

Designing a Robust IIoT to SCADA Gateway

Class 4: Programming the R-IN Protocol Engine

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This Week's Agenda

10/22 The Challenges of IIoT and Industrial Ethernet

10/23 Introduction to the RZ/N1

10/24 Many Protocols, One Abstraction - GOAL

10/25 Programming the R-IN Protocol Engine

10/26 Writing and Testing Our Application

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10/25 **Programming the R-IN Protocol Engine**

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Developing for the RZ/N1D

- For the next two days, we will look at some example programs and what setup is needed to write, load, and debug code on the three processors in the Renesas RZ/N1D
- Our setup will be the minimum needed, without the protocol analyzers and other test equipment that would be needed for proper development

Question1 – What IDEs do you use for ARM?

Programming the R-IN

ARM Cortex-M3 (with special HW accel)

- Windows (7/10) computer running IAR Embedded Workbench for ARM 8.22+
- GOAL OSAL (included in CONNECT-IT)
- Renesas Drivers
- μ ITRON
- IAR iJet JTAG




Programming the Dual A7s

Dual ARM Cortex-A7

- Linux computer (Ubuntu 16+ recommended) running linaro-6.3.1-2017.02 GCC-based cross-compiler system for ARM
- Although we will concentrate on the dual A7 application side tomorrow, we need to run some demos on the application side to test our R-IN implementations

Development Environments

- We will use Linux for the A7s for our demos
- They can also run ThreadX or VxWorks
- Choices can also depend on your license for IAR

Device	RZ/N1D		
CPU	Cortex-A7		Cortex-M3 (R-IN engine)
OS	Linux or ThreadX		uITRON (HWRTOs)
IDE	Linux 	ThreadX 	IAR EWARM 
Bootloader	U-Boot*		

Bring up the Quick Start

CONNECT IT! - ETHERNET RZ/N1D
Quick Start Guide

RZ Family RZ/N1 Series

List of reference documents

Document name
User's Manual: System Introduction, Multiplexing, Electrical and Mechanical Information
User's Manual: System Control and Peripheral
User's Manual: Peripherals
User's Manual: R-IN Engine and Ethernet Peripherals
User's Manual: Generic Open Abstraction Layer
RZ/N1D Development Board Schematic
RZ/N1D Development Board Setup Notes
RZ/N1 U-Boot User Manual
RZ/N1 Linux User Manual

Your Windows Computer Will Need

The screenshot shows a web browser window with the address bar displaying <https://sourceforge.net/projects/dfu-util/files/latest/download>. The SourceForge website header is visible, including the logo and navigation links for 'Open Source Software', 'Business Software', 'Services', and 'Resources'. Below the header, there are several advertisements, including one for 'Time to build' and another for 'VOIPReview.org'. The main content area shows the 'dfu-util' project page, which includes a 'DFU' logo, the text 'Multiplatform USB DFU host utility', and a link to 'Brought to you by: tormod'. A 'Learn more' link is also present. Below this, there are buttons for 'Get Updates', 'Share This', and 'Problems Downloading?'. A 'dfu-util-0.9-win64.zip' file is listed, with a note 'Scanned by: Bitdefender'. A 'Other Useful Business Software' section is visible at the bottom, featuring 'SolarWinds Bandwidth Analyzer Pack'.

The overlaid Windows File Explorer dialog box is titled 'Opening dfu-util-0.9-win64.zip'. It displays the following information:

- You have chosen to open:
- dfu-util-0.9-win64.zip**
- which is: Compressed (zipped) Folder (718 KB)
- from: <https://iweb.dl.sourceforge.net>

What should Firefox do with this file?

- Open with **Windows Explorer (default)**
- Save File**
- Do this automatically for files like this from now on.

Buttons for 'OK' and 'Cancel' are at the bottom of the dialog.

U-boot Is Also Needed

GitHub, Inc. (US) | <https://github.com/u-boot/u-boot>

Search or jump to... Pull requests Issues Marketplace Explore

u-boot / u-boot Watch 93 Star 455 Fork 662

Code Pull requests 7 Projects 0 Insights

"Das U-Boot" Source Tree

53,073 commits 6 branches 342 releases 904 contributors

Branch: master New pull request Create new file Upload files Find file Clone or download

Commit	Message	Time
sglass68 and trini binman: Add a test for Intel reference code	Latest commit 3ae192c	22 days ago
Documentation	board: Add gazerbeam driver	24 days ago
Licenses	Licenses/README: Update some style and add explicit license to the do...	5 months ago
api	SPDX: Convert all of our single license tags to Linux Kernel style	6 months ago
arch	Merge git://git.denx.de/u-boot-x86	a day ago
board	ARM: omap3_logic: Add NOR Flash Support for SOM-LV	2 days ago
cmd	Merge tag 'signed-efi-2018.11' of git://github.com/agraf/u-boot	7 days ago
common	spl: fpga: Implement fpga bistream loading with fpga_load	8 days ago
configs	Merge git://git.denx.de/u-boot-x86	a day ago
disk	Rename GPT_HEADER_SIGNATURE to avoid conflict	15 days ago
doc	x86: doc: Remove stale sections of 64-bit support	2 days ago
drivers	Merge git://git.denx.de/u-boot-x86	a day ago
dts	powerpc/dts: Makefile changes to clean and build dts	26 days ago
env	arm64: versal: Add support for new Xilinx Versal ACAPs	8 days ago
examples	lib: Add hexdump	4 months ago

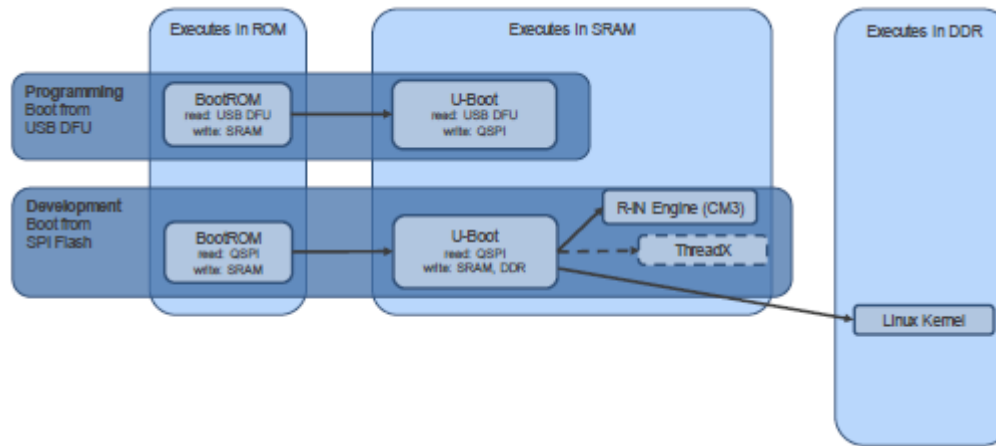
Now We Bring up IAR EWARM

GOAL Projects**	Several example projects showing the different functionalities for the switch management and GOAL	Cortex M3	\\GOAL\goal\projects\00410_goal\
Protocol Stack Projects***	Several Protocol Stack slave application examples, which are running I/O communication between a PLC and RZ/N1D	Cortex M3	\\GOAL\goal\projects\goal_co_lib\ \\GOAL\goal\projects\goal_ecaf\ \\GOAL\goal\projects\goal_eip_lib\ \\GOAL\goal\projects\goal_epl_lib\ \\GOAL\goal\projects\goal_mbs\ \\GOAL\goal\projects\goal_pnio_lib\

Boot Sequence and Binaries

Linux and U-Boot binaries are to be found in the solution kit under:

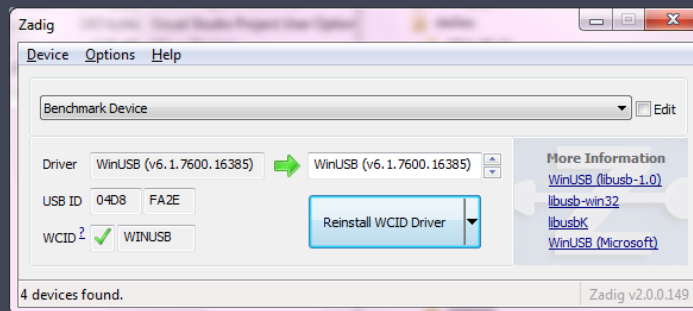
U-Boot for RZ/N1D	YCONNECT-IT-RZN_V1.X\Software\U-Boot-and-Linux\u-boot\binaries\u-boot-rzn1d400-db.bin.spkg
Linux Kernel	YCONNECT-IT-RZN_V1.X\Software\U-Boot-and-Linux\kernel\binaries\ulmage
Device Tree Blob	YCONNECT-IT-RZN_V1.X\Software\U-Boot-and-Linux\kernel\binaries\ulmage-rzn1d400-db.dtb



Another Handy Tool



USB driver installation made easy



Zadig is a Windows application that installs generic USB drivers, such as [WinUSB](#), [libusb-win32/libusb0.sys](#) or [libusbK](#), to help you access USB devices.

It can be especially useful for cases where:

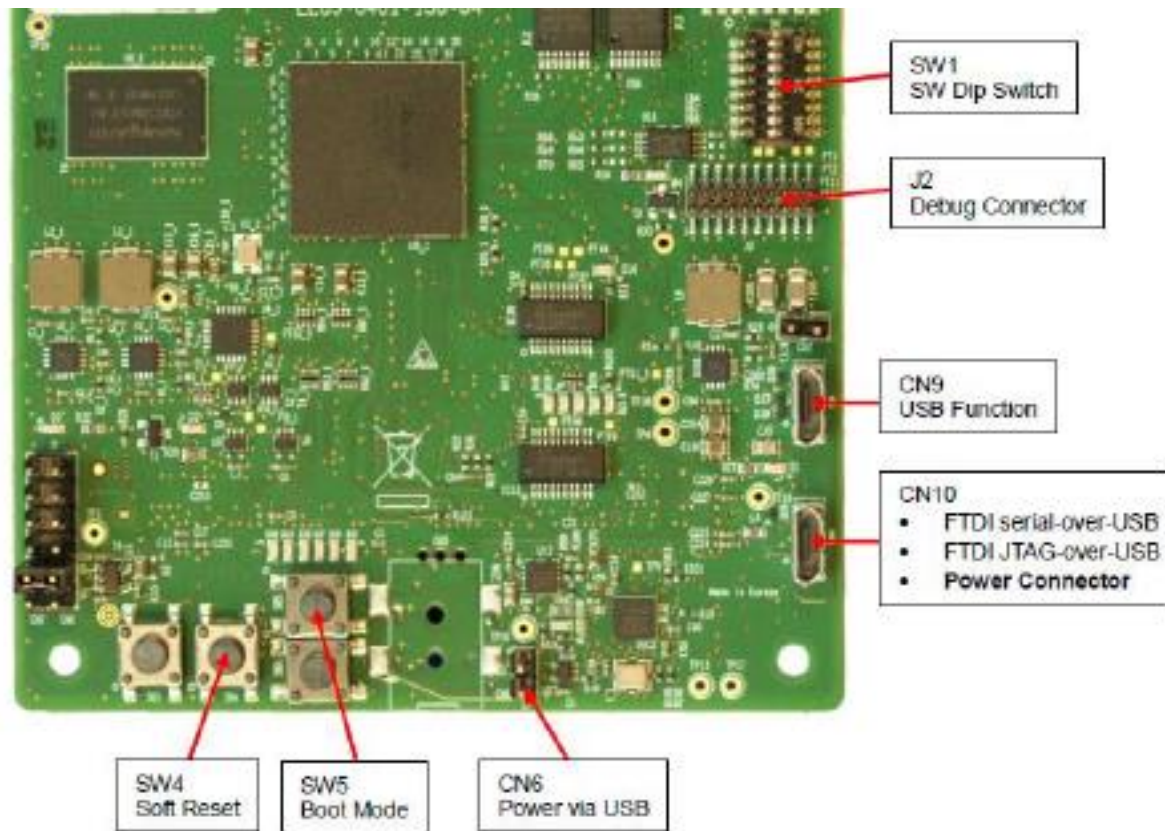
- you want to access a device using a libusb-based application
- you want to upgrade a generic USB driver
- you want to access a device using WinUSB

Note: "libusb-based" above means an application that uses either [libusb](#), [libusb-win32](#) or [libusbK](#).

[Download](#)

Updated 2018.07.26:

Our Programming Connections

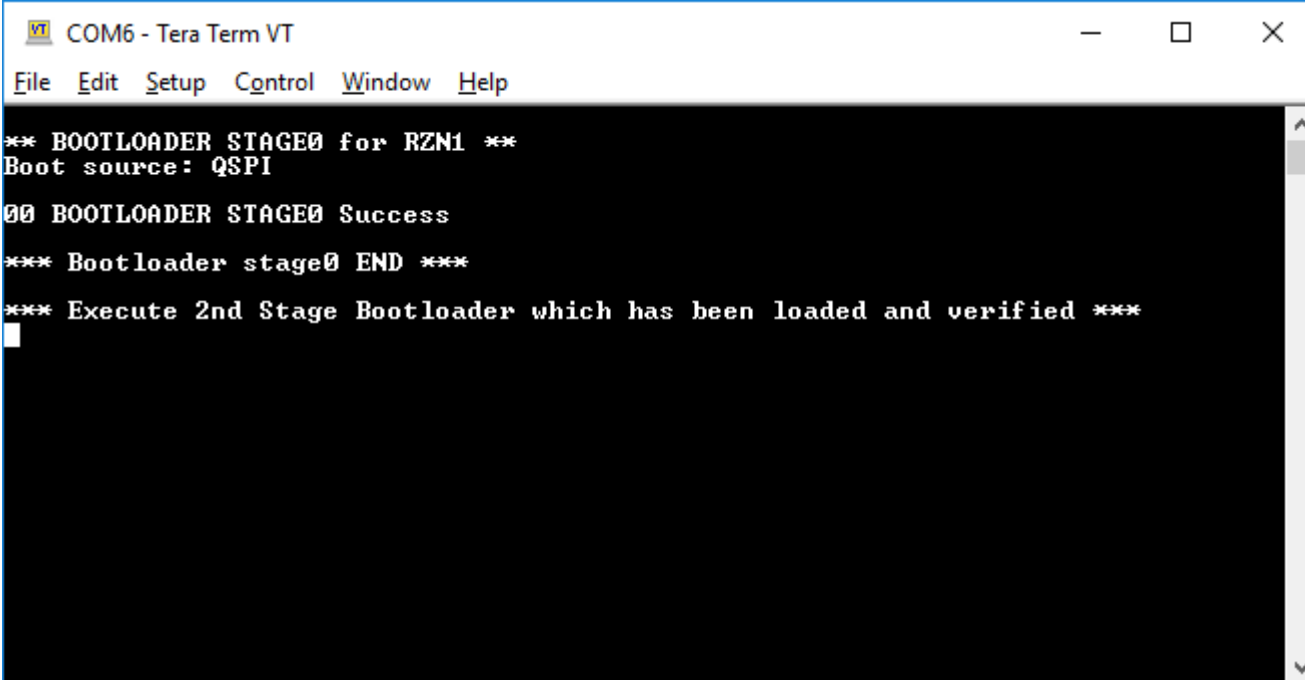


Question 2 – What Does FTDI stand for – and who started the company?

Putting it together

- Following the manual, we loaded DFU on our PC
- Then we run Zadig on our PC (once to register the software-over-USB)
- Connect to the “CN10 USB port”
- Once we set up our new serial port
- we installed U-Boot on the RZ/N1D

We are now ready to run the bootloader



```
COM6 - Tera Term VT
File Edit Setup Control Window Help
** BOOTLOADER STAGE0 for RZN1 **
Boot source: QSPI
00 BOOTLOADER STAGE0 Success
*** Bootloader stage0 END ***
*** Execute 2nd Stage Bootloader which has been loaded and verified ***
```


Installing Linux

- For today, we will just load the pre-compiled Linux that is provided and set up the environment. The distribution is based on Yocto which is popular for embedded systems
- These steps are in the quick-start manual pages 17-20

Our Demo Code

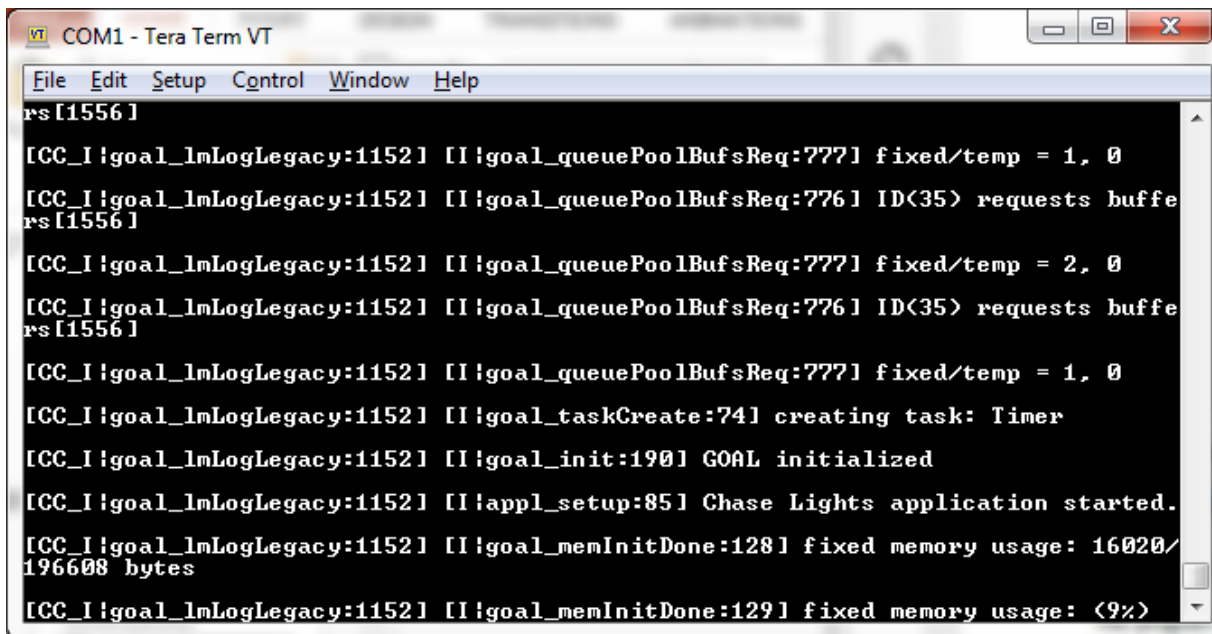
- We will start with the general demo to test out our setup
- This is found at
Software\GOAL\goal\projects\00410_goal\chase_lights\iar\7_70\rzn1d_demo_board\rzn1d_demo_board_eww
- NOTE – is you don't have the expansion board use
...rzn1d_demo_board.eww
- Load this workspace in IAR (8.22 or later)

Now we need to set the environment

- In the U-Boot console type
 - => setenv cm3 "sf probe&&mw 0x04000004 1&&rn1_start_cm3"
 - => saveenv
 - => run cm3
- Press enter.
- Now connect your i-Jet to the JTAG connector, make and debug the project.

Your Green LEDs Should “Chase”

- The green LEDs will chase back and forth and you should see the following in your serial terminal window



```
COM1 - Tera Term VT
File Edit Setup Control Window Help
rs [1556]
[CC_I!goal_lmLogLegacy:1152] [I!goal_queuePoolBufsReq:777] fixed/temp = 1, 0
[CC_I!goal_lmLogLegacy:1152] [I!goal_queuePoolBufsReq:776] ID<35> requests buffers [1556]
[CC_I!goal_lmLogLegacy:1152] [I!goal_queuePoolBufsReq:777] fixed/temp = 2, 0
[CC_I!goal_lmLogLegacy:1152] [I!goal_queuePoolBufsReq:776] ID<35> requests buffers [1556]
[CC_I!goal_lmLogLegacy:1152] [I!goal_queuePoolBufsReq:777] fixed/temp = 1, 0
[CC_I!goal_lmLogLegacy:1152] [I!goal_taskCreate:74] creating task: Timer
[CC_I!goal_lmLogLegacy:1152] [I!goal_init:190] GOAL initialized
[CC_I!goal_lmLogLegacy:1152] [I!appl_setup:85] Chase Lights application started.
[CC_I!goal_lmLogLegacy:1152] [I!goal_memInitDone:128] fixed memory usage: 16020/196608 bytes
[CC_I!goal_lmLogLegacy:1152] [I!goal_memInitDone:129] fixed memory usage: <9%>
```

Presented by:

Now We Are Ready

- We can now look at the different fieldbus drivers and stacks in GOAL, but for that we need to be able to program the A7s to run our test application
- Tomorrow, we look at how we program the application processor in Linux and run some real code!

Question 3 – Experience with Linux? Embedded? What Distos?

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Please stick around as I answer your questions!

- Please give me a moment to scroll back through the chat window to find your questions
- I will stay on chat as long as it takes to answer!
- I am available to answer simple questions or to consult (or offer in-house training for your company)

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<http://www.blueridgetechnc.com>

<http://www.linkedin.com/in/charleslord>

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<https://www.github.com/bradatrainning>