

# Exor PLC+HMI Development Kit User Manual



## **Exor PLC+HMI Development Kit User Manual**

Rev	Date	Description	By
1.3	22/Jul/2015	<ul> <li>Added section 1.3, briefly explaining how to start building from the Docker container.</li> <li>Section 3.3: solved an inconsistence between paths in build instructions.</li> </ul>	N.Ô.
1.4	4/Apr/2016	- Updated references to new SD card image and JMobile 2.1     - Chapter 4: add note on supported SD-cards. A capacity of at least 4GB is required.     - Chapter 6: add note clarifying the purpose of the serial port, serial protocols are not supported	N.O.
1.5	24/May/2016	- Add references to usom01 and usom03 based development kits. - Chapter 1: add VirtualBox virtual machine references. - Chapter 3: update to use Yocto 2.1 recipes.	N.O.
1.6	5/Sep/2016	<ul> <li>Chapter 1: add instructions for installing VirtualBox VM from OVA. Installing Vagrant is no more required.</li> <li>Chapter 5: add instructions for BSP deploy on eMMC</li> <li>Chapter 6: add some more informations, section 6.3 has now more detailed instructions.</li> <li>Chapter 7: add instructions for expansion plugins</li> </ul>	N.O.
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1.8	27/Sep/2017	- Add references to nsom01 based development kit. - Chapter 3: update to use Yocto 2.3 recipes	N.O.
1.9	18/Jun/2018	- Update for release 4.x, Yocto 2.4 - Remove Docker instructions, now unsupported	N.O.
1.10	5/Aug/2018	- Chapter 5: update instructions	N.O.

Reference				
Cross Reference	Filename	Description		
[1]				

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D	Document contains			
		Author(s)		
	Functional Specs			
	Usability Specs			
	Techical Specs			
	Test Procedures			
	Technical Documentation			
V	User Documentation			

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## **TABLE OF CONTENTS**

X

1.	Title Getting started	6
	1.1 Running the VirtualBox VM	6
	1.1.1 Setup a guest-host shared folder	
	1.1.2 Configuring the SDK	
	1.1.3 Using QtCreator	
	1.1.4 Compiling the BSP with Yocto	
2	The Sato desktop	9
	2.1 Network configuration	
	2.2 Start JMobile from Sato	10
3	Compiling Yocto BSP from scratch	11
	3.1 Setup the build environment	11
	3.2 Optional customizations	
	3.3 Compiling Yocto BSP	
	3.3.1 Creating the SDK (optional)	
4	BSP deploy on SD-card	13
	4.1 Using a ready image	
	4.1.1 Under Linux	
	4.1.2 Under Windows	
	<ul><li>4.2 Using the SD-card installer (Linux users only)</li><li>4.3 Manually</li></ul>	
5	BSP deploy on eMMC	
6	Setup the workspace for building applications	
U	6.1 Cross development environment setup	
	6.2 Connecting to the device	
	6.3 QtCreator setup	
	6.3.1 Application deploy	
7	Using Expansion Plugins	24
	7.1 Use PLCM01 plugin (Canbus)	
	7.1.1 Plugin connection	24
	7.1.2 System configuration and Plugin use	
	7.1.3 Canbus connector (CN2)	
	<ul><li>7.2 Use PLCM04 module (RS-422/485)</li><li>7.2.1 Plugin connection</li></ul>	
	7.2.1 System configuration and Plugin use	
	7.2.3 Exaple C code	
	7.2.4 RS485 connector (CN2)	27
	7.3 Use PLCM05 module (Expansion module)	28
	7.3.1 SPI Plugin connection	
	7.3.2 SPI System configuration and plugin use	
	<ul><li>7.3.3 SPI Example C code</li><li>7.3.4 CN4 Connector</li></ul>	
0		
8	Upgrade FPGA firmware ( us02-kit only)	



JMobile Portable runtime	33
9.1 JMobile portable runtime installation	
CODESYS V3	
10.1Enabling CODESYS runtime	39
10.3Creation of a new PLC project	40
10.4Communication setup in the CODESYS software	40
Accessing PLC from JMobile	43
11.1Codesys project creation	43
11.2CDS3 protocol configuration on JMobile	46
	<ul> <li>9.1 JMobile portable runtime installation</li> <li>9.2 JMobile OpenHMI Studio quick start guide</li> <li>CODESYS V3</li> <li>10.1Enabling CODESYS runtime</li> <li>10.2Installing CODESYS Devices</li> <li>10.3Creation of a new PLC project</li> <li>10.4Communication setup in the CODESYS software</li> <li>Accessing PLC from JMobile</li> </ul>



## 1. Title Getting started

To work with the development kits a Linux operating system with a properly configured build environment is required. The simplest way to get started, especially for Windows users, may be using one of our development virtual machines. We provide a VirtualBox VM and a Docker container, both are preconfigured with:

- Yocto workspace for building the BSP
- Preinstalled SDKs to start building your own application for the development kit
- QtCreator IDE with preconfigured target toolchains (Qt 5.9)

If you are already working on a Linux machine or you already have a Linux VM you may consider configuring yourself the build environment instead. In this case skip this chapter and go to chapter 3 if you are interested in building the BSP or chapter 6 if you are interested in building your own applications for the target.

#### 1.1 Running the VirtualBox VM

You can download the Exor's VirtualBox development VM from here:

http://download.exorembedded.net:8080/Public/VirtualBoxVMs

Instructions found on this document are compatible with versions 4.x of the VM. If you are about to use a greater version please consider looking for an updated version of this manual.

The virtual machine comes in the OVA (Open Virtualization Archive) format. To import it on VirtualBox got to "File" -> "Import Appliance...", select the downloaded .ova file and then click "Import". At this point VirtualBox will give you the opportunity to customize the VM, double-click on entries to edit them.

You will notice there are two network adapters, one is set to work in NAT mode while the second one works in bridged mode, the virtual machine will always use the bridged interface if possible and fall back to the other only if necessary. Adjust both adapters to work with the real network interface you use to have access to internet. Note that if the bridged adapter is not correctly configured you won't be able to resolve the Kit hostname, its IP address has to be used in this case.

#### Appliance settings

These are the virtual machines contained in the appliance and the suggested settings of the imported VirtualBox machines. You can change many of the properties shown by double-clicking on the items and disable others using the check boxes below.

Virtual System 1	Configuration
-	
😽 Name 🛛 🗧 E	xorDev-VM
🗮 Guest OS Type 📲	🚪 Ubuntu (64-bit)
💭 СРИ 2	
RAM 2	048 MB
🌽 USB Controller 🛛	2
🗐 Network Adapter 🛛	Intel PRO/1000 MT Desktop (82540EM)
🗐 Network Adapter 🛛	Intel PRO/1000 MT Desktop (82540EM)
🗸 🗼 Storage Controller (SATA) 🛛 A	HCI
🔊 Virtual Disk Image 🛛 C	:\VirtualBox VMs\ExorDev-VM\ExorDev-VM





The default amount of RAM is set to 2GB but if you plan working with Yocto we recommend to increase it to at least 4GB (suggested 6GB), adjusting the number of CPU cores is also a good idea. When you're done click on "Import". Once finished importing you will be able to change VM settings

File Machine View Input Devices Help	🕎 ExorDev-VM [Running] - Oracle VM VirtualBo>	x — 🗆 ×
helloworld - Qt Creator	File Machine View Input Devices Help	
	💓 Applications Menu 💿 helloworld - Qt Creator	r 10:23 user
Trash   Image: Trash	File System Home WM-Share	File       Edit       Build       Debug       Analyze       Tools       Window       Help         helloworld       Edit       Configure Project       Editor       Code Style       De         Edit       The project helloworld is not yet configured. Qt Creator uses the kit Desktop to parse the pro       Image: Select all kits         Debug       Image: Select all kits       Image: Select all kits       Image: Select all kits         Projects       Image: Select all kits       Image: Select all kits       Image: Select all kits         Unconfigure       Image: Select all kits       Image: Select all kits       Image: Select all kits         Unconfigure       Image: Select all kits       Image: Select all kits       Image: Select all kits         Unconfigure       Image: Select all kits       Image: Select all kits       Image: Select all kits         Unconfigure       Image: Select all kits       Image: Select all kits       Image: Select all kits         Unconfigure       Image: Select all kits       Image: Select all kits       Image: Select all kits         Unconfigure       Image: Select all kits       Image: Select all kits       Image: Select all kits         Image: Select all kits       Image: Select all kits       Image: Select all kits       Image: Select all kits         Unconfigure       Image: S

again.

The Linux operating system used is based on Ubuntu 16.04, the default user is:

- username: user
- password: password

To run a command with root privileges you can use sudo, entering the password is not required.

#### 1.1.1 Setup a guest-host shared folder

We recommend configuring a shared folder between host and guest, it's the easiest way to move files from and to the VM. From VirtualBox right-click on Exor's VM and select "Settings...". Now go to "Shared Folders" and click on the add button to the right. Configure as follow:

- Folder Path: choose the host folder to share with the virtual machine
- Folder Name: must be share.
- Read-only: leave unchecked.
- Auto mount: leave unchecked.
- Make Permanent: set checked.





The chosen folder will be available inside the virtual machine from /home/user/VM-share, a link to this location can be also found on the VM's desktop. If the VM was already running a restart will be

🥘 ExorDev	VM - Settir	ngs					?	$\times$
E Gene	ral	Share	ed Folders					
🛒 Syster	n	Folders L	ist					
Displa	ay	Name				Auto-mount	Access	
Stora	ge		chine Folders sient Folders	🥝 Add Shar	e	? >	<	
Audio	)			Folder Path:	<not selected<="" th=""><th>&gt;</th><th>~</th><th></th></not>	>	~	
📄 Netw	ork			Folder Name:	share Read-only			
Serial	Ports				Auto-moun	t		
🏈 USB					✓ Make Perm	ianent		
Share	d Folders					_		
📰 User I	nterface				OK	Cancel		
					ОК	Cancel	Help	

required.

## 1.1.2 Configuring the SDK

To reduce the initial weight of the VM the SDK is not shipped with it. Scripts named "Install [...] SDK.sh" can be found on the desktop, by just executing these with a double-click it's possible to automatically download and install the required SDK files for each device.

During installation QtCreator will be reconfigured, if found running it will be automatically closed during the process.

#### 1.1.3 Using QtCreator

The QtCreator IDE is already installed and configured to deploy and debug applications for each development kit. When creating a new project make sure to select the kit configuration for your device, if not available make sure that the corresponding SDK has been installed using one of the scripts that can be found on the desktop. There's also a "Desktop" kit configuration which can be used to build your application and run it on the virtual machine instead of deploying it, useful for fast testing and heavy profiling.

You will find a helloworld sample project in /home/user/helloworld, open it with QtCreator, compile it for your platform and press Ctrl+R, a window will pop up in the development kit.

You can find more details about configuring QtCreator in section 6.3, in particular how to change the hostname or IP address of the target device.

#### 1.1.4 Compiling the BSP with Yocto

Inside /home/user/exor-yocto-4.0 you will find the preconfigured Yocto workspace for building the BSP for your development kit. As we do not update our development virtual machines as often we do with our Yocto recipes you may want to update the meta-exor layer before starting the build:





```
$ cd /home/user/exor-yocto-4.0/git/meta-exor
$ git checkout rocko
$ git pull
```

Go to chapter 3 to go ahead compiling the BSP.

## 2 The Sato desktop

The development kit will boot with the configured to run as **root** user and an

6

default Yocto SATO interface. The machine is empty password

#### 2.1 Network configuration

By default network configuration is done using a DHCP service. To change this and set a static IP click on the Ethernet icon on the right top of the screen and choose "Preferences".



Here, in "Connection Preferences", choose "Ethernet" from thee Services list and select "MANUAL" under "Configuration". Now you can fill in your network configuration. To do this you can toggle the on-screen keyboard or just plug-in a real USB keyboard. Rememer to click on "Apply" when you are done.





Connection Preferences	<b>A C S S</b> 06:47 <b>S</b>	3
Services System Configuration Wired Networks Ethernet	Configuration: MANUAL  IP address: Netmask: Gateway: Apply	
L	<u>C</u> lose	_

### 2.2 Start JMobile from Sato

By default, among other applications, a portable version of JMobile Runtime is installed. To launch the HMI just click on the JMobile icon you will find in the "Applications" menu in Sato. A demo project is already loaded for evaluation purpose. As the Runtime is meant to run by his own on the system the Sato user interface will be terminated.

To close JMobile and return to Sato you can both reboot the board or kill the HMI by issuing the following command from an ssh session:

\$ killall xinit



## 3 Compiling Yocto BSP from scratch.

#### 3.1 Setup the build environment

If you are using Exor's VirtualBox VM you can skip the first two steps: you will find the exor-yocto-4.0 folder already in the user's home (/home/user/exor-yocto-4.0).

1. Create a workspace directory structure:

```
$ mkdir -p exor-yocto-4.0
$ cd exor-yocto-4.0/
```

2. Get the source code from github repositories:

```
$ curl http://commondatastorage.googleapis.com/git-repo-downloads/repo > repo
$ chmod a+x repo
$ ./repo init -u https://github.com/ExorEmbedded/exor-bsp-platform -b rocko
$ ./repo sync
```

3. Setup the Yocto environment. From the exor-yocto-4.0 folder execute:

\$ source git/yocto-poky/oe-init-build-env build

You should now find yourself in a newly created "build" directory located in exor-yocto-4.0/build. The source command above

4. Configure Yocto by copying the provided sample configuration files. From the the build directory:

\$ cp ../git/meta-exor/conf/bblayers.conf.sample conf/bblayers.conf \$ cp ../git/meta-exor/conf/local.conf.sample conf/local.conf

5. Now edit your conf/local.conf and set the MACHINE variable to us01-kit, us02-kit (AlteraKit), us03-kit Or ns01-kit. For example:

MACHINE = "us02-kit"

You are now ready to build the BSP.

#### 3.2 Optional customizations

Here are some customizations you may be interested in:

• You can force Yocto to build a 32-bit SDK uncommenting the following line in the build/conf/local.conf file:

#SDKMACHINE ?= "i686"

• Uncomment following lines in the build/conf/local.conf file to be able to set the number of threads and CPU cores you want to use for the build process:

```
#BB_NUMBER_THREADS ?= "4"
#PARALLEL MAKE ?= "-j 4"
```



#### 3.3 Compiling Yocto BSP

Make sure to run following commands from your "build" folder:

1. Compile the bootloader:

\$ bitbake bootloader

2. The xloader (for the us01-kit only):

\$ bitbake xloader

3. The Linux kernel:

\$ bitbake virtual/kernel

4. And finally the rootfs:

\$ bitbake core-image-exor-x11

This will build the classic x11 sato image, the one that can be found in the SD-card included with the development kit.

At the end of these operations you will find build output files in build/tmp/deploy/images/usom0x:



## 3.3.1 Creating the SDK (optional)

Start the SDK build for the x11 image:

\$ bitbake -c populate\_sdk core-image-exor-x11

The SDK installer can be found in build/tmp/deploy/sdk/exor-evm-qt5-sdk.sh.





## 4 BSP deploy on SD-card

This section describes how to prepare a bootable SD-card for the evaluation kit, for this remember that only SD-cards with at least 4GB of space are supported.

Also note that following operations can be dangerous, harm your system or cause loss of data. Do not blindly execute these operations if you don't know what they actually do.

For Linux users we will assume below the SD-card device is named /*dev/sdb* and its partitions /*dev/sdbX*, change these to the actual names.

#### 4.1 Using a ready image

We provide a fully working 4GB image containing the x11-sato environment to let you start using the kit in no time. Note that by using this option, even with a more capable SD, only  $\sim$ 4GB of space will be available to the system.

Download the latest disk image for your evaluation kit:

```
US01kit images:http://download.exorembedded.net:8080/Public/usom01/sdcard-images/US02Kit images:http://download.exorembedded.net:8080/Public/usom02/sdcard-images/US03Kit images:http://download.exorembedded.net:8080/Public/usom03/sdcard-images/US01Kit images:http://download.exorembedded.net:8080/Public/usom01/sdcard-images/
```

#### 4.1.1 Under Linux

From a Linux shell:

```
# unzip SDcard-image-4gb.zip
# dd if=SDcard-image-4gb.img of=/dev/sdb bs=64k
# sync
```

Your SD-card is now ready to be used on the development kit.

#### 4.1.2 Under Windows

Download Win32DiskImager from http://sourceforge.net/projects/win32diskimager/. From the user interface of Win32DiskImager select the extracted .img image file and the SD-card drive and press "Write".

😼 Win32 Disk Imager	- • ×
Image File	Device
MD5 Hash:	
Progress	
Cancel Read Wr	rite Exit
Waiting for a task.	

#### 4.2 Using the SD-card installer (Linux users only)

If you want to take advantage of all your SD-card space or you have built by your own some components you want to deploy, it's also possible to use a SD-card installer script:





\$ wget http://download.exorembedded.net:8080/Public/utils/mkSDTool/mkSDTool-v4.0.sh -O mkSDTool.sh \$ sudo chmod +x mkSDTool.sh

\$ sudo ./mkSDTool.sh --machine [us01-x11|us01-wayland|us02|us03|ns01] --device /dev/sdb

By default the script will deploy on your SD-card all the necessary files by downloading the needed components from following locations:

US01kit:	http://download.exorembedded.net:8080/Public/usom01/
US02kit:	http://download.exorembedded.net:8080/Public/usom02/
US03kit:	http://download.exorembedded.net:8080/Public/usom03/
NS01kit:	http://download.exorembedded.net:8080/Public/nsom01/

If you want to provide yourself one or more of these components you can take advantage of following options supported by the mkSDTool script:

- --rootfs <path/to/my/rootfs.tar.gz>
- --kernel <path/to/my/kernel.tar.gz>
- --uboot <path/to/my/u-boot.tar.gz>
- --xloader <path/to/my/xloader.tar.gz> (only for us01)

#### 4.3 Manually

1. Create the SD-card partition layout :

```
# umount /dev/sdb*
# SIZE=`fdisk -1 /dev/sdb | grep -m1 Disk | awk '{print $5}'`
# CYLINDERS=$(( $(( $SIZE )) / 255 / 63 /512 ))
# sfdisk --force -D -H 255 -S 63 -C $CYLINDERS /dev/sdb << EOF
1,5
6,$(( $CYLINDERS - 10 ))
$(( $CYLINDERS - 10 )),a2
EOF
# mkfs.vfat -n BOOT /dev/sdb1
# mkfs.ext4 -L ROOT /dev/sdb2</pre>
```

2. Mount partitions. Execute following operations:

```
// Mount partitions if not already mounted
# mkdir /media/BOOT
# mount /dev/sdb1 /media/BOOT
# mkdir /media/ROOT
# mount /dev/sdb2 /media/ROOT
```

Now the actual deploy phase depends on the specific board. Make sure to follow the appropriate steps:

```
// Deploy files to SD-card for us01-Kit
# mkdir /media/BOOT/boot
# tar xzvf us01-kit-kernel[...].tar.gz --no-same-owner -C /media/BOOT/boot
# tar xzvf us01-kit-bootloader.tar.gz --no-same-owner -C /media/BOOT
# tar xzvf us01-kit-xloader.tar.gz --no-same-owner -C /media/BOOT
# tar xzvf core-image-exor-[...].tar.gz -C /media/ROOT
# sync
// Deploy files to SD-card for us02-kit
# tar xzvf us02-kit-kernel.tar.gz --no-same-owner -C /media/BOOT
# tar xzvf us02-kit-woot.tar.gz
# dd if=u-boot.img of=/dev/sdb3 bs=64k seek=4
# sync
```



```
×
```

```
// Deploy files to SD-card for us03-kit
# mkdir /media/BOOT/boot
# tar xzvf us03-kit-kernel.tar.gz --no-same-owner -C /media/BOOT/boot
# tar xzvf core-image-exor-[...].tar.gz -C /media/ROOT
# tar xzvf us03-kit-uboot.tar.gz
# dd if=u-boot.imx of=/dev/sdb bs=1k seek=1
# sync
// Deploy files to SD-card for ns01-kit
# mkdir /media/BOOT/boot
# tar xzvf ns01-kit-kernel-[...].tar.gz --no-same-owner -C /media/BOOT/boot
# tar xzvf core-image-exor-[...].tar.gz -C /media/ROOT
# tar xzvf ns01-kit-kernel-[...].tar.gz --no-same-owner -C /media/BOOT/boot
# tar xzvf ns01-kit-kernel-[...].tar.gz -C /media/ROOT
# tar xzvf ns01-kit-uboot[...].tar.gz
# dd if=u-boot.imx of=/dev/sdb bs=1k seek=1
```

```
# sync
```





## 5 BSP deploy on eMMC

This section describes how to deploy the BSP on eMMC and boot from it. All the kits have the possibility to boot without an SD-Card except for the us03-kit.

On the iMX6Q the location where the bootloader needs to loaded is defined by OTP fuses that on the us03-kit are already set to use the SD-Card. Once the bootloader is loaded into ram the roots used will still be the one on the eMMC and the SD-card could be removed. For more information on OTP fuse programming please refer to NXP processor reference manual ( chapter 5 *Fusemap* and chapter 46 *On-Chip OTP Controller*):

#### https://www.nxp.com/docs/en/reference-manual/IMX6DQRM.pdf

To deploy the BSP to the internal eMMC it is required to define the partition layout and then modify the bootloader environment in order to inform the u-boot on where to look for all the necessary files. Here, for demonstration purposes, we will use the simplest layout, a single ext4 partition. Following instructions needs to be executed on the development kit via ssh, it requires you have a working SDcard and these files available on it:

- The bootloader image, uboot.img.
- The rootfs, core-image-exor.tar.gz.
- Kernel and dtb or a kernel.tar.gz containing both.

Here are the steps to follow:

1) Reformat the eMMC device to have a single partition and create the ext4 filesystem. The eMMC device is defined as /dev/mmcblk1 on all the development kits except for the us02-kit where it's /dev/mmcblk0, for this reason the operation is slightly different for the latter.

```
// Format eMMC and mount rootfs partition for us01-kit, us03-kit and ns01-kit
# umount /dev/mmcblk1p*
# SIZE=`fdisk -l /dev/mmcblk1 | grep -m1 Disk | awk '{print $5}'`
# CYLINDERS=$(( $(( $SIZE )) / 255 / 63 /512 ))
# echo -e "o\nn\np\n1\n2\n\nw" | fdisk -H 255 -S 63 -C $CYLINDERS /dev/mmcblk1
# mkfs.ext4 /dev/mmcblk1p1
# mkdir emmc
# mount /dev/mmcblk1p1 emmc
// Format eMMC and mount rootfs partition for us02-kit
# umount /dev/mmcblk0p*
# SIZE=`fdisk -l /dev/mmcblk0 | grep -m1 Disk | awk '{print $5}'`
# CYLINDERS=$(( $(( $SIZE )) / 255 / 63 /512 ))
# echo -e "o\nn\np\n1\n2\n\nw" | fdisk -H 255 -S 63 -C $CYLINDERS /dev/mmcblk0
# mkfs.ext4 /dev/mmcblk0p1
# mkdir emmc
# mount /dev/mmcblk0p1 emmc
```

2) Deploy rootfs and kernel. Make sure at the end emmc/boot contains both a zImage and a dtb.

```
# tar xzvf core-image-exor.tar.gz -C emmc
# tar xzvf kernel.tar.gz -C emmc/boot // Or just copy zImage and dtb to
emmc/boot # sync
```

3) Deploy the bootloader. Again, this is platform dependent.

```
// Deploy bootloader on eMMC for us01-kit
# echo 0 > /sys/block/mmcblk1boot0/force_ro
# dd if=u-boot.img of=/dev/mmcblk1boot0 bs=512 seek=0
```





```
// Deploy bootloader on eMMC for us02-kit
# echo 0 > /sys/block/mmcblk0boot0/force_ro
# dd if=u-boot.img of=/dev/mmcblk0boot0 bs=512 seek=0
// Deploy bootloader on eMMC for us03-kit and ns01-kit
# dd if=u-boot.imx of=/dev/mmcblk1 bs=512 seek=2
```

Now if you remove the SD-card the bootloader written to the eMMC will be executed (except for the us03-kit, see the note at the beginning of this chapter) but the system won't boot because the uboot will still look for files inside the SD-card.

To make it work the bootloader environment must be changed. To do this connect to the kit's serial port using a client like putty and while keeping pressed Ctrl+C on the console power off and then on the device. A prompt should appear.

From here execute these commands:

```
// U-boot environment changes for us01-kit, us03-kit and ns01-kit
# setenv mmcboot 'run findfdt; mmc rescan; ext2load mmc 1:1 ${loadaddr} /boot/zImage;
ext2load mmc 1:1 ${fdtaddr} /boot/${fdtfile}; setenv mmcroot /dev/mmcblk1p1; run
mmcargs; bootz ${loadaddr} - ${fdtaddr};'
# saveenv
// U-boot environment changes for us02-kit
# setenv mmcroot /dev/mmcblk0p1
# setenv mmcloadcmd ext2load
# setenv bootimage /boot/zImage
# setenv fdtimage /boot/socfpga.dtb
# setenv mmcload "mmc rescan; ${mmcloadcmd} mmc 0:${mmcloadpart} ${loadaddr}
    ${bootimage};
# saveenv
# saveenv
```

To restore the bootloader's environment and boot again from SD-card stop the machine at the u-boot's prompt again and type:

# env default -a
# saveenv



## 6 Setup the workspace for building applications

This section describes how to setup a 64bit Linux PC or virtual machine to be able to build applications for the target development kit. Our virtual machine and our Docker image are already preconfigured and ready to use, these steps can be skipped when using one of these solutions.

#### 6.1 Cross development environment setup

Download the latest v4.x SDK from here:

X

US01kit:	http://download.exorembedded.net:8080/Public/usom01/SDK
US02kit:	http://download.exorembedded.net:8080/Public/usom02/SDK
US03kit:	http://download.exorembedded.net:8080/Public/usom03/SDK
NS01kit:	http://download.exorembedded.net:8080/Public/nsom01/SDK

Execute the SDK installation file exor-evm-qt5-sdk.sh (requires admin privileges):

```
$ cd /opt
$ sudo chmod a+x ./ exor-evm-qt5-sdk.sh
$ sudo ./exor-evm-qt5-sdk.sh
```

You will be asked for the installation directory, press enter to use the default, /opt/exorintos/2.3.2. To setup the cross development environment for the current shell run this command (correct the path if you have changed the default installation directory):

```
// Environment setup for us01-kit
$ source /opt/exorintos/2.3.2/environment-setup-cortexa8hf-vfp-neon-poky-linux-gnueabi
// Environment setup for us02-kit and us03-kit
$ source /opt/exorintos/2.3.2/environment-setup-cortexa9hf-vfp-neon-poky-linux-gnueabi
// Environment setup for ns01-kit
$ source /opt/exorintos/2.3.2/environment-setup-cortexa7hf-vfp-neon-poky-linux-gnueabi
```

To build a simple hello world application use the arm cross compiler that should now be reachable from your PATH:

\$ arm-poky-linux-gnueabi-gcc main.c -o hello\_world

#### 6.2 Connecting to the device

On each device a console is active over serial port for debugging purposes. An ssh server is also running, useful for having a shell over ethernet or transferring files via sftp. In both cases the username to use is **root**, no password is required.

If your system has an avahi client installed the kit can also be addressed by its hostname:

US01kit:	exorUS01kit.local
US02kit:	exorUS02kit.local
US03kit:	exorUS03kit.local
NS01kit:	exorNS01kit.local

#### 6.3 QtCreator setup

When developing Qt applications it may be usefull to have the Qt IDE preconfigured to use the toolchain. You can get latest QtCreator package from DIGIA here:





http://download.qt.io/official\_releases/qtcreator/3.3/3.3.2/qt-creator-opensource-linuxx86-3.3.2.run

Install it in your machine:

\$ sudo chmod a+x ./qt-creator-opensource-linux-x86-3.3.2.run \$./qt-creator-opensource-linux-x86-3.3.2.run

You will find qtcreator installed in ~/qtcreator-3.3.2. Start it:

\$ ~/qtcreator-3.3.2/bin/qtcreator

We are now going to setup the QtCreator build kit for the target. From Tools menu select "Options..." -> "Build & Run", then follow these steps:

- In the "Compilers" tab click on "Add" -> "GCC" -> "C" and select the cross compiler picking it from the SDK installation folder. If the SDK has been installed in the default location the correct path is: /opt/exorintos/2.4.2/sysroots/x86\_64-pokysdklinux/usr/bin/arm-poky-linux-gnueabi/arm-poky-linux-gnueabi-gcc.
   Optionally edit "Name" to give a more meaningful name for the entry, select "arm-linuxgeneric-elf-32bit" as ABI and finally click "Apply".
- 2) From the same tab now click "Add" -> "GCC" -> "C++" and select /opt/exorintos/2.4.2/sysroots/x86\_64-pokysdk-linux/usr/bin/arm-poky-linuxgnueabi/arm-poky-linux-gnueabi-g++ instead. Again, select "arm-linux-generic-elf-32bit" as ABI and click "Apply"

QL	Options	×
Filter	Build & Run	
Environment	General Kits Qt Versions Compilers Debuggers CMake	
Text Editor		dd -
FakeVim	GCC (x86 32bit in /usr/bin) GCC	Clone
Help	▼ Manual ExorAlteraKITGCC GCC Re	emove
<b>{}</b> c++		
Qt Quick		
🕕 Build & Run		
🔍 Debugger		
Analyzer		
Version Control	Name: ExorAlteraKITGCC	
🧔 Android	Compiler path: sysroots/i686-pokysdk-linux/usr/bin/arm-poky-linux-gnueabi/arm-poky-linux-gnueabi-gcc Browse	
BlackBerry	Platform codegen flags:	
<sup>∋</sup> anx QNX	Platform linker flags:	
Devices	ABI: arm-linux-generic-elf-32t v arm v - linux v - generic v - elf v - 32bit v	
😤 Cada Dacting 💌		
	OK Cancel	Apply

3) From "Debuggers" tab press "Add" and select gdb from the same directory. The default location is: /opt/exorintos/2.4.2/sysroots/x86\_64-pokysdk-linux/usr/bin/arm-poky-linux-gnueabi/arm-poky-linux-gnueabi-gdb. Optionally edit "Name", then click "Apply".



₿	Options	×
Filter	Build & Run	
Environment	General Kits Qt Versions Compilers Debuggers CMake	
Text Editor	Name Path	Add
FakeVim	Auto-detected	Clone
Pelp	ExorAlteraKITGDB. /opt/poky/1.5.3/sysroots/i686-pokysdk-lipux/usr/bip/arm-poky-lipux-gpueabi/arm-	temove
() c++		
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🔍 Debugger		
Analyzer		
Version Control		
🧔 Android		
BlackBerry		
∋anx QNX		
Devices		
Code Decting 🔻		
	OK Cancel	Apply

4) From "Qt Versions" tab, press "Add..". The default path to select is: /opt/exorintos/2.4.2/sysroots/x86\_64-pokysdk-linux/usr/bin/qmake. QtCreator should automatically recognize the qt version selected. Press "Apply".

Q <b>.</b>			Opti	ons			×
Filter	Build & Run						
Environment	General Kits	Qt Versions	Compilers	Debuggers	CMake		
Text Editor	Name		qmake Loca	tion			Add
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P Help		(ExorAlteraKIT	) /opt/poky/1.	5.3/sysroots/i6	86-pokysdk-linux/us	r/bin/qmake	
() c++							Clean Up
Qt Quick							
🕵 Build & Run							
🔍 Debugger							
Analyzer							
Version Control							
🤠 Android	Version name:	Qt %{Qt:Versi	on} (ExorAlte	raKIT)			
BlackBerry	qmake location:					Browse	
<sup>∋</sup> anx QNX	ABI detection fail No qmlviewer ins	led: Make sure stalled.	to use a matc	hing compiler v	vhen building.		
Devices	Qt version 4.8.5	for Desktop				Details 🔻	
Code Decting							
						OK Cancel	Apply

X



- 5) This step is required for configuring automatic application deploy on the target. Move from "Build & Run" section to "Devices". Click "Add..", select "Generic Linux Device" and press "Start Wizard". Fill in these informations:
  - Name: the device name, for example, us01-kit.
  - Host name:

US01-kit:	exorUS01kit.local
US02-kit:	exorUS02kit.local
JS03-kit:	exorUS03kit.local
NS01-kit:	exorNS01kit.local

- Username: root.
- Authentication type: set to "Password".
- User's password: leave empty, no password is needed.

Click "Next" and then "Finish". Qt Creator will attempt a test connection, if the device is already powered on and reachable everything should be ok.

If for any reason you cannot reach the target by its hostname make sure avahi is installed on your system or edit "Host name" to set the actual board IP address instead. Press on "Test" button to check the connection again.

QL	Options	×
Filter	Devices	
Environment	Devices	
Text Editor	Device: ExorAlteraKIT (default for Generic Linux)	<u>A</u> dd
🕌 FakeVim	General	<u>R</u> emove
Help	Name: ExorAlteraKIT	Set As Default
<b>{}</b> c++	Type: Generic Linux	Test
📣 Qt Quick	Auto-detected: No	Show Running Processes
🕕 Build & Run	Current state: Unknown	Deploy Public Key
🔍 Debugger	Type Specific	
Analyzer	Machine type: Physical Device	
Version Control	Authentication type:   Password  Key	
🙀 Android	Host name: exoralterakit.local SSH port: 22	
BlackBerry	Free ports: 10000-10100 Timeout: 10s	
∋anx QNX	Username: root	
Devices	Password: Show password	
Code Pasting	Private key file: Browse Create New	
🔀 Designer	GDB server executable: Leave empty to lo	
	NO	Cancel Apply



- 6) Finally move again to "Build & Run" section, "Kits" tab. Combine all pieces together in a new kit. Click "Add" and fill in as follows:
  - Name: choose a name for the kit.
  - Device Type: select "Generic Linux Device".
  - **Device**: select the device configured in 5).
  - Sysroot: if the SDK is installed in the default location, these are the paths to select:

```
US01-kit: /opt/exorintos/2.4.2/sysroots/cortexa8hf-neon-poky-linux-gnueabi
US02-kit: /opt/exorintos/2.4.2/sysroots/cortexa9hf-neon-poky-linux-gnueabi
US03-kit: /opt/exorintos/2.4.2/sysroots/cortexa9hf-neon-poky-linux-gnueabi
NS01-kit: /opt/exorintos/2.4.2/sysroots/cortexa7hf-neon-poky-linux-gnueabi
```

- **Compiler**: select C and C++ compilers by name as configured in 1) and 2).
- **Debugger**: select debugger by name as configured in 3).
- Qt version: select qt version added in 4).

Auto-detected   Help   C++   Qt Quick   Build & Run   Debugger   Analyzer   File system name:   Version Control   Device type:   Generic Linux Device   Device:   ExorAlteraKIT (default for Generic Linux)	Add Clone Remove Make Defat
Environment         Text Editor         FakeVim         Help         C++         Qt Quick         Build & Run         Debugger         Analyzer         Yersion Control         Device type:         Generic Linux Device         Device:         ExorAlteraKIT (default for Generic Linux)	Clone Remove Make Defau
Image: Search of the system name:       Auto-detected         Image: Auto-detected       ✓ Manual         Image: Auto-detected       ✓ Auto-detected         Image: Auto-detected       ✓ Auto-detected         Image: Auto-detected       ✓ ExorAlteraKIT         Image: Auto-detected       ✓ Auto-detected         Image: Auto-detected       ✓ ExorAlteraKIT         Image: Auto-detected       ✓ Auto-detected         Image: Auto-detectected       ✓ Auto-detectectectectectectectectectectec	Clone Remove Make Defau
FakeVim   Help   C++   Q Q Quick   Debugger   Analyzer   File system name:   Version Control   Device type:   Generic Linux Device   Device:   ExorAlteraKIT (default for Generic Linux)	Remove Make Defat
Help   C++   Qt Quick   Build & Run   Debugger   Analyzer   File system name:   Version Control   Device type:   Generic Linux Device   Device:   ExorAlteraKIT (default for Generic Linux)	Make Defat
Qt Quick     Name:     ExorAlteraKIT       Debugger     Name:     ExorAlteraKIT       Analyzer     File system name:     Device type:       Version Control     Device type:     Generic Linux Device       Android     Device:     ExorAlteraKIT (default for Generic Linux)	
& Build & Run       Name:       ExorAlteraKIT         Debugger       File system name:       Device:         Version Control       Device type:       Generic Linux Device         Android       Device:       ExorAlteraKIT (default for Generic Linux)	
Debugger       Name:       ExorAlteraKIT         Analyzer       File system name:       Device type:         Version Control       Device type:       Generic Linux Device         Android       Device:       ExorAlteraKIT (default for Generic Linux)	
Analyzer       File system name:         Version Control       Device type:         Generic Linux Device         Device:       ExorAlteraKIT (default for Generic Linux)	
Version Control     Device type:     Generic Linux Device       Android     Device:     ExorAlteraKIT (default for Generic Linux)	
Android Device: ExorAlteraKIT (default for Generic Linux)	
	•
BlackBerry Sysroot: /opt/poky/1.5.3/sysroots/cortexa9hf-vfp-neon-poky-linux	▼ Manage
	-gnueabi Browse
awx QNX Compiler: ExorAlteraKITGCC	▼ Manage
Devices Environment: No Changes to apply	Change
Code Pasting Debugger: ExorAlteraKITGDB	▼ Manage
Designer Qt version: Qt 4.8.5 (ExorAlteraKIT)	▼ Manage
Qt mkspec:	

#### 6.3.1 Application deploy

Before starting here, make sure QtCreator has been correctly configured for application deployment and that the development kit is reachable.

- 1) First, let's create a dummy Qt project. Select "File" -> "New File or Project..." -> "Qt Widgets Application" and click "Choose". Enter a project name, press "Next". Make sure that in the "Kit Selection" wizard dialog the SDK kit for the target is selected.
- 2) Make sure the target kit the one currently in use by checking in the menu on the left shown below:



	Project: Test Deploy: Dep Run: TestAp					
TestAation	Kit		Build			
Γ.	Desktop		Debug			
Debug	Exor-SDK		Release			
<b>A</b>						
>	🔲 🔎 Туј	pe to loca	te (Ctrl+K)	1 :	Issues	1

3) Now edit the .pro project file to add these two lines:

```
target.path = /home/root/
INSTALLS += target
```

This will define where the application will be installed on the device (/home/root)



 Finally press the green "play" button in the menu on the left or use the "Ctrl+R" shortcut. QtCreator should compile the application and an empty Qt window should appear on the device.



7 Using Expansion Plugins

X

7.1 Use PLCM01 plugin (Canbus)

## 7.1.1 Plugin connection

The Plcm01 can be plugged in every plugin connector.

If you connect the Plcm01 on the connector "Plugin 1" the system provide the Can0 interface. If you connect the Plcm01 on the connector "Plugin 2" the system provide the Can1 interface.



## 7.1.2 System configuration and Plugin use

Once connected the plugin you can power-up the development kit and wait the booting process. With the following system command you can:

• Set the can interface

```
# ip link set can0 up type can bitrate 250000
```

• Enable the can interface

# ifconfig can0 up

• Send can packet

# cansend can0 -i 0x1A5 0x01 0x23 0x45 0x67 0x89 0xAB 0xCD 0xEF





• Received can packet

# candump can0

## 7.1.3 Canbus connector (CN2)

Plcm01 is equipped with a standard male DB9 canbus connector.



## 7.2 Use PLCM04 module (RS-422/485)

## 7.2.1 Plugin connection

The Plcm04 can be plugged in every kit plugin connector.

If you connect the Plcm04 on the connector "Plugin 1" the system provide the ttyS1 interface. If you connect the Plcm04 on the connector "Plugin 2" the system provide the ttyS2 interface.







#### 7.2.2 System configuration and Plugin use

Once connected the plugin you can power-up the development kit and wait the booting process. The system is just configured to use this module, and you can read/write on the serial port.

#### 7.2.3 Exaple C code

Here a simple example writed in C:

```
#include <stdio.h>
#include <stdlib.h>
#include <sys/ioctl.h>
#include <sys/stat.h>
#include <fcntl.h>
#include <unistd.h>
#include <linux/serial.h>
#include <asm-generic/termbits.h>
#include <string.h>
#include <signal.h>
/* Driver-specific ioctls: */
#define TIOCGRS485 0x542E
#define TIOCSRS485 0x542F
#define MSG_LENGTH 255
#define HELLO WORLD "Hello from Exor uS02 kit\n"
#define SERIAL_PORT_PLUGIN_1 "/dev/ttyS1"
#define SERIAL PORT PLUGIN 2 "/dev/ttyS2"
/*
* SELECT USED PORT
*/
#define SERIAL PORT SERIAL PORT PLUGIN 2
int main(int argc, char const *argv[])
Ł
    int i, fd, ret=0;
```



```
struct serial_rs485 rs485conf;
unsigned char b[MSG LENGTH], c[MSG LENGTH];
fprintf(stdout, "Start!\n");
fprintf(stdout, "Open open port %s...!", SERIAL_PORT);
fd = open(SERIAL_PORT, O_RDWR);
if (fd < 0) {
    perror ("Open device failure");
    return -1;
ł
fprintf(stdout, " done!\n");
fprintf(stdout, "Enable RS485 mode...");
if (ioctl(fd, TIOCGRS485, &rs485conf) < 0) {
    perror ("ioctl failure");</pre>
    return -2;
}
rs485conf.flags = SER RS485 ENABLED | SER RS485 RTS ON SEND;
if (ioctl(fd, TIOCSRS485, &rs485conf) < 0) {
    perror ("ioctl failure");</pre>
    return -3;
3
fprintf(stdout, " done!\n");
//Set custom or std baudrate
struct termios2 tio;
ioctl(fd, TCGETS2, &tio);
tio.c_cflag &= ~CBAUD;
tio.c_cflag |= BOTHER;
tio.c_ispeed = 115200;
tio.c_ospeed = 115200;
ioctl (fd, TCSETS2, &tio);
write(fd, HELLO_WORLD, strlen(HELLO_WORLD));
while(strncmp(b, "exit", 4))
{
     fprintf(stdout, "Waiting data on %s \n", SERIAL PORT);
    memset(b, 0, sizeof(b));
    ret = read(fd, b, sizeof(b));
    printf("Data received: %s\n", b );
    strcpy(c, "uS02 send: \t");
    strcat(c, b);
    write(fd, c, strlen(c));
    printf("Data sendend: s\n", c );
}
fprintf(stdout, "Close fd...");
if (close (fd) < 0) {</pre>
    perror ("Close device failure");
    return -4;
ł
fprintf(stdout, "done!\n");
fprintf(stdout, "Stop!\n");
return 0;
```

## 7.2.4 RS485 connector (CN2)

}

Plcm04 is equipped with a standard male DB9 connector.





## 7.3 Use PLCM05 module (Expansion module)

X

The Plcm05 is a simple plugin build to simplify the connections, and use various interfaces.



## 7.3.1 SPI Plugin connection

The Plcm05 can be plugged in every development kit plugin connector. If you connect the Plcm05 on the connector "Plugin 1" the system provide the spidev0.1 interface. If you connect the Plcm05 on the connector "Plugin 2" the system provide the spidev1.1 interface.



#### 7.3.2 SPI System configuration and plugin use

Once connected the plugin you can power-up the development kit and wait the booting process. The system is just configured to use this module, and you can read/write on the SPI port.

#### 7.3.3 SPI Example C code

X

Here a simple example writed in C:

```
#include <stdio.h>
#include <stdlib.h>
#include <stdint.h>
#include <string.h>
#include <errno.h>
#include <fcntl.h>
#include <linux/spi/spidev.h>
#include <stdio.h>
#include <sys/ioctl.h>
#define MSG LENGTH 2
#define SPI_PORT_PLUGIN_1 "/dev/spidev0.1"
#define SPI_PORT_PLUGIN_2 "/dev/spidev1.1"
/*
* SELECT USED PORT
*/
#define SPI_PORT SPI_PORT_PLUGIN_1
static void writeSPI(unsigned char buf[2])
£
    int fd;
   unsigned char swap_buf[2];
    char name[20];
    struct spi ioc transfer xfer[2];
    sprintf( name, SPI_PORT );
    //fprintf(stdout,"writeSPI on %s \n ", name );
    fd = open(name, O RDWR);
    if (fd < 0) {
       perror("Open");
        return;
    }
    memset(xfer, 0, sizeof xfer);
   memset(swap_buf, 0, sizeof swap_buf);
    swap_buf[0] = buf[1];
    swap_buf[1] = buf[0];
    xfer[0].tx_buf = (unsigned long)swap_buf;
    xfer[0].len = 2;
    ioctl(fd, SPI_IOC_MESSAGE(2), xfer);
    close(fd);
}
static void readSPI(unsigned char buf[2])
£
    int fd;
   unsigned char swap_buf[2];
    char name[20];
    struct spi_ioc_transfer xfer[2];
    sprintf( name, SPI PORT );
    //fprintf(stdout,"readSPI on %s \n ", name );
    fd = open(name, O_RDWR);
    if (fd < 0) {
    perror("Open");</pre>
        return;
    }
    memset(xfer, 0, sizeof xfer);
    memset(swap buf, 0, sizeof swap buf);
    swap_buf[0] = buf[1];
```



```
swap_buf[1] = buf[0];
xfer[0].tx_buf = (unsigned long)swap_buf;
      xfer[0].len = 1;
xfer[1].rx_buf = (unsigned long) buf;
xfer[1].len = 1;
ioctl(fd, SPI_IOC_MESSAGE(2), xfer);
      close(fd);
}
int main(int argc, char const *argv[])
Ł
      int i;
      unsigned char b[MSG_LENGTH];
      for(i=0; i<0xFFFF; i++)</pre>
      £
            memset( b, 0, sizeof(b) );
b[1] = ((unsigned char) ((i & 0xFF00) >> 8));
b[0] = ((unsigned char) ((i & 0x00FF) >> 0));
            writeSPI( b );
            usleep(100000);
      }
      exit(0);
}
```

X



7.3.4 CN4 Connector

X







## 8 Upgrade FPGA firmware (us02-kit only)

Power up the uS02 kit and block the boot process during u-boot countdown by pressing CTRL-C.

```
U-Boot 2015.02.17 (Aug 21 2016 - 12:28:46)
CPU
      : Altera SOCFPGA Platform
BOARD : Altera SOCFPGA Cyclone V Board
I2C:
      ready
DRAM: 1 GiB
MMC:
       initializing dwmmc...
initializing ultisdc...
ALTERA DWMMC: 0, ultisdc: 1
In:
       serial
Out:
      serial
Err:
      serial
Loading configuration from I2C SEEPROM
bootargs environment variable set to "setenv bootargs console=ttyS0,115200 roo
Hit any key to stop autoboot:
                               0
SOCFPGA CYCLONE5 #
```

Type the following commands:

# mw.l ff210010 7fe
# run bootcmd

Now wait the booting process and in Linux terminal type:

# dd if=path\_to\_new\_fpga\_image.bin of=/dev/mtdblock0 bs=1M

After few minutes the command ends, for use new FPGA firmware power-off and power-on the board.



## 9 JMobile Portable runtime

X

JMobile is a software suite designed to offer a complete HMI solution with client-server architecture. It is made of several software components, integrated into a unique application. JMobile applies the latest available technology developed for HMI in industrial automation to every situation where a user interface is required. The suite includes commissioning tools, to allow easy maintenance and configuration of multiple remote units, and both desktop and runtime engineering software for application development.

The portable version of JMobile is a standard Linux JMobile runtime provided as a chroot-based container designed to run under Linux 32bit ARM platforms.

The portable JMobile runtime is provided for rapid prototyping and evaluation purposes and contains a subset (Codesys V3/, Modbus and the internal variables protocol) of the available protocols. In particular serial protocols are not supported, the serial port on the evaluation kits is only meant for debugging purpose.

A closer integration with the final target system and access to the complete set of protocols can be achieved on demand during the product engineering phase.

#### 9.1 JMobile portable runtime installation

By default JMobile in preinstalled on both the standard SD image and the rootfs generated by our standard Yocto recipes. In this case a JMobile icon can be seen on the desktop that can be used to manually start it.

The portable can however also be downloaded separately from here:

http://download.exorembedded.net:8080/Public/OpenHMI/

Then to install and run it from ssh follow these steps:

1. Copy it into the kit.

\$ scp jmobile-[...]-portable-devkit.tar.gz root@[hostname]:~

2. Connect to the kit:

\$ ssh root@[hostname]

3. Now, from the remote shell, untar the package in a folder with write permissions (e.g. /opt)

\$ tar xzpf jmobile-[...]-portable-devkit.tar.gz /opt
\$ rm -rf jmobile-[...]-portable-devkit.tar.gz

4. Make sure X11 is not running:

# /etc/init.d/xserver-nodm stop

5. Start JMobile:

# /opt/jmobile\_portable/run.sh





In both cases it's possible to configure the BSP to automatically start JMobile Runtime at boot:

1) Remove the script xserver-nodm:

```
# update-rc.d -f xserver-nodm remove
```

2) Add a new script to the init sequence:

```
# echo "/opt/jmobile_portable/run.sh &" > /etc/init.d/jmobile
# chmod a+x /etc/init.d/jmobile
# update-rc.d jmobile defaults 99
```

#### 9.2 JMobile OpenHMI Studio quick start guide

To download a free trial of OpenHMI Suite go to our web page dedicated to development kits on exorint.com:

```
https://exorint.com/product-category/embedded/dev-kits/
```

Select the device you are working with then, from the "Download" section, download the latest version of OpenHMI Suite. After installation, start OpenHMI Studio and create a new project from "File" -> "New..":

OpenHMI Studio     File Edit Run Format View Window Help     PojectView     ■ X     PojectView     ■ X     + - = = ∧ ✓		- 다 X Properties · · X (아이이이이) 유민 유민 · · · · · · · · · · · · · · · · ·
NT The Cross Reference	Project Waard     Project Nime:     Project Nime:	
Ready	id: Page1 x: 0 y: 0	w: 800 h: 480

Chose a project name, select a location folder and click on "Next". Select now the correct target corresponding to the board:



Ø OpenHMI Studio           File         Edit         Run         Format         View         Window         Help           Image: I		- 🗆 X
Projective ■ X + - 但 × ▼ 100 Cross Redounce Ready	Project Witard         Project Size: 60 HB (max)         Project Witard         Project Witard	Properties • × × • • • • • • • • • • • • • • • •

The goal is to create a project simply consisting of an increasing numerical counter. Although at the end it won't do very much, this example project will introduce you to some of the basic mechanics JMobile uses to combine protocols, data and visualization.

To begin with, from the "ProjectView" on the left panel, click on "Protocols". Here click "+" to add a new protocol and select "Variables" as shown in the figure below:

File Edit Run Format View Wind	dow Help				
🗄 🗅 😂 🗟 🗊 🗼 🖻 🗶 🕹 🔗 💐	🕯 💽 📎 I 🛲 🏾 📲 🔛 🖉 💽 🖢	ເລ ລ Lang1 🔹	÷		
ProjectView 📮 🗙	1:Page1 Protocols x				- 🔍
	+ - ^ ~   🗊				W
Project 3	PLC	Configuration		Dictionaries	Enable Offline Alc
Project properties	▶ Variables:prot1	CfgVer=1	1	lone available	
Pages					ery
→ 1 : Page1					
Templates					
a → Templates → Web → Pages → Templates → Dialogs					
Templates					
Dialogs					
Config					
Protocols					
⊕ 🗎 Tags					
Trends					
- 🖶 Reports					
- 🔔 Alarms					
Events Buffer					
- Scheduler					
🎭 MultiLanguage					
- Screen Saver					
🕂 🖳 Database Link 🗸	<				>
	<b>`</b>				
Ready					

Use the left panel to move to "Tags". Press "+" and add an unsignedShort tag named "Tag1" representing our counter.



ProjectView 📮 🗙	1:Page1 Protocols	Tags* 🗙				-
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Reports						
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- Scheduler						
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Screen Saver						

Add a numeric field widget to the project's page by dragging it from the Widget Gallery:

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Double click on the numeric filed and select "Tag1" to bind the widget to the tag's value:

X


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Tag & Scale XForms Source: Tag Alias System Widget Recipe			
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Read Only      Read/Write      Write Only Items used: 1/10000	TagIndex:	0	•
Ready			
reay .			

Now move to "Scheduler". Add a HighResolution scheduler with a "StepTag" action to increment the counter. Note in the figure below that our tag has been selected for "TagName" under "Action Properties":

File Edit Run Format View	Window Help ✔ ≹ ③ ℕ   == ☜ 📮   😤 ④	🖉 📑 😭 🦳 🖓 🕴 Lang1 🔹 📮		
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Conig	tion List + - ^ >	Action  MultiLanguage  SetLanguage  Tag  DataTransfer  ToggleBit  SetBit  ResetBit  WriteTag  StepTag  ActivateGroup  DeactivateGroup  DeactivateGroup  ActivateGroup  DeactivateGroup  DeactivateGroup  ActivateGroup  DeactivateGroup  DeactivateG	Action Propertie StepTag TagName Step Do not step StepLimit	Project:_TagMgr;Tag1;Tag 1

Click on the "Download to Target" icon in the toolbar or simply press Ctrl+D. Make sure the development kit is powered on, that you can reach it over the network and that JMobile Runtime is running. Select the target from the drop-down list and click "Download" to deploy the project:



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+ - 4       ∧ ∨         → Project3       →         → Project properties       →         → Pages       →         → 1 : Page1       →	Lame Type Schedule Action <sup>&gt;</sup> riority hedule HighResolution Every 100 msec StepTag Mediu	Widget Gallery
Config Config	Download to Target     ×       Ready to download     I0 · 10 · 207 V       I · Advanced	
Scheduler		

If the JMobile Runtime on the device is found to be an older version the Studio will automatically update it before downloading the project.

The portable version of JMobile uses non standard ports for FTP and HTTP protocols in order to avoid conflicts with other services on the host device:

FTP port: 2525 HTTP port: 8585

From the OpenHMI Studio nothing needs to be configured as long the device is selected form the target list the correct ports will be used. However when accessing a JM4Web html project page from a browser, the http port needs to be specified in the url bar:

http://<target-IP>:8585





# 10 CODESYS V3

The CODESYS V3 programming software can be downloaded for free from the CODESYS web site at <u>www.codesys.com/download.html</u>.

You will need to register before you can download the software. The version used in this chapter is CODESYS v3.5 SP10 Patch 5.

## 10.1 Enabling CODESYS runtime

The Codesys runtime is included inside the JMobile portable but to make it start it's required to enable it first. To do this all it's required to do is to create a specific file from a ssh shell:

```
# touch /opt/jmobile_portable/mnt/data/hmi/qthmi/codesys_auto
# sync
```

This is assuming the portable is installed in /opt/jmobile\_portable. After rebooting the device Codesys will automatically start with JMobile Runtime.

## 10.2 Installing CODESYS Devices

A device descriptor is required to allow the standard CODESYS V3 to work with the evaluation kits. This is provided inside a Codesys .package file that can be found inside OpenHMI Studio installation directory:

```
C:\Program Files (x86)\Exor\OpenHMI Suite 2.8\CODESYS\V3\CODESYS_JMobile_[...].package
```

This file can be imported from the CODESYS programming software. Select "Tools" -> "Package Manager..." from the toolbar, the below dialog should appear:

Currently installed packages:						
Refresh			Sort by:	Name	~	Install
Name	Version	Installation date	Update info		License	Uninstall
CODESYS SoftMotion	4.2.1.1	6/4/2018	Free version 4.3.2.0	) available!	No licens	Details
						Updates
						Search updates
						Download
						CODESYS Store
						Rating
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້ ີ Display versions      ∕ Search ເ						Close

Click on the "Install..." button and browse for the package file. The choice can be confirmed with "Open". Finally select "Typical Setup" and continue trough the guided installation until completed.



### 10.3 Creation of a new PLC project

X

To create a new CODESYS V3 project select "File" > "New Project" or click on the corresponding icon from the upper tool bar. The "New Project" dialog will be displayed, here, among the available templates, select the "Standard project" template. Choose a project name and a location then confirm with "OK".

Categories	:	Templates:			
	raries ojects	Empty project	eTOP500 project	Standard project	Standard project w
A project co	ontaining one device, on	e application, and an e	mpty implemer	ntation for PLC	PRG
Name:	Demo_Project				
Location:	C:\Users\user\Desktop				▼
				OK	Cancel

There are two different device descriptors for the development kits. The one to choose depends on whether the hardware does have an FRAM or not:

US02-kit, US03-kit, NS01-kit	DevKit(FRAM)
US01-kit, NS01-kit-OpenHMI	DevKit(no FRAM)

To complete the project creation, select the one of the two devices above and the preferred programming language of choice.

Standard Pr	roject		×		
You are about to create a new standard project. This wizard will create the followin objects within this project: - One programmable device as specified below - A program PLC_PRG in the language specified below - A cyclic task which calls PLC_PRG - A reference to the newest version of the Standard library currently installed.					
	Device: PLC_PRG in:	DevKit (FRAM) (Exor International S.p.A.) Structured Text (ST) OK Cancel	>		

#### 10.4 Communication setup in the CODESYS software

The selection of the target where to download the project must be done from the device communication settings tab before proceeding with the download operation.

Double click on the "Device (DevKit ...)" node available in the project tree to display the Device properties in the work area, select the "Communication Settings" tab then click on the "Scan Network..." button.





The "Select Device" dialog will be displayed, this dialog lists all the compatible devices available in the network, select here your device then press on "OK".

In case more panels using CODESYS V3 PLC runtime are present into the network each panel can be recognized by the string between square brackets shown just after the device name. In the figure below, for example, the string is "0000.392B" for the highlight device. The last part of the string "392B" corresponds to the last 2 bytes of the panel IP Address in Hex format so, in this case, the corresponding operator panel is the one with IP address xxx.xxx.57.43 as 39Hex corresponds to 57 Dec and 2B Hex corresponds to 43 Dec.

Select Device	×
Select the network path to the controller:	
Select the network path to the controller:	
OK Cancel	

The selected device is then listed in the Communication Settings as shown below. the device properties are listed on screen. A green dot over the device graphical representation informs that the device is correctly recognized and available on the network.

100,000,000			
Gateway-1	~	[0000.392B] (active)	~
IP-Address: localhost		Device Name: Exor DevKit	
Port: 1217		Device Address: 0000.392B	
		Target ID: 10A3 0005	
		Target Type: 4096	
		Target Vendor: EXOR International S.p.A.	
		Target Version: 3.5.10.50	
	Gateway-1 IP-Address: localhost Port:	Gateway-1 ~ IP-Address: localhost Port:	Gateway-1 Gateway-1 IP-Address: localhost Port: 1217 Device Name: Exor DevKit Device Address: 0000.392B Target ID: 10A3 0005 Target Type: 4096 Target Vendor: EXOR International S.p.A. Target Version:





Communication with the available devices is established through a Gateway, a default Gateway is available, and it is generally not needed to change the standard Gateway settings. For more information about the Gateway set-up please refer to CODESYS V3 documentation.





## 11 Accessing PLC from JMobile

JMobile and CODESYS projects discussed in this section are included in the "JMobile\_CDS\_demo" folder from the demo projects package "Demo\_Projects.zip", downloadable from exorembedded.net (Products > Development Kits).

The JMobile Portable contains also a demo version of CODESYS v3 runtime which is started along with JMobile runtime. Here is presented an example in wich JMobile will be able to access variable values from the PLC.

## 11.1 Codesys project creation

First of all we need to create a simple Codesys program. Assuming a configured project has already been created on CODESYS v3 and that the Development kit is properly connected we can write these few lines of code inside the PLC\_PRG file:



Now right click on "Application" and select "Add Object > System configuration":







Double click on the newly created "Symbol configuration" object and from the opening tab click "Build". Make sure to check at least the PLC\_PRG symbols which contains our iCounter variable:





Demo\_Project.project\* - CODESYS

Eile Edit View Project Build Online Debug Tools Window Help	ă <b> 0\$ 0\$ →                                </b>
Devices       ▼       ₽       ×         Image: Device (DevKit (FRAM))       Image: Device (DevKit (FRAM))       Image: Device (DevKit (FRAM))         Image: Device (DevKit (FRAM))       Image: Device (DevKit (FRAM))       Image: Device (DevKit (FRAM))         Image: Device (DevKit (FRAM))       Image: Device (DevKit (FRAM))       Image: Device (DevKit (FRAM))         Image: Device (DevKit (FRAM))       Image: Device (DevKit (FRAM))       Image: Device (DevKit (FRAM))         Image: Device (DevKit (DevKit (FRAM))       Image: Device (DevKit (DevKit (FRAM))       Image: Device (DevKit (	PLC_PRG       Symbol Configuration ×         Niew        Build       Settings < Tools          There are 2 configured variables which are not referenced by the IEC code.         Changed symbol configuration will be transferred with the next download or or         Symbols       Access Rights         Maximal       Attribute         Image: Constants       Image: Constants         Image: Constants       Image: Constants <t< th=""></t<>

In the main toolbar click on "Build > Generate code" to create, among other files, an xml file that we will later use to import PLC variables on JMobile.

Now from the main toolbar choose "Online" -> "Login" to deploy the program on the device. If you get a warning about an existing program on the PLC click OK to overwrite it with the new one.

Lastly, to run the program on the PLC, right click on Application and choose "Start":



Demo_Project.project* - CODES	SYS
<u>File E</u> dit <u>V</u> iew <u>P</u> roject <u>B</u> uild	<u>O</u> nline <u>D</u> ebug <u>T</u> ools <u>W</u> indow <u>H</u> elp
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Devices	<b>▼</b> ₽
Demo_Project	
🖹 🤣 💷 Device [connected] (De	evKit (FRAM))
PLC Logic	
Application	Cut
Symbol (	
Task Cor X	
🖻 🎲 Main	Delete
<b>B</b>	Browse
	Refactoring
6	Properties
***	Add Object 🕨
<b></b>	Add Folder
D.	Edit Object
	Edit Object With
¢,	Logout
•	Start
	Online Change
	Delete application from device

To keep PLC project on CPU also after a reboot, once the device is online, click on "Online > Create boot project".

## 11.2 CDS3 protocol configuration on JMobile

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On the OpenHMI Studio create a project for the target Development Kit. Select "Protocols" from the Project View on the left, click on the "+" button and select "CODESYS V3 ETH".



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ObjectView	Pages		A-B DF1	
	1: Page1		A-B DH-485	
	- 🦳 Dialogs		A-B ENET BACnet	
24	Templates		Baldor NextMove	
	🖂 🗁 Web		Beckhoff ADS	
Tag			CANopen HMI	
Cross	Pages		CODESYS V2 ETH CODESYS V2 SER	
sso			CODESTS V2 SER	
	Dialogs		CT Modbus CMP ETH	
efe	🚊 🗁 Config		EIA Modbus TCP	
Reference	Protocols		Ethemet/IP CIP Fatek FACON ETH	
ĉe	🚛 🖷 Tags		Fatek FACON ETH	
	Trends		GE Intelligent Platforms SNP	
	Reports		GE Intelligent Platforms SRTP	
			GE SRTP	
	Alarms		Hitachi ETH Hitachi SER	
	Events Buffer		iPLC CODESYS	
	Scheduler		Jetter Ext ETH	
	MultiLanguage		Keyence KV	
	Screen Saver		KNX TP/IP	
	🖳 🖳 Database Links		Koyo DL Koyo DL ETH	
	Data transfers		Lenze CANopen	
			Mitsubishi FX ETH	
			Mitsubishi FX SER	
	🗄 🔓 AuditTrail		Mitsubishi Q/L ETH	

Configure the protocol as shown in the figure below, then click "OK".

CODESYS V3 ETH		×
PLC Network		ОК
Alias		Cancel
IP address	127 . 0 . 0 . 1	
Timeout (ms)	1000	
Full node address		
Variable list count	10	
PLC Models		
CODESYS 3		

**Note** that with the above configuration JMobile Runtime will look for Codesys connection on the localhost. This will work only when the project is running on the Development kit. To connect remotely you can enter the Development kit network interface IP instead of 127.0.0.1.

Now, to import tags from our Codesys project, select "Tags" from the Project View. Here you have to:

1. Select "CODESYS V3 ETH:prot1" as protocol.



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24			
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90	Pages		
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Tag Cross Reference*	🖕 🗁 Config		
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°e*	🗼 📄 Tags		
	- 🚔 Reports	1	

2. Click on the "Import Tags" button 2. Choose "CodeSys3 v1.0", "Linear" type as tag importer, click "OK" and then browse and select the xml file you will find in the Codesys project folder created before.

The name of this file should be something like "<project\_name>.Device.Application.xml".

3. From the lower section of the "Tags" tab select the variable "Application/PLC\_PRG/iCounter" and click on the Import Tag(s)" button



Lastly, on a project page, add a numeric label widget, right click on it and choose "Attach to..". Here select the Codesys tag and click "OK".



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₽- Search			<ul> <li>Protocol: S</li> </ul>	Show all 🔹	Show all tags	
Data	Туре	Tag name		Property	Value	
CODESYS V3 ETH:prot1	Container			⊿ Driver		
Model: CODESYS 3				Model	CODESYS 3	:
Application/PLC_PRG/iCour	nter unsignedSho	rt Application/PLC_PRG/iCounter		. Protocol	CODESYS V3 ETH:prot1	
				⊿ Tag		_
				Active	false	
				Data Type	unsignedShort	
				Default value		
				Description		
				Encoding		
				Groups		
				Max value		

Once you have downloaded the project to the Development kit, if the PLC program is running, you should see the Codesys "iCounter" variable being incremented.







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