

# **Installing and using gr-satellites**

Version 0.1

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# Contents

<b>1</b>	<b>Requirements</b>	<b>2</b>
<b>2</b>	<b>Software Installation</b>	<b>2</b>
2.1	Installing gr-satellites . . . . .	2
2.1.1	Installing miniconda . . . . .	2
2.1.2	Installing GNU Radio . . . . .	2
2.1.3	Installing gr-satellites . . . . .	3
2.2	(Optional) Verifying gr_satellites works using supplied demon- stration recordings . . . . .	3
2.3	Installing gr-frontends . . . . .	4
2.4	Downloading and preparing real recordings from SatNOGS . .	4
<b>3</b>	<b>Software Operation</b>	<b>5</b>
3.1	Operating gr-frontends and gr-satellites . . . . .	5
<b>4</b>	<b>Unfinished or WIP Sections</b>	<b>5</b>
4.1	Installing Docker Container . . . . .	5
4.2	Installing gr-satellites from source . . . . .	6
4.2.1	Installing Dependencies (GNU Radio, python3-pip, python packages, git ) . . . . .	6
4.2.2	Downloading and building gr-satellites . . . . .	7

## List of Code Listings

# 1 Requirements

This guide is written assuming a fresh install of Ubuntu 20.04 LTS.

You must be connected to the internet to install the necessary software.

## 2 Software Installation

### 2.1 Installing gr-satellites

The following subsections are adapted from the official documentation for gr-satellites [official documentation for gr-satellites](https://gr-satellites.readthedocs.io/en/latest/installation_intro.html)<sup>1</sup>

#### 2.1.1 Installing miniconda

Step 1: Download the Miniconda3 Linux 64-bit installer for python 3.9 from <https://docs.conda.io/en/latest/miniconda.html>

Step 2: In the file explorer, navigate to the folder where the installer was downloaded (Typically the 'Downloads' folder). Right click, and select "open in terminal." Enter the following command in the terminal window.

```
bash Miniconda3-py39_4.9.2-Linux-x86_64.sh
```

Note that 'Miniconda3-py39\_4.9.2-Linux-x86\_64.sh' should be replaced by the name of the file you downloaded, if for some reason the name of the file is different to that given above. You can type "bash Miniconda3" and then press tab to auto-complete with the name of the file.

Step 3: Follow the prompts to agree to the licensing agreement. When asked if you initialise Miniconda3, enter "yes"

Step 4: Close the terminal window.

#### 2.1.2 Installing GNU Radio

Step 1: Open a new terminal window, by pressing ctrl+alt+t. Enter the following command.

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<sup>1</sup>[https://gr-satellites.readthedocs.io/en/latest/installation\\_intro.html](https://gr-satellites.readthedocs.io/en/latest/installation_intro.html)

```
conda activate base
```

Step 2: Install GNU Radio by entering the following command.

```
conda install -c conda-forge gnuradio
```

When asked if you wish to proceed, enter "Y".

### 2.1.3 Installing gr-satellites

Step 1: In the terminal window from the previous subsection, enter the following command.

```
conda install -c conda-forge gnuradio-satellites
```

When asked if you wish to proceed, enter "Y".

## 2.2 (Optional) Verifying gr\_satellites works using supplied demonstration recordings

Daniel Estévez, the author of gr-satellites, supplies a variety of sample recordings. These recordings are all high quality recordings with little background, and relatively short, so can be used as a basic test to ensure gr-satellites has been installed properly (But do not necessarily serve as a good test of how the program functions in real world conditions).

Step 1: Install git by entering the following command into a terminal window.

```
sudo apt install git
```

Enter your password if prompted to do so. When asked if you wish to proceed, enter "Y".

Step 2: Download the satellite recordings by entering the following command into a terminal window.

```
git clone  
→ https://github.com/daniestevez/satellite-recordings.git  
→ Documents/satellite-recordings
```

Step 3: Enter the following command into the terminal window.

```
gr_satellites "Suomi 100" --wavfile  
→ Documents/satellite-recordings/suomi_100.wav
```

You should see a packet output with a selection of telemetry data. The last line of the output should be "clock = 2068-11-18 01:41:59"

## 2.3 Installing gr-frontends

gr-frontends is a utility that allows us to output audio over UDP, in the same format as is output by GQRX.

Clone the gr-frontends git repository by entering the following command into the terminal.

```
git clone https://github.com/daniestevez/gr-frontends.git
↪ Documents/gr-frontends
```

## 2.4 Downloading and preparing real recordings from SatNOGS

For the purposes of this guide, we will be using the Finnish cube-sat Suomi 100 (NORAD ID 43804).

Step 1: Go to the [SatNOGS database page for Suomi 100](#). Under the 'Status' filter, filter out all observations except 'Good'. Under 'Results', filter to only include results 'With Waterfall', 'With Audio', and 'With Data' only.

Step 2: Select any of the resulting observations. In this guide, we will use [Observation #4125948](#). Click on 'audio' next to the downloads label to download the audio file.

Step 3: Installing ffmpeg. In the terminal window, enter the following command.

```
sudo apt install ffmpeg
```

Enter your password if prompted to do so. When asked if you wish to proceed, enter "Y".

Step 4: In the terminal window, enter the following command.

```
mkdir Documents/satnogs
```

Note that the next command is a single command, but is split over several lines in this document. If you chose to use a recording other than observation #4125948, you will need to replace "satnogs\_4125948\_2021-05-18T18-43-13.ogg" with the name of the audio file you downloaded in step 2.

```
ffmpeg -i
↳ Downloads/satnogs_4125948_2021-05-18T18-43-13.ogg
↳ -r 48e3 /Documents/satnogs/suomi100.wav
```

Step 5: Enter the following command in the terminal to open GNU radio

```
gnuradio-companion
```

In the gnuradio GUI that opens, select file->open. In the resulting dialogue, navigate to the 'gr-frontends' folder, inside the 'Documents' folder. Select 'wav\_48kHz.grc', and click on 'Open'.

Step 6: Double click on the parameter block with the ID value 'input\_file' (This is the 2nd block, assuming an order going from left to right, and top to bottom). In the 'value' field, enter '/home/[username]/Documents/satnogs/suomi100.wav', substituting your username for [username]. Press 'OK' to close the dialogue window.

## 3 Software Operation

### 3.1 Operating gr-frontends and gr-satellites

Step 1: In a terminal window, enter the following command to start gr-satellites.

```
gr_satellites "Suomi 100" --udp --samp_rate 48e3
```

Step 2: In the GNU Radio companion GUI, click the Play icon on the toolbar to execute the flowgraph. If this is your first time executing the flowgraph, a dialogue box concerning a missing xterm executable will appear. Click 'OK' to dismiss this.

Step 3: Wait a few moments. The output of the container will appear in the terminal window.

## 4 Unfinished or WIP Sections

### 4.1 Installing Docker Container

This section is unfinished as I am still working on creating the Docker Container.

## 4.2 Installing gr-satellites from source

This section is unfinished, as I ran into several issues at the compiling stage that prevented installation.

### 4.2.1 Installing Dependencies (GNU Radio, python3-pip, python packages, git )

Step 1: Installing GNU Radio. Press ctrl+alt+t to open a new terminal window. Enter the following command:

```
sudo add-apt-repository  
↪ ppa:gnuradio/gnuradio-releases
```

If prompted to do so, enter your password. Press 'Enter' when asked if you want to continue. Then, enter the following 2 commands. Enter 'Y' when asked if you want to continue.

```
sudo apt-get update  
sudo apt-get install gnuradio
```

Step 2: Installing Python. Enter the following command in the terminal:

```
sudo apt install python3-pip
```

If prompted to do so, enter your password. Enter 'Y' when asked if you want to continue.

Step 3: Installing python packages (construct, requests). Enter the following command in the terminal:

```
pip3 install --user --upgrade construct requests
```

Step 4: Installing git. Enter the following command in the terminal:

```
sudo apt install git
```

If prompted to do so, enter your password. Enter 'Y' when asked if you want to continue.

Step 5: Installing cmake. Enter the following command in the terminal:

```
sudo apt install cmake
```

If prompted to do so, enter your password. Enter 'Y' when asked if you want to continue.

### 4.2.2 Downloading and building gr-satellites

Step 1: Cloning gr-satellites repository. In a terminal window, enter the following command (note that this is a single command, broken across several lines):

```
git clone  
→ https://github.com/daniestevez/gr-satellites.git  
→ Documents/gr-satellites
```

Step 2: Building from source. First, change the terminal directory to the location where we just cloned gr-satellites:

```
cd Documents/gr-satellites
```

(Instructions on how to compile unwritten, pending further debugging)