Open IE Communication: Data Exchange S7-300/400 <-> S7-1200

S7-1200

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1 Automation Problem

1.1 **Problem definitions**

With the aid of open TCP/IP communication, deterministic data exchange (for example, for time-of-day synchronization) is to take place between one S7-300 master controller and several S7-1200 slave controllers via Industrial Ethernet.

Diagrammatic representation of the application task

Figure 1-1



Requirements for the application

Both the master and each slave have one send and one receive data block (Send_DB and Receive_DB).

Via the TCON block, the master sends a TCP/IP connection request to the first slave. To acknowledge connection establishment, the opposite side also executes the TCON block.

When there is a synchronization job, the master reads the system time and sends this time and the user data to the slave via the TSEND communication block. With the TRCV receive block, this block receives the data in the Receive_DB data block. The slave synchronizes its system time with the time of day received from the master.

Then slave 1 sends its user data to the master via the TSEND block. On the master side, the TRCV block is used to store the user data of slave 1 at a specified location in the receive data block.

Subsequently, the master disconnects the connection to slave 1 using the TDISCON block.

This procedure is repeated for the following slaves. After the master has exchanged data with the last slave, the master restarts data exchange with slave 1.

Once a connection has been established on the slave side, it remains reserved. TCON thus has to be called only for initialization.

1.2 Configuration

The automation problem is demonstrated using the example of data exchange between a CPU 315-2PN/DP as a master and two S7-1200 controllers (slave 1 and slave 2).

Schematic configuration



Figure 1-2 shows the basic configuration. The communicating CPUs and the programming unit with the "STEP 7 Basic V10.5" software for programming the S7-1200 and "STEP 7 V5.4" for programming the S7-300 are connected to the CSM 1277 using Ethernet cables.

Subnet mask

Since the CPU 1214C with IP address "192.168.1.3" is not in the same subnet as the other nodes with IP addresses "192.168.0.x", this configuration is a Class B network. Communication of the nodes requires at least subnet mask "255.255.0.0" for Class B networks. However, Class A subnet mask "255.0.0.0" is selected, which allows communication with all nodes with IP address "192.x.x.x".

List of components

Table 1-1				
No.	Component	Qty.	MLFB/order number	
1.	PS307 24V / 5A	1	6ES7307-1EA00-0AA0	
2.	CPU315-2 PN/DP, 256 KB	1	6ES7315-2EH13-0AB0	
3.	S7 MICRO MEMORY CARD, 8 MB	1	6ES7953-8LP10-0AA0	
4.	CSM 1277 COMPACT SWITCH MODULE	1	6GK7277-1AA00-0AA0	
5.	S7-1200 PM1207 POWER SUPPLY	2	6EP1332-1SH71	
6.	S7-1200 CPU1212C	1	6ES7212-1AD30-0XB0	
7.	S7-1200 CPU1214C	1	6ES7214-1AE30-0XB0	
8.	PC/PG	1		
9.	STEP 7 V5.4	1	6ES7810-4CC08-0YA5	
10.	STEP 7 V5.4 Service Pack 5	1	ID Number:36184684	
11.	STEP 7 BASIC V10.5	1	6ES7822-0AA00-0YA0	
12.	STEP 7 Basic V10.5 Service Pack 2	1	ID Number:39741113	

2 Automation Solution

Both the S7-1200 and the S7-300/400 offer T communication blocks for open TCP/IP communication:

TCON, TSEND, TRCV and TDISCON (with manual connecting and disconnecting)

The S7-1200 additionally offers T communication blocks with integrated connecting and disconnecting:

• TSEND_C and TRCV_C

The following protocols are supported for data exchange between S7-1200 and S7-300/400 via open TCP/IP communication:

- TCP native
- ISO-on-TCP (dynamic data length transfer)

Communication blocks with manual connecting and disconnecting are selected for both the S7-300 and the S7-1200:

- TCON for connecting
- TSEND for sending data
- TRCV for receiving data
- TDISCON for disconnecting

"ISO-on-TCP" is selected as protocol.

In the OSI model, "ISO-on-TCP" is based on TCP and offers the advantage of a message-oriented principle of operation, which is particularly useful for communication between SIMATIC systems.

The connection is configured in STEP 7 V5.4 using the Open Communication Wizard (OC Wizard).

The respective connection partner is identified by the IP address. The OC Wizard reserves a connection resource and creates a relevant connection data block. The IP address of the partner is stored in this data block.

The maximum number of connections for open IE communication depends on the used CPU. For the used CPU 315-2 PN/DP, max. 8 simultaneous connections can be established using "ISO-on-TCP".

By changing the IP address in the connection data block, data can be successively exchanged with more than 8 different communication partners via the same connection resource.

"ISO-on-TCP" allows to transfer up to 8,192 bytes per job.

2.1 Connection diagram

For the list of components, please refer to chapter 1.2.



2.2 Program structure

This chapter describes the program structure of the example at a functional and data block level of the automation system.

2.2.1 S7-300 block structure

Representation

Figure 2-2 shows the call hierarchy of the used blocks and the access to the data blocks used for the S7-300 master.

Figure 2-2



Description

In the hardware configuration of the CPU 315-2PN/DP, the OB10 "TOD_INTO" time-of-day interrupt is enabled and set to execute "every day".

The DB303 "Status_DB" data block contains the IP address and control and status information from all S7-1200 slaves in the form of the "STATUS" data structure. Aside from the IP address and the "SYNC" synchronization request bit, this data structure includes information on the analysis of communication errors.

OB1 "MAIN" cyclically calls the FB300 "T-com" function block with its instance DB300 "T-com_DB".

FC304 reads the IP address of the first slave from status DB 303 and writes it to the DB1 connection data block of the "TCON_PAR" data type.

FB65 "TCON" establishes a connection to the IP address stored in the connection data block.

Program structure

When executing the OB10 "TOD_INT0" time-of-day interrupt, all "SYNC" synchronization request bits are set. Time-of-day synchronization, however, can also be executed individually for each slave using the variable table.

When setting the "SYNC" synchronization request for the first slave in DB303 "Status_DB", the PLC time is read with the aid of SFC1 "READ_CLK" and stored in the DB301 "Send_DB" send data block together with the synchronization request.

The data type of the read "READ_CLK_CDT" time is DATE_AND_TIME.

The FB300 function block calls the FB63 "TSEND" send block. This block transfers the contents of the DB301 send data block to the first slave. Aside from the time-of-day synchronization information, "User_data" and an "M_ID" (message ID) are also transferred.

FB64 "TRCV" waits for data from slave 1 and stores the contents in the respective UDT2 "RCV_Struct_1" data type in DB 302 "Receive_DB".

The received "M_ID" message ID is then compared to the sent message ID. Any discrepancy is stored in the status DB in the relevant "Status_1" data structure for slave 1.

After successful synchronization of slave 1 (signaled by the "synchronized" variable), the "SYNC" synchronization request bit is reset in "Status_1" of the status DB.

FB66 "TDISCON" disconnects the connection to slave 1.

The "M_ID" message ID is increased and data exchange with slave 2 is handled in the same way.

2.2.2 S7-1200 block structure

Representation

Figure 2-3 shows the call hierarchy of the used blocks and the access to the data blocks used for the S7-1200 slaves.

Figure 2-3





Description

OB1 "MAIN" cyclically calls the FB1200 "T-com" function block with its instance DB1200 "T-com_DB".

In the first cycle, FB1200 "T-com" calls SFB102 "TCON" with its instance DB 1. TCON receives the identification of the master from DB 4 "PLC_1_Connection-DB". Once the connection has been established, it is maintained.

SFB101 "TRCV" with its instance DB 2 waits for data from the master and stores the contents in DB1201 "Receive_DB".

When a "sync_CLK" synchronization request is issued, FB1200 "T-com" calls the FC1200 "DnT_DTL" function. This function converts the "READ_CLK_CDT" time of the S7-300 master of the DATE_AND_TIME type to the DTL data type. The "WR_SYS_T" function is used to write the converted time to the S7-1200 system time. After successful time-of-day synchronization, the "synchronized" bit is set in DB1202 "Send_DB".

The "M_ID" message ID received from DB 1201 "Receive_DB" is mirrored to the DB 1202 "Send_DB" send data block.

With the aid of SFB100 "TSEND", FB1200 "T-com" sends the contents of the DB1202 "Send_DB" send data block with its instance DB 3 to the master.

After successful send acknowledgement, slave 1 waits for new data from the master via TRCV and repeats the data exchange.

2.3 Used blocks

The following tables provide an overview of the blocks used on the master and slave side.

2.3.1 Master (S7-300)

Table 2-1

Object name	Symbolic name	Description
OB1	MAIN	Cyclic organization block
OB10	TOD_INT0	Time-of-day interrupt
FB63	TSEND	T communication block for sending data
FB64	TRCV	T communication block for receiving data
FB65	TCON	T communication block for connecting
FB66	TDISCON	T communication block for disconnecting
FB300	T-com	Function block for deterministic data exchange with several slaves via the T communication blocks
FC301	read_bit	Function to read out the value of a bit using a pointer (used in FB300)
FC302	reset_bit	Function to reset a bit using a pointer (used in FB300)
FC303	output_bit	Function to output the value of a bit using a pointer (used in FB300)
FC304	IP_INT_B	Function to read out the octets of an IP address in integer format and to convert them to byte format (used in FB300)
DB300	T-com_DB	Multi-instance data block for FB300, FB63 to FB66
DB301	Send_DB	Send data block for FB15
DB302	Receive_DB	Receive data block for FB14
DB303	Status_DB	Status data block for all slaves
UDT2	RCV_STRUCT	Data type structure for receiving slave data

T-com (FB300)

The function block for deterministic data exchange with several slaves via the T communication blocks is called cyclically in OB1.

Figure 2-4 OB1 : Title: Comment: Metwork 1: Title: Comment: 'S7-com_PUT_GET_DB'' "S7-com_PUT_GET" EN ENO 2-ID_max Symbol information: S7-com_PUT_GET FB300

S7-com_PUT_GET_DB DB300 DB300 has been selected as an instance data block. It also contains the instances for the TCON, TSEND, TRCV and TDISCON T communication blocks.

As the only input, the maximum number of slaves "max" must be specified.

The relevant slave is identified by the "index" variable. Data exchange with the slaves is sequential.

The following static variables of FB300 provide configuration options via the initial value or the status evaluation of SFC1 "READ_CLK".

Data type	Description
Int	Number of the receive data block
Int	Size of the UDT2 receive data structure in bytes
Int	Number of the status data block
Int	Size of the status data structure in bytes
S5Time	Maximum wait time until the step sequence in FB300 continues automatically
Bool	Error output of the READ_CLK block (SFC1)
Int	Status of the READ_CLK block (SFC1)
	Data type Int Int Int S5Time Bool Int

Table 2-2

Status_DB (DB303)

The status DB consists of the two STATUS data structures for the two S7-1200 slaves with which the CPU 315-2PN/DP communicates. The structure includes 18 bytes and looks as follows:

Used blocks

Fable 2	-3

Name	Data type	Description
IP_ADDR	ARRAY[14] of INT	IP address of the slave (4 octets)
SYNC	Bool	Time-of-day synchronization request
TCON_ERROR	Bool	Error message of the TCON communication block
TCON_TIMEOUT	Bool	Execution time of the TCON communication block exceeded
TSEND_ERROR	Bool	Error message of the TSEND communication block
TRCV_ERROR	Bool	Error message of the TRCV communication block
TRCV_TIMEOUT	Bool	Execution time of the TRCV communication block exceeded
TDISCON_ERROR	Bool	Error message of the TDISCON communication block
M_ID_UNEQUAL	Bool	Sent and received M_IDs differ
TCON_ERROR_STATUS	Word	Status of the TCON block when the last error occurred
TSEND_ERROR_STATUS	Word	Status of the TSEND block when the last error occurred
TRCV_ERROR_STATUS	Word	Status of the TRCV block when the last error occurred
TDISCON_ERROR_STATUS	Word	Status of the TDISCON block when the last error occurred

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2.3.2 Slave (S7-1200)

Table 2-4

Object name	Symbolic name	Description
OB1	Main	Cyclic organization block
FC1200	DnT_DTL	Function to convert the DATE_AND_TIME data type to the DTL data type
FB1200	T-com	Function block for data exchange with an S7-300 master via the T communication blocks
DB4	PLC_1_Connection_D B	Connection data block for TCON
DB1200	T-com_DB	Instance data block for T-com
DB1201	Receive_DB	Data block for receiving from the master
DB1202	Send_DB	Data block for sending to the master
DB1	TCON_DB	Instance data block for TCON
DB2	TRCV_DB	Instance data block for TRCV
DB3	TSEND_DB	Instance data block for TSEND

2.3.3 Data consistency

DB301 and DB1201

The send block of the master and the receive block of the slave must have the same length and structure. In the application example, they consist of 160 bytes and have the following structure:

Table 2-5

Name	Data type	Description
M_ID	Int	Message ID
sync_CLK	Bool	Time-of-day synchronization request
READ_CLK_CDT	DATE_AND_TIME or array of 8 bytes	Synchronization time of master (S7-300)
User_data	Array of 148 bytes	User data (S7-300 -> S7-1200)

DB302 and DB1202

The RCV_STRUCT receive structure (UDT2) of the master and the send block of the slave must be identical. Receive DB 302 consists of the two receive structures for the two S7-1200 slaves. The UDT2 receive structure or send DB 1202 consist of 160 bytes and look as follows:

Table 2-6

Name	Data type	Description
M_ID	Int	Mirrored message ID for acknowledgement
synchronized	Bool	Time-of-day synchronization acknowledgement
User_data	Array of 156 bytes	User data (S7-1200 -> S7-300)

The "User_data" can be changed individually. However, the data structure must be identical on the sending and receiving side.

Sequential processing of the send and receive jobs ensures program data consistency.

Status DB 303 offers the option of directly influencing communication errors. Due to continuous data exchange between master and slaves, data consistency can be ensured for only one cycle.

Consequently, the user has to write consistent data to the send data blocks or read consistent data from the receive data blocks within one cycle.

2.4 **Program flow**

2.4.1 Program flow in the master controller

Flowchart

The flowchart below shows the program flow in the master controller. The functionality is combined in FB300 "T-com", which is called cyclically by OB1. FB300 is realized as a step sequence.

Figure 2-5



Flowchart description

The respective slave with which data is exchanged is identified by the "index" variable.

Starting with "index" = 1, the IP address of the first slave is read from the status DB using the "IP_INT_B" function and written to the connection data block.

TCON is used to send a connection request to this slave. Since the step sequence can only be continued after acknowledging the connection request, a maximum execution time, "TIMEOUT", elapses.

This time or the "Error" feedback is output in the status DB depending on the index (slave).

Subsequently, the "SYNC" synchronization request is read from the status information for this slave. Depending on the request, the system time ("READ_CLK") is read and written to the send data block.

The "TSEND" send data block is used to transfer the contents of the send data block to the slave. Aside from the time-of-day synchronization information, an "M_ID" message ID is also transferred.

In the event of an "ERROR" message of the "TSEND" send block, the error information is written to the status structure of the "index" slave in the status DB.

The "TRCV" receive block is used to receive the data of the "index" slave and to write it to the "index" receive structure in the receive DB.

Once the maximum execution time, "TIMEOUT", is exceeded or if there is an "ERROR" message of the "TRCV" receive block, the error information is written to the status structure of the "index" slave in the status DB.

Subsequently, the connection to the slave is disconnected using the "TISCON" block. Errors when disconnecting are also output in the status DB.

Based on the receive data, the "RCV_M_ID" message ID mirrored by the slave is compared to the sent "M_ID". If the IDs differ, this information is stored in the status structure of the "index" slave in the status DB ("M_ID_unequal").

When a "SYNC" synchronization request of the "index" slave is issued, successful synchronization is checked using the receive data of the "index" slave ("synchronized"). When the result is positive, the "SYNC" synchronization request is reset for the "index" slave. Otherwise, time-of-day synchronization is repeated with this slave during the next communication.

The message ID is increased ("INC M_ID") and the "ID" is compared to the "ID_max", i.e. the maximum number of slaves. The index is increased ("INC index") until "max" is reached. Otherwise, the index is set to the initial value ("index = 1").

2.4.2 Program flow in the slave controller

Flowchart

The flowchart below shows the program flow on the slave side. The functionality is combined in FB1200 "T-com", which is called cyclically by OB1. FB1200 is realized as a step sequence.

Figure 2-6



Flowchart description

When initializing, TCON is used to send a connection request to the master. If an "ERROR" feedback is received, the status information is kept in the "TCON_ERROR_STATUS" variable. In the event of a positive acknowledgement of a set of the status of the status of the status of the set of the status of the status of the status of the set of the status of the status of the status of the set of the status o

"TCON_ERROR_STATUS" variable. In the event of a positive acknowledgement of the connection establishment, "DONE", the slave waits for data from the master via the "TRCV" block.

If an "ERROR" feedback is received from the receive block, the status information is kept in the "TRCV_ERROR_STATUS" variable.

When receiving new data, "NDR", the received "SYNC" synchronization request of the master is queried.

When there is a request, the "DnT_DTL" function is used to convert the received system time of the DATE_AND_TIME data type to DTL format and "WR_SYS_T" is used to write it to the S7-1200 system time. Subsequently, successful synchronization is signaled in the send data of the slaves via the "synchronized" bit.

The "RCV_M_ID" message ID received from the master is mirrored in the "SEND_M_ID" send data. Using "TSEND", the slave sends the send data to the master. If an "ERROR" message occurs, the "TSEND_ERROR_STATUS" error status information is stored. Finally, the slave is ready to receive again and waits for new data from the master.

When the master disconnects, the reserved connection resource to the master remains active. A new connection request using "TCON" is thus only necessary after a restart.

Installing the hardware and software

3 Configuration

3.1 Installing the hardware and software

3.1.1 Installing and wiring the hardware

Table 3-1

No.	Instruction	Note/screen shot
13.	Mount the S7-1200 modules onto a standard DIN rail.	
14.	Mount the S7-300 modules onto an S7-300 mounting rail.	
15.	Use an RJ45 Ethernet cable to connect the controllers and your programming unit to the CSM 1277.	See chapter "Connection diagram"
16.	Connect all ground connections to ground.	See chapter "Connection diagram"
17.	Connect the controllers to the voltage supply.	See chapter "Connection diagram"
18.	Insert the MICRO MEMORY CARD into the CPU 315-2PN/DP.	See Table 1-1

3.1.2 Installing the software

No.	Instruction	Note/screen shot
1.	Install STEP 7 BASIC V10.5 on your programming unit.	See Table 1-1
2.	Install Service Pack 2 for STEP 7 BASIC V10.5 on your programming unit.	See Table 1-1
3.	Install STEP 7 V5.4 on your programming unit.	See Table 1-1
4.	Install Service Pack 5 for STEP 7 V5.4 on your programming unit.	See Table 1-1

3.2.1 Assigning the IP address of the PG/PC

An IP address that is in the same subnet as the CPUs must be assigned to your PG/PC. The IP addresses of the individual nodes are shown in Figure 1-2.

To assign the IP address for your network card in the Windows XP operating system, proceed as follows:

Table 3	3-3
---------	-----

No.	Instruction	Note/screen shot
1.	Open the Windows Control Panel and select "Network Connections".	File Edit View Favorites Tools Help Back Image: Search Folders Image: Search Folders Image: Search Folders Address Image: Control Panel Image: Search Folders Image: Search Image: Search Folders Image: Search Imag
2.	Select the network card to be used and right- click to open "Properties".	Network Connections File Edt View Favorites Oracle Poders Poders Poders Address Network Connections Name Type Address Network Connections Name Type Image: Status Create a new connection Image: Status Name Disable Softice network Change Windows Firewall Image: Status Repair Name Disable Softice network Create Shortcut Disable Status Repair Disable Status Softice network View status of this Create Shortcut Defete Rename Softice network View status of this Properties Properties

No.	Instruction	Note/screen shot
3.	Select "Internet Protocol (TCP/IP)" and click on the "Properties" button.	Local Area Connection Properties General Authentication Advanced Connect using: Broadcom NetXtreme Gigabit Etherne Configure This connection uses the following items: This connection uses the following items: Simarrie PROFINET ID RT-Protocol Simarrie 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 DK Cancel
4.	 Select "Use the following IP address". Enter the following IP address: "192.168.0.241" (see Figure 1-2). Enter the following subnet mask: "255.0.0.0" (see Figure 1-2). Click on "OK" to confirm the settings. 	Internet Protocol (TCP/IP) Properties ? X 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. © Dotain an IP address automatically © Use the following IP address: 192.168.0.241 Subnet mask: 255.0.0.0 Default gateway: . © Obtain DNS server address automatically © Obtain DNS server address automatically © Use the following IP settings. 192.168.0.241 Subnet mask: 255.0.0.0 Default gateway: . . C Obtain DNS server addresses: Preferred DNS server: . Alternate DNS server: . Advanced

3.2.2 Configuring the S7-300

Configuring the PG/PC interface

To download the project and to communicate with the CPU 315-2PN/DP online, the PG/PC interface must be set as follows:

No.	Instruction	Note/screen shot
1.	 In the Windows Control Panel, select the "Set PG/PC Interface" dialog box. 	File Edit View Favorites Tools Help Back Image: Search Image: Folders Image: Folders Image: Folders Address Image: Control Panel Image: Folders Image: Folders Image: Folders Image: Control Panel Image: Folders Image: Folders Image: Folders Image: Folders Image: Control Panel Image: Folders Image: Folders Image: Folders Image: Folders Image: Control Panel Image: Folders Image: Folders Image: Folders Image: Folders Image: Control Panel Image: Folders Image: Folders Image: Folders Image: Folders Image: Control Panel Image: Folders Image: Folders Image: Folders Image: Folders Image: Control Panel Image: Folders Image: Folders Image: Folders Image: Folders Image: Control Panel Image: Folders Image: Folders Image: Folders Image: Folders Image: Folders Image: Folders Image: Folders Image: Folders Image: Folders Image: Folders Image: Folders Image: Folders Image: Folders Image: Folders
2.	 Select "S7ONLINE (STEP 7)" as access point of the application. Select "TCP/IP(Auto)" as the interface parameter assignment used for your network card. Click on "OK" to confirm the settings. 	Set PG/PC Interface Access Path LLDP Access Point of the Application: \$Z7NLINE (STEP 7) Interface (Standard for STEP 7) Interface Parameter Assignment Used: Properties TCP/IP(Auto) > Broadcom NetXtreme Gig. Properties Image: TCP/IP > Broadcom NetXtreme Gig. Diagnostics Image: TCP/IP > NdisWanlp Copy Image: TCP/IP(Auto) > Broadcom NetXtreme Gig. Delete Image: TCP/IP(Auto) > Broadcom NetXtreme Gig. Delete

Creating a connection

For open IE communication, the connection parameters are stored in a connection data block. A connection ID is assigned to each connection data set. The TCON connection block accesses this connection data block. The T communication blocks then use the connection ID to assign it to the connection data set.

To configure the connection, the S7-300 offers the Open Communication Wizard.

The following sections describe the configuration of an open IE connection using the OC Wizard.

Table 3-5	
1 4010 0 0	

3.	In the SIMATIC Manager in the S7 program of your controller, select the "Blocks" folder and right-click to open the OC Wizard.	SIMATIC Manager - [CE-X18_T-com_57-300 C:\Program Files\! File Edit Insert PLC View Options Window Help File Edit Insert PLC View Options Window Help File Edit Insert PLC File Edit Insert New Object File Structure PLC Rewire Compare Blocks Reference Data Check Block Consistency Print Rename F2 Object Properties Alt+Return Special Object Properties OC Wizard
4.	In the project, the OC Wizard searches for existing connection data blocks for open communication and displays the search result. Click on "OK" to confirm the display.	Open Communication Wizard - Upload report

5.	Select "New" and "Next >" to create a new connection.	Open Communication Wizard Upload connections List of connections ID (16#) DB/UDT Connection type Connection name Remote IP Upload New Change Copy Export Cancel
6.	Select the "ISO on TCP" protocol version and click on "Next>".	Open Communication Wizard Cannection type Choose the type of your connection. • TCP native Open, connection-oriented communication as per RFC 793. • ISO on TCP Open, connection-oriented communication as per RFC 1006. • UDP Open, connectionless communication as per RFC 768. Cancel
7.	Select "Only communication partner A shall be configured" and click on "Next >".	Open Communication Wizard Communication Partners Which communication parter would you like to configure? Communication partner A Communication partner B S7-300 or S7-400 S7-300 or S7-400 Image: Communication partner B S7-300 or S7-400 Image: Communication partner A Communication partner B S7-300 or S7-400 S7-300 or S7-400 Image: Communication partner A S7-300 or S7-400 Image: Communication partner A S7-300 or S7-400 Image: Communication partner A S7-300 or S7-400 Image: Communication partner B S7-300 or S7-400 Image: Communication partner B S7-300 or S7-400 Image: Communication partner B S7-200 or S7-400 <

8.	 Assign a specific name to the connection. Select "Active" for the connection establishment of communication partner A (S7-300). Assign the IP address of communication partner B (S7-1200). Select the integrated IE interface of your CPU 315-2PN/DP as the interface to be used. 	Open Communication Wizard Communication Partners Enter the properties of the communications partners. Connection ID: U#16# 0001 U#16# 0001 U#16# 0001 Connection name: ISO-on-TCP Connection establishment Active Passive Connection Unspecified connection partner Unspecified connection partner IP address: 000,000,000,000 192 168,0,2 Used interface: Integrated (315/317.) Image (315/317.) Rack / Stot of the CPU: P4433 Advanced (14/416) Integrated (315/315.8 CPU) 3 Rack / Stot of the CPU: Integrated (315/315.8 CPU) Integrated (2150 INT51.8 CPU) Stot Stot Stot Stot Stot Stot Stot Stot
9.	 Assign TSAP IDs for both communication partners. In this case, "S7-300" has been selected for partner A and "S7-1200" in ASCII characters has been selected for partner B. For S7-300 CPU firmware revision levels < V2.7, partner A must be checked. The TSAP ID is then prefixed with the hexadecimal ID E002. Partner B (the S7-1200) must not be checked. 	Open Communication Wizard Image: Connection parameters Connection parameters Enter the parameters for the connection. Communication partner A Communication partner B TSAP extension: Image: Specify TSAP (D Image: Communication partner B Specify TSAP (D Image: CPU 3xx (FW < V2.7), CPU 4xx (FW < V5.2)
10.	As a name for the connection data block, enter a free DB (here: "DB1").	Open Communication Wizard Choose destination project Into which STEP 7 project the blocks shall be compiled? STEP 7 project: C:\Program Files\Siemens\Step7\s7proj\test Communication partner A Name: DB1 Block folder: test\SIMATIC 300(1)\CPU 315-2 PN/DP\S7 Program(1)\Blocks Communication partner B Name: (absolute or symbolic, eg. UDT 65 or "TCON_PAR") Block folder: Cancel < Previous

11.	Select "Next>" to confirm the overview of connections	Open Communication Wizard Image: State Sta
12.	Select "Finish" to confirm the compilation report and click on "Yes" to confirm the following message.	Open Communication Wizard Compilation report Would you like to configue yet another connection? The following UDTs / DBs were compiled successfully: DB1 Compilation report: 10/02/09 14:19:28: COMPILE von tmp8.av1 Compile: tsst\SINATIC 300(1)\CPU 315-2 PN/DP\S7 Program (1)\Sources\tmp8.av1 Compiler result: 0 Brror(s), 0 Open Communication Wizard Image: Configure another connection. Ves Cancel Cancel
13.	 The connection data structure of the generated DB1 connection data block starts with the symbolic name "OUCW_1". Thus enter "DB1.OUCW_1" as an address for the connection data on the CONNECT parameter of the TCON connection block. Parameterize the "ID" input with the assigned "W#16#1" connection ID. This connection ID also has to be specified for the other T communication blocks: TSEND, TRCV and TDISCON. 	Image: Struct Structure Struct Structure Image: Struct Structure Struct Structure Image: Struct Struct Structure Struct Structure Image: Struct Struct Structure Struct Structure Image: Struct Struct Structure Struct Struct Structure Image: Struct Stru

Setting the synchronization time

The CPU 315-2PN/DP is the time-of-day master for synchronizing the S7-1200 slaves. The interval for time-of-day synchronization can be set by configuring the time-of-day interrupt. Aside from this automatic synchronization, each slave can also be synchronized manually using the variable table.

Note UTC time (Universal Time Coordinated) is the system time for both the S7-300 and the S7-1200.

No.	Instruction	Note/screen shot
1.	In the "CE-X18B_Master_v1d2" STEP 7 project, double-click on the hardware configuration to open it.	SIMATIC Manager - [CE-X18_T-com_57-300 Ci/Program Files File Edit Insert PLC View Options Window Help Image: Simatic Stress of the stress
2.	Double-click on the CPU 315-2PN/DP to open the Properties.	Image: Head Configure (SIMATIC 300(1) (Configuration) CE-X1) Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options Window Help Image: Station Edit Insert PLC View Options View
3.	 In the "Time-of-Day Interrupts" tab, activate OB10. For Execution, select "Every day". Specify the time of day when the slaves are to be synchronized every day. Click on "OK" to confirm the settings. 	Properties - CPU 315-2 Ph/DP - (R0/S2) X General Statup Synchronous Cycle Interrupts Diagnostics/Clock Protection Communication Web Cycle/Clock Memory Retentive Memory Interrupts Time-of-Day Interrupts Cycle/Clock Priority Active Execution Stat date Time of Day PIP 0B10 2 r Every day V1/01/1934 0.000 - Y 0B11: 0 None Y1/01/1934 0.000 - Y 0B13: 0 None Y1/01/1934 0.000 - Y 0B14: 0 None Y1/01/1934 00.00 - Y 0B15: 0 None Y1/01/1934 00.00 - Y 0B17: 0 None Y1/01/1934 00.00 - Y 0B17: 0 None Y1/01/1934 00.00 - Y 0B17: 0 None Y1/01/1934 00.
4.	 Click on the "Save and Compile" button. Finally, you have to download the changed hardware configuration to the CPU. 	HW Config - [SIMATIC 300(1) (Configuration) Station Edit Insert PLC View Options Windo Image: Station Edit Insert PLC View Options View

Downloading the master project to the controller

Unzip the "CE-X18B_Master_v1d2.zip" sample program to any directory on your hard drive.

The unzipped file includes the "CE-X18B_Master_v1d2" project for the CPU 315-2PN/DP.

Table 3-	-7
	-

No.	Instruction	Note/screen shot
1.	Open the "SIMATIC Manager".	SIMATIC Manager
2.	Click on the "Open Project/Library" button.	SIMATIC Manager File PLC View Options Window Help P P P Project/Library
3.	Click on the "Browse" button.	Open Project × User projects Libraries Sample projects Multiprojects Name Storage path • Selected User projects: • User projects: Elected • Sample projects: Browse ØK Cancel Help
4.	 Navigate to the folder to which you have unzipped the sample project and select the "CE-X18B_Master_v1d2" S7-300 project. Click on "OK" to confirm the opening of the project. 	Browse Found Salected CVEX18_T-com/CEX18_T-com_S7:300 User projects: 1 Selected 1 1

No.	Instruction	Note/screen shot
5.	 The SIMATIC Manager opens the S7-300 project. Select the "SIMATIC 300(1)" station. Right-click and select "PLC" -> "Download" to download the entire project. 	Image: - [CE-X18_T-com_\$7-300 -C:\CE-X18_T-com_\$7-30 Image: - [CE-X18_T-com_\$7-300 -C:\CE-X18_T-com_\$7-30 Image: - [CE-X18_T-com_\$7-300 Image: - [CE-X18_T-com_\$7-300 Image: - [CE-X18_T-com_\$7-300 Image: - [CE-X18_T-com
6.	 The window for selecting the node address opens. Click on the "View" button to display a list of accessible nodes. 	Select Node Address X Over which station address is the programming device connected to the module CPU 315:2 PN/DP? Rack: Image: Station: Image: Station: Image: Carl be reached by means of gateway Enter connection to target station: Image: Address: MAC address: Module type Station: Image: Station: <t< td=""></t<>
7.	 From the list of accessible nodes, select the S7-300 CPU (identified by the MAC address). Click on "OK". 	Select Node Address X Over which station address is the programming device connected to the module CPU 315-2 PN/DP? Rack: Image: Station: Slot: Image: Station: Target Station: Image: Station: Image: Station: Image: Station:

No.	Instruction	Note/screen shot
8.	Once the project has been successfully downloaded, set the CPU to "RUN" mode.	Properties - Program (online) (13:4363) Image: CPU 315-2 PN/DP [R 0/S 2] is in the STOP mode. Do you want to start the module now (complete restart)? Yes

3.2.3 Configuring the S7-1200

Creating a connection

The connection parameters are stored in a connection data block. A connection ID is assigned to each connection data block. The TCON connection block accesses this connection data block. The TRCV, TSEND and TDISCON T communication blocks then access the connection parameters via the connection ID.

To configure the connection, the S7-1200 offers the Connection Wizard.

The following sections describe the configuration of an open IE connection using the Connection Wizard.

Ta	ble	3-8

1.	 In the "CE-X18B_Slave_v1d2.ap10" project in the PLC for which the connection is to be created (here: "PLC_1"), open FB1200 "T-com". 	Siemens - CE-X18_T-com_S7-1200 Project Edit View Insert Online Op Project tree Devices Project tree Output CE-X18_T-com_S7-1200 Add new device Devices & Networks PLC_1 [CPU 1214C DQ/DQ/DC] Program blocks Program blocks Program blocks Program blocks Pont_DTL [FC1200]
2.	 Open network 1. Select the "TCON" block. Open the "Properties". In the "Configuration" tab, select "Connection parameter". 	Wetwork 1: 100H Commerce 50H VICUL_R2 10H VICUL_R2 10H <

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3.	 As an end point for the partner (S7-300), select "Unspecified". Enter the IP address of the partner. Select the "ISO-on-TCP" connection type. For connection ID, enter "1". In "Connection data", select the symbolic name of the connection data block. For the local TSAP, select the "S7- 	Connection parameter
	 For the partner TSAP in Select the SP1 1200" ASCII string. For the partner TSAP ID, select the hexadecimal string of communication partner A from step 9 in Table 3-5. 	Establish active connection Establish active connection Establish active connection Address details Local TSAP TSAP (ASCII): S7-1200 TSAP ID: S3 37 20-31 32 30 30 E0 02 55 37 20-33 30 30

Downloading the slave project to the controllers

Unzip the "CE-X18B_Slave_v1d2.zip" sample program to any directory on your hard drive.

The unzipped file includes the "CE-X18_ T-com_S7-1200" project for the two S7-1200 controllers.

No.	Instruction	Note/screen shot
1.	 In Windows Explorer, navigate to the "CE- X18_ T-com_S7-1200.ap10" S7-1200 project and open it with a double-click. 	CE-X18_T-com_S7-1200 File Edit View Favorites Tools Help • Back • • • • • • • • • • • • •
2.	The project opens in STEP 7 Basic.Open the project view.	Staret - C2312 - 32 cm - 3ever Staret

No.	Instruction	Note/screen shot
3.	 Select the two PLC folders "PLC_1 [CPU 1212C DC/DC/DC]" and "PLC_2 [CPU 1214C DC/DC/DC]". Click on the "Download to Device" button to download the entire projects to the controllers. 	Siemens - CE-X18_T-com_S7-1200 Project Edit View Insert Online Options Tools W Image: Save project Image:
4.	 Select the network card you are using. Enable "Show all accessible devices". From the list of accessible devices, identify PLC_1 using the MAC address or "Flash LED". Select the desired controller and click on the "Load" button. Repeat these two steps to download PLC_2. 	Extended download to device X Configured access nodes of "ICC_1" Process type PIC_1 Online type PIC_1 PIC PIC_1 PIC PIC PIC
5.	 Enable consistent downloading for both controllers. Click on the "Load" button. 	Load preview X Check before loading Message Action Status 1 Farjet Message Action Image: Status - Program Blocks Download program coststerely? Image: Status Image: Status Image: Status - Program Blocks Download program coststerely? Image: Status
6.	 After transferring all program blocks to the controllers, a "Load results" window appears. Check the "Start all" boxes to set both controllers to "Run" mode. Click on the "Finish" button to finish the download. 	Load results X Image: The set of control of the state of th

3.3 Activating online mode

To control and monitor communication, your PG/PC must be set to online mode for the S7-1200 and the S7-300 using the watch/variable table.

Activating the watch table for the S7-300 master

Table 3-10	
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No.	Instruction	Note/screen shot
1.	In the SIMATIC Manager in project name -> station name -> CPU -> "Blocks" container, select the "VAT_1" variable table.	SIMATIC Manager - [CE-X18_T-com_S7-300 C:\CE-X18_T- Pile Edit Insert PLC View Options Window Help □
2.	Use the "Monitor variable" button to activate the variable table.	War - [VAT_1 CE-X18_T-com_57-300\SIMATIC 300(1)\CPU 315-2 PN/DP\ Table Edit Insert PLC Variable View Options Window Help Image: Comparison of the second
3.	 Ine variable table contains (row numbers in brackets): Instance data block of FB300 (2-12) Specified initial values (2-7) Return values of the "BLKMOV" and "read system time" functions (8-10) Step (11) Index (12) Hexadecimal IP address in the connection data block (14) Send data block (16-26) Message ID (16) Synchronization request (17) Master system time in DATE_AND_TIME format (18-25) First user data byte (26) Receive data of slave 1 (28-30) Message ID (28) Synchronization acknowledgement (29) First user data byte (30) Status information of slave 1 (32-47) IP address (32-35) Synchronization request (36) Communication error analysis (37-47) 	Table Edit Insett PLC Variable Wew Options Window Help Address Syntod Despiny formal Status Imiliatione-DE for FB3001-1-cmir Imiliatione-DE for FB3001-1-cmir Despiny formal Status value Imiliatione-DE for FB3001-1-cmir DEC 2 Despiny formal Status value Imiliatione-DE for FB3001-1-cmir DEC 302 Status value Despiny formal Status value Imiliatione-DE for FB3001-1-cmir DEC 302 Status value Despiny formal Status value Imiliatione-DE for FB3001-1-cmir DEC 302 Status value Despiny formal Status value Imiliatione-DE for FB3001-1-cmir DEC 303 Despiny formal Status value Imiliatione-DE for FB3001-1-cmir Status value DEC 0 Despiny formal Status value Imiliatione-DE for FB3001-1-cmir DEC 0 DEC 0 DEC 0 Imiliatione-DE for FB3001-1-cmir DEC 0 DEC 0 DEC 0 DEC 0 DEC 0 DEC 0
	• Status information of slave 2 (53-68)	

Activating the watch table for the S7-1200 slaves

No.	Instruction	Note/screen shot
1.	 In the STEP 7 Basic project navigation, select "PLC_1" -> "Watch tables" -> "Watch table_1". 	Siemens - CE-X18_T-com_S7-1200 Project Edit View Insert Online Project tree Project tree Devices Project CE-X18_T-com_S7-1200 Add new device Devices & Networks PLC_1 [CPU 1214C DC/DC/DC] Project configuration Online & diagnostics Program blocks PLC tags PLC tags Add new Watch table
2.	• Use the "Monitor all" button to activate the watch table.	CE-X18_T-com_S7-1200 → PLC_1 → Watch tables → Watch table_1 Image: Im
3.	 Repeat steps 1 and 2 for slave 2: PLC_2 [CPU 1212C DC/DC/DC] Watch table_2 	

Activating online mode

No.	Instruction	Note/screen shot	
4.	Each watch table contains the following information (row numbers in brackets):	CEX18_T-com_S7-1200 → PLC_1 → Watch tables → Watch table_1	
	 Bosoivo data block (2.12) 	Name Address Display format Monitory	/alue
		1 //Receive-DB	
	- Message ID (2)	2 "Receive_DB".M_ID %DB1201.DBW0 DEC_signed -17842	
		3 "Receive_DB".sync_CLK %DB1201.DBX2.0 Hex 0	
	 Synchronization request (3) 	4 "Receive_DB".READ_CLK_CDT[0] %DB1201.DBB4 Hex 10	
	Cynonicalization roquoot (C)	S RECEIVE_DB_READ_CLK_CDT[1] %0B1201.0885 Hex 08	
	 Master system time in 	7 "Receive_DB.*READ_CLK_CDT[3] %DB1201.0500 Hex 02	
		B "Receive DB" READ CLK CDT[4] %DB1201 DBB8 Hex 00	
	DATE_AND_TIME format (4-11)	9 "Receive DB".READ CLK CDT[5] %DB1201.DBB9 Hex 00	
		10 "Receive_DB".READ_CLK_CDT[6] %DB1201.DBB10 Hex 06	
	 First user data byte (12) 	11 "Receive_DB".READ_CLK_CDT[7] %DB1201.DBB11 Hex 92	
		12 "Receive_DB".User_data[0] %DB1201.DBB12 Hex 00	
	 Time-of-day synchronization data (14-15) 	13 //clock synchronization	
		14 "T-com_DB".WR_SYS_T_IN.YEAR DEC_unsigned 2010	
	 Converted master system time in DTL 	15 "T-com_DB".WR_SYS_T_IN.MONTH DEC_unsigned 8	
	format (11 01)	16 "T-com_DB".WR_SYS_T_IN.DAY DEC_unsigned 2	
	101mat (14-21)	17 "T-com_DB".WR_SYS_T_IN.WEEKDAY DEC_unsigned 2	
	Deturn value of the "write evetern	18 "T-com_DB".WR_SYS_T_IN.HOUR DEC_unsigned 10	
	- Return value of the write system	19 "T-com_DB".WR_SYS_T_IN.MINUTE DEC_unsigned 0	
	time" function (22)	20 "I-com_DB_WR_SYS_T_IN.SECOND DEC_Unsigned U	
		21 F-com_DB_WR_SYS_T_IN.NANOSECOND DEC_Unsigned 3200000	10
	 Send data block (2/1-26) 	22 Pedingbe www.originglet.vwc	
		24 "Send DB" M ID %DB1202 DBW0 DEC signed -17842	
	Mirrored message ID (24)	25 "Send DB" synchronized %DB1202.DB×2.0 Hex 0	
		26 "Send_DB".User_data[0] %DB1202.DBB4 Hex 00	
	 Synchronization acknowledgement 	27 l/control	
		28 "T-com_DB".step DEC_signed 10	
	(25)	29 "T-com_DB".TCON_ERROR Bool FALSE	
		30 "T-com_DB".TCON_ERROR_STATUS Hex 0000	
	 First user data byte (26) 	31 "T-com_DB".TRCV_ERROR Bool TRUE	
	, , ,	32 "T-com_DB".TRCV_ERROR_STATUS Hex 80C4	
	 Status information (28-34) 	33 "T-com_DB".TSEND_ERROR Bool FALSE	
		Prom_DB_ISENU_EXKOR_STATUS Hex 0000	
	- Step (28)		
	 Communication error analysis (29-34) 		

3.4 Live demo

3.4.1 Cyclic sequence

Table 3-12

No.	Instruction	Note/screen shot
No.	 Instruction FB300 "T-com" of the master is called cyclically (which is indicated by the step display change in row 11). The FB1200 "T-com" function blocks of the slaves are called cyclically (which is indicated by the step display change in rows 29). The master continuously communicates with slaves 1 and 2 (indicated by the index change in row 12 and the hexadecimal IP address in row 14). Message IDs with even numbers are sent to slave 1 where they are mirrored and received again. Message IDs with uneven numbers are sent to slave 2 where they are mirrored and received again. 	Note/screen shot War- VAL @CE-XEA Construct 200(1)/CPU 315-2 PM/0P/S7 Program(1) ONLT Stable Death PLC Variable View Or Wriden View Image: Colspan="2">Image: Colspan="2" Image: Colspan="2" I
		2 "Receive_D8" M_JD %DB1201.DBW0 DEC_signed 31537 23 ///Send-D8 ///Send-D8 DEC_signed 31537 24 "Send-D8" M_JD %DB1202.DBW0 DEC_signed 31537 27 ///Gontrol DEC_signed 31537 28 "T-com_D8" step DEC_signed 10

3.4.2 User data transfer

S7-300 master -> S7-1200 slaves

No.	Instruction	Note/screen shot
1.	 As an example of transferring user data from the master to the slaves, send byte 0 of the user data field in row 26 is to be changed: Enter a value in the "Modify value" column in row 26. Use F9 to apply the value. 	War-[VA1_1 - @CE-X10_[-com_S7-300\SIMATIC 300(1)(CPU 315-2 PN/DP\S7 Program(1) 0* Image: State in the three the C variable vew Options Window Help Image: State in the three thr

Live demo

No.	Instruction	Note/screen shot
2.	The value is transferred to both slaves and written to receive byte 0 of the user data field in receive data block 1201 (as can be seen in rows 12 of the slave watch tables).	Image: Symbol Display format By Balling or C (Construction) By Balling or C (Construction)
		CE-X18_T-com_\$7-1200 > PLC_2 > Watch tables > Watch table_2
		2 國現單外後後下.F. 대 11 11 11 11 11 11 11 11 11 11 11 11 1
		Name Address Display format Monitor valu
		12 "Receive_DB".User_data[0] %DB1201.DBB12 Hex 33

S7-1200 slave 1 -> S7-300 master

No.	Instruction	Note/screen shot
1.	 As an example of transferring user data from slave 1 to the master, send byte 0 of the user data field in row 26 is to be changed: Open "Watch table_1" and enter a value in the "Modify value" column in row 26. Right-click and select "Modify" -> "Modify now" to apply the value. 	Siemens - CEX18 -com_S7-1200 Project Edit View Insert Online Options Tools > Totally Im Save project 2 X 2 X 2 X 2 X 2 X 2 X 2 X 2 X 2 X 2
2.	The value is transferred to the master and written to receive byte 0 of the user data field of the receive structure for slave 1 (as can be seen in row 30 of the master variable table).	Siemens - CE-X18_T-com_S7-1200 Project Edit View Insert Online Options Tools > Image: Signal

S7-1200 slave 2 -> S7-300 master

No.	Instruction	Note/screen shot
1.	 As an example of transferring user data from slave 2 to the master, send byte 0 of the user data field in row 26 is to be changed: In "Watch table_2"´, enter a value in the "Modify value" column in row 26. Right-click and select "Modify" -> "Modify now" to apply the value. 	Siemens - CE-X18_T-com_S7-1200 Project Eff. View Image: Colspan="2">Totally in Project Silve project X Image: Colspan="2">Totally in Image: Colspan="2">Silve project Image: Colspan="2">Totally in Image: Colspan="2"Silveproject Image: Colspan="
2.	The value is transferred to the master and written to receive byte 0 of the user data field of the receive structure for slave 2 (as can be seen in row 51 of the master variable table).	Siemens - CE-X18_T-com_\$7-1200 Project Edit View Insert Online Options Tools > CEX18_T-com_\$7-1200 > PLC_2 > Watch tables > Watch table_2 Project Edit Options Tools > Project Edit Tools Prove Poter Project Poter P

3.4.3 Time-of-day synchronization

Manual synchronization of one slave

Slave 1 is to be manually synchronized with the master system time. Table 3-16 shows the procedure. Slave 2 can be synchronized using the same procedure.

1.	• Right-click and select -> "Modify Address to 1" (row 36 in the master variable table) to set the synchronization request in the status structure for slave 1.	War - [VAT_1 - @CE-X18_T-com_57-300\SIMATIC 300(1)\CPU 315-2 PN/DP\57 Table Edit Insert PLC Variable View Options Window Help Image: Comparison of the second sec
2.	 The system time is written to the send data in DATE_AND_TIME format (rows 18-25). The synchronization request in the send data is set (row 17). The send data is sent to slave 1, including index 1 (row 12). 	Var VAr - @CE-X18_T-com ST-300/SIN411C 300(1)/CPU 315-2 PM/DP/S7 Prog Table Edit Insert PLC Variable View Options Window Help Main Image: Status Imag
3.	 The time-of-day synchronization data is written to the receive block of slave 1 ("Watch table_1", rows 3-11). The converted synchronization time of the DTL data type is written to the S7-1200 system time (rows 14-22). After successful time-of-day synchronization, the synchronization acknowledgement is set (row 25). 	Siemens - CE-X18_T-com_S7-1200 Project Edit View Inset Online Options Tools Window Help Project Edit View Inset Online Options Tools Window Help Project Edit View Inset Online Options Tools Window Help Project Edit View Inset Online Options Tools Window Help Project Edit View Inset Online Options Tools Window Help Project Edit View Inset Online Options Tools Window Help Project Edit View Inset Online Options Tools Window Help Project Edit View Inset Online Options Tools Window Help Project Edit View Inset Online Options Tools Window Help Project Edit View Inset Options Tools Window Help Project Distribution Options Tools Window Help Project Edit View Inset Options Tools Window Help Project Distribution Options Tools Window Help Provenue Distribution Options Tools Window Help Provenue Distribution Options Tools Window Help Provenue Distribution Options Tools Window Help Receive Distribution Options Tools Window Help
4.	 On the master side, the synchronization acknowledgement is written to the receive structure of slave 1 (row 29). The synchronization request in the status structure for slave 1 is reset (row 36). 	War - [VAT_1 - @CE-X18_T-com_\$7-300\SIMATIC 300(1)\CPU 315-2 PN/DP\S7 Proc Image: Status and Status

Automatic synchronization of all slaves

In chapter 3.2.2, the daily synchronization time of all slaves has been set to 00:00. To test this function, the master system time is set to 11:59 PM.

No.	Instruction	Note/screen shot		
1.	In Step 7 V5.4, select "PLC" -> "Diagnostic/Setting" -> "Set Time of Day".	Image MC State State Manager MC System Image MC System Site State Manager MC System Image MC System Site State Manager MC System Image MC System Site State Manager MC System		
2.	 Uncheck "Take from PG/PC". Set the module time to "11:59:59 PM". Apply the settings. 	Set Time of Day X Path: CE-X18_T-com_S7-300\SIMATIC 300(1)\CPU 315- Online: Order No.: 6ES7 315-2EH13-0AB0 Name: CPU 315-2 PN/DP Date: Time of Day: PG/PC time: 08/04/2010 05:20:15 PM Module time: 08/04/2010 11:59:59 PM Take from PG/PC More >>		
3.	The written system time of the slaves can be used to check whether the time-of-day synchronization of the slaves has been successful (rows 14-21 in "Watch table_1" and "Watch table_2").	Stemens - CF-X18_T-com_SY-1200 Project Edit View Insert Online Options Tools Window Help Image: Start Sta		

3.4.4 Communication errors

The Ethernet cable of slave 1 is removed to demonstrate communication error analysis.

Table 3-16 describes the procedure.

The same procedure can be used to simulate and analyze the interruption of communication with slave 2.

Tab	le	3-1	8
			_

No.	Instruction	Note/screen shot
1.	Remove the Ethernet cable from the LAN port of slave 1.	
2.	 The step sequence stops (row 11) when communicating with slave 1 (row 12) and waits for slave 1 to confirm the connection establishment. Once the timeout time of one second (row 7) has elapsed, the step sequence continues and the timeout message occurs in the status structure for slave 1 (row 38). The TSEND and TRCV communication blocks report errors (rows 39 and 40) with their error statuses (rows 45 and 46). In addition, the discrepancy between the sent message ID (row 16) and the ID last received from slave 1 (row 24) is identified and output in row 28. Data exchange with slave 2 still takes place correctly (rows 58-68). While slave 1 is not accessible, a new attempt to establish a connection to slave 1 generates the same error profile. 	Var VAT I= @CE-X18 T-com. 57-300/SIMATIC 300(1)/CPU 315-2 PV/DP/S7 Program(1) DN Table Edit Insert PLC Variable Wein Options Window Heip Table Edit Insert PLC Variable Wein Options Window Heip Table Edit Insert PLC Variable Image: Plant Options Edit Options Edit Options Edit Options Edit Options Edit Image: Plant Image: Plant <t< td=""></t<>
3.	Reconnect the Ethernet cable to the LAN port of slave 1.	

No.		Instruction			Note/screen sh	ot	
4.	•	After connection recovery has been identified, the error bits are reset in the	強いし	Var-[VAT_1@ Table Edit Insert ₩ _ D 🚅 🖬 🤞	E-X18_T-com_57-300\5IMATIC 300(1)\C PLC Variable View Options Window He	PU 315-2 PN/DP P ?	'\ 57 Program(1) ON 제 66(비리 40
		status structure for slave 1 (rows 37-43)		Address	Symbol	Display format	Status value
			1	//Instance-DB for	FB300 "T-com"		
	•	Data exchange with slave 1 has been	7	DB300.DBW 10	"T-com_DB".TIMEOUT	SIMATIC_TIME	S5T#1s0ms
			11	DB300.DBW 18	"T-com_DB".step	DEC	4
		restored.	12	2 DB300.DBW 20	"T-com_DB".index	DEC	1
			13	3 //IP-address in co	nnection DB	1	
	٠	The error statuses of the TSEND (row 45)	14	DB1.DBD 34		HEX	DVV#16#C0A80002
		and TPCV (row 46) communication blocks	15	DDDDd DDW/ 0	Incred DDI (CDID, Character ID)	050	05050
			10	/Resolution data 1	Send_DB_SEND_Struct.M_D	DEC	25256
		include the status information of the last	20	DB302 DB44 0	"Receive DB" RCV Struct 1 M ID	DEC	25254
			34	(Status for index	=1	DEC	23234
		errors.	32	DB303 DBMC 0	"Status DB" Status 1 IR ADDR[1]	DEC	192
			33	DB303 DBM/ 2	"Status DB" Status 1 IR ADDR[2]	DEC	162
			34	DB303 DEVV 4	"Status DB" Status 1 IP ADDR[3]	DEC	0
			35	DB303.DBW 6	"Status DB" Status 1 IP ADDR[4]	DEC	2
			37	DB303.DBX 8.1	"Status DB" Status 1 TCON ERROR	BOOL	false
			38	B DB303.DBX 8.2	"Status DB".Status 1.TCON TIMEOUT	BOOL	false
			39	DB303.DBX 8.3	"Status_DB".Status_1.TSEND_ERROR	BOOL	false
			40	DB303.DBX 8.4	"Status_DB".Status_1.TRCV_ERROR	BOOL	false
			41	DB303.DBX 8.5	"Status_DB".Status_1.TRCV_TIMEOUT	BOOL	false
			42	2 DB303.DBX 8.6	"Status_DB".Status_1.TDISCON_ERROR	BOOL	false
			43	DB303.DBX 8.7	"Status_DB".Status_1.M_ID_UNEQUAL	BOOL	false
			44	DB303.DBW 10	"Status_DB".Status_1.TCON_ERROR_STATUS	HEX	VV#16#0000
			45	5 DB303.DBW 12	"Status_DB".Status_1.TSEND_ERROR_STATU	S HEX	W#16#80C4
			46	DB303.DBW 14	"Status_DB".Status_1.TRCV_ERROR_STATUS	HEX	VV#16#80C4
			47	7 DB303.DBWV 16	"Status_DB".Status_1.TDISCON_ERROR_STAT	HEX	V/#16#0000
			48	8 //Receiving data 1	rom Slave 2		
			49	DB302.DBWV 160	"Receive_DB".RCV_Struct_2.M_ID	DEC	25255
			52	2 //Status for index	= 2	050	100
			53	DB303.DBW 18	"Status_DB".Status_2.IP_ADDR(1)	DEC	192
			54	DB303.DBW 20	"Status_DB".Status_2.IP_ADDR(2)	DEC	168
			55	DB303.DBW 22	"Status_DB".Status_2.IP_ADDR[3]	DEC	2
			58	DB303.DBV 24	"Status_DB .Status_2.IF_ADDR[4]	BOOL	falce
			59	DB303 DBX 26.	P "Status DB" Status 2 TCON TIMEOUT	BOOL	false
	1		60	DB303.DBX 26.	3 "Status DB" Status 2.TSEND ERROR	BOOL	false
	1		61	DB303.DBX 264	Status DB" Status 2.TRCV ERROR	BOOL	false
	1		62	2 DB303.DBX 26.5	5 "Status_DB".Status_2.TRCV_TIMEOUT	BOOL	false
	1		63	DB303.DBX 26.6	Status_DB".Status_2.TDISCON_ERROR	BOOL	false
	1		64	DB303.DBX 26.3	"Status_DB".Status_2.M_ID_UNEQUAL	BOOL	false
			65	DB303.DBW 28	"Status_DB".Status_2.TCON_ERROR_STATUS	HEX	VV#16#0000
	1		66	DB303.DBW 30	"Status_DB".Status_2.TSEND_ERROR_STATU	S HEX	VV#16#0000
			67	DB303.DBW 32	"Status_DB".Status_2.TRCV_ERROR_STATUS	HEX	VV#16#0000
1	1		68	DB303.DBW 34	"Status_DB".Status_2.TDISCON_ERROR_STA1	HEX	VV#16#0000

3.4.5 Master power failure

After power recovery of the master, the step sequence of FB300 "T-com" continues from the last executed position.

4 Code Elements

This example uses the following program codes:

Table 4-1

No.	File name	Contents
1.	CE-X18B_Master_v1d2.zip • CE-X18_ T-com_S7-300	Zip file with the S7-300 master project for deterministic T communication
2.	CE-X18B_Slave_v1d2.zip CE-X18B_Slave_v1d2.ap10	Zip file with the S7-1200 slave project for deterministic T communication

5 History

Table 5-1

Version	Date	Modification
V1.0	01/13/10	T-communication via the integrated S7-300 CPU interface (task A) and via a S7-300 CP (task B)
V1.1	02/10/10	Extensions in chapter 2.3: S7-1200 Data transfer
V1.2	08/31/10	Modification of the automation task in deterministic data exchange via T communication (task B)