

# Developer Manual openPOWERLINK Development Kit

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system house for distributed automation

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	EUROPE	NORTH AMERICA
Address:	SYS TEC electronic GmbH August-Bebel-Str. 29 D-07973 Greiz GERMANY	PHYTEC America LLC 203 Parfitt Way SW, Suite G100 Bainbridge Island, WA 98110 USA
Ordering Information :	+49 (3661) 6279-0 info@systec-electronic.com	1 (800) 278-9913 info@phytec.com
Technical Support:	+49 (3661) 6279-0 <u>support@systec-electronic.com</u>	1 (800) 278-9913 <u>support@phytec.com</u>
Fax:	+49 (3661) 62 79 99	1 (206) 780-9135
Web Site:	http://www.systec-electronic.com	http://www.phytec.com

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#### **1** Document Overview

The document on hand describes the commissioning of the openPOWERLINK Development Kit on the basis of the Development Kit ECUcore-5484 as well as the existent openPOWERLINK demo application.

Initially, **section 4** of this document deals with the **commissioning and configuration** of the openPOWERLINK Development Kit on the basis of the Development Kit ECUcore-5484.

In section 5 the usage of the ECUcore-5484 is described, including the login to the system as well as the configuration of the file system.

The **Ethernet POWERLINK functionality** of the ECUcore-5484 is defined in chapter 6.

In section 7 the diagnostics tool Wireshark is explained.

**Section 8** offers a first introduction to the demo application of the ECUcore-5484.

For more information about the openPOWERLINK Protocol Stack please refer to the manuals L-1108 "Introduction into openPOWERLINK Protocol Stack" and L-1098 "Software Manual openPOWERLINK Protocol Stack".

# 2 Scope of Delivery



Figure 1: Scope of Delivery

The openPOWERLINK Development Kit consist of the following parts.

Quantum	Part
1	Development Kit ECUcore-5484 as Controlled Node
1	openPOWERLINK Live-CD for X86 processors with Realtek RTL8139 network card as Managing Node.
2	Network cable CAT 5e
1	RS-232 cable for configuration and debugging of ECUcore- 5484
1	Power supply 12 VDC, 1.5 A
1	Documentation

Table 1:Scope of Delivery

# 3 Basic Setup

#### 3.1 Requirements

Using this Development Kit requires a personal computer with

- X86 compatible processor with 1 GHz or higher
- at least 256 MB RAM
- optionally at least 5 GB free space on hard disk for VMware appliance with development environment for ECUcore-5484
- DVD-ROM drive and
- Realtek RTL8139 network controller, e.g.
  - o Zyxel FN312
  - o Netgear FA311 v2 Rev-D1
  - D-Link DFE-528TX

# 3.2 Step by Step Instructions

These steps lead you to your own POWERLINK network within a few minutes.

- 1. Connect the network cable to the RJ45 jack named "EPL1" of the Developmentboard ECUcore-5484 and the RJ45 jack of the Realtek RTL8139 network controller.
- Ensure that the HEX switches for the node-ID on the Developmentboard ECUcore-5484 are set correctly (S307 = '0', S306 = '1');
- 3. Connect power supply (24 VDC, 1 A) to the Developmentboard ECUcore-5484 (connector X700).
- 4. Switch on and boot the personal computer from the openPOWERLINK Live-CD and wait until the welcome screen appears.
- 5. Start the POWERLINK demo application on the personal computer (e.g. via the icon on the destop).
- 6. Click on the button "Start EPL Stack"

- 7. When the POWERLINK network has entered NMT state OPERATIONAL, you can enjoy a running light on your personal computer and the LEDs on the Developmentboard ECUcore-5484.
- 8. Press the buttons on the Developmentboard ECUcore-5484 to change the direction and mode of the running light.

# 4 Commissioning of the Development Kit ECUcore-5484

# 4.1 Electrical Connections

The wall power supply and the Ethernet- and RS232 cables which are necessary for operating the Development Kit ECUcore-5484 are included in the delivery. All connections listed in the table below are the minimum connections to start the Kit.

Connection	Marking on the Demoboard	Remark
Supply voltage	X700 or X701	The wall power supply included in the delivery is intended for direct connection to X700
Ethernet (ETH0)	X500	Interface which facilitates communication to the development system
Ethernet (EPL1)	X501	Interface to the POWERLINK network (is connected to EPL2 via a Hub)
Ethernet (EPL2)	X502	Interface to the POWERLINK network (is connected to EPL1 via a Hub)
RS232 (COM0)	X400 / top	Interface which only allows configuration of the subassembly (e.g. setting the IP-Address) and is not necessary during normal operation
CAN (CAN0)	X400 / bottom	CAN-cable is an optional accessory and is not included in the Kit delivery contents

Table 2: Connections of the Development Kit ECUcore-5484

Figure 2 shows the position of all connections on the baseboard of the Development Kit ECUcore-5484. The power

supply for the Kit may optionally as well run over X701 with an external source of 9VDC to 24VDC with 12W at minimum.



Figure 2: Position of the connections on the baseboard of the Development Kit ECUcore-5484

Advice: For correct commissioning, the Ethernet and RS232 cables have to be connected prior to activating the supply voltage.

# 4.2 Jumper Configuration

All jumpers on the baseboard must be configurated as follows:

Jumper	Setting	Remark
JP505	2-3	Important for Ethernet POWERLINK
JP506	2-3	Important for Ethernet POWERLINK

Table 3:	Jumper configuration
----------	----------------------

#### 4.3 Configuration of the ECUcore-5484

The configuration of the ECUcore-5484 takes place via a serial interface at a computer. Therefore, any kind of terminal program must be started on the computer (e.g. HyperTerminal, TeraTerm, ...) and configuration steps must be taken as follows (also compare picture 2):

- 19200 Baud
- 8 Data-bit
- 1 Stop-bit
- no parity
- no flow control

Tera Term: Serial port setup				
<u>P</u> ort: Roud rate:	COM2 -	ОК		
<u>D</u> ata:	8 bit -	Cancel		
P <u>a</u> rity:	none 🔻	Help		
<u>s</u> top. <u>F</u> low control:				
Transmit delay 0 msec/ <u>c</u> har 0 msec/ <u>l</u> ine				

Figure 3: Terminal configuration

For configurating the ECUcore-5484, the DIP-switch 2 on the ECUcore-5484 must first be set to position "Off" (see Figure 4).



Figure 4: Position of the DIP-switch 2 on the ECUcore-5484

After operating the Reset-pushbutton (pushbutton S303), the Linux-Bootloader "CoLilo" prints its prompt "colilo>".

By entering "?" at the "CoLilo" command prompt, assistance about all available commands is offered and the current module configuration is shown (see Figure 5).

🂐 COM1:19200baud - Tera Term VT		- O ×
<u>File Edit Setup Control Window Help</u>		
Default values for paranaters: doun_addr: source_addr: dest_addr: flash_addr: flash_addr: size: dounloadPort: dounloadBaud: kernel connand line defined by user: kernel connand line passed to linux: kernel inage in flash: start booting autonaticaly:	c2000000 feD40000 c0001000 c0002000 fe040000 334a2f 0 19200 root=/dev/ran root=/dev/ran sercon=tty50,19200 yes	*
Current TCP/IP configuration: Board MRC: Board IP: Board Gateway: Board Broadcast: Board Metnask: TFTP server: Inage name:	00:50:C2:39:33:E2 192.168.10.248 0.0.0.0 192.168.10.255 255.255.255.0 192.168.10.58 Inage.bin.gz	
For more board specific information use the 'bo	ardinfo' command	-

Figure 5: Display of the module configuration in "CoLilo"

The configuration of the ECUcore-5484 takes place at the "CoLilo" command prompt, using the commands listed in Table 4.

Configuration	command	Remark
MAC-address of the ECUcore- 5484	set mac <xx:xx:xx:xx:xx:xx></xx:xx:xx:xx:xx:xx>	The MAC-address is a well- defined module worldwide identification which is assigned by the producer. It should not be modified by the user.
IP-address of the ECUcore- 5484	set ip <xxx.xxx.xxx.xxx></xxx.xxx.xxx.xxx>	This command sets the local IP-address of the ECUcore- 5484. The IP-address is determined by the network administrator.
Net mask	set netmask <xxx.xxx.xxx.xxx></xxx.xxx.xxx.xxx>	This command configures the net mask of the ECUcore-5484. The net mask is set by the network administrator.

Gateway-	set gw	This command defines the
address	<xxx.xxx.xxx.xxx></xxx.xxx.xxx.xxx>	IP-address of the gateway to be used by the ECUcore-
		5484. This Gateway-address
		network administrator.
		Advice: If ECUcore-5484
		and development system
		are located in the exact same sub net, the definition
		of the Gateway-address can
		be left out and "0.0.0.0" can

Table 4:"CoLilo" commands for configurating the ECUcore-5484

Modified configurations can again be verified at the "CoLilo" command prompt by entering "?". Current configurations are permanently saved in the flash of the ECUcore-5484 by entering the command

config save

The modifications are adopted after resetting the ECUcore-5484.

# To restart the Linux of the ECUcore-5484 after finishing the configurations, the DIP-switch 2 on the ECUcore-5484 is to be put back into position "On" (compare Figure 4).

After pressing the reset-button (reset S303), Linux starts with the current configuration.

# 5 How to use the ECUcore-5484

#### 5.1 Logging on to the System

The ECUcore-5484 is delivered with preinstalled Embedded Linux. After booting up the system, the user may log in as "PlcAdmin" with password "Plc123". Accessing the system is possible via the serial interface (COM0) on the baseboard of the Development Kit ECUcore-5484 which was used for the configuration already. It is essential to use the settings of the serial connection which were described in section 4.3 (19200 Baud, 8 Data-bits, 1 Stop-bit, no parity, no flow control).

As alternative solution to the serial interface, the access to the ECUcore-5484 is as well possible over the Ethernet interface ETH0 (see Figure 2) using a Telnet-Client. The standard Windows Client may be used to log on to the ECUcore-5484. Therefore, the command "telnet" must be called at the IP-address for the ECUcore-5484 determined in chapter 2.3, e.g.

telnet 192.168.10.244



Figure 6: Access to the ECUcore-5484 via Telnet

Figure 6 illustrates the access to the ECUcore-5484 via the Telnet-Client that Windows contains as a standard feature.

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#### 5.2 File system of the ECUcore-5484

The preinstalled Embedded Linux on the ECUcore-5484 provides parts of the system memory in form of a file system. As it is common for embedded systems, most of this file system is displayed as "read/only". This implies that modifications can only be made through a rebuild of the Linux-Image for the ECUcore-5484 on the development computer. The advantage hereby is the resistance of the read/only file system against damages in connection with power supply breakdowns that occur very often in embedded systems. Embedded systems are usually switched off without completing a shutdown command afore.

Paths of the file system which are usable for the user during runtime (without rebuild of the Linux-Image for the ECUcore-5484) are listed in Table 5. If parts of the development computer are not already integrated via NFS (compare section 8.3.1), one of both RAM-Disk directories "/var" or "/tmp" should be generally used for tests during the development phase.

Path	Usable size	Description
/var	1000 kByte	RAM-Disk, well suited for the testing of programs, but no persistence in case of power supply breakdown
/mnt/mtd3	1000 - 5632 kByte depending on Linux configuration	Flash-Disk, to persistently store user programs, configuration files, etc.; data persistence in case of power supply breakdown is given
/mnt/nfs		Target for integrating remote directories of other systems via NFS, also compare section 8.3.1.
/tmp	2000 kByte	RAM-Disk, as "/var" it is well suited for the testing of programs, but no data persistence in case of power supply breakdown

Table 5:File system configuration of the ECUcore-5484

Advice: Sizes of the file system paths "/var" and "/tmp" may be modified in the start script "/etc/rc.d/rcS".

However, this calls for a rebuild of the Linux-Image for the ECUcore-5484.

Using the command "df" ("DiskFree"), it is possible to determine currently configured sizes and available sizes of file system paths. Figure 7 shows an example for the usage of this command.

🚾 Telnet 192.168.10.248						_ 🗆 ×
ECUcore-5484 login Password: sh-2.05:~# df Filesystem /dev/root tmpfs tmpfs /dev/mtdblock/3 sh-2.05:~# _	: PlcAdmin 1k-blocks 5035 8192 1024 5632	Used 5035 0 32 512	Available 0 8192 992 5120	Use% 100% 0% 3% 9%	Mounted on / /tmp /uar /home	

Figure 7: Example for the usage of command "df"

# 6 Functionality of Ethernet POWERLINK

The openPOWERLINK Development Kit upon delivery is configured, so that the openPOWERLINK demo application starts automatically when the system is booted. The following sections describe how the demo application can be configured and used.

# 6.1 Configurating the Node-ID

The node-ID, i.e. the POWERLINK address, of the ECUcore-5484 within an Ethernet POWERLINK network is configured via the HEX switches S306 and S307. S306 hereby corresponds to the low-order 4 Bit and S307 to the high-order 4 Bit of the node-ID. The address modification only takes effect after resetting the ECUcore-5484.

The node-ID 0xF0 = 240 configures the ECUcore-5484 to run as Managing Node. Otherwise it runs as Controlled Node.

#### 6.2 Connection to the Ethernet POWERLINK Network

The connection to an Ethernet POWERLINK network is possible via the RJ45 jack X501 and X502 (EPL1 and EPL2). Both jacks are connected to the Ethernet controller of the ECUcore-5484 via an Ethernet hub integrated on the baseboard. For diasgnostic purposes, it is possible to connect a computer to the integrated Ethernet hub and, for example, to monitor and store traffic of the POWERLINK network via Wireshark.

#### 6.3 Digital In- and Outputs

The pushbuttons S0 to S4 on the baseboard are linked as digital inputs in the object directory in object 0x60000 sub-index 0x01 of the type UNSIGNED8.

The LED D0 to D4 on the baseboard are linked as digital outputs in the object directory in object 0x6200 sub-index 0x01 of the type UNSIGNED8.

#### 6.4 Process Data Objects (PDO)

There is a receive PDO (PollRequest of MN) and a transmit PDO (PollResponse), each of the length 1 Byte. Object 0x6200 sub-index 0x01 is mapped in the reception PDO and object 0x6000 sub-index 0x01 in the transmit PDO.

# 7 Diagnostics Tools

#### 7.1 Wireshark

Wireshark (former Ethereal) supports the analysis of network connections. Since its version 0.99.4, Wireshark includes a dissector for POWERLINK-frames. With it, POWERLINKframes are displayed easy to understand and not only as hexdump.

Tile Edit	cn.pcap - Wire	shark antura Analuza Statistics I	telo (						
		🕷 🗁 🖾 🗙 🤅	5 <u>5</u> 9 4 4	> <b>e</b> o (	<u>ም</u> ጉ		•	Θ, Ο, 🖂	X 🗹 🔢
Eilter: Expression Clear Apply									
No.	Time	Source	Destination	Protocol	Info +				
65906 2 65907 2 65908 2 65909 2 65910 2	42.819792 42.819812 42.819834 42.824591 42.824740	BencentT_a8:64:f0 SmartNet_0a:0c:1a BencentT_a8:64:f0 BencentT_a8:64:f0 BencentT_a8:64:f0	SmartNet_Oa:Oc:1a EPLv2_PRes EPLv2_SOA EPLv2_SOC Rftnc_a8:64:01	EPL EPL EPL EPL EPL	PReq PRes SoA SoC PReq	dest = 3 dest = 25 dest = 25 dest = 25 dest =	2 (CN) 5 (bc) 5 (bc) 5 (bc) 1 (CN)	src = 240 (MN) src = 32 (CN) src = 240 (MN) src = 240 (MN) src = 240 (MN)	Noservic
65912 4 65913 4 65914 4 65915 4 65916 4 65916 4	42.824783 42.824791 42.824812 42.824839 42.829591 42.829591 42.829741	BencentT_a8:64:f0 SmartNet_0a:0c:la BencentT_a8:64:f0 BencentT_a8:64:f0 BencentT_a8:64:f0 BencentT_a8:64:01	EPLV2_PRES SmartNet_0a:Oc:1a EPLV2_PRES EPLV2_SOA EPLV2_SOA EPLV2_SOC Rftnc_a8:64:01 EPLV2_Desc	EPL EPL EPL EPL EPL EPL	PREQ PRES SOA SOC PREQ DDAC	dest = 25 dest = 25 dest = 25 dest = 25 dest = 25 dest = 25	2 (CN) 5 (bc) 5 (bc) 5 (bc) 5 (bc) 1 (CN) 5 (bc)	SFC = 240 (MN) SFC = 32 (CN) SFC = 240 (MN) SFC = 240 (MN) SFC = 240 (MN) SFC = 240 (MN)	IdentReq
E ETHERI E ETHERI Dest Sour NMTS 0 0 0 0 0 0 0 0	NET Power1 0 0100 = M tination: cce: 1 (Co Status: NM 0 = M 0 = M 0 = R 0 0 = P 000 = R version 0. 2: 1	<pre>ink v2 essageType: PollResp 255 (broadcast) ntrolled Node) T_MS_OPERATIONAL (25 5 (Multiplexed slot) N (Exception New): 0 0 (Ready): 1 R (Priority): Generi 5 (RequestToSend): 0 0</pre>	onse (PRes) (4) 3) : 0 cRequest (0)		d d				
0000 01 0010 01 0020 00 0030 00	11 1e 00 fd 01 00 00 00 00 00 00 00	00 02 00 03 C0 48 0 00 00 01 00 00 00 00 00 00 00 00 00 00 00 00 00	54 01 88 ab 04 ff 20 00 00 00 00 00 00 20 00 00 00 00 00 00 20 00		d. 				
File: "L:\alle\	Krueger\Ivon mi	selbst\EPL\test5_2cn.pcap" 728	4 KB 00:01:11	P: 9648	5 D: 9648	5 M: 0			1

Figure 8: Analysis of a PRes-frame with Wireshark

#### 7.1.1 Download and Installation

The current version of Wireshark can be downloaded at http://www.wireshark.org/. During the installation, WinPcap is installed on Microsoft Windows as well. This driver is necessary

to put the network interface card of the computer into the so called Promiscuous Mode. This mode enables the network interface card to pass through every frame received to the operating system or the application – and not only the frames that are addressed to the network interface card.

#### 7.1.2 Premises

For diagnostics using Wireshark, the computer must be connected to the POWERLINK network. Therefore, it is necessary to use an additional network interface card. Only the network monitor driver and perhaps the internet protocol (TCP/IP) are allowed to be bound to this additional network interface card. However, a permanent IP-address should be set for the internet protocol (TCP/IP), e.g. 192.168.100.245.

#### 7.1.3 Recording the Network Traffic

Recording the network traffic is relatively simple. Initially, within the menu item "Capture" -> "Options…" the appropriate network interface card must be chosen. Additionally, among "Display Options" the check boxes "Update list of packets in real time", "Automatic scrolling in live capture" and "Hide capture info dialog" may be selected.

Now, the recording is ready to be started by pressing the button "Start". By choosing the menu item "Stop" within the menu "Capture", the recording can be stopped.

# 8 **POWERLINK Demo Application**

# 8.1 Setting up the Toolchain

For development, Linux BSP for Freescale MCF548x processors is necessary – including the corresponding Toolchain. This is to be unzipped in any directory (e.g. /home/user/projects/LinuxBSP-2.6). Thereby, the Toolchain is located beneath Linux BSP in the directory toolchain (e.g. /home/user/projects/LinuxBSP-2.6/toolchain).

The following environment variables must be set within the shell used. Therefore, the following lines can be inserted into, for example, the file "~/.bashrc". The variable M68K\_LINUX\_BSP\_PATH must be adjusted appropriately.

```
M68K_LINUX_BSP_PATH=/home/user/projects/LinuxBSP-2.6
M68K_LINUX_KDIR_PATH=$M68K_LINUX_BSP_PATH/linux-2.6.10
M68K_CC_PREFIX=$M68K_LINUX_BSP_PATH/toolchain/bin/m68k-
linux-gnu-
M68K_CFLAGS=-malign-int
M68K_LD_LIBRARY_PATH=
```

export M68K\_LINUX\_BSP\_PATH export M68K\_LINUX\_KDIR\_PATH export M68K\_CC\_PREFIX export M68K\_CFLAGS export M68K\_LD\_LIBRARY\_PATH

The following steps are necessary for the first initialization:

```
cd $M68K_LINUX_BSP_PATH
make fresh
make menuconfig
make
```

Since the standard configuration can be adopted, all three appearing dialogs are to be left via "Exit" and each storing of the configuration is to be confirmed with "Yes". Afterwards, the Toolchain is ready for operation.

### 8.2 Building the POWERLINK Demo Application

The openPOWERLINK Stack contains demo projects for the ECUcore-5484 within the directory Examples/PLCcore-CF54/Linux/gnu.

At first, you may need to extract the ZIP archive with the source code of the openPOWERLINK Stack. The source code can be found on the openPOWERLINK Live-CD or downloaded from http://openpowerlink.sourceforge.net/.

user@host: ~> unzip openPOWERLINK\_v1.3.0.zip user@host: ~> cd openPOWERLINK\_v1.3.0

#### 8.2.1 Project demo\_mn\_kernel

This project demonstrates how the openPOWERLINK Stack can be utilized as Linux-kernel module. It is located in the directory Examples/PLCcore-CF54/Linux/gnu/demo\_mn\_kernel of the openPOWERLINK source code. The demo application "demo\_main.c" is placed within the same Linux-kernel module as the openPOWERLINK Stack. This implies the advantage of a direct and efficient connection between the application and the openPOWERLINK Stack.

This demo application provides the functionality described in section 6. It contains an object directory, PDO support, SDO server and client, support of SDO via ASnd and UDP, a virtual Ethernet driver for Linux and the Data Link Layer, and the NMT module for Controlled Nodes and Managing Nodes.

#### 8.2.1.1 Translating the Source Codes

On the development system, the command "make" is to be completed within the above mentioned directory .

```
user@host:Examples/PLCcore-CF54/Linux/gnu/
    demo_mn_kernel> make
```

Therewith, the Linux-kernel module epl.ko is built. As described in section 8.3, this module can be copied onto the ECUcore-5484.

#### 8.2.1.2 Executing the Application

The Linux-kernel module epl.ko requires the Board-support driver cf54drv.ko which is automatically loaded on the delivered ECUcore-5484.

Loading the kernel module takes place via the Linux command "insmod". Consequently, the openPOWERLINK Stack is initialised, the network interface is configured and the NMT state machine is started.

sh-2.05:/nfs# insmod epl.ko

After loading the kernel module, the demo application is running. It installs a device "epl" in the proc file system over which status information about the openPOWERLINK Stack may be inquired.

sh-2.05:/nfs# cat /proc/epl

🛄 Tera Term - COM1 VT	
File Edit Setup Control Window Help	
sh-2.05:"/nfs# cat /proc/ep1 EPL V2 V1.0 r0 (c) 2006 SYS TEC electronic GmbH NHT state: 0x011E CurflsyncTxGen=0 CurflsyncTxNnt=0 CurflsyncRx=0 MaxflsyncTxGen=0 MaxflsyncTxNnt=0 MaxflsyncRx=0 FEC_ECR = 0xF0000002 FEC_EIR = 0x00000000 FEC_EIMR = 0x083E0000 FEC_TCR = 0x00000000 FECTFSR = 0x00030000 FECRFSR = 0x00010000 DbgTracePoints: TracePoint1 01: 4 TracePoint1 01: 4 TracePoint1 11: 0 TracePoint1 11: 0 TracePoint1 31: 0 TracePoint1 31: 0 TracePoint1 31: 0 TracePoint1 51: 0 TracePoint1 51: 0 TracePoint1 61: 0	<b>X</b>

Picture 9: Part of the output of "cat/proc/epl"

During the unload of the kernel module via "rmmod", the EPL Stack is stopped. This command is as well necessary to eventually remove an EPL Stack that is already loaded.

sh-2.05:/nfs# rmmod epl.ko

#### 8.3 Updating the Demo Application on the ECUcore-5484

Provided that the ECUcore-5484 is configured as described in section 5, the EPL demo application on the module can be updated. After rebooting the module (DIP switch 2 positioned at "on", compare Figure 4), the login as **user "PlcAdmin" with password "Plc123"** is possible.

Transmitting the demo application on the ECUcore-5484 can take place using two different possiblities that each include advantages and disadvantages:

**NFS**: The "Network File System" (NFS) represents the simplest way of starting the demo application – that has been built on the development system – directly on the ECUcore-5484. Therefore, on the development system a directory is mounted into the local file system of the ECUcore-

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5484. To start the program, only the appropriate command must then be entered on the ECUcore-5484. The data transmission from the development system to the ECUcore-5484 takes place automatically by NFS, without any other commands of the user. The method NFS is described in section 8.3.1.

FTP: The "File Transfer Protocol" is a standardized and platform independent protocol that is securely established in practice. Both, FTP server and clients are available for different operating systems such as Linux and Windows. In contrast to NFS. FTP enables the transmission of data from a computer using Windows to the ECUcore-5484 (e.g. program updates of a service technician using a Windows laptop). Moreover, FTP allows for a detailled control through username and access password authentication. Disadvantageous for FTP is that a command must be entered for each file transmission which can be annoying or even forgotten especially during the development phase. Consequently, it could be possible that perhaps an old version of the program is accidentally run. The method FTP is described in section 8.3.2.

# 8.3.1 Using NFS

Mounting a directory on the development system directly in to the local file system of the ECUcore-5484 represents the simplest way of starting a demo application (that has been built on the development system) on the ECUcore-5484. Therefore, a NFS server must be installed and configured on the development system.

#### 1. Mounting a directory on the ECUcore-5484

To integrate the directory "/tftpboot" of the development system into the local file system of the ECUcore-5484, the command "mount" is to be used as follows: mount -t nfs -o nolock <ip\_host>:/tftpboot /mnt/nfs

After the command "mount" is successfully completed, the directory "/tftpboot" of the development system (including any subfolders) is accessible in the local directory "/mnt/nfs" of the ECUcore-5484.

Afterwards, the built demo application (e.g. epl.ko) has to be copied into the directory "/tftpboot" of the development system.

#### 8.3.2 Using FTP

As an alternative to mounting a directory of the development system directly into the local file system of the ECUcore-5484 via NFS, it is possible to transfer data between the development system and the ECUcore-5484 in both directions via FTP.

FTP Download

Downloading files from the development system on the ECUcore-5484 takes place with the help of the command "ftpget". Both parameters, "-u" for username and "-p" for password enable authetication at the host system. The command "ftpget" is written as follows:

```
ftpget -u <username> -p <password> <ip_host>
        <local_file> <remote_file>
```

To transmit the EPL demo application "eplapp" from the directory "/tftpboot" to the ECUcore-5484 via FTP for example, the following command is necessary:

```
ftpget -u systec -p systec 192.168.10.56
    /var/epl.ko /tftpboot/epl.ko
```

#### FTP Upload

Uploading files from the ECUcore-5484 to the development system takes place with the help of the command "ftpput". Both parameters, "-u" for username and "-p" for password enable authetication at the host system. The command "ftpput" is written as follows:

ftpput -u <username> -p <password> <ip\_host>
 <remote\_dir> <local\_file>

#### Glossary

- AMI Abstract memory interface
- ASnd EPL frame type: Asynchronous Send, which may contain SDO or NMT messages
- CAL Communication Abstraction Layer, internal openPOWERLINK Stack module
- CN Controlled Node, i.e. slave device in the POWERLINK network
- DCF Device configuration file (generated by configuration tools)
- DLL Data Link Layer
- DNS Domain Name System (Internet Protocol)
- EPL Ethernet POWERLINK
- EPSG Ethernet POWERLINK Standardization Group
- IP Internet Protocol
- HMI Human machine interface
- MAC Media Access Control
- MN Managing Node, i.e. master device in the POWERLINK network
- NMT Network Management
- node an arbitrary POWERLINK device. Often an POWERLINK CN
- OBD Object dictionary module
- OD Object dictionary
- PDO Process Data Object
- PReq EPL frame type: Poll Request

- PRes EPL frame type: Poll Response
- RPDO Receive PDO
- SDO Service Data Object
- SoA EPL frame type: Start of Asynchronous
- SoC EPL frame type: Start of Cyclic
- TFTP Trivial File Transfer Protocol
- TCP Transmission Control Protocol
- TPDO Transmit PDO
- UDP User Datagram Protocol

#### References

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