

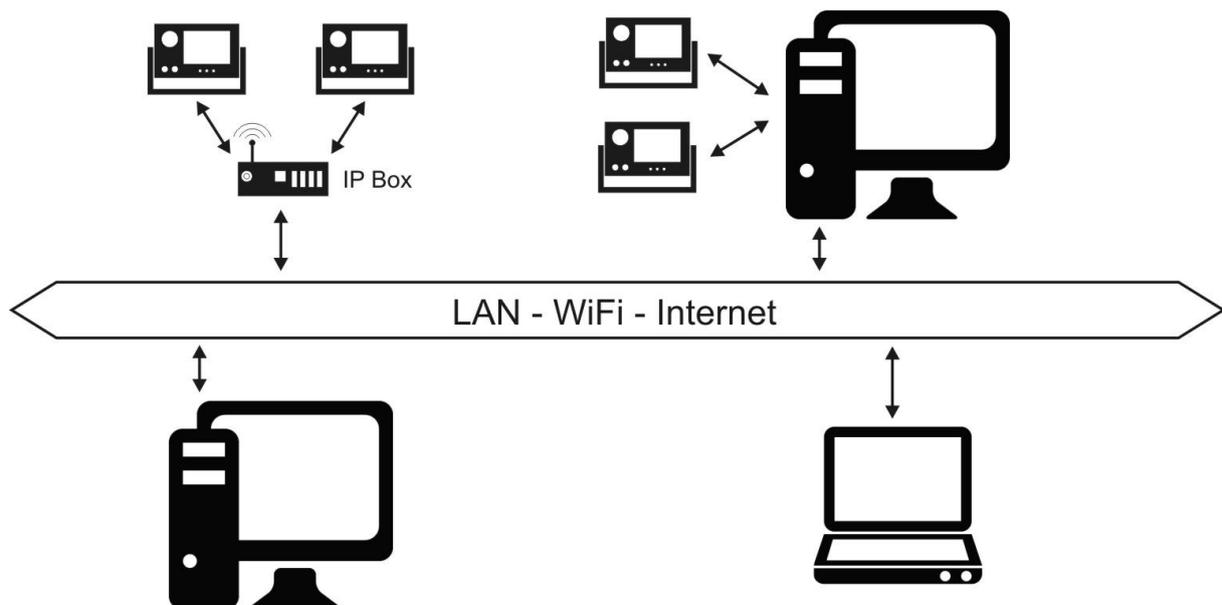
# Internet based monitoring networks for SARAD instruments

*SARAD application note AN-008, Version: 10/15/2015*

The software solutions Radon Vision (from version 6.2.0) and dVISION/dCONFIG (from version 3.3.1) contain a complete solution for TCP/IP based communication with the most of SARAD instruments. The Implementation is very easy and does not require special skills in the IT field. If the available network structure of an organisation shall be used, the assistance of the responsible network administrator may be required. For a better understanding of the network communication we added the chapter “Definitions”. It contains the basic network/internet definitions and explains the functionality of data transfer.

## General Information

The instruments need to be connected to a local computer or a SARAD IP-Box providing the bridge to the internet. That can be realized by a router directly or by an available local network (LAN, WiFi). The following picture shows the typical network topology.



In addition to the application software (Radon Vision, dVISION/dCONFIG), two more small programs are required: the Instrument Server (InstrumentServer.exe) and the Registration Server (RegistrationServer.exe). Both executable files are copied into the program folder of the application (standard C:\SARAD) during the installation process.

### Instrument Server

This program must be installed on the computer or IP-Box at the instrumentation site. It provides the connection between the instruments connected to the local computer interfaces (USB, RS232) and the internet.

### Registration Server

This program can be installed on any computer in the internet. This computer must be accessible through a router with a static IP address. The Registration Server manages the continuous availability of IP addresses of all connected installation sites.

### **SARAD IP-Box**

The IP-Box, in fact, is a tiny, pre-configured computer with Windows operational system. The program Instrument Server is already installed in the auto-start folder of Windows. It will be opened automatically after turning on the power. The IP-Box is equipped with several USB and serial ports to connect the instruments. The connection to the internet can be realized either by LAN cable or WiFi. The WiFi adapter is integrated in the IP-Box. Of course, any other (perhaps available) computer can be used instead of the IP-Box.

## Definitions

**TCP/IP:** Shortcut for Transfer Control Protocol and Internet Protocol. This protocol describes the modality of communication between computers through the internet. The protocol offers the frame into which the user data can be embedded. The protocol has been designed for internet but is also used in local area networks.

**Server:** means a program or part of program which offers a communication interface, in our case via Internet Protocol (IP). Other programs (called clients) can call the server to establish a communication channel between client and server. To localize a server, the internet address (IP address) and an assigned communication port (exclusive for the server) needs to be known by the client. After starting, the server listens to all messages which are directed to that communication port.

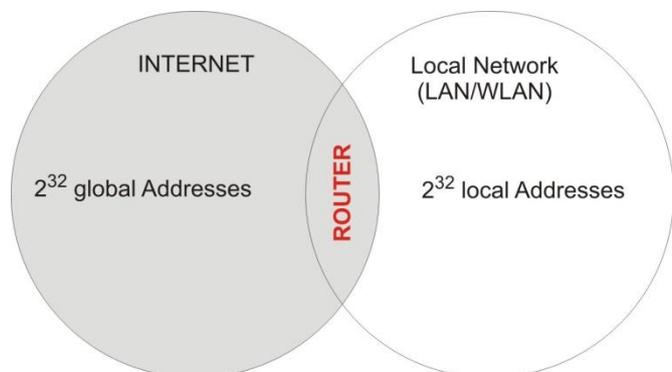
**Client:** means a program or part of a program which can initiate a communication with a server (this can be never done by the server). To contact the server, the client needs to know the IP address as well as the communication port used by the server.

**IP address:** means four sequential bytes (8 bit). Each can represent a decimal number between 0 and 255. IP addresses are commonly expressed as decimal numbers separated by dots (e.g. 192.255.107.100). An IP address identifies a unique communication resource (network adapter, internet router) within a network. Please note: computer names (in local networks or VPNs) or web addresses (e.g. hq.sarad.de) can be used instead of the IP address.

**Port:** represents a 16 bit number (0...65535) which is assigned to a server as communication channel. The server accepts only incoming data directed to that port. To establish a connection both, IP address as well as port number are required.

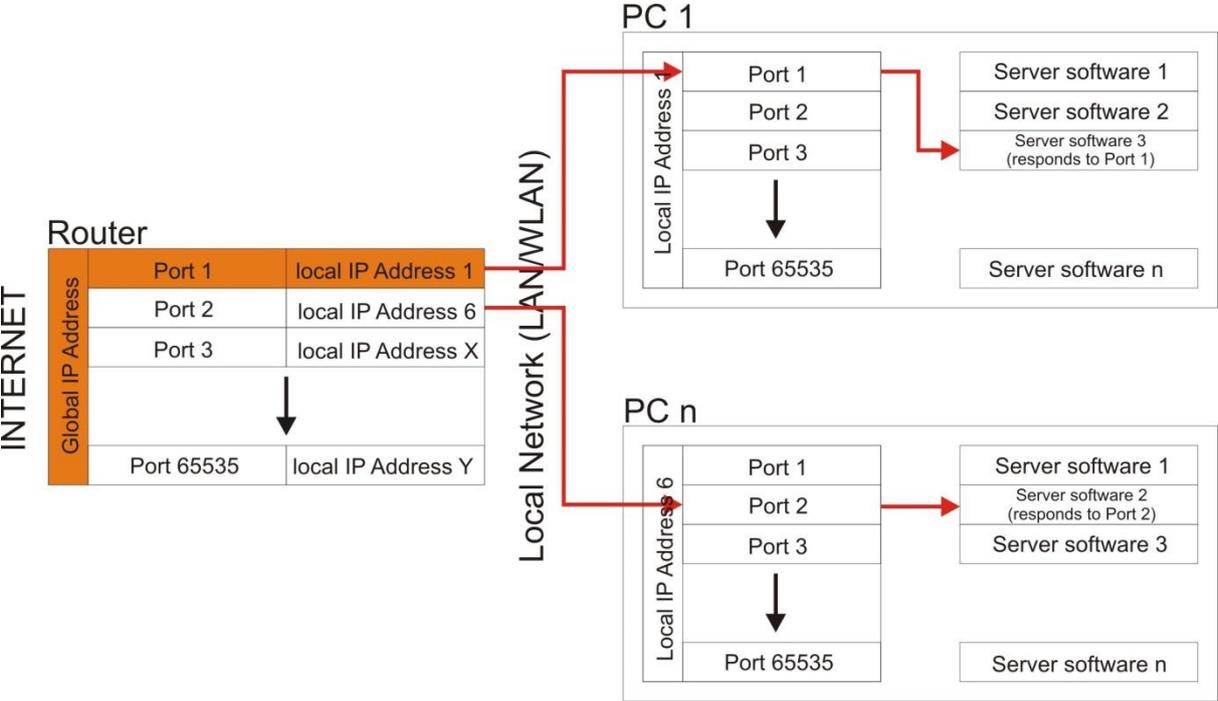
**Global and local IP addresses:** Because the IP address is limited to four bytes, the number of globally available internet end points is limited to  $2^{32}$  too. There are static (IP address bytes never changes) and dynamic IP addresses. Dynamic IP addresses are assigned daily by the internet administration. This offers the possibility to assign one address to more than one end point if they are not simultaneously connected to the internet. Thus, even more than  $2^{32}$  end points can be addressed.

Local networks are using own addresses which are exists independently on the global internet addresses. Therefore,  $2^{32}$  computers can be theoretical addressed within a local network. The addresses here can be also defined as static or dynamic by the administrator. The bridge between the local network and the internet is realized by a gateway. In practice it is the internet router (picture)



**Router:** Computer within locale networks will be normally connected to the internet by a router. The router occupies an own global IP address within the address space of the internet. All local computers use this single global IP address in parallel - independent on their local IP address (local

networks using an independent address space). To establish a connection from the internet to the desired local computer behind the router, each router offers the port forwarding functionality. The configuration interface of the router allows the assignment of one or more ports to local IP addresses (means local computers). If a client sends a message to the global router IP address with the port number used by the server, the router will pass the message to the assigned computer. Then, the operational system of the computer passes the message to the server software. The graphic below shows the principal of port forwarding.



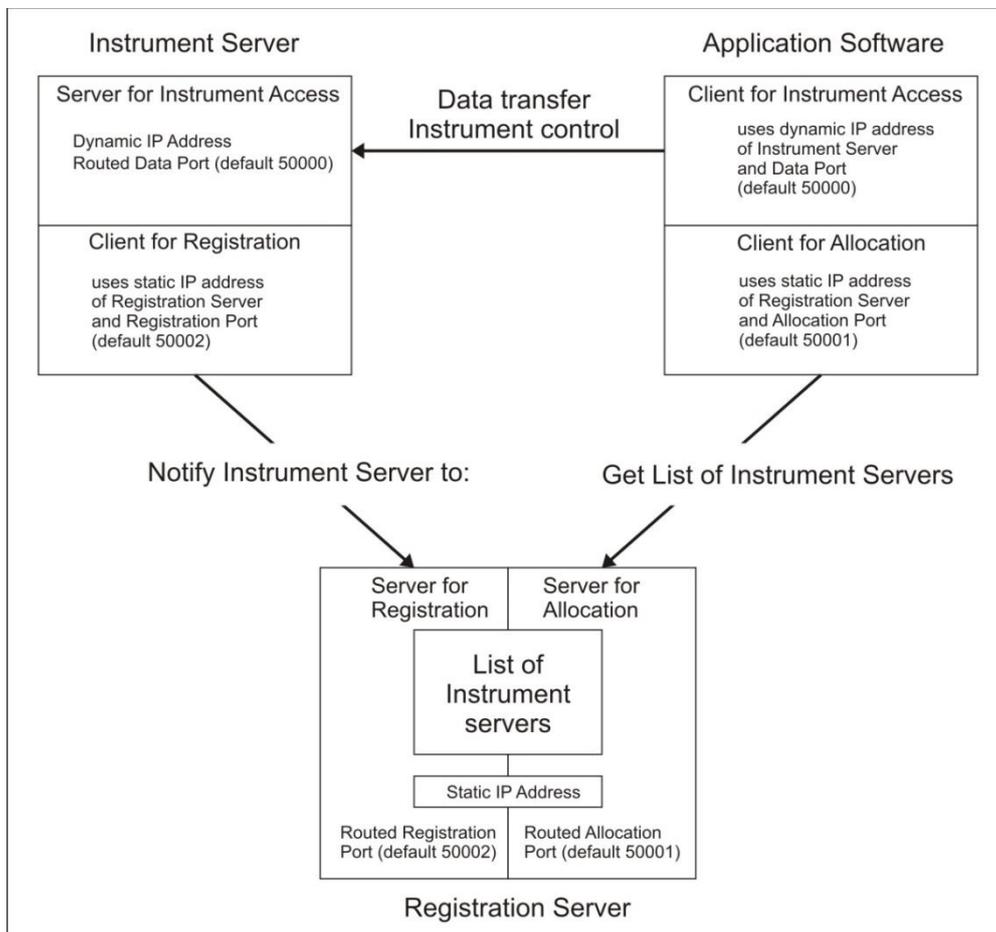
**Instrumentation site:** means a computer (or IP box) at the place of measurement with one or more connected instruments (RS232, USB, Net Monitors wireless). On this computer runs the server program "SARAD Instrument server". This program provides the bridge between the internet and the connected instruments. The „Instrument server“ contains a server to communicate with the application software as well as a client to provide the own IP address (IP/port) to the “Registration server” software.

## Communication via the internet

If an instrumentation site (SARAD instrument server) shall be connected to a computer (Application software) via Internet, the application software (e.g. Radon Vision, dVISION etc.) needs to know the Internet address (IP address) of the computer at the instrumentation site. Normally, IP addresses will be automatically changed at least once per day, except the customer has reserved a static IP address. Static IP addresses mean additional costs as well as some effort in administration, especially if many instrumentation sites have to be connected. Possible solutions are the usage of so-called Virtual Personal Networks (VPN) or Dynamic Name Servers (DNS). The disadvantage is that third party products are required, data transfer is re-directed and the implementation can be realized only by IP experts. The SARAD Registration Server offers an efficient alternative solution which reduces the number of required static IP addresses to just one, the one used by itself.

## Theory of operation

The principle IP address management between the three parts of the communication system is shown in the graphic below. Each instrument server transfers its own address information in pre-set intervals to the registration server. The addresses of all instrument servers inserted in a dynamic address list which will be updated continuously. The application software is able to access the registration server too because of its static IP address. Now the actual dynamic addresses for the desired instrument server can be obtained from the list. In the next step, this dynamic address is used by the application software to call the instrument server directly. All three programs can run on one computer for test purposes.



## Installation of the Registration Server

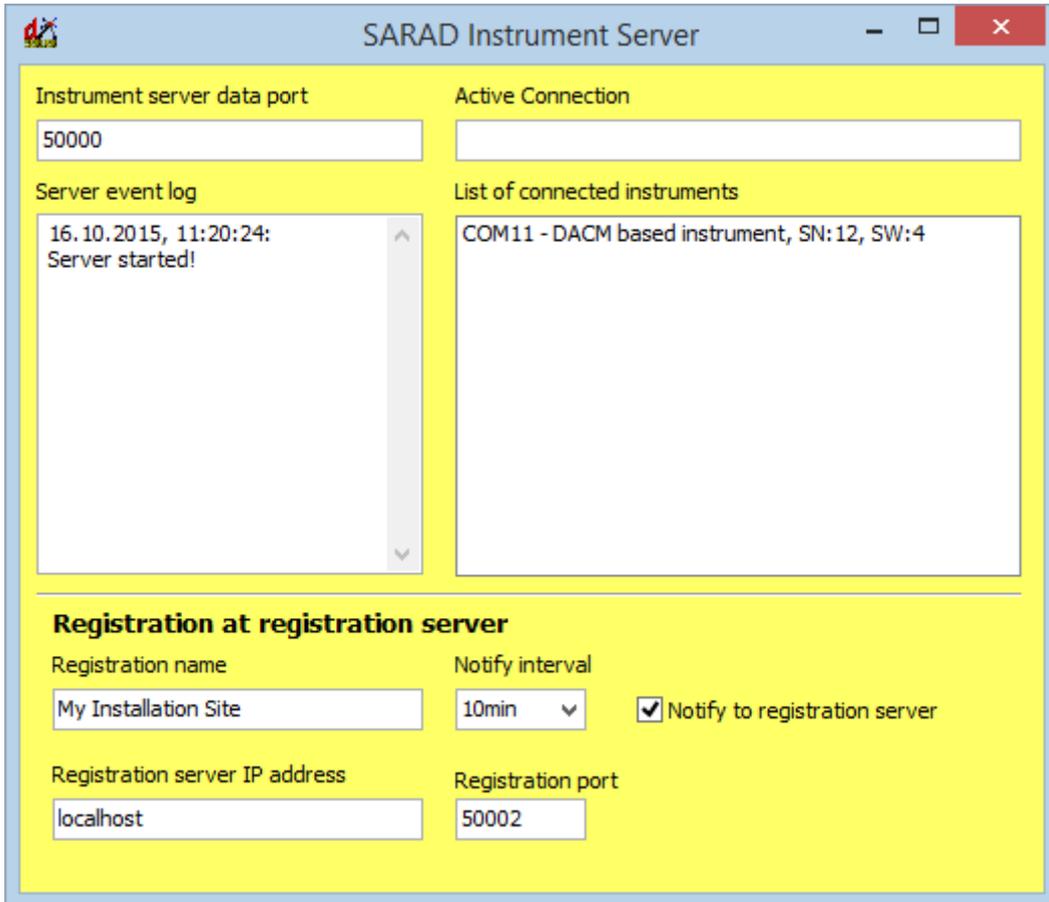
The registration server needs to be installed on a computer which is permanently in operation. Thus, the actualized address list is immediately available even if the instrument server sends its address information in larger intervals. The computer must be accessible through the fixed (static) IP address of the router connected to. Two ports must be enabled and forwarded by the router to that computer (possible by router configuration). One port ("registration port") serves to receive the address information from the instrument servers, the other port ("allocation port") to be accessed by the application software. Both port numbers may be assigned by the user. After installation, the port numbers 50001 and 50002 are pre-set for allocation- and registration port. The registration server is listening for calls as soon as it has been started.

If the port numbers have been changed, the program must be closed and opened again to update the new ports. The recent port numbers are saved on the hard disk and are set after re-start. The upper memo box shows a list of all activities in order to communicate with the registration server initiated either by the instrument server or the application software. The lower memo box contains a list of all registered instrument sites with the time stamp of their individual last address forwarding.



## Instrument server settings

To register an instrumentation site at the registration server, at first, the IP address and the assigned port number (50002 is pre-set) of the registration server must be entered in the edit lines right bottom of the window. Furthermore, a unique registration name must be assigned for the instrumentation site. This name (registration name) is used to identify the station later on. The user may enter the interval used for the cyclic address forwarding. The pre-set value is 10 Minutes. To activate the instrument server check the box "Notify to".

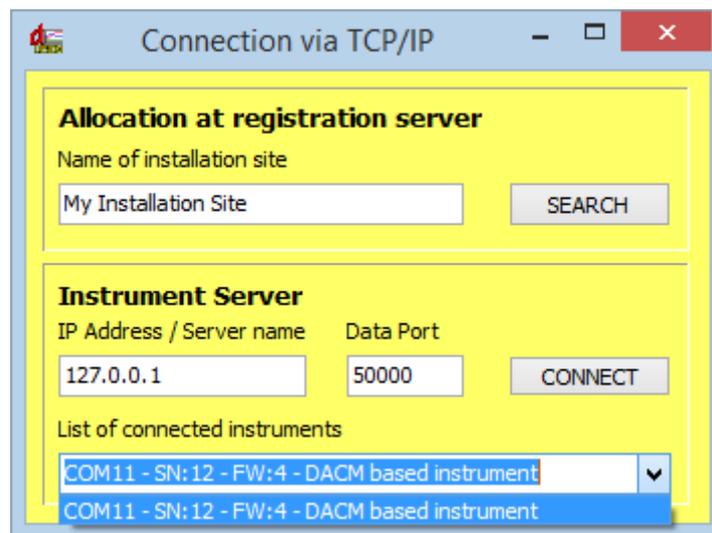


The screenshot shows the 'SARAD Instrument Server' window with a yellow background. It is divided into several sections:

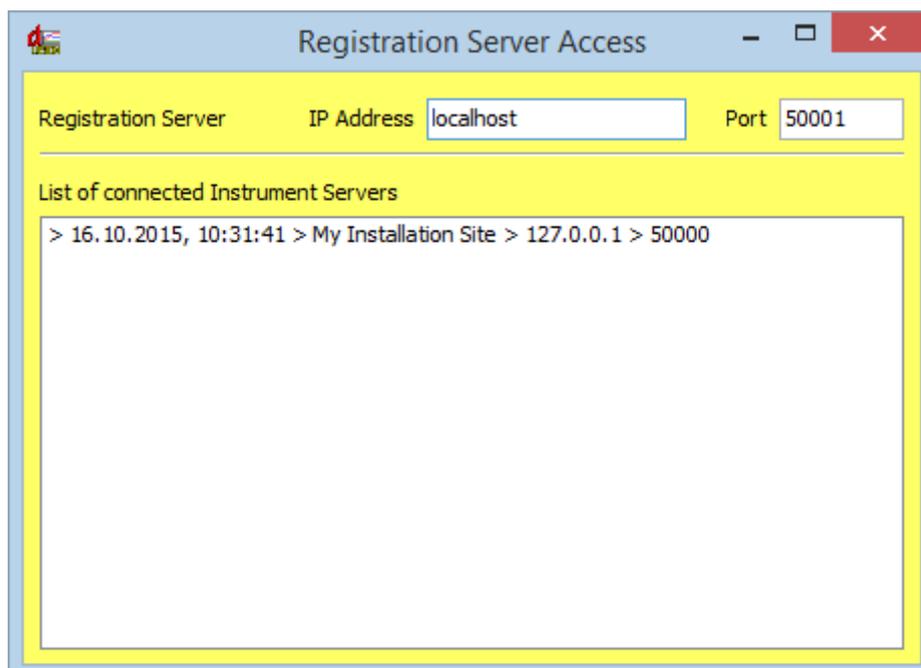
- Instrument server data port:** A text box containing '50000'.
- Active Connection:** An empty text box.
- Server event log:** A scrollable area containing the text '16.10.2015, 11:20:24: Server started!'.
- List of connected instruments:** A scrollable area containing the text 'COM11 - DACM based instrument, SN:12, SW:4'.
- Registration at registration server:** A section with four input fields and a checkbox:
  - Registration name:** 'My Installation Site'
  - Notify interval:** '10min' (dropdown menu)
  - Notify to registration server:**
  - Registration server IP address:** 'localhost'
  - Registration port:** '50002'

## Establishing the connection between application software and instrument site

To open a connection through the internet, the entry TCP/IP must be selected from list of available Com Ports in the application software. The appearing TCP/IP connection dialog offers an edit field to enter the registration name (Instrument server name) of a desired instrumentation site. The "SEARCH" button calls the registration server to provide the actual address information of the instrumentation site. If the name has been found in the registration list, IP address as well as port number will be automatically inserted into the edit fields below the registration name. Now, the button "CONNECT" can be clicked to get the list of instruments connected at the instrumentation site. Select one item to establish the communication channel.



If the entered registration name is not listed at the registration server, another window will be opened containing a list of all available instrumentation sites. A double click to any entry of the list closes the window and takes over the address information of that site.



That window allows the user also to define the IP address and port of the registration server called by the button „SEARCH“. The pre-set port is 50001. The information is saved on the hard disk and will be present when starting the application software again.

## Trouble shooting

Application software cannot connect to the registration server (if SEARCH button has been clicked)	<ul style="list-style-type: none"> <li>• Wrong registration server IP address or port selected in the registration server access window</li> <li>• Registration server has not been started</li> <li>• Used port of the registration server not enabled or forwarded by the router</li> </ul>
List window does not contain any instrumentation site	<ul style="list-style-type: none"> <li>• Instrument server not started</li> <li>• Instrument server not activated by "Notify to".</li> <li>• Instrument server uses wrong address information for communication with registration server</li> </ul>
Instrument server cannot connect to the registration server	<ul style="list-style-type: none"> <li>• Wrong IP address or port selected for communication with the registration server</li> <li>• Registration server not started</li> <li>• Used port of the registration server not enabled or forwarded by the router</li> </ul>

## Function test

To test the functionality, all three programs can be installed on the same computer. In that case, the IP address is always 127.0.0.1. The name "localhost" may be entered instead of the address. Both settings resulting in an internal communication loop using the internet protocol. The instruments must be connected to that computer too. At first, the registration server should be started (Allocation Port = 50001, Registration Port = 50002). Then start the instrument server and enter a name of the instrumentation site (computer network name is pre-set), set the data port to 50000 and the registration server address information to IP address = localhost and port = 50002. Click twice (remove and set the cross again) onto the "Notify to" check box to announce the instrument server at the registration server. The registration server window should show the instrument server in the list. Now, start the application software, select the item TCP/IP from the list of Com Ports and click onto the connect button. The connection dialog appears on the screen and you can click onto the "SEARCH" button. Eventually appears an error message if already an address for the registration server has been selected before. In that case confirm the message and enter "localhost" and "50002" for registration server access into the editor fields of the appearing "Registration Server Access" window. Close the window and open it again to apply the new settings. Now, the list box of the re-opened window should contain an entry with the name of the instrumentation site entered into the instrument server. A click onto that entry closes the window and transfers the address information into the input fields of the connection dialog. Click onto "CONNECT" button to get the list of connected instruments. This procedure can take a few seconds. After selecting one of the connected instruments, the communication is established.

## Required network administration

No special settings are required within a local network or a VPN because the network names of the connected computers can be used instead of the IP addresses. Thus, all computers can be identified without knowledge of their (changing) IP addresses. The name of the computer with the registration

server must be entered into the related IP address fields in the application software and instrument server.

Following settings must be done in case of an internet connection:

### **Instrumentation site**

The port used for data transfer (standard 50000) must be forwarded by the router to the PC at the instrumentation site.

### **Computer with registration server**

A static internet address must be registered by the internet provider for the router to which the registration server computer is connected. In general, big companies and organisations will have it already.

The ports used for allocation and registration (standard 50001 and 50002) must be forwarded by the router to the PC with registration server.

The port forwarding requires administrator rights for the router. The configuration software of any router provides the possibility for port forwarding.