

Ham Satting

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1. Introduction

What is Ham Satting?

Ham Satting is a comprehensive satellite tracking application designed specifically for Amateur Radio (Ham Radio) operators who engage in satellite communications. The app provides real-time satellite tracking, pass predictions, contact logging, and comprehensive grid locator mapping functionality.

Who Should Use This App?

- Amateur Radio Operators with valid licensing
- Satellite Communication Enthusiasts
- ARISS Operators (Amateur Radio on the ISS)
- Grid Square Hunters working towards VUCC awards

Key Features at a Glance

Real-Time Satellite Tracking

- Visualize amateur radio satellites with arrows on the map
- Track many amateur radio satellites with icons in real-time
- Color-coded directional arrows showing satellite position and elevation

Comprehensive Pass Predictions

- Detailed pass predictions (AOS, LOS, duration, azimuth, elevation)
- Countdown timer showing time until each pass
- Timeline visualization for multiple passes
- Pass quality indicators (Excellent/Good/Fair/Poor)
- Export predictions as images or CSV files

AR Doppler Shift Correction

- Real-time Doppler frequency correction during satellite passes
- Mode-specific correction logic (SSB, CW, APT, FM)
- Live frequency updates every 2 seconds
- Visual blinking indicator when Doppler correction is active

Satellite Selection Colors

The satellite list uses a color-coding system to indicate each satellite's capabilities:

- FM/SSB/APT satellites: white label
- SSTV-capable (non-FM): blue label — if also FM-based, blue dot next to name
- SSDV-capable (non-FM): green label — if also FM-based, green dot next to name
- Digital-capable (non-FM): orange label — if also FM-based, orange dot next to name

Smart API Management

- Automatic pause of satellite tracking when navigating away from map
- API hit counter with visual bar chart showing daily usage
- Warning alerts at 80% and 100% of daily API limit
- Prevents accidental API limit hits and saves battery

Interactive Map Features

- Maidenhead grid squares at all zoom levels
- Current GPS location and saved QTH
- Real-time satellite tracking with footprint visualization
- Grid Hunters mode to visualize worked grids from your QSO log

QSO Management

- Save satellite contacts to local database
- Filter and search by callsign or satellite
- Export complete QSO list via email or file sharing
- Automatic grid square extraction for Grid Hunters

Smart Notifications

- Schedule alerts for upcoming satellite passes
- Background notifications (with proper battery settings)
- Customizable alert timing (minutes before pass)
- Visual and audio notification options

SSTV/SSDV Audio Recording

- Record satellite SSTV and SSDV audio directly from AR tracking
- Smart filename format: SatName_SSTV/SSDV_Date_Time_FreqkHz.wav
- Automatic Doppler-corrected frequency in filename
- Supports both SSTV and SSDV capable satellites

Digital Mode Recording

- Record APRS, FSK packet, and GMSK digital mode audio directly from AR tracking
- DIGI button (orange) appears for digital-capable satellites alongside SSTV and SSDV buttons
- Doppler-corrected frequency for UHF downlinks; nominal frequency for VHF (below 300 MHz)
- Filename format: SatName_Digital_Date_Time_FreqkHz.wav

Compass Pass Visualization

- Interactive compass dialog showing satellite pass trajectory
- Download and share pass images with watermark
- Local time display in-app, UTC in exported images
- Square format export for clean sharing

- **Weather Satellite Tracking**

- Track active VHF weather satellites — Meteor-M N2-3 and N2-4 on 137.900 MHz LRPT
- Dedicated purple Weather mode button on the AR page with Doppler-corrected frequency
- Audio session recording during pass for your own logging or decoder archiving
- Legend filter pill lets you isolate weather satellites in the selection list

2. Getting Started

First-Time Setup (IMPORTANT!)

When you first open Ham Satting, you'll see a welcome dialog. Follow these steps carefully:

Step 1: Navigate to Settings

Tap the Settings icon at the bottom navigation bar (gear icon)

Step 2: Enter Your Default Values

Configure these essential settings:

1. Default Grid Location (e.g., LL93eo33)

- Enter your home station's Maidenhead grid square
- Can be 4, 6, or 8 characters
- Example formats: LL93, LL93eo, LL93eo33

2. Default Callsign (e.g., A46UNX)

- Your amateur radio callsign

3. Default Email

- For support and exporting QSO logs

Step 3: Get Your N2YO API Key (REQUIRED)

Important: Pass predictions and satellite map tracking require a free API key from N2YO.

- Visit: <https://www.n2yo.com/api/>
- Sign up for a free account
- Get your API key
- Paste it into the N2YO API Key field in Settings then press Save

Step 4: Set Minimum Pass Angle

- Min Pass Angle: 0° (shows all passes, even low ones)
- Higher values (e.g., 15°) filter out low elevation passes
- Recommendation: Start with 0° and adjust based on your horizon

Step 5: Select Satellites

Scroll down to the Satellite Settings section and enable the satellites you want to track. Popular Amateur Radio Satellites:

- ISS, SO-50, IO-86, AO-91, AO-73, PO-101, RS-44 and more
- **Tip:** Enable 3-5 satellites initially to avoid overwhelming data.

Step 6: Android Battery Optimization (CRITICAL!)

For notifications to work in the background on Android:

- Go to your phone's Settings → Apps → Ham Satting → Battery
- Select "Unrestricted" or "Don't optimize"

3. Interactive Map & Grid Locator

Understanding the Map Page

The Map page (first icon in bottom navigation) is the heart of Ham Satting. It shows:

- Maidenhead grid square overlay
- Real-time satellite positions
- Your current location
- Saved QTH location
- ISS and other satellites footprint (radio coverage area)
- ISS and other satellites ground tracking
- Directional arrow to satellites selected and highlighted

Map Controls (Right Side)

1. Satellite Toggle (Purple Icon)

- ON (Dark Purple): Shows all enabled satellites in real-time
- OFF (Gray): Hides satellites
- Small progress indicator appears during updates
- **Smart Pause:** Automatically pauses when you navigate away to save API calls and battery
- **Tip:** Turn off when not needed to save battery

2. Grid Toggle (Purple Icon)

- ON (Dark Purple): Shows Maidenhead grid squares
- OFF (Gray): Hides grid overlay
- Grid automatically adjusts detail based on zoom level

3. API Hit Counter

Visual bar chart at the top of the screen showing your daily N2YO API usage:

- Displays current usage as percentage and count (e.g., "80% (800/1000)")
- Green bar: 0-79% usage - Safe
- Yellow bar: 80-99% usage - Warning
- Red bar: 100% usage - Limit reached
- Automatic reset at UTC midnight
- Prevents API key reuse after changes

Real-Time Satellite Tracking

Satellite Icons

Each satellite appears as a colored circle with:

- Satellite name (short version, e.g., "SO-50")
- Altitude in km
- Velocity in km/s (at high zoom)

Directional Arrow

A color-coded arrow points from your location toward the satellite:

- Green Arrow: Elevation $> 10^\circ$ (Excellent visibility)
- Orange Arrow: Elevation $0-10^\circ$ (Difficult, near horizon)
- Red Arrow: Below horizon (Not visible)
- The arrow appears at $1/4$ distance between you and the satellite

Worked Grids on the Map

When Grid mode is enabled, every Maidenhead grid square you have worked (based on your QSO list) is drawn on the map as a red circle. The circles scale with zoom level so that they remain readable whether you are looking at a single country or the full globe.

Tap a Worked Grid for Details

Tap any red circle to see a panel showing the callsigns you have worked in that grid, the bearing from your home station (in degrees plus cardinal direction, e.g. 245° / SW), and the great-circle distance in kilometres. Tap the X on the panel or tap another grid to dismiss it.

Great-Circle Paths

When a worked grid is selected, a curved orange line is drawn between your home station and the grid following the true great-circle path (the shortest path on the surface of the Earth). This is more accurate than a straight line on a flat map projection, especially for long-distance contacts.

The same great-circle rendering is used for the distance line drawn when you use the Enter Grid Location feature to preview the path to any arbitrary grid.

Automatic Zoom to Fit

When you toggle Grid mode ON, the map automatically zooms and centres to fit all of your worked grids into view. If you have only one worked grid, it is centred with a sensible default zoom. When you toggle Grid mode OFF, the map returns to the zoom and position it had before you enabled the grid.

Auto-Refresh After Changes

The worked-grid layer refreshes automatically whenever you add, edit, delete, or clear QSOs, or after a JSON / CSV import. No app restart is needed.

4. AR Tracking & Recording

What is Doppler Shift?

As a satellite moves toward or away from you, its radio frequency shifts due to the Doppler effect. This shift can be several kHz, causing you to miss contacts if your radio frequency isn't adjusted. Ham Satting now provides real-time Doppler correction during AR tracking!

How to Access AR Doppler

- Navigate to the Map page
- Enable satellite tracking (purple icon)
- Tap on a satellite to highlight it
- Tap the "Track in AR" button
- Point your phone at the satellite using the on-screen guidance

Doppler Features

Real-Time Frequency Correction

- Updates every 2 seconds with current Doppler shift
- Shows corrected TX (transmit) and RX (receive) frequencies
- Frequencies rounded to nearest 1 kHz for radio convenience

- Zero extra API calls - uses existing position data

Mode-Specific Logic

Doppler correction is applied based on the satellite's operating mode:

| Mode | Doppler Correction | Reason |
|---------------|--------------------|----------------------|
| FM VHF (2m) | ✗ No | Wide bandwidth |
| FM UHF (70cm) | ✓ Yes | Narrower bandwidth |
| SSB | ✓ Yes | Very narrow (~3 kHz) |
| CW | ✓ Yes | Extremely narrow |
| APT (Weather) | ✓ Yes | Precise freq needed |

Visual Indicators

- **Blinking Orange Circle:** Appears when Doppler correction is active
- **Phone Alignment Panel:** Shows TX and RX frequencies with Doppler applied
- **Alignment Arrows:** Guide you to point at the satellite correctly
- **Phone Pitch Indicator:** Shows elevation angle for precise pointing

Using Doppler Correction

- Start AR tracking for your selected satellite
- Point your phone at the satellite using the alignment guides
- Watch for the blinking orange circle (Doppler active)
- Read the corrected TX and RX frequencies from the phone panel
- Set your radio to the displayed frequencies
- Make your contact with perfect frequency alignment!

SSTV/SSDV Audio Recording

- Ham Satting can record satellite audio directly during AR tracking for later SSTV or SSDV decoding.

How to Record

While in AR tracking mode, look for the SSTV button (right side) or SSDV button (left side)

- The SSTV button appears for SSTV-capable satellites (e.g., ISS, IO-86, UmKA-1)
- The DIGI button (orange) appears for digital-capable satellites (e.g., KNACKSAT-2, BOTAN, SPIRONE) — all three buttons (SSTV, SSDV, DIGI) stack on the right side of the screen
- Some satellites support both modes (e.g., Lobachevsky)
- Tap the button to start recording - it will pulse to indicate active recording
- Tap again to stop recording

Only one mode can be active at a time — all other mode buttons hide while one is active

Recording File Format

Audio files are saved with a descriptive filename:

- Format: {ShortName}_{SSTV|SSDV}_{Date}_{Time}_{FreqkHz}kHz.wav
- Example: RS40S_SSTV_2026-02-16_18-42-03_437625kHz.wav
- Example: ISS_SSTV_2026-02-16_20-15-30_145800kHz.wav
- The frequency includes Doppler correction at the time of recording
- The short satellite name is extracted automatically from the full name:
- "UmKA-1 (RS40S)" becomes RS40S
- "GALAPAGOS-UTE-SWSU (HC1PX)" becomes HC1PX
- "ISS" stays as ISS (no parentheses, uses full name)

SSDV Mode

SSDV (Slow Scan Digital Video) is a digital image transmission mode used by some amateur satellites. Unlike SSTV which is analog, SSDV uses packet-based digital encoding.

SSDV vs SSTV

- SSTV: Analog image transmission - decoded from audio waveforms
- SSDV: Digital image transmission - uses packet-based digital encoding
- Some satellites transmit SSTV, some SSDV, and some both

AR Display in SSDV Mode

- TX Panel: Shows "SSDV Mode" indicator in red when SSDV is active
- RX Panel: Shows SSDV frequency with real-time Doppler correction
- The SSDV button pulses while recording is active

SSDV-Capable Satellites

AO-123, Lobachevsky, SilverSat, CroCube, LASARsat, GEOSCAN 1-6, Vizard Ion, TUSUR GO, INNOSAT16, INNOSAT3

Digital Mode

Ham Satting can record digital-mode satellite audio during AR tracking for later decoding using packet radio software (APRS clients, Direwolf, etc.).

Digital vs SSTV/SSDV

SSTV/SSDV: encodes images into audio or digital packets — decoded by the built-in SSTV Decoder or external apps

Digital: packet-based encoding (APRS, FSK, GMSK) — decoded by external packet software

AR Display in Digital Mode

- TX Panel: shows TX frequency (orange background) if satellite has uplink, or "Digi Mode" (red) if receive-only
- RX Panel: shows downlink frequency with Doppler for UHF; nominal for VHF (below 300 MHz)
- The DIGI button pulses green while recording is active

Digital-Capable Satellites

KNACKSAT-2, BOTAN, e-kagaku-1, PARUS-T2, SPIRONE, HO-113 (XW-3), SNUGLITE-3 HANA, D-STAR ONE iSat, D-STAR ONE Sparrow, ISS (APRS channel), IO-86 (APRS channel)

Weather Mode

Weather vs Other Modes

Weather Mode targets VHF LRPT weather satellites. Unlike SSTV (analog FM audio) or SSDV (narrow digital on FM), LRPT is QPSK at 72 kSymbols/s and ~150 kHz wide. The standard decoding workflow for LRPT uses IQ capture (from SDR software such as SDR#, GQRX, SDR++) fed directly into SatDump or MeteorDemod for image decoding.

The Weather Mode audio recording in this app captures session audio during the pass for logging / archival purposes. It is NOT a substitute for IQ decoding. For actual imagery, run an IQ-capable decoder alongside this app.

AR Display in Weather Mode

Purple WX button on the right side of the AR screen (hidden when another mode is active)

TX panel shows "WX Mode" in purple — LRPT is receive-only, no uplink

RX panel shows the Doppler-corrected downlink frequency (137.9 MHz ± ~3 kHz)

Tap the WX button again to stop recording and save the WAV

Weather-Capable Satellites

Meteor-M N2-3 (NORAD 57166) and Meteor-M N2-4 (NORAD 59051) — both Russian polar-orbit LRPT weather satellites, 137.900 MHz. As of 2026 these are the only active amateur-accessible VHF weather satellites; the NOAA APT series (NOAA-15, NOAA-18, NOAA-19) was decommissioned in summer 2025.

Recording File Format

Filename pattern: {ShortName}_Weather_{date}_{time}_{freqKHz}kHz.wav — for example, N2-3_Weather_2026-04-19_14-30-45_137900kHz.wav. Files are saved to the app's documents folder.

5. Satellite Pass Predictions

Understanding Satellite Passes

A satellite "pass" occurs when a satellite moves across your sky. Key terms:

- **AOS (Acquisition of Signal):** When satellite rises above your horizon
- **LOS (Loss of Signal):** When satellite sets below your horizon
- **Max Elevation:** Highest angle during the pass
- **Duration:** Length of the pass (typically 2-10 minutes)
- **Azimuth:** Direction (0° = North, 90° = East, etc.)
- **Time Until:** ★ NEW - Countdown showing how long until the pass starts

Understanding Pass Cards

Each pass prediction card now displays:

- Pass number and satellite name
- Max elevation and quality indicator (Excellent/Good/Fair/Poor)
- Time Until badge (green) - Shows countdown like "2h 30m" or "15m"
- AOS and LOS times in local time and UTC
- Duration of the pass
- AOS and LOS azimuth directions
- TX, RX, Mode, and Tone information (if available)
- Notification bell icon for scheduling alerts

Time Until Display Formats

| Time Remaining | Display Format | Example |
|----------------|-----------------|---------|
| > 1 day | Days + Hours | 2d 5h |
| 1-24 hours | Hours + Minutes | 3h 45m |
| 1-60 minutes | Minutes only | 25m |
| < 1 minute | Less than | <1m |
| Pass started | Status | Started |

Compass Pass Visualization

- View and export detailed pass trajectory visualizations by tapping on a pass prediction card.

- The compass shows the satellite's path across your sky with AOS direction, max elevation point, and LOS direction
- Displays pass trajectory in local time while viewing in the app
- Close button (X) in the corner to dismiss the dialog

Exporting Pass Images

- Download Icon: Save the pass visualization to your photo gallery
- Share Icon: Share directly to other apps with "Generated by Ham Satting" watermark
- Exported images use UTC time (not local time) for universal reference
- Images are exported as square format with satellite name on one line, grid/date/time on another

Exporting Predictions

Screenshot Export

- Button: "Save Screenshot"
- Captures entire prediction view as image
- ★ **NEW:** Time Until countdown is included in the exported image
- Saved to your device's gallery/photos
- Great for sharing with your ham radio club

CSV Export

- Button: "Export CSV"
- Creates comma-separated file
- ★ **NEW:** Includes "Time_Until" column showing countdown to each pass
- Can open in Excel, Google Sheets, etc.
- Perfect for detailed planning and spreadsheet integration

6. QSO Logging & Management

What is a QSO?

A QSO is an amateur radio contact. Ham Satting lets you log satellite QSOs with detailed information.

Logging a New QSO

Navigate to New QSO (fourth icon in bottom navigation).

Required Fields:

- Worked Callsign - The callsign you contacted (e.g., 9A1CAL)
- Worked GRID - Their Maidenhead grid square (e.g., JN86dm)
- Date - Format: YYYYMMDD (e.g., 20251115)
- Time - Format: HH:MM:SS in UTC (e.g., 14:30:00)
- Satellite - Which satellite was used (e.g., SO-50)
- Mode - Operating mode (e.g., FM, USB, LSB, CW)
- TX Band & Frequency - Your transmit band and frequency
- RX Band & Frequency - Your receive band and frequency

QSO List Management

The QSO list (third icon in bottom navigation) is where all your logged contacts are stored. Beyond simple browsing, it offers filtering, exporting, and bulk management.

Filtering the List

Use the filter fields at the top of the QSO list to narrow by callsign, satellite, date, or grid. Filters are case-insensitive and persist when you return from editing an individual QSO. Clear filters at any time by emptying the fields.

Clearing the Entire List

Tap the three-dot menu in the top-right of the QSO list and choose "Clear List". A confirmation dialog shows the number of QSOs that will be removed and warns that the action cannot be undone. This only clears QSOs stored on your device — it does not affect any exports or backups you have already made.

Exporting Your Log

Three export formats are available from the three-dot menu: CSV (spreadsheet-friendly), JSON (structured data), and ADIF 3.1.4 (the standard amateur-radio log exchange format accepted by contest, award, and DXCC logging programs). Exported files are named with a consistent "ham_satting_" prefix so they are easy to find when re-importing or sharing.

All exports include QSO date and time in UTC, as required for award submissions and contest logs. The satellite name, callsigns, grid squares, bands, frequencies, mode, and propagation mode (SAT) are included in every format.

To share the exported file, use the Share option, which opens the system share sheet. You can send the file via email, messaging apps, or save it to your Files app / cloud storage.

Importing a Log

Import JSON or CSV log files from the three-dot menu. The importer accepts files exported by this app as well as log files using standard key names. UTC / local time markers are handled automatically during import. Newly imported QSOs appear in the list immediately, and worked grids refresh on the map without needing an app restart.

Editing a QSO

Tap any QSO in the list to open it for editing. The entry form shows "QSO Entry Update" as its title and displays a back arrow on the left to return to the list without saving. All fields are pre-filled with the QSO's current values; change any field and tap Save to update.

While editing, the Clear button is hidden to prevent accidental data loss. Any filters you had active on the QSO list are preserved when you return after saving or cancelling.

Satellite Field Behaviour

The Satellite field's autocomplete is scoped to FM transponder satellites, since the QSO Entry page is designed for two-way voice contacts through FM repeaters. SSTV-only, SSDV-only, and digital-only satellites are not suggested in this dropdown but are fully supported elsewhere in the app (AR tracking, recording, map visualization). You can still type any satellite name manually if you need to log a contact on a satellite that is not in the suggestion list.

Fill Defaults

After choosing a satellite, tap the circular "Fill Defaults" button next to the Mode field to auto-populate Mode, TX Band, TX Frequency, RX Band, and RX Frequency with the satellite's standard values. This works for any FM transponder satellite regardless of how its name is capitalised. You can always adjust the filled values before saving.

Grid Square Auto-Formatting

When you type a Maidenhead grid square (Worked GRID or My GRID in settings), the app automatically enforces the standard per-position casing convention: uppercase for the first two letters (field), lowercase for characters 5–6 (subsquare), and uppercase for characters 9–10 (extended subsquare). You do not need to worry about case while typing — it is applied live.

Back-to-Back QSO Logging

After saving a QSO in new-entry mode, the Clear button resets only the callsign, grid, and time fields, keeping the satellite, mode, bands, and frequencies from the previous entry. This streamlines logging multiple contacts on the same pass.

7. SSTV Decoder

The SSTV (Slow Scan Television) Decoder allows you to decode images from audio recordings of SSTV transmissions. These transmissions are commonly used by satellites like the ISS and amateur radio operators to send images over radio frequencies.

Accessing the SSTV Decoder

Navigate to the SSTV Decoder from the main menu or the Tools section.

Supported SSTV Modes

HamSatting supports the following SSTV transmission modes:

Robot Modes (YCrCb color format):

- Robot 36: 320x240 pixels
- Robot 72: 320x240 pixels

Scottie Modes (RGB color format):

- Scottie 1: 320x256 pixels
- Scottie 2: 320x256 pixels
- Scottie DX: 320x256 pixels

Martin Modes (RGB color format):

- Martin 1: 320x256 pixels
- Martin 2: 320x256 pixels

PD Modes (YCrCb color format):

- PD 90: 320x256 pixels
- PD 120: 640x496 pixels
- PD 160: 512x400 pixels
- PD 180: 640x496 pixels
- PD 240: 640x496 pixels

How to Decode an SSTV Image

- Tap "Browse File" to select a WAV audio file containing the SSTV signal

- Select the correct mode from the dropdown menu

If you don't know the mode, try Robot 36 first (most common)

ISS commonly uses PD 120 or PD 180

Try different modes if the image appears distorted

- The image will decode automatically after selecting the file
- Use the adjustment controls if the image needs fine-tuning (see below)
- Tap "Reset" to return all adjustments to default values

Adjustment Controls

SHIFT (-100 to +100 pixels)

Moves the image horizontally. Use this if you see color bars on the left or right edges of the decoded image.

- Positive values shift the image right
- Negative values shift the image left

SLANT (-2.0 to +2.0 ms)

Corrects diagonal skewing of the image. Use this if the image appears tilted like a parallelogram. This adjusts timing drift per scan line.

- Positive values correct clockwise skew
- Negative values correct counter-clockwise skew

START (0 to 5000 ms)

Adjusts where in the audio file decoding begins. Use this if colors are misaligned or you see noise at the start of the image. Increase this value to skip past the leader tone and VIS code.

Viewing the Decoded Image

- Pinch to zoom in/out on the decoded image
- Double-tap to reset zoom level
- Swipe to pan when zoomed in

Saving and Sharing

Save to Gallery:

Tap the green download button to save the decoded image to your photo gallery. Images are saved with "SSTV_Decoded_" prefix and timestamp.

Share:

Tap the blue share button to share the decoded image directly to other apps. The shared image includes a "Generated by Ham Satting" watermark.

Clear:

Tap the red X button to clear the current image and start fresh.

Tips for Best Results

Recording Quality:

- Record SSTV audio at 44100 Hz sample rate
- Use WAV format for best quality
- Avoid audio clipping (keep levels below maximum)
- Minimize background noise during recording

Mode Selection:

- ISS commonly uses PD 120 or PD 180
- Amateur radio operators often use Robot 36 or Scottie 1
- If unsure, try different modes until the image looks correct

Common Issues and Solutions:

Problem: Colored vertical bars on edges

Solution: Adjust the Shift slider, or try a different SSTV mode

Problem: Image is diagonally skewed

Solution: Adjust the Slant slider

Problem: Colors are completely wrong or misaligned

Solution: Increase the Start offset, or try a different SSTV mode

Problem: Image is too noisy or unclear

Solution: The original recording may have poor signal quality. Try recording with better reception.

Supported Audio Formats

- WAV (recommended)
- MP3
- M4A
- AAC
- OGG
- FLAC

8. Settings & Configuration

Default Values Section

- **Default Grid Location** - Your home station grid square (4, 6, or 8 characters)
- **Default Callsign** - Your amateur radio callsign
- **Default Email** - For support and exports
- **N2YO API Key** - REQUIRED for all satellite functionalities
- **Min Pass Angle** - Minimum elevation to show in predictions

Slider Controls

- **All sliders now include +/- circle buttons for precise value adjustment**
- **Tap - to decrease or + to increase in small increments**
- **Especially useful for Min Pass Angle fine-tuning**

Font Scale (Display Size)

Location: Settings → Advanced Settings (slider above the Ham Satting Dark Mode checkbox)

Range: 0.85x to 1.40x. Changes apply live to every screen as you drag the slider.

Preserved across app restarts. Reset All App Settings restores the default 1.00x.

API Management

API Hit Counter Settings

- **Location:** Top of screen (visual bar chart)
- **Daily Limit:** 1000 API calls per day (N2YO free tier)
- **Warning at 80%:** Yellow bar when you reach 800 calls
- **Alert at 100%:** Red bar when you reach 1000 calls
- **Auto Reset:** Counter resets at UTC midnight
- **Key Protection:** Detects and prevents API key reuse after changes

Smart Pause Settings

- **Auto-Pause:** Automatically pauses tracking when navigating away from map
- **Auto-Resume:** Resumes tracking when returning to map
- **Triggers:** Tab switching, navigation to Settings, QSO Log, etc.
- **State Preservation:** Returns exactly as you left it
- **Benefit:** Prevents wasting API calls and saves battery

9. Troubleshooting

API Counter Issues

Problem: Counter stuck at 100%

Solution:

- The counter automatically resets at UTC midnight
- You can also change your API key in Settings to reset immediately
- Wait until midnight UTC or use a different API key

Problem: Smart Pause not working

Solution:

- Update to the latest version
- Smart Pause works automatically - no settings needed
- If API calls continue when navigating away, report bug to support

Doppler Not Showing

Problem: No blinking orange circle in AR mode

Solution:

- Check satellite mode - FM VHF (2m) doesn't show Doppler (not needed)
- Doppler only applies to SSB, CW, APT, and FM UHF modes
- Ensure you're pointing at the satellite (use alignment arrows)
- Wait 2 seconds for frequency update

Problem: Doppler frequencies seem wrong

Solution:

- Frequencies are rounded to nearest 1 kHz for radio convenience
- Doppler shift can be ± 3 to 10 kHz depending on satellite speed and frequency
- This is normal behavior - use the corrected frequencies on your radio

SSDV/SSTV Recording Issues

Problem: SSDV button not appearing in AR mode

Solution:

- Not all satellites support SSDV - check if your satellite is SSDV-capable
- SSDV button only appears for satellites in the SSDV frequency database
- SSDV and SSTV buttons hide each other when one mode is active
- Return to normal mode first before switching between SSTV and SSDV

Problem: Recording file not found

Solution:

- Recordings are saved as WAV files in the app's documents directory
- Check that you have sufficient storage space on your device
- Ensure you tapped the button to stop recording (it should stop pulsing)

Digital Mode Recording Issues

Problem: DIGI button not appearing in AR mode

Solution: Verify the satellite is in the digital list (KNACKSAT-2, BOTAN, SPIRONE, SNUGLITE-3 HANA, etc.)

Problem: DIGI button disappears after tapping SSTV or SSDV

Solution: Only one mode can record at a time; SSTV and SSDV buttons hide while DIGI is active — stop DIGI recording first

Time Until Not Updating

Problem: Countdown not changing

Solution:

- Time Until is calculated when predictions are fetched
- Refresh your predictions to get updated countdowns
- The countdown does not auto-update in real-time
- Tap "Get Passes" again to recalculate

10. Frequently Asked Questions

Q: How does AR Doppler Shift work?

A: AR Doppler Shift calculates the frequency offset caused by the satellite's motion relative to you. It updates every 2 seconds using the satellite's velocity (calculated from position deltas) and applies mode-specific correction. For SSB and CW, this is critical as even a few kHz can cause missed contacts.

Q: Why doesn't FM VHF show Doppler correction?

A: FM VHF (2-meter band) has a wide enough bandwidth (~10-15 kHz) that Doppler shift doesn't significantly affect reception. However, FM UHF (70cm), SSB, CW, and APT modes do need correction due to their narrower bandwidths.

Q: Does Smart Pause drain battery?

A: No! Smart Pause actually SAVES battery by stopping satellite position updates when you're not looking at the map. It also prevents wasting your daily API calls.

Q: What happens when I hit the API limit?

A: At 80% (800 calls), you'll see a yellow warning bar. At 100% (1000 calls), the bar turns red and you won't be able to make more API requests until UTC midnight when it resets automatically. You can also change your API key to reset immediately.

Q: How often does Time Until update?

A: Time Until is calculated at the moment you fetch predictions. It doesn't auto-update in real-time. To get fresh countdown times, simply refresh your predictions by tapping "Get Passes" again.

Q: What is the difference between SSTV and SSDV?

A: SSTV (Slow Scan Television) is an analog image transmission mode that encodes images into audio tones. SSDV (Slow Scan Digital Video) is a digital packet-based image format. Some satellites use SSTV (like ISS, IO-86), some use SSDV (like AO-123, SilverSat), and some support both (like Lobachevsky).

Q: How do I record satellite audio for SSTV/SSDV decoding?

A: While in AR tracking mode, tap the SSTV or SSDV button (depending on the satellite's capability). The button will pulse while recording. Tap again to stop. The audio is saved as a WAV file with the satellite name, mode, date, time, and Doppler-corrected frequency in the filename.

Q: Can I use both SSTV and SSDV at the same time?

A: No. Only one mode can be active at a time. When SSTV recording is active, the SSDV button is hidden, and vice versa. Stop the current recording before switching modes.

Q: What is Digital Mode in Ham Satting?

A: Digital mode covers packet radio modes such as APRS digipeating, FSK 9600 bps, and GMSK beacons — used by CubeSats for telemetry and data relay. Unlike SSTV/SSDV which encode images, digital satellites transmit data packets decoded by external software such as APRS clients or Direwolf.

Q: How do I record a digital-mode satellite pass?

A: While in AR tracking, tap the DIGI button (orange circle). It will pulse green while recording. Tap again to stop. The file is saved as SatName_Digital_Date_Time_FreqkHz.wav.

Q: Can I record SSTV/SSDV and Digital simultaneously?

A: No. Only one mode can record at a time. Stop any active recording before tapping another mode button.

Q: How does the compass pass visualization work?

A: Tap on any pass prediction card to open an interactive compass dialog showing the satellite's trajectory across your sky. You can download or share the visualization as an image with a watermark. The in-app view shows local time, while exported images use UTC.

General Questions

Q: Is the app free?

A: Yes, completely free! You need a free N2YO API key for pass predictions and tracking multiple satellites.

Q: How often does satellite data update?

A: Satellite positions update every 0.5 seconds (twice per second) for smooth real-time tracking when satellite tracking is enabled.

Q: What does "pass quality" mean?

A:

- **Excellent:** Max elevation $>50^\circ$ - Perfect passes high overhead, very strong signals
- **Good:** Max elevation $30-50^\circ$ - Good elevation, strong signals
- **Fair:** Max elevation $15-30^\circ$ - Moderate elevation, decent signals
- **Poor:** Max elevation $<15^\circ$ - Low elevation, weak signals, may be difficult

11. Support & Contact

Getting Help

In-App Support

- **User Manual** - About page → "Open User Manual"
- **Contact Support** - About page → "Contact Support" (Developer responds within 24-48 hours)

Social Media

- X: @Unixeer
- Instagram: @unixeer
- TikTok: @unixeer
- UpScrolled: @Unixeer

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- Amateur Radio Community - Continuous support and feedback
- N2YO.com - Satellite tracking API

12. Legal & Copyright

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Disclaimer

Provided 'as is' without warranty. Developer assumes no liability. Predictions are for informational purposes only. Always verify satellite schedules and orbital data before critical operations.

Privacy

Ham Satting:

- Stores all data locally on your device
- Does NOT collect or transmit personal information
- N2YO API requests only include satellite names and location coordinates
- Email and callsign are stored locally only

73 from A46UNX - RF for Life!

Developed with Flutter & Dart for smooth performance.
Future updates are unstoppable and inevitable.

End of User Manual

Appendix — April 2026 Updates

Collapsible QSO List

The My QSO List page now groups your contacts by year and month with collapsible headers. By default, the most recent year is expanded, and within it the most recent month with QSOs is expanded; everything else collapses. Tap a year header to expand or collapse a year; tap a month header to do the same. Each header shows the QSO count for that period. Filters (callsign, satellite, date range) work the same way and the count badges always reflect the filtered subset.

You can disable the grouped view from Settings → Advanced Settings → Collapsible QSO List. With the toggle off, the page returns to the original flat list.

Tips & Tricks Library Expanded

The in-app tips library has grown from 50 to 100 unique tips covering the full feature set — including weather satellites, digital modes, the SSTV events scheduler, the SSTV decoder, and the AR recording filename pattern. Tips appear at most twice per rolling seven-day window with at least three days between appearances. Tap Never show again in any tip dialog to disable, or re-enable from Settings.

QSL Card Export

Each row in the My QSO List page now carries a QSL Card icon (left of Edit). Tap it to render a themed postcard-style PNG and share via the system share sheet. The card shows your callsign and grid (DE strip

from Settings), the worked station's callsign, the QSO date and UTC time, the satellite name, the mode, and the TX band and frequency. The design is theme-aware — cyan accents on a navy background in dark mode, deep blue accents on a cream background in light mode. Filename pattern: ham_satting_qsl_<callsign>_<date>.png.

Appendix — April 22, 2026 Updates

These updates were added in the April 22, 2026 cross-app session. After opening this manual in Word, right-click the Table of Contents → Update Field → Update entire table to refresh the page numbers.

Themed Auto-Complete Dropdowns

Type-as-you-go fields (Satellite search on Add QSO, Duration on the prediction pages) now show a dropdown that is exactly as wide as the longest visible match — no more wide white panel covering the form. The dropdown background and text follow the app's dark/light theme.

Appendix — April 23, 2026 Updates

My APRS Beacons on Map

A new opt-in map layer shows your own APRS position beacons after they reach the worldwide APRS-IS network. It is a confirmation tool: when you transmit an APRS packet from any APRS-capable rig, if any internet-connected ground station ("iGate") decoded your packet, it appears on the map within seconds. Useful for verifying your transmit setup, antenna performance, or simply seeing how far your signal reached today.

How to Enable

Settings → Advanced Settings → "Enable Grid Hunting" → "Show My APRS Beacons on Map" (the new checkbox just below the existing Place Worked Grids / Coverage Circles / Grid Lines options). The checkbox shows only when Grid Hunting is enabled. Tap "Save All" to persist the setting. The (i) icon next to the checkbox opens a quick reference.

Activating on the Map

After enabling in Settings, go to the Map tab. A purple tower icon appears in the floating button stack on the right side (in the slot where the old "Head North" button used to be — that button was removed because the map is now permanently locked to north-up, no rotation possible). Tap the purple tower to start showing beacons. The button pulses softly while active.

What You See

Each beacon transmitted from your callsign (and any SSID variant like -1, -7, -9 for mobile rigs) appears as a purple circle marker at the position your rig encoded into the packet. Markers fade gradually over 60 minutes, then disappear. Tapping a marker shows a popup card with: callsign+SSID, Maidenhead grid, time-since-heard (live counter that ticks every second), and distance + bearing from your saved QTH grid. Tap anywhere on the map outside the popup to dismiss it.

Testing Your Beacon

Transmit a single APRS beacon from your rig (most rigs have a manual "send beacon now" button on the APRS menu). Wait 5–30 seconds. If the marker appears on the map, an iGate received your transmission and

uploaded it to APRS-IS. If no marker appears after 60 seconds, your signal did not reach an iGate this time — try again from a more open location, or check your TX power, antenna, and APRS path settings.

Battery and Background Behaviour

The APRS connection uses a single TCP socket to the APRS-IS server. When you switch to another tab in Ham Satting (Settings, QSO List, etc.), the connection automatically closes — zero battery drain while away. When you switch back to the Map tab, the connection re-opens automatically and your markers resume appearing. The same auto-pause behaviour applies when you open a sub-screen like AR Tracking or the Notification list. Markers already on the map stay visible during the pause.

Changing Your Callsign

If you upgrade your license, change your callsign, or want to test using a friend's callsign, edit it in Settings → Default Callsign and tap "Save All". The APRS connection automatically reconnects with the new callsign in the background — no need to toggle the feature off and on. Existing markers stay visible across the swap.

Privacy

Ham Satting does NOT transmit anything via APRS-IS. The app connects as a passive read-only listener. Your callsign appears in APRS-IS server connection logs as a logged-in listener — this is required by the protocol for any client connection. The map markers you see are YOUR OWN beacons that you transmitted from your radio, not other people's observations of you. No other personal data is shared.

Note: The "Head North" Button

The teal navigation button at the top-right of the map (third from the top in the floating button stack) has been removed. The map is now permanently locked to north-up — pinch and pan still work, but the two-finger rotate gesture is disabled. The button slot is reused for the new APRS toggle described above.

Appendix — April 24, 2026 Updates

Heard By: Stations That RF-Received Your Beacon

The APRS map layer now does more than just show your own beacons. For each beacon you transmit, Ham Satting parses the packet header and extracts the iGate (and any digipeaters) that received your signal over the air. These "heard by" stations appear on the map as darker-purple circle markers, connected back to your QTH by light-purple great-circle bearing lines.

How It Works

Every APRS packet that travels via RF carries a path field showing which stations relayed it. Packets gated to APRS-IS via radio (qAR q-construct) name the iGate that decoded your signal. Ham Satting extracts those callsigns from your beacons, queries aprs.fi for each station's last known position, and plots them on the map.

aprs.fi API Key (required for markers)

To draw markers + bearing lines for "heard by" stations, the app needs to look up each iGate's position. This is done via the free aprs.fi REST API. Sign up for a free key at aprs.fi/account, then paste the key into Settings → "aprs.fi API Key (optional)" — it sits directly under the "Show My APRS Beacons on Map" checkbox.

Test Button (Green Tick)

A small circle button next to the API key field lets you verify your key works. Tap it: spinner appears, then turns green with a tick when the key is valid, or red with an X if the key is wrong or aprs.fi is unreachable. Status resets when you edit the key.

Without an API Key (Text Fallback)

If you don't enter an aprs.fi key, the heard-by callsigns are still extracted from your beacon packets — they're shown as a simple text list inside the popup that opens when you tap your own beacon marker on the map. No markers, no bearing lines drawn.

Tap a Heard-By Marker

Tapping any darker-purple "heard by" marker opens a detail panel showing: the iGate callsign, its Maidenhead grid (computed from aprs.fi position), distance and bearing from your QTH, and a live "Heard X minutes ago" counter that ticks every second. Tap anywhere on the map outside the panel to dismiss it.

Privacy Note

aprs.fi is a public service — your callsign appears in their access logs as a passive read-only listener (the same as it does in APRS-IS server logs). The app does not transmit anything to either service.

Appendix — APRS Callsign + Live Refresh

Dedicated APRS Callsign Field

The APRS feature now uses its own dedicated callsign field, kept completely separate from the default callsign you use for QSO logs. This means an APRS-only SSID like -13 (weather), -9 (mobile), or -7 (handheld) lives only in the APRS row — it does not bleed into your QSO records, exports, or any other part of the app.

Where It Lives

In Settings, when "Show My APRS Beacons on Map" is ticked, a single row appears below the checkbox with three controls side by side: the aprs.fi API key field (about two thirds wide), the new APRS Call field (about one third wide), and the test button. When the checkbox is unticked, the entire row is hidden — there is nothing to configure when the feature is off.

Strict Behavior

When you toggle APRS on the map, the app strictly requires this APRS callsign to be set. There is no silent fallback to your default QSO callsign — that is exactly what this separation prevents. If the APRS Call field is empty, the toggle shows a warning snackbar and will not connect.

Changing the Callsign

When you save a new APRS callsign in Settings, the app treats it as a brand new identity. The active APRS-IS connection is fully torn down, all cached station markers and heard-by entries are dropped, the aprs.fi position cache is wiped, and a fresh connection opens with the new callsign. This guarantees no stale data from the old identity remains on the map.

Format

Use uppercase letters, digits, and an optional dash + SSID. Common APRS SSIDs: no SSID = home base, -7 = handheld, -9 = mobile (vehicle), -11 = balloon or aircraft, -13 = weather station. The field auto-capitalizes and rejects spaces, slashes, and lowercase characters as you type.

Live Position Refresh Every 30 Seconds

When APRS is active, the map now refreshes positions from the aprs.fi REST API every 30 seconds in addition to the live RF stream. This keeps your beacons fresh on the map even when the live socket is quiet (no recent transmission from your rig).

Why Both Sources

The live APRS-IS socket pushes packets in real time when your rig transmits. The 30-second REST refresh is a safety net: it picks up positions that may have been transmitted while the app was backgrounded, and refreshes the "last seen" timestamp on the popup so you always see the most recent server-side reality.

aprs.fi Rate Limit Friendliness

Each refresh is a single batched call (your callsign plus all common SSIDs in one request). With the heard-by lookups also sharing the budget, total traffic stays well under aprs.fi free-tier limits. A 15-second per-callsign guard prevents toggle-spam from burning the rate-limit budget.

Appendix — APRS expansion (Apr 25 2026)

The APRS map layer received a substantial expansion. All additions live on the Map page only — Settings is unchanged. Your APRS callsign and aprs.fi key fields work exactly as before.

Track lines for moving rigs

Whenever any visible APRS station moves, a thin purple polyline trails behind its marker. The trail fades with age — recent movement is full opacity, segments older than an hour fade out and drop off automatically. Stationary stations don't accumulate clutter; the recorder suppresses no-movement re-hears.

Velocity arrow on moving rigs

Stations whose packets include course + speed get a small rotated arrow at their marker showing direction of travel. Arrow size grows with speed (capped) so a fast aircraft is instantly distinguishable from a slow mobile.

Tap-driven heard-by

When you tap any APRS station that has known iGate-reception data, the map automatically draws bearing lines from THAT station's position to each iGate that received its packets. Lines are the same light-purple as your own QTH-origin heard-by lines for visual consistency.

Smaller markers with real APRS symbols

APRS markers are now ~30% smaller than before so dense clusters don't drown out the rest of the map. When the parsed APRS symbol code matches a known station type (car, iGate, weather station, aircraft, balloon, boat, motorcycle, repeater, etc.), the marker renders that icon inside a thin purple ring. Unknown symbols fall back to the legacy purple dot.

Object / Item shape distinction

APRS supports three packet kinds — position, object, and item — that previously all rendered as identical circles. Now each has its own silhouette: position = circle (rig location), object = diamond (operator-placed entity, e.g. weather alert), item = rounded square (named reference, e.g. satellite ground track or repeater).

Bulletins feed

When any visible station broadcasts an APRS bulletin (BLN1–BLN9, BLNA–BLNZ), an amber megaphone button appears on the map. Tap it to open a chronological list of every active bulletin across all stations. Bulletins from your own callsign are displayed alongside others, with sender + age timestamps.

SSID filter chips

A small chip strip in the top-left corner of the map (visible only while APRS is active) lets you scope what renders to a specific SSID class: All, -9 (Mobile), -13 (Weather), -11 (Aircraft / Balloon), or Other. Selection persists across app restarts. Bulletins are always shown regardless of filter — broadcasts apply to everyone.

Rate-limit safe-side budget

The periodic aprs.fi REST refresh was doubled from 30 seconds to 60 seconds as a safe-side measure. The live APRS-IS TCP socket already provides sub-second freshness while your rig is beaconing, so 60-second REST polls are comfortable as a safety net. The 15-second per-callsign refetch guard still prevents toggle-spam from burning rate-limit slots, and the 25-call-per-minute global cap remains unchanged.

What didn't change

Your existing APRS callsign, aprs.fi API key, "Show My APRS Beacons on Map" toggle, the purple APRS FAB, the 60-minute stale-fade window, and dispose-on-callsign-change all behave exactly as they did before. The expansion is purely additive — turn off APRS in Settings and nothing new is visible.

Appendix — April 26, 2026 Updates

Map: Followed APRS Station Shrunk

When you tap an APRS station to follow it, that one marker now renders about 30% SMALLER than the surrounding markers. The smaller pin makes the station's exact position more precise on the map and reduces occlusion of nearby data you're comparing against.

Map: YOU Marker Auto-Hides Behind Followed Station

When you're tracking a callsign and the followed station's screen position is within roughly 24 pixels of YOUR live GPS position, the YOU marker is hidden so the two markers don't visibly overlap. Zoom out and they re-separate; YOU reappears the moment they're visually distinguishable. The threshold is zoom-aware: at street zoom you can be ~30 m apart and both stay visible; at world zoom you can be ~50 km apart and YOU still hides because both pins overlap on screen.

Map: SSID Filter Strip Moved to the Bottom

The "All / -9 / -13 / -11 / Other" SSID filter strip now docks at the BOTTOM-LEFT of the map (above the bottom navigation bar). When you tap an APRS station and the details panel slides up from the bottom, the filter strip automatically reflows to sit just above the panel — so you can always see both at once and the strip never overlaps the station details.

Map: APRS Velocity Arrows Removed

The small directional arrows that previously rendered on top of moving rigs (course/speed indicators) have been removed. Track polylines that fade with age remain unchanged — you can still see where a rig has been, just without the extra arrow on top.

Appendix — April 26, 2026 Satellite Batch (v4.0.0+40)

Eight New Satellites — All With Permanent NORAD IDs

Ham Satting v4.0.0+40 adds eight new satellites with confirmed permanent NORAD catalog IDs and TLE-derived orbital parameters. The list reflects two recent rideshare missions:

Transporter-16 (SpaceX, March 30, 2026)

HADES-SA (SpinnyONE) — NORAD 68446. Operator: AMSAT-EA, Spain. Multi-service: Digital (FSK 200 / CODEC2 voice) + SSDV image downlink, all on 436.875 MHz. BBS messaging uplink on 145.875 MHz. The SSTV decoder tab can decode SSDV when it is transmitting.

PARUS-T3 (BN0TIT) — NORAD 68456. Operator: National Taipei University of Technology, Taiwan. APRS digipeater on 145.825 MHz simplex (also has a 437.195 MHz GMSK 9k6 telemetry beacon).

HYPERVIEW-1G (RS66S) — NORAD 61772. Operator: Samara National Research University (Russia, SPUTNIX 6U platform). Robot 36 SSTV event-based downlink on 436.540 MHz. Note: this frequency is flagged "uncoordinated" in SatNOGS but the satellite is active and transmits SSTV during scheduled events.

JAXA Kakushin Rising (Rocket Lab Electron, April 23, 2026)

Five amateur payloads from this rideshare are in this batch. The sixth amateur sat from the launch (MAGNARO-II Tigris) and KOSEN-2R are still on provisional NORADs and will be added in a future update once their permanent catalog IDs are assigned.

MAGNARO-II Piscis (JJ2YXG) — NORAD 68798. Operator: Laboratory of Aerospace Vehicle Dynamics, Nagoya University. 1U formation-flying companion to the (still-pending) MAGNARO-II Tigris. Digital telemetry on 436.325 MHz (CW + AFSK 1k2 + GMSK 9k6/19k2).

ARICA-2 (JS1YSD) — NORAD 68796. Operator: Aoyama Gakuin University, Sakamoto Lab. Mission is gamma-ray-burst alert via commercial satellite modems; the amateur UHF link is a backup channel, so expect intermittent activity. Digital downlink on 436.830 MHz (CW 20 wpm + GMSK 4k8 AX.25).

FSI-SAT2 (JS1YQU) — NORAD 68792. Operator: Fukuoka Institute of Technology lineage (Trifne Future Sciences). Multi-service on 437.175 MHz: Digital (CW 18.5 wpm + GMSK 9k6) plus a DTMF-triggered SSTV reply — unique in our list. The user transmits an FM-DTMF tone on 437.175 MHz; the satellite responds with an SSTV image on the same channel.

WASEDA-SAT-ZERO-II (JK1UDE) — NORAD 68797. Operator: Waseda University. Digital telemetry on 437.200 MHz (CW 8 wpm + FSK AX.25 1k2).

OrigamiSat-2 — NORAD 68795. Operator: Tokyo Institute of Technology (Titech). Deployable origami reflectarray antenna technology demonstrator. Tracked downlink: 437.505 MHz (AFSK 1k2 + CW 80 cpm). Also has a 5.840 GHz S-band link (BPSK/QPSK 100 kbps to 20 Mbps), which is outside the app's supported band range and is not tracked.

Settings Page — Visual Balance Polish

When the satellite list count would render with an asymmetric two-column layout (an odd total with no service filter active), the Silent-Ghost memorial entry is hidden on first render so the columns come out even. The entry is not removed permanently — it returns whenever the count happens to be even after

additions. Silent-Ghost is the SO-124 (HADES-R) memorial; it re-entered in February 2025 and never produces live passes.

Map Page — Wi-Fi Scanning Dialog Loop Fix

Earlier versions could trigger an Android "For a better experience, your device will need to use Location Accuracy" dialog every single second of the 1 Hz live-position refresh — once dismissed it would re-pop on the next tick, never stopping. v4.0.0+40 fixes this in two layers: periodic location ticks now use medium accuracy (which does not insist on Wi-Fi scanning), and a failure-streak backoff throttles the actual platform call after 3 consecutive failures while the timer keeps firing at 1 Hz. On the next success the streak resets and full-rate polling resumes immediately — refresh rate stays high in the normal path.

Other Robustness Improvements

Every `Geolocator.getCurrentPosition` call now has a `timeLimit` (15s on the first fix, 10s on periodic ticks) so weak-GPS or cold-start scenarios cannot indefinitely stall the page. The periodic-location timer also has a reentrancy guard so a slow fix cannot stack concurrent platform calls. ADIF PROP_MODE export now emits spec-correct UTF-8 byte counts, resolving an LoTW / TQSL upload rejection that affected satellite-mode QSO uploads.

Appendix — April 27, 2026 Updates (Audio Session + N2YO Errors)

Recording coexists with music and podcasts

AR Tracking's four capture modes — SSTV, SSDV, Digital, and Weather — now configure the device audio session before recording starts so they no longer interrupt music, podcasts, or navigation prompts you may already be playing. Tap a mode's record button and your audio keeps going; the recorder mixes alongside it. This works on iOS, iPadOS, and Android.

Why this matters during a pass

Operating amateur radio satellite passes mobile, you often want background audio (a club net stream, a podcast, music) running while you record SSTV / SSDV / digital telemetry to disk. Earlier builds yanked the audio focus the moment recording began and forced you to stop and re-start your other audio app. The new audio-session configuration eliminates that interruption.

Bluetooth and speaker routing

Recording also defaults to your built-in speaker for the AR page's tone feedback (so you don't lose audio cues to a paired headphone) and allows Bluetooth mics if you have a paired headset. The session is set up once when the AR page opens — no per-mode configuration needed.

Better N2YO error messages

Pass-prediction failures now show specific, actionable messages: invalid API key (point you at Settings), rate-limit exceeded (asks you to wait), connection timeout (check internet), no network (no signal), SSL handshake failure (check device date), or unknown satellite (NORAD lookup miss). Earlier builds collapsed all of these into a generic "Unable to fetch passes" — frustrating when the right action depended on the cause.

Appendix - April 29, 2026 - AMSAT Coverage Audit

New APRS / Digipeater Service on Already-Tracked Satellites

A deep audit against the AMSAT live-digipeater status page surfaced two satellites already in the tracking list that were missing their APRS digipeater service tag. Both are now correctly flagged with the orange Digital indicator in Settings and on the prediction cards.

SONATE-2 (DP0SNX) - half-duplex APRS digipeater on 145.825 MHz simplex, 1200 bps AFSK AX.25. Distinct from its existing 145.880 MHz Martin M1 SSTV downlink. Activations are scheduled and announced by the operator (University of Wuerzburg).

NO-44 (PCSAT, W3ADO-1) - the original 2001 PCSAT mission. APRS digipeater on 145.825 MHz simplex, 1200/9600 bps AFSK AX.25. Power-budget-limited: comes alive in mid-day sunlight passes only.

IO-86 (LAPAN-A2) gained a secondary SSDV channel on 145.880 MHz (1k2 IL2P) in addition to its 70cm SSTV. Operators alternate, so only one mode is active per pass.

Three New Satellites - Permanent NORADs

TO-108 (CAS-6, BJ1SO) - NORAD 44881. Inverting Linear V/u transponder (UL 435.270-290 LSB / DL 145.915-935 USB). Has a CW beacon on 145.910 MHz and a 4k8 GMSK telemetry channel on 145.890 MHz. Currently operating intermittently (~2 seconds on, 5 seconds off) due to ongoing investigation; pass predictions still work.

GRBBeta (HA2GRB) - NORAD 60237. Slovak 2U from the Technical University of Kosice on the Ariane 6 inaugural launch (July 2024). Cross-band 9k6 GFSK G3RUH digipeater (UL 145.935 / DL 436.785). Mid-inclination orbit (62 degrees) - unlike most amateur sats which are sun-synchronous, GRBBeta has noticeably different pass timing.

Foresail-1p - NORAD 66778. Aalto University 3U on Transporter-15 (December 2025). Skylink-protocol digipeater on 437.125 MHz simplex, 9k6 FSK with FORESAIL-1 framing. Skylink uses virtual-channel routing - operators need the Aalto Skylink ground software to format packets correctly.

Three New SSDV Satellites (Geoscan Family)

Three additional Russian SSDV satellites from the Geoscan family were added per the AMSAT image-transmitting satellites page. They use the same Geoscan framing as the GEOSCAN-1 through GEOSCAN-6 birds already in the app.

Horizon (RS59S) - NORAD 61757. Baltic State Technical University (Voenmekh), launched November 2024 from Vostochny on the same Geoscan-platform batch as HYPERVIEW-1G. SSDV downlink on 435.430 MHz, 9k6 GFSK Geoscan framing.

239Alferov (RS61S) - NORAD 64881. Russian 3U on the Ionosfera-M 3-4 launch (July 2025). Carries an SSDV downlink on 436.270 MHz plus a gamma-ray-burst spectrometer payload.

Luca (RS90S) - NORAD 67287. Space Research Montenegro 1U, launched December 2025. SSDV on 437.180 MHz, 2k4 GMSK. SatNOGS flags this frequency as IARU-uncoordinated; the satellite is operational and tracked, the frequency choice is the open issue.

Music Broadcast - New Service Category

A new Music service was added to track satellites that periodically broadcast short music tones as a unique RF identifier in place of a CW Morse beacon. These are NOT amateur-radio satellites - they operate on UHF 400-402 MHz (Space Operations band, just below the 70cm amateur band). They are receive-only curiosities best heard with an SDR; standard amateur radios will not tune there.

BALKAN-1 - NORAD 62611. EnduroSat 16U Earth-observation satellite. Broadcasts a classical composition on 401.360 MHz.

Flamingo-1 - NORAD 67391. Vyoma Space Domain Awareness 12U. Broadcasts a classical composition on 401.050 MHz.

OTP-2 - NORAD 63235. Rogue Space Systems thruster demonstrator. Broadcasts a video-game theme on 400.500 MHz.

T.MicroSat-1 - NORAD 66766. Tron Future Tech (Taiwan) 8U. Broadcasts the opening notes of Beethoven's "Ode to Joy" on 401.025 MHz, followed by a telemetry burst.

In Settings, the new "Music" filter pill (rightmost in the row) isolates these four satellites. The pill row uses Wrap layout so it reflows gracefully on narrow phones - on iPhone SE you may see two rows of pills instead of one. The Music indicator color is brown, theme-aware (warmer in dark mode, deeper in light).

About Page Refresh

The About page first paragraph was rewritten to be satellite-agnostic. The previous wording highlighted "the ISS satellite pass" which was misleading since the app tracks dozens of satellites. The 16-feature key list is unchanged.

Pending Satellites - Held for Future Promotion

Several satellites confirmed amateur-active per AMSAT or SatNOGS are not yet in the tracking list because their permanent NORAD catalog IDs have not been issued by CSpOC. They wait on a single consolidated list inside the app source and will be added once their permanent IDs land. Held entries currently include: LILIUM-4, PARUS-6U1, INCA-2 (amateur digipeaters) and EMISAR, OPTISAT, "Out of the Box", T.MicroSat-2 (music broadcasters).

Music Mode in AR Tracking - Toggle and Recording

For satellites that carry a Music broadcast service (BALKAN-1, Flamingo-1, OTP-2, T.MicroSat-1), the AR Tracking page shows a brown "MUS" toggle button on the right-side stack alongside the existing SSTV / SSDV / Digital / Weather toggles. Tap MUS to enter Music mode: the TX panel switches to a brown "MUS Mode" label and the RX panel displays the music downlink frequency (401.025 / 401.050 / 401.360 / 400.500 MHz depending on the sat) with Doppler correction applied. Doppler at ~400 MHz is similar magnitude to 70cm passes (about 10 kHz at AOS) so listeners will hear a slight pitch glide on the music tones during the pass.

Tap MUS again to start recording. While recording, the toggle pulses green just like every other recording mode. The output WAV file is saved to the app documents directory under the standard naming convention: shortname_Music_yyyy-mm-dd_HH-MM-SS_freqkHz.wav (for example BALKAN-1_Music_2026-04-29_18-42-03_401360kHz.wav). Only one recording mode can be active at a time across all five modes, so the app will prompt you to stop a current recording before starting another.

Scheduled Service Events - Frequency Overrides for 4 Modes

Some satellites occasionally use a non-primary frequency for short windows. The Scheduled Service Events feature lets you register an override so the AR page picks the right frequency during the event and automatically falls back to the published default outside it. The feature covers four services:

SSTV - alternate frequencies for special transmissions, e.g. ARISS school events on the ISS or operator-announced shifts on smaller birds.

SSDV - occasional schedule shifts on Geoscan-style Russian birds where the operator announces an alternate downlink for an event window.

Digital - APRS or digipeater channel changes during ARISS school contacts (the ISS sometimes moves between cross-band voice and standard APRS for a short period) or test windows announced by the satellite team.

Weather - the most concrete current case: Roscosmos rotates Meteor-M N2-3 and N2-4 between 137.900 MHz and 137.100 MHz on operational cycles. Add an event with the active frequency to keep the AR page tuned correctly.

Music broadcasts are intentionally excluded - their frequency IS the unique identifier so they cannot drift without becoming a different satellite.

Adding a Scheduled Event

Open Settings and scroll to the satellite list panel. The button "Add Scheduled Event (SSTV / SSDV / Dig / WX)" sits below the minimum-pass-angle slider. The (i) info icon to its right opens a quick reference dialog explaining the four service types and when an override is useful.

Tap the button. The dialog opens with four service-type chips at the top: SSTV / SSDV / Dig / WX. Pick the service first; the satellite dropdown automatically narrows to satellites that have that service. Then pick the satellite, enter the override frequency in MHz, and pick the From and To dates from the calendar pickers. Tap Save.

Validation rules: the override frequency must differ from the satellite's published default for that service, and you cannot create two overlapping events for the same satellite and same service type. Different services on the same satellite can overlap in time - they listen on different downlinks - so an SSTV event and a Digital event for the ISS during the same week is fine.

Event List - Type Badges and Sharing

Once events exist, the panel shows a table with a colored type badge before each satellite name: blue for SSTV, green for SSDV, orange for Dig, purple for WX. Active events (today within the date range) show the satellite name in green. The share icon at the top of the table renders the events list as a PNG with the same type badges and theme-aware colors - share to messaging apps or save to Photos.

Editing and Deleting Events

Tap the edit icon on any row to change the satellite, frequency, or dates. The service-type chips are greyed out during edit because changing the type would invalidate the satellite eligibility check; if you need to change type, delete and create a new event. The delete icon shows a confirmation dialog with the event's service type, satellite, dates, and frequency.

Expired events (end date strictly before today) are removed automatically the next time you open the app.

SSTV Decoder Info Icon

The SSTV Decoder button now has its own (i) info icon to the right. Tapping it opens a quick reference dialog covering the decoding workflow: record SSTV audio on the AR page (or import a WAV), open the decoder, pick the file and the SSTV mode (Robot 36, PD 120, PD 180, Martin, Scottie, etc.), then view the decoded image. The dialog also reminds you that the ISS commonly uses PD 120 or PD 180 and that Russian Geoscan-family birds use Robot 36 - color bands or skew in the result usually mean the wrong mode was selected.

Long Satellite Names - Adaptive Sizing

Long satellite names in the Settings list (for example "GALAPAGOS-UTE-SWSU (HC1PX)" or "WASEDA-SAT-ZERO-II (JK1UDE)") now automatically shrink to fit on a single line, even when global Font Scale is increased above 1.0. The shrinking is visual only - the name itself is preserved unchanged - so identification is never lost to truncation. The same behavior applies to the satellite-selection dialog opened via the magnifier icon: very long names auto-fit while short names render at full size.

Appendix - April 29, 2026 - AMSAT Live Activity Indicator

A small color-coded activity dot now appears on every prediction card (both single-satellite and multi-satellite views), every notification list card, and is baked into the image-share exports of all three pages. The dot reflects real-world activity sourced from the AMSAT Live OSCAR Satellite Status page (<https://www.amsat.org/status/>) over the last 24 hours UTC.

Color Scale

The dot uses the AMSAT cell palette so it mirrors what you see on [amsat.org/status/](https://www.amsat.org/status/): blue = Active (heard), purple = ISS Crew Voice, amber = Telemetry/Beacon only, orange = Conflicting reports (with a small "?" overlay glyph), magenta = No-signal reported, grey = no reports. The dot also carries a small inner glyph (check / tilde / dot) so the indicator stays readable for color-blind users and in monochrome image exports. / beacon only OR conflicting reports (a small "?" overlay glyph appears on conflict). Orange = operators tried and reported "No signal". Red = no positive reports in the 24-hour window. The dot also carries a small inner glyph (check mark / tilde / dot / cross) so the indicator stays readable for color-blind users and in monochrome image exports.

No-Data States

Three distinct grey states tell you when the indicator has no opinion to offer: a hollow grey ring means AMSAT does not currently track this satellite (no reports are being collected for it - this is normal for non-AMSAT-list birds like Meteor-M weather sats and the Tevel constellation). A solid grey dot means the data has not yet been fetched (give it a few seconds on first launch). A solid grey dot with a "!" overlay means the cached data is older than the 15-minute refresh window, usually because your network was offline.

Tap for Detail

Tapping the dot opens a themed popup with the last 48-hour strip from AMSAT, one row per mode. For ISS this means six rows - Crew Voice, FM, SSTV, UHF Digi, VHF Digi, and DATV - so you can see at a glance which transponder is up. Each cell is a 2-hour UTC window; tapping a cell with reports expands an inline list showing the reporter callsign, Maidenhead grid square, status text, and the precise 15-minute UTC slot of each individual report. A small refresh button forces a fresh fetch from AMSAT; an expandable Source /

About section discloses the AMSAT attribution; and a small share button on the popup exports the current view as a compact themed PNG suitable for posting to social media or sharing with your club.

Pass Info Popup Share

The (i) Pass Info popup, available from every prediction card, gained the same compact share button. Tap it to export the pass details (date, max elevation, AOS, LOS, mode, tone, frequencies) as a watermark-sized PNG share image.

Refresh Policy

Activity data is fetched at most once every 15 minutes while a prediction page or the notification list is open, and is cached on your device for offline display. The same in-memory snapshot is shared across every dot in the app - there are no extra fetches per card. If the network is unreachable, the indicator shows the last data with a "!" stale overlay; the app silently retries in the background every 15 minutes - you don't need to do anything. You can also tap the refresh button inside the popup to force a fresh fetch.

Privacy and Attribution

The fetch is read-only: Ham Satting does NOT submit reports back to AMSAT. No callsign, location, or any other personal data is sent in the request - only the standard headers your operating system attaches to outbound HTTPS connections. To submit your own "Heard" / "Telemetry Only" / "Not Heard" reports, visit <https://www.amsat.org/status/> in a browser and use AMSAT's own submission form. The popup's expanded Source / About section, and every share image, carry the attribution: "Activity data: AMSAT Live OSCAR Satellite Status (amsat.org). © Radio Amateur Satellite Corporation (AMSAT-NA)."

Coverage Notes

AMSAT's status page covers a subset of amateur satellites - primarily the active linear / FM / digital birds the AMSAT community reports on. Approximately 32 of the satellites Ham Satting tracks have at least one mode row on AMSAT; the other ~44 (Meteor-M weather sats, the Tevel constellation, formation-flying CubeSats, etc.) display the hollow-ring state. When AMSAT adds new satellites in the future, Ham Satting picks them up automatically as long as the local catalog uses the standard naming convention. When you export the popup as a share image, the currently-open cell detail panel is INCLUDED in the export — what you see is what you share. Dismiss the panel before tapping share if you want a clean strip-only image.

Appendix — May 10, 2026 Updates (Production Hardening v4.2.0+42)

Notification Race Fix

When you toggled multiple pass-notification bells in quick succession, one of the scheduled entries could disappear from the in-app list (the OS-level alarm still fired at the right time, but you couldn't see or cancel it from inside the app). The save path now serialises rapid mutations the same way the QSO log does, so the list always reflects what's actually scheduled.

AR Page Smoothness

The AR tracking page used to redraw on every magnetometer event (10-20 times a second) even when your phone was sitting still. The compass listener now only updates the screen when the heading changes by at least 0.5° — the smooth arrow motion you see is unchanged because the dedicated 60 FPS arrow timer still drives it. Lower CPU on the AR page, especially on older devices.

Faster QSO Imports

Importing a large QSO log (e.g. cross-app from Ham Logging) used to slow down on big lists because the duplicate-check ran in $O(N \times M)$ time. The dedup is now $O(N)$ via a hash-set lookup — same dedup criteria, dramatically less wait time on 5,000+ row imports.

Diagnostic Crash Log (NEW)

A new in-memory diagnostic capture mechanism. When the app catches an unexpected error during your session, a one-shot snackbar appears with an EMAIL action — tapping it opens your mail app pre-filled with a plain-text report (callsign, app version, error trace) addressed to support. Repeat errors stay silent for 5 minutes after the first surface so you don't get spammed. No third-party crash reporter; nothing leaves your device unless you tap EMAIL.

Cleaner Error Messages

Failed shares, downloads, or saves no longer leak the per-install sandbox path (e.g. `/private/var/mobile/Containers/Data/Application/<UUID>/...`) or URL-embedded API keys into the snackbar. Messages are sanitised to a clean prefix + the actual failure reason, capped at 160 characters.

APRS Map Performance

The APRS packet parser used to allocate up to ten regular-expression objects per inbound packet. In dense APRS coverage at 5-20 packets per second, that was a real CPU draw. The patterns are now compiled once at app start and reused for every packet — same matches, lower battery cost when the APRS layer is active on the map.

Internal Hardening

Tightened Android FileProvider scope so external storage access is limited to user-visible Documents/ and Download/ folders only (defense-in-depth — share_plus only ever exposes URIs we explicitly grant). Notification IDs now use a collision-resistant scheme that prevents one alarm from silently overwriting another. AMSAT-resolver fetch errors no longer expose URLs in the cached error badge. Added tolerant HTTP-body decoding across the network layer so a stray legacy byte from N2YO / aprs.fi / CelesTrak can't crash a refresh.

Build & Release Polish

macOS app metadata corrected (was showing a placeholder copyright). Production AAB builds now refuse to silently sign with debug keys (Play Store would reject the upload anyway, now you find out at build time with a clear message). Multiple mounted-checks added throughout async code paths to prevent setState-after-dispose races on the support page and QSO list.

Appendix — May 2026 Update: 10-Language Support (v4.2.0)

Ham Satting v4.2.0 ships with full interface localisation across ten languages: English, العربية (Arabic), Español, Français, Deutsch, 日本語, 中文, Português, Русский, and Italiano.

Switch language from Settings → Default Values → Language. The picker uses the Ham-Satting One-Sat-style dropdown — tap to see all ten native names; the currently-selected language has a filled radio dot. Like every other Default Values setting, your language choice is held in memory until you tap the Save All FAB at the bottom-right of Settings. On Save All the entire app rebuilds in the new language instantly.

Arabic is the only right-to-left language at present. When Arabic is selected, most pages flip RTL (About / Support / User Manual / Tips Dialog / First-Time Dialog / Settings). Three pages deliberately stay left-to-right regardless of language: the Map page, the AR Tracking page, and image-export pages (Compass / AMSAT / Pass Timeline / QSL card). This is intentional — those pages render directional layouts (zoom +/- buttons, mode buttons, time axis, compass arrows) that must stay consistent so screenshots and exports look the same worldwide.

Ham-radio technical terms stay English in every language for compatibility with the wider ham-radio ecosystem. Terms like AOS, LOS, AMSAT, SSTV, SSDV, APRS, NORAD, TLE, Maidenhead, callsign, grid, FM, USB, CW, ISS, QSO, QSL, ADIF, MHz, TX, RX, Doppler, N2YO — these are international amateur-radio terms-of-art and stay literal English so your ADIF, CSV, and JSON exports remain compatible with LoTW, eQSL, ClubLog, and desktop logging software.

Entry-field labels (the small floating labels above text inputs in Settings — Callsign, Grid Location, Email Address, N2YO API Key) also stay English literal. This protects ADIF field-name mental models for experienced operators. Form hints follow the same rule, except the Support page's main message box which translates fully so non-English users can write the prompt in their language.

Image-export watermarks ('Generated by Ham Satting') always read English, left-to-right, in every language. This applies to compass dialog PNG exports, AMSAT activity sharing, pass-timeline screenshots, QSL card exports, service-events table sharing, and per-pass info share cards. Outbound support emails also stay English so they're readable in any inbox.

ملحق (v4.2.0) — تحديث مايو 2026: دعم 10 لغات

الإصدار 4.2.0 يدعم 10 لغات للواجهة بالكامل: الإنجليزية، العربية، الإسبانية، الفرنسية، الألمانية، اليابانية، الصينية، البرتغالية، الروسية، والإيطالية.

بدّل اللغة من الإعدادات → القيم الافتراضية → اللغة. القائمة تستخدم نفس تصميم منتقي قمر واحد — اضغط لرؤية الأسماء العشرة بلغاتها الأصلية؛ اللغة المحددة حالياً تحمل نقطة دائرية. مثل كل القيم الافتراضية، اختيار اللغة محفوظ في الذاكرة حتى تضغط زر «حفظ الكل» أسفل يمين الإعدادات. عند الضغط يُعاد بناء التطبيق فوراً باللغة الجديدة.

حول / الدعم / دليل المستخدم / النصائح RTL العربية هي اللغة الوحيدة الحالية المكتوبة من اليمين إلى اليسار. عند اختيارها تنقلب معظم الصفحات / وصفحات تصدير الصور (البوصلة، الترحيب / الإعدادات). (ثلاث صفحات تبقى من اليسار إلى اليمين مهما كانت اللغة: الخريطة، التتبع / هذا متعمد — تلك الصفحات تعرض تخطيطات اتجاهية) أزرار التكبير، أزرار الأوضاع، محور الوقت. (QSL الجدول الزمني / بطاقة / AMSAT / أسهم البوصلة (يجب أن تبقى ثابتة لتظهر لقطات الشاشة والصور المُصدّرة بنفس الشكل عالمياً).

AOS, LOS, مصطلحات الراديو الهواة التقنية تبقى بالإنجليزية في كل اللغات لضمان التوافق مع منظومة الراديو الهواة العالمية. مصطلحات مثل AMSAT, SSTV, SSDV, APRS, NORAD, TLE, Maidenhead, callsign, grid, FM, USB, CW, ISS, QSO, QSL, ADIF, MHz, TX, RX, Doppler, N2YO — هذه مصطلحات راديوية دولية وتبقى حرفياً بالإنجليزية حتى تظل صادرات متوافقة مع JSON و CSV و ADIF هذه مصطلحات راديوية دولية وتبقى حرفياً بالإنجليزية حتى تظل صادرات متوافقة مع JSON و CSV و ADIF. وبرامج التسجيل المكتبية ClubLog و eQSL و LoTW.

تبقى أيضاً (N2YO API key، البريد، grid، callsign — التسميات الصغيرة فوق صناديق النص في الإعدادات) تسميات حقول الإدخال عند المشغلين ذوي الخبرة. تلميحات النماذج تتبع نفس القاعدة، عدا صندوق رسالة ADIF بالإنجليزية حرفياً. هذا يحمي النموذج الذهني لأسماء حقول الدعم الرئيسي الذي يُترجم بالكامل ليتمكن المستخدمون غير الإنجليز من كتابة رسالتهم بلغتهم.

تظل بالإنجليزية من اليسار إلى اليمين دائماً، في كل اللغات. هذا ينطبق على («Generated by Ham Satting») علامة مائية لتصدير الصور جدول الأحداث المجدولة، وبطاقات معلومات المرور. البريد الإلكتروني، QSL لقطات الجدول الزمني، بطاقات AMSAT، صور البوصلة، صور الصادر للدعم يبقى أيضاً بالإنجليزية ليكون قابلاً للقراءة في أي صندوق وارد.

Appendix — May 23, 2026 Updates (v4.3.0+43)

Ham Satting v4.3.0+43 adds an in-app Version History page, improves map stability, refines the About-page layout for right-to-left languages, and updates the satellite catalogue after a re-entry.

Version History page. A new Version History entry sits next to Support on the About page. Tap it to open a bundled archive of every release — the newest at the top and expanded by default, older releases collapsed. Each entry lists that version's headline changes. Because the archive ships inside the app it works with no internet connection. The page follows your light / dark theme, is shown in English, and stays left-to-right in every language.

Map stability. The interactive map now recovers cleanly from a rapid two-finger pinch-and-flick that previously could leave the camera in an invalid state. Momentum 'fling' panning is disabled so a fast gesture can no longer push the view past the world bounds.

About-page layout. The developer signature and the copyright line on the About page now stay left-aligned and left-to-right regardless of the interface language. Previously, selecting Arabic right-anchored these lines; they are brand and credit text and are intentionally kept consistent worldwide.

Satellite catalogue. HADES-ICM (also known as SO-125) re-entered the atmosphere on 23 May 2026 and has been removed from the active satellite list, joining the other re-entered birds. As always, the satellite selection menu in Settings shows the complete live list.