Deutschmann Automation

Cam Controls | Fieldbus Gateways | Industrial Ethernet Products

Instruction manual
EPL-Router

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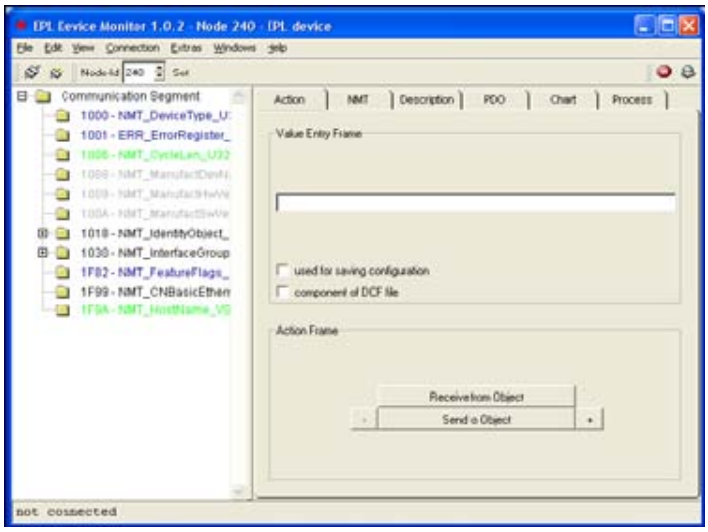
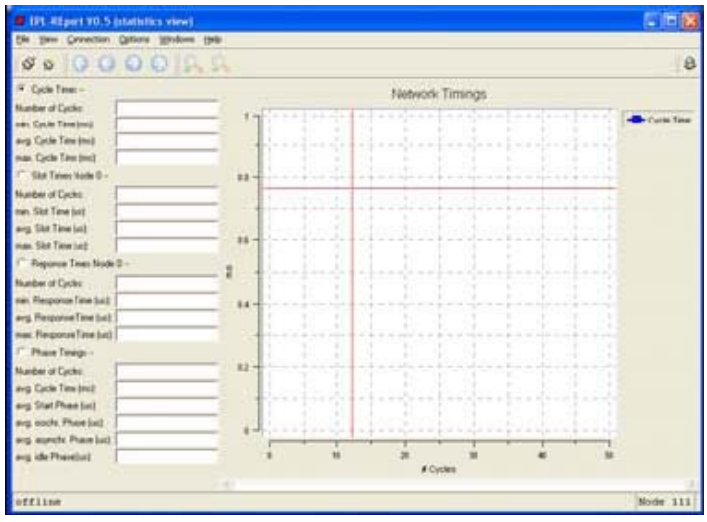
1 Introduction

This document describes the usage of an EPL Gateway. The EPL Gateway includes several features and enables to analyze and configure an EPL network. Deutschmann Automation´s EPL Gateway supports the following tools:

EPL Device Monitor
Our application tool partner writes this tool like "EPL-REport". For the EPL network configuration CANopen mechanisms are used. So every CN (Control Node) has an object dictionary, which can be accessed over the SDO (Service Data Object) communication. The Device Monitor only needs an EDS file from the linked device to access its object dictionary. It also provides a graphical PDO mapping and allows observing several objects with polling.



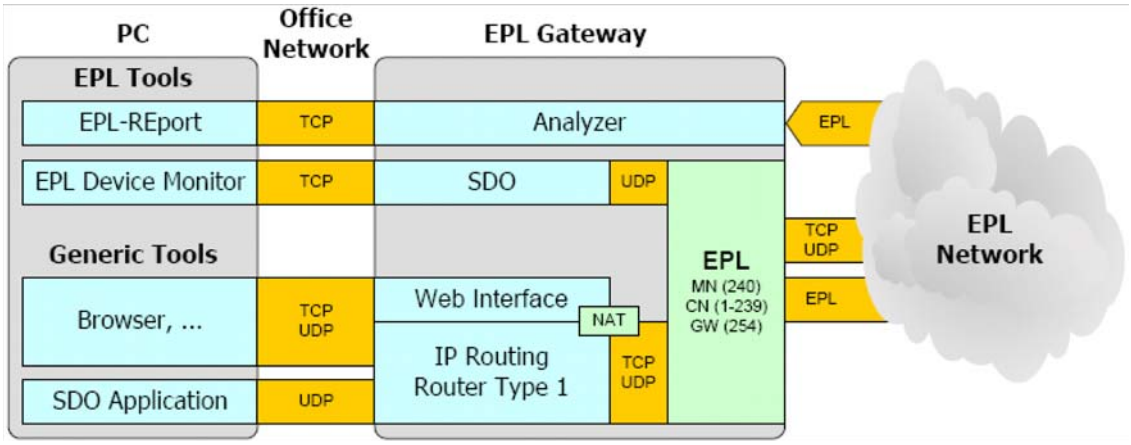
EPL-REport
"EPL-REport" allows analyzing of several timings (cycle time, CN response times, …) and PDO payloads. Main feature is an overview about actual cycle with graphical schematic about all frames with exact times in microseconds. All timings can be analyzed over a graph view and a maximum / minimum view. For additional information please contact us.



Others
One advantage of Industrial Ethernet is the huge number of available protocols and mechanisms. Route type 1 allows to route IP packets from office network to EPL network. So it is possible to access every node over a protocol that is IP based like HTTP or FTP. For remote maintenance web interfaces can be implemented on every node to allow easy configuration or display any kind of process values. FTP is a well-known transfer protocol that allows EPL nodes to retrieve configuration or firmware from locations outside the EPL network. The SDO application that communicates directly over UDP is able to access EPL network.

The EPL Gateway allows very flexible and cost-effective solutions. It is also possible to add additional functionality. The powerful hardware has reserves for all kinds of applications. Please contact us for additional information and references.

The following schematic gives an overview about the EPL Gateway modules:



Actual following modules are implemented on EPL Gateway:

IP Routing
(Router Type 1) This module is part of the EPL specification routing type 1. The configuration is taking place over a web interface that can be access over the generic Ethernet side. The actual web interface allows to setup routing and NAT table. The Web interface is organized like object dictionary for easy handling. It is possible to enable and disable NAT functionality. Configuration parameters are stored in flash when the EPL Gateway is shut down.

Web Interface
This module allows graphical configuration of NAT and routing tables. It directly depends on object dictionary set of router type 1. For additional information please refer to chapter 3.

SDO
The SDO module is implemented from our partner Port. It is an interface for the EPL configuration tool "EPL Device Monitor". The Device Monitor can connect to Gateway and send commands over TCP to a separate SDO stack. This stack generates an SDO session from TCP command and access a node in the EPL network. It is also possible to access the EPL side of the gateway.

Analyzer
The Analyzer module collects the EPL traffic and sends statistics about the EPL network to the connected PC.

2 Hardware

The following schematic shows an EPL Gateway's front view:

The EPL gateway is structured in following areas:

- EPL
- Generic
- Basic

The EPL area includes an RJ45 interface, two EPL indication LEDs ("State" LED = BS; "Err" LED = BE) and node ID selector. EPL-RJ45 interface is not a normal connector. It is designed as crossover connection like specification, which allows connecting it directly with a patch Ethernet cable to another CN. Both indicators are also part of the EPL specification. BS indicates changes from the NMT state and BE indicates error conditions. The node ID switch allows setup the node ID of device. It is possible to use for every node ID setting a different configuration file, which allows using another object dictionary and using other initialisation. So it is possible to be MN or CN at the same time. To select boot-up behavior node ID selector has to set to 240 or 1-239. For router behavior also a special file is located which is linked to node ID 254. The selector has three different modes:

- Gateway starts with default settings -> IP address 10.10.10.10 (0x00)
- Gateway starts with special EPL IP address with modified last byte
  -> 192.168.100.[NodeID] (1 - 239) (0x01-0xEF)

In the future setting 0x00 means that the gateway starts as EPL diagnostic node, which analyses the EPL timing with EPL-REport.
The generic Ethernet side includes also an RJ45 interface which is designed like a normal Ethernet interface. As additional feature for future use the generic side also include two LEDs for status and error.
The basic side contents an IP switch and power connector. The IP switch is used for both sides, EPL and generic, and forces the IP address to 10.10.10.10. On the EPL side node ID selector is not used. The allowed voltage limit for power is 8-25V.

3 Web interface

The Web Interface allows to configure the EPL gateway without any special EPL tools for SDO transfer. Actual design depends directly on EPL object dictionary. Every screen represents one special index.

3.1 Login

Web Interface access is locked by a password, which allows to protect settings from attacks of the Internet.

In software version V1.0 only a standard password is used:

Username	admin
Password	1234

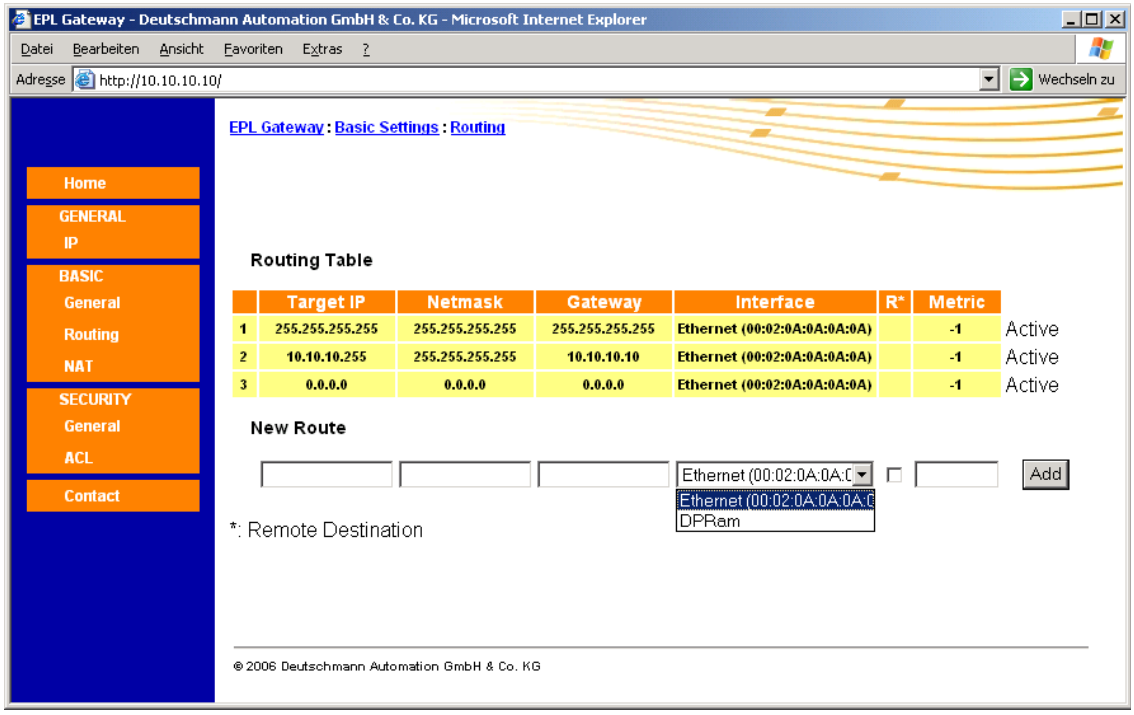
3.2 Basic: General

It is possible to setup:

- Enables or disables the Network Address Translation on the EPL Router. (Subindex 0x01)
- Depending on the value of EnablePacketFiltering_BOOL, the Packet Filter on the EPL Router is enabled or disabled. (Subindex 0x02)

The following screen shows settings based on the EPL index 0x1E80:

3.3 Basic: Routing

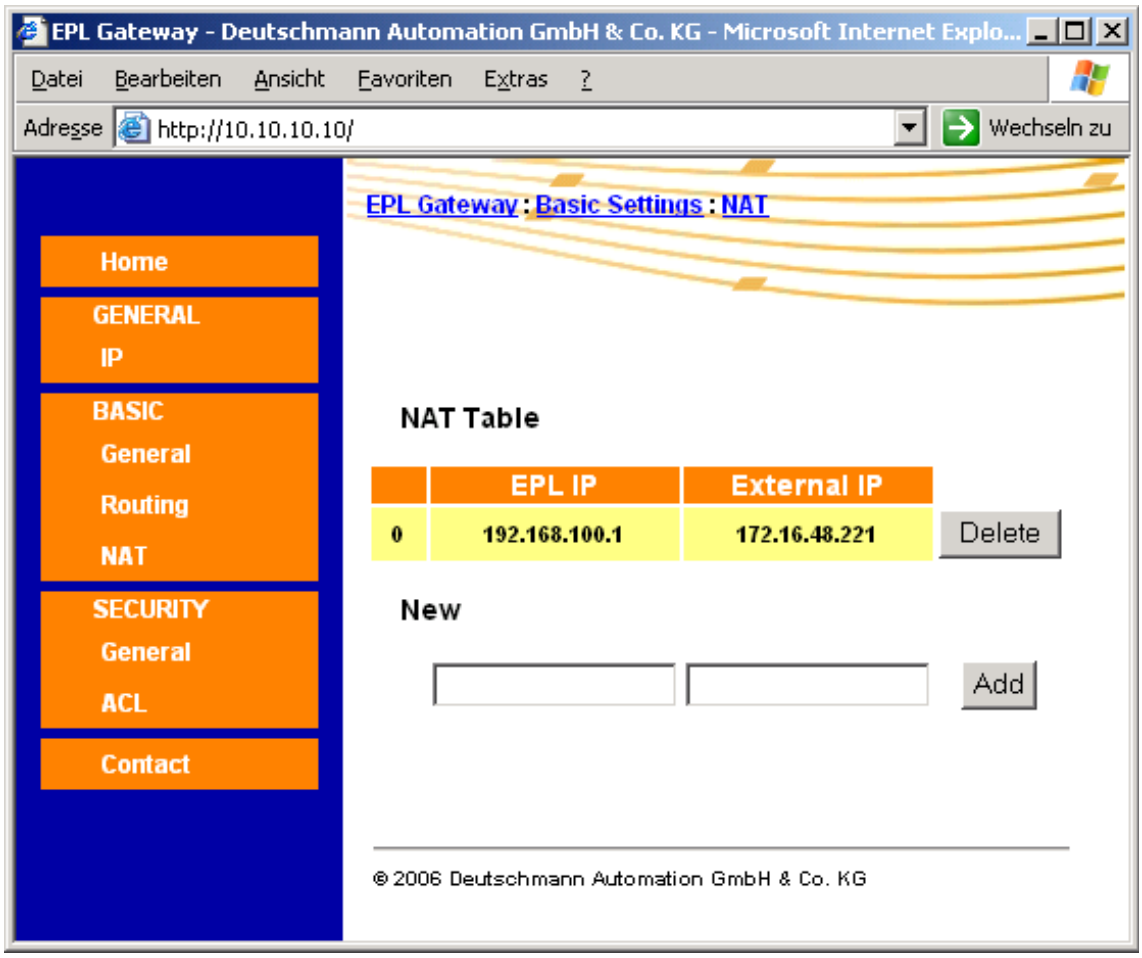


The previous screen shows settings based on EPL index 0x1E90 - 0x1ECF.
The routing screen allows to view or delete existing routes and to add new routes. Every time 4 existing routes are part of the routing table, which are based on the actual IP address. Without this route the device has no ability to communicate over Ethernet. The EPL gateway has two different interfaces. One for the generic side and one for the EPL side. Based on the actual hardware design interface for EPL side is called DPRAM because the EPL is connected over DPRAM.

Note
Metric is not used in actual stack version. Every time when the stack tries to find a route, the first is taken from the list.

3.4 Basic: Network Address Translation (NAT)

The following screen shows the settings based on EPL index 0x1D00 - 0x1DFF:



The network address translation shows a table for the translation between the EPL addresses and the generic addresses. The EPL gateway implements source and destination NAT, so it is possible to reach every node in the network over an IP address of another subnet.

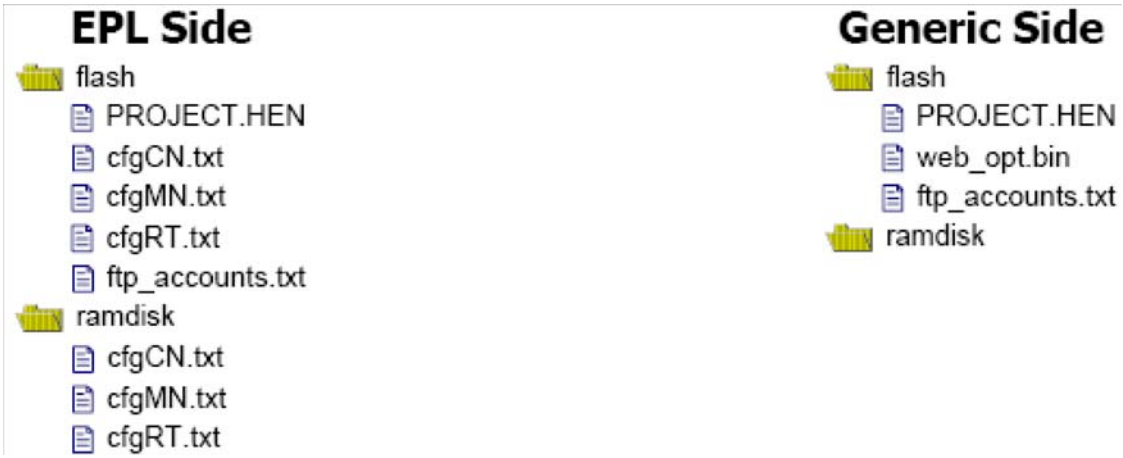
NAT
NAT is principally used because public IP addresses running out in bigger networks. NAT allows using private IP addresses in an internal network. Every request, which is sent over a NAT gateway, gets a new IP source address. Frames, which come to a network over a NAT gateway, get a correct destination IP address from the NAT table. There are two different kinds of NAT, 1-1 and 1-n NAT. **1-1** This version is also called basic NAT. Private IP addresses are directly mapped into public network. E.g. IP address 192.168.0.1 is a private IP. With NAT this private IP will be translated to a public IP, e.g. 200.0.20.1. This mechanism allows the device with IP 192.168.0.1 to access the internet. The private IP addresses are not routed, but with NAT the device gets a public IP and reaches every other device with a public IP. This is also the way EPL Router Type 1 works (For additional information please refer to the EPL specification). **1-n** This version is called hidden NAT, because one public IP represents a network of several private IP addresses. It is not possible to detect how many devices are behind this IP address because every outgoing frame source IP is replaced by a gateway IP and every incoming frame destination IP is replaced by an individual device IP. This kind of NAT is used in every standard office router.

3.5 EPL Router Configuration

With the node ID switch it is possible to setup different kinds of devices. The EPL Router Firmware allows an easy configuration from the file. On both sides of the Gateway there is an active FTP server. Over following Login you are able to connect:

Username test
Password test

The file system contains following Files:



File PROJECT.HEN is the program that actually runs on this device. For a remote update please replace this file by a new program and reset the device. "cfgXX.txt" files are used to configure EPL devices. Depending on the node one of these files is used for node configuration (240=cfgMN.txt (not supported)/ 254=cfgRT.txt / other cfgCN.txt). "ftp_accounts.txt" includes login information for ftp server. To establish other configurations, replace corresponding file.

3.5.1 File layout

The file layout is kept in a very simple way to reduce the file size. The following table shows the main keywords from the file:

Keyword	Description	
	Create a new index and link it in the object dictionary.	
[index]	Syntax:	index subcount object_type
	Example:	[index] 0x1000 12 ARRAY 0x1001 0xD RECORD
	Create a new subindex and link it with the corresponding index.	
[subindex]	Syntax:	index subindex data_type access pdo llimit ulimit
	Example:	[subindex] 0x1000 2 0x0007 RW NO NULL NULL 0x1000 3 0x0006 RO OPT 50 80
	Initialise an object dictionary entry with a specific value.	
[init]	Syntax:	index subindex value
	Example:	[init] 0x1000 2 500

Following indices are most important for the configuration:

0x1006	**NMT_CycleLen_U32**
This object defines the communication cycle period in µs. This period defines the SYNC interval.	

0x1F81	**NMT_CNAssignment_AU32**
This object assigns CNs to the NMT Master (MN). On the MN, the object controls the identification of CNs. If the object is modified in state NMT_MS_PRE_OPERATIONAL_1, identification process shall be restarted.	

0x1F84	**NMT_MNDeviceTypeIdList_AU32**
This object holds a list of the expected NMT_DeviceTypeId_U32 value for each configured CN. The object should be set by the system configuration. It shall be filled with the D_NMT_DeviceType_U32 device descrition entry of the respective device. It may be used by the verification of CNs. If the object is modified in state NMT_MS_PRE_OPERATIONAL_1 after start of verification, verification process shall be restarted.	

0x1F8A	**NMT_MNCycleTiming_RE**
This object holds timing parameter use by the MN only to control the EPL cycle.	

0x1F8D	NMT_PResPayloadList_AU16
This object holds a list of the expected PRes Payload data size in octets for each configured CN that is isochronously accessed, e.g. via PReq / PRes frame exchange.	

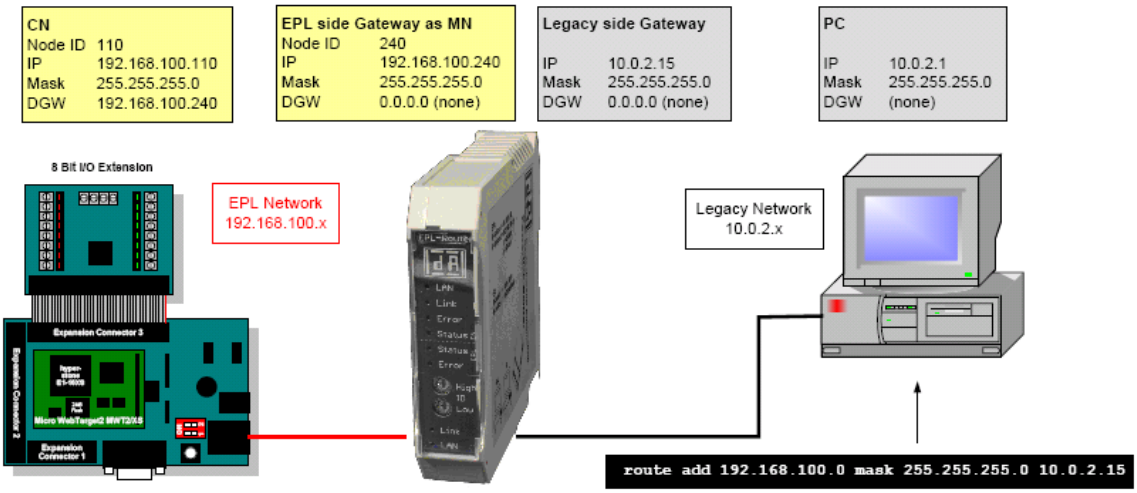
0x1F98	NMT_CycleTiming_REC
NMT_CycleTiming_REC provides node specific timing parameters, that influence the EPL cycle timing. All entries must be supported by a CN. On the MN, some of the entries are irrelevant.	

4 Setups

The following chapter gives an overview over two scenarios with the EPL Gateway.

4.1 Variant 1 (No NAT)

This variant includes a PC with one network interface, EPL Gateway and MicroWeb Target2 with I/O extension as CN. Please setup environment like following schematic:



To reach the EPL network a route to 192.168.100.0 over the Gateway has to be set on the PC. NAT is deactivated so every node can be reached over direct IP access. EPL Gateway is also a legacy router. If EPL is not active it should also be possible to reach all other nodes when they are in basic Ethernet mode. In bigger networks the EPL Gateway has the IP address 192.168.100.254 (Router ID). This address is configured as standard gateway (DGW) on every EPL device. The Gateway have to be part of the cycle as isochronous or asynchronous only node. For this behavior set CNAssignment_AU32 (0x1F81) subindex 254 to 0x00000003 for isochronous or 0x00000103 for asynchronous only accessed node. For additional information please refer to EPL specification.

Attention
Do never Force both sides of the Gateway to default IP address. This will cause address conflict and one side will shut down.

If you assembled installation above you should be able to see:

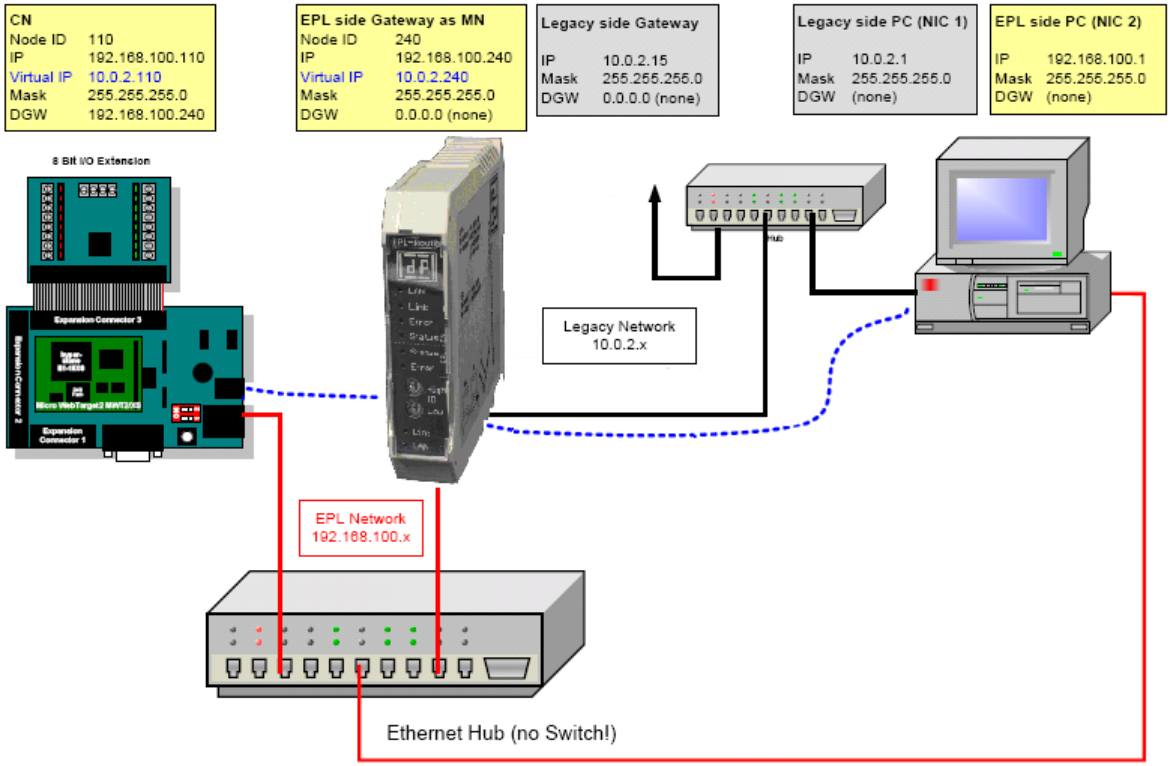
- Intensive Ethernet Traffic on EPL segment (yellow traffic LEDs on Ethernet connectors flashing fast).
- Moving light on red LED bar of I/O module of CN 110 (only when Gateway contains standard SND demo application)

From the PC you should now be able to:

- Ping the legacy side of the Gateway via 10.0.2.15
- Ping the EPL side of the Gateway (EPL MN) via 192.168.100.240
- Ping the EPL CN via 192.168.100.110
- Access the web interface of the gateway via 10.0.2.15

4.2 Variant 2 (with NAT)

The following schematic shows a good setup for development environments:



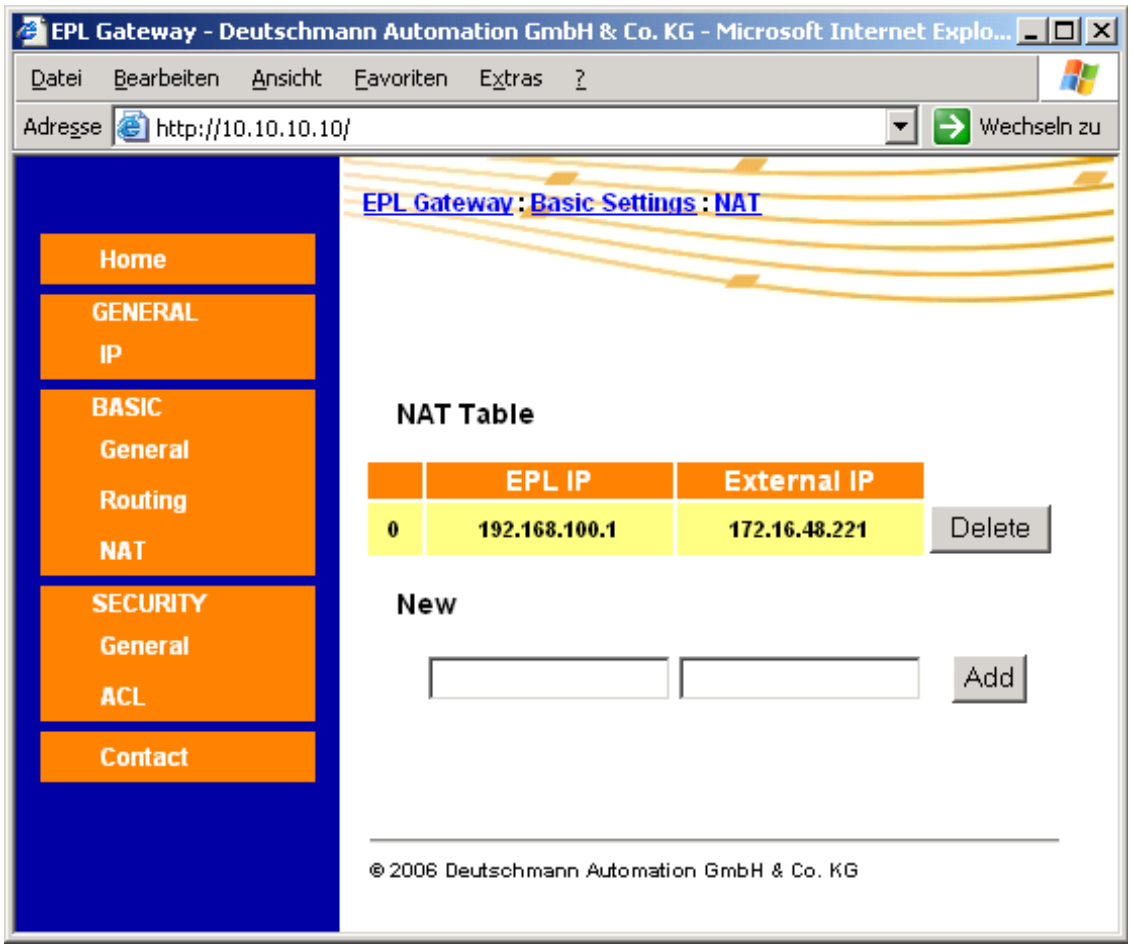
PC contains two Ethernet interfaces. One is connected to the office network and allows access to the ethernet or share files. The other Ethernet interface is connected directly to the EPL network to analyse EPL traffic with tools like Ethereal (www.ethereal.com). ZHW created a special plug-in that allows to analyse the EPL traffic and decode EPL frames. To avoid a collision we recommend to disable all available protocols then TCP/IP.
In the schematic above the red lines show the EPL network, the black lines shows legacy or office network and the blue line shows the virtual extension to legacy network. This node can be reached from every device outside the EPL network that is part of the router subnet.
If you assembled installation above you should be able to see:

- Intensive Ethernet Traffic on EPL segment (yellow traffic LEDs on Ethernet connectors flashing fast).
- Moving light on red LED bar of I/O module of CN 110 (only when Gateway contains standard SND demo application)

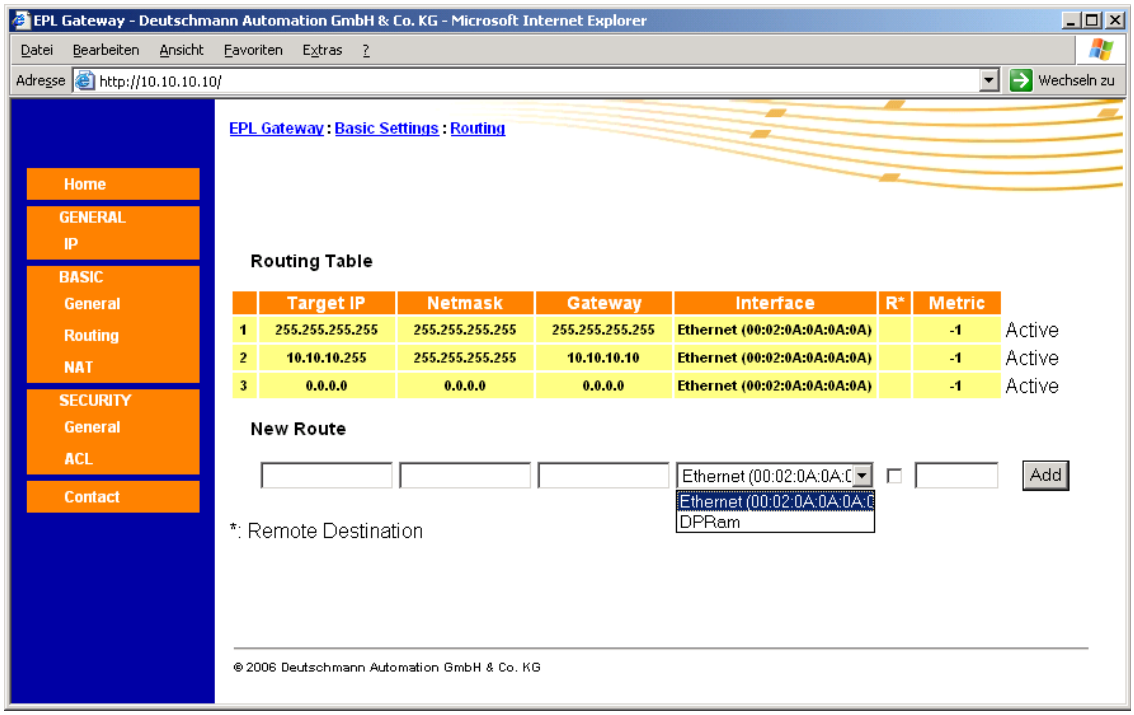
From the PC you should now be able to:

- Ping the legacy side of the Gateway via 10.0.2.15
- Ping the EPL side of the Gateway (EPL MN) via virtual IP 10.0.2.240
- Ping the EPL CN via virtual IP 10.0.2.110
- Trace (for example) the EPL MN via virtual IP 10.0.2.240
- Trace (for example) the EPL CN via virtual IP 10.0.2.110
- Access the web interface of the gateway via 10.0.2.15
- Be able to sniff the Ethernet traffic on the EPL network with Etherreal

• See the following NAT table on the gateway's web interface:



• See the following routing table on the gateway's web interface:

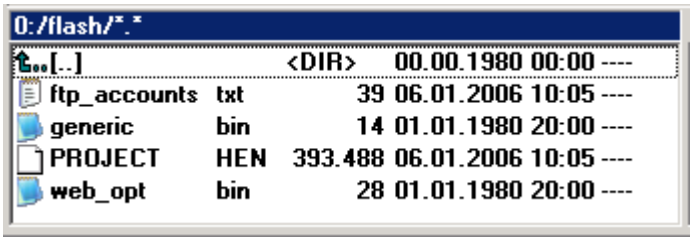


5 Firmware Update

For firmware updates please contact us.

6 Generic IP address

To setup the device IP addresses please modify generic.bin (for software version V1.0).



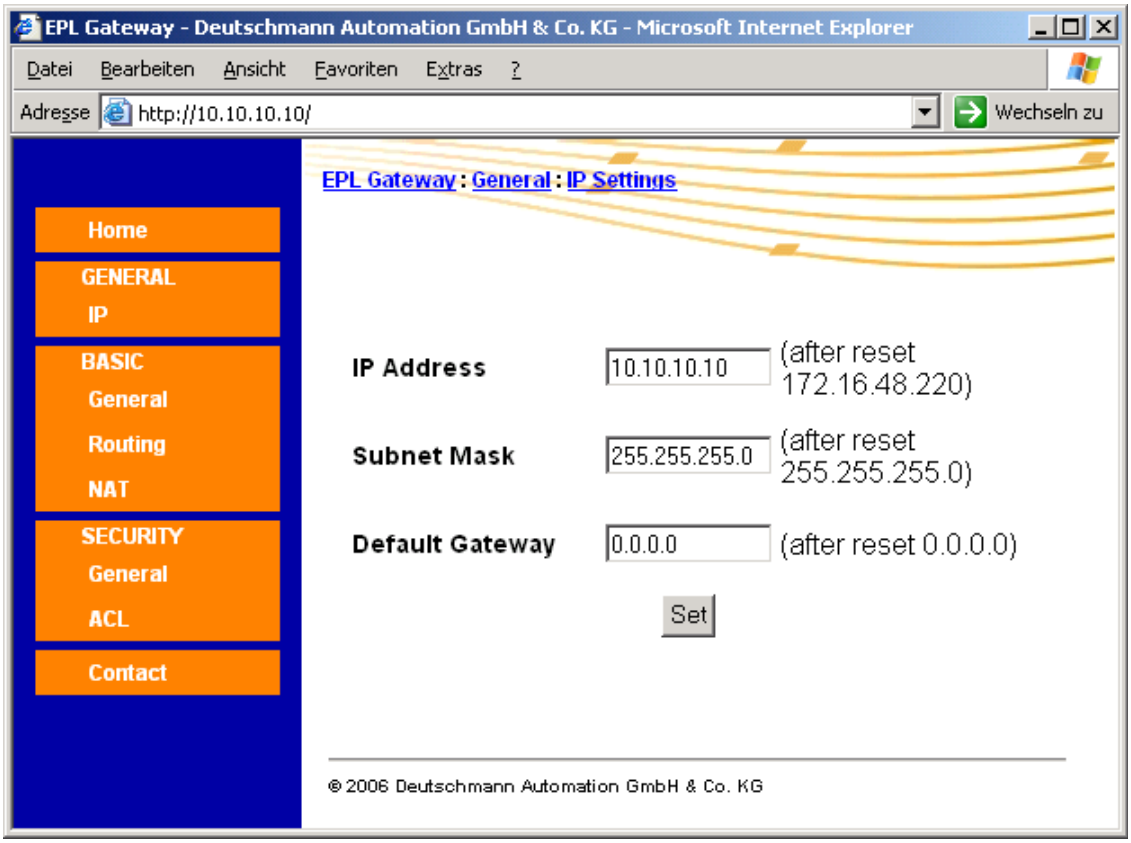
Default generic IP in generic.bin: 172.16.48.220

Make a ftp connection (like Total Commander) and change the IP address with an editor.

Note:

Username	test
Password	test

From software version V1.1 and higher:
To setup the device IP addresses please modify it with a standard browser.



7 Technical details

Mounting	DIN-rail with integrated grounding
Temperature	range 0°C – 55°C
Dimension	23x100x115 (BxHxD)
Supply voltage	24 VDC