

PowerLogic® ION7550 / ION7650

Energy & Power Quality Meter

DNP 3.0 Device Profile

December 2006



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1. Introduction

This document describes the DNP V3.00 communications protocol employed by the ION7550 / ION7650 meter. The DNP protocol can be selected for the following:

- up to two serial communication ports (which can consist of RS232/RS485/Internal Modem)
- the optical port
- up to three Ethernet connections

A maximum of three ports/connections in total may be used at the same time.

It is assumed that the reader is familiar with the DNP V3.00 protocol and serial communications in general.

2. DNP Device Profile

<h1>DNP V3.0</h1> <h2>DEVICE PROFILE DOCUMENT</h2>	
Vendor Name: Power Measurement Ltd	
Device Name: ION7550, ION7650	
Highest DNP Level Supported: For Requests: Level 2 For Responses: Level 2	Device Function: <input 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 07 and 08 (limited quantity), and 17 and 28 (index) are supported. Static object requests sent with qualifiers 07, or 08, will be responded with qualifiers 00 or 01. 16-bit, 32-bit and Floating Point Analog Change Events with Time may be requested. 16-bit, 32-bit Frozen Analog Input and Frozen Analog Events with and without Time may be requested. Floating Point Analog Output Status and Output Block Objects 40 are supported.	
Maximum Data Link Frame Size (octets): Transmitted: 292 Received 292	Maximum Application Fragment Size (octets): Transmitted: Configurable 50 to 2048 Received 2048
Maximum Data Link Re-tries: <input type="checkbox"/> None <input type="checkbox"/> Fixed <input checked="" type="checkbox"/> Configurable from 0 to 15	Maximum Application Layer Re-tries: <input checked="" type="checkbox"/> None <input type="checkbox"/> Configurable
Requires Data Link Layer Confirmation: <input type="checkbox"/> Never <input type="checkbox"/> Always <input type="checkbox"/> Sometimes <input checked="" type="checkbox"/> Configurable as: Never, Only for multi-frame messages, or Always	
Requires Application Layer Confirmation: <input type="checkbox"/> Never <input type="checkbox"/> Always <input type="checkbox"/> When reporting Event Data (Slave devices only) <input type="checkbox"/> When sending multi-fragment responses (Slave devices only) <input type="checkbox"/> Sometimes <input checked="" type="checkbox"/> Configurable as: "Only when reporting event data", or "When reporting event data or multi-fragment messages."	

DNP V3.0

DEVICE PROFILE DOCUMENT

Timeouts while waiting for:

- Data Link Confirm: None Fixed at _____ Variable **Configurable.**
- Complete Appl. Fragment: **None** Fixed at _____ Variable Configurable
- Application Confirm: None **Fixed at 10s** Variable Configurable.
- Complete Appl. Response: **None** Fixed at _____ Variable Configurable

- Others:
- Transmission Delay, configurable
 - Select/Operate Arm Timeout, configurable 0 sec to 30 sec
 - Need Time Interval, configurable 1 sec to 86400 sec (1 day)
 - Data Link Confirm Timeout, configurable 0.1 sec to 30 sec
 - Unsolicited Notification Delay, random value between 1 and 10 sec
 - Unsolicited Response Retry Delay, configurable 1 sec to 7200 sec (2 hours)
 - Unsolicited Max Number of Retries, configurable 0 to 100, 0 is infinite retries
 - Binary Change Event Scan Period, fixed at 1 sec
 - Analog Change Event Scan Period, fixed at 1 sec
 - Counter Change Event Scan Period, fixed at 1 sec
 - Frozen Counter Change Event Scan Period, fixed at 1 sec
 - Analog Change Event Scan Period, fixed at 1 sec
 - Frozen Analog Change Event Scan Period, fixed at 1 sec

Sends/Executes Control Operations:

- WRITE Binary Outputs **Never** Always Sometimes Configurable
- SELECT/OPERATE Never **Always** Sometimes Configurable
- DIRECT OPERATE Never **Always** Sometimes Configurable
- DIRECT OPERATE – NO ACK Never **Always** Sometimes Configurable

- Count > 1 **Never** Always Sometimes Configurable
- Pulse On Never **Always** Sometimes Configurable
- Pulse Off **Never** Always Sometimes Configurable
- Latch On Never **Always** Sometimes Configurable
- Latch Off Never **Always** Sometimes Configurable

- Queue **Never** Always Sometimes Configurable
- Clear Queue **Never** Always Sometimes Configurable

Attach explanation if 'Sometimes' or 'Configurable' was checked for any operation.

Reports Binary Input Change Events when no specific variation requested:

- Never
- Only time-tagged
- Only non-time-tagged
- Configurable to send time-tagged or non-time-tagged**

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

- Never
- Binary Input Change With Time
- Binary Input Change With Relative Time
- Configurable to Binary Input Change With Time and Binary Input Change With Relative Time**

<h1 style="margin: 0;">DNP V3.0</h1> <h2 style="margin: 0;">DEVICE PROFILE DOCUMENT</h2>																						
<p>Sends Unsolicited Responses:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Never <input type="checkbox"/> Configurable – enable/disable <input type="checkbox"/> Only certain objects <input type="checkbox"/> Sometimes (attach explanation) <input type="checkbox"/> ENABLE/DISABLE UNSOLICITED Function codes supported 	<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 type="checkbox"/> Default Object Default Variation: <input type="checkbox"/> Point-by-point list attached 	<p>Counters Roll Over at:</p> <ul style="list-style-type: none"> <input type="checkbox"/> No Counters Reported <input checked="" type="checkbox"/> Configurable – controlled partly by rollover configured in input ION modules. See the <i>Multiport DNP 3.0 and ION Technology</i> technical note. <input type="checkbox"/> 16 Bits <input type="checkbox"/> 32 Bits <input type="checkbox"/> Other Value: _____ <input type="checkbox"/> Point-by-point list attached 																					
<p>Sends Multi-Fragment Responses:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Configurable – “Always” or “When reporting Event Data” 																						
<p>Sequential File Transfer Support:</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 30%;">Append File Mode</td> <td style="width: 30%;"><input type="checkbox"/> Yes</td> <td style="width: 30%;"><input checked="" type="checkbox"/> No</td> </tr> <tr> <td>Custom Status Code Strings</td> <td><input type="checkbox"/> Yes</td> <td><input checked="" type="checkbox"/> No</td> </tr> <tr> <td>Permissions Field</td> <td><input type="checkbox"/> Yes</td> <td><input checked="" type="checkbox"/> No</td> </tr> <tr> <td>File Events Assigned to Class</td> <td><input type="checkbox"/> Yes</td> <td><input checked="" type="checkbox"/> No</td> </tr> <tr> <td>File Events Send Immediately</td> <td><input type="checkbox"/> Yes</td> <td><input checked="" type="checkbox"/> No</td> </tr> <tr> <td>Multiple Blocks in a Fragment</td> <td><input type="checkbox"/> Yes</td> <td><input checked="" type="checkbox"/> No</td> </tr> <tr> <td>Max Number of Files Open</td> <td>0</td> <td></td> </tr> </table>		Append File Mode	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	Custom Status Code Strings	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	Permissions Field	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	File Events Assigned to Class	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	File Events Send Immediately	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	Multiple Blocks in a Fragment	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	Max Number of Files Open	0	
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Multiple Blocks in a Fragment	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No																				
Max Number of Files Open	0																					

2.1 Implementation Table

Level 2 Implementation (DNP-L2)

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)	
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
1	0	Binary Input - Any Variation	1	00,01,06,07,08, 17,28		
1	1	Binary Input	1	00,01,06,07,08, 17,28	129	00,01,17,28
1	2	Binary Input with Status	1	00,01,06,07,08, 17,28	129	00,01,17,28
2	0	Binary Input Change - All Variations	1	06,07,08		
2	1	Binary Input Change without Time	1	06,07,08	129	17,28
2	2	Binary Input Change with Time	1	06,07,08	129	17,28
2	3	Binary Input Change with Relative Time	1	06,07,08	129	17,28
10	0	Binary Output – always mapped to variation 2				
10	1	Binary Output	1	00,01,06,07,08, 17,28	129	00,01,17,28
10	2	Binary Output Status	1	00,01,06,07,08, 17,28	129	00,01,17,28
12	1	Control Relay Output Block	3,4,5,6	17,28	129	echo of request
12	2	Pattern Control Block				
12	3	Pattern Mask				
20	0	Binary Counter - Any Variation	1 7,8	00,01,06,07,08, 17,28 00,01,06,07,08		
20	1	32-Bit Binary Counter	1	00,01,06,07,08, 17,28	129	00,01,17,28
20	2	16-Bit Binary Counter	1	00,01,06,07,08, 17,28	129	00,01,17,28
20	5	32-Bit Binary Counter without Flag	1	00,01,06,07,08, 17,28	129	00,01,17,28
20	6	16-Bit Binary Counter without Flag	1	00,01,06,07,08, 17,28	129	00,01,17,28

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)		
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)	
21	0	Frozen Counter - Any Variation	1	00,01,06,07,08,17,28			
21	1	32-Bit Frozen Counter	1	00,01,06,07,08,17,28	129	00,01,17,28	
21	2	16-Bit Frozen Counter	1	00,01,06,07,08,17,28	129	00,01,17,28	
21	5	32-Bit Frozen Counter with Time of Freeze	1	00,01,06	129	00,01,17,28	** 1
21	6	16-Bit Frozen Counter with Time of Freeze	1	00,01,06	129	00,01,17,28	**
21	9	32-Bit Frozen Counter without Flag	1	00,01,06	129	00,01,17,28	
21	10	16-Bit Frozen Counter without Flag	1	00,01,06	129	00,01,17,28	
22	0	Counter Change Event - Any Variation	1	06,07,08			
22	1	32-Bit Counter Change Event without Time	1	06,07,08	129	17,28	
22	2	16-Bit Counter Change Event without Time	1	06,07,08	129	17,28	
22	5	32-Bit Counter Change Event with Time	1	06,07,08	129	17,28	**
22	6	16-Bit Counter Change Event with Time	1	06,07,08	129	17,28	**
23	0	Frozen Counter Event - Any Variation	1	06,07,08			**
23	1	32-Bit Frozen Counter Event without Time	1	06,07,08	129	17,28	**
23	2	16-Bit Frozen Counter Event without Time	1	06,07,08	129	17,28	**
23	5	32-Bit Frozen Counter Event with Time	1	06,07,08	129	17,28	**
23	6	16-Bit Frozen Counter Event with Time	1	06,07,08	129	17,28	**
30	0	Analog Input - Any Variation	1,7,8	00,01,06,07,08,17,28			
30	1	32-Bit Analog Input	1	00,01,06,07,08,17,28	129	00,01,17,28	
30	2	16-Bit Analog Input	1	00,01,06,07,08,17,28	129	00,01,17,28	
30	3	32-Bit Analog Input without Flag	1	00,01,06,07,08,17,28	129	00,01,17,28	
30	4	16-Bit Analog Input without Flag	1	00,01,06,07,08,17,28	129	00,01,17,28	
30	5	Short Floating Point	1	00,01,06,07,08,17,28	129	00,01,17,28	**

¹ The device can be configured to respond with the object/variations marked with "**". Note that these object/variations are not listed in the DNP V3.00 Subset 2 definitions. If the meter is configured to respond with these objects care must be taken to ensure that the master can parse the response.

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)		
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)	
30	6	Long Floating Point	1	00,01,06,07,08, 17,28	129	00,01,17,28	**
31	0	Frozen Analog Input - Any Variation	1	00,01,06,07,08, 17,28			**
31	1	32-Bit Frozen Analog Input	1	00,01,06,07,08, 17,28	129	00,01,17,28	**
31	2	16-Bit Frozen Analog Input	1	00,01,06,07,08, 17,28	129	00,01,17,28	**
31	3	32-Bit Frozen Analog Input with Time of Freeze	1	00,01,06,07,08, 17,28	129	00,01,17,28	**
31	4	16-Bit Frozen Analog Input with Time of Freeze	1	00,01,06,07,08, 17,28	129	00,01,17,28	**
31	5	32-Bit Frozen Analog Input without Flag	1	00,01,06,07,08, 17,28	129	00,01,17,28	**
31	6	16-Bit Frozen Analog Input without Flag	1	00,01,06,07,08, 17,28	129	00,01,17,28	**
32	0	Analog Change Event - Any Variation	1	06,07,08			
32	1	32-Bit Analog Change Event without Time	1	06,07,08	129	17,28	
32	2	16-Bit Analog Change Event without Time	1	06,07,08	129	17,28	
32	3	32-Bit Analog Change Event with Time	1	06,07,08	129	17,28	**
32	4	16-Bit Analog Change Event with Time	1	06,07,08	129	17,28	**
32	5	Short Floating Point Analog Change Event without Time	1	06,07,08	129	17,28	**
32	6	Long Floating Point Analog Change Event without Time	1	06,07,08	129	17,28	**
32	7	Short Floating Point Analog Change Event with Time	1	06,07,08	129	17,28	**
32	8	Long Floating Point Analog Change Event with Time	1	06,07,08	129	17,28	**
33	0	Frozen Analog Event - Any Variation	1	06,07,08	129	17,28	**
33	1	32-Bit Frozen Analog Event without Time	1	06,07,08	129	17,28	**
33	2	16-Bit Frozen Analog Event without Time	1	06,07,08	129	17,28	**
33	3	32-Bit Frozen Analog Event with Time	1	06,07,08	129	17,28	**
33	4	16-Bit Frozen Analog Event with Time	1	06,07,08	129	17,28	**
40	0	Analog Output Status – Any Variation	1	00,01,06,07,08, 17,28			

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)		
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)	
40	1	32-Bit Analog Output Status	1	00,01,06,07,08,17,28	129	00,01,17,28	**
40	2	16-Bit Analog Output Status	1	00,01,06,07,08,17,28	129	00,01,17,28	
40	3	Short Floating Point Analog Output Status	1	00,01,06,07,08,17,28	129	00,01,17,28	**
40	4	Long Floating Point Analog Output Status	1	00,01,06,07,08,17,28	129	00,01,17,28	**
41	0	Analog Output Block - Any Variation					
41	1	32-Bit Analog Output Block	3,4,5,6	17,28	129	echo of request	**
41	2	16-Bit Analog Output Block	3,4,5,6	17,28	129	echo of request	
41	3	Short Floating Point Analog Output Block	3,4,5,6	17,28	129	echo of request	**
41	4	Long Floating Point Analog Output Block	3,4,5,6	17,28	129	echo of request	**
50	0	Time and Date - Any Variation					
50	1	Time and Date	1	00,01,06,07,08	129	00,01,17,28	**
			2	07 where quantity = 1			
52	0	Time Delay - All Variations					
52	1	Time Delay Coarse			129	07, quantity=1	
52	2	Time Delay Fine			129	07, quantity=1	
60	0	Not defined					
60	1	Class 0 Data	1	06,07,08			
60	2	Class 1 Data	1	06,07,08			
60	3	Class 2 Data	1	06,07,08			
60	4	Class 3 Data	1	06,07,08			
80	1	Internal Indications	1	00,01			**
			2	00 index=7			
		No Object (Cold Restart)	13				
		No Object (Warm Restart)	14				
		No Object (Delay Measurement)	23				

3. Time Sync Information

Parameter	Time
Maximum time base drift over a 10 minute interval	See the ION7550 / ION7650 Product Datasheet for the most current specifications.
Maximum difference between meter time base and master station time base after time set from DNP protocol	2s
Maximum delay measurement error	200ms

3.1 Time Sync Request Configuration

The time interval that the device waits before requesting a time sync from the master (using IIN1-4) is configurable from 1 second to 1 day (in 1 second intervals). The factory default is 1 day.

A Setup option in the **DNP Slave Options ION Module** is used to configure the Time Sync Request period.

3.2 Configuring DNP Comm Port to Accept Time Syncs

Setup options in the **ION Clock Module** need to be configured for DNP Time Syncs to be processed correctly:

- **TimeSyncSource** identifies the communications port running the DNP Protocol.
- **TimeSyncType** indicates if the time syncs are sent in local time or universal time format.

For more information see the *Time Synchronization and Timekeeping* technical note, available from the PowerLogic web site.

4. ION7550 / ION7650 Default DNP Configuration

The ION7550 / ION7650 is shipped from the Factory with the following DNP static objects defined. These objects are returned in response to a Class 0 Poll. Note that the protocol of the desired communications port must set to “DNP V3.00” before the meter will respond to DNP master requests.

Analog Input Objects (16-Bit Analog Input without Flag) (Object 30, Variation 4)		
Point	Measurement	Scaling
0	VIn a	x1
1	VIn b	x1
2	VIn c	x1
3	VIn avg	x1
4	VII ab	x1
5	VII bc	x1
6	VII ca	x1
7	VII avg	x1
8	I a	x1
9	I b	x1
10	I c	x1
11	I avg	x1
12	kW a	x1
13	kW b	x1
14	kW c	x1
15	kW tot	x1
16	kVAR a	x1
17	kVAR b	x1
18	kVAR c	x1
19	kVAR tot	x1
20	kVA a	x1
21	kVA b	x1
22	kVA c	x1
23	kVA tot	x1
24	PFsign a	x1
25	PFsign b	x1
26	PFsign c	x1
27	PFsign tot	x1
28	V unbal	x10
29	I unbal	x10
30	I4	x1
31	Freq	x10
32	kW sd del-rec ²	x1
33	kVAR sd del-rec ³	x1
34	kVA sd del+rec ³	x1

Binary Counter Objects (16-Bit Binary Counter without Flag) (Object 20, Variation 6)		
Point	Measurement	Scaling
0	kWh del (Import)	x1
1	kWh rec (Export)	x1
2	kWh del+rec (Total)	x1
3	kWh del-rec (Net)	x1
4	kVARh del (Import)	x1
5	kVARh rec (Export)	x1
6	kVARh del+rec (Total)	x1
7	kVARh del-rec (Net)	x1
8	kVAh del+rec (Total)	x1

² Note : These are instantaneous demand quantities, not peak (maximum) demand.

5. Details on Customizing DNP V3.00 Configuration

The ION7550 / ION7650 meter is factory configured with the basic DNP objects as outlined in the section “**ION7550 / ION7650 Default DNP Configuration**”. The ION7550 / ION7650 DNP configuration can be further customized to take advantage of other DNP features.

5.1 Customizing the DNP Point map

The ION7550 / ION7650 configuration can be modified to define which measurements are mapped to DNP Static points – this allows a user to exactly control the number of objects returned in a Class 0 poll. ION Modules are used to map ION7550 / ION7650 measurements to DNP points as follows:

- Up to **100** ION7550 / ION7650 measurements can be mapped to DNP Static points. The **ION DNP Slave Export Module** is used to map ION7550 / ION7650 measurements to DNP Binary Input, Binary Counter, or Analog Input points. A DNP Static point is defined for each ION7550 / ION7650 measurement that is “linked” to a DNP Slave Export ION Module. The type of DNP Static point is a setup option of the DNP Slave Export ION Module.
- Up to **16** relays can be controlled through DNP. The **ION DNP Slave Import Module** is used to map DNP Control Relay Output Block, and Analog Output Block points to ION7550 / ION7650 relay and analog output hardware.

5.2 Report-by-exception processing (DNP Events)

Any DNP Static point can be configured to create DNP Event objects on value changes. Binary Input Change Events are created when a DNP Binary Input point changes state. Counter and Analog Change Event objects are created when the corresponding Static object changes by more than a programmable deadband value. Deadbands can be set on a per-object basis. Further, Event objects can be assigned as Class 1, Class 2, or Class 3 on a per-object basis.

Setup options in the **ION DNP Slave Export Module** are used to enable Events, define deadband values, and assign DNP Event Classes.

DNP Change (deadband) events are generated after comparing the difference between the current value and the last change event logged. If this is greater than the deadband, a new change event will be logged. The current value is scanned and change events generated (if necessary) on a one second period. High-speed changes to the input values to the DSE modules will not necessarily be detected.

A freeze command received through the communication port will generate a frozen static value and/or frozen events for that DNP point, exclusively for that session. If the internal freeze input of the DSE module is pulsed, a new frozen static and frozen event will be generated for each session. The DNP point map is common to all ports and cannot be configured to only show specific DNP points for a specific port.

Setup options in the **ION DNP Slave Options Module** are used to select the Object/Variations of Events that will be produced.

Event capacities are:

- Binary Input Change Events – 25 events
- Frozen Counter Events – 25 events
- Counter Change Events – 25 events
- Frozen Analog Events – 25 events
- Analog Change Events – 50 events

5.3 Control Relay Output Block

Both ‘1 point per address’ and ‘2 points per address’ modes of addressing are supported for Control Relay Output Block objects. A setup option in the **ION DNP Slave Options Module** selects the addressing mode. Up to 10 CROB requests can be requested in a single message.

5.4 Freezing Binary Counter, Analog Input Points

Any DNP Binary Counter or Analog Input Point can be configured to support the freeze command. When a Binary Counter/Analog Input is frozen it copies its value into a DNP Frozen Counter/Analog Input point. These Frozen Counter/Analog Input points are returned in a Class 0 poll. Freeze and Freeze/No-Ack functions are supported.

A Setup option in the **ION DNP Slave Export Module** is used to give freeze capabilities to the associated Static point.

A Setup option in the **ION DNP Slave Options Module** is used to select the Object/Variation of the Frozen Static object.

5.5 Scaling

Counter and Analog Input objects can be scaled on a per-object basis. Scaling can be used to maintain resolution for integer-based variations. For example, Frequency measurements can be multiplied by 10 to obtain one decimal place of resolution. Alternatively, for Analog Input objects, floating point variations can be requested to maintain multiple decimal places of resolution.

5.6 Assigning ION DNP Slave Options Modules to Meter Communication Ports

The **ION DNP Slave Options Module** contains a *CommPort* setup register that assigns this **ION DNP Slave Options Module** to a particular communication port. Only the settings in the assigned **ION DNP Slave Options Module** have any affect on that communications port.

For TCP/IP connections (port is set to Ethernet) the *MasterIP Addr* setup register is used to differentiate between the connections. Setting a specific IP address in this register allows only that IP address to connect to this session. If the register is set to None or left blank, any IP address can connect and use the session.

For more information see the *Multiport DNP 3.0 and ION Technology* technical note, available from the PowerLogic web site.

6. Glossary of Terms

Application	A piece of software (a program) consisting of one or more processes and supporting functions.
Binary	A number system having only two symbols (1 and 0), and where values are expressed in the base two number system.
Bit	Abbreviation of binary digit. The smallest unit of information in a binary system. Has a value of either one (1) or zero (0).
Master	The client or host station or computer, with which the RTU equipment communicates. Also referred to as a host or host computer.
Non-volatile random-access memory	A semi-permanent type of data storage (memory) that is backed up by batteries to maintain stored data even if system power is lost. Can be both read and changed by the system. Abbreviated as NVRAM.
Random-access memory	A type of temporary data storage (memory) that can be read and changed while the computer is in use. Data stored in random-access memory is lost if the system loses power. Abbreviated as RAM.
Remote terminal unit	A piece of equipment located at a distance from a master station to monitor and control the status of outlying equipment, and to communicate the information back to the master station or host. Abbreviated as RTU.
Sequence of events	A time-tagged change of state, logged as part of a chronological record of significant changes in the condition of a particular point or points being monitored. Abbreviated as SOE.

7. List of Acronyms and Abbreviations

DNP	distributed network protocol
IED	intelligent electronic device
NVRAM	non-volatile random-access memory
OSI	open systems interconnect
RAM	random-access memory
RTU	remote terminal unit
SOE	sequence of events