

# RTL-SDR Setup Guide

## CONTENTS

1. Current Status
2.  Running Services
3.  Not Installed
4. Hardware Requirements
5. Two RTL-SDR Dongles
6. Installation Instructions
7. Step 1: Install RTL-SDR Drivers
8. Step 2: Install dump1090 for ADS-B
9. Step 3: Install NOAA Decoders
10. Step 4: Configure for Two Dongles
11. Step 5: Create NOAA Recording Service
12. Testing Procedures
13. Test 1: Verify RTL-SDR Detection
14. Test 2: Test NOAA Reception (Dongle 1)
15. Test 3: Test ADS-B Reception (Dongle 2)
16. Test 4: Verify Web Interface
17. Test 5: Full Integration Test
18. Troubleshooting
19. “No RTL-SDR devices found”
20. “Device busy”
21. “PLL not locked”
22. Poor Signal Quality
23. No ADS-B Aircraft
24. Services Overview
25. File Locations
26. Next Steps
27. References

# RTL-SDR Setup Guide for [satellite.stsgym.com](https://satellite.stsgym.com)

**Created:** March 13, 2026 **Status:** Pending Hardware Installation

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## Current Status

### ☐ Running Services

Service	Status	Port
stsgym-satellite-web	Running	5006
satellite-db (PostgreSQL)	Running	5432
satellite-redis	Running	6379

### ☐ Not Installed

Component	Status
RTL-SDR drivers	Not installed
dump1090/readsb	Not installed
wxtoimg/noaa-apt	Not installed
RTL-SDR hardware	Not connected

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## Hardware Requirements

### Two RTL-SDR Dongles

- Dongle 1 (NOAA Weather Satellites) - 137 MHz**
    - Frequency: 137.100 - 137.9125 MHz
    - Satellites: NOAA-15, NOAA-18, NOAA-19, Meteor-M2
    - Antenna: V-dipole or QFH antenna recommended
  - Dongle 2 (ADS-B) - 1090 MHz**
    - Frequency: 1090 MHz
    - Purpose: Aircraft tracking via ADS-B
    - Antenna: 1/4 wave ground plane or collinear
- 

## Installation Instructions

### Step 1: Install RTL-SDR Drivers

```
# Run the setup script (requires sudo)
cd ~/stsgym-satellite/scripts
```

```

sudo ./setup_sdr.sh

# Or manually:
sudo apt update
sudo apt install rtl-sdr librtlsdr-dev sox

# Blacklist DVB-T drivers (conflict with RTL-SDR)
sudo bash -c 'cat > /etc/modprobe.d/rtl-sdr.conf << EOF
blacklist dvb_usb_rtl28xxu
blacklist rtl2832
blacklist rtl2830
EOF'

# Unload existing drivers
sudo modprobe -r dvb_usb_rtl28xxu 2>/dev/null || true
sudo modprobe -r rtl2832 2>/dev/null || true
sudo modprobe -r rtl2830 2>/dev/null || true

# Create udev rules
sudo bash -c 'cat > /etc/udev/rules.d/99-rtl-sdr.rules << EOF
# RTL-SDR dongles
SUBSYSTEMS=="usb", ATTRS{idVendor}=="0bda", ATTRS{idProduct}=="2832", MODE=="0666"
SUBSYSTEMS=="usb", ATTRS{idVendor}=="0bda", ATTRS{idProduct}=="2838", MODE=="0666"
EOF'

sudo udevadm control --reload-rules
sudo udevadm trigger

```

## Step 2: Install dump1090 for ADS-B

```

# Option A: dump1090-mutability (stable)
sudo apt install dump1090-mutability

# Option B: readsb (recommended, more modern)
# Build from source:
cd /tmp
git clone https://github.com/wiedehopf/readsb.git

```

```
cd readsb
make
sudo make install

# Create systemd service for readsb
sudo bash -c 'cat > /etc/systemd/system/readsb.service
[Unit]
Description=readsb ADS-B receiver
After=network.target

[Service]
ExecStart=/usr/local/bin/readsb --net --gain 40 --quiet
Type=simple
Restart=always
RestartSec=30

[Install]
WantedBy=multi-user.target
EOF'

sudo systemctl daemon-reload
sudo systemctl enable readsb
sudo systemctl start readsb
```

### Step 3: Install NOAA Decoders

```
# wxtoimg (NOAA APT decoder)
sudo apt install wxtoimg

# Or build noaa-apt from source (open source alternative)
cd /tmp
git clone https://github.com/martinber/noaa-apt.git
cd noaa-apt
cargo build --release
sudo cp target/release/noaa-apt /usr/local/bin/
```

### Step 4: Configure for Two Dongles

Since we need two dongles, we must assign them different serial numbers and create separate services:

```
# First, set unique serial numbers for each dongle
# Plug in dongle 1:
rtl_eeprom -s 'NOAA_001' -d 0

# Plug in dongle 2:
rtl_eeprom -s 'ADSB_001' -d 1

# Verify serial numbers:
rtl_eeprom -d 0 -q
rtl_eeprom -d 1 -q
```

## Step 5: Create NOAA Recording Service

```
# Create systemd service for NOAA recording
sudo bash -c
'cat > /etc/systemd/system/noaa-recorder.service << EOF
[Unit]
Description=NOAA Satellite Recorder
After=network.target

[Service]
Type=simple
User=wez
WorkingDirectory=/home/wez/stsgym-satellite
ExecStart=/home/wez/stsgym-satellite/venv/bin/python -m
services.noaa_recorder
Restart=always
RestartSec=60

[Install]
WantedBy=multi-user.target
EOF'

# Create ADS-B collector service
sudo bash -c 'cat > /etc/systemd/system/adsb-
collector.service << EOF
[Unit]
Description=ADS-B Data Collector
After=network.target readsb.service
```

```
[Service]
Type=simple
User=wez
WorkingDirectory=/home/wez/stsgym-satellite
ExecStart=/home/wez/stsgym-satellite/venv/bin/python -m
services.adsb_collector
Restart=always
RestartSec=30

[Install]
WantedBy=multi-user.target
EOF'

sudo systemctl daemon-reload
```

---

## Testing Procedures

### Test 1: Verify RTL-SDR Detection

```
# Test device detection
rtl_test -t

# Expected output:
# Found 1 device(s):
# 0: Realtek, RTL2838UHIDIR, SN: NOAA_001 (or ADSB_001)
#
# Supported gain values (29): 0.0 0.9 1.4 2.7 ...
# [R82XX] PLL not locked!
# Sampling at 2048000 S/s.
# NO EES, NO OVERRUN
```

### Test 2: Test NOAA Reception (Dongle 1)

```
# Check next NOAA pass
# First, update TLE data:
cd ~/stsgym-satellite
./scripts/download_tle.sh
```

```
# Find next NOAA pass (manual test):
# NOAA-15: 137.620 MHz
# NOAA-18: 137.9125 MHz
# NOAA-19: 137.100 MHz

# Quick test recording (60 seconds):
rtl_fm -d 0 -f 137100000 -s 55000 -g 40 -r 11025 -t 60
test_noaa.wav

# Decode test:
wxtoimg -n -e HVC test_noaa.wav test_noaa.png

# View image:
# Look for horizontal lines indicating APT signal
# If image is mostly noise, check antenna and gain
```

### Test 3: Test ADS-B Reception (Dongle 2)

```
# Start readsb/dump1090 on dongle 1 (index 1 = second d
readsb --device-type rtl_sdr --device-index 1 --net --ga
--quiet

# Check JSON output:
curl http://localhost:8080/data/aircraft.json | jq .

# Expected output:
# {
#   "now": 1710352800.123,
#   "messages": 12345,
#   "aircraft": [
#     {
#       "hex": "a12345",
#       "flight": "UAL123",
#       "lat": 40.7128,
#       "lon": -74.0060,
#       "alt_baro": 35000,
#       "gs": 450.5,
#       ...
```

```
#     }
#   ]
# }

# If no aircraft, check:
# 1. Antenna connected to dongle 2
# 2. Antenna has clear sky view
# 3. Gain setting (try 40-50)
```

## Test 4: Verify Web Interface

```
# Check satellite.stsgym.com API
curl http://localhost:5006/api/satellites/ | jq .

# Check ADS-B API
curl http://localhost:5006/api/aircraft/live | jq .

# Access web interface:
# https://satellite.stsgym.com
```

## Test 5: Full Integration Test

```
# 1. Start all services:
sudo systemctl start readsb
sudo systemctl start adsb-collector
sudo systemctl start noaa-recorder

# 2. Check status:
sudo systemctl status readsb
sudo systemctl status adsb-collector
sudo systemctl status noaa-recorder

# 3. Monitor logs:
tail -f /var/log/syslog | grep -E 'readsb|adsb|noaa'

# 4. Check database:
cd ~/stsgym-satellite
docker exec -it satellite-db psql -U satellite -d satel
```

```
c "SELECT COUNT(*) FROM aircraft_positions;"

# 5. View live data:
curl http://localhost:5006/api/aircraft/live | jq '.air
| length'
```

---

## Troubleshooting

### “No RTL-SDR devices found”

```
# Check USB connection
lsusb | grep Realtek

# Check kernel messages
dmesg | tail -20

# Re-plug device and reload drivers
sudo modprobe -r dvb_usb_rtl28xxu rtl2832
sudo modprobe rtl2832
```

### “Device busy”

```
# Find process using device
lsof | grep rtl
fuser -v /dev/bus/usb/**/*

# Kill if needed
kill -9 <pid>
```

### “PLL not locked”

```
# This is normal for RTL-SDR dongles
# Can usually be ignored
```

### Poor Signal Quality

1. Check antenna connections

2. Move antenna away from electronics
3. Try different gain settings:
  - NOAA: Start at 40, adjust based on signal strength
  - ADS-B: Start at 40, increase if range is low
4. Add LNA (Low Noise Amplifier) for weak signals

## No ADS-B Aircraft

1. Verify dump1090/readsb is running:

```
pgrep -a readsb
```

2. Check antenna position (outdoor is best)
3. Verify correct dongle (use -d 1 for second dongle)
4. Check gain setting (too low = no signals, too high = noise)

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## Services Overview

Service	Purpose	Port	Status
readsb	ADS-B receiver	8080	<input type="checkbox"/> Not installed
adsb-collector	Store ADS-B data	-	<input type="checkbox"/> Not configured
noaa-recorder	Record satellite passes	-	<input type="checkbox"/> Not configured
stsgym-satellite	Web interface	5006	<input type="checkbox"/> Running

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## File Locations

Path	Purpose
/var/satellite/recordings/	NOAA audio recordings
/var/satellite/images/	Decoded satellite images
~/stsgym-satellite/scripts/	Setup and utility scripts
~/stsgym-satellite/services/	Python services
/etc/systemd/system/	Service definitions

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## Next Steps

1. **Connect RTL-SDR hardware** to the server via USB
2. **Run setup script:** `sudo ./scripts/setup_sdr.sh`
3. **Set serial numbers:** Configure each dongle with unique ID
4. **Install dump1090/readsb:** For ADS-B reception
5. **Install wxtoimg/noaa-apt:** For NOAA image decoding
6. **Create systemd services:** For automatic startup

7. **Test reception:** Follow testing procedures above
  8. **Monitor:** Check web interface and database for data
- 

## References

- RTL-SDR Wiki: <https://www.rtl-sdr.com/>
  - dump1090: <https://github.com/flightaware/dump1090>
  - readsb: <https://github.com/wiedehopf/readsb>
  - wxtoimg: <https://wxtoimgrestored.org/>
  - noaa-apt: <https://github.com/martinber/noaa-apt>
  - Skyfield: <https://rhodesmill.org/skyfield/>
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