RISC-V eXpress Installation Manual

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v2025-07-10 or later

Contents

1 Overview

- This manual explains how to install RVX on a local machine using the RVX design git repository.

2 Notice

- All results produced using RVX are subject to the following conditions:
  - They must not be used beyond the predefined purpose and scope specified in advance for a particular class or research project.
  - They must not be distributed to third parties other than the designated users or organizations.
  - They are free for non-commercial research use, provided that the paper is cited. All other uses require prior approval and a technology transfer agreement.

3 Things to Know

- Manuals are available online - `riscvexpress.github.io`
- Any part starting with `#` should be replaced or modified according to your environment.
- On Linux, use the `bash` shell for command-line operations.
- On Windows, use the `Windows Power Shell` for command-line operations.
- Skills for Linux
- Skills for Windows

4 Requirements

- License Tools
  - Mixed-language RTL Simulator: Modelsim/Questa or Xcelium/NCSim/Incisive
  - FPGA Tool: Xilinx Vivado 2022.1 or later
- A High-Performance Computer
  - A capable machine is required to run license tools efficiently.
  - The actual performance needed depends on the specific license tools being used.
  - Note: the RVX engine itself does not require a high-performance machine.
- Recommended OS Version
  - Must be compatible with license tools, not just RVX.
  - RVX-compatible OS
    - CentOS 7 / 8
    - Redhat 8 / 9
    - Ubuntu 18 / 20 / 22 (recommended) / 24
    - Windows 10 Home / Enterprise
    - Windows 11 Home
- For Linux systems, the locale setting must be `en_US.UTF-8`.
  - If using a GUI, set the language format to United States.
  - Or, comment out the line `SendEnv LANG LC*` in `/etc/ssh/ssh_config`
    - i.e., add a `#` at the beginning).
- User Account
  - Linux: Requires `sudo` privileges
  - Windows: Requires administrator rights
- RVX Design Git Repository
  - Build your own design repository (See Repository Setup Manual)
  - Or, use the repository provided by the instructor for the lecture
- RVX Server Information (RVX-cloud Only)
  - IP address, SSH port, account, password
  - Provided by the instructor or project supervisor
  - Account must not be shared between multiple computers.

5 Step 1

5.1 Overview

Install the environments for Git, make, and python3.
These are commonly used programs,
so any installation method is acceptable as long as the [Objective] is met.

5.2 Git Program

5.2.1 Objective

```
Install and verify Git version 1.8.2 or later.
```

5.2.2 Check

```
cmd) git -version
```

5.2.3 Instruction @ CentOS

```
cmd) sudo yum install git
```

5.2.4 Instruction @ Ubuntu

```
cmd) sudo apt-get install git
```

5.2.5 Instruction @ Windows

Use Microsoft Store.
Or, `https://git-scm.com/download/win`

5.2.6 Instruction @ Any OS

If the version above does not meet the required specifications,
please manually locate and install the appropriate version.

5.3 Python3

5.3.1 Objective

```
Install and verify a Python version between 3.8 and 3.10.
```

5.3.2 Check

Depending on your environment, the command may be python3 or python.

```
cmd) python3 -version or python -version
```

5.3.3 Instruction @ CentOS

```
cmd) sudo yum install python3.X
```

5.3.4 Instruction @ Ubuntu

```
cmd) sudo apt-get install python3.X python3.X-distutils
```

5.3.5 Instruction @ Linux (Alternative)

```
cmd) sudo yum install gcc zlib zlib-devel openssl openssl-devel
cmd) wget https://www.python.org/ftp/python/3.8.16/Python-3.8.16.tar.xz
cmd) tar xvf Python-3.8.16.tar.xz
cmd) cd Python-3.8.16; ./configure; make; sudo make install
```

5.3.6 Instruction @ Windows

Search for python3 in Microsoft Store and install version 3.8.
Versions between 3.8 and 3.10 are acceptable.

5.3.7 Instruction @ Windows (Alternative)

Download and install version 3.9.12 from python.org.
Any version between 3.8 and 3.10 is acceptable,
but make sure to choose one that includes a Windows installer.
During installation, be sure to check Add Python 3.x to PATH.
If you forgot to do this, manually add the following directories to your PATH variable:

- ex) C:\Users\kshan\AppData\Local\Programs\Python\Python3x
- ex) C:\Users\kshan\AppData\Local\Programs\Python\Python3x\Scripts

5.4 Make

5.4.1 Objective

```
Set up an environment that supports Makefile execution.
```

5.4.2 Instruction @ Linux

No additional installation is required.

5.4.3 Instruction @ Windows

Install using the Complete package from
`http://gnuwin32.sourceforge.net/packages/make.htm`
After the installation, add the following directories to your PATH variable:

- C:\Program Files (x86)\GnuWin32\bin

6 Step 2

6.1 Overview

```
Clone the RVX design git repository and set up a Python3 environment for RVX.
Check whether Python3 is installed and configured properly.
Resolve conflicts when multiple versions of Python3 are installed.
```

6.2 Git Repository Cloning

6.2.1 Instruction @ Any OS

```
inst) Open a terminal.
inst) Navigate to the parent directory where you want to clone.
cmd) git clone --recursive #(design repository URL)
cmd) cd #(cloned directory)
cmd) git submodule init
cmd) git submodule update
```

6.3 Python3 Configuration for RVX

6.3.1 Objective

```
Set the python3 command used in RVX.
```

6.3.2 Check

```
cmd) cd #(cloned directory)
cmd) make check_python
```

6.3.3 Instruction @ Linux

```
cmd) cd #(cloned directory)
cmd) make config_python
inst) Verify that ‘‘rvx_python_config.mh’’ is generated.
inst) Open ‘rvx_python_config.mh’ in a text editor
> If no path is listed, manually enter the path to the executable.
> If more than one path is listed, keep only the one you intend to use and
delete the others.
```

6.3.4 Instruction @ Windows

```
cmd) cd #(cloned directory)
cmd) make config_python
inst) Verify that ‘rvx_python_config.mh’ and ‘python3.bat’ are generated.
inst) Do NOT modify ‘rvx_python_config.mh’
inst) Open ‘python3.bat’ in a text editor
> If no path is listed, manually enter the path to the executable.
> If more than one path is listed, keep only the one you intend to use and
delete the others.
> Do NOT remove ‘%*’ at the end of the line.
> If the directory name contains spaces, enclose it in double quotation marks as
shown below.
ex) C:\Users\‘‘Kyuseung Han’’\... %*
```

6.4 Python3 Library Install

6.4.1 Objective

```
Install python3 libaries.
```

6.4.2 Check

```
cmd) make check_pip
```

6.4.3 Instruction @ Any OS

```
cmd) make pip
```

If you encounter any issues, try:

```
cmd) make fix_pip
```

6.5 Preparation

6.5.1 Instruction @ Linux

```
cmd) cd #(cloned directory)
cmd) make prepare
> Check that the file ./rvx_setup.sh has been created.
inst) Add the line source #(cloned directory)/rvx_setup.sh to your .bashrc.
> Be sure to replace #(cloned directory) with the absolute path before adding
it.
inst) To apply the changes to .bashrc, close and reopen the terminal.
> Now, #(cloned directory) is registered as ${RVX_MINI_HOME}.
```

6.5.2 Instruction @ Windows

```
cmd) cd #(cloned directory)
cmd) make install
inst) Update the PATH variable
> If a message indicates that it was updated successfully, proceed to the next
step.
> If a WARNING appears, manually add “#(cloned directory)\windows_binary” to the
PATH.
inst) To apply the changes to PATH variable, close and reopen the terminal.
> Now, #(cloned directory) is registered as ${RVX_MINI_HOME}.
```

6.6 Install Check

6.6.1 Objective

```
Check which installation process has issues
```

6.6.2 Instruction @ Any OS

```
cmd) cd #(cloned directory)
cmd) make check
```

7 Step 3

7.1 Olimex Driver (Windows Only)

7.1.1 Instruction @ Windows

```
inst) Connect the Olimex ARM-USB-TINY-H cable to your computer.
inst) Run the zadig program
> Run ‘zadig-2.5.exe’ from the ${RVX_MINI_HOME}\windows_binary directory.
> Or, Download it from ‘https://zadig.akeo.ie’ and run it.
inst) In the zadig program,
> Select [Olimex OpenOCD JTAG ARM-USB-TINY-H (Interface 0)].
> Click [Install Driver].
> Select [Olimex OpenOCD JTAG ARM-USB-TINY-H (Interface 1)].
> Click [Install Driver].
```

7.2 Telnet (Windows Only)

7.2.1 Instruction @ Windows

```
inst) Open [Control Panel]
> e.g., type ‘control’ into the Windows Search bar.
inst) Click [Programs]
inst) Click [Turn Windows features on or off]
inst) Enable [Telnet Client]
inst) Confirm
```

8 Step 4

Carefully install the license programs you intend to use
by following their respective manuals.
Add the installation directory to the PATH environment variable.
On Windows, it may be added automatically.
During Vivado installation, don't forget to install all devices.

9 Step 5 for RVX-free

9.1 Activation

9.1.1 Objective

```
This step activates RVX functionality by installing the RVX components.
```

- For RVX-free, if the repository has been newly cloned or updated, this step must be executed at least once.

9.1.2 Instruction @ Linux

```
cmd) cd ${RVX_MINI_HOME}
cmd) make activate
cmd) source rvx_setup.sh
```

10 Step 5 for RVX-cloud

10.1 Synchronization

10.1.1 Objective

```
This step fetches the latest version of the RVX components from the RVX server.
```

- You must run this at least once after receiving the repository.
- After the first run, it will be automatically triggered during the update process.
- During synchronization, you will be prompted to enter your RVX server account credentials.
- Make sure you know your account credentials in advance.
- These credentials will be saved in ${RVX_MINI_HOME}/.rvx_server_config.
- If you need to change your RVX account info, simply delete that file.

10.1.2 Instruction @ Any OS

```
cmd) cd ${RVX_MINI_HOME}
cmd) make sync
> When prompted for SSH access, answer 'no'.
```

10.2 Force Synchronization

10.2.1 Objective

```
Run this if an issue occurs during the sync process.
```

10.2.2 Instruction @ Any OS

```
cmd) cd ${RVX_MINI_HOME}
cmd) make resync
```

11 Miscellaneous

11.1 Checking RVX Version

```
cmd) cd ${RVX_MINI_HOME}
cmd) make rvx_version
```

11.2 Handling Configuration Files

- If you encounter configuration issues,
  delete the relevant file(s) from the list below and try again:
  - ${RVX_MINI_HOME}/.rvx_path_config
  - ${RVX_MINI_HOME}/.rvx_sudo_config
  - ${RVX_MINI_HOME}/.rvx_tool_config
  - ${RVX_MINI_HOME}/.rvx_server_config
- If you delete ${RVX_MINI_HOME}/.rvx_key,
  make sure to also delete all of the files listed above.

11.3 Changing RTL Simulators

The RTL simulator used in RVX is automatically selected based on
the executable file found in the system's `PATH` environment variable.
If automatic selection fails,
the simulator's installation path has not been added to the `PATH`.
If multiple simulators are installed,
you can manually select one by modifying the settings as described below.

1. Open ${RVX_MINI_HOME}/.rvx_path_config with a text editor.
2. Set the value of `rtl_simulator` to one of the following:
   - xcelium, ncsim, modelsim

11.4 Accessing RVX Platform Examples

```
cmd) cd ${RVX_MINI_HOME}
cmd) make example
```

11.4.1 Instruction @ Any OS

```
inst) If you have any work in progress, backup it.
cmd) cd ${RVX_MINI_HOME}
cmd) git checkout .
cmd) git pull origin master
cmd) git submodule init
cmd) git submodule update
cmd) make reconfig_python
cmd) make pip3
cmd) make config
inst) close and reopen the terminal.
```

11.5 Updating (RVX-cloud Only)

If an update message appears during usage, follow the steps below.
After the update, you need to clean the platform and restart with `make syn`.

11.5.1 Instruction @ Linux

```
inst) If you have any work in progress, backup it.
cmd) cd ${RVX_MINI_HOME}
cmd) ./update.sh
inst) close and reopen the terminal.
```

11.5.2 Instruction @ Linux

```
inst) If you have any work in progress, backup it.
cmd) cd ${RVX_MINI_HOME}
cmd) update.bat
inst) close and reopen the terminal.
```

11.6 Updating Manually (RVX-cloud Only)

Performed at the request of the administrator.
After the update, you need to clean the platform and restart with `make syn`.

12 Navigate

- Home