Low Cost tool for i.MX JTAG debugging
How to use OpenOCD + JTAG probe + Eclipse

Alan Assis, Renato Frias and Rogerio Pimentel

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Goal

The aim of this work is to provide directions to setup a low cost development environment option to bring up i.MX designs.

This presentation does not provide details about the tools, it rather shows how to build and use them. A few Internet links are provided for those interested on more details about the tools.

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Tools - What is needed?

- ARM toolchain
  - Included on FSL BSP.
- OpenOCD
  - Open Source project.
- Eclipse IDE
  - Open Source project.
- Jtag Probe
  - Several options available, including build your own.
- Hardware Prototype
  - Target board to be debugged.

Warning: The next pages will detail the toolset install procedure for Linux hosts, but it is possible to setup the environment for Windows hosts with a few changes.

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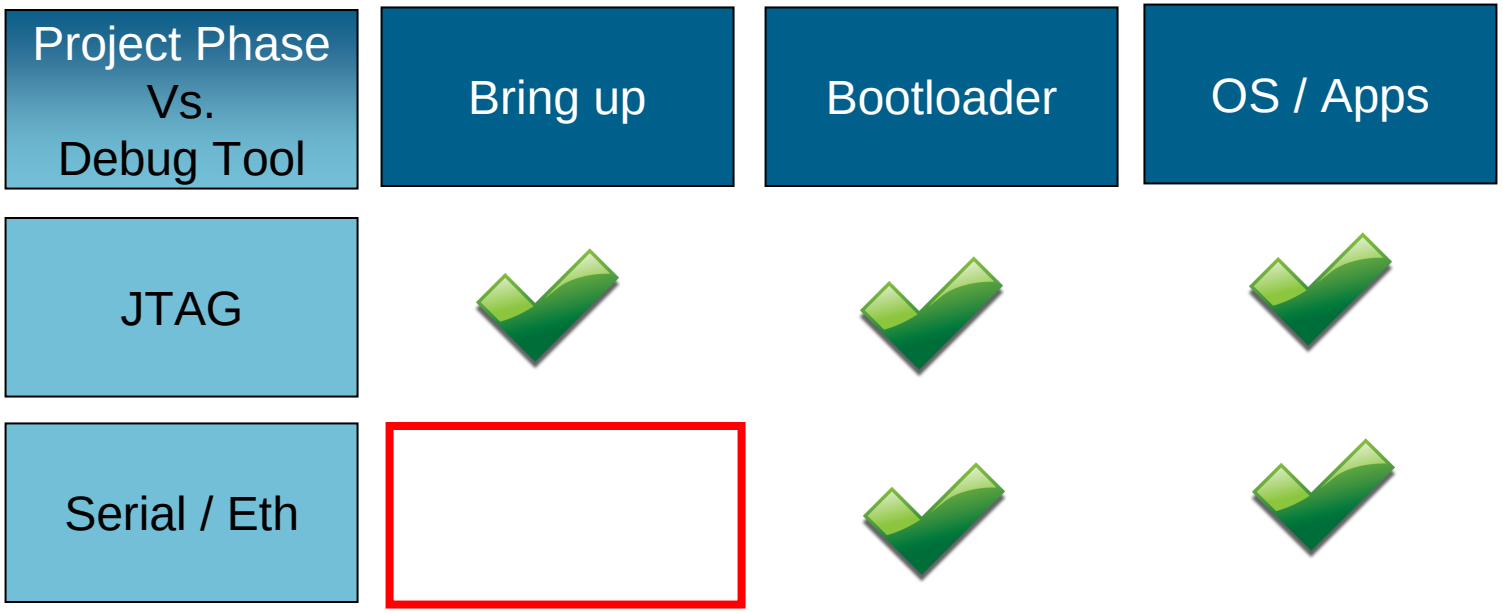
Low Cost Debug Options

- My new i.MX board is ready, how do I debug it?
  - Besides blinking LEDs…



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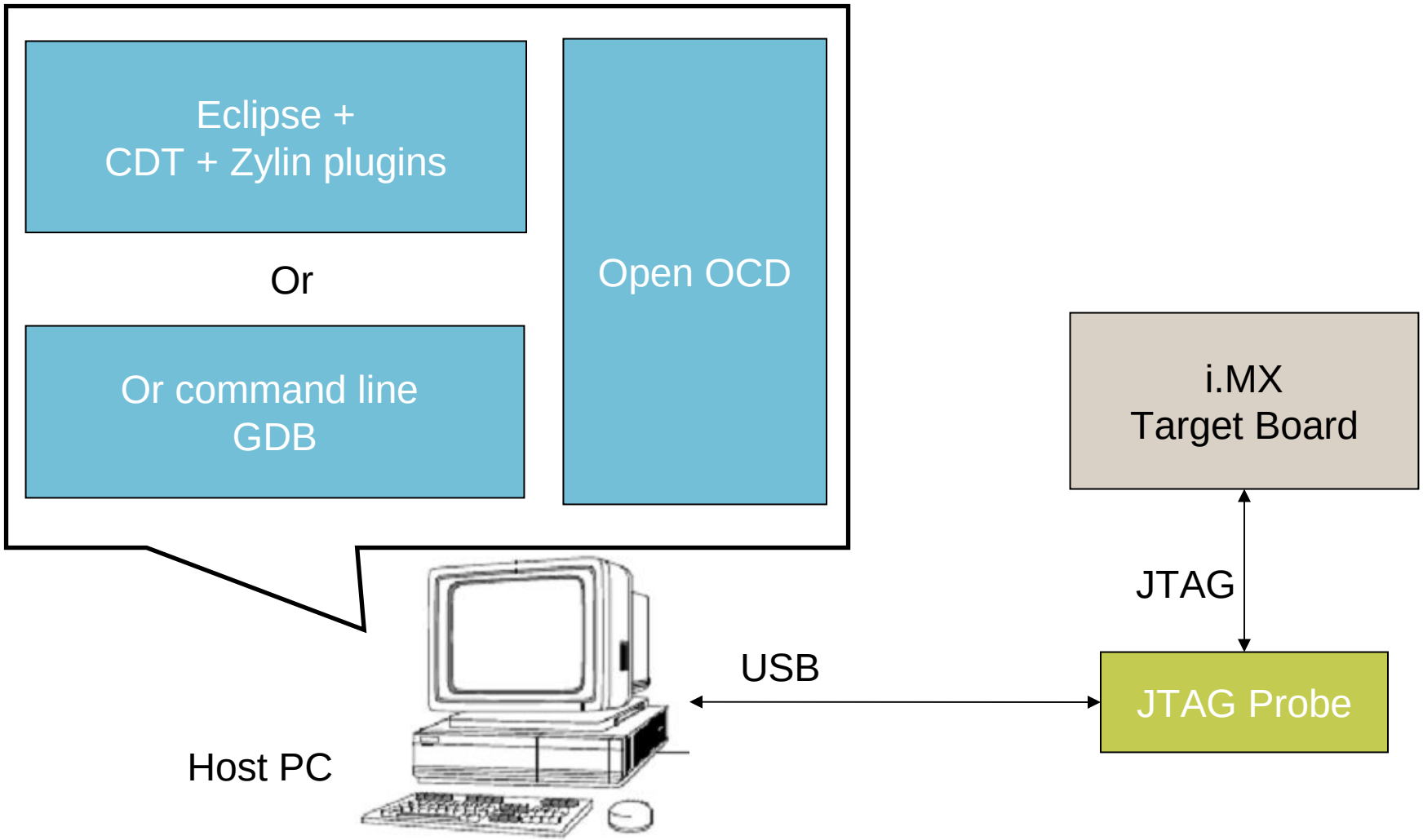
Development Tool Overview



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Using the tools

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A first debug session – Blinking LEDs

Alan Assis included some example test code on Open OCD for i.MX27 and i.MX31. We can follow the steps below to run a simple environment check.

1. Setup Eclipse Project.
2. Turn on the target board on bootstrap mode.
3. Start OpenOCD.
4. Launch Debugger on Eclipse.
5. Debug.

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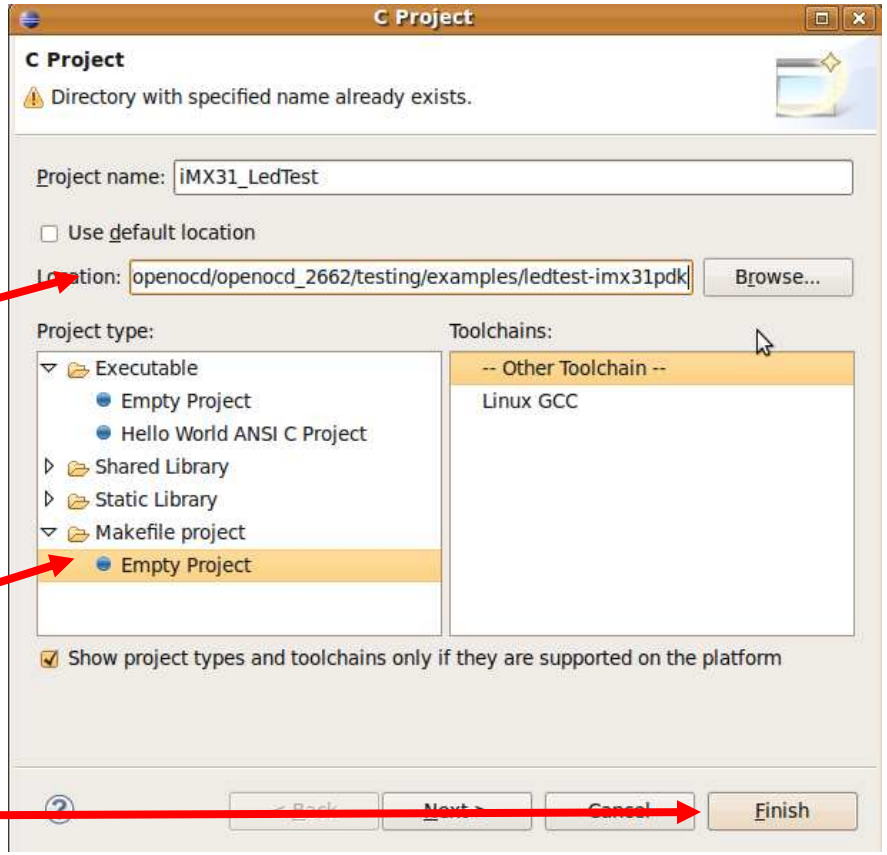
A first debug session – Blinking LEDs

1. Start Eclipse Project. (Optional)

- Start Eclipse and click on New -> C Project
- Use the “*<openocd path>/testing/examples/ledtest-imx31pdk*” as location.
- Chose Makefile project.
- Click Finish.



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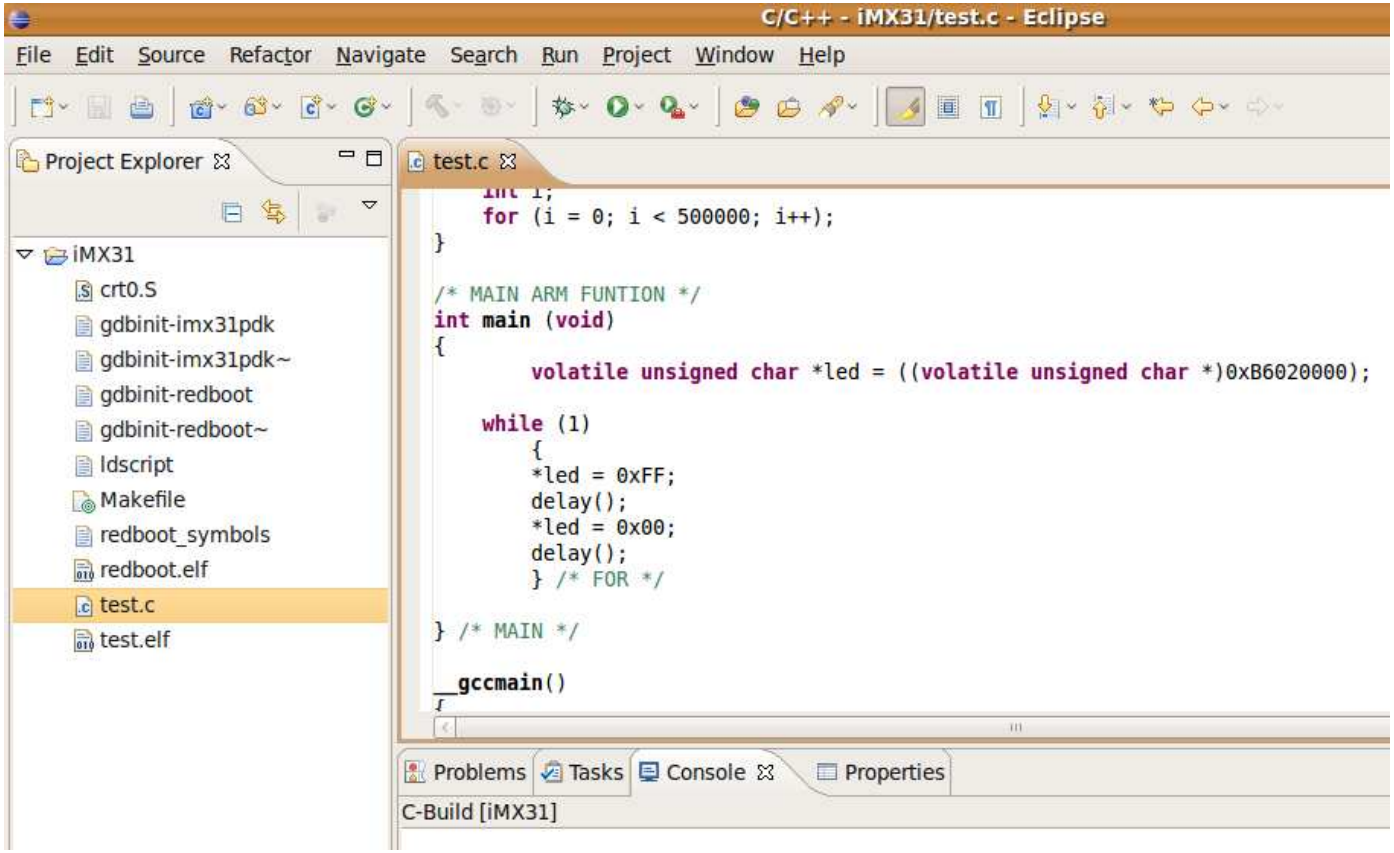
A first debug session – Blinking LEDs



2. Turn on the board on bootstrap boot mode

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A first debug session – Blinking LEDs

3. Start OpenOCD.

$ sudo openocd –f interface/signalyzer.cfg –f board/imx31pdk.cfg

File with jtag probe details.

File describing board specific configuration.

```
#interface
interface ft2232
ft2232_device_desc "Signalyzer A"
ft2232_layout signalyzer
ft2232_vid_pid 0x0403 0xbca0
```

```
# ========================================
# Init CCM
# ========================================
mww 0x53FC0000 0x040
mww 0x53F80000 0x074B0B7D

sleep 100

# ========================================
# 399MHz - 26MHz input, PD=1,MFI=7, MFN=27, MFD=40
# ========================================
mww 0x53F80004 0xFF871D50
mww 0x53F80010 0x00271C1B
```

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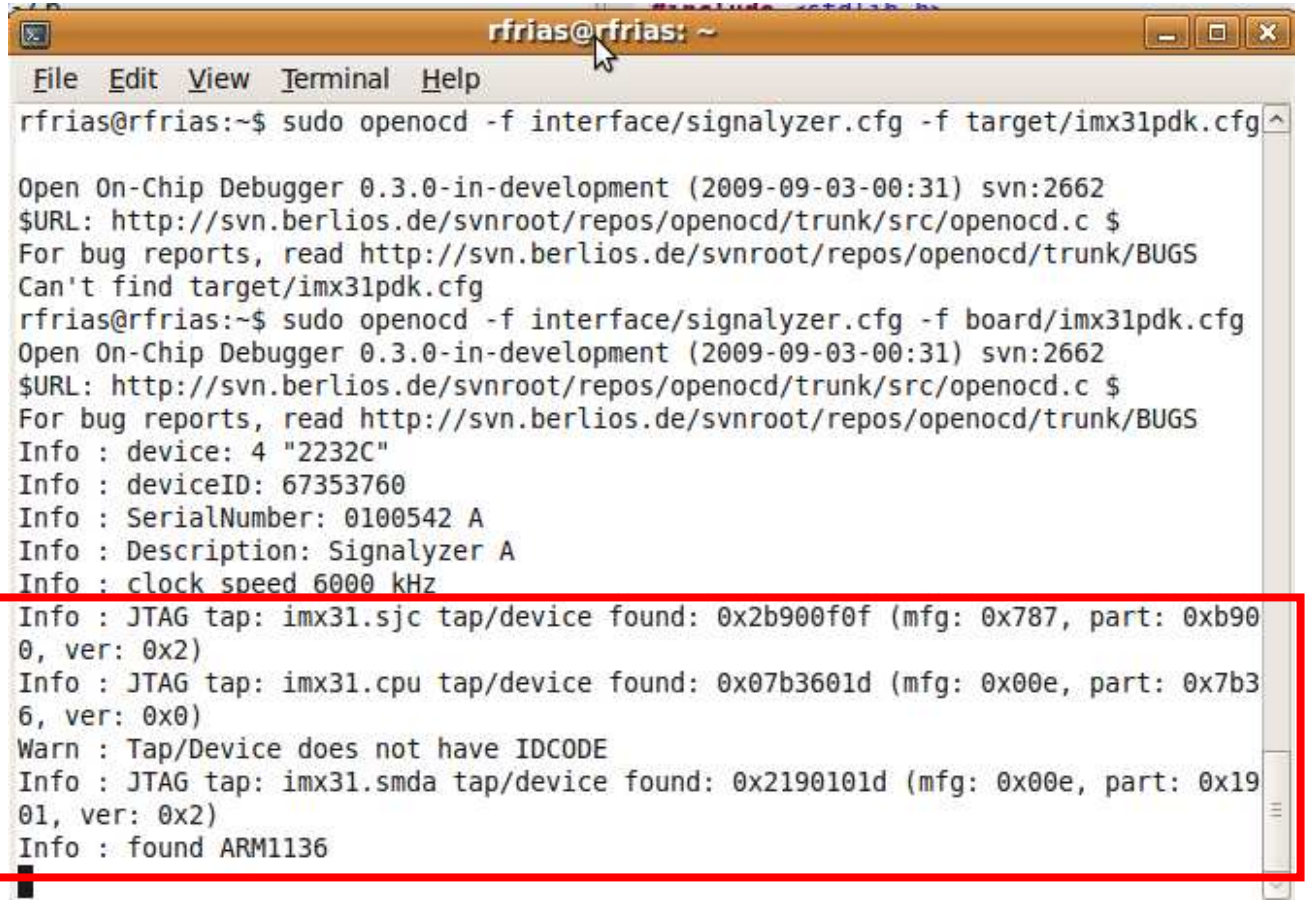
A first debug session – Blinking LEDs



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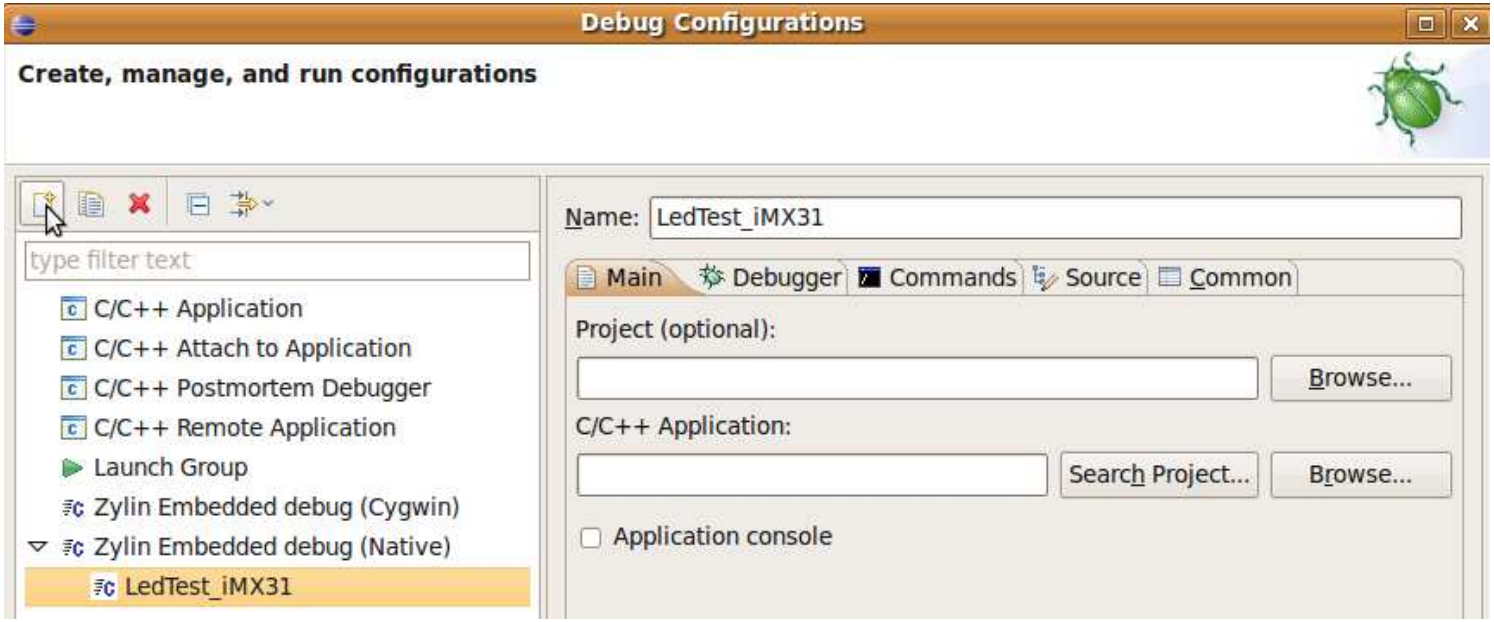
A first debug session – Blinking LEDs

4. Launch Debugger on Eclipse (or command line GDB).
   - Switch to Debug Perspective on Eclipse.
   - Click Debug and Debug Configuration…
   - Select Zylin and create a new debug config
   - Select Project



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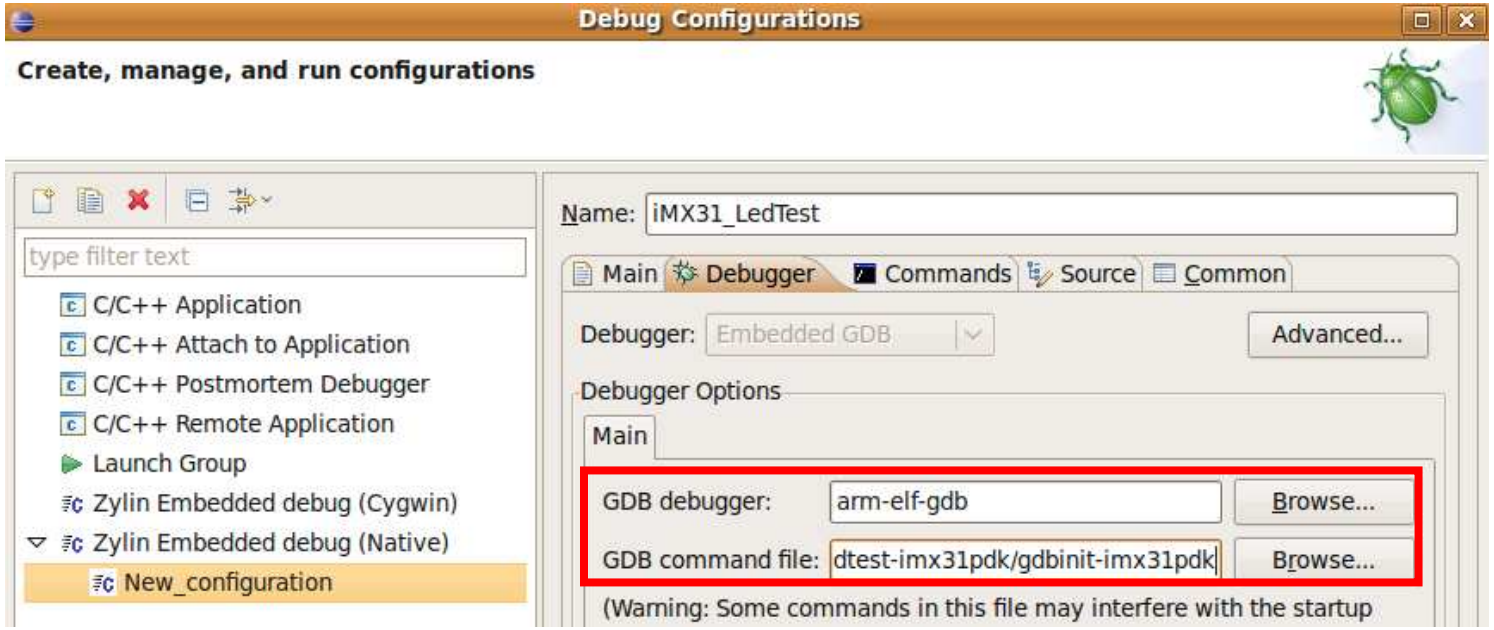
A first debug session – Blinking LEDs

4. Launch Debugger on Eclipse (or command line GDB).
   - Click the Debugger tab.
   - Change GDB-debugger to arm-elf-gdb
   - Select GDB command file: gdbinit-imx31pdk
   - Click Debug.



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A first debug session – Blinking LEDs

- ELF file and GDB init

```
26: 80000100     0 NOTYPE  GLOBAL DEFAULT    1 _mainCRTStartup
27: 80000300     0 NOTYPE  GLOBAL DEFAULT  ABS __bss_end__
28: 80000100     0 NOTYPE  GLOBAL DEFAULT    1 _start
29: 80000180    64 FUNC    GLOBAL DEFAULT    1 main
30: 8000013c    68 FUNC    GLOBAL DEFAULT    1 delay
31: 800001e8    16 FUNC    GLOBAL DEFAULT    1 atexit
```

```
# CONNECT TO TARGET :
target remote 127.0.0.1:3333

#  LOAD IMAGE :
#

# Load the test file
load test.elf

# Load the symbols
symbol-file test.elf
```

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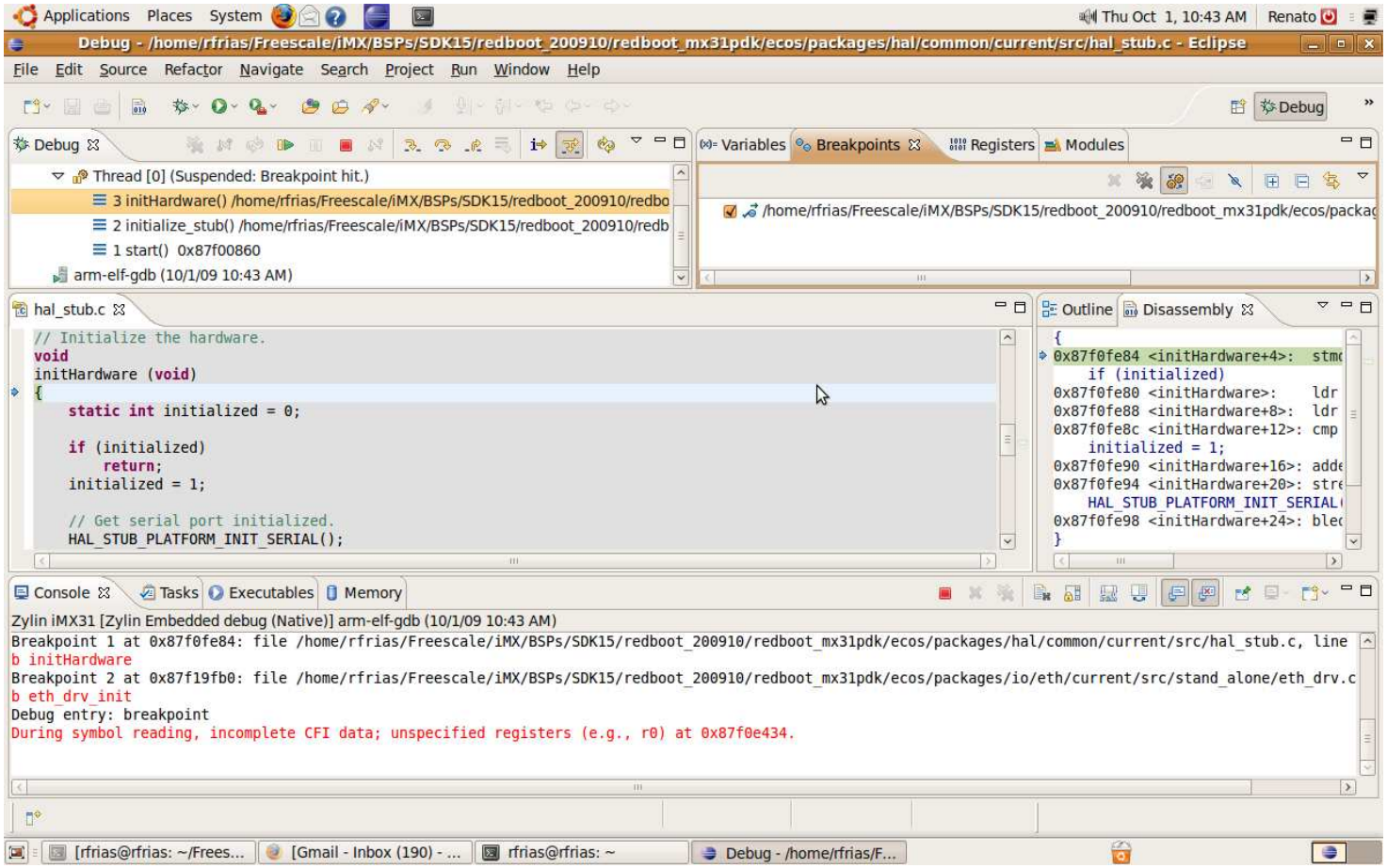
A first debug session – Blinking LEDs

5. Debug.



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A typical debug session – Redboot

This toolset can be used to debug the bootloader.
Once redboot is running on the DDR it is possible to initialize the NFC and program the NAND.

Once Redboot is running on target board use the commande:

Redboot> factive NAND
Redboot> romupdate

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Installing the tools

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GNU ARM Toolchain 1/2

- Usage:

Cross Compiling tools for ARM.

- Source:

Freescale i.MX BSP

- Install instructions:

After BSP install the toolchain resides in:

`/opt/freescale/usr/local/gcc-4.1.2-glibc-2.5-nptl-3/arm-none-linux-gnueabi`

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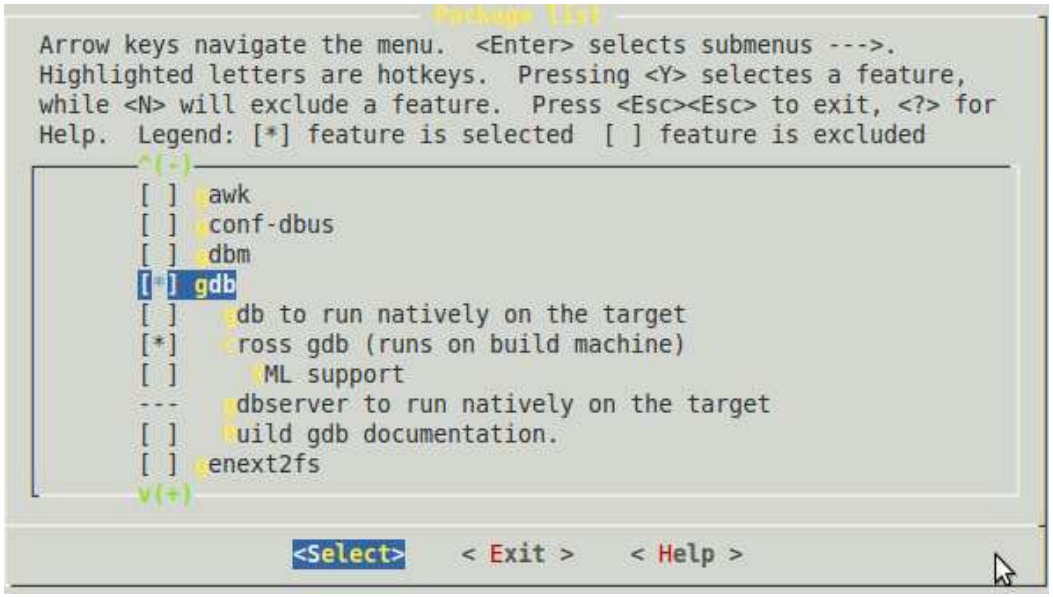
GNU ARM Toolchain 1/2

- Install instructions (cont):

After BSP installation run “ltib –c” and select GDB on package list section:



Copy “gdb” from <ltib install folder>/bin/gdb to /usr/bin/arm-elf-gdb :

$ sudo cp ltib/bin/gdb /usr/bin/arm-elf-gdb

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OpenOCD (Open On-Chip Debugger) – 1/2

- Usage:

Provides means to Eclipse/CDT debugger interface with remote target through GDB connection.

- Source:

Open Source project initiated by Dominic Rath and maintained by several developers.

http://openocd.berlios.de/web/

- Install instructions:

Download stable version from:

http://developer.berlios.de/projects/openocd

Or get latest release from SVN:

$ svn checkout http://svn.berlios.de/svnroot/repos/openocd/trunk openocd

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OpenOCD – 2/2

- Install instructions (cont.):

After downloading the source from website or SVN, do:

```
$ cd openocd
$ ./bootstrap
$ ./configure –-enable-<your probe option>*
$ make
$ sudo make install
```

Detailed install instructions can be found on Readme file on openocd folder.

```
* On this presentation case, to configure for a FTDI based probe: $
./configure –-enable-ft2232-ftd2xx
```

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Eclipse IDE – 1/3

- Usage:

Graphical integrated development environment. Can be used to cross compile on this case will be used to debug.

- Source:

Latest Eclipse release is “Galileo”.

http://www.eclipse.org/

- Install instructions:

Go to downloads and get C/C++ package (CDT).

http://www.eclipse.org/downloads/

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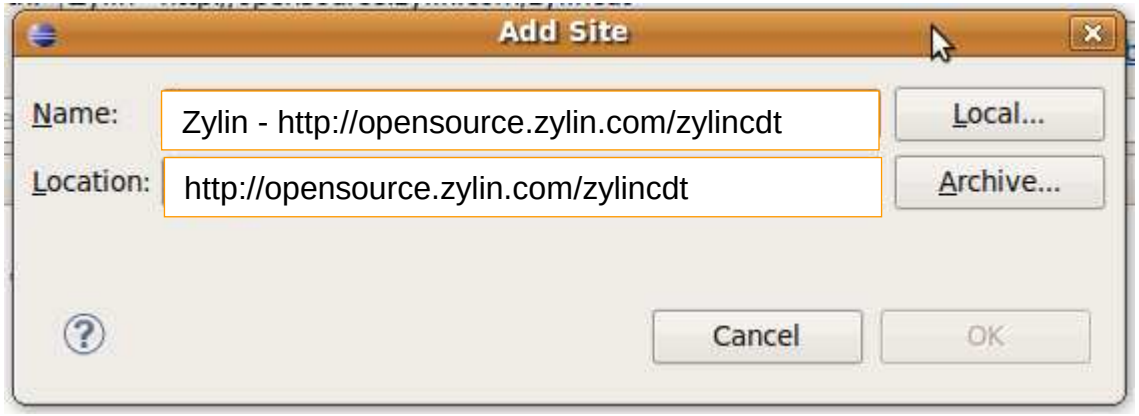
Eclipse IDE – 2/3

- Install instructions:

After downloading the Eclipse Package, extract it using “tar” and run it. There are several Eclipse install tutorials available on the net.

Debug features on Eclipse does not allow connecting to the embedded processor directly, thus we need to install Zylin plugin.
On Eclipse “Help” Menu item, chose “Software Updates”. Click on add and enter:



Then click “OK”, select Zylin Embedd CDT on the list and install it

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JTAG Probe - 1/4

- Usage:

Connects USB port on PC with JTAG port on i.MX SoC.

- Source:

There are some vendors selling low cost JTAG probes, few examples:
http://www.amontec.com/jtagkey2.shtml ***- 115 EURO***
http://www.signalyzer.com/ ***- 89 USD***

There are some “open hardware” JTAG probe projects based on FTDI USB to Serial chip, FT2322. We can build our own and even embed on PCB.

FT2322 is popular for this application as FTDI provides a JTAG command library for the FT2322, look for: “AN2232C-01_MPSSE_Cmnd.pdf”.
[http://www.ftdichip.com/Documents/AppNotes/AN2232C-01_MPSSE_Cmnd.pdf]

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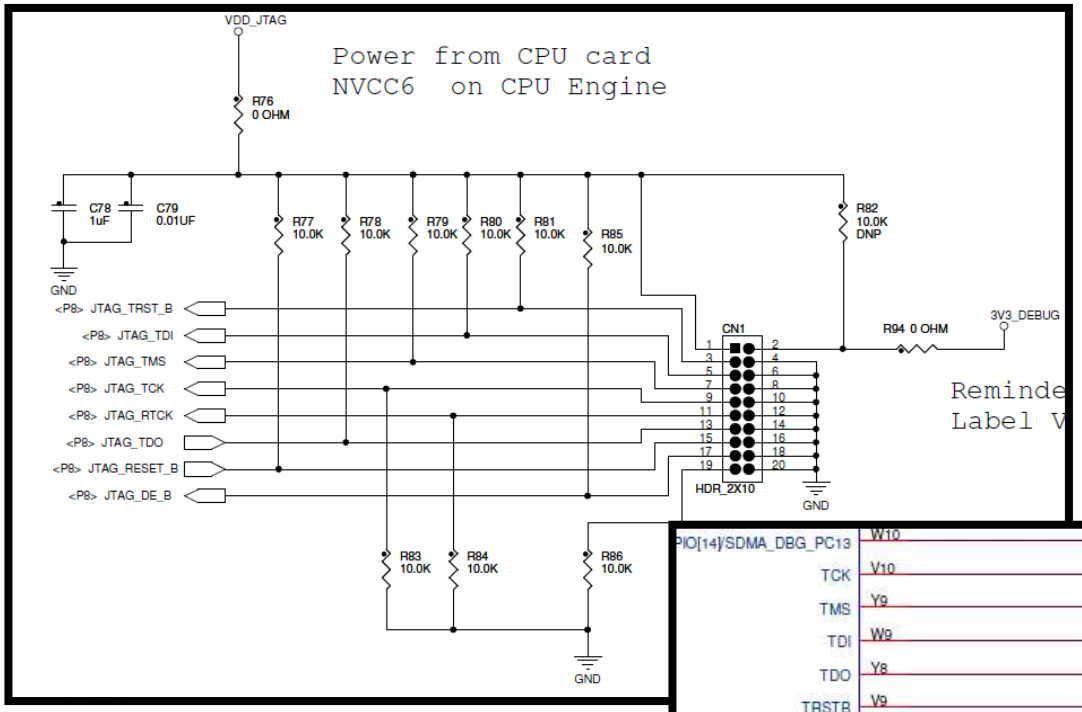
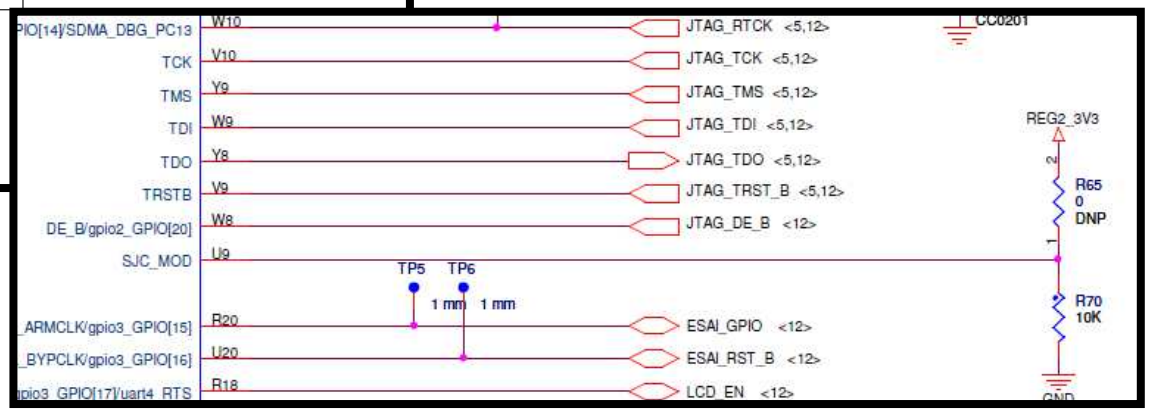
JTAG - 2/4

- JTAG on the PDK:



Debug Board

CPU Board



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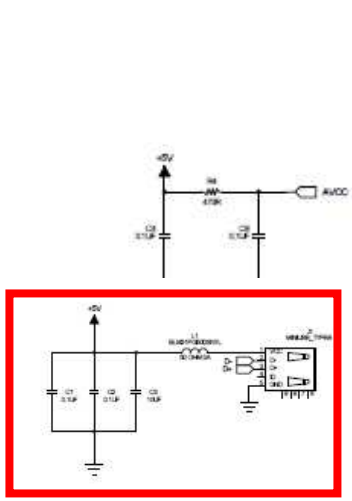
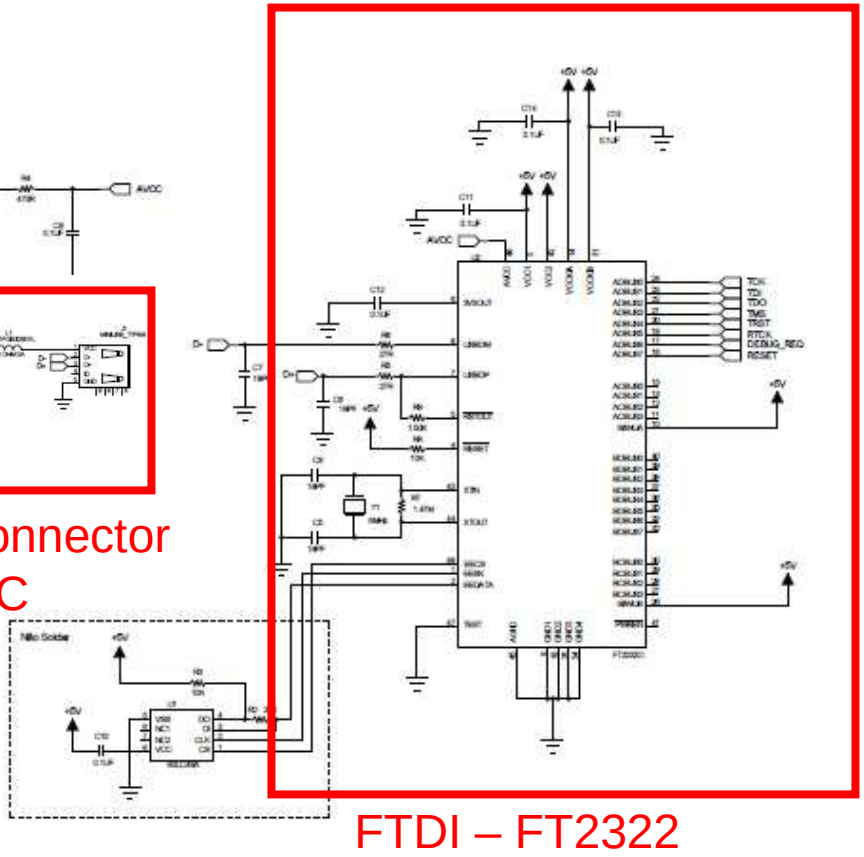
JTAG Probe - 3/4

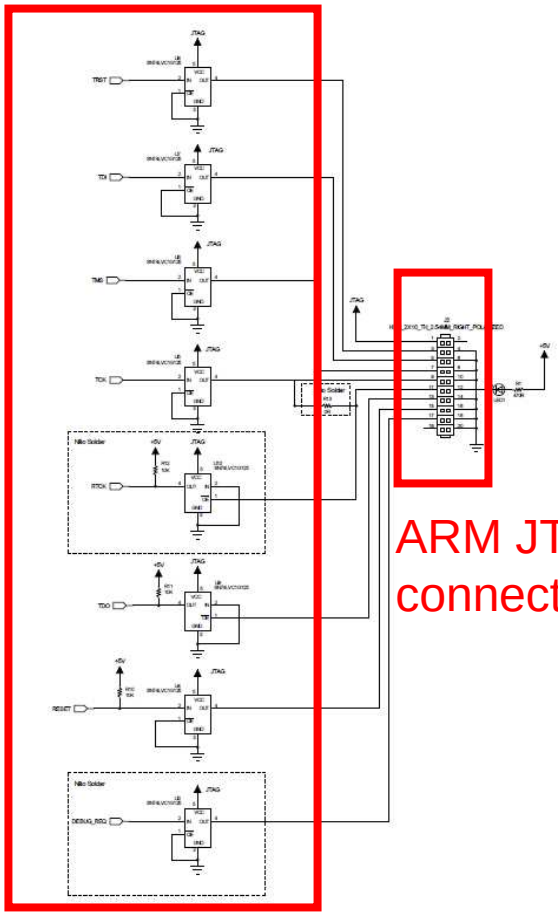
- A really simple probe:



USB Connector
From PC



FTDI – FT2322



ARM JTAG
connector

Voltage translation

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JTAG Probe - 4/4

- Install Instructions:

FTDI drivers are need on host PC, there are two drivers available, open source and proprietary. The latter is optimized, so let's use it.

Download the drivers:

http://www.ftdichip.com/Drivers/D2XX.htm

Current release for Linux was 0.4.16 at the time this document was written.

Linux	FT2232H, FT4232H, FT232R, FT245R, FT2232, FT232B, FT245B, FT8U232AM, FT8U245AM	0.4.16	2nd December 2008	Instructions in ReadMe file.

Follow instructions from ReadMe file.

Or execute the commands listed on:
http://www.imxdev.org/wiki/index.php?title=IMX27_ADS_Board_Installing_OpenOCD_and_GDB

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Next Steps

- NFC is still not supported directly on OpenOCD. (One need to run redboot to program flash)
- Add i.MX35 and 25 support on the project.
- Validate more JTAG probes with i.MX devices.

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Eclipse Install Example (posted on the net)

Source: http://johnpaulett.com/2009/06/26/install-eclipse-galileo-3-5-on-ubuntu-jaunty-9-04/

26 Jun, 2009

Install Eclipse Galileo (3.5) on Ubuntu Jaunty (9.04)

Posted by: John Paulett In: Ubuntu| python

Eclipse 3.5, codenamed "Galileo," was released this week! While there is a team actively working on building an Ubuntu deb package, they do not yet have a package yet for Eclipse 3.5.

I put together some super simple instructions for installing Eclipse 3.5.

C++ Eclipse White Paper
Free Tech Guide to Generating C++ Web Services Using Eclipse Plug-ins

Scientific Python Course
Intro to Scientific Comp w/Python Aust Chicago, Silicon Valley

Ads by Goo

I am going to perform a per-user installation into my home-directory. If multiple people use eclipse on the same computer, you may want to modify these instructions to install into */opt/*. I am going to put the installable in *~/bin/packages/eclipse3.5*.

First, create the installation directory (change according to your own tastes)

```
mkdir -p ~/bin/packages
cd ~/bin/packages
```

Now download the appropriate tar.gz file from eclipse. I am going to grab them from Amazon's Cloudfront.

For 64-bit Ubuntu:

```
wget http://d2u376ub0heus3.cloudfront.net/galileo/eclipse-java-
```

For standard 32-bit Ubuntu:

```
wget http://d2u376ub0heus3.cloudfront.net/galileo/eclipse-java-
```

Now unzip, and rename the directory (I want multiple version of Eclipse):

```
tar xzvf eclipse-java-galileo-linux-gtk*.tar.gz
mv eclipse eclipse3.5
```

Great, almost there. I am going to create a file so that I can launch eclipse from the command line. Create a new file *~/bin/eclipse*, and in that file, put:

```
#/usr/bin/bash
`~/bin/packages/eclipse3.5/eclipse -vmargs -Xms128M -Xmx512M -
```

(You can later change these values if you get out of memory issues from Eclipse.)

Lastly, make the file executable:

```
chmod u+x ~/bin/eclipse
```

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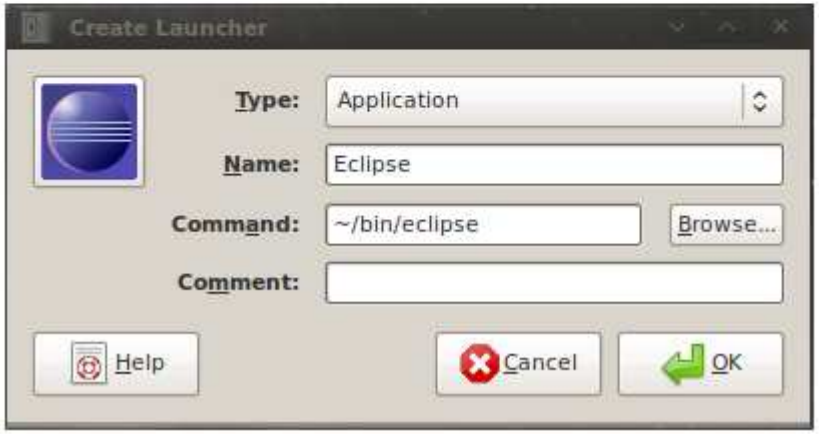
Eclipse Install Example

Source: http://johnpaulett.com/2009/06/26/install-eclipse-galileo-3-5-on-ubuntu-jaunty-9-04/

Add Icon to the Panel

I like having an icon on my panel to quickly launch Eclipse, like so:

To do so, right click on your panel in a place with no other panel tool. Select "Add to Panel" then create a "Custom Application Launcher". You can enter *~/bin/eclipse* as the command to run, and if you click the icon on the left, you can use the Eclipse icon in *~/bin/packages/eclipse3.5/*.



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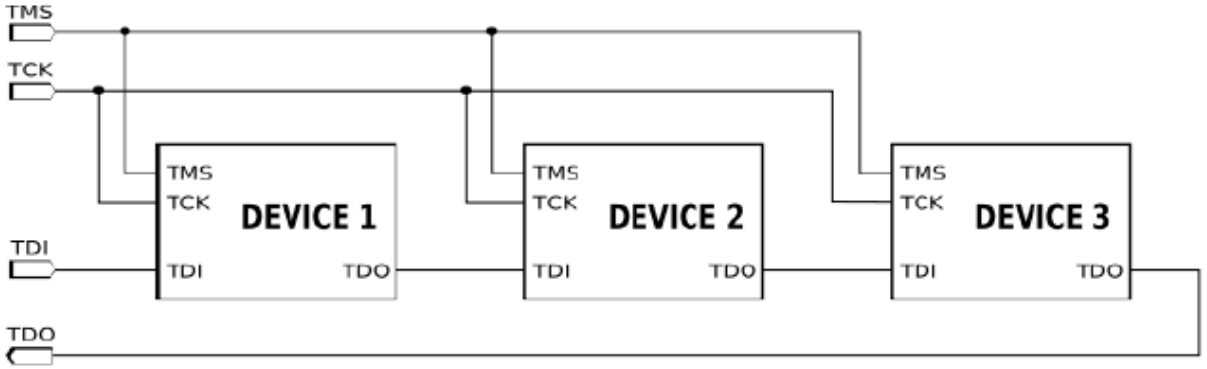
JTAG



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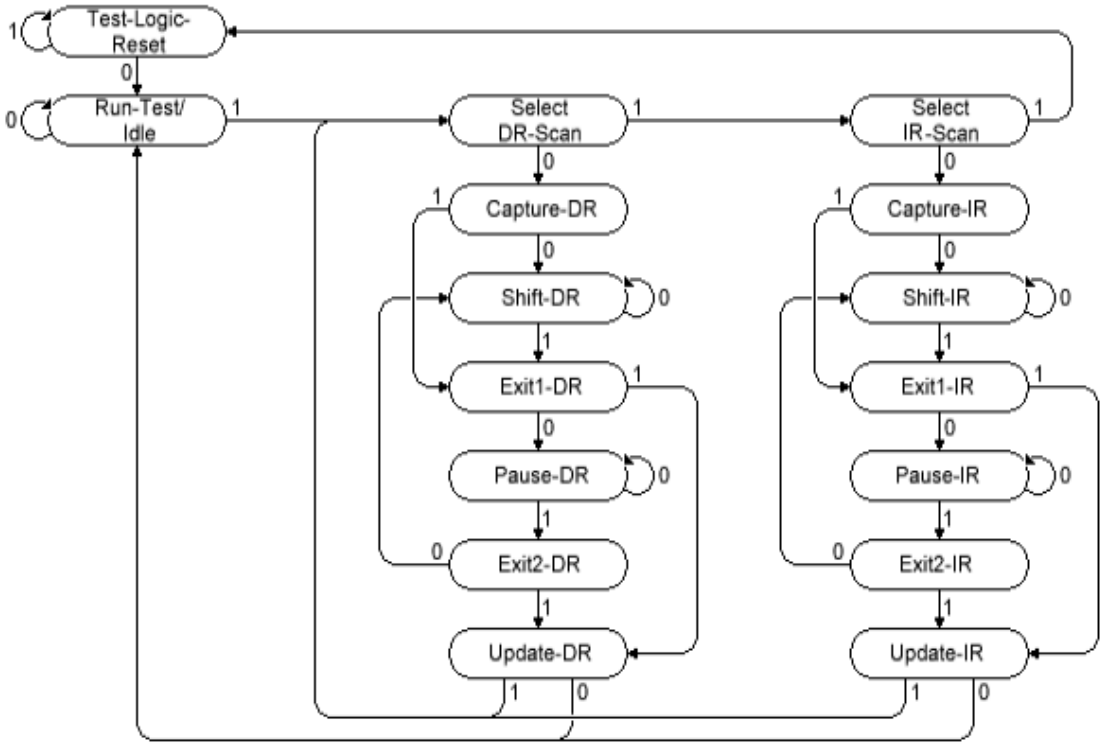
JTAG TAP State Machine



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