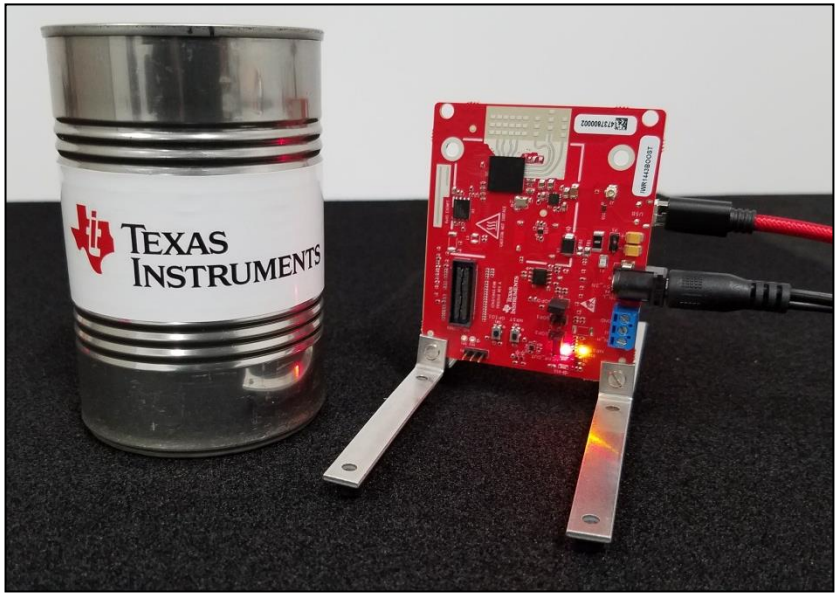
TI mmWave Training

xWR16xx mmWave Demo

Contents

Lab Overview

- Configurable visualization tool for processed radar data
- The following plots are available:
  - Scatter Plot
  - Range Profile
  - Noise Profile
  - Range Azimuth Heat Map
  - Range Doppler Heat Map
  - Statistics

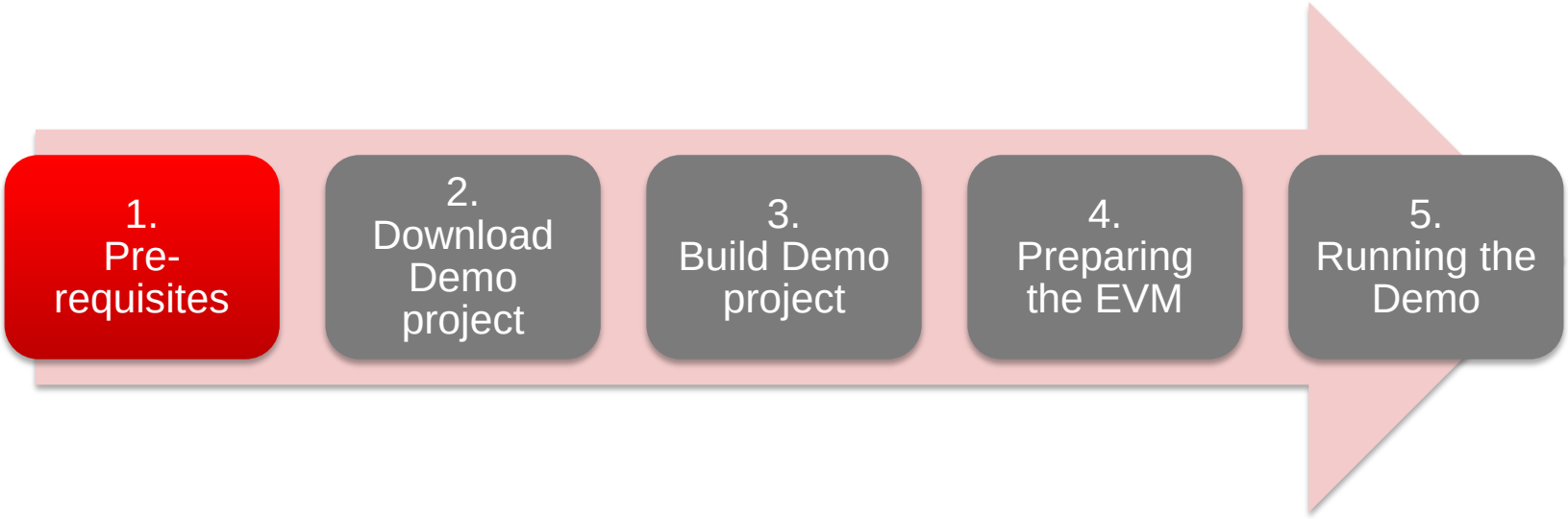


1. Requirements

- Software
  - **Pre-requisites**
    - Latest TI mmWave SDK and all related dependencies installed as mentioned in the mmWave SDK release notes.
  - Google Chrome with TI Cloud Agent Extension
    - For running the mmWave Demo Visualizer
    - Download from TI Cloud Agent or install when accessing the demo
  - mmWave SDK Demo
    - Download from TI Resource Explorer
  - UniFlash
    - For flashing firmware images onto
    - Download from TI.com/tool/uniflash
  - XDS110 Drivers
    - For EVM XDS device support
    - Included with CCS Installation, or standalone through TI XDS Emulation Software

- Hardware
  - xWR16xx EVM
  - Micro USB cable (included in the EVM package)
  - 5V/2.5A Power Supply
    - Purchase from Digikey

Steps

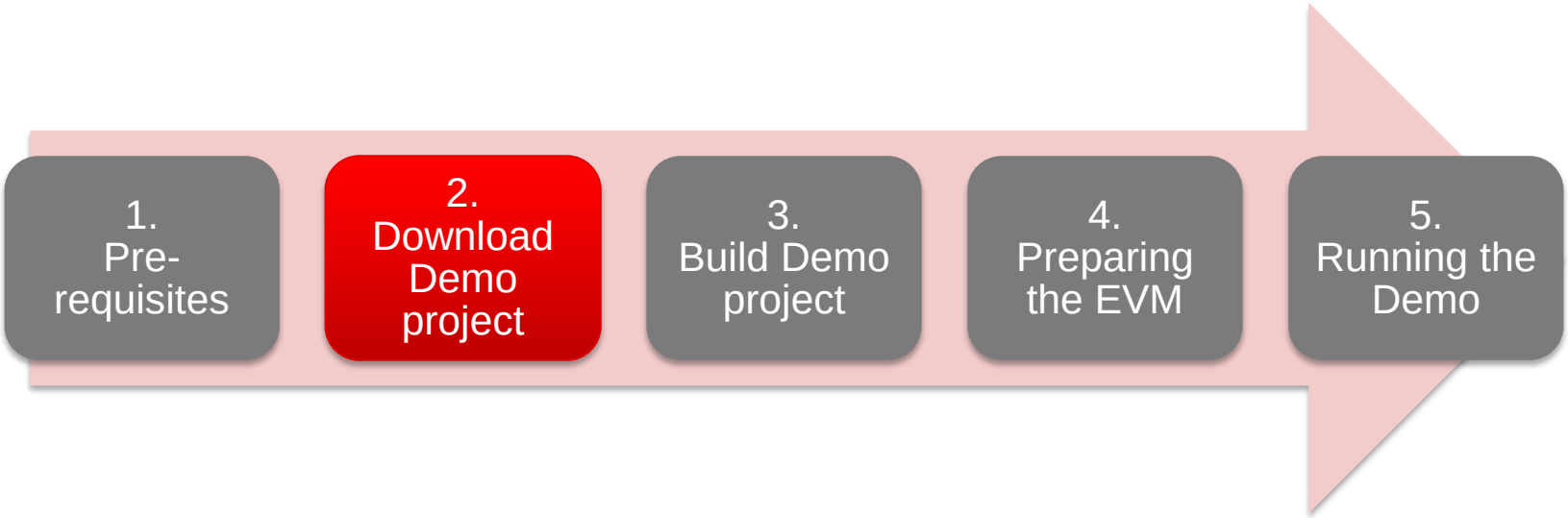

1. Pre-requisites
2. Download Demo project
3. Build Demo project
4. Preparing the EVM
5. Running the Demo

1. Pre-requisites

- It is assumed that you have the latest TI mmWave SDK and all the related tools installed as mentioned in the mmWave SDK release notes.
  - The mmWave SDK release notes include the links for downloading the required versions of the above tools.
  - Helpful Tips
    - Please make sure that any existing PERL installations are removed from the PC before installing the version of PERL listed in the SDK release notes
    - After you've downloaded and saved **CRC.pm**, locate the saved file and remove the .txt extension if it is there. Please ensure that the file has a **.pm** extension and not a .txt extension at the end
    - XDC tools are provided as a zip file which needs to be extracted in the TI install directory (typically C:\ti)
  - Note: For this video, we used mmWave SDK 1.0.0.5 and the snapshot shown here corresponds to **mmWave SDK 1.0.0.5**
- If you have already installed the mmWave SDK and all the required tools, you can move on to the next step i.e. downloading the lab on to your machine.

Tool	Version	Download link
CCS	7.1 or later	download link Please note that CCS v7.1 or later is mandatory. CCSv6.x cannot be used
TI SYS/BIOS	6.50.1.12 or later	download link
TI ARM compiler	16.9.1.LTS or later	Included in CCS v7.1
TI CGT compiler	8.1.3 or later	Included in CCS v7.1
XDC	3.50.00.10 or later	download link Use the installer that has no mention of JRE which by default has JRE (this installer will be bigger than the one without JRE). Also it is recommended that this be installed separately even if CCS has this version installed since the CCS version is without JRE.
C64x+ DSPLIB	3.4.0.0	Please download the installer for C64x+. download link
C674x MATHLIB (little-endian, elf/coff format)	3.1.2.1	Please download the installer for C674x. download link
Perl	5.20.2 or later	download link
CRC.pm	0.21	download link This is an add-on to the Perl installation. This file needs to be copied to <PERL installation folder>\perl\lib\Digest folder.
Mono JIT compiler	3.2.8	Only for Linux builds
mmwave device support packages	1.5.3 or later	Upgrade to the latest using CCS update process
TI Emulators package	6.0.0576.0 or later	Upgrade to the latest using CCS update process

Steps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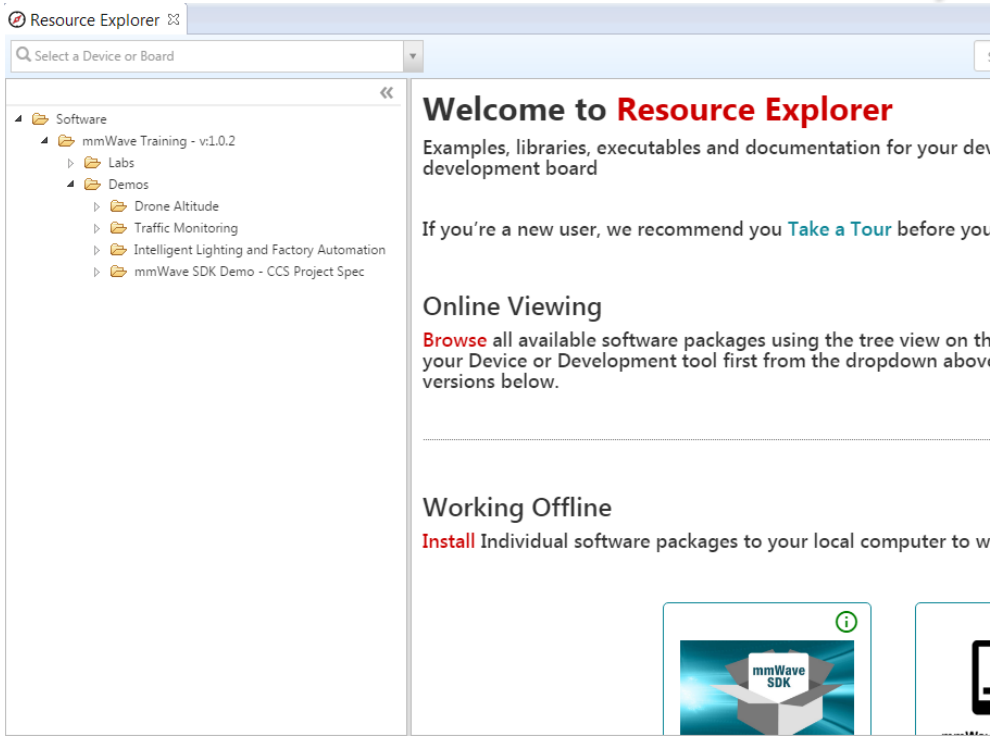
2. Download Demo project
3. Build Demo project
4. Preparing the EVM
5. Running the Demo

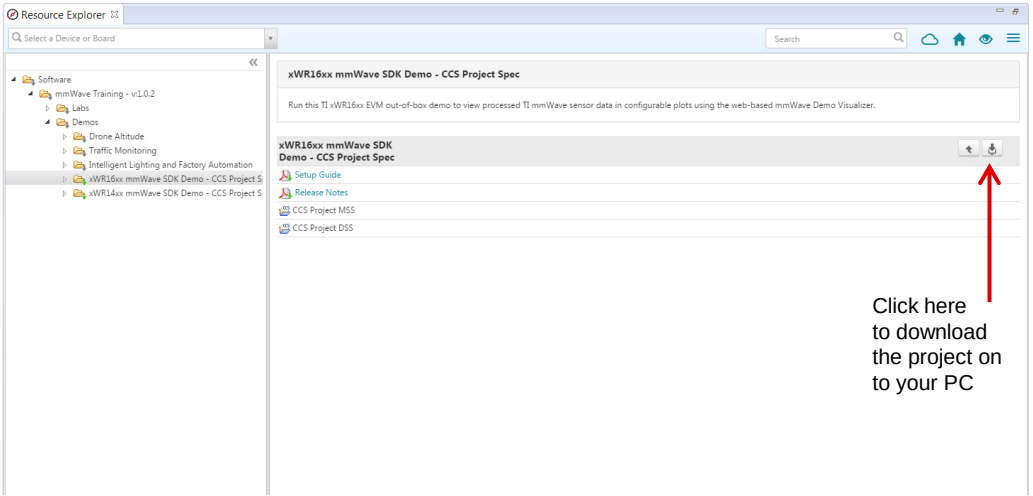
2. Download the Lab project

- The mmWave projects are available under **mmWave Training** in CCS Resource Explorer.
- To download the xWR16xxmmWave demo, start CCS v7.1 (or later) and select **View ► Resource Explorer** to open the Resource Explorer.
- In the Resource Explorer Window, select **Software ► mmWave Training ► Demos**.



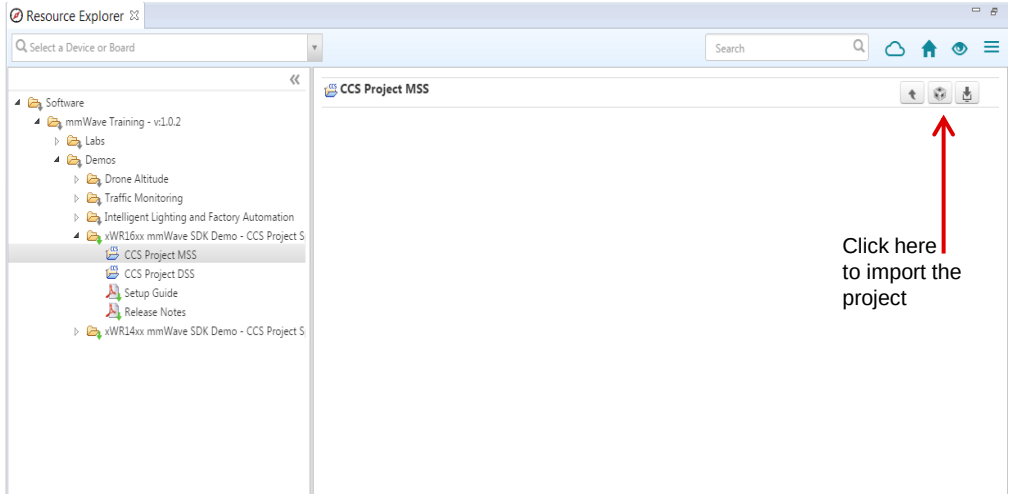
2. Download - continued

- Select the **xWR16xx mmWave SDK** demo in the left view.
- The right view shows the contents of the Lab which contains the CCS Project and the PC GUI.
- Click on the **Download and Install** button  in the top right corner as shown.
- Select the **Make Available Offline** option from the drop down to start downloading the Lab.



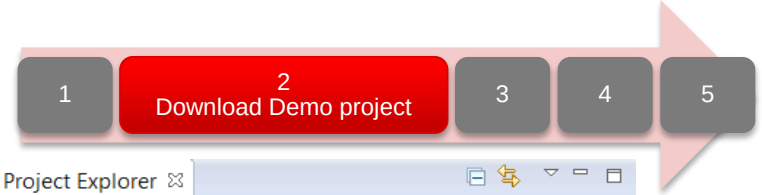
2. Download - continued

- The xWR16xx mmWave Demo consists of two CCS projects, one for the R4F core and one for the C674x DSP core
- The projects will be downloaded in C:\ti\mmwave_training
- Select the CCS Project MSS file in the left view
- Click on the **Import to IDE** button which should be visible in the right side view after a successful download.



- This copies the project in the user's workspace and imports it into the CCS project explorer.
  - It is important to note that the copy created in the workspace is the one that gets imported in CCS. The original project downloaded in mmwave_training is not touched.
- Repeat with the CCS Project DSS file

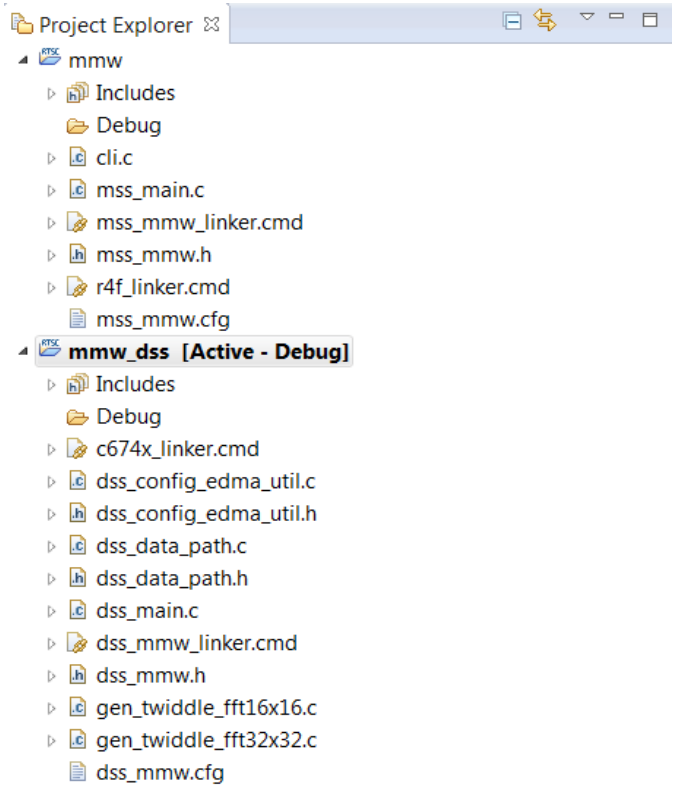
2. Download - continued



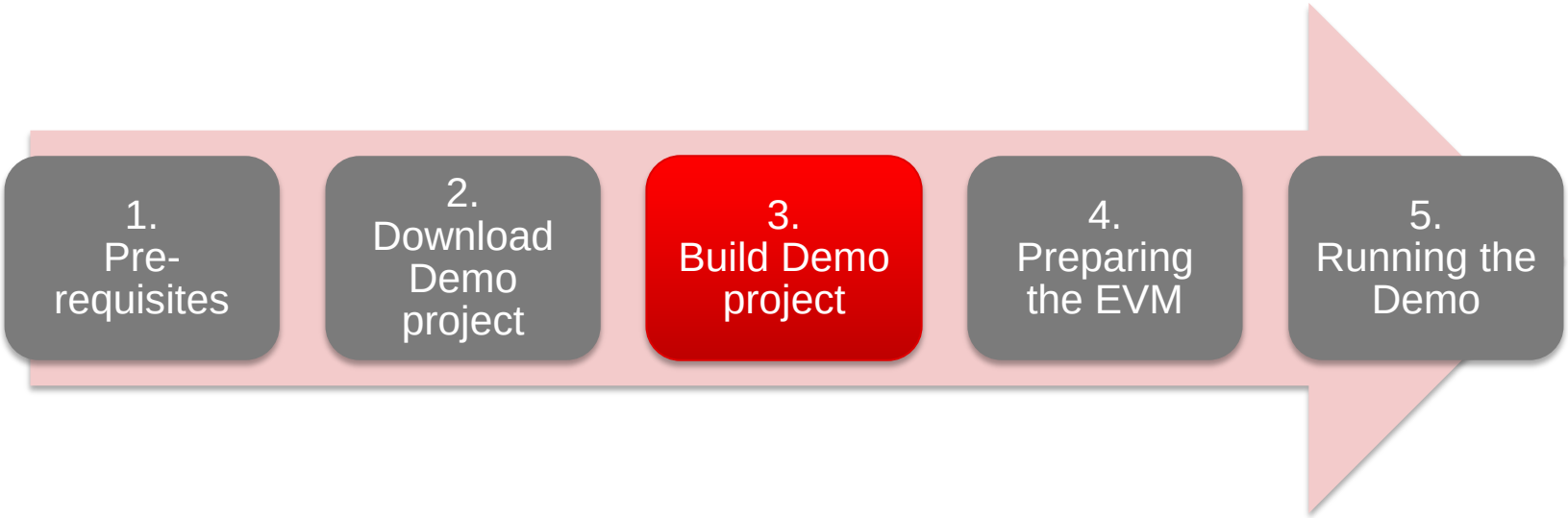
- After successfully completing the **Import to IDE** operation, the both projects should be visible in CCS Project Explorer as shown here.

- At this point, we have successfully downloaded the mmWave demo and imported it in CCS.

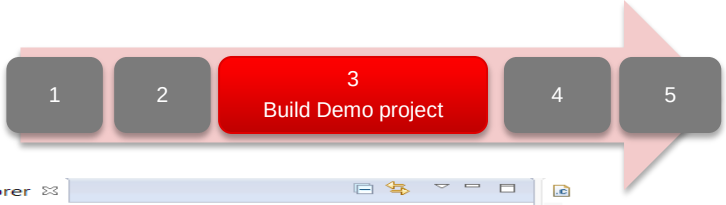
- We are ready to move on to the next step i.e. Building the projects.



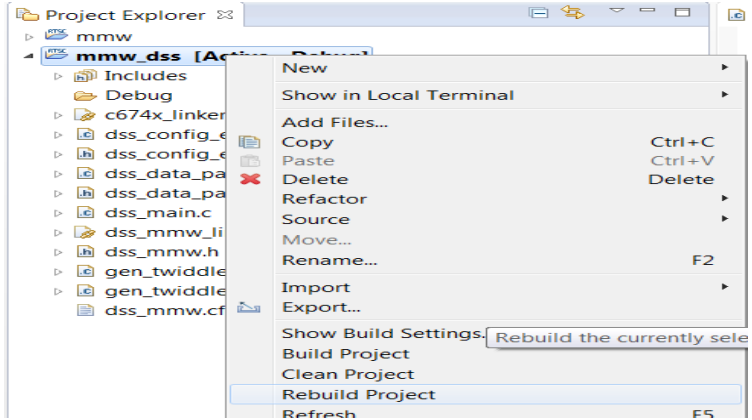
Steps


1.
Pre-
requisites
2.
Download
Demo
project
3.
Build Demo
project
4.
Preparing
the EVM
5.
Running the
Demo

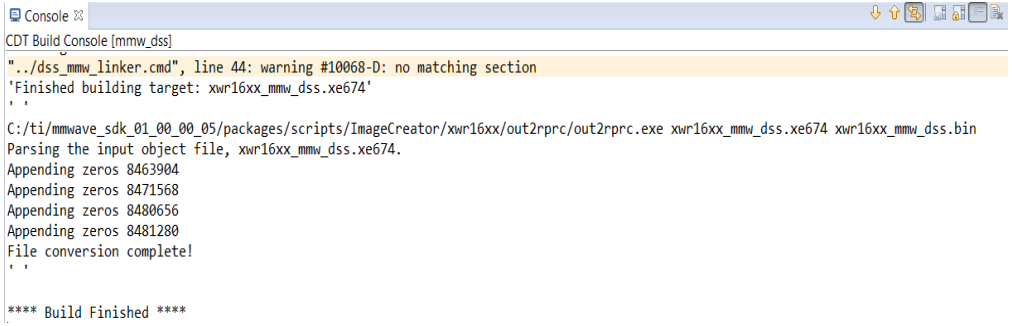
3. Build the Lab



- With the mmw_dss project selected in Project Explorer, right click on the project and select **Rebuild Project**.
  - Selecting **Rebuild** instead of **Build** ensures that the project is always re-compiled. This is especially important in case the previous build failed with errors.

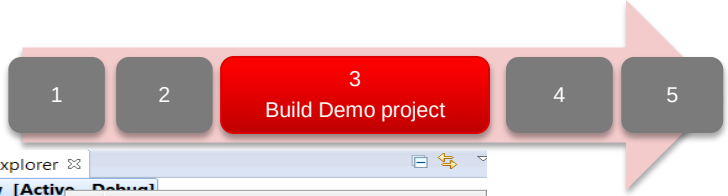


- On successful completion of the build, you should see the output in CCS console as shown here and the following two files should be produced in the project debug directory
  - xwr16xx_mmw_dss.xe674
  - xwr16xx_mmw_dss.bin

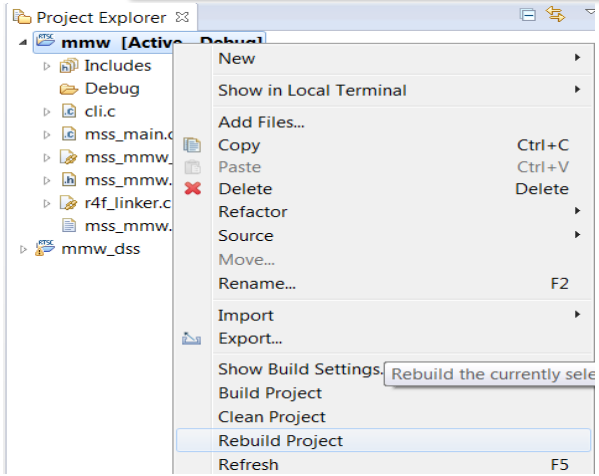


- If the build fails with errors, please ensure that all the pre-requisites are installed as mentioned in the mmWave SDK release notes.

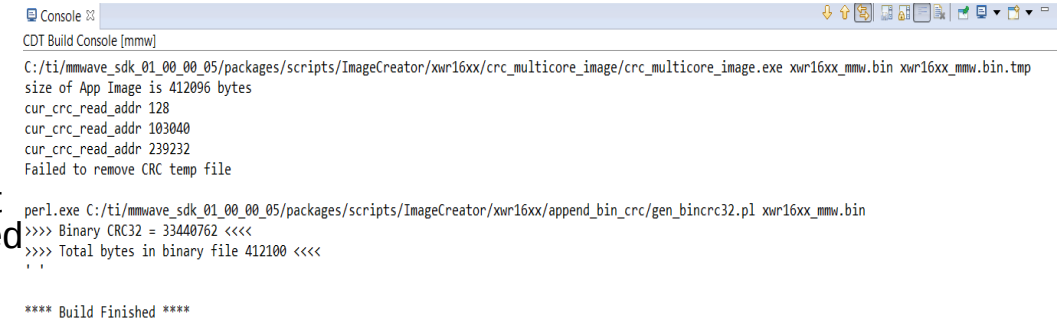
3. Build the Lab



- The mmw_dss project must be built BEFORE the mmw project is built.
- With the mmw project selected in Project Explorer, right click on the project and select **Rebuild Project**.

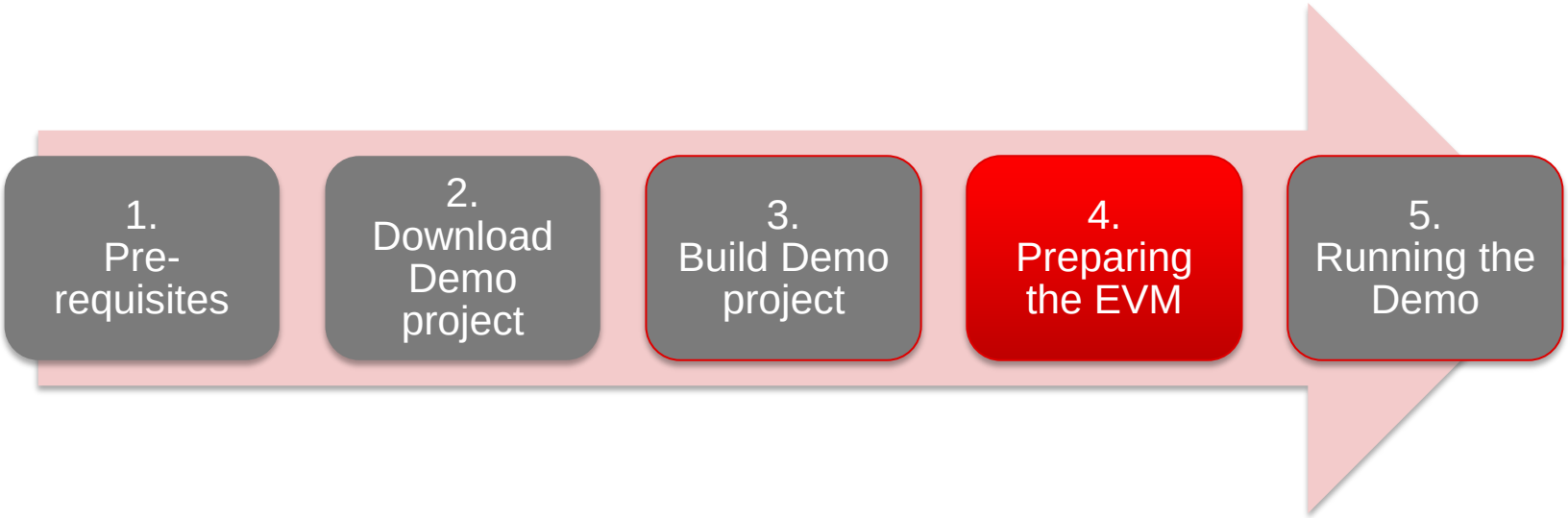


- On successful completion of the build, you should see the output in CCS console as shown here and the following three files should be produced in the project debug directory
  - xwr16xx_mmw_mss.xer4f
  - xwr16xx_mmw_mss.bin
  - xwr16xx_mmw.bin



- If the build fails with errors, please ensure that all the pre-requisites are installed as mentioned in the mmWave SDK release notes.

Steps


1.
Pre-
requisites
2.
Download
Demo
project
3.
Build Demo
project
4.
Preparing
the EVM
5.
Running the
Demo

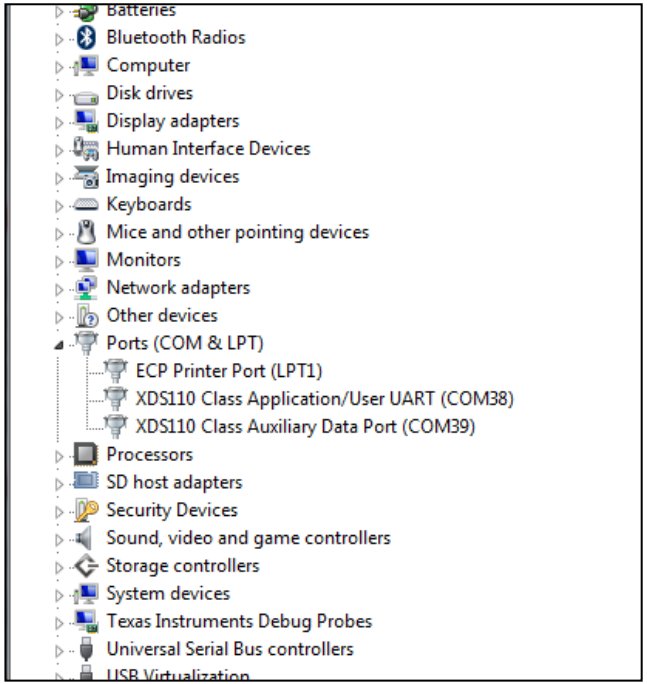
4.1 Preparing the EVM

- There are two ways to execute the compiled code on the EVM:
  - Deployment mode: Flashing the binary (.bin image) on to the EVM serial flash
    - In this mode, the EVM boots autonomously from flash and starts running the bin image.
  - Debug mode: Downloading and running the executable (.xer4f image and .xe674) from CCS.
    - You will need to flash a small CCS debug firmware on the EVM (one time) to allow connecting with CCS. This debug firmware image is provided with the mmWave SDK.
  - As a recap, the build process in Step 3 produces the .bin .xer4f and .xe674 images.

- This presentation explains the second method i.e. Debug mode (CCS).
  - To prepare the EVM for debug mode, we start with flashing the CCS debug firmware image.
  - Please note that the same flashing process can be used to flash the Lab binary to run it in deployment mode.

4.2 Connecting to the EVM

- Power on the EVM using a 5V/2.5A power supply.
- Connect the EVM to your PC and check the COM ports in Windows Device Manager
- The EVM exports two virtual COM ports as shown below:
  - XDS110 Class Application/User UART (COM_{UART}):
    - Used for passing configuration data and firmware to the EVM
  - XDS110 Class Auxiliary Data Port (COM_{AUX})
    - Used to send processed radar data output
- Note the COM_{UART} and COM_{AUX} port numbers, as they will be used later for flashing and running the Lab.

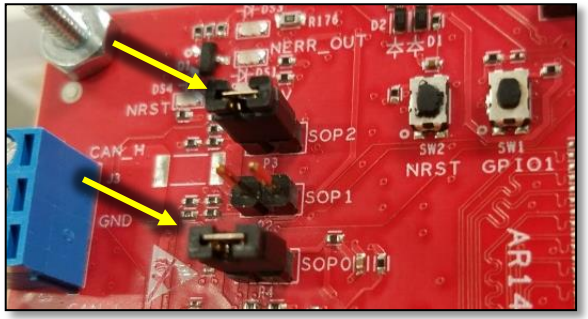


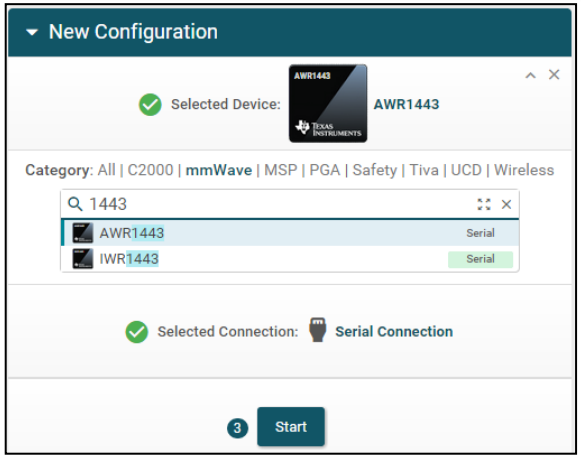
COM_{UART}: COM38 **COM_{AUX}**: COM39

- The actual port numbers on your machine may be different

4.3 Flashing CCS debug firmware

1. Put the EVM in flashing mode by connecting jumpers on SOP0 and SOP2 as shown in the image.
2. Open the **UniFlash** tool
3. In the **New Configuration** section, locate and select the appropriate device (xWR14xx)
4. Click **Start** to proceed





4.3 Flashing CCS debug firmware

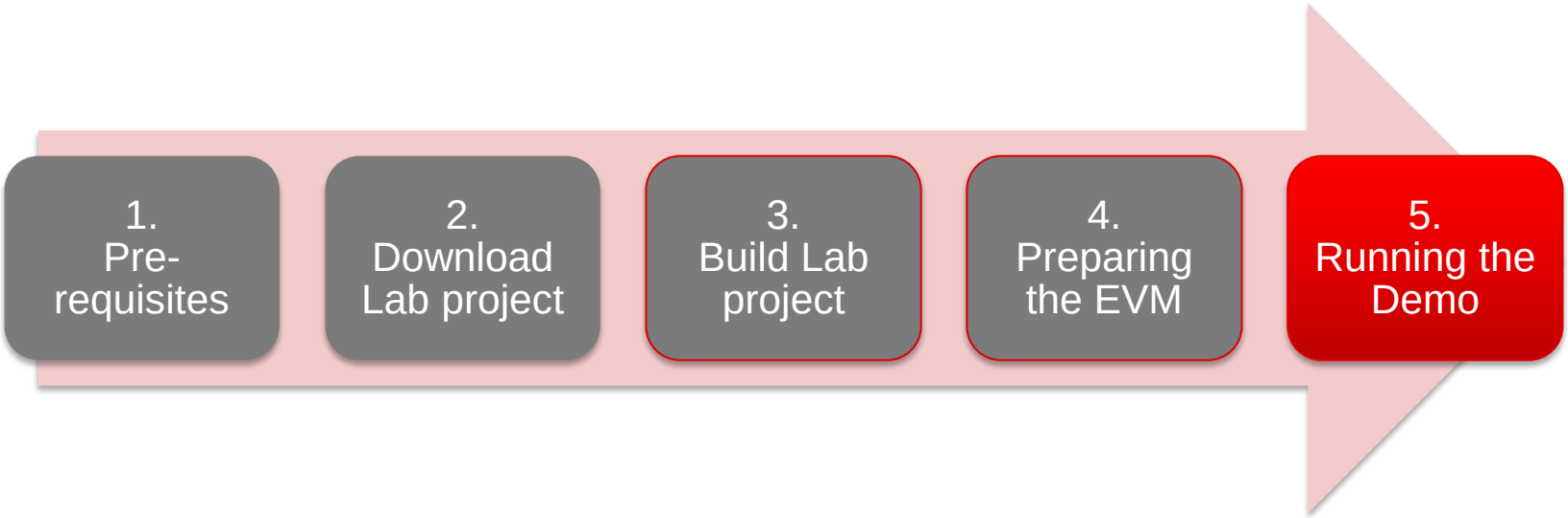
5. In the **Program** tab, browse and locate the CCS debug image shown below:

Image	Location
Meta Image 1	C:\ti\mmwave_sdk_<ver>\packages\ti\utils\ccsdebug

6. In the **Settings & Utilities** tab, fill the **COM Port** text box with the Application/User UART COM port number (**COM_{UART}**) noted earlier

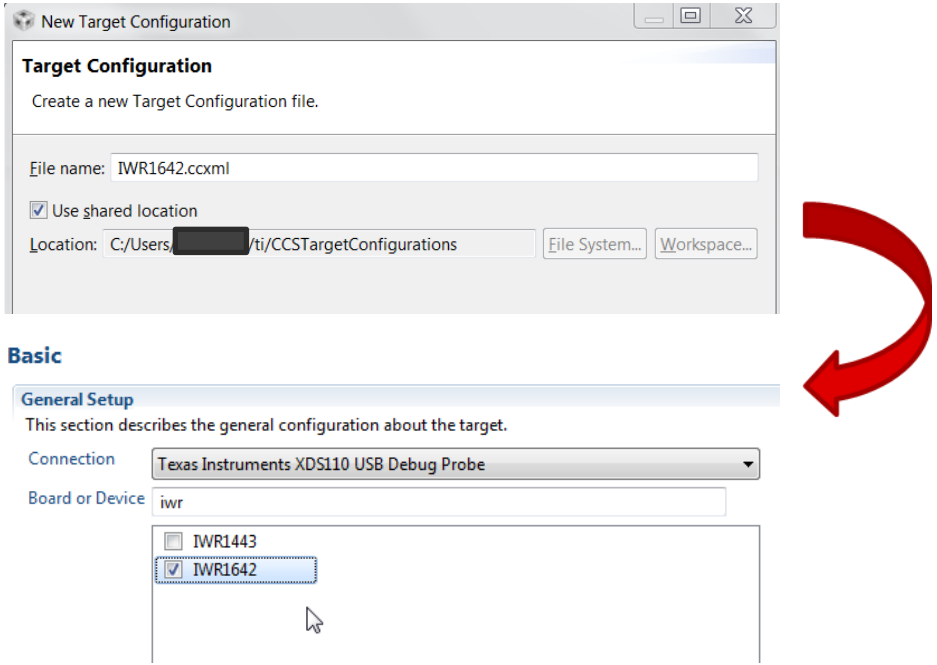
7. Return to the **Program** tab, power cycle the device and click on **Load Images**
8. When the flash procedure completes, UniFlash's console should indicate: [SUCCESS] Program Load completed successfully
9. Power off the board and remove the jumper from only header **SOP2.** Power the board back on (this puts the board back in functional mode)

Steps


1.
Pre-
requisites
2.
Download
Lab project
3.
Build Lab
project
4.
Preparing
the EVM
5.
Running the
Demo

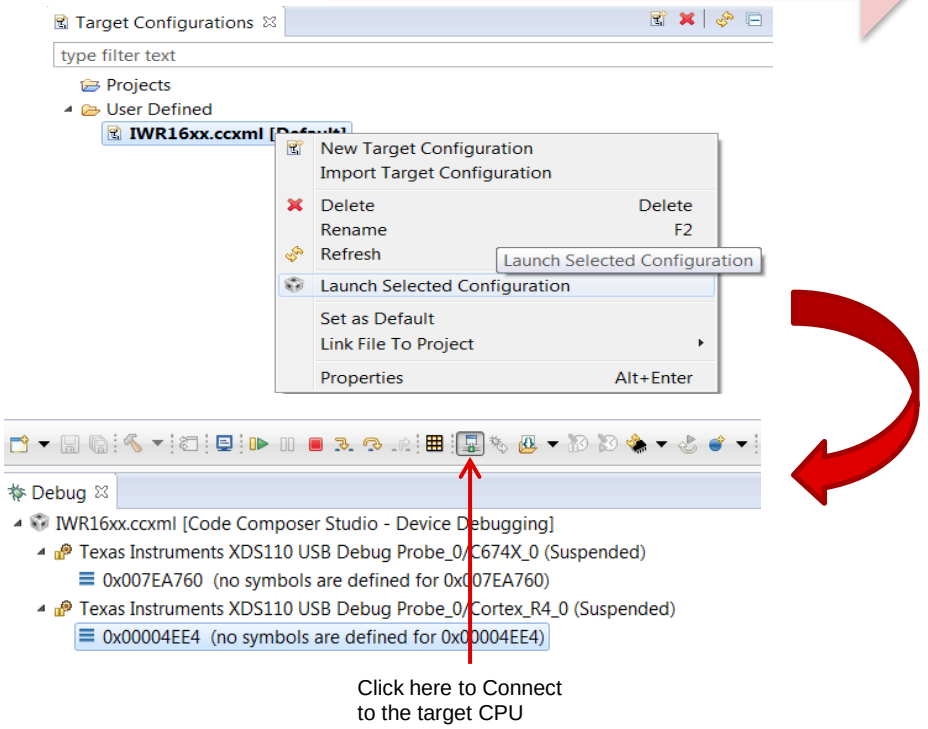
5.1 Connecting EVM to CCS

- It is assumed that you were able to download and build the Lab in CCS (completed steps 1, 2 and 3)
- To connect the Radar EVM to CCS, we need to create a target configuration
  - Go to File ► New ► New Target Configuration File
  - Name the target configuration accordingly and check the “Use shared location” checkbox. Press Finish
  - In the configuration editor window:
    - Select “Texas Instruments XDS110 USB Debug Probe” for **Connection**
    - Select **IWR1642** or **AWR1642** in the **Board or Device** list
    - Press the **Save** button to save the target configuration.
    - You can press the **Test Connection** button to check the connection with the board.



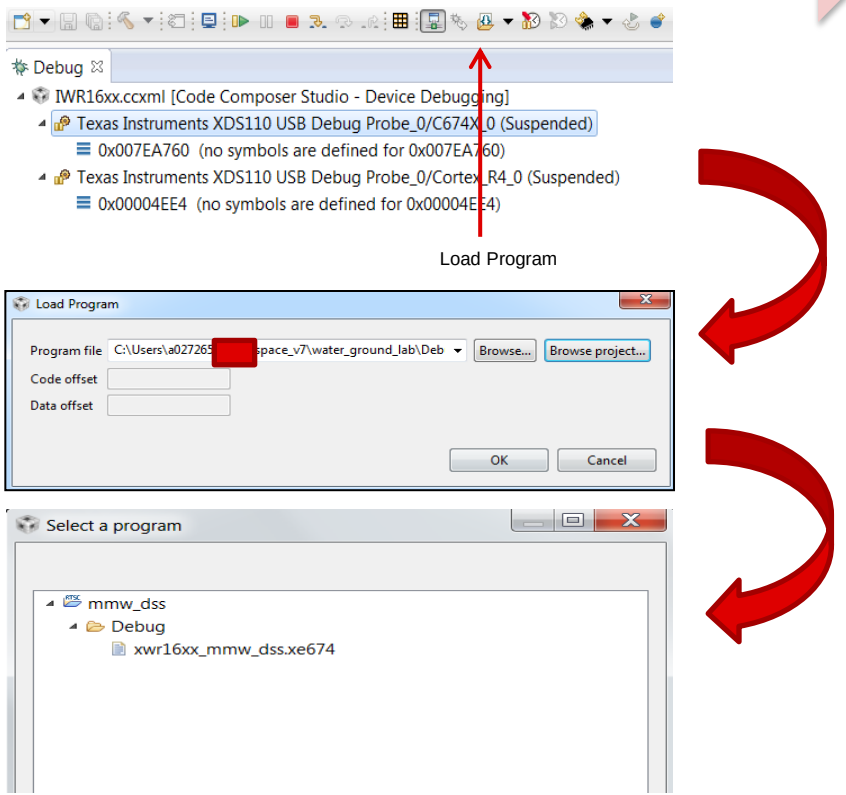
5.1 Connecting - continued

- Go to **View ► Target Configurations** to open the target configuration window.
- You should see your target configuration under **User Defined** configurations.
- With the board powered on, right click on the target configuration and select **Launch Select Configuration**.
- This will launch the target configuration in the debug window.
- Select the Texas Instruments XDS110 USB Debug probe/C674X_0 and press the **Connect Target** button 
- Select the Texas Instruments XDS110 USB Debug probe/Cortex_R4_0and press the **Connect Target** button 



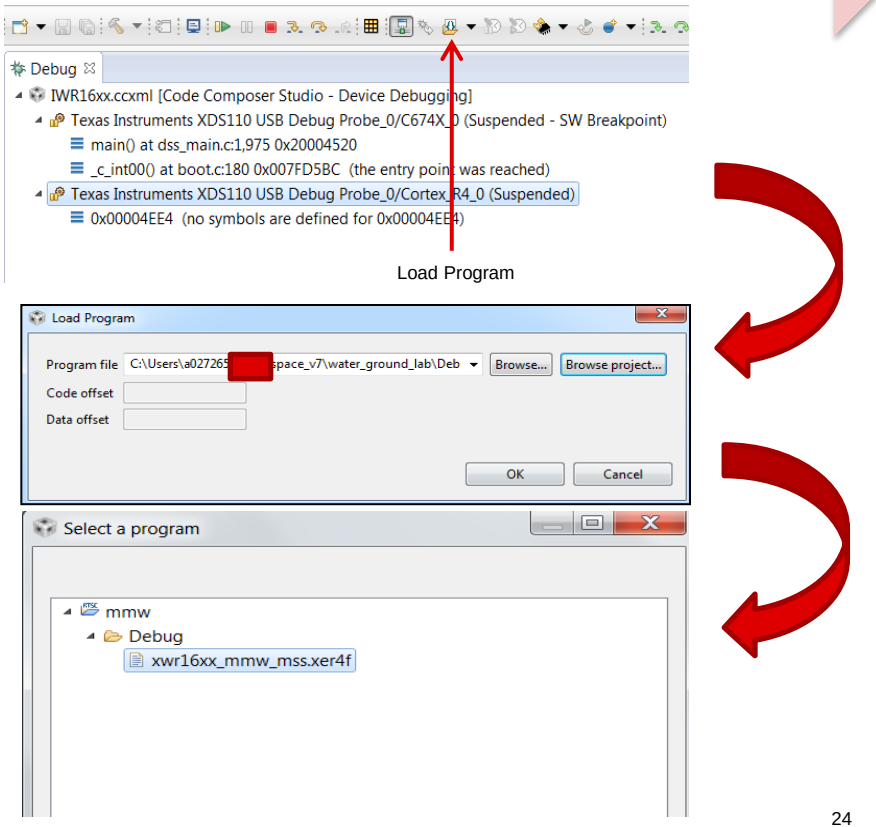
5.2 Loading the binary

- Once both targets are connected, select the C674X_0 target, and click on the **Load** button in the toolbar.
- In the **Load Program** dialog, press the **Browse Project** button .
- Select the lab executable (.xe674) found in the mmw_dss project as shown, and press OK.
- Press OK again in the **Load Program** dialog.



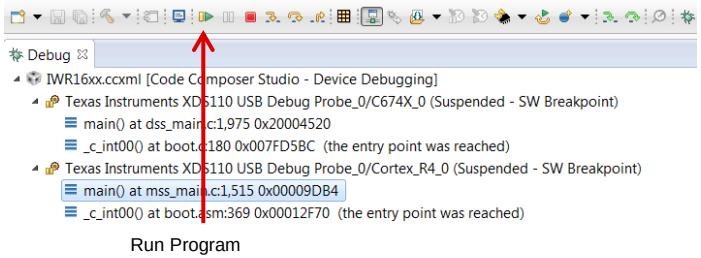
5.2 Loading the binary

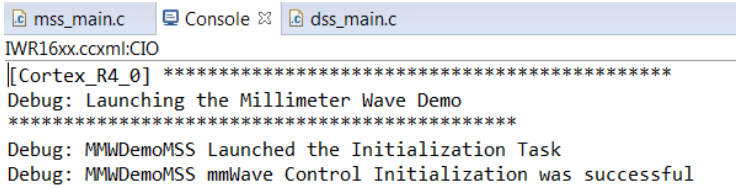
- Now select the Cortex_R4_0 target, and click on the **Load** button in the toolbar.
- In the **Load Program** dialog, press the **Browse Project** button .
- Select the lab executable (.xer4f) found in the mmw project as shown, and press OK.
- Press OK again in the **Load Program** dialog.



5.3 Running the binary

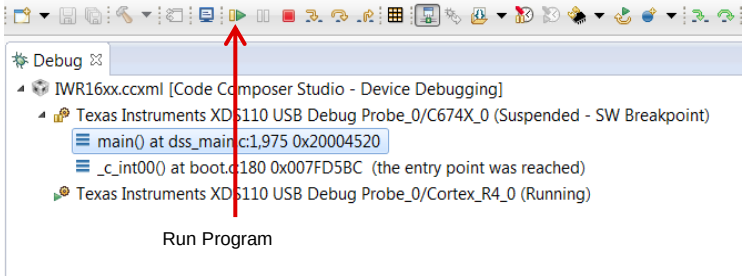
- With both executables loaded, select mss_main.c, as shown, and press the Run/Resume button 
- The program should start executing and generate console output as shown.
- If everything goes fine, you should see the “MMWDemoMSS mmWave Control Initialization was successful” message which indicates that the program is waiting for the DSS to be started

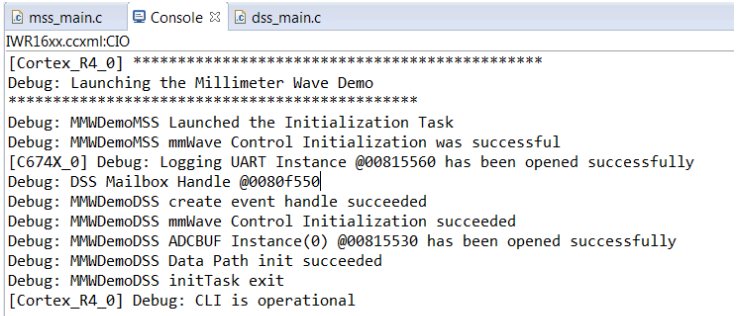




5.3 Running the binary

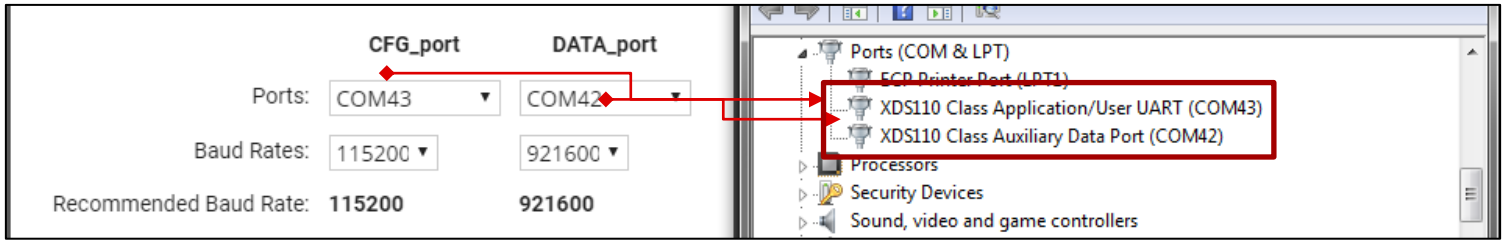
- Select dss_main.c, as shown, and press the Run/Resume button 
- Further console output should be generated as shown.
- You should see the “CLI is operational” message which indicates that the program is ready and waiting for the sensor configuration
- The sensor configuration is sent using the web GUI





5.4 Running the Lab GUI

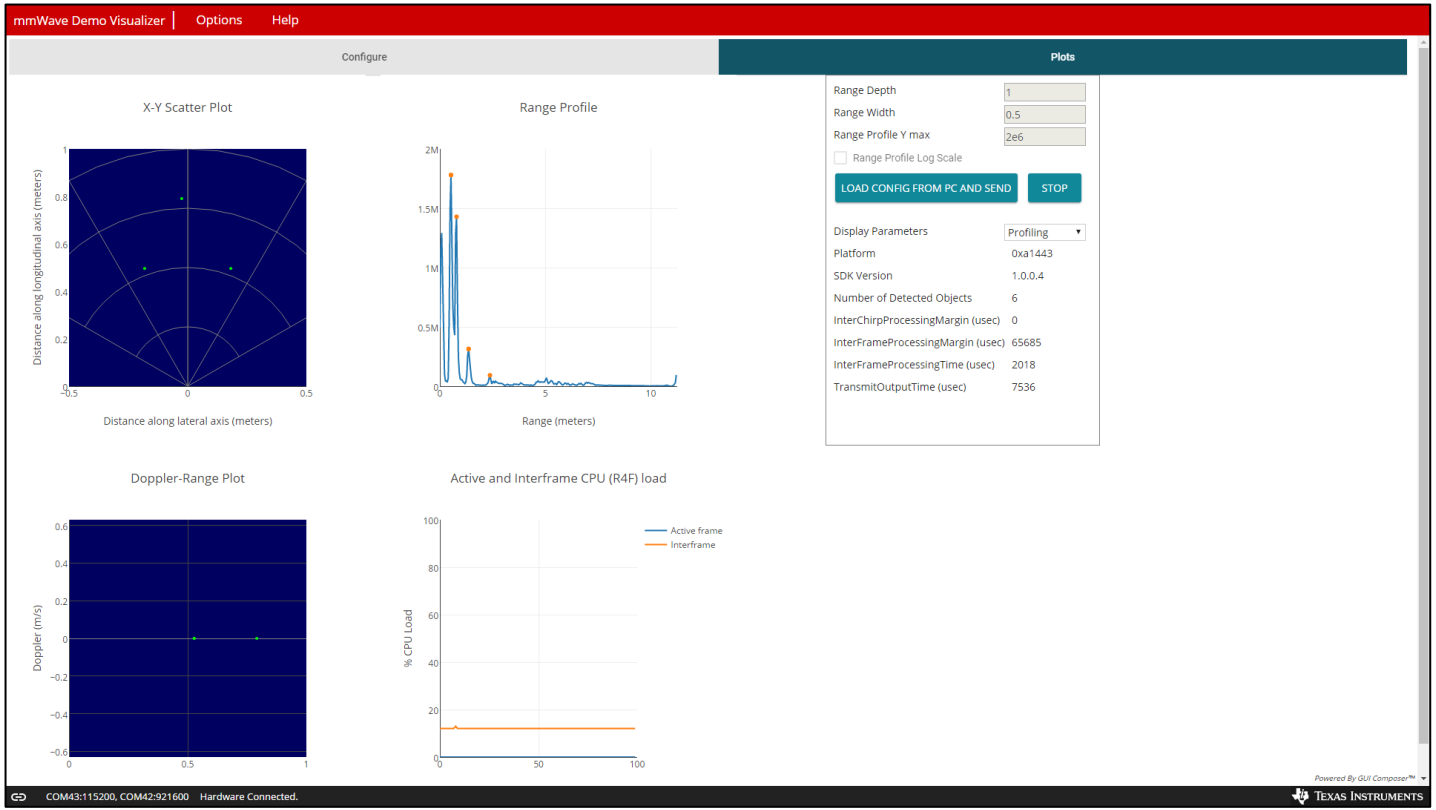
1. Using Google Chrome, navigate to the following URL: https://dev.ti.com/mmWaveDemoVisualizer
   – Alternatively, go to https://dev.ti.com/gallery and search for “mmWave Demo Visualizer”
2. If prompted, follow the on-screen instructions for installing TI Cloud Agent
3. Once the demo is loaded, go to **Options → Serial Port**
4. In the serial port window, enter the appropriate port in each of the drop down menus based on your port numbers from Step 2



5.4 Running GUI - continued

5. Click on **Configure** and the demo will automatically connect to the EVM
   - Not connected:  Connected: 
   - If the connection fails, try clicking on the connection icon in the bottom left corner
6. Select the appropriate mmWave device from the **Platform** dropdown menu
7. Use the available options to create the desired configuration
   - Additional details about the configuration parameters can be found in the **mmWave Demo Visualizer User Guide**
8. When ready to send the configuration, click on **Send Config To mmWave Device**
9. Click on the **Plots** tab to view the plots that were selected to be shown
10. Move a highly reflective object in front of the EVM and see how the demo responds

5.4 Running GUI - continued



Learn more about TI mmWave Sensors

- Learn more about xWR1x devices, please visit the product pages
  - IWR1443: http://www.ti.com/product/IWR1443
  - IWR1642: http://www.ti.com/product/IWR1642
  - AWR1443: http://www.ti.com/product/AWR1443
  - AWR1642: http://www.ti.com/product/AWR1642
- Get started evaluating the platform with xWR1x EVMs, purchase EVM at
  - IWR1443 EVM: http://www.ti.com/tool/IWR1443BOOST
  - IWR1642 EVM: http://www.ti.com/tool/IWR1642BOOST
  - AWR1443 EVM: http://www.ti.com/tool/AWR1443BOOST
  - AWR1642 EVM: http://www.ti.com/tool/AWR1642BOOST
- Download mmWave SDK @ http://www.ti.com/tool/MMWAVE-SDK
- Ask question on TI's E2E forum mmWave Sensors forum @ https://e2e.ti.com/support/sensor/mmwave_sensors/