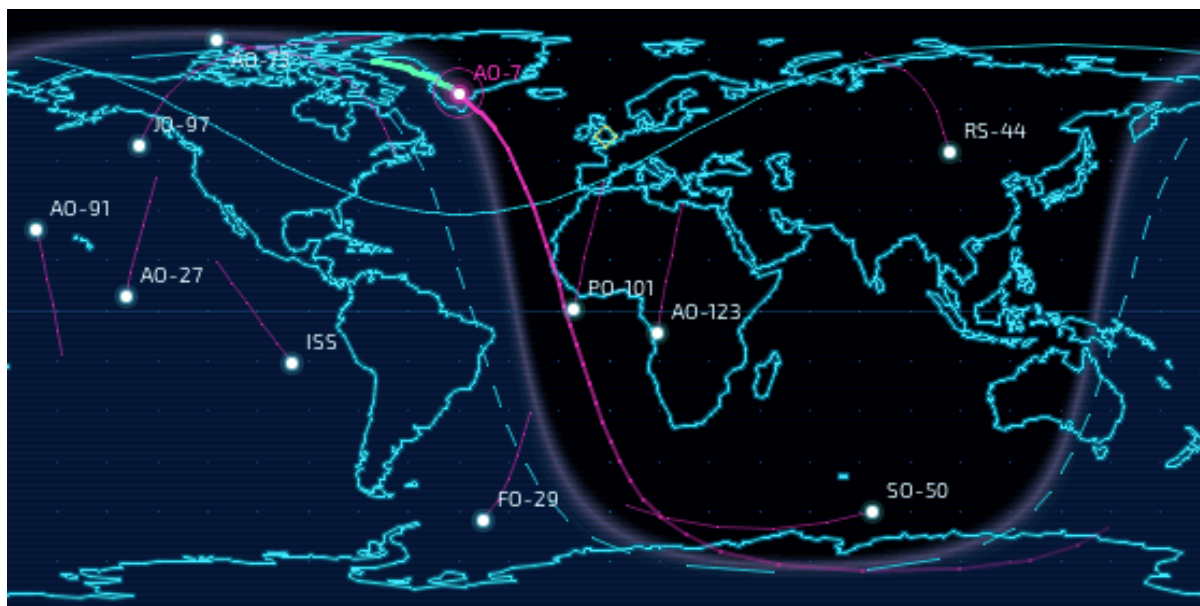
The daylit half of the Earth is lit (deep blue in NEON, grey in OPS) and the night half is dark. Along the boundary runs the **grey line**, a lighter band where the sun is just below the horizon (civil twilight, centred on 3° below). The terminator moves west at 15° of longitude an hour, so the movement is slow to watch — compare the map an hour apart. The shading is redrawn every minute. It is useful for HF grey-line propagation and for seeing which satellite passes will be in sunlight.

Your home

Marked with a small diamond (NEON) or ring (OPS).

Satellites

Every tracked satellite is shown with its name and a short trail behind it (the last ten minutes of its ground track). The marker colour tells you its state:



State	NEON	OPS
Below your horizon	cyan dot	white square
Above your horizon	green dot	green square
Selected	magenta dot with pulsing ring	amber square with crosshair

Selected satellite

The satellite shown in the detail panel also gets:

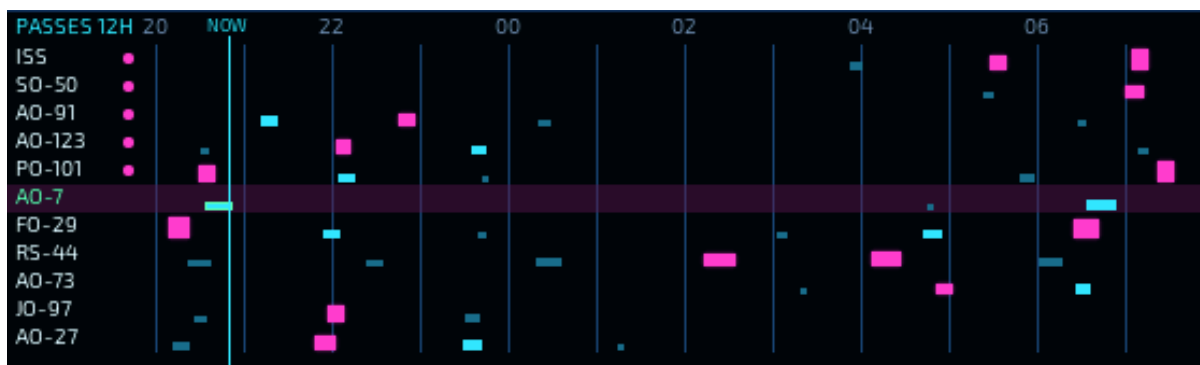
- its **footprint** — the circle on the Earth from which it is currently above the horizon. When your home is inside the circle, you can work it.
- its **recent track** (a fading trail behind it)
- its **future track** — a dashed line (NEON) or a line with a dot every five minutes (OPS), running far enough ahead to reach its next pass over you
- the **next pass** — the stretch of future track where it will be above your horizon, drawn as a thick green line and tagged with the acquisition time, e.g. AOS 22:04

Tip: Many amateur satellites are in polar orbits. After a pass from north to south the satellite goes on over the South Pole, up the far side of the Earth and back over the North Pole, so its next pass is often an orbit (about 95 minutes) later and starts in the north. Follow the dashed future track to see it come round.

Selecting a satellite

Tap a satellite on the map to select it. SatTracker can also select each satellite for you as it rises — see **Auto-select satellite at AOS** in *Pass Alerts*.

3.4 The Pass Timeline



The timeline covers one hour back and eleven hours ahead, with a row for each tracked satellite and the hours (local time) along the top. The vertical **NOW** line marks the present.

Each pass is a bar from AOS to LOS. The **taller the bar, the higher the pass**, and its colour shows how good it is:

Pass	NEON	OPS
Good (at or above your threshold)	magenta	amber
Medium (15° up to the threshold)	cyan	teal
Low (under 15°)	dim blue	dim teal

A dot after a satellite's name means alerts are on for it. The selected satellite's row is highlighted. A satellite that is above your horizon right now has its name in green, and its current pass bar is outlined in green. A geostationary satellite such as QO-100 has no passes; its row shows its fixed azimuth and elevation from your location instead.

- Tap a row to select that satellite.
- Tap the header line (the hours) to open the upcoming-passes table.

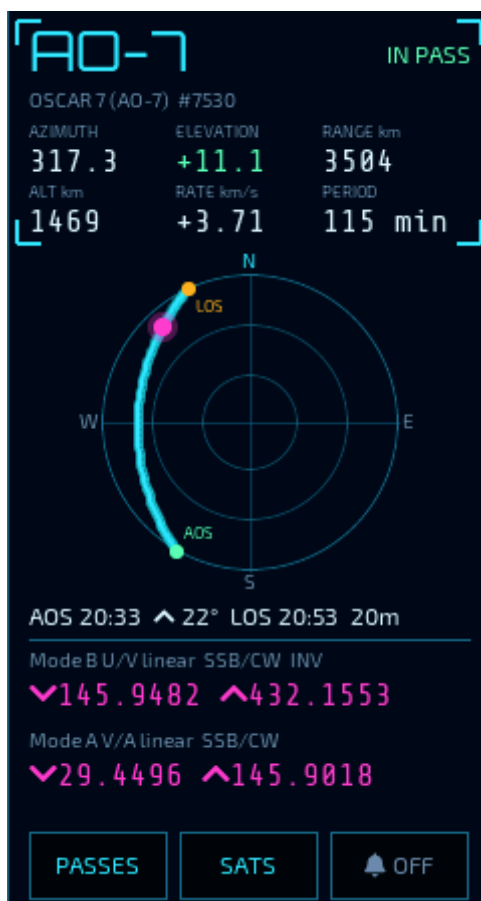
3.5 The Detail Panel

The right-hand panel describes the selected satellite.

3.5.1 Name and Status

The short name (e.g. AO-91) with its full catalogue name and NORAD number below. At the top-right a status shows:

- **IN PASS** — the satellite is above your horizon now
- **AOS 1h32 / AOS 6:15** — time until its next pass begins
- **GEO UP / GEO DOWN** — a geostationary satellite visible / not visible from your location
- **NO PASS** — no pass in the next 24 hours
- **PREDICTING** — passes are being calculated (a few seconds after start-up)
- **NO TIME (amber)** — the clock has not been set from the internet yet, so positions and passes cannot be trusted



3.5.2 Live Readings

AZIMUTH	Compass bearing to the satellite, degrees (0 = north, 90 = east)
ELEVATION	Angle above the horizon, degrees. Negative = below the horizon. Shown in green while the satellite is up.
RANGE km	Straight-line distance from you to the satellite
ALT km	Height of the satellite above the Earth
RATE km/s	How fast the range is changing: negative = approaching, positive = receding. This drives the Doppler shift.
PERIOD	Time for one orbit, or GEO for a geostationary satellite

3.5.3 Sky Plot

The circle is your sky seen from below: the edge is the horizon, the centre is straight overhead, and the rings are 30° and 60° elevation, with north at the top. The curve is the path of the current or next pass, from **AOS** (green dot) to **LOS** (orange dot). During the pass a bright dot shows where the satellite is now — point your antenna there.

Below the plot, the pass summary gives AOS time, maximum elevation, LOS time and duration, e.g. AOS 21:23 ▲ 31° LOS 21:36 12m. It is shown in the accent colour when the pass is a good one.

Tap the sky plot to open the upcoming-passes table.

3.5.4 Frequencies

Up to two transmitters are shown for the selected satellite, workable ones first. Each takes two lines:

- **Description and mode**, e.g. U/V FM repeater CTCSS 141.3 or V/U linear SSB/CW INV. INV marks an inverting linear transponder (an upper sideband uplink comes down as lower sideband, and tuning up the uplink tunes down the downlink). RX ONLY marks a beacon or telemetry downlink.
- **Frequencies** in MHz: ▼ the downlink (what you listen to) and ▲ the uplink (what you transmit on). For a linear transponder the centre of the passband is shown.

While the satellite is above (or within a few degrees of) your horizon, the frequencies are **Doppler-corrected** and shown in the accent colour:

- the **downlink** is the frequency the signal actually arrives on
- the **uplink** is the frequency to transmit on so the satellite hears its nominal frequency

As the satellite approaches, the downlink is shifted up and the uplink down; at the moment of closest approach the shift passes through zero, and as it recedes the directions reverse. At 435 MHz the shift is up to about ± 10 kHz, and at 145 MHz about ± 3.5 kHz.

Tip: For FM satellites, set your radio to the nearest 5 kHz step to the displayed downlink, and step it as the display moves. For the uplink most operators leave 145 MHz fixed and correct only the 435 MHz side.

3.5.5 Buttons

PASSES

Opens the upcoming-passes table.

SATS

Opens the satellite picker.

Bell (ON / OFF)

Turns good-pass alerts on or off for the selected satellite.

3.6 Upcoming Passes Table

All passes of all tracked satellites in the next 24 hours, in time order:

SAT	Satellite
AOS (LOCAL)	Day and local time the satellite rises above your horizon
DURATION	Length of the pass (minutes:seconds)
MAX EL	Highest elevation; ▲ marks a good pass
AZ AOS > LOS	Compass bearing where it rises and where it sets
STARTS	Countdown to AOS, or IN PASS

Good passes are shown in the accent colour. Tap a row to select that satellite and return to the main screen. **ALERT RULES** opens the alert settings.

UPCOMING PASSES 24 H					
SAT	AOS (LOCAL)	DURATION	MAX EL	AZ AOS > LOS	STARTS
FO-29	Mon 21:03:35	14:24	34° ▲	010 > 226	IN PASS
AO-91	Mon 21:23:52	12:07	31° ▲	020 > 169	6m 39s
AO-7	Mon 21:37:48	14:20	8°	244 > 327	20m 35s
RS-44	Mon 21:57:23	12:24	5°	320 > 029	40m 10s
PO-101	Mon 22:04:40	10:33	17°	002 > 241	47m 27s
AO-27	Mon 22:18:13	15:00	90° ▲	162 > 345	1h 01m
JO-97	Mon 22:31:00	10:52	53° ▲	176 > 343	1h 13m
AO-123	Mon 22:35:57	10:52	62° ▲	010 > 203	1h 18m
FO-29	Mon 22:49:28	9:42	7°	002 > 281	1h 32m
AO-91	Mon 22:58:05	12:05	33° ▲	007 > 221	1h 40m
PO-101	Mon 23:41:59	2:39	1°	335 > 310	2h 24m
< RETURN			ALERT RULES		

3.7 Pass Alerts

When a satellite with alerts turned on is about to make a good pass, a banner appears over the map:

- **INCOMING PASS** with a countdown, at the configured time before AOS (10 minutes by default)
- **ACQUISITION** when the satellite rises (AOS)

The banner shows the AOS time and azimuth, the maximum elevation, the LOS azimuth and the pass duration, and the satellite's main receive and transmit frequencies, mode and CTCSS tone. Tap the banner to select the satellite; it closes by itself after a minute.

If night mode has turned the screen off, an alert turns it back on for five minutes.

Each pass alerts once — recalculating the predictions does not repeat an alert.

3.8 Choosing Satellites

Tap **SATS** (or **Settings** → **SATELLITES**) to choose which satellites to track.

- Filter the list with **WORKABLE** (every satellite with a usable transponder or repeater), **FM**, **LINEAR** or **TRACKED** (your current selection).
- Each row shows the satellite, its catalogue name, and its main mode with uplink ▲ and downlink ▼ frequencies.
- **TRACK** adds the satellite to the map, timeline and predictions; tap again to remove it.
- **ALERT** turns good-pass alerts on or off (and tracks the satellite if it isn't already).
- **PREV** / **NEXT** page through the list; **TRACKING 11 / 12** shows how many you are tracking out of the maximum of 12.

Tap **DONE** to return. Predictions for a changed selection are ready a few seconds later.

Out of the box SatTracker tracks the ISS, SO-50, AO-91, AO-123 and PO-101 (with alerts), and AO-7, FO-29, RS-44, AO-73, JO-97 and QO-100.

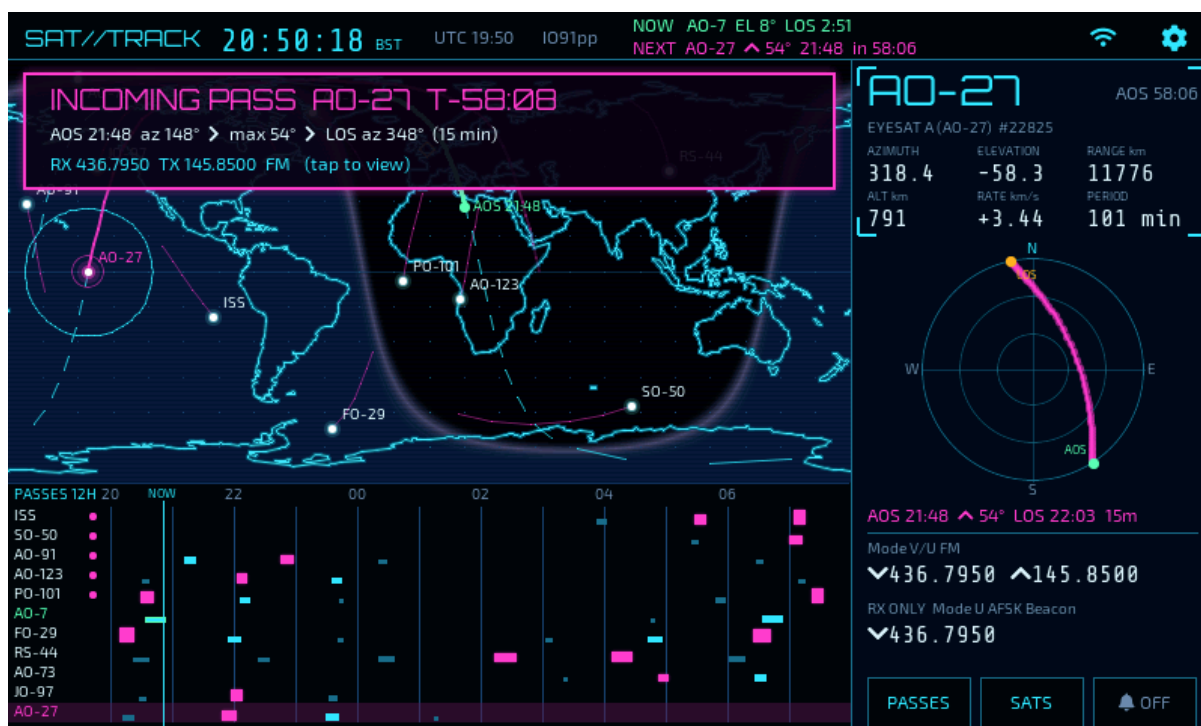
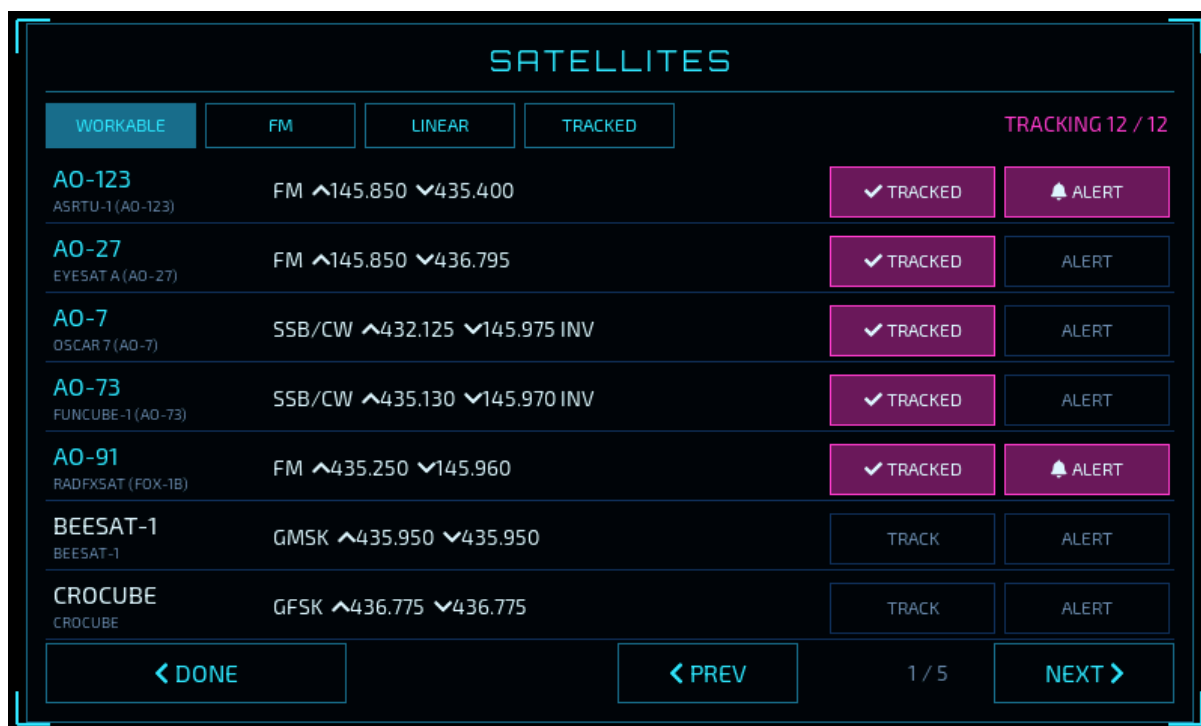


Fig. 2: The INCOMING PASS banner for a 54° pass of AO-27, with a countdown to AOS.



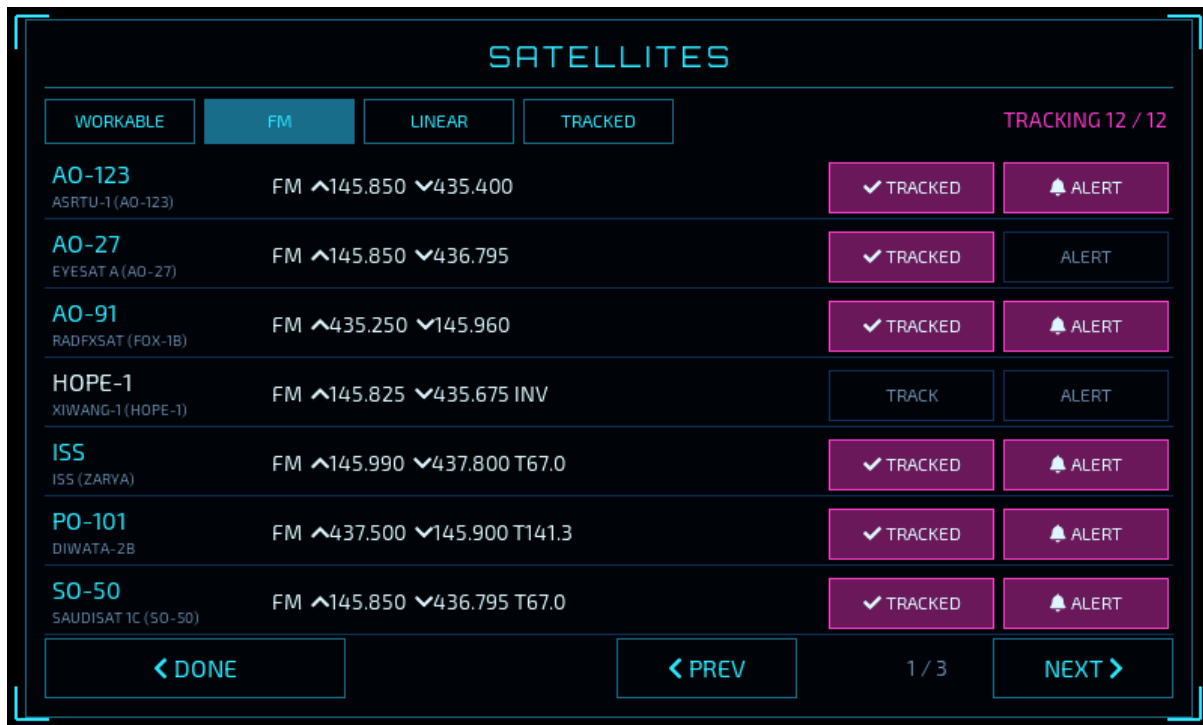


Fig. 3: The picker filtered to FM satellites.

3.9 Geostationary Satellites (QO-100)

QO-100 sits over the equator at 25.9° E and does not move across the sky, so it has no passes. Its timeline row and detail panel show its fixed azimuth and elevation from your location (for example, about 148° and 26° from southern England), or GEO DOWN if it is below your horizon. The Doppler correction applied to its frequencies is negligible, because a geostationary satellite barely moves relative to you.

CONFIGURATION

All settings are made on the touchscreen and saved in the device's non-volatile memory, so they survive power cuts and firmware updates.

4.1 The Settings Page

Tap the **gear** icon at the top-right of the main screen.



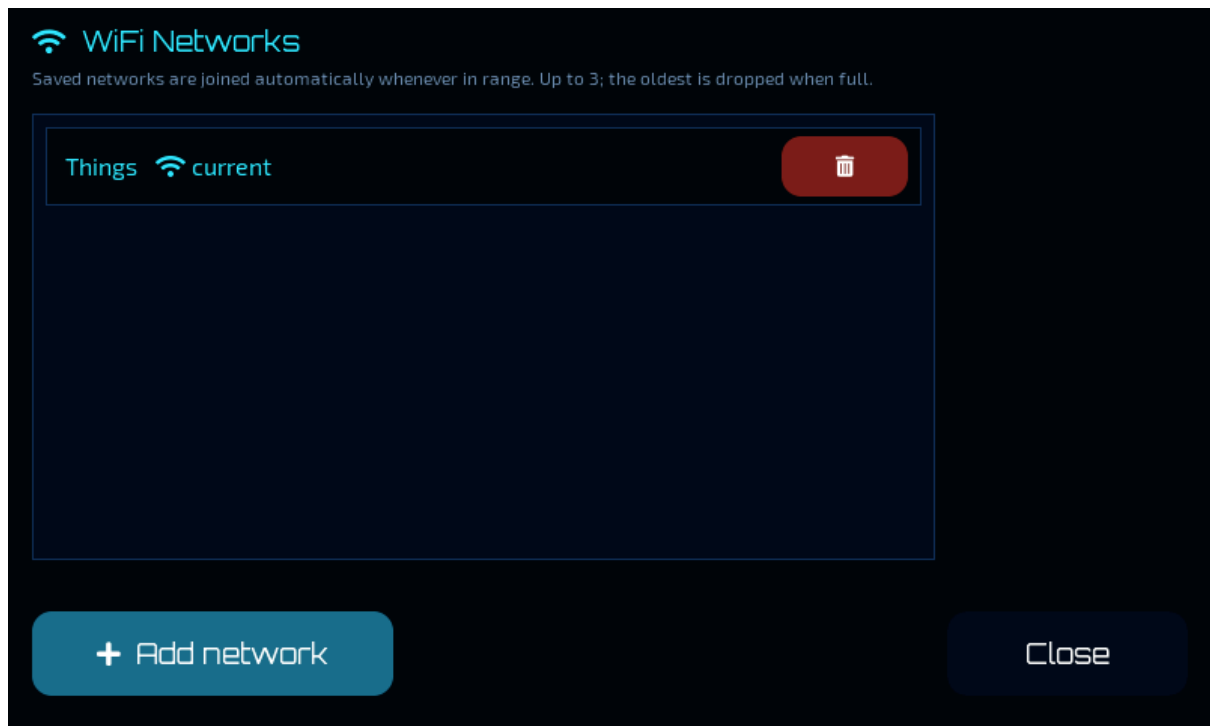
Each row shows a setting and its current value; tap a row to change it. Tap **RETURN** to go back to the main screen.

LOCATION	Your home position (grid square shown)
WIFI	Saved WiFi networks (current network shown)
TIMEZONE	Timezone for local times
ORBITAL DATA	Age of the orbital data and satellite count; tap to download fresh data now
ABOUT / UPDATE	Device information and firmware update
SATELLITES	Which satellites are tracked (number shown)
PASS ALERTS	Good-pass rules (summary shown)
NIGHT MODE	Overnight screen-off schedule
SCREEN	Normal or rotated 180°
THEME	NEON or OPS (the device restarts to apply)
BRIGHTNESS	Backlight level slider (on dimmable hardware)

4.2 Location

See *Setting Your Home Location* in *Getting Started*. Enter a Maidenhead grid square (4, 6 or 8 characters) and tap **Set grid**, or enter latitude and longitude in decimal degrees and tap **Set coords**. Tap **Done** to close. All passes are recalculated for the new position.

4.3 WiFi



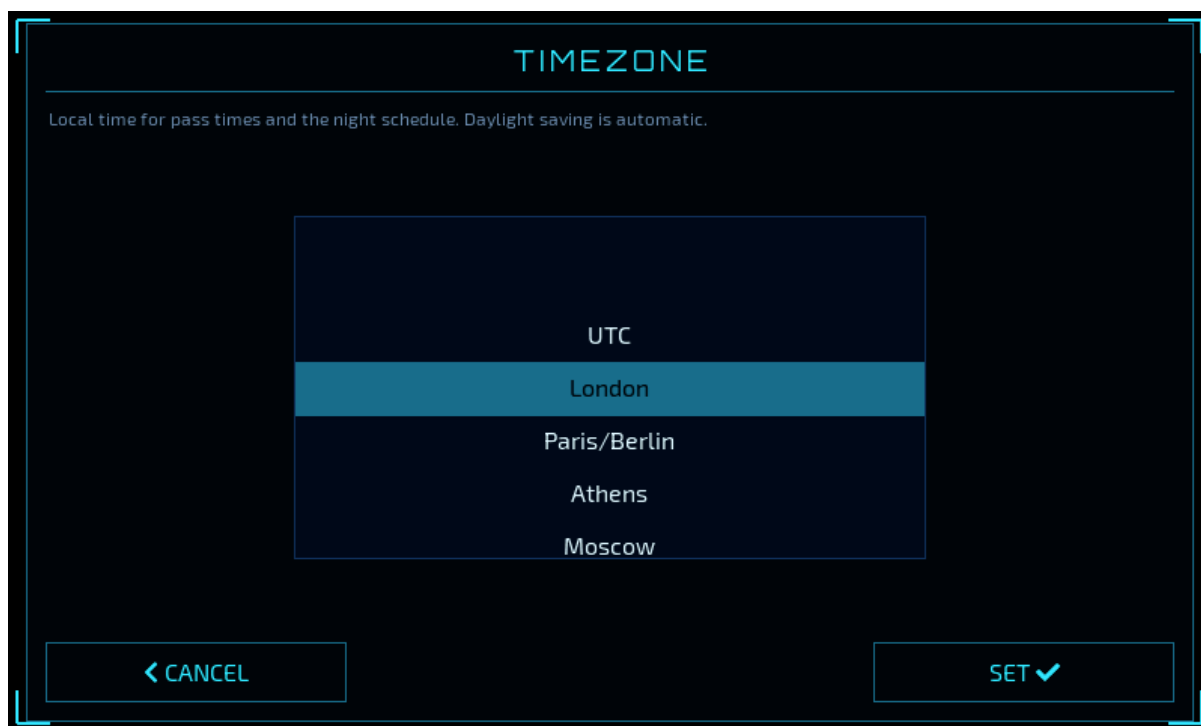
The **WiFi Networks** page lists the saved networks. SatTracker remembers up to three and joins whichever is in range; when a fourth is added, the oldest is dropped.

- **Add network** opens the scan list and password entry described in *Getting Started*.
- The red bin button forgets a network.
- **Close** returns to settings.

4.4 Timezone

Scroll the list to your zone and tap **SET**. Eighteen zones are available: UTC, London, Paris/Berlin, Athens, Moscow, Dubai, Mumbai, Bangkok, Singapore, Tokyo, Sydney, Auckland, New York, Chicago, Denver, Los Angeles, Honolulu and São Paulo. Daylight saving time changes are applied automatically.

The timezone affects the clock, the pass times in the timeline, pass table, detail panel and alerts, and the night-mode schedule. Predictions themselves are always made in UTC.



4.5 Orbital Data

The row shows how old the downloaded orbital data is, e.g. 3 h old (95 sats). BUILT-IN means the device is still using the data built into its firmware because it has not yet completed a download.

SatTracker downloads fresh data from CelesTrak once a day by itself. Tap the row to download now — useful after a satellite has manoeuvred, or when a newly launched satellite has just been catalogued. The row shows DOWNLOADING... while it works.

4.6 Satellites

Opens the satellite picker described in [Operation](#). You can track up to **12** satellites at once. Tracking fewer makes the map and timeline easier to read.

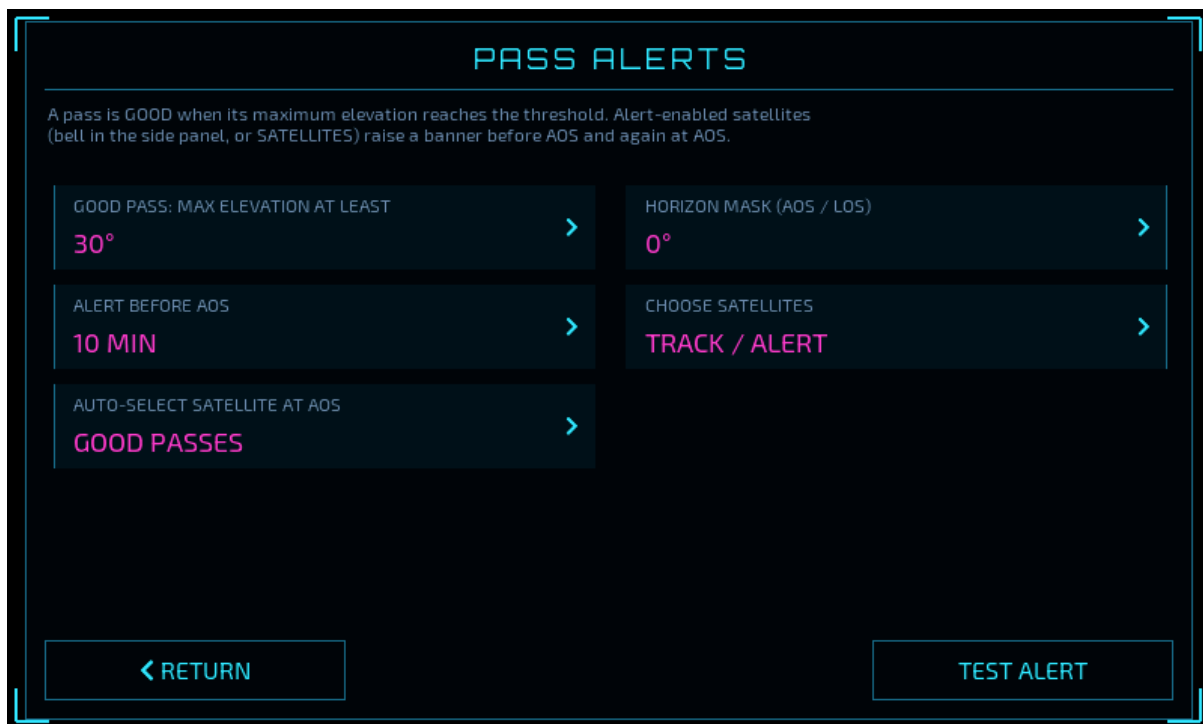
4.7 Pass Alerts

Tap a row to step through its values:

Setting	Values	Default
GOOD PASS: MAX ELEVATION AT LEAST	10°, 20°, 30°, 45°, 60°	30°
ALERT BEFORE AOS	2, 5, 10, 15, 30 min	10 min
HORIZON MASK (AOS / LOS)	0°, 5°, 10°, 15°	0°
AUTO-SELECT SATELLITE AT AOS	OFF, GOOD PASSES, ALL PASSES	OFF

Good pass — a pass whose highest elevation reaches this value. Good passes are highlighted in the timeline and pass table, shown on the top bar's **NEXT** line, and raise alerts. Low passes are short and often obstructed; 30° is a good starting point for an omni-directional antenna, and you can lower it if you have a clear horizon and a beam.

Alert before AOS — how far ahead the **INCOMING PASS** banner appears. A second **ACQUISITION** banner appears at AOS.



Horizon mask — the elevation at which a pass is considered to start and end. If trees or buildings hide your low horizon, set 5° or 10° so that AOS and LOS times match when you can actually hear the satellite. Changing the mask recalculates the passes and shrinks the footprint circle on the map to match.

Auto-select satellite at AOS — switches the detail panel, map footprint and sky plot to a satellite as it rises, so the screen is ready for the pass without touching it. **GOOD PASSES** switches only for passes that reach the good-pass elevation; **ALL PASSES** switches for any pass of a tracked satellite. It works with or without alerts turned on for the satellite.

- It never switches away from the selected satellite while that satellite is still above your horizon. If another satellite rises during the pass, the panel moves to it when the first one sets (the higher pass first, if several are up).
- If you select a satellite yourself, passes already in progress are left alone; the next satellite to rise is selected as usual.

CHOOSE SATELLITES opens the satellite picker, where the **ALERT** buttons choose which satellites raise alerts. You can also use the bell button in the detail panel.

TEST ALERT shows a sample banner for the next good pass.

4.8 Night Mode

Turns the screen off overnight. Tap **ENABLED / DISABLED** to switch the schedule on or off, set the **Turn OFF at** and **Turn ON at** times (local time, five-minute steps), and tap **SAVE**.

While the screen is off:

- Touching it turns it on for five minutes. The first touch only wakes the screen; it doesn't operate the button under your finger.
- A pass alert turns it on for five minutes so you see the banner.
- Tracking, prediction and data downloads carry on as normal.



4.9 Screen

Tap to switch between **NORMAL** and **ROTATED 180**, for mounting the device upside down. The change is immediate; the touch panel is rotated to match.

4.10 Theme

Tap to switch between the two display themes. The device restarts to apply the new theme (about five seconds); all your settings are kept.

NEON

A futuristic holographic HUD — deep-space background, cyan and magenta neon, glowing coastlines, a comet-tail trail on the selected satellite and angled corner brackets. Text is set in Exo 2 and Orbitron, numbers in Share Tech Mono.

OPS

A hi-tech mission-control console — charcoal panels, crisp white, amber and teal, a labelled latitude/longitude grid and five-minute ticks along the future track. Text is set in IBM Plex Sans Condensed, numbers in IBM Plex Mono.

4.11 Brightness

On hardware with a dimmable backlight, the **BRIGHTNESS** slider at the bottom of the settings page sets the level from 10% to 100%. It takes effect as you drag and is saved when you let go. On hardware without dimming the slider is not shown.

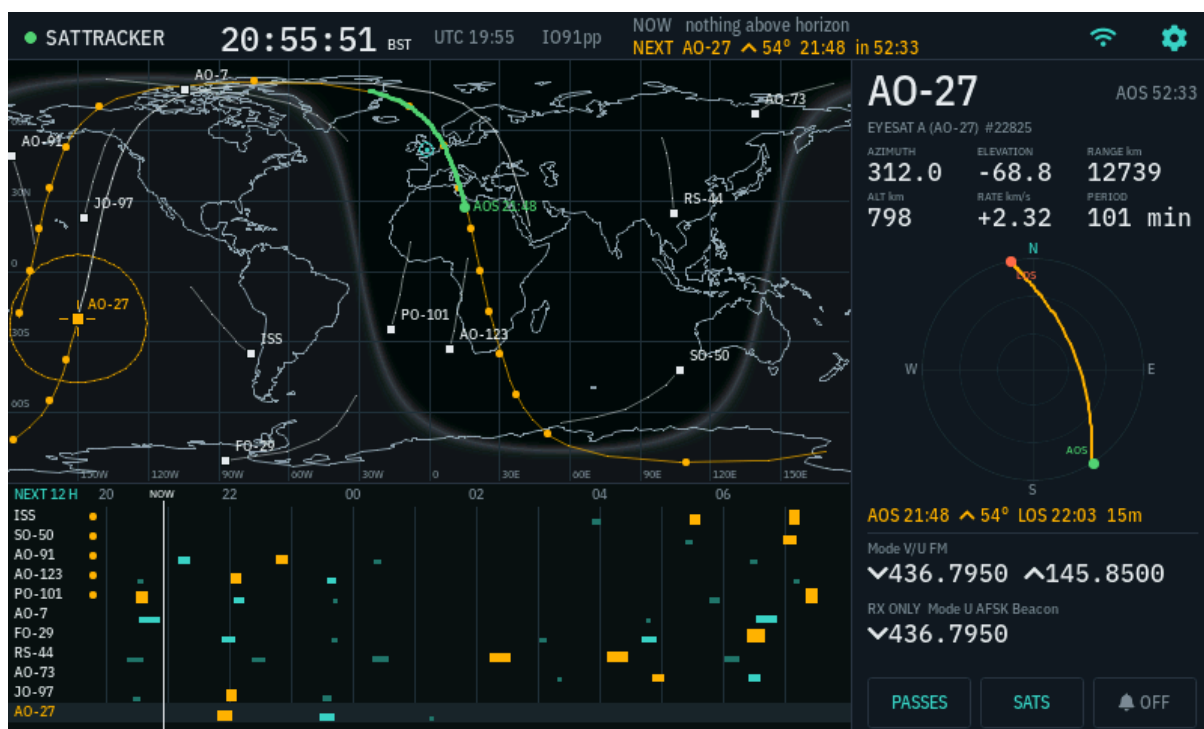


Fig. 1: The OPS theme.

UPCOMING PASSES 24 H					
SAT	AOS (LOCAL)	DURATION	MAX EL	AZ AOS > LOS	STARTS
AO-91	Mon 21:23:52	12:07	31° $\nearrow$	020 > 169	IN PASS
AO-7	Mon 21:37:48	14:19	8°	244 > 327	3m 22s
RS-44	Mon 21:57:23	12:25	5°	320 > 029	22m 56s
PO-101	Mon 22:04:40	10:33	17°	002 > 241	30m 13s
AO-27	Mon 22:18:13	15:00	90° $\nearrow$	162 > 345	43m 47s
JO-97	Mon 22:31:00	10:52	53° $\nearrow$	176 > 343	56m 33s
AO-123	Mon 22:35:57	10:51	62° $\nearrow$	010 > 203	1h 01m
FO-29	Mon 22:49:28	9:42	7°	002 > 281	1h 15m
AO-91	Mon 22:58:05	12:05	33° $\nearrow$	007 > 221	1h 23m
PO-101	Mon 23:41:59	2:39	1°	335 > 310	2h 07m
RS-44	Mon 23:55:10	15:26	9°	344 > 076	2h 20m

[< RETURN](#) [ALERT RULES](#)

Fig. 2: The upcoming-passes table in the OPS theme.

4.12 About / Update



Shows the firmware version, the **device ID** (needed when registering or contacting support), the WiFi network and signal strength, IP address, home location, data sources and registration status.

CHECK UPDATE asks the TopBytes update service for newer firmware straight away (the device also checks by itself). See *Over-The-Air (OTA) Firmware Updates*.

TROUBLESHOOTING

This section helps you diagnose and fix common problems.

5.1 Quick Checks

Before anything else:

1. **Power** — use a 5 V USB-C supply of at least 1 A and a data-capable cable.
2. **WiFi** — the WiFi symbol at the top-right should be shown (not AP or a cross).
3. **Time** — the top bar must not show **TIME NOT SYNCED**.
4. **Location** — the grid square in the top bar should be yours.
5. **Restart** — unplug for ten seconds and plug back in.

5.2 Time and Predictions

5.2.1 "TIME NOT SYNCED" Stays On

Cause: the device hasn't been able to reach an internet time server.

Fix:

- Check the WiFi symbol is shown and that other devices on the network have internet access.
- Make sure your router or firewall allows outbound NTP (UDP port 123) to `pool.ntp.org` and `time.google.com`.
- Restart the device.

No passes are predicted until the time is set — tracking a satellite without accurate time would put it in the wrong place.

5.2.2 The Timeline Is Empty / "PREDICTING..." Doesn't Clear

- Prediction starts as soon as the time is set and takes about ten seconds. Wait a little longer after the time warning clears.
- Check that you are tracking some satellites (**Settings** → **SATELLITES** shows the count).
- If you have just changed location, satellites or the horizon mask, the timeline refreshes within a few seconds.

5.2.3 "NEXT no good pass in 24h"

None of your tracked satellites reaches your good-pass elevation in the next day. Track more satellites, or lower **GOOD PASS: MAX ELEVATION AT LEAST** in **Settings** → **PASS ALERTS**. Most satellites have a few passes a day over any one location, and only some of them are high.

5.2.4 Pass Times Look Wrong

- **Check the home location.** Every prediction depends on it. Confirm the grid square in the top bar, or open **Settings** → **LOCATION**.
- **Check the timezone.** Pass times are shown in local time; the small time beside the clock is UTC. If the big clock is right but in the wrong zone, set the timezone.
- **Check the orbital data age** in **Settings** → **ORBITAL DATA**. If it is more than a few days old, tap the row to download fresh data, and see the connectivity checks below.
- **A pass an orbit away is normal.** A satellite you saw far south of you may come back over the pole about 95 minutes later. Select it and follow the dashed future track to the green next-pass segment.
- Compare with another tracker using the **same location and orbital data**; small differences of a few seconds are normal between programs.

5.2.5 I Didn't Hear the Satellite During a Predicted Pass

The prediction tells you where the satellite is; whether you hear it depends on the satellite and your station:

- Check the satellite is operating — see **AMSAT status**. Some satellites only operate in sunlight or on a schedule.
- Low passes are often blocked by buildings and trees; set a **HORIZON MASK** that matches your surroundings.
- Make sure you are tuning the Doppler-corrected frequency shown in the panel.
- On FM satellites, check your CTCSS tone (shown in the panel).

5.3 Alerts

5.3.1 I Didn't Get an Alert

- Alerts are only raised for satellites with the **bell turned ON** (detail panel, or **ALERT** in the satellite picker).
- The pass must reach your good-pass elevation.
- The alert appears at **ALERT BEFORE AOS** minutes before the pass; if the device was restarted after that moment, the alert for that pass is skipped.
- Use **Settings** → **PASS ALERTS** → **TEST ALERT** to check the banner appears.

5.3.2 The Screen Is Off

Night mode is active. Touch the screen to wake it for five minutes, or change the schedule in **Settings** → **NIGHT MODE**. Alerts wake the screen automatically.

5.4 WiFi Problems

5.4.1 The Device Won't Connect

- SatTracker supports **2.4 GHz only**. Make sure your router's 2.4 GHz band is enabled; dual-band routers that combine both bands under one name usually work.
- WPA3-only networks are not supported — use WPA2 or WPA2/WPA3 mixed mode.
- Enterprise (802.1X) networks and networks that need a web login after joining are not supported.
- Check the password: open **Settings** → **WIFI**, delete the network and add it again.
- Move the device closer to the router.

5.4.2 The "SatTracker Setup" Hotspot Appears

The device couldn't join any saved network, so it started its setup hotspot. Use the on-screen setup or join SatTracker Setup from a phone (see *Getting Started*).

5.4.3 Orbital Data Doesn't Update

Settings → **ORBITAL DATA** keeps showing the same age, or BUILT-IN.

- Check the device has internet access (the time is synced).
- Allow outbound HTTPS (TCP 443) to celestrak.org.
- Tap the row to retry. A failed download is retried automatically every 15 minutes.

The device keeps working with the data it already has; predictions slowly become less accurate over the following days.

5.5 Display Problems

5.5.1 The Screen Is Upside Down

Tap **Settings** → **SCREEN** to switch between **NORMAL** and **ROTATED 180**.

5.5.2 The Screen Is Too Bright or Too Dim

Use the **BRIGHTNESS** slider at the bottom of the settings page. On hardware without a dimmable backlight the slider is not shown.

5.5.3 Touches Land in the Wrong Place

Restart the device. If the problem persists, contact support.

5.5.4 The Theme Didn't Change

Changing the theme restarts the device; the new theme appears when it has restarted (about five seconds).

5.6 Device Registration

5.6.1 "Device Not Registered"

The TopBytes service reports that this unit is not registered. Contact support@topbytes.net quoting the **Device ID** shown on the screen and a copy of your sales receipt. The message clears by itself once the unit is registered.

If the service simply can't be reached, the device carries on working normally.

5.7 Getting Help

If none of the above helps, contact support@topbytes.net with:

- the **Device ID** and firmware version from **Settings** → **ABOUT / UPDATE**
- a description of the problem and what you have tried
- if possible, a photo of the screen

Advanced users can also capture the serial log (see *Advanced Features*), which is very helpful for diagnosing network and prediction problems.

ADVANCED FEATURES

This section explains how SatTracker predicts passes and calculates Doppler, where its data comes from, firmware updates, network administration and the serial console — for users who want to understand what's happening under the hood.

6.1 How Pass Prediction Works

6.1.1 Orbital Elements

A satellite's orbit is described by a **two-line element set (TLE)** published by the US Space Force and distributed by [CelesTrak](#). SatTracker downloads the CelesTrak *amateur radio* group (about 95 satellites):

- about **30 seconds** after the device first comes online, then **once a day**
- retried every **15 minutes** if a download fails
- stored in flash memory, so the latest set is available immediately after a restart and survives an internet outage

Until the first successful download the device uses a copy of the elements built into its firmware. The **ORBITAL DATA** row in settings shows how old the current set is.

Elements are a snapshot of the orbit at one moment (the *epoch*); predictions slowly lose accuracy as the epoch gets older — typically a few seconds per day for low-orbit satellites, faster for those in very low or decaying orbits. Daily refresh keeps the error small.

6.1.2 The Orbit Model

Positions are calculated with **SGP4/SDP4**, the standard model the elements are designed for (the SparkFun SGP4 Arduino Library, a port of David Vallado's reference implementation). SDP4, the deep-space variant, is used automatically for high orbits such as QO-100's.

Once a second the device calculates, for every tracked satellite, its position over the Earth and its azimuth, elevation and range from your home location. The selected satellite's range is calculated half a second either side to get the **range rate** used for Doppler.

6.1.3 Finding Passes

In the background, SatTracker searches the next **24 hours** (from 30 minutes ago, so a pass in progress is included) for each tracked satellite:

1. It steps through time checking the satellite's elevation — every minute when the satellite is near your horizon, and in larger strides when it is far below it.
2. When the elevation crosses the horizon mask, it narrows the crossing down to under a second to find **AOS** and **LOS**.
3. Between them it searches for the highest point — the time of closest approach (**TCA**) and the **maximum elevation**.

A full run for 12 satellites takes about ten seconds and runs on its own processor core, so the display is never held up. Passes are recalculated every 15 minutes, and straight away when the orbital data, your location, the horizon mask or the tracked satellites change.

6.1.4 Accuracy

SatTracker's predictions have been checked against the reference implementation (Skyfield) using the same orbital elements: over 79 passes, AOS, TCA and LOS times agreed to within about one second and maximum elevations to within 0.05°.

The real-world accuracy is limited mainly by the age of the orbital elements and by the device clock, which is why SatTracker refuses to predict until its clock has been set over the internet.

Note: Very short, low passes (under about a minute, grazing the horizon) can occasionally be missed. They are rarely workable.

6.2 Doppler Correction

A satellite in low orbit moves at about 7.5 km/s, so the frequency you receive is shifted by the Doppler effect. With $\dot{r}$ the range rate (km/s, negative when the satellite is approaching) and c the speed of light:

$$f_{\text{receive}} = f_{\text{downlink}} \left(1 - \frac{\dot{r}}{c} \right) \quad f_{\text{transmit}} = f_{\text{uplink}} \left(1 + \frac{\dot{r}}{c} \right)$$

The transmit correction is chosen so that the satellite hears your signal on its nominal uplink frequency.

Typical maximum shifts for a low-orbit satellite:

Band	Maximum shift
145 MHz	about ± 3.5 kHz
435 MHz	about ± 10 kHz
2.4 GHz	about ± 57 kHz

For linear transponders the centre of the passband is shown. On an inverting transponder, remember that the uplink and downlink move in opposite directions within their passbands.

6.3 Frequency Data

Transmitter data is built into the firmware:

- A **curated list** for the core amateur satellites (the ISS, SO-50, AO-91, AO-123, PO-101, AO-7, FO-29, RS-44, AO-73, JO-97 and QO-100), checked against operator and AMSAT information and including CTCSS tones and inverting-transponder details.
- For other satellites, active transmitters from the [SatNOGS DB](#) that lie in the amateur-satellite bands (21, 28, 144, 435, 1260, 2400 and 10450 MHz).

Only satellites with at least one usable transponder, repeater or digipeater appear in the **WORKABLE** list. Frequency data is updated with firmware updates.

Note: Satellite operators sometimes change modes, switch transponders off, or run special events. Check current status with [AMSAT](#) before relying on a schedule.

6.4 Over-The-Air (OTA) Firmware Updates

SatTracker checks for firmware updates automatically and installs them securely over HTTPS from the TopBytes update service.

6.4.1 How OTA Works

- About **30 seconds** after WiFi comes up, the device asks the update service whether a newer release is available for this unit (identified by its Device ID).
- After the first check, it re-checks **every hour** for the rest of uptime.
- Released units automatically install only **strictly newer** released firmware.

6.4.2 Manual Update Check

In **Settings** → **ABOUT / UPDATE**, tap **CHECK UPDATE** to check immediately. While checking it shows **CHECKING...**; if you're already up to date it shows **UP TO DATE** briefly.

6.4.3 Beta / Pre-Release Builds

If the update service offers a pre-release **beta** build for your unit, installing it is never automatic. SatTracker shows a confirmation page first:

! Beta version X.Y.Z

This is a pre-release beta build and may be unstable. Install it now?

[CANCEL] [INSTALL]

Only if you tap **INSTALL** does the beta firmware download.

6.4.4 The Update Progress Screen

During an update, a full-screen page shows a **download progress bar** with the percentage and the warning **Do not power off**. The device restarts when done.

On success the device shows **Update complete. Restarting...** and reboots into the new firmware. If the download fails it shows **Update failed. Resuming.** and returns to normal operation — your existing firmware is untouched. Settings, tracked satellites and the orbital-data cache are kept across updates.

Warning: Do not remove power during an update. The previous firmware is only replaced once the new image has fully downloaded, so a power loss mid-download leaves the existing firmware running — but it's still best to let it finish.

6.5 Device Registration

SatTracker checks in with the TopBytes service (u.topbytes.net) to confirm the unit is registered. This is the same check that drives OTA.

- The check runs about 30 seconds after coming online and hourly thereafter.
- If the service can't be reached, the device **assumes it is registered** and keeps working — a network outage never locks a unit.
- If the service explicitly reports the unit as **not registered**, a full-screen page asks you to contact support@topbytes.net quoting the **Device ID** shown, with a copy of your sales receipt. Once the unit is registered, the next check clears the page automatically.

6.6 Network Administration

6.6.1 Ports Used

Port	Protocol	Purpose
80	TCP (HTTP)	Web setup page (inbound, AP setup mode only)
53	UDP (DNS)	DNS resolution (outbound; also the captive-portal DNS in AP mode)
123	UDP (NTP)	Time synchronisation (outbound)
443	TCP (HTTPS)	Orbital data (celestrak.org) and OTA + registration (u.topbytes.net) — all outbound

6.6.2 Firewall Considerations

For normal operation, allow outbound:

- **HTTPS (443)** to celestrak.org and u.topbytes.net
- **NTP (123)** to pool.ntp.org / time.google.com
- **DNS (53)**

The inbound web page on port 80 only runs while the device is in access-point setup mode; it is not exposed on your home network during normal operation.

Warning: The setup web page has no password protection. Only use it on the device's own SatTracker Setup access point; never expose it to the public internet.

6.7 Time Synchronisation

SatTracker sets its clock via NTP shortly after WiFi comes up, from `pool.ntp.org` and `time.google.com`. The clock then runs from the processor's crystal, accurate to a fraction of a second over many hours.

Accurate time is essential: an error of one second moves a low-orbit satellite about seven kilometres along its track and shifts every AOS and LOS by a second. Until NTP has succeeded the top bar shows **TIME NOT SYNCED** and no passes are predicted.

6.8 Serial Console

Connect SatTracker to a computer with a USB-C data cable and open a serial terminal at **115200 baud**. The boot log looks like this:

```
SatTracker 0.1.0 booting...
[tle] LittleFS mounted on 'ffat' (24 KB used)
[tle] loaded cache: 95 satellites
UI ready.
[net] online: MyHomeWiFi ip=192.168.1.42 rssi=-63
[clock] NTP synced
[pass] predicted 81 passes for 12 sats in 10527 ms
[tle] downloaded 15960 bytes, 95 satellites
[alert] incoming PO-101 maxEl=66
```

The console also accepts a few commands, typed followed by Enter:

help	List the commands
stat	Firmware, time, WiFi, catalogue, selected satellite and memory
passes	Every predicted pass in UTC: AOS / TCA / LOS times, azimuths and maximum elevation
tlcs	The orbital elements in use for the tracked satellites
tle	Download fresh orbital data now
sel <norad>	Select a tracked satellite by NORAD number (e.g. sel 25544)
home <grid>	Set the home location from a grid square
alert	Show a test alert banner
autosel <n>	Auto-select at AOS: 0 off, 1 good passes, 2 all passes
reboot	Restart the device

The `tlcs` and `passes` output can be fed to other software to cross-check predictions.

6.9 Power Consumption

- **Typical:** ~2–4 W at 5 V (dominated by the LCD backlight)
- **Peak** (during an OTA update): up to ~1 A at 5 V
- Use a quality 5 V / 1 A or higher USB-C supply
- USB-C power banks work for portable use — handy for field days and portable satellite operation
- Use **Night Mode** to switch the backlight off overnight

6.10 Security Notes

1. Use a **WPA2/WPA3** WiFi network; avoid open networks.
2. Keep firmware up to date — the OTA check runs hourly.
3. The setup web page is unauthenticated by design and only runs in AP setup mode; don't route it to the internet.

6.11 What's Next?

- Hardware and network specifications: *Technical Specifications*
- Regulatory and safety information: *Compliance*
- Return to daily operation: *Operation*

TECHNICAL SPECIFICATIONS

This section provides detailed technical specifications for the SatTracker device.

7.1 Hardware Specifications

7.1.1 Processor and Memory

SoC

Espressif ESP32-S3 (dual-core, 240 MHz)

PSRAM

8 MB OPI (octal) PSRAM

Flash

8 MB or 16 MB (variant dependent)

7.1.2 Wireless Connectivity

WiFi Standard

IEEE 802.11 b/g/n

Frequency Band

2.4 GHz only (5 GHz not supported)

WiFi Modes

Station (STA), Access Point (AP)

Security

WPA, WPA2, WPA2/WPA3 mixed

Antenna

On-board PCB antenna

Note: SatTracker does **not** contain a radio receiver or transmitter for the amateur bands. It predicts and displays; you operate the satellite with your own station.

7.1.3 Display

Type	7-inch IPS colour LCD (RGB parallel)
Resolution	800 x 480 pixels
Backlight	White LED (dimmable on supported hardware)
Touch Panel	Capacitive multi-touch
Surface	Glass

7.1.4 Power Requirements

Input Voltage	5 V DC $\pm 5\%$ (via USB-C)
Input Current	500 mA typical, ~1 A peak
Power Consumption	2–4 W typical
Connector	USB-C
Battery Support	Via USB-C power bank (not included)

Warning: Use only a quality 5 V USB-C power supply rated for at least 1 A. Insufficient power may cause boot loops, display flicker, or instability.

7.1.5 Physical Specifications

Form factor	7-inch landscape tablet-style enclosure
Mounting	Desktop or shelf; supports 180° screen rotation for inverted mounting
Environmental Rating	Indoor use only

7.1.6 Operating Environment

Operating Temperature	0 °C to 40 °C (32 °F to 104 °F)
Storage Temperature	−20 °C to 60 °C (−4 °F to 140 °F)
Humidity	20% to 80% RH non-condensing

Altitude

Up to 2000 m

7.2 Tracking Specifications

Orbit Model

SGP4 / SDP4 (near-earth and deep-space)

Satellites in Catalogue

About 95 (CelesTrak amateur radio group)

Workable Satellites with Frequency Data

33 (firmware 0.1.0)

Tracked Satellites

Up to 12 at once

Prediction Horizon

24 hours, up to 12 passes per satellite

Prediction Accuracy

within about 1 s (AOS / TCA / LOS) and 0.05° (maximum elevation) of the reference implementation, for the same orbital data

Position Update Rate

1 per second

Pass Recalculation

every 15 minutes, and on any change of data, location or settings

Horizon Mask

0° , 5° , 10° or 15°

Doppler Correction

live, for uplink and downlink, from the range rate

7.2.1 Map and Display

Map Projection

Equirectangular (plate carrée), whole Earth

Map Area

560 x 280 pixels

Coastlines

Natural Earth 1:110m

Day/Night

Solar terminator with grey-line (civil twilight) band, full resolution, updated every minute

Pass Timeline

12 hours (1 h past, 11 h ahead), one row per tracked satellite

Themes

NEON, OPS

7.2.2 Alerts

Good-Pass Threshold

10°, 20°, 30°, 45° or 60° maximum elevation

Alert Lead Time

2, 5, 10, 15 or 30 minutes before AOS, plus at AOS

Alert Output

On-screen banner; wakes the screen from night mode

7.3 Network Specifications

7.3.1 Supported Protocols

Orbital Data

HTTPS (TCP port 443) to celestrak.org

Firmware Updates & Registration

HTTPS (TCP port 443) to u.topbytes.net

Web Setup Page

HTTP (TCP port 80, AP setup mode only)

Time Sync

NTP (UDP port 123)

DNS

UDP port 53

7.3.2 Orbital Data

Source

CelesTrak GP data, amateur radio group, TLE format

Refresh

Daily (retry every 15 minutes on failure)

Storage

Flash file system; firmware-built-in fallback

7.3.3 Time Synchronisation

Protocol

NTP (Network Time Protocol)

Servers

pool.ntp.org, time.google.com

Timezone

Configurable (18 worldwide zones, automatic DST)

Clock Display

Local HH:MM:SS with zone, plus UTC HH:MM

7.3.4 Configuration Limits

Max WiFi Networks

3 (priority-ordered)

Max Tracked Satellites

12

Brightness Range

10–100% (dimnable hardware)

7.4 Performance Specifications

Cold Boot

~2 seconds to UI ready

WiFi Connection

5–30 seconds (network dependent)

NTP Sync

1–3 seconds after WiFi

First Predictions

about 10 seconds after the time is set

Watchdog Timer

Yes

Automatic Recovery

WiFi disconnections, failed downloads

OTA Failure Handling

Failed updates leave the running firmware untouched

7.5 Compatibility

7.5.1 WiFi Router Compatibility

Compatible With

- All 2.4 GHz 802.11 b/g/n routers
- WPA / WPA2 / WPA2-WPA3 mixed
- Most home and portable routers (including phone hotspots)

Not Compatible With

- 5 GHz only networks
- WPA3-only networks (use WPA2/WPA3 mixed-mode)
- Enterprise WiFi with 802.1X
- Captive portals requiring web-form authentication after joining

7.5.2 Power Source Compatibility

Compatible With

- USB-C wall adapters (5 V, ≥ 1 A)
- USB-C ports on computers
- USB-C power banks
- USB-C car chargers

Not Recommended

- Charge-only USB-C cables (won't expose the serial console)
- Supplies under 1 A — display flicker likely

7.6 Data Sources

- **Orbital elements:** [CelesTrak](#)
- **Transmitter data:** TopBytes curated list and [SatNOGS DB](#) (CC BY-SA 4.0)
- **Coastlines:** [Natural Earth](#) (public domain)
- **Fonts:** Exo 2, Orbitron, Share Tech Mono, IBM Plex Sans Condensed and IBM Plex Mono (SIL Open Font License)

These are independent sources not affiliated with TopBytes Ltd.

7.7 Support and Documentation

- **User Manual:** This document
- **Product Website:** <https://sattracker.topbytes.net>
- **Company Website:** <https://www.topbytes.net>
- **Support Email:** support@topbytes.net

COMPLIANCE

This product complies with the essential requirements of the following EU directives:

Directive	Title
2014/53/EU	Radio Equipment Directive (RED)
2011/65/EU	Restriction of Hazardous Substances (RoHS), as amended by 2015/863
2012/19/EU	Waste Electrical and Electronic Equipment (WEEE)

8.1 Radio Equipment Information

Per RED Article 10(10)

8.1.1 WiFi Operating Parameters

Technology	IEEE 802.11 b/g/n (WiFi)
Operating frequency band	2400–2483.5 MHz
Maximum transmit power	<100 mW (20 dBm) EIRP
Number of channels	13 (EU)
Channel bandwidth	20 MHz
Antenna	Internal (PCB trace, non-removable)

8.2 EU Declaration of Conformity

Per Radio Equipment Directive 2014/53/EU, Article 10(9)

Hereby, **TopBytes Ltd** declares that the radio equipment type **SatTracker** (Model: SATTRK-01) is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity is available on request from support@topbytes.net.

8.3 UKCA Declaration of Conformity

SatTracker (Model: SATTRK-01) complies with the relevant UK statutory instruments:

- Radio Equipment Regulations 2017
- Electrical Equipment (Safety) Regulations 2016
- Electromagnetic Compatibility Regulations 2016
- Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

8.4 FCC Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

Note: Changes or modifications not expressly approved by TopBytes Ltd could void the user's authority to operate this equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

8.5 RF Exposure Information

8.5.1 General Statement

This device complies with EU and US/UK requirements for limiting exposure of the general public to electromagnetic fields, as assessed in accordance with EN 62311:2020.

SatTracker is a low-power device that transmits at a maximum of 100 mW EIRP in the 2.4 GHz band. It is designed for tabletop / desktop use and is not intended to be worn on the body or held against the head.

8.5.2 Usage Distance

This device has been evaluated for RF exposure compliance at a minimum separation distance of **20 cm** between the device and the user's body. At this distance and power level, the electromagnetic field exposure is well below the limits set by Council Recommendation 1999/519/EC (based on ICNIRP guidelines).

8.5.3 Recommendations

- Use the device on a desk, table, or shelf — not directly against the body
- Do not modify the antenna or connect external antennas
- If co-locating with other radio equipment, maintain reasonable separation

8.6 Safety Warnings

8.6.1 Power Supply

- **Use only a USB-C power supply that complies with applicable safety standards** (e.g. IEC 62368-1, CE / UKCA / FCC marked). Using a non-compliant power supply may create safety hazards.
- The device requires a 5 V DC power supply providing at least 1 A, connected via a USB-C cable that supports data (not charge-only).
- Do not exceed the rated input voltage of 5 V DC.
- Disconnect the USB-C cable before cleaning the device.
- Do not use damaged cables or power supplies.

8.6.2 Operating Environment

- **Indoor use only.** This device is not designed for outdoor or weatherproof use.
- Operating temperature: 0 °C to +40 °C.
- Storage temperature: −20 °C to +60 °C.
- Humidity: 20% to 80% relative humidity, non-condensing.
- Do not expose the device to moisture, rain, or liquids.
- Do not use the device in dusty, dirty, or excessively hot or cold environments.
- Do not block ventilation openings or place the device in enclosed spaces without airflow.
- Maximum operating altitude: 2000 m above sea level.

8.6.3 General Safety

- **This device is not a toy.** Keep out of reach of small children.
- Do not disassemble, modify, or attempt to repair the device. There are no user-serviceable parts inside.
- Do not expose the device to strong magnetic fields, excessive vibration, or mechanical shock.
- If the device emits unusual smells, sounds, or smoke, disconnect the power immediately and contact the manufacturer.
- This device is intended for general consumers and hobbyists. It is not intended for use in safety-critical, medical, or life-support applications.

8.6.4 LCD Display and Touch Panel

- The capacitive touch panel responds to bare-finger touches; gloves and styluses without conductive tips will not register.
- Do not press the LCD with sharp objects, fingernails, or excessive force — this can permanently damage the panel.
- Clean the screen with a soft, dry, microfibre cloth. If liquid is required, use a small amount of distilled water on the cloth and never spray directly onto the screen.
- The LCD contains no mercury and uses LED backlighting.
- Avoid leaving high-contrast static images on the screen for extended periods to minimise the risk of image retention. The overnight **Night Mode** schedule can help.

8.7 Intended Use

SatTracker is a WiFi-enabled, touchscreen display device that predicts and shows the positions and passes of amateur-radio satellites, with their published frequencies, using orbital data fetched over the internet from third-party sources.

Intended users: Radio amateurs, satellite enthusiasts, and hobbyists.

Intended environment: Indoor domestic, office or radio-shack environments.

Important: SatTracker is an **informational display only**. Its predictions depend on orbital data and frequency information from third parties, which may be out of date, incomplete or inaccurate. SatTracker does not transmit or receive on the amateur bands; operating a radio transmitter requires an appropriate licence, and the operator remains responsible for transmitting only on frequencies and modes they are licensed for. Do not rely on SatTracker for any safety-of-life, navigational or operational space-situational-awareness purpose.

The device is not intended for:

- Outdoor installation
- Use in explosive or hazardous atmospheres
- Medical, navigational or safety-critical applications
- Use as an authoritative source of satellite positions or frequencies

8.8 WEEE — Waste Disposal Information

Per WEEE Directive 2012/19/EU, Article 14

8.8.1 Disposal Instructions

This product is marked with the crossed-out wheelie bin symbol, indicating that it must **not** be disposed of with unsorted household waste when it reaches the end of its life.

Correct disposal: Take the product to a designated collection facility for the recycling of waste electrical and electronic equipment (WEEE). Contact your local authority or retailer for information on your nearest collection point.

8.8.2 Why Separate Collection Matters

Separate collection and recycling of waste electrical and electronic equipment helps to:

- Conserve natural resources
- Ensure hazardous substances are handled safely
- Protect the environment and human health

8.8.3 Batteries

This product does not contain an internal battery. If powered from a USB-C power bank, dispose of the power bank separately in accordance with Directive 2006/66/EC (Battery Directive) or its successor Regulation (EU) 2023/1542.

8.8.4 Producer Information

Producer	TopBytes Ltd
WEEE category	Category 3 — IT and telecommunications equipment

8.9 Manufacturer

Name	TopBytes Ltd
Model number	SATTRK-01
Address	55 Kings Ride, HP10 8BP, UK
Website	https://www.topbytes.net
Product support	https://sattracker.topbytes.net
Email	support@topbytes.net

8.10 Firmware Updates

SatTracker supports over-the-air (OTA) firmware updates via WiFi. Firmware updates may include:

- Bug fixes and performance improvements
- New features
- Updates to maintain regulatory compliance

The device checks for updates automatically when connected to the internet. Updates are downloaded securely via HTTPS from the TopBytes update service.

Note: Firmware updates do not change the radio parameters (frequency, power) beyond the limits declared in this documentation.

CHANGELOG

9.1 0.1.0 — October 2026

First release.

9.1.1 Tracking and Prediction

- SGP4/SDP4 orbit model on the device; up to 12 tracked satellites
- 24-hour pass prediction (AOS, TCA, LOS, azimuths, maximum elevation), verified against the reference implementation
- Daily orbital-data download from CelesTrak, cached in flash, with built-in fallback
- Prediction waits for the clock to be set over the internet

9.1.2 Display

- World map with coastlines, day/night terminator and grey line, satellite trails, and the selected satellite's footprint, recent and future track
- Next pass of the selected satellite highlighted on the map with its AOS time
- 12-hour pass timeline, upcoming-passes table and polar sky plot
- Live azimuth, elevation, range, altitude and range rate
- Two themes: NEON and OPS, each with its own typefaces
- Local clock with timezone, plus UTC
- Top bar shows the satellite above your horizon now (with time to LOS) and the next good pass; satellites that are up are highlighted in the timeline

9.1.3 Frequencies

- Uplink/downlink, mode, CTCSS and inverting-transponder details for 33 workable satellites
- Live Doppler correction of uplink and downlink during a pass

9.1.4 Alerts

- Good-pass alerts per satellite: configurable elevation threshold and lead time, with a second alert at AOS
- Alerts wake the screen from night mode
- Optional auto-select of each satellite at AOS (good passes or all passes)

9.1.5 Device

- On-screen and hotspot WiFi setup; up to 3 saved networks; WiFi settings imported from other TopBytes firmware on first boot
- Home location by Maidenhead grid square or coordinates; 18 timezones
- Night mode, brightness, 180° rotation
- Over-the-air firmware updates and device registration
- Serial console with status, pass and orbital-data commands

QUICK LINKS

- [genindex](#)
- [search](#)

ABOUT THIS MANUAL

This manual covers:

- Powering on and the on-screen WiFi setup
- Setting your home location (Maidenhead grid or latitude/longitude) and timezone
- Reading the world map, pass timeline and satellite detail panel
- Frequencies, modes and Doppler correction
- Choosing satellites and setting up good-pass alerts
- The NEON and OPS display themes, brightness, night mode and screen rotation
- Troubleshooting connectivity and display issues
- Firmware updates (OTA) and technical specifications

DATA SOURCES AND CREDITS

SatTracker uses data provided by third parties:

- **Orbital elements (TLEs)** are provided by [CelesTrak](#) (amateur radio satellite group).
- **Transmitter frequencies and modes** are compiled from a TopBytes-curated list and the [SatNOGS DB](#) (CC BY-SA 4.0).
- **Coastlines** are from [Natural Earth](#) (public domain).

Orbits are propagated on the device with the SGP4/SDP4 model (the SparkFun SGP4 Arduino Library, a port of David Vallado's reference implementation).

REGULATORY AND SAFETY INFORMATION

Per Radio Equipment Directive 2014/53/EU, Article 10(9)

Hereby, **TopBytes Ltd** declares that the radio equipment type **SatTracker** (Model: SATTRK-01) is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at [Compliance](#).

SUPPORT

For additional support, please visit:

- Website: <https://www.topbytes.net>
- SatTracker Portal: <https://sattracker.topbytes.net>
- Support email: support@topbytes.net

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