Building and Installing the USRP Open-Source Toolchain (UHD and GNU Radio) on Linux

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Application Note Number

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Revision History

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Abstract

This Application Note provides a comprehensive guide for building, installing, and maintaining the open-source toolchain for the USRP (UHD and GNU Radio) from source code on the Linux platform. The Ubuntu and Fedora distributions are specifically discussed. Several other alternate installation methods are also discussed.

<http://files.ettus.com/manual/page_build_guide.html#build_instructions_unix>

UHD on Linux

UHD is fully supported on Linux, using the GCC compiler, and should work on most major Linux distributions.

Devices

This document applies only to the USRP X300, X310, B200, B210, B200mini, N200, N210 devices. The E310 and E312 devices are embedded devices, and are fundamentally different from the other non-embedded USRP devices, and are not addressed by this document.

Install Linux

If you already have a recent version of Linux installed, then you may be able to skip this section. If you are starting from scratch, or simply want to start with a fresh new installation of Linux, then please follow the instructions and recommendations in this section.

We suggest that you use either Ubuntu 16.04.5, Ubuntu 18.04, Ubuntu 18.10, Fedora 27, 28, 29, and that you use a 64-bit architecture, not a 32-bit architecture. There are several re-spins of Ubuntu, such as Xubuntu, Lubuntu, Kubuntu, Linux Mint, all of which should also work. For the purposes of this document, these re-spins can be considered equivalent. Both Ubuntu and Fedora are known to work well with UHD and GNU Radio.

Download and install Ubuntu, Xubuntu, Linux Mint, or Fedora from the links below. Download the appropriate ISO image, and write it to a USB flash drive. Be sure to verify that the ISO file was not corrupted during the download process by checking the MD5 and/or SHA1 hash.

* [Ubuntu download page](http://www.ubuntu.com/download/desktop)
* [Xubuntu download page](http://www.xubuntu.org/getxubuntu/)
* [Linux Mint download page](https://www.linuxmint.com/download.php)
* [Fedora download page](https://getfedora.org/en/workstation/download/)

You can learn more about Ubuntu, Xubuntu, Linux Mint, and Fedora at the links below.

* [Wikipedia article on Ubuntu](https://en.wikipedia.org/wiki/Ubuntu_%28operating_system%29)
* [Wikipedia article on Xubuntu](https://en.wikipedia.org/wiki/Xubuntu)
* [Wikipedia article on Linux Mint](https://en.wikipedia.org/wiki/Linux_Mint)
* [Wikipedia article on Fedora](https://en.wikipedia.org/wiki/Fedora_%28operating_system%29)

There are many tools for writing an ISO image to a USB flash drive. In Linux, you can use the "dd" utility, or the UNetbootin utility. On Ubuntu systems, there is also the Startup Disk Creator utility as well.

* [UNetbootin homepage](http://unetbootin.sourceforge.net/)
* [Wikipedia article on UNetbootin](http://en.wikipedia.org/wiki/UNetbootin)
* [Startup Disk Creator homepage](https://launchpad.net/usb-creator)
* [Wikipedia article on Startup Disk Creator](https://en.wikipedia.org/wiki/Startup_Disk_Creator)
* [Article about Startup Disk Creator](http://www.ubuntu.com/download/desktop/create-a-usb-stick-on-ubuntu)

Be sure to use a USB flash drive with at least 8 GB capacity, and use a USB 3.0 flash drive, not a USB 2.0 flash drive. If you use a slower USB 2.0 flash drive, then the install process will take significantly longer.

Update and Install dependencies

Before building UHD and GNU Radio, you need to make sure that all the dependencies are first installed.

However, before installing any dependencies, you should first make sure that all the packages that are already installed on your system are up-to-date. You can do this from a GUI, or from the command-line, as shown below.

On Ubuntu systems, run:

sudo apt-get update

On Fedora 21 systems, run:

sudo yum update

On Fedora 22, 23, 24 and 25 systems, run:

sudo dnf update

Once the system has been updated, then install the required dependencies for UHD and GNU Radio.

On Ubuntu 18.10 systems, run:

sudo apt-get -y install git swig cmake doxygen build-essential libboost-all-dev libtool libusb-1.0-0 libusb-1.0-0-dev libudev-dev libncurses5-dev libfftw3-bin libfftw3-dev libfftw3-doc libcppunit-1.14-0 libcppunit-dev libcppunit-doc ncurses-bin cpufrequtils python-numpy python-numpy-doc python-numpy-dbg python-scipy python-docutils qt4-bin-dbg qt4-default qt4-doc libqt4-dev libqt4-dev-bin python-qt4 python-qt4-dbg python-qt4-dev python-qt4-doc python-qt4-doc libqwt6abi1 libfftw3-bin libfftw3-dev libfftw3-doc ncurses-bin libncurses5 libncurses5-dev libncurses6-dbg libfontconfig1-dev libxrender-dev libpulse-dev swig g++ automake autoconf libtool python-dev libfftw3-dev libcppunit-dev libboost-all-dev libusb-dev libusb-1.0-0-dev fort77 libsdl1.2-dev python-wxgtk3.0 git libqt4-dev python-numpy ccache python-opengl libgsl-dev python-cheetah python-mako python-lxml doxygen qt4-default qt4-dev-tools libusb-1.0-0-dev libqwtplot3d-qt5-dev pyqt4-dev-tools python-qwt5-qt4 cmake git wget libxi-dev gtk2-engines-pixbuf r-base-dev python-tk liborc-0.4-0 liborc-0.4-dev libasound2-dev python-gtk2 libzmq3-dev libzmq5 python-requests python-sphinx libcomedi-dev python-zmq libqwt-dev libqwt6abi1 python-six libgps-dev libgps23 gpsd gpsd-clients python-gps python-setuptools

On Ubuntu 18.04 systems, run:

sudo apt-get -y install git swig cmake doxygen build-essential libboost-all-dev libtool libusb-1.0-0 libusb-1.0-0-dev libudev-dev libncurses5-dev libfftw3-bin libfftw3-dev libfftw3-doc libcppunit-1.14-0 libcppunit-dev libcppunit-doc ncurses-bin cpufrequtils python-numpy python-numpy-doc python-numpy-dbg python-scipy python-docutils qt4-bin-dbg qt4-default qt4-doc libqt4-dev libqt4-dev-bin python-qt4 python-qt4-dbg python-qt4-dev python-qt4-doc python-qt4-doc libqwt6abi1 libfftw3-bin libfftw3-dev libfftw3-doc ncurses-bin libncurses5 libncurses5-dev libncurses5-dbg libfontconfig1-dev libxrender-dev libpulse-dev swig g++ automake autoconf libtool python-dev libfftw3-dev libcppunit-dev libboost-all-dev libusb-dev libusb-1.0-0-dev fort77 libsdl1.2-dev python-wxgtk3.0 git libqt4-dev python-numpy ccache python-opengl libgsl-dev python-cheetah python-mako python-lxml doxygen qt4-default qt4-dev-tools libusb-1.0-0-dev libqwtplot3d-qt5-dev pyqt4-dev-tools python-qwt5-qt4 cmake git wget libxi-dev gtk2-engines-pixbuf r-base-dev python-tk liborc-0.4-0 liborc-0.4-dev libasound2-dev python-gtk2 libzmq3-dev libzmq5 python-requests python-sphinx libcomedi-dev python-zmq libqwt-dev libqwt6abi1 python-six libgps-dev libgps23 gpsd gpsd-clients python-gps python-setuptools

On Ubuntu 17.04 systems, run:

sudo apt-get -y install git swig cmake doxygen build-essential libboost-all-dev libtool libusb-1.0-0 libusb-1.0-0-dev libudev-dev libncurses5-dev libfftw3-bin libfftw3-dev libfftw3-doc libcppunit-1.13-0v5 libcppunit-dev libcppunit-doc ncurses-bin cpufrequtils python-numpy python-numpy-doc python-numpy-dbg python-scipy python-docutils qt4-bin-dbg qt4-default qt4-doc libqt4-dev libqt4-dev-bin python-qt4 python-qt4-dbg python-qt4-dev python-qt4-doc python-qt4-doc libqwt6abi1 libfftw3-bin libfftw3-dev libfftw3-doc ncurses-bin libncurses5 libncurses5-dev libncurses5-dbg libfontconfig1-dev libxrender-dev libpulse-dev swig g++ automake autoconf libtool python-dev libfftw3-dev libcppunit-dev libboost-all-dev libusb-dev libusb-1.0-0-dev fort77 libsdl1.2-dev python-wxgtk3.0 git-core libqt4-dev python-numpy ccache python-opengl libgsl-dev python-cheetah python-mako python-lxml doxygen qt4-default qt4-dev-tools libusb-1.0-0-dev libqwt5-qt4-dev libqwtplot3d-qt4-dev pyqt4-dev-tools python-qwt5-qt4 cmake git-core wget libxi-dev gtk2-engines-pixbuf r-base-dev python-tk liborc-0.4-0 liborc-0.4-dev libasound2-dev python-gtk2 libzmq3-dev libzmq5 python-requests python-sphinx libcomedi-dev python-zmq python-setuptools

On Ubuntu 16.04 systems, run:

sudo apt-get -y install git swig cmake doxygen build-essential libboost-all-dev libtool libusb-1.0-0 libusb-1.0-0-dev libudev-dev libncurses5-dev libfftw3-bin libfftw3-dev libfftw3-doc libcppunit-1.13-0v5 libcppunit-dev libcppunit-doc ncurses-bin cpufrequtils python-numpy python-numpy-doc python-numpy-dbg python-scipy python-docutils qt4-bin-dbg qt4-default qt4-doc libqt4-dev libqt4-dev-bin python-qt4 python-qt4-dbg python-qt4-dev python-qt4-doc python-qt4-doc libqwt6abi1 libfftw3-bin libfftw3-dev libfftw3-doc ncurses-bin libncurses5 libncurses5-dev libncurses5-dbg libfontconfig1-dev libxrender-dev libpulse-dev swig g++ automake autoconf libtool python-dev libfftw3-dev libcppunit-dev libboost-all-dev libusb-dev libusb-1.0-0-dev fort77 libsdl1.2-dev python-wxgtk3.0 git-core libqt4-dev python-numpy ccache python-opengl libgsl-dev python-cheetah python-mako python-lxml doxygen qt4-default qt4-dev-tools libusb-1.0-0-dev libqwt5-qt4-dev libqwtplot3d-qt4-dev pyqt4-dev-tools python-qwt5-qt4 cmake git-core wget libxi-dev gtk2-engines-pixbuf r-base-dev python-tk liborc-0.4-0 liborc-0.4-dev libasound2-dev python-gtk2 libzmq-dev libzmq1 python-requests python-sphinx libcomedi-dev python-zmq python-setuptools

On Ubuntu 15.04 and 15.10 systems, run:

sudo apt-get -y install git swig cmake doxygen build-essential libboost-all-dev libtool libusb-1.0-0 libusb-1.0-0-dev libudev-dev libncurses5-dev libfftw3-bin libfftw3-dev libfftw3-doc libcppunit-dev libcppunit-doc ncurses-bin cpufrequtils python-numpy python-numpy-doc python-numpy-dbg python-scipy python-docutils qt4-bin-dbg qt4-default qt4-doc libqt4-dev libqt4-dev-bin python-qt4 python-qt4-dbg python-qt4-dev python-qt4-doc python-qt4-doc libqwt6 libfftw3-bin libfftw3-dev libfftw3-doc ncurses-bin libncurses5 libncurses5-dev libncurses5-dbg libfontconfig1-dev libxrender-dev libpulse-dev swig g++ automake autoconf libtool python-dev libfftw3-dev libcppunit-1.13-0v5 libboost-all-dev libusb-dev libusb-1.0-0-dev fort77 libsdl1.2-dev python-wxgtk2.8 git-core libqt4-dev python-numpy ccache python-opengl libgsl0-dev python-cheetah python-mako python-lxml doxygen qt4-default qt4-dev-tools libusb-1.0-0-dev libqwt5-qt4-dev libqwtplot3d-qt4-dev pyqt4-dev-tools python-qwt5-qt4 cmake git-core wget libxi-dev gtk2-engines-pixbuf r-base-dev python-tk liborc-0.4-0 liborc-0.4-dev libasound2-dev python-gtk2 libzmq-dev libzmq1 python-requests python-sphinx libcomedi-dev python-zmq python-setuptools

On Ubuntu 14.04 and 14.10 systems, run:

sudo apt-get -y install git swig cmake doxygen build-essential libboost-all-dev libtool libusb-1.0-0 libusb-1.0-0-dev libudev-dev libncurses5-dev libfftw3-bin libfftw3-dev libfftw3-doc libcppunit-1.13-0 libcppunit-dev libcppunit-doc ncurses-bin cpufrequtils python-numpy python-numpy-doc python-numpy-dbg python-scipy python-docutils qt4-bin-dbg qt4-default qt4-doc libqt4-dev libqt4-dev-bin python-qt4 python-qt4-dbg python-qt4-dev python-qt4-doc python-qt4-doc libfftw3-bin libfftw3-dev libfftw3-doc ncurses-bin libncurses5 libncurses5-dev libncurses5-dbg libfontconfig1-dev libxrender-dev libpulse-dev swig g++ automake autoconf libtool python-dev libfftw3-dev libcppunit-dev libboost-all-dev libusb-dev libusb-1.0-0-dev fort77 libsdl1.2-dev python-wxgtk2.8 git-core libqt4-dev python-numpy ccache python-opengl libgsl0-dev python-cheetah python-mako python-lxml doxygen qt4-default qt4-dev-tools libusb-1.0-0-dev libqwt5-qt4-dev libqwtplot3d-qt4-dev pyqt4-dev-tools python-qwt5-qt4 cmake git-core wget libxi-dev gtk2-engines-pixbuf r-base-dev python-tk liborc-0.4-0 liborc-0.4-dev libasound2-dev python-gtk2 libzmq1 libzmq-dev python-requests python-sphinx libcomedi-dev python-setuptools

On Fedora 21 systems, run:

sudo yum -y groupinstall "Engineering and Scientific" "Development Tools" "Software Development Tools" "C Development Tools and Libraries"

sudo yum -y install fftw-devel cppunit-devel wxPython-devel boost-devel alsa-lib-devel numpy gsl-devel python-devel pygsl python-cheetah python-mako python-lxml PyOpenGL qt-devel qt qt4 qt4-devel PyQt4-devel qwt-devel qwtplot3d-qt4-devel libusbx-devel cmake git wget python-docutils cppzmq-devel PyQwt PyQwt-devel qwt-devel gtk2-engines xmlrpc-c-"\*" tkinter orc orc-devel python-sphinx SDL-devel swig zeromq2-devel python-zmq comedilib comedilib-devel thrift-devel python-thrift scipy zeromq zeromq-devel

On Fedora 22, 23, 24 and 25 systems, run:

sudo dnf -y groupinstall "Engineering and Scientific" "Development Tools" "C Development Tools and Libraries"

sudo dnf -y install fftw-devel cppunit-devel wxPython-devel boost-devel alsa-lib-devel numpy gsl-devel python-devel pygsl python-cheetah python-mako python-lxml PyOpenGL qt-devel PyQt4-devel qwt-devel qwtplot3d-qt4-devel libusbx-devel cmake python-docutils PyQwt PyQwt-devel gtk2-engines xmlrpc-c-"\*" tkinter orc-devel python-sphinx SDL-devel swig perl-ZMQ-LibZMQ2 perl-ZMQ-LibZMQ2 zeromq zeromq-devel python-requests gcc-c++ doxygen zeromq-ada-devel cppzmq-devel perl-ZeroMQ amavisd-new-zeromq amavisd-new-snmp-zeromq php-zmq python-zmq czmq uwsgi-logger-zeromq comedilib comedilib-devel pygtk2 ncurses-"\*" thrift-devel python-thrift scipy

After installing the dependencies, you should reboot the system.

If the installation of the dependencies completes without any errors, then you can proceed to build and install UHD and GNU Radio.