User Manual

3964R

Handshake Mechanism

Hilscher Gesellschaft für Systemautomation mbH

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1 Introduction

1.1 Introduction to this Manual

This manual provides information about the handshake mechanism for serial 3964R communication.

The 3964R protocol for serial data transfer is used on netTAP NT 100 and netBRICK NB 100 gateway devices.

1.1.1 List of Revisions

Index	Date	Chapter	Revision
1	2010-04-16	All	Created
2	2011-05-30	1.1.2	Section *Reference to Firmware and Software*: Firmware version updated Firmware for netBRICK added
		2.3.1.2	Section *3964R to Superordinated Control Unit*: Bit PROT_HS_RUN_IND (bit 3) added

Table 1: List of Revisions

1.1.2 Reference to Firmware and Software

Firmware

Firmware File	Firmware Version
NTxxxASC.NXF netTAP NT 100 firmware with 3964R protocol	1.4.4.x or higher
NBASCxxx.NXF netBRICK NB 100 firmware with 3964R protocol	1.4.4.x or higher

Table 2: Reference to Firmware

Software

Software	Software Version
SYCONnet netX setup.exe	1.310.x.x

Table 3: Reference to Software

1.1.3 Conventions in this Manual

Operation instructions, a result of an operation step or notes are marked as follows:

Operation Instructions:

➢ <instruction>

Or

1. <instruction>
2. <instruction>

Results:

➮ <result>

Notes:

Important: <important note>

Note: <note>

<note, were to find further information>

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2 3964R

2.1 Introduction

The superordinated control unit communicates with a cyclically running protocol with the netTAP respectively with the netBRICK device. However, 3964R works acyclically (job oriented). A handshake mechanism is necessary to connect both communication types. Therefore synchronization registers are included in the transfer structure to the 3964R protocol

The following figure shows that data from the 3964R protocol can be mapped to the protocol on port X2 and data from port X2 can be mapped to the 3964R protocol. In this mapping, the synchronization registers are included as well as the user data.

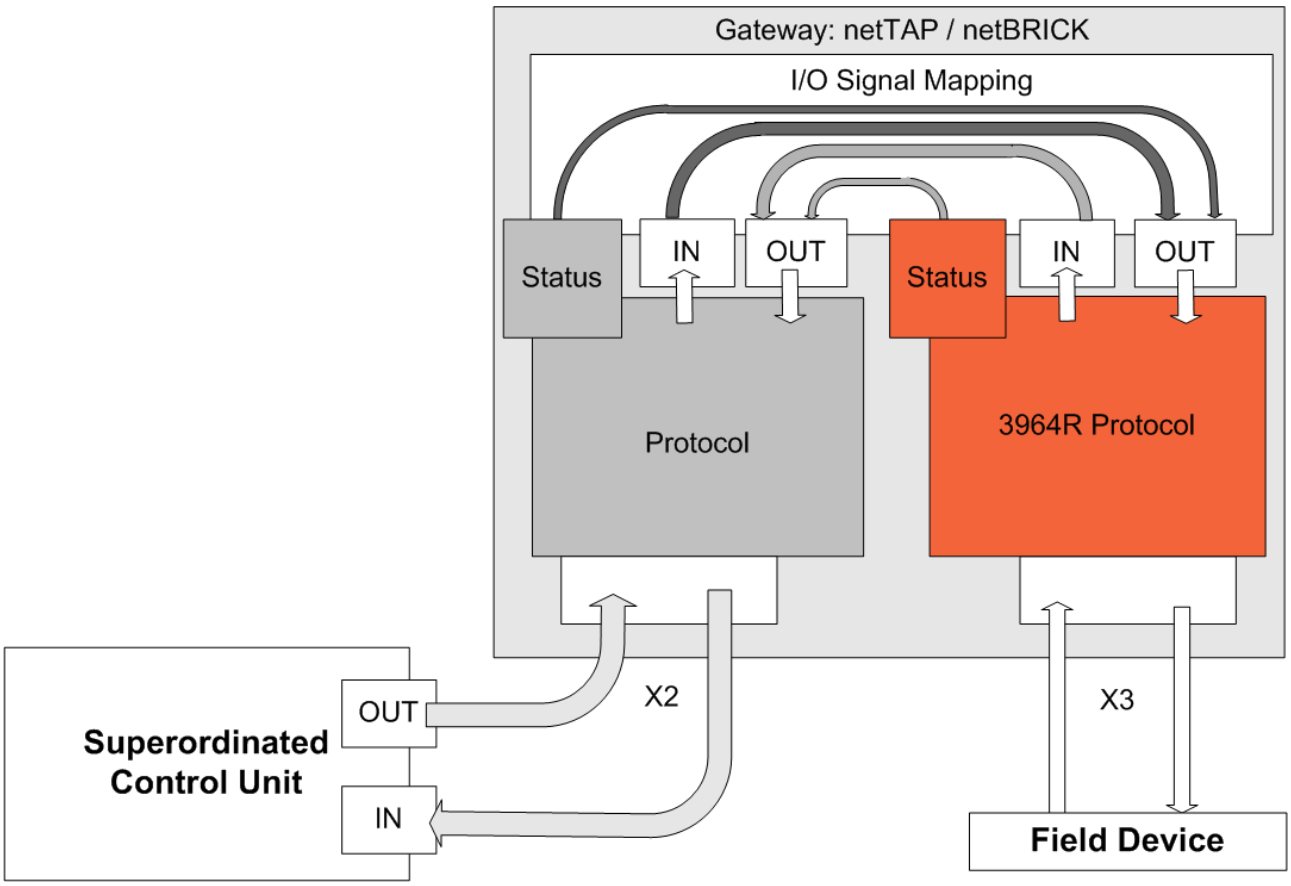

Figure 1: Principal Mapping of the Data between the Protocols

The signal mapping of the data is configured with the configuration software SYCON.net.

2.2 I/O Data Structure for the Transfer to and from the Control Unit

2.2.1 Structure for Output - Data from the Control Unit

Data Type	Signal	Signal for mapping in SYCON.net
UINT32	Output synchronization register	Application handshake flags
UINT32	Amount of user data (counted in bytes) to be transferred	Byte count of OutData
Array of Bytes[0 … 5711]	Output User data for the superordinated control unit and send user data for 3964R	OutData.UNSIGNED8_0000 OutData.UNSIGNED8_0001 … OutData.UNSIGNED8_5711

Table 4: 3964R – Structure for Output – Data from the Control Unit

2.2.2 Structure for Input - Data to the Control Unit

Data Type	Signal	Signal for mapping in SYCON.net
UINT32	Input synchronization register	Protocol handshake flags
UINT32	Amount of user data (counted in bytes) o be transferred	Byte count of InData
UINT32	Error register to transfer error information about receive errors	Error code in case of receive error
UINT32	Error register to transfer error information about transmit errors	Error code in case of transmit error
Array of Bytes[0 … 5711]	Receive user data for 3964R and input user data for the superordinated control unit	InData.UNSIGNED8_0000 InData.UNSIGNED8_0001 … InData.UNSIGNED8_5711

Table 5: 3964R – Structure for Input – Data to the Control Unit

2.3 Handshake and Initialization of the I/O Communication

The data transfer is between the control unit and the 3964R protocol is organized by a transfer method within the I/O data transfer memory.

The basic idea of this method is: for each action, a pair of bits is used in both synchronization registers. One bit is used to request an action, and the other is used to acknowledge the action. One is located in the input synchronization register, and the other in the output synchronization register.

One action is requested by setting the command bit unequal to the acknowledge bit. The other side acknowledges this request by setting the acknowledge bit equal to the command bit.

2.3.1 Structure of the Synchronization Register in the I/O Data

2.3.1.1 Superordinated Control Unit to 3964R

Structure of the synchronization register of the control unit to 3964R:

Bit No.	Name and Description
0	**APP_HS_TX_CMD** Command from the control unit to send output data to 3964R. Is checked by 3964R automatically.
1	**APP_HS_RX_ACK** Acknowledge received input data in the control unit. The bit is checked automatically within 3964R.
2 … 5	Not used and reserved
6	**APP_HS_TX_ENABLE_CMD** Enable the output user data transfer from the control unit to 3964R. If this bit is not set, then 3964R will not evaluate requested commands via the bit **APP_HS_TX_CMD**.
7	**APP_HS_RX_ENABLE_CMD** Enable the input user data transfer from 3964R to the control unit. If this bit is not set, then 3964R can not requested commands via the bit **APP_HS_RX_CMD**.
8 … 31	Not used and reserved

Table 6: 3964R – Synchronization Register to 3964R

2.3.1.2 3964R to Superordinated Control Unit

Structure of the synchronization register from 3964R to the control unit:

Bit No.	Name and Description
0	**PROT_HS_TX_ACK** Acknowledge bit from 3964R to the superordinated control unit for sent output data. Is used by 3964R automatically.
1	**PROT_HS_RX_CMD** Command for input user data from 3964R to the superordinated control unit. The bit is checked automatically within 3964R.
2	Not used and reserved
3	**PROT_HS_RUN_IND** To indicate the end of the configuration process and to signal that the 3964R is ready. 0: 3964R is not ready. 1: 3964R is ready. **Note:** This was added in the netTAP NT 100 and netBRICK NB 100 firmware to version 1.4.4.0
4	**PROT_HS_TX_ERROR_IND** To indicate, if a send error has occurred. Is set by the 3964R protocol. This bit is set back to zero (0) by the 3964R protocol with the next error free send telegram. 0: No send error 1: Send error occurred. The error code is written by the 3964R protocol into the “Error register to transfer error information about receive errors“. The error codes are described in section *Error Codes* on page 17.
5	**PROT_HS_RX_ERROR_IND** To indicate, if a receive error has occurred. Is set by the 3964R protocol. This bit is set back to zero (0) with the next error free receive telegram. 0: No receive error 1: Receive error. The error code is written by the 3964R protocol into the “Error register to transfer error information about receive errors“. The error codes are described in section *Error Codes* on page 17.
6	**PROT_HS_TX_ENABLE_ACK** Acknowledges the enabling of output data transfer from the control unit to 3964R. This bit is controlled from 3964R automatically.
7	**PROT_HS_RX_ENABLE_ACK** Acknowledges the enabling of input data transfer from 3964R to the control unit. This bit is controlled from 3964R automatically.
8 … 31	Not used and reserved

Table 7: 3964R – Synchronization Register to the Superordinated Control Unit

2.3.2 Initializing of the Communication

Start of the communication

Step	Action: **Start of the communication, initialization is done by the superordinated control unit.**	**Handshake-send byte of the superordinated control unit** 7 6 5 4 3 2 1 0	**Handshake-receive byte of the superordinated control unit** 7 6 5 4 3 2 1 0
0	Memory after device reset. 3964R signals 'not ready'.	0 0 x x x x 0 0	0 0 0 0 0 0 0 0
1	3964R signals 'ready'.	0 0 x x x x 0 0	0 0 0 0 1 0 0 0
2	The superordinated control unit starts the communication with 3964R. Setting bit 6 and 7 allows 3964R to communicate with the superordinated control unit.	1 1 x x x x 0 0	0 0 0 0 1 0 0 0
3	3964R receives the handshake flags from the superordinated control unit. These release the following actions: The send direction to the superordinated control unit is enabled based on bit 6. The receive direction for 3964R is enabled based on bit 7.	1 1 x x x x 0 0	
4	The receipt is acknowledged by 3964R. The data transfer to the superordinated control unit can start.		1 1 0 0 1 0 0 0
5	After the superordinated control unit has received the acknowledgment from 3964R for 'send and receive ready' it can send data to 3964R.		1 1 0 0 1 0 0 0

Table 8: 3964R – Initializing of the Communication

Note: After enabling the communication the communication can start any time.

2.3.3 Acknowledgment of the Processing between the Superordinated Control and 3964R

An acknowledgment of the receipt is expected (in the corresponding synchronization register) from the receiver for each data transfer from 3964R to the superordinated control unit and visa versa. As long as this receive acknowledgment is not available, no further data can be send to the receiver.

This handshake procedure is described in the following section for both directions.

Note: In the following tables an "x" marks an undefined bit position and an "X" marks a defined but not relevant bit position.

2.3.3.1 Superordinated Control Unit to 3964R

The value of a bit marked with "x" don't cares.

Step	Action: **The superordinated control unit sends data to 3964R**	**Handshake-send byte of the superordinated control unit / receive byte of the gateway** 7 6 5 4 3 2 1 0	**Handshake-receive byte of the superordinated control unit / send byte of the gateway** 7 6 5 4 3 2 1 0
0	State before beginning to send (and after initialization). Handshake bit 0 in the receive and send buffer has the same value. → It is possible to send data to 3964R.	1 1 x x x x X 0	1 1 x x 1 x X 0
1	The superordinated control unit has provided user data in its send buffer to be send and sets handshake bit 0.	1 1 x x x x X 1	
2	The data is transferred to 3964R	1 1 x x x x X 1	
3	As long as bit 0 of the handshake in the send and receive buffer is unequal, it is not allowed for the superordinated control unit to send new user data to the gateway.	1 1 x x x x X 1	1 1 x x 1 x X 0
4	3964R recognizes that bit 0 of the handshake in the send and receive buffer is unequal, that new user data is available from the superordinated control unit.	1 1 x x x x X 1	1 1 x x 1 x X 0
5	When 3964R unit has taken the user data from the receive buffer, 3964R sets bit 0 in the handshake send byte and acknowledges		1 1 x x 1 x X 1
6	The handshake send byte of the gateway is transferred to the superordinated control unit.		1 1 x x 1 x X 1
7	The superordinated control unit recognizes that handshake bit 0 in the send and receive buffer is equal → 3964R has received the data and is ready to receive new user data	1 1 x x x x X 1	1 1 x x 1 x X 1
8	The superordinated control unit provides new user send data to 3964R and sets the handshake bit 0 to zero.	1 1 x x x x X 0	
9	The data is transferred to 3964R	1 1 x x x x X 0	
10	As long as bit 0 of the handshake in the send and receive buffer is unequal, it is not allowed for the superordinated control unit to send new user data to the gateway.	1 1 x x x x X 0	1 1 x x 1 x X 1
11	3964R recognizes that bit 0 of the handshake in the send and receive buffer is unequal, that new user data is available.	1 1 x x x x X 0	1 1 x x 1 x X 1
12	When 3964R has taken the user data from the receive buffer, the superordinated control unit sets bit 0 to zero in the handshake send byte and acknowledges		1 1 x x 1 x X 0
13	The handshake send byte of 3964R is transferred to the superordinated control unit.		1 1 x x 1 x X 0
14	The superordinated control unit recognizes that handshake bit 0 in the send and receive buffer is equal → 3964R has received the data and is ready to receive new user data		1 1 x x 1 x X 0
15	Handshake bit 0 in the receive and send buffer has the same value. This is the same state as in step 0. Now this procedure can start from the beginning.	1 1 x x x x X 0	1 1 x x 1 x X 0

2.3.3.2 3964R to the superordinated Control Unit

The value of a bit marked with x does not matter.

Step	Action: **3964R sends data to the superordinated control unit**	**Handshake-send byte of the superordinated control unit / receive byte of 3964R** 7 6 5 4 3 2 1 0	**Handshake-receive byte of the superordinated control unit / send byte of 3964R** 7 6 5 4 3 2 1 0
0	State before beginning to send. Handshake bit 1 in the receive and send buffer has the same value. → It is possible to send data to the superordinated control unit.	1 1 x x x x 0 X	1 1 x x 1 x 0 X
1	3964R has provided user data to be sent and sets handshake bit 1.		1 1 x x 1 x 1 X
2	The data is transferred to the superordinated control unit		1 1 x x 1 x 1 X
3	As long as bit 1 of the handshake in the send and receive buffer is unequal, 3964R will not send new user data to the superordinated control unit.	1 1 x x x x 0 X	1 1 x x 1 x 1 X
4	The superordinated control unit recognizes that bit 1 of the handshake in the send and receive buffer is unequal, that new user data from 3964R is available.	1 1 0 0 0 0 0 X	1 1 x x 1 x 1 X
5	When the superordinated control unit has taken the user data from the receive buffer, the superordinated control unit sets bit 1 in the handshake send byte and acknowledges	1 1 0 0 0 0 1 X	
6	The handshake send byte of the superordinated control unit is transferred to 3964R.	1 1 0 0 0 0 1 X	
7	3964R recognizes that handshake bit 1 in the send and receive buffer is equal → The superordinated control unit has received the data and is ready to receive new user data	1 1 0 0 0 0 1 X	1 1 x x 1 x 1 X
8	3964R provides new user send data and sets the handshake bit 1 to zero.		1 1 x x 1 x 0 X
9	The data is transferred to the superordinated control unit		1 1 x x 1 x 0 X
10	As long as bit 1 of the handshake in the send and receive buffer is unequal, 3964R is not allowed to send new user data to the superordinated control unit.	1 1 0 0 0 0 1 X	1 1 x x 1 x 0 X
11	The superordinated control unit recognizes that bit 1 of the handshake in the send and receive buffer is unequal, that new user data from 3964R is available.	1 1 0 0 0 0 1 X	1 1 x x 1 x 0 X
12	When the superordinated control unit has taken the user data from the receive buffer, the superordinated control unit sets bit 1 to zero in the handshake send byte and acknowledges	1 1 0 0 0 0 0 X	1 1 x x 1 x 0 X
13	The handshake send byte of the superordinated control unit is transferred to 3964R.	1 1 0 0 0 0 0 X	1 1 x x 1 x 0 X
14	3964R recognizes that handshake bit 1 in the send and receive buffer is equal → The superordinated control unit has received the data and is ready to receive new user data		
15	Handshake bit 1 in the receive and send buffer has the same value. This is the same state as in step 0. Now this procedure can start from the beginning.	1 1 x x x x 0 X	1 1 x x 1 x 0 X

3 Error Codes

Error Code	Definition / Description
0x00000000	TLR_S_OK Status ok
0xC0000007	TLR_E_INVALID_PACKET_LEN Packet length is invalid
0xC0000009	TLR_E_INVALID_PARAMETER Found invalid Parameter in packet
0xC0000201	TLR_E_APPLICATION_ALREADY_REGISTERED Application is already registered
0xC0000119	TLR_E_NOT_CONFIGURED Configuration not available
0xC0000181	TLR_E_CONFIG_LOCK Changing configuration is not allowed
0xC0000180	TLR_E_BUS_OFF Bus Off flag is set
0xC0900001	TLR_E_P3964R_APP_COMMAND_INVALID Unknown command
0xC0900002	TLR_E_P3964R_APP_RINGBUFFER_FULL Ring buffer is full
0x40900003	TLR_E_P3964R_APP_RINGBUFFER_EMPTY Ring buffer is empty
0xC0900004	TLR_E_P3964R_APP_RINGBUFFER_INIT_ERROR Error initializing the ring buffer, possibly not enough memory available
0xC08F0001	TLR_E_P3964R_COMMAND_INVALID Invalid command received
0xC08F0002	TLR_E_P3964R_STACK_PACKET_TOO_LONG Packet is too long
0xC08F0003	TLR_E_P3964R_STACK_LED_NOT_SUPPORTED LED is not supported
0xC08F0004	TLR_E_P3964R_INIT_CONFLICT_HIGH_PRIO Init conflict, both devices have high priority
0xC08F0005	TLR_E_P3964R_INIT_CONFLICT_LOW_PRIO Init conflict, both devices have low priority
Errors during Transmission	
0xC08F0006	TLR_E_P3964R_TX_NEG_ACK_TO_CON_CLEARDOWN Negative acknowledge at connection clear down
0xC08F0007	TLR_E_P3964R_TX_NEG_ACK_TO_CON_BUILDUP Negative acknowledge at connection buildup
0xC08F0008	TLR_E_P3964R_TX_TRANSM_ABORT_BY_RECEIVER Transmission aborted by receiver
0xC08F0009	TLR_E_P3964R_TX_ACK_TIMEOUT_AT_BUILDUP Acknowledge timeout at connection build up
0xC08F000A	TLR_E_P3964R_TX_ACK_TIMEOUT_AT_CLEARDOWN Acknowledge timeout at connection clear down
0xC08F001B	TLR_E_P3964R_TX_DATA_TRANSM_INTERRUPTED Transmission interrupted by receiver

Error Code	Definition / Description
0xC08F000C	TLR_E_P3964R_TX_RAND_CHAR_TO_CON_BUILDUP Received arbitrary character at connection build up
0xC08F000D	TLR_E_P3964R_TX_RAND_CHAR_TO_CON_CLEARDOWN Received arbitrary character at connection clear down
Errors during Receive	
0xC08F000E	TLR_E_P3964R_RX_FRAME_TOO_LONG Received frame was too long
0xC08F000F	TLR_E_P3964R_RX_DLE_NOT_DOUBLED DLE was not doubled
0xC08F0010	TLR_E_P3964R_RX_RANDOM_CHAR_RECVD_IN_IDLE Other character than STX received in idle state
0xC08F0011	TLR_E_P3964R_RX_CHARACTER_TIMEOUT Character timeout
0xC08F0012	TLR_E_P3964R_RX_CHECKSUM_ERROR Checksum (BCC) error
0xC08F0013	TLR_E_P3964R_RX_NO_MEM_SEG_AVAILABLE No memory segment available. (Temporary error)
UART Errors	
0xC08F0014	TLR_E_P3964R_UART_PARITY_ERROR UART: Parity error
0xC08F0015	TLR_E_P3964R_UART_BREAK UART: Break
0xC08F0016	TLR_E_P3964R_UART_FRAME_ERROR UART: Framing error
0xC08F0017	TLR_E_P3964R_UART_OVERRUN UART: Overrun

Table 9: Error Codes 3964R

4 Appendix

4.1 List of Figures

4.2 List of Tables

4.3 Contacts

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