

IEC 60870-5-101 MASTER PICS

➤ SUMMARY:

This document is the conformance statement for the CimWay IEC 60870-5-101 Master driver.

The last revision of the technical content accommodates changes in PcVue 15.1. Unless otherwise stated, this document is valid for releases made publicly available since.

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REVISION HISTORY

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1. Introduction

This document describes the specific implementation of the IEC 60870-5-101 driver in CimWay.

It is based on the IEC 60870-5-101 edition 2 standard document, starting on page 93 but only operates in unbalanced mode over TCP or UDP. While this flavor of the IEC 101 over IP does not correspond to the original standard, it is used in a variety of systems where legacy IEC 101 devices are accessed through serial-to-IP gateways.

Selected parameters are marked as follows:

- ☐ Function or ASDU is not used
- ☒ Function or ASDU is used as standardized (default)
- ☒ Function or ASDU is used in reverse mode
- ☒ Function or ASDU is used in standard and reverse mode

The possible selection (blank, X, R, or B) is specified for each specific clause or parameter.

2. System or device

(system-specific parameter, indicate the station's function by marking one of the following with 'X')

- ☐ System definition
- ☒ Controlling station definition (Master)
- ☐ Controlled station definition (Slave)

3. Network configuration

(network-specific parameter, all configurations that are used are to be marked 'X')

- ☐ Point-to-point
- ☐ Multipoint
- ☐ Multiple point-to-point
- ☐ Multipoint-star

4. Physical layer

(network-specific parameter, all interfaces and data rates that are used are to be marked 'X')

Transmission speed (control direction)

Unbalanced interchange
Circuit V.24/V.28
Standard

Unbalanced interchange
Circuit V.24/V.28
Recommended if > 1 200bit/s

Balanced interchange
Circuit X.24/X.27

- | | | | |
|------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------|
| <input type="checkbox"/> 100 bit/s | <input type="checkbox"/> 2 400 bit/s | <input type="checkbox"/> 2 400 bit/s | <input type="checkbox"/> 56 000 bit/s |
| <input type="checkbox"/> 200 bit/s | <input type="checkbox"/> 4 800 bit/s | <input type="checkbox"/> 4 800 bit/s | <input type="checkbox"/> 64 000 bit/s |

☐ 300 bit/s

☐ 600 bit/s

☐ 1 200 bit/s

☐ 9 600 bit/s

☐ 9 600 bit/s

☐ 19 200 bit/s

☐ 38 400 bit/s

5. Link layer

(network-specific parameter, all options that are used are to be marked 'X'. Specify the maximum frame length. If a non-standard assignment of class 2 messages is implemented for unbalanced transmission, indicate the Type ID and COT of all messages assigned to class 2.)

Frame format FT 1.2, single character 1 and the fixed time out interval are used exclusively in this companion standard.

Link transmission

☐ Balanced transmission

☒ Unbalanced transmission

Address field of the link

☐ not present (balanced transmission only)

☒ One octet

☒ Two octets

Frame length

☐ Maximum length L (control direction)

☒ Structured

☒ Unstructured

☐ Maximum length L (monitor direction)

☐ Time during which repetitions are permitted (Trp) or number of repetitions

When using an unbalanced link layer, the following ASDU types are returned in class 2 messages (low priority) with the indicated causes of transmission:

☒ The standard assignment of ASDUs to class 2 messages is used as follows:

Type identification	Cause of transmission
9, 11, 13, 21	<1>

☐ A special assignment of ASDUs to class 2 messages is used as follows:

Type identification	Cause of transmission

Note: (In response to a class 2 poll, a controlled station may respond with class 1 data when there is no class 2 data available).

6. Application layer

Transmission mode for application data

Mode 1 (Least significant octet first), as defined in clause 4.10 of IEC 60870-5-4, is used exclusively in this companion standard.

Common address of ASDU

(system-specific parameter, all configurations that are used are to be marked 'X')

- ☒ One octet
- ☒ Two octets

Information object address

(system-specific parameter, all configurations that are used are to be marked 'X')

- ☒ One octet
- ☒ Structured
- ☒ Two octets
- ☒ Unstructured
- ☒ Three octets

Cause of transmission

(system-specific parameter, all configurations that are used are to be marked 'X')

- ☒ One octet
- ☒ Two octets (with originator address)
Originator address is set to zero if not used

Length of APDU

(system-specific parameter, specify the maximum length of the APDU per system)

The maximum length of APDU for both directions is 253. It is a fixed system parameter.

- 253

Maximum length of APDU per system in control direction
- 253

Maximum length of APDU per system in monitor direction

Selection of standard ASDUs

Process information in monitor direction

(station-specific parameter, mark each Type ID 'X' if it is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

- ☒

<1> := Single-point informationM_SP_NA_1
- ☒

<2> := Single-point information with time tagM_SP_TA_1
- ☒

<3> := Double-point informationM_DP_NA_1
- ☒

<4> := Double-point information with time tagM_DP_TA_1
- ☒

<5> := Step position informationM_ST_NA_1
- ☒

<6> := Step position information with time tagM_ST_TA_1
- ☒

<7> := Bitstring of 32 bitM_BO_NA_1
- ☒

<8> := Bitstring of 32 bit with time tagM_BO_TA_1

<input checked="" type="checkbox"/>	<9> := Measured value, normalized value	M_ME_NA_1
<input checked="" type="checkbox"/>	<10> := Measured value, normalized value with time tag	M_ME_TA_1
<input checked="" type="checkbox"/>	<11> := Measured value, scaled value	M_ME_NB_1
<input checked="" type="checkbox"/>	<12> := Measured value, scaled value with time tag	M_ME_TB_1
<input checked="" type="checkbox"/>	<13> := Measured value, short floating point value	M_ME_NC_1
<input checked="" type="checkbox"/>	<14> := Measured value, short floating point value with time tag	M_ME_TC_1
<input checked="" type="checkbox"/>	<15> := Integrated totals	M_IT_NA_1
<input checked="" type="checkbox"/>	<16> := Integrated totals with time tag	M_IT_TA_1
<input type="checkbox"/>	<17> := Event of protection equipment with time tag	M_EP_TA_1
<input type="checkbox"/>	<18> := Packed start events of protection equipment with time tag	M_EP_TB_1
<input type="checkbox"/>	<19> := Packed output circuit information of protection equipment with time tag	M_EP_TC_1
<input type="checkbox"/>	<20> := Packed single-point information with status change detection	M_SP_NA_1
<input checked="" type="checkbox"/>	<21> := Measured value, normalized value without quality descriptor	M_ME_ND_1
<input checked="" type="checkbox"/>	<30> := Single-point information with time tag CP56Time2a	M_SP_TB_1
<input checked="" type="checkbox"/>	<31> := Double-point information with time tag CP56Time2a	M_DP_TB_1
<input checked="" type="checkbox"/>	<32> := Step position information with time tag CP56Time2a	M_ST_TB_1
<input checked="" type="checkbox"/>	<33> := Bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1
<input checked="" type="checkbox"/>	<34> := Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1
<input checked="" type="checkbox"/>	<35> := Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1
<input checked="" type="checkbox"/>	<36> := Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1
<input checked="" type="checkbox"/>	<37> := Integrated totals with time tag CP56Time2a	M_IT_TB_1
<input type="checkbox"/>	<38> := Event of protection equipment with time tag CP56Time2a	M_EP_TD_1
<input type="checkbox"/>	<39> := Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1
<input type="checkbox"/>	<40> := Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1

In this companion standard only the use of the set <30> – <40> for ASDUs with time tag is permitted.

Process information in control direction

(station-specific parameter, mark each Type ID 'X' if it is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

<input checked="" type="checkbox"/>	<45> := Single command	C_SC_NA_1
<input checked="" type="checkbox"/>	<46> := Double command	C_DC_NA_1
<input checked="" type="checkbox"/>	<47> := Regulating step command	C_RC_NA_1
<input checked="" type="checkbox"/>	<48> := Set point command, normalized value	C_SE_NA_1
<input checked="" type="checkbox"/>	<49> := Set point command, scaled value	C_SE_NB_1
<input checked="" type="checkbox"/>	<50> := Set point command, short floating point value	C_SE_NC_1
<input checked="" type="checkbox"/>	<51> := Bitstring of 32 bit	C_BO_NA_1

<input checked="" type="checkbox"/>	<58> := Single command with time tag CP56Time 2a	C_SC_TA_1
<input checked="" type="checkbox"/>	<59> := Double command with time tag CP56Time 2a	C_DC_TA_1
<input checked="" type="checkbox"/>	<60> := Regulating step command with time tag CP56Time 2a	C_RC_TA_1
<input checked="" type="checkbox"/>	<61> := Set point command, normalized value with time tag CP56Time 2a	C_SE_TA_1
<input checked="" type="checkbox"/>	<62> := Set point command, scaled value with time tag CP56Time 2a	C_SE_TB_1
<input checked="" type="checkbox"/>	<63> := Set point command, short floating point value with time tag CP56Time 2a	C_SE_TC_1
<input checked="" type="checkbox"/>	<64> := Bitstring of 32 bit with time tag CP56Time 2a	C_BO_TA_1

Either the ASDUs of the set <45> – <51> or of the set <58> – <64> are used.

System information in monitor direction

(station-specific parameter, mark with an "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions)

<input checked="" type="checkbox"/>	<70> := End of initialization	M_EI_NA_1
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System information in control direction

(station-specific parameter, mark with an "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions)

<input checked="" type="checkbox"/>	<100>:= Interrogation command	C_IC_NA_1
<input checked="" type="checkbox"/>	<101>:= Counter interrogation command	C_CI_NA_1
<input checked="" type="checkbox"/>	<102>:= Read command	C_RD_NA_1
<input checked="" type="checkbox"/>	<103>:= Clock synchronization command (option see 7.6)	C_CS_NA_1
<input checked="" type="checkbox"/>	<104>:= Test command	C_TS_NA_1
<input checked="" type="checkbox"/>	<105>:= Reset process command	C_RP_NA_1
<input type="checkbox"/>	<106>:= Delay acquisition command	C_CD_NA_1
<input checked="" type="checkbox"/>	<107>:= Test command with time tag CP56time2a	C_TS_TA_1

Parameter in control direction

(station-specific parameter, mark with an "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions)

<input checked="" type="checkbox"/>	<110>:= Parameter of measured value, normalized value	P_ME_NA_1
<input checked="" type="checkbox"/>	<111>:= Parameter of measured value, scaled value	P_ME_NB_1
<input checked="" type="checkbox"/>	<112>:= Parameter of measured value, short floating point value	P_ME_NC_1
<input type="checkbox"/>	<113>:= Parameter activation	P_AC_NA_1

File Transfer

(station-specific parameter, mark with an "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions)

<input type="checkbox"/>	<120>:= File ready	F_FR_NA_1
<input type="checkbox"/>	<121>:= Section ready	F_SR_NA_1

<input type="checkbox"/>	<123>:= Last section, last segment	F_LS_NA_1
<input type="checkbox"/>	<122>:= Call directory, select file, call file, call section	F_SC_NA_1
<input type="checkbox"/>	<124>:= Ack file, ack section	F_AF_NA_1
<input type="checkbox"/>	<125>:= Segment	F_SG_NA_1
<input type="checkbox"/>	<126>:= Directory {blank or X, only available in monitor (standard) direction}	F_DR_TA_1
<input type="checkbox"/>	<127>:= Query Log – Request archive file	F_SC_NB_1

Type identifier and cause of transmission assignments

(station-specific parameters)

Shaded boxes are not required.

Black boxes are not permitted in this companion standard

Blank: functions or ASDU not used.

Mark Type Identification/Cause of transmission combinations:

'X' if only used in the standard direction

'R' if only used in the reverse direction

'B' if used in both directions

Type identification		Cause of transmission																		
		periodic, cyclic	background scan	spontaneous	initialized	request or requested	activation	activation confirmation	deactivation	deactivation confirmation	activation termination	return info caused by a remote cmd	return info caused by a local cmd	file transfer	interrogated by group <number>	request by group <n> counter request	unknown type identification	unknown cause of transmission	unknown common address of ASDU	unknown information object address
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<1>	M_SP_NA_1		X	X		X						X	X		X					
<2>	M_SP_TA_1		X	X		X						X	X		X					
<3>	M_DP_NA_1		X	X		X						X	X		X					
<4>	M_DP_TA_1		X	X		X						X	X		X					
<5>	M_ST_NA_1		X	X		X						X	X		X					
<6>	M_ST_TA_1		X	X		X						X	X		X					
<7>	M_BO_NA_1		X	X		X									X					
<8>	M_BO_TA_1		X	X		X									X					
<9>	M_ME_NA_1	X	X	X		X									X					
<10>	M_ME_TA_1		X	X		X									X					
<11>	M_ME_NB_1	X	X	X		X									X					
<12>	M_ME_TB_1		X	X		X									X					

Type identification		Cause of transmission																		
		periodic, cyclic	background scan	spontaneous	initialized	request or requested	activation	activation confirmation	deactivation	deactivation confirmation	activation termination	return info caused by a remote cmd	return info caused by a local cmd	file transfer	interrogated by group <number>	request by group <n> counter request	unknown type identification	unknown cause of transmission	unknown common address of ASDU	unknown information object address
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<13>	M_ME_NC_1	X	X	X		X									X					
<14>	M_ME_TC_1		X	X		X									X					
<15>	M_IT_NA_1		X	X												X				
<16>	M_IT_TA_1		X	X												X				
<17>	M_EP_TA_1																			
<18>	M_EP_TB_1																			
<19>	M_EP_TC_1																			
<20>	M_PS_NA_1																			
<21>	M_ME_ND_1	X	X	X		X									X					
<30>	M_SP_TB_1			X		X						X	X							
<31>	M_DP_TB_1			X		X						X	X							
<32>	M_ST_TB_1			X		X						X	X							
<33>	M_BO_TB_1			X		X														
<34>	M_ME_TD_1			X		X														
<35>	M_ME_TE_1			X		X														
<36>	M_ME_TF_1			X		X														
<37>	M_IT_TB_1			X												X				
<38>	M_EP_TD_1																			
<39>	M_EP_TE_1																			
<40>	M_EP_TF_1																			
<45>	C_SC_NA_1						X	X	X	X	X						X	X	X	X
<46>	C_DC_NA_1						X	X	X	X	X						X	X	X	X
<47>	C_RC_NA_1						X	X	X	X	X						X	X	X	X
<48>	C_SE_NA_1						X	X	X	X	X						X	X	X	X
<49>	C_SE_NB_1						X	X	X	X	X						X	X	X	X
<50>	C_SE_NC_1						X	X	X	X	X						X	X	X	X
<51>	C_BO_NA_1						X	X	X	X	X						X	X	X	X
<58>	C_SC_TA_1						X	X	X	X	X						X	X	X	X
<59>	C_DC_TA_1						X	X	X	X	X						X	X	X	X

Type identification		Cause of transmission																		
		periodic, cyclic	background scan	spontaneous	initialized	request or requested	activation	activation confirmation	deactivation	deactivation confirmation	activation termination	return info caused by a remote cmd	return info caused by a local cmd	file transfer	interrogated by group <number>	request by group <n> counter request	unknown type identification	unknown cause of transmission	unknown common address of ASDU	unknown information object address
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<60>	C_RC_TA_1						X	X	X	X	X						X	X	X	X
<61>	C_SE_TA_1						X	X	X	X	X						X	X	X	X
<62>	C_SE_TB_1						X	X	X	X	X						X	X	X	X
<63>	C_SE_TC_1						X	X	X	X	X						X	X	X	X
<64>	C_BO_TA_1						X	X	X	X	X						X	X	X	X
<70>	M_EI_NA_1*				X															
<100>	C_IC_NA_1						X	X	X	X	X						X	X	X	X
<101>	C_CI_NA_1						X	X			X						X	X	X	X
<102>	C_RD_NA_1																			
<103>	C_CS_NA_1			X			X	X												
<104>	C_TS_NA_1						X	X												
<105>	C_RP_NA_1						X	X												
<106>	C_CD_NA_1						X	X												
<107>	C_TS_TA_1						X	X												
<110>	P_ME_NA_1						X	X												
<111>	P_ME_NB_1						X	X												
<112>	P_ME_NC_1						X	X												
<113>	P_AC_NA_1																			
<120>	F_FR_NA_1																			
<121>	F_SR_NA_1																			
<122>	F_SC_NA_1																			
<123>	F_LS_NA_1																			
<124>	F_AF_NA_1																			
<125>	F_SG_NA_1																			
<126>	F_DR_TA_1*																			
<127>	F_SC_NB_1*																			
* Blank or X only																				

* Blank or X only

7. Basic application functions

Station initialization

(station-specific parameter, mark 'X' if function is used)

☒ Remote

Cyclic data transmission

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

☒ Cyclic data transmission

Read procedure

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

☒ Read procedure

Spontaneous transmission

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

☒ Spontaneous

Double transmission of information objects with cause of transmission spontaneous

(station-specific parameter, mark each information type 'X' where both a Type ID without time and corresponding Type ID with time are issued in response to a single spontaneous change of a monitored object)

The following type identifications may be transmitted in succession caused by a single status change of an information object. The particular information object addresses for which double transmission is enabled are defined in a project-specific list.

- ☐ Single-point information M_SP_NA_1, M_SP_TA_1, M_SP_TB_1 and M_PS_NA_1
- ☐ Double-point information M_DP_NA_1, M_DP_TA_1 and M_DP_TB_1
- ☐ Step position information M_ST_NA_1, M_ST_TA_1 and M_ST_TB_1
- ☐ Bitstring of 32 bit M_BO_NA_1, M_BO_TA_1 and M_BO_TB_1 (if defined for a specific project)
- ☐ Measured value, normalized value M_ME_NA_1, M_ME_TA_1, M_ME_ND_1 and M_ME_TD_1
- ☐ Measured value, scaled value M_ME_NB_1, M_ME_TB_1 and M_ME_TE_1
- ☐ Measured value, short floating point number M_ME_NC_1, M_ME_TC_1 and M_ME_TF_1

Station interrogation

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

☒ global

☒ group 1

☒ group 7

☒ group 13

<input checked="" type="checkbox"/> group 2	<input checked="" type="checkbox"/> group 8	<input checked="" type="checkbox"/> group 14
<input checked="" type="checkbox"/> group 3	<input checked="" type="checkbox"/> group 9	<input checked="" type="checkbox"/> group 15
<input checked="" type="checkbox"/> group 4	<input checked="" type="checkbox"/> group 10	<input checked="" type="checkbox"/> group 16
<input checked="" type="checkbox"/> group 5	<input checked="" type="checkbox"/> group 11	
<input checked="" type="checkbox"/> group 6	<input checked="" type="checkbox"/> group 12	

Information Object Addresses assigned to each group must be shown in a separate table

Clock synchronization

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

- ☒ Clock synchronization
- ☐ Day of week used
- ☐ RES1, GEN (time tag substituted/ not substituted) used
- ☐ SU-bit (summertime) used

Command transmission

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

- ☒ Direct command transmission
- ☒ Direct set point command transmission
- ☒ Select and execute command
- ☒ Select and execute set point command
- ☒ C_SE ACTTERM used
- ☒ No additional definition
- ☒ Short pulse duration (duration determined by a system parameter in the outstation)
- ☒ Long pulse duration (duration determined by a system parameter in the outstation)
- ☒ Persistent output
- ☒ Supervision of maximum delay in command direction of commands and set point commands

Configurable

Maximum allowable delay of commands and set point commands

Transmission of integrated totals

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

- ☒ Mode A: Local freeze with spontaneous transmission
- ☒ Mode B: Local freeze with counter interrogation
- ☒ Mode C: Freeze by counter-interrogation commands
- ☒ Mode D: Freeze by counter-interrogation command, frozen values reported spontaneously
- ☒ Counter read
- ☐ Counter freeze without reset

- ☐ Counter freeze with reset
- ☐ Counter reset
- ☒ General request counter
- ☒ Request counter group 1
- ☒ Request counter group 2
- ☒ Request counter group 3
- ☒ Request counter group 4

Parameter loading

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

- ☒ Threshold value
- ☒ Smoothing factor
- ☒ Low limit for transmission of measured values
- ☒ High limit for transmission of measured values

Parameter activation

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

- ☒ Act/deact of persistent cyclic or periodic transmission of the addressed object

Test procedure

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

- ☒ Test

File transfer

(station-specific parameter, mark 'X' if function is used)

File transfer in monitor direction

- ☐ Transparent file
- ☐ Transmission of disturbance data of protection equipment
- ☐ Transmission of sequences of events
- ☐ Transmission of sequences of recorded analog values

File transfer in control direction

- ☐ Transparent file

Background scan

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

☒ Background scan

Acquisition of transmission delay

(station-specific parameter, mark 'X' if function is only used in the standard direction, 'R' if only used in the reverse direction, and 'B' if used in both directions)

☐ Acquisition of transmission delay

Definition of time outs

Parameter	Default value	Remarks	Selected value
t ₀	30s	Time-out of connection establishment	Configurable
t ₁	15s	Time-out of send or test APDUs	Configurable
t ₂	10s	Time-out for acknowledges in case of no data messages t ₂ < t ₁	Configurable
t ₃	20s	Time-out for sending test frames in case of a long idle state	Configurable

Maximum range of values for all time outs: 1 to 255 s, accuracy 1 s

Port number

Parameter	Value	Remarks
TCP Remote Port number	2404	Configurable
UDP Listening Port number	2405	Configurable
UDP Remote Port number	2404	Configurable

Redundant connections

Number N of redundancy group connections used

* CimWay uses 1 group per device and its associated standby devices.

RFC 2200 suite

RFC 2200 is an official Internet Standard which describes the state of standardization of protocols used in the Internet as determined by the Internet Architecture Board (IAB). It offers a broad spectrum of actual standards used in the Internet. The suitable selection of documents from RFC 2200 defined in this standard for given projects has to be chosen by the user of this standard.

- ☒ Ethernet 802.3
- ☐ Serial X.21 interface
- ☐ Other selection from RFC 2200:



List of valid documents from RFC 2200

- 1.
 - 2.
 - 3.
 - 4.
 - 5.
- etc.



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