Wireless Data Communication via GPRS with S7-1200 and CP 1242-7

Scenario 1: Process data exchange between a Remote Station and Telecontrol Server Basic

Application Description • July 2012

Applications & Tools

Answers for industry.

SIEMENS

Siemens Industry Online Support

This article is taken from the Siemens Industry Online Support. The following link takes you directly to the download page of this document:

http://support.automation.siemens.com/WW/view/en/39863979

Caution

The functions and solutions described in this article confine themselves to the realization of the automation task predominantly. Please take into account furthermore that corresponding protective measures have to be taken up in the context of Industrial Security when connecting your equipment to other parts of the plant, the enterprise network or the Internet. Further information can be found under the Item-ID 50203404.

http://support.automation.siemens.com/WW/view/en/50203404

You can also actively use our Technical Forum from the Siemens Industry Online Support regarding this subject. Add your questions, suggestions and problems and discuss them together in our strong forum community:

http://www.siemens.com/forum-applications

SIMATIC
Remote Control with S7-1200

Warranty and Liability

Note

The application examples are not binding and do not claim to be complete regarding configuration, equipment and any eventuality. The application examples do not represent customer-specific solutions. They are only intended to provide support for typical applications. You are responsible for ensuring that the described products are used correctly. These application examples do not relieve you of the responsibility to use sound practices in application, installation, operation and maintenance. When using these Application Examples, you recognize that we cannot be made liable for any damage/claims beyond the liability clause described. We reserve the right to make changes to these application examples at any time without prior notice. If there are any deviations between the recommendations provided in this application example and other Siemens publications – e.g. Catalogs – the contents of the other documents have priority.

We accept no liability for information contained in this document.

Any claims against us - based on whatever legal reason - resulting from the use of the examples, information, programs, engineering and performance data etc., described in this application example shall be excluded. Such an exclusion shall not apply in the case of mandatory liability, e.g. under the German Product Liability Act (“Produkthaftungsgesetz”), in case of intent, gross negligence, or injury of life, body or health, guarantee for the quality of a product, fraudulent concealment of a deficiency or breach of a condition which goes to the root of the contract (“wesentliche Vertragspflichten”). The damages for a breach of a substantial contractual obligation are, however, limited to the foreseeable damage, typical for the type of contract, except in the event of intent or gross negligence or injury to life, body or health. The above provisions do not imply a change in the burden of proof to your detriment.

Preface

Objective of this application

This application assists during the commissioning of a GPRS based Telecontrol system with SIMATIC S7-1200 CPU, CP 1242-7 GPRS and the server software Telecontrol Server Basic. All available articles on this topic are administrated under the title Configuration Example X-21 and are identifiable via the scenario-number.

This application is the Configuration Example X21, Scenario 1.

Core topics of this application

The following main points are dealt with in this scenario:

- Process value exchange between Remote Station[1] and Central Station[2]
  - Process values are transmitted cyclically from the Remote Station to the Central Station
  - The Remote Station sends event controlled (acyclic) process values to the Remote Station.
  - The Central Station controls, if required, process values in the Remote Station.
- Status and diagnosis information of the Remote Station are displayed in the Central Station.
- The process values are displayed in the Central Station assisted by adequate visualization software.
- The process values are archived in the Central Station

[1] Remote Station (RS) is a remote station with a SIMATIC S7-1200 CPU and a CP 1242-7 GPRS

[2] Central Station (CS) designates a PC or IPC with the connection management software TELECONTROL Server

Table of contents

1 Automation task

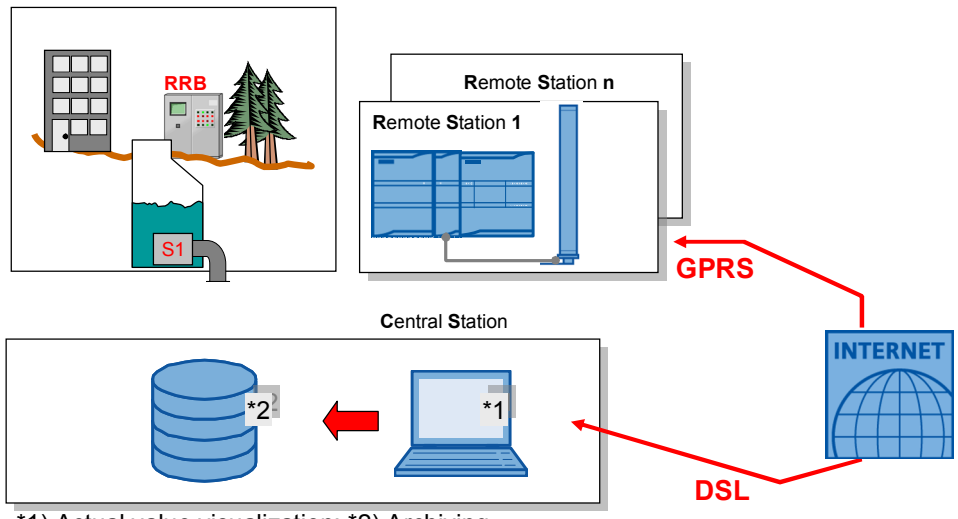
Introduction

The functions and features in the application – scenario 1 – will be explained here taking as an example a rain retention basin (RRB).

Overview of the automation task

Excessive water is stored in the RRB to relieve the sewage system. A continuous filling level measurement takes place in the RRB. An electronically controlled sluice S1 is opened as soon the capacities in the sewage system allow it.

Figure 1-1



*1) Actual value visualization; *2) Archiving

Solution requirements

The automated plant should be coupled wireless with a control room (**C**entral **S**tation).

- The wireless data transmission is done via GPRS.
- A standard PC or ICP will be used as the platform for the Central Station.
- The process values from the Remote Station will be visualized and be operable via standard methods.
- A contiguous archiving of the process values to the Central Station for further processing is required.

The following communication cases result for the selected task.

Table 1-1

Direction	Initiator	Function
RS → CS	CS	The measured level will be sent cyclically from the Remote Station to the Central Station.
RS → CS	RS	In case of maintenance or fault in sluice S1, an alarm will be sent immediately from the Remote Station to the Central Station.
CS → RS	CS	The sluice S1 will be opened or closed manually via remote access.

2 Automation Solution

2.1 Overview of the general solution

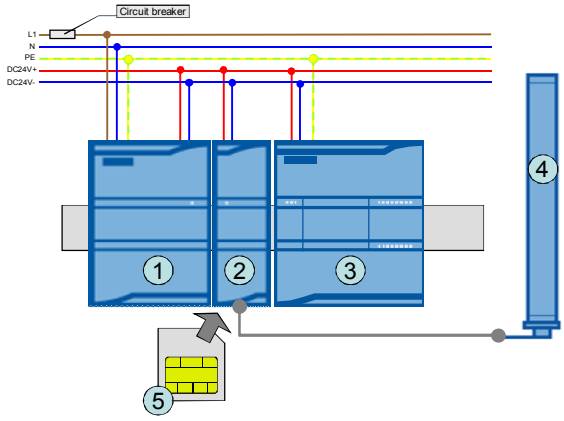
Remote station

A GSM/GPRS Modem **CP 1242-7 GPRS (2)** is coupled via a bus interface to the **SIMATIC S7-1200 controller 1211C (3).**

The GSM/GPRS Modem has a **SIM card (5)**. For coupling with the air interface a quad band GSM/GPRS **antenna ANT 794-4MR (4)** is used.

The power supply of all components is carried via a **SIMATIC PM 1207 Power Module (1).**

Figure 2-1 Configuration of the Remote Station



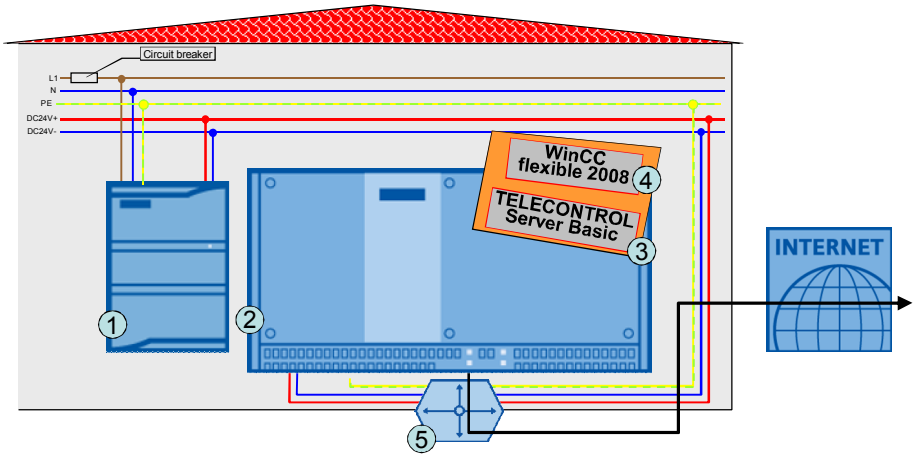
Central Station

The Central Station consists of a Box PC **SIMATIC IPC627C (2).** The software components **Telecontrol Server Basic (3)** and **WinCC flexible 2008 (4)** are installed in the Box PC.

The power supply is available from a **SIMATIC PM1207 Power Module (1)**

The IPC is connected to the Internet via **Router (5).**

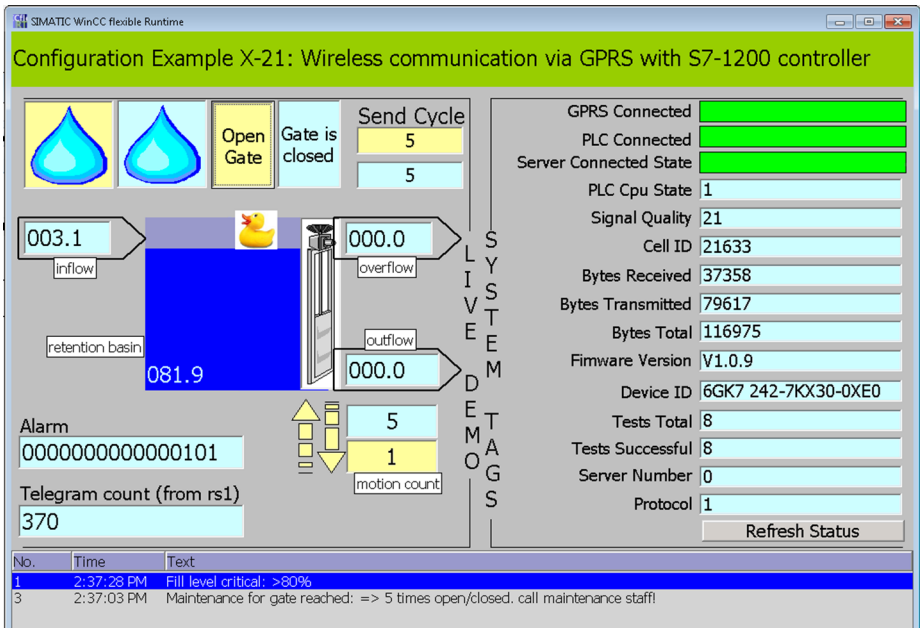
Figure 2-2 Configuration of Central Station



2.2 Overview and description of the user interface

The following graphic shows the WinCC flexible interface for the operation of the application example.

Figure 2-3 Faceplate



In the „LIVE DEMO“ area of the operating interface you can operate and monitor all the relevant values of the application.

The system values generated in the CP 1242-7 GPRS are displayed for diagnosis in the „SYSTEM TAG“ area.

Chapter 6 describes all possible operating consequence in detail.

2.3 Hardware and software components used

2.3.1 Remote Station

Hardware components

Table 2-1

Component	No.	MLFB/order number	Note
SIMATIC S7-1200, PM 1207	1	6EP1332-1SH71	2,5A
SIMATIC S7-1200, CPU 1211C	1	6ES7211-1AD30-0XB0	DC/DC/DC
SIMATIC CP 1242-7 GPRS,	1	6GK7242-7KX30-0XE0	As of FW 1.0.9
SINAUT ANT 794-4MR, rod aerial	1	6NH9860-1AA00	Alternative: Flat antenna ANT794-3M (6NH9870-1AA00)
Ethernet line	1	6XV1870-3QH20	For design purposes (2 meters of this type or

Component	No.	MLFB/order number	Note
			similar cable)
Circuit breaker	1	5SX2116-6	1 pole B, 16A
Standard mounting rail	1	6ES5 710-8MA11	35mm
SIM card	1	Available at your mobile phone provider	Check if special M2M tariffs with included data volume are available

Standard Software components

Table 2-2

Component	No.	MLFB/order number	Note
STEP 7 Basic V11	1	6ES7822-0AA01-0YA0	

2.3.2 Central station

Hardware components

Table 2-3

Component	No.	MLFB/order number	Note
SIMATIC S7-1200, PM 1207	1	6EP1332-1SH71	2,5A
SIMATIC IPC627C	1	6ES7647-6CA16-0JB0	
Circuit breaker	1	5SX2116-6	1 pol. B, 16A
Router	1	Specialist dealer	With port forwarding

Note

The shown order number of SIMATIC IPC627C includes the following system configuration:

- Processor: Celeron P4505 (2C/2T, 1,86 GHz, 2MB L2)
- Memory capacity: 2 GB DDR3 1066 DIMM
- Required power supply: 24V DC Industrial power supply
- Expansion (HW): 2x PCI free
- Drives: Solid State Disc 32 GB
- Operating system (pre-installed and activated): Windows 7 Ultimate, MUI (EN, DE,FR,IT, ES)
- Expansion (SW): without expansion (SW)

The system data was specially selected for application as a Server.

The system data can be adapted in detail in the Industry Mall.
http://eb.automation.siemens.com

A Windows standard PC can be used for test purposes instead of the IPC627C

Standard Software components

Table 2-4

Component	No.	MLFB/order number	Note
Telecontrol Server Basic	1	6NH9910-0AA20-0AA0	8 stations; alternatively: 64, 256, 1000 or 5000 stations
Optional: SIMATIC OPC-Scout	1	On the SIMATIC NET CD	To test the OPC interface of the Telecontrol Server Basic.
WinCC flexible 2008 SP2, Advanced	1	6AV6613-0AA51-3CA5	

Note

The ES Version of WinCC flexible is required when you want to once adapt the memory path of the archiving script in WinCC flexible.

If you don't want to show the archiving function, or is the default path for the archiving script sufficient, the RT-Version of WinCC flexible is also adequate to operate the runtime file with 128 tags.

Services of a provider

Table 2-5

Component	No.	MLFB/order number
Internet connection with static IP address	1	Internet provider
DynDNS Service (when no static IP address is available)	1	z. B.: http://www.dyndns.com

2.3.3 Example files and projects

Example files and projects

The following list includes all files and projects used in this example.

Table 2-6 Project data

No.	Component	Note
1.	CE-X21_RS_Projekt_Vxx.zip	STEP 7 V11 Project of the Remote Station
2.	CE-X21_CS_config_Vxx.zip	Configuration files of Telecontrol Server Basic
3.	CE-X21_CS_WinCCflex_Vxx.zip	Runtime files and engineering files of the WinCC flexible project

3 Basics of the data transmission with CP 1242-7 and the Telecontrol Server Basic

Introduction

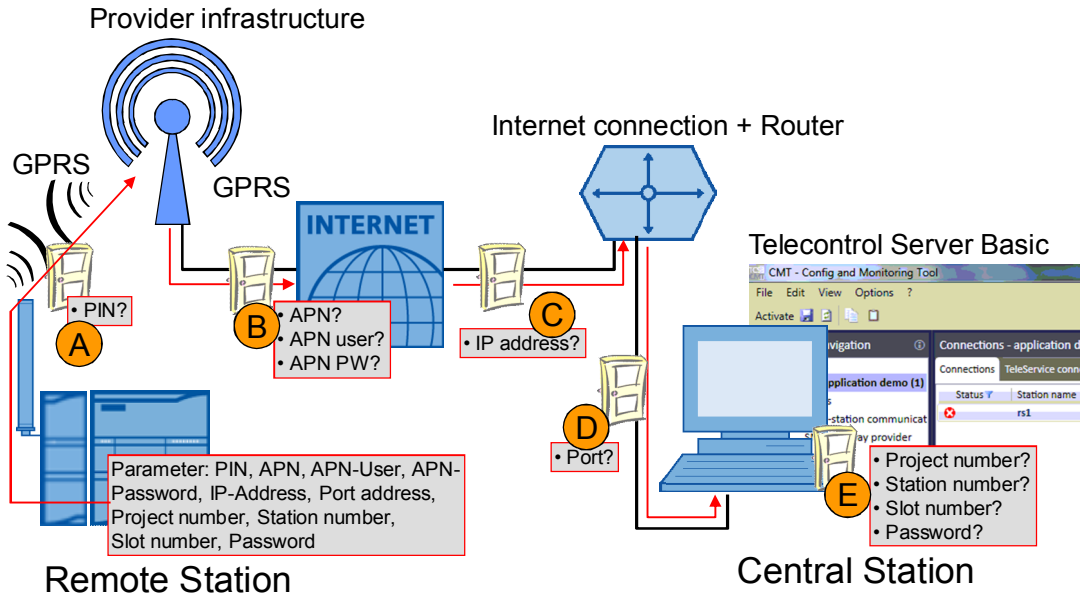
The following chapter describes the sequences of the important mechanisms around the System S7-1200, CP 1242-7 GPRS and Telecontrol Server Basic.

3.1 Overview of the GPRS communication platform

Overview

The following graphic shows the complete system with all parameters, which are required for a communication between the Remote Station and the Central Station.

Figure 3-1



Note

Before a process data exchange between the Remote Station and the Central Station is possible, the Modem (of the CP 1242-7 GPRS) must be parameterized and the connection to the Server (Telecontrol Server Basic) must be setup. The following function descriptions assume that all components, as described in chapter 5 are configured correctly and are ready for operation.

Connection setup between the Remote Station and the Central Station

Table 3-1 Explanation of the connection setup correspondent to Figure 3-1.

Digit	Description
A	The CP 1242-7 GPRS logs in automatically in the GSM network of the provider, provided that the **PIN number** of the SIM card has been recognized as valid.
B	The CP logs on at the GPRS access point of the mbile provider with the help of the **APN address**, the **APN user name** and the **APN user password.** An IP address from the address range of the provider is assigned now to the CP. The Modem is now accessible via the Internet and can send IP based enquiries to other participants in the Internet.
C	The Modem sends a connection enquiry to the Central Station. The **static IP address** of the Internet connection via which the Central Station is accessible is required. This could also be done with the help of the combination of **DNS name server** (in form of an IP address) and the **host address** (in form of a URL)
D	As soon as the connection enquiry has reached the Router of the local IT-network of the Central Station, it will lead it to the Central Station PC/ICP with the **port number**.
E	The software Telecontrol Server Basic now checks the connection enquiry of the CP with the data stored in the design. A Remote Station is always identified by the **project number**, **station number** and **slot number** (This three values are generating a six-digit identification number). A **password** for the authentication of the Remote Station is additionally scanned. If the connection enquiry is evaluated successfully the Software Telecontrol Server Basic updates the internal routing table entry related to this Remote Stationand the corresponding IP address of the CP. Between the CP of the Remote Station and the Central Station there is a connection for the transmission of TCP/IP packages. The Telecontrol System shown here uses this TCP/IP connection to transmit in both directions with the help of an individual log.

Note

- The **Project** and the **Station number** must be defined in the Telecontrol Server Basic Software and stored in the Remote Station**.**
- **Slot number** is defined by the Hardware setup of the Remote Station (slot number) and must be stored in the Telecontrol Server Basic Software.

3.2 Overview of the process data transfer

The following table shows an overview of all possible logic alternatives to control the process data transfer with Telecontrol Server Basic.

This example only implements the types 1 to 3 which will be discussed in more detail in chapter 4.1.

Table 3-2 Mechanisms for controlling the process data transfer

No.	Direction	Initiator	Trigger type
1	RS → CS	RS	cyclic
2	RS → CS	RS	event
3	RS ← CS	CS	event
4	RS → CS	CS	cyclic
5	RS → CS	CS	event

3.3 Definition of the connection specific characteristics

Introduction

This chapter explains how the different types of connections are defined and how the connection to the Telecontrol Server Basic is setup.

Overview of the characteristics of a connection

The following characteristics define the function of the Telecontrol system.

Table 3-3

Parameters	Possible values for the parameters	Remarks
Operating mode	• Telecontrol • GPRS direct	Is adjusted directly in the equipment configuration and at the Telecontrol Server Basic. In the following it's called **main connection.**
Connecting mode	• Permanent • Temporary	
Connection type	• Telecontrol Connection • UDP • ISO on TCP • SMS • Teleservice	Is programmed in the user program using the system block modules. In the following it's called **sub-connection**. A connection is always reserved for the connection type Teleservice. This doesn't have to be programmed separately.
Connection parameter	Active/passive Connection setup, Connection ID, Information on the connection partner	

Definition of main connection

The main connection is defined by the selection of the corresponding parameters in the equipment configuration for theCP 1242-7 GPRS. In this application example (scenario 1) the operating mode **Telecontrol** and the connecting mode **Permanent** have been selected for the main connection of the Remote Station.

This means that the connection setup from the CP 1242-7 GPRS must always be routed via a Telecontrol Server (Central Station) and the GPRS connection must always be held. The parameters are described in more detail in document \1\, chapter 4.1.

Definition of sub-connection

There are several **connecting types available** for the sub-connection, which are already determined by the selection of the main connection.

The desired connection type is programmed directly in the user program with the help of the system blocks.

In this example (scenario 1) a sub-connection with the connection type „Telecontrol connection“ is selected.

The selection of the different connection types (SDTs) are described in more detail in document \1\, chapter 1.5 and 5.4.7.

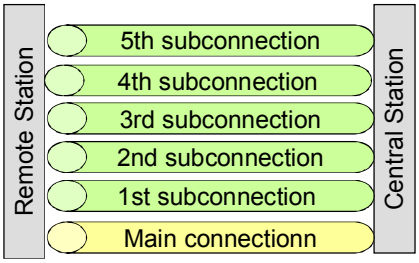
3.4 Establish connection

Sequence

The process data can be transmitted in both directions between the Remote Station and the Central Station via **sub-connections** as soon as the **main connection** has been setup to the Telecontrol Server. There are several **connection types** for the sub-connections (see Table 3-3).

Five different sub-connections can be used simultaneously in the main connection used here.

Fig. 3-2, Number of available connections



The main connection is a pre-requisite for all other sub-connections and is used additionally for the connection type Teleservice. The main connection is setup automatically by the CP 1242-7 GPRS provided that all parameters in the Remote Station are accessible. (see chapter 3.1).

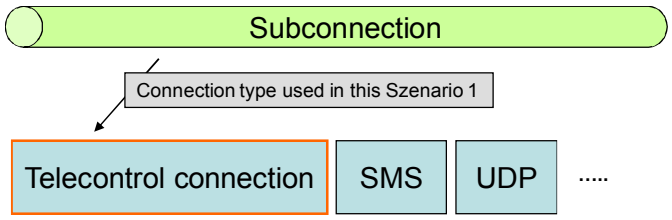
The different sub-connections are setup on demand and represent, depending on the **connection type** a connection:

- Direct to the Central Station (Telecontrol connection), or
- to another Remote Station which can be reached via the Central Station (Telecontrol connection), UDP {only send}) or
- to another piece of equipment (SMS)

Connection type in this example

In this application example (scenario 1), the Telecontrol connection has been selected as connection type for the sub-connections in order to be able to exchange the process data in the Central Station.

Figure. 3-3 Available connection types in the operating mode „Telecontrol“



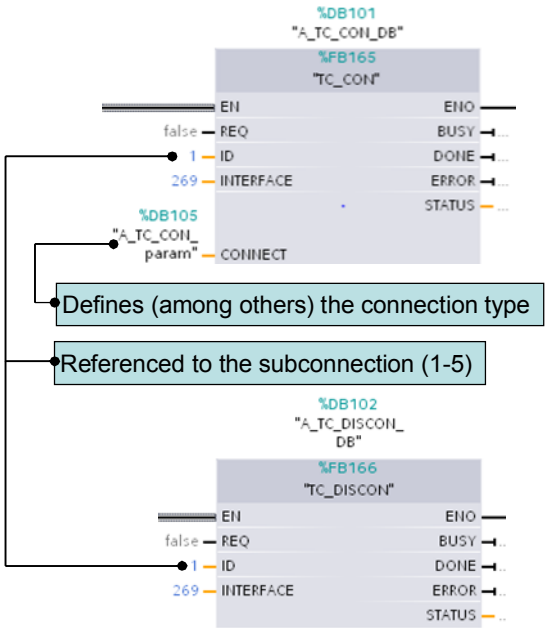
Setting up and removing a connection

For the control of the sub-connection there are system blocks in the STEP V11.

Out of this system blocks the command „TC_CON“ is used for the setup of a sub-connection and the command “TC_DISCON” is used to remove a sub-connection. The information which **type of connection** is selected will be given as parameter (SDT) at the “TC_CON”.

All other commands of the system blocks „TC_DISCON“, „TC_SEND“ and „TC_RECV“ refer to a connection type or to this sub-connection with the help of the ID.

Figure 3-4 Access of „TC_CON“ and „TC_DISCON“ to control of the sub-connections



Each sub-connection can be used for the process data transmission with the help of one or more control mechanisms.

If there is a problem establishing the connection with TC_CON or if there is an error coming from TC_SEND or TC_RECV (As far as the error here is pending for a long time not only appearing once) then you have to call the TC_DISCON always before triggering TC_CON again.

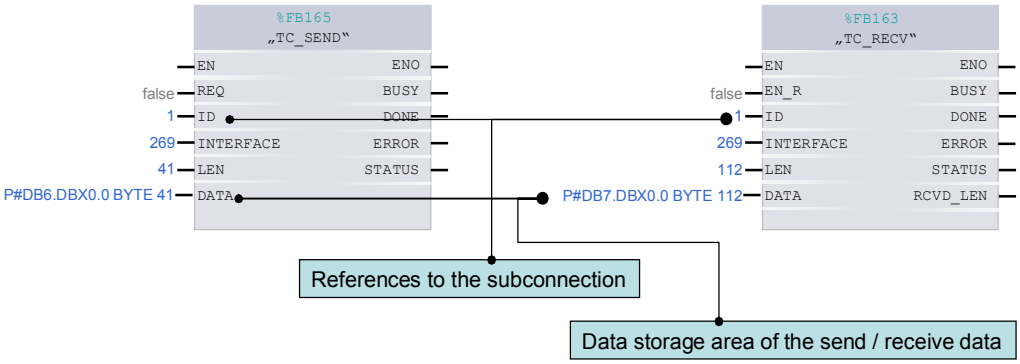
3.5 Send process data via a sub-connection

For each sub-connection there are several possibilities to control the process data transfer. The understanding of the differences is extremely important in order to be able to select the correct alternative for the individual automation task.

Send / Receive block

For the control of the process data transfer there are blocks in STEP 7 V11 which are available as from the “Hardware Support Package” for the CP 1242-7 GPRS. The statement „TC_SEND“ is used to send an TC_RECV“ is used to receive process data via the corresponding sub-connection.

Fugure 3-5 Invocation of „TC_SEND“ and „TC_RECV“ to control the process data transfer



Note The handling of the block is equal to the Open User Communication of the S7-1200 (TSEND, TREC).

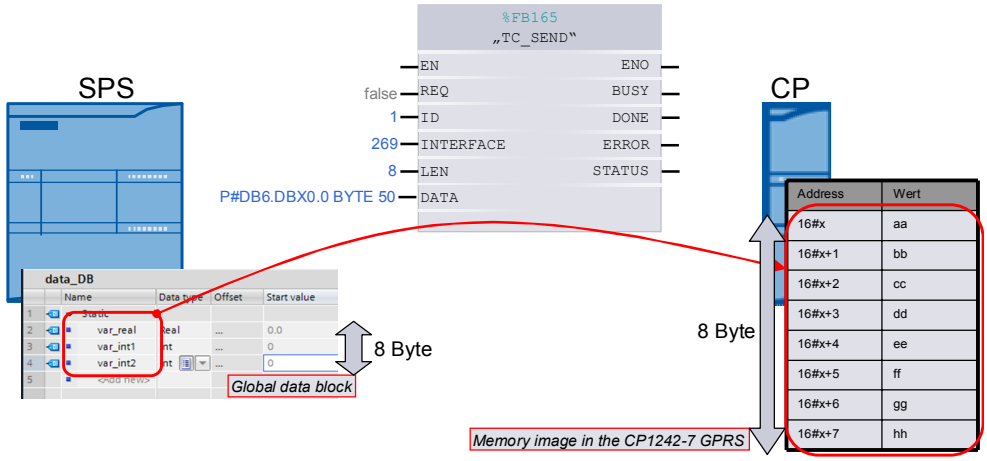
3.5.1 Send process data with TC_SEND

PLC memory area and CP memory image

The system block „TC_SEND“ sends process values from a global data block of the PLC to the memory image of the CP 1242-7 GPRS.

Note TC_SEND and TC_RECV each require an individual global data module.

Figure. 3-6



The size of the defined PLC memory area also determines the CP memory image for this sending procedure that will be sent to the connection partner.

Parameter LEN at the module „TC_SEND“

The parameter „LEN“ indicates what size the transmission range of the global data block should be. The length of the pointer at the parameter „DATA“ in this case is irrelevant.

Parameter DATA at the module „TC_SEND“

The transmitted area from the global data block always begins with Byte 0, independent of the start value given by the pointer.

Note

- It is not possible to partially write on data storage areas in the memory image of the CP 1242-7 GPRS.
- The global data block for the „TC_SEND“ and the global data block of the process values in the user program should be separated. Subsequent modifications in the data structure are then easier to consider

Memory organization in the global data block and in the memory image in the CO

The data type information is lost during the transmission of the process values. The transmitted data storage area must be interpreted once again at the Central Station (in the OPC Client).

The parameterized block access for the global data block must always be projected as „standard compatible with S7-300/400“.

Parameter DONE at the module “TC_SEND”

The output „done“ at the module TC_SEND does not inform about the successful or not successful transmission to the connection partner but only if the process data is transfered sucessfully to the memory inside of the CP. This is how the parameter „done“ works when the CP is in the mode „Telecontrol“.

It is not possible to make any conclusion regarding the status of the GPRS-connection based on this parameter.

3.5.2 Receive process data with TC_RECV

PLC memory area and CP image

The system block „TC_RECV“ receives the process values from the memory image of the CP 1242-7 GPRS and transmits them to a global data block.

Note TC_SEND and TC_RECV each require an individual data block.

Mechanism General

During the send routine the PLC storage area for the system block „TC_SEND“ defines the size of the CP image to be transmitted.

During the receiving routine the connection partner (here the Central Station) defines the amount of process values to be transmitted. Those will be stored in the CP-Image without exception. At the block “TC-RECV” you can define how much process values shall be transmitted from CP-Image to the global Data Block in the PLC.

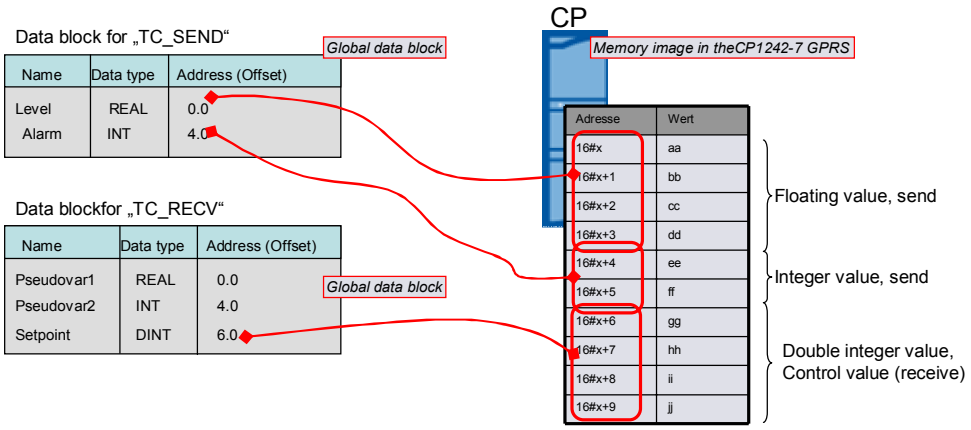
Limitations

The result is that the CP image must be displayed on two PLC memory areas for **two** different applications. The rnge for „TC_SEND“ and the range for „TC_RECV“ i.e. to send and to receive.

The process values that have to be received now by the connection partner normally do not coincide with the process values that have to be sent. In the PLC memory range of the received routine, pseudo-variables must be created in order to consider the already used variables for the send routine regarding the reserved storage area in the CP image.

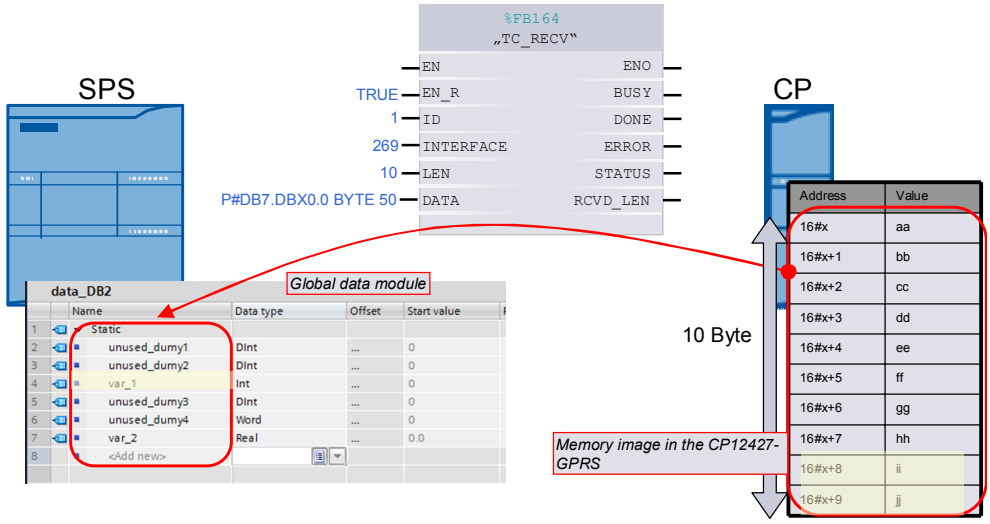
The following graphic illustrates this.

Figure 3-7



Mechanism shown in an example

Figure 3-8



The address “16#x+8” and “16#x+9” in the CP-Image is linked with the variable “var_1” in the global Data Block in the PLC. To achieve that there are 8 Bytes reserved in the global Data Block (“unused_dumy1” and “unused_dumy2”). Those unused 8 Bytes are used for example with the previous used Sending variables from Figure. 3-6, means from an other global Data Block.

Parameter LEN at the system block „TC_RECV“

The parameter „LEN“ shows how big the data storage area which is transmitted by the CP 1242-7 GPRS can be. The length of the pointer at the parameter “DATA” is irrelevant.

Parameter DATA at the system block „TC_RECV“

The data storage area transmitted by the CP 1242-7 GPRS will always start from 0 byte of the global block, independent value is given by the pointer as starting value.

Note It is not possible to influence the memory area of the receiving process values.

Parameter RCVD_LEN at the system block „TC_RECV“

If the receiving data storage area of the CP 1242-7 GPRS of the connection partner is larger /equal to the parameter LEN at the system block „TC_RECV“ then the value of the parameter “LEN” is read out.

If the received data storage area is smaller than the parameter LEN of the system block „TC_RECV“ then the actually received value of the data storage area is sent.

Attention It is not possible to identify which incoming process values were changed by the connection partner and which were not. It is therefore sometimes necessary to check the incoming process values regarding the change in value.

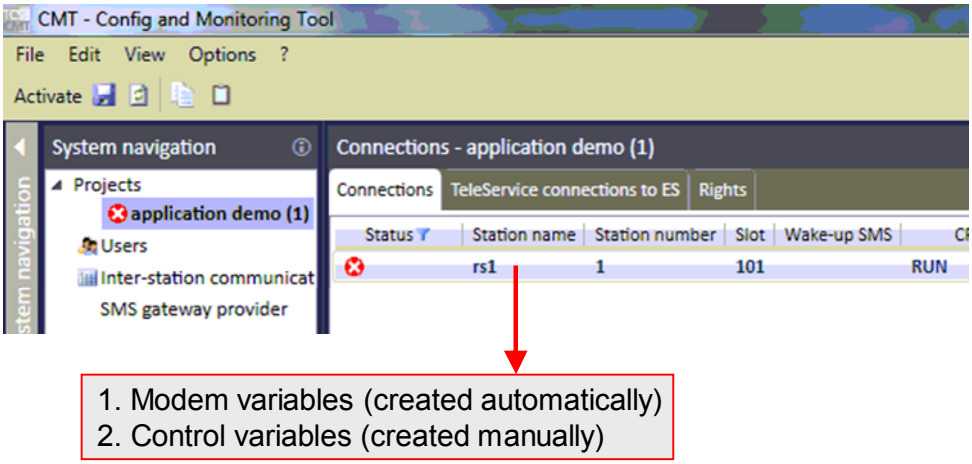
3.6 ‚Receive and represent process at the Central Station

Variable types

For each Remote Station created in the Software Telecontrol Server Basic the following variable types are available in the OPC Server which is integrated in the system:

- System generated modem variables
- Manually generated control variables

Figure 3-9



Overview system generated Modem variables

Table 3-4

No.	Address assignment	Description
1.	TSC:[Stationidentification]**GPRSConnected**	• UBYTE, Read only • 1= Connected, 3= Disconnected • CP 1242-7 GPRS is connected to the Central Station (the connection with the GPRS is available, the connection partners are correct)
2.	TSC:[<Stationidentification>]**PLCConnected**	• BOOL, Read only • S7-1200 control is connected to the Central Station (connection between control and CP 1242-7 GPRS is alright, control reacts to the telegrams Central
3.	TSC:[< Stationidentification>]**InternetConnected**	• BOOL, Ready only • The connection from the Telecontrol Server to the Internet is setup (the

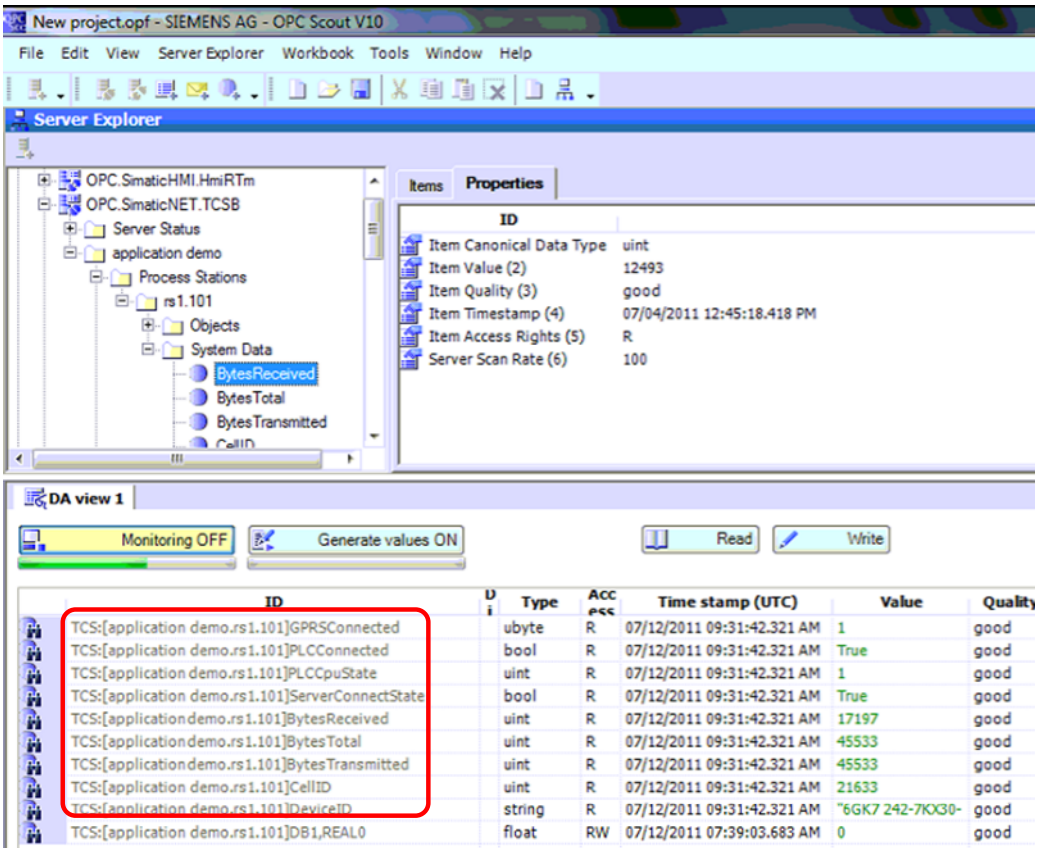
No.	Address assignment	Description
		connection to the Remote Station is not considered.
4.	TSC:[<Stationidentification>]**CellID**	• DWORD, Read only • ID for radio cell which has been booked into the CP-1242-7 GPRS. Can be used to determine the location. Disclose the Cell-ID and location is dependent of provider.
5.	TSC:[<Stationidentification>]**SignalQuality**	• BYTE, Read only, Values 0 to 31 • Receiving intensity of the GMS antenna at the CP 1242-7 GPRS
6.	TSC:[<Stationidentification>]**BytesReceived**	• DWORD, Read only • Counter value in the CP 1242-7 GPRS for the sum of all received bytes.
7.	TSC:[<Stationidentification>]**BytesTransmitted**	• DWORD, Read only • Counter value in the CP 1242-7 GPRS for all the sent bytes.
8.	TSC:[<Stationidentification>]**BytesTotal**	• DWORD, Read only • Counter value in the CP 1242-7 GPRS for the sum of the sent **and** received data
9.	TSC:[<Stationidentification>]**Firmware**	• STRING, Read only • Reserve 7 characters • Firmware Version of the CP 1242-7 GPRS (e.g. T1.0.0)
10.	TSC:[<Stationidentification>]**DeviceID**	• STRING, Read only • Reserve 20 characters • Equipment identification number of the Modem CP 1242-7 GPRS (e.g. 6GK7242-7KX30-0XE0)
11.	TSC:[<Stationidentification>]**TestsTotal**	• DWORD, Read only • The counter indicates how often the status of the CP 1242-7 GPRS has been scanned with the help of the Modem variable „RefereshStatus“
12.	TSC:[<Stationidentification>]**TestsSuccessful**	• DWORD, Read only • This counter shows how often the status scan of the CP 1242-7 GPRS was succesfully closed (this refers to the accessibility of the CPs but not to the ones of the PLC)
13.	TSC:[<Stationidentification>]**ServerNr**	• DWORD, Read only • Server number of the

No.	Address assignment	Description
		Telecontrol Servers, connected to the Remote Station
14.	TSC:[<Stationidentification>]**Protocol**	• DWORD, Read only • Send report • 1= IPT (S7-1200 + CP 1242-7 GPRS), 2= MSC (S7-200-, S7-300-, S7-1200 + MD720-3)
15.	TSC:[<Stationidentification>]**RefreshStatus**	• BOOL, Write only • Checks the connection to the CP 1242-7 GPRS and to the S7-1200 • Information regarding the status is given by the Modenm variables PLCConnected and GPRSConnected. • Is reset automatically to FALSE after setting
16.	TSC:[<Stationidentification>]**ResetStatus**	• BOOL, Write only • Resets all Modem variables with count values (e.g. BytesReceived) • Is reset automatically to FALSE after setting.

Note The Modem variables stated here are relevant for this scenario 1 or at least give a reasonable information. Further Modem variables can be found in document \2\ chapter 3.2.

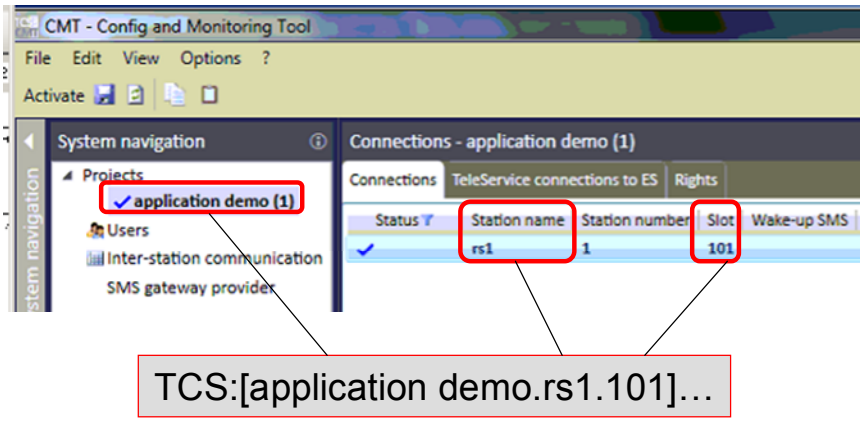
Access to modem tags in the example of the OPC client OPC-Scout

Figure 3-10



In the row „ID“, you see the OPC compliant random addressing of the Modem variables just the same that can be selected in other OPC-clients. The station „application demo.rs1.101“ (station identification) was previously created in Telecontrol Server Basic.

Figure 3-11



Control tags

Variables from the S7-1200 control are addressed by the OPC client as follows:

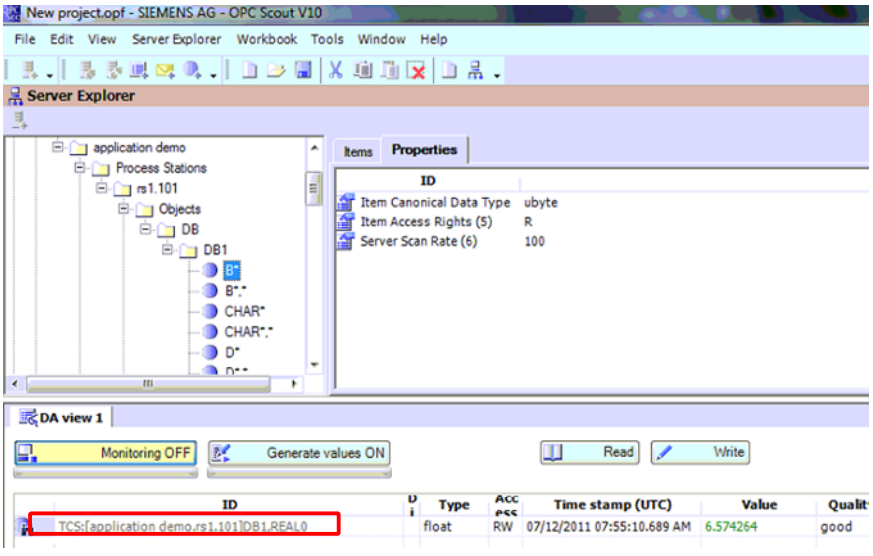
TSC:[<Stationidentification>]DB1,<Datatype><Memoryaddress>

Table 3-5 addressable data types.

Type	Description	Comment
B	Byte	
W	Word	
D	Double word	
CHAR	Byte	
INT	Word, signed	
DINT	Word, signed	
REAL	Floating point value	Example: TSC:[application demo.rs1.101]DB1,REAL0 The abbreviation „DB1“ here doesn't mean that the information is coming from the data block No. 1 or will be written there, resp.
STRING	String with fixed length	Example: TSC:[application demo.rs1.101]DB1,STRING30.20
DT	Date and time in BCD Format	

Access to the control variables seen in the example of the OPC-Scout

Figure 3-12



4 Functional Mechanisms of this Application

This chapter shows the resulting solution elements and their software complement for the requirements of this application example.

4.1 Control of the process data transfer in this example

The following table again shows an overview of all possible alternatives to control the process data transfer with Telecontrol Server Basic. The alternatives marked in color are used in this application example (scenario 1). The program technical conversion of this alternative will be commented hereafter.

Table 4-1 Mechanisms used to control the process data transfer.

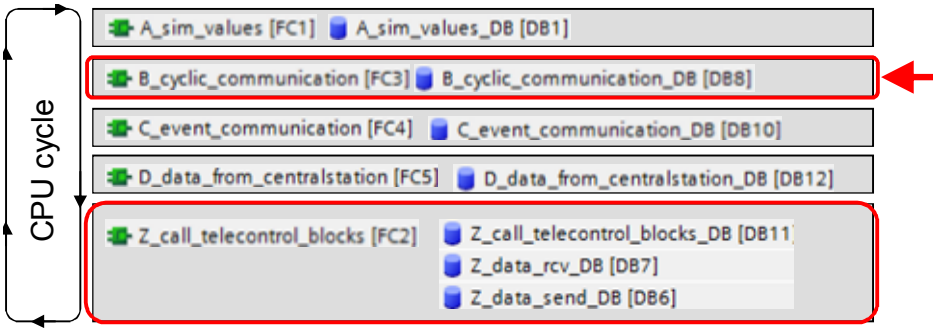
No.	Direction	Initiator	Trigger type	Description
1	RS → CS	RS	cyclic	The program block „TC_SEND“ is activated with the help of the input „REQ“ when the corresponding timer has expired. The transmitted data storage area should also contain a time variable (see problematic old/new comparison chapter 4.3.3).
2	RS → CS	RS	event	The program block „TC_SEND“ is activated with the help of the input „REQ“ when a certain event emerges.
3	RS ← CS	CS	event	The Central Station sends the value of the OPC-Item automatically when there is a change of the corresponding OPC Item. Normally a change in value of the OPC Item is caused with the help of an input/output display.
4	RS → CS	CS	cyclic	The Central Station fetches with the help of the option „cyclic communication“ in the Telecontrol Server Basic the image of the CP 1242-7 GPRS in a definable interval. It must be assured in the CPU with the help of the command „TC_SEND“ that the process data in the image of the CP 1242-7 GPRS are up to date. The alternative cannot transmit historical time stamps (see problematic historic values 4.3.4).
5	RS → CS	CS	event	The Central Station fetches the image of the CP 1242-7 GPRS in the Telecontrol Server Basic when the OPC items „RefreshValues“ are activated (see document \2\ chapter 3.2). The OPC-Item has to be activated after a certain event (e.g. pressing a key).Make sure that in the CPU, with the help of the command “TC_SEND” the process data in the image of the CP 1242-7 GPRS are up to date. This alternative cannot transmit historical time stamps)

4.1.1 Send process values cyclic to the Central Station (RS -> CS)

Program overview

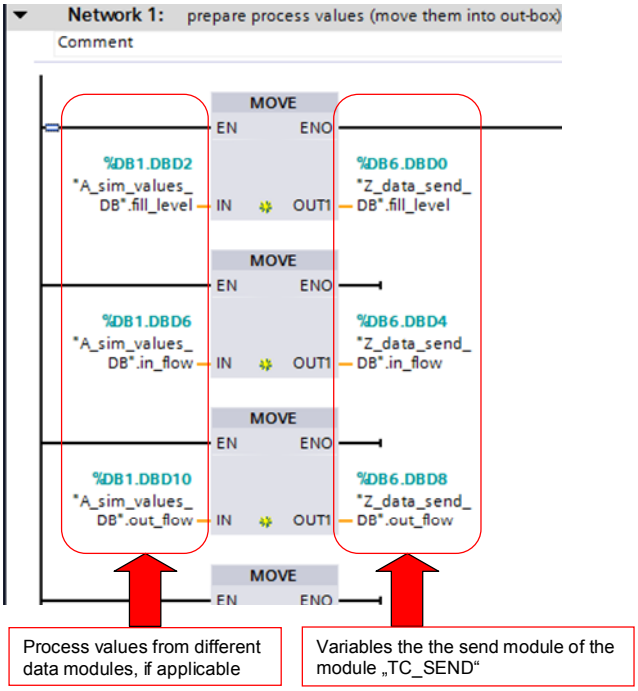
The cyclic data transmission is carried out in the function block „B_cyclic_communication (FC3)“ and will be described in in more detail below.

Figure 4-1 Frame count sequence of the blocks in the program



1. File process values in the send data module

Figure 4-2

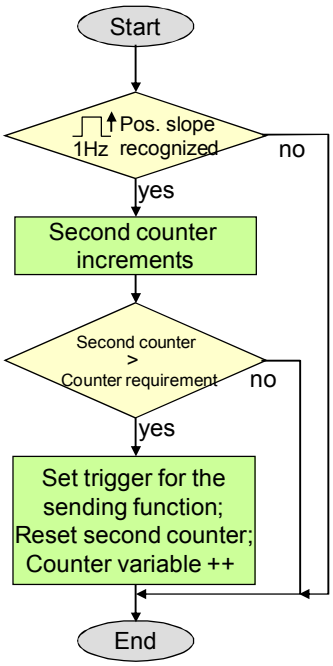


This function is carried out in each cycle.

2. Operate the time switch start the send function

The time switch is implemented with the help of the flag in the S7-1200 CPU. The advantage, as compared to the TON timer, is the immediate reaction when changes in parameters occur, and not a reaction during the next interval. This is reasonable if you want to change the counter parameter from the Central Station.

Figure 4-3



A counter variable is incremented additionally which is also sent to the send block. This assures that when the send routine is started there always is at least one modified value.

3. Carry out send process and reset trigger

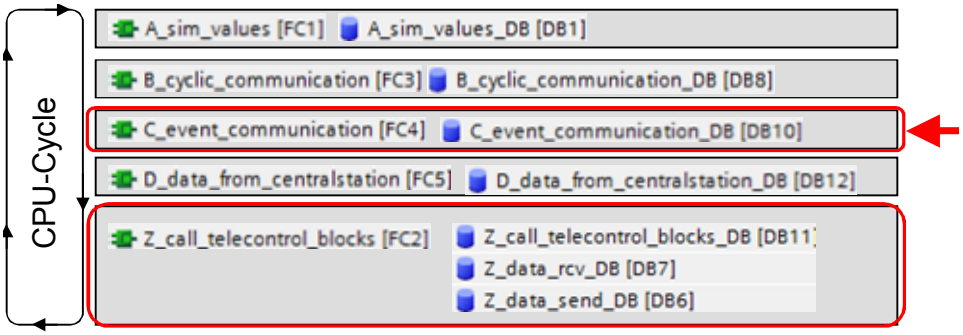
The send function is carried out by the invocation of the system block „TC_SEND“ (in the function block „Z_call_telecontrol_blocks“ (FC2). The trigger of the send function is also reset here.

4.1.2 Send process values event controlled to the Central (RS -> CS)

Program overview

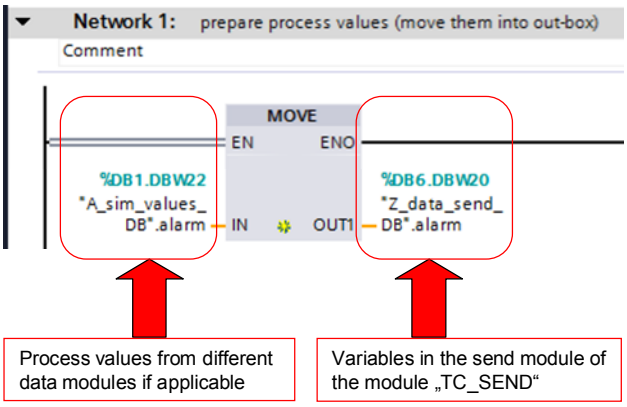
The event controlled data transmission is carried out in the function block „C_event_communication“ (FC4) and will be described in more detail later on.

Fiure 4-4 Initiation sequence of the blocks in the program



1. Place process values in the transmission block

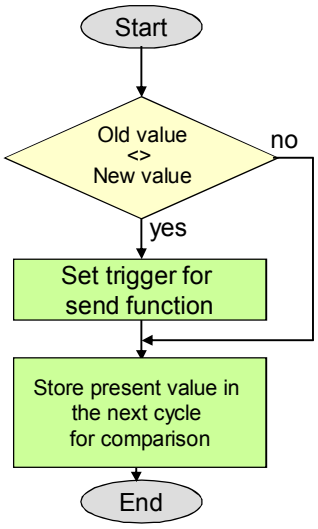
Figure 4-5



2. Recognize change in value and start send function

The send function will be triggered after the change in value of the send variable has been recognized. The cyclic send mechanism is not influenced by this event controlled mechanism.

Figure 4-6



3. Carry out send function reset trigger

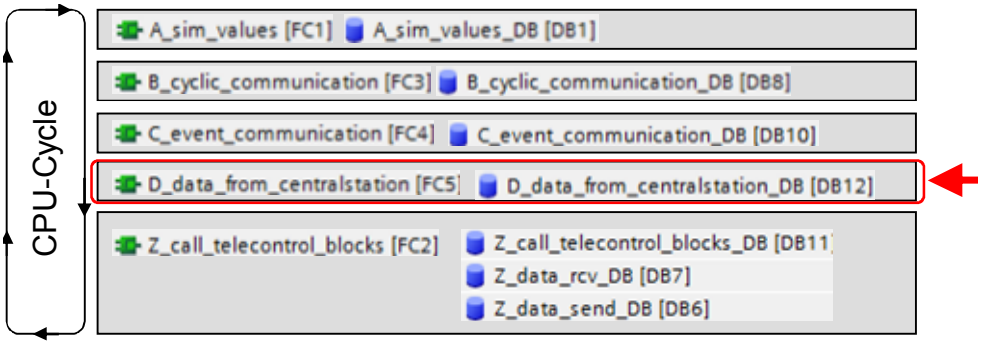
The send function is carried out by the invocation of the system block „TC_SEND“ (in the function block „Z_call_telecontrol_blocks“ (FC2). The trigger of the send function is also reset here.

4.1.3 Receive process values from the Central Station (RS <-CS)

Program overview

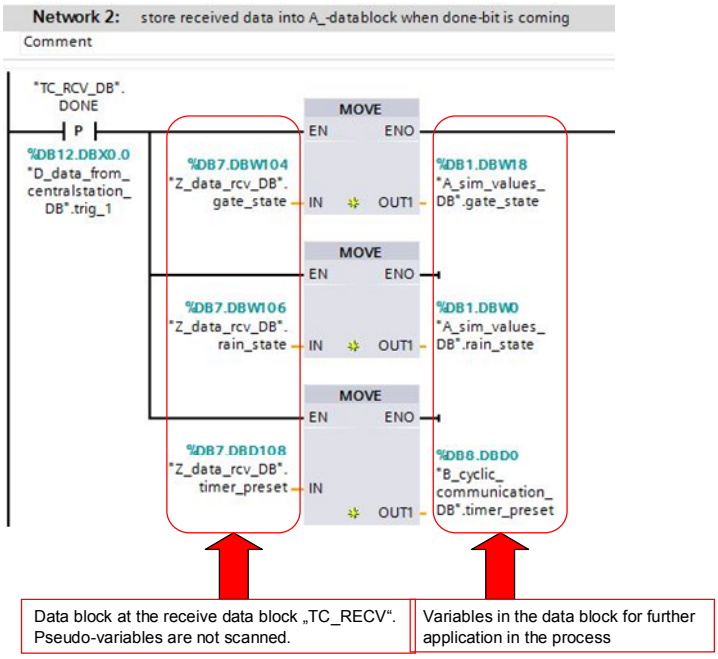
The receipt of process values from the Central Station is carried out in the function block „D_data_from_centralstation“ (FC5) and will be discussed in detail in the following:

Figure 4-7



1. Recognize receipt of new process values and copy them from the receive data block

Figure 4-8

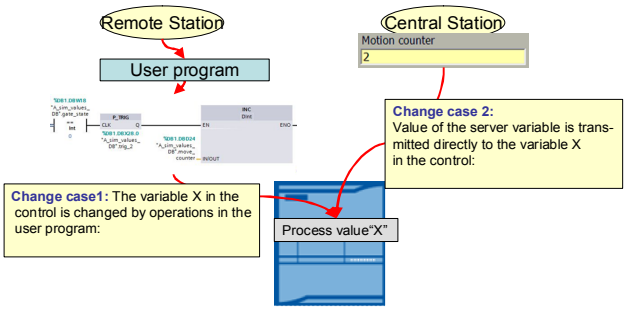


Due the cognitions of chapter 3.5.2 there are pseudo-variables of 100 Byte for the sending process. This means that the receiving data is stored beginning at Byte 100.

2. Receive process values only when value changes

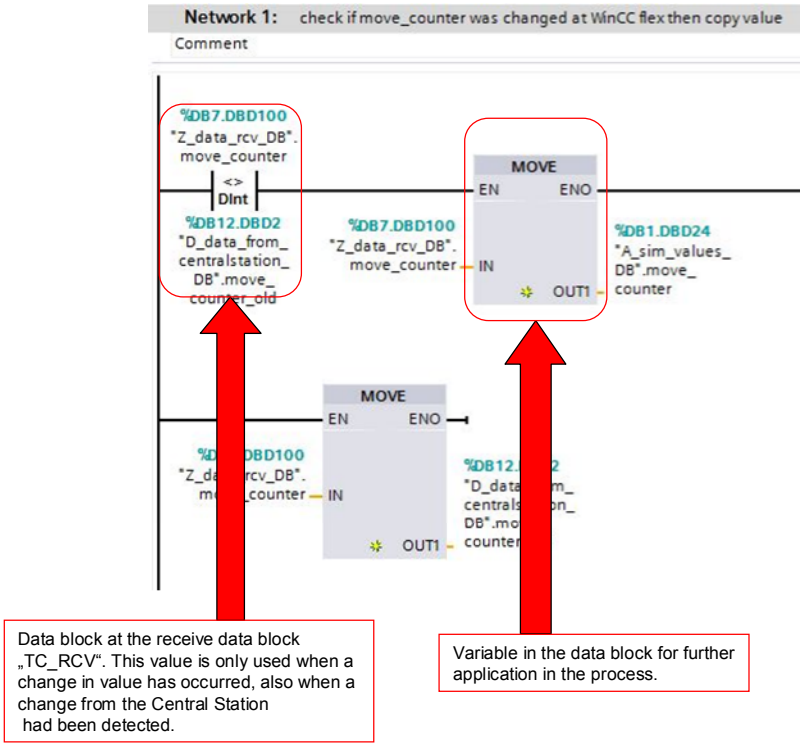
When the same process value can be changed by the control of the Central Station and also by the user program in the PLC, it will be necessary to differentiate these two alternatives in the program sequence.

Figure 4-9



The process value in the receiving data block monitors a change in value in the control. Only when this change in value has been recognized, the value from the receiving data module will be used.

Figure 4-10

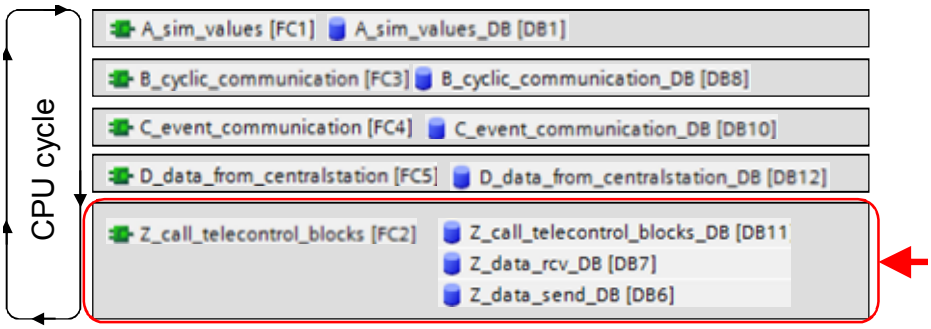


4.1.4 Controlling a connection establishment / connection release

Program overview

The invocation of the system blocks TC_CON, TC_DISCON, TC_SEND and TC_RECV, as well as the control of the connection establishment / connection release is achieved in the function block „Z_call_telecontrol_blocks“ (FC2).

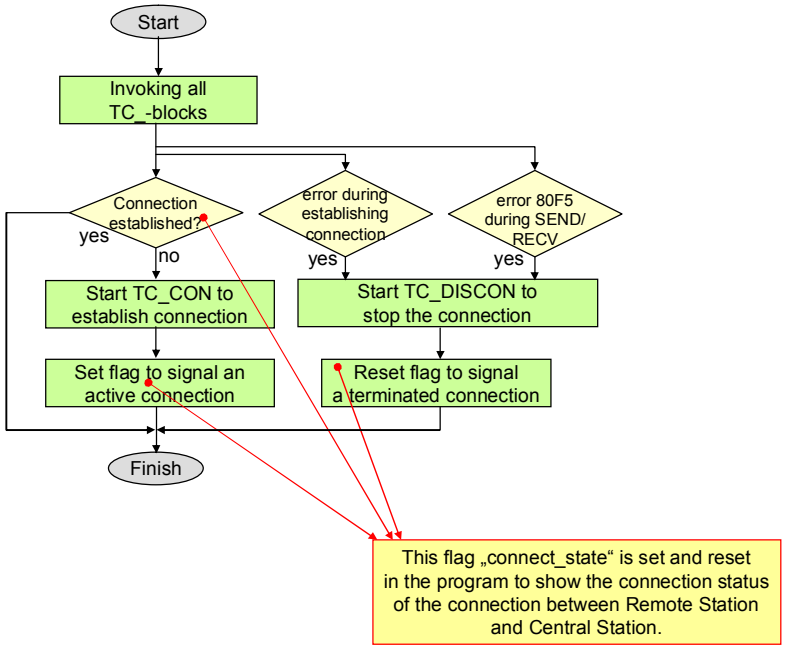
Figure 4-11



Handle Connection

Apart from invoking the system blocks TC_CON, TC_DISCON, TC_SEND and TC_RECV in this FC there is also the connection controlling implemented. It establishes the connection and terminates the connection if any error occurs.

Figure 4-12



4.2 Implementing archived variables

Introduction

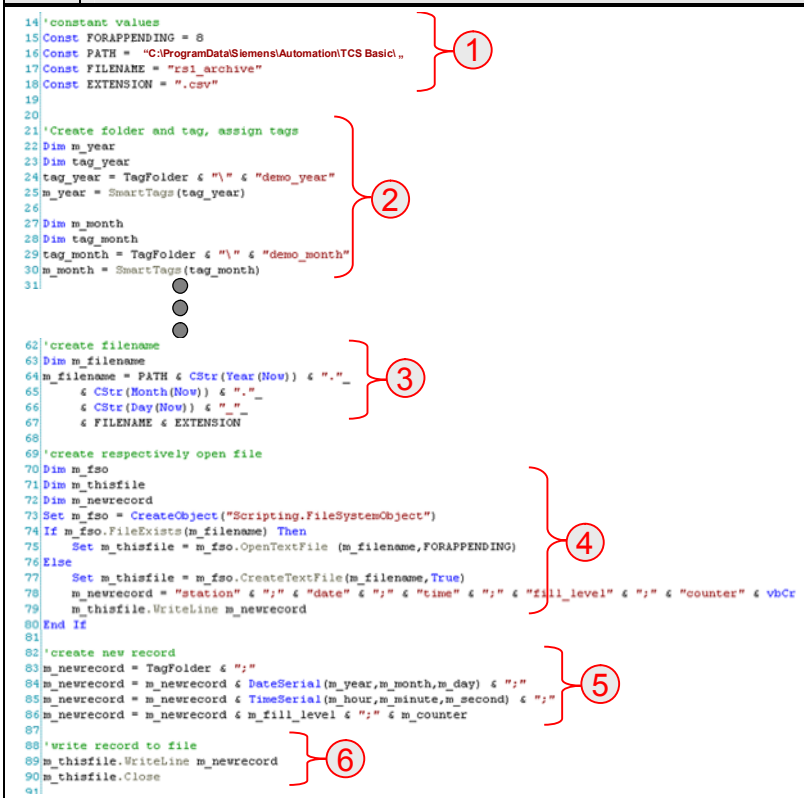
Aside from the visualization of the updated values in the OPC-Client WinCC flexible, it is possible, with the help of a VBA script to archive the updated values. Therefore, the updated time stamp is sent together with the simulated process variables to the measured values acquisition point. It is the CPU internal time stamp and not the time stamp of the CP 1242-7GPRS.

A change in value at the variable „demo_counter“ is used as an invocation condition for the script „rs1_archive“. This variable represents the counter variable from chapter 4.1.2 and changes for each cyclic data transmission. This guarantees that the script is only carried out when new incoming values have been received due to the cyclic data transmission.

Skript Code

WinCC flexible is implemented in the following „rs1_archive“

Table 4-2

No.	Explanation
	
1	The constants for the subsequent data generation are created here. Since the memory location is “PATH” it has to be adapted accordingly. Example Windows 7: "C:\ProgramData\Siemens\Automation\TCS Basic\“ (in Windows 7 files can be created with the help of the VBA script only in files with available write authorization of the registered user. Per default the work directory of the software Telecontrol Server Basic is used because normally you should have sufficient permissions there.)

No.	Explanation
2	The following steps are carried out for each variable, that will be archived later: • Variable1 to declare value. • Variable 2 to declare path (text). • Variable 2 to allocate the path in WinCC flexible for the subsequent "SmartTag" application • Allocate variable 1 to the current value with the help of „SmartTag".
3	The names for the *.csv-file are generated. Elements are the current date and the station name in order to be able to allocate the archive data sets.
4	The generated data name is now compared with existing data name in the filing path. If the file does not yet exist, it will be created. In each case the csv-file is opened afterwards in order to enable the succeeding write process.
5	The data set separated with semicolons with the values „station", „date", „time", „fill_level" and „counter" are created now.
6	In the last step the data record is written to the opened file and the file is closed.

Script invocation

When invocating the script, the file's name of the variable list in WinCC flexible (here „rs1\from") is assigned. Thus, it is possible to use the same script for different stations (with differently appointed file names, e.g. "rs2\from").

Figure 4-13

4.3 Important system characteristic for this application

The following chapters summarize the characteristics for the scenario 1 but for this version still restricted characteristics of the system consisting of CP 1242-7 and WinnCC flexible and describe the solutions which were implemented here for the scenario 1.

4.3.1 Times

Overview

The PLC and the CP 1242-7 GPRS access at different system times. The system time of the CP 1242-7 GPRS is stored in UTC format and is synchronized automatically via the Telecontrol Server.

The system time of the CP 1242-7 GPRS can be read by the PLC with the help of the command RD_REC at RECNUM 160.

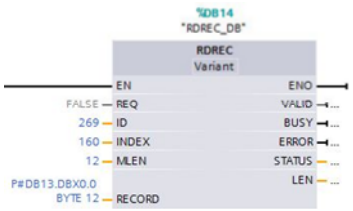
Writing of the system time of the CP 1242-7 GPRS from the PLC is not possible.

The time stamp of the sent process values cannot be influenced. The system time of the CP 1242-7 GPRS, i.e. the UTC time of the Central Station, is **always** used.

Example for reading out the time

The time can be read out with the help of the RDREC blocks. This block does not belong to the Telecontrol system blocks but is part of the STEP 7 V11.

Table 4-3

Block call	Parameters	Value
	ID	„PLCxy > PLC-variables> Standard variables > System constants > GPRS_Interface > value“
	INDEX	160
	MLEN	12 (length of the DTL format)
	RECORD	Pointer on DB with DTL variable

In this application this block is implemented to read out the clock from the CP 1242-7 GPRS and to store this clock in the controller.

4.3.2 Problems related to the time stamp

Overview

It is possible to access the time stamp of the transmitted process values directly with the OPC client OPC-Scout. With the OPC clients or with the WinCC flexible this is not possible – neither in the display nor in their archiving.

Solution of the time stamp problems in this application example

In this application the date (year, month, day) and the time (hour, minute, second) is sent as a separate process value to the other simulated process values. This brings the advantage that also OPC-Clients which cannot access the OPC-Item time stamp still have an evaluable time stamp.

Another advantage is to be able to influence the time stamp in case the measured data acquisition time should be different from the measured data sending time.

4.3.3 Comparison between old and new

Overview

If Process values are sent with the command „TC_SEND“ to the CP 1242-7 GPRS the CP will check if the process values have changed as compared to the CP image have changed.

A telegram is sent to the Central Station only of a change in the value has been recognized. This causes a reduction in data traffic as well as a cost reduction.

Problems

It could occur that a telegram was not sent although a send job was triggered at the „TC_SEND“ and that this had been acknowledged correspondingly when the process values had not changed.

Solution old/new comparison problematic in this application example

For the solution of the automation task in scenario 1 (cyclic transmission) the comparison old/new is **not desired**. For a continuous measured data display it is required that a telegram is always sent even if the values remain unchanged.

Due to this reason a counter variable is introduced, which will make sure that each CP image is different from the previous one and thus will be sent.

4.3.4 Mode – cyclic communication

Definition of the mode – cyclic communication

In order to set up a cyclic communication between the Remote Station and the Central Station is advisable to use the feature „cyclic communication“ of the Telecontrol Server Basic Software.

A defined area from the memory image of the CP 1242-7 GPRS is fetched in a parameterizable intervall. The system block “TC_SEND” must be continuously invocated in order to assure that the memory image is supplied with the current process values. The parameter “CONNECT” at the system block “TC_CON” must be assigned with the value W#16#FEEDDADA instead of with the real receiver address.

Problematic – historic values

This alternative is not suitable for automation tasks where time stamps are important especially for historic process values. In this case only the current (last) value is fetched from the memory image of the CP 1242-7 GPRS in case of connection abort of the Telecontrol Server Basic. Possible historic values which were stored in the cycle of the parameterized interval do not exist.

Solution of the problems related to the cyclic communication in this application example.

For this reason the cyclic communication of this application example is also implemented in form of a user program in the Remote Station.

4.3.5 Several sub-connections with the same receiver address

Overview

If event controlled and cyclically controlled send mechanisms are combined in the Remote Station, or different send cycles are implemented, then several sub-connections with the same receiver address must be setup.

Each sub-connection has its own TC_SEND statement which shows in form of a data storage area (parameter PARA) to the data block in the CPU.

Problemat

It is not possible to differentiate between the storage area of both TC_SEND commands in the image of the CP 1242-7 GPRS in order to also correspond to the relevant variables at the OPC Server.

Due to this reason the same data block from the S7-1200 control is used for every TC_SEND command. Therefore all variables are always sent to both sub-connections at the time of transmission (i.e. both TC_SEND commands).

→ It can therefore happen in this application example (scenario 1) that there are one or more self-controlled transmitted measured values between two cyclic transmitted measured values at the OPC Server during archiving.

This must be taken into consideration when archiving at the Central Station.

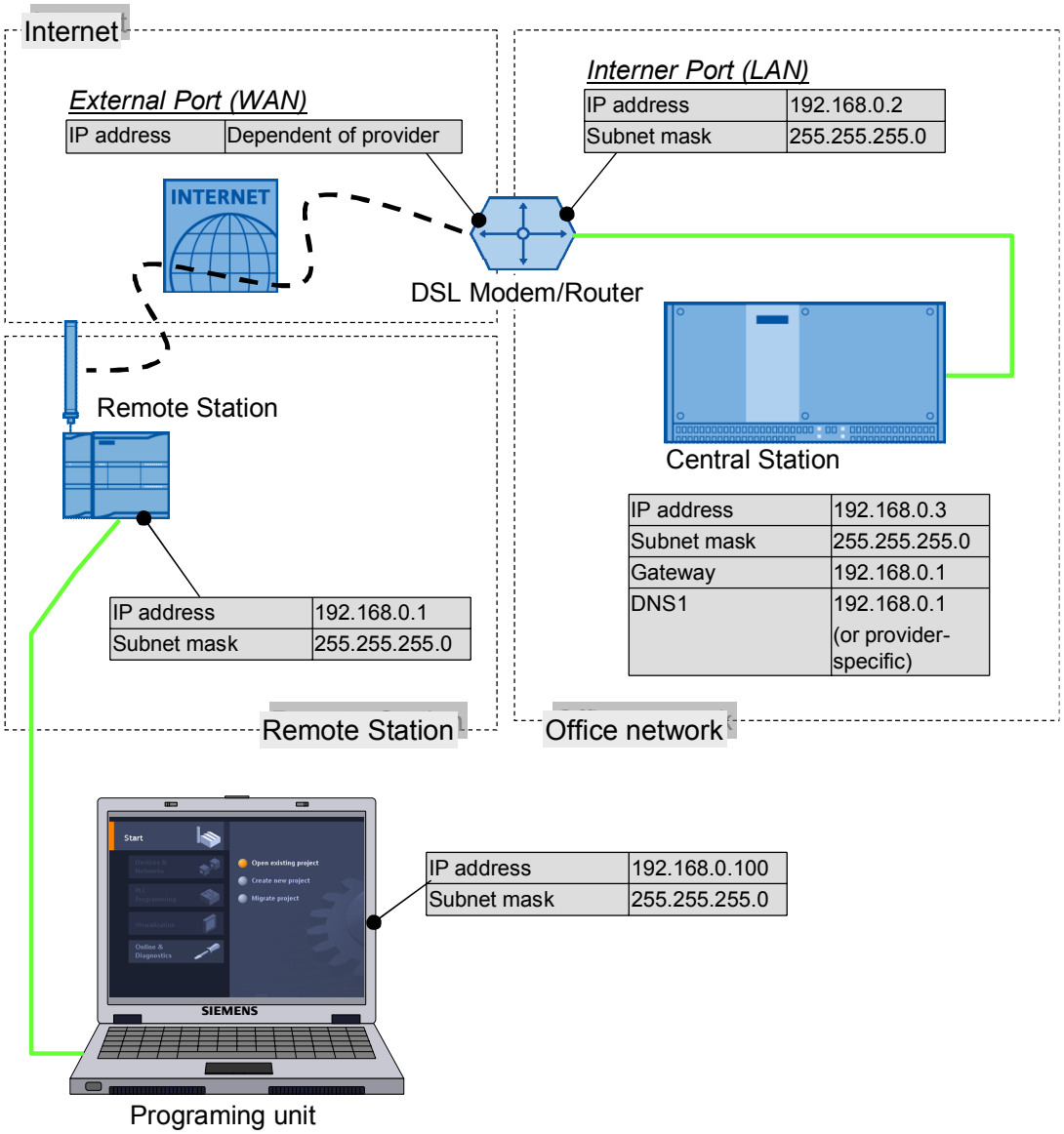
5 Starting up the Application

5.1 Installing and wiring the hardware

Network plan

The following graphic shows all the network relevant information which you require for the interconnection of all components.

Figure 5-1 Network plan with IP adresses



Install hardware

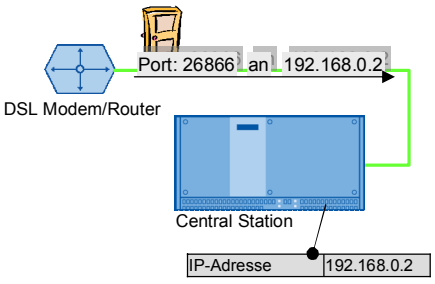
Table 5-1

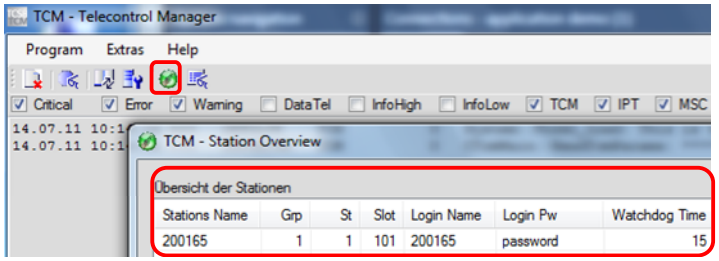
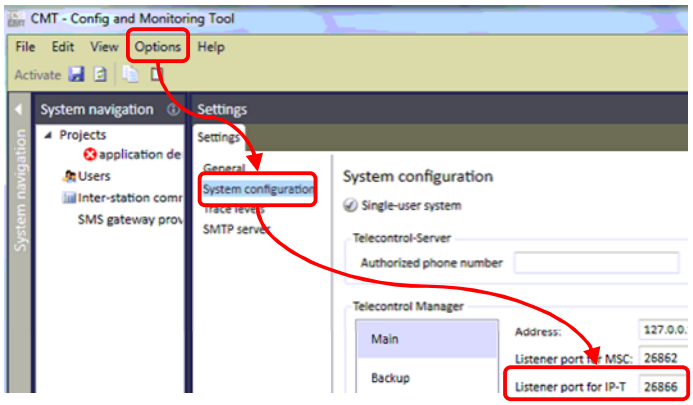
No.	Action	Note
1	Install all the required components on the DIN rails	• Remote station: Component list Chapter 2.3.1 • Central station: Component list Chapter 2.3.2
2	Wire and connect all required components for the remote station and for the central station as described. Please watch the ground connections of the components and only activate the power supply for the SIMATIC PM 1207 at the very end. Place the SIM card in the CP 1242-7 GPRS	• Remote station: Configuration display Figure 2-1 • Central station: Configuration display Figure 2-2

5.2 Configuration instructions

Configuring the central station

Table 5-2

No.	Action	Note
1	Install all software components on your central station IPC.	• Telecontrol Server Basic • WinCC flexible • Optional: SIMATIC OPC-Scout
2	Establish the internet connection on your IPC. Allocate the office network addresses to all network participants shown in Figure 5-1 with IP addresses given in the network address (or comparable ones)	• It is assumed that the Router is already connected to the Internet. • Check the Internet connection at your Central Station with the help of the Internet Browser by invocating any Internet page.
3	• At the router you set a port forwarding for port 26866 to the IP address of the central station • If you have activated a **firewall on your central station IPC**, you define an exception for port 26866.	
4	End the Telecontrol Manager of the Software Telecontrol Server Basic. Use the right mouse-button to click the icon in the info area of Windows and select “Exit”.	

No.	Action	Note
5	Copy the file “Smsc.sqlite” (see file Table 2-6 No.2) in the work directory of the Telecontrol Server Basic. Please observe that possibly available configurations in the Telecontrol Server Basic could get lost! See the “Note” at the end of the table.	**Folder of file** C:\ProgramData\Siemens\Automation\TCS Basic\Data Notice that the folder „Program Data“ is „hidden“. **Wrong folder of file** There is also a file „Smsc.sqlite“ in the installation directory C:\Programs\...\... This file is not allowed to be overwritten.
6	Open the program “Config and Monitoring Tool” via „Start > Programs > Siemens Automation > SIMATIC > TCS Basic > Config and Monitoring Tool“. Activate the project via the button “Actiavte”.	From now on the Station „rs1“ in the project „application demo“ must be displayed as a white „x“ with a red background.
7	Start the Telecontrol Manager again via „Start > Programs > Siemens Automation > SIMATIC > TCS Basic > Telecontrol Manager“.	
8	Check the settings for the station „rs1“in the „Database“ – info window (See “Note” at the end of the table). 	
9	Check the settings for the IP-T-port in the „Config and Monitoring Tool“. The value must be at 26866. 	
10	Open the *.hmi file (Table 2-6 No. 3). With WinCC flexible. Navigate via „Project>cex21_live_demo>Scripts>rs1_archive“ in the script to be processed. Now modify the constant „PATH“ with respct to the desired memory location for the archiving files.	 Standard path: „C:\ProgramData\Siemens\Automation\TCS Basic\“
11	Store the project and start the Runtime	

Note

The Telecontrol Manager has two functions which can be invocated via key combinations.

- STRG + ALT + double click for the TCS icon in the key strip opens the database info window.
- STRG + SHIFT + double click on the TCS icon in the key strip opens the „Log and Trace Control“ window.

Note

The standard password for the „Config and Monitoring Tool“ is „0000“.

Note

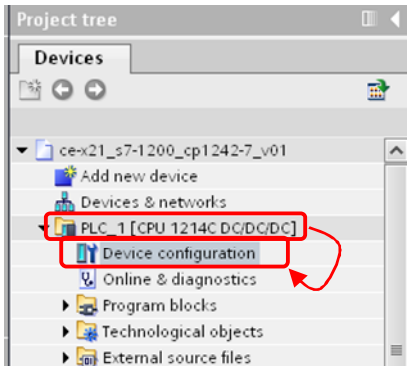
When you have already some Remote stations configured in your Telecontrol Server Basic and you don´t want to overwrite this configuration with this offered configuration file „Smsc.sqlite“ then you have to add a Remote Station with following Parameters on your own:

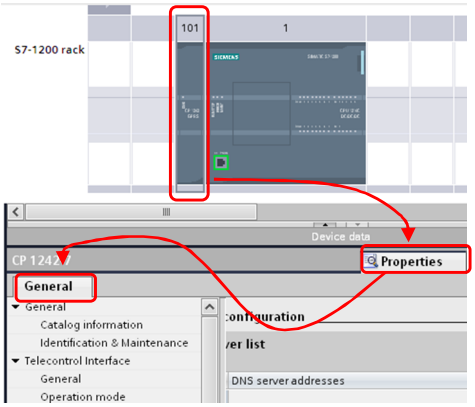
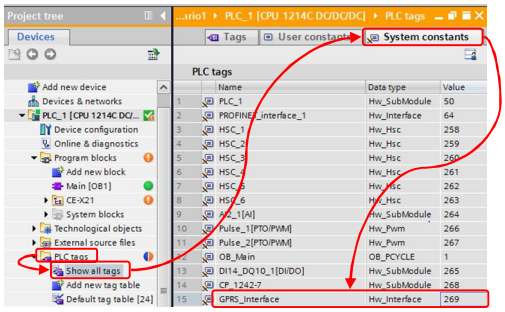
- Project name/Project number for this station: „application demo/1“
- Station name/Station number: „rs1/1“
- Telecontrol Password: „GEHEIM123“

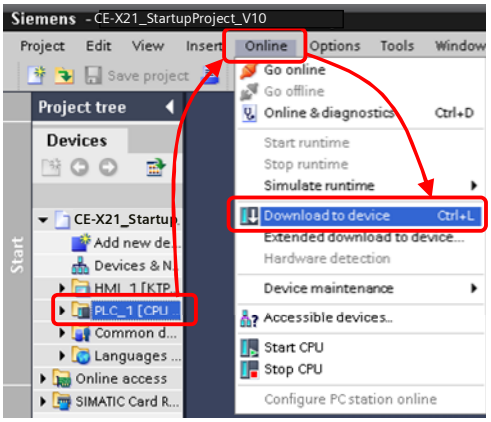
Only with this configuration of the Station it is possible to use all the other Startup-files without problems.

Configuring the remote station

Table 5-3

No.	Action	Note
1.	Network the S7-1200 controller with your programming device. Assign the Ethernet parameters as shown in Figure 5-1 Network plan with IP addresses.	Assign to S7-1200 IP address: http://support.automation.siemens.com/WW/view/de/36932465 --> Chapter 7.1.3
2.	Open the file CE-X21_RS_Project_V10.zpi with the STEP 7 V11	Table 2-6 No. 1
3.	Open the equipment configuration of the control „PLC_1“.	

No.	Action	Note
4.	Mark the CP 1242-7 GPRS and open the window „properties“ in order to be able to input the connection parameters. Assign the parameters now as described in the following steps. You can find a complete description of the parameters in document \1\ chapter 5.2.	
5.	Static IP-address of the Modem (see Figure 5-1 “WAN” <u>or</u> hostname when DynDNS is used.	Telecontrol interface >>operating mode >> CP 1242-7 GPRS *assign name or IP-address to Telecontrol Server)*
6.	PIN Number of the SIM card which is introduced into the Modem.	Telecontrol interface>> Modem settings >> *PIN* and *confirm PIN*
7.	Project number, station number and password for identification of the Remote Station in the Telecontrol Server. No need to change when you use the Telecontrol Server Basic database file from Table 2-6 Project data Nr. 2.	Telecontrol interface >> Modem identification >> *Project number*, *Station number*, *Password* and *confim password*
8.	APN address, APN user name and APN user password to login in the GPRS network of the provider.	Telecontrol interface>> GPRS access>> *APN Name*, *APN User name*, *APN Password* und *confirm APN Passwo*rd
9.	Test the Hardware-ID of the CP 1242-7 GPRS and adapt it if necessary to the parameters „INTERFACE“ at the blocks „TC_CON“, „TC_DISCON“, „TC_RECV“ and „TC_SEND“ in the function „Z_call_telecontrol_blocks“.	„PLC_1 > PLC-Variables> Standard variables > System constants > GPRS_Interface > Value“ 

No.	Action	Note
10.	Store the project. Marc the program file of the S7-1200 and transmit the program via „online/load in the equipment“ in the control. Make sure that the LED on the S7-1200 control indicates „RUN“.	

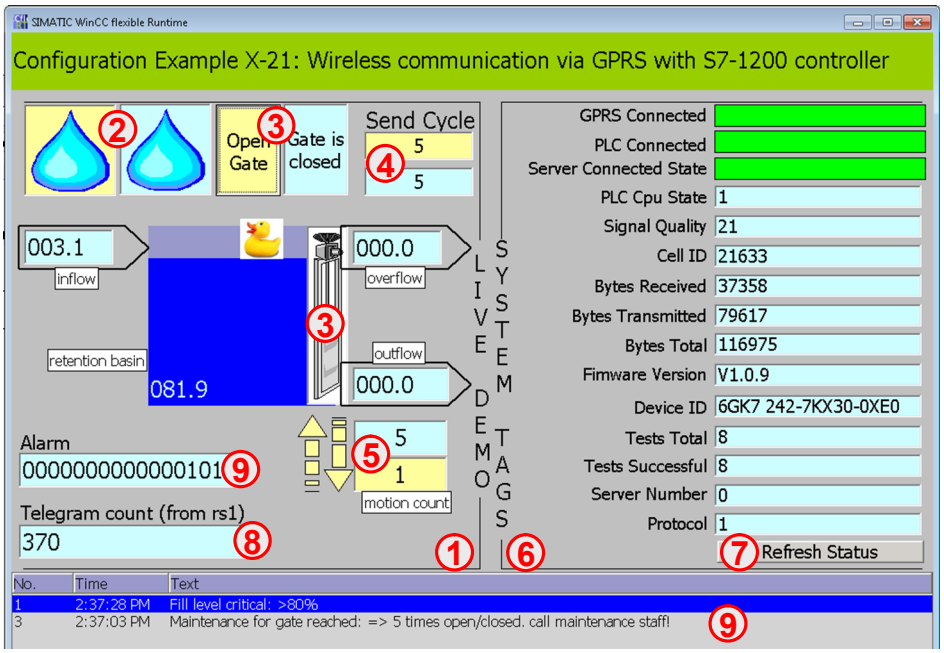
ATTENTION	**The following chapters assume that Remote station is logged in successfully at the Telecontrol Server Basic. The indicator on the Remote Station shows three permanently glowing LEDs (INTERNET, CONNECT, SIGNAL QUALITY) on the CP 1242-7 GPRS. The indicator on the Telecontrol Server Basic is the symbol of a blue check mark in front of the station used here.**

6 Operation of the Application

Provided that the Remote Station and the Central Station are configured and have been started correctly, the application can be operated with the help of Win CC as follows:

Operate WinCC flexible Project

Table 6-1

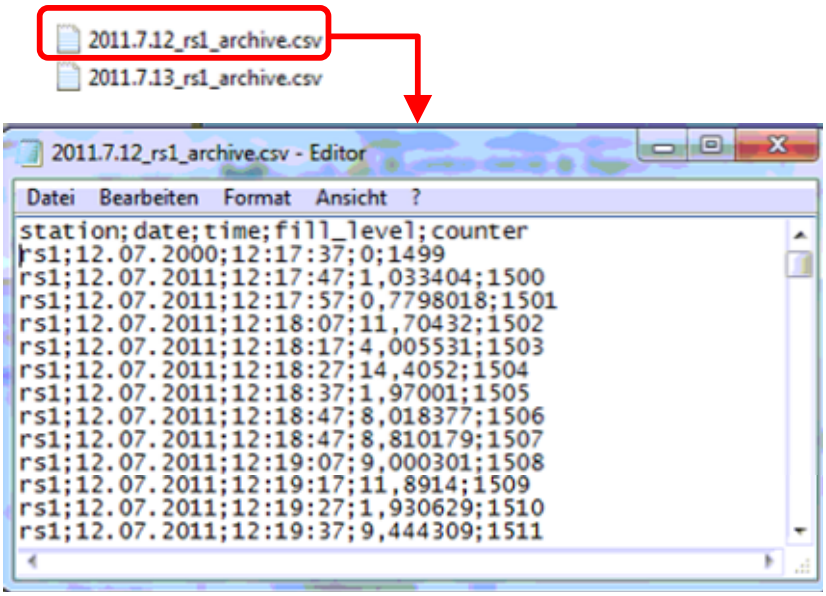
No.	Function
	
1	All the process values simulated in the control are indicated in the area „Live Demo“ • Level (output) • Inflow (output) • Drain (output) • Overflow (output) • Move counter at the sluice (input/output) • Alarms (output) • Counter of the cyclically transmissions (output) • Sun/rain (input/output) • Sluice open/close (input/output) • Transmission cycle (input/output)
2	Simulate sunshine or rain with this faceplate
3	Open or close the sluice with this faceplate
4	Here set the transmission cycle (in seconds). The process values are updated in the interval of the transmission cycle. A usable value to test or demonstrate the Live-Demo is 5 to 10 seconds.
5	This process value indicates the open and close moves of the sluice. After 5 moves, an alarm (maintenance due date) is sent out. The counter can be set back to 0 manually.

No.	Function
6	Generated system values are indicated in the area „system tags“ of the CP 1242-7 GPRS.
7	With the help of this faceplate the connection to the Remote Station is checked and the “system tags” are updated. When this faceplate is activated the value is incremented in the display field “tests total”. After a successful check of the connection the value is incremented in the display field „tests successful“.
8	This output field shows the cyclically sended telegrams from the Remote Station to the Central Station.
9	The alarm signals are displayed in this display window. • No. 1 (2#1) level is critical • No. 2 (2#2) basin is overflowing • No. 3 (2#4) Maintenance interval of the sluice has been reached. The alarm signals are available until the corresponding bit in the alarm word in the Remote Station has been reset and sent to the Central Station.

Use WinCC flexible Script for archiving

A counter variable is incremented for each cyclic controlled send function. This counter variable is used as an invocation mechanism for the archiving script and in order to allow the archiving function to differentiate between process values which are cyclically sent and those sent event dependent.

Figure 6-1



Open the archive with any texteditor or with Microsoft Office Excel via „File > Open > „Data type textfile (*.prn, *.txt, *.csv)“ > Open“.

The consistency of the archived data is not given and must be reset in continuation systems e.g. with the help of a screening function based on the stored time stamp.

7 Links & Literature

7.1 Internet links

This list is by no means complete and only presents a selection of appropriate information.

Table 7-1

	Topic	Title
\1\	CP 1242-7 GPRS Operating instruction	http://support.automation.siemens.com/WW/view/en/42330276
\2\	Telecontrol Server Basic Operating instruction	http://support.automation.siemens.com/WW/view/en/50898745
\3\	S7-1200 Automation system with system handbook	http://support.automation.siemens.com/WW/view/en/36932465

8 History

Table 8-1

Version	Date	Revisions
V1.0	July 2011	First issue
V1.1	November 2011	• STEP 7 V11 Startup-Project (Table 2-6 Project data No. 1) adapted to FW 1.0.9 and clock synchronization with Central Station implemented • WinCC flexible 2008 Startup-Project (Table 2-6 Project data No. 3) changed • Chapter 3.5.2 4.1.3 4.3.1 changed • Instruction to configure the Central Station (chapter 5.2) changed
V1.2	July 2012	• New connectin management implemented in STEP 7 V11 Startup Project (Table 2-6 Project data No. 1) • Chapter 3.5.1 4.1.4 updated