

Communication in Ethernet Network

Abstract

The application note describes the setting of control system parameters for Ethernet communication option and data transfer between control systems by the company AMiT through Ethernet using the DB-Net/IP communication protocol.

Author: Zbyněk Říha
File: ap0006_en_04.pdf

Appendix

File content: ap0006_cz_02.zip

dbnetip_p1_cz_02.dso	A sample application with defined variables designed for communication.
dbnetip_p2_cz_02.dso	A sample application of communication using Ethernet.

Contents

1	Definitions of Terms.....	5
1.1	Network Topology	6
2	DB-Net/IP	7
2.1	Specific Features of DB-Net/IP	7
2.2	Data Transfer Rate.....	7
2.3	Options for Control System Connection into DB-Net/IP Network	8
2.3.1	Internal interface	8
2.3.2	Converter RS232 to Ethernet	8
2.3.3	Modem DM-GPRS	9
2.3.4	Radio transfer.....	9
2.4	Ways of Control System Connection into DB-Net/IP Network.....	9
2.4.1	Direct connection PC-control system.....	9
2.4.2	Connecting multiple control systems and PC into DB-Net/IP network.....	9
2.4.3	Connecting DB-NET segment into DB-Net/IP Network.....	10
3	Network Implementation.....	11
3.1	IP Configuration in Control Systems.....	11
3.1.1	IP Configuration of internal interface	12
3.1.2	IP configuration of the RS232 converter to Ethernet.....	13
3.1.3	IP configuration broadcast.....	14
3.2	Setting Communication on PC	17
3.2.1	Setting communication with control system in DetStudio	17
3.2.2	Setting communication with control system in ViewDet	20
3.3	Programming Control Systems.....	21
3.3.1	Communication Statuses.....	21
3.4	Connecting to Ethernet network	22
3.4.1	Ethernet line terms of use.....	22
4	Sample Communication in Ethernet Network	23
4.1	Application for control system 1	23
4.2	Application for control system 2.....	23
5	Routing into DB-Net network.....	25
5.1	Sample Routing into DB-Net network	25
6	APPENDIX A	28
6.1	Typical connection examples	28
6.1.1	Communication in a local network	28
6.1.2	Connecting PC into local network via Internet	29
7	APPENDIX B	31
7.1	Setting router for communication via Internet	31
7.2	Setting Communication in SW for Connection via Internet.....	32
8	APPENDIX C	33
8.1	IP konfigurace on PC	33
8.1.1	Connecting PC into a network with DHCP	34
8.1.2	Connecting PC into a network without DHCP	35
9	APPENDIX D	36
9.1	Troubleshooting in Case of Local Network Connection	36
9.1.1	System with integrated Ethernet interface	36
9.1.2	System with converter DM-232TOETH.....	36

9.2	Troubleshooting in case of Internet connection	36
10	APPENDIX E	37
10.1	Communication with dynamic / private IP address	37
10.1.1	Example of control system parametrization	37
10.1.2	Example of PC parametrization	38
10.1.3	Example of router parametrization.....	39
11	Technical Support.....	40
12	Warning.....	41

Revision history

Version	Date	Changes
001	21. 09. 2007	New document.
002	15. 02. 2010	Chapter 3.3 modified, password processing corrected, the halfduplex option removed in the converter 232<->Eth, a note in Chapter 3.3.1 complemented, Appendix D amended.
003	30. 07. 2012	Images updated, Chapter 10 APPENDIX E modified, applications created in DetStudio 1.7.2.
004	03. 03. 2014	Table of contents updated – Chapter 10 was not included.

Related documents

1. Help section for DetStudio development environment
File: DetStudioHelp.chm
2. Application note AP0004 – Communication in GSM/GPRS network
File: ap0004_en_xx.pdf
3. Application note AP0009 – Communication in DB-Net network
File: ap0009_en_xx.pdf
4. Application note AP0011 – Connecting radiomodems CONEL/RACOM
File: ap0011_en_xx.pdf
5. Application note AP0037 – Ethernet network – Terms of Use
File: ap0037_en_xx.pdf

1 Definitions of Terms

IP address

It is the address of the device interface (PC or a control system) in networks Ethernet and Internet. Each device in the network must have its unique IP address in the “given network”. **There are static, dynamic, public and private IP addresses.** The address value is a 32-bit number. Addresses are written in individual bytes separated by fullstops (e.g. 192.168.1.250).

Static IP address

It is an IP address allocated by the internet connection provider who also guarantees its value during the entire connection time.

Dynamic IP address

It is an IP address the value of which is not guaranteed by the provider and the provider changes its value according to their own needs. Therefore, the dynamic IP address value may change with each connection made into the network.

Public IP address

It is an IP address visible from anywhere on the Internet. At the same time, a public IP address represents a certain risk due to possible attacks of viruses and hackers.

Private IP address

It is an IP address only visible within a local network. Part of the IP address space is reserved for private networks where devices connected have private IP addresses. Such networks are connected to the Internet through a router with a public IP address. A device with a private IP address is not directly visible from the Internet and any communication from/to the Internet is carried out via router.

Local network

It is a network of devices with IP addresses that can “hear” each other (see network mask). Communication with another local network is possible only through a default gateway. The local network may be either private or part of a public network.

Public network

It is a network in a device with IP addresses and unlimited access. This network is freely accessible from other networks. Therefore, its security is very low.

Private network

It is a network in a device with IP addresses and limited access. Only devices within the network are able to communicate with each other which provides the highest level of security. In private networks, IP addresses need to be assigned so as to fall within a special range of addresses (see chart). Addresses within this specified range are not used anywhere else on the Internet, network elements (routers) automatically assume that they concern communication within private networks and do not route their data into the Internet. The following chart states the aforementioned address ranges:

Network type	Range – From	Range – To	Number of IP addresses
A	010.000.000.000	010.255.255.255	16 777 216
B	172.016.000.000	172.031.255.255	1 048 576
C	192.168.000.000	192.168.255.255	65 535

Network mask

It is a bit mask that determines what IP addresses belong or not belong into a local network. In order for IP addresses to belong into one local network, they must match in positions where there is bit 1 in the network mask. Addresses may differ in positions where there is bit 0 in the network mask.

UDP Protocol

This protocol transfers packets between computers in the network, but unlike TCP it does not guarantee that the packet transferred does not get lost, or that the packet order does not change or that a packet gets delivered multiple times. This makes UDP faster and more efficient for undemanding and time-pressure purposes.

Network port

It is a special number (0 to 65535) used during communication in computer networks (e.g. using TCP and UDP protocols) to distinguish applications within the computer. (Each application uses its own assigned port).

UDP port

It is a network port used for communication through UDP protocol.

Gateway

The address of the default gateway through which the local network communicates with other networks (Internet).

Password

A security password used to encrypt data during communication in the DB-Net/IP network.

DB-Net segment

A network of control systems communicating by means of the DB-Net protocol (communication by means of serial lines). In case of this AP, we can presume that at least one of them is active and has an Ethernet interface.

Station

Control system or PC in the network DB-Net/IP (DB-Net).

1.1 Network Topology

Ethernet networks allow use of basically any topology (apart from ring network). At present, the star topology is the most frequent; find an example of one in the following image.

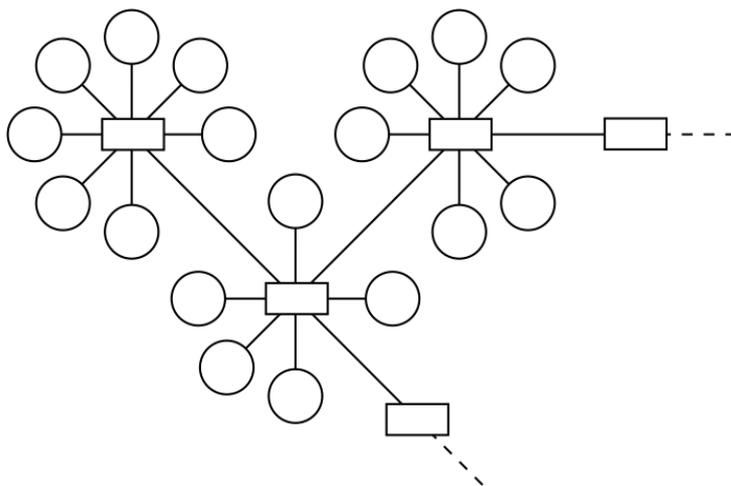


Fig. 1 – Star topology of Ethernet network

Individual PC or control systems are always connected in one point with an active element (e.g. an Ethernet switch). These active elements are usually connected to others, forming a complex network structure.

2 DB-Net/IP

Communication between control systems by means of Ethernet is carried out using the system DB-Net/IP. It is a set of technical and program means allowing integration of AMiT control systems directly into intranet networks. The DB-Net/IP system philosophy is based on technologies that are commonly available and verified today in the environment of the Internet public network with emphasis on providing additional attributes, specific in the field of industrial automation, such as data transfer reliability, robustness and reliable service and supervision.

The DB-Net/IP network uses transfer technology Ethernet and communication protocols from the protocol family TCP/IP (**communication is carried out by means of UDP packets**). This allows connecting control networks as well as PC in one network. The DB-Net/IP network retains all basic features of DB-Net protocol (see AP0009 – Communication in DB-Net Network) with possible addition of IP attributes in existing DB-Net networks.

The technology used allows you to create almost unlimitedly extensive network structures with the option to use intranet and Internet technology.

DB-Net/IP allows remote or local

- ◆ visualisation
- ◆ supervision
- ◆ diagnostics
- ◆ control system parametrization
- ◆ application program download

Note:

As far as reliability and security is concerned, it is advisable to separate office company networks from technological networks.

2.1 Specific Features of DB-Net/IP

Authentication

DB-Net/IP allows primary data protection through encryption. Using encryption increases security of transferred data. During communication, the party issuing a request needs to know receiver's correct password, otherwise the receiver will ignore the communication.

Application program download

Same as the DB-Net protocol, DB-Net/IP allows remote loading of application programs into control systems, their remote service and diagnostics.

Direct connectivity

Control systems can be directly connected without the necessity to communicate with PC.

Routing into DB-Net networks

The DB-Net/IP also allows communication with control systems connected in DB-Net segment (e.g. using RS485). DB-Net/IP defines such a control system with its number (set e.g. using DIP switches designated SW) and by the IP address of the system connected into Ethernet network. For more information see Chapter "5 Routing into DB-Net network".

2.2 Data Transfer Rate

Data transfer in the DB-Net/IP network is always performed in the form of requests. Each control system (or PC) sending or requesting data issues a request and awaits a response. However, the

time between issuing the request and receiving a response is not specifically defined in Ethernet networks and it depends on current network load and status.

In control systems, communication speed depends on the operating system version (NOS) and on the control system type, as the following chart shows.

NOS version	Communication speed	
	Basic types of control systems CPU C167	Control systems designated S CPU ST10F269
Up to 03.50	19,200 bps	76,800 bps
From 3.50 (incl.)	76,800 bps	192,000 bps

The maximum number of requests communicated in 1 s is in the following chart.

NOS version	Number of request per 1 s			
	Basic types of control systems CPU C167		Control systems designated S CPU ST10F269	
	Recommended number	Theoretically possible number	Recommended number	Theoretically possible number
Up to 03.50	25	50	100	200
From 3.50 (incl.)	100	200	250	500

Attention

Exceeding the recommended number of request may result into higher control system load which is undesirable in applications requiring time.

Issuing a number of requests approaching the theoretical value represents a risk that some will not manage to get through! The number of requests communicated also depends on how much the control system is loaded with other communications and on the actual control system's workload.

Recommendation

*If you use communication by means of Ethernet and by means of serial lines (RS232/RS485) simultaneously, we recommend setting serial line transfer speed (for NOS version 3.50) to 38,400 bps. Lower rate would cause conflict with Ethernet communication, and the rate 57,600 bps overloads the control system processor. **These limitations do not apply for versions above NOS 3.50.***

2.3 Options for Control System Connection into DB-Net/IP Network

2.3.1 Internal interface

Some AMiT control systems are equipped with Ethernet interface by default. These control systems can be connected into Ethernet communication network without any additional devices. However, it is necessary for the applicator in the control system to set the IP configuration.

2.3.2 Converter RS232 to Ethernet

Control systems not equipped with Ethernet interface can be connected into such network by means of the RS232 converter to Ethernet by the company AMiT. The actual communication between the control system and the converter is carried out on the line RS232. The RS232 interface receives and sends IP packets using the APE company protocol. The APE protocol is supported by control systems with operating system NOS from version 3.24. Converter parametrization is performed independently from the control system. However, it is necessary for the applicator to set the IP address, gateway and the network mask directly in the control system. These parameters are sent to the converter after it connects to the control system.

2.3.3 Modem DM-GPRS

To communicate with control systems by the company AMiT using DB-Net/IP, you can also use GPRS modem **DM-GPRS** (also made by AMiT) connected to the control system using the line RS232 (**the control system needs to have NOS version 3.40 or higher**). More information on application of the modem **DM-GPRS** is available in AP0004 – Communication in GSM/GPRS network.

2.3.4 Radio transfer

DB-Net/IP can also be used for communication in radio networks. For more information see AP0011 – Connecting radiomodems CONEL/RACOM.

2.4 Ways of Control System Connection into DB-Net/IP Network

2.4.1 Direct connection PC-control system

This type of connection allows communication with one control system only. To make the connection, you need **Ethernet crossover cable** with RJ45 connectors. This connection is rather for emergency purposes and allows adjusting and services from a laptop using its network card, no other devices are necessary.



Fig. 2 – Direct connection between the control system and PC

2.4.2 Connecting multiple control systems and PC into DB-Net/IP network

When connecting multiple stations into Ethernet network during network building a **direct Ethernet cable** with connectors RJ45 is used, and a corresponding Ethernet device (switch, router, etc.). After connecting the cables, we must configure the PC according to the customs of the network we are connecting to, and subsequently set the communication according to parameters assigned in the control system.

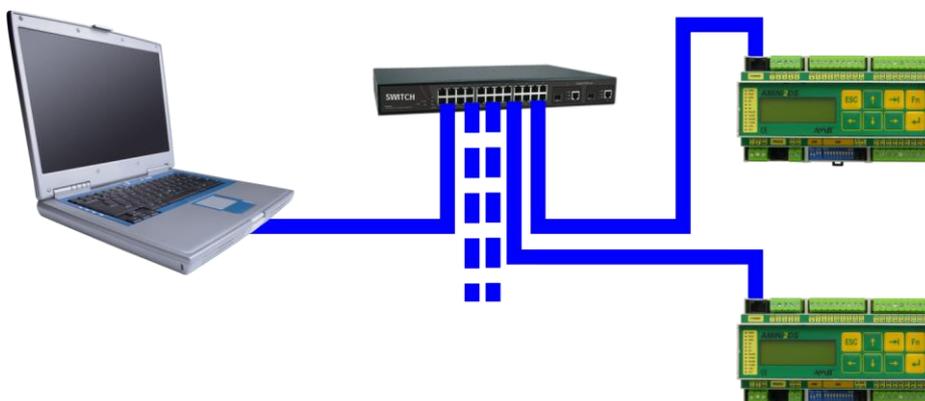


Fig. 3 – Connecting more stations into the network

2.4.3 Connecting DB-NET segment into DB-Net/IP Network

DB-Net/IP allows communication with the whole DB-Net segment (control systems communicating e.g. by means of RS485). This is so-called routing into DB-Net network. For more information on routing into DB-Net network see Chapter “5 Routing into DB-Net network”.

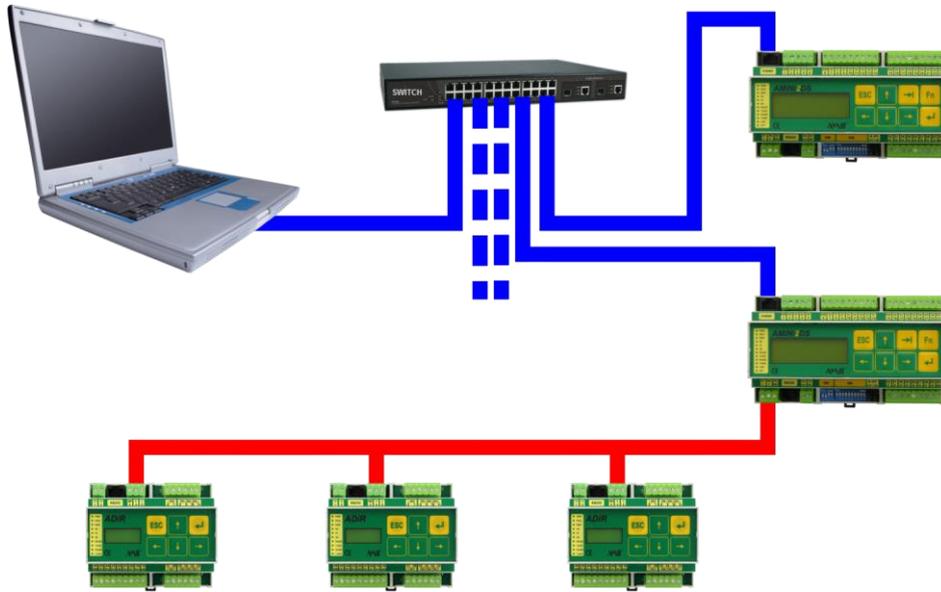


Fig. 4 – Routing into DB-Net network (RS485)

3 Network Implementation

In order to provide quality and reliable connection to Ethernet network, we need to take the following steps:

- ◆ Set IP configuration in control systems.
- ◆ Set IP configuration of PC (possibly selecting the communication interface in programs on PC).
- ◆ Programming control systems communication (if control systems will communicate with each other).
- ◆ Connecting into Ethernet network (connect the cables correctly and connect individual devices in Ethernet network).

3.1 IP Configuration in Control Systems

Control systems by the company AMIT are manufactured without pre-set IP configuration (it is necessary to set it manually). **Control systems need to have a static IP address assigned.**

Attention

Attention! The operating system NOS in the control systems has to be version 3.40 or higher. The transfers may not work correctly with lower NOS versions.

The best way to set IP configuration is by means of some of the serial lines the control system is provided with (see Helps section of the **DetStudio** development environment). The actual IP configuration can be carried out in the **DetStudio** development environment using the service environment called **ViewDet**. When using the **DetStudio** development environment, proceed as follows:

After connecting the control system to PC and successfully establishing communication via serial line, select menu **Communication/IP Configuration**.

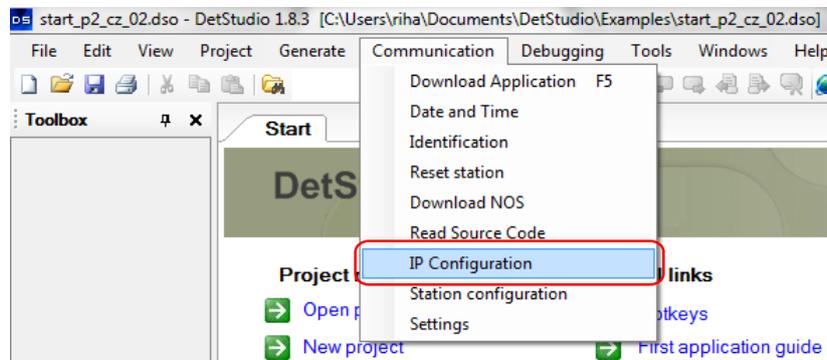


Fig. 5 – Setting IP configuration in DetStudio

After clicking this option, the window **IP Configuration Settings** pops up in case the connection with the control system was successful.

In case the control system is equipped with Ethernet interface, the window will look as follows (in case there is no Ethernet interface in the control system, the chart does not show the item **Internal Interface configuration**).

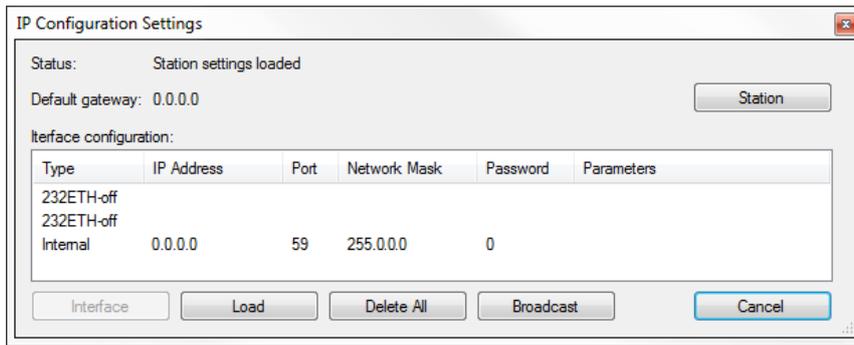


Fig. 6 – Default IP configuration setting

By clicking the button **Station** you summon the window **Station configuration**, in which you set the IP address of the default gateway (the administrator of the given network will tell you about the gateway). In case we do not require communication with the control system outside the local network, we may leave this box empty. If the default gateway's address is 192.168.168.1, we fill in the individual boxes in the windows according to the following image and confirm everything by clicking the button **Save**.



Fig. 7 – Setting the default gateway

3.1.1 IP Configuration of internal interface

In the chart **Interface configuration** of the window **IP Configuration Settings**, click on the item **Internal** and then click the button **Interface**. The window **Station configuration** pops up. In this window, we set the required parameters (e.g. according to the following image). Confirm everything by clicking the button **Save**.

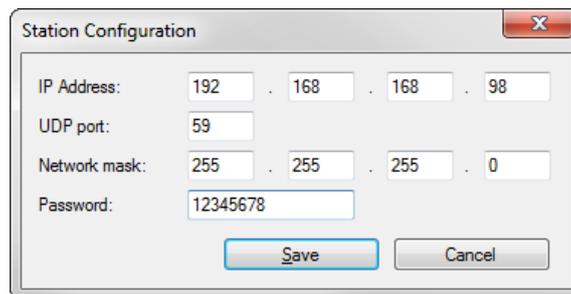


Fig. 8 – IP Configuration of internal Ethernet interface

After the save (in case you set all the aforementioned parameters correctly), the window **IP Configuration Settings** will look like the following image.

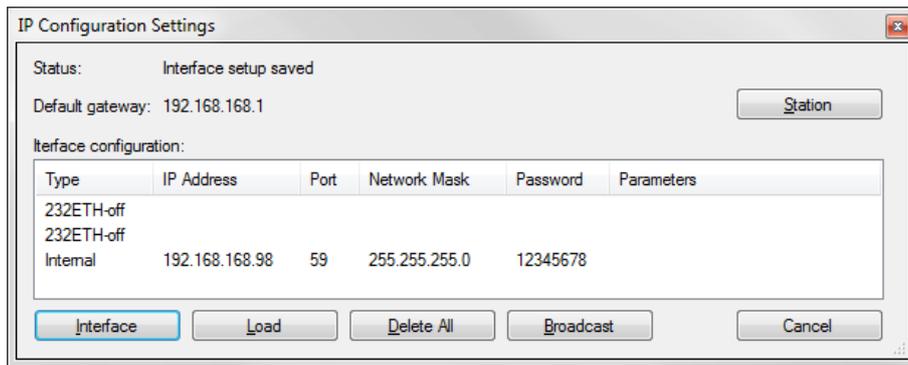


Fig. 9 – An internal IP address set successfully

3.1.2 IP configuration of the RS232 converter to Ethernet

In the chart **Interface configuration** of the window **IP Configuration Settings**, click on the item **232 ETH-off** and then click the button **Interface**. The window **Station configuration** pops up. In this window, we set the required parameters (e.g. according to the following image). Confirm everything by clicking the button **Save**.

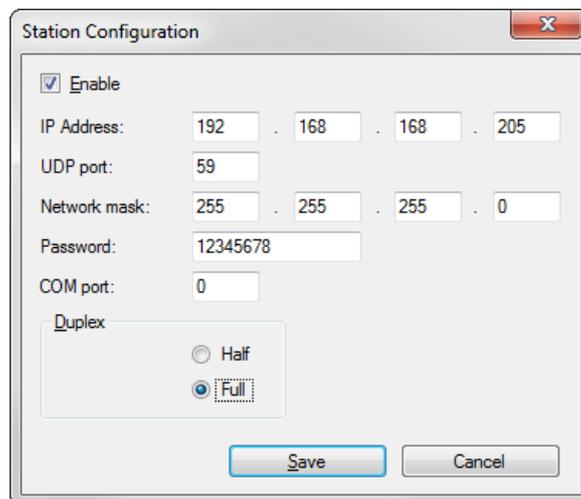


Fig. 10 – IP configuration of the RS232 converter to Ethernet

We select the communication mode using a converter by selecting the item **Duplex**. Usually, the converter is connected to the control system using the line **RS232** and the mode **Full** is selected.

Note:

*The converter communicates with the control system by means of APE protocol. This protocol can be set in any serial interface of the control system by means of the item **COM Port** of the window **Station configuration**.*

After the save (in case you set all the aforementioned parameters correctly), the window **IP Configuration Settings** will look like the following image.

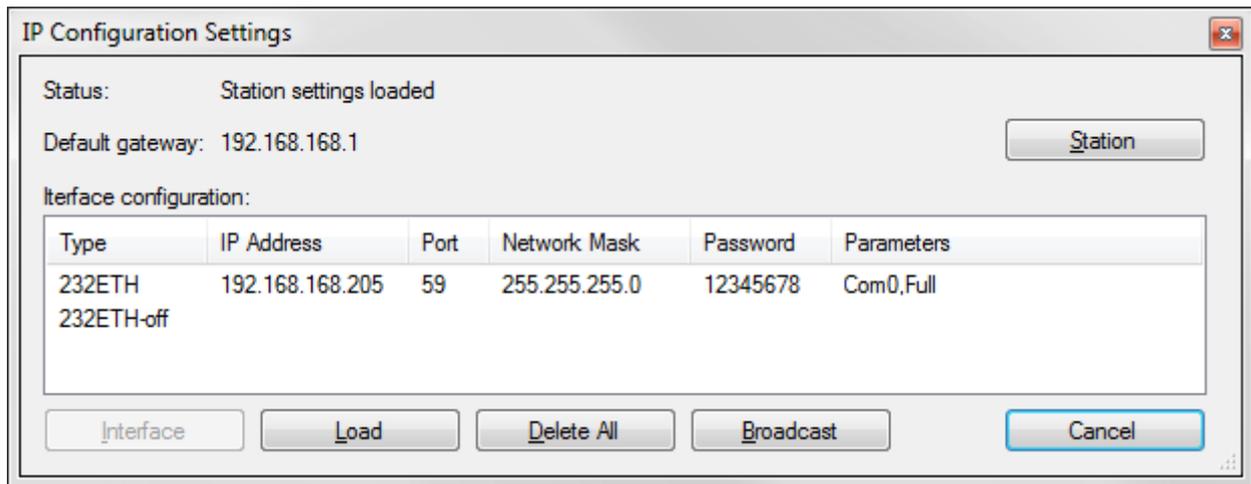


Fig. 11 – IP configuration of the RS232 converter to Ethernet set successfully

Attention

If the converter **RS232 to Ethernet** is configured to COM0 interface (or to line RS485 of the control system), it is not possible to communicate with the control system any more in the given interface using the DB-Net protocol (only one communication protocol can operate in one communication interface). In case you will need to communicate with the control system through the given interface using DB-Net, it is necessary to shut down the course of the application. You can do this by switching the SW of switch No. 9 to the position OFF (or by setting the item “Aplikace” in service menu to status “Blokovat”) and restarting the control system.

3.1.3 IP configuration broadcast

Using the window **IP Configuration Settings**, you can also summon the so-called broadcast. This is used in case the existing IP configuration of the control system is incompatible with the host IP network (e.g. the configuration is zero or contains data for an entirely different network), but you still need to communicate with the control system and configure it using Ethernet. That is why it is necessary to set valid communication parameters in the control system first by means of broadcast.

The necessary pre-requisite is knowledge of the previous (changed) IP configuration of the interface. If it is unknown to us, we cannot perform the change by means of broadcast and we have to use RS232/485.

If the broadcast is to succeed, it requires that stations and PC were connected in the same local network; otherwise, the broadcast will probably fail. It is because most computers giving access to various local networks to each other implicitly do not allow broadcasting from one network to another (so-called multicast, or more specifically directed broadcast). Although DetStudio will correctly attempt to send a “multicast” packet, it is very probable that the target network gateway will ignore the packet and will not distribute it in the target network. In such case, it is necessary to connect PC into the same local network as the control system, or to connect to the control system using RS232/485 and configure it in this communication interface.

Say we have e.g. a control system with a set IP address 10.0.0.2 (communicating on UDP port 59), that we need to connect to a network with IP address range 192.168.168.XXX and set IP address 192.168.168.98 in it using the internal Ethernet interface. The control system configuration will be performed in the DetStudio development environment.

Connect the control system into the new communication network and set the communication parameters according to the following image in the DetStudio; main menu **Communication / Settings**.

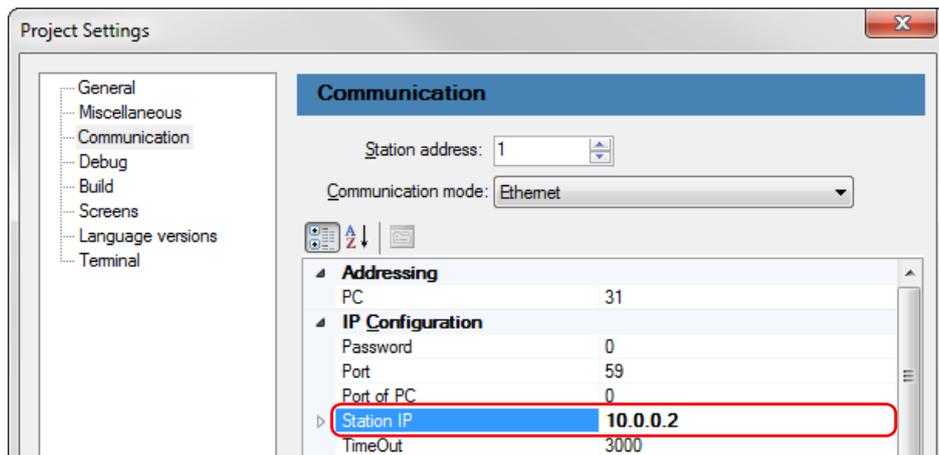


Fig. 12 – Setting communication parameters for broadcast IP configuration

Confirm the setting and use the main menu **Communication/IP configuration** to summon the window **IP Configuration Settings**.

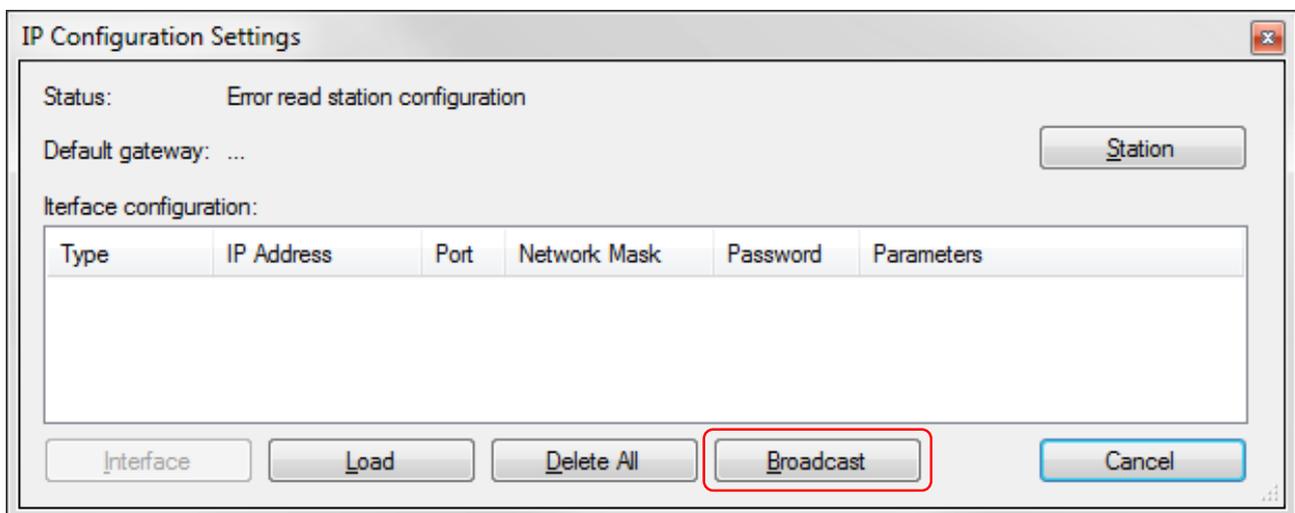
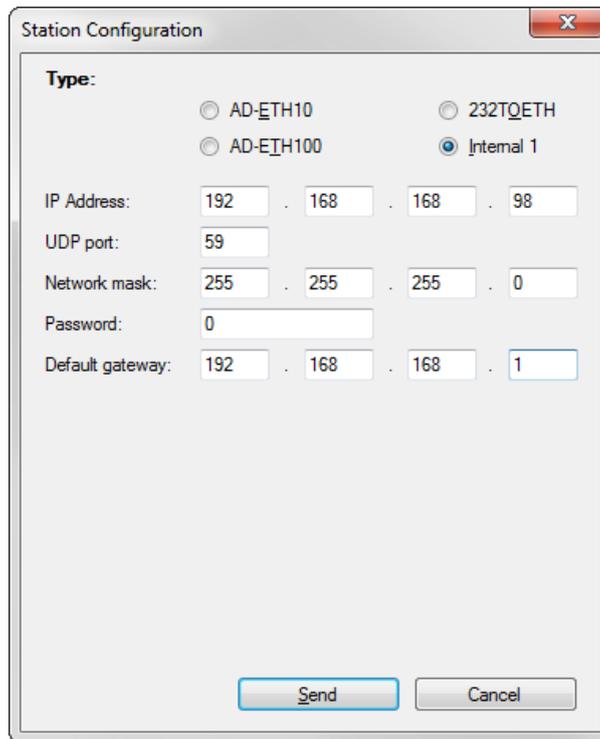


Fig. 13 – The button Broadcast in the window IP Configuration Settings

The IP configuration loading will terminate with the error of reading the control system configuration because the control system has an IP address set that does not correspond to the network to which it is connected.

Click the button **Broadcast** and summon the window **Station configuration**. In this window, select the type of the control system interface you want to configure using broadcast and enter its IP configuration required.



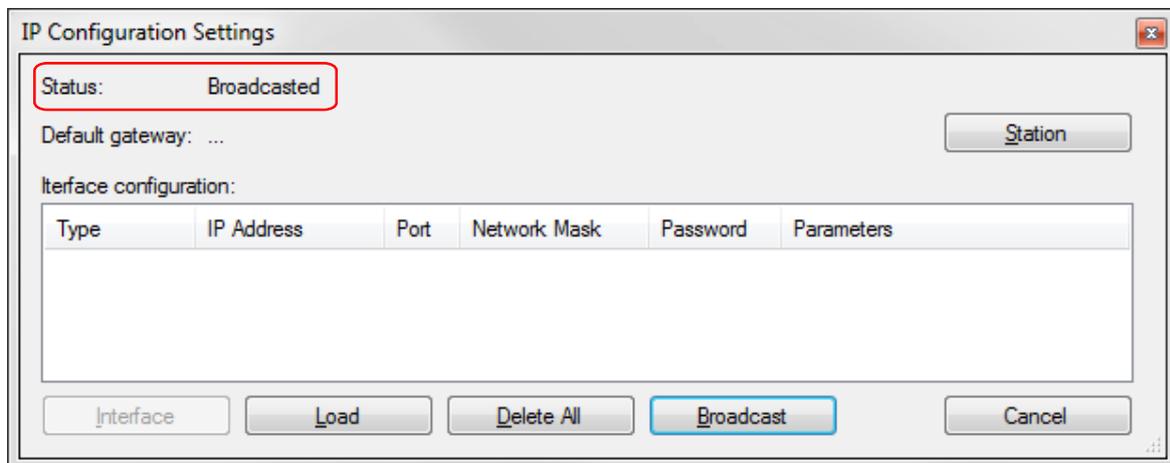
The 'Station Configuration' dialog box is shown with the following settings:

- Type: AD-ETH10, 232TOETH, AD-ETH100, Internal 1
- IP Address: 192 . 168 . 168 . 98
- UDP port: 59
- Network mask: 255 . 255 . 255 . 0
- Password: 0
- Default gateway: 192 . 168 . 168 . 1

Buttons: Send, Cancel

Fig. 14 – Setting IP configuration of internal interface for broadcasting

After you send the configuration parameters, click the button **Send**. The window **Station configuration** will close and the window **IP Configuration Settings** will inform you whether the broadcast configuration was sent or not.



The 'IP Configuration Settings' dialog box shows the following information:

- Status: Broadcasted
- Default gateway: ...
- Interface configuration table:

Type	IP Address	Port	Network Mask	Password	Parameters

Buttons: Interface, Load, Delete All, Broadcast, Cancel

Fig. 15 – Sending broadcast configuration

Attention

This message only informs you that the broadcast configuration has been sent. However, it does not provide information whether the control system has been configured successfully or not.

After broadcasting the configuration, use the button **Cancel** to close the window **IP Configuration Settings** and set new configuration parameters for the control system in the main menu **Communication / Settings**.

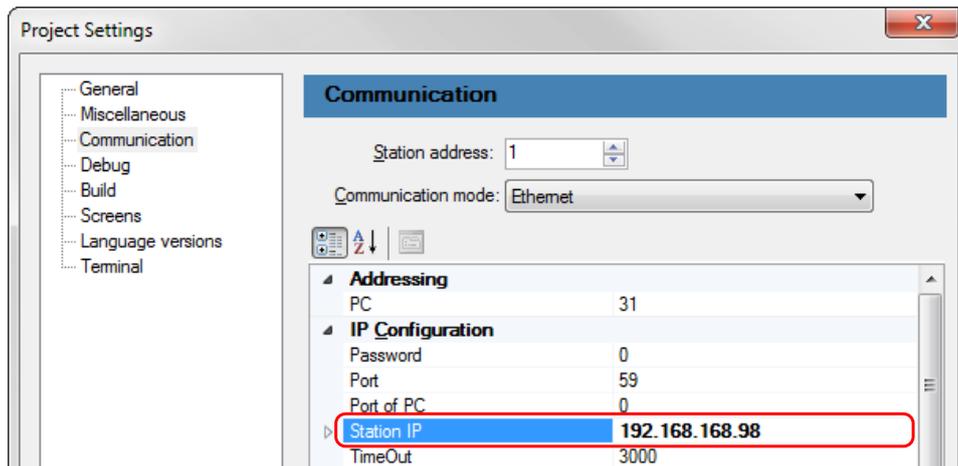


Fig. 16 – Setting communication parameters according to broadcast configuration

Note:

Station with blank (implicit) configuration has IP configuration equal to 0.0.0.0:59, password 0.

3.2 Setting Communication on PC

3.2.1 Setting communication with control system in DetStudio

If the control system has IP configuration set correctly (see Chapter “3.1 IP Configuration in Control Systems”) and a PC by means of which we want to communicate with the control system, it belongs to the same network as the control system (see APPENDIX C), we can establish communication from DetStudio according to the following process:

We select the menu **Communication / Settings**.

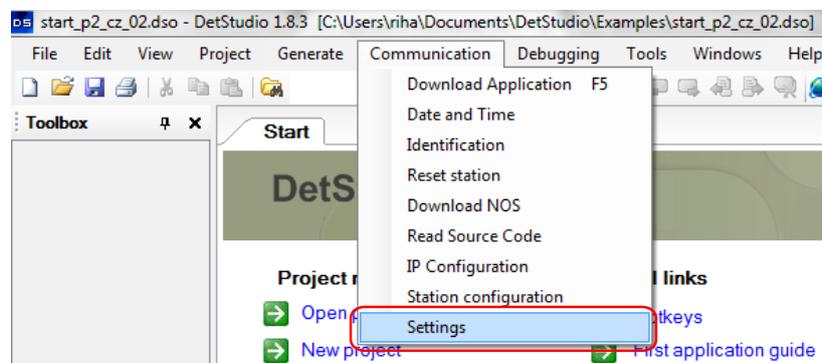


Fig. 17 – DetStudio menu for communication setting

The window **Project Settings** opens with a selected item **Communication**, in which we select the item **Ethernet** from the drop-down menu **Communication mode**.

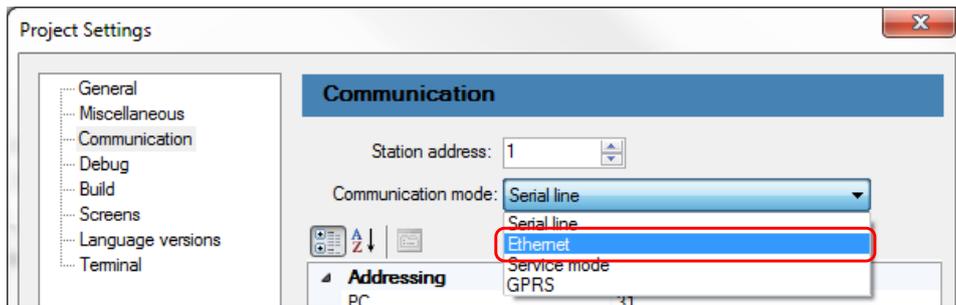


Fig. 18 – Selecting Ethernet interface

Then we fill the individual boxes with the same data we entered when setting IP configuration of the control system (see Chapter “3.1 IP Configuration in Control Systems”).

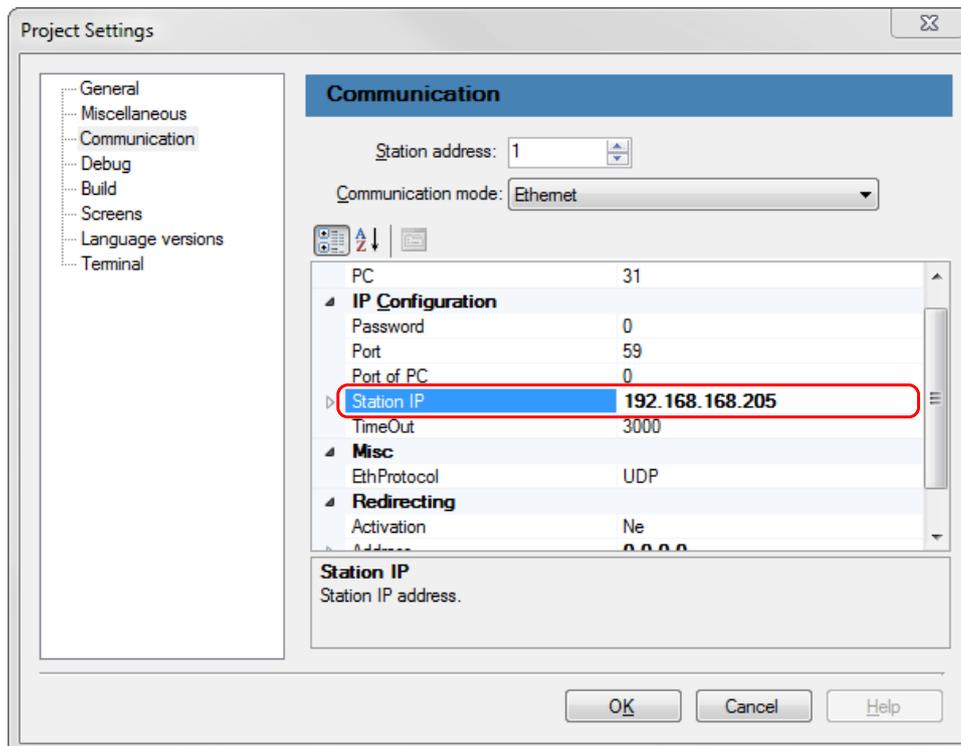


Fig. 19 – Setting communication parameters for Ethernet

The individual items are explained below:

PC

Number of PC within the DB-Net/IP network.

IP Configuration / Password

Password for encryption. Its value must match the password set during IP configuration of the control system, otherwise communication will fail.

IP Configuration / Station IP

IP address of the control system we want to communicate with. It must match the IP address set during IP configuration of the control system.

IP Configuration / Mask

Network mask. May remain in default status.

IP Configuration / Offset

Offset of the control system number compared to the number set on its SW DIP switch. May remain in default status.

IP Configuration / PC password

PC password for potential access from a different station on PC. May remain in default status.

IP Configuration / Port of PC

UDP port used in the PC. If the network administrator does not specify otherwise and we are not limited by a firewall, it may remain in default status.

IP Configuration / Port

Control system UDP port. It must match the UDP port set during IP configuration of the control system.

IP Configuration / TimeOut

The communication timeout. After it expires, the network is considered impenetrable and the communication will be marked as error. May remain in default status.

Redirecting / Address

We communicate with this address if the forwarding mode is on.

Redirecting / Activation

Enabling / disabling forwarding.

Redirecting / Port

UDP port we communicate with if the forwarding mode is on.

Attention

The item **Redirecting** is not used during communication within the local network. The item is designed for communication outside the local network (see APPENDIX A).

After setting the parameters, we confirm the configuration window and attempt to perform control system identification using the main menu **Communication / Identification**.

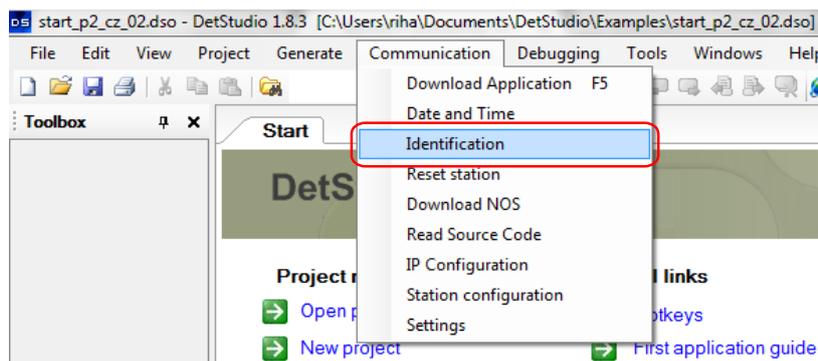


Fig. 20 – Verifying the communication using control system identification

In case the communication has been set correctly, a window with control system identification pops up (see Help section of DetStudio development environment).

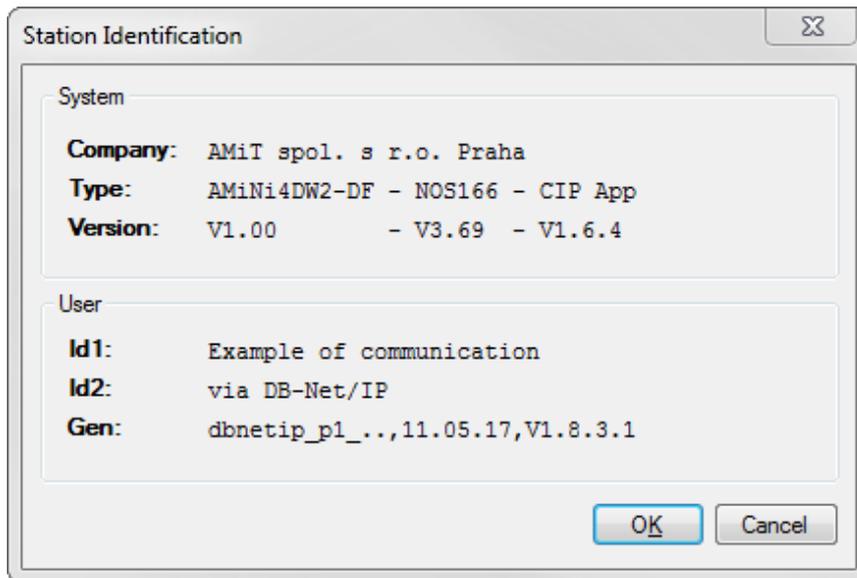


Fig. 21 – Control system identification window

If communication with the control system has been established successfully, you may use the DetStudio development to adjust applications in the same way as if the control system was directly connected to RS232 (classic DB-Net). The only limitation is in NOS loading; that it can only be loaded using the COM0 interface on the control system.

3.2.2 Setting communication with control system in ViewDet

If the control system has IP configuration set correctly (see Chapter “3.1 IP Configuration in Control Systems”) and a PC by means of which we want to communicate with the control system, it belongs to the same network as the control system (see APPENDIX C), we can establish communication from ViewDet according to the following process:

Double-click with the left mouse button in the window **Project** on the profile with which you want to communicate in Ethernet.

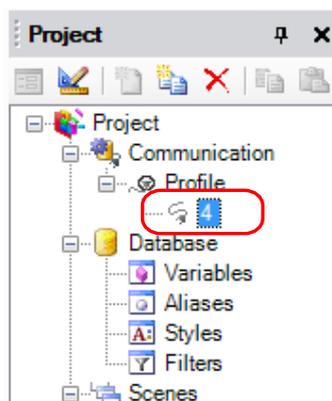


Fig. 22 – Selecting the communication profile

The window **Edit params of station** pops up in which we select **Connection type: Ethernet** and in the bookmark **Station** we enter the same data we entered when setting IP configuration of the control system (see Chapter “3.1 IP Configuration in Control Systems”).

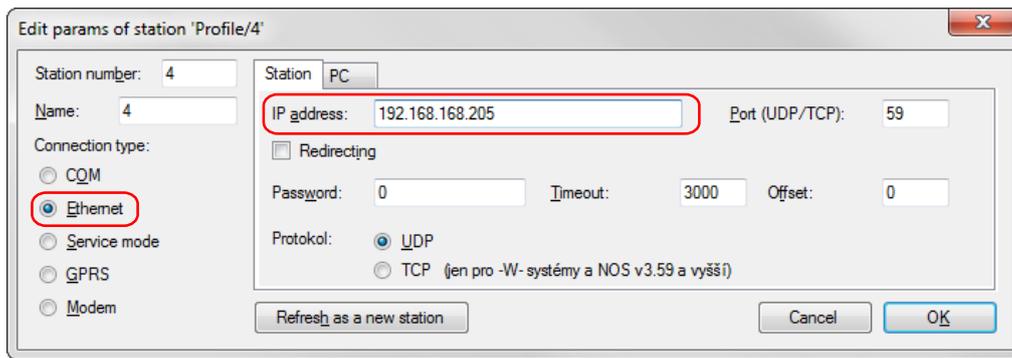


Fig. 23 – Setting communication parameters for Ethernet

Data pre-set in the bookmark **PC** may remain in the default status.

After setting the parameters, we confirm the configuration window and attempt e.g. to load variables from the control system. If the load is successful, we can use the environment to display and edit variables located in the control system as if the control system was directly connected to RS232 (classic DB-Net).

Meanings of individual items for communication setting in the DetView environment is the same as in DetStudio (see Chapter “3.2.1 Setting communication with control system in DetStudio”).

3.3 Programming Control Systems

Should control systems communicate with each other without any PC interference, it is necessary to program this communication using the DetStudio development environment. Reading/writing data using Ethernet is performed by means of SW modules `EthXXX`. Individual module descriptions are available in the Help section of DetStudio development environment.

- ◆ `EthDynSnd` – Request for transfer of information on the IP address where the control system is available for communication.
- ◆ `EthNetSeg` – defines another remote station (or a group of stations) on Ethernet that is available for communication by means of modules `EthReqDb` or `EthRqDbDr`.
- ◆ `EthReqDb` – request for transfer of the database variable in Ethernet network.
- ◆ `EthRqDbDr` – request for transfer of the database variable in Ethernet network. It differs from the `EthReqDb` module by the fact that its parameters can be entered using variables.
- ◆ `EthRoute` – definition of static routing
- ◆ `EthState` – resets the status of remote station on the DB-Net segment defined by the module `EthNetSeg`.

Note:

In case the control system does not actively initiate communication in the DB-Net/IP network (but only responds to potential queries in the network); it is not necessary to program the control system any further. In such a control system, performing IP configuration is sufficient.

3.3.1 Communication Statuses

You can get status and result of communication of data requested using parameters `RqState` and `State` of communication modules `EthReqDb` and `EthRqDbDr`. If we substitute variables type Integer for these parameters, they will get various values depending on the current communication status. We recommend using parameters `Vložení` and `Stav` especially when adjusting the communication, when you are able to get information on possible communication error on the basis of their values.

Attention

The status variables serve to provide information on the communication status and result. The application should not write anything into variables substituted for parameters `RqState` and `State`.

At the same time, it is necessary that each module *EthReqDb/EthRqDbDr* uses its own status variables. The variable substituted for the parameter *State* must not be shared by multiple modules.

Entering a request for serial transfer

Value	Meaning
1	Request issued – no error.
2	Request not issued because there was an identical request earlier that is still pending.
4	Request not issued because the request buffer is full.
8	Request not issued because: 1) this station is the owner of the database variable requested or 2) the transfer of database matrix VYŘEZ is requested that exceeds the dimensions of the matrix or 3) the local variable has a different data type than the one defined by the communication module (only for modules for direct transfer of variables).
18	The request not issued because transfer in Ethernet is requested and no functional interface is available (Ethernet card).

Request status

Bit	Meaning
0	Has value 1 if communication is taking place.
1	Has value 1 if last communication terminated was finished successfully.
2	Has value 1 if last communication terminated was finished with an error.
3	Has value 1 if the request was split into multiple frames and transfer of one of the frames ended in an error and other frames are still being communicated.
12 to 15	If the communication ended in an error (bit 0 has value 0 and bit 2 has value 1), these bits contain the communication error codes according to the following chapter. Values of these bits are not otherwise specified.

Error codes in bits 12 to 15

Value	Meaning
1	Transfer error (check sum, invalid frame control character, ...).
2	Wrong WID, type or dimension of the remote station database variable. Error in database parametrization, variable definitions differ in this and remote station.
3	The remote station does not support the function requested.
4	Unknown error.
5	The remote station has not responded.
7	The remote station responded with an incorrect frame type.

3.4 Connecting to Ethernet network

Ethernet activity is indicated by means of LED (LNK and ACT) on the control system. The LNK diode indicates Ethernet is connected to the control system and diode ACT indicates data transmission or reception.

3.4.1 Ethernet line terms of use

- ◆ Maximum segment length 100 m.
- ◆ Maximum number of stations in the network is unlimited.
- ◆ To increase the function reliability, we recommend using network components designed for industrial operation, not for office applications.

More information is available in Application note AP0037 – Ethernet network – Terms of Use.

4 Sample Communication in Ethernet Network

Communication is laid out between two control systems numbered 1 and 2. The control system 2 reads/writes variables from/to the control system 1. The communication takes place within a local network.

IP Configuration in Control Systems:

Control System 1		
IP address	Mask	Port
192.168.168.201	255.255.255.0	59
Control System 2		
IP address	Mask	Port
192.168.168.202	255.255.255.0	59

4.1 Application for control system 1

In control system 1, there are variables defined that we would like to read as well as variables into which we would like to write. The control system itself will not actively initiate communication.

Variables defined in control system 1

Name	WID	Type	Station	Comment
Read	1000	L	1	Variable to be read
Entry	1001	F	1	Variable into which we will write
Matrix	1002	MF[5,3]	1	Matrix to be read

The application with defined variables is included in the file ap0006_cz_02.zip. It is a sample project called dbnetip_p1_cz_02.dso created in the DetStudio development environment. This project is created for the control system **StartKit**. However, it can be changed for any other control system provided with Ethernet interface (or a control system with connected converter RS232 to Ethernet) by means of DetStudio menu "Tools / Change station".

4.2 Application for control system 2

Before we actually enter the request for reading/writing, the program checks (based on bit no. 0 variables substituted for parameter Stav) whether an identical request has been entered previously and whether it is being communicated at the moment. If not, the request for reading/writing is entered.

Use of EthReqDb

In control system 2, we define two variables with any WID but the same data type that we would like to communicate (variable Cteni and variable Zapis). Furthermore, we define variables for communication request assessment, requested variables communication status and the variable into which the communication status with the remote segment (control system) will be saved.

Name	WID	Type	Station	Comment
Read	2000	L	2	Variable to be read.
Entry	2001	F	2	Variable into which we will write.
Read_Stat	2501	I	2	Variable "Read" – status of the communication.
Read_Put	2502	I	2	Variable "Read" – status of the entered request.
Entry_Stat	2503	I	2	Variable "Entry" – Status of the communication.
Entry_Put	2504	I	2	Variable "Entry" – Status of the entered request.
SegStat	2500	I	2	Status of communication with a remote segment.

We establish an INIT process in which we define the segment (remote control system with which we want to communicate using Ethernet). Therefore, we enter the following code into the INIT process:

```
:01000 EthNetSeg 0xC0A8A8C9, 59, 0, 5000, 0x00000002, SegStat
      L Remote control systems IP (192.168.168.201)
```

Now, all we have to do is enter the following code into a periodic process with a suitable period:

```
//mode read
If Read_Stat.0
  //The communication is not called when reading is active
Else
  EthReqDb :01000, 0x0000, 1, Read[0,0], 1, 1, 1000, Read_Put, Read_Stat
      L Remote control systems number
      L WID of variable (read)
      L Read
EndIf
//mode write
If Entry_Stat.0
  //The communication is not called when writing is active
Else
  EthReqDb :01000, 0x0001, 1, Entry[0,0], 1, 1, 1001, Entry_Put, Entry_Stat
      L Remote control systems number
      L WID of variable (write)
      L Write
EndIf
```

Use of EthRqDbDr

The module `EthRqDbDr` differs from the module `EthReqDb` by the fact that its parameters can be entered using variables.

In the following example, we will use the module `EthRqDbDr` to read matrix MF with WID 1002 from the control system 1. Therefore, we establish the following variables:

Name	WID	Type	Station	Comment
Matrix	2002	MF[5,3]	2	Matrix to be read
H_Row	2505	I	2	The initial row where the reading starts.
H_Col	2506	I	2	The initial column where the reading starts.
H_Rows	2507	I	2	Number of rows we want to read.
H_Cols	2508	I	2	Number of columns we want to read.
Mtx_Stv	2509	I	2	Matrix communication status.
Mtx_Vlz	2510	I	2	Status of the entered (Vložení) request to read the matrix.

Then we enter the following code into a periodic process with a suitable period:

```
If Mtx_Stat.0
  //The communication is not called when reading is active
Else
  EthRqDbDr :01000, 0x0000, 1, NONE, 1002, NONE, 5, NONE, 0, h_Row, 0,
  H_Col, 0, h_Rows, 0, h_Cols, Matice, 0, NONE, 0, NONE, Mtx_Put, Mtx_Stat
EndIf
```

The application using `EthReqDb` as well as `EthRqDbDr` is included in the file `ap0006_en_04.zip`. It is a sample project called `dbnetip_p2_cz_02.dso` created in the DetStudio development environment. This project is created for the control system **StartKit**. However, it can be changed for any other control system provided with Ethernet interface (or a control system with a connected converter RS232 to Ethernet) by means of DetStudio menu "Tools/Change station".

5 Routing into DB-Net network

Control systems by the company AMiT communicating through DB-Net/IP allow so called routing into DB-Net network. I.e. it is possible to communicate through Ethernet with any control system connected to the DB-Net segment. In terms of DB-Net/IP protocol, this segment is described by the IP address of the control system communicating through Ethernet and number of any control system communicating with this control system using the DB-Net protocol.

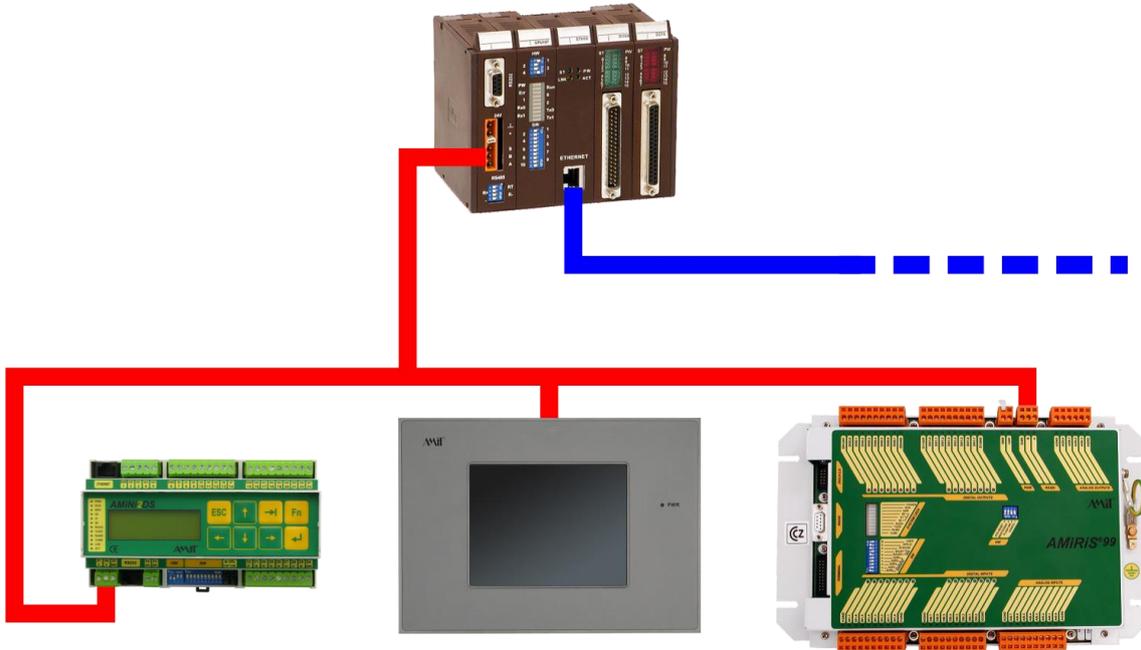


Fig. 24 – DB-Net segment

Conditions for functional routing into DB-Net network:

- ◆ Correctly connected DB-Net network (see AP0009 – Communication in DB-Net Network).
- ◆ The control system assigned for routing into DB-Net network has to be active within the DB-Net network.
- ◆ In the control system assigned for routing into DB-Net network, at least one process has to run.
- ◆ The control system assigned for routing into DB-Net network has to have a correctly set IP configuration.

Attention

Control systems mediating routing into DB-Net network should not process time-consuming programs. We must bear in mind that the more data the system processes and the more frequently it operates actual routing into DB-Net network, the more it is loaded with communication requests.

5.1 Sample Routing into DB-Net network

Say we have a network connected according to the following image, where the control system **AMiNi2DS** reads data from two control systems **ADiR** using the control system **ADiS**.

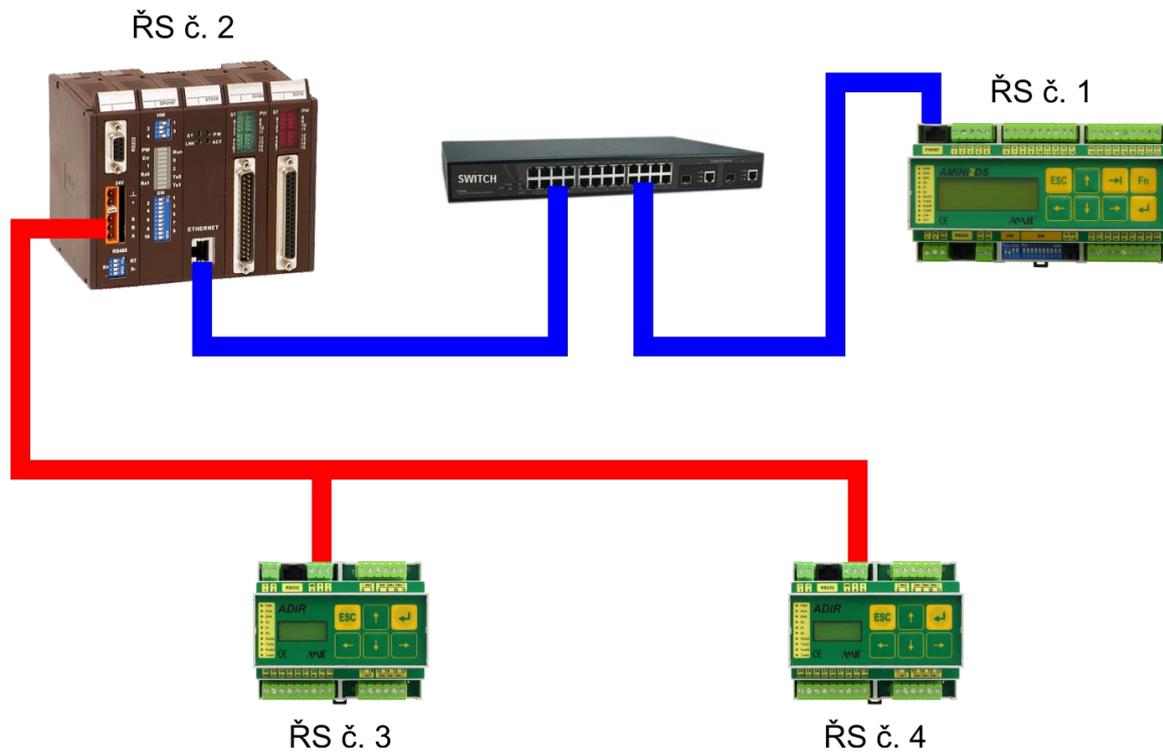


Fig. 25 – Routing into DB-Net network

The control system **AMiNi2DS** (No. 1) and the control system **ADiS** (No. 2) are connected via switch with direct Ethernet cables (marked in blue colour) and they need to have a correctly set IP configuration, e.g. according to the following setting.

Control system AMiNi2DS		
IP address	Mask	Port
192.168.168.201	255.255.255.0	59
Control system ADiS		
IP address	Mask	Port
192.168.168.202	255.255.255.0	59

Control system numbers (set on SW switches of each control system) are as follows:

Control system	Number
AMiNi2DS	1
ADiS	2
ADiR 1	3
ADiR 2	4

The control system **ADiS** will mediate routing into DB-Net network. Therefore it has to be active (see AP0009 – Communication in DB-Net Network). It is connected with two control systems **ADiR** using the line RS485 (marked in red colour). All control systems connected using the line RS485 have to have RS485 interface selected on the SW DIP switches, and the same communication speed must be set in this interface.

SW operation for reading the variables from control systems No. 3 and 4 will look as follows in the control system **AMiNi2DS**:

We define the DB-Net segment in the INIT process.

```
:01000 EthNetSeg 0xC0A8A8CA, 59, 0, 5000, 0x00000002, SegStat
      L DB-Net segments IP (192.168.168.202)
```

In the period process, we will perform data reading from control systems No. 3 and 4.

6 APPENDIX A

6.1 Typical connection examples

6.1.1 Communication in a local network

Both PC and the control system(s) are connected in a single local network (typically a home LAN or office LAN).

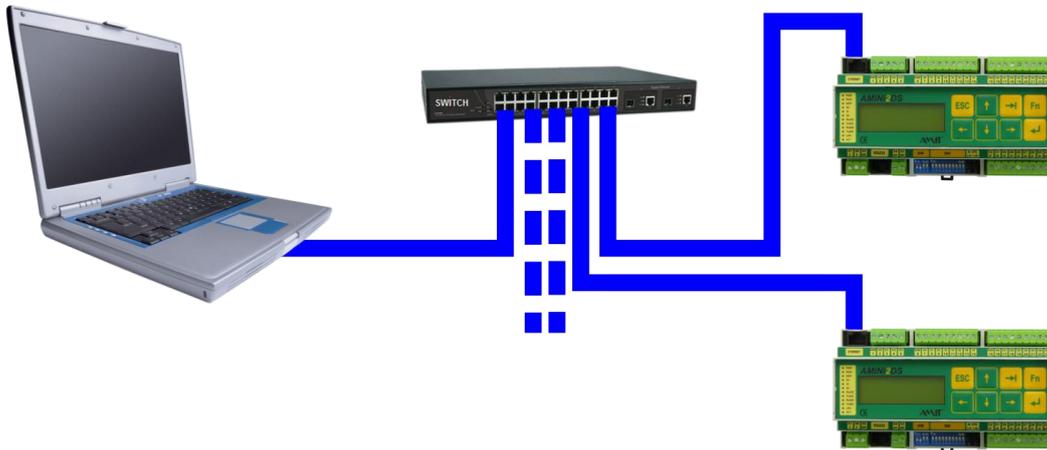


Fig. 26 – PC and control systems connected in a local network

Establish communication by taking the following steps.

- ◆ Use DetStudio or ViewDet to set the IP configuration in control systems (see Chapter “3.1 IP Configuration in Control Systems”)
 - ◆ Set the parameters: IP address
Network mask
Password (if you intend to use one)
Other parameters may remain in their default status.
- ◆ Set communication parameters in DetStudio or ViewDet (see Chapter “3.2 Setting Communication on PC”)
 - ◆ Select Ethernet communication
 - ◆ Set the parameters: IP address
Password (if you intend to use one)
Other parameters may remain in their default status.

Your network administration will provide you with IP addresses. In case you are the network administrator, it is necessary to set control system IP addresses different from IP addresses of devices already connected in the network. All IP addresses must belong into one local network. The control systems (CS) must have static IP addresses assigned.

After you connect the CS and PC into the communication network, you can establish communication. You may verify that the setting is correct in DetStudio using identification (see Chapter “3.2.1 Setting communication with control system in DetStudio”)

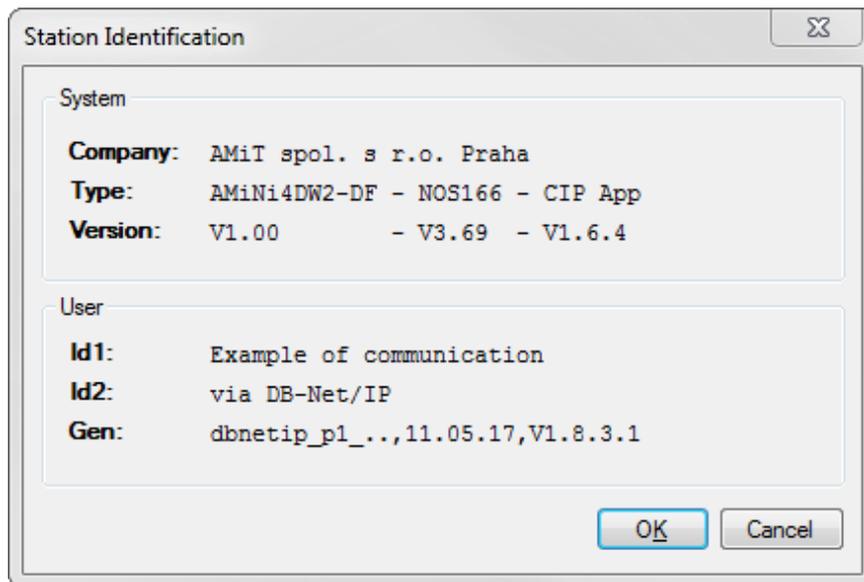


Fig. 27 – Control system identification window

6.1.2 Connecting PC into local network via Internet

Control systems are connected in one local network (typically a home LAN or office LAN), PC is remotend and connected into Internet.

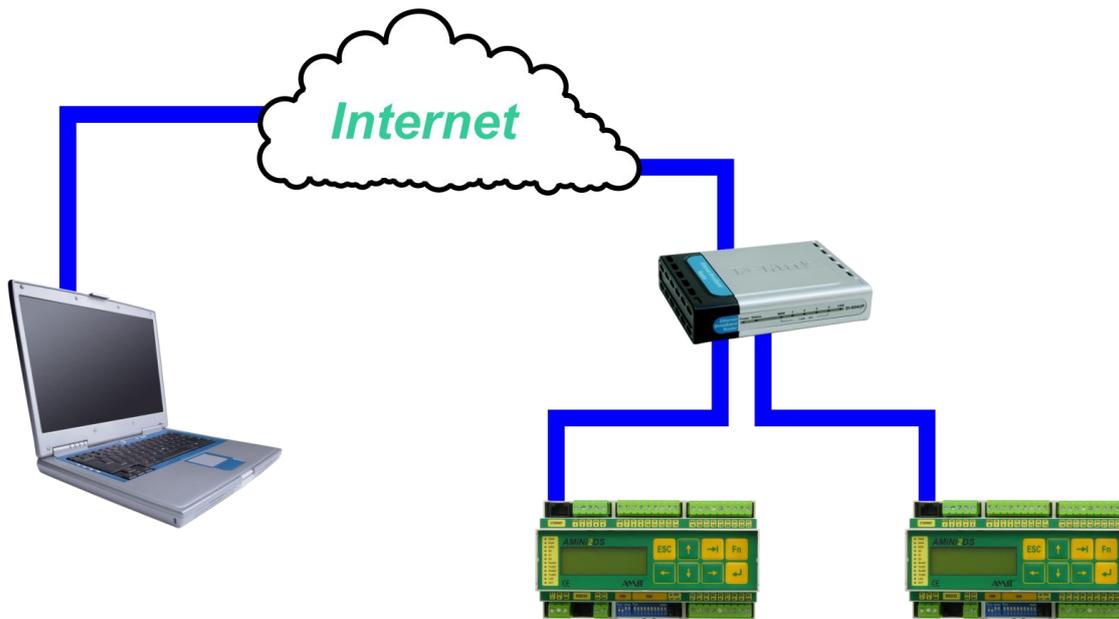


Fig. 28 – Communication with control systems via Internet

Establish communication by taking the following steps.

- ◆ Use DetStudio or ViewDet to set the IP configuration in control systems (see Chapter “3.1 IP Configuration in Control Systems”)
 - ◆ Set the parameters
 - Gateway (router IP address in the local network)
 - IP address
 - Network mask
 - Password (if you intend to use one)
 - Other parameters may remain in their default status.

- ◆ Set network address translation (NAT) on the router from the outside public veřejné IP address to the static local IP address and the control system port (see APPENDIX B).
- ◆ Set communication parameters in DetStudio or ViewDet (see Chapter “7.2 Setting Communication in SW for Connection via Internet”)
 - ◆ Select Ethernet communication
 - ◆ Set parameters
 - IP address (public IP address of your network)
 - Port (according to the address translation set on the router)
 - Password (if you intend to use one)
 - Other parameters may remain in their default status.

Your internet connection provider will give you the public IP address. In case your address is private, it is not possible to communicate with the control system via Internet. It is then necessary to order a public address with your Internet provider.

Your network administrator will provide you with control system IP addresses. In case you are the network administrator, it is necessary to set control system IP addresses different from IP addresses of devices already connected in the network. All IP addresses must belong into one local network. The control systems (CS) must have static IP addresses assigned.

After you connect the CS and PC into the communication network, you can establish communication. You may verify that the setting is correct in DetStudio using identification (see Chapter “3.2.1 Setting communication with control system in DetStudio”).

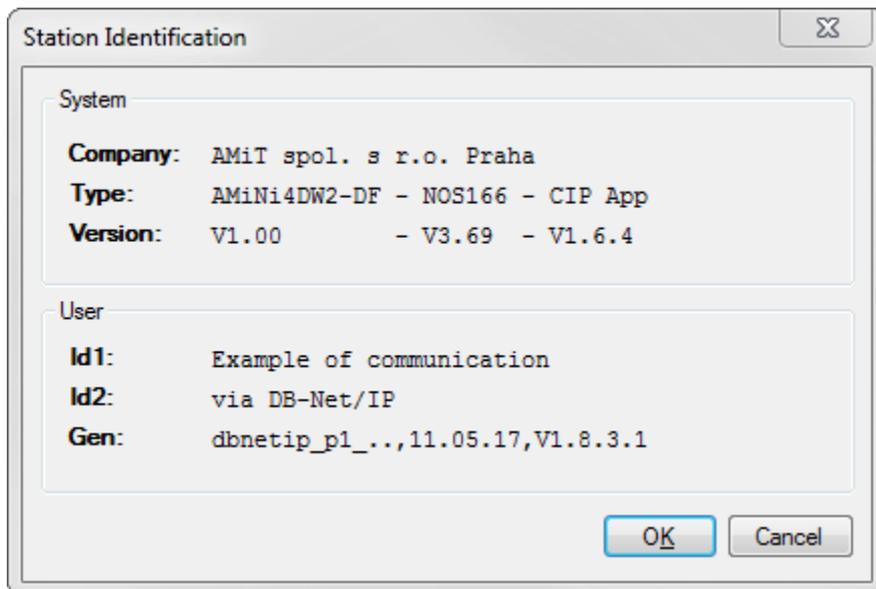


Fig. 29 – Control system identification window

7 APPENDIX B

7.1 Setting router for communication via Internet

Say we have a local network, with IP address range 192.168.XXX.XXX. This local network is connected to the Internet by means of a router with a static public IP address 74.08.25.5. In the network, there is control system No. 1 with IP address 192.168.168.204 communicating on UDP port 59 and control system No. 2 with IP address 192.168.168.205 also communicating on UDP port 59. Within the local network, the router IP address 192.168.168.1.

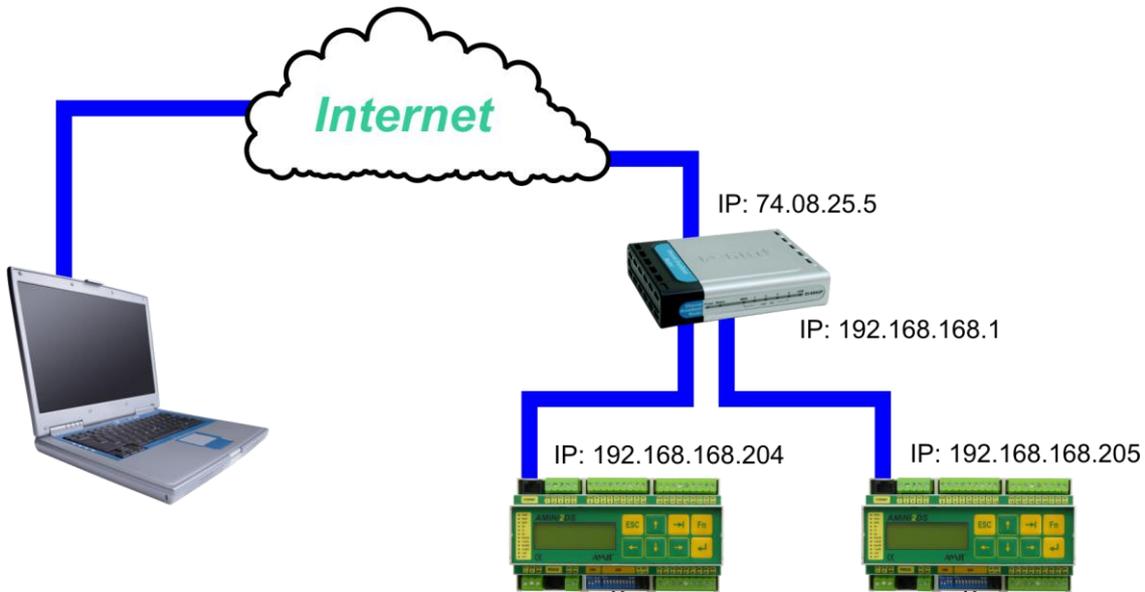


Fig. 30 – Communication with control systems via Internet

In order to communicate with these control systems from anywhere on the Internet, **it is necessary to set a so called network address translation (NAT) on the router to pre-defined UDP ports**. The following image shows an example of such setting by means of a router web interface.

The screenshot shows the 'Virtual Server' configuration page in the AirLive router web console. The table below represents the data shown in the interface:

ID	Public Port	Private Port	Server IP	Data Type	Enable	Use Rule#
1	68	59	192.168.168.204	UDP	<input checked="" type="checkbox"/>	0
2	69	59	192.168.168.205	UDP	<input checked="" type="checkbox"/>	0
3			192.168.168.	BOTH	<input type="checkbox"/>	0
4			192.168.168.	BOTH	<input type="checkbox"/>	0
5			192.168.168.	BOTH	<input type="checkbox"/>	0
6			192.168.168.	BOTH	<input type="checkbox"/>	0
7			192.168.168.	BOTH	<input type="checkbox"/>	0

Fig. 31 – Network address translation in router OvisLink

By selecting Public Port, we determine the communication port by means of which the control system will be available at the public IP address. **It is necessary to enable UDP packets in the item Data Type!** Furthermore, it is also necessary to set the correct gateway IP address (it is the router IP address within the local network – 192.168.168.1). We set this in the control system IP configuration (by means of the button **Stanice**) according to Chapter “3.1 IP Configuration in Control Systems”.

7.2 Setting Communication in SW for Connection via Internet

In SW supplied by the company AMiT, if you want to communicate with control systems via Internet, you fill the item IP address with the public IP address of the router providing network address translation and UDP port on which the network address translation is set. In case of DetStudio development environment, the communication configuration looks like the one illustrated in the following picture.

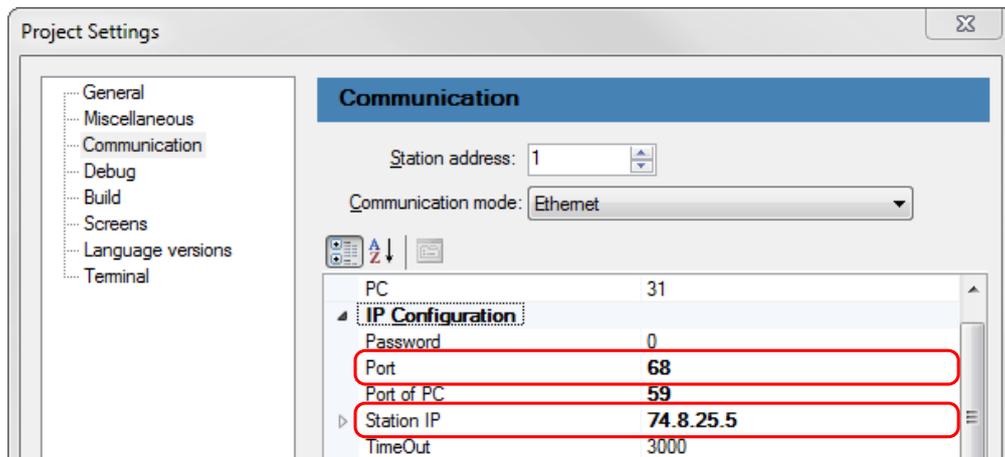


Fig. 32 – Setting communication with control system No. 1

As far as the forwarding item is concerned, it is not necessary to use it. Communication with the control system via internet works even without entering data into this item. In case you choose to use the forwarding item, the communication setting looks as follows. However, this item only serves to activate a guard watching for the user not to change the control system IP configuration remotely from DetStudio. Should the user attempt to change it, DetStudio automatically informs them about the risks of losing communication upon setting new communication parameters.

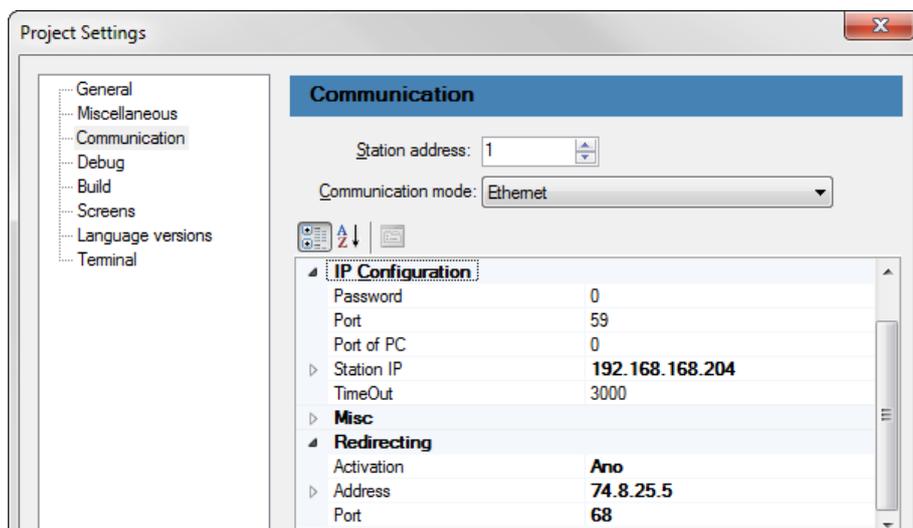


Fig. 33 – Setting the forwarding item

8 APPENDIX C

8.1 IP konfigurace on PC

In order to set IP configuration on PC, click the button **Start** in the Windows bar and select **Settings/Control panel**.

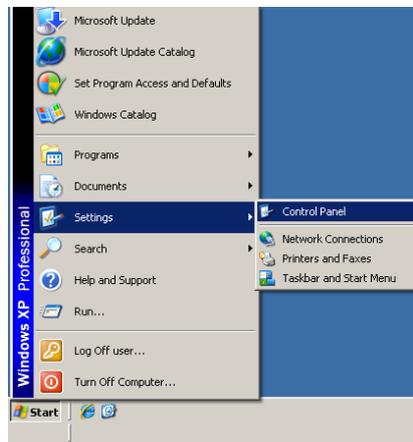


Fig. 34 – Open Control Panels

The window **Control panels** pops up; click the item **Network connections** in it. That summons the window with network connections on your PC. Click the network connection you wish to configure with your right mouse button and select item **Properties** (see image below).

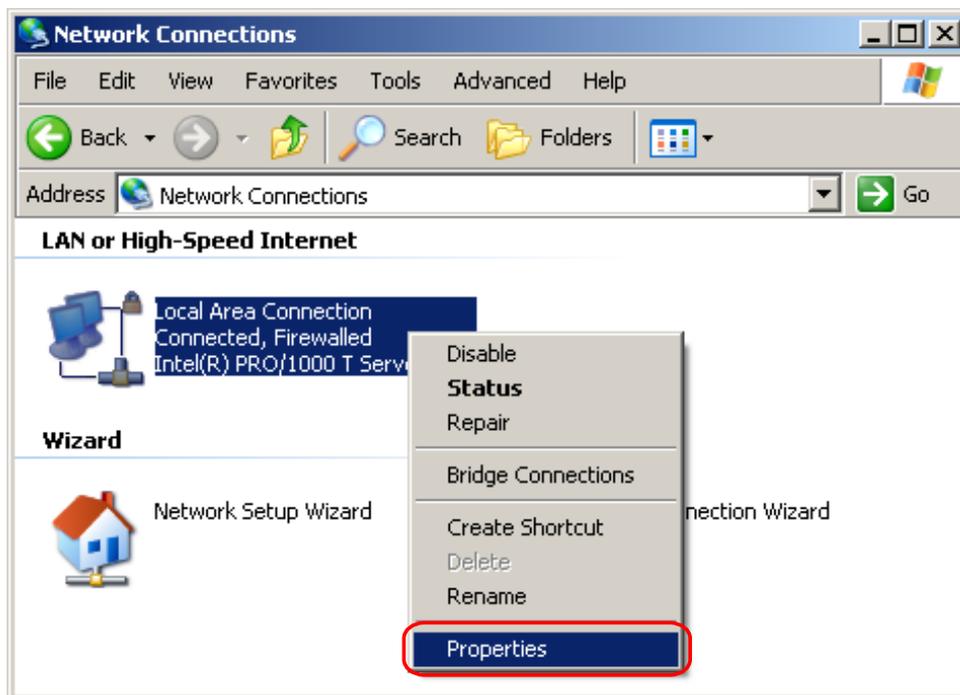


Fig. 35 – Selecting properties of the required Ethernet interface

By doing so, you open the window with connection properties of the given interface. In bookmark **General** select the item **Internet protocol (TCP/IP)** in the chart **This connection uses the following items:** and click the button **Properties**.

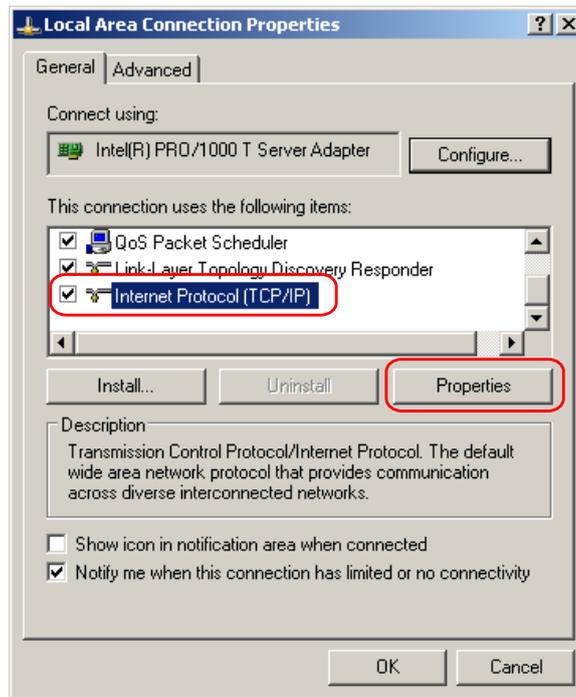


Fig. 36 – Bookmark of general network properties

By doing so, you summon the window for setting Internet network protocol properties (TCP/IP). Here, you set the required IP configuration.

8.1.1 Connecting PC into a network with DHCP

If the PC is connected to the network with automatic IP address allocation (uses DHCP services with automatic DNS detection), select both the item **Obtain an IP address automatically** in the window with Internet network protocol properties (TCP/IP) and the item **Obtain DNS server address automatically**. Confirm everything by clicking the button **OK** and the PC is configured.

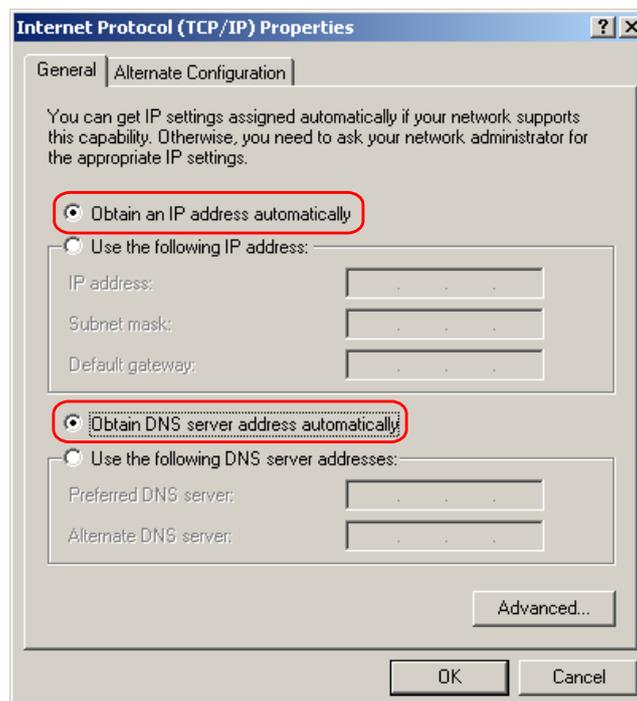


Fig. 37 – Getting the IP configuration automatically

Then you have to get IP addresses that can be assigned to control systems from the network administrator.

8.1.2 Connecting PC into a network without DHCP

If you are building your own network or connecting into a network without DHCP, proceed as follows: The first step is to enter the IP address and network mask in the PC.

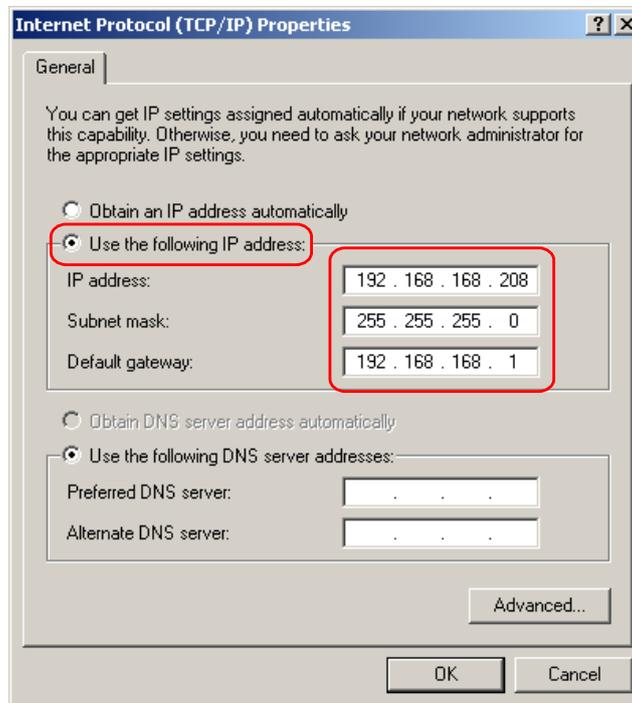


Fig. 38 – IP configuration on PC

Select the item **Use the following IP address** and enter the required IP address and network mask. In case communication outside the local network is necessary, you also have to enter the gateway (the network administrator will provide information about the gateway IP address). After entering all values required, confirm everything by clicking **OK**. The PC is now configured.

Then you have to get IP addresses that can be assigned to control systems from the network administrator.

9 APPENDIX D

9.1 Troubleshooting in Case of Local Network Connection

9.1.1 System with integrated Ethernet interface

If you have a problem establishing the connection using the integrated Ethernet interface within the local network, try the following procedure:

- 1) Verify that the control system responds to a ping. If not, the IP configuration may be set incorrectly (IP address/mask) or there is a problem in the cable.
- 2) If you get a response to the ping and are still unable to connect to the control system, try disconnecting the system from the network and use the ping command again. If you get a response, there is a collision of IP addresses in the network. Contact the network administrator. If you do not get any response to the ping, connect the control system back to the network and check whether the communication password is correct and whether the UDP port entered is correct (both in the PC and in the control system).
- 3) If the control system responds to the ping and all communication parameters are set correctly, check whether the software from which you are trying to communicate is not blocked by a firewall (a firewall is sometimes a part of some anti-virus SW and of Windows as well).

9.1.2 System with converter DM-232TOETH

If you have a problem establishing the connection using the converter **DM-232TOETH** within the local network, try the following procedure:

- 1) Verify that the control system responds to a ping. If not, the IP configuration may be set incorrectly (IP address/mask/duplex) or there is a problem in the cable. The connection problem may also have occurred in the RS232 interface. Check whether the converter is connected to the control system correctly.
- 2) If you get a response to the ping and are still unable to connect to the control system, try disconnecting the system from the network and use the ping command again. If you get a response, there is a collision of IP addresses in the network. Contact the network administrator. If you do not get any response to the ping, connect the control system back to the network and check whether the communication password is correct and whether the UDP port entered is correct (both in the PC and in the control system).
- 3) If the control system responds to the ping and all communication parameters are set correctly, check whether the software from which you are trying to communicate is not blocked by a firewall (a firewall is sometimes a part of some anti-virus SW and of Windows as well).

9.2 Troubleshooting in case of Internet connection

If you have a problem establishing communication with the control system via Internet, first make sure that the control system is available for communication within the local network (see Chapter “9.1 Troubleshooting in Case of Local Network Connection”). If you successfully connect to the system in the local network, check the following:

- ◆ Settings of the network address translation in the router
- ◆ UDP permissions in the router
- ◆ Firewall settings in the router
- ◆ Verify that your Internet provider does not filter UDP frames
- ◆ Verify you entered correct static public IP address in communication parameters
- ◆ Verify you have correct communication parameters in your SW

Information on the IP address and port through which the control system is available on the Internet is available in the file "atouch32.dynamic.udp.host" that is automatically created in Windows SP after activating the communication control (with correctly set parameters) in Directory C:\Documents and Settings\All Users\Application data\AMIT\ATOUCH32\ (applies in Windows XP default setting). The file is only created upon effort to use the automatic reading of the control system's IP address and port.

10.1.3 Example of router parametrization

In order for the PC to get information from control system from anywhere on the Internet, **it is necessary to set a so called network address translation (NAT) on the router to pre-defined UDP ports**. The following image shows an example of such setting by means of a router web interface.

The screenshot shows the 'Virtual Server' configuration page in the AirLive router web console. The table below represents the data shown in the interface:

ID	Public Port	Private Port	Server IP	Data Type	Enable	Use Rule#
1	98	98	192.168.168.104	UDP	<input checked="" type="checkbox"/>	0
2			192.168.168.	BOTH	<input type="checkbox"/>	0
3			192.168.168.	BOTH	<input type="checkbox"/>	0
4			192.168.168.	BOTH	<input type="checkbox"/>	0
5			192.168.168.	BOTH	<input type="checkbox"/>	0
6			192.168.168.	BOTH	<input type="checkbox"/>	0
7			192.168.168.	BOTH	<input type="checkbox"/>	0

Fig. 42 – The network address translation for PC on IP address 192.168.168.104

11 Technical Support

All information on communication in an Ethernet network will be provided by the technical support department of the company AMiT. Do not hesitate to contact the technical support via e-mail using the following address **support@amit.cz**.

12 Warning

The company AMiT, spol s r. o. does not provide any guarantee concerning the contents of this publication and reserves the right to change the document with no obligation to inform any person or authority.

This document can be copied and redistributed under following conditions:

1. The whole text (all pages) must be copied without making any modifications.
2. All copies must include the AMiT, spol. s r. o. copyright and any other notices stated in the document.
3. This document must not be distributed for profit.

The names of products and companies used herein may be trademarks or registered trademarks of their respective owners.