THE MOTIVATION

The market demand encouraged us to develop ipConv. Development objective of ipConv was to emphasize customer's benefit, such as safe commissioning, quick debugging, simple upgrade options and a best price-performance ratio.

During and after commissioning phase adaptations and additions may be done on-site as well as remote (modem / phone) in a very simple way.

With the help of intelligent software tools commissioning is considerably simplified, faster and calculable. That means commissioning costs are reduced to a minimum and time scheduling of the customer is guaranteed.

Hardware and software are designed to add the single modules if required, similar to a modular system.

ipConv is a communication system that takes the transmitted process data of the telecontrol devices, converts the data, if necessary, and distributes them to the master control system for data processing.

Data conversion and distribution turn ipConv, the gateway and/or telecontrol head / frontend processor into the ideal link between control station and telecontrol devices.

Furthermore, ipConv is suitable for use as gateway, router, bridge and data concentrator.

ipConv comprising hardware and software components thus offers a universal system for solving communication tasks. This breaks new ground in the field of communication to reduce costs.

THE FIELD OF APPLICATION

ipConv is mostly used by energy supply companies, on the industrial sector, e.g. in chemical and automotive industry, rail sector and in all other fields where communication devices must be connected with each other.

ipConv can be used for a number of network topologies.

THE SOFTWARE

- **Internal Software Structure**

  The professional conversion requires a universal software structure to integrate all common protocols without great effort.

  The node process plays an important part there. Its task is to receive the protocol information, to process and, if necessary, to transmit them to other protocols.

  All information to and from the node are transferred in a standardized format in case of value / status changes. This process enables connecting of any existing protocols in the easiest way.

  - **Transparency**

    Both during commissioning phase and the following operation it is of great use to make a quick diagnosis of occurring faults.

    For this purpose, each protocol enables tracking of all communication traffic with the receiving station on different abstraction levels, starting with raw data (telegrams in HEX format) to a decoded telegram view (clear text format).

    The switching node facilitates tracking of the information flow as well. You can see the module that sent the information, its value and status and where this information is transferred to.

    Information gained in this way can be archived over a longer period, this makes it possible to diagnose rarely occurring problems.

    Monitoring enables the interactive connection with the node. Updated information values can be accessed systematically. In addition you can enter information into the node to simulate data records.

    You can check all information values and states at any time and immediately modify, if required (e.g. during testing phase).
ipConv provides an universal operating system and hardware interface, so the application is platform independent.

THE HARDWARE

Platforms

Depending on customer’s requirements and needs a wide range of different hardware is available.

The following criteria play a decisive role in the hardware selection:

- Number of data being transmitted
- Type of communication interface
- Number of communication interfaces
- Choice of operating system

An in-house hardware development secures optimum harmonization of our products for every application and guarantees a high reliability, long life and availability.

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Interfaces</th>
<th>Ethernet</th>
<th>V.24</th>
<th>Brief Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet</td>
<td>1</td>
<td>4</td>
<td>✓</td>
<td>SEC2: PC-based embedded controller especially designed for industrial applications. It contains no rotating parts. Thanks to its extremely low power demand no fan is needed.</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>4</td>
<td>✓</td>
<td>DIN-Rail Embedded Controller (HECPM / HECPS): Compact controller mountable on a DIN-rail with Profibus-DP, master or slave interface.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>4</td>
<td>✓</td>
<td>Midrange Embedded Controller (MEC): Compact and powerful controller mountable on a DIN-rail. No rotating parts due to a passive cooling system and a CompactFlash used as mass storage device.</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>16</td>
<td>✓</td>
<td>19” Industrial PC IPC191: A robust and flexible industrial PC in ultra flat design. Usage of a CompactFlash as mass storage device.</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>Channel Switch (CS): Channel switch for coupling of two redundant devices to one communication line.</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>Telecontrol Transformer (TCT): Telecontrol converter for pulse-code and pulse-length modulated protocols.</td>
</tr>
</tbody>
</table>

THE RANGE OF FUNCTIONS

Front End Processor / Telecontrol Head

ipConv can take over the task of a front-end processor (telecontrol head). Due to the modular system it is possible to link any number of stations to the superior control system. ipConv gathers the information from the connected telecontrol devices and distributes them according to configuration data to one or more control stations.

General Poll

As the control station does not directly receive information about a failed telecontrol line, ipConv automatically triggers a general poll of the telecontrol devices after the next connection setup.

Time Synchronization

ipConv allows time synchronization of the connected telecontrol devices. ipConv internal time synchronization may be performed in different ways:

1. Time synchronization via NTP protocol
2. Many communication protocols such as IEC 60870-5-104 permit time transmission.
3. Time synchronization via a linked GPS or DCF77 receiver

ipConv time synchronization is followed by time synchronization of the telecontrol devices.

Password Protection

Access to all administration channels is password protected to prevent unauthorized access.

Mass Storage Device

The use of industrial SolidStateDisks (CompactFlash) as mass storage device ensures a high data integrity (MTBF ≥ 1.000.000) and shock resistance.

The hours of operation of the used memory cards - even Windows operating system - are far below the usual operating time of terminal equipment due to the intelligence of the controller. The controller knows the number of write and delete records of each memory cell. This ensures the optimization of storage. Data are kept even in case of power outage during writing.

From operating system’s point of view the SolidStateDisk is treated exactly the same like a hard-disk. It is possible to remove and insert the SolidStateDisk without loosening a single screw. This allows fast hardware replacement without reinstall of software and configuration. Switching the flashcard is sufficient.
- **Redundancy**
  To meet increased requirements, ipConv is with a second device fully redundant. Redundant devices are interlinked either via serial interface or Ethernet. The IPCOMM Channel Switch (CS) is used for coupling two redundant devices to one communication line.

- **Configuration**
  By means of an integrated web server, configuration can be done very easily via Ethernet using a web browser, e.g. Microsoft Internet Explorer or Mozilla Firefox. There is no additional configuration software required.

### MAIN MENU

All relevant ipConv functions are accessible from the main menu:
- Complete configuration backup and recovery
- Software upgrade
- Parameter setting
- Data import of configuration tables
- System start and stop
- Access to diagnostics information
- Access to process image and data simulation
- Access to latest logfiles

### CONFIGURATION EXAMPLE

All relevant ipConv functions are accessible from the main menu:

### DIAGNOSTICS

The **Diagnostics** displays - at a glance - the state of communication on all interfaces. The diagnostics menu shows all information in a clearly structured form. Text with colored background immediately reflects the state of each message. In addition to pure messages and measured values, control commands may be triggered off (e.g. general poll via graphical elements).

### Logging

With the **Logging** function information can be recorded and archived for a certain time. The following data can be logged:
- All data sent and received
- System messages, that is disconnects, communication error messages etc.
- Configuration and software error messages

The **Logging** function is of great benefit particularly during commissioning.

### Simulation

Beside the Logging function, signals can be displayed and simulated in a plain, project-related form. This is very helpful during commissioning. The web browser allows to simulate data and commands directly. The ability to simulate is very interesting for pre-tests, where installation of communication routes is not or partly finished.

### REDUNDANCY

![Diagram of redundant system](image)

The configuration example shows the link layer of the IEC 60870-5-101 master protocol stack.

All parameters with set values, the corresponding units of measurement and a brief description are listed. Only necessary parameters are displayed for parameterizing. For example, if type of link layer is set to „unbalanced“, only needed information is asked. A plausibility check defends from incorrect entries.

For the fast and efficient **parameterization** ipConv is able to import user data from tables, particularly with large amounts of data.

The tables are created from templates and can be modified with spreadsheets (e.g. MS Excel). Using algorithms (formula) the data volume to be entered is reduced to a minimum.

- **Simulation**
  - Beside the Logging function, signals can be displayed and simulated in a plain, project-related form. This is very helpful during commissioning. The web browser allows to simulate data and commands directly. The ability to simulate is very interesting for pre-tests, where installation of communication routes is not or partly finished.
**Example 1:**

At the Mainova Gas section there is a number of substations which are to be controlled directly over the network. Twenty gateways, one at each station, are used as network node computer to link up the substations with the superior redundantly laid out control stations.

Communication to the superior control stations is implemented with the IEC 60870-5-104 protocol.

The substations can also be controlled locally by a connected station control computer, should there be a network failure.

The gateway and station control computer use platform-independent OPC DAXML for communicating. The sphinx open visualization system of in-integrierte Informationssysteme GmbH runs on the station control computer. Both the network node computer and the station control computer use the LINUX operating system.

Data transfer between gateway and substations is based on SEAB 1F, IEC 60870-5-101 and Modbus RTU.

The SEAB 1F data of the AEG MODICON A120 substations are transmitted over AEG UEM 201 modems.

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**Example 2:**

The aim of this project was to connect the AC networks of Victoria and Tasmania. The interconnector is a submarine high voltage cable running from Tasmania to the Australian mainland.

The protocol conversion software was installed on hardware supplied by Siemens. Conversion is from the proprietary Siemens Simatic TDC protocol to DNP 3.0. Communication between the gateway and the redundant substation automation system runs via a redundant LAN. Control stations are connected via two independent RS-232 lines.

The converter clock is synchronized with SNTP.

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**Example 3:**

The station, as illustrated right, operates within the Swiss Loetschberg base tunnel. The Loetschberg base tunnel with its 34.6 km length is one of the longest railway tunnels worldwide; it connects Frutigen (canton of Berne, Switzerland) with Raron (canton of Wallis). The Loetschberg railway is to be operated by the BLS Loetschbergbahn AG (BLS = Bern-Loetschberg-Simplon).

IPCOMM employs three products to control the station: the gateway ipConv, the router ipRoute-IEC101/104 and the Ethernet converter ipEther232.

The central control devices (ZLG) have just serial RS-232 interfaces available. The Ethernet converter puts IEC 60870-5-101 data into TCP/IP parcels and allocates them at the Ethernet interface.

In between IEC 60870-5-101 information are transparently converted (1:1) to IEC 60870-5-104 by the router. This transparent data transmission is a prerequisite for the communication with HS management.

Our gateway ipConv undertakes the connection to the superior control stations (TLS-North, TLS-South and BSV). TLS-North and TLS-South are supplied with information by the OPC interface.

Data are transmitted to BSV control station by IEC 60870-5-104. All systems are redundant.
## THE PROTOCOL OVERVIEW

Extract of protocols realizable on ipConv basis

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Type</th>
<th>Interface / Profiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>3964R</td>
<td>master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>ACS</td>
<td>master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>ACS 3100</td>
<td>master / slave</td>
<td>PCM sync</td>
</tr>
<tr>
<td>ADLC</td>
<td>link layer</td>
<td>PCM async</td>
</tr>
<tr>
<td>ADLP 80</td>
<td>master / slave</td>
<td>PCM sync</td>
</tr>
<tr>
<td>ADLP 180</td>
<td>master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>ANSI X3.28</td>
<td>balanced / master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>CDC Type I / II</td>
<td>master / slave</td>
<td>PCM sync / async</td>
</tr>
<tr>
<td>CETT-20</td>
<td>master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>CETT-50</td>
<td>master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>CETT-80</td>
<td>master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>COMLI</td>
<td>master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>Conitel-2020</td>
<td>master / slave</td>
<td>PCM sync</td>
</tr>
<tr>
<td>DF1</td>
<td>master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>DNP 3.0</td>
<td>master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>EFD300/400</td>
<td>master / slave</td>
<td>PDM</td>
</tr>
<tr>
<td>ESTEL Version 7</td>
<td>master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>F4F</td>
<td>master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>Fuji</td>
<td>master / slave</td>
<td>PCM sync</td>
</tr>
<tr>
<td>FW535/537</td>
<td>master / slave</td>
<td>PDM</td>
</tr>
<tr>
<td>GEADAT 81</td>
<td>master / slave</td>
<td>PCM</td>
</tr>
<tr>
<td>GEADAT 90</td>
<td>master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>GEATRANS F202</td>
<td>master / slave</td>
<td>PCM</td>
</tr>
<tr>
<td>Harris 5000/5500/6000</td>
<td>master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>HDLC</td>
<td>link layer</td>
<td>PCM sync</td>
</tr>
<tr>
<td>Hitachi HC 4300</td>
<td>master / slave</td>
<td>PCM sync</td>
</tr>
<tr>
<td>HNZ 66 S XX</td>
<td>master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>IEC 61850</td>
<td>client / server</td>
<td>TCP/IP</td>
</tr>
<tr>
<td>IEC 60870-5-101</td>
<td>balanced / unbalanced / master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>IEC 60870-5-102</td>
<td>master / slave</td>
<td>PCM</td>
</tr>
<tr>
<td>IEC 60870-5-103</td>
<td>unbalanced / master / slave</td>
<td>PCM async</td>
</tr>
<tr>
<td>IEC 60870-5-104</td>
<td>master / slave</td>
<td>TCP/IP</td>
</tr>
<tr>
<td>IEC 60870-6-XXX</td>
<td>client / server</td>
<td>TCP/IP</td>
</tr>
<tr>
<td>TASE-2, ICCP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Further protocols on request!