

ipRoute-IEC101/104

The IEC 60870-5-101/104 Router



THE CHALLENGE

The IEC 60870-5-104 protocol is becoming ever more important in process data transmission via Ethernet (TCP/IP). Increasingly, companies are considering switching from their 101 control station to the TCP/IP enabled 104 protocol. The network offers considerable benefits compared with the serial data transmission:

- + Higher level safety
- + Flexible network layout
- + Numerous network utilities
- + Simplified management of connected devices
- + Reduced time and cost for maintenance and servicing

An upgrade from the 101 control station will amortize itself very quickly, assuming the connected remote terminal devices can still be operated.

THE SOLUTION

ipRoute-IEC101/104 enables fast and cost-efficient coupling between control stations and RTUs using the IEC 60870-5-101 and IEC 60870-5-104 communication standards, while profiting from the extensive compatibility of the protocols at the application level.

THE SOFTWARE

ipRoute-IEC101/104 is a router-based system. The ASDU (Application Service Data Unit) data packet exchange between the communication components is transparent. The IEC 60870-5-101 link layer functions and the IEC 60870-5-104 transport layer functions however are executed directly by the **ipRoute-IEC101/104**.

The data packets sent by a control station are either switched through to all or only a specified substation depending on the configuration. Conversely, the data packets received by a substation are transmitted to all or specified control stations. The decision where to transmit a packet is made by using the corresponding common address of ASDU. The transparent operating principle enables fast and simple system integration with the help of **ipRoute-IEC101/104**. System configuration is reduced to a few parameters such as baud rate or information object address size. Configuration of the individual information objects is not required.

SUPPORTED PROTOCOLS:

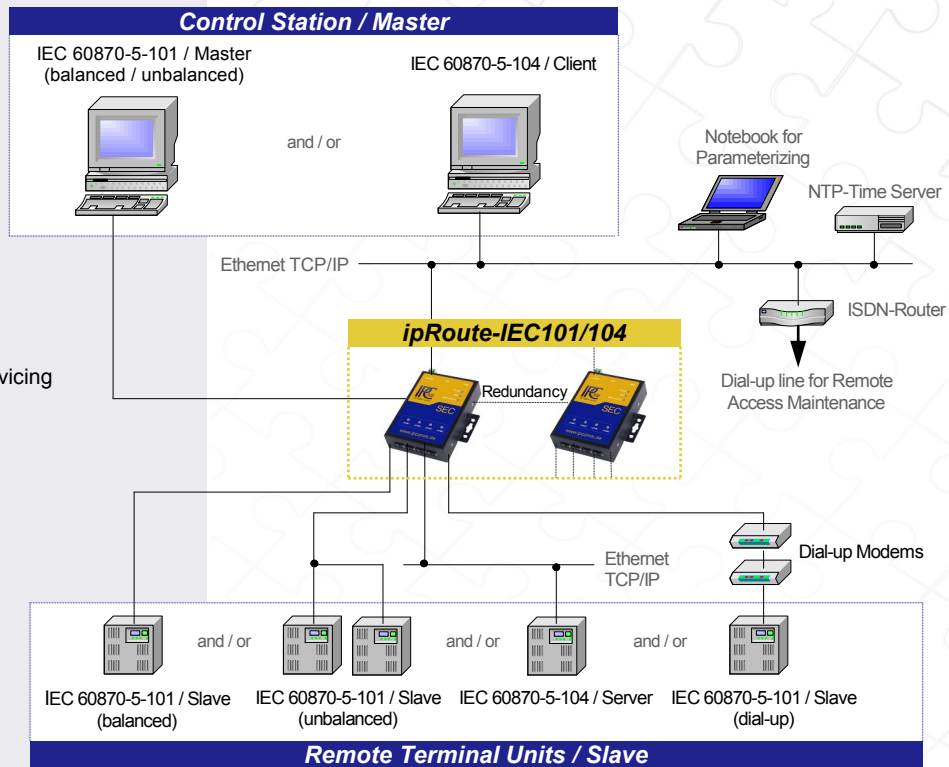
Up-Link

- **IEC 60870-5-101 balanced / unbalanced, slave**

This enables control stations to be connected via a conventional serial dedicated line. The "balanced" or "unbalanced" transport procedure is used. There are several V.24 interfaces for connecting DCE (Data Communications Equipment) devices.

ISO / OSI MODEL

LAYER:	IEC 60870-5-104 Control Station	ipRoute-IEC 101/104	IEC 60870-5-101 Substation
Application	●.....●		●
Presentation			
Session			
Transport	●.....●		
Network			
Link			
Physical	●.....●		●



- **IEC 60870-5-104 server**

This enables one or more IEC 60870-5-104 control stations to be connected via Ethernet (TCP/IP). Data can be fed to the master connection lines individually (1 of n) or simultaneously to all. **ipRoute-IEC101/104** supports the configuration of several IP addresses and different port settings. The physical connection is based on a 100BaseT interface.

Down-Link

- **IEC 60870-5-101 balanced, master**

This allows substations to be connected via a conventional serial dedicated line based on the balanced transmission mode.

- **IEC 60870-5-101 unbalanced, master**

This allows substations to be connected via a conventional serial dedicated line based on the unbalanced transmission mode. Several substations can be connected simultaneously.

- **IEC 60870-5-104 client**

This standard enables IEC 60870-5-104 substations to be connected via TCP/IP. It supports connection to redundant devices as well as communication via redundant communication lines.

- **IEC 60870-5-101 dial-up, master**

This protocol allows substations to be connected via dial-up lines. This communication mode is gaining in popularity even though it is not supported by the IEC 60870-5-101 standard. The protocol can manage several dial-up modems as well as several dial-up slaves. Communication can either be balanced or unbalanced.

These protocols can be put together in any combination, enabling even highly complex network structures to be implemented.

SCOPE OF FUNCTIONS:

Transparent ASDU transmission

ipRoute-IEC101/104 transmits ASDUs transparently without interpreting them. This enables ASDUs from the private part of the standard to be exchanged, without the necessity of prior configuration.

Configuration of different address length

The lengths of the common ASDU (CA = Common Address of ASDU), the cause of transmission and the information object address (IOA) can be configured differently and may not be the same.

Conversion between IEC 104 and IEC 101 ASDU types

ipRoute-IEC101/104 supports conversion between monitoring direction ASDU types with long time stamp (M_SP_TB_1, M_DP_TB_1, etc.) and ASDU types with short time stamp (M_SP_TA_1, M_DP_TA_1, etc.) and vice versa. It also supports conversion between control direction ASDU types with long time stamp (C_SC_TA_1, C_DC_TA_1, etc.) and ASDU types without timestamp (C_SC_NA_1, C_DC_NA_1, etc.) and vice versa. Additionally an individual size of originator address can be specified for each communication module. By means of this functionality the most of the differences between IEC 60870-5-104 and IEC 60870-5-101 devices can be eliminated.

Intelligent data flow control and bandwidth adjustment

ipRoute-IEC101/104 offers data flow control which prevents unnecessary data buffering. If the up-link connection to the control station fails or data transmission is suspended by the control station, ipRoute-IEC101/104 automatically stops the data transmission to all down-link connections. This shifts buffering to the substation as much as possible.

If master connections are slower than slave connections, ipRoute-IEC101/104 slows down the slave connections using data flow control in order to prevent buffer overflow.

The ASDU TTL (Time to Live) monitoring which can be configured flexibly ensures that no data is needlessly transmitted to the control station and - this is of particular importance with respect to commands - to the slave or substation.

Accurate monitoring of acknowledged ASDUs prevents loss of data packets in case of temporary connection failures or communication interferences. Unacknowledged ASDUs are repeated after the next connection set-up, even if they had already been transmitted.

ASDU filtering

ipRoute-IEC101/104 allows ASDU filtering in control and monitoring directions based on the ASDU address (Common ASDU address). In control direction (downlink), ASDUs may either be sent to all or only to specified ASDU addresses. Broadcast ASDUs are dispatched to all connected devices. In monitoring direction, the ASDUs are generally sent to all superordinate systems. A filter may also be configured for each uplink connection, so that only certain ASDUs are passed on.

General Polls

As the master does not directly register a substation connection failure, ipRoute-IEC101/104 allows the automatic triggering of a general poll to the substations after the connection is restored.

Virtual RTU

In addition, the substation connection status can be signaled to the control station using a virtual RTU. In this case ipRoute-IEC101/104 behaves like a full IEC-101/104 substation.

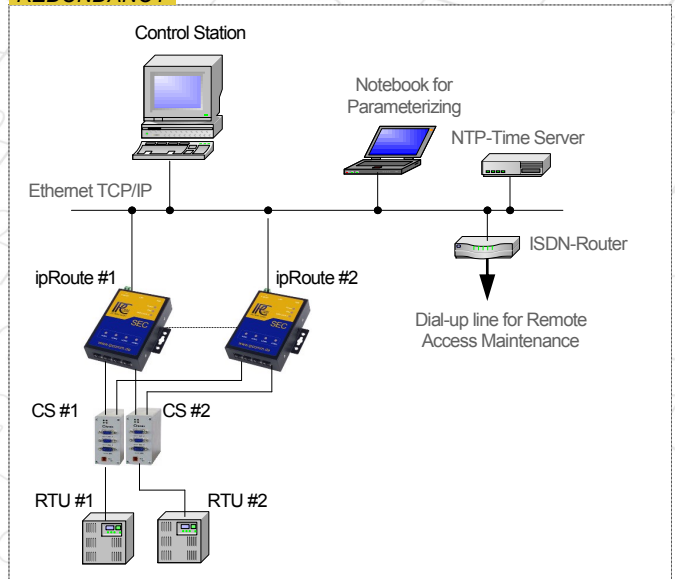
Clock synchronization

ipRoute-IEC101/104 allows substation clock synchronization. The ipRoute-IEC101/104 internal clock can be synchronized via the NTP protocol or the IEC protocol. Following its own synchronization, the connected substations are then synchronized.

Redundancy

In order to meet higher data safety requirements, ipRoute-IEC101/104 can be used with a second device and thus provide the necessary redundancy. The redundancy connection is implemented via a serial link or the Ethernet. Our proprietary Channel Switch (CS) can be used for connecting serial communication lines to both devices.

REDUNDANCY



CONFIGURATION EXAMPLE

id	name	reason	path	addr
1	name	reason	path	192.109.223.84
2	name	reason	path	192.109.223.99
3	name	reason	path	192.109.223.242



CONFIGURATION

Configuration is easily carried out via the Ethernet interface using an integrated web server. The access to the web server is enabled simply by a web browser, such as Microsoft IE or Mozilla Firefox. No additional configuration software is needed.

THE HARDWARE

Our PC-based embedded controller (SEC2) is used as hardware platform. SEC2 is a DIN-rail mounted and space-saving device thanks to its compact design. In addition to a 100BaseT Ethernet adapter there are also four serial RS232/RS485 interfaces. Integrated LEDs offer a number of diagnostic functions. A power indicator, a send and receive indicator for the serial interfaces and a network controller indicator show the current operation states. A CPU LED shows the different software conditions.

Hardware cooling is completely passive, there are no rotating parts.

DIAGNOSIS

The image shows two browser windows. The left window, titled 'Diagnosis Module', displays the status of a connection named 'down1 (IEC101UnbalMaster)'. It shows 'Data Flow' as 'released', 'Frame Rate' as '61 frames / min', and 'Manually Blocked' as 'NO'. The right window, titled 'History Module', shows a 'LOGGING' table with columns for FILE, TIME, and SIZE, listing various log files like 'diag_err', 'diag_log', and 'iec2_err'. Below the logging table is a 'HISTORY' section showing a list of 'ipRoute test' events with their start and stop times.

TECHNICAL DATA

RS-232 Interfaces	4 x IEC 60870-5-101
Ethernet Adapter	1 x 100BaseT
Send / Receive Indicator	RS-232/RS-485, Ethernet
Power Supply	9 – 48 V DC
Mounting	35 mm DIN-rail
Environmental / Storage Temperature	0° C bis 70° C / - 20° C bis 80° C 32° F to 158° F / - 4° F to 176° F
Relative Humidity	5 % to 95 % non condensing
Standards	CE Class A, FCC Class A
Dimensions W/H/D	78/108/24 mm
Scope of Delivery	ipRoute-IEC101/104, Documentation: English

Detailed diagnosis information can be accessed using a web browser, too.

The diagnosis display allows the communication state of all configured connections to be seen at a glance. In addition communication traffic of all lines can be logged and called up in an easy to read format, which greatly facilitates troubleshooting.

THE COMMISSIONING

Configuration and commissioning can easily be carried out by the customer. In order to avoid any problems, the service technician should be well acquainted with the IEC 60870-5-101/104 protocols. A one-day training session has been proven to be most useful. This may include a configuration and integration test. In this case it takes only a few hours to complete the commissioning.

THE REQUIREMENTS

These requirements ensure successful integration of IEC 60870-5-101/104 systems:

- ASDU addresses used must be unambiguous and unique for all connections, multiple assignments are not allowed.
- ASDU types used for the control station or substations must be compatible. This can be ensured by matching interoperability lists. ipRoute-IEC101/104 supports the conversion of the following ASDU types (the behaviour is configurable):
 - ⇒ Monitoring direction ASDU types with long time stamp (M_SP_TB_1, M_DP_TB_1, etc.) into ASDU types with short time stamp (M_SP_TA_1, M_DP_TA_1, etc.) and vice versa
 - ⇒ Control direction ASDU types with long time stamp (C_SC_TA_1, C_DC_TA_1, etc.) into ASDU types without timestamp (C_SC_NA_1, C_DC_NA_1, etc.) and vice versa
 - ⇒ Test command ASDU with long time stamp C_TS_TA_1 into test command ASDU without timestamp C_TS_NA_1 and vice versa

We gladly offer our support to assist you in checking these requirements.



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