

SOFTWARE DOCUMENTATION

DNP3 Configuration/Interoperability Guide for DRMCC DNP Slave V0.1

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1 Introduction

The purpose of this document is to describe the specific implementation of the Distributed Network Protocol (DNP) 3.0 within DRMCC DNP Slave, V0.1.

DRMCC DNP Slave uses the Triangle MicroWorks, Inc. DNP3 Slave Source Code Library Version 2.25.

This document, in conjunction with the DNP3 Basic 4 Document Set, and the DNP Subset Definitions Document, provides complete information on how to communicate with DRMCC DNP Slave via the DNP3 protocol.

This implementation of DNP3 is fully compliant with DNP3 Subset Definition Level 2, contains many Subset Level 3 features, and contains some functionality even beyond Subset Level 3.

DRMCC DNP Slave is a highly configurable gateway to data produced by applications running on a DRMCC system. As such, this guide cannot provide a list of data points; a list of points will be provided with each specific configuration.

The TMW Library will accept and parse requests well above DNP Subset 3, especially in respect of how requests are 'bundled'. DNP subsetting will be in terms of the objects supported by an application.

2 DNP v3.00 Device Profile

The following table provides a 'Device Profile Document' in the standard format defined in the DNP3 Subset Definitions Document. While it is referred to in the DNP3 Subset Definitions as a "Document," it is only a component of a total interoperability guide. This table, in combination with the following should provide a complete interoperability/configuration guide for DRMCC DNP Slave:

- the Implementation Table provided in Section 'ÿ' (beginning on page 8),
- the Point List table specified for a particular configuration
- and a description of configuration methods and user-interface in the DRMCC Reference Manual

<h1>DNP V3.00</h1> <p>DEVICE PROFILE DOCUMENT</p> <p>(Also see the Implementation Table beginning on page 8.) For details of configurable parameters, see the separate DRMCC DNP Reference Manual</p>	
Vendor Name: Dynamic Ratings Pty Ltd	
Device Name: DRMCC DNP Slave, using the Triangle MicroWorks, Inc. DNP3 Slave Source Code Library, Version 2.25	
Highest DNP Level Supported: (some level 3 functions supported) For Requests: Level 2 For Responses: Level 2	Device Function: <input checked="" type="checkbox"/> Master <input checked="" type="checkbox"/> Slave
Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table): For static (non-change-event) object requests, request qualifier codes 00 and 01 (start-stop), 07 and 08 (limited quantity), and 17 and 28 (index) are supported in addition to request qualifier code 06 (no range - or all points). Static object requests received with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01. Static object requests received with qualifiers 17 or 28 will be responded with qualifiers 17 or 28. For change-event object requests, qualifiers 17 or 28 are always responded. No timestamps can be reported with the current application/DNP relationship. See Note 5 T, p12 for further discussion on this. The read function code for Object 50 (Time and Date), variation 1, is supported.	
Maximum Data Link Frame Size (octets): Transmitted: 292 Received: 292	Maximum Application Fragment Size (octets): Transmitted: automatic Received: 2048
Maximum Data Link Re-tries: <input checked="" type="checkbox"/> Fixed at 2 <input checked="" type="checkbox"/> None <input checked="" type="checkbox"/> Configurable	Maximum Application Layer Re-tries: <input checked="" type="checkbox"/> None <input checked="" type="checkbox"/> Configurable
Requires Data Link Layer Confirmation: <input checked="" type="checkbox"/> Never <input checked="" type="checkbox"/> Always <input checked="" type="checkbox"/> Sometimes <input checked="" type="checkbox"/> Configurable	

DNP V3.00

DEVICE PROFILE DOCUMENT

(Also see the Implementation Table beginning on page 8.)

For details of configurable parameters, see the separate DRMCC DNP Reference Manual

Requires Application Layer Confirmation:

- Never
- Always
- When reporting Event Data**
- When sending multi-fragment responses**
- Sometimes
- Configurable

Timeouts while waiting for:

- | | | | | |
|--------------------------|---|--|-----------------------------------|--|
| Data Link Confirm: | <input type="checkbox"/> None | <input checked="" type="checkbox"/> Fixed at 3s | <input type="checkbox"/> Variable | <input type="checkbox"/> Configurable |
| Complete Appl. Fragment: | <input checked="" type="checkbox"/> None | <input type="checkbox"/> Fixed at ____ | <input type="checkbox"/> Variable | <input type="checkbox"/> Configurable |
| Application Confirm: | <input type="checkbox"/> None | <input type="checkbox"/> Fixed at ____ | <input type="checkbox"/> Variable | <input checked="" type="checkbox"/> Configurable, (ref manual.) |
| Complete Appl. Response: | <input checked="" type="checkbox"/> None | <input type="checkbox"/> Fixed at ____ | <input type="checkbox"/> Variable | <input type="checkbox"/> Configurable |

Others

- | | |
|---|---------------------------------------|
| Transmission Delay | none. |
| Inter-character Timeout: | none. |
| Need Time Delay: | none. |
| Unsolicited response notification delay | 15s. |
| Unsolicited response retry delay: | equal to Application confirm timeout. |

Sends/Executes Control Operations:

- | | | | | |
|-------------------------|--|---|------------------------------------|---------------------------------------|
| WRITE Binary Outputs | <input checked="" type="checkbox"/> Never | <input type="checkbox"/> Always | <input type="checkbox"/> Sometimes | <input type="checkbox"/> Configurable |
| SELECT/OPERATE | <input type="checkbox"/> Never | <input checked="" type="checkbox"/> Always | <input type="checkbox"/> Sometimes | <input type="checkbox"/> Configurable |
| DIRECT OPERATE | <input type="checkbox"/> Never | <input checked="" type="checkbox"/> Always | <input type="checkbox"/> Sometimes | <input type="checkbox"/> Configurable |
| DIRECT OPERATE - NO ACK | <input type="checkbox"/> Never | <input checked="" type="checkbox"/> Always | <input type="checkbox"/> Sometimes | <input type="checkbox"/> Configurable |
| Count > 1 | <input checked="" type="checkbox"/> Never | <input type="checkbox"/> Always | <input type="checkbox"/> Sometimes | <input type="checkbox"/> Configurable |
| Pulse On | <input checked="" type="checkbox"/> Never | <input type="checkbox"/> Always | <input type="checkbox"/> Sometimes | <input type="checkbox"/> Configurable |
| Pulse Off | <input checked="" type="checkbox"/> Never | <input type="checkbox"/> Always | <input type="checkbox"/> Sometimes | <input type="checkbox"/> Configurable |
| Latch On | <input type="checkbox"/> Never | <input checked="" type="checkbox"/> Always | <input type="checkbox"/> Sometimes | <input type="checkbox"/> Configurable |
| Latch Off | <input type="checkbox"/> Never | <input checked="" type="checkbox"/> Always | <input type="checkbox"/> Sometimes | <input type="checkbox"/> Configurable |
| Queue | <input checked="" type="checkbox"/> Never | <input type="checkbox"/> Always | <input type="checkbox"/> Sometimes | <input type="checkbox"/> Configurable |
| Clear Queue | <input checked="" type="checkbox"/> Never | <input type="checkbox"/> Always | <input type="checkbox"/> Sometimes | <input type="checkbox"/> Configurable |

Reports Binary Input Change Events when no specific variation requested:

- Never
- Only time-tagged
- Only non-time-tagged
- Configurable**

Reports time-tagged Binary Input Change Events when no specific variation requested:

- Never (see section X)
- Binary Input Change With Time
- Binary Input Change With Relative Time
- Configurable**

<h1 style="margin: 0;">DNP V3.00</h1> <h2 style="margin: 0;">DEVICE PROFILE DOCUMENT</h2> <p style="margin: 0;">(Also see the Implementation Table beginning on page 8.) For details of configurable parameters, see the separate DRMCC DNP Reference Manual</p>	
<p>Sends Unsolicited Responses:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Never <input checked="" type="checkbox"/> Configurable <input type="checkbox"/> Only certain objects <input type="checkbox"/> Sometimes (attach explanation) <input checked="" type="checkbox"/> ENABLE/DISABLE <p>UNSOLICITED Function codes supported</p>	<p>Sends Static Data in Unsolicited Responses:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Never <input type="checkbox"/> When Device Restarts <input type="checkbox"/> When Status Flags Change <p>No other options are permitted.</p>
<p>Default Counter Object/Variation:</p> <ul style="list-style-type: none"> <input type="checkbox"/> No Counters Reported <input checked="" type="checkbox"/> Configurable <input checked="" type="checkbox"/> Default Object: 20 <input checked="" type="checkbox"/> Default Variation: Configurable 	<p>Counters Roll Over at:</p> <ul style="list-style-type: none"> <input type="checkbox"/> No Counters Reported <input type="checkbox"/> Configurable (attach explanation) <input type="checkbox"/> 16 Bits <input checked="" type="checkbox"/> 32 Bits <input type="checkbox"/> Other Value: _____
<p>Sends Multi-Fragment Responses:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No 	

3 Implementation Table

The following table identifies the variations, function codes, and qualifiers supported by the DRMCC DNP Slave in both request messages and in response messages.

For static (non-change-event) objects, requests sent with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01. Static object requests sent with qualifiers 17 or 28 will be responded with qualifiers 17 or 28. For change-event objects, qualifiers 17 or 28 are always responded.

In the table below text **Subset Level 3** indicates Subset Level 3 functionality (beyond Subset Level 2), and text **beyond Subset Level 3** indicates functionality beyond Subset Level 3.

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
1	0	Binary Input (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
1	1 (default - see note 1)	Binary Input	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index - see note 2)
1	2	Binary Input with Status	1 (read) (see note 5)			
2	0	Binary Input Change (Variation 0 is used to request default variation)	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
2	1 (default - see note 1)	Binary Input Change without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
2	2 (parse only)	Binary Input Change with Time	1 (read)			
2	3 (parse only)	Binary Input Change with Relative Time	1 (read)			
10	0	Binary Output Status (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
10	2 (default - see note 1)	Binary Output Status	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index - see note 2)
12	1	Control Relay Output Block	3 (select) 4 (operate) 5 (direct op) 6 (dir. op, noack)	00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)	129 (response)	echo of request
20	0	Binary Counter (Variation 0 is used to request default variation)	1 (read))	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
20	1	32-Bit Binary Counter	1 (read) 7 (freeze)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index - see note 2)
20	2	16-Bit Binary Counter	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index - see note 2)

OBJECT			REQUEST (Library will parse)	RESPONSE (Library will respond with)
20	5	32-Bit Binary Counter without Flag	1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response) 00, 01 (start-stop) 17, 28 (index - see note 2)
20	6 (default - see note 1)	16-Bit Binary Counter without Flag	1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response) 00, 01 (start-stop) 17, 28 (index - see note 2)
21	0	Frozen Counter (Variation 0 is used to request default variation)	Parse only	
21	1	32-Bit Frozen Counter	Parse only	
21	2	16-Bit Frozen Counter	Parse only	
21	3		Parse only	
21	4		Parse only	
21	9	32-Bit Frozen Counter without Flag	Parse only	
21	10 (default - see note 1)	16-Bit Frozen Counter without Flag	Parse only	
22	0	Counter Change Event (Variation 0 is used to request default variation)	1 (read) 06 (no range, or all) 07, 08 (limited qty)	
22	1 (default - see note 1)	32-Bit Counter Change Event	1 (read) 06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp) 17, 28 (index)
22	2	16-Bit Counter Change Event	1 (read) 06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp) 17, 28 (index)
22	5	32-Bit Counter Change Event with Time	1 (read)	
22	6	16-Bit Counter Change Event with Time	1 (read)	
23	0	Frozen Counter Event (Variation 0 is used to request default variation)	Parse only	
23	1 (default - see note 1)	32-Bit Frozen Counter Event	Parse only	
23	2	16-Bit Frozen Counter Event	Parse only	
23	5	32-Bit Frozen Counter Event with Time	Parse only	
23	6	16-Bit Frozen Counter Event with Time	Parse only	
30	0	Analog Input (Variation 0 is used to request default variation)	1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	
30	1	32-Bit Analog Input	1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response) 00, 01 (start-stop) 17, 28 (index - see note 2)
30	2 (default - see note 1)	16-Bit Analog Input	1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response) 00, 01 (start-stop) 17, 28 (index - see note 2)
30	3	32-Bit Analog Input without Flag	1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response) 00, 01 (start-stop) 17, 28 (index - see note 2)
30	4	16-Bit Analog Input without Flag	1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response) 00, 01 (start-stop) 17, 28 (index - see note 2)
30	5	short floating point	1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response) 00, 01 (start-stop) 17, 28 (index - see note 2)
30	6	long floating point	Not parsed	
32	0	Analog Change Event (Variation 0 is used to request default variation)	1 (read) 06 (no range, or all) 07, 08 (limited qty)	

OBJECT			REQUEST (Library will parse)	RESPONSE (Library will respond with)
32	1	32-Bit Analog Change Event without Time	1 (read) 06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp) 17, 28 (index)
32	2 (default - see note 1)	16-Bit Analog Change Event without Time	1 (read) 06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp) 17, 28 (index)
32	3	32-Bit Analog Change Event with Time	1 (read)	
32	4	16-Bit Analog Change Event with Time	1 (read)	
32	5	short floating point Analog Change Event without Time	1 (read) 06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp) 17, 28 (index)
32	7	short floating point Analog Change Event with Time		
34	0	Analog Input Reporting Deadband (Variation 0 is used to request default variation)		
34	1	16-Bit Analog Input Reporting Deadband		
34	2 (default - see note 1)	32-Bit Analog Input Reporting Deadband		
34	3	short floating point Analog Input Reporting Deadband		
40	0	Analog Output Status (Variation 0 is used to request default variation)	1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	
40	1	32-Bit Analog Output Status	1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response) 00, 01 (start-stop) 17, 28 (index - see note 2)
40	2 (default - see note 1)	16-Bit Analog Output Status	1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response) 00, 01 (start-stop) 17, 28 (index - see note 2)
40	3	short floating point Analog Output Status	1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response) 00, 01 (start-stop) 17, 28 (index - see note 2)
41	1	32-Bit Analog Output Block	3 (select) 4 (operate) 5 (direct op) 6 (dir. op, noack) 00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)	129 (response) echo of request
41	2	16-Bit Analog Output Block	3 (select) 4 (operate) 5 (direct op) 6 (dir. op, noack) 00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)	129 (response) echo of request
41	3	short floating point Analog Output Block	3 (select) 4 (operate) 5 (direct op) 6 (dir. op, noack) 00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)	129 (response) echo of request

OBJECT			REQUEST (Library will parse)	RESPONSE (Library will respond with)		
50	0	Time and Date	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index - see note 2)
50	1 (default - see note 1)	Time and Date	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07 (limited qty=1) 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index - see note 2)
			2 (write)	00, 01 (start-stop) 07 (limited qty=1) 08 (limited qty) 17, 28 (index)		
52	2	Time Delay Fine			129 (response)	07 (limited qty) (qty = 1)
60	0	Class 0, 1, 2, and 3 Data	1 (read) 20 (enbl. unsol.) 21 (dsbl. unsol.)	06 (no range, or all)		
60	1	Class 0 Data	1 (read)	06 (no range, or all)		
60	2	Class 1 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
			20 (enbl. unsol.) 21 (dsbl. unsol.)	06 (no range, or all)		
60	3	Class 2 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
			20 (enbl. unsol.) 21 (dsbl. unsol.)	06 (no range, or all)		
60	4	Class 3 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
			20 (enbl. unsol.) 21 (dsbl. unsol.)	06 (no range, or all)		
70	1	File Identifier	2 (write)	1b (free-format)	129 (response)	1b (free-format)
80	0	Internal Indications(Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
80	1	Internal Indications	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index - see note 2)
			2 (write) (see note 4)	00 (start-stop) 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)		
112	string length	Virtual Terminal Output Block	2 (write)	00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)		
113	string length	Virtual Terminal Event Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
		No Object (function code only) -See Note 3	13 (cold restart)			
		No Object (function code only)	14 (warm restart)			
		No Object (function code only)	23 (delay meas.)			

Note 1: A Default variation refers to the variation responded when variation 0 is requested and/or in class 0, 1, 2, or 3 scans. Default variations are configurable (see Section); however, default settings for the configuration parameters are indicated in the table above.

Note 2: For static (non-change-event) objects, qualifiers 17 or 28 are only responded when a request is sent with qualifiers 17 or 28, respectively. Otherwise, static object requests sent with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01. (For change-event objects, qualifiers 17 or 28 are always responded.)

Note 3: For DRMCC DNP Slave, all restart requests are ignored.

Note 4: Writes of Internal Indications are only supported for index 7 (Restart IIN1-7). The honouring of the Restart request will in any case be application-dependent. User-defined IINs are not supported as to use them for critical functions would deny the ability of restricted SCADA systems to work with DRMCC DNP Slave.

Note 5 The communications gateway reports quality of data using a simple set of flags. This is held as part of the DRMCC data held in a shared memory segment. The applications interface is described in a separate document. The time of last change is not recorded.

4 Event Management

Events are generated when a data item's value is seen to have changed when a periodic inspection is made. In all cases the change is in terms of the internal value, not how the SCADA system views it. This means that an internal floating-point value may have changed, but the externally reported scaled value may not, even though a change event is queued.

Binary change events are queued, so a short history of changes is available. The queue is 5 times the total number of binary points configured. Other change events are not queued. In those cases, a read of the event will report the current value, which might not be that which triggered the event.

Requests for event variations which report time stamps, report the time at which the event change was detected, not the time at which the change actually took place. The discrepancy is dependent on the rate at which inspections are made (DNP `master_timeout` configuration parameter).

5 Configuration

The DRMCC DNP Slave has a number of configurable parameters. The values for the parameters are defined in a configuration file, or (for a limited set) on the command line.

The configuration file defines:

- the DRMCC application variable set
- gateway-to-application communications
- the point-to-variable mapping
- any configurable DNP behaviour different from the default.

The configuration file may be edited using a standard text editor, or may be generated automatically.

Where a DNP master may alter the DRMCC DNP Slave behaviour, such alterations are temporary, and cannot change the contents of a configuration file. Such operation is not encouraged.

A complete description of the configuration file is contained in the DRMCC DNP Reference Manual.