# Installation Guide for GNU Radio, UHD (Drivers) and gr-MRI package under Ubuntu 14.04 LTS

In this guide I describe my experiences with installing GNU Radio [1], USRP Hardware Driver (UHD) [2] and the gr-MRI package [3] for GNU Radio developed by Christopher Hasselwander. I installed those applications on a computer running the Linux operating system Ubuntu 14.04 LTS. Thereby, I followed the instructions given in the user-guide provided by Hasselwander, which is available as pdf under [4] in the download section (at the time of writing this was rather an incomplete document).

First thing to do is installing the GNU Radio software. You can find instructions under [5] where several ways are described. I believe – even though I am not entirely sure – that an installation from source is necessary because we later on want to add the gr-MRI package. So first thing I tried was installing everything from source by myself, however in the end this didn’t work – and I used the install script provided by Marcus Leech – nevertheless I will describe what I did in the first place:

I started with installing the USRP Hardware Driver (UHD), because in [6] under the section “Installing manually from source” it states that if one wants to be able to use a USRP device with GNU Radio the UHD should be installed first. Instructions for this can be found under [7]. After installing the dependencies[[1]](#footnote-1) you need to download the source code using the version control system GIT. If you have never used GIT before you will need to create a new username first. To set a new username for every repository on your computer use the following command [8]:

**git config --global user.name "Your\_Username"**

You only have to do this once (later you will use GIT again to download other source files, you can use the same username for this) and the username can be whatever you want (doesn’t have to match your username of Ubuntu). Now you should be able to use the **git clone** command to download the files as explained in [7] under the “Getting the source code” section. If this was successful change to the directory “host” within the downloaded files and create a new folder named “build” (with the command mkdir). Change into this folder and generate the makefiles using cmake. Then build (make command) and install (sudo make install command) the UHD package and set the library path (sudo ldconfig). All those steps are described in [7] in the section “Build Instructions (Unix)”. Now the computer should recognize the USRP1 if you plug it in and type in a terminal the command “sudo uhd\_find\_devices”. By default non-root access is not provided to the USRP but you can change this either by following the directions in [5] under the section “Configuring USRP support”, or by following the steps given in [9] in the section “Setup Udev for USB (Linux)” or by changing the number 0660 to 0666 at the end of the first line in the file “40\_uhd\_host.rules” which can be found in the directory /lib/udev/rules.d (the last solution is the one that worked for me but is probably also the least legitimate, so I wouldn’t recommend). Now Linux should be able to access the USRP board also without root permissions (try again “uhd\_find\_devices”, this time without using sudo).

Once this is done, you can move on to installing the GNU Radio software itself. Therefor a whole bunch of pre-requisites are required as listed in [5]. Make sure you have installed all of them (section “Trusty Tahr (14.04)” in [5]) and set the system variable PYTHONPATH to use PyQT (with export PYTHONPATH=/opt/qt/lib/python2.7/dist-package). Then you use again GIT to download the source files for GNU Radio, create the build folder and the makefiles (with cmake) and start the build (make) and installation (sudo make install) processes (see instructions in [5] under section “Installing GNU Radio”). If this all has gone through you should now be able to run the gnuradio-companion by simply typing in a terminal **gnuradio-companion**.

However, in my case the installation didn’t work, unfortunately I couldn’t figure out what the problem was, so that in the end I uninstalled the GNU Radio software again (using cmake uninstall). I tried installing it with the package manager **synaptic** but this also did not work. Finally, I tried the build-gnuradio script provided by Marcus Lech by running the following command (see [6] in the “Using the build-gnuradio script” section)

**wget http://www.sbrac.org/files/build-gnuradio && chmod a+x build-gnuradio && ./build-gnuradio**

This script downloads all dependencies and installs them, downloads the UHD and the GNU Radio source files from GIT (thus it is also an installation from source), runs the make process and finally installs both components on the system. This process can take quite a while (in my case around two hours). When the script is finished GNU Radio should be ready to use. Lucky me, this time it did also work for me and the only thing I needed to do afterwards is to change the USRP permissions so that also non-root users can access it.

As a conclusion, I would recommend using the build-gnuradio script straight away as it saves you a lot of work and troubles during installation. If this should be not successful you can still install everything yourself.

Once GNU Radio is running the gr-MRI package needs to be added so that GNU Radio is able to recognize the additional gr-MRI blocks and can use them. This process is described in detail in the User Guide provided by Hasselwander (so please refer to that). The steps are not too complicated: basically you download the gr-MRI files using GIT, create once again a build folder, generate the makefiles, and run the make process and the installation. Now the GNU Radio software should be able to deal with the gr-MRI blocks and recognize them if you open a gr-MRI sequence (e.g. FID\_flowgraph.grc) in gnuradio-companion.

# References:

[1] <http://gnuradio.org/>

[2] <http://files.ettus.com/manual/> ; <http://files.ettus.com/manual/page_build_guide.html>

[3] Hasselwander C., Grissom W. A., Cao Z. MR Expeeriments Using a Commercially-Available Software-Defined Radio, Proc. Intl. Soc. Mag. Reson. Med. 23 (2015)

[4] <https://bitbucket.org/wgrissom/gnuradiomri>

[5] <http://gnuradio.org/redmine/projects/gnuradio/wiki/UbuntuInstall>

[6] <http://gnuradio.org/redmine/projects/gnuradio/wiki/InstallingGRFromSource#Using-the-build-gnuradio-script>

[7] <http://files.ettus.com/manual/page_build_guide.html>

[8] <https://help.github.com/articles/setting-your-username-in-git/>

1. For those of you who are completely new to Linux (and also for those of you who forgot about Linux); under Linux you usually use a terminal to install new software. To open a terminal press Strg+Alt+T, to navigate through the directories use cd (change directory) and the command sudo is there to gain root permissions. So to install new software one possible command is: *sudo apt-get install package-name .* [↑](#footnote-ref-1)