ELVAC RTU in Primary Substation

Usual application names:

- Central Communication Unit and Data Concentrator
- Intelligent Electronic Device (IED) / Remote Terminal Unit (RTU) for Monitoring, Measurement, Fault indication, Protection and Control

Location specification:

- primary substation (HV/MV).

Typical application demands:

- mounting is usually in 19“ rack mount cabinet or on back panel,
- communication with SCADA system usually via Ethernet LAN or optical fiber lines, sometimes communication backup via GSM/UMTS/LTE modem,
- typical communication demands:
  - communication protocols to SCADA – IEC 60870-5-104, DNP3, IEC 61850,
  - communication protocols to IEDs – IEC 60870-5-104, IEC 60870-5-101, IEC 60870-5-103, DNP3, IEC 61850, MODBUS TCP/RTU, sometimes others, when retrofits are demanded,
  - secured communication, router functionality, communication tunnels etc.,
- data collection from many other devices in substation, like protection relays and power meters,
- high number of digital inputs and outputs,
- sometimes – direct feeder measurements, power quality measurement.

Note: As the standards may vary from country to country, your demands can be always discussed with our professionals.

Centralized system example

ELVAC RTU7M system description

1. **Whole systems** can be generally built as:
   a. Centralized system – all signals from substation are brought to one location. RTU system is large with many inputs and outputs, built from more RTUs interconnected via LAN and they all are located in one or more cabinets next to each other. One RTU is Master, which works as data concentrator, another Slave RTUs resend the data to the Master. This system is more common in primary substations.
   b. Decentralized system – signals are brought to the nearest collection cabinet, then RTU systems are usually smaller but many and they are usually connected in communication ring (optical or metallic) for safe communication. This system is commonly used for substation control in large factories.

2. **Chassis** – as the number of signals is usually high (typically hundreds), the RTU system is usually assembled in 19” chassis with 16 slots for I/O cards. When more RTUs are needed, then system expandability is provided via Ethernet LAN.

3. **Power supply** – there is usually used DC voltage for power supply, because there are usually battery systems in substations available for non-interruptible operation. Available power supply cards for ELVAC RTUs are:
   a. PWRI-60DH ... 10–60 V DC,
   b. PWRI-110DH ..... 110 V DC,
   c. PWRI-220DH ..... 220 V DC.

   If 230V AC is used for powering of whole system, then external power supply 230V AC to 24V DC is used. Exact RTU consumption can be calculated according to catalogue information for each type of card used in system. Then total load of system can be calculated according to the number of RTUs in whole system plus charging current up to 3A for one battery charger card, if it is used.

4. **Battery charger** – if battery system is not available in substation, there can be used battery charger card directly built in ELVAC RTU7M. There are available versions for 24V and 48V battery pack. One battery charger card can be used for up to 4 RTUs. There is thermal sensor input available for optimal battery charging control. Status of batteries is regularly checked by RTU and alarms are sent to maintenance team.

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5. **Communication** – ELVAC RTUs use the newest type of communication card COMIO PC3, which can be used in different versions according to demanded number of Ethernet, optical or serial ports. There are available versions with embedded GSM/UMTS/LTE modem. This card supports all necessary communication protocols and it has enough power for all tasks, like secured communication with SCADA and maintenance team, collecting all data from I/O cards and IEDs in substation. This card supports routing functions for separation of LANs, role-based access and many other functions used in modern secured networks.

6. **Digital inputs** – there are available cards DI20-Uxx in Dry or Wet contact versions with different signaling voltage from 12 to 220V DC/AC. DI card have optically isolated inputs, the signal polarity can be bidirectional. Signaling voltage is usually the same as RTU power supply voltage, so Wet contact are more commonly used in substation applications. Dry contact version is available in 24V version. If AC voltage is used, there can be used filters for correct signal evaluation.

7. **Digital outputs** – there are available cards DO10-U with relay outputs 24 V DC / 8 A (250 V AC / 8 A). Each card has 8 NO contacts and 2 changeover contacts. When other DC voltage is used for relay outputs, then the current load shall be considered according to loading curve visible in user manual for RTU7M. If DO card relay load limit is not sufficient, there can be used external contactors/relays with higher load.

8. **Measuring cards** – if feeder measurement is demanded, there can be used cards from RTU7M EP series, which have high accuracy, fault indication functions for MV feeders and they can be used also as protection relays on MV feeders. They are available in different combinations for voltage and current measurement, including versions for low power resistive or capacitive sensors. All measuring groups are isolated from each other and from system. There are available also cards from RTU7M AI series for power quality monitoring and measuring from transducers or other type of sensors.

All cards specification can be found in our catalogue, the most commonly used variants are on internet e-shop at www.rtu.cz in RTU7M section.

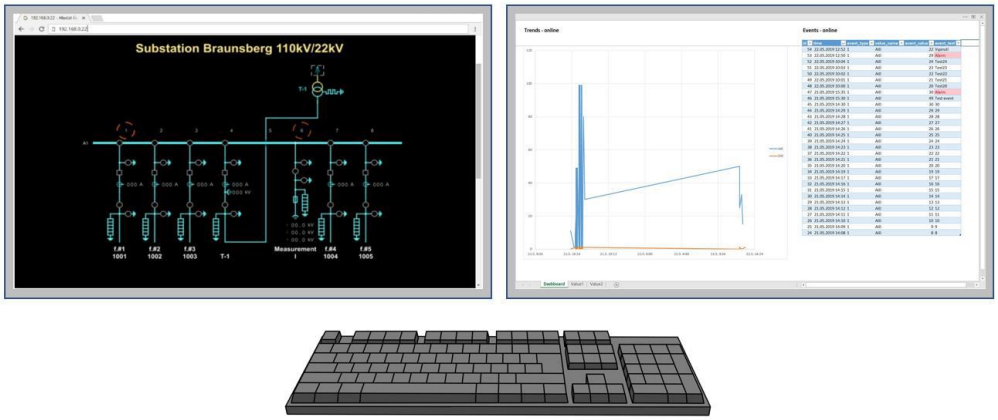
Example of RTU combining communication, I/O cards and 3 protection relays in one chassis

ELVAC RTU7M advantages:

- all in one solution – complete remote monitoring, control and maintenance, communication with SCADA, power backup, IEDs data concentration, I/O signals, measurement, indication and protection, waveform recording, programmability, HMI interface.
- wide system expandability – practically unlimited number of signals from substation,
- optional power supply voltages,
- optional battery backup controlled directly from RTU – the battery status is regularly tested and alarms are transferred to SCADA or maintenance system,
- variety of communication ports with support for all state-of-art standards in power distribution control – different protocols, communication security and many others,
- ready for retrofits – older communication support after consultation with producer,
- optional feeder measurement with protection relay functionality for MV feeders – price efficient solution,
- waveform recording, commonly used for evaluation of faults on lines,
- optional power quality monitoring,
- programmable interface for special automation functions,
- HMI interface is embedded in each RTU (free of charge), system visualization is easy and fast. There is no special and expensive SW demanded, there can be visualized schemes and historical data thanks to embedded SQL support in RTU. The systems can be controlled via active elements in scheme including details displaying. The standard computer, panel PC or tablet with internet browser is all you need. There are supported Windows and Android platforms.

Example of HMI installed directly on cabinet door

Example of cabinet for smaller substation



Example of HMI visualization with historical data using separate computer with dual display in control room

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Configuration example 1

Primary substation system with the following systems specification:

- power supply from substation battery system 110 V DC,
- communication to SCADA via IEC 60870-5-104 or DNP3 via Ethernet,
- backup communication to SCADA via LTE modem,
- optional data collection from protection relays in substation via optical interface with protocol IEC 61850,
- 6 x RS-485 port for data collection from IEDs in substation via MODBUS RTU,
- 2 x Ethernet LAN port for data collection from IEDs in substation via MODBUS TCP, IEC 61870-5-104 or IEC 61850,
- demand for 100 x DI and 40 x DO.

Description of this example – system is assembled into one RTU in the following configuration:

Slot 1 – power supply card for 110 V DC,

Slot 2, 3 – communication card COMIO-PC3 LTE ESW2 with the following features:

a) high performance for communication with SCADA and whole substation data concentration,
b) LTE modem for backup communication with SCADA,
c) Ethernet LAN port NET2 for main communication with SCADA,
d) Ethernet LAN port NET1/1 for communication ports expansion,
e) Ethernet LAN port NET1/2 for communication ports expansion,
f) 2 x serial port for communication with IEDs,
g) optional 2 x optical interface for communication with protection relays in optical ring with protocol IEC 61850 or other.

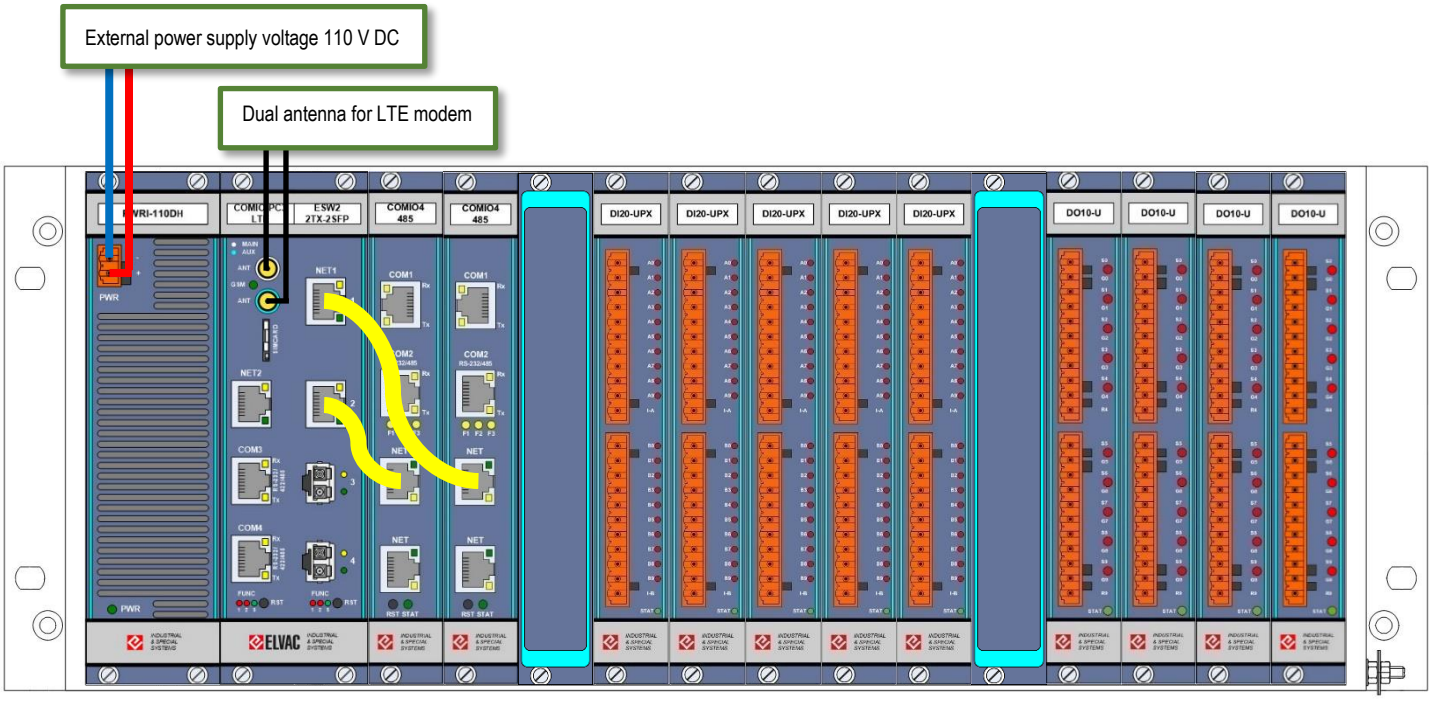
Slot 4 – communication card COMIO4 485 working as communication port converter from serial lines to Ethernet LAN, offers another Ethernet port, 2 serial ports RS-485 and RS-232/485 in RTU,

Slot 5 – communication card COMIO4 485 working as communication port converter from serial lines to Ethernet LAN, offers another Ethernet port, 2 serial ports RS-485 and RS-232/485 in RTU,

Note: There can be used card COMIO 485-485, where one Ethernet port is changed to serial RS-485 port. Then the system can have 7 serial ports in this configuration.

Slot 7 to 11 – digital input cards in version DI20-UPX for external signaling voltage 110 V DC (wet contact), altogether 100 DI,

Slot 13 to 16 – digital output cards DO10-U, altogether 40 x relay DO.



Description:

Ethernet LAN cable
\- DC power wire
\+ DC power wire

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Configuration example 2

Primary substation system with the following systems specification:

- power supply 230 V AC,
- battery backup 24 V DC, battery monitoring,
- communication to SCADA via IEC 60870-5-104 or DNP3 via Ethernet,
- backup communication to SCADA via LTE modem,
- data collection from protection relays in substation via optical interface with protocol IEC 61850
- 6 x RS-485 port for data collection from IEDs in substation via MODBUS RTU,
- 2 x Ethernet LAN port for data collection from IEDs in substation via MODBUS TCP, IEC 61870-5-104 or IEC 61850,
- demand for 220 x DI and 60 x DO,
- demand for 12 x 20 mA current inputs from transducers,
- demand for 4 x 3-phase MV feeder monitoring, fault indication and protection relay 100V, 5A.

Description of this example – system is assembled from 3 RTUs, mountable into 19" rack. First Master RTU works as main communication unit with SCADA and data concentrator, Slave RTUs resend data to the Master RTU.

Master RTU

Slot 1 – power supply card for 24 V DC powered from battery backup card,
Slot 2 – battery backup card for 24V battery pack, powered from external power supply 230V AC / 24 V DC, 10A
Slot 3,4 – communication card COMIO-PC3 LTE ESW2 with the following features:

h) high performance for communication with SCADA and whole substation data concentration,
i) LTE modem for backup communication with SCADA
j) Ethernet LAN port NET2 for main communication with SCADA
k) Ethernet LAN port NET1/1 for communication with IEDs
l) Ethernet LAN port NET1/2 for communication with Slave RTUs
m) 2 x serial port for communication with IEDs
n) 2 x optical interface for communication with protection relays in optical ring with protocol IEC 61850 or other.

Slot 6 to 16 – digital input cards in version DI20-UPM for external signaling voltage 24 V DC (wet contact), altogether 220 DI.

Slave RTU 1

Slot 1 – power supply card for 24 V DC powered from battery backup card in Master RTU,
Slot 3 – communication card COMIO4 485 with the following features:

a) interconnection with Master RTU and another Slave RTUs via LAN chain,
b) RS-485 and RS-232/485 ports for communication with IEDs,

Slot 6 to 11 – digital output cards DO10-U, altogether 60 x relay DO,
Slot 15, 16 – measuring cards AI-6ID/20/20-AI for 20mA transducers connection.

Slave RTU 2

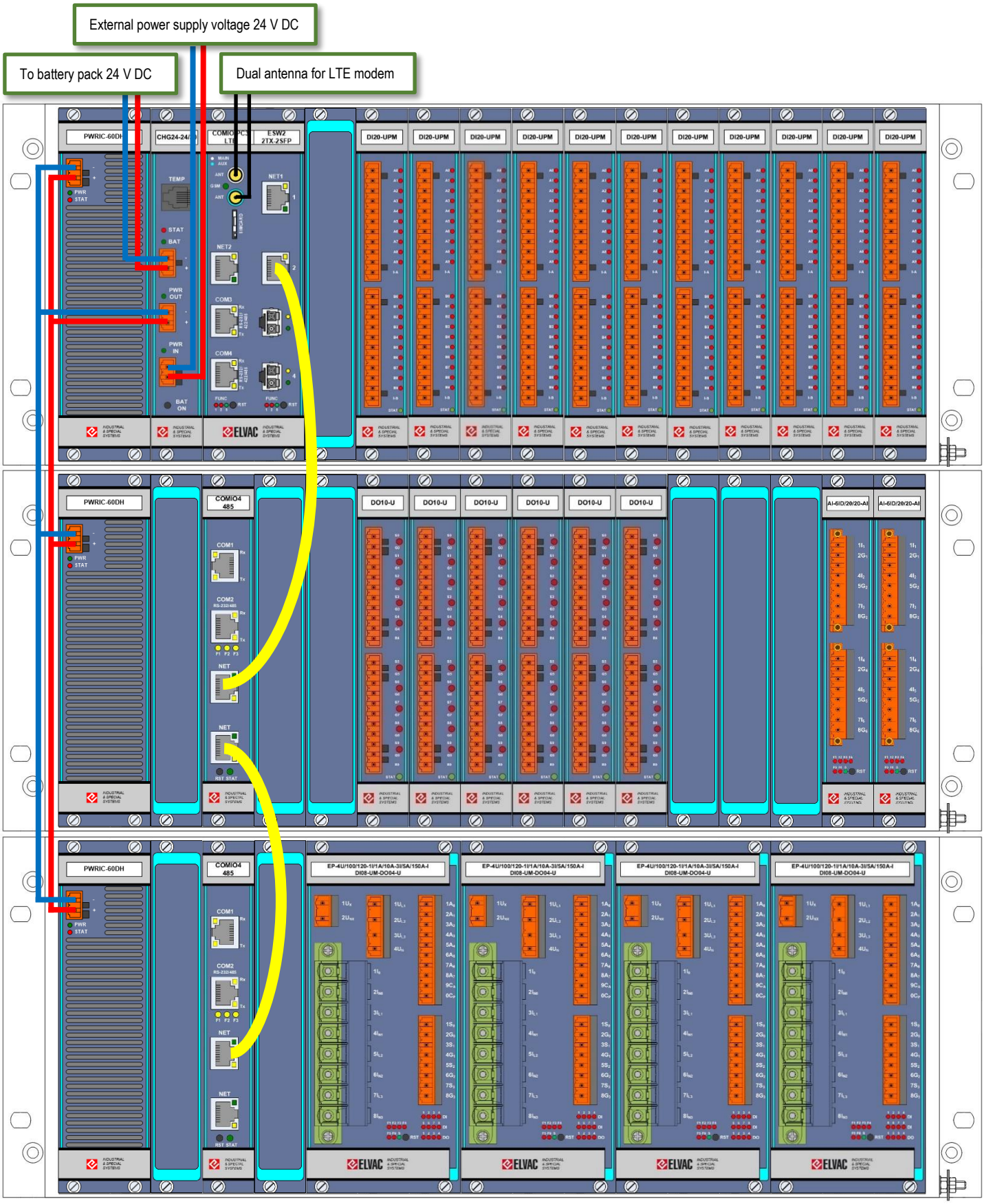
Slot 1 – power supply card for 24 V DC powered from battery backup card in Master RTU,
Slot 3 – communication card COMIO4 485 with the following features:

a) interconnection with Master RTU and another Slave RTUs via LAN chain,
b) RS-485 and RS-232/485 ports for communication with IEDs,

Slot 5 to 16 – measuring cards RTU7M EP-4U/100/120-1I/1A/10A-3I/5A/150A-I-DI08-UM-DO04-U, they measure 3-phase 100V (optionally neutral voltage) and 3-phase current 5A with 30 x overloading (still measured value) and 100 x withstand for 1s, neutral current can be calculated or directly measured by 4th current input, they are equipped with 8 x DI and 4 x DO for direct connection to feeders for signaling and automatic control, they calculate another values (P, Q, S, frequency, etc.) from measured values, they evaluate faults on lines upon limits setup using standards ANSI 27/59, 46BC, 47, 50, 50N, 51, 51N, 67, 67N, so they are used as protection relay for MV feeders.

General notes:

1) All free slots in RTUs can be used for future system extension.
2) If external Ethernet switches are used in substation for communication between many Ethernet devices, then this network can be certainly used also for connection between RTUs in standard star topology.
3) All ELVAC RTUs are delivered with female connectors for DI, DO and measuring cards for cable connection of signals from substation. Thus, the signals can be quickly disconnected from cards during testing, service works or commissioning.



Description:

Ethernet LAN cable
- DC power wire
+ DC power wire

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