PACiS SPP DNP3

Gateway and C264

SPP/EN DNP3/D10

PACiS V5

Slave Protocol Profile
DNP3

Issue A1

Schneider Electric

CONTENTS

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1. SCOPE OF THE DOCUMENT

This document is a chapter of PACiS MiCOM C264 and PACiS GATEWAY documentation binders. It describes the communication protocol DNP3 implemented on:

- PACiS GATEWAY
- MiCOM C264

This document deals with communication with an upper level SCADA system.

2. DNP3 – INTEROPERABILITY

This companion standard presents sets of parameters and alternatives from which subsets have to be selected to implement particular telecontrol systems. Certain parameter values, such as the number of bytes in the Treatment of Static BI represent mutually exclusive alternatives. This means that only one value of the defined parameters is admitted per system. Other parameters, such as the listed set of different process information in command and in monitor direction allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarises the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters.

The selected parameters should be filled up (N => **S**).

NOTE : In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.

To simplify the PID, we use the following conventions:

N	Not supported
S	Supported
S*	Supported with special configuration

2.1 System or device

C264	GTW	Description
N	N	System definition
N	N	Controlling station definition (Master)
S	**S**	Controlled station definition (Slave)

2.2 Network configuration (Network-specific parameter)

C264	GTW	Description
S	**S**	Point-to-point
N	N	Multiple point-to-point

Multi-SCADA on one protocol is not allowed. i.e.: Only one SCADA client can communicate with one protocol.

This document describes:

- Specific behaviours attached to the protocol DNP3
- Part of the DNP3 protocol used and not used

NOTE: It is supposed that the reader knows the DNP3 protocol.

2.3 Physical layer (protocol communicate link)

C264	GTW	Description
S	**S**	Serial link
S	**S**	IP link

2.4 Physical layer (Network-specific parameter)

Transmission speed (control and monitor direction):

C264	GTW	Description
N	**S***	100 bit/s
N	**S***	200 bit/s
S	**S**	300 bit/s
S	**S**	600 bit/s
S	**S**	1 200 bit/s
S	**S**	2 400 bit/s
S	**S**	4 800 bit/s
S	**S**	9 600 bit/s
S	**S**	19 200 bit/s
S	**S**	38 400 bit/s
N	N	56 000 bit/s
N	N	57 600 bit/s
N	**S****	64 000 bit/s

**Only with Acksys card.

*PACiS GATEWAY uses a standard PC RS232 and is limited by the possibilities of this hardware. Using a dedicated hardware it is possible to configure 100 or 200 bit/s.

C264 uses RS232 or RS485 depending on configuration (Hardware part).

2.5 Link layer (Network-specific parameter)

Network-specific parameter, all options that are used should be filled up (**N** => **S**). 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.

2.5.1 Address field of the link

C264	GTW	Description
S	**S**	Not present (balanced transmission only)
S	**S**	One octet
S	**S**	Two octets
S	**S**	Structured
S	**S**	Unstructured

2.5.2 Data Link Frame Size

C264	GTW	Description
up to 292	up to 292	Maximum Data Link Frame Size (octets)

2.5.3 Data Link Layer parameter

C264	GTW	Description
S	**S**	Maximum Data Link Re-tries Fixed at 3_(GTW) Fixed at 2 (C264)
N	N	Requires Data Link Layer Confirmation
S	**S**	Data Link timeout GTW : Data Link timeout is configurable: 0.1s to 30s (in registry) C264 : Data Link timeout is fixed to 30s
N	N	Timeouts while waiting for Data Link Confirm

2.6 Application layer

2.6.1 Application layer Frame Size

C264	GTW	Description
Up to 2048 (configurable: 15 to 2048 octects)	Up to 2048	Maximum Application Fragment Size (octets)

2.6.2 Application Layer parameter

C264	GTW	Description
N	N	Maximum Application Layer Re-tries
S	N	Requires Application Layer Confirmation ■ When reporting Event Data (Slave devices only) (C264 only) ■ When sending multi-fragment responses (Slave devices only) (C264 only)
N	N	Timeouts while waiting for Complete Appl. Fragment
S	N	Timeouts while waiting for Application Confirm (C264) Variable (GTW) None
N	N	Timeouts while waiting for Complete Appl. Response

2.6.3 Process information in monitor direction

(Station-specific parameter)

C264	GTW	Object	Variation	Data	Function
N	N	01	0	Static BI	[22] ASSIGN CLASS
S	**S**	12	1	Command : Control Relay Output Block	[3] SELECT [{3] SELECT
S	**S**				[4] OPERATE
S	**S**				[5] DIRECT OPERATE
S	**S**				[6] DIRECT OPERATE - NO ACK
S	**S**	20	0,1,2,5,6	Static Counter	[7] FREEZE
S	**S**				[8] FREEZE - NO ACK
S	**S**				[9] FREEZE & CLEAR
S	**S**				[10] FREEZE & CLEAR - NO ACK
N	N				[22] ASSIGN CLASS
S	**S**	41	1	Setpoint : 16-bits analog output block	[3] SELECT
S	**S**				[4] OPERATE
S	**S**				[5] DIRECT OPERATE
S	**S**				[6] DIRECT OPERATE - NO ACK
S	**S**	41	2	Setpoint : 32-bits analog output block	[3] SELECT
S	**S**				[4] OPERATE
S	**S**				[5] DIRECT OPERATE
S	**S**				[6] DIRECT OPERATE - NO ACK
S	**S**	51	1	Time and Date CTO (Common Time Occurrence)	[2] WRITE
S	N	60	1	Class 1	[20] Enable spontaneous
S	N				[21] Disable spontaneous
N	N				[22] Assign Class
S	N	60	2	Class 2	[20] Enable spontaneous
S	N				[21] Disable spontaneous
N	N				[22] Assign Class
S	N	60	3	Class 3	[20] Enable spontaneous
S	N				[21] Disable spontaneous
N	N				[22] Assign Class
N	N	70	1	File	
S	**S**	80	1	Internal Indications	[2] WRITE

2.6.4 Information sent to SCADA

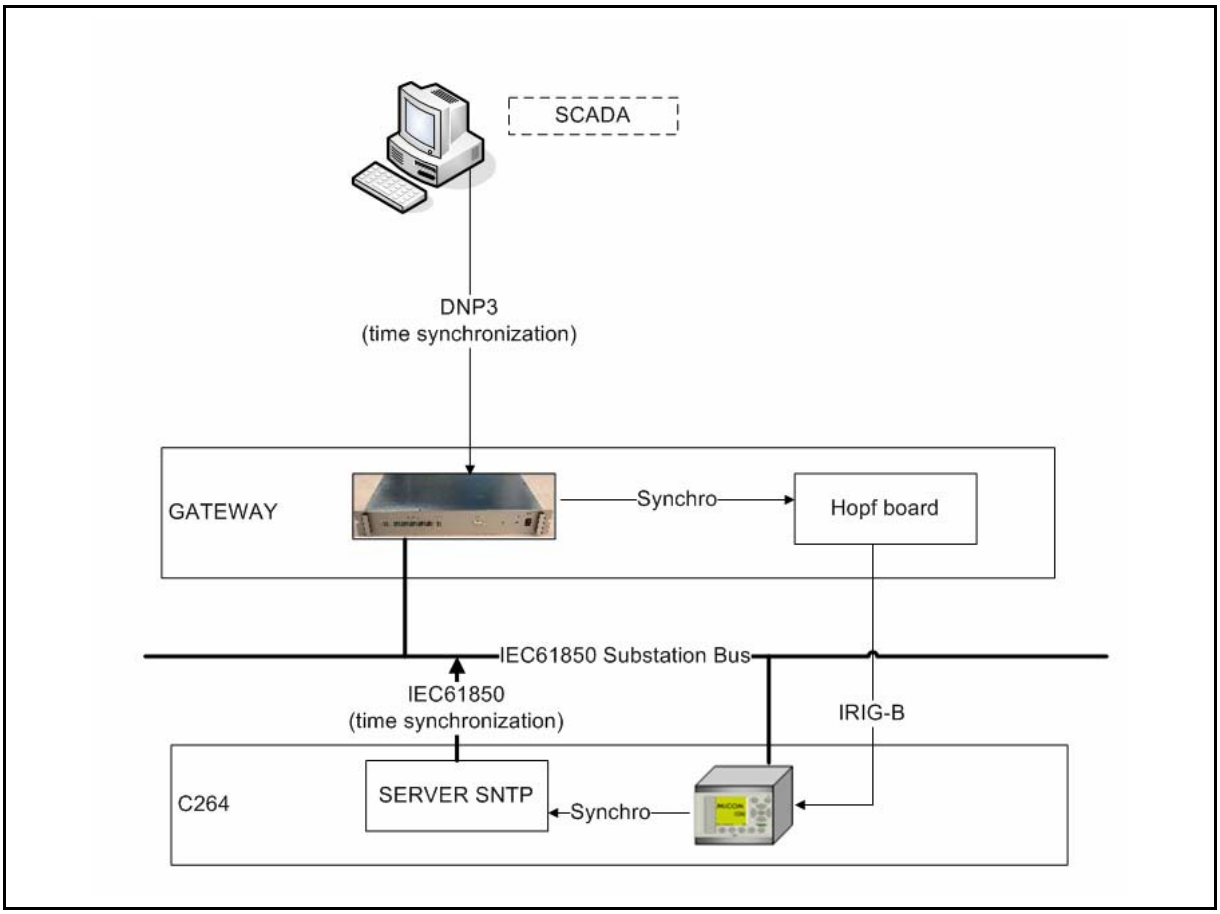
C264	GTW	Object	Variation	Data	Function
S	**S**	01	0,1,2	Static BI	[1] READ
S	**S**	12	0,1,2,3	BI Event	[1] READ
S	**N**	10	2	Binary Output Status	[1] READ (C264 only)
S	**S**	20	0,1,2,5,6	Static Counter	[1] READ
S	**S**	21	0,1,2,9,10	Static Frozen Counter	[1] READ
S	**S**	21	0, 5,6	Counter change event	[1] READ
S	**S**	23	0,5,6	Frozen Counter change event	[1] READ
S	**S**	30	0,1,2,3,4	Static Measurement	[1] READ
S	**S**	32	0,3,4	Measurement Event	[1] READ
S	**S**	51	1	Time and date	[1] READ
S	**S**	60	1	Class 0	[1] READ
S	**S**	60	2,3,4	Class 1,2,3	[1] READ

2.7 Basic application functions

2.7.1 Clock synchronization

C264	GTW	Description
S	**S***	Clock synchronization

- System Synchronization by SCADA is not recommended
- GTW specific:
  - ⇒ System Synchronization by *Hopf* board is only available on GTW. The Hopf card hardware is installed in the GATEWAY PC to synchronize, through the Hopf card IRIGB output, the PACiS equipment and particularly the PACiS SNTP server.
  - ⇒ Even in that condition the PACiS Gateway is synchronized by the PACiS SNTP server.
  - ⇒ (*) DNP3 dll can synchronize the *Hopf* board.
  - ⇒ The dll can synchronize *Hopf* board on receiving SOE TIME_SYNCH Message.
  - ⇒ If registry key “iHopf_Present” is set to 1, DNP3 dll write time on *Hopf* board 6039, that sends an IRIGB signal.
  - ⇒ The time set on *Hopf* board is given by SCADA frame without any modification.



2.7.2 SBMC Mode

Suppressed state does not exist in DNP3. So when bay turns to SBMC mode, C264 will tag data with “Local Forced” state.

See below chapter “Mapping of IEC 61850 quality onto dnp3” to have detailed information for C264 and gateway.

2.7.3 Analog reported as COUNTER

In configuration file all data type are tagged at system level. To send an analog input like a counter a field is added at protocol level “DNP3TM_DEFINE_AS_COUNTER”

DNP3TM_DEFINE_AS_COUNTER	S : (Y,N)	**‘N’** if no process, ‘**Y’** is the TM define as a counter Default value N Note Always set to N if is an Analog order feeback

If this fiel is set to Y, the analog data is created and managed as a counter.

2.7.4 Unsolicited Message

C264	GTW	Description
S	N	Unsolicited message

GTW specific:

Unsolicited message are not implemented in PACiS GATEWAY.

C264 specific:

The unsolicited message implementation in C264 is presented below.

The implemented behaviour is done in order to optimize the number of unsolicited messages exchanged between SCADA and slave. To limit the number of unsolicited messages, messages are filled with multiple events whenever this is possible. A delay before transmission is used in order not to send each event immediately, nevertheless when the number of events is important, to shorten the wait before sending, the waiting time can be bypassed.

- The C264's configuration field *"configuration_messages"* is allowing or not the unsolicited mode for the protocol.
- If the field is configured to *"no unsolicited mode"*, the '*enable message*', sent by the SCADA, will be refused. C264 will reply indicating bad function information. There is no possibility to enable it, but to change the configuration.
- If the field is configured to allow unsolicited mode, the DNP3 slave will be able to send unsolicited events as soon as communication SCADA is initialized. The SCADA, may use it, after enabling unsolicited mode.
- The configuration field *"class_spontaneous"* gives the different classes which are concerned by the unsolicited mode. This field is used when the unsolicited mode is allowed.
- If events are in class 1, they are kept for one second ("1s") before being sent. If at least five ("5") events are present, the events may be sent before this one second timeout.
- If events are in class 2 or in class 3, events are kept for five seconds ("5s") before being sent. If at least five ("5") events are present, the events may be sent before this 5 seconds timeout.

2.7.5 Command transmission

C264	GTW	Description
S	N	Pulse duration for trip and for close

Pulse duration for trip and close is only used by C264 when C264 physically manages the control on the process.

2.8 Limits and Performances

2.8.1 Redundancy:

DNP3 protocol redundancy is not managed (no link redundancy).

2.8.2 Events:

- C264: DNP3s can manage up to 1000 events by kind of elements.
- GTW: DNP3s can manage up to 10000 events.

2.8.3 Management of response timeout

C264 timeout calculation

- C264 manages the called “incremental timeout” (automatically calculated):
- The “incremental timeout” corresponds to the maximum transmission time between a SCADA requests and associated responses. This timeout is calculated according to:
  - ⇒ The baud rate.
  - ⇒ The maximum applicative frame size.
- According to DNP3 protocol: The maximum applicative frame is 2048 bytes

GTW timeout parameter

- On the gateway the response timeout parameter can be modify through the registry key “TimeOut_Organes”.

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