

# DNP3 Router

## Datasheet

A-DNP3R

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# 1. PREFACE

## 1.1. ABOUT THIS DOCUMENT

This document contains the technical data for the DNP3 Router. The DNP3 Router provides intelligent data routing between EtherNet/IP and DNP3 (serial, Ethernet UDP, or Ethernet TCP). The DNP3 Router allows the user to integrate DNP3 devices over a secure link into a Rockwell Logix platform (e.g. ControlLogix or CompactLogix) with minimal effort.

## 1.2. FEATURES

The DNP3 Router is able to transfer data from various DNP3 devices to a maximum of three Logix controllers. The module operates in one of three modes, simplifying the configuration for all applications.

Mode	Description	Message Initiator
Reactive Tag	The DNP3 Router will convert DNP3 messages to Logix controller tag reads or tag writes.	Remote Device
Scheduled Tag	The DNP3 Router transfers data between a DNP3 device and a number of Logix tags, using a preconfigured scheduled. No Logix or remote device configuration is required.	DNP3 Router
Unscheduled	The DNP3 Router transfers messages received from a Logix Message Instruction.	Logix (Msg)

Table 1 – Modes of Operation

The DNP3 Router is configured using the Aparian Slate application. This program can be downloaded from [www.aparian.com](http://www.aparian.com) free of charge. Slate offers various configuration methods, including a controller tag browser.

Hereafter the DNP3 Router will be referred to as the **module**.

The module can operate in both a Logix “owned” and standalone mode. With a Logix connection the input and output assemblies will provide additional diagnostics information which will be available in the Logix controller environment.

The DNP3 Router allows the user to integrate DNP3 devices into a Logix system with minimal effort. No copying or mapping of data in the Logix controller is required as the DNP3 Router writes directly into Logix tags.

The DNP3 Router also provides DNP3 Secure Authentication 5 which enables the user to connect DNP3 devices to a Logix platform securely. The module also provides a range of statistics and traffic analyser to help fault find any problems.

The DNP3 Router supports DNP3 on three ports which can be configured from the Slate environment; Serial, Ethernet TCP, or Ethernet UDP.

Previously complicated data mapping is made easy by precompiled UDTs which converts the various DNP3 data formats into sensible data in the Logix environment.

The DNP3 Router also supports repeater functionality in Outstation mode allowing the user to have infield configurable repeaters in radio network applications.

The module uses isolated RS232 for DNP3 serial communication providing better noise immunity. The RS232 port also uses a terminal block for convenient installation.

A built-in webserver provides detailed diagnostics of system configuration and operation, including the display of DNP3 operation and communication statistics, without the need for any additional software.

### 1.3. ARCHITECTURE

The figure below provides an example of the typical network setup in reactive mode.

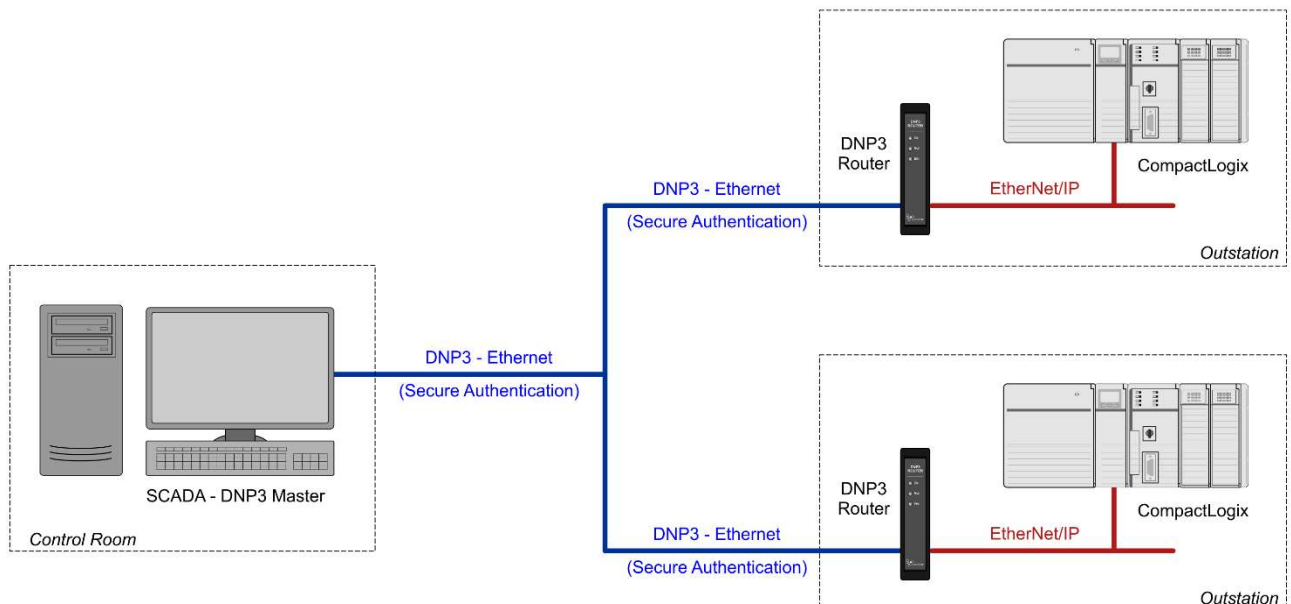


Figure 1 - Example of a typical network setup in reactive mode

By converting and redirecting serial DNP3 messages from legacy devices to EtherNet/IP, the module provides an interface for data exchange to Allen-Bradley ControlLogix and

CompactLogix platforms. This enables user to replace legacy devices and systems with minimal effort and downtime.

The DNP3 Router allows a Logix platform to seamlessly integrate into a DNP3 network with Reactive Tag Mode. The module will route DNP3 message directly to Logix tags with no need for additional ladder logic.

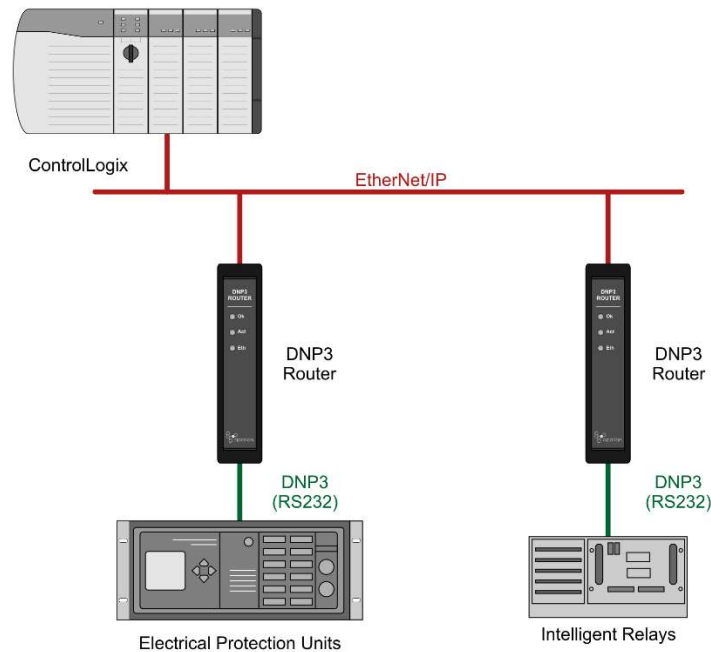


Figure 2 - Example of a typical network setup in scheduled/unscheduled mode

Systems that rely on a central ControlLogix communicating to a number of remote DNP3 devices, (e.g. Electrical Protection Units or Intelligent Relays), may find the DNP3 Router useful when operating in Scheduled Tag Mode as shown in the image above. The module will exchange data between the DNP3 device and Logix platform at a configured interval without any need for additional coding or mapping.

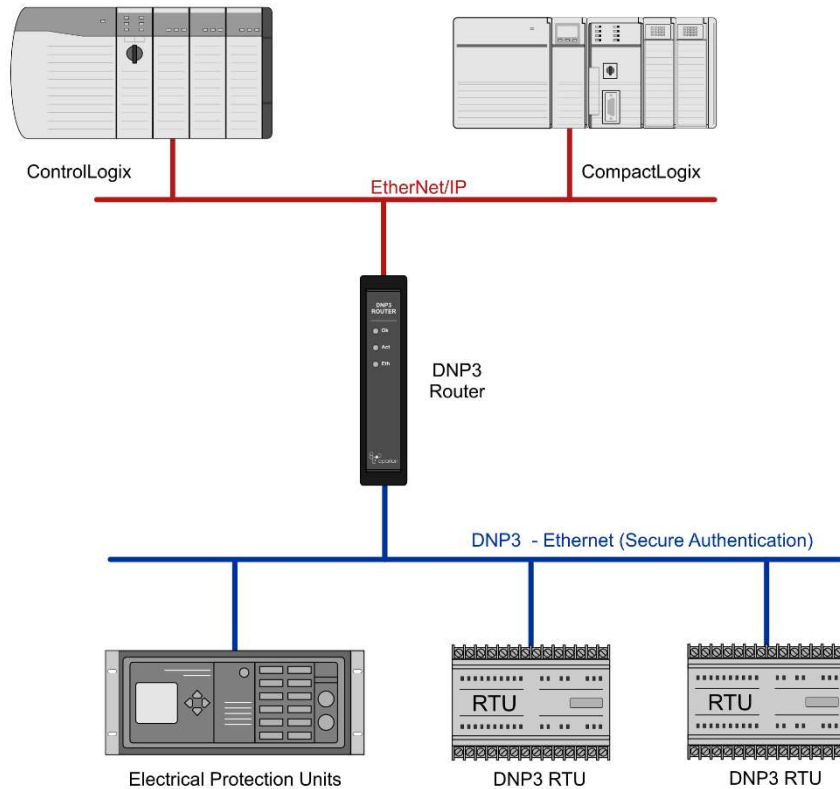


Figure 3 – Example of a typical network setup when using secure authentication

The DNP3 Router also provides the latest DNP3 Secure Authentication 5 standard which allows for secure authentication across the DNP3 network (Serial or Ethernet). The need for network security is essential to utility installations and operations to prevent unwanted attacks from outsiders. The DNP3 Router allows the user to configure the type and level of security needed with minimal effort.

The DNP3 Router also allows the user to implement repeaters into a radio network architecture when the DNP3 Master cannot see all the outstations (see below). The DNP3 Router in Outstation mode can be configured to repeater certain messages as well as route messages to other DNP3 Routers over Ethernet.

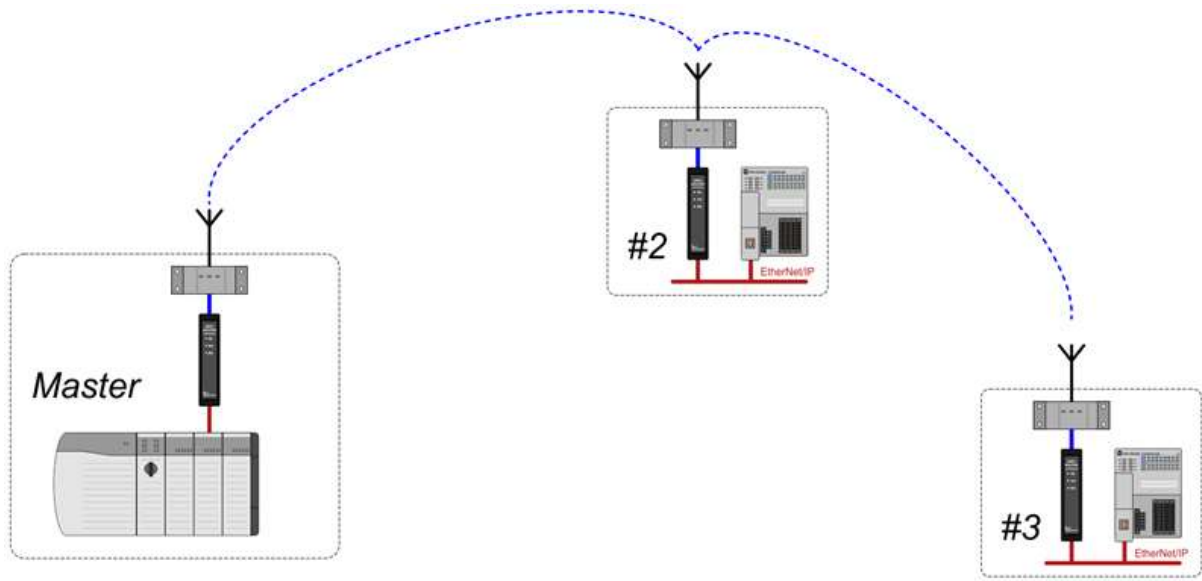


Figure 4 – Example of using the DNP3 Router as a repeater

## 2. ETHERNET/IP NETWORK

Specification	Rating
Connector	RJ45
Conductors	CAT5 STP/UTP
ARP connections	Max 20
TCP connections	Max 20
CIP connections	Max 10
Communication rate	10/100Mbps
Duplex mode	Full / Half
Auto-MDIX support	Yes

Table 1 - Ethernet specification

## 3. SERIAL PORT

Specification	Rating
RS232 Connector	4-way terminal
RS232 Conductor	24 – 18 AWG
RS232 Isolation voltage	2.5 kV
BAUD	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Parity	None, Even, Odd
Data bits	8
Stop bits	1

Table 2 – Serial port specification

## 4. DNP3 NETWORK

Specification	Rating
Reactive Tag mode	Max 30 mapping items

Scheduled Tag mode	Max 30 mapping items
Application Functions Supported	Read Write Select/Operate Direct-Operate Direct-Operate-No-Response Confirm (only in Reactive Mode) Immediate Freeze (only in Reactive Mode) Immediate Freeze No Response (only in Reactive Mode) Immediate Freeze and Clear (only in Reactive Mode) Immediate Freeze and Clear No Response (only in Reactive Mode) Cold Restart (only in Reactive Mode) Enable / Disable Unsolicited Messages (only in Reactive Mode) Delay Measure (only in Reactive Mode) Record Current Time (only in Reactive Mode) Unsolicited Response (only in Reactive Mode) Authentication Request Authentication Response
Maximum DNP3 objects per request	30
Maximum DNP3 request size per mapped item in Reactive Tag Mode	1000 bytes
Maximum DNP3 request size per mapped item in Scheduled Tag Mode	230 bytes
Maximum Logix Controller support	3
Unsolicited Response support	Yes
Maximum event buffer per DNP3 group	100,000
Number of Commands per Request	1
Event Read Interval	10ms

Table 3 – DNP3 specification



## 5. DNP3 SECURITY

Specification	Rating
Key Change Method Supported	Pre-shared
MAC Algorithms Supported	HMAC SHA-1 encryption (4 octets – serial) – for legacy support HMAC SHA-1 encryption (8 octets – serial) HMAC SHA-1 encryption (10 octets – networked) HMAC SHA-256 encryption (8 octets – serial) HMAC SHA-256 encryption (16 octets – networked) AES-GMAC (12 octets)
Key Wrap Algorithms Supported	AES-128 Key Wrap AES-256 Key Wrap
Aggressive Mode Supported	Yes

Table 4 – DNP3 Security

## 6. ELECTRICAL SPECIFICATIONS

Specification	Rating
Power requirements	Input: 10 – 28V DC, (70mA @ 24VDC)
Power consumption	1.7 W
Connector	3-way terminal
Conductors	24 – 18 AWG
Enclosure rating	IP20, NEMA/UL Open Type
Temperature	-20 – 70 °C
Earth connection	Yes, terminal based
Emissions	IEC61000-6-4
ESD Immunity	EN 61000-4-2
Radiated RF Immunity	IEC 61000-4-3
EFT/B Immunity	EFT: IEC 61000-4-4
Surge Immunity	Surge:IEC 61000-4-5
Conducted RF Immunity	IEC 61000-4-6

Table 5 - Electrical specification

## 7. CERTIFICATIONS






Specification	Rating
CE Mark	
UL Mark File: E494895	 CLASS 1, DIV 2, GROUPS A, B, C, D
ODVA Conformance	 * F/W 1.009
RoHS2 Compliant	
RCM	

Table 6 - Certifications

## 8. DIMENSIONS

Below are the enclosure dimensions as well as the required DIN rail dimensions.

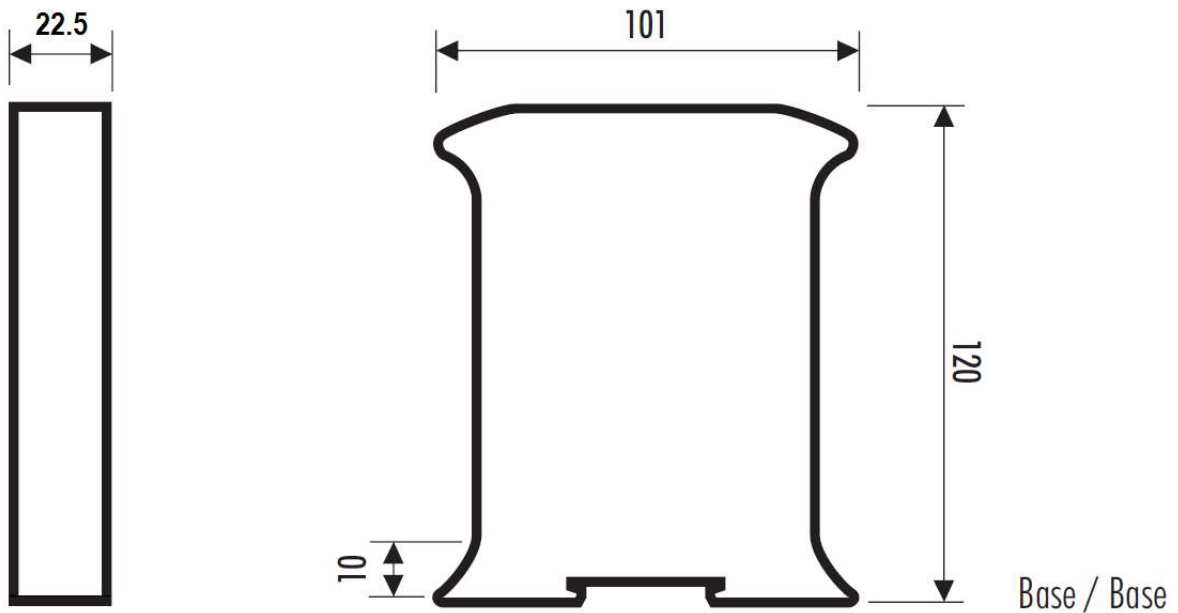


Figure 1 – DNP3 Router enclosure dimensions

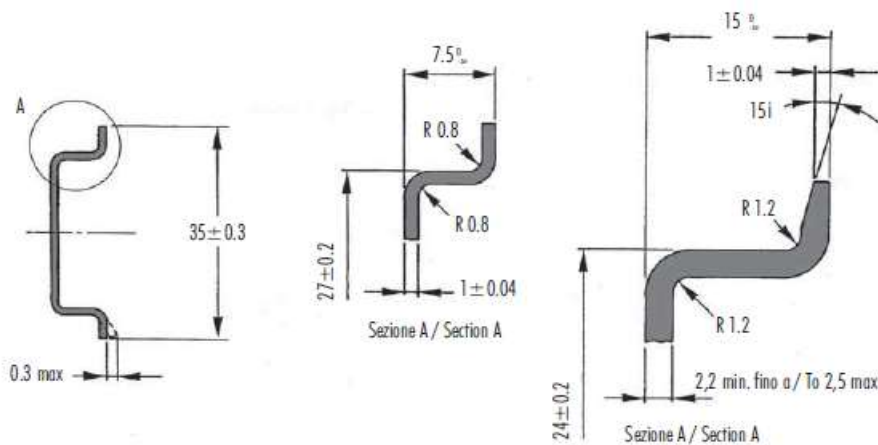


Figure 2 - Required DIN dimensions

# A. APPENDIX – DNP3 REFERENCE

## A.1. DNP3 FUNCTIONS

Code	Function
00	Confirm
01	Read
02	Write
03	Select
04	Operate
05	Direct Operate
06	Direct Operate - No Response
07	Freeze
08	Freeze - No Response
09	Freeze Clear
0a	Freeze Clear - No Response
0b	Freeze At Time
0c	Freeze At Time - No Response
0d	Cold Restart
0e	Warm Restart
0f	Initialize Data
10	Initialize Application
11	Start Application
12	Stop Application
13	Save Configuration
14	Enable Unsolicited
15	Disable Unsolicited
16	Assign Class
17	Delay Measurement
18	Record Current Time
19	Open File
1a	Close File
1b	Delete File
1c	Get File Information
1d	Authenticate File
1e	Abort File
1f	Activate Config
20	Authenticate Request
21	Authenticate Request - No Ack
81	Response
82	Unsolicited Response
83	Authentication Response

Table A.1 – DNP3 Functions

## A.2. DNP3 FUNCTIONS

Group	Description
0	Device Attributes
1	Binary Inputs
2	Binary Input Events
3	Double Bit Binary Inputs
4	Double Bit Binary Input Events
10	Binary Outputs
11	Binary Output Events
12	Binary Output Commands
13	Binary Output Command Events
20	Counters
21	Frozen Counters
22	Counter Events
23	Frozen Counter Events
30	Analog Inputs
31	Frozen Analog Inputs
32	Analog Input Events
33	Frozen Analog Input Events
34	Analog Input Reporting Deadbands
40	Analog Output Status
41	Analog Outputs
42	Analog Output Events
43	Analog Output Command Events
50	Time And Date
51	Time And Date Of Occurrence
52	Time Delays
60	Class Objects
70	File Control
80	Internal Indications
81	Device Storage
82	Device Profiles
83	Data Sets
85	Data Set Prototypes
86	Data Set Descriptors
87	Data Sets Present Value
88	Data Set Events
90	Applications
91	Status Of Requested Operations
100	Floating Point
101	BCD Integers
102	Unsigned Integers
110	Octet Strings

111	Octet String Events
112	Virtual Terminal Output Blocks
113	Virtual Terminal Event Data
120	Authentication
121	Security Statistics
122	Security Statistic Events

Table A.2 – DNP3 Groups

### A.3. DNP3 GROUP VARIATIONS

Group	Group Description	Supported Functions	Var. Code	Variation Description	Recommended Data Type	Supports Events
1	Binary Inputs	Read	1	Packed Format	SINT	
			2	With Flags	AparianDNP3BinaryInputWithFlag	●
3	Double Bit Binary Inputs	Read	1	Packed Format	SINT	
			2	With Flags	AparianDNP3DoubleBinaryInputWithFlag	●
10	Binary Outputs	Read	1	Packed Format	SINT	
			2	Output Status With Flags	AparianDNP3BinaryOutputWithFlag	●
12	Binary Output Commands	Operate*	1	Control Relay Output Block	AparianDNP3CROB	●
20	Counters	Read Freeze Clear	1	32-bit With Flag	AparianDNP3Counter32WithFlag	●
			2	16-bit With Flag	AparianDNP3Counter16WithFlag	●
			5	32-bit Without Flag	DINT	
			6	16-bit Without Flag	INT	
21	Frozen Counters	Read	1	32-bit With Flag	AparianDNP3Counter32WithFlag	●
			2	16-bit With Flag	AparianDNP3Counter16WithFlag	●
			5	32-bit With Flag And Time	AparianDNP3Counter32WithFlagTime	●
			6	16-bit With Flag And Time	AparianDNP3Counter16WithFlagTime	●
			9	32-bit Without Flag	DINT	
			10	16-bit Without Flag	INT	
30	Analog Inputs	Read	1	32-bit With Flag	AparianDNP3AnalogInput32Flag	●
			2	16-bit With Flag	AparianDNP3AnalogInput16Flag	●
			3	32-bit Without Flag	DINT	
			4	16-bit Without Flag	INT	
			5	Single Floating Point With Flag	AparianDNP3AnalogInputRealFlag	●
40	Analog Output Status	Read	1	32-bit With Flag	AparianDNP3AnalogOutput32Flag	●
			2	16-bit With Flag	AparianDNP3AnalogOutput16Flag	●
			3	Single Floating Point With Flag	AparianDNP3AnalogOutputRealFlag	●
41	Analog Outputs	Operate*	1	32-bit	AparianDNP3AnalogOutput32	●
			2	16-bit	AparianDNP3AnalogOutput16	●
			3	Single Floating Point	AparianDNP3AnalogOutputReal	●
102	Unsigned Integers	Read Write	1	8-bit	SINT	

Table A.3 – Supported DNP3 Group Variations

\*Note: The function Operate refers to all the Operate functions: Select, Operate, Direct Operate and Direct Operate without Acknowledge.

Note: The *Supportes Events* column is only relevant for DNP3 Outstation mode.

## A.4. DNP3 QUALIFIER CODE

The qualifier code (byte) is made up of the Object Prefix nibble and the Range Field nibble as described in the table below.

Bit Number -->	7	6	5	4	3	2	1	0
	Prefix Code				Range Specifier Code			

Table A.4 – DNP3 Qualifier Code

Prefix Code	Object Prefix
0	Objects packed without a prefix
1	Objects prefixed with 8-bit index
2	Objects prefixed with 16-bit index
3	Objects prefixed with 32-bit index
4	Objects prefixed with 8-bit size
5	Objects prefixed with 16-bit size
6	Objects prefixed with 32-bit size
7	Reserved

Table A.5 – DNP3 Object Prefix Code

Range Code	Range Specifier
0	8-bit Start-Stop index
1	16-bit Start-Stop index
2	32-bit Start-Stop index
3	8-bit Start-Stop virtual address
4	16-bit Start-Stop virtual address
5	32-bit Start-Stop virtual address
6	No range - implies All
7	8-bit Count of objects
8	16-bit Count of objects
9	32-bit Count of objects
A	Reserved
B	8-bit Count of objects, variable format
C	Reserved
D	Reserved
E	Reserved
F	Reserved

Table A.6 – DNP3 Range Field Specifier Code



Qualifier Code	Object Prefix	Range Specifier	Preferred
00	Objects packed without a prefix	8-bit Start-Stop index	●
01	Objects packed without a prefix	16-bit Start-Stop index	●
02	Objects packed without a prefix	32-bit Start-Stop index	
03	Objects packed without a prefix	8-bit Start-Stop virtual address	
04	Objects packed without a prefix	16-bit Start-Stop virtual address	
05	Objects packed without a prefix	32-bit Start-Stop virtual address	
06	Objects packed without a prefix	No range - implies All	●
07	Objects packed without a prefix	8-bit Count of objects	●
08	Objects packed without a prefix	16-bit Count of objects	●
09	Objects packed without a prefix	32-bit Count of objects	
17	Objects prefixed with 8-bit index	8-bit Count of objects	●
18	Objects prefixed with 8-bit index	16-bit Count of objects	
19	Objects prefixed with 8-bit index	32-bit Count of objects	
27	Objects prefixed with 16-bit index	8-bit Count of objects	
28	Objects prefixed with 16-bit index	16-bit Count of objects	●
29	Objects prefixed with 16-bit index	32-bit Count of objects	
37	Objects prefixed with 32-bit index	8-bit Count of objects	
38	Objects prefixed with 32-bit index	16-bit Count of objects	
39	Objects prefixed with 32-bit index	32-bit Count of objects	
4B	Objects prefixed with 8-bit size	8-bit Count of objects, variable format	
5B	Objects prefixed with 16-bit size	8-bit Count of objects, variable format	●
6B	Objects prefixed with 32-bit size	8-bit Count of objects, variable format	

Table A.7 – DNP3 Valid Qualifier Range Codes