Getting Started with Xplorer for EVK-MIMXRT595



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Chapter 1 Overview

Cadence[®] Tensilica[®] Xplorer is a complete development environment that helps users create application code for highperformance Tensilica[®] processors. Xplorer is the interface to powerful software development tools such as the XCC compiler, assembler, linker, debugger, code profiler, and full set of GUI tools.

Xplorer (including both GUI and command-line environment) is the only available development IDE for the DSP core of MIMXRT595.

Chapter 2 Install Xplorer Toolchains

In this chapter:

- Xtensa Software Tools Platform Support
- Install the Xtensa Xplorer IDE and Tools
- Install License Key
- Identify PC MAC Address
- Download License Key
- Install RT500 DSP Build Configuration
- Install Xtensa On Chip Debugger Daemon
- Install Xtensa Software Tools without IDE

2.1 Xtensa Software Tools Platform Support

The Xtensa Software Tools are officially supported on the following platforms:

- Windows: Win 10 64-bit, Win 8 64-bit, Win 7 64-bit
- · Linux: RHEL 6 64-bit (with 'Desktop' package installed)

There may be compatibility issues with other versions of Linux or Windows, especially when using the IDE. Also note that security-enhanced Linux (SELinux) is not a supported platform because the OS can prevent different shared libraries (including Xtensa Tools) from loading.

For details on platform support and installation guidelines, see the Xtensa Development Tools Installation Guide.

2.2 Install the Xtensa Xplorer IDE and Tools

To install the Xtensa Xplorer IDE and tools:

1. Go to the URL https://tensilicatools.com/download/fusion-f1-dsp-sdk-for-rt500/ and login.



2. You receive an email confirmation with an activation link from 'Tensilica Tools' no-reply@tensilicatools.com.

NOTE Ensure to check the spam folder if this email is not in your inbox. Click the activation link to complete the registration.

- 3. Login with your credentials to see the available materials for download.
 - Download and install the XTENSA Xplorer IDE V8.0.15 for your operating system (Windows or Linux).

Download the DSP Configuration V8.0.15 for your operating system. This is installed later through the IDE. For details, see Install RT500 DSP Build Configuration.

NOTE NXP recommends version 8.0.15 of the Xtensa Xplorer IDE and tools for use with the RT500 DSP.

2.3 Install License Key

Xtensa development tools use FLEXIm for license management. FLEXIm licensing is required for tools such as the Xtensa Xplorer IDE, Xtensa C and C++ compiler, and Instruction Set Simulator (ISS).

Currently RT500 supports node-locked license for Xtensa tools. A node-locked license permits tools to run on a specific computer, tied to the MAC address of the primary network interface that is permanently attached to the machine.

2.3.1 Identify PC MAC Address

To generate the correct license file, identify the appropriate MAC for the computer you plan to run Xtensa tools on. Remove '-' or ':' symbols in the MAC address.



NOTE

Linux NOTE MAC address MUST be associated with eth0 interface. If not, FlexIm cannot perform the license checkout and you will not be able to compile or simulate you code. If your host has the MAC address associated with another interface. For example: em1, you may use the following approach, or another approach recommended by your IT team to rename the interface to eth0.

```
# Add udev rule for naming interface
$ sudo vim /etc/udev/rules.d/70-persistent-net.rules
# udev rule (replace 'XX' with the MAC address of your PC):
SUBSYSTEM=="net", ACTION=="add", ATTR{address}=="XX:XX:XX:XX:XX:XX", NAME="eth0"
# Change "em1" to "eth0" in your interfaces file.
$ sudo vim /etc/network/interfaces
# Restart udev or reboot machine
$ sudo reboot
```

2.3.2 Download License Key

To download the license key:

1. Click the CLICK TO GET A LICESNE KEY FOR RT500 SDK button.



2. Click the Accept button.

	Click to Get a License Key for RT500 SDK
	MAC Address (no "-" or "+" or spaces, please) MAC Address
	Please enter your machine's MAC address. If you have more than one, please use one that is permanently installed. The license checker will confirm that the MAC address is present, even if that particular network interface isn't in use. For example, you can enter the MAC address for your LAN interface, and that will work even if you are using the WiFi interface for your development.
he follo	wing message appears.

Your license has been generated downloaded, and saved in your user profile. In the future if you need to recover it, you can find it on your user profile page. Click here to visit your profile page now, or return to the page you were on



3. Check the license in the user-profile or the email.

User Profile		
Licenses		
SDK Name	Version License	Exp. Date
Fusion F1 DSP SDK for RT500	1.0 Download License	28/08/2020

The license file gets generated.

- 4. Download the license file.
- 5. Open the recently installed Xplorer 8.0.15, select menu Help Xplorer License Keys > Install Software Keys.
- 6. Select the license key file.
- 7. Click the Finish button.



The generated license file only supports debug/run on the RT500 device target. It does not support software simulation/Xplorer ISS. Contact Cadence directly if you have special must run software simulations.

2.4 Install RT500 DSP Build Configuration

'Build Configuration' is a term that describes all parameters and necessary build includes for the Tensilica processor implementation you are developing with. It is mandatory to install a specific build configuration before starting development on RT500.

The build configuration is provided by NXP as a binary file that can be imported into the Xplorer IDE. This file can be downloaded for your OS from the Tensilica URL.

The build configuration can be installed into the IDE using the 'System Overview' panel which is in the lower left corner by default. If this panel is not visible, it can be toggled using menu item **Window > Show View - System Overview**.

	System Overview 🛿 🗖 🗖	
	> Configurations Configurations Configurations Configuration Configuration	
	Add an Already Installed Configuration Build	
Figure 6. System o	verview	

Browse

Select the directory and click OK.

2.5 Install Xtensa On Chip Debugger Daemon

The Xtensa On Chip Debugger Daemon (xt-ocd), is a powerful gdb-based debugging tool. It is not installed by default with the Xplorer IDE. A self-extracting executable installer is included with the IDE, which can be found at the following location:

Windows

C:\usr\xt-ocd-14.05-windows64-installer.exe

Linux

~/xtensa/XtDevTools/downloads/RI2020.5/tools/xt-ocd-14.05-linux64-installer

At this moment xt-ocd supports J-Link and ARM RVI/DSTREAM probes over Serial Wire Debug (SWD) for RT500. xt-ocd installs support for J-Link probes but does not install the required J-Link drivers which must be installed separately. The RT500 requires J-Link software version 6.46 or newer.

NOTE

When installing xt-ocd on Linux, you must manually add a symlink to the installed J-Link driver:

ln -s <jlink-install-dir>libjlinkarm.so.6 <xocd-install-dir>/modules/libjlinkarm.so.6

xt-ocd is configured with an XML input file 'topology.xml' that you will need to modify to fit your debugger hardware. Using J-link as example, please use below content to replace the original template.

NOTE

You must replace 'usbser' section to your own JINK serial number (9 digits number on the back of the J-Link hardware).

```
<configuration>
<controller id='Controller0' module='jlink' usbser='600100000' type='swd' speed='1000000'
locking='1'/>
<driver id='XtensaDriver0' dap='1' xdm-id='12' module='xtensa' step-intr='mask,stepover,setps' />
<chain controller='Controller0'>
<tap id='TAP0' irwidth='4' />
</chain>
</cystem module='jtag'>
<component id='Component0' tap='TAP0' config='trax' />
</system>
<device id='Xtensa0' component='Component0' driver='XtensaDriver0' ap-sel='3' />
<application id='GDBStub' module='gdbstub' port='20000' sys-reset='0'>
<target device='Xtensa0' />
</application>
</configuration>
```

Below showing another topology.xml example for ARM RealView ICE (RVI) and DSTREAM debug probes.

```
<configuration>
<controller id='Controller0' module='rvi' />
<driver id='XtensaDriver0' debug='' inst-verify='mem' module='xtensa' step-</pre>
intr='mask,stepover,setps'/>
<driver id='TraxDriver0' module='trax' />
<chain controller='Controller0'>
<tap id='TAP0' irwidth='4' />
</chain>
<system module='jtag'>
<component id='Component0' tap='TAP0' config='trax' />
</system>
<device id='Xtensa0' component='Component0' driver='XtensaDriver0' xdm-id='12' />
<device id='Trax0' component='Component0' driver='TraxDriver0' xdm-id='12' />
<application id='GDBStub' module='gdbstub' port='20000' >
<target device='Xtensa0' />
</application>
<application id='TraxApp' module='traxapp' port='11444'>
<target device='Trax0' />
</application>
</configuration>
```

Congratulations! Now you have all Xplorer toolchains installed.

For more details, about Xtensa software tools, build configurations, or xt-ocd daemon, see the full set of documents in Xplorer menu Help > PDF Documentation.

2.6 Install Xtensa Software Tools without IDE

The Xtensa Software Tools optionally be installed without the use of the IDE, which may be desired for use in a command-line only Linux environment, or for better compatibility with an unsupported Linux environment.

The command-line tools package is available as a redistributable zip file that is extracted with an Xplorer IDE install. The IDE will need to be installed one time in your organization to gain access to the tools package, which is then available at:

~/xtensa/XtDevTools/downloads/RI2020.5/tools/ XtensaTools_RI_2020_5_linux.tgz

With the tools package and the DSP Build Configuration package available from the Tensilica Tools download site (see Xtensa Software Tools Platform Support, the toolchain can be setup as follows.

```
# Create Xtensa install root
mkdir -p ~/xtensa/tools
mkdir -p ~/xtensa/builds
# Set up the configuration-independent Xtensa Tool:
tar zxvf XtensaTools_RI_2020_5_linux.tgz -C ~/xtensa/tools
# Set up the configuration-specific core files:
tar zxvf nxp_RT500_RI2020_5_newlib_linux_redist.tgz -C ~/xtensa/builds
# Install the Xtensa development toolchain:
cd ~/xtensa
./builds/RI-2020.5-linux/nxp_RT500_RI2020_5_newlib/install \
--xtensa-tools./tools/RI-2020.5-linux/XtensaTools \
--registry ./tools/RI-2020.5-linux/XtensaTools/config
```

Chapter 3 Install MCUXpresso SDK

In this section:

- Download MCUXpresso SDK for RT500
- MCUXpresso SDK DSP Enablement
- DSP Core Initialization

3.1 Download MCUXpresso SDK for RT500

DSP enablement for RT500, including drivers, middleware libraries, and demo applications are included with the latest RT500 SDK available for download at https://mcuxpresso.nxp.com.

NOTE

Ensure to register, if you are accessing the page for the first time.

Log-in to use the SDK builder. The steps are:

- 1. Click Select Board.
- 2. Search by name for board: RT595'.
- 3. Select EVK-MIMXRT595.
- 4. Click Build MCUXpresso SDK.

earch for your board or kit to get started.		Not Actual Board Image	
Search by Name		IMXRTRT595-EVKB: EVK Develop	ment Platform for i.MX MIMXRT595S MCU
Search		Hardware Details	
		Board	EVK-MIMXRT595
Select a Board, Kit, or Processor		Device	MIMXRT595S
EVK-MIMXRT1050 (MIMXRT1052xxxxx) Deprecated	•	Core Type / Max Freq	Cadence-FusionF1 / 200MHz
EVK-MIMXRT1060 (MIMXRT1062xxxxA)			Cortex-M33 / 200MHz
EVK-MIMXRT1064 (MIMXRT1064xxxxA)		Device Memory Size	0 KB Flash 5120 KB RAM
EVK-MIMXRT595 (MIMXRT595S) Controlled access			
EVK-MIMXRT685 (MIMXRT685S)		Actions	
EVKB-IMXRT1050 (MIMXRT1052xxxxB)		Build MCUXpresso SDK	
MEK-MIMX8QM (MIMX8QM6xxxFF)			
MEK-MIMX8QX (MIMX8QX6xxxFZ)		Explore selection with Pir	ns tool
MIMXRT1170-EVK (MIMXRT1176xxxxx) Controlled access		Explore selection with Cle	ocks tool
SLN-ALEXA-IOT (MIMXRT106AxxxxA)	•		
Name your SDK			
SDK_2.6.2_EVK-MIMXRT595			
Don't use: (<, >, ; ",/,I, ?, `, I) in the name of your SDK			

3.2 MCUXpresso SDK DSP Enablement

The DSP-specific enablement is available inside the MCUXpresso SDK release package for RT500. The path is: <sdk_ROOT>/ devices/MIMXRT595S/

Unified device and peripheral driver source code that compiled for both ARM and DSP cores.

NOTE

Only a limited subset of peripheral drivers and components are supported on the DSP.

<SDK ROOT>/boards/evkmimxrt595/dsp examples/

DSP example applications are available at:<SDK ROOT>/middleware/multicore/rpmsg lite/

Unified RPMsg-Lite multicore communication library, with porting layers for ARM and DSP cores. <SDK ROOT>/

middleware/dsp/audio_framework/

Xtensa Audio Framework (XAF) for DSP core

3.3 DSP Core Initialization

In order to minimize power consumption, the DSP core is NOT powered when RT500 boots up.

To run or debug DSP applications: you will first need to execute some code on the ARM core to initialize the DSP.

A DSP management interface library is provided in the SDK, located at <SDK ROOT>/devices/MIMXRT595S/drivers/fsl dsp.c:

```
/* Initialize DSP core. */
void DSP_Init(void);
/* Deinit DSP core. */
void DSP_Deinit(void);
/* Copy DSP image to destination address. */
void DSP_CopyImage(dsp_copy_image_t *dspCopyImage);
<SDK_ROOT>/devices/MIMXRT595S/drivers/fsl_dsp.h:
/* Start DSP core. */
void DSP_Start(void);
/* Stop DSP core. */
void DSP stop(void);
```

The SDK includes a helper function used by the DSP example applications at <SDK ROOT>/boards/evkmimxrt595/

dsp_examples/hello_world_usart /cm33/

```
/* Prepare DSP core for code execution:
- Setup PMIC for DSP
- Initialize DSP clock and core
- (Optional) Copy DSP binary image into RAM
- Start DSP core
*/
void BOARD_DSP_Init(void);
```

After executing this function during your ARM application startup, the DSP is initialized and ready to run. The code is loaded and debugged on the DSP with Xplorer IDE and tools.

Chapter 4 Run and Debug DSP Demo using Xplorer IDE

- Prepare Arm Core for 'Hello World'
- Prepare DSP Core for 'Hello World'
- DSP Linking Profiles
- Build the Xplorer project.
- Start Xtensa Debugger Daemon
- Run and Debug DSP Audio Framework
- EVK Board Setup for Audio Demo
- Debug Audio Demo
- Launch DSP Application from Arm Core

4.1 Prepare Arm Core for 'Hello World'

The DSP demos contained in the MCUXpresso SDK each consist of two separate applications that run on the Arm core and DSP core. The Arm core application initializes the DSP core in the manner described in section 2.3 and executes other application-specific functionality.

In order to debug the 'Hello World' DSP application, you will first need to setup and execute the Arm application using an environment of your choosing:

· Build and execute the 'Hello World' Arm demo located at:

<SDK ROOT>/boards/evkmimxrt595/dsp examples/hello world usart/cm33/

Preparing an Arm core development environment is outside of the scope of this document. Please refer to the document 'Getting Started with MCUXpresso SDK for MIMXRT500.pdf' located under <SDK_ROOT>/docs/ for information on how to use the SDK for Arm core development.

NOTE SEGGER J-Link software version >= 6.46 is required for compatibility with RT500. MCUXpresso IDE may ship with an older version, which is customized as in Figure 9

4.2 Prepare DSP Core for 'Hello World'

The RT500 SDK provides a collection of DSP example applications located under $boards/evkmimxrt595/dsp_examples/$. Each DSP example has two source directories, one for the Arm Cortex-M33 core ('cm33') and one for the DSP fusion f1 core ('fusionf1'):



Under these directories will be build projects for different supported toolchains. For the DSP example above, the 'xcc' project will allow to build on the command line and the 'xtensa' directory is an Xplorer IDE project.

To run the 'Hello World' demo, first you need to import SDK sources into Xplorer IDE.

1. Use menu item File > Import > Existing Projects into Workspace .

Select an import source: type filter text ✓ Constrained Image: Archive File Image: Existing Projects into Workspace Image: File System Image: Preferences Image: Image	M Import Select Create new projects from an archive file or directory.		- L	×
type filter text	Select an import source:			
 ✓ General ☑ Archive File ☑ Existing Projects into Workspace ☑ File System ☑ Preferences > ☑ Install ➢ Run/Debug ➢ Team > ☑ Xtensa Xplorer 	type filter text			
	 ✓ General (a) Archive File (b) Existing Projects into Workspace (c) File System (c) Preferences (c) Install (c) Run/Debug (c) Team (c) Xtensa Xplorer 			
	(?) < <u>Back</u> <u>Next ></u>	inish	Cance	I
Image: Second				

2. Select SDK directory <SDK_ROOT>\boards\evkmimxrt595\dsp_examples\hello_world_usart \fusionf1\xtensa as root directory and leave all other check boxes blank as default.

Browse For Folder	×
Select root directory of the projects to import	
• boards • evkmimxrt595 > cmsis_driver_examples > demo_apps > demo_apps > dsp_examples > audio_demo_bm • hello_world_usart > cm33 • dsp binary > xcc > xtensa > mu_interrupt > naturedsp	
Figure 11. Select root directory	

3. Click OK.

📉 Import					
Import Projects Select a directory to sea	rch for existing Eclipse projects.				
Select root directory:	C:\SDK\SDK_2.9.0_EVK-MIMXRT	595\boards\evkmi	mxrt595\dsp_examp	ples\hello_world, ~	Browse
O Select archive file:				~	Browse
Projects:					
dsp_hello_world_u	usart_fusionf1 (C:\SDK\SDK_2.9.0	EVK-MIMXRT595\b	ooards\evkmimxrt5	95\dsp_examples\he	Select All
				[Deselect All
				[Refresh
<			_	>	
Search for nested pro Copy projects into w Hide projects that all	ojects orkspace ready exist in the workspace				
Working sets					
Add project to work	ing sets				
Working sets:				~	Select
0		< Back	Next >	Finish	Cancel
e 12 Import project	e				

4. Click the Finish button.

The 'dsp_hello_world_usart_fusionf1' project appears in the Project Explorer.

4.3 DSP Linking Profiles

The Xtensa Software Tools use linker support packages (LSPs) to link a Fusion DSP application for the RT500. An LSP includes both a system memory map and a collection of libraries to include into the final binary. These LSPs are provided in the MCUXpresso SDK under <SDK_ROOT>/devices/MIMXRT595S/xtensa/.

DSP sample applications are configured to link against one of these custom LSPs. By default, 'Debug' targets will link against the gdbio LSP which is intended to be used with an attached debugger and captures I/O requests (printf) through gdb. The 'Release' target will link against the min-rt LSP which includes minimal runtime support.

You can see and change which LSP is being actively used by the project target in the Xplorer IDE in the Linker menu of the project.

File Edit Source	Refactor Nav	igate	Search	Proje	ct F	Run	Tools	Window	Help	р		
📑 – 🖪 🕼 🍡 🔰	FBmode: Of	f 🔻	No Activ		Open	n Proje	ct				-	Bu
					Close	e Proje	ct					
					Build	Work	ing Set			>		
Project Explorer		C	Clear	.	5							
> 🖭 dsp_hello_wo	orld_usart_fusion	nf1			c	ا معا						
> 🥗 HelloWorld				BB	C/C+ Ratek	+ ind	EX Set		Chr	4.5		
				SET	Unar	ade Vt	onco D	rojecto	cu	1+1		
					Build	Prone	erise r	rojecis				
					Libra	rv Den	enden	cies			1	
					Prop	erties						
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type filter text	Target: Debug Advanced Optimizatio W Linker support package None O Standard © © Custom LSP Path O Custom LSP Name	/arnings La sim \${xt_projec	>)	Ma compiler A	ssemble	it r AddI ass RT595S/xte	Mana sembler Co nsa/gdbio	ge Target	for Linker	Memor	y »6 Browse	<u>ave</u>
type filter text	Target: Debug Advanced Optimizatio (W Linker support package None Standard © Custom LSP Path Custom LSP Path Custom LSP Name Custom LSP Name ☐ Embed map info in e Generate linker map ☐ Omit debugger symt Omit all symbol info ☐ Link with interproced Use linkorder.tx to co Hardware Profile Timer for hardware pro	/arnings (La sim \${xt_project sim le object wit xecutable file sol informat file sol informat file file sol informat film film film film film film film film	ct_loc)/// thout stdlib for tion from output m output file is enabled tion link order e	Ma compiler A //./device code sizing ut file	ssemblei s/MIMXF	it r AddI ass RT595S/xte es	Mana æmbler (Co	ge Target	for Linker	Memor	pply S py) *6 Browse Select	ave
type filter text	Target: Debug Advanced Optimizatio (W Linker support package \None Standard Image: Custom LSP Path Custom LSP Path Custom LSP Name Create non-executab Embed map info in e Generate linker map Omit debugger symble Omit debugger symble Omit debugger symble Use linkorder.tot to cold Use linkorder.tot to cold Hardware Profile Timer for hardware profile Timer for hardware profile	/arnings La sim \${xt_project [] signature secutable file pool informat mration fror fural analysi ontrol funct filing None	thout stdlib for tion from output m output file is enabled tion link order e	Ma compiler A ///device code sizing st file	ssemble	r Addl ass RT595S/xte es	Mana embler Co	ge Target	for Linker	Memor	pply S py %6 Browse Select	ave
type filter text	Target: Debug Advanced Optimizatio W Linker support package None Standard Standard © Custom LSP Path Custom LSP Name Create non-executab Embed map info in e Generate linker map Omit debugger symt Omit all symbol info Link with interproced Use linkorder.bt to co Hardware Profile Timer for hardware pro Information Area	/arnings La sim S(xt_project le object wit xecutable file bool informat rrmation fror dural analysi ontrol funct filing None	thout stdlib for tion from output moutput file is enabled tion link order	Ma compiler A //./device code sizing ut file	ssemble	r AddI ass RT595S/xte es	Mana iembler Co	ge Target	for Linker	Memor	Browse	
type filter text	Target: Debug Advanced Optimizatio (W Linker support package None Standard © Custom LSP Path Custom LSP Name Custom LSP Name Custom LSP Name Create non-executab Embed map info in e Generate linker map Omit debugger symt Omit all symbol info Link with interproced Use linkorder.txt to co Hardware Profile Timer for hardware pro Information Area All Options: Local + Int	/arnings (La sim \${xt_project sim [le object with executable file sol informat filing None filing None herited 0	ct_loc)/// thout stdlib for tion from output m output file is enabled tion link order e	Ma compiler A //./device code sizing ut file	ssemble	r Addl ass RT595S/xte es	Mana eembler (Co	ge Target	for Linker	nplate: A Memor	Browse Select	
type filter text >	Target: Debug Advanced Optimizatio (W Linker support package None Standard © Custom LSP Path Custom LSP Path Custom LSP Name Create non-executab Embed map info in e Generate linker map Omit all symbol info Link with interprocec Use linkorder.bt to co Hardware Profile Timer for hardware pro Information Area All Options: Local + Int Linker: -mIsp=S(xt_project (st, project (st, project (st, projet), st, project (st, project (st, projet), st, project (st, projet), st, projet)	/arnings La sim [sim [s[xt_project [st_project] [st_proje	thout stdlib for tion from output tion from output file is enabled tion link order e Local only /device: ware/dsp/code ware/dsp/code	Ma compiler A ///device code sizing t file Commo /MIMXRT5 cs/ascplus_ c	n target	r Addl ass RT595S/xte es sa/gdbio onf1/lib/xa 1/lib/xa m	Mana embler Co nsa/gdbio	ge Target pmpiler options	target	nplate: A Memor	Browse Select	

The MCUXpresso SDK ships with other standard LSPs for RT500. For more information on using LSPs and how to create a custom memory map using Xtensa software tools, see the Cadence Linker Support Packages (LSPs) Reference Manual.

4.4 Build the Xplorer project.

Use the drop down buttons on the menu bar to make a build selection for the project and hardware target configuration.



4.5 Start Xtensa Debugger Daemon

Connect the EVK board to a PC via the USB debug interface (J40) and open up a serial interface on your PC using a terminal tool such as Tera term or PuTTY on Windows or screen on Linux.

Remove Jumpers JP17, JP18, JP19 for SWD to connect to the chip and Serial interface on J40.

- 1. Load CM33 hello_world_usart you build from step 3.1 using J-link
- 2. To debug DSP applications on RT500, you must have the xt-ocd daemon up running. This application runs a gdb server that the Xtensa core debugger connects with.
- Go to the command-line window and cd to xt-ocd daemon installation path. By default, it is C:\Program Files (x86)\Tensilica\Xtensa OCD Daemon 14.05 on Windows.
- Update the topology.xml file with your J-link serial number. Topology.xml file : Edited J-link serial number in usbser field. Ensure dap = 1 in order for it to work.

5. Execute the daemon with your custom topology:

xt-ocd.exe -c topology.xml

C:\WINDOWS\system32\cmd.exe - xt-ocd.exe -c topology.xml

:\Program Files (x86)\Tensilica\Xtensa OCD Daemon 14.05> :\Program Files (x86)\Tensilica\Xtensa OCD Daemon 14.05>xt-ocd.exe -c topology.xml XOCD 14.05 2020-10-12 17:38:02 (c) 1999-2021 Cadence Design Systems Inc. All rights reserved. [Debug Log 2021-02-02 22:06:58] Loading module "gdbstub" v2.0.0.12 oading module "jlink" v2.0.2.0 Using JLINK lib v.68803 Jlink USB Serial Number: 600112004 Connected to Jlink Device: Name: 'SEGGER J-Link ARM' S/N:600112004 Firmware: J-Link V10 compiled Nov 12 2020 10:06:35 Requested/Set TCK: 1000kHz/65534kHz Jlink: Select SWD SWD-DP with ID 0x6BA02477 oading module "jtag" v2.0.0.20 oading module "xtensa" v2.0.0.48 Starting thread 'GDBStub' Opened GDB socket at port 20000 Initialize XDM driver Warning: Warning: DAP Reset request failed! Ignoring...

NOTE

tSome warning messages are expected and can be ignored. If you receive an error initializing the XDM driver, you may need to initialize and start he DSP core before debugging. For details, see DSP Core Initialization.

NOTE For more information on xt-ocd runtime options and configuration, see Chapter 7 of the Xtensa Debug Guide (available in Help > PDF Documentation).

6. Use the action buttons on the right side of the menu bar to debug / profile / trace. A default debug configuration is provided by the SDK project which utilizes the on-chip debugger.



×

Nebug Configurations

Create, manage, and run configurations

	Name: dsp_hello_world_usart_fusionf1 debug jlink							
type filter text	Main Trace Synchronized Debug Common							
Attach To Xtensa GDB Port MB Laurach	4 X	Target						
Post Mortem Launch	✓ I Target	Host name: localh						
v 🕲 Xtensa On Chip Debug	w coleo. \${xt_project}		Status	Unknown				
@ dsp_hello_world_usart_fusionf1		XOCD Manager Por	 Connect 	Connect				
		OCD Connection (requires XOCD Manager)						
		OCD Version:	Use latest	~	Refresh			
		Topology File:	Auto create	~	Browse			
		JTAG Probe:			~			
		JTAG Probe Spee	ed					
		IP Address						
		USB Serial Num	ber					
		Ocd Diagnostics	Diagnose					
		OCD Log options	5					
		 Profiling 						
< >								
Filter matched 7 of 7 items				Revert	Apply			
\odot				Debug	Close			

7. Once the **Debug**' button is selected, the actual debug on the chip starts. Xplorer prompts you to download binaries to the hardware.

Now	nload binary	X	
?	Download binary to: core0?		
	Yes: download binary and restart. No : attach to target without restart.		
		Yes <u>N</u> o	

- 8. Select Yes.
- 9. Xplorer IDE transitions to the **Debug** perspective after binary download.
- 10. After stepping through the 'printf' statement, thr output appears in the Console view of the IDE:

X Debug - dsp_hello_world_usart_fusionf1/source/main_dsp.c - Xtensa Xplorer	
File Edit Source Refactor Navigate Search Project Run Tools Window Help	
🖆 🕈 🗟 🖏 🗱 FBmode: Off 🔻 P: dsp_hello_world_usart_fusionf1 🔻 C: nxp_rt500_Rl2020_5_newlib 💌 T: Debug 🔻 Build Active 💌	Run 🔻 Profile 👻 Debug 💌 Trace 💌 🕐 🗰 🕺 🐔 💊
四・如・むか・シャ	
拳 Debug 🛛 🦓 🖉 ▼ 🕪 💷 📕 🗱 🕺 💀 😥 👘 党 🌼 文 🙂 🗆	🗱 Variables 😫 🂁 Breakpoints 🍕 Expressions 🕮 Registers 🗡 Tie W
 	Name Type
GDB Console for core: core0	
< >	<
i main_dsp.c ∞	
<pre>************************************</pre>	^
<pre>2 { /* Init board hardware. */</pre>	
<pre>BOARD_InitPins(); CLOCK_SetXtalFreq(BOARD_XTAL_SYS_CLK_HZ); BOARD_InitDebugConsole();</pre>	
PRINTF("\r\nHello World running on DSP core '%s'\r\n", XCHAL_CORE_ID);	~
	>
🖸 Console 😫 🎟 Grid Registers 🔋 Memory 📟 Bounded Memory 🖹 Problems	■ X 🔆 B. 55 00 57 57 00 1 - 10 - 10 - 10 - 10 - 10 - 10 - 1
dsp_hello_world_usart_fusionf1 debug jlink [Xtensa On Chip Debug] Program Console for core: core0	

- 11. Hello World starts running on core nxp_RT500_RI2020_5_newlib.
- 12. After the debug is complete, select the previous code perspective to return to the default IDE layout.

	<u>W</u> in	dow	<u>H</u> elp			
1		New Edito Hide	Window or Toolbar	>	Debug ▼ Build Active ▼ . Run ▼ Profile ▼ Debug ▼	-
		Show	v View	>	Wanables & See	58
1		Persp	pective	>	Open Perspective > F Benchmark	l
		Navi	gation	>	Customize Perspective	
	:	Refre	esh Debug Views		Save Perspective As Other	ŀ
		Prefe	erences		Reset Perspective	l
	_				Close Perspective <	
					Close All Perspectives	

4.6 Run and Debug DSP Audio Framework

The DSP audio framework demo consists of separate applications that run on the Arm core and DSP core. The Arm application runs a command shell and relays the input requests to the DSP application using RPMsg-Lite.

4.6.1 EVK Board Setup for Audio Demo

The DSP audio demo is tested against EVK-MIMXRT595 and requires the use of the DMIC daughter board (attached at J31), the CODEC line out (J4), and UART for serial console.

In order for the CODEC to output audio properly, you will need to attach two jumpers on the board as follows:

• The 1-2 connected for JP7, JP8, JP9, JP28, JP29.

The demo uses the UART for console input and output. Connect the EVK board to a PC via the USB debug interface (J40) and open up a serial interface on your PC using a terminal tool such as Tera term or PuTTY on Windows or screen on Linux.

- Remove Jumpers JP17, JP18, JP19 for SWD to connect to the chip and Serial interface on J40.
- · DSP debugging is through SWD only, so please connect J-Link to SWD interface.

4.6.2 Debug Audio Demo

In order to debug this DSP application, you will first need to setup and execute the ARM application using an environment of your choosing (see 'Getting Started with MCUXpresso SDK for EVK-MIMXRT595.pdf' for ARM development environment options).

The example that follows will use NXP MCUXpresso IDE for the ARM environment.

- Install the MCUXpresso SDK for RT500 into the MCUXpresso IDE using the 'Installed SDKs' panel at the bottom:
- Use the QuickStart menu on the lower left of the screen to import an example from the installed SDK:



• Select the 'dsp_xaf_demo_cm33' example for Cortex-M33 core:

Please select UART in project options after clicking the dsp_xaf_demo_cm33 example project.

🗙 Import proj	ects		
Project name prefix:	evkmimxrt595	Ū.	2 Project name suffix:
✓ Use default locat	ion		
Location: C:\Users\n	xf55936\Documents\MCUXpressoIDE_11.0.0_25	16\workspace5\ev	vkmimxrt595 Browse
Project Type			Project Options
● C Project ○ C+	+ Project 🔵 C Static Library 🔵 C++ Static Lib	rary	SDK Debug Console Semihost UART Example default Copy sources Import other files
Examples			🔤 🖉 🖗 🕀 🖻
type to filter			
Name Name Constant of the second s	er_examples nt_examples ps mples ples llo_world_usart_cm33 f_demo_cm33 pples ples examples ples	Description The dsp_hello_wo The dsp_xaf_demo	orld_usart demo application demonstrates starting DSP core with no demo application demonstrates starting DSP core with DSP im
?			< Back Next > Finish Cancel

• Configure project settings, notably choose to link the application to RAM for ease of initial debug. Select 'Finish' to complete the import:

X Advanced Settings	^
* C/C++ Library Settings	
Set library type (and hosting variant) Redlib (nohost-nf)	
Redlib: Use floating point version of printf NewlibNano: Use floating point version of printf Redlib: Use character rather than string based printf NewlibNano: Use floating point version of scanf	
Redirect SDK "PRINTF" to C library "printf" Redirect printf/scanf to ITM Include semihost HardFault handler Redirect printf/scanf to UART	
* Hardware settings	
Set Floating Point type FPv5-SP-D16 (Hard A8I)	~
* MCU C Compiler	
Language standard GNU C99 (-std=gnu99)	~
TrustZone Project Type None	¥.
* MCU Linker	
TrustZone Project Type	. [
None None	<i>4</i>
Memory Configuration	
Memory details	
Default LinkServer Flash Driver Browse	~
(7) < Back Next > Finish Cance	I

• Build the project and launch the debugger on success:



• Use the debug toolbar to resume the code execution:

B5_dsp_xaf_demo_cm33/source/main_cm33.c - MCUXpresso IDE

Navigate Search Project ConfigTools Run Analysis FreeRTOS Window Help 🖉 🕓 🚳 👻 📴 🔌 🔟 🔳 N 3. 🤨 🔬 🗮 🐚 🗓 🖷 🤽 🗞 伦 🔻 🕹 🖉 🦼 🍢 🎋 🔻 🔾 🗸 🧌 egis... 🏘 Faults 🎋 Debug 😫 🖻 🕵 🖶 🗞 🗙 ✓ P Thread #1 57005 (Suspended : Breakpoint) Resume code execution main() at main_cm33.c:604 0x81822 i main_cm33.c ≅ i fsl_usart.c 598 * @brief Main function 599 */ 600 int main(void) 601 { 602 int ret: 603 BOARD_InitPins(); 604

· Observe serial terminal output with shell prompt:

```
Configure WM8904 codec
XAF DSP demo start
SHELL build: Nov 30 2020
Copyright 2021 NXP
SHELL>>
```

Using the Xplorer IDE, load and execute xaf_demo using the procedure described in sections 3.4 and 3.5 of this document.

 After the DSP application is running, use the serial shell to invoke the 'rec' command – this will create an audio pipeline that captures microphone audio and plays it back via the codec speaker line out (J4 on the EVK):

```
SHELL>> help
"help": List all the registered commands
"exit": Exit program
"echo": Query DSP for component versions
"rec": Record DMIC audio and playback on WM8904 codec
SHELL>>
SHELL>> rec
```

• The Xplorer IDE console will show output of the audio framework pipeline initializing:

```
© Console ≅ IIII Grid Registers ◎ Memory ■ Bounded Memory இ Problems

dsp_xaf_demo_hifi4 debug jlink [Xtensa On Chip Debug] Program Console for core: core0

Initializing...

Initialized

Number of channels 2, sampling rate 16000, PCM width 16

Audio Framework : 'capturer -> gain -> renderer'

Build: XTENSA_HIFI4_RF3, On: Jul 31 2019 12:11:07

Lib Name : Audio Framework (Hostless)

Lib Version : 1.3p5_Alpha

API Version : 1.2

Audio Device Ready

connected CAPTURER -> GAIN_0

connected XA_GAIN_0 -> XA_RENDERER_0
```

· Please make sure jumper settings on the board as follows to hear the sound output.



4.7 Launch DSP Application from Arm Core

In the previous example, the Arm application and DSP application were independently loaded and debugged. In this section, we will show how to produce one Arm application binary that includes and starts the DSP application without the use of a debugger/loader.

The Arm core application for each DSP demo uses a global preprocessor macro to control loading of the DSP binary application:

DSP_IMAGE_COPY_TO_RAM

This macro is set to 0 by default. When this macro is changed to '1'/TRUE, it will instruct the DSP demo application to do the following:

- · Link the DSP application binary images into the Arm binary
- · Copy the DSP application images into RAM on program boot
- Initialize the DSP to run from the RAM image

NOTE

Ensure that this macro is supplied to both the C compiler and assembler when modifying the Arm project.

To build the DSP application image so it can be used by the Arm application, you must select the 'Release' target in Xplorer IDE (building with min-rt LSP – see section 2.4 for more information).

 M Debug - dsp_hello_world_usart_fusionf1/source/main_dsp.c - Xtensa Xplorer

 File
 Edit
 Source
 Refactor
 Navigate
 Search
 Project
 Run
 Tools
 Window
 Help

 Image: The state of the

Two DSP binaries are generated.

```
<SDK_ROOT>\boards\evkmimxrt595\dsp_examples\xaf_demo\dsp\binary\dsp_text_release.bin
<SDK_ROOT>\boards\evkmimxrt595\dsp_examples\xaf_demo\dsp\binary\dsp_data_release.bin
```

NOTE

Depending on the environment used, you may need to manually copy these binary images into your Arm application workspace.

Chapter 5 Run and Debug from Command Line Environment / LINUX

RT500 SDK has been configured to be as flexible as possible to support multiple toolchains, including ARMGCC and XCC command line environment. The principles and essentials are still the same as with the IDE. Command line environment settings are nearly identical between WIN32 and LINUX, just with a few different path settings.

5.1 Build and Debug Arm Application

The Arm application requires the GNU Arm Embedded Toolchain and CMake version 3.x for command line compile and linking. See the 'Getting Started with MCUXpresso SDK for RT500.pdf' in the <SDK_ROOT>/docs/ directory for more information on installation and configuration of required build tools for command line development.

1. Launch a command prompt / terminal and change directory to the xaf_demo application.

```
user@linux:~/SDK/boards/evkmimxrt595/dsp_examples/xaf_demo/cm33/Armgcc$ ls -1
build_all.bat
build_all.sh
build_debug.bat
build_debug.sh
build_flash_debug.sh
build_flash_release.bat
build_flash_release.sh
clean.bat
clean.sh
CMakeLists.txt
```

2. Use .bat files to build the configuration on Windows, and .sh files on Linux/UNIX.

```
user@linux:~/SDK/boards/evkmimxrt595/dsp_examples/xaf_demo/cm33/Armgcc$ ./build_debug.sh
...
[100%] Linking C executable debug/dsp_xaf_demo_cm33.elf
[100%] Built target dsp_xaf_demo_cm33.elf
```

3. Launch the GDB server (NOTE: J-Link requires version >= 6.46).

```
user@linux:/opt/JLink$ ./JLinkGDBServerCLExe -device MIMXRT595_M33 -if SWD
SEGGER J-Link GDB Server V6.46j Command Line Version
...
Listening on TCP/IP port 2331
Connecting to target...Connected to target
Waiting for GDB connection...
```

4. Connect with GDB to the device and load Arm application.

```
user@jlinux:~/SDK/boards/evkmimxrt595/dsp_examples/xaf_demo/cm33/Armgcc$ Arm-none-eabi-gdb debug/
dsp_xaf_demo_cm33.elf
...
Reading symbols from debug/dsp_xaf_demo_cm33.elf...
(gdb) target remote localhost:2331
Remote debugging using localhost:2331
0x1301ec7a in ?? ()
```

Getting Started with Xplorer for EVK-MIMXRT595, Rev. 0, 22 February 2021

```
(gdb) mon reset
        Resetting target
        (gdb) load
       Loading section .flash config, size 0x200 lma 0x7f400
       Loading section .interrupts, size 0x130 lma 0x80000
       Loading section .text, size 0xe330 lma 0x80130
       Loading section CodeQuickAccess, size 0x52c lma 0x8e460
       Loading section .Arm, size 0x8 lma 0x8e98c
       Loading section .init array, size 0x4 lma 0x8e994
       Loading section .fini array, size 0x4 lma 0x8e998
       Loading section .data, size 0x104 lma 0x8e99c
       Start address 0x801e4, load size 60576
       Transfer rate: 272 KB/sec, 5506 bytes/write.
        (gdb) b main
       Breakpoint 1 at 0x808f2: file /SDK/boards/src/dsp examples/xaf demo/cm33/main cm33.c,
line 161.
       (gdb) c
       Continuing.
       Breakpoint 1, main ()
       at /SDK/boards/src/dsp examples/xaf demo/cm33/main cm33.c:161
       161
              BOARD InitHardware();
```

5.2 Build and Debug DSP Application

The Xtensa command line toolchain is installed as part of the Xplorer IDE. The tools can optionally be installed on a new Windows or Linux system without the IDE using the redistributable compressed file found under <XTENSA_ROOT>/XtDevTools/ downloads/RI-2020.5/tools/. For details, see Install Xtensa On Chip Debugger Daemon.

In order to use the command line tools, some environment variables need to be setup that are used by the cmake build scripts:

```
# Add tools binaries to PATH. Assume ~/xtensa/ is install root - please adjust accordingly.
export PATH=$PATH:~/xtensa/XtDevTools/install/tools/RI-2020.5-linux/XtensaTools/bin
# (Optional) Use environment variable to control license file
# NOTE: ~/.flexlmrc will override this selection. Please delete that file before proceeding.
export LM_LICENSE_FILE=~/RT500.lic
# Setup env vars needed for compile and linking
export XCC_DIR=~/xtensa/XtDevTools/install/tools/RI-2020.5-linux/XtensaTools
export XTENSA_SYSTEM=~/xtensa/XtDevTools/install/builds/RI-2020.5-linux/nxp_RT500_RI2020_5_newlib/
config
export XTENSA CORE=nxp RT500 RI2020 5 newlib
```

NOTE

On Windows, you can use the 'setx' command instead of 'export' to set environment variables.

• Use the batch/shell script to build out the DSP application from the command-line, in the 'xcc' directory.

user@linux:~/SDK/boards/evkmimxrt595/dsp_examples/xaf_demo/dsp/xcc\$./build_debug.sh

```
[100%] Built target dsp_xaf_demo_fusion1.elf
```

NOTE

Some warnings during the linking process (floating point ABI) may appear - these are normal and can be ignored.

• Launch xt-ocd debugging server (replace topology.xml with your custom version – see section 1.5 of this document):

user@linux:/opt/Tensilica/xocd-14.05\$./xt-ocd.exe -c topology.xml

NOTE

If the xt-ocd daemon fails to start, it may be because the DSP has not been initialized by the ARM core which must be done first.

· Connect with Xtensa GDB to the device and execute the DSP application:

```
user@linux:/SDK/boards/evkmimxrt595/dsp examples/xaf demo/dsp/xcc$ xt-gdb debug/
dsp xaf demo fusion1.elf
GNU gdb (GDB) 7.11.1 Xtensa Tools 14.05
. . .
Reading symbols from debug/dsp xaf demo fusion1.elf...done.
(xt-gdb)
(xt-gdb) target remote localhost:20000
Remote debugging using localhost:20000
DoubleExceptionVector ()
at /home/xpgcust/tree/RI-2020.5/ib/tools/swtools-x86 64-linux/xtensa-elf/src/xos/src/xos vectors.S:216
216 /home/xpgcust/tree/RI-2020.5/ib/tools/swtools-x86 64-linux/xtensa-elf/src/xos/src/xos vectors.S:
No such file or directory.
(xt-gdb) reset
_ResetVector ()
at /home/xpgcust/tree/RI-2020.5/ib/tools/swtools-x86 64-linux/xtensa-elf/src/xtos/xea2/reset-vector-
xea2.S:71
71 /home/xpgcust/tree/RI-2020.5/ib/tools/swtools-x86 64-linux/xtensa-elf/src/xtos/xea2/reset-vector-
xea2.S: No such file or directory.
(xt-gdb) load
Loading section .rtos.rodata, size 0x80 lma 0x200000
Loading section .rodata, size 0x17d50 lma 0x200080
Loading section .text, size 0x633f0 lma 0x217dd0
Loading section .rtos.percpu.data, size 0x4 lma 0x27b1c0
Loading section .data, size 0x110c lma 0x27b1d0
Loading section NonCacheable, size 0x2960 lma 0x20040000
Loading section .Level3InterruptVector.literal, size 0x4 lma 0x24000000
Loading section .DebugExceptionVector.literal, size 0x4 lma 0x24000004
Loading section .NMIExceptionVector.literal, size 0x4 lma 0x24000008
Loading section .ResetVector.text, size 0x13c lma 0x24020000
Loading section .WindowVectors.text, size 0x16c lma 0x24020400
Loading section .Level2InterruptVector.text, size 0x1c lma 0x2402057c
Loading section .Level3InterruptVector.text, size 0xc lma 0x2402059c
Loading section .DebugExceptionVector.text, size 0xc lma 0x240205bc
Loading section .NMIExceptionVector.text, size 0xc lma 0x240205dc
Loading section .KernelExceptionVector.text, size 0xc lma 0x240205fc
Loading section .UserExceptionVector.text, size 0x18 lma 0x2402061c
Loading section .DoubleExceptionVector.text, size 0x8 lma 0x2402063c
Start address 0x24020000, load size 520016
Transfer rate: 8 KB/sec, 10612 bytes/write.
(xt-qdb) b main
Breakpoint 1 at 0x21ab5b: file /home/jlydick/mcu-sdk-2.0/boards/src/dsp examples/xaf demo/dsp/
xaf main dsp.c, line 366.
(xt-gdb) c
Continuing.
Breakpoint 1, main ()
at /SDK/boards/src/dsp examples/xaf demo/dsp/xaf main dsp.c:366
      xos start main("main", 7, 0);
366
(xt-gdb) c
Continuing.
Initializing...
Initialized
```

NOTE

You can use the gdb command 'set substitute-path' to map the missing symbols from the toolchain libraries, for example: set substitute-path /home/xpgcust/tree/RI-2020.5/ib/tools/swtools-x86_64-linux ~/xtensa/ tools/RI-2020.5-linux/XtensaTools.

For more details about xt-gdb, please refer to Cadence GNU Debugger User's Guide and Cadence Xtensa Debug Guide. These are located at:

- ~/xtensa/XtDevTools/downloads/RI-2020.5/docs/gnu_gdb_ug.pdf
- ~/xtensa/XtDevTools/downloads/RI-2020.5/docs/xtensa_debug_guide.pdf

Chapter 6 Revision history

This table summarizes the revisions of this document.

Table 1. Revision history

Revision number	Date	Substantive changes
0	22 Feb 2021	Initial Draft

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