

Vision SDK TDA2Ex

(v03.05.00)

User Guide

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1 Introduction

Vision Software Development Kit (Vision SDK) is a multi-processor software development package for TI's family of ADAS SoCs. The software framework allows users to create different ADAS application data flows involving video capture, video pre-processing, video analytics algorithms, and video display. The framework has sample ADAS data flows which exercises different CPUs and HW accelerators in the ADAS SoC and shows customer how to effectively use different sub-systems in the SoC. Frame work is generic enough to plug in application specific algorithms in the system.

Vision SDK is currently targeted for the TDA2xx and TDA3xx family of SoCs

This document explains the HW/SW setup for TDA2Ex EVM. Refer to [VisionSDK_UserGuide_TDA2xx.pdf](#) and [VisionSDK_UserGuide_TDA3xx.pdf](#) for respective EVM related Hw/SW setup

1.1 References

Refer the below additional documents for more information about Vision SDK

Document	Description
VisionSDK_ReleaseNotes.pdf	Release specific information
VisionSDK_UserGuide_TDA2Ex.pdf	This document. Contains install, build, execution information
VisionSDK_ApiGuide.CHM	User API interface details
VisionSDK_SW_Architecture.pdf	Overview of software architecture
VisionSDK_DevelopmentGuide.pdf	Details how to create data flow (s) & add new functionality
VisionSDK_SurroundView_DemoSetUpGuide.pdf	Document contains the steps for hardware setup for calibrated surround view demo
VisionSDK_FAQs.pdf	Document contains FAQ

2 System Requirements

This chapter provides a brief description on the system requirements (hardware and software) and instructions for installing Vision SDK.

2.1 Windows Installation

2.1.1 PC Requirements

Installation of this release needs a windows machine with about 8GB of free disk space. Building of the SDK is supported on windows environment.

2.1.2 Software Requirements

All software packages required to build and run the Vision SDK are included as part of the SDK release package except for the ones mentioned below.

2.1.2.1 A15 Compiler, Linker

The windows installer for the GCC ARM tools should be downloaded from below link <https://launchpad.net/gcc-arm-embedded/+milestone/4.9-2015-q3-update>

The tools need to be installed under

"<install dir>/ti_components/cg_tools/windows/".

IMPORTANT NOTE: A15 Compiler and linker MUST be installed before proceeding else compile will fail. Also make sure the compiler is installed at the exact path mentioned above

2.1.3 Code Composer Studio

CCS is needed to load, run and debug the software. CCS can be downloaded from the below link. CCS version 6.0.1.00040 or higher should be installed.

http://processors.wiki.ti.com/index.php/Download_CCS

2.2 Linux Installation

2.2.1 PC Requirements

Installation of this release needs a Linux Ubuntu 14.04 machine.

IMPORTANT NOTE: If you are installing Ubuntu on a virtual machine, ensure it's a 64 bit Ubuntu.

2.2.2 Software Requirements

All software packages required to build and run the Vision SDK are included as part of the SDK release package except for the ones mentioned below.

2.2.2.1 A15 Compiler, Linker

The Linux installer for the GCC ARM tools should be downloaded from below link <https://launchpad.net/gcc-arm-embedded/+milestone/4.9-2015-q3-update>

The tools need to be installed under

"<install dir>/ti_components/cg_tools/linux/".

IMPORTANT NOTE: A15 Compiler and linker MUST be installed before initiating the build else compilation will fail. Also make sure the compiler is installed at the exact path mentioned above after installation of vision sdk.

Use following steps to install the toolchain

```
$> cd $INSTALL_DIR/ti_components/cg_tools/linux
$> tar -xvf gcc-arm-none-eabi-4_9-2015q3-20150921-linux.tar.tar
```

IMPORTANT NOTE: Ensure the toolchain is for 32 / 64 bit machine as per configuration of installation machine
If your machine is 64 bit and you have downloaded toolchain from link above
Execute following step on installation machine
\$>sudo apt-get install ia32-libs lib32stdc++6 lib32z1-dev lib32z1 lib32ncurses5 lib32bz2-1.0

2.2.3 Other software packages for build depending upon OS baseline

Ensure these packages/tools are installed on the installation machine

uname, sed, mkimage, dos2unix, dtrx, mono-complete, git, lib32z1 lib32ncurses5 lib32bz2-1.0 libc6:i386 libc6-i386 libstdc++6:i386 libncurses5:i386 libz1:i386 libc6-dev-i386 device-tree-compiler mono-complete

To install

```
$>sudo apt-get install <package_name>
```

2.3 Hardware Requirements

Hardware setup for Single Camera View (SCV) and LVDS Multi Camera View (LVDS MCV) use-case is described in this section

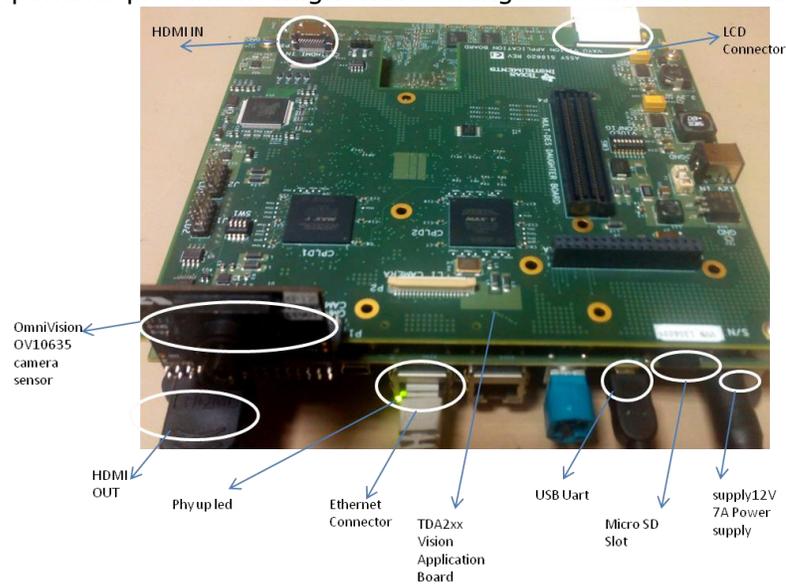
2.3.1 SRV Use-cases / Multi Channel Use-cases

SRV use-case needs the below hardware

1. TDA2Ex EVM (Rev D)
2. TDA2xx Vision Application Board (Rev C)
3. OV10635 Sensor (for SCV only)
4. WVGA LCD DC from Spectrum Digital (part #703663) OR
5. HDMI 1080p60 capable Display Monitor

Setup is shown below

(Physical components placement might have changed in different board versions)



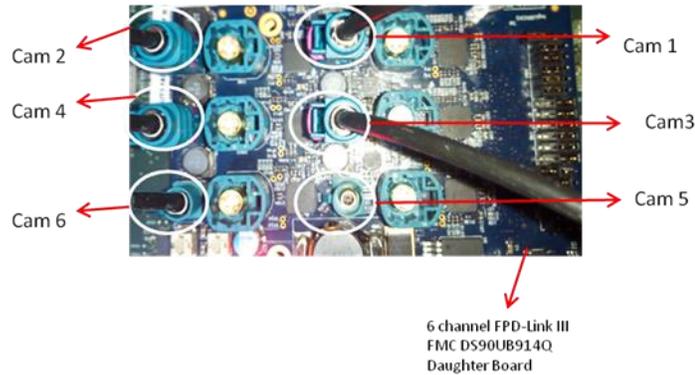
2.3.2 With multides-surround-view-kit

LVDS MCV Use-case Hardware Setup

1. TDA2Ex EVM (Rev B)
2. TDA2xx Vision Application Board (Rev C)
3. 6 channel FPD-Link III FMC SV600964 Daughter Board (Rev E1)
4. 4 x DS90UB913A EVMs (Rev A)
5. 4 x OV10635 Sensor (additional 5th DS90UB913A EVM, OV10635 sensor and cable would be required in order to run the Surround view demo).
6. 4 x Rosenberger HSD connectors and cables
7. WVGA LCD DC from Spectrum Digital (part #703663) OR
8. HDMI 1080p60 capable Display Monitor

The LVDS MCV use case setup is shown in the snapshots below:

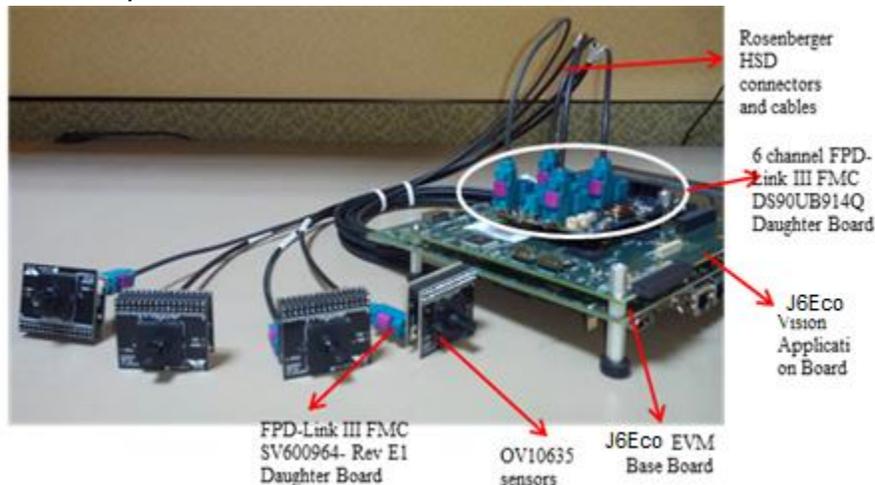
2.3.2.1 DeSerializer board



IMPORTANT NOTE: Camera 1, Camera 2, Camera 3 and Camera 4 are used for 4 channel LVDS use-case and MUST be connected as shown in above figure.

IMPORTANT NOTE: There is a board modification required for LVDS capture on TDA2EX boards. Refer to BSP user guide under section “**Changes needed for 4 Channel Multi-deserializer on TDA2EX EVM**” for more information.

2.3.2.2 Complete LVDS Setup



2.3.2.3 With UB964 EVM (CSI2 based capture only)

Multi-channel usecases and surround view based on CAL / CSI2 would require

1. TDA2Ex EVM
2. UB964 EVM (<http://www.ti.com/tool/ds90ub964-q1evm>)
3. 4 X OV10635 sensor modules
4. 4 X DS90UB913A serializer (SAT0088) (http://support.spectrumdigital.com/boards/sat0088_0089/)
5. 4 X FAKRA Cables
6. TV (1080P60 Capable) Connected to HDMI out of TDA2Ex EVM

2.3.2.4 UB964 EVM Configurations

1. Separate power to UB964 EVM
 - a. UB960 EVM require separate power, please power TDA2Ex EVM & UB964 EVM separately
2. Power over FPD Link III

- a. Depending on Camera module (OV10635 & SAT0088) you would require to source appropriate voltage
 - b. The UB964 EVM user guide documents the option to choose different voltages, please refer <http://www.ti.com/lit/pdf/snlu177>
 - c. The picture of UB964 below, highlights the connector J14 / J16 with an arrow. This could be used to select different voltage, it's recommended to refer the UB964 EVM guide for up-to-date/accurate configs
3. Mode Selection
- a. UB964 Require to operate in "RAW10 (DS90UB913A compatible)"
 - b. This can be achieved with DIP switches on UB964 EVM, please refer the EVM user guide (link above)
 - c. The picture below highlights the switch with a circle for RAW10 mode
4. Connecting UB964 to TDA2Ex EVM
- a. There are two **CSI2 connectors on top of EVM**
 - b. Highlighted with white rectangular boxes
 - c. **Recommended not to use** these (would require an additional CSI2 / differential cable to connect to TDA2Ex EVM)
 - d. **Use** the male CSI2 **connector (back of EVM)** to connect to TDA2Ex EVM

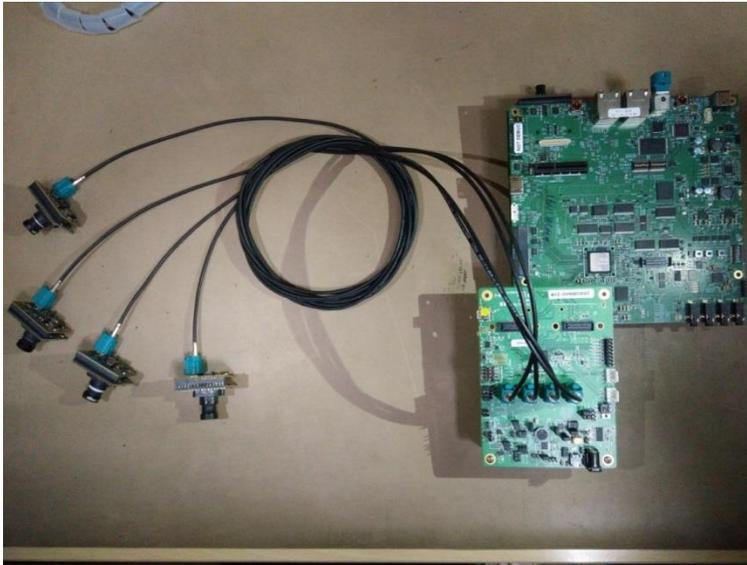


2.3.2.5 TDA2Ex CSI2 receiver port

The CSI2 receiver is highlighted with a red circle, please connect UB964/CSI 2 source to this.



2.3.2.6 Complete setup



WARNING: CSI2 Clock: The maximum CSI2 clock could be 750 MHz, please refer the device data manuals for details. Some of the VisionSDK use cases (UB964 based), overclocks by 50 MHz (i.e. 800 MHz) and it works as expected. This over clocking is due the crystal (25 MHz) used in UB964 EVM, by choosing 24 MHz crystal UB964 CSI2 clock can be operated with-in specified limits.

2.3.3 Capture Pin Settings

Video Config pins needs to set for different capture inputs



VIDEO CONFIG switch settings (SW3 on TDA2xx Vision Application Board (set for Ov10635 in Original version of CPLD))

Capture Type	Hardware controlled pin settings Vision Application Board (Rev C CPLD) (default cpld image)								Software controlled pin settings New Version Of CPLD flashed (cpld_1_cam3_shift.pof)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
OV10635	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LVDS	OFF	OFF	ON	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
HDMI	OFF	OFF	ON	ON	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

CPLD image is required for VIP input Muxing,

With the cpld_1_cam3_shift.pof and later the software control will work,

On default Rev C board the captured image won't be proper. Either program the Cpld with new image or use hardware controlled pin settings.

2.3.4 EDID Programming for HDMI Capture

EDID information needs to be programmed on the EEPROM present on Vision Application Board. This is required for the HDMI capture source to recognize the format and resolution in which to send data to the TDA2Ex SoC. If this step is not done or if this step fails, then TDA2Ex SoC will not be able to receive data via HDMI capture source

IMPORTANT NOTE: It's recommended to program the HDMI receivers EDID. The default EDID is programmed to receive 1080P60 video streams only. If stream of different resolution is required (or EDID is corrupted), the EDID would require an update. Refer the EDID programming points in the section *Running VPS Application on (TDAxxx EVM)* documented in *VPS User Guide in PDK*.

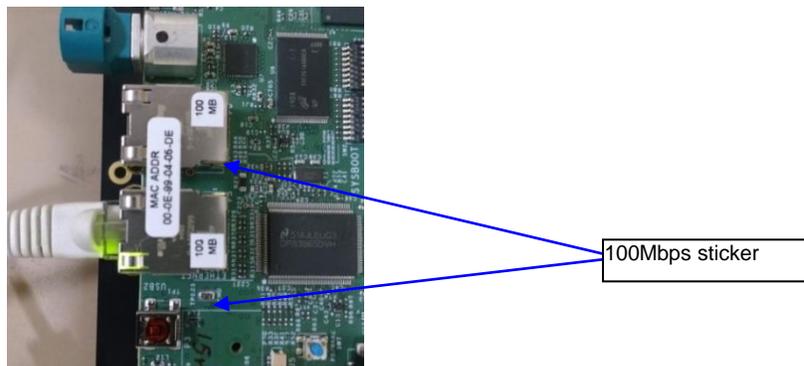
2.3.5 1Gig Ethernet link does not come up on some EVMs

On few of TDA2xx EVMs, we have seen stability issues with 1Gbps Ethernet link. The issue symptoms are

1. Link not detected when connected to 1Gbps switch/router
2. Stability issues with 1Gbps link - multiple connect/disconnect
3. Data transfer not happening due to CRC errors on Ethernet Rx

These are known timing issues due to PHY "wire" side connection and not with the TDAx processor. Spectrum Digital screens all the EVMS and places a sticker labelled 100Mbps if any of EVM fails such test. The EVM boards having TI DP83867 PHY do not have this issue.

Note: Not all failing EVMs have 100Mbps sticker, in order to identify if 1Gbps link is supported run VSDK network application.



2.3.6 TDA2ex Board Rev Ethernet care-about

In order for correct operation of the TDA2ex Ethernet use-cases kindly ensure the physical connection of the Ethernet cable is as per the table below:

Sr. No.	TDA2ex EVM revision	Use-case	Recommended Ethernet port connection
1.	Rev A/Rev B	Any	RGMII0 (Port0)
2.	Rev C	LVDS	RGMII1 (Port1)
3.	Rev C	HDMI Capture	RGMII0 (Port0)

2.4 Software Installation

PROCESSOR_SDK_VISION_03_xx_xx_xx_setupwin.exe is the SDK package installer.

Copy the installer to the path of your choice.

Double click the installer to begin the installation.

Follow the self-guided installer for installation.

IMPORTANT NOTE: On some computers running as administrator is needed. Right click on the installer and select option of "Run as administrator". If this is not done then you may see a message like "This program might not have installed correctly"

On completion of installation a folder by name PROCESSOR_SDK_VISION_03_xx_xx_xx would have got created in the installation path.

2.4.1 Uninstall Procedure

To uninstall, double click on uninstall.exe created during installation in the folder PROCESSOR_SDK_VISION_03_xx_xx_xx.

At the end of uninstall, PROCESSOR_SDK_VISION_03_xx_xx_xx folder still remains. It is just an empty folder. It can be deleted manually.

3 Build and Run

This chapter provides a brief overview of the sample application or use case present in the SDK and procedure to build and run it.

3.1 Overview of application in release

The Vision SDK supports the following use-cases as examples

- Single channel capture use-cases
 - All single camera usecase.
- Multi-channel LVDS capture use-cases
 - All LVDS camera usecase.
- AVB RX Use-cases,
 - All AVB usecase.
- Dual Display Use cases
 - All Dual display usecase.
- ISS Use cases
 - All ISS capture usecase
- Network RX/TX Use cases
 - All Network test usecase

Refer to VisionSDK_DataSheet.pdf for detailed description of use-case.

The demos support following devices as capture source

- OV10635 sensor (default)
- HDMI source

The demos support following devices as display devices

- LCD 800x480
- HDMI 1080p60 (default)

Use option "s" on the main menu in UART to select different capture and display devices.

3.2 Building the application

1. On windows command prompt, go inside the directory
PROCESSOR_SDK_VISION_03_xx_xx_xx\vision_sdk\build.
2. Open file \vision_sdk\build\Rules.make and set required config
MAKECONFIG=tda2ex_evm_bios_all
3. Open file \vision_sdk\\$(MAKEAPPNAME)\configs\tda2xx_evm_bios_all\cfg.mk
 - a. For Building AVB application
NDK_PROC_TO_USE is to be set for ipu1_1
 - b. If running AVB use-cases, make sure "AVB_INCLUDE=yes" is set.
4. Build is done by executing gmake. "gmake" is present inside XDC package.
For "gmake" to be available in windows command prompt, the XDC path must be set in the windows system path.
IMPORTANT NOTE: xdc path is needed to be set in environment variables.
If not, then set it using the set PATH =
<Install_dir>/ti_components/os_tools/windows/xdctools_x_xx_xx_xx;%PATH
% in command prompt

Ensure that gmake is picked from vision sdk xdc path only.

Use which gmake or where gmake depending upon the git bash or win cmd

IMPORTANT NOTE: A15 Compiler and linker MUST be installed before proceeding else compile will fail. Also make sure the compiler is installed at the exact path as mentioned in <install_dir>/vision_sdk/build/tools_path.mk.

IMPORTANT NOTE: If the installation folder depth is high then windows cmd prompt fails with error that it cannot find a file, even in file is present in mentioned path, this is because Windows has a limitation of 8191 characters for the commands that can execute. In such a situation as a workaround either restrict the folder depth to d:/ or if it cannot be restricted use git bash to build. Refer <https://support.microsoft.com/en-in/kb/830473> for more details.

Git version used for testing is 2.13

(Always point to xdc path gmake only)

5. Under vision_sdk directory
 - a. When building first time run the below sequence of commands


```
> gmake -s -j depend
> gmake -s -j
```

IMPORTANT NOTE: For Windows PC use "-j<number of CPUs>" instead of just -j. For example if PC has 2 CPUs then use "-j2". Random build dependency issues has been noticed with -j & windows PC. If not sure about the number of CPUs of PC, then suggests not using -j option with windows build environment.

- b. When building after the first time or incremental build, run the below command


```
> gmake -s -j
```

Executing "gmake -s -j depend" will build all the necessary components (PDK drivers, EDMA drivers and sdk dependent files) and "gmake -s -j" will build the Vision SDK framework and examples.

IMPORTANT NOTE: For incremental build, make sure to do "gmake -s -j depend" before "gmake -s -j" when below variables specified in \vision_sdk\\$(MAKEAPPNAME)\configs\\$(MAKECONFIG)*cfg.mk are changed

- when PROC_\$(CPU)_INCLUDE is changed
- when DDR_MEM is changed
- when PROFILE is changed
- when ALG plugin or usecase is enabled or disabled in \vision_sdk\\$(MAKEAPPNAME)\configs\\$(MAKECONFIG) *_cfg.mk
- when any .h or .c file in TI component is installed in ti_components is changed
- when any new TI component is installed in ti_components

If "gmake -s -j depend" not done in these cases then build and/or execution may fail

IMPORTANT NOTE: When options (other than those specified above) are changed in \vision_sdk\\$(MAKEAPPNAME)\configs\\$(MAKECONFIG)\cfg.mk a clean build is recommended for the updated settings to take effect.

6. On a successful build completion, following executables will be generated in the below path

```
\vision_sdk\binaries\$(MAKEAPPNAME)\$(MAKECONFIG)\vision_sdk\bin\tda2ex-evm
vision_sdk_a15_0_release.xa15fg
```

```
vision_sdk_c66xdsp_1_release.xe66  
vision_sdk_ipu1_0_release.xem4  
vision_sdk_ipu1_1_release.xem4
```

7. To speed up the incremental builds the following can be done as required. The number of processors included in the build can be changed by modifying below values in `\vision_sdk\$(MAKEAPPNAME)\configs\$(MAKECONFIG)\cfg.mk`. A value of "no" means CPU not included in build, value of "yes" means CPU included in build. Make sure to do "**gmake -s -j depend**" before "**gmake -s- j**" when number of CPUs included is changed

```
PROC_DSP1_INCLUDE=yes  
PROC_A15_0_INCLUDE=yes  
PROC_IPU1_0_INCLUDE=yes  
PROC_IPU1_1_INCLUDE=yes
```

8. The build config that is selected in config file can be confirmed by doing below

```
> gmake -s showconfig
```

Cleaning the build can be done by following command

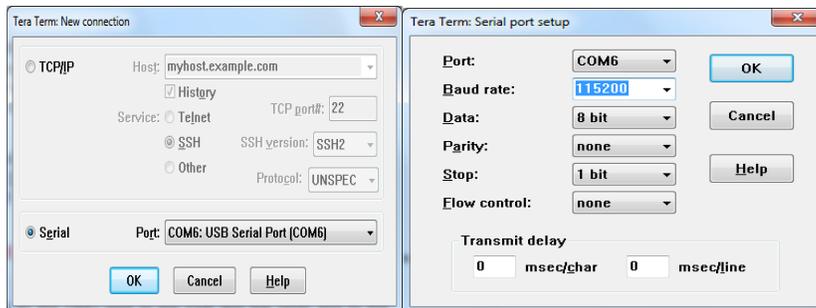
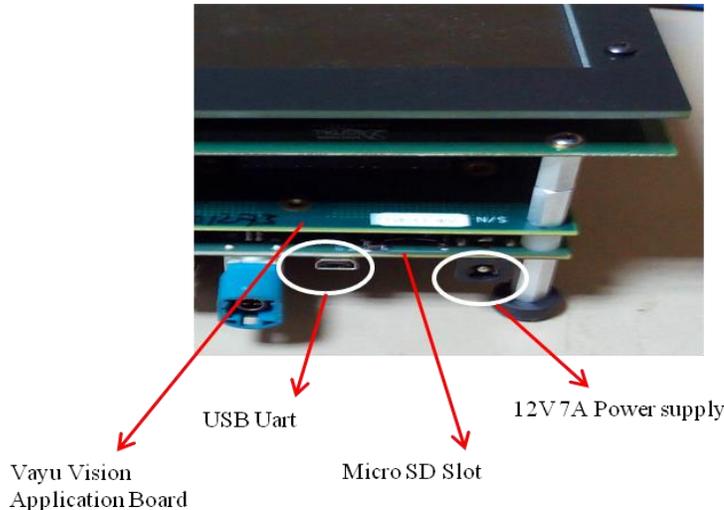
```
> gmake -s clean
```

Built binaries need to be deleted by

```
> rm -rf ../binaries/$(MAKEAPPNAME)/$(MAKECONFIG)
```

3.3 UART settings

Connect a serial cable to the UART port of the EVM and the other end to the serial port of the PC (*configure the HyperTerminal at 115200 baud rate*) to obtain logs and select demo.



3.4 Boot Modes

Supported boot modes on TDA2Ex ES1.0 device:

Boot Mode	EVM Switch Setting SYSBOOT(SW2)[1:16]	EVM Switch Setting SW5[1:10]
QSPI_1	01101100 10000001	0001100000
QSPI_4	11101100 10000001	0001100000
NOR	10101100 10000101	0100100000
SD	00001100 10000001	0001100000
Debug	00000000 10000001	XXXXXXXXXX

3.5 Load using SD card

NOTE: The application can be run using SD card and SD card boot or using CCS. This section shows how to run using SD card boot.

Application image is run on the SoC via Secondary Boot Loader (SBL) present in SD card.

3.5.1 Option 1: Steps to prepare a bootable SD card

- Ensure Empty SD card (at least 256MB, preferably 4GB SDHC) is available.
- Ensure SD memory card reader is available.

- Create a primary FAT partition on MMC/SD card (FAT32 format with sector size 512) and mark it as Active. A partition manager utility has to be used for the same.
- Format SD card from DOS command line as below.
"format <drive> /A:512 /FS:FAT32"

Make SD card partition as active using below tool

<http://www.pcdisk.com/download.html>

IMPORTANT NOTE: Create a primary FAT partition on MMC/SD card (FAT32 format) with sector size 512 bytes mark the partition as active.

3.5.2 Option 2: Steps to prepare a bootable SD card using DISKPART

- Open windows 7 Command prompt and Run as Administrator mode
- Enter command "diskpart.exe"
C:\Windows\system32>diskpart.exe will take you DISKPART prompt
Warning: Enter below command carefully w.r.t your computer/laptop SD card disk number. Choosing wrong disk number may delete data present in other drive

To list all disk drive present on computer

```
DISKPART> list disk
```

Select the SD card disk number, in my case it is disk 1

```
DISKPART> select disk 1
```

Now all next command applicable only to disk 1(SD card)

Delete entire partition

```
DISKPART> clean
```

To create Primary partition

```
DISKPART> create partition primary
```

To list partition

```
DISKPART> list partition
```

Select partition

```
DISKPART> select partition 1
```

To list volume

```
DISKPART> list volume
```

Select volume associated with SD card, In my case its 3

```
DISKPART> select volume 3
```

Format SD card, please wait this may take few seconds

```
DISKPART>format quick fs=fat32 unit=512 label=SD_BOOT
```

Make disk active

```
DISKPART> active
```

To exit utility

```
DISKPART> exit
```

3.5.3 Steps to generate MLO

NOTE: SBL MLO image is built from PDK package.

To build MLO Run the command **gmake -s sbi** from vision_sdk\build dir

This generates an MLO under

vision_sdk\binaries\\$(MAKEAPPNAME)\\$(MAKECONFIG)\sbi\sd\\$(OPP)\\$(PLATFORM)

To build the mlo for different memory map, select required configuration in Makefile under vision_sdk (follow comments from Makefile under SBL build Targets).

3.5.4 Steps to generate appimage

Following steps need to be followed to generate the application image

1. Make sure the executables are built as shown in [Building the application](#)
2. To generate the application image run below command from "vision_sdk" folder
> gmake -s appimage

IMPORTANT NOTE: The config options, like CPUs to use, debug or release profile etc, used to make the application image will be the values specified in \vision_sdk\\$(MAKEAPPNAME)\configs\\$(MAKECONFIG)\cfg.mk file

3.5.5 SD Card setup

Once the AppImage and MLO are generated, Copy the MLO and AppImage at root folder of formatted SD Card

3.5.6 Hardware Pin settings for SD Boot

Make sure the Boot Mode Select Switch is set for the SD boot mode **on TDA2Ex Base EVM**. This is done by setting the pins SYSBOOT (SW2+SW3) [0:15] to the below shown position

- Please refer [Boot Modes](#)

3.6 Load using QSPI

3.6.1 Steps to generate qspi writer tools

NOTE: SBL qspi image is built from PDK package.

To build qspi Run the command **gmake -s sbi** from vision_sdk\build dir

This generates all required tools under

vision_sdk\binaries\\$(MAKEAPPNAME)\\$(MAKECONFIG)\sbi\qspi\\$(OPP)\\$(PLATFORM)
vision_sdk\binaries\\$(MAKEAPPNAME)\\$(MAKECONFIG)\sbi\qspi_flash_writer\\$(PLATFORM)

1. sbi_qspi_\$(OPP_MODE)_a15_0_release.tiimage
2. qspi_flash_writer_ipu1_0_release.xem4

To build the qspi for different memory map, select required configuration in Makefile under vision_sdk (follow comments from Makefile under SBL build Targets).

IMPORTANT NOTE: Refer section "**Board Modification**" under SBL_userguide for hardware modifications if required.

3.6.2 Steps to generate appimage

Following steps need to be followed to generate the application image

Make sure the executables are built as shown in [Building the application](#)

To generate the application image run below command from "vision_sdk\build" folder

> gmake -s appimage

IMPORTANT NOTE: The config options, like CPUs to use, debug or release profile etc, used to make the application image will be the values specified in \vision_sdk\\$(MAKEAPPNAME)\configs\\$(MAKECONFIG)\cfg.mk file

- **The Surround View LUT and Perspective Matrix are flashed at an offset of 20 MB in the QSPI hence make sure the generated appImage doesn't exceed 20 MB in case Surround View use cases are intended to be run.**

3.6.3 Flashing steps

Flashing pin settings:

- Please refer **Boot Modes**

For loading binaries using CCS refer [Load using CCS](#) till step 8.

1. Connect A15. Do CPU reset

Select CortexA15_0, navigate to Scripts->TDA2Ex MULTICORE Initialization TDA2Ex_MULTICORE_EnableALLCores

2. Connect M4 (IPU)

Halt A15 core, and Load image on M4

vision_sdk\binaries\\$(MAKEAPPNAME)\\$(MAKECONFIG)\sbl\qspi_flash_writer \\$(SOC)\qspi_flash_writer_ipu1_0_release.xem4

3. Run the core. You would see below console logs

<pre>[Cortex_M4_IPU1_C0] QSPI Flash writer application Enter Device type to use 1 - 1 bit read from flash 2 - 4 bit (Quad) read from flash Select appropriate Device Type, for TDA2ex EVM, press '2'. MID - 1 DID - 18 Enter 0 for Erase-Only (without flashing any image) Note : File size should be less than 33554432 Bytes. Enter the file path to flash: <PATH>\sbl_qspi_\$(OPP_MODE)_a15_0_release.tiimage Enter the Offset in bytes (HEX) 0x00</pre>	<pre>Erase Options: ----- 0 -> Erase Only Required Region 1 -> Erase Whole Flash 2 -> Skip Erase Enter Erase Option: 1 Load Options: ----- 0 -> fread using code (RTS Library) 1 -> load raw using CCS (Scripting console) Enter Load Option: 0 Read xxxxxx bytes from [100%] file...Done. QSPI whole chip erase in progress QSPI file write started *****QSPI flash completed sucessfully*****</pre>
---	--

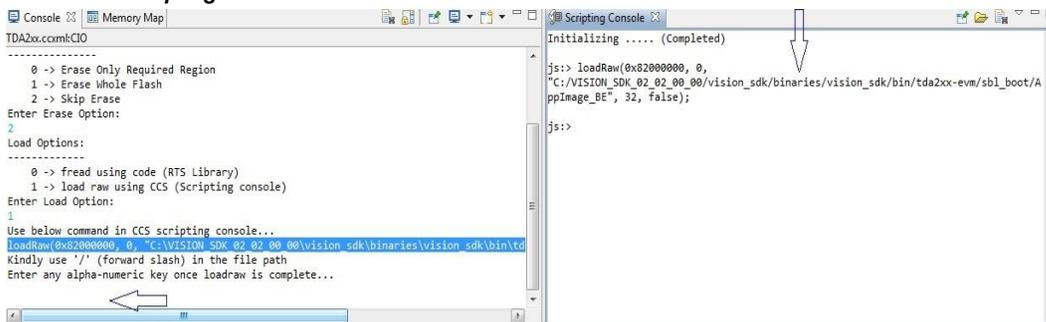
4. Reset the board and Repeat step 1, 2 and 3.

5. Reset the board and Repeat step 1 and 2

<pre>[Cortex_M4_IPU1_C0] QSPI Flash writer application Enter Device type to use 1 - 1 bit read from flash 2 - 4 bit (Quad) read from flash Select appropriate Device Type, for TDA2ex EVM, press '2'. MID - 1</pre>	<pre>Load Options: ----- 0 -> fread using code (RTS Library) 1 -> load raw using CCS (Scripting console) Enter Load Option: 1</pre>
--	--

<p>DID - 18</p> <p>Enter the File Name c:\vision_sdk\binaries\\$(MAKEAPPNAME)\\$(MAKECONFIG)\vision_sdk\bin\\$(SOC)\sbl_boot\AppImage_BE</p> <p>Enter the Offset in bytes (HEX): 0x80000</p> <p>Erase Options: ----- 0 -> Erase Only Required Region 1 -> Erase Whole Flash 2 -> Skip Erase Enter Erase Option: 0</p>	<p>Open Scripting console window by clicking "Menu -> View -> Scripting console" and enter below command on scripting console as shown 3.5.3.1</p> <pre>loadRaw(0x80500000, 0, "C:/vision_sdk/binaries/\$(MAKEAPPNAME)/\$(MAKECONFIG)/vision_sdk/bin/\$(SOC)/sbl_boot/AppImage_BE", 32, false);</pre> <p>IMPORTANT NOTE: The load address in loadRaw command could be different based on the board/SBL size etc. SBL figures out the address and prints it on CCS console. Use this address in loadRaw command for copying AppImage_BE.</p> <p>In CCS console Enter any alpha-numeric key once loadraw is complete... as shown in below image</p> <p>QSPI file write started</p> <p>****QSPI flash completed successfully*****</p>
---	---

CCS console and scripting console



6. On completion change the pin setting as shown in [Boot Modes](#) table.

3.7 Load using NOR

3.7.1 Steps to generate nor writer tools

NOTE: SBL nor image is built from PDK package.
 To build nor Run the command **gmake -s sbl** from vision_sdk\build dir
 This generates all required tools under
 vision_sdk\binaries\\$(MAKEAPPNAME)\\$(MAKECONFIG)\sbl\nor\\$(OPP)\\$(PLATFORM)
 vision_sdk\binaries\\$(MAKEAPPNAME)\\$(MAKECONFIG)\sbl\nor_flash_writer\\$(PLATFORM)

1. sbl_nor_\$(OPP_MODE)_a15_0_release.bin
2. nor_flash_writer_ipu1_0_release.xem4

To build the nor for different memory map, select required configuration in Makefile under vision_sdk (follow comments from Makefile under SBL build Targets).

IMPORTANT NOTE: Refer section "Board Modification" under SBL_userguide for hardware modifications if required.

3.7.2 Steps to generate applmage

Following steps need to be followed to generate the application image

Make sure the executables are built as shown in [Building the application](#)
 To generate the application image run below command from "vision_sdk\build" folder

```
> gmake -s appimage
```

IMPORTANT NOTE: The config options, like CPUs to use, debug or release profile etc, used to make the application image will be the values specified in \vision_sdk\\$(MAKEAPPNAME)\configs\\$(MAKECONFIG)\cfg.mk file

3.7.3 Flashing steps

Flashing pin settings:

- Please refer [Boot Modes](#)

For loading binaries using CCS refer [Load using CCS](#) till step 8.

1. Connect A15. Do CPU reset

Load image

```
vision_sdk\binaries\$(MAKEAPPNAME)\$(MAKECONFIG)\sbl\nor_flash_writer\$(SOC)\nor_flash_writer_ipu1_0_release.xem4
```

2. Run the core.

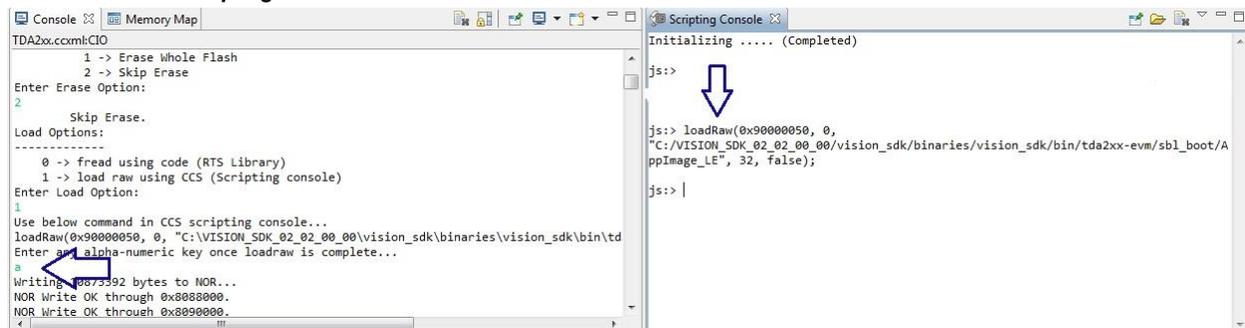
<pre>[CortexA15_0] Starting NOR Flash Writer. CFI Query...passed. NOR Initialization: Command Set: Spansion Manufacturer: SPANSION Size: 0x40 MB Enter the File Name <PATH>\sbl_nor_\$(OPP_MODE)_a15_0_release.bin Enter the Offset in bytes (HEX) 0x00 Erase Options: ----- 0 -> Erase Only Required Region 1 -> Erase Whole Flash 2 -> Skip Erase Enter Erase Option: 1 Erasing the NOR Flash Erased through 0x8020000 . . Erased through 0x9000000</pre>	<pre>Load Options: ----- 0 -> fread using code (RTS Library) 1 -> load raw using CCS (Scripting console) Enter Load Option: 0 Reading 71896 bytes from file... Read 16384 bytes [22%] from file... Read 32768 bytes [45%] from file... Read 49152 bytes [68%] from file... Read 65536 bytes [91%] from file... Read 71896 bytes [100%] from file. Done!! Writing 0x118D8bytes to NOR... NOR Write OK through 0x8008000. NOR Write OK through 0x8010000. NOR Write OK through 0x80118D8. Done. !!! Successfully Flashed!!! NOR boot preparation was successful!</pre>
---	--

3. Reset the board and Repeat step 1 & 2

4. Reset the board and Repeat step 1

<pre>[CortexA15_0] Starting NOR Flash Writer. CFI Query...passed. NOR Initialization: Command Set: Spansion Manufacturer: SPANSION Size: 0x40 MB Enter the File Name <PATH>\sbl_nor_\$(OPP_MODE)_a15_0_release.bin Enter the Offset in bytes (HEX) 0x80000 Erase Options: ----- 0 -> Erase Only Required Region 1 -> Erase Whole Flash 2 -> Skip Erase Enter Erase Option: 2</pre>	<pre>Load Options: ----- 0 -> fread using code (RTS Library) 1 -> load raw using CCS (Scripting console) Enter Load Option: 1 Use below command in CCS scripting console... loadRaw(0x90000050,0,"<PATH>/AppImage_LE", 32, false); Kindly use '/' (forward slash) in the file path Enter any alpha-numeric key once loadraw is complete... s1 Writing 0x1175F10bytes to NOR... NOR Write OK through 0x8088000. . . NOR Write OK through 0x91F5F10. Done. !!! Successfully Flashed!!! NOR boot preparation was successful!</pre>
--	--

CCS console and scripting console



5. On completion change the pin setting as shown in [Boot Modes](#) table.

3.8 Load using CCS

After installing CCS, follow below steps to complete the platform setup,

1. GELs are available in <Install_dir>\ti_components\ccs_csp \auto_device_support_x.x.x.zip
NOTE:
 1. GELs are also be available at http://processors.wiki.ti.com/index.php/Device_support_files
Under Automotive pick **Automotive vX.X.X**
 2. To install the new GEL versions, you need to extract the zip to <CCS_INSTALL_DIR>/ccsv6/ccs_base

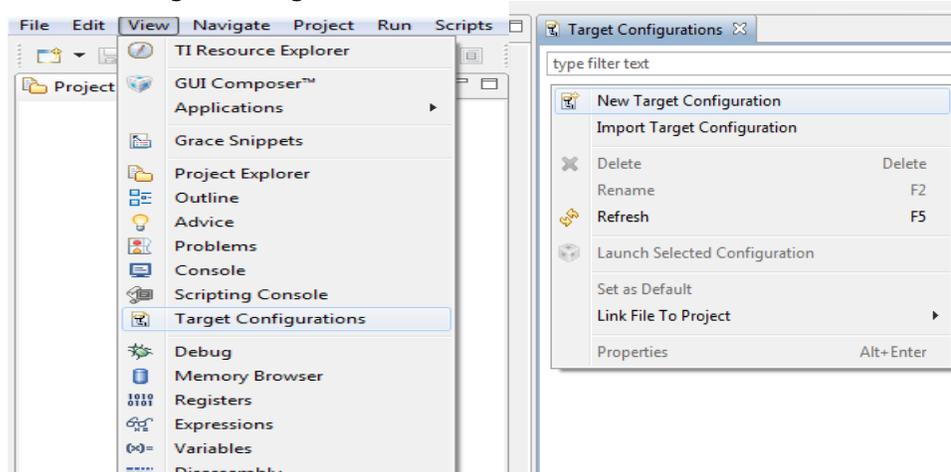
Change the following GEL files for vision SD as below,

- TDA2Ex_multicore_reset.gel
 - Set VISION_SDK_CONFIG to 1 always
 - Set VISION_SDK_CONFIG_OLD to 0

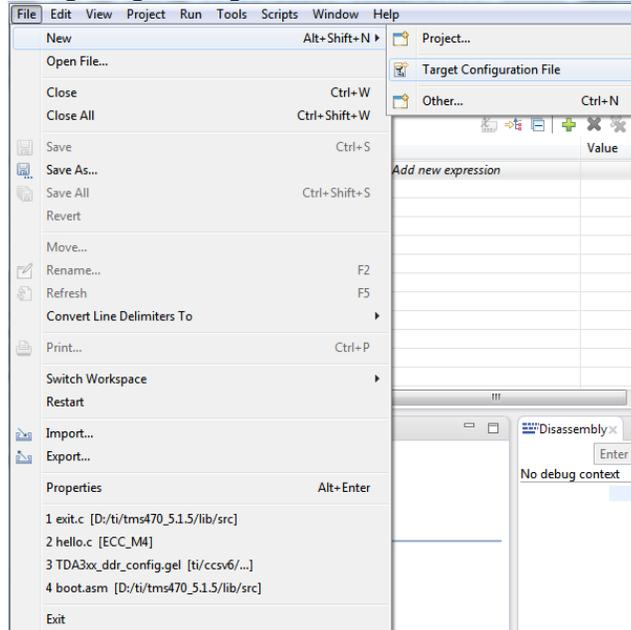
- For older versions of VisionSDK (2.08 and older) this should be set to 1

2. CCS Target Configuration creation:

- Open "Target Configurations" tab, by navigating through the menu "View ->Target Configurations".

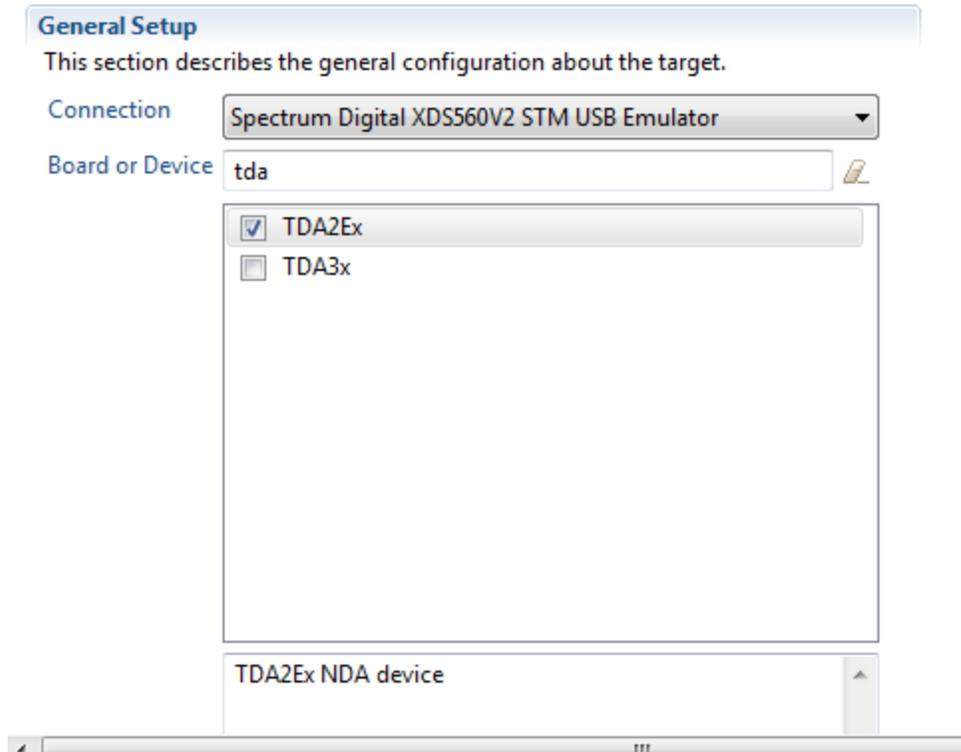


- Create a new Target Configuration (TDA2Ex Target Configuration) by navigating through the menu "File->New->Target Configuration File".

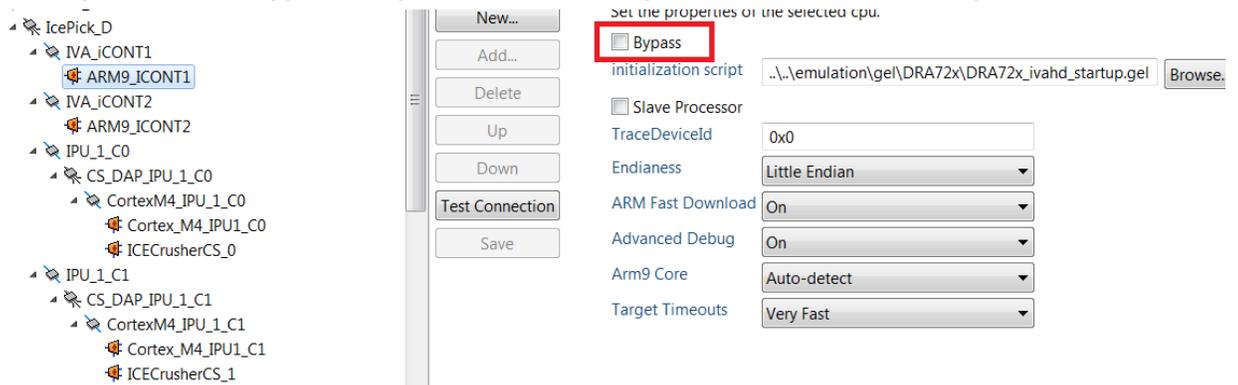


- Specify Connections as "Spectrum Digital XDS560V2 STM USB Emulator". Specify Board or Device as "TDA2Ex".

Basic

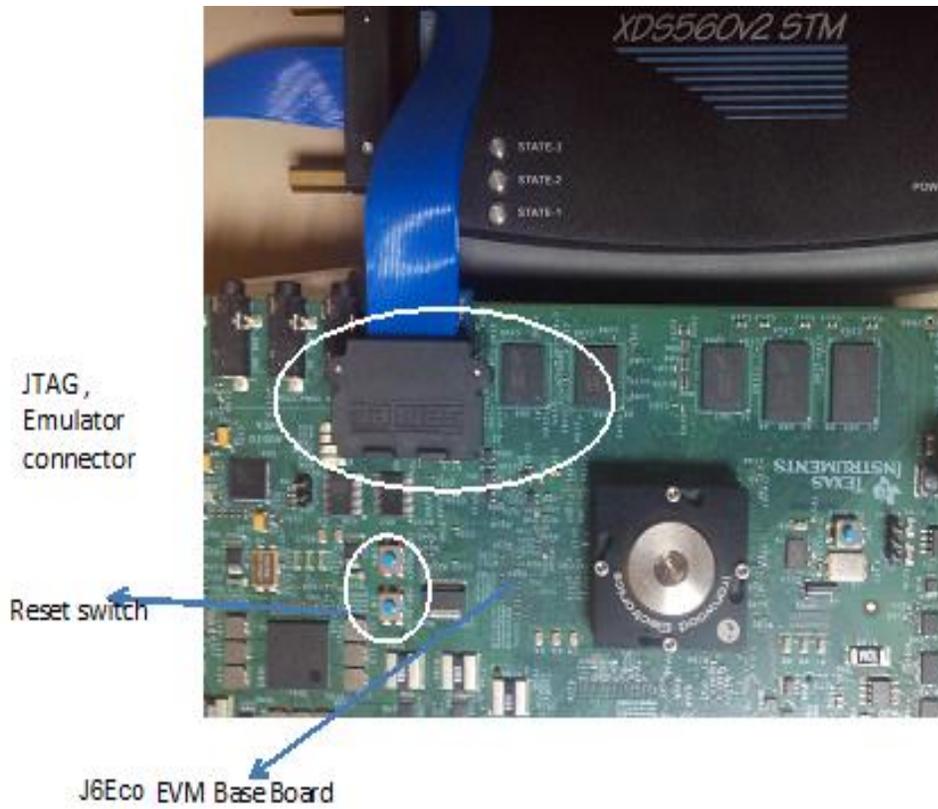


- d. ByPass unused cores. Click on the core which needs to be bypassed and check ByPass under Bypass Properties. The settings is under advance setup tab.



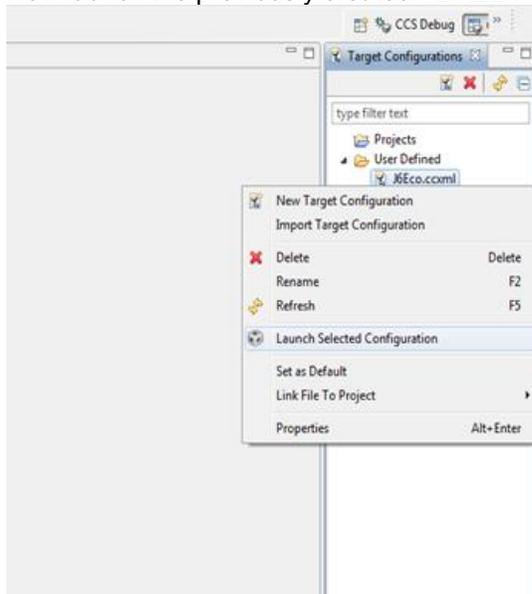
3. Connect JTAG to the board.

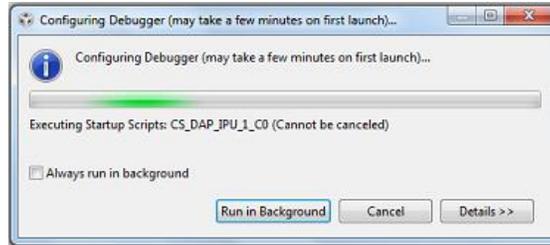
IMPORTANT NOTE: There are two JTAG connectors on the board. The one shown below **MUST** be used for CCS debug.



Reset EVM through the blue button (SW4, out of two, the one away from the JTAG).

4. Now launch the previously created TDA2Ex Target Configuration.

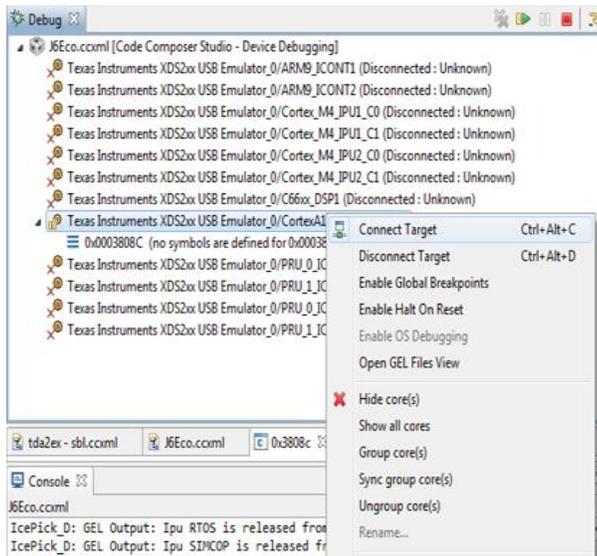




5. Once the target configuration is launched successfully, the following log should be observed on the CCS console:

CortexA15_0: GEL Output: --->>> TDA2Ex Cortex A15 Startup Sequence DONE! <<<---

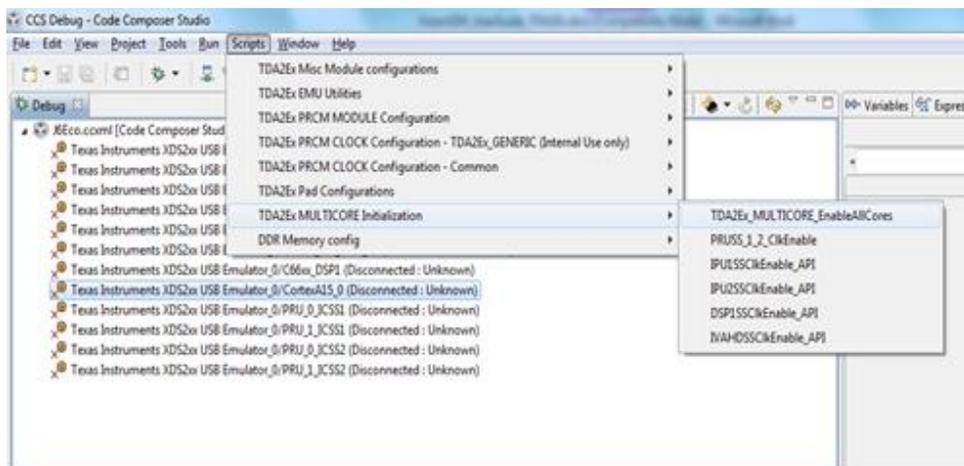
6. Connect to core CortexA15_0.



7. On successful connect, the following log appears on CCS console:

CortexA15_0: GEL Output: --->>> TDA2Ex Target Connect Sequence DONE !!!!! <<<---

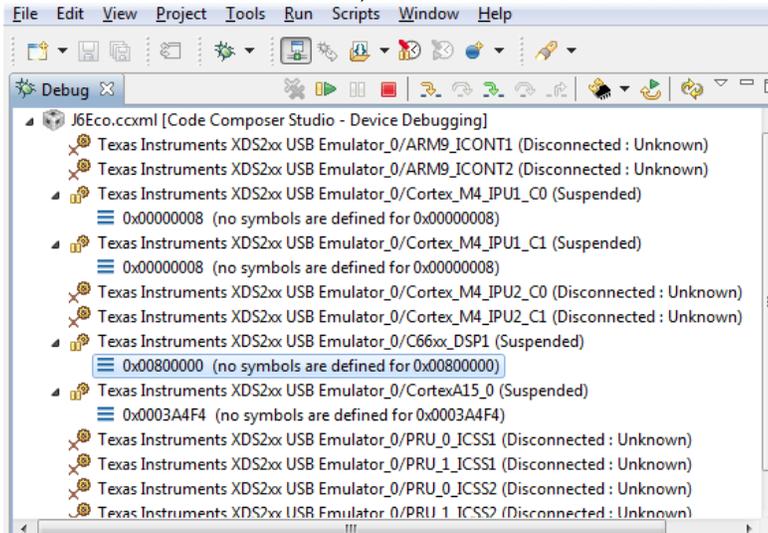
8. Select CortexA15_0, navigate to Scripts->TDA2Ex MULTICORE Initialization TDA2Ex_MULTICORE_EnableALLCores



9. On successful script execution, the following log appears on CCS console:

CortexA15_0: GEL Output: --->>> PRUSS 1 and 2 Initialization is in complete ... <<<---

10. Now connect the core shown below,
C66xx_DSP1,Cortex_M4_IPU1_C0, Cortex_M4_IPU1_C1.
11. Once the cores are connected, do CPU Reset for all the cores.



12. On the cores load the binaries as mentioned below



On C66xx_DSP1, load the binary, "vision_sdk_c66xdsp_1_release.xe66".
 On Cortex_M4_IPU1_C0, load the binary, "vision_sdk_ipu1_0_release.xem4".
 On Cortex_M4_IPU1_C1, load the binary, "vision_sdk_ipu1_1_release.xem4".
 On CortexA15_0, load the binary, "vision_sdk_a15_0_debug.xa15fg"

IMPORTANT NOTE: Binary for Cortex_M4_IPU1_C0 MUST be loaded before Cortex_M4_IPU1_C1 since IPU1-0 does MMU config for the complete IPU1 system. Other binaries can be loaded in any order.

3.9 Run the demo

1. Power-on the Board after loading binaries by (SD, QSPI, NOR or CCS) and follow [Uart settings](#) to setup the console for logs and selecting demo.
2. Select demo required from the menu by keying in corresponding option from uart menu.

IMPORTANT NOTE: Make sure you select SCV (1Ch VIP capture) use-case or LVDS (4Ch VIP capture) use-case depending on the camera that is connected

NOTE 1: For AVB MCV Demo Ethernet port must be connected as shown in [SCV/AVB Use-case Hardware Setup](#)

NOTE 2: Data is streamed from Linux talker (Ref: AVB Used guide for building talker binaries) VMware can also be used but the throughput of talker is not as desired and depends on PC configurations.

NOTE 3: For AVB use-cases with AVBTX, run PC listener on Ubuntu PC. Also install ffplay for using listener as AVBTP Listener launches ffplay internally. Please close ffplay window before stopping listener from terminal. Check orphan ffplay tasks via “ps -al” and kill all of them explicitly.

```
sudo bash ./avbtp_listener.sh
```

4 TDA2Ex_17x17

TDA2Ex has two variants 23x23 referred as TDA2Ex and 17x17 referred as TDA2Ex_17x17. The steps and procedure defined in this document is applicable to both the devices. Please refer the device specific data manual for detailed feature set.

When VisionSDK is used on TDA2Ex_17x17 device, please ensure to build for TDA2Ex. The software (VisionSDK and its components) would determine the package type and act accordingly.

Determining SoC type: Please use API Bsp_platformGetSocId(), in case of TDA2Ex, BSP_PLATFORM_SOC_ID_TDA2EX is returned.

Determining TDA2Ex_17x17: Below code could be used to identify

```
if (BSP_PLATFORM_SOC_ID_TDA2EX == Bsp_platformGetSocId())
{
    if (BSP_PLATFORM_PACKAGE_TYPE_17x17 == Bsp_platformGetPackageType())
    {
        /* any TDA2Ex_17x17 specific operations */
    }
}
```

5 TDA2Ex Ethernet Surround View Starter Kit

This document explains the HW/SW setup for TDA2Ex Ethernet SRV starter kit. The TDA2EX Ethernet SRV Starter Kit developed by D3 Engineering is one of the evaluation platforms for Vision SDK, used for evaluating the Ethernet Surround View use-case along with other networking use-cases. The starter kit supports the following Vision SDK data flows:

- Ethernet Surround View (SRV) Auto Calibration
- Ethernet SRV 2D
- Network Tx/Rx
- Multi-channel DMA Mosaic.

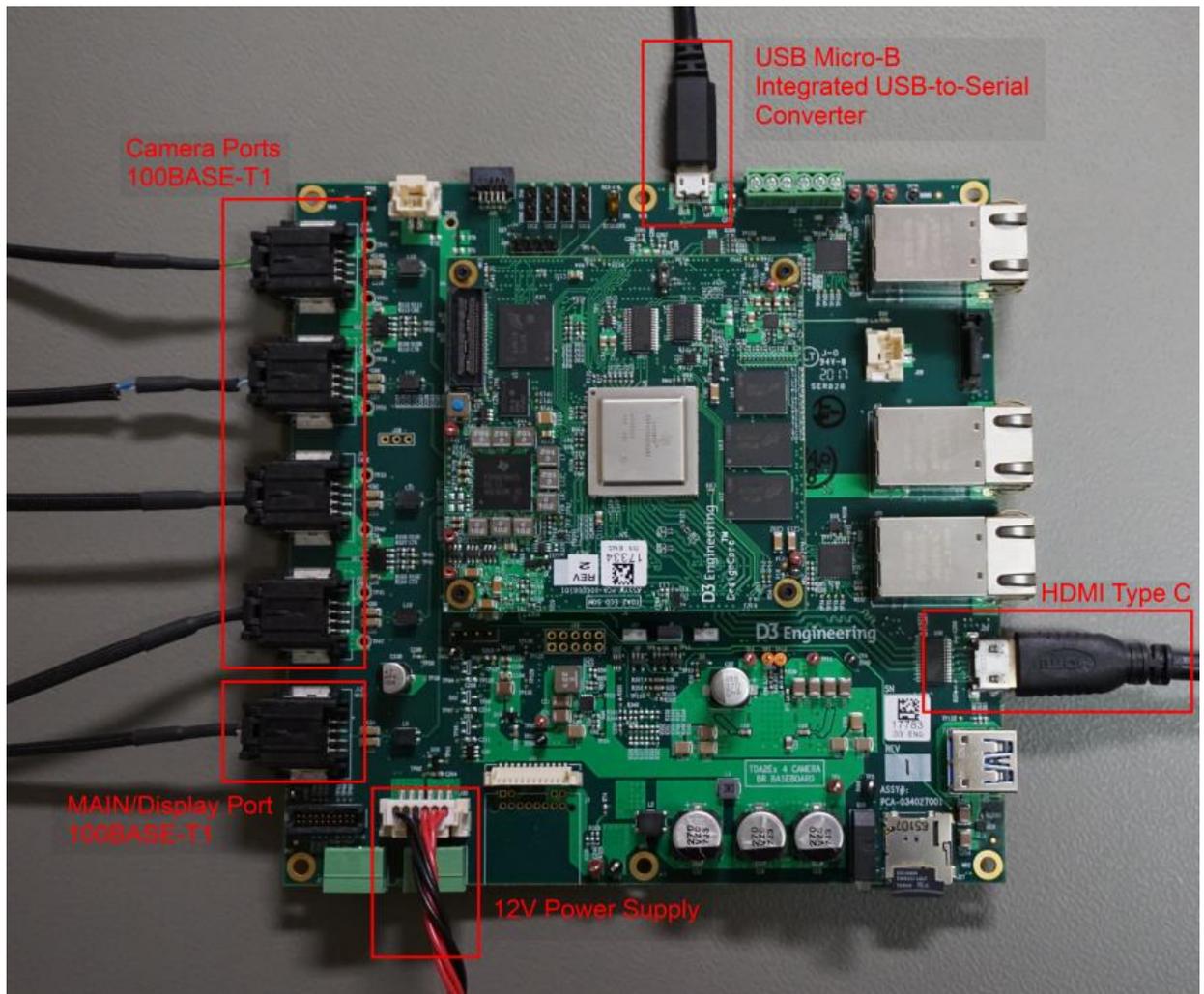
The steps to install and run the use-cases on TDA2Ex Eth SRV board are same as of TDA2Ex EVM. Please refer to respective section in this document above for this information. This document details only additional set up and build requirements.

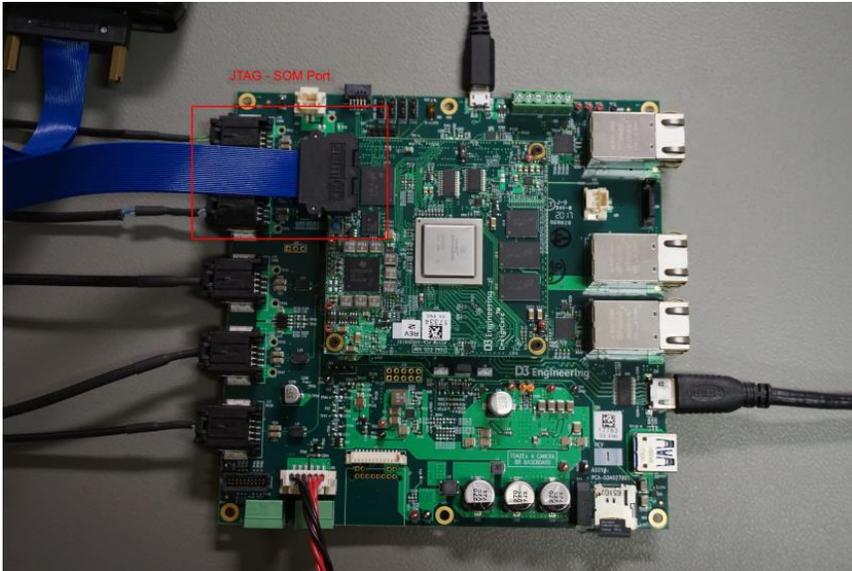
5.1 Hardware Setup

1. Power supply (12V, 5 - AMP)
2. Four camera modules and JST-to-Mini50 cables to connect to the 100BASE-T1 input ports of the TDA2Ex Ethernet Surround View Board.

Note: For VSDK testing on starter kit, AVB camera modules from [Truly™](#) are used. The camera configuration as below

- i. 1MP (1280x720) H264 all I frames @30fps
- ii. Camera module configured in master mode (this is needed as switch on the starter kit is in slave mode)
- iii. Firmware images on Camera flashed with below stream id's (which are used in the VSDK use-cases)
 - {0x01, 0x23, 0x45, 0x67, 0x89, 0xAB, 0xCD, 0xE0}
 - {0x01, 0x23, 0x45, 0x67, 0x89, 0xAB, 0xCD, 0xE1}
 - {0x01, 0x23, 0x45, 0x67, 0x89, 0xAB, 0xCD, 0xE2}
 - {0x01, 0x23, 0x45, 0x67, 0x89, 0xAB, 0xCD, 0xE3}
3. Display – Display can be via HDMI or Ethernet (AVB listener)
4. USB micro-B cable for user inputs.





5.2 Building VSDK for ETH SRV board

To enable build for TDA2Ex Ethernet surround view starter kit, enable below macro in the `\vision_sdk\apps\configs\tda2ex_evm_bios_all\cfg.mk`. You can use your own configuration as well with below configuration enabled.

```
#
# Enable below macro to run ETH SRV on TDA2EX ETH SRV Board
#
TDA2EX_ETHSRV_BOARD=yes
```

Make sure, `gmake -s -j showconfig` shows below config

- `TDA2EX_ETHSRV_BOARD=yes`
- `PROC_IPU1_1_INCLUDE=yes`
- `NDK_PROC_TO_USE=ipu1_1`
- `AVB_INCLUDE=yes`

Note 1: The TDA2Ex Eth SRV starter kit supports only below use-cases; please disable other use-cases from use-case config file.

`UC_avbrx_dec_display_avbtx`

`UC_avbrx_sv_display_avbtx`

`UC_srv_calibration`

`UC_network_rx_tx`

`UC_saveDisFrame`

5.3 Run the demo

Steps to run any use-case on TDA2Ex Eth starter kit is same as of TDA2Ex EVM. Please refer to

5.3.1 Streaming data via talker or AVB Camera

On TDA2Ex, AVB use-cases can be run either with Truly™ camera modules or AVBTP PC talker application. Also if sufficient camera modules are not available, combination of talker and camera can be used to make 4-channels. This needs modification in stream id's of talker to make sure those are not conflicting.

By default, PC talker uses stream id 01_23_45_67_89_AB_CD_Ex (x - channel number). So if you start 2 streams it would use stream id E0 and E1. This should not clash with camera stream id.



Figure Truly™ camera module

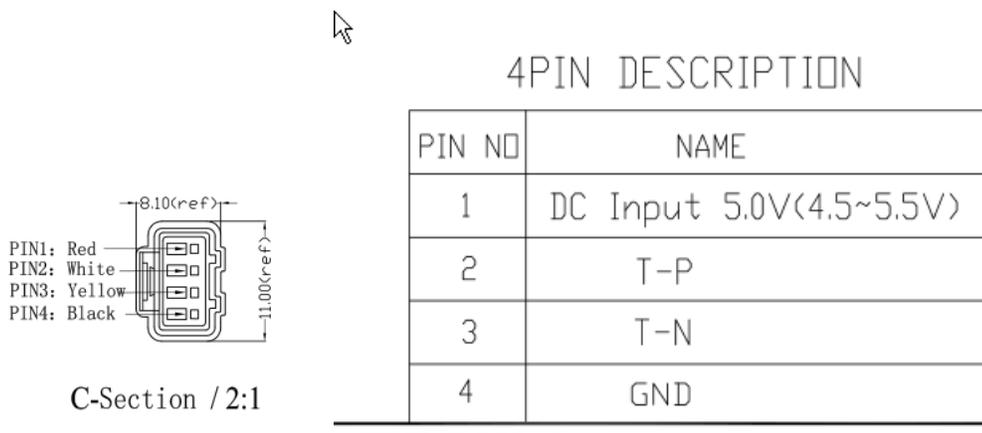
5.3.1.1 Streaming with Camera modules

- a. For using camera make sure camera modules are started and data is being streamed.

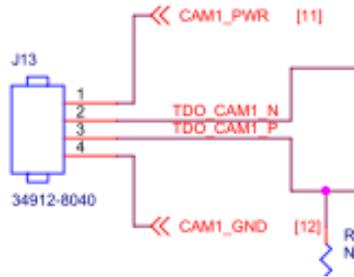
Note: When using PC talker make sure camera modules are not powered on (disable capture start and capture stop from the use-case main file). The stream from the camera module can interfere with the AVB talker and causes decode errors.

- b. Pin connections for Truly™ camera and TDA2Ex Eth SRV board

i. Truly™ Camera



ii. 4-Cam BR Baseboard



5.3.1.2 Streaming with PC talker

- a. Refer to AVB Used guide for building talker binaries.
- b. VMware can also be used but the throughput of talker is not as desired and depends on PC configurations.

NOTE: AVB Talker code present at
ti_components\networking\avbtp_0_10_00_00\utils\avbtp_talker

5.3.2 Display – HDMI or AVB listener

Display can be via HDMI or Ethernet (AVB listener)

1. HDMI 1080p60 capable Display Monitor and Type C HDMI cable.
2. Display via AVB listener – needs below
 - a. PC (preferably Ubuntu) for running AVB listener – current AVB Tx use-cases uses spoofed MAC address for constructing the AVB packets to be sent out to AVB listener, address used is ab:cd:ef:ab:cd:ef. Run AVB listener with this MAC address as source.
 - b. Listener configuration
 - i. AVB listener can be found at vsdk_install_path\ti_components\networking\avbtp_0_10_00_00\utils\avbtp_listener
 - ii. To build listener, open Makefile located in listener directory and change BUILD_OS to your OS.
 - iii. Use instructions given in AVB user guide located at vsdk_install_path\ti_components\networking\avbtp_0_10_00_00\docs\avbtp_0_10_00_00_user_guide.html
 - iv. Important points to note on Windows:

1. Please download WinPCAP library & not install it as listener needs header file. You can download WinPCAP library from <https://www.winpcap.org/archive/> or <https://www.winpcap.org/devel.htm>
2. Please make sure the MingW installation (standalone or with Codeblocks) contains sched.h header files. You may get below error if Codeblocks installation is without MingW. "fatal error: sched.h: No such file or directory" Please download Codeblocks with mingw from <http://www.codeblocks.org/downloads/26>
3. On Windows, auto playing of received stream is disabled as ffmpeg path might not be in the added in environmental PATH. So to play received stream you need to start new command prompt and run below command
"ffmpeg -framerate 33 -v quiet Received.h264"
If you want to play received stream from listener, remove below check from the avbrx_listener_main.c and rebuild listener. Make sure

you have *ffplay* in your PATH variable.

```
#ifndef linux
#if (1 == LAUNCH_FFPLAY)
    system("ffplay -framerate 33 -v quiet \"Received.h264\" &");
#endif
#endif
```

- v. To run listener, follow instructions in "Running listener" in AVB userguide. Make sure you have below set up.

Command prompt 1:

```
./avbtp_listener.out --srcMac ab:cd:ef:ab:cd:ef
```

Command prompt 2:

```
ffplay -framerate 33 -v quiet Received.h264
```

- vi. For Windows, download FFmpeg *build* package if you don't want to build it locally (<https://ffmpeg.zeranoe.com/builds/>)
- vii. **PC configuration for static IP** – as the AVB talker running on TDA2ex does broadcast, to avoid issues disconnect from Enterprise network and use static IP between board and PC. Basically make local connection between board and PC running listener. If you have two network interfaces, one can be used to connect Enterprise network and other for board connection with static IP.
- Configure PC into the static address (IP: 192.168.1.200 subnet: 255.255.255.0 default gateway: 192.168.1.1)
 - <https://kb.netgear.com/27476/How-to-set-a-static-IP-address-in-Windows>
- viii. **IMP Note:** Due to large number of broadcast from TDA2ex EVM, sometime Windows firewall blocks the AVB traffic and AVB listener stops working after initial few frames. Please disable firewall to work around this issue.
- c. Ethernet Media converter – BroadReach to 100BaseTx/1000BaseT converter to connect to PC (media converter from [Technica™](#) is used for testing)

6 Revision History

Version	Date	Revision History
1.0	22th August 2014	Initial Version
1.1	14 th November 2014	Added QSPI+SD boot, GCC and CCSversion
1.2	31 st December 2014	Some minor changes
1.3	4 th July 2015	Updated for 2.7 release
1.4	16 th Oct 2015	Updated for 2.8 release
1.5	18 th March 2016	Updated for 2.9 release
1.6	4 th July 2016	Updated for 2.10 release
1.7	2 nd Nov 2016	Updated for 2.11 release
1.8	8 th Feb 2017	Updated for 2.12 release TDA2Ex 17x17 package details added
1.9	19 th June 2017	Updated linux installer
2.0	27th June	Updated for release 3.0
2.1	10 th Oct 2017	Updated for release 3.1 TDA2Ex Ethernet SRV Starter kit details added and release 3.1
2.2	20 th Dec 2017	Updated for release 3.2
2.3	3 rd April 2018	Updated for release 3.3
2.4	4 th August 2018	Updated section 5 for adding info about listener configuration.

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