



Quick Start Guide

IMPINJ R700 EMBEDDED TOOLKIT

QUICK START GUIDE

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OVERVIEW

The Impinj R700 embedded toolKit (Impinj R700 ETK) provide the tools required to develop applications for an Impinj R700 RAIN RFID reader. The Impinj R700 ETK contain cross-compilation toolchains, third-party and Impinj libraries, and header files. Wherever possible both dynamic and static libraries are provided. It also contains tools for the host (development) machine that facilitate the software development process (e.g. gdb) and for packaging an application to be installed on a reader.

This guide explains how to use the Impinj R700 ETK version that accompanies the Impinj R700 firmware version 7.5.x.x.

CREATE A LINUX ENVIRONMENT

Use of the Impinj R700 ETK requires a GNU/Linux Operating System. This guide uses Ubuntu 20.04.

Ubuntu 20.04

Using your preferred method (Desktop, Virtual Machine, Vagrant, etc.) create a Linux environment. This guide assumes the following commands have been run successfully against that Ubuntu 20.04 Linux system, at a minimum:

```
[user@machine]$ dpkg --add-architecture i386
[user@machine]$ sudo apt-get update --fix-missing
[user@machine]$ sudo apt-get install -y apt-utils
[user@machine]$ sudo DEBIAN_FRONTEND=noninteractive apt-get install -y build-essential
[user@machine]$ sudo DEBIAN_FRONTEND=noninteractive apt-get install -y cmake
[user@machine]$ sudo DEBIAN_FRONTEND=noninteractive apt-get install -y libc6-i386
[user@machine]$ sudo DEBIAN_FRONTEND=noninteractive apt-get install -y libssl-dev
[user@machine]$ sudo DEBIAN_FRONTEND=noninteractive apt-get install -y zlib1g:i386
```

Note: In the above commands, vim is installed to perform file editing. Feel free to install any editor of your choosing.

SETTING UP A DEVELOPMENT ENVIRONMENT

Download the Impinj R700 ETK

From the [Impinj Support Portal](#), download the Impinj R700 7.5.0_Octane_Embedded_Development_Tools.tar.gz file.

Extract the Impinj R700 ETK

Navigate to the folder where the tarballs are located. Use the following commands to extract the Impinj R700 ETK

```
[user@machine]$ tar xzfv 7.5.0_Octane_Embedded_Development_Tools.tar.gz
[user@machine]$ cd 7.5.0_Octane_Embedded_Development_Tools
```

Now your environment is ready to compile code to run on the Impinj R700.

Note: The commands in this guide assume they begin in the 7.5.0_Octane_Embedded_Development_Tools folder.

CONFIGURING AND COMPILING A SAMPLE APPLICATION

Documentation

Building the example applications that come with the Impinj R700 ETK can be done by either reading the rest of this manual or reading the examples/README.md file

```
[user@machine]$ cat examples/README.md
```

Compile the Application

Execute the build.sh script in the folder of the c or c++ (aka cxx) language you want to use.

```
[user@machine]$ rm -f examples/output examples/ltk-c/output examples/ltk-cxx/output
[user@machine]$ cd examples/ltk-c/ && ./build.sh
[user@machine]$ cd examples/ltk-cxx/ && ./build.sh
```

Docker Integration

Impinj R700 ETK version 7.5 introduces support for the development environment to be run via a Docker container instead of natively on the host machine. You are required to have Docker installed on your system to be able to use this approach. Should you decide to use it, please refer to the instructions in the examples/README.md file or just issue the following commands if you have Docker installed:

```
[user@machine]$ rm -f examples/output examples/ltk-c/output examples/ltk-cxx/output
[user@machine]$ cd examples && ./dockerized.sh /bin/bash
[user@docker_machine]$ cd /etk/examples/ltk-c/ && ./build.sh
[user@docker_machine]$ cd /etk/examples/ltk-cxx/ && ./build.sh
[user@docker_machine]$ cd ../../
```

Note: The examples/output folder is being removed prior to building the Docker container to prevent prior compilation errors from appearing.

Note: The commands in this guide assume they begin in the /etk folder if Docker is being used.

BUILDING THE INSTALLATION PACKAGE

Besides using FTP to transfer the files directly to a reader, one of the best ways to copy the cross-compiled application onto Impinj readers is through a package (aka CAP) file. The R700 reader has a “.upgx” package file.

Modify the Example to Meet your Request

Running the sample application may require you to update the NUM_ANTENNAS value in the main.cpp file. Please edit the main.cpp file and update the NUM_ANTENNAS variable to the number that the reader you plan to run on supports.

```
[user@machine]$ vi examples/cap/main.cpp
```

Build CAP File

Impinj R700 ETK now has a folder for creating a sample application and putting it into a cap folder for placement into a cap.upgx file. Here is how to create that cap file:

```
[user@machine]$ make -C examples/cap
[user@machine]$ ls -l examples/cap/cap/
total 21652
-rwxr-xr-x 1 root root 22162308 Mar 10 16:15 example
-rwxr-xr-x 1 root root      63 Mar 10 16:15 start
drwxr-xr-x 2 root root   4096 Mar 10 16:15 sys
```

In an upcoming section, there will be instructions for how to build the cap file using one of the example programs.

Note: Impinj R700 ETK version 7.5 introduces a start file in the cap folder to automatically start the example program after reboot and continually loop that example if it were to crash or exit:

```
[user@machine]$ cat examples/cap/cap/start
#!/bin/bash

while true; do
    /cust/example
    sleep 1
done
```

Please remove this file prior to creating the cap file if you plan to manually start the application instead.

Note: There are instructions below to manually stop the processes on the reader if you leave the start file in-place.

Impinj R700 CAP File

The Impinj R700 cap file ends in “.upgx”

```
[user@machine]$ ls -l examples/cap/cap.upgx
-rw-r--r-- 1 root root 8280276 Mar 10 16:15 examples/cap/cap.upgx
```

Copy All Files into the CAP Directory

Copy all the files that you want to show up on the reader (in directory “/cust”) in the “cap” directory. By default, you need to copy the LTK library docsample arm binaries into the “cap” directory. Here is how to copy the first docsample into the cap folder.

```
[user@machine]$ cd examples
[user@machine]$ cp ltk-c/output/target/docsample1/docsample1    cap/cap/docsample1_c
[user@machine]$ cp ltk-cxx/output/target/docsample1/docsample1  cap/cap/docsample1_cxx
[user@machine]$ cd ..
```

The CAP Description File

With version 7.5 of Impinj R700 ETK, the cap_description.in file already exists. Using the text editor of your choice, edit the cap_description.in file to make any appropriate changes for your application.

```
[user@machine]$ vi examples/cap/cap_description.in
```

Example Impinj R700 CAP Description File

```
# Upgrade Description File
#
# This file contains the settings used by the upgrade generation tool
# to produce an Impinj firmware upgrade file.
[Description]

# Version is a 4 part number in decimal with each part limited to
# 0-255. It is the version of the upgrade file to be generated.
Version = 1.2.3.4

# Valid Reader Hardware is a 3 part number in decimal representing
# the reader model and major/minor revisions on which the upgrade may be
# loaded. Each field may be replaced by the wildcard '*' or '255',
# which matches any.
# Format = aaa.bbb.ccc
#  aaa - Model number
#  bbb - Major revision
#  ccc - Minor revision
Valid Reader Hardware = R700

# File System Layout is an value used by the reader to determine how
# the upgrade partition should be loaded to flash. Currently the only
# supported layout version is 10.
File System Layout = 10
```

```
# Input Directory is the top-level directory of the filesystem to
# create. The files under this directory will be available on the
# reader under /cust after the upgrade is loaded.
Input Directory = ./cap

# Encrypt the upgrade filesystem content. Note this will be
# decrypted when the upgrade file is processed by the reader.
# The default is 'False' (don't encrypt)
#Encrypt = True

# Use the expanded NAND Flash partition sizes available on
# all Revolution based readers and gateways with PCBAs equal or
# greater than v5.00.
# The default is 'False' (build for all PCBAs).
#ExpandedNAND = True
```

Create a Reader Config File

Optionally, you may create a reader config file to specify the default oshell password to log into the oshell of the reader. With Impinj R700 ETK, the reader.conf file already exists. Using the text editor of your choice, edit the reader.conf file to make any appropriate changes for your application.

```
[user@machine]$ vi examples/cap/reader.conf
```

Using the text editor of your choice, copy the following text into reader.conf:

```
[rshell]
password=developer

[SoftwareFeatures]
StartFTP=yes
```

Create a CAP File

Impinj R700 ETK already comes with a makefile to build the cap.upgx in folder “examples/cap/” as seen previously. The following commands could also be used to generate the cap file using the files beneath folder “examples/cap/cap”.

Impinj R700 .upgx CAP file

```
[user@machine]$ cd examples/cap
[user@machine]$ PATH=$PATH:../../arm-toolchain/bin/
[user@machine]$ ../../cap_gen.sh -d cap_description.in -o cap.upgx
[user@machine]$ ls -l .
total 31444
```

```
-rw-r--r-- 1 1001 1001      1398 Mar 10 03:09 Makefile
drwxr-xr-x 3 root root      4096 Mar 10 16:20 cap
-rw-r--r-- 1 root root  9615572 Mar 10 16:23 cap.upgx
-rw-r--r-- 1 1001 1001      1470 Mar 10 03:09 cap_description.in
-rwxr-xr-x 1 root root 22162308 Mar 10 16:15 example
-rw-r--r-- 1 1001 1001     58837 Mar 10 03:09 main.cpp
-rw-r--r-- 1 root root  332956 Mar 10 16:15 main.o
-rw-r--r-- 1 1001 1001        61 Mar 10 03:09 reader.conf
-rwxr-xr-x 1 1001 1001        63 Mar 10 03:09 start
[user@machine]$ cd ../..
```

Update the CAP File Location

Copy or move the CAP (.upgx) file to a location that can be accessible to the Impinj R700 reader using the firmware upgrade mechanism of your choosing.

DEPLOYING AND RUNNING THE APPLICATION

Deploying the CAP

Using a web browser, navigate to your reader's WebUI, <http://impinj-AA-BB-CC> where AA-BB-CC are the last three octets of your reader's MAC address. Select the Browse button and navigate to the location of the CAP (.upgx) file. Select the Upgrade button. When the reader says reader for reboot, reboot the reader. After reboot take note of the reader's IP address.

Enter OSSHELL

Using putty SSH into the reader. When connected to RShell, use the following command to get access to the Linux shell.

```
> oshell developer
```

Stop the Running Application on Impinj R700

Before you test manually, it is important to stop the application if the start script is present beneath /cust/start. The following instructions will stop the example application running on the Impinj R700:

```
root@[reader]:~# cd /cust
root@[reader]:/cust# systemctl status cap
● cap.service - Octane Custom Application
   Loaded: loaded (/usr/lib/systemd/system/cap.service; enabled; vendor preset: enabled)
   Active: active (running) since Wed 2021-03-10 17:36:24 UTC; 4min 15s ago
   Process: 1222 ExecStart=/bin/launch_cust (code=exited, status=0/SUCCESS)
   Main PID: 1252 (start)
   CGroup: /system.slice/cap.service
           └─1252 /bin/bash /cust/start
           └─1474 /cust/example
```



```

Mar 10 17:40:39 USCANDYRDRBELT16252 launch_cust[1222]: User memory (Word 0)
: 00                                00
Mar 10 17:40:39 USCANDYRDRBELT16252 launch_cust[1222]: Tag report
Mar 10 17:40:39 USCANDYRDRBELT16252 launch_cust[1222]: -----
-----
Mar 10 17:40:39 USCANDYRDRBELT16252 launch_cust[1222]: Antenna ID : 2
Mar 10 17:40:39 USCANDYRDRBELT16252 launch_cust[1222]: EPC : 31D0-2E29-5D06-
09FE                                -7400-0000
Mar 10 17:40:39 USCANDYRDRBELT16252 launch_cust[1222]: Timestamp :
1615398039914                        294
Mar 10 17:40:39 USCANDYRDRBELT16252 launch_cust[1222]: Peak RSSI : -24
Mar 10 17:40:39 USCANDYRDRBELT16252 launch_cust[1222]: FastID :
E280119020004703                       B0DD0300
Mar 10 17:40:39 USCANDYRDRBELT16252 launch_cust[1222]: TID : E2801190
Mar 10 17:40:39 USCANDYRDRBELT16252 launch_cust[1222]: User memory (Word 0)
: 0000
root@[reader]:/cust# systemctl stop cap

```

Running the Application

Note: For Impinj R700, before running the example applications, please make sure the “Impinj LLRP Interface” is enabled.

Use the following commands to navigate to the /cust folder and execute the application:

```

cd /cust
./example 127.0.0.1
[Hit CTRL-C after the tag output appears]

./docsample1_c 127.0.0.1
[Hit CTRL-C after the tag output appears]

./docsample1_cxx 127.0.0.1
[Hit CTRL-C after the tag output appears]

```

The application will print the tags that are in the field of view of the reader:

```
root@USCANDYDRBELT16252:/cust# ./docsample1_c 127.0.0.1
INFO: Starting run 1 =====
INFO: 2 tag report entries
AABB-CCDD-A502-0060-161B-22F3
31D0-2E29-5D06-09FE-7400-0000
INFO: Starting run 2 =====
INFO: 2 tag report entries
31D0-2E29-5D06-09FE-7400-0000
AABB-CCDD-A502-0060-161B-22F3
INFO: Starting run 3 =====
^C
root@USCANDYDRBELT16252:/cust# ./docsample1_cxx 127.0.0.1
EPC: 31D0-2E29-5D06-09FE-7400-0000
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: 31D0-2E29-5D06-09FE-7400-0000
EPC: AABB-CCDD-A502-0060-161B-22F3
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EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
EPC: AABB-CCDD-A502-0060-161B-22F3
```

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