Industrial Ethernet Communication: Data Exchange S7-200 <-> S7-1200

SIMATIC S7 -1200

Configuration Example X20 • October 2010

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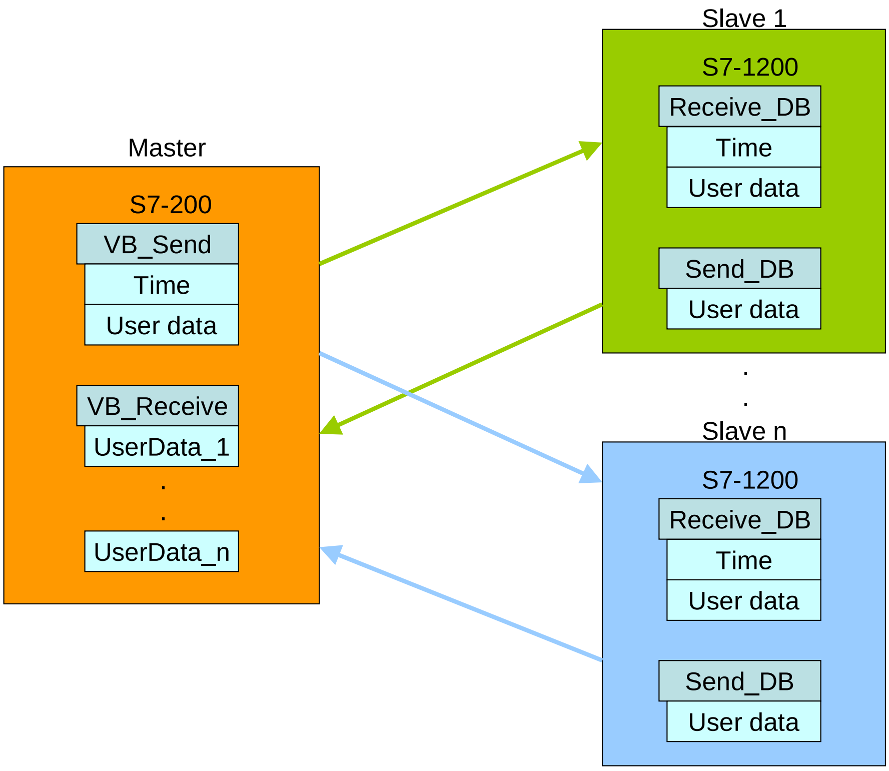
1 Automation Task

1.1 Tasks

Deterministic data exchange (e.g. for time synchronization) shall be enabled between an S7-200 master controller and several S7-1200 slave controllers.

Layout of the application task

Figure 1-1



Application requirements

Master and slaves have one send and one receive area. For S7-200 these areas are created in the variable buffer (VB_Send and VB_Receive). For the S7-1200 the data blocks are used (Receive_DB and Send_DB). At a synchronization request the master reads the system time and sends it to the first slave together with the user data. This slave synchronizes its system time with the received clock time of the master.

The user data of slave 1 is then received. This user data of slave 1 is then saved at a given location in the variable buffer of the master.

This procedure is repeated with the subsequent slaves. After the data exchange between master and the last slave the master starts the data exchange with slave 1.

1.2 Setup

For data transfer via Industrial Ethernet the SIMATIC S7-200 provides the expansion modules Ethernet-CP 243-1 and Internet-CP 243-1 IT.
The real-time cock is supported by the S7-200 as follows:

Table 1-1

CPU	Real-time clock
221	Optimal plug-in module (6ES7297-1AA23-0XA0)
222	
224	Integrated
224XP/224XPsi	
226	

The automation task is demonstrated at the example of data exchange between a CPU 224 with Ethernet CP 243-1 as a master and two slave S7-1200 controllers (slave 1 and slave 2).

Schematic layout

Figure 1-2

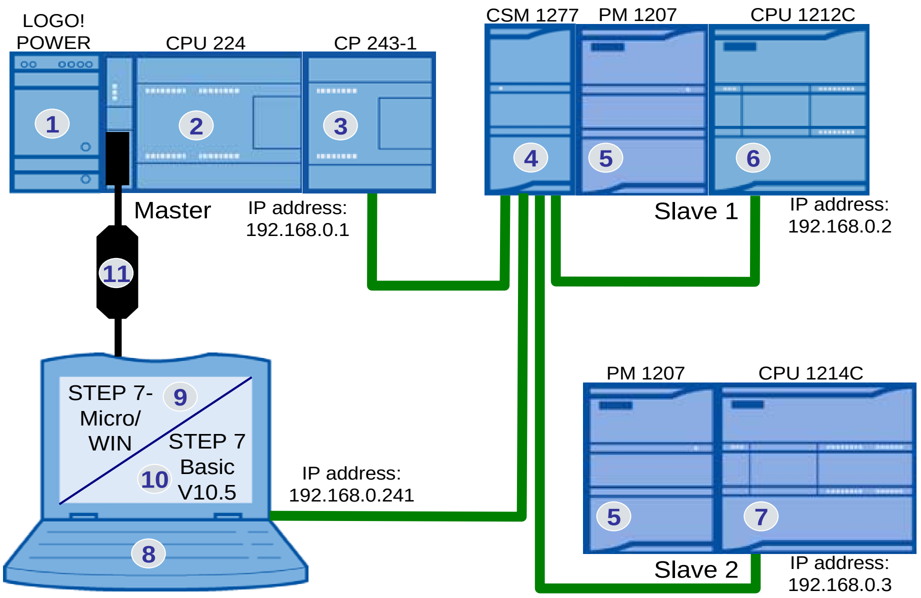


Figure 1-2 shows the principal setup. The communicating CPUs as well as the programming device with the software “STEP 7 Basic V10.5” for programming the S7-1200 and “STEP 7-Micro/WIN” for programming the S7-200, are each connected with the CSM 1277 switch via Ethernet cable. Configuring the Ethernet CPs 243-1 requires an additional connection (i.e. via the USB/PPI cable) between PG and CPU 224.

Component list

Table 1-2

No.	Component	Qty.	MLFB / order number
1.	LOGO!POWER 24V / 5A	1	6EP1331-1SH02
2.	CPU224, DC PS, 14DE DC/10DA DC	1	6ES7214-1AD23-0XB0
3.	COMMUNICATION PROCESSOR CP 243-1	1	6GK7243-1EX00-0XE0
4.	COMPACT SWITCH MODULE CSM 1277	1	6GK7277-1AA00-0AA0
5.	POWER SUPPLY S7-1200 PM1207	2	6EP1332-1SH71
6.	S7-1200 CPU1212C	1	6ES7212-1AD30-0XB0
7.	S7-1200 CPU1214C	1	6ES7214-1AE30-0XB0
8.	PC/PG	1	
9.	STEP7-MICRO/WIN V4.0	1	6ES7810-2CC03-0YX0
10.	STEP 7 BASIC V10.5	1	6ES7822-0AA00-0YA0
11.	S7-200, USB/PPI CABLE	1	6ES7901-3DB30-0XA0
12.	STEP 7 Micro/WIN V4.0 Service Pack (SP7)	1	Entry ID: 33005232
13.	STEP 7 Basic V10.5 Service Pack 2	1	Entry ID:39741113

2 Automation Solution

Common basis for data exchange between S7-1200 and S7-200 via Industrial Ethernet is the S7 communication protocol. For the S7 communication the S7-1200 offers the passive server functionality which provides read or write access to data.

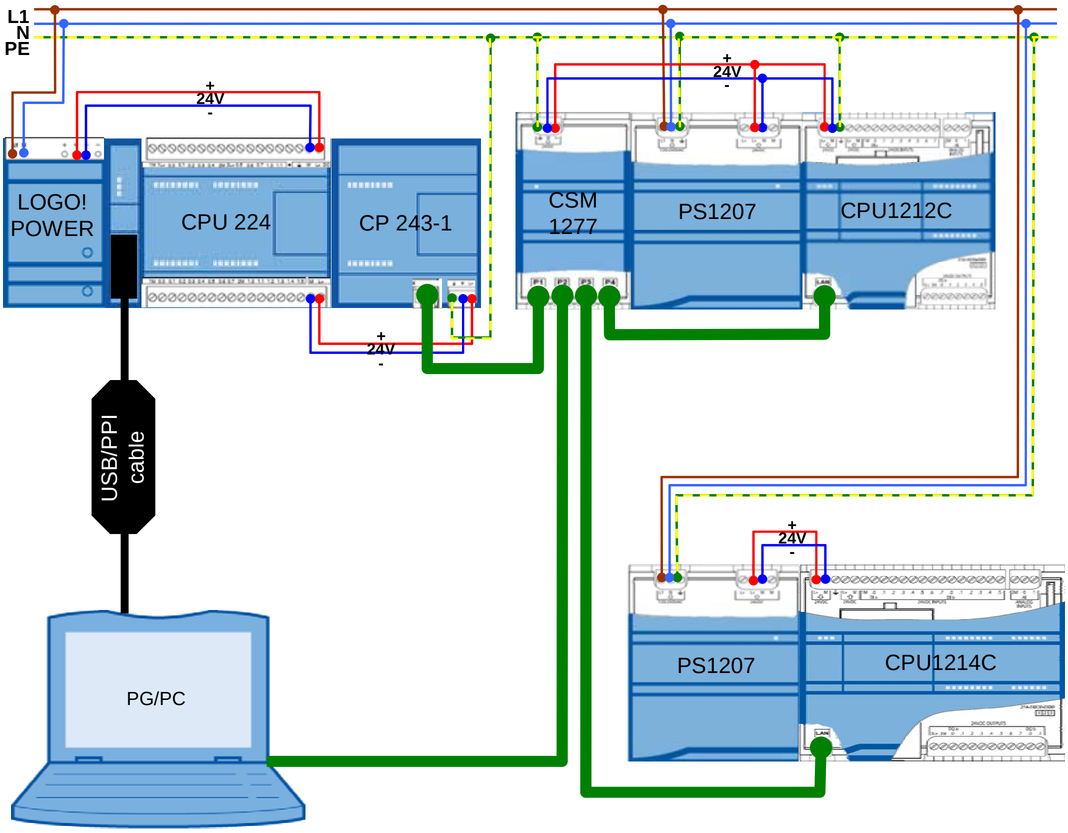
In S7-200 the configuration process occurs as a client via the Ethernet wizard in STEP 7 Micro/WIN. With the Ethernet wizard the respective connection partner as well as the exchanged data is established for both sides (client and server). The configuration parameters (such as IP address of the server) are stored in the CPU. The communication partner is identified via the IP address.

A maximum number of 8 simultaneous connections can be configured with the Ethernet wizard. By changing the IP address in the configuration parameters during runtime more than 8 partners can exchange data sequentially via a configured connection. However, each adoption of modified configuration parameters requires a reinitialization of the Ethernet CPs, which may take approx. 30 seconds.
For this reason the deterministic data exchange with clock time synchronization via default configured connections (i.e. maximal 8) is chosen.

2.1 Connection diagram

The components list is available in chapter 1.2.

Figure 2-1



2.2 Program structure

This chapter describes the program structure of the example on the function and data block level of the automation system.

2.2.1 Presentation of block structure

Figure 2-2 and Figure 2-3 show the call hierarchy of the used subprograms/blocks as well as the access to the used data areas or data blocks for the S7-200 client and the S7-1200 server.

Figure 2-2

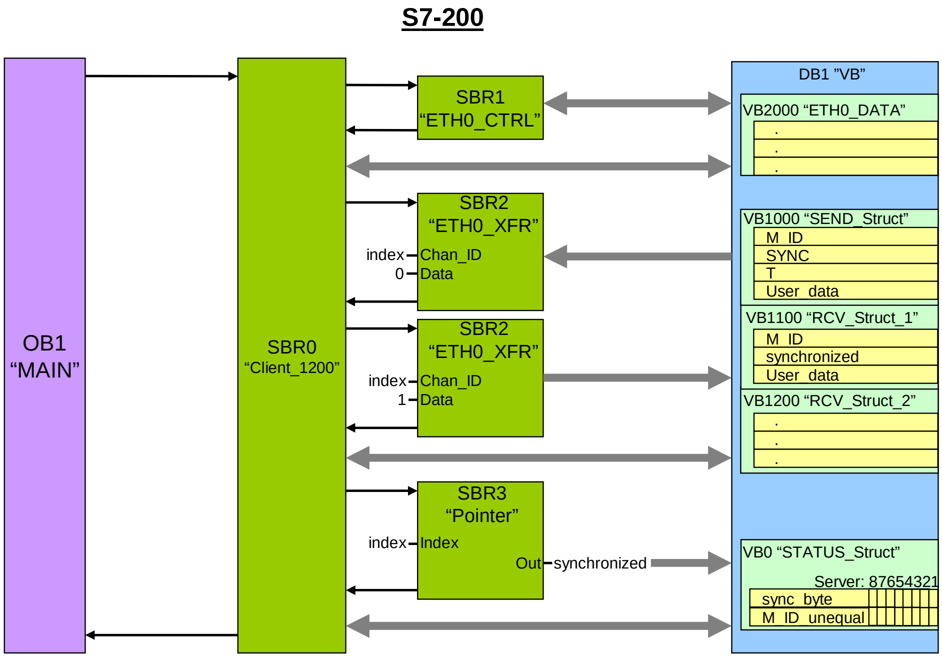
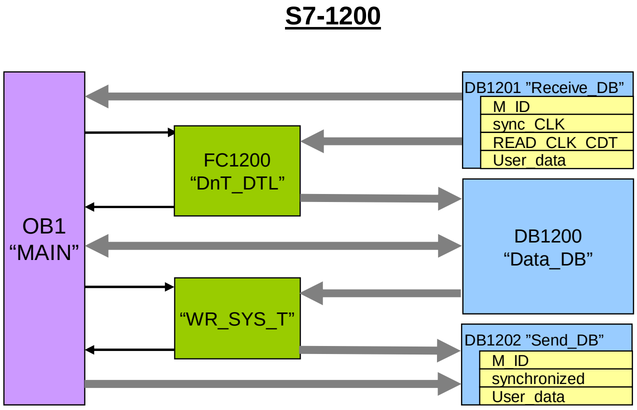


Figure 2-3



2.2.2 Description of the block structure

S7-200 has only one data block (“DB1”) which stores all the variables.

DB1 contains:

Table 2-1

Variable buffer area	Description
VB 0 – VB 23	Status and monitoring information
VB 1000 – VB 1099	Send data
VB 1100 – VB 1199	Receive data of server 1
VB 1200 – VB 1299	Receive data of server 2
VB 2000 – VB 2268	Configuration data of the Ethernet wizard

Amongst other things the status and monitoring information contain the synchronization byte “sync_byte”. Each bit of this byte contains the synchronization request for on of the maximal 8 servers to be synchronized.

OB1 cyclically calls the subprogram SBR0 “Client_1200”.
The control block “ETH0_CTRL” generated by the Ethernet wizard is called cyclically by the “Client_1200” and accesses the configuration data.

In the SBR0 “Client_1200” the system time “T” is read cyclically and compared with a synchronization time which is given daily. If it agrees the synchronization request bits of all servers are set. The clock synchronization can also be executed individually for each server via the status table.

Setting the synchronization request bit of the first S7-1200 server in the synchronization byte “sync_byte” causes setting the synchronization request “SYNC“ in the send data.

Sub-program ETH0_XFR causes the CP 243-1 to transfer the send data to the DB1201 “Receive_DB” of the first server (defined by the “index” variable) (“Data” = “1”).

Apart from the clock time synchronization information, “User_data” and a message ID “M_ID” are also transferred.

OB1 “MAIN” of the server calls the FC1200 “DnT_DTL” function for the synchronization request “sync_CLK”. It transforms the clock time of the S7-200 client “T” of “DATE_AND_TIME” type into data type “DTL”.
All variables are stored in DB1200 “Data_DB”.
The transformed time is written to the system time of the S7-1200 via the “WR_SYS_T” function. After successful clock synchronization the “synchronized” bit is set in the send DB1202 “Send_DB”.
The received message ID “M_ID” from DB1201 “Receive_DB” is mirrored to the send data block DB1202 “Send_DB”.

After the data has been transferred to the server using subprogram ETH0_XFR (“Data” = “1”) the content of send data block DB1202 “Send_DB” is called again by the first server using subprogram ETH0_XFR (“Data” = “0”) and written to the preconfigured receive buffer (represented as “RCV_STRUCT_1”) in the variable buffer VB1100 – VB1199.

Using the subprogram SBR3 “Pointer” and depending on the respective server (“index”) the received message ID “M_ID” is read from its receive data and compared with the sent data. Any deviation is stored in variable “M_ID_unequal”. In byte “M_ID_unequal” each bit corresponds to one of the maximal 8 servers equivalent to the synchronization byte.

After successful synchronization of server 1 (signaled by the “synchronized” variable) the synchronization request bit 0 (for server 1) is reset in synchronization byte “sync_byte”.

The message ID “M_ID” is increased and the data exchange with server 2 is handled in the same way.

2.3 Used blocks

The following tables give an overview of the used blocks on the client and server side.

2.3.1 S7-200 client

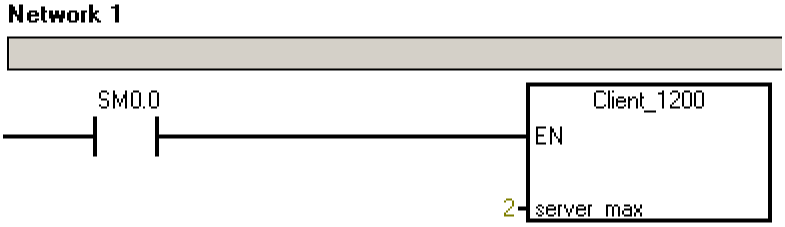
Table 2-2

Object name	Symbolic name	Description
OB1	MAIN	Cyclic organization block
SBR0	Client_1200	Subprogram for deterministic data exchange with several S7-1200 servers using the Ethernet wizard
SBR3	Pointer	Subprogram for value reading values of an integer via a pointer
SBR1	ETH0_CTRL	Control subprogram for the Ethernet CP on slot 0 (generated by the Ethernet wizard)
SBR2	ETH0_XFR	Ethernet wizard generated by the subprogram for sending data (parameter “Data” = “0”) or receiving data (“Data” = “1”)

Client_1200 (SBR0)

The subprogram for deterministic data exchange with several S7-1200 servers using the Ethernet wizard is called cyclically in OB1.

Figure 2-4



As the only input the maximal number of servers “server_max” must be specified. A maximum number of 8 connections per Ethernet CP can be configured with the Ethernet wizard.

The data exchange with the servers occurs sequentially depending on the “server” variable.

The following variables provide configuration options of the SBR0 “Client_1200” via the initial value in the data block or via the status table:

Table 2-3

Name	Data type	Description
hour	Int	Hour specification of the daily synchronization time (value range: 0 – 23)
minute	Int	Minute specification of the daily synchronization time (value range: 0 – 59)
Timeout	Int	Maximum wait time in 0.1s until the step chain in SBR0 is automatically switched further (default: 0.5 s)

Status information

The following variables provide status information of the maximal 8 connected S7-1200 servers. Each bit represents information of a server (Bit0 = Server1 … Bit7 = Server8).

Table 2-4

Name	Data type	Description
sync_byte	Byte	Clock synchronization request
Timeout_byte	Byte	Maximum processing time exceeded
M_ID_unequal	Byte	Sent and received M_ID unequal
Ch_Ready	Word	The 1st byte specifies the connected server.

2.3.2 S7-1200 server

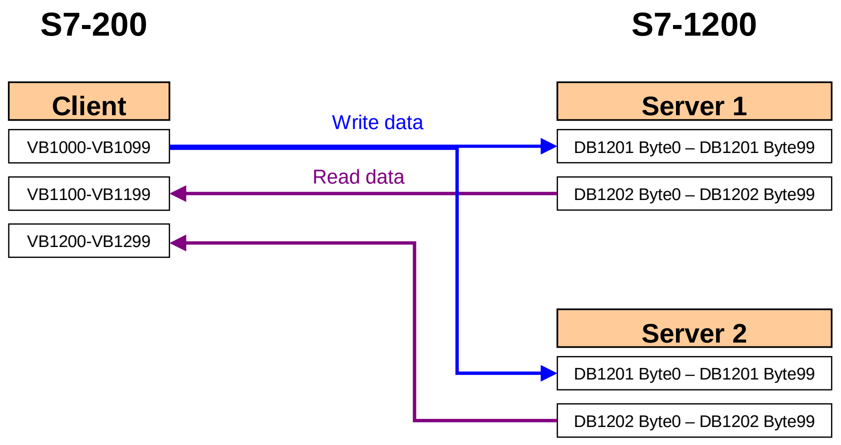
Table 2-5

Object name	Symbolic name	Description
OB1	Main	Cyclic organization block
FC1200	DnT_DTL	Function for converting data type "DATE_AND_TIME" into data type "DTL"
DB1200	Data_DB	Variable data block
DB1201	Receive_DB	Data block for received data from the client
DB1202	Send_DB	Data block for the send data to the client

2.3.3 Data consistency

Figure 2-5 illustrates the data exchange between client and both S7-1200 servers.

Figure 2-5


S7-200
S7-1200
Client
VB1000-VB1099
VB1100-VB1199
VB1200-VB1299
Write data
Read data
Server 1
DB1201 Byte0 – DB1201 Byte99
DB1202 Byte0 – DB1202 Byte99
Server 2
DB1201 Byte0 – DB1201 Byte99
DB1202 Byte0 – DB1202 Byte99

Client -> Server

The send area of the client and the receive block of the server must have the same length and structure. In the application example they consist of 100 bytes and have the following structure:

Table 2-6

Name	Data type	Description
M_ID	Int	Message ID
SYNC	Bool	Clock synchronization request
T	DATE_AND_TIME or array of 8 bytes	Synchronization time of the master (S7-200)
User_data	88 bytes	User data (S7-200 -> S7-1200)

Server -> Client

The client receive area for each server and the send block of the server must be identical. The receive areas and the send DB 1202 consist of 100 bytes and are structured as follows:

Table 2-7

Name	Data type	Description
M_ID	Int	Mirrored message ID for acknowledgement
synchronized	Bool	Clock synchronization acknowledgement
User_data	96 bytes	User data (S7-1200 -> S7-200)

The user data “User_data” can be changed individually. However, the data structure must be identical on the sending and receiving side.
Data consistency is on the program side guaranteed by the sequential processing of the send and receive jobs.

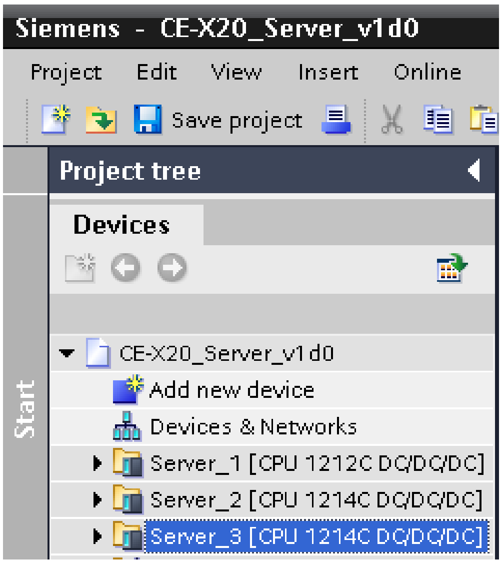
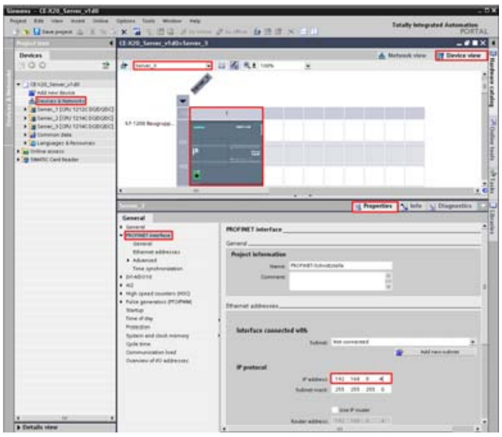
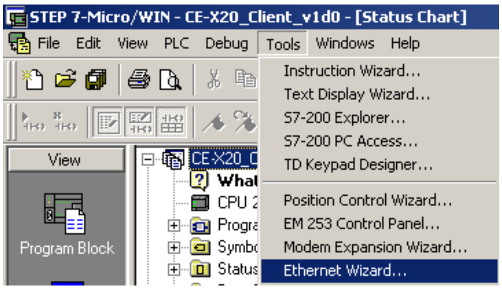
Due to the continued data exchange between client and servers the data consistency can only be provided for one cycle.
Consistent data must therefore be written into the send data blocks by the user within one cycle or be read from the receive data blocks.

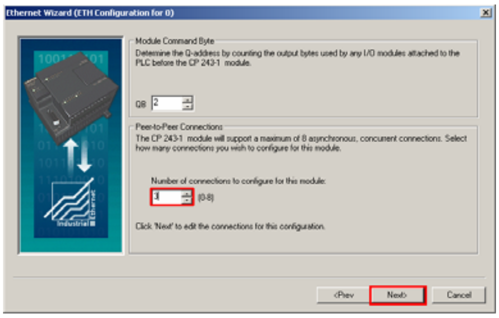
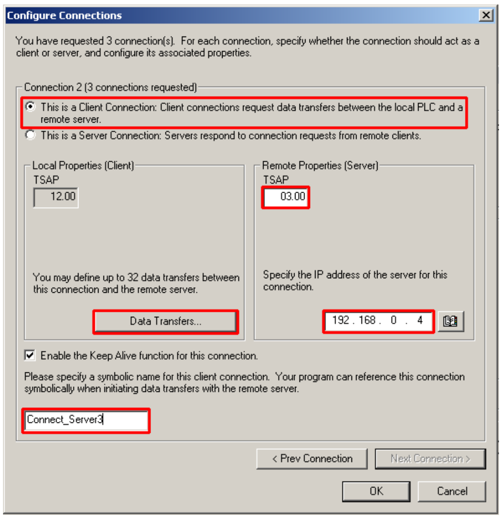
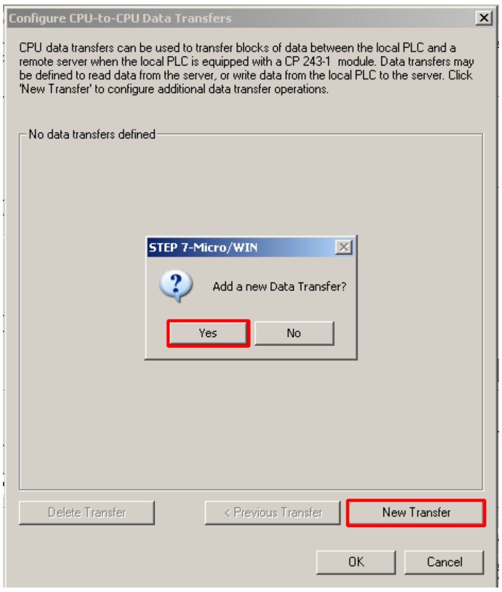
2.3.4 Expanding the server number

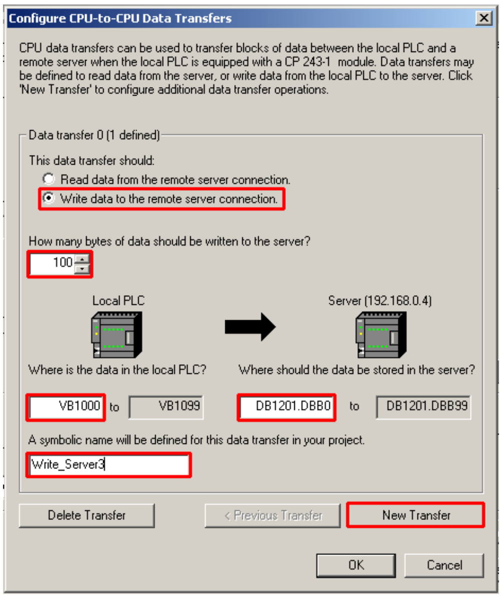
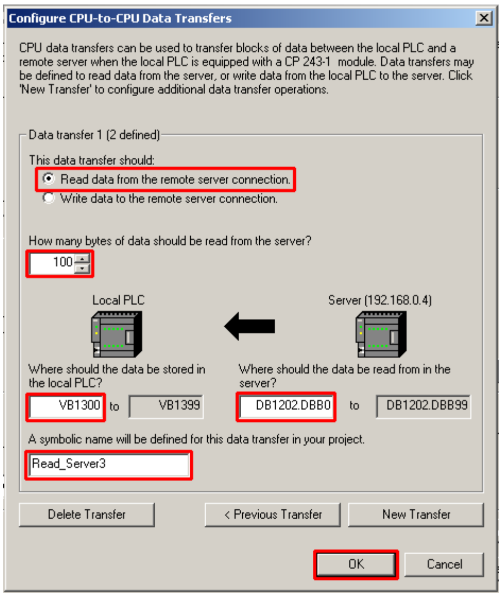
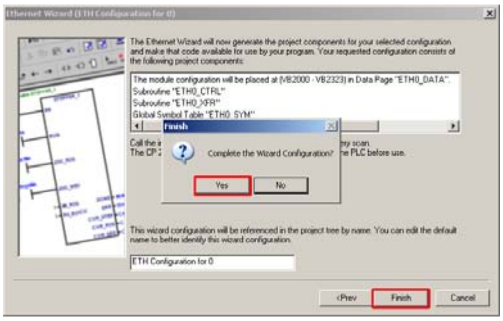
To adjust the client and the server project to an increased number of subordinate server controllers, please proceed as follows:

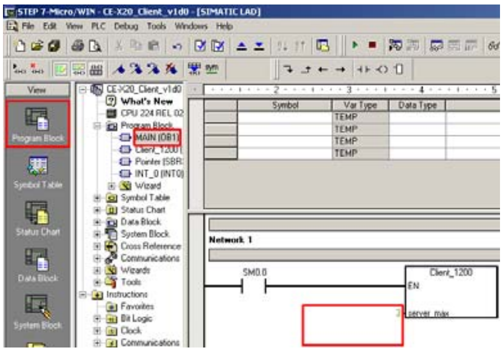
The expansion to three servers is illustrated.

Table 2-8

No.	Instruction	Note/picture
1.	• In the “CE-X20_Server_v1d0” project you duplicate one of both controller folders “Server_1” or “Server_2” via “Copy & Paste”.	 Siemens - CE-X20_Server_v1d0 Project Edit View Insert Online Save project Project tree Devices Start CE-X20_Server_v1d0 Add new device Devices & Networks Server_1 [CPU 1212C DC/DC/DC] Server_2 [CPU 1214C DC/DC/DC] Server_3 [CPU 1214C DC/DC/DC]
2.	• In the menu item “Devices & Networks” you open the device view for the newly created “Server_3”. • Mark the controller and open the settings of the “PROFINET interface” • Adjust the IP address to the newly created controller (here: “192.168.0.4“). • Here you also exchange the CPU from the hardware catalog (if necessary). • Finally, you load the newly created project part into server 3.	
3.	• In the STEP 7 MicroWIN project “CE-X20_Client.mwp” you open the Ethernet wizard via the menu “Extras → Ethernet wizard…”.	 STEP 7-Micro/WIN - CE-X20_Client_v1d0 - [Status Chart] File Edit View PLC Debug Tools Windows Help Instruction Wizard... Text Display Wizard... S7-200 Explorer... S7-200 PC Access... TD Keypad Designer... Position Control Wizard... EM 253 Control Panel... Modem Expansion Wizard... Ethernet Wizard... View Program Block CE-X20_C What CPU 2 Progra Symbo Status
4.	• Press the “Next >” button four times until you get to the configuration of the “Peer-to-Peer Connections”.	

No.	Instruction	Note/picture
5.	• Change the “Number of connections to configure for this module” to “3”. • Apply the settings with “Next”.	 Ethernet Wizard (ETH Configuration for 0) Module Command Byte Determine the Q-address by counting the output bytes used by any I/O modules attached to the PLC before the CP 243-1 module. QB 2 Peer-to-Peer Connections The CP 243-1 module will support a maximum of 8 asynchronous, concurrent connections. Select how many connections you wish to configure for this module. Number of connections to configure for this module: 3 (0-8) Click 'Next' to edit the connections for this configuration. <Prev Next> Cancel
6.	• Press the “Next Connection >” button twice until you get to the configuration of “Connection 2”.	
7.	• Select the S7 connection as a client connection. • Enter “03.00” for the S7-1200 as remote TSAP. • As remote parameter you enter the IP address of the newly added server (“192.168.0.4” -> see step 2). • Assign a specific symbolic name for the connection (“Connect_Server3”). • Then press the “Data Transfer...” button.	 Configure Connections You have requested 3 connection(s). For each connection, specify whether the connection should act as a client or server, and configure its associated properties. Connection 2 (3 connections requested) ● This is a Client Connection: Client connections request data transfers between the local PLC and a remote server. ○ This is a Server Connection: Servers respond to connection requests from remote clients. Local Properties (Client) TSAP 12.00 You may define up to 32 data transfers between this connection and the remote server. Data Transfers... Remote Properties (Server) TSAP 03.00 Specify the IP address of the server for this connection. 192 . 168 . 0 . 4 ☑ Enable the Keep Alive function for this connection. Please specify a symbolic name for this client connection. Your program can reference this connection symbolically when initiating data transfers with the remote server. Connect_Server3 < Prev Connection Next Connection > OK Cancel
8.	• Press the “New Transfer” button. • Confirm the addition of the new data transfer with “Yes”.	 Configure CPU-to-CPU Data Transfers CPU data transfers can be used to transfer blocks of data between the local PLC and a remote server when the local PLC is equipped with a CP 243-1 module. Data transfers may be defined to read data from the server, or write data from the local PLC to the server. Click 'New Transfer' to configure additional data transfer operations. No data transfers defined STEP 7-Micro/WIN Add a new Data Transfer? Yes No Delete Transfer < Previous Transfer New Transfer OK Cancel

No.	Instruction	Note/picture
9.	Create the data transmission to server 3 according to the transmissions to the other two servers: • Select the function “This data transfer should: Write data to the remote server connection.” • Please enter the number and start addresses of the data: - 100 data bytes - Local: VB1000 - Server: DB1201.DBB0 • Assign a symbolic name for the data transmission (“Write_Server3”). • Press the “New Transfer...” button to read data from server 3. • Confirm the addition of the new data transfer with “Yes”.	 Configure CPU-to-CPU Data Transfers CPU data transfers can be used to transfer blocks of data between the local PLC and a remote server when the local PLC is equipped with a CP 243-1 module. Data transfers may be defined to read data from the server, or write data from the local PLC to the server. Click 'New Transfer' to configure additional data transfer operations. Data transfer 0 (1 defined) This data transfer should: ○ Read data from the remote server connection. ● Write data to the remote server connection. How many bytes of data should be written to the server? 100 Local PLC → Server (192.168.0.4) Where is the data in the local PLC? VB1000 to VB1099 Where should the data be stored in the server? DB1201.DBB0 to DB1201.DBB99 A symbolic name will be defined for this data transfer in your project. Write_Server3 Delete Transfer · < Previous Transfer · New Transfer · OK · Cancel
10.	• Select the function “This data transfer should: Read data from the remote server connection.” • Please enter the number and start addresses of the data: - 100 data bytes - Local: VB1300 - Server: DB1202.DBB0 • Assign a symbolic name for the data transmission (“Read_Server3”). • Click “OK” twice to accept the configured data transfer.	 Configure CPU-to-CPU Data Transfers CPU data transfers can be used to transfer blocks of data between the local PLC and a remote server when the local PLC is equipped with a CP 243-1 module. Data transfers may be defined to read data from the server, or write data from the local PLC to the server. Click 'New Transfer' to configure additional data transfer operations. Data transfer 1 (2 defined) This data transfer should: ● Read data from the remote server connection. ○ Write data to the remote server connection. How many bytes of data should be read from the server? 100 Local PLC ← Server (192.168.0.4) Where should the data be stored in the local PLC? VB1300 to VB1399 Where should the data be read from in the server? DB1202.DBB0 to DB1202.DBB99 A symbolic name will be defined for this data transfer in your project. Read_Server3 Delete Transfer · < Previous Transfer · New Transfer · OK · Cancel
11.	• Pres the “Next>” button twice.	
12.	• Press the “Finish” button and confirm the termination of the Ethernet wizard with “Yes”.	 Ethernet Wizard (ETH Configuration for 0) The Ethernet Wizard will now generate the project components for your selected configuration and make that code available for use by your program. Your requested configuration consists of the following project components: The module configuration will be placed at (VB2000 - VB2323) in Data Page "ETH0_DATA". Subroutine "ETH0_CTRL" Subroutine "ETH0_XFR" Global Symbol Table "ETH0_SYM" Finish Complete the Wizard Configuration? Yes · No This wizard configuration will be referenced in the project tree by name. You can edit the default name to better identify this wizard configuration. ETH Configuration for 0 <Prev · Finish · Cancel

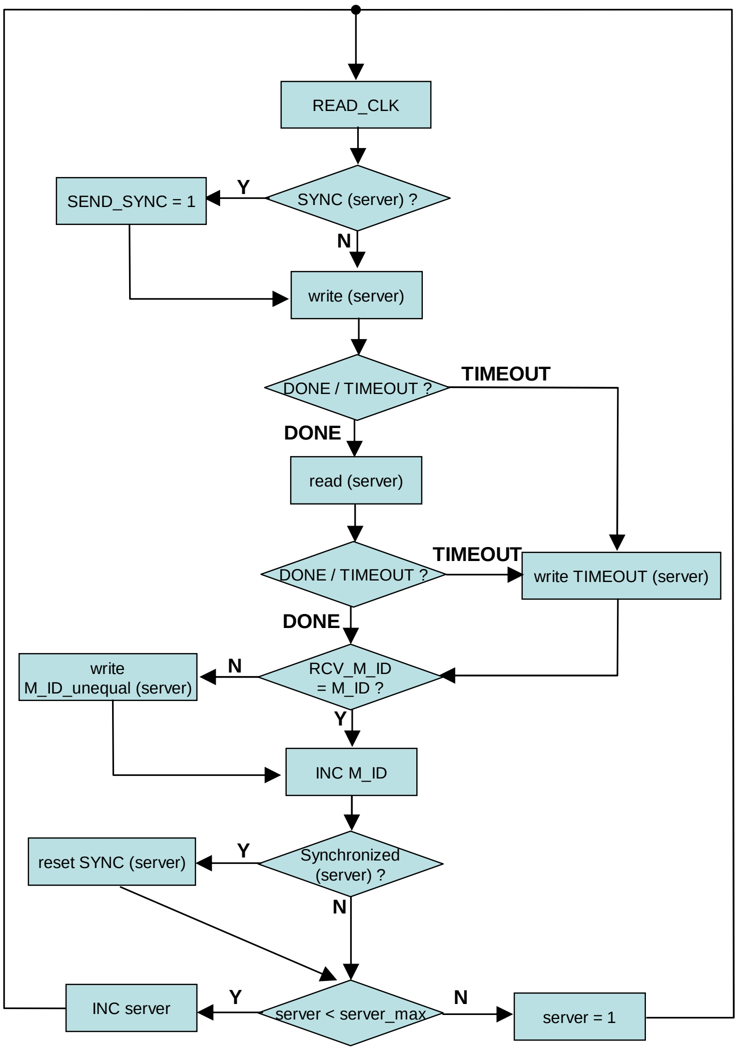
No.	Instruction	Note/picture
13.	- Open OB1 “MAIN” and change the “server_max” input of subprogram “Client_1200” to “3” connected servers. - Then load the changed client project into the S7-200.	 STEP 7-Micro/WIN - CE-X20_Client_v1d0 - [SIMATIC LAD] File Edit View PLC Debug Tools Windows Help View Program Block Symbol Table Status Chart Data Block System Block CE-X20_Client_v1d0 What's New CPU 224 REL 02 Program Block MAIN (OB1) Client_1200 Pointer (SBR INT_0 (INT0) Wizard Symbol Table Status Chart Data Block System Block Cross Reference Communications Wizards Tools Instructions Favorites Bit Logic Clock Communications Symbol Var Type Data Type TEMP TEMP TEMP TEMP Network 1 SM0.0 Client_1200 EN 3 server_max

2.4 Program sequence in the client

Flow chart

The following flowchart illustrates the program sequence on the client side. The functionality is bundled in the SBR0 “Client_1200”, which is called cyclically by OB1. SBR0 is realized as a step chain.

Figure 2-6



Description of the flow chart

The system time is read cyclically ("READ_CLK") and written to the send data block.

Depending on the server ("server" variable) the synchronization request "SYNC" is read from the synchronization byte "sync_byte".

For a synchronization request it is transferred to the send data (SEND_SYNC = 1).

The content of the send data area is transferred to the server ("server") using the subprogram "ETH0_XFR" (parameter "Data" = 1). Apart from the clock time synchronization information, a message ID "M_ID" is also transferred.

If the "server" cannot be reached the maximal processing time "Timeout" elapses and the reception is jumped by the server.
For a positive feedback of the send job data is also read from the server ("server") via the subprogram "ETH0_XFR" (parameter "Data" = 0). The maximal processing time "Timeout" is also checked here. An exceeded "Timeout" time is also stored in the bit for the respective server in the "Timeout_byte".

From the receive data the message ID "M_ID" mirrored by the server is compared with the sent "M_ID". Any deviation is marked in the bit of the server in the "M_ID_unequal" byte.

The message ID is increased ("INC M_ID").

The successful synchronization is read and checked ("synchronized") from the receive data of the server using the subprogram "Pointer". In the positive case the synchronization request bit "SYNC" is reset for the respective server in the "sync_byte". Otherwise, the clock synchronization is repeated at the next communication with this server.

The server number "server" is compared with the maximum server number "server_max". As long as "server_max" has not been reached, the server number is increased ("INC server"). Otherwise, the data exchange with the first server is repeated ("server = 1").

3 Configuration

3.1 Hardware and software installation

3.1.1 Installing and wiring the hardware

Table 3-1

No.	Instruction	Note/picture
1.	Mount the S7-200 and S7-1200 modules on the standard top-hat rails.	
2.	Connect the controller and your programming device with the CSM 1277 switch via RJ45 Ethernet cable.	See chapter “Connection diagram”
3.	Connect all ground connections to earth.	See chapter “Connection diagram”
4.	Additionally, connect the programming device with CPU 224 via the USB/PPI multi-master cable.	See chapter “Connection diagram”
5.	Supply power to the controller.	See chapter “Connection diagram”

3.1.2 Software installation

Table 3-2

No.	Instruction	Note/picture
1.	Install STEP 7 Basic V10.5 on your programming device.	See Table 1-2
2.	Install Service Pack 2 for STEP 7 Basic V10.5 on your programming device.	See Table 1-2
3.	Install STEP 7 Micro/WIN on your programming device.	See Table 1-2
4.	Install Service Pack 7 for STEP 7 Micro/WIN on your programming device.	See Table 1-2

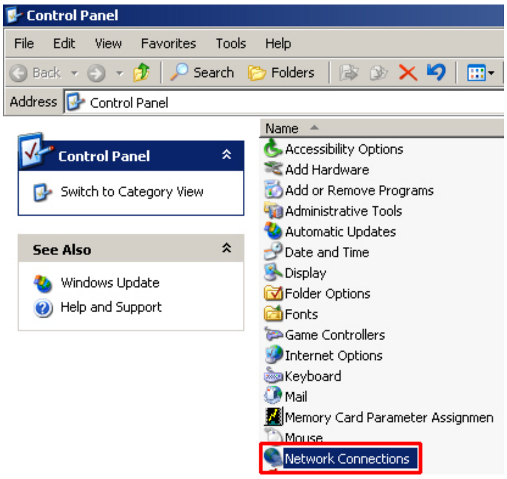
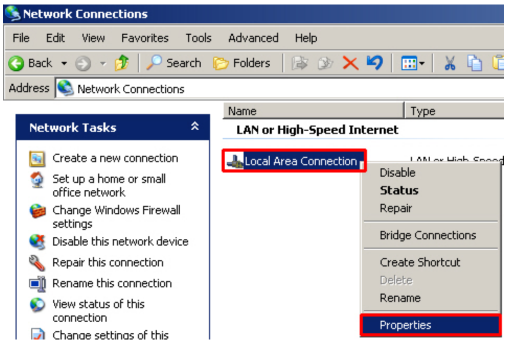
3.2 Hardware and network configuration

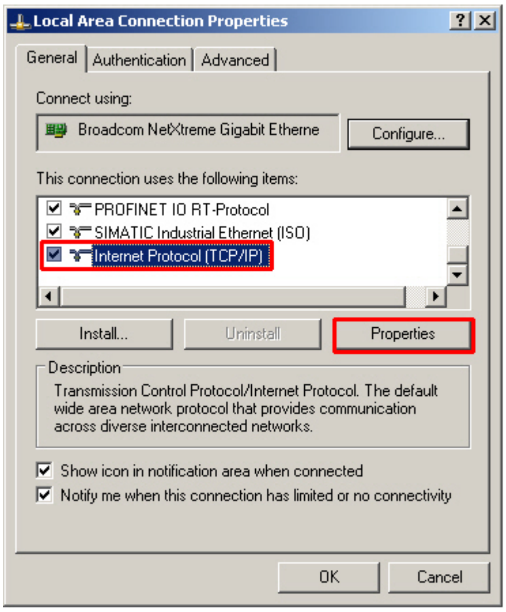
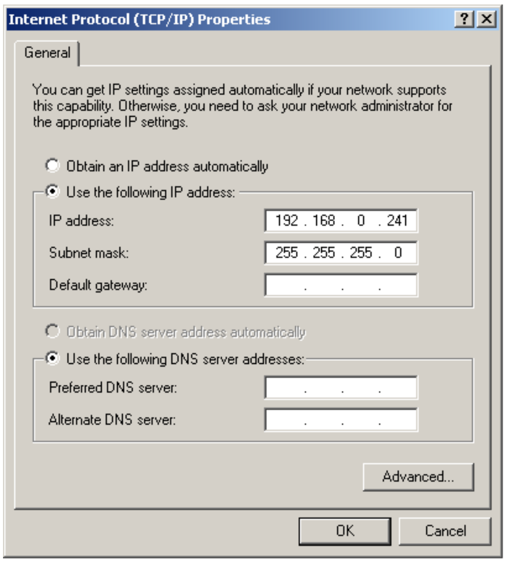
3.2.1 Assigning the IP address of the PG/PC

Your PG/PC must have an IP address assigned to it in the same subnet as the controllers. The IP addresses of the individual nodes are displayed in Figure 1-2.

In order to assign the IP address for your network card in the Windows XP operating system please proceed as follows:

Table 3-3

No.	Instruction	Note/picture
1.	Select the “Network Connections” option in the Control Panel.	
2.	Select the network card to be used and open the properties via right-click.	

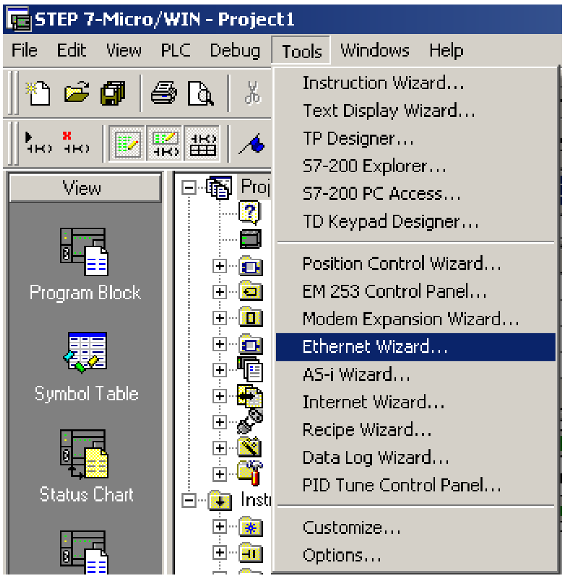
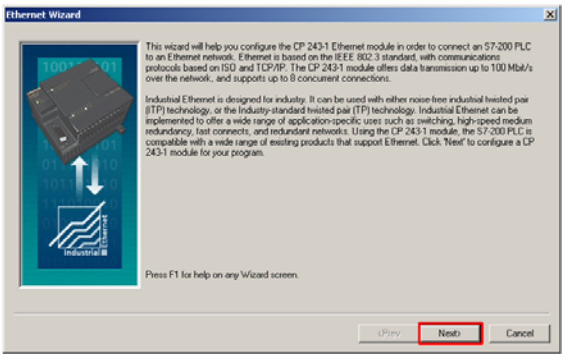
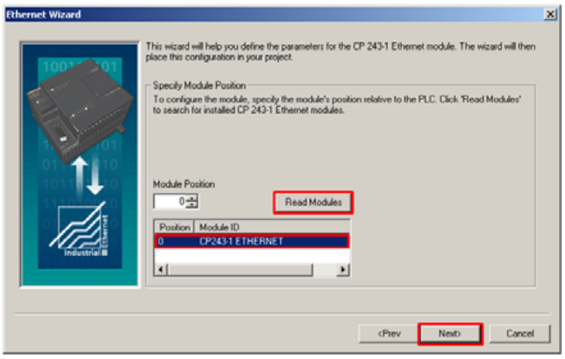
No.	Instruction	Note/picture
3.	Select the element “Internet Protocol (TCP/IP)” and open its properties.	 Local Area Connection Properties General | Authentication | Advanced Connect using: Broadcom NetXtreme Gigabit Etherne — Configure... This connection uses the following items: ☑ PROFINET IO RT-Protocol ☑ SIMATIC Industrial Ethernet (ISO) ☑ Internet Protocol (TCP/IP) Install... — Uninstall — Properties Description Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks. ☑ Show icon in notification area when connected ☑ Notify me when this connection has limited or no connectivity OK — Cancel
4.	- Select “Use the following IP address” - Enter “192.168.0.241” as an IP address (see Figure 1-2). - Enter “255.255.255.0” as the subnet mask. - Click on “OK” to confirm the settings.	 Internet Protocol (TCP/IP) Properties General You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings. ○ Obtain an IP address automatically ● Use the following IP address: IP address: 192 . 168 . 0 . 241 Subnet mask: 255 . 255 . 255 . 0 Default gateway: . . . ○ Obtain DNS server address automatically ● Use the following DNS server addresses: Preferred DNS server: . . . Alternate DNS server: . . . Advanced... OK — Cancel

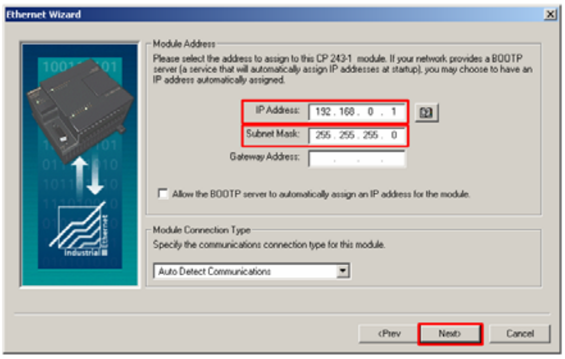
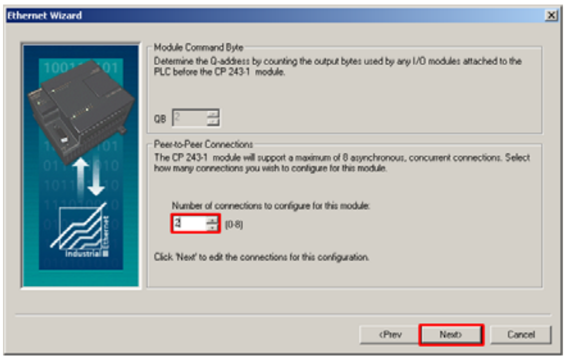
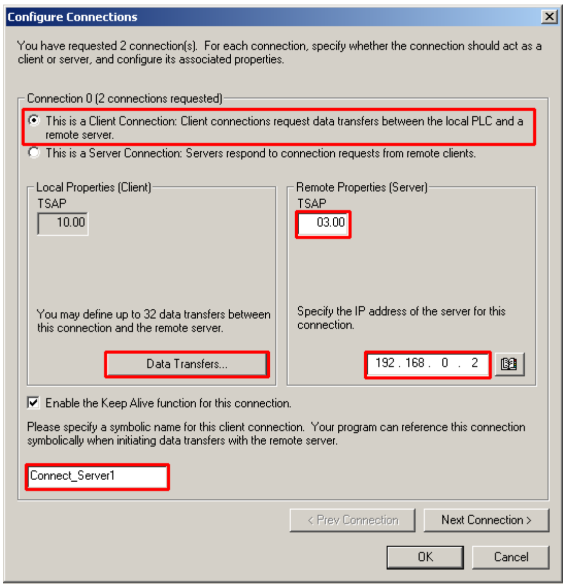
3.2.2 Configuration of the client

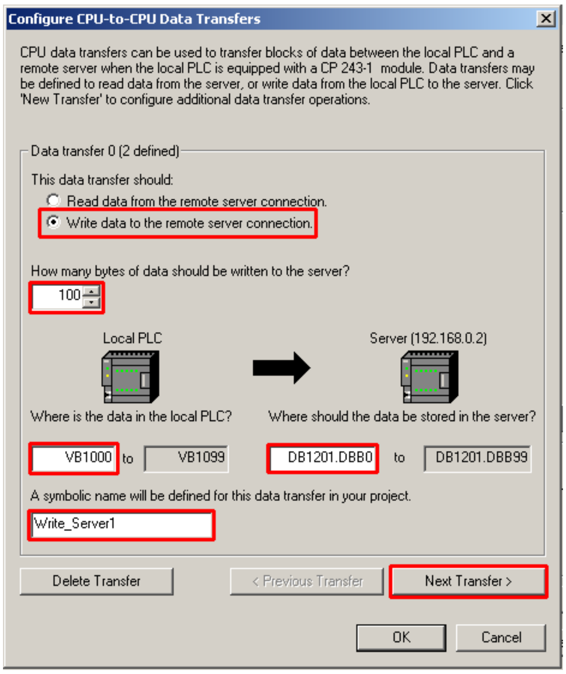
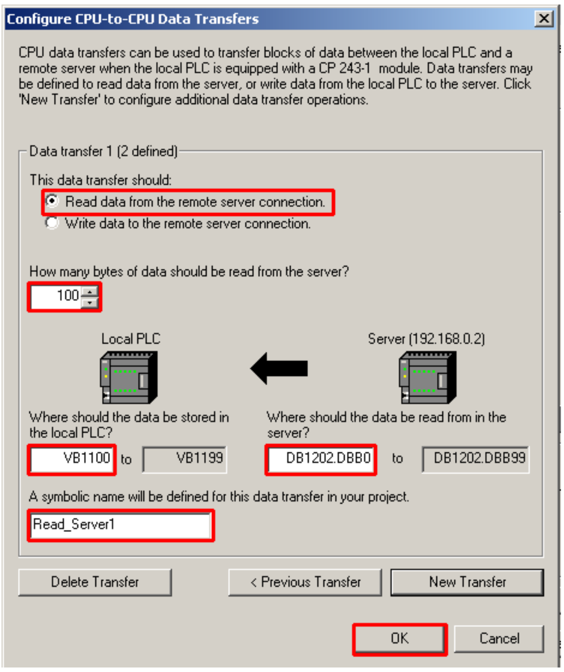
Establishing a connection

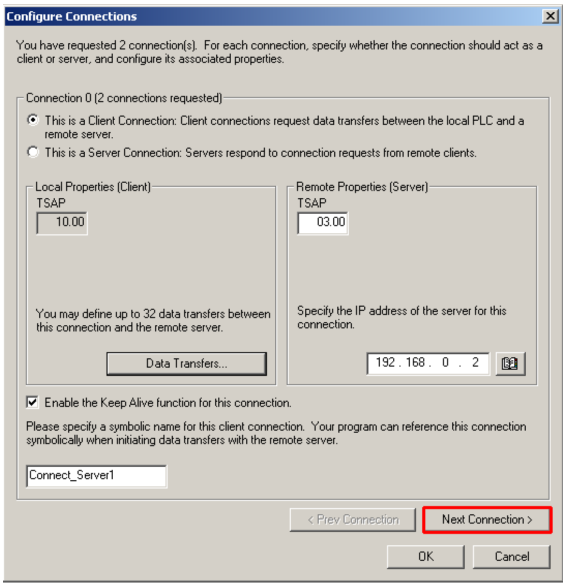
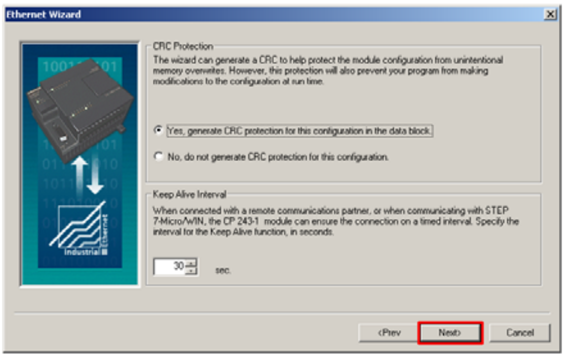
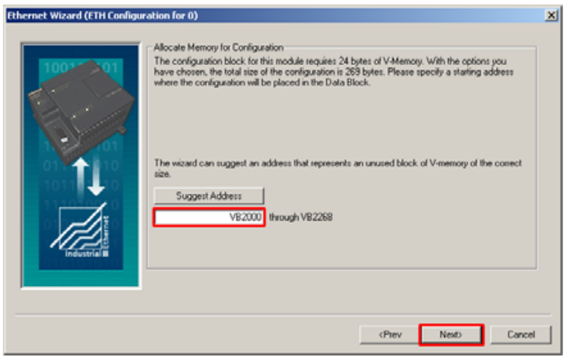
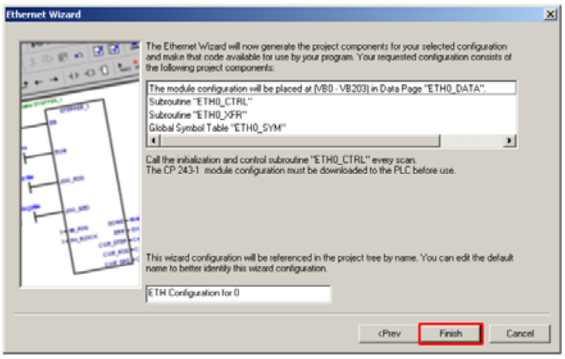
Configuring the connection, defining the send and receive side occurs unilaterally for the S7-200. STEP 7 Micro/WIN provides the Ethernet wizard for this. Using the Ethernet wizard the Ethernet-CP 243-1 is configured at the same time. The Ethernet wizard has been preconfigured according to the following procedure.

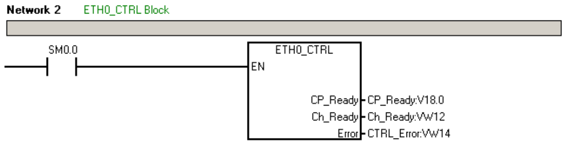
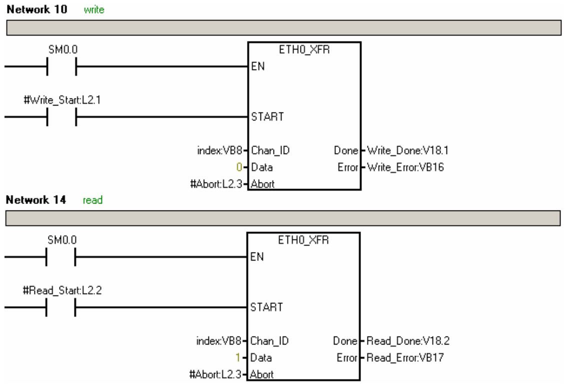
Table 3-4

No.	Instruction	Note/picture
1.	• In STEP 7 MicroWIN you open the Ethernet wizard via the menu “Extras → Ethernet wizard…”.	 STEP 7-Micro/WIN - Project1 File Edit View PLC Debug Tools Windows Help Instruction Wizard... Text Display Wizard... TP Designer... S7-200 Explorer... S7-200 PC Access... TD Keypad Designer... Position Control Wizard... EM 253 Control Panel... Modem Expansion Wizard... Ethernet Wizard... AS-i Wizard... Internet Wizard... Recipe Wizard... Data Log Wizard... PID Tune Control Panel... Customize... Options... View Program Block Symbol Table Status Chart Proj Insti
2.	In the first step of the Ethernet wizard you find a description of the Ethernet wizard. • Click the “Next” button to start with the configuration.	 This wizard will help you configure the CP 243-1 Ethernet module in order to connect an S7-200 PLC to an Ethernet network. Ethernet is based on the IEEE 802.3 standard, with communications protocols based on ISO and TCP/IP. The CP 243-1 module offers data transmission up to 100 Mbit/s over the network., and supports up to 8 concurrent connections. Industrial Ethernet is designed for industry. It can be used with either noise-free industrial twisted pair (ITP) technology, or the Industry-standard twisted pair (TP) technology. Industrial Ethernet can be implemented to offer a wide range of application-specific uses such as switching, high-speed medium redundancy, fast connects, and redundant networks. Using the CP 243-1 module, the S7-200 PLC is compatible with a wide range of existing products that support Ethernet. Click 'Next' to configure a CP 243-1 module for your program. Press F1 for help on any Wizard screen.
3.	• With the selected USB/PPI cable you can now automatically have the module position of the CP243-1 determined via the “Read Modules” button. However, you can also enter the module position manually. • Then you click the “Next” button.	 This wizard will help you define the parameters for the CP 243-1 Ethernet module. The wizard will then place this configuration in your project. Specify Module Position To configure the module, specify the module's position relative to the PLC. Click 'Read Modules' to search for installed CP 243-1 Ethernet modules. Module Position: 0 Position: 0 — Module ID: CP243-1 ETHERNET

No.	Instruction	Note/picture
4.	• Assign a unique IP address to the CP243-1 (see Figure 1-2). • Depending on the assigned IP of the communication nodes you enter appropriate subnet mask (here: “255.255.255.0” for a class C network). • Apply the settings with “Next”.	 Ethernet Wizard Module Address Please select the address to assign to this CP 243-1 module. If your network provides a BOOTP server (a service that will automatically assign IP addresses at startup), you may choose to have an IP address automatically assigned. IP Address: 192 . 168 . 0 . 1 Subnet Mask: 255 . 255 . 255 . 0 Gateway Address: . . . ☐ Allow the BOOTP server to automatically assign an IP address for the module. Module Connection Type Specify the communications connection type for this module. Auto Detect Communications
5.	• In the following dialog you enter the number of S7 connections to be configured for the CP243-1 (here: “2”). Via an S7 connection data can be read from the communication partner or be written to the communication partner. • Click on the “Next” button to continue with the configuration of the S7 connection.	 Ethernet Wizard Module Command Byte Determine the Q-address by counting the output bytes used by any I/O modules attached to the PLC before the CP 243-1 module. QB 2 Peer-to-Peer Connections The CP 243-1 module will support a maximum of 8 asynchronous, concurrent connections. Select how many connections you wish to configure for this module. Number of connections to configure for this module: 2 (0-8) Click 'Next' to edit the connections for this configuration.
6.	• In this example the S7 connection is configured as client connection. • As remote parameter you enter the IP address of the first server (“192.168.0.2” -> see Figure 1-2). • Enter “03.00” for the S7-1200 as remote TSAP. The TSAP is composed as follows: - 03 – unilateral connection - 00 – slot of the CPU in the S7-1200 (always “0”) • Assign a specific symbolic name for the connection (“Connect_Server1”). • Then press the “Data Transfer...” button.	 Configure Connections You have requested 2 connection(s). For each connection, specify whether the connection should act as a client or server, and configure its associated properties. Connection 0 (2 connections requested) ● This is a Client Connection: Client connections request data transfers between the local PLC and a remote server. ○ This is a Server Connection: Servers respond to connection requests from remote clients. Local Properties (Client) TSAP 10.00 You may define up to 32 data transfers between this connection and the remote server. Remote Properties (Server) TSAP 03.00 Specify the IP address of the server for this connection. 192 . 168 . 0 . 2 ☑ Enable the Keep Alive function for this connection. Please specify a symbolic name for this client connection. Your program can reference this connection symbolically when initiating data transfers with the remote server. Connect_Server1

No.	Instruction	Note/picture
7.	• To transfer data to the first server select the function “This data transfer should: Write data to the remote server connection.” • Specify the volume of data to be written to the server. In this example 100 bytes of data (variables bytes 1000-1099) are send by the S7-200. The data is stored in DB1201 (byte 0-99) of the S7-1200 (see Figure 2-5). • Assign a symbolic name for the data transmission (“Read_Server1”). • Assign the “New Transfer...” button to read data from the S7-1200.	 Configure CPU-to-CPU Data Transfers CPU data transfers can be used to transfer blocks of data between the local PLC and a remote server when the local PLC is equipped with a CP 243-1 module. Data transfers may be defined to read data from the server, or write data from the local PLC to the server. Click 'New Transfer' to configure additional data transfer operations. Data transfer 0 (2 defined) This data transfer should: ○ Read data from the remote server connection. ● Write data to the remote server connection. How many bytes of data should be written to the server? 100 Local PLC Server (192.168.0.2) Where is the data in the local PLC? VB1000 to VB1099 Where should the data be stored in the server? DB1201.DBB0 to DB1201.DBB99 A symbolic name will be defined for this data transfer in your project. Write_Server1 Delete Transfer < Previous Transfer Next Transfer > OK Cancel
8.	• To read data from the S7-1200 select the function “This data transfer should: Read data from the remote server connection.” • Specify the volume of data to be read from the server. In this example 100 bytes of data (byte 0 to 99) are read from the DB1202 of the first server. The data is stored in variable buffer VB1100 to VB1199 of the S7-200 (see Figure 2-5). • Assign a symbolic name for the data transmission (“Read_Server1”). • Click “OK” to accept the configured data transfer.	 Configure CPU-to-CPU Data Transfers CPU data transfers can be used to transfer blocks of data between the local PLC and a remote server when the local PLC is equipped with a CP 243-1 module. Data transfers may be defined to read data from the server, or write data from the local PLC to the server. Click 'New Transfer' to configure additional data transfer operations. Data transfer 1 (2 defined) This data transfer should: ● Read data from the remote server connection. ○ Write data to the remote server connection. How many bytes of data should be read from the server? 100 Local PLC Server (192.168.0.2) Where should the data be stored in the local PLC? VB1100 to VB1199 Where should the data be read from in the server? DB1202.DBB0 to DB1202.DBB99 A symbolic name will be defined for this data transfer in your project. Read_Server1 Delete Transfer < Previous Transfer New Transfer OK Cancel

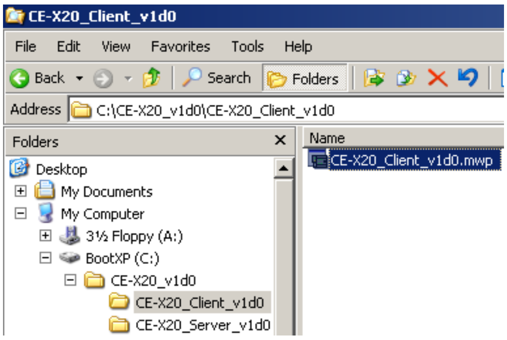
No.	Instruction	Note/picture
9.	- Press “Next Connection >” and repeat step 7 to 10 for the data exchange with server 2. - Use the template from Figure 1-2 and Figure 2-5. - Terminate the connection configuration via the “OK” button.	 Configure Connections You have requested 2 connection(s). For each connection, specify whether the connection should act as a client or server, and configure its associated properties. Connection 0 (2 connections requested) ● This is a Client Connection: Client connections request data transfers between the local PLC and a remote server. ○ This is a Server Connection: Servers respond to connection requests from remote clients. Local Properties (Client) TSAP 10.00 You may define up to 32 data transfers between this connection and the remote server. Data Transfers... Remote Properties (Server) TSAP 03.00 Specify the IP address of the server for this connection. 192 . 168 . 0 . 2 ☑ Enable the Keep Alive function for this connection. Please specify a symbolic name for this client connection. Your program can reference this connection symbolically when initiating data transfers with the remote server. Connect_Server1 < Prev Connection · Next Connection > OK · Cancel
10.	- Activate the “CRC protection” against unintended overwriting of the configuration. - Adopt the preset time of the Keep Alive Interval of 30 seconds. - Click the "Next" button.	 Ethernet Wizard CRC Protection The wizard can generate a CRC to help protect the module configuration from unintentional memory overwrites. However, this protection will also prevent your program from making modifications to the configuration at run time. ● Yes, generate CRC protection for this configuration in the data block. ○ No, do not generate CRC protection for this configuration. Keep Alive Interval When connected with a remote communications partner, or when communicating with STEP 7-Micro/WIN, the CP 243-1 module can ensure the connection on a timed interval. Specify the interval for the Keep Alive function, in seconds. 30 sec. <Prev · Next> · Cancel
11.	- Select a free address area for storing the configuration.	 Ethernet Wizard (ETH Configuration for 0) Allocate Memory for Configuration The configuration block for this module requires 24 bytes of V-Memory. With the options you have chosen, the total size of the configuration is 269 bytes. Please specify a starting address where the configuration will be placed in the Data Block. The wizard can suggest an address that represents an unused block of V-memory of the correct size. Suggest Address VB2000 through VB2268 <Prev · Next> · Cancel
12.	- Terminate the Ethernet wizard by pressing the “Finish” button. This creates the required function blocks for the configuration of the CP 243-1 (ETHx_CTRL) and for reading or writing of data (ETHx_XFR).	 Ethernet Wizard The Ethernet Wizard will now generate the project components for your selected configuration and make that code available for use by your program. Your requested configuration consists of the following project components: The module configuration will be placed at (VB0 - VB203) in Data Page "ETH0_DATA". Subroutine "ETH0_CTRL" Subroutine "ETH0_XFR" Global Symbol Table "ETH0_SYM" Call the initialization and control subroutine "ETH0_CTRL" every scan. The CP 243-1 module configuration must be downloaded to the PLC before use. This wizard configuration will be referenced in the project tree by name. You can edit the default name to better identify this wizard configuration. ETH Configuration for 0 <Prev · Finish · Cancel

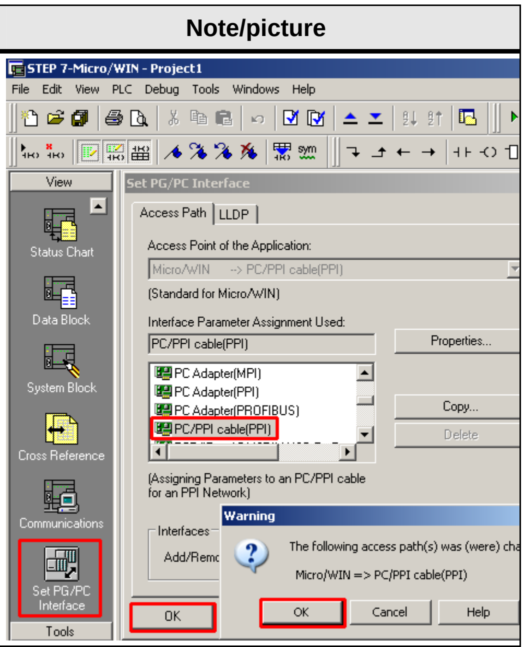
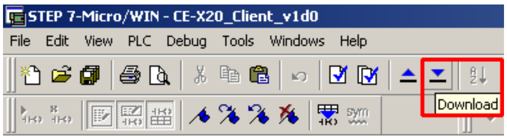
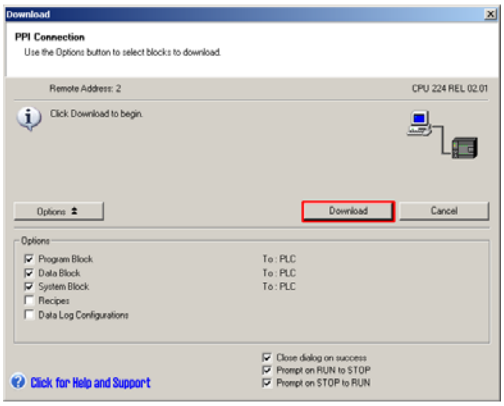
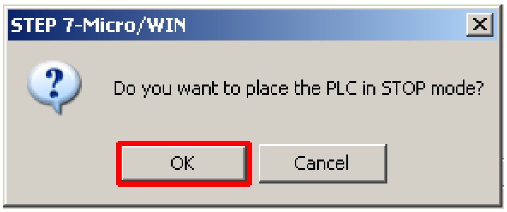
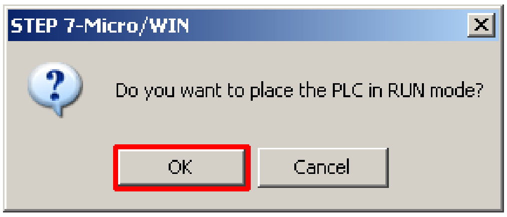
No.	Instruction	Note/picture
13.	• The control block ETH0_CTRL must be called cyclically (in the example in SBR0 "Client_1200" in network 2).	 Network 2 ETH0_CTRL Block SM0.0 ETH0_CTRL EN CP_Ready CP_Ready:V18.0 Ch_Ready Ch_Ready:VW12 Error CTRL_Error:VW14
14.	• Function block ETH0_XFR is called for any data direction in SBR0 "Client_1200" (input "Data" = "0" for writing and "Data" = "1" for reading from the communication node.	 Network 10 write SM0.0 ETH0_XFR EN #Write_Start:L2.1 START index:VB8 Chan_ID 0 Data #Abort:L2.3 Abort Done Write_Done:V18.1 Error Write_Error:VB16 Network 14 read SM0.0 ETH0_XFR EN #Read_Start:L2.2 START index:VB8 Chan_ID 1 Data #Abort:L2.3 Abort Done Read_Done:V18.2 Error Read_Error:VB17

Load client project to the S7-200

Unzip the example program "CE-X20_Client_v1d0.zip" into any directory on your hard drive.

Table 3-5

No.	Instruction	Note/picture
1.	• In the Windows Explorer you navigate to the S7-200 project "CE-X20_Client_v1d0.mwp" and open it via double-click.	 CE-X20_Client_v1d0 File Edit View Favorites Tools Help Back Search Folders Address C:\CE-X20_v1d0\CE-X20_Client_v1d0 Folders Desktop My Documents My Computer 3½ Floppy (A:) BootXP (C:) CE-X20_v1d0 CE-X20_Client_v1d0 CE-X20_Server_v1d0 Name CE-X20_Client_v1d0.mwp

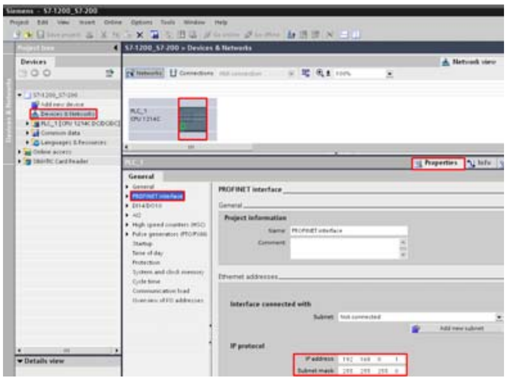
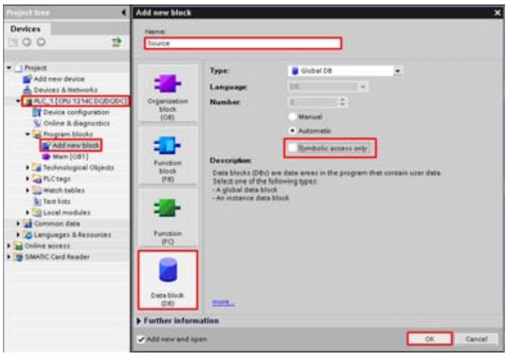
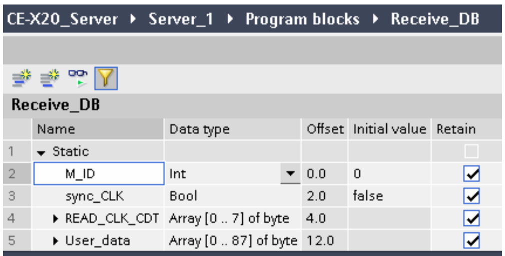
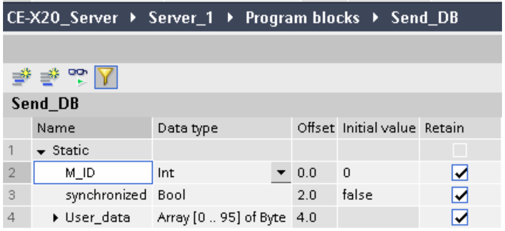
No.	Instruction	Note/picture
2.	If the configured IP address as well as the subnet mask of the CP 243-1 are not known, you require an additional communication path to CPU 224 in order to configure the CP 243-1. • Connect your programming device with CPU 224 via the USB/PPI cable. • In STEP 7 Micro/WIN you open the “Set PG/PC Interface” view. • Select the used interface configuration “PC/PPI cable(PPI)” as access path. • Confirm your selection with “OK”.	 STEP 7-Micro/WIN - Project1 Set PG/PC Interface Access Point of the Application: Micro/WIN --> PC/PPI cable(PPI) (Standard for Micro/WIN) Interface Parameter Assignment Used: PC/PPI cable(PPI) PC Adapter(MPI) PC Adapter(PPI) PC Adapter(PROFIBUS) PC/PPI cable(PPI) (Assigning Parameters to an PC/PPI cable for an PPI Network) Warning The following access path(s) was (were) cha Micro/WIN => PC/PPI cable(PPI)
3.	• Load the project into the S7-200 via the “Download to CPU” button.	 STEP 7-Micro/WIN - CE-X20_Client_v1d0 Download
4.	• Select the transfer options: - Program block - Data block - System block • Press the “Download” button to start the download.	 Download PPI Connection Use the Options button to select blocks to download. Remote Address: 2 CPU 224 REL 02.01 Click Download to begin. Options ☑ Program Block To : PLC ☑ Data Block To : PLC ☑ System Block To : PLC ☐ Recipes ☐ Data Log Configurations ☑ Close dialog on success ☑ Prompt on RUN to STOP ☑ Prompt on STOP to RUN Click for Help and Support
5.	• Set your CPU to “STOP” mode for the download.	 STEP 7-Micro/WIN Do you want to place the PLC in STOP mode? OK Cancel
6.	• Set the CPU back to “Run” mode after the transfer.	 STEP 7-Micro/WIN Do you want to place the PLC in RUN mode? OK Cancel

3.2.3 Configuration of the server

Establishing a connection

On the S7-1200 side only the Ethernet interface must be configured and the send and receive buffers be created.
Configuration is done in STEP 7 Basic V10.5 SP2.
The “CE-X20_Server_v1d0.ap10” project has been configured for both S7-1200 servers according to the following procedure.

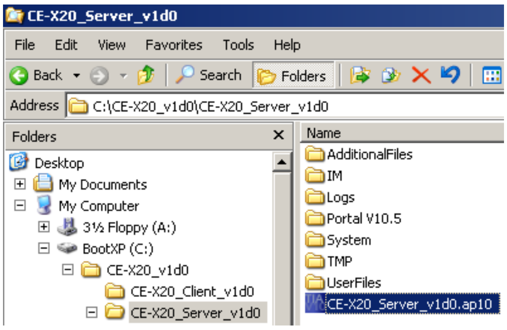
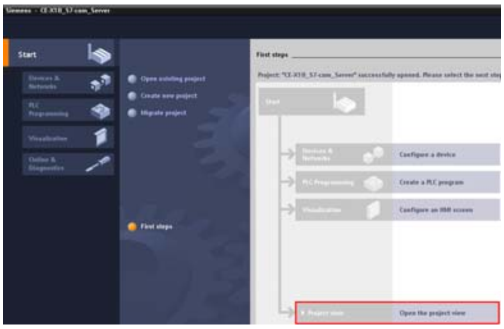
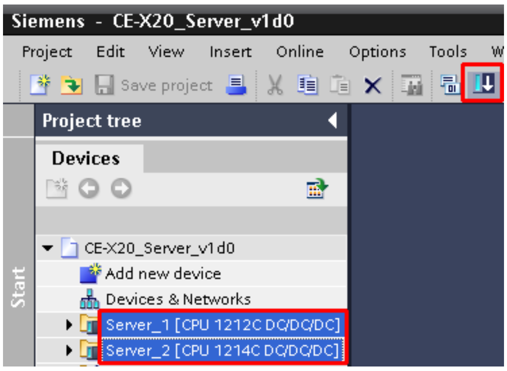
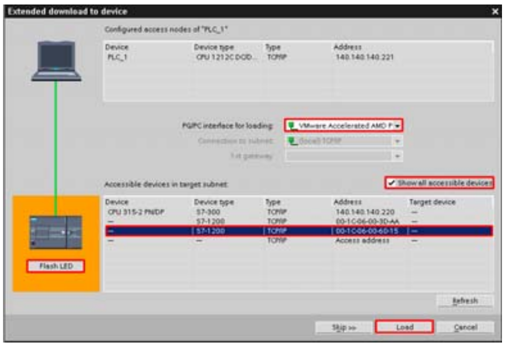
Table 3-6

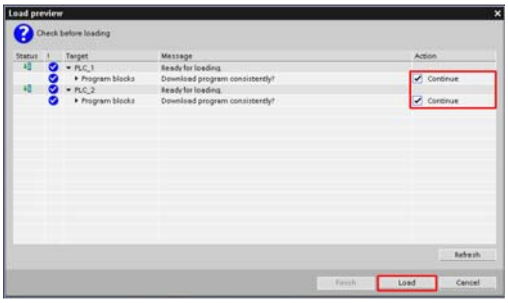
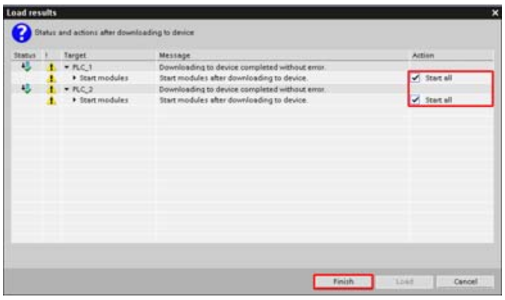
<table>
<tr><th>No.</th><th>Instruction</th><th>Note/picture</th></tr>
<tr><td>1.</td><td>The Ethernet interface configuration is made in “Devices & Networks” view of STEP 7 Basic V10.5 SP2.
• Select the “Server_1” to be configured.
• Select the “Properties” tab.
• Open the “PROFINET interface”
• For the IP protocol you assign:
- the IP address “192.168.0.2”
- the subnet mask “255.255.255.0”
(see Figure 1-2)</td><td> PROFINET interface
Project information
Name: PROFINET interface
Comment:
Ethernet addresses
Interface connected with
Subnet: Not connected
Add new subnet
IP protocol
IP address: 192 168 0 1
Subnet mask: 255 255 255 0</td></tr>
<tr><td>2.</td><td>In the “Add new block” folder you add a new data block for the send and receive buffer.
• DB1201 for data reception from the client (see Table 3-4 Step 7)
• DB1201 for the send data to the client (see Table 3-4 Step 8)
• Assign a specific name.
• Deactivate the property “Symbolic address only”.
Since the Ethernet wizard in STEP 7 Micro/WIN accesses absolutely addressed data, this setting is mandatory.</td><td> Name: Source
Type: Global DB
Language: DB
Number: 1
○ Manual
● Automatic
□ Symbolic access only
Description:
Data blocks (DBs) are data areas in the program that contain user data.
Select one of the following types:
- A global data block
- An instance data block
☑ Add new and open</td></tr>
<tr><td>3.</td><td>The data elements to be transferred must be created in the data block.
• Create the receive structure (Table 2-6) and send structure (Table 2-7).
Data consistency can only be guaranteed if the same data type structure has been created on the sending and receiving side.</td><td>CE-X20_Server ▸ Server_1 ▸ Program blocks ▸ Receive_DB
Receive_DB
<table>
<tr><th></th><th>Name</th><th>Data type</th><th>Offset</th><th>Initial value</th><th>Retain</th></tr>
<tr><td>1</td><td>▾ Static</td><td></td><td></td><td></td><td>□</td></tr>
<tr><td>2</td><td>M_ID</td><td>Int</td><td>0.0</td><td>0</td><td>☑</td></tr>
<tr><td>3</td><td>sync_CLK</td><td>Bool</td><td>2.0</td><td>false</td><td>☑</td></tr>
<tr><td>4</td><td>▸ READ_CLK_CDT</td><td>Array [0 .. 7] of byte</td><td>4.0</td><td></td><td>☑</td></tr>
<tr><td>5</td><td>▸ User_data</td><td>Array [0 .. 87] of byte</td><td>12.0</td><td></td><td>☑</td></tr>
</table>
CE-X20_Server ▸ Server_1 ▸ Program blocks ▸ Send_DB
Send_DB
<table>
<tr><th></th><th>Name</th><th>Data type</th><th>Offset</th><th>Initial value</th><th>Retain</th></tr>
<tr><td>1</td><td>▾ Static</td><td></td><td></td><td></td><td>□</td></tr>
<tr><td>2</td><td>M_ID</td><td>Int</td><td>0.0</td><td>0</td><td>☑</td></tr>
<tr><td>3</td><td>synchronized</td><td>Bool</td><td>2.0</td><td>false</td><td>☑</td></tr>
<tr><td>4</td><td>▸ User_data</td><td>Array [0 .. 95] of Byte</td><td>4.0</td><td></td><td>☑</td></tr>
</table></td></tr>
</table>

Load server project into the S7-1200 controller

Unzip the example program "CE-X20_Server_v1d0.zip" into any directory on your hard drive.
The unzipped file contains the "CE-X20_Server_v1d0.ap10" project for both S7-1200 controllers.

Table 3-7

No.	Instruction	Note/picture
1.	• In the Windows Explorer you navigate to the S7-1200 project "CE-X20_Server_v1d0.ap10" and open it via double-click.	 CE-X20_Server_v1d0 File Edit View Favorites Tools Help Back Search Folders Address C:\CE-X20_v1d0\CE-X20_Server_v1d0 Folders Desktop My Documents My Computer 3½ Floppy (A:) BootXP (C:) CE-X20_v1d0 CE-X20_Client_v1d0 CE-X20_Server_v1d0 Name AdditionalFiles IM Logs Portal V10.5 System TMP UserFiles CE-X20_Server_v1d0.ap10
2.	The project is opened in STEP 7 Basic. • Open the Project view.	 Start Open existing project Create new project Migrate project First steps Configure a device Create a PLC program Configure an HMI screen Open the project view
3.	• Select both controller folders "Server_1 [CPU 1212C DC/DC/DC]" and "Server_2 [CPU 1214C DC/DC/DC]". • Press the "Extended download to device" button for downloading the entire projects to the controller.	 Siemens - CE-X20_Server_v1d0 Project Edit View Insert Online Options Tools W Save project Project tree Devices Start CE-X20_Server_v1d0 Add new device Devices & Networks Server_1 [CPU 1212C DC/DC/DC] Server_2 [CPU 1214C DC/DC/DC]
4.	• Select the used network card. • Activate the display of all accessible nodes. • Identify the controller "Server_1" from the list of accessible nodes via the MAC address or via "Flash LED". • Mark the selected controller and press the "Load" button. Repeat those two points for the download of "Server_2".	 Extended download to device Configured access nodes of "PLC_1" Device / Device type / Type / Address PLC_1 / CPU 1212C DC/D... / TCP/IP / 140.140.140.221 PG/PC interface for loading: VMware Accelerated AMD P Connection to subnet: (local) TCP/IP 1st gateway: Accessible devices in target subnet: ☑ Show all accessible devices Device / Device type / Type / Address / Target device CPU 315-2 PN/DP / S7-300 / TCP/IP / 140.140.140.220 / — — / S7-1200 / TCP/IP / 00-1C-06-00-3D-AA / — — / S7-1200 / TCP/IP / 00-1C-06-00-60-15 / — — / — / TCP/IP / Access address / — Flash LED Refresh Skip >> Load Cancel

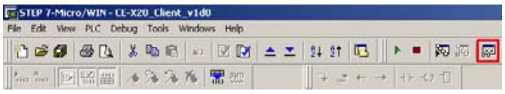
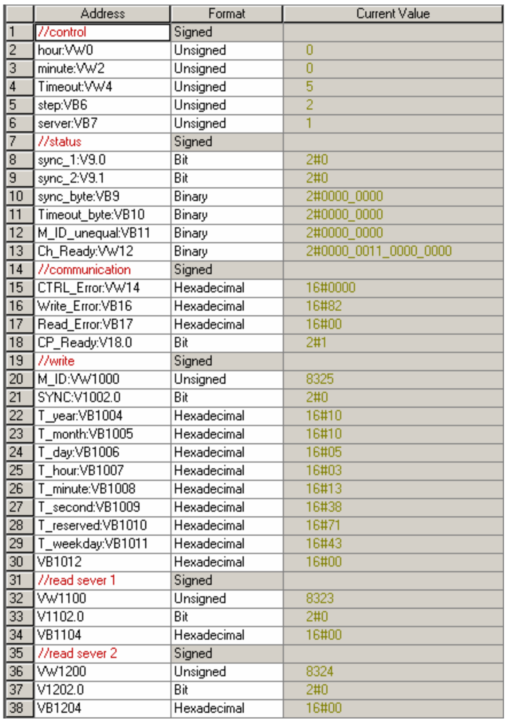
No.	Instruction	Note/picture
5.	• Activate the consistent loading for both controllers. • Press the “Load” button.	 Load preview Check before loading Status ! Target Message Action ▾ PLC_1 Ready for loading. ▸ Program blocks Download program consistently? ☑ Continue ▾ PLC_2 Ready for loading. ▸ Program blocks Download program consistently? ☑ Continue
6.	After transferring all program blocks to the controller a window appears with the “Download result”. • Select the “Start all” fields to set both controllers to “Run” mode. • Terminate the download via the “Finish” button.	 Load results Status and actions after downloading to device Status ! Target Message Action ▾ PLC_1 Downloading to device completed without error. ▸ Start modules Start modules after downloading to device. ☑ Start all ▾ PLC_2 Downloading to device completed without error. ▸ Start modules Start modules after downloading to device. ☑ Start all

3.3 Activate the online mode

For control and monitoring of the communication your PG/PC must be switched online to S7-200 and S7-1200 via the status table / watch table.

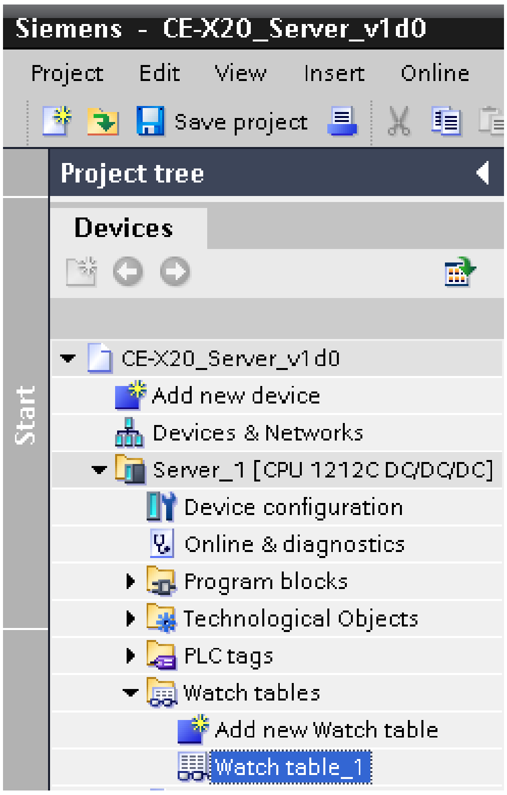
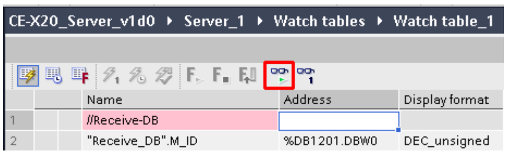
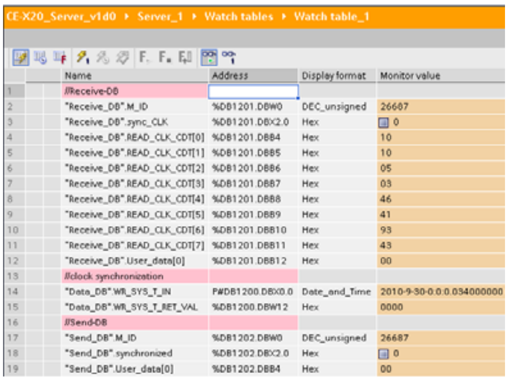
Activate table status for the S7-200 client

Table 3-8

<table>
<tr><th>No.</th><th>Instruction</th><th>Note/picture</th></tr>
<tr><td>1.</td><td>In the STEP 7 Micro/WIN project “CE-X20_Client_v1d0.mwp” you press the “Table status” button.</td><td>
</td></tr>
<tr><td>2.</td><td>The status table “USER1” opens. It contains (row numbers in brackets):
• Monitoring information (2-17)
- Default synchronization time (2-3)
- Maximum processing time (4)
- Step detail (5)
- Currently addressed server (6)
• Status information per server (8-13)
- Synchronization request (8-10)
- Exceeding of processing time (11)
- Unequal message ID (12)
- Channel check (13)
• Communication error (15-18)
- Error status of the control block (15)
- Error status during writing (16)
- Error status during reading (17)
- Ready message of the CP (18)
• Send data (20-30)
- Message ID (20)
- Synchronization request (21)
- Client system time in DATE_AND_TIME format (22-29)
- First byte of the user data (30)
• Receive data of server 1 (32-34)
- Message ID (32)
- Synchronization acknowledgement (33)
- First byte of the user data (34)
• Receive data of server 2 (36-38)</td><td>
<table>
<tr><th></th><th>Address</th><th>Format</th><th>Current Value</th></tr>
<tr><td>1</td><td>//control</td><td>Signed</td><td></td></tr>
<tr><td>2</td><td>hour:VW0</td><td>Unsigned</td><td>0</td></tr>
<tr><td>3</td><td>minute:VW2</td><td>Unsigned</td><td>0</td></tr>
<tr><td>4</td><td>Timeout:VW4</td><td>Unsigned</td><td>5</td></tr>
<tr><td>5</td><td>step:VB6</td><td>Unsigned</td><td>2</td></tr>
<tr><td>6</td><td>server:VB7</td><td>Unsigned</td><td>1</td></tr>
<tr><td>7</td><td>//status</td><td>Signed</td><td></td></tr>
<tr><td>8</td><td>sync_1:V9.0</td><td>Bit</td><td>2#0</td></tr>
<tr><td>9</td><td>sync_2:V9.1</td><td>Bit</td><td>2#0</td></tr>
<tr><td>10</td><td>sync_byte:VB9</td><td>Binary</td><td>2#0000_0000</td></tr>
<tr><td>11</td><td>Timeout_byte:VB10</td><td>Binary</td><td>2#0000_0000</td></tr>
<tr><td>12</td><td>M_ID_unequal:VB11</td><td>Binary</td><td>2#0000_0000</td></tr>
<tr><td>13</td><td>Ch_Ready:VW12</td><td>Binary</td><td>2#0000_0011_0000_0000</td></tr>
<tr><td>14</td><td>//communication</td><td>Signed</td><td></td></tr>
<tr><td>15</td><td>CTRL_Error:VW14</td><td>Hexadecimal</td><td>16#0000</td></tr>
<tr><td>16</td><td>Write_Error:VB16</td><td>Hexadecimal</td><td>16#82</td></tr>
<tr><td>17</td><td>Read_Error:VB17</td><td>Hexadecimal</td><td>16#00</td></tr>
<tr><td>18</td><td>CP_Ready:V18.0</td><td>Bit</td><td>2#1</td></tr>
<tr><td>19</td><td>//write</td><td>Signed</td><td></td></tr>
<tr><td>20</td><td>M_ID:VW1000</td><td>Unsigned</td><td>8325</td></tr>
<tr><td>21</td><td>SYNC:V1002.0</td><td>Bit</td><td>2#0</td></tr>
<tr><td>22</td><td>T_year:VB1004</td><td>Hexadecimal</td><td>16#10</td></tr>
<tr><td>23</td><td>T_month:VB1005</td><td>Hexadecimal</td><td>16#10</td></tr>
<tr><td>24</td><td>T_day:VB1006</td><td>Hexadecimal</td><td>16#05</td></tr>
<tr><td>25</td><td>T_hour:VB1007</td><td>Hexadecimal</td><td>16#03</td></tr>
<tr><td>26</td><td>T_minute:VB1008</td><td>Hexadecimal</td><td>16#13</td></tr>
<tr><td>27</td><td>T_second:VB1009</td><td>Hexadecimal</td><td>16#38</td></tr>
<tr><td>28</td><td>T_reserved:VB1010</td><td>Hexadecimal</td><td>16#71</td></tr>
<tr><td>29</td><td>T_weekday:VB1011</td><td>Hexadecimal</td><td>16#43</td></tr>
<tr><td>30</td><td>VB1012</td><td>Hexadecimal</td><td>16#00</td></tr>
<tr><td>31</td><td>//read sever 1</td><td>Signed</td><td></td></tr>
<tr><td>32</td><td>VW1100</td><td>Unsigned</td><td>8323</td></tr>
<tr><td>33</td><td>V1102.0</td><td>Bit</td><td>2#0</td></tr>
<tr><td>34</td><td>VB1104</td><td>Hexadecimal</td><td>16#00</td></tr>
<tr><td>35</td><td>//read sever 2</td><td>Signed</td><td></td></tr>
<tr><td>36</td><td>VW1200</td><td>Unsigned</td><td>8324</td></tr>
<tr><td>37</td><td>V1202.0</td><td>Bit</td><td>2#0</td></tr>
<tr><td>38</td><td>VB1204</td><td>Hexadecimal</td><td>16#00</td></tr>
</table></td></tr>
</table>

Activate watch table for the S7-1200 server

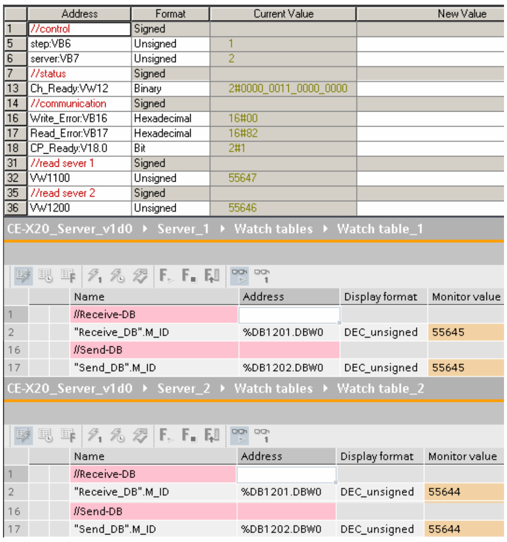
Table 3-9

<table>
<tr><th>No.</th><th>Instruction</th><th>Note/picture</th></tr>
<tr><td>1.</td><td>• In the project navigation of STEP 7 Basic under the controller “Server_1” -> “Watch tables” you open the table “Watch table_1”.</td><td>
</td></tr>
<tr><td>2.</td><td>• Activate the watch table via the “Watch all” button.</td><td>
CE-X20_Server_v1d0 ▸ Server_1 ▸ Watch tables ▸ Watch table_1
<table>
<tr><th></th><th>Name</th><th>Address</th><th>Display format</th></tr>
<tr><td>1</td><td>//Receive-DB</td><td></td><td></td></tr>
<tr><td>2</td><td>"Receive_DB".M_ID</td><td>%DB1201.DBW0</td><td>DEC_unsigned</td></tr>
</table></td></tr>
<tr><td>3.</td><td>Repeat step 1 and 2 for server 2.
• Server_2 [CPU 1214C DC/DC/DC]
• Watch table_2</td><td></td></tr>
<tr><td>4.</td><td>The watch tables contain (lines numbers in brackets):
• Receive data block (2-12)
- Message ID (2)
- Synchronization request (3)
- Client system time in DATE_AND_TIME format (4-11)
- First byte of the user data (12)
• Variable data block (14-15)
- Transformed client system time in DTL format (14)
- Return value of the “Write system time” function (15)
• Send data block (17-19)
- Mirrored message ID (17)
- Synchronization confirmation (18)
- First byte of the user data (19)</td><td>
CE-X20_Server_v1d0 ▸ Server_1 ▸ Watch tables ▸ Watch table_1
<table>
<tr><th></th><th>Name</th><th>Address</th><th>Display format</th><th>Monitor value</th></tr>
<tr><td>1</td><td>//Receive-DB</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>"Receive_DB".M_ID</td><td>%DB1201.DBW0</td><td>DEC_unsigned</td><td>26687</td></tr>
<tr><td>3</td><td>"Receive_DB".sync_CLK</td><td>%DB1201.DBX2.0</td><td>Hex</td><td>□ 0</td></tr>
<tr><td>4</td><td>"Receive_DB".READ_CLK_CDT[0]</td><td>%DB1201.DBB4</td><td>Hex</td><td>10</td></tr>
<tr><td>5</td><td>"Receive_DB".READ_CLK_CDT[1]</td><td>%DB1201.DBB5</td><td>Hex</td><td>10</td></tr>
<tr><td>6</td><td>"Receive_DB".READ_CLK_CDT[2]</td><td>%DB1201.DBB6</td><td>Hex</td><td>05</td></tr>
<tr><td>7</td><td>"Receive_DB".READ_CLK_CDT[3]</td><td>%DB1201.DBB7</td><td>Hex</td><td>03</td></tr>
<tr><td>8</td><td>"Receive_DB".READ_CLK_CDT[4]</td><td>%DB1201.DBB8</td><td>Hex</td><td>46</td></tr>
<tr><td>9</td><td>"Receive_DB".READ_CLK_CDT[5]</td><td>%DB1201.DBB9</td><td>Hex</td><td>41</td></tr>
<tr><td>10</td><td>"Receive_DB".READ_CLK_CDT[6]</td><td>%DB1201.DBB10</td><td>Hex</td><td>93</td></tr>
<tr><td>11</td><td>"Receive_DB".READ_CLK_CDT[7]</td><td>%DB1201.DBB11</td><td>Hex</td><td>43</td></tr>
<tr><td>12</td><td>"Receive_DB".User_data[0]</td><td>%DB1201.DBB12</td><td>Hex</td><td>00</td></tr>
<tr><td>13</td><td>//clock synchronization</td><td></td><td></td><td></td></tr>
<tr><td>14</td><td>"Data_DB".WR_SYS_T_IN</td><td>P#DB1200.DBX0.0</td><td>Date_and_Time</td><td>2010-9-30-0:0:0.034000000</td></tr>
<tr><td>15</td><td>"Data_DB".WR_SYS_T_RET_VAL</td><td>%DB1200.DBW12</td><td>Hex</td><td>0000</td></tr>
<tr><td>16</td><td>//Send-DB</td><td></td><td></td><td></td></tr>
<tr><td>17</td><td>"Send_DB".M_ID</td><td>%DB1202.DBW0</td><td>DEC_unsigned</td><td>26687</td></tr>
<tr><td>18</td><td>"Send_DB".synchronized</td><td>%DB1202.DBX2.0</td><td>Hex</td><td>□ 0</td></tr>
<tr><td>19</td><td>"Send_DB".User_data[0]</td><td>%DB1202.DBB4</td><td>Hex</td><td>00</td></tr>
</table></td></tr>
</table>

3.4 Live Demo

3.4.1 Cyclical sequence

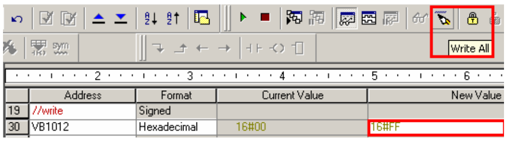
Table 3-10

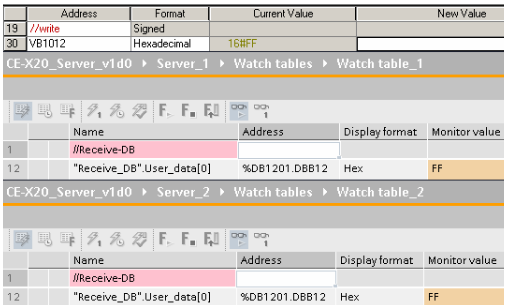
<table>
<tr><th>No.</th><th>Instruction</th><th>Note/picture</th></tr>
<tr><td>1.</td><td>
<ul>
<li>The subprogram SBR0 “Client_1200” of S7-200 is called cyclically (apparent by the changed step display in line 5)</li>
<li>It communicates continuously with server 1 and 2 (apparent by the change in server number in row 6).</li>
<li>Reaching both servers is signaled by bit 0 and 1 of VB12 in row 13.</li>
<li>Writing to the server alternates with reading from the server which is why the inactive direction gives the status “16#82” (row 16/17).</li>
<li>The odd message IDs are sent to server 1, where they are mirrored and received again.</li>
<li>The even message IDs are sent to server 2, where they are mirrored and received again.</li>
</ul>
</td><td>

<table>
<tr><th></th><th>Address</th><th>Format</th><th>Current Value</th><th>New Value</th></tr>
<tr><td>1</td><td>//control</td><td>Signed</td><td></td><td></td></tr>
<tr><td>5</td><td>step:VB6</td><td>Unsigned</td><td>1</td><td></td></tr>
<tr><td>6</td><td>server:VB7</td><td>Unsigned</td><td>2</td><td></td></tr>
<tr><td>7</td><td>//status</td><td>Signed</td><td></td><td></td></tr>
<tr><td>13</td><td>Ch_Ready:VW12</td><td>Binary</td><td>2#0000_0011_0000_0000</td><td></td></tr>
<tr><td>14</td><td>//communication</td><td>Signed</td><td></td><td></td></tr>
<tr><td>16</td><td>Write_Error:VB16</td><td>Hexadecimal</td><td>16#00</td><td></td></tr>
<tr><td>17</td><td>Read_Error:VB17</td><td>Hexadecimal</td><td>16#82</td><td></td></tr>
<tr><td>18</td><td>CP_Ready:V18.0</td><td>Bit</td><td>2#1</td><td></td></tr>
<tr><td>31</td><td>//read sever 1</td><td>Signed</td><td></td><td></td></tr>
<tr><td>32</td><td>VW1100</td><td>Unsigned</td><td>55647</td><td></td></tr>
<tr><td>35</td><td>//read sever 2</td><td>Signed</td><td></td><td></td></tr>
<tr><td>36</td><td>VW1200</td><td>Unsigned</td><td>55646</td><td></td></tr>
</table>
CE-X20_Server_v1d0 ▸ Server_1 ▸ Watch tables ▸ Watch table_1
<table>
<tr><th></th><th>Name</th><th>Address</th><th>Display format</th><th>Monitor value</th></tr>
<tr><td>1</td><td>//Receive-DB</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>"Receive_DB".M_ID</td><td>%DB1201.DBW0</td><td>DEC_unsigned</td><td>55645</td></tr>
<tr><td>16</td><td>//Send-DB</td><td></td><td></td><td></td></tr>
<tr><td>17</td><td>"Send_DB".M_ID</td><td>%DB1202.DBW0</td><td>DEC_unsigned</td><td>55645</td></tr>
</table>
CE-X20_Server_v1d0 ▸ Server_2 ▸ Watch tables ▸ Watch table_2
<table>
<tr><th></th><th>Name</th><th>Address</th><th>Display format</th><th>Monitor value</th></tr>
<tr><td>1</td><td>//Receive-DB</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>"Receive_DB".M_ID</td><td>%DB1201.DBW0</td><td>DEC_unsigned</td><td>55644</td></tr>
<tr><td>16</td><td>//Send-DB</td><td></td><td></td><td></td></tr>
<tr><td>17</td><td>"Send_DB".M_ID</td><td>%DB1202.DBW0</td><td>DEC_unsigned</td><td>55644</td></tr>
</table>
</td></tr>
</table>

3.4.2 User data transfer

Client -> Server

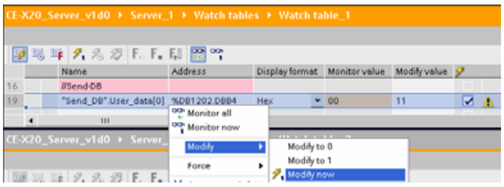
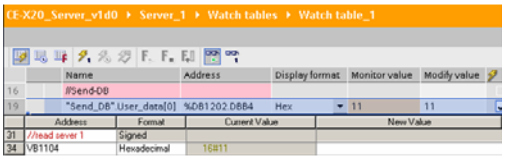
Table 3-11

<table>
<tr><th>No.</th><th>Instruction</th><th>Note/picture</th></tr>
<tr><td>1.</td><td>
As an example for the user data transmission from the client to the servers the send byte 0 of the user data in row 30 shall be modified:
<ul>
<li>Enter a value in row 30 of the “New Value” column.</li>
<li>Accept the value with the “Write all” button.</li>
</ul>
</td><td>


<table>
<tr><th></th><th>Address</th><th>Format</th><th>Current Value</th><th>New Value</th></tr>
<tr><td>19</td><td>//write</td><td>Signed</td><td></td><td></td></tr>
<tr><td>30</td><td>VB1012</td><td>Hexadecimal</td><td>16#00</td><td>16#FF</td></tr>
</table>
</td></tr>
<tr><td>2.</td><td>
The value is transferred to both slaves and written to the receive byte 0 of the user data field in the receive data block 1201 (apparent in rows 12 of the server watch table).
</td><td>

<table>
<tr><th></th><th>Address</th><th>Format</th><th>Current Value</th><th>New Value</th></tr>
<tr><td>19</td><td>//write</td><td>Signed</td><td></td><td></td></tr>
<tr><td>30</td><td>VB1012</td><td>Hexadecimal</td><td>16#FF</td><td></td></tr>
</table>
CE-X20_Server_v1d0 ▸ Server_1 ▸ Watch tables ▸ Watch table_1
<table>
<tr><th></th><th>Name</th><th>Address</th><th>Display format</th><th>Monitor value</th></tr>
<tr><td>1</td><td>//Receive-DB</td><td></td><td></td><td></td></tr>
<tr><td>12</td><td>"Receive_DB".User_data[0]</td><td>%DB1201.DBB12</td><td>Hex</td><td>FF</td></tr>
</table>
CE-X20_Server_v1d0 ▸ Server_2 ▸ Watch tables ▸ Watch table_2
<table>
<tr><th></th><th>Name</th><th>Address</th><th>Display format</th><th>Monitor value</th></tr>
<tr><td>1</td><td>//Receive-DB</td><td></td><td></td><td></td></tr>
<tr><td>12</td><td>"Receive_DB".User_data[0]</td><td>%DB1201.DBB12</td><td>Hex</td><td>FF</td></tr>
</table>
</td></tr>
</table>

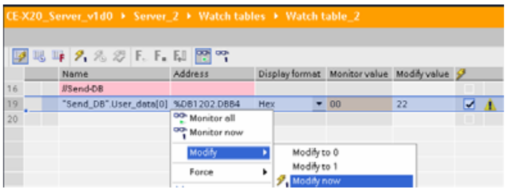
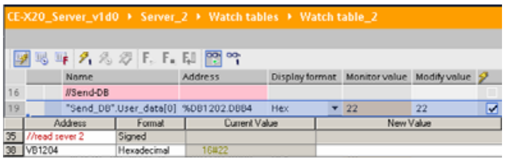
Server 1 -> Client

Table 3-12

No.	Instruction	Note/picture
1.	As an example for the user data transmission from server 1 to the client, the send byte 0 of the user data field in row 19 shall be modified: • In the monitoring table “Watch table_1” you enter a value in row 19 of the “Modify value” column. • Accept the value by right-clicking “Modify” -> “Modify now”.	 CE-X20_Server_v1d0 ▸ Server_1 ▸ Watch tables ▸ Watch table_1 Name | Address | Display format | Monitor value | Modify value 16 //Send-DB 19 "Send_DB".User_data[0] | %DB1202.DBB4 | Hex | 00 | 11 | ☑ Monitor all Monitor now Modify ▸ Modify to 0 / Modify to 1 / Modify now Force ▸
2.	The value is transferred to the client and written to the first user data byte of the receive area for server 1 (apparent in row 34 of the client status table).	 CE-X20_Server_v1d0 ▸ Server_1 ▸ Watch tables ▸ Watch table_1 Name | Address | Display format | Monitor value | Modify value 16 //Send-DB 19 "Send_DB".User_data[0] | %DB1202.DBB4 | Hex | 11 | 11 Address | Format | Current Value | New Value 31 //read sever 1 | Signed 34 VB1104 | Hexadecimal | 16#11

Server 2 -> Client

Table 3-13

No.	Instruction	Note/picture
1.	As an example for the user data transmission from server 2 to the client, the send byte 0 of the user data field in row 19 shall be modified: • In the monitoring table “Watch table_2” you enter a value in row 19 of the “Modify value” column. • Accept the value by right-clicking “Modify” -> “Modify now”.	 CE-X20_Server_v1d0 ▸ Server_2 ▸ Watch tables ▸ Watch table_2 Name | Address | Display format | Monitor value | Modify value 16 //Send-DB 19 "Send_DB".User_data[0] | %DB1202.DBB4 | Hex | 00 | 22 | ☑ 20 Monitor all Monitor now Modify ▸ Modify to 0 / Modify to 1 / Modify now Force ▸
2.	The value is transferred to the client and written to the first user data byte of the receive area for server 2 (apparent in row 38 of the client status table).	 CE-X20_Server_v1d0 ▸ Server_2 ▸ Watch tables ▸ Watch table_2 Name | Address | Display format | Monitor value | Modify value 16 //Send-DB 19 "Send_DB".User_data[0] | %DB1202.DBB4 | Hex | 22 | 22 | ☑ Address | Format | Current Value | New Value 35 //read sever 2 | Signed 38 VB1204 | Hexadecimal | 16#22

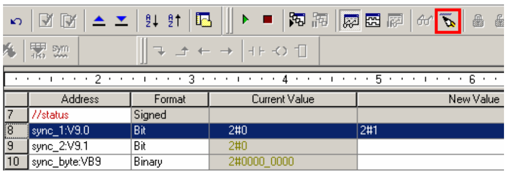
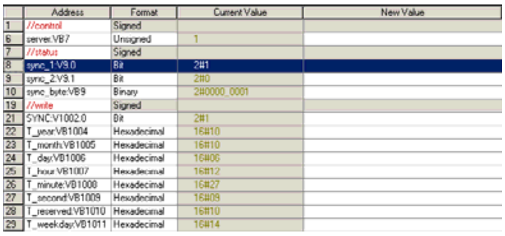
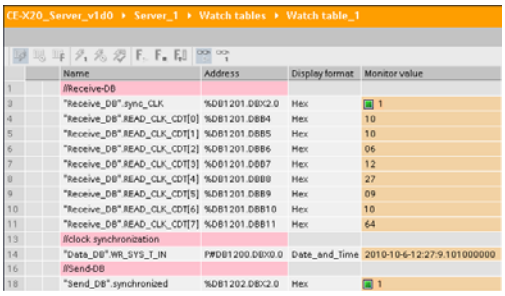
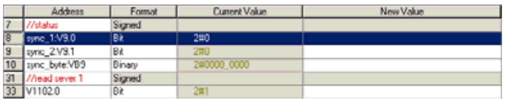
3.4.3 Time synchronization

The synchronization time written to the system time of the S7-1200 server is the UTC time. The real-time clock of the S7-200 client must be set to UTC time. The time is set in STEP 7 Micro/WIN under menu item “PLC” -> “Time of Day Clock…”.

Manual synchronization of a server

Server 1 shall be synchronized manually with the system time of the client.
Table 3-14 shows the procedure.
With the respective procedure server 2 can also be synchronized.

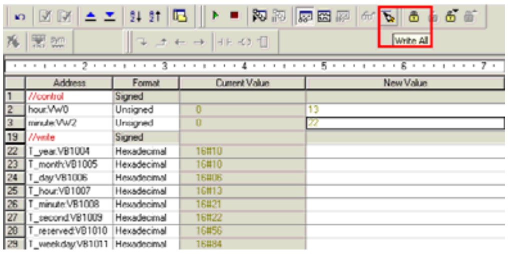
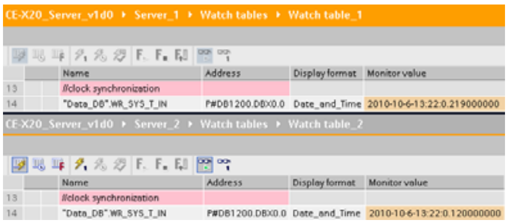
Table 3-14

<table>
<tr><th></th><th></th><th></th></tr>
<tr><td>1.</td><td>Set the synchronization request for server 1 in the client status table.
• Enter “2#1“ in row 8 of the “New Value“ column.
• Accept the value with the “Write all” button.</td><td>
<table>
<tr><th></th><th>Address</th><th>Format</th><th>Current Value</th><th>New Value</th></tr>
<tr><td>7</td><td>//status</td><td>Signed</td><td></td><td></td></tr>
<tr><td>8</td><td>sync_1:V9.0</td><td>Bit</td><td>2#0</td><td>2#1</td></tr>
<tr><td>9</td><td>sync_2:V9.1</td><td>Bit</td><td>2#0</td><td></td></tr>
<tr><td>10</td><td>sync_byte:VB9</td><td>Binary</td><td>2#0000_0000</td><td></td></tr>
</table></td></tr>
<tr><td>2.</td><td>• The system time is continuously written to the send data in DATE_AND_TIME format (line 22)
• The synchronization request in the send data is set (line 21)
• The send data are sent to server 1 (line 6)</td><td>
<table>
<tr><th></th><th>Address</th><th>Format</th><th>Current Value</th><th>New Value</th></tr>
<tr><td>1</td><td>//control</td><td>Signed</td><td></td><td></td></tr>
<tr><td>6</td><td>server:VB7</td><td>Unsigned</td><td>1</td><td></td></tr>
<tr><td>7</td><td>//status</td><td>Signed</td><td></td><td></td></tr>
<tr><td>8</td><td>sync_1:V9.0</td><td>Bit</td><td>2#1</td><td></td></tr>
<tr><td>9</td><td>sync_2:V9.1</td><td>Bit</td><td>2#0</td><td></td></tr>
<tr><td>10</td><td>sync_byte:VB9</td><td>Binary</td><td>2#0000_0001</td><td></td></tr>
<tr><td>19</td><td>//write</td><td>Signed</td><td></td><td></td></tr>
<tr><td>21</td><td>SYNC:V1002.0</td><td>Bit</td><td>2#1</td><td></td></tr>
<tr><td>22</td><td>T_year:VB1004</td><td>Hexadecimal</td><td>16#10</td><td></td></tr>
<tr><td>23</td><td>T_month:VB1005</td><td>Hexadecimal</td><td>16#10</td><td></td></tr>
<tr><td>24</td><td>T_day:VB1006</td><td>Hexadecimal</td><td>16#06</td><td></td></tr>
<tr><td>25</td><td>T_hour:VB1007</td><td>Hexadecimal</td><td>16#12</td><td></td></tr>
<tr><td>26</td><td>T_minute:VB1008</td><td>Hexadecimal</td><td>16#27</td><td></td></tr>
<tr><td>27</td><td>T_second:VB1009</td><td>Hexadecimal</td><td>16#09</td><td></td></tr>
<tr><td>28</td><td>T_reserved:VB1010</td><td>Hexadecimal</td><td>16#10</td><td></td></tr>
<tr><td>29</td><td>T_weekday:VB1011</td><td>Hexadecimal</td><td>16#14</td><td></td></tr>
</table></td></tr>
<tr><td>3.</td><td>• The time synchronization data are written to the receive block of server 1 (“watch table_1”, row 3 – 11)
• The transformed synchronization time of data type DTL is written to the system time of the S7-1200 (line 14).
• After successful time synchronization the synchronization acknowledgement is set (line 18)</td><td>
CE-X20_Server_v1d0 ▸ Server_1 ▸ Watch tables ▸ Watch table_1
<table>
<tr><th></th><th>Name</th><th>Address</th><th>Display format</th><th>Monitor value</th></tr>
<tr><td>1</td><td>//Receive-DB</td><td></td><td></td><td></td></tr>
<tr><td>3</td><td>"Receive_DB".sync_CLK</td><td>%DB1201.DBX2.0</td><td>Hex</td><td>🟩 1</td></tr>
<tr><td>4</td><td>"Receive_DB".READ_CLK_CDT[0]</td><td>%DB1201.DBB4</td><td>Hex</td><td>10</td></tr>
<tr><td>5</td><td>"Receive_DB".READ_CLK_CDT[1]</td><td>%DB1201.DBB5</td><td>Hex</td><td>10</td></tr>
<tr><td>6</td><td>"Receive_DB".READ_CLK_CDT[2]</td><td>%DB1201.DBB6</td><td>Hex</td><td>06</td></tr>
<tr><td>7</td><td>"Receive_DB".READ_CLK_CDT[3]</td><td>%DB1201.DBB7</td><td>Hex</td><td>12</td></tr>
<tr><td>8</td><td>"Receive_DB".READ_CLK_CDT[4]</td><td>%DB1201.DBB8</td><td>Hex</td><td>27</td></tr>
<tr><td>9</td><td>"Receive_DB".READ_CLK_CDT[5]</td><td>%DB1201.DBB9</td><td>Hex</td><td>09</td></tr>
<tr><td>10</td><td>"Receive_DB".READ_CLK_CDT[6]</td><td>%DB1201.DBB10</td><td>Hex</td><td>10</td></tr>
<tr><td>11</td><td>"Receive_DB".READ_CLK_CDT[7]</td><td>%DB1201.DBB11</td><td>Hex</td><td>64</td></tr>
<tr><td>13</td><td>//clock synchronization</td><td></td><td></td><td></td></tr>
<tr><td>14</td><td>"Data_DB".WR_SYS_T_IN</td><td>P#DB1200.DBX0.0</td><td>Date_and_Time</td><td>2010-10-6-12:27:9.101000000</td></tr>
<tr><td>16</td><td>//Send-DB</td><td></td><td></td><td></td></tr>
<tr><td>18</td><td>"Send_DB".synchronized</td><td>%DB1202.DBX2.0</td><td>Hex</td><td>🟩 1</td></tr>
</table></td></tr>
<tr><td>4.</td><td>• The synchronization acknowledgement is on the client side written to the receive area of server 1 (row 33)
• The synchronization request for server 1 is reset in the synchronization byte (row 8)</td><td>
<table>
<tr><th></th><th>Address</th><th>Format</th><th>Current Value</th><th>New Value</th></tr>
<tr><td>7</td><td>//status</td><td>Signed</td><td></td><td></td></tr>
<tr><td>8</td><td>sync_1:V9.0</td><td>Bit</td><td>2#0</td><td></td></tr>
<tr><td>9</td><td>sync_2:V9.1</td><td>Bit</td><td>2#0</td><td></td></tr>
<tr><td>10</td><td>sync_byte:VB9</td><td>Binary</td><td>2#0000_0000</td><td></td></tr>
<tr><td>31</td><td>//read server 1</td><td>Signed</td><td></td><td></td></tr>
<tr><td>33</td><td>V1102.0</td><td>Bit</td><td>2#1</td><td></td></tr>
</table></td></tr>
</table>

Automatic synchronization of all servers

The daily synchronization time of all slaves can be set via the initial default value in the data block of the S7-200 project “CE-X20_Client_v1d0.mwp” or via the status table.
The respective parameters “hour” and “minute” are kept remnant.

Table 3-15

No.	Instruction	Note/picture
1.	The current system time of the S7-200 client can be read via row 25 and 26 (here: 13:22). • Set the daily synchronization time to one minute in the future via row 2 and 3 (here: 13:22) and accept the settings with the “Write all” button.	
2.	The successful time synchronization of the servers can be checked via the written system time of the server (line 14 in the watch tables “Watch table_1” and “Watch table_2”).	

	Address	Format	Current Value	New Value
1	//control	Signed		
2	hour:VW0	Unsigned	0	13
3	minute:VW2	Unsigned	0	22
19	//write	Signed		
22	T_year:VB1004	Hexadecimal	16#10	
23	T_month:VB1005	Hexadecimal	16#10	
24	T_day:VB1006	Hexadecimal	16#06	
25	T_hour:VB1007	Hexadecimal	16#13	
26	T_minute:VB1008	Hexadecimal	16#21	
27	T_second:VB1009	Hexadecimal	16#22	
28	T_reserved:VB1010	Hexadecimal	16#56	
29	T_weekday:VB1011	Hexadecimal	16#84	

CE-X20_Server_v1d0 ‣ Server_1 ‣ Watch tables ‣ Watch table_1

	Name	Address	Display format	Monitor value
13	//clock synchronization			
14	"Data_DB".WR_SYS_T_IN	P#DB1200.DBX0.0	Date_and_Time	2010-10-6-13:22:0.219000000

CE-X20_Server_v1d0 ‣ Server_2 ‣ Watch tables ‣ Watch table_2

	Name	Address	Display format	Monitor value
13	//clock synchronization			
14	"Data_DB".WR_SYS_T_IN	P#DB1200.DBX0.0	Date_and_Time	2010-10-6-13:22:0.120000000

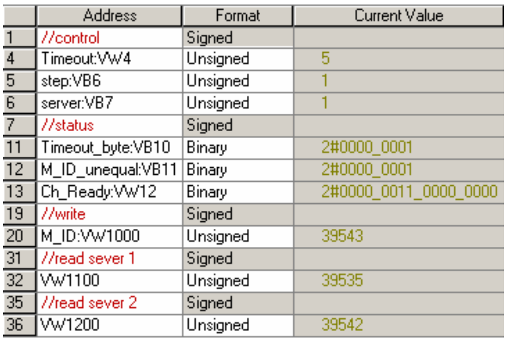
3.4.4 Communication errors

Pulling the Ethernet cable from server 1 the communication error evaluation shall be demonstrated.
Table 3-16 shows the procedure.
With the respective procedure a communication interruption with server 2 can be simulated and evaluated.

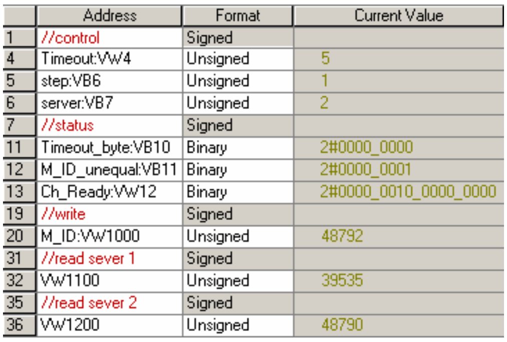
Table 3-16

<table>
<tr><th>No.</th><th>Instruction</th><th>Note/picture</th></tr>
<tr><td>1.</td><td>Pull the Ethernet cable from the LAN connection of server 1.</td><td></td></tr>
<tr><td>2.</td><td>

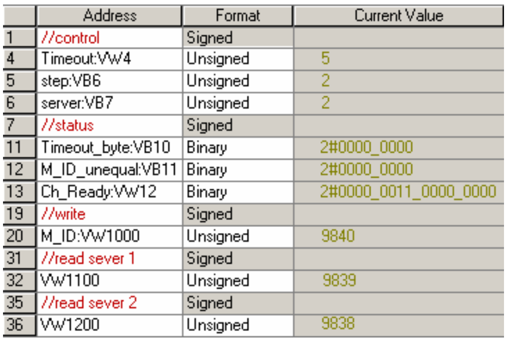
- The interruption with server 1 is initially not recognized (row 13: Bit12.0 = “1”).
- However, exceeding the maximum processing time of 500ms (row 4) is displayed in row 11 (Bit10.0 = “1”).
- Additionally, bit 11.0 in row 12 indicates that the sent message ID (row 20) is not identical with the one last received by server 1 (row 32).

</td><td>
<table>
<tr><th></th><th>Address</th><th>Format</th><th>Current Value</th></tr>
<tr><td>1</td><td>//control</td><td>Signed</td><td></td></tr>
<tr><td>4</td><td>Timeout:VW4</td><td>Unsigned</td><td>5</td></tr>
<tr><td>5</td><td>step:VB6</td><td>Unsigned</td><td>1</td></tr>
<tr><td>6</td><td>server:VB7</td><td>Unsigned</td><td>1</td></tr>
<tr><td>7</td><td>//status</td><td>Signed</td><td></td></tr>
<tr><td>11</td><td>Timeout_byte:VB10</td><td>Binary</td><td>2#0000_0001</td></tr>
<tr><td>12</td><td>M_ID_unequal:VB11</td><td>Binary</td><td>2#0000_0001</td></tr>
<tr><td>13</td><td>Ch_Ready:VW12</td><td>Binary</td><td>2#0000_0011_0000_0000</td></tr>
<tr><td>19</td><td>//write</td><td>Signed</td><td></td></tr>
<tr><td>20</td><td>M_ID:VW1000</td><td>Unsigned</td><td>39543</td></tr>
<tr><td>31</td><td>//read sever 1</td><td>Signed</td><td></td></tr>
<tr><td>32</td><td>VW1100</td><td>Unsigned</td><td>39535</td></tr>
<tr><td>35</td><td>//read sever 2</td><td>Signed</td><td></td></tr>
<tr><td>36</td><td>VW1200</td><td>Unsigned</td><td>39542</td></tr>
</table></td></tr>
<tr><td>3.</td><td>

- After approx. 40 seconds the interrupted connection with server 1 is recognized and represented in row 13 (Bit12.0 = “0”) .
- Data exchange with server 1 is jumped. There is no check of the maximum processing time (row 11: V10.0 = “0”).
- The deviation between the sent message ID (row 20) and the one last received by server 1 (row 32) is detected and output in row 12 (Bit11.0 = “1”).

</td><td>
<table>
<tr><th></th><th>Address</th><th>Format</th><th>Current Value</th></tr>
<tr><td>1</td><td>//control</td><td>Signed</td><td></td></tr>
<tr><td>4</td><td>Timeout:VW4</td><td>Unsigned</td><td>5</td></tr>
<tr><td>5</td><td>step:VB6</td><td>Unsigned</td><td>1</td></tr>
<tr><td>6</td><td>server:VB7</td><td>Unsigned</td><td>2</td></tr>
<tr><td>7</td><td>//status</td><td>Signed</td><td></td></tr>
<tr><td>11</td><td>Timeout_byte:VB10</td><td>Binary</td><td>2#0000_0000</td></tr>
<tr><td>12</td><td>M_ID_unequal:VB11</td><td>Binary</td><td>2#0000_0001</td></tr>
<tr><td>13</td><td>Ch_Ready:VW12</td><td>Binary</td><td>2#0000_0010_0000_0000</td></tr>
<tr><td>19</td><td>//write</td><td>Signed</td><td></td></tr>
<tr><td>20</td><td>M_ID:VW1000</td><td>Unsigned</td><td>48792</td></tr>
<tr><td>31</td><td>//read sever 1</td><td>Signed</td><td></td></tr>
<tr><td>32</td><td>VW1100</td><td>Unsigned</td><td>39535</td></tr>
<tr><td>35</td><td>//read sever 2</td><td>Signed</td><td></td></tr>
<tr><td>36</td><td>VW1200</td><td>Unsigned</td><td>48790</td></tr>
</table></td></tr>
<tr><td>4.</td><td>Reconnect the Ethernet cable with the LAN connection of server 1.</td><td></td></tr>
<tr><td>5.</td><td>

- After detecting the recurring connection of server 1 (row 13: Bit12.0 = “1”), data exchange occurs with server 1 and checking the message ID is positive (row 12 Bit11.0 = “0”).

</td><td>
<table>
<tr><th></th><th>Address</th><th>Format</th><th>Current Value</th></tr>
<tr><td>1</td><td>//control</td><td>Signed</td><td></td></tr>
<tr><td>4</td><td>Timeout:VW4</td><td>Unsigned</td><td>5</td></tr>
<tr><td>5</td><td>step:VB6</td><td>Unsigned</td><td>2</td></tr>
<tr><td>6</td><td>server:VB7</td><td>Unsigned</td><td>2</td></tr>
<tr><td>7</td><td>//status</td><td>Signed</td><td></td></tr>
<tr><td>11</td><td>Timeout_byte:VB10</td><td>Binary</td><td>2#0000_0000</td></tr>
<tr><td>12</td><td>M_ID_unequal:VB11</td><td>Binary</td><td>2#0000_0000</td></tr>
<tr><td>13</td><td>Ch_Ready:VW12</td><td>Binary</td><td>2#0000_0011_0000_0000</td></tr>
<tr><td>19</td><td>//write</td><td>Signed</td><td></td></tr>
<tr><td>20</td><td>M_ID:VW1000</td><td>Unsigned</td><td>9840</td></tr>
<tr><td>31</td><td>//read sever 1</td><td>Signed</td><td></td></tr>
<tr><td>32</td><td>VW1100</td><td>Unsigned</td><td>9839</td></tr>
<tr><td>35</td><td>//read sever 2</td><td>Signed</td><td></td></tr>
<tr><td>36</td><td>VW1200</td><td>Unsigned</td><td>9838</td></tr>
</table></td></tr>
</table>

3.4.5 Voltage failure of the client

After recurring voltage of the S7-200 client the step chain of subprogram SBR0 “Client_1200” continues from the last performed position.

4 Code Elements

In the example on hand the following program codes are used.

Table 4-1

No.	File name	Content
1.	CE-X20_Client_v1d0.zip • CE-X20_Client_v1d0.mwp	Zip-file with the S7-1200 client project for the deterministic S7 communication with S7-1200 servers
2.	CE-X20_Server_v1d0.zip • CE-X20_Server_v1d0.ap10	Zip-file with the S7-1200 server project for the deterministic S7 communication with S7-200 client

5 History

Table 5-1

Version	Date	Changes
V1.0	07.10.2010	First publication