



IP Router N146

5WG1 146-1AB01

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Introduction

Using the existing data network for communication between bus lines in non-residential buildings is a logical step. The advantages are: fast communication between EIB lines, extension of an EIB system beyond one building by using LAN and WAN connections, direct transmission of EIB data to any network user, EIB remote configuration from any network access point.

The IP Router N146 offers these features:

- Simple connection to hierarchically superimposed systems via Internet Protocol (IP)
- Direct access to the EIB installation from any access point to the IP network (EIBnet/IP Tunneling)
- Fast communication between EIB lines, EIB areas and systems (EIBnet/IP Routing)
- Communication between buildings and facilities (networking of distributed facilities)
- Filtering and routing of telegrams depending on
 - individual address
 - group address
- LED display of
 - operation
 - EIB communication
 - IP communication
- Simple configuration with standard ETS
- Simple connection of EIB with visualization and facility management systems

This manual is intended to achieve three goals:

- (1) Provide support for optimal configuration of the IP Router N146.
- (2) List examples of typical applications of the IP Router N146.
- (3) Convey basic knowledge about the Internet Protocol (IP).

This manual assumes that you are familiar with the Technical Product Information (TPI) and the Application Program Description (APB).

It also assumes that you are familiar with ETS and the EIB system.

Please find technical documentation regarding *instabus EIB* and product database entries for ETS at http://www.ad.siemens.de/et/gamma/html_76/support/techdoku.htm

Configuration recommendations for the IP Router N146

Device features

The IP Router N146 operates as a line coupler and connects EIB lines with each other via a data network. Besides the line coupler function the IP Router offers communication of EIB devices with PCs or other data processing devices via the same data network. Routing of EIB telegrams between lines and access to the line from a PC can happen concurrently. The connection to the bus is established via a bus terminal block. The connection to the data network (IP over 10BaseT) is established via a RJ45 socket. The IP Router employs the EIBnet/IP standard set by Konnex Association. This standard defines how EIB / KNX telegrams are sent across an IP network.

Bus parameters

The N146 can be used as line coupler or area coupler in existing *EIB* networks as well as in new KNX *EIB* networks. The N146 holds a filter table determining, which bus telegrams are transmitted or blocked from or to the bus line thus reducing the bus load. The filter table is automatically generated by the ETS (*EIB Tool Software*) during configuration and start-up of the system.

The physical address of the IP Router assigned by ETS automatically determines the IP Router function as a line coupler or area coupler. The definition follows these assignments:

Coupler function	Line
Area coupler	Main line 1- 15
Line coupler	Line 1- 15

Note

When assigning the physical address take care that IP Router and line couplers receive the topologically correct physical address (Fig. 1, IP Router as area coupler and line coupler).

Adhere to these rules:

Rule 1:

In general an IP Router N 146 is used as a line coupler or an area coupler. The physical address has the format x.y.0, with x=1...15, y=1...15.

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Rule 2:

If an IP Router N 146 is applied as an area coupler with the physical address x.0.0 then no other IP Router with the line coupler address x.y.0 (y=1...15) shall be placed topologically „below“ this IP Router (Fig. 2, IP Router N 146 as area coupler).

Rule 3:

If an IP Router N146 is applied as a line coupler (e.g. with physical address 1.2.0) then no other IP Router N146 shall be used with a superior area coupler address (e.g. 1.0.0) in this installation (Fig. 3, IP Router N 146 as line coupler).

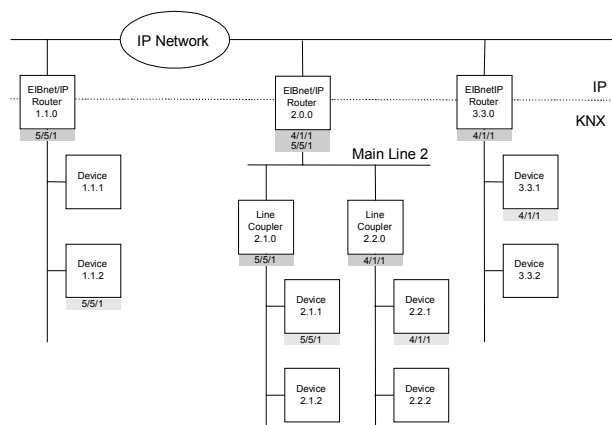


Figure 1. IP Router N 146 as area and line coupler

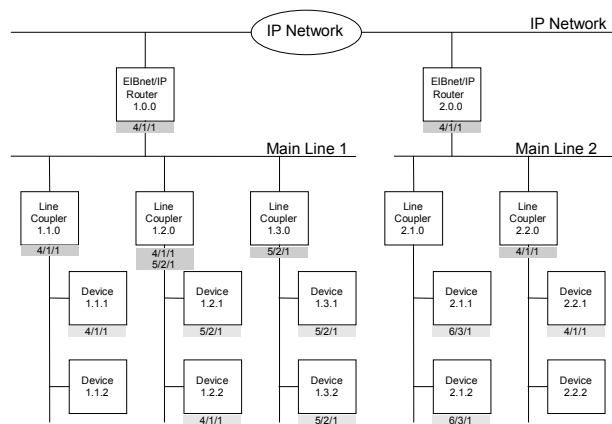


Figure 2. IP Router N 146 as area coupler

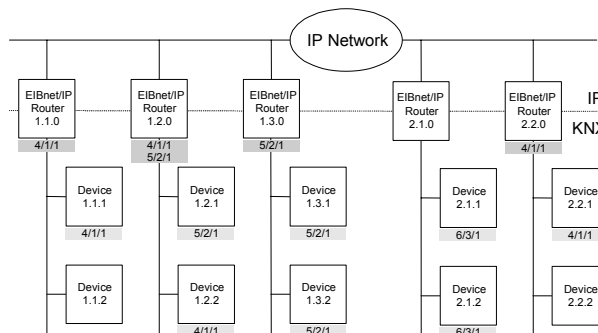


Figure 3. IP Router N 146 as line coupler

Network settings

The IP Router N146 requires an IP address to communicate on the IP network. This IP address can be assigned manually using ETS or automatically by a DHCP service.

When can an IP address be assigned by a DHCP service?

IP address assignment via DHCP is typically activated when the network is managed by a network administrator. Configuration of the DHCP server may require the MAC address, which is printed on the device.

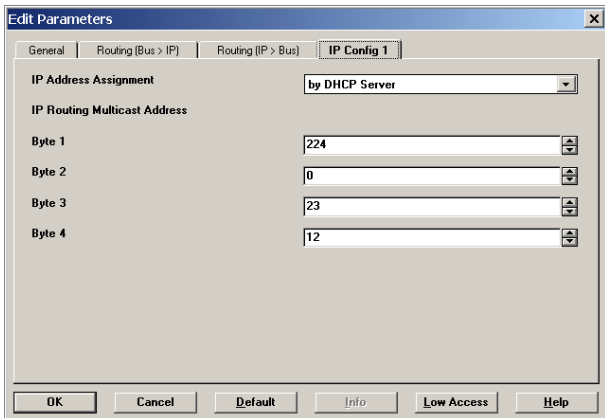
The DHCP service is employed by newer LAN modems and DSL routers. These devices support DHCP:
SIEMENS SE505 DSL Router

When should the IP address be set manually ?

The IP address has to be set manually if no DHCP service is present in the network.

Networked Building Controls are a part of the building infrastructure. It's structure is unchanged for longer periods, which lends itself to reserving a fixed IP address in the network.

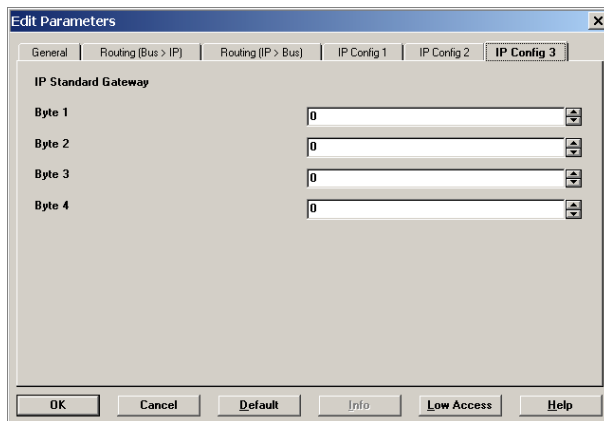
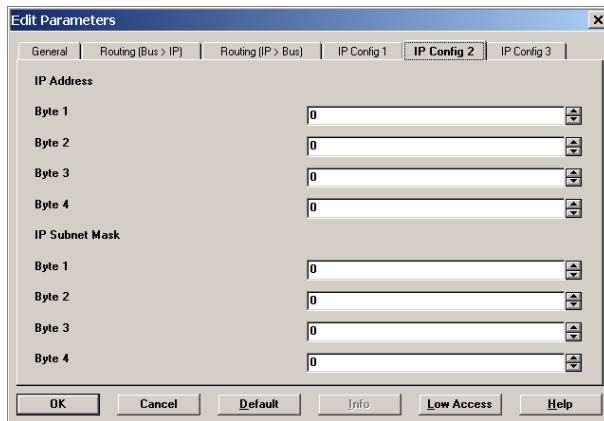
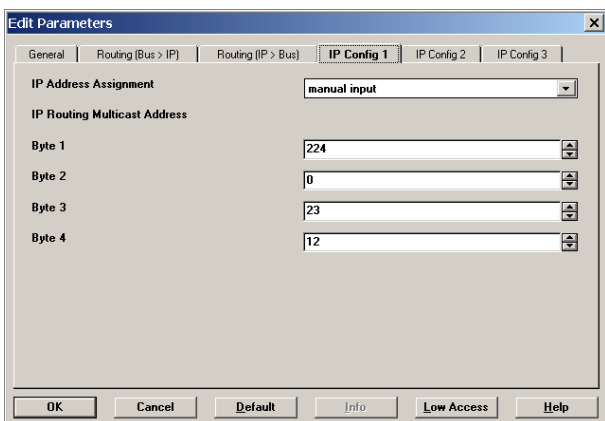
Automatic IP address assignment by DHCP service
 IP address assignment by DHCP server is the default ETS configuration setting of the IP Router N146.



Automatic assignment of the IP address by a DHCP server has advantages. Because the address is automatically assigned via the network addressing conflicts (dual address assignment, false address assignment) are avoided. Assignment of the IP address by a DHCP server allows for changes of the device IP address without using ETS.

Manual IP address assignment

When manual address assignment is selected two additional parameter tabs appear in ETS for entry of IP address, subnet mask and standard gateway.



If the IP address, subnet mask, and standard gateway have not been provided proceed with the assignment as follows:

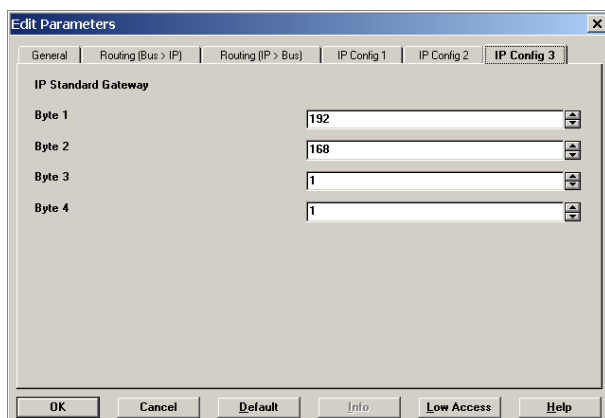
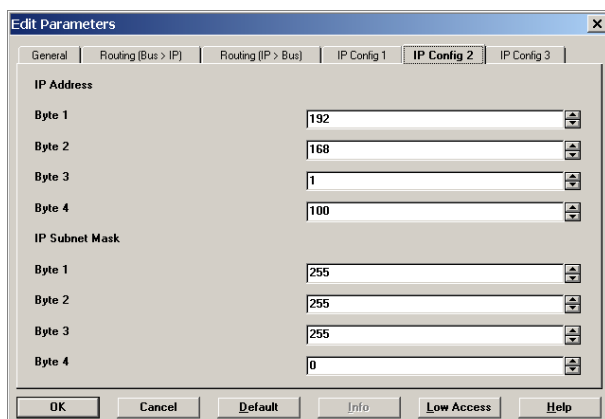
If you have setup a local independent network you may use IP addresses in the range from 192.168.0.1 to 192.168.255.254 in this network.

Depending on how many devices you want to run on a network the subnet mask should be set to 255.255.255.0 (maximum of 254 IP addresses) or 255.255.0.0 (maximum of 65024 IP addresses). If the subnet mask is set to 255.255.255.0 the first three numbers of the IP address of the devices in this network must be identical. When using the subnet mask 255.255.0.0 the first two numbers of the IP address of the devices in this network must be identical. If there is a connection to other networks e.g. via a LAN modem to the Internet then it functions as a standard gateway. Enter the IP address of this device as IP standard gateway in the ETS configuration.

Example

You have a network with less than 255 IP devices and have selected an IP address range of 192.168.1.1 to 192.168.1.254. The standard gateway has been assigned the IP address 192.168.1.1. The subnet mask

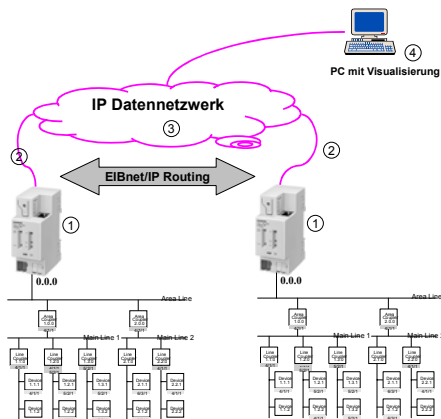
has been set as 255.255.255.0. The IP Router is to receive the IP address 192.168.1.100. The following screen shots show the corresponding entries in ETS.



IP Router N146 application examples

IP Router N146 as coupler between installations

An EIB installation may comprise of up to 12,000 EIB devices. Should more than one EIB installation be required because of the size of the building or the number of buildings on a campus then these installations are often connected with each other and always connected to a supervisory building management system. This requirement can easily be met by using one or several *instabus* IP Routers as installation couplers. This is possible under the condition that the different installations were configured in such a way that those group addresses used across installations are associated with the same function (e.g. central off). At the same time the *instabus* IP Routers serve as access point for a visualization to each installation.



System design

The *instabus* IP Router N146 (1) has a 10BaseT interface (Ethernet with 10Mbit/s over Cat5 cable). A patch cable (2) is plugged into the RJ45 socket of the IP Router and a network socket (3) and thus connects the IP Router with a data network (3).

The ComBridge Studio visualization system (4) can directly read data from EIB devices using group addresses or can simply eaves-drop the group address telegrams that are exchanged over the data network. Processing of the data, data presentation, and user interface are set with the visualization system. The visualization operation and control user interface is accessed using a standard browser like Internet Explorer.

Configuration of the N146

The IP Router N146 (1) in each EIB installation is placed on the back-bone and the physical address is set to 0.0.0. The IP Router is configured to transmit all EIB group telegrams sent to main groups 14 and 15. All other group addresses and the directly addressed telegrams are blocked.

All EIB telegrams with main group addresses 14 and 15 that are exchanged on the back-bone line are also forwarded to the other installations (EIBnet/IP Routing). When designing the project ensure that these group addresses are used the same way in the whole project i.e. all EIB installations use these group addresses in the same way!

Configure the network settings of the N146 according to the section on network settings.

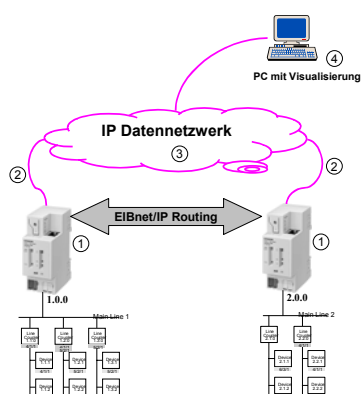
IP Router N146 as area coupler

Depending on the design of an EIB installation massive telegram exchange could occur on the back-bone line. This could lead to a bottle-neck situation, especially if a visualization is reading a larger amount of data from EIB or sending many commands to EIB.

This situation can easily be handled by using the *instabus* IP Router as an area coupler.

Additionally, using the IP Router several buildings on a campus can be connected to each other cost-effectively via the existing data network.

At the same time the *instabus* IP Routers serve as access point for a visualization to the installation.



System design

The *instabus* IP Router N146 (1) has a 10BaseT interface (Ethernet with 10Mbit/s over Cat5 cable). A patch cable (2) is plugged into the RJ45 socket of the IP Router and a network socket and thus connects the IP Router with a data network (3).

The ComBridge Studio visualization system (4) can directly read data from EIB devices using group addresses or can simply eaves-drop the group address telegrams that are exchanged over the data network. Processing of the data, data presentation, and user interface are set with the visualization system. The visualization operation and control user interface is accessed using a standard browser like Internet Explorer.

Configuration of the N146

The IP Router N146 (1) is placed on the respective EIB main line and the appropriate physical address is set to x.0.0 (x = 1,...15). The filter tables of the IP Router are generated as with any area coupler and then

downloaded to the IP Router. Filtering is activated. All other parameters are set as with an area coupler.

Configure the network settings of the N146 according to the section on network settings.

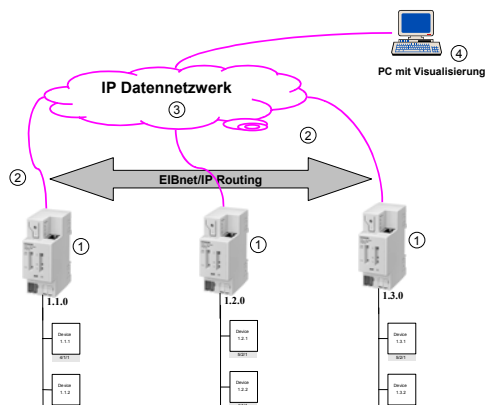
IP Router N146 as line coupler

Simple system design and fast communication between EIB lines can be achieved with the *instabus* IP Router N146 when used as a line coupler.

Depending on the size of the project the direct connection of each line to a data network can accelerate communication up to 200 times compared to the conventional system design.

When using up to three EIB repeaters below the IP Router up to 250 EIB devices can be deployed per line. This enables installations with up to 48,000 EIB devices. Using the existing data network the IP Router makes connecting the EIB controls of several buildings on a campus easy and cost-effective.

At the same time the *instabus* IP Routers serve as access point for a visualization to the installation.



System design

The *instabus* IP Router N146 (1) has a 10BaseT interface (Ethernet with 10Mbit/s over Cat5 cable). A patch cable (2) is plugged into the RJ45 socket of the IP Router and a network socket and thus connects the IP Router with a data network (3).

The ComBridge Studio visualization system (4) can directly read data from EIB devices using group addresses or can simply eaves-drop the group address telegrams that are exchanged over the data network. Processing of the data, data presentation, and user interface are set with the visualization system. The visualization operation and control user interface is accessed using a standard browser like Internet Explorer.

Configuration of the N146

The IP Router N146 (1) is placed as an EIB line coupler and the appropriate physical address is set to x.y.0 (x = 1,...15; y = 1...15). The filter tables of the IP Router are generated as with any line coupler and then downloaded to the IP Router. Filtering is activated. All other parameters are set as with a line coupler.

Configure the network settings of the N146 according to the section on network settings.

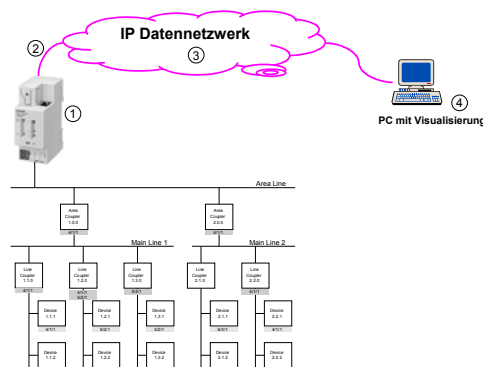
Building Control via EIB Control Center

Modern visualization systems like ComBridge Studio use network communication based on the Internet Protocol (IP). With the EIBnet/IP protocol integration of EIB into this network communication is straightforward.

It allows for simple connection of EIB installations in different buildings or locations with a central visualization or building management system.

Data transmitted to the visualization system can be collected, archived, and processed. Modern visualization systems enable user interaction via a web browser interface, effectively making every web browser equipped PC an operator station. If access to the data network exists any PC world-wide could become a control interface to the EIB system.

For the users in the building such a visualization solution allows them to take direct control of their immediate work environment by changing lighting, shading and heating settings from their PC.



System design

The *instabus* IP Router N146 (1) has a 10BaseT interface (Ethernet with 10Mbit/s over Cat5 cable). A patch cable (2) is plugged into the RJ45 socket of the IP Router and a network socket and thus connects the IP Router with a data network (3).

The IP Router is primarily used for connection of EIB areas or lines with each other.

At the same time the IP Router N146 offers access to an EIB installation via an IP network from a PC with a visualization (4). One IP Router may be used as visualization interface to an EIB installation. It could also be that several IP Routers are used as area or line couplers. In this case the visualization establishes an IP connection to

with all IP Routers and/or eaves-drops on the EIB telegrams exchanged between IP Routers.

The ComBridge Studio visualization system (4) is installed on a PC, which is connected to the IP network. The visualization can directly read data from EIB devices using group addresses or can simply eaves-drop the group address telegrams that are exchanged over the data network. Processing of the data, data presentation, and user interface are configured in a simple text file. An EIB Control Center presents the current values and states as a table in a window that also provides for control of the data points.

Configuration of the N146

If the IP Router and the visualization server (4) are connected to each other via an independently operating local network, the IP address of the IP Router should be set using ETS. To make configuration easy the first three numbers of the IP address of IP Router and visualization server should be identical. The subnet mask of the IP Router must be identical to that of the visualization server.

Beyond these recommendations, configure the network settings of the N146 according to the section on network settings.

Building Control via OPC Server

Modern visualization systems like ComBridge Studio use network communication based on the Internet Protocol (IP). With the EIBnet/IP protocol integration of EIB into this network communication is straightforward.

Nearly all building management and SCADA (Supervisory Control And Data Acquisition) systems can exchange data with other systems via OPC (OLE for Process Control). In this case the building management system takes the role of an OPC Client, i.e. it connects to an OPC Server to exchange data.

If OPC Server and OPC Client are installed on the same machine commissioning is reduced to determining the data to exchange.

ComBridge Studio OPC Server strongly supports this simple configuration.

Communication between EIB and OPC Server is very simple using the EIBnet/IP protocol and requires just a few settings.

With EIBnet/IP building control via OPC Server is as simple as can be.

System design

The *instabus* IP Router N146 (1) has a 10BaseT interface (Ethernet with 10Mbit/s over Cat5 cable). A patch cable (2) is plugged into the RJ45 socket of the IP Router and a network socket and thus connects the IP Router with a data network (3).

The IP Router is primarily used for connection of EIB areas or lines with each other.

At the same time the IP Router N146 offers access to an EIB installation via an IP network from a PC with an OPC Server (4). One IP Router may be used by the OPC Server as interface to an EIB installation. It could also be that several IP Routers are used as area or line couplers. In this case the OPC Server establishes an IP connection to with all IP Routers and/or eaves-drops on the EIB telegrams exchanged between IP Routers.

The ComBridge Studio OPC Server (4) is installed on a PC, which is connected to the IP network. The OPC Server can directly read data from EIB devices using group addresses or can simply eaves-drop the group address telegrams that are exchanged over the data network. The OPC interface, i.e. which data is provided to the OPC Client, is simply configured using a text file.

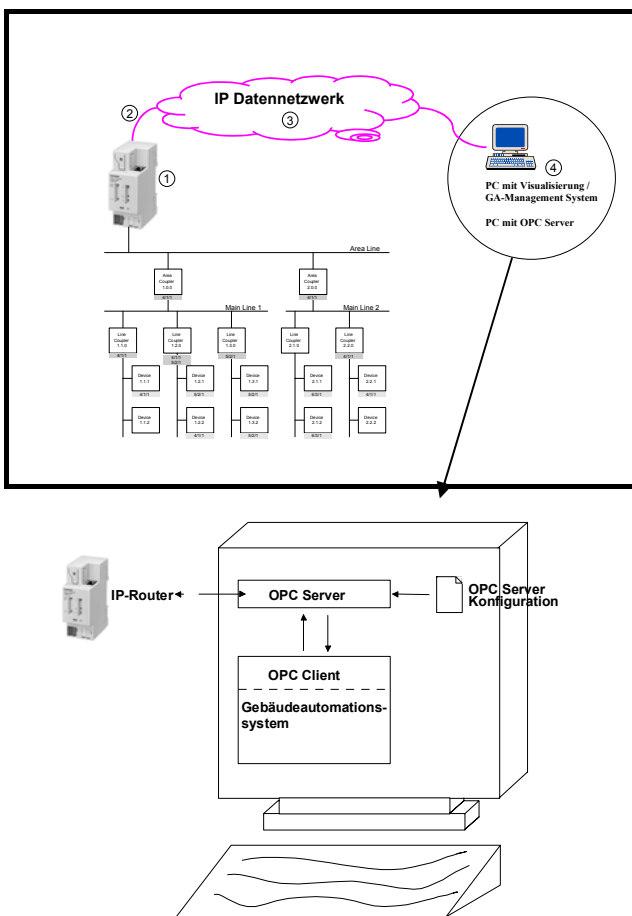
Configuration of the N146

In the simplest case the default settings of the N146 are sufficient. The ComBridge Studio OPC Server communicates with all IP Routers using the Router Multicast Address, which must be identically set for all IP Routers.

Beyond these recommendations, configure the network settings of the N146 according to the section on network settings.

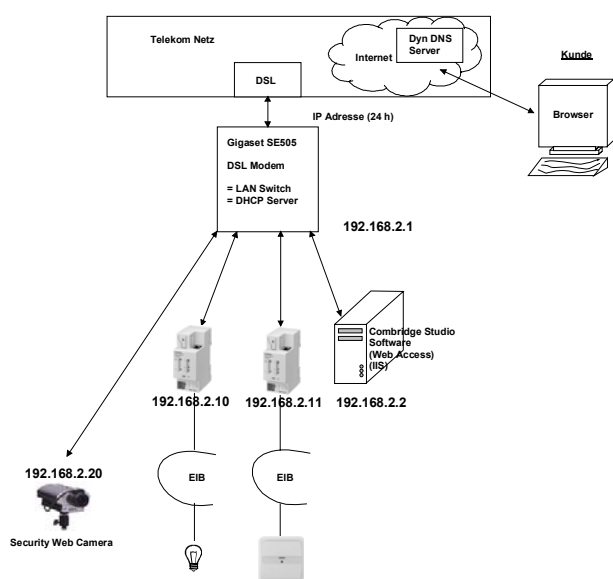
Configuration of OPC Server

The ComBridge Studio OPC Server forwards those group addresses to the OPC Client, which are listed in a simple text file.



Building Control via DSL Router with DynDNS

DSL (Digital Subscriber Line) connections provide for fast communication with the Internet. DSL not only enables fast access to web pages on the Internet but also simple access to an EIB installation in a building. This facilitates remote operation of locations via a web browser.



System design

The demo system consists of two *instabus* IP Routers N146 acting as line couplers between two EIB lines via the 10BaseT interface (Ethernet with 10 Mbit/s over Cat5 cable) and EIBnet/IP. A patch cable (2) is plugged into the RJ45 socket of the IP Router and a network socket (3). The demo system can be monitored via web camera, which is also connected to the DSL Router.

The IP Router is primarily used for connection of EIB areas or lines with each other.

The ComBridge Studio visualization system (4) is installed on a PC, which is connected to the IP network. The visualization can directly read data from EIB devices using group addresses or can simply eaves-drop the group address telegrams that are exchanged over the data network. User operation is based on a browser interface, which presents web pages configured by a simple text file (Web Access) or a tool, Visual Editor. The ComBridge Studio software running on the server in the local network receives data exchanged between the lines and presents this data on the pre-configured web pages. The web browser can also be used for control. The DSL Router enables access to these web pages from the Internet and thus operation of the EIB from any PC on the Internet.

Configuration of the N146

In the simplest case the N146 default settings and loading the filter tables are adequate. To deliberately direct group addresses to the user interface control software these group addresses should be connected to a dummy device that is placed on the back-bone line, i.e. has a physical address 0.0.z (z = 1...255). The ComBridge Studio software communicates with all IP Routers via the Router Multicast Address, which must be identical for all IP Routers.

Beyond these recommendations, configure the network settings of the N146 according to the section on network settings.

DynDNS

The DSL provider assigns every DSL connection an individual IP address for communication on the Internet. This IP address is only assigned for a limited time, typically 24 hours. Then a new IP address is assigned. To communicate with an Internet participant its IP address must be known. The well-known web addresses like www.siemens.com are translated to the true IP address for the actual communication with that site. This translation is provided by DNS (Domain Name System) servers. If the IP address is dynamic as in the case of DSL a server like DynDNS (dynamic DNS) links the current IP address with a DNS name like eibnetip.dyndns.org. DynDNS also takes care of forwarding this information about the IP address of a DSL router to all DNS servers on the Internet. This approach allows any user to access a specific DSL router by "name" without having to know its current IP address.

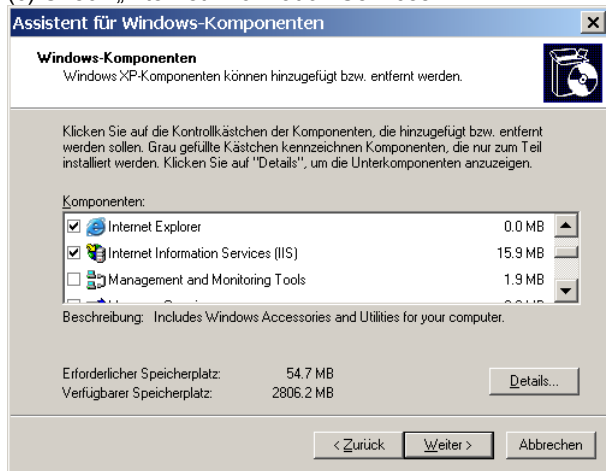
Building Control via Web-Browser

A web server is required to operate a building control system via a web browser like Internet Explorer, Opera or Netscape.
 From Windows 2000 Professional on the Internet Information Server (IIS) has been delivered as part of the operating system. There are other webs servers that can be run on Windows or Linux like the Apache Web Server.

How to configure Internet Information Server (IIS) as web server

If IIS has not yet been installed under Windows 2000 or Windows XP follow these steps (administrator rights are required!):

- (a) Start → Settings → Configuration → Software
- (b) Select „Add/Remove Windows components“
- (c) Check „Internet Information Services“

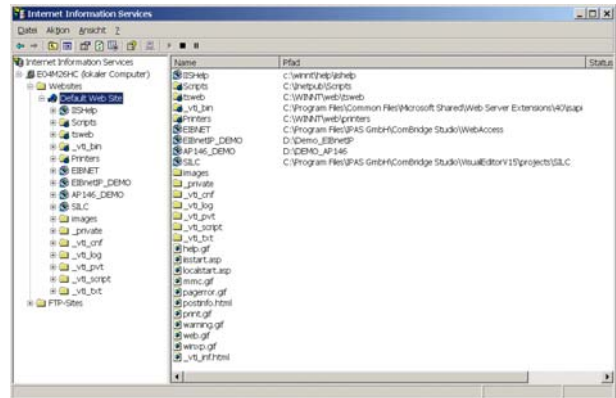


- (d) Click on „Next“.
The selected components are installed.
- (e) Click on „Finish“.

Now Internet Information Server (IIS) is installed.

Take these steps to configure IIS:

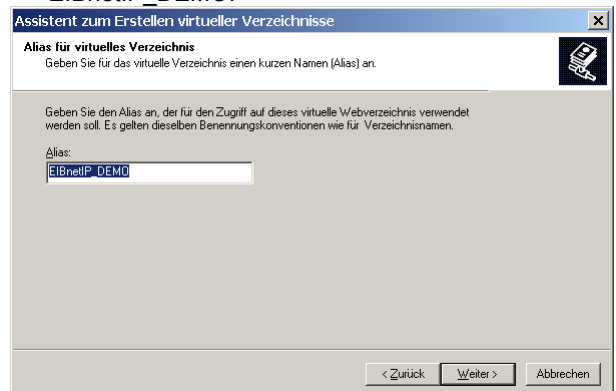
- (a) Start → Settings → Configuration → Administration → Internet Information Services



- (b) Right click on „Default Web Site“ and select „New → Virtual Directory“ to start the assistant for generating a new web site.



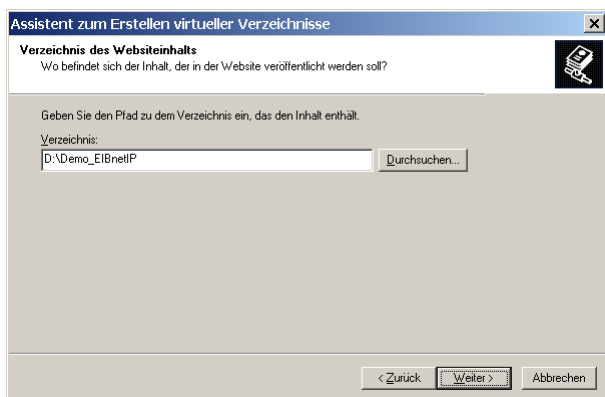
- (c) Enter the name of the new virtual directory, e.g. EIBnetIP_DEMO.



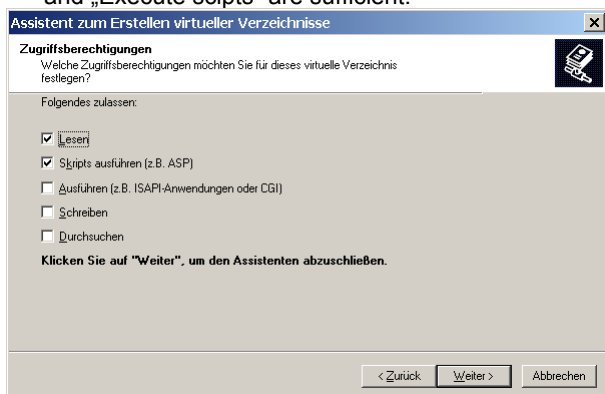
- (d) Select the directory on your local hard drive that shall be associated with the virtual directory.

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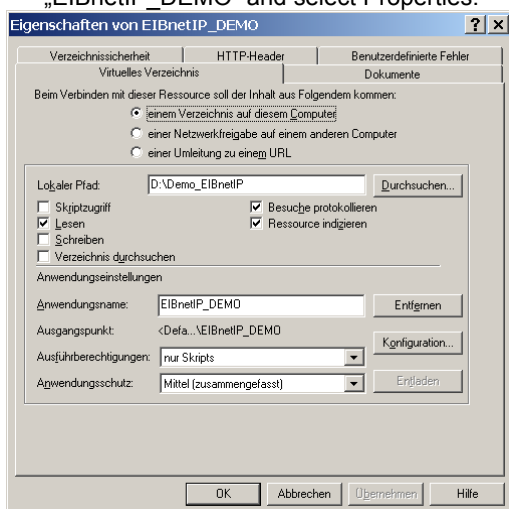


(e) Enter the access rights. The default settings „Read“ and „Execute scripts“ are sufficient.

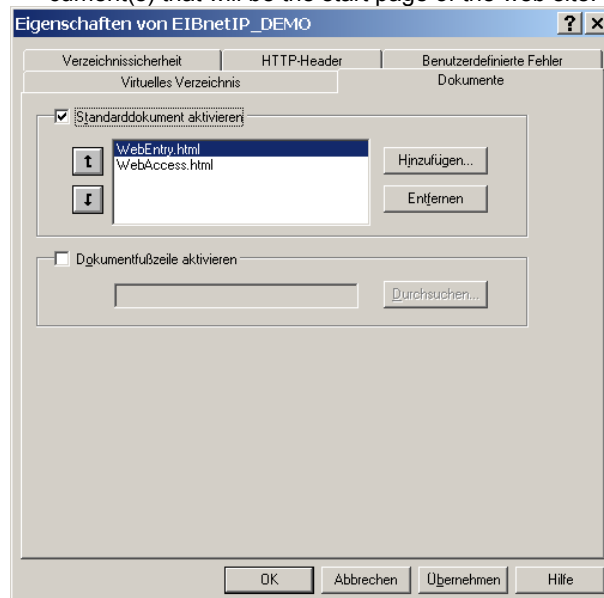


(f) Finish the assistant.

(g) Right click on the new virtual directory „EIBnetIP_DEMO“ and select Properties.



(h) Select the Documents tab and insert the HTML document(s) that will be the start page of the web site.



(i) Close the configuration with OK.

Now start your browser and enter this:

http://IP ADDRESS OF YOU PC/EIBnetIP_DEMO.

Your browser open the file that was listed first in the list of standard documents (in this example WebEntry.html).

Introduction to the Internet Protocol (IP)

Introduction

The connection between three universities in the USA was the starting point for the Internet in the 1970's. The intention was to facilitate data exchange and cooperation between these universities by a network of the networks (= Internet).

Originally the Internet was developed as a network between local networks. These local networks used different, manufacturer-specific network technologies.

The Internet Protocol (IP) was designed as the protocol for communication between networks.

With the Ethernet developed by Intel, Xerox and Digital Equipment a low cost, vendor-independent technology for local networks between computers became available. Shortly after the Ethernet was released as vendor-independent technology the Internet Protocol was used together with Ethernet for communication between single computers in a local network.

Today Ethernet and the Internet Protocol are the standard in local networks.

Struktur eines IP Netzwerks

A local network is similar to an EIB line: The Ethernet connects to every participant (PC, printer). Special participants are Hub and Switch.

is designed to avoid collisions between the participants that are connected to it in a star-like fashion.

The EIB Line Coupler offers the same basic functions that an IP router offers. A router sends datagrams from one network into the other and at the same time functions as a filter between networks. A device can find and address other devices in a different network via a router.

A Hub is a network component in networks using cat5 cables. A Hub may connect 4, 8, 16 or even 32 participants to the network. The connection to the participants is made via cat5 cable and RJ45 connectors. Just like a hub in wheel all participants are connected to the network at all times. When high data rates occur participants on a hub often experience collisions and thus lower data transfer throughput. A Switch has the same purpose as a hub: connect the participants with the Ethernet. Contrary to a hub a switch

In essence the structure of a network is similar to EIB: The smallest entity is a device (participant) in a local network. Local networks are connected to each other via routers (~ line couplers).

The Internet functions as a Backbone between networks.

- Existierende lokale Netze werden durch ein Netzwerk zwischen den Netzen verbunden (= Internet).
- Das Internet Protokoll (IP) wird auch für die Kommunikation zwischen einzelnen Rechnern in einem lokalen Netzwerk (LAN) verwendet. → weltweiter de-facto Standard

Addressing

IP Address

In an IP network every IP device must have a unique address.

This address can be assigned permanently or for a limited time only. A temporary assignment of the IP address is used when the number of available IP addresses in a network is limited. This is the case in most networks today. The protocol used for automatic assignment of IP addresses is DHCP (Dynamic Host Configuration Protocol).

The IP address notation is xxx.yyy.zzz.xxx, where xxx is a number between 1 and 254 and yyy is a number between 0 and 254.

Subnet and subnet mask

Subnets were introduced to optimally use the existing IP address space. Only devices assigned to the same subnet can communicate directly with each other. The subnet mask determines which part of the IP address represents the subnet. This mask takes the form zzz.zzz.zzz.zzz. One of these numbers zzz can take any of these values: 255, 254, 252, 248, 240, 224, 192, 128, 0. The numbers before this number must be 255, all after it must be 0. Examples of valid subnet masks are:

255.255.255.0

255.255.255.240

255.240.0.0

The subnet mask must be entered besides the IP address.

Standard Gateway

If an IP device wants to communicate with other IP devices outside of its subnet this communication is directed through the standard gateway. This standard gateway can be e.g. a network router, a DSL modem, or a LAN modem.

IP Multicast Address

As with EIB group telegrams IP allows to transmit a datagram to several recipients at the same time. This so-called multicast form of IP communication requires that sender and recipient are member of the same Multicast Group and use the same Multicast Address as target address.

The Multicast Address 224.0.0.252 has especially been reserved for EIBnet/IP.

For general use in a network multicast addresses in the range from 239.0.0.0 to 239.255.255.255 may be used.

Glossary

DHCP

Abbreviation of "Dynamic Host Configuration Protocol" – communication protocol for automatic assignment of IP address settings

DNS

Abbreviation of "Domain Name Service" – assigns Internet names to IP addresses

DSL

Abbreviation of "Digital Subscriber Line" – fast communication over telephone lines between telephone subscriber and exchange

EIB

European Installation Bus – Standard for Building Controls

EIBA

EIB Association – Association of manufacturers of EIB products

IP

Internet Protokoll

OPC

Abbreviation of "OLE for Process Control" – this is a widely used interface for industrial and building automation

TCP/IP

Transmission Control Protocol over Internet Protocol – connection-oriented communication over the Internet

UDP/IP

User Datagram Protocol over Internet Protocol – connection-less communication over the Internet