

ARM DS-5 Tools and Avnet ZED Series

#2

Configuring DS-5 for ZedBoard and MicroZed



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Version 03

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ARM DS-5 Tools and Avnet ZED Series

This tutorial is one in a series of step by step instruction manuals. Together they document the procedures necessary to utilize the ARM Development Studio 5 (DS-5™) Software Suite and the DSTREAM Debugging tools with the Avnet Zynq Evaluation and Development (ZED) boards. These tutorials can be used on their own, or in combination with Avnet online videos and OnRamp Technical Session™.

The ARM software and hardware tools provide a powerful debugging suite for processor-based systems built around the dual Cortex-A9 cores present in the Xilinx Zynq SoC, at the heart of the Avnet ZED boards. A Linux software developer can simultaneously debug applications and kernel module code, with separate control over each thread. You can step through Linux boot code, first stage bare metal boot code, and bare metal applications. When used in concert with the Xilinx Vivado tools for FPGA fabric development, the ARM debugger and Internal Logic Analyzer (ILA) IP can be cross-triggered to stop on software and hardware breakpoints, or when a hardware event occurs. For difficult-to-isolate intermittent faults, DS-5 provides access to the Cortex-A9 on-chip Trace facility. Once your embedded system is running correctly, DS-5 uses Streamline, a graphical system profiler, to identify performance bottlenecks in your design to ensure top-shelf operation.

This tutorial series begins with the most basic tool configuration and board connection. It takes you all the way through to the most complex aspects of hardware/software co-debugging to root out design errors that are otherwise apparent only in very complex use cases, or worse, after a product is released. Together the ARM DS-5 tools, Xilinx Vivado and Avnet ZED boards provide an unparalleled combination to compress design timelines, cut project costs and optimize your product for the marketplace.

Required Installations

Software

The recommended software for this tutorial series is:

- ARM Development Studio 5 (Exact version used is 5.14, build 1702)
- Xilinx ISE WebPACK 14.5 (Free license and download from Xilinx website)
- Cypress CY7C64225 USB-to-UART Bridge Driver (for ZedBoard serial output)
- Silicon Labs CP2104 USB-to-UART Bridge Driver (for MicroZed serial output)
- Tera Term (Exact version used is V4.75)
- Xilinx Software Development Kit, version 14.5
- For hardware/software co-debugging, Xilinx Vivado 2013.2

Hardware

The targeted hardware consists of the following:

- PC workstation with at least 5 GB RAM, 30GB free hard disk space, Windows 7 64-bit operating system, and a wired GB Ethernet connection
- Available SD card slot on PC or external USB-based SD card reader
- One of:
 - Avnet ZedBoard Kit (**AES-Z7EV-7Z020-G**)
 - USB cable (Type A to Micro-USB Type B)
 - 4GB SD card
 - 12v Power supply
 - Avnet MicroZed Kit (**AES-Z7MB-7Z010-G**)
 - USB cable (Type A to Micro-USB Type B)
 - 4GB SD card
- Avnet ZedBoard Debug Adapter Kit (**AES-ZBDB-ADPT-G**)
 - 14-pin Xilinx PC4 ribbon cable
- ARM DSTREAM unit and Keil pod with wide cable connector
 - 20-pin JTAG ribbon cable
 - USB cable (Type A to Printer)
 - 5v Power supply
- CAT-5 Ethernet cable

Technical Support

For technical support with any of the instructions, please contact your local Avnet/Silica FAE or visit the support forums:

<http://www.zedboard.org/forum>

<http://www.microzed.org/forum>

Additional technical support resources are listed below.

ZedBoard Kit/MicroZed Kit support page with Documentation and Reference Designs

<http://www.zedboard.org/content/support>

<http://www.microzed.org/content/support>

For Xilinx technical support, you may contact your local Avnet/Silica FAE or Xilinx Online Technical Support at www.support.xilinx.com . On this site you will also find the following resources for assistance:

- Software, IP, and Documentation Updates
- Access to Technical Support Web Tools
- Searchable Answer Database with Over 4,000 Solutions
- User Forums
- Training - Select instructor-led classes and recorded e-learning options

Contact your Avnet/Silica FAE or Avnet Support for any additional questions regarding the reference designs, kit hardware, or if you are interested in designing any of the kit devices into your next design.

<http://www.em.avnet.com/techsupport>

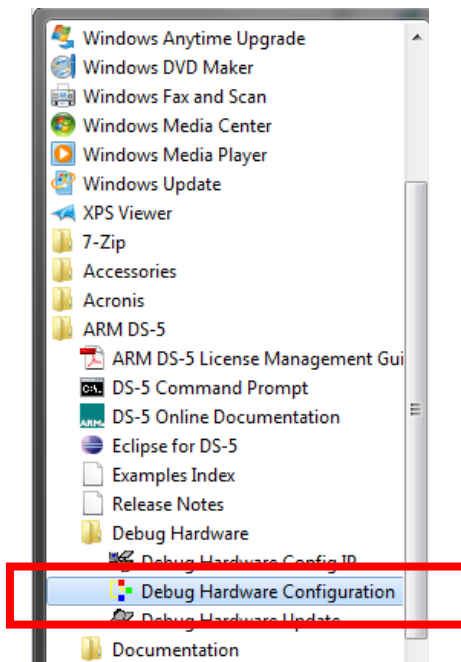
For ARM technical support, you may contact your local Avnet/Silica FAE or ARM Online Technical Support at www.arm.com/support .

Add a ZED Debug Configuration to the ARM Design Studio

Both the Avnet ZedBoard and MicroZed can use identical board configuration files within the DS-5 database. This tutorial describes the procedure for adding configuration files for a single JTAG connection (used for basic debugging with a DSTREAM unit) and a split JTAG connection (used for co-debugging with DSTREAM and Xilinx Internal Logic Analyzer). The single JTAG connection is part of the DS-5 default configuration beginning with the DS-5 version **5.15** release, but the split JTAG is only scheduled for inclusion later. If your desired configuration is present in the release of DS-5 you are using, you may skip to the next tutorial. However, this information may be useful if you wish to add your own custom board to the DS-5 database.

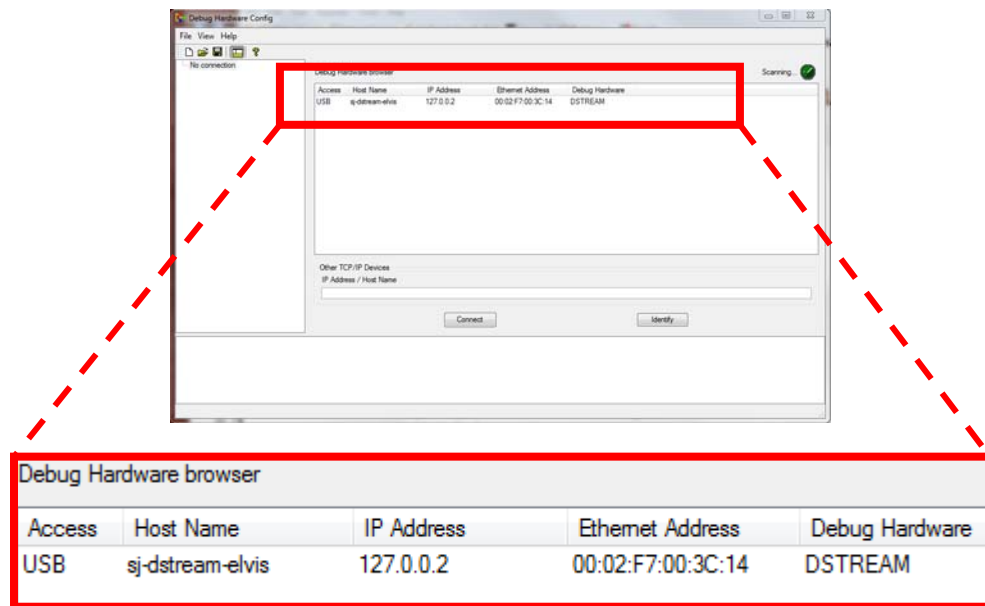
You will need to have your DSTREAM and target board connected as described in tutorial #1 to complete these instructions.

1. Boot your ZED target board. If you do not know how to do this, consult Appendix I.
2. Open the DS-5 Hardware Configuration Utility, which is one of the external tools included in your DS-5 installation. From the Windows Start menu, open the ARM DS-5 folder and select **Debug Hardware | Debug Hardware Configuration**.



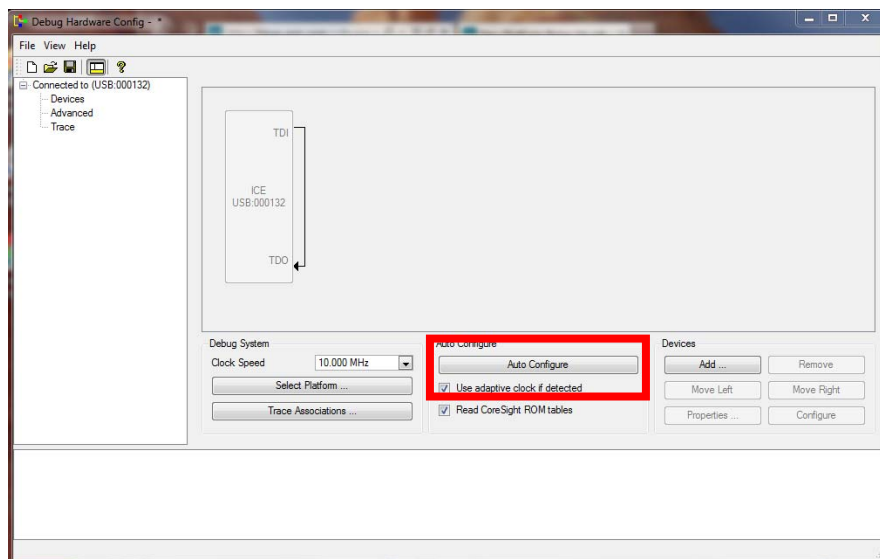
Start Hardware Configuration Utility

3. The Hardware Configuration Utility will scan your connections looking for a DSTREAM unit, which it will find via the USB port where your DSTREAM is connected to your PC.



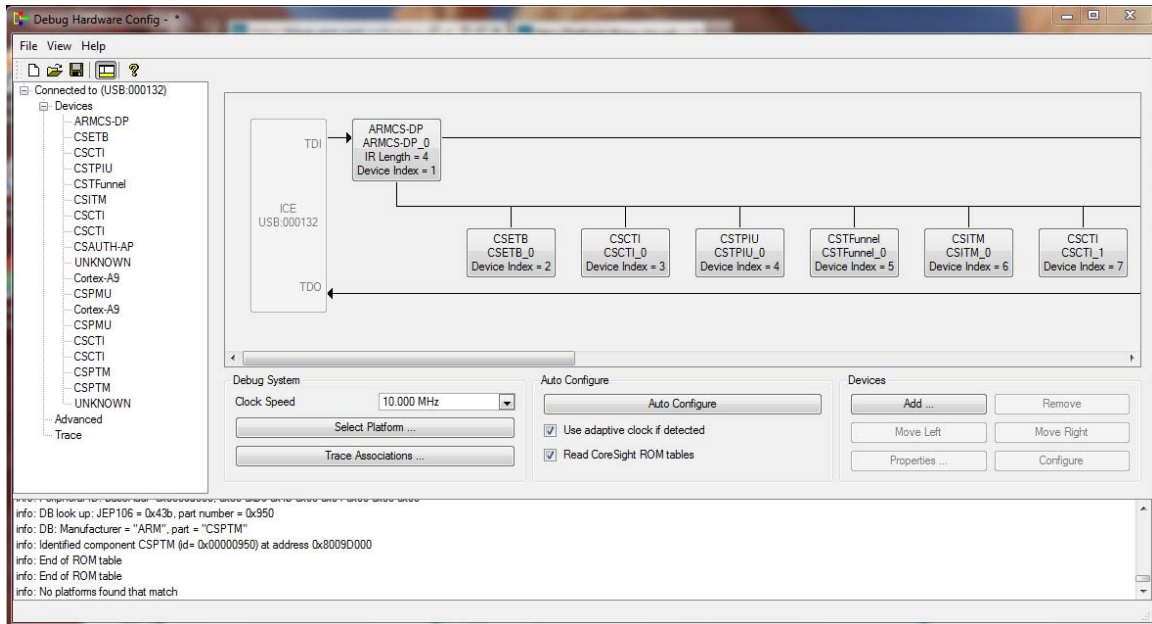
DSTREAM Detected on USB Port

4. Select the DSTREAM entry, and either double-click or press the **Connect** button to establish contact between the debug unit and the Hardware Configuration Utility.



Auto Configuration (Step 4)

5. Click the **Auto Configure** button. The Hardware Configuration Utility interrogates the connected target to determine which ARM CoreSight™ debug components are implemented by reading the CoreSight ROM table.



Target Configuration Map

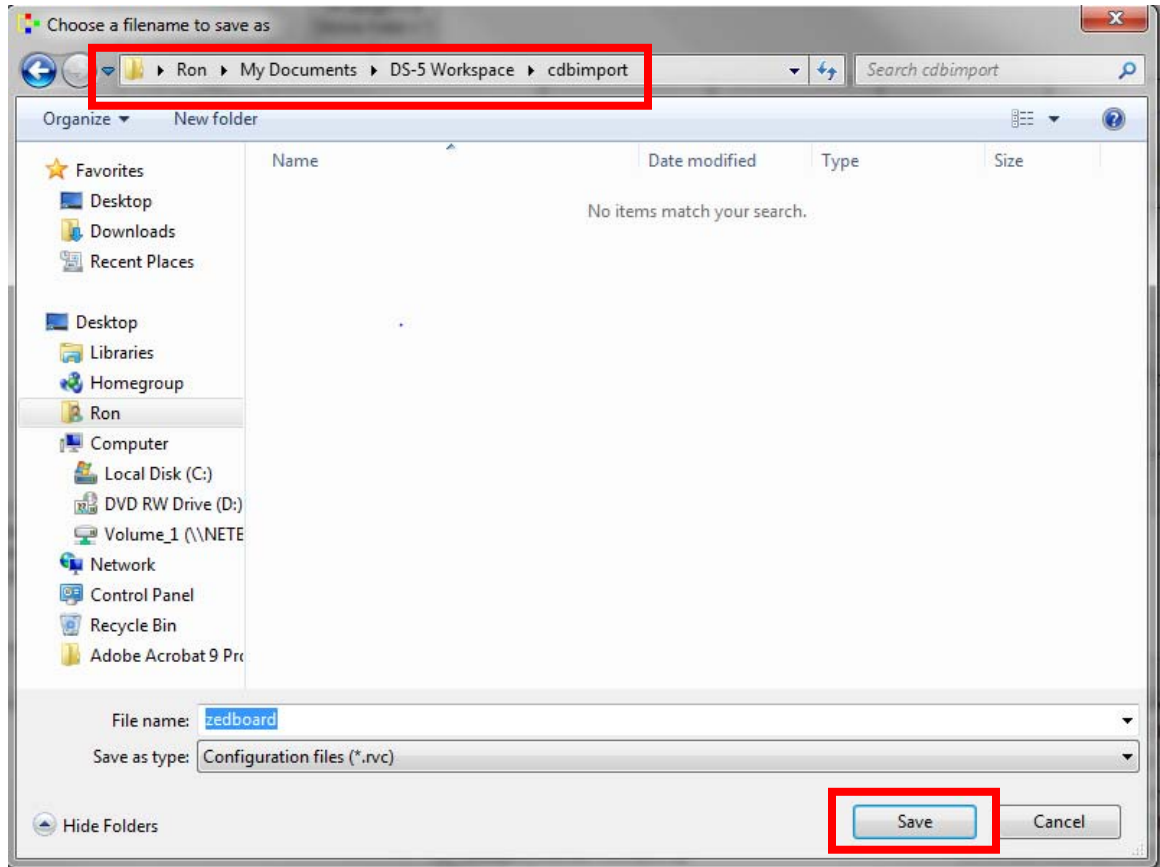
6. From the main menu, select **File | Save** to store the configuration file. You can save it anywhere you like, but to keep everything together and to ensure there are no issues with administrative access levels, you can put it in your DS-5 Workspace. If you have used the default installation path (recommended), this will be at:

C:\Users\<Your Username>\Documents\DS-5 Workspace

Note: In Windows Explorer, you may see the automatic shortcuts used to indicate the directory is:

<Your Username>\My Documents\DS-5 Workspace

Create a new folder **cdbimport** at this location, name the file **zedboard.rvc** and click the **Save** button.

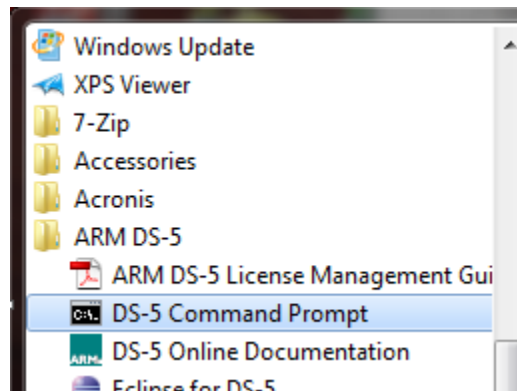


Save Configuration File

You can close the Debug Hardware Configuration Utility once the configuration file is saved.

Note: At present the configuration sequence for split JTAG has not been tested, so when you will not see a configuration for **ZedBoard_JE1**. This will be corrected in the next release of this document.

7. Now we have a new configuration file `zedboard.rvc`, and we need to import it into the DS-5 database. To do this, a command line utility is called **`cdbimporter`** is provided as part of the DS-5 installation package.



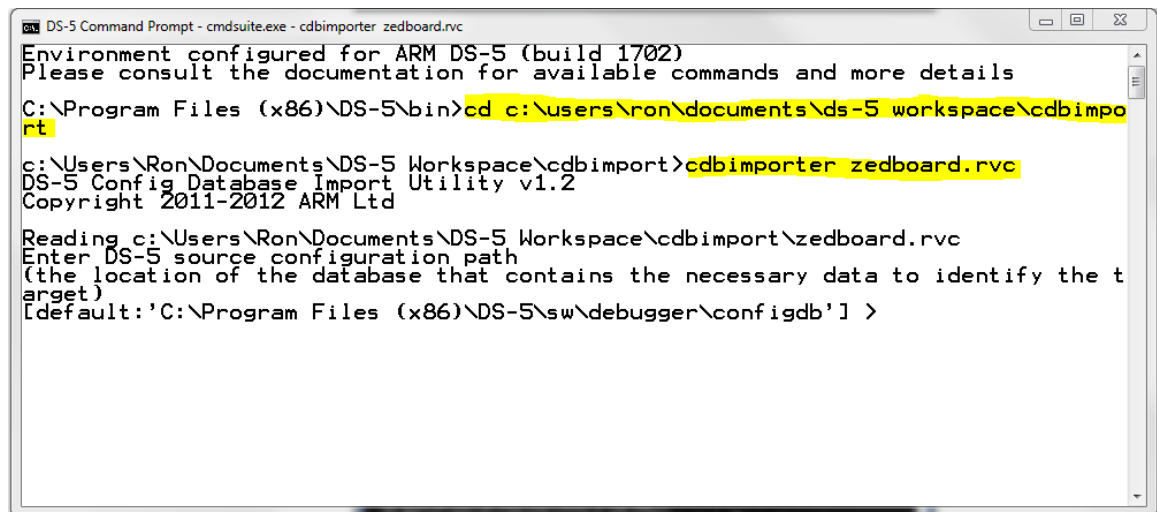
Start DS-5 Command Prompt

From the Windows Start menu, again open the ARM DS-5 folder and open a DS-5 Command Prompt window. Change to the directory where you saved your configuration file:

`cd C:\users\<your user name>\documents\ds-5 workspace\cdbimport`

Run the `cdbimporter` utility:

`cdbimporter zedboard.rvc`



Database Location

The import utility asks for the DS-5 database location, so hit the **Enter** key to accept the default location.

The DS-5 destination configuration path is the location on your system where you will create a custom database extension. You should select a location you can easily find, or you simply hit the **Enter** key if the location specified is acceptable.

```
DS-5 Command Prompt - cmdsuite.exe - cdbimporter zedboard.rvc
Environment configured for ARM DS-5 (build 1702)
Please consult the documentation for available commands and more details
C:\Program Files (x86)\DS-5\bin>cd c:\users\ron\documents\ds-5 workspace\cdbimport
rt
c:\Users\Ron\Documents\DS-5 Workspace\cdbimport>cdbimporter zedboard.rvc
DS-5 Config Database Import Utility v1.2
Copyright 2011-2012 ARM Ltd

Reading c:\Users\Ron\Documents\DS-5 Workspace\cdbimport\zedboard.rvc
Enter DS-5 source configuration path
(the location of the database that contains the necessary data to identify the t
arget)
[default:'C:\Program Files (x86)\DS-5\sw\debugger\configdb'] >

Enter DS-5 destination configuration path
(the location of the database that will receive the generated platform (must be
writable))
[default:'C:\Users\Ron\My Documents\ARM\DS-5\configdb_extension'] >
```

Database Extension Location

8. Hit the **Enter** key to select both Cortex-A9 cores in the Zynq chip.

```
DS-5 Command Prompt - cmdsuite.exe - cdbimporter zedboard.rvc

Reading c:\Users\Ron\Documents\DS-5 Workspace\cdbimport\zedboard.rvc
Enter DS-5 source configuration path
(the location of the database that contains the necessary data to identify the t
arget)
[default:'C:\Program Files (x86)\DS-5\sw\debugger\configdb'] >

Enter DS-5 destination configuration path
(the location of the database that will receive the generated platform (must be
writable))
[default:'C:\Users\Ron\My Documents\ARM\DS-5\configdb_extension'] >

Found 2 ARM cores
Import Summary -
ID   Name      Definition  Associated TCF files
--   -
10   Cortex-A9_0 Cortex-A9    <none>
12   Cortex-A9_1 Cortex-A9    <none>

Select a core to modify (enter its ID and hit return) or press enter to continue
. [ ]
```

Select Cores

9. For the Platform Manufacturer, enter **Avnet** and hit the **Enter** key. Hit the **Enter** key again to accept the default platform name zedboard.

```
DS-5 Command Prompt - cmdsuite.exe - cdbimporter zedboard.rvc

Enter DS-5 destination configuration path
(the location of the database that will receive the generated platform (must be
writable))
[default:'C:\Users\Ron\My Documents\ARM\DS-5\configdb_extension'] >

Found 2 ARM cores
Import Summary -
ID   Name      Definition  Associated TCF files
--   -
10   Cortex-A9_0  Cortex-A9   <none>
12   Cortex-A9_1  Cortex-A9   <none>

Select a core to modify (enter its ID and hit return) or press enter to continue
. []

Enter Platform Manufacturer
[default:'Imported'] >Avnet

Enter Platform Name
[default:'zedboard'] >
```

Platform Manufacturer and Target Name

10. The utility will import the new zedboard entry, and will indicate that the operation completed successfully.

```
DS-5 Command Prompt - cmdsuite.exe

Enter Platform Name
[default:'zedboard'] >

Building configuration XML...
Creating database entry...

DTSL_script assumptions:
  The first CTI is associated with the ETB and TPIU for trace triggers.
  The Cortex-A9 cores are using trace sources of type PTM.
  All PTMs are connected to funnel 0 in a linear fashion (PTM 0 to port 0, PTM
  1 to port 1 ...).

Import successfully completed

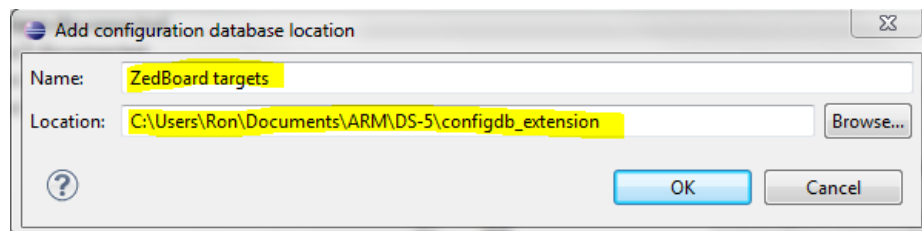
The new platform will not be visible in the DS-5 Debugger until the destination
database
has been added to the "User Configuration Databases" list and the database has b
een rebuilt.
A rebuild is done either when DS-5 is (re)started, a user configuration database
is added or
by forcing a database rebuild.
To force a rebuild or add a database, select the "Window -> Preferences" menu it
em,
then expand the DS-5 group. To rebuild, select "Configuration Database", then pr
ess
the "Rebuild database ..." button.
To add a database to the "User Configuration Databases" list, click the "Add" bu
tton
and supply a suitable "Name" (E.g. Imported) and "Location" for the database.

c:\Users\Ron\Documents\DS-5 Workspace\cdbimport>
```

Database Extension Created

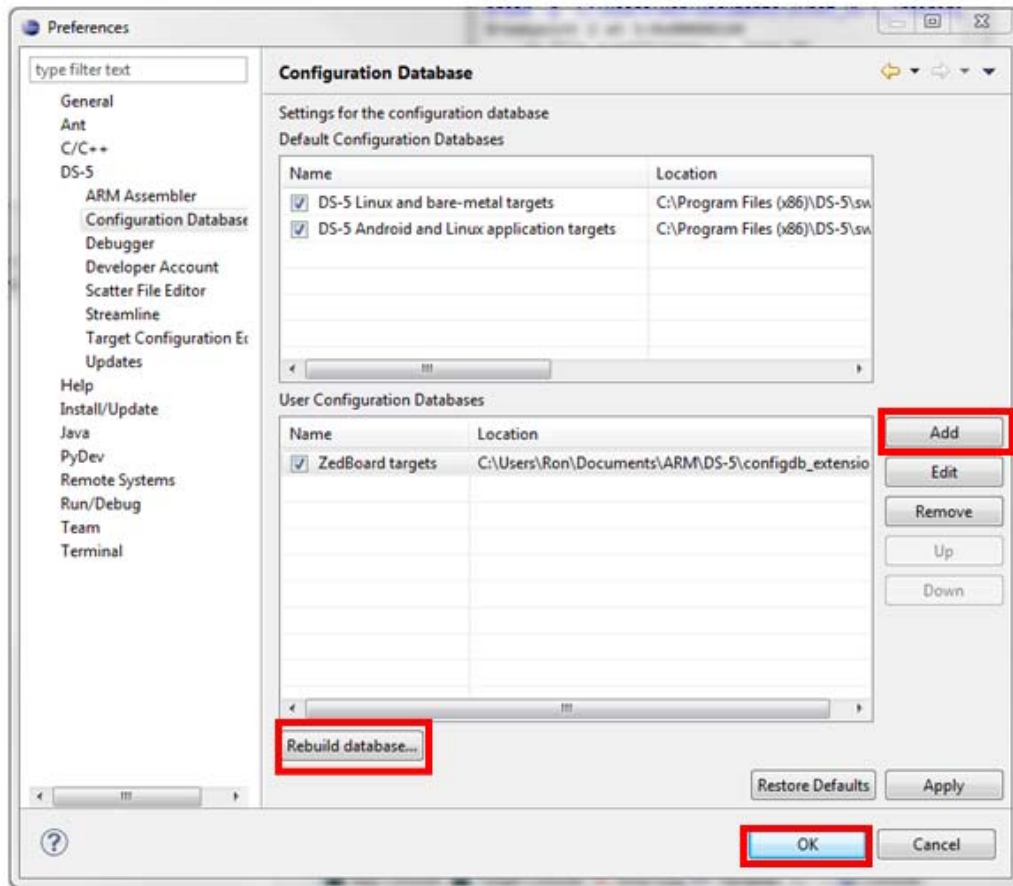
The remaining text details the final configuration stage for rebuilding the DS-5 database, which we will do in the following steps. You can close the command window at this point.

11. Open the ARM DS-5 application, and performed the following steps:
 - a. Select your preferred DS-5 Workspace in the pop-up window.
 - b. Select **Window | Preferences** from the main menu to open the Preferences window.
 - c. Expand the **DS-5** entry by clicking on the triangle icon to the left of the text.
 - d. Select Configuration Database.
12. The configuration database includes default targets for bare metal, Linux and Android. We need to add our custom configuration to the main database, which we do by specifying the files as User Configuration Databases.
 - a. In the Configuration Databases panel, click the **Add** button.
 - b. Specify **ZedBoard targets** for the database name, and click the **Browse** button to locate the configuration path chosen when importing the configuration. Click the **OK** button.



Specify Database Extension Location

- c. The new configuration appears in the User Configuration Databases panel. Click the **Rebuild Database** button to complete the addition of your configuration to the DS-5 database.

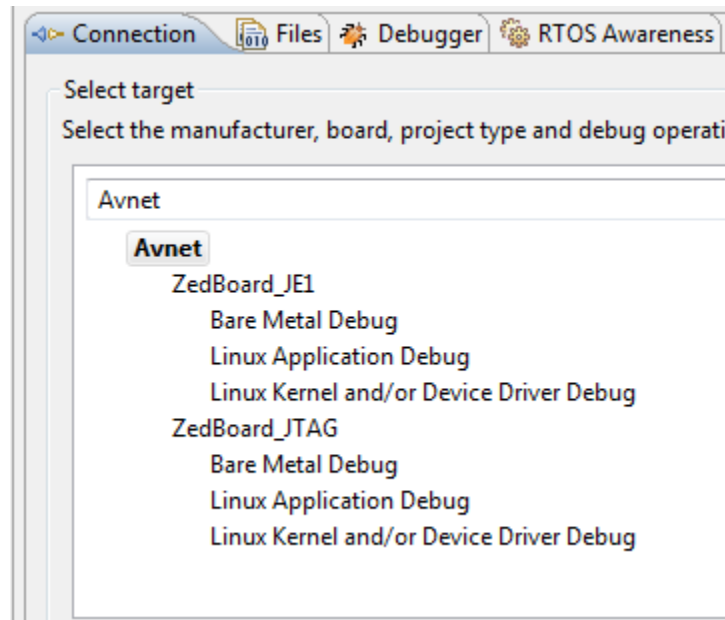


Rebuild DS-5 Configuration Database

When the compilation completes, click the **OK** button to close the window.

13. To validate that all the steps have been successfully completed, from the DS-5 main menu:

- a. Select **Run | Debug Configurations**.
- b. In the Debug Configurations window. Select the **Connection** tab. In the **Filter platforms** text box, enter **Avnet**. Expand the entries and you will see two new entries for the ZedBoard.



Avnet ZED Target Configurations

ZedBoard_JE1 is for split JTAG. This means the ARM Debug Access Port (DAP) is separate from the JTAG chain for the Programmable Logic (PL). You would use this mode in conjunction with the Internal Logic Analyzer IP from Vivado to perform cross-trigger debugging, when you can stop on hardware or software breakpoints, and also in response to hardware events you trap.

ZedBoard_JTAG is for cascaded JTAG, which means the ARM DAP and PL JTAG are on the same chain. This mode supports all the software-only debugging operations, and is probably the one you will most often use.

14. You may close the Debug Configurations window at this point. If you have no more debugging work to do with DS-5 at the moment, you can close the DS-5 application and power down the DStream and target hardware.

Appendix I – Boot the ZED Target

In this section we will boot the ZED target from the SD card. You should start a serial terminal emulator such as Tera Term Pro to monitor the output from the target.

For ZedBoard:

To begin the procedure, set the ZedBoard Boot Mode to SD boot using jumpers JP11 to JP7 set to the following:

	JP11	JP10	JP9	JP8	JP7
Position	SIG-GND	3V3-SIG	3V3-SIG	SIG-GND	SIG-GND

For MicroZed:

To begin the procedure, set the MicroZed Boot Mode to JTAG only using jumpers JP3 to JP1 set to the following:

	JP3	JP2	JP1
Position	2-3	2-3	1-2

You should have your DSTREAM, ZED target, ZedBoard Adapter and host PC connected together as described in Tutorial #1.

To prepare to boot the target, copy:

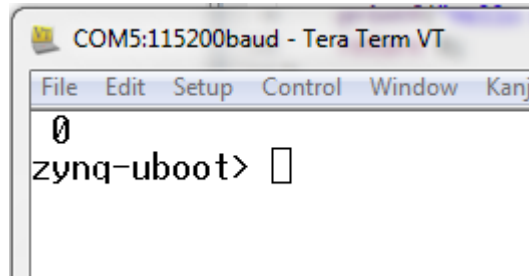
C:\OnRamps\Support04\<ZED target>\boot.bin

to the SD card, and insert the card into the SD card slot on the underside of the target. In later tutorials, we will be working with Linux, so a logical application to use is the second stage boot loader U-boot.

Power the target, start Tera Term¹ and U-boot will cycle through its countdown but will be unable to jump to a Linux image, since we have not supplied one. You may also

¹ We don't start Tera Term first because the UART bridge must be active before Tera Term can detect the COM port.

interrupt the countdown by pressing the space bar on your host computer, but in either case you will be left at the U-boot prompt with the system running.



U-boot Prompt in Tera Term

Revision History

Date	Version	Revision
13 May 13	00	Initial Draft
19 Jun 13	01	Added User Database Specification
27 June 13	02	Updated User Configuration location text
20 Aug 13	03	Release

Resources

<http://www.zedboard.org>

<http://www.xilinx.com/zynq>

<http://www.arm.com/products/tools/software-tools/ds-5/index.php>