DNP3.0
Distributed Network Protocol

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Contents

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1. DNP Introduction

1.1 What is DNP?

- Communication Protocol for Telecontrol

- Defined communications between Master station and Intelligent Electronic Device (IED)

1.2 Benefits of DNP

- Open standard

- Supported by an active DNP User Group

- A protocol that is supported by a large and increasing number of equipment manufacturers

- Optimized for reliable and efficient SCADA (Supervisory Control And Data Acquisition)

communication

- Supported by comprehensive implementation testing standards

- Defined protocol subsets (level 1, level 2, level 3) for particular applications

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1.3 Features of DNP

- Supports time stamped messages for sequence of event (SOE) recording

- Allows master-slave topology

- Allows multiple master topology

- Provides user definable objects

- Provides for reporting by exception/event without polling by master

- Provides for "changed data" only response

- Addressing for over 65000 devices on single link

- Provides time synchronization and time-stamped events

- Data link and application layer confirmation

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2. DNP Basic Concepts

2.1 Point and Point Type
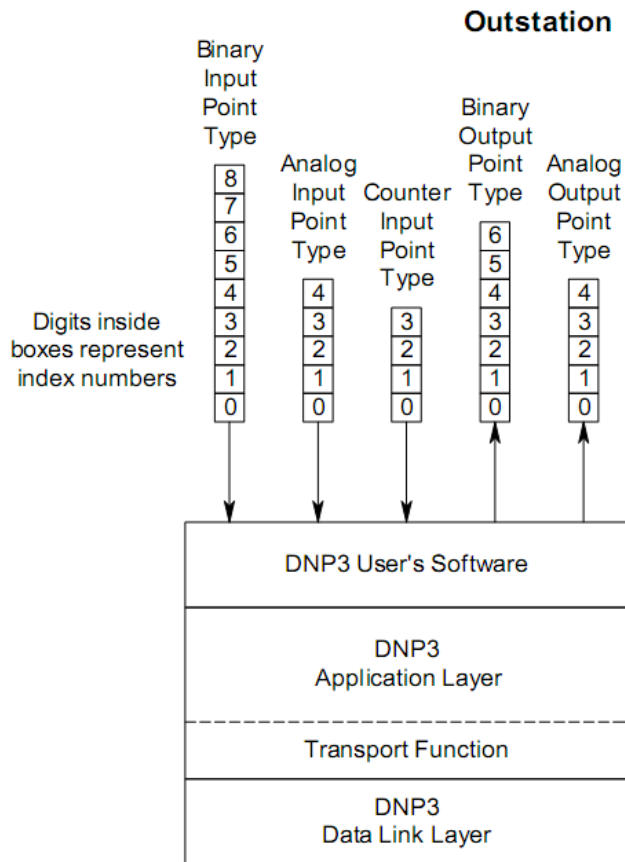
- A point is identified by an index
- A point usually has a static value
- A point may generate events
- Information about a point is reported using one or more objects

2.2 Static Data

- The point's current value, which is the most recently measured, computed or obtained value

- Static binary data = the present ON or OFF condition of a binary state point

- Static Analog data = the most recently obtained value of an analog input point

2.3 Event Data

- Associated with something of significance happening

- State changes, a measurement whose values crosses some threshold, and analog input changing by more than its deadband, etc
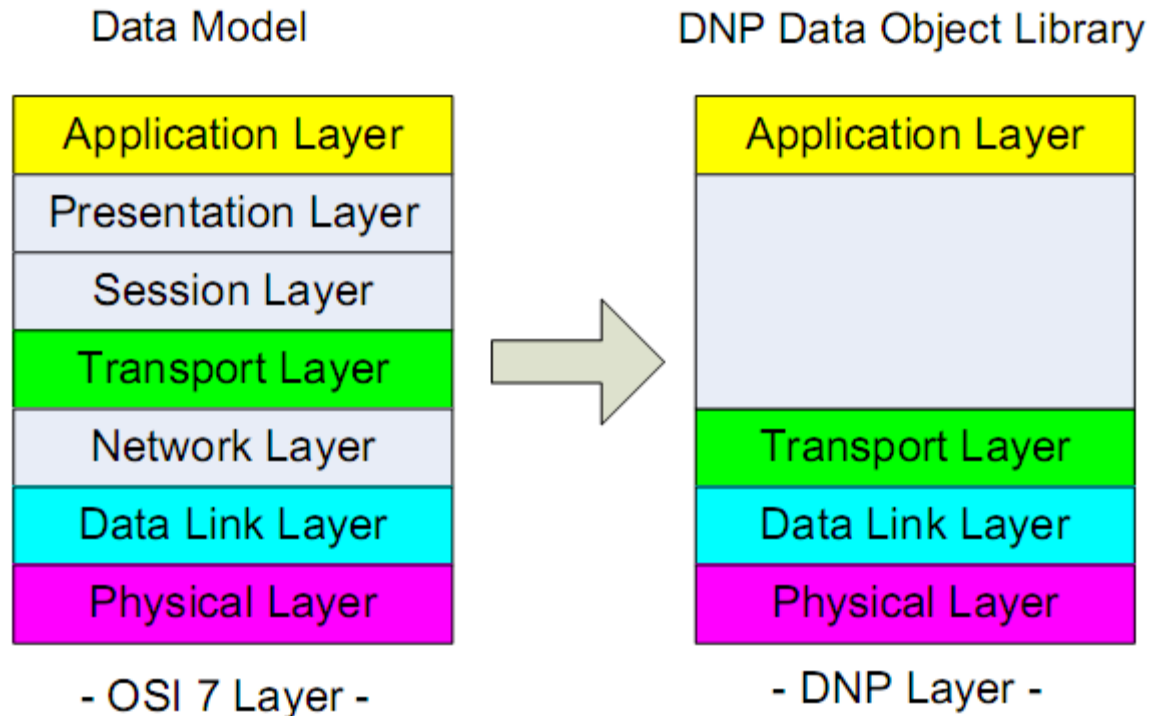
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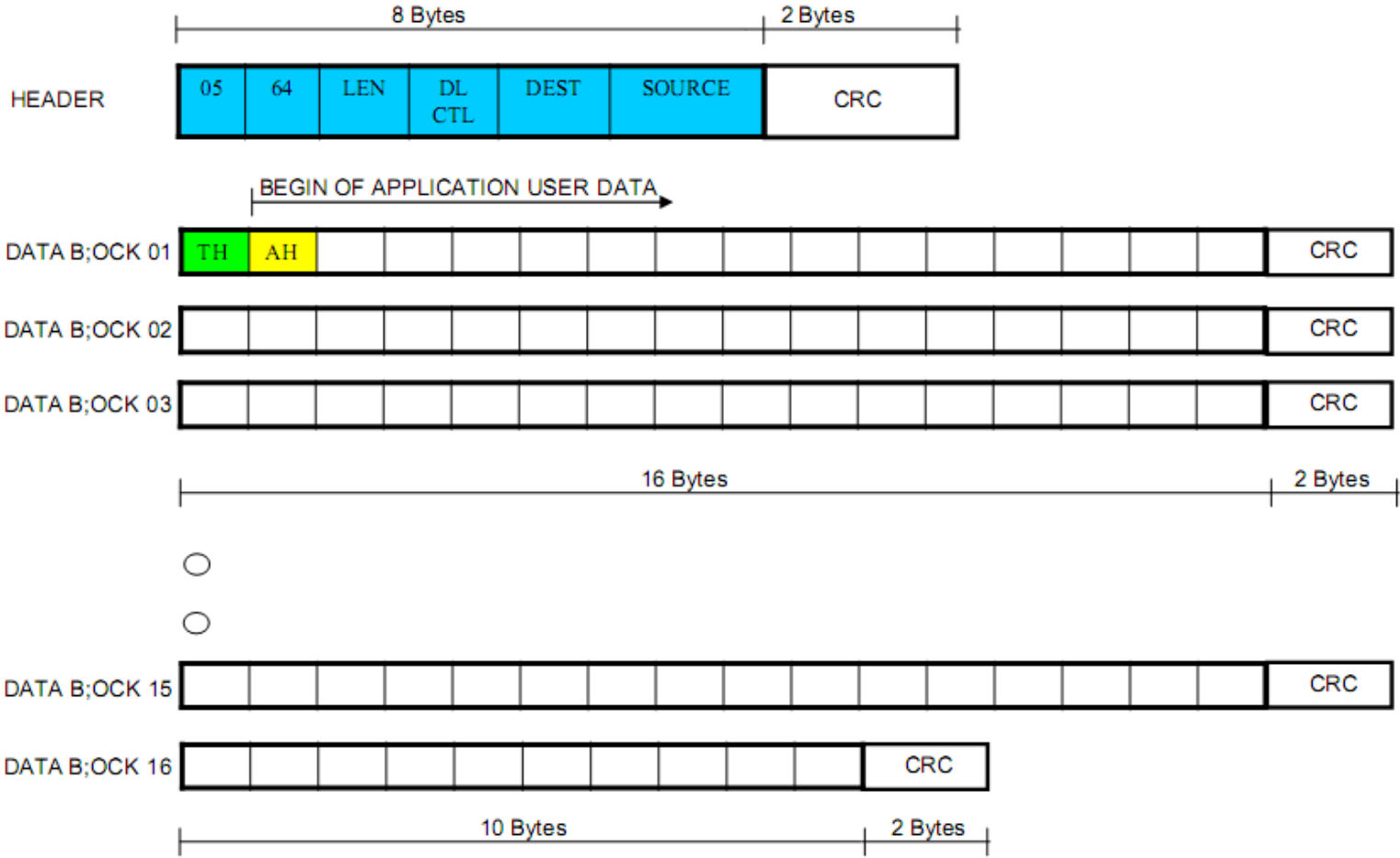
2.4 DNP Object Classes

- Data object classes allow for the management of message content and message triggering based upon user-determined priority of the data

- Data classes are assigned independently of the data priority

- Class 0 data refers to static data or the current values, the present of binary and analog input points data, the most recently measured, computed or obtained values

- Supported other three event Classes:

• Class 1 – highest priority

• Class 2 – medium priority

• Class 3 – lowest priority

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3. DNP Layer

3.1 OSI 7 Layer and DNP Layer Overview

Data Model

DNP Data Object Library

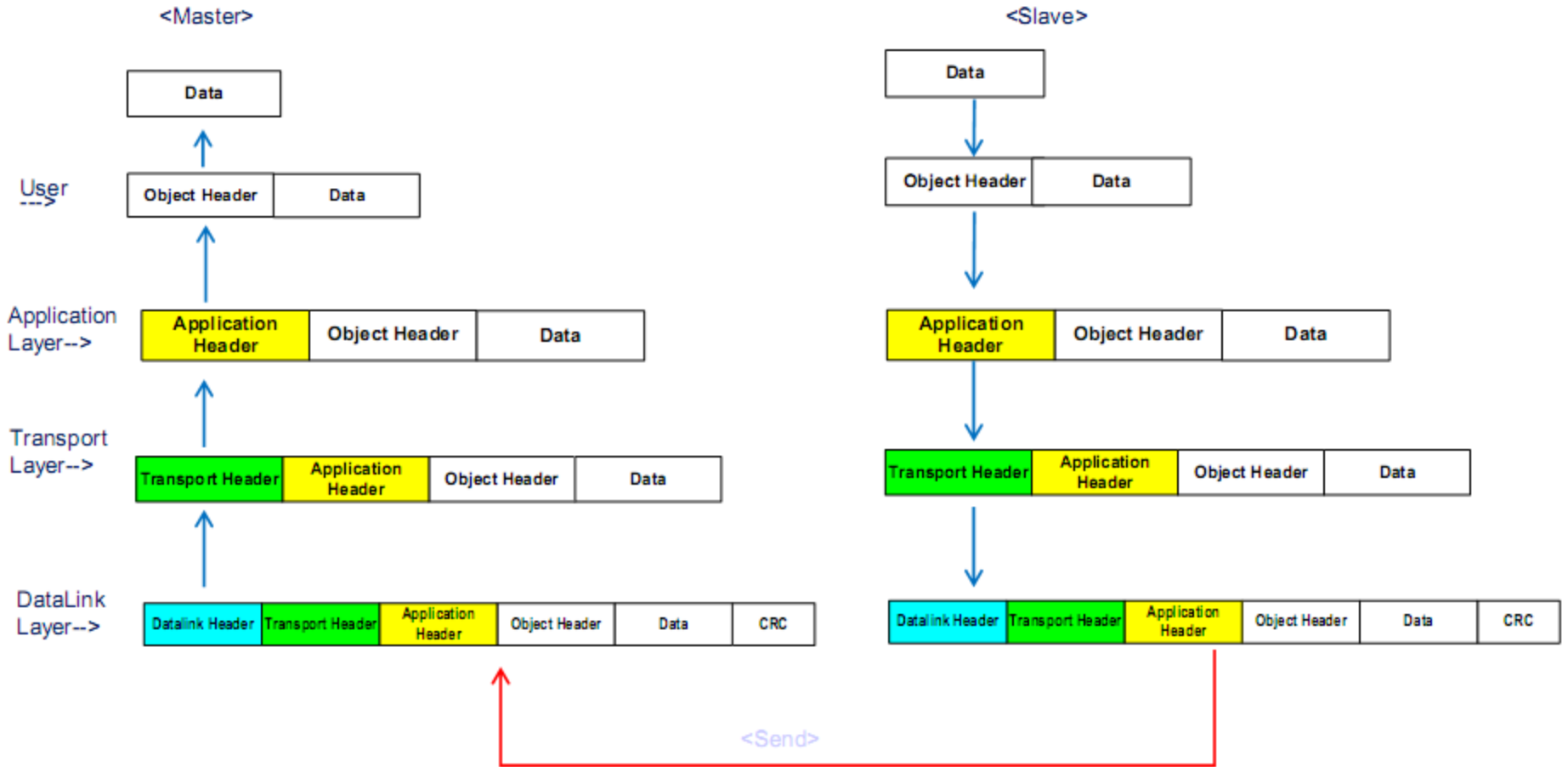| OSI 7 Layer	DNP Layer
Application Layer	Application Layer
Presentation Layer	
Session Layer	
Transport Layer	
Network Layer	Transport Layer
Data Link Layer	Data Link Layer
Physical Layer	Physical Layer

- OSI 7 Layer -

- DNP Layer -

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3.2 DNP Frame Structure Overview

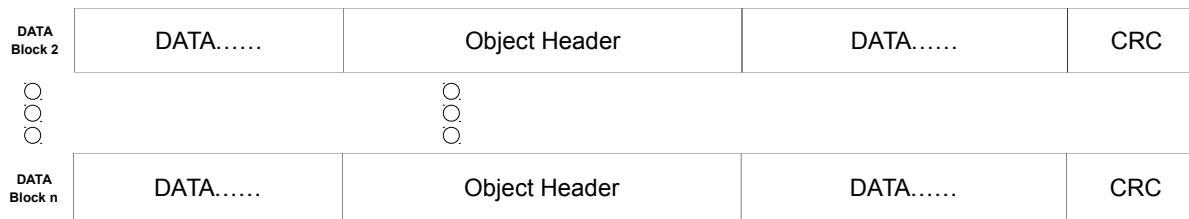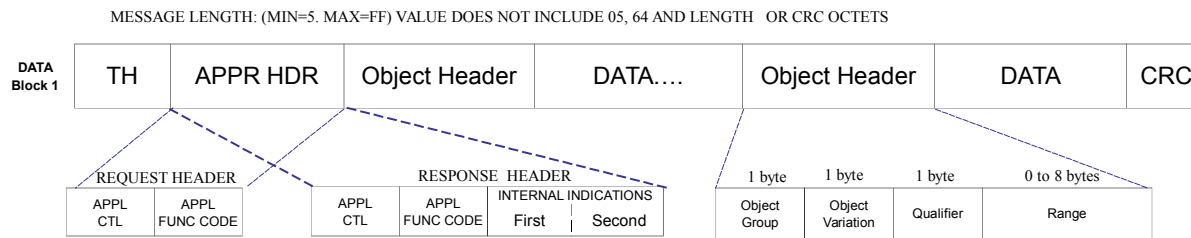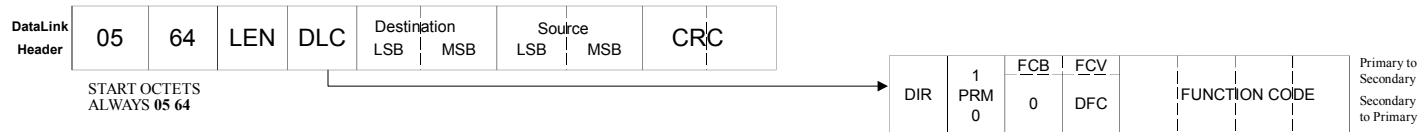## 3.3 Buildup of DNP message (master -> slave)
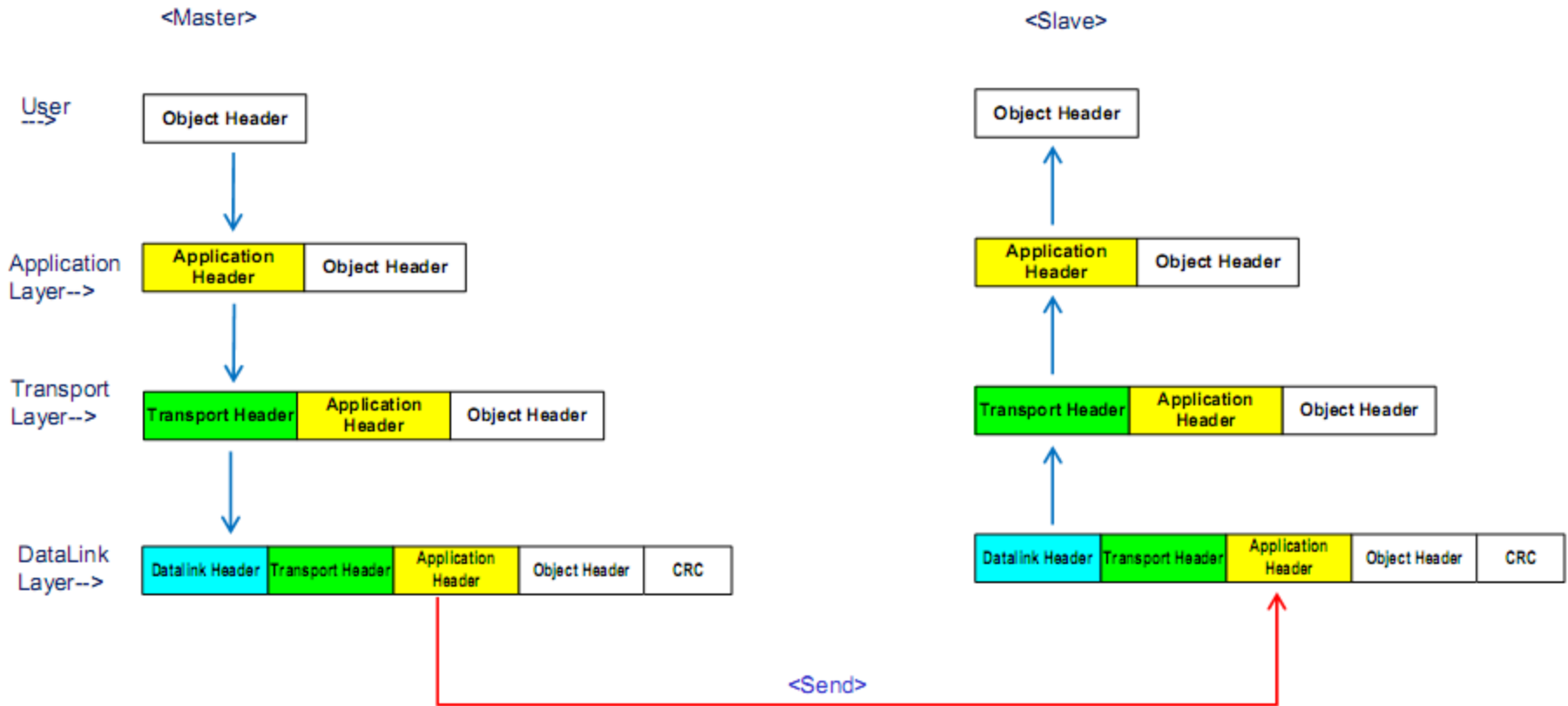
3.4 Buildup of DNP message (slave -> master)

3.5 DNP Frame Structure

DataLink Header	05	64	LEN	DLC	Destination LSB	MSB	Source LSB	MSB	CRC

START OCTETS ALWAYS **05 64**

DIR	1 PRM 0	FCB 0	FCV DFC	FUNCTION CODE

Primary to Secondary

Secondary to Primary

MESSAGE LENGTH: (MIN=5. MAX=FF) VALUE DOES NOT INCLUDE 05, 64 AND LENGTH OR CRC OCTETS

DATA Block 1	TH	APPR HDR	Object Header	DATA….	Object Header	DATA	CRC

REQUEST HEADER

APPL CTL	APPL FUNC CODE

RESPONSE HEADER

APPL CTL	APPL FUNC CODE	INTERNAL INDICATIONS First	Second

1 byte	1 byte	1 byte	0 to 8 bytes
Object Group	Object Variation	Qualifier	Range

DATA Block 2	DATA……	Object Header	DATA……	CRC

DATA Block n	DATA……	Object Header	DATA……	CRC

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4. DNP Object Library

4.1 DNP Object Group Number and Variation

- DNP Object Group Number

- Classified the type of types of data within a DNP message
- Specified the general type of data
- Binary Inputs, Binary Outputs, Counters, Analog Inputs, Analog Outputs, Time, Class

- DNP Object Variations

- Specified a particular variation of the type of data defined by Object Number
- Specified how the data from within the group is encoded
- Single bit or Status byte Binary Inputs
- 16 bit or 32 bit Analogs
- Variation 0 = Any Variation

4.2 DNP Object Group Number Overview

Binary Inputs	group numbers 1 to 9
Binary Outputs	group numbers 10 to 19
Counters	group numbers 20 to 29
Analog Inputs	group numbers 30 to 39
Analog Outputs	group numbers 40 to 49
Time	group numbers 50 to 59
Class	group numbers 60 to 69
Files	group numbers 70 to 79

4.3 DNP Object Group Number and Variation Example 1

- Binary Input Static Data (Object 1)

- Obj 1, Var 1 = Binary Input
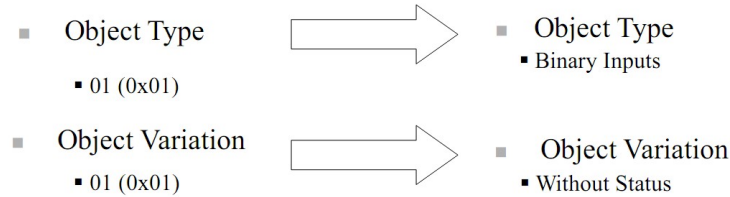
- Obj 1, Var 2 = Binary Input with Status

Binary Input Event Objects (Object 2)

- Obj 2, Var 1 = Binary Input Change without Time

- Obj 2, Var 2 = Binary Input Change with Time

- Obj 2, Var 3 = Binary Input Change with Relative Time

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4.4 DNP Object Group Number and Variation Example 2

- CASE1 : Object Group = 1, Variation = 1

- Object Type
  - 01 (0x01)

→ Object Type
  - Binary Inputs

- Object Variation
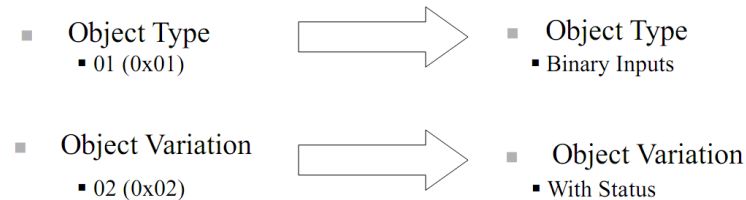 - 01 (0x01)

→ Object Variation
  - Without Status

Binary Inputs Without Status, Object 01, Variation 01

Object Format : Bit String of 1

[State]
[Bit 0]

- CASE2 : Object Group = 1, Variation = 2

- Object Type
  - 01 (0x01)

→ Object Type
  - Binary Inputs

- Object Variation
  - 02 (0x02)

→ Object Variation
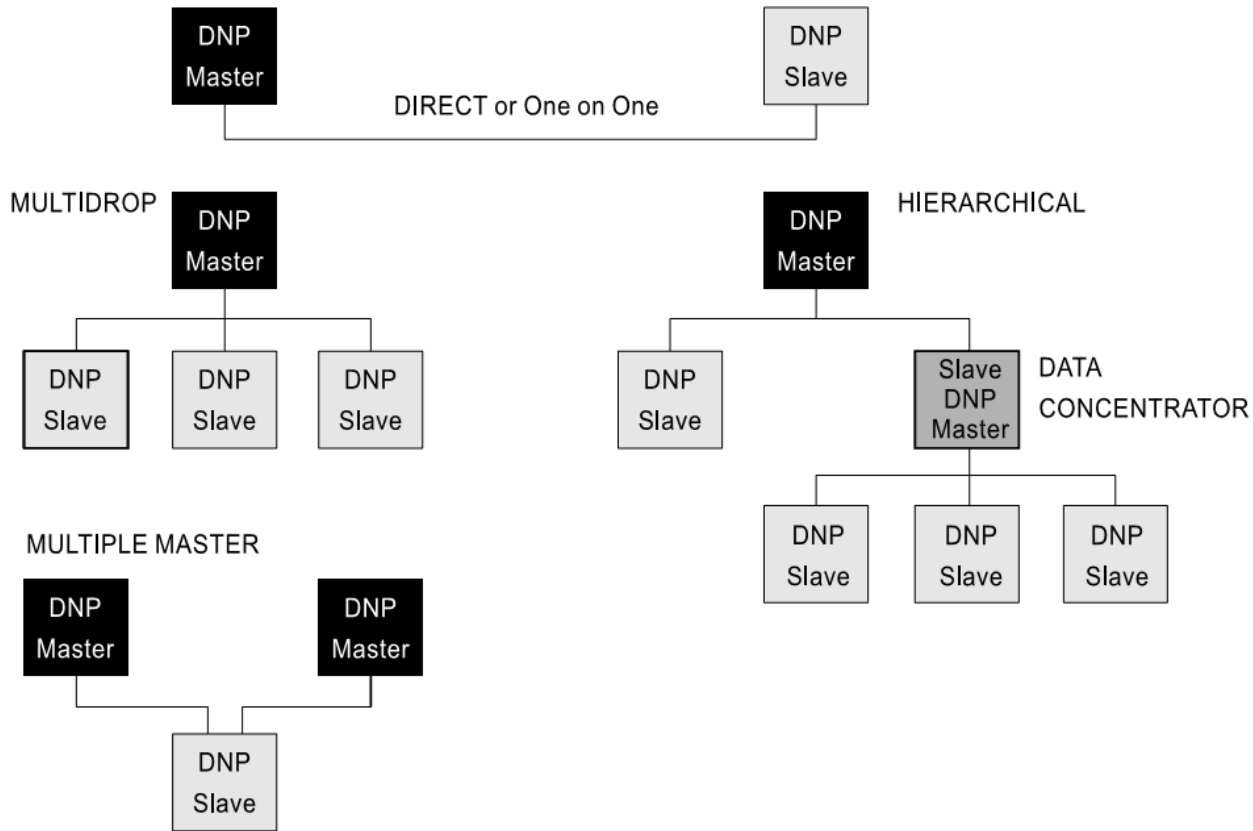 - With Status

Binary Inputs With Status, Object 01, Variation 02

Object Format : Bit String of 8

[State, Resrvd, ChatterFilter, LocForce, RemForce, CommLost, Restart, Online]
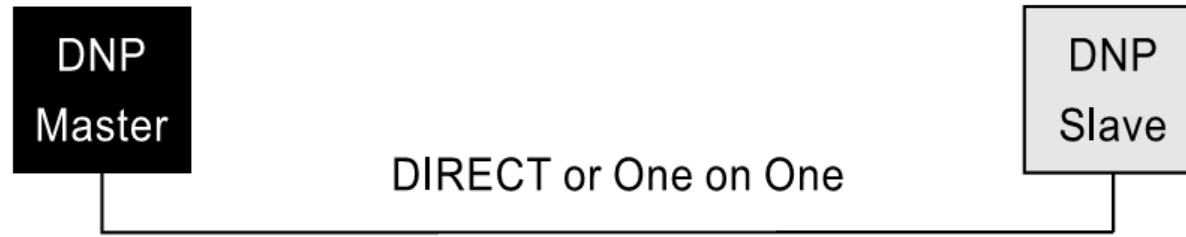[Bit07 , . , , , , …, Bit00]

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5. DNP Communication Configuration

5.1 DNP network topologies

5.2 DNP Communication Configuration

- Master Address, Slave Address

- Data Link Layer Configuration

- Application Layer Basic Configuration

- Unsolicited Message Configuration

- Physical Communication Method Configuration

  • Serial(232 or 485), TCP/IP, Dial-up modem

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5.3 Configuration related with DNP

- Master Address, Slave Address

- 0 ~ 0xFFEF : DNP Address Range
- 0xFFF0 ~ 0xFFFB : Reserved
- 0xFFFC: Self-Address,
- 0xFFFD ~ 0xFFFF: All-Stations address

- Data Link Layer Configuration

- Data Link Confirm
- Data Link Retries
- Data Link Timeout

- Application Layer Basic Configuration

- Application Layer Retries
- Application Timeout

- Unsolicited Message Configuration

- Enable or Disable Unsolicited Message
- Unsolicited Message Retries
- Unsolicited Message Hold Time

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- Physical Communication Method Configuration

• Serial (232/485) Communication :

Baud rate, Parity/Stop/Start bit set,

Flow control setting (CTS, DCD, RTS, CTS)
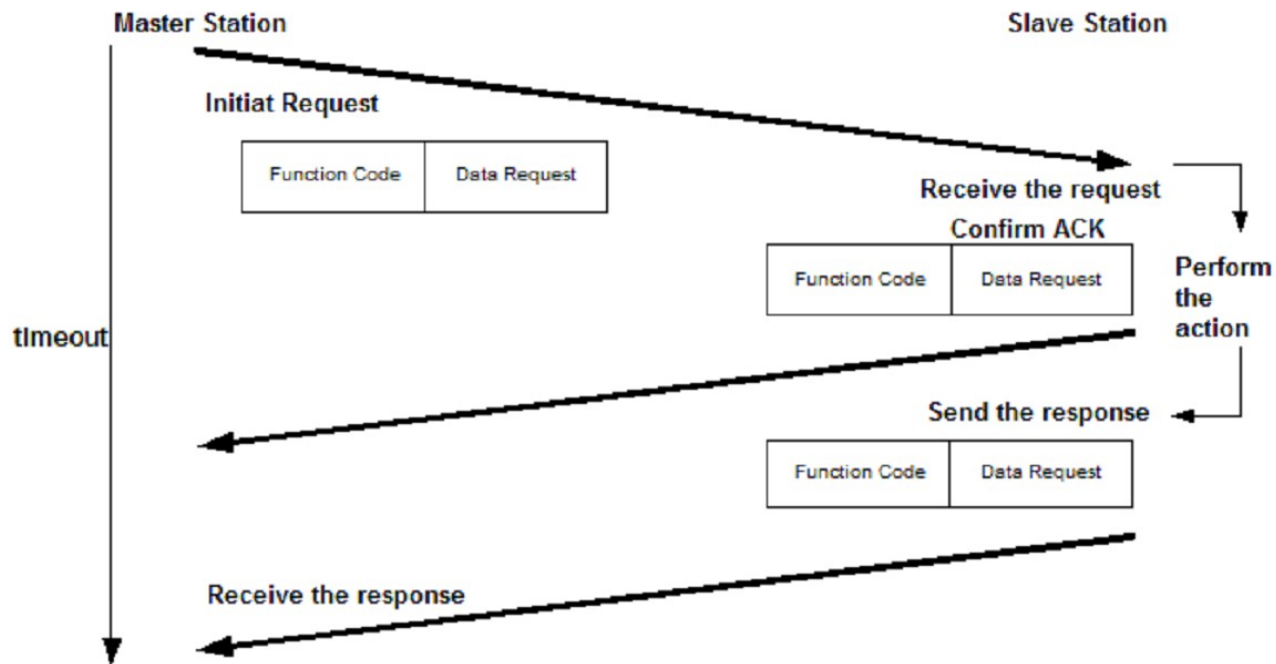
• TCP/IP or UDP Communication :

Master and Slave IP Address

Gateway Address

Subnet Mask

TCP or UDP Port

• Dial-up Modem (GSM) Communication

Calling or Called Phone Number

AT Command Setting

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6. DNP Communication Process

6.1 Master/Slave Communication Process

6.2 Unsolicited and Solicited Communications

[1] Transmit of unsolicited response

[2] Confirmation

[3] Issue of a read request

[4] Response

[5] Confirmation

[6] Transmit of new unsolicited response

[7] Confirmation