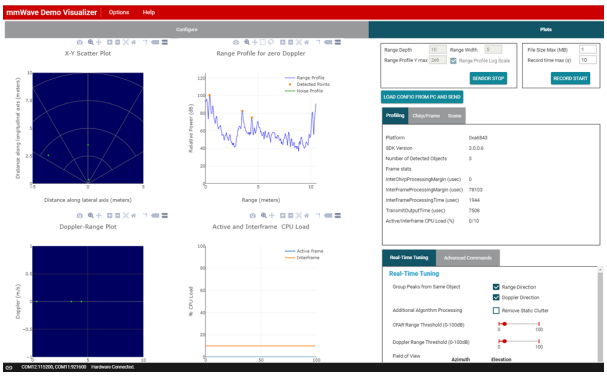
Overview of MMWAVE SDK Demo - 68xx DSP Version

This is the mmWave SDK out-of-box demo lab for the TI IWR68xx EVM. Run this TI IWR68xx EVM out-of-box demo to view processed TI mmWave sensor data in configurable plots using the web-based mmWave Demo Visualizer.

NOTE: This version of the SDK out-of-box demo is for IWR68xx EVM and uses both the on-chip Hardware Accelerator (HWA) and on-chip c674x DSP.



Quickstart

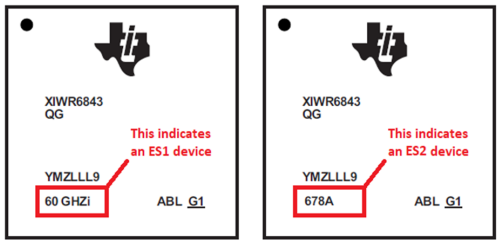
The quickstart uses:

- Precompiled mmw demo binary for flashing the device using Uniflash. The pre-compiled binary for mmWave SDK Out-of-box demo is available at `<MMWAVE_SDK_INSTALL_DIR>\mmwave_sdk_03_03_xx_xx\packages\ti\demo\xwr68xx\mmw\xwr68xx_mmw_demo.bin`
- Web based mmWaveDemoVisualizer GUI available at https://dev.ti.com/mmwavedemovisualizer (https://dev.ti.com/mmwavedemovisualizer)

1. Hardware and Software Requirements

Hardware

Item	Details
Device	Industrial mmWave Carrier Board (http://www.ti.com/tool/MMWAVEICBOOST) and IWR6843ISK ES2.0 Antenna Board (http://www.ti.com/tool/IWR6843ISK). These two boards combined are referred to as the Industrial mmWave Starter Kit
	Note: The rest of this document will refer to the above board combination as **EVM** .
Computer	Windows 7 or 10 PC with Google Chrome Browser and TI Cloud Agent Extension installed.
Micro USB Cable	Provided with the Industrial Radar Carrier Board (http://www.ti.com/tool/MMWAVEICBOOST)
Power Supply	5V, 3A with 2.1-mm barrel jack (center positive). The power supply can be wall adapter style or a battery pack with a USB to barrel jack cable.

> **IWR6843 ES2.0 Only**
>
> This lab is only compatible with ES2.0 version of IWR6843. Check the device version on your IWR6843ISK using the on-chip device markings as shown below>
>
> 1. If line 4 reads `678A` , you have an ES2 device. In this case, this lab is compatible with your EVM.
> 2. If line 4 reads `60 GHZi` , you have an older ES1 device. In this case, the lab is NOT compatible with your EVM. ES2 IWR6843ISK boards are orderable from the EVM link above.
>
> 
>

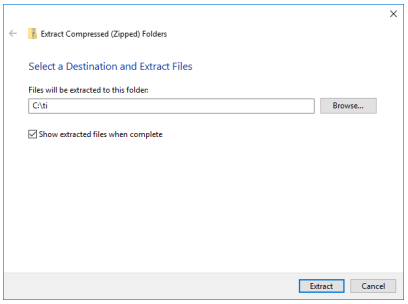
Software

Tool	Version	Download Link
TI mmWave SDK	3.3.x.x	TI mmWave SDK 3.3 (http://software-dl.ti.com/ra-processors/esd/MMWAVE-SDK/03_03_00_03/index_FDS.html) and all the related tools are required to be installed as specified in the mmWave SDK release notes (http://software-dl.ti.com/ra-processors/esd/MMWAVE-SDK/latest/exports/mmwave_sdk_release_notes.pdf)
Uniflash	Latest	Uniflash tool is used for flashing TI mmWave Radar devices. Download offline tool (http://www.ti.com/tool/UNIFLASH) or use the Cloud version (https://dev.ti.com/uniflash/#!/)

Expand for mmWave Industrial Toolbox installation without Code Composer Studio

1. Navigate to the TI Resource Explorer
2. Click the download button. A .zip file will be downloaded.

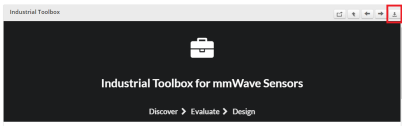
3. Navigate to the .zip file. Right click and then select **Extract All...**. Do NOT use the default path. The path must be `C:\ti`.



4. Verify installation by navigating to view the MMWAVE SDK Demo - 68xx dsp Version Lab files at `C:\ti\<mmwave_industrial_toolbox_install_dir>\labs\out_of_box_demo\68xx_mmwave_sdk_dsp`

Expand for mmWave Industrial Toolbox installation using Code Composer Studio

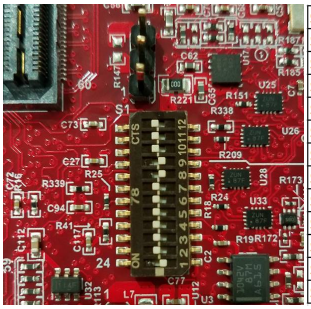
1. Open CCS
2. In the top toolbar, navigate to **View** → **Resource Explorer**
3. In the **Resource Explorer** side panel (not the main panel with "Welcome to.."), navigate to Industrial Toolbox at **Software** → **mmWave Sensors** → **Industrial Toolbox - <ver>**
4. With Industrial Toolbox selected, the main panel should show the Industrial toolbox landing page. Click on the **Download icon** in the right corner of panel.



5. Verify installation by navigating to view the MMWAVE SDK Demo - 68xx DSP Version Lab files at `C:\ti\<mmwave_industrial_toolbox_install_dir>\labs\out_of_box_demo\68xx_mmwave_sdk_dsp`

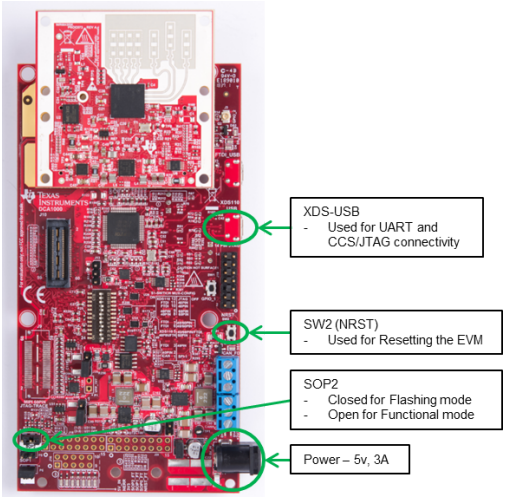
2. Physical Setup

1. Setup the Carrier Board in standalone mode using the S1 switch combination as shown below.



Switch ID	Position for Standalone Mode
S1.12	ON
S1.11	ON
S1.10	ON
S1.9	OFF
S1.8	OFF
S1.7	ON
S1.6	ON
S1.5	ON
S1.4	ON
S1.3	ON
S1.2	ON
S1.1	OFF

2. Connect the IWR6843ISK to the MMWAVEICBOOST board and mount the EVM vertically as shown below:



3. Plug in micro-usb and power supply to EVM using the connectors shown above.

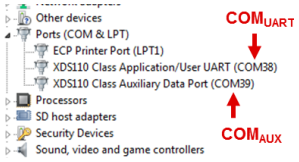
3. Flash the EVM

- Power on the EVM using a 5V/3A power supply.
- Flash the following image using **Uniflash**

Image	Location
Meta Image 1	`<MMWAVE_SDK_INSTALL_DIR>\mmwave_sdk_03_03_xx_xx\packages\ti\demo\xwr68xx\mmw\xwr68xx_mmw_demo.bin`

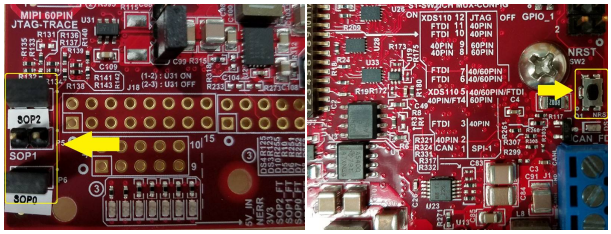
Expand for help using Uniflash

- 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

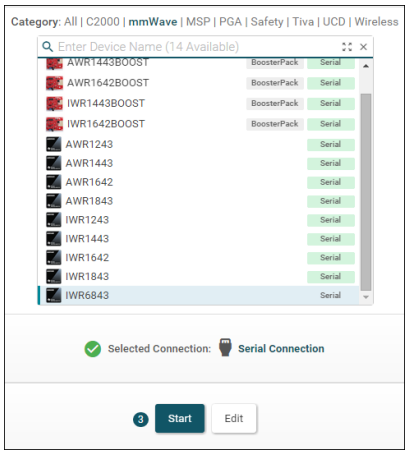


> Note the COM UART and COM AUX port numbers, as they will be used later for flashing and running the lab.

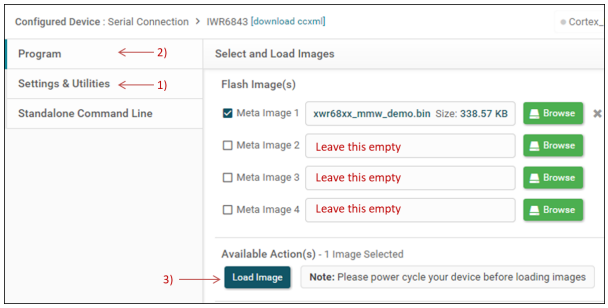
- Put the EVM in flashing mode by connecting jumpers on **SOP0** and **SOP2** as shown in the image. Then power cycle the EVM with **SW2** (NRST).



- Open the **UniFlash tool** (Download offline tool (http://www.ti.com/tool/UNIFLASH) or use the Cloud version (https://dev.ti.com/uniflash/#!/))
  - In the New Configuration section, locate and select the appropriate device (IWR6843)
  - Click Start to proceed



- Click the **Settings & Utilities** tab. Under setup, fill the **COM Port** text box with the Application/User UART COM port number (COM UART) noted earlier.
- In the **Program** tab, browse and locate the images (.bin file) as specified above.



- **Power cycle** the device and click on **Load Images**

> **Successful Flash Procedure**
> UniFlash's console should indicate: [SUCCESS] Program Load completed successfully

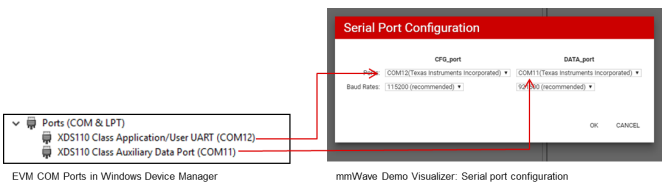
- Power off the board and **remove only SOP2 jumper**

> **SOP2 Removed?**
> Ensure that the jumper has been removed and the EVM power cycled. This puts the board back in functional mode.

4. Run the Lab

1. GUI Setup

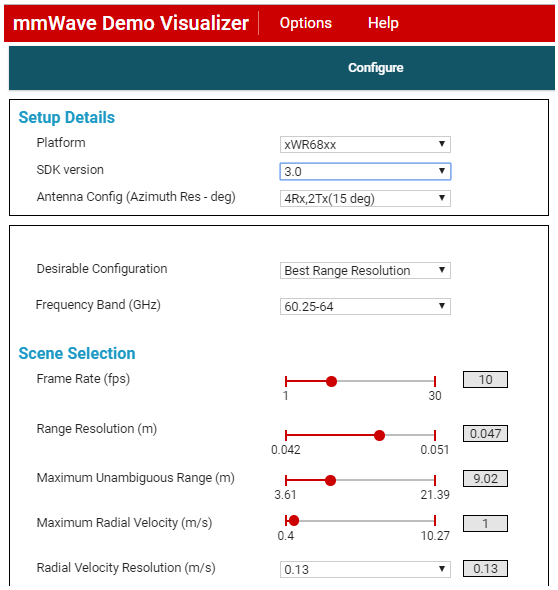
- Power up the EVM and connect it to the Windows PC with the provided USB cable (make sure that the SOP2 jumper is removed). Mount the setup vertically as shown in Physical Setup
- Using Google Chrome, navigate to the following URL: https://dev.ti.com/mmWaveDemoVisualizer (https://dev.ti.com/mmWaveDemoVisualizer)
- If prompted, follow the on-screen instructions for installing TI Cloud Agent (this is need the first time on a new PC)
- In the GUI menu, select Options → Serial Port
- In the serial port window, enter the appropriate port in each of the drop down menus based on your port numbers from the Flash the EVM section
- Click on Configure to connect the GUI to the EVM. The GUI Status bar should show **Conected:**



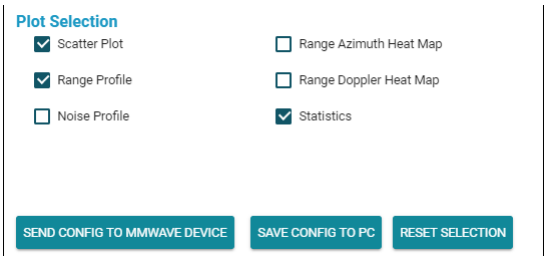
EVM COM Ports in Windows Device Manager — mmWave Demo Visualizer: Serial port configuration

2. Running the Demo

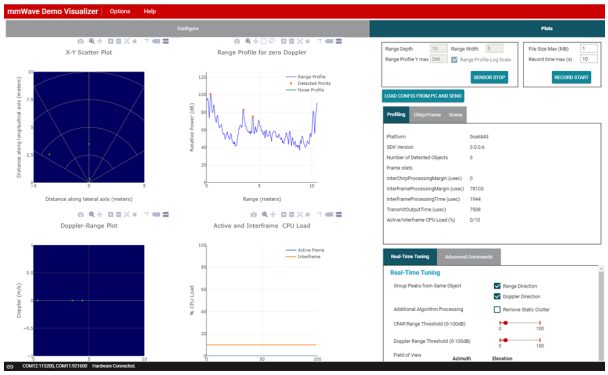
- On the Configure Tab, select the appropriate mmWave SDK and the **xWR68XX device** from the Platform dropdown menu
- Use the available sliders to create the desired configuration.
    - You can also use the presets available in the Desirable Configuration drop-down list.
    - Additional details about the configuration parameters can be found in the mmWave Demo Visualizer User Guide (http://www.ti.com/lit/pdf/swru529)



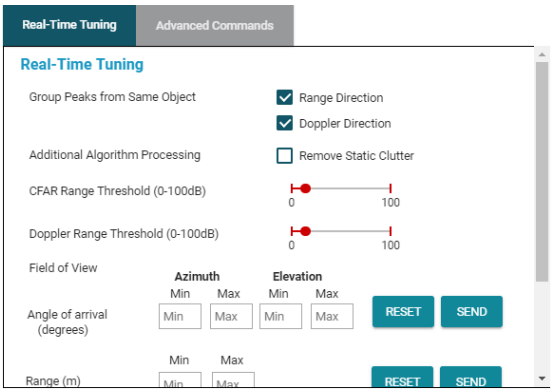
- Select the desired plots under Plot Selection (e.g. Scatter Plot, Range Azimuth Plot)
- When ready to send the configuration, click on Send Config To mmWave Device



- Click on the Plots tab to view the plots that were selected to be shown



- Move a highly reflective object in front of the EVM and see how the demo responds.
    - You can use the Real Time Tuning controls shown below to adjust CFAR thresholds, Modify Field of View and enable or disable Peak grouping in real time.



- This concludes the Quick Start Section

Developer's Guide

Build the Firmware from Source Code

1. Software Requirements

Tool	Version	Download Link
TI mmWave SDK	3.3.x.x	TI mmWave SDK 3.3 (http://software-dl.ti.com/ra-processors/esd/MMWAVE-SDK/03_03_00_03/index_FDS.html) and all the related tools are required to be installed as specified in the mmWave SDK release notes
Code Composer Studio	8.3.1	Code Composer Studio v8.3.1 (http://processors.wiki.ti.com/index.php/Download_CCS)
mmWave Industrial Toolbox	4.x.x	Download and install the toolbox. Go to Using TI Resource Explorer & the mmWave Industrial Toolbox (../../../../docs/readme.html) for instructions.

2. Import Lab Project

The mmWave SDK Out-of-box demo Lab CCS Project is available under on TI Resource Explorer under mmWave Sensors → mmWave Industrial Toolbox. You can import the project in your CCS workspace using TI Resource Explorer in CCS or using a browser. Both methods of importing projects are defined in the Expand boxes below.

- Start CCS and setup workspace as desired.
- Import the project below to CCS using either TI Resource Explorer in CCS or CCS Import Projectspecs method:
  - **mmwave_sdk_68xx_dsp_dss**
  - **mmwave_sdk_68xx_dsp_mss**

<details>
<summary>Expand for details on importing via TI Resource Explorer in CCS</summary>

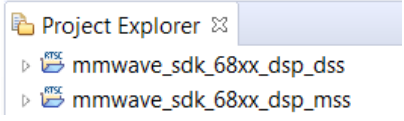
- In the top toolbar, navigate to **View** → **Resource Explorer**
- In the **Resource Explorer** side panel (not the main panel with "Welcome to.."), navigate to **Software** → **mmWave Sensors** → **Industrial Toolbox - <ver>** → **Labs** → **mmWave SDK Demo - 68xx DSP Version**
- Under the expanded **mmWave SDK Demo - 68xx DSP Version** folder, there should be a CCS project named **mmwave_sdk_68xx_dsp**.
- Click on the project, which should open the project in the right main panel, and then click on the Import to IDE button  .
</details>

<details>
<summary>Expand for details on importing via CCS Import Projectspecs</summary>

- In the top toolbar, navigate to **Project** → **Import CCS Projects...**
- With the **Select search-directory** option enabled, click **Browse...**, navigate to the **68xx_mmwave_sdk_dsp** folder at `C:\ti\<mmwave_industrial_toolbox_install_dir>\labs\out_of_box_demo\68xx_mmwave_sdk_dsp` , and then click **OK**.
- Under **Discovered projects**, select **mmwave_sdk_68xx_dsp** then click **Finish**.
</details>

Successful Import to IDE

After using either method, the mmwave_sdk_68xx_mss project should be visible in **CCS Project Explorer**



> **Project Workspace**
>
> When importing projects to a workspace, a copy is created in the workspace. It is important to note that the copy in user's workspace is the one that gets built and all modifications will only be implemented for the workspace copy. The original project downloaded in mmWave Industrial Toolbox is not modified.

3. Build the Lab

Build DSS Project

The DSS project must be built before the MSS project.

With the **mmwave_sdk_68xx_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.

> **Successful DSS Project Build**
>
> In the **Project Explorer** panel, navigate to and expand **mmwave_sdk_68xx_dsp_dss > Debug** directory. The project has been successfully built if the following files appear in the **Debug** folder:
>
> - mmwave_sdk_68xx_dss.bin
> - mmwave_sdk_68xx_dss.xe674

Build MSS Project

After the DSS project is successfully built, select **mmwave_sdk_68xx_dsp_mss** in **Project Explorer**, right click on the project and select **Rebuild Project**.

> **Successful MSS Project Build**
>
> In the **Project Explorer** panel, navigate to and expand **mmwave_sdk_68xx_dsp_mss > Debug** directory. The project has been successfully built if the following files appear in the **Debug** folder:
>
> - xwr68xx_mmw_mss.xer4f
> - xwr68xx_mmw_demo.bin

> **Build Fails with Errors**
>
> If the build fails with errors, please ensure that all the prerequisites are installed as mentioned in the mmWave SDK release notes.

4. Execute the Lab

There are two ways to execute the compiled code on the EVM:

- **Deployment mode**: In this mode, the EVM boots autonomously from flash and starts running the bin image
  - Using Uniflash, flash the **xwr68xx_mmw_demo.bin** found at `<PROJECT_WORKSPACE_DIR>\mmwave_sdk_68xx_dsp_mss\Debug\xwr68xx_mmw_demo.bin`
  - The procedure to flash the EVM is the same as detailed in the Flash the EVM section.
- **Debug mode**: This mode is is used for downloading and running the executable (.xer4f) from CCS. This mode enables JTAG connection with CCS while lab is running; useful during development and debugging

Expand for help with Debug mode:

The CCS debug firmware (provided with the mmWave SDK) needs to be flashed once on the EVM.

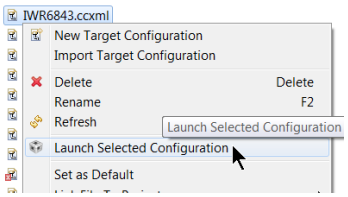
- CCS Debug method is enabled by flashing the CCS Debug Firmware (provided with the mmWave SDK) using the methods covered in the Quickstart Flash the EVM section.
- Use the following image instead

Image	Location	Comment
Meta Image 1/RadarSS	`C:\ti\mmwave_sdk_<ver>\packages\ti\utils\ccsdebug\xwr68xx_ccsdebug.bin`	Provided with the mmWave SDK

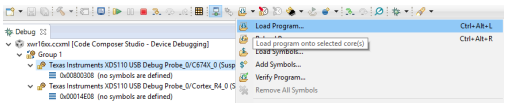
After the CCS debug firmware has been flashed, connect the EVM to CCS

- Create a target configuration (skip to "Open the target..." if config already created previously in another lab for xwr68xx)
  - Go to **File > New > New Target Configuration File**
  - Specify an appropriate file name (ex: IWR68xx.ccxml) and check "**Use shared location**". Click **Finish**.
- In the configuration editor window:
  - Select **Texas Instruments XDS110 USB Debug Probe** for Connection
  - Select **IWR6843** device as appropriate in the Board or Device text box.
  - Press the **Save** button to save the target configuration.
  - [Optional]: Press the **Test Connection** button to check the connection with the board.
- Open the target configuration window by going to **View > Target Configurations**.

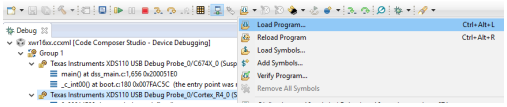
- Under **User Defined** configurations the target configuration previously created should appear.
- Right click on the target configuration and select **Launch Select Configuration**. The target configuration will launch in the **Debug Window**.



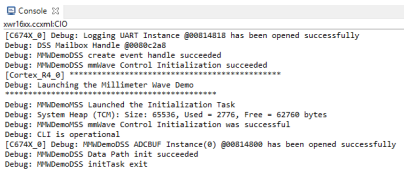
- Connect to Cores
  - Select the **Texas Instruments XDS110 USB Debug probe/C674X_0**, then right click and select **Connect Target**
- Select the **Texas Instruments XDS110 USB Debug probe/Cortex_R4_0** and then right click and select **Connect Target**
- Load the binary
  - Once both targets are connected, click on the C674X_0 target and then click **Load** button in the toolbar. 



  - In the **Load Program** dialog, press the **Browse Project** button .
  - Select **mmwave_sdk_68xx_dss.xe674** found at `<PROJECT_WORKSPACE_DIR>\mmwave_sdk_68xx_dsp_dss\Debug\mmwave_sdk_68xx_dss.xe674` and press **Ok**.
  - Press **Ok** again in the **Load Program** dialog.
  - Repeat the above Load the Binary process for the Cortex_R4_0 target, selecting instead **xwr68xx_mmw_mss.xer4f** found at `<PROJECT_WORKSPACE_DIR>\mmwave_sdk_68xx_dsp_mss\Debug\xwr68xx_mmw_mss.xer4f`



- Run the binary
  - Select **Texas Instruments XDS110 USB Debug probe/Cortex_R4_0**, press the **Run/Resume** button 
  - Repeat above step for the **Texas Instruments XDS110 USB Debug probe/C674X_0**
  - The program should start executing and generate console output as shown.



> **Successful Run Binary**
>
> If binary is running correctly, the Console will include the “CLI is operational” message which indicates that the program is ready and waiting for the sensor configuration.

After running the lab using either method, the demo firmware should be executing on the EVM and waiting for sensor configuration. After this point, please follow the instructions provided in the Quickstart section to bring-up the mmWave Demo Visualizer for sending the configuration and visualizing the results.

Need More Help?

- Additional resources in the documentation of the mmWave SDK (note hyperlinks will only work if the mmWave SDK has been installed on PC):
  - mmWave SDK Module Doc located at `<mmwave_sdk_install_dir>/docs/mmwave_sdk_module_documentation.html` (file:///C:/ti/mmwave_sdk_03_03_00_03/docs/mmwave_sdk_module_documentation.html)
  - mmWave SDK User's Guide located at `<mmwave_sdk_install_dir>/docs/mmwave_sdk_user_guide.pdf` (file:///C:/ti/mmwave_sdk_03_03_00_03/docs/mmwave_sdk_user_guide.pdf)
  - mmWave SDK Release Notes located at `<mmwave_sdk_install_dir>/docs/mmwave_sdk_release_notes.pdf` (file:///C:/ti/mmwave_sdk_03_03_00_03/docs/mmwave_sdk_release_notes.pdf)

- Search for your issue or post a new question on the mmWave E2E forum (https://e2e.ti.com/support/sensor/mmwave_sensors/f/1023)