AdaptiTel

June
2018

System Planner

Version 1.4

elcomplus

Table of contents

Revision history

The following table contains the history of updates to the AdapTel System Planner.

Date	Version	Description
December, 2017	1.0	Initial release
February, 2018	1.1	Updated technical parameters
April, 2018	1.2	Updated technical parameters
May, 2018	1.3	Updated technical parameters
June, 2018	1.4	Updated technical parameters

1. Device purpose

The AdapTel is an interface adapter for receiving and transmitting telemetry data from distributed industrial objects to the dispatch level of the customer's SCADA systems in DMR networks. It is required to use MOTOTRBO Radios by regions:

EMEA	APAC	LACR*	NA
DM2000 DM3000 DM3000	XiR M6000 XiR M8200 XiR M8600	DGM 4100 DGM 5000 DGM 6100 DGM 8000	XPR 2500 XPR 4000 XPR 4000 XPR 5000

The AdapTel provides transparent channel RS-232/RS-485/Ethernet interfaces between third-party devices (PLC, RTU, meters, etc) and SCADA systems, also the AdapTel gathers technological signals through built-in channels, as well as through third-party input / output modules with the digital Modbus interface and provides data by Modbus TCP and IEC104 industrial protocols for third-party SCADA systems. All data is transmitted through DMR network.

2. Terminology

MASTER – AdapTel, nodal input into DMR network from the dispatch terminal side.

SLAVE – AdapTel, nodal input into DMR network from the controlled object side.

POLLING – process of data collection executed by MASTER sending serial requests to the **SLAVES.**

INITIATIVE – process of data transmission from the **SLAVE** to the **MASTER** without a request from the **MASTER.**

3. Abstract

This document is intended to familiarize users with technical capabilities of the **AdapTel** in a DMR network. **AdapTel** in a DMR network can provide the transmission of any data types, such as data from control equipment, monitoring systems and other devices using RS-232/RS-485/Ethernet digital interfaces as well as from the equipment status sensors and parameter monitoring sensors.

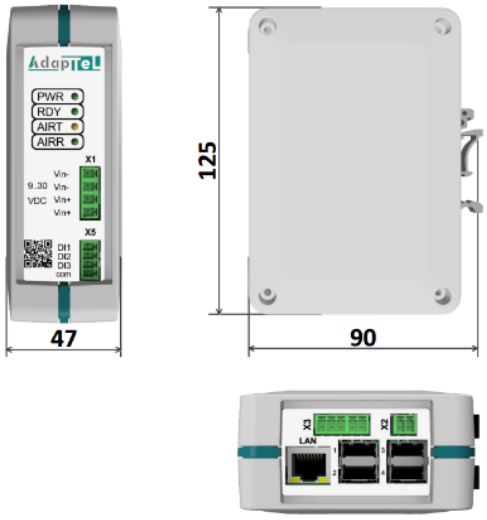
4. Characteristics

Parameter	SB70 model	SB70-16DI model	SB70-16DI/DO model
USB (2.0) ports quantity	4		
Ethernet ports quantity	1		
RS-485/RS-232 ports quantity	1: Interface type is set at web page (galvanic isolation 2.5 kV). The RS board can be replaced in case of breakdown. The port quantity can be increased by using USB-to-COM converters based on FTDI/CH34x/PL2303 chips.		
Digital input channels (galvanic isolation 5 kV).	3	19	3 + Up to 16 (share with DO)
	Quantity increase and other type of channels are also available by using Modbus TCP/Modbus RTU (RS-485) expansion I\O modules.		
Digital output channels	-	-	Up to 16 (share with DI)
	Quantity increase and other type of channels are also available by using Modbus TCP/Modbus RTU (RS-485) expansion I\O modules.		
Indication	Power (PWR), Ready (RDY), Transmit AIR MotoTRBO (AIRT), Receive AIR MotoTRBO (AIRR).		
Additional information	Real time clock, Watchdog timer, Web-interface for configuration.		
Cable for radio connection	AIC1 or AIC2. It is necessary to indicate the series of radio DM2000 or DM3000\DM4000 when ordering.		
Operation modes	Transparent mode – transparent mode for data transferring. It allows to set up the transparent channel of data transmission for third-party devices and SCADA systems. Available interfaces: Ethernet/RS-232/RS-485. Any data communication protocol can be used for serial interfaces. UDP and TCP based address protocols can be used for Ethernet.		
	RTU mode – in this mode AdapTel plays the role of an RTU itself by executing data acquisition, using both built-in DI channels and external I/O modules with Modbus digital interface. Also it can collect data from PLC via Modbus protocol.		
Input supply voltage	=9..30 V. There is polarity reversal protection.		
Maximum input power	3 W		
Operating temperature	-30..+70 °C		
Storage temperature	-30..+70 °C		
Overall dimensions (WxHxD, mm)	90x125x47	90x125x67	

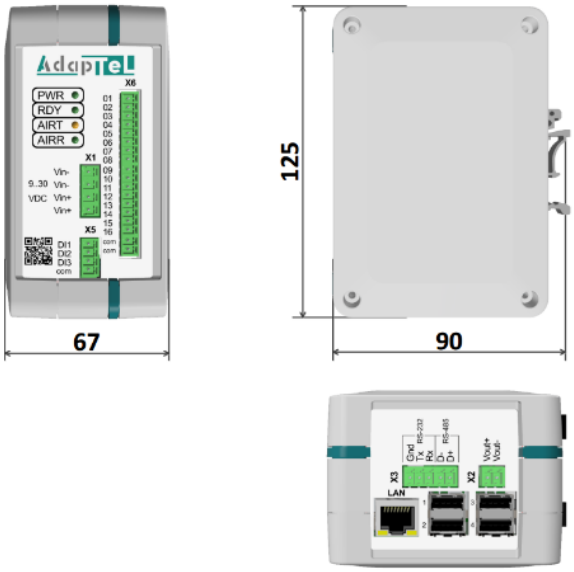
Parameter	SB70 model	SB70-16DI model	SB70-16DI/DO model
Case material	Plastic		
Mounting	DIN rail		
Maximum weight, g	270	350	
Protection degree provided by housing	IP20		

5. General view and dimensions

AdapTel SB70 model



AdapTel SB70-16DI model
AdapTel SB70-16DI/DO model



6. Preparation for use

AdapTel is mounted on a DIN-35 rail. In order to do that, hook the lug of the catch on the bottom lug of the rail and fix the module on the rail by pressing the top surface of the **AdapTel**.

Connect external circuits to the **AdapTel** terminals. Terminal description and connecting scheme are shown in table 1 and figure 1.

Apply supply voltage to the **AdapTel**. Make sure that the «PWR» indicator is on.

Configure **AdapTel** if needed.

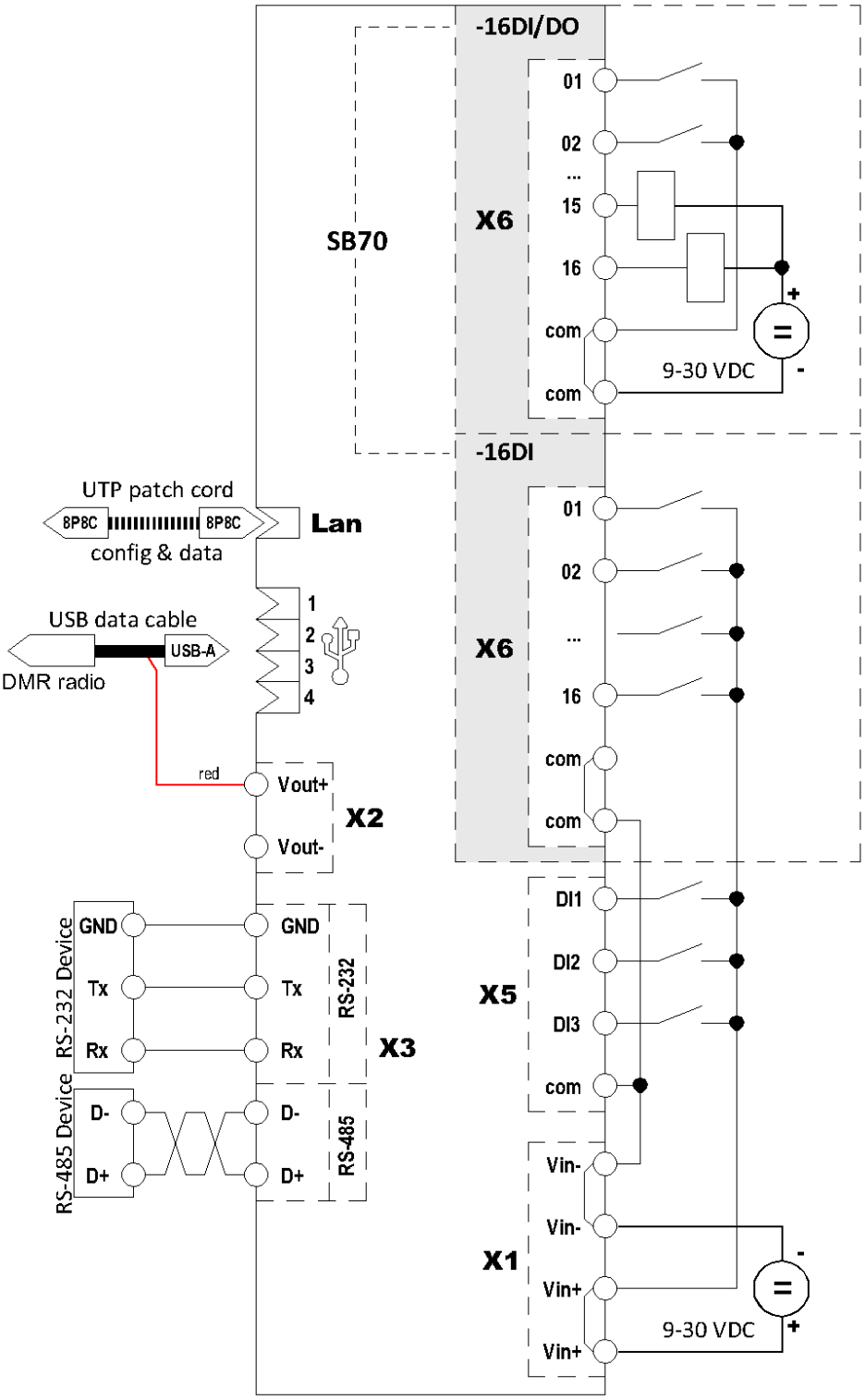


Figure 1. Connection diagram for AdapTel

Table 1 – AdapTel terminals description

Description	Pin label	Comments
X1		
Power supply 9…30 VDC	Vin-	In case the function «Radio On/Off» (terminal X2) is used, supply voltage band should be limited to 9…14 VDC
	Vin-	
	Vin+	
	Vin+	
X2		
Radio On/Off (for Motorola MotoTRBO radios)	Vout+	Duplicates the X1 voltage, maximum current 50 mA
	Vout-	
X3		
RS-232 port, optocoupler	GND	RS-232 and RS-485: Interface type is set at web page.
	Tx	
	Rx	
RS-485 port, optocoupler	D-	
	D+	
X5		Used for monitoring wet contacts up to 30 V. If you need monitoring dry contacts you can use external power supply: ▪ second pins Vin+, Vin- of X1 terminal of **AdapTel** supply; other 9…30 VDC power supply.
Digital inputs,3 channels with common cable, with optocoupler for each channel	DI1	
	DI2	
	DI3	
	com	
X6 (for SB70-16DI)		
Digital input, 16 channels with common cable, with optocoupler for each channel	01	
	02	
	…	
	16	
	com	
	com	
X6 (for SB70-16DI/DO)		Used for monitoring dry contacts (put sensor between channel and common pins) For digital output you have to use external power supply 9…30 VDC.
Digital input, 16 channels with common cable Digital output, 16 channels with common cable up to 30 V@200 mA per each channel	01	
	02	
	…	
	16	
	com	
	com	

Description	Pin label	Comments
LAN		
Ethernet 10/100 port		Used for connecting third-party devices to the AdapTel.
USB		
4 ports USB 2.0		Used for devices connection to the AdapTel via USB, including DMR radios.

7. First activation

Attention If the device is ordered with a full integration service, the following steps may be omitted as the device is already set correctly and can be activated directly.

In order to configure the device, a computer with NIC and Google Chrome is needed.

Enter the IP of the device in the browser:

default IP: **192.168.8.199**

Enter the password on the opened web page:

default password: **elcomplus**

Next, the **Control Center** page is loaded.

8. Indication

There are 4 indicators on the front panel.

Indicator	Description
PWR	Power – always on while power is supplied.
RDY	Ready – shows the current state of the device: ▪ OK: one flash, 3 seconds pause ▪ Warning: two flashes, 3 seconds pause ▪ Error: half a second on, half a second off
AIRR	Receiving packages through the radio channel.
AIRT	Transmitting packages through the radio channel.

9. Application schemes

This section helps user to select the scheme for data acquisition in each specific case.
The following questions must be answered before selecting the scheme:

1. What is going to be monitored and what is going to be controlled:
   a. Sensors (e.g. door opening, temperature, pressure, voltage measurement);
   b. Smart monitoring devices (e.g. electric meter, controllers and others), which have digital data communication interface RS-232/RS-485/Ethernet.
2. How and where the received information is going to be displayed:
   a. Which dispatch software is going to be used;
   b. Which data protocol is going to be applied during data acquisition.

AdapTel can work in two modes:

- **Transparent mode** – data transmission transparent mode for the connection to a DMR network of third-party devices with RS-232, RS-485 or Ethernet digital interfaces. There is a limitation for communication protocols in case of the Ethernet interface: only UDP/TCP based address protocols of data communication (e.g. IEC 60870-5-104, Modbus TCP) can be used.
- **RTU mode** – **AdapTel** plays the role of an **RTU** in this mode. **AdapTel** collects the data using built-in digital channels. Modbus TCP/Modbus RTU modules may also be connected to **AdapTel** in order to increase the number and types of received physical signals. Moreover, third-party PLCs can be connected via the Modbus protocol. All signals are transmitted from the SLAVE to the MASTER. Data transmission from the MASTER to a SCADA system is available through Modbus TCP or IEC 60870-5-104.

AdapTel is able to operate in both modes simultaneously, however it should be kept in mind that DMR network is a bottleneck. Thus, the final equipment configuration should be done carefully in order to provide the most reasonable data traffic timing characteristics.

9.1. General settings

For the correct system operation, network settings must be configured as for radios and for repeaters (if specified by network) and basic **AdapTel** settings. Below are the general settings which should be set for any **AdapTel** system configuration:

1. DMR network configuration: it is highly preferable to use a separate channel for data communication, otherwise voice data will always have the highest priority in case of simultaneous voice and other data transmission.
2. Radio configuration:
   a. Set the radio frequencies depending on the DMR network configuration (double-frequency plan if repeaters are used and single-frequency plan otherwise);
   b. Unique ID (since an IP address in a CAI network is formed from the ID);
   c. CAI network of all radios should be the same in the general case (others are possible, but considering each case individually with a clear understanding of the required result);

   d. CAI network of a group should be set the same for all radios as well (necessary for broadband packets).
3. **AdapTel** configuration:
   a. Unique ID (**AdapTel** has its own address which doesn't depend on the radio's address. It is recommended to use the same IDs as the radio's in order to have a unique network architecture);
   b. IP addresses of CAI IP and MT IP are provided by the radio. They are shown in the figures for clear understanding of the network architecture;
   c. Configuration of the routes in the radio network (for radios and **AdapTel** accessories), including the packages for CAI network group.

There are some important rules of using DMR network for data transfer:
1. time for waiting response after request has to be more than 3 seconds;
2. delay between requests has to be more than 3 seconds;
3. it's strongly recommended to send packets less than 500 bytes.

Settings mentioned in this section should be considered for each of the following application schemes.

9.2. Transparent mode (transparent mode of data transmission)

9.2.1. Transparent channel organization scheme for RS-232/RS-485 interfaces

This scheme helps in construction of a point-to-multipoint network for RS-232/RS-485 interfaces over a DMR network. The solution is applicable to organization of data acquisition from existing or planned interface modules of the facility, such as sensors, controller equipment, smart sensors and others.

AdapTel has 1 configurable RS-232/RS-485 port, thus only one type of device can be connected to a standard SLAVE (the quantity of the devices is defined by the network topology), e.g. 3 electric meters with RS-485 interface with proprietary data communication protocol. In case several types of devices need to be connected, USB-RS adapters (e.g. Moxa UPort) should be used. Note that if each type of devices uses a proprietary protocol, extension of serial ports via USB-RS must also be applied to the MASTER.

An example transparent channel organization scheme for RS-232/RS-485 interfaces showing the main settings of **AdapTel** and radio is presented in figure 2.

Following settings must be configured as well as general settings mentioned in section 9.1 to configure this network:

1. **AdapTel** configuration (MASTER and SLAVE):
   a. Serial port configuration: port number, transfer rate, number of stop bits et cetera.
2. Target device configuration (SCADA/PLC/RTU/Device):
   a. Serial port configuration of the terminal device: transfer rate, packet format, number of stop bits must be the same as set in **AdapTel**;

b. Data communication protocol must be the same for all target devices and each device must have a unique ID in the protocol notation as **AdapTel** provides only provides packet transmission to all network subscribers and does not analyze transmitted packages;
c. The latency parameter value between the requests in protocol settings should be set at more than 2 seconds (as this is the shortest period needed for 2 transactions through a DMR network both ways from one node to another).

More information on **AdapTel** and radio configuration can be found in the "AdapTel. Manual" document.

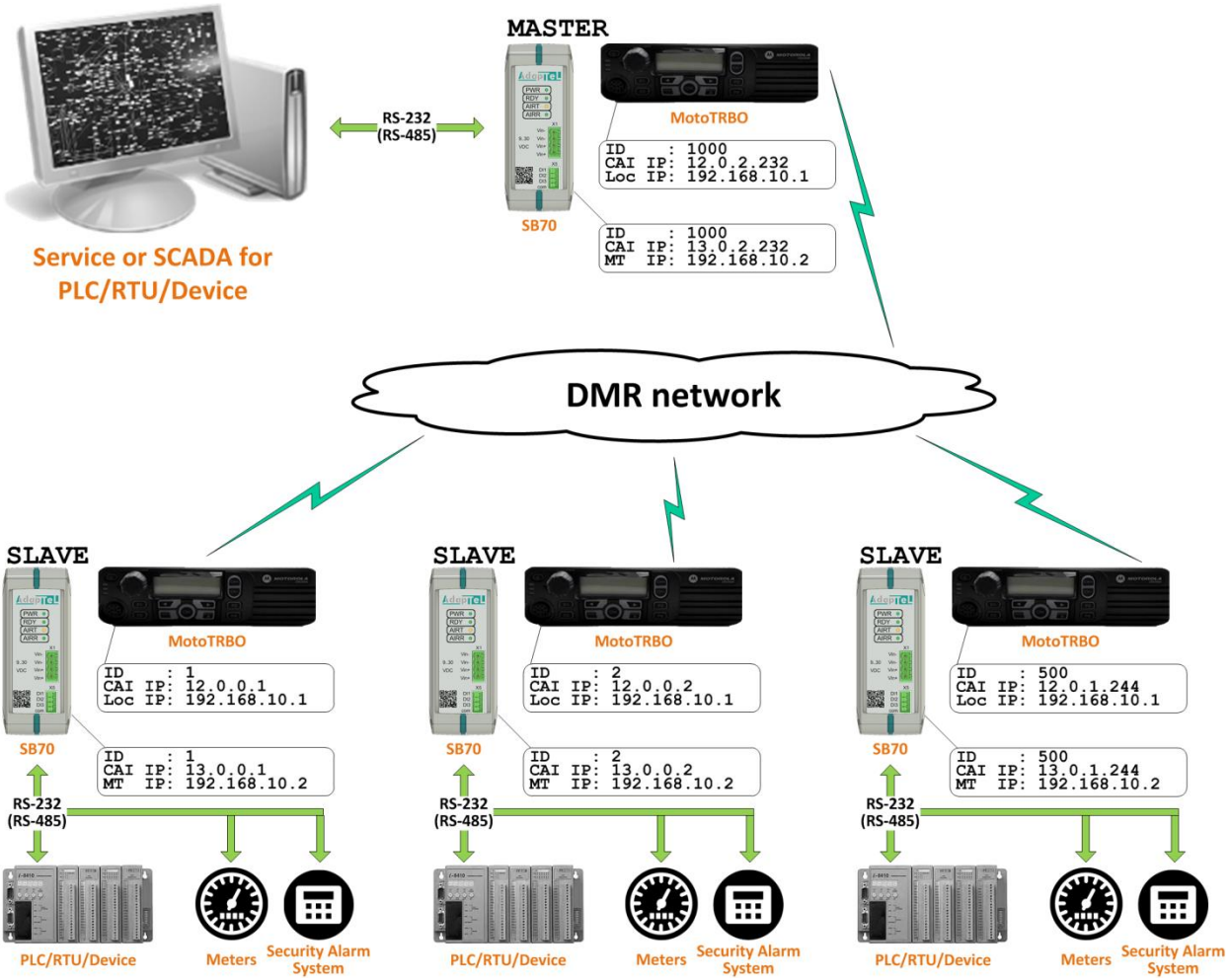


Figure 2 – Organization scheme of transparent channel for RS-232/RS-485 interfaces

9.2.2. Ethernet UDP (TCP) transparent channel organization scheme

This scheme helps in construction of a point-to-multipoint network for equipment with an Ethernet interface for data communication address protocols when using the TCP(UDP) protocol in a DMR network.

An example scheme for transparent Ethernet UDP(TCP) channel organization for address protocols showing the main settings of **AdapTel** and radio is presented in figure 3.

Following settings must be configured as well as the general settings mentioned in section 9.1 for network configuration:

1. **AdapTel** configuration (MASTER and SLAVE):
   a. Configuration of a port which listens for the **AdapTel** and transmits data packets to radio network;
   b. Target receiver's IP:Port configuration in the radio network (broadcast IP of a group should be entered on the MASTER, default 255.0.0.1:Port).
2. SLAVE's target devices configuration on the SLAVE side (PLC/RTU/Device):
   a. IP address configuration. The IP address should be in the **AdapTel** network (see Loc Ip);
   b. The device should wait for the requests at the port set in the **AdapTel** settings from the MASTER SCADA/PLC/RTU/Device;
   c. The device must have a unique ID in the protocol's notation as the MASTER provides packet broadcasting.
3. MASTER device configuration (SCADA/PLC/RTU/Device) :
   a. IP address configuration. The IP address should be in the **AdapTel** network (see Loc Ip);
   b. The device should be sending the requests to the port set in the **AdapTel** settings;
   c. In fact, only one TCP/UDP connection will be set up, which is the connection to the MASTER **AdapTel**. Polling or waiting for the data packets from SLAVEs must occur through this connection. Each SLAVE device must have a unique ID in the data communication protocol's notation.

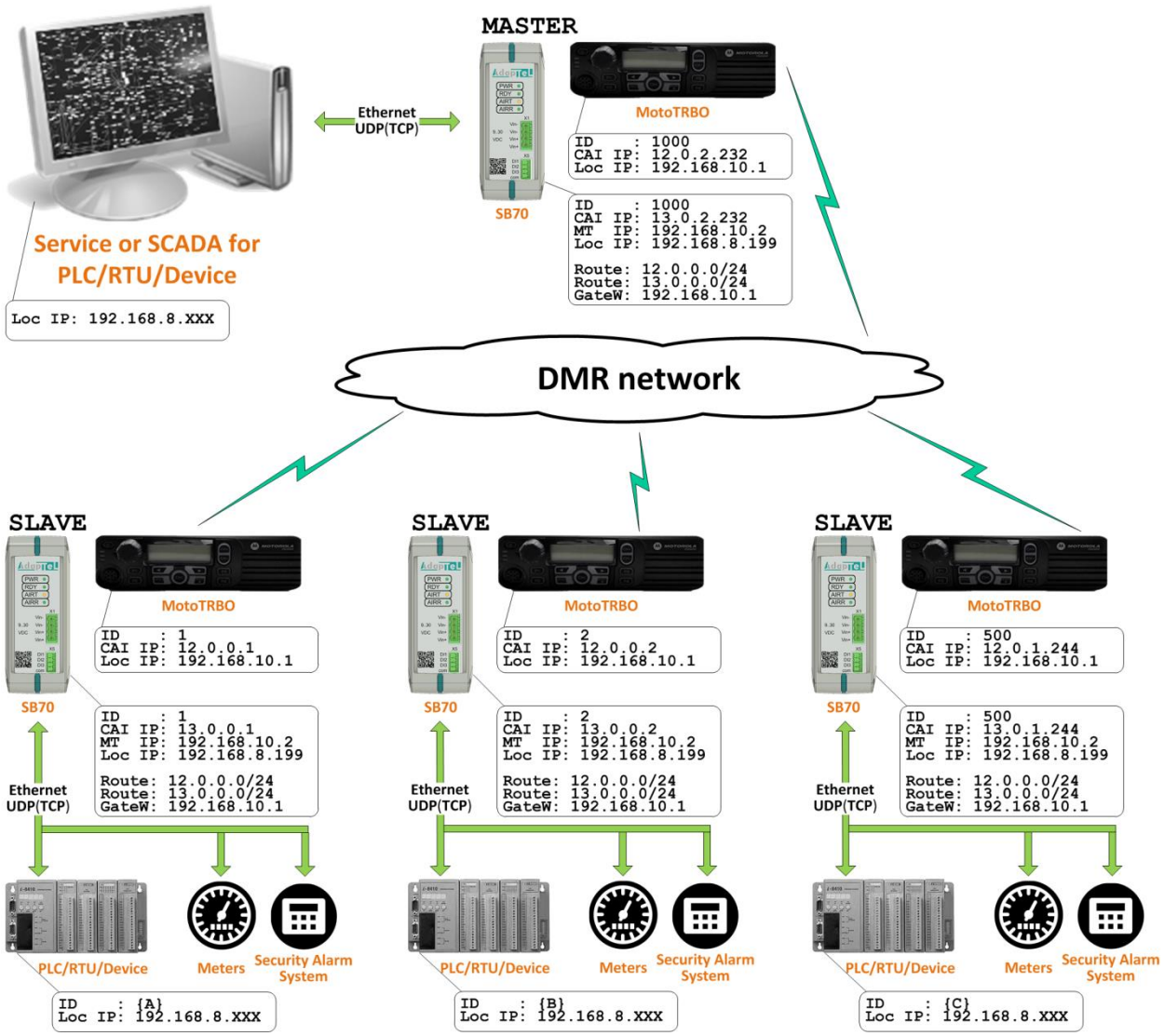


Figure 3 – Organization scheme of transparent channel for Ethernet UDP (TCP) channel

9.2.3. Organization scheme of Modbus TCP – Modbus RTU transparent channel

This scheme helps in construction of a point-to-multipoint network in the case where dispatch terminal software provides data acquisition via Modbus TCP and target SLAVE devices transmit data via the Modbus RTU protocol. In fact, **AdapTel** is able to play the role of converter from Modbus TCP to Modbus RTU via a DMR network.

An example scheme for transparent Modbus TCP – Modbus RTU channel organization showing the main settings of **AdapTel** and radio is presented in figure 4.

Following settings must be configured as well as the general settings mentioned in section 9.1 for the network configuration:

1. **AdapTel** configuration (MASTER and SLAVE):
   a. Configuration of a port which listens for the **AdapTel** and redirects data packages to the radio network;
   b. Target receiver's serial port configuration: port number, transfer speed, number of stop bitsetc.
2. SLAVE's terminal device configuration on the SLAVE side (PLC/RTU/Device):
   a. target device's serial port configuration: transfer speed, packet format, number of stop bits must be the same as set in **AdapTel**;
   b. Modbus RTU data communication protocol and each device must have a unique ID in the protocol's notation as **AdapTel** provides only packages transmission to all network members and does not analyze transmitted packages.
3. MASTER devices configuration (SCADA/PLC/RTU/Device):
   a. IP address configuration. IP address must be in the **AdapTel** network (see Loc Ip);
   b. The device should send requests to the port stated in **AdapTel**'s settings;
   c. The latency parameter value between the requests in the protocol settings should be set at more than 2 seconds (as this is the shortest period needed for 2 transactions through a DMR network both ways from one node to another).

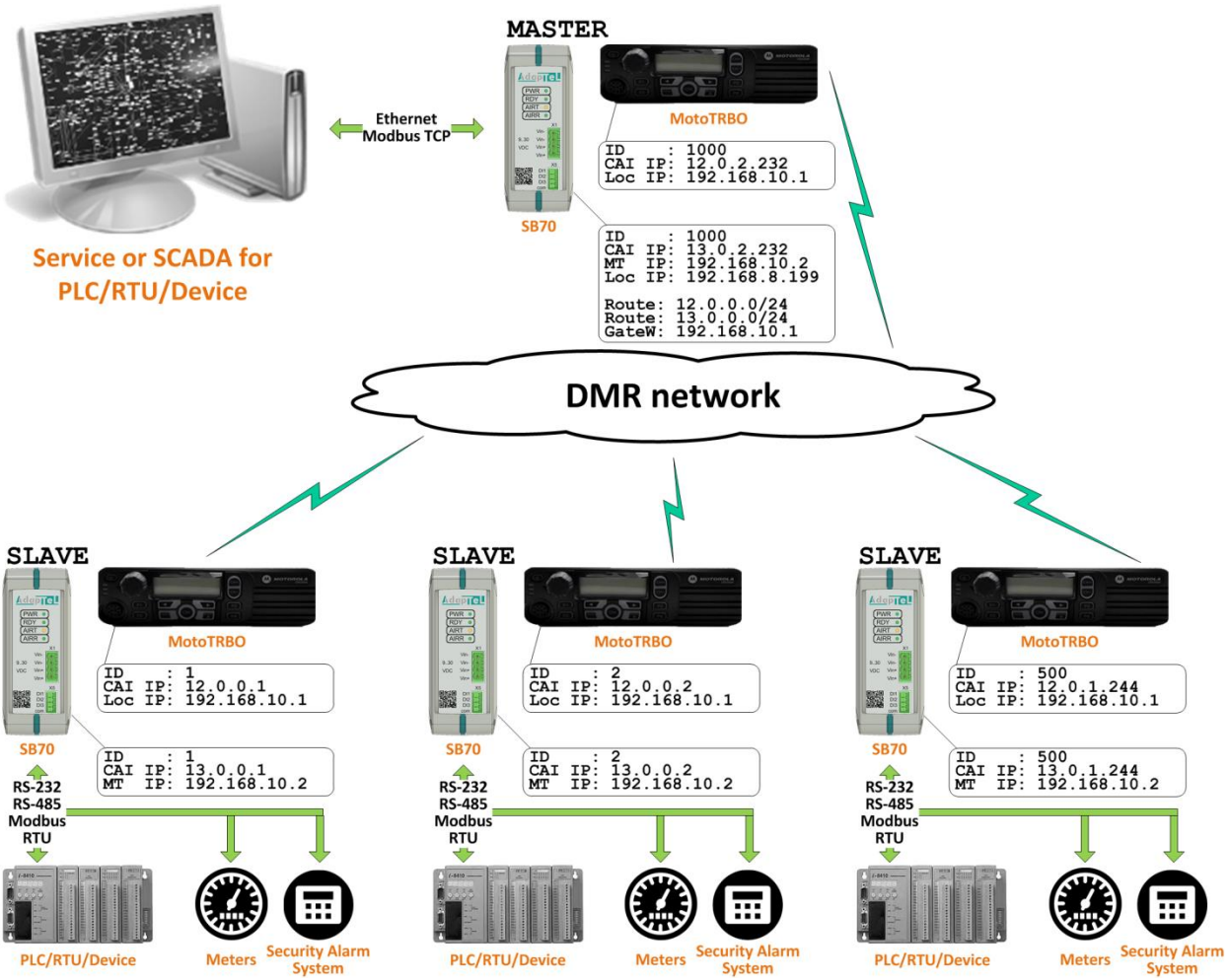


Figure 4 – Organization scheme of transparent channel Modbus TCP – Modbus RTU

9.3. RTU mode

RTU mode is preferable in cases when signals from several sensors must be collected and displayed on the dispatcher's screen but there is no controller equipment for signal acquisition and converting them into telemetry protocol. **AdapTel** provides a solution both for sensor data acquisition and for data transmission via DMR network.

The main advantage of this mode is that DMR network access is determined in the **AdapTel** settings. Thus, data collection from the SLAVE is asynchronous with providing this data for the target dispatch systems, resulting in:

1. providing reliable data acquisition through the slow DMR network channel where collision resolution is provided by **AdapTel**;
2. removing strict limitations of data collection configuration for SCADA system software thanks to data buffering at the MASTER. However, the commands from the SCADA software are immediately sent to the SLAVE.

The concept of data transmission from SLAVE to MASTER in RTU mode is as follows:

1. MASTER executes serial cyclic polling of the data from SLAVES. A sufficient pause is set between the requests in order to create session gap for initiated packets from the SLAVE;
2. SLAVE transmits data when polled and if it receives an emergency situation signal from the facility transmits this information to the MASTER immediately (initiative-based sending).

9.3.1. Data acquisition organization scheme from built-in AdapTel SB70, SB70-16DI and SB70-16DI/DO channels

This scheme represents data acquisition from the digital sensors of a distant plant and data transmission to SCADA system via a DMR network through Modbus TCP and IEC 60870-5-104 industrial protocols.

The example scheme for data acquisition organization from built-in **AdapTel** channels is shown in figure 5.

Following settings must be configured as well as the general settings mentioned in section 9.1 for network configuration:

1. **AdapTel** configuration (SLAVE): no additional adjustments are needed apart from the basic ones.
2. **AdapTel** configuration (MASTER):
   a. Select the data representation protocol for the SCADA system (Modbus TCP or IEC 60870-5-104) and set the main parameters for the selected protocol.
3. SCADA/PLC/RTU/Device configuration on the MASTER side:
   a. Set up the connection to IP:Port of the MASTER;
   b. Set up the address map for each Slave ID (See "AdapTel User Manual" document).

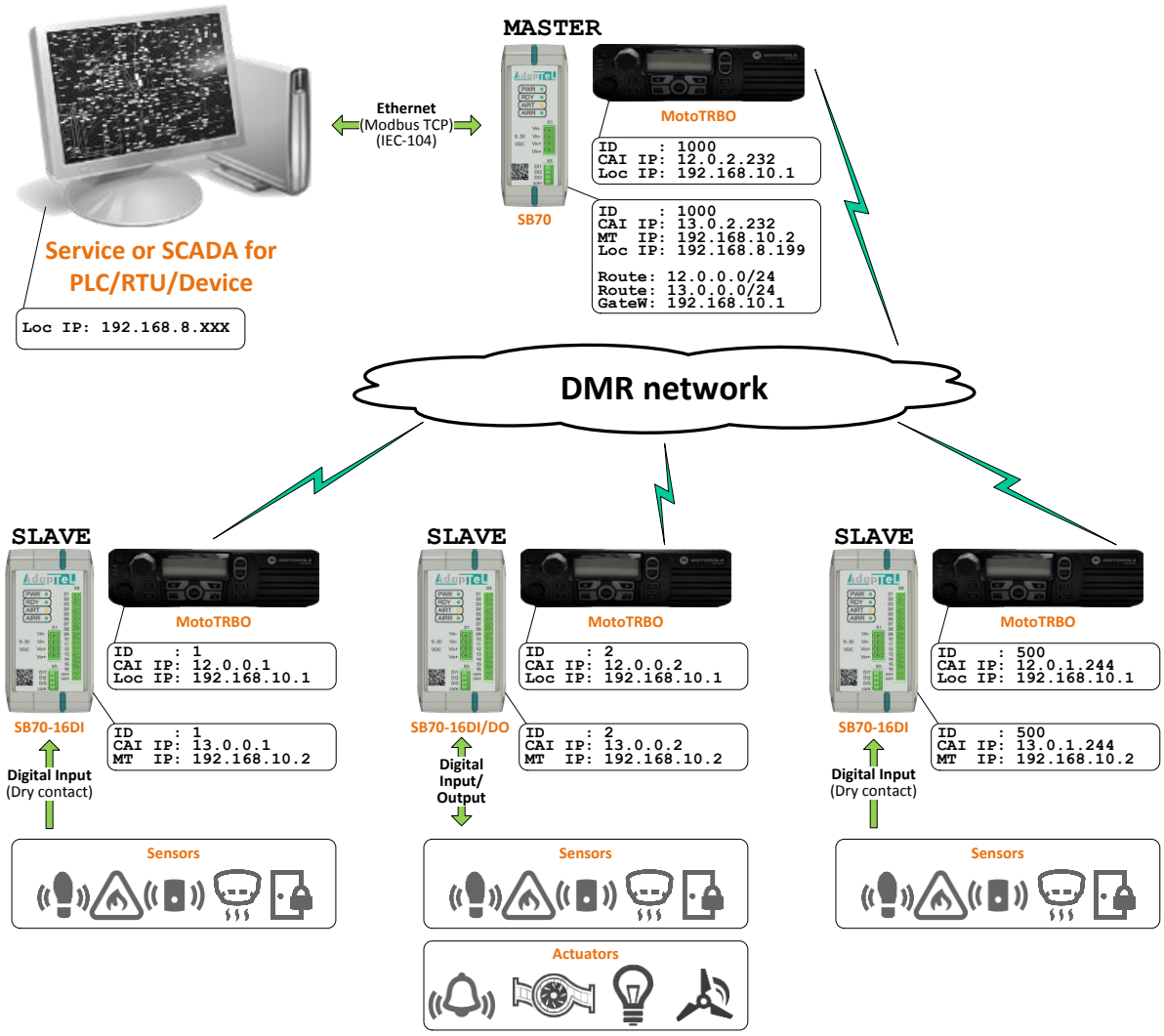


Figure 5 – Data acquisition scheme from in-built AdapTel channels

9.3.2. Data acquisition organization scheme from I/O modules via Modbus TCP (Modbus RTU) protocol

In case of insufficient number and type of input channels in the SLAVE, the connection capability of the **AdapTel** for sensors and additional devices may be increased with the help of Modbus IO modules. Moreover, there is an ability of data acquisition from any type of device via the Modbus protocol and transmission of this data along with values from the sensors to the MASTER.

An example data acquisition organization scheme from built-in inputs, Modbus modules and other Modbus supporting interface devices is shown in figure 6.

Following settings must be configured as well as the general settings mentioned in section 9.1 for the network configuration:

1. **AdapTel** configuration (SLAVE):
   a. no additional settings for signal acquisition and transmission from built-in digital inputs are needed;
   b. configure polling for Modbus devices: ID, address map, and data acquisition interface (RS/Ethernet);
   c. configure rules for collected data transmission to the MASTER (if it is required to transmit the value immediately to change it by certain amount or it is necessary to receive this data during polling of the MASTER).
2. **AdapTel** configuration (MASTER):
   a. Select the data communication protocol for the SCADA system (Modbus TCP or IEC 60870-5-104) and configure the main settings for this protocol.
3. SCADA/PLC/RTU/Device configuration on the MASTER side:
   a. Configure the connection to IP:Port of the MASTER;
   b. Configure the address map for each Slave ID (see “AdapTel. Manual” document).

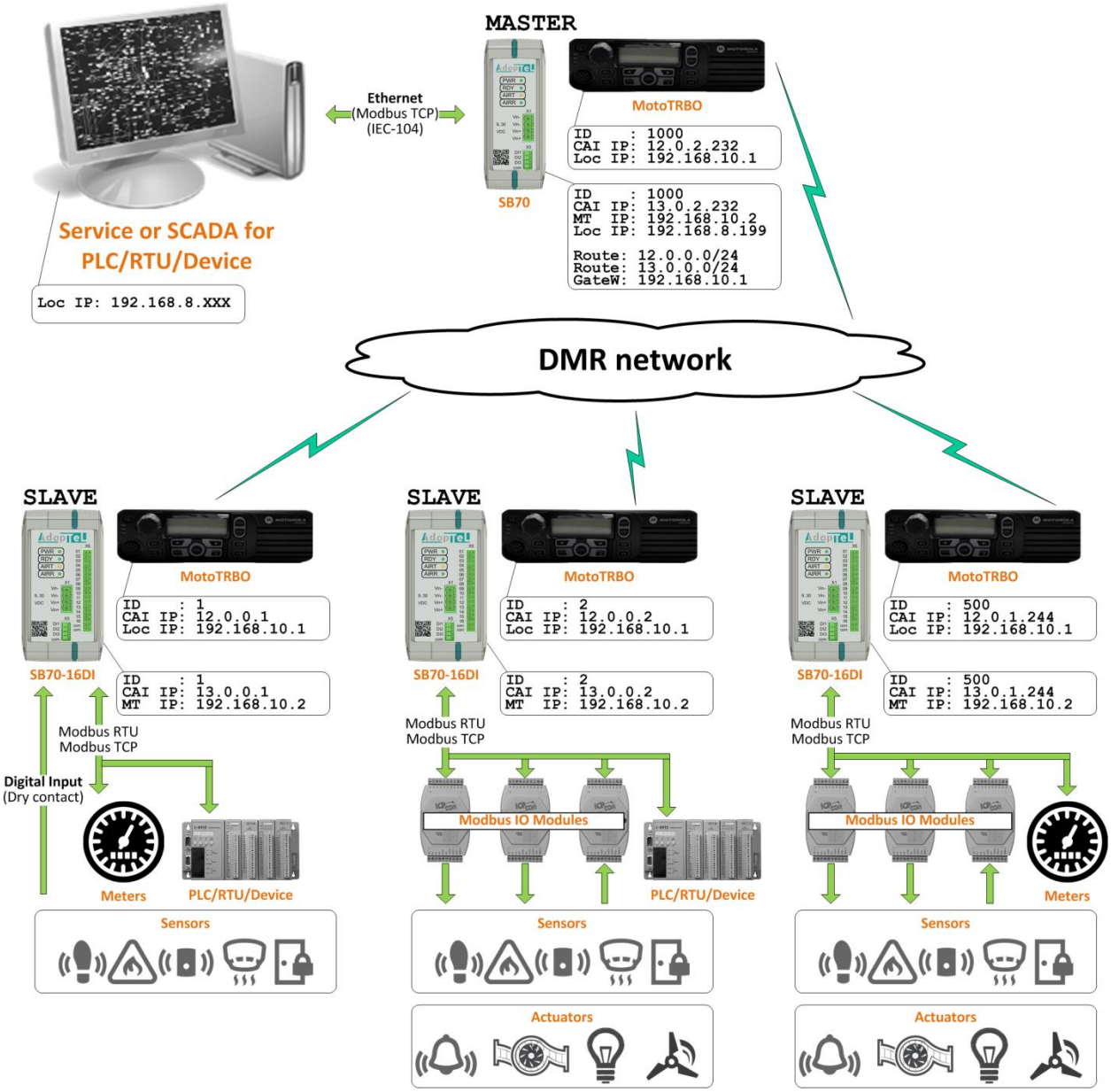


Figure 6 – Data collection organization scheme from Modbus modules

9.4. Mixed mode of Transparent mode and RTU mode

This method is also available, however it should be noted that a DMR network is a bottle-neck and the channel must be used carefully. As it is stated in section 9.3, **AdapTel** structures access to the DMR channel in RTU mode, but in the case of Transparent mode **AdapTel** provides full access to the DMR network for the third-party equipment and does not control data packet transmission, as **AdapTel** has no information on the transmitted data (how urgent must the data be transmitted and so on). Collision occurrence in DMR channel is highly likely in such a situation and the more SLAVEs, the higher is the chance of collision. Thus, it is recommended to set sufficiently large timeouts and polling periods both for RTU mode data and transparent mode data.

An example data acquisition organization scheme is presented in figure 7 where all capabilities of **AdapTel** are shown. This scheme combines the schemes described in sections 9.2 and 9.3

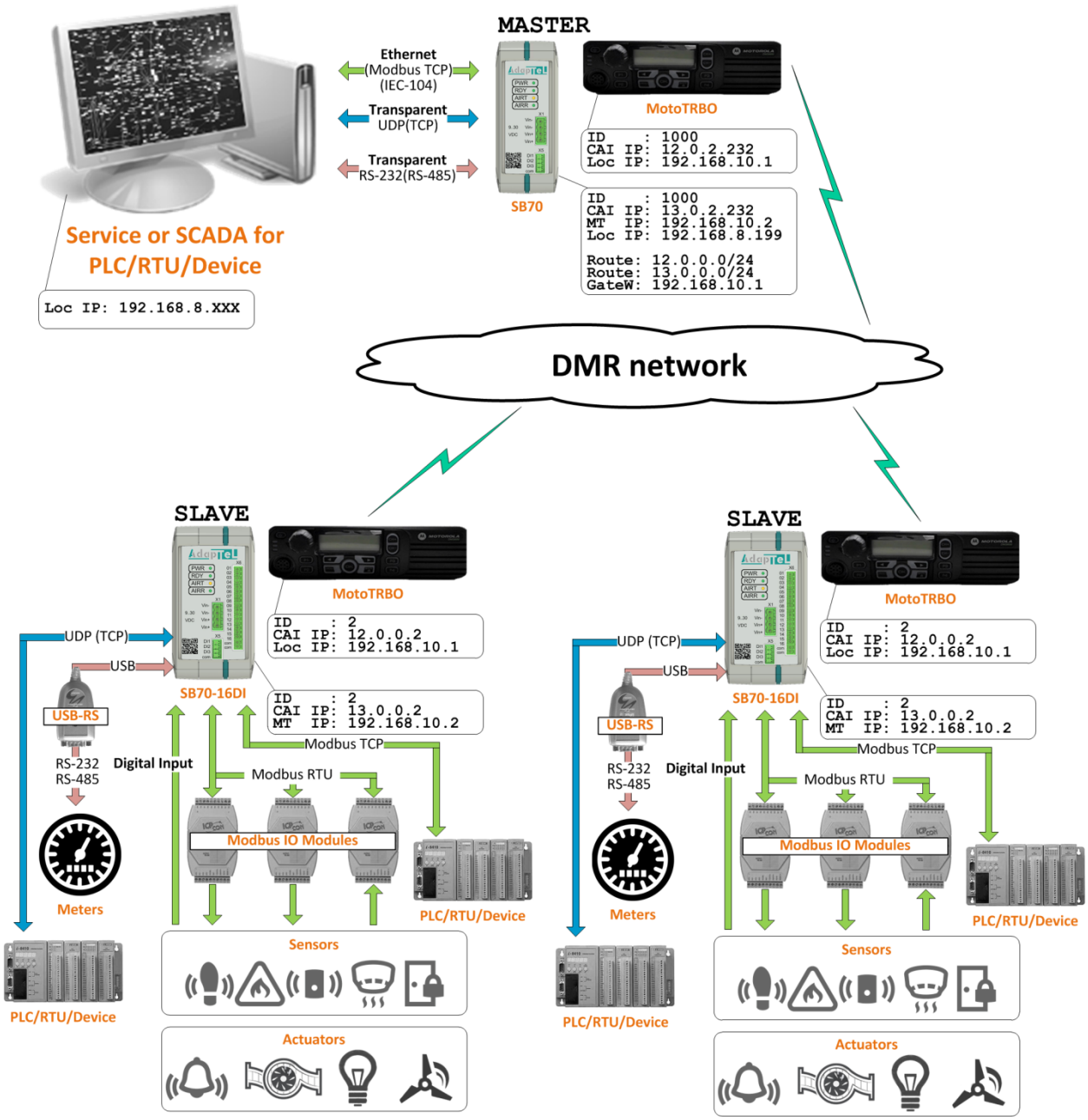


Figure 7 – Data acquisition organization scheme (mixed mode)

Contacts

For information on purchasing AdapTel, please, contact our sales at sales@smartptt.com.

If you need more detailed documentation, contact our Technical Support Team at support@smartptt.com.

Web: www.support.smartptt.com