DRAFT

GOES HDR
Latitude/Longitude/Transmitter Identification
Lat/Lon/TxID Specification

V0.2

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National Oceanic and Atmospheric Administration

National Environmental Satellite, Data, and Information Service

NOAA/NESDIS

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1 Introduction

The purpose of this document is to extend the current GOES DCPRS Certification Standard to define a Lat/Lon/TxID message, or simply an Identify Message that will be automatically sent on deployment or re-deployment of a GOES DCS Data Collection Platform (DCP). The parameters that will be defined in this Draft document are the following:

- Identify Message Flag Word Changes
- Identify Message Binary Data Structure
  - Section and Field Definitions
  - Field Formatting and Bit Sizes
  - Value and Range Specifications
- Compact Alphanumeric Field Encoding

Future revisions to this document will address the following:

- When the DCP shall send the ID Message sequence.
- How many times the DCP shall repeatedly send an ID Message when the sequence is initiated.
- What will be the interval used between multiple ID Messages if more than one is sent.
- What channel(s) will be used for Identification Messages.

2 Background

Since the inception of the Data Collection System (DCS), NOAA/NESDIS has been required to maintain logistical data on all DCPs. While NOAA assigns some of these parameters (e.g. channel, data rate, self-timed transmit interval, self-timed transmit window, etc.), other parameters can only be defined/provided by the DCS user. Specifically, the user is required to update the DCS Platform Database Table (PDT) with information such as the latitude and longitude of the deployed DCP, and the certified transmitter make and model.

2.1 Purpose

To facilitate ensuring that the critical post-deployment data is properly populated in the NOAA database, this standard is being proposed as an extension to the *GOES Data Collection Platform Radio Set (DCPRS) Certification Standards at 300 bps and 1200 bps, Version 2.0, June 2009* (aka Certification Standards 2 or CS2). Specifically, the goal of this extension to the Certification Standards 2 is to require the transmitter portion of the DCP to automatically send an Identification Message upon deployment or re-deployment, and possibly on a random long interval basis; e.g. perhaps once every 30 days.

Some of the identification data in the message will be used to populate key fields in the NOAA DCP database, while others will be utilized to validate that the DCP has been

properly configured by the DCS user. For example, fields such as latitude and longitude as provided by an integral GPS receiver or some other positioning device will be used to update the position information in the DCS database. Alternately, fields such as channel number and time window assignments will be utilized to confirm that the DCP has been properly configured.

2.2 Tie In with Binary Protocol

Since the Lat/Lon/TxID extension is occurring in tandem with the advancement of the DCS to allow Binary messages, and since it is desirable and advantageous to have the special DCP Identify message be short in duration, the Lat/Lon/TxID will be a special Binary message.

3 Binary Message Structure

Figure 1 shows the general structure of a Binary message. The special Identify message will not deviate from this overall structure, but will define the fields to be included in the Binary Data portion of the message, and will define the formats to be utilized.

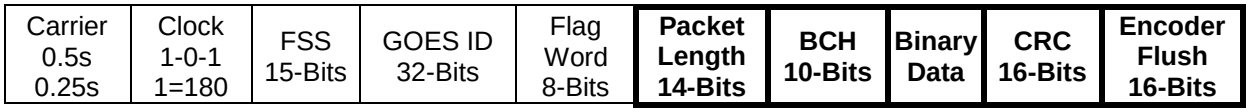

Figure 1: Binary Message Structure Single Packet

3.1 Updated GOES HDR Flag Word

Table 1: GOES HDR Flag Byte

Bit(s)	Name	Description
1 LSB	Spare	Send as 0
2	UTC Time Sync B_{TS}	0 = No UTC Time Sync since last transmission. 1 = UTC Time Sync since last transmission. Only used for Self-Timed Messages.
4/3	Binary Compaction B_{CM} (Applicable When B_{MT} = 10)	00 = None (Open Binary) 01 = Pseudo Binary Compaction 10 = ASCII Numeric Compaction 11 = ASCII Alphanumeric Compaction NOTE: These bits are not currently defined or used for ASCII or Pseudo Binary message types; send as 00.
5	Identify Message, B_{IM}	0 = Normal DCS Message 1 = Identify Message
7/6	Message Type B_{MT}	00 = Reserved 01 = ASCII 10 = Binary 11 = Pseudo Binary
8 MSB	Parity P_O	Odd Parity

The 8-Bit GOES HDR flag word immediately follows the GOES ID (as in the standard message formats), but is extended by this specification as defined in Table 1. Note that the bit numbering convention is the same as in the Certification Standard (i.e. the least significant bit is designated as Bit 1 and the most significant bit is Bit 8). While the field size of the Flag Word will not change, extensions to the bit designations will be made to support the Lat/Long/TxID message.

To specify that the transmission is an Identify Message, the B_{IM}, B_{MT}, and BCM Flag Word fields must be set as given below:

- B_{CM} (Bits 3 & 4) = 00 (None)
- B_{IM} (Bit 5) = 1 (Identify Message)
- B_{MT} (Bits 6 & 7) = 10 (Binary)

In other words, Identify Messages must be in Open Binary format. An overview of the Binary Protocol structure is provided in Figure 1 while complete detail of the Open Binary format can be found in the *GOES HDR Binary Protocol Specification* document.

4 Identify Message Binary Data Structure

Table 2 shows the Identify Binary Message structure, which is a complete data payload that must be contained in the “Binary Data” block of Figure 1. As shown, the data is segregated into four separate sections summarized below:

- DCP Identification Section consisting of:
  - A 2-bit format specifier to support future revisions/changes to the Identify Message format.
  - A 26-bit field representing the Latitude of the DCP.
  - A 26-bit field representing the Longitude of the DCP.
  - A 10-bit Transmitter ID that identifies the manufacturer and model of the transmitter that is assigned by NOAA/NESDIS.
  - An 80-bit Compact ASCII field that specifies the Serial Number of the transmitter.
  - An 80-bit Compact ASCII field that specifies the Firmware Version(s) of the transmitter.
- Prime Channel Section consisting of:
  - A 10-bit field indicating the Prime Channel assigned to the DCP.
  - A 3-bit field representing the Prime Bit Per Second (BPS) Rate (e.g. 300 or 1200).
  - A 3-bit field representing the Prime Data Transmission Format that will be used by the DCP (e.g. ASCII, Pseudo-Binary, or Binary).
  - A 3-bit field representing the Binary Message Format that will be used by the DCP if Binary is in use (e.g. Open, Compact Pseudo Binary, Compact Numeric ASCII, or Compact Alphanumeric ASCII).
  - A 3-bit field representing the Prime Channel Mode of Operation (e.g. Self-Timed, Random, Interrogate, etc.).
  - A 17-bit field representing the Time of First Transmission for Self-Timed transmissions on the Prime Channel.
  - A 17-bit field representing the Transmission interval for the Prime Channel Mode of Operation (Self-Timed or Random).
  - An 8-bit field specifying the Self-Timed Window for Self-Timed transmissions on the Prime Channel.
- Second Channel Section consisting of:
  - A 10-bit field indicating the Second Channel assigned to the DCP.
  - A 3-bit field representing the Second Bit Per Second (BPS) Rate (e.g. 300 or 1200).
  - A 3-bit field representing the Second Data Transmission Format that will be used by the DCP (e.g. ASCII, Pseudo-Binary, or Binary).
  - A 3-bit field representing the Binary Message Format that will be used by the DCP if Binary is in use (e.g. Open, Compact Pseudo Binary, Compact Numeric ASCII, or Compact Alphanumeric ASCII).
  - A 3-bit field representing the Second Channel Mode of Operation (e.g. Random, Interrogate, etc.).
  - A 1-bit unused field.

  - A 17-bit field representing the Random Interval transmission on the Second Channel.

- An Optional Flexible Text Section consisting of a maximum of 280 bits (35 bytes).

Table 2: Identify Message Data Structure

Field	Bits	Min/Max/Range		Res	Number Format
Format Version	2	0	3	1	V
Latitude	26	-90	90	0.00001	100,000 * sll.ddddd
Longitude	26	-180	180	0.00001	100,000 * slll.ddddd
Transmitter ID	10	1	1023	1	Tttt
Serial Number	80	Compact ASCII 10-byte field (1 filled if shorter)			
Firmware Version(s)	80	Compact ASCII 10-byte field (1 filled if shorter)			
Sub-Total Bits/Bytes:	224	28	DCP Identification Section		
Prime Channel	10	0-266 and 301-566		1	Ccc
Prime Rate	3	000=300, 001=1200			
Prime Format	3	001=ASCII, 010=Binary, 011=Pseudo-Binary			
Prime Binary Format	3	000=Open/None, 001=CPB, 010=CN, 011=CA			
Prime Mode	3	000=Self-Timed, 001=Random, 010=Interrogate			
Prime First	17	00:00:00	23:59:59	00:00:01	hh:mm:ss
Prime Period/Interval	17	00:05:00	24:00:00	00:00:15	hh:mm:ss
Prime Window	8	1	110	0.5	0.5*www
Sub-Total Bits/Bytes:	64	8	Prime Channel Section		
Second Channel	10	0-266 and 301-566		1	Ccc
Second Rate	3	000=300, 001=1200			
Second Format	3	001=ASCII, 010=Binary, 011=Pseudo-Binary			
Second Binary Format	3	000=Open/None, 001=CPB, 010=CN, 011=CA			
Second Mode	3	001=Random, 010=Interrogate			
Not Used	1	Set to zero (0)			
Interval	17	00:05:00	24:00:00	00:00:15	hh:mm:ss
Sub-Total Bits/Bytes:	40	5	Second Channel Section		
Total Bits/Bytes:	328	41	Fixed Portion Sections		
Optional/Flex Data	280	35 Bytes for Optional Compact ASCII Data			
Max Total Bits/Bytes:	608	76			

Notes:

1. Undefined values are reserved for future use.
2. If field values are received outside of the above defined range and are not equal to an otherwise specified erroneous or undefined value, the Identify transmission will be flagged as improperly received.

4.1 Data Field Specifics

4.1.1 DCP Identification Section

The fields in the DCP Identification section are primarily determined by the DCP or transmitter itself. The latitude and longitude field must be determined upon deployment by an integral positioning device (e.g. GPS receiver). The remaining values must be set by the manufacturer; many will be hardcoded into the transmitter's firmware by the manufacturer.

The primary purpose of sending these fields is to automatically populate key fields in the DCS Platform Database Table (PDT).

4.1.1.1 Identify Message Format

The ID Message format specification field consists of two bits, and will be set to 00.

While it is not expected that the format will change, if it does, future revisions to the Identify Message format will sequentially use values of 01, 10, and finally 11.

4.1.1.2 Latitude and Longitude

The latitude and longitude fields are 26-bit signed integers in two's complement binary format. The value is computed by multiplying the latitude/longitude degree value by 100,000 and then rounding to the nearest integer. This yields a value that has a resolution of 0.00001 degrees.

The range of values for the latitude is -9,000,000 to +9,000,000, which is equivalent to ±90.00000° with positive latitudes representing North of the Equator and negative latitudes representing South of the Equator.

The range of values for the longitude is -18,000,000 to +18,000,000, which is equivalent to ±180.00000° with positive longitudes representing East of the Prime Meridian and negative latitudes representing West of the Prime Meridian.

This definition provides for a worst case distance resolution of approximately 1.2 meter or 4 feet.

If the latitude and longitude cannot be determined, the 26-bit binary value of 0x1FFFFFF shall be sent (equivalent to a decimal value of +335.54431).

4.1.1.3 Transmitter ID

The Transmitter ID is a numerical value in the range of 0 to 1023 that is assigned by NOAA/NESDIS for all Version-2 or CS2 certified transmitters. Each value will uniquely identify the manufacturer and model of the certified DCS transmitter. In the message, the Transmitter ID is represented by 10 bits.

4.1.1.4 Transmitter Serial Number

The serial number of the transmitter must be included in the 10 byte field using the DCS Binary Protocol's Compact Alphanumeric representation (see Section 4.2). Unused bits in the 80-bit serial number field must be set to 1.

The format of the un-compacted Transmitter Serial Number is manufacturer specific. If the serial number is all numeric symbols, the maximum un-compacted length is 16 characters. Assuming an equal mix of numeric symbols and letters the maximum length reduces to 14 characters, while an all alphabetic field has a maximum of 13 characters.

4.1.1.5 Transmitter Firmware Version(s)

The firmware version or versions of the transmitter must be included in the 10 byte field using the DCS Binary Protocol's Compact Alphanumeric representation (see Section 4.2). Unused bits in 80-bit firmware version(s) field must be set to 1.

The format of the un-compacted Transmitter Firmware Version(s) is manufacturer specific. If the firmware version is all numeric symbols, the maximum un-compacted length is 16 characters. Assuming an equal mix of numeric symbols and letters the maximum length reduces to 14 characters; while an all alphabetic field has a maximum of 13 characters.

4.1.2 Prime Channel Section

The Prime Channel fields for a DCP are specified by NOAA/NESDIS, but must be entered into the DCP/transmitter as necessary prior to deployment. The primary purpose of sending these fields is to check them against the corresponding NOAA/NESDIS populated fields in the DCS Platform Database Table (PDT). If a discrepancy is detected, both the user and NOAA personnel will be notified of the issue so mitigation and correction steps can be taken.

If no Prime Channel is specified in the transmitter, send all fields/bytes in this section with all values/bits set to 0.

4.1.2.1 Prime Channel

The Prime Channel is the DCS channel assigned by NOAA/NESDIS to this DCP. Typically, but not always, this is DCP's Self-Timed transmit channel.

DCS channel numbers range from 1-266 and 301-566. As such, this field is a 10-bit value. This value must be populated based on the user entered channel for the prime or self-timed channel.

If no Prime Channel is specified in the transmitter, send this field as 0 and all fields/bytes remaining in the Prime Chanel Section with all values/bits set to 0.

4.1.2.2 Prime BPS Rate

This is a 3-bit field representing the Prime Rate assigned by NOAA, which is also a function of the channel assignment.

Currently the only two BPS rates used in the DCS are 300 and 1200, which are to be represented by binary values 000 and 001, respectively. The remaining binary values (010 through 111) are reserved for future use. This value must be populated based on the user entered rate for the prime channel.

4.1.2.3 Prime Format

Another 3-bit field, the Prime Format field indicates the message format for the Prime Channel.

Currently three formats have been defined: ASCII, Pseudo-Binary, or Binary. For ASCII, this field shall be set to 001; for binary, this field shall be set to 010; and for Pseudo Binary, this field shall be set to 011. All other binary values are reserved for future use. This value must be populated based on the user entered format for the prime channel.

Note that while the Lat/Lon/TxID message must use the Binary format, this is distinct from the Prime Format used on the Prime Channel, which can be anyone of the three defined DCS formats.

4.1.2.4 Prime Binary Format

The 3-bit field Prime Binary Format field is an extension of the Prime Format field when it indicates the message format is in Binary Format.

There are four subcategories of binary formats as shown in the Flag Word definition of Table 1; specifically, Open Binary (000), Compact Pseudo Binary (001), Compact Numeric ASCII (010), and Compact Alphanumeric ASCII (011). For this field the acceptable values are shown parenthetically in the previous sentence; note that these values are equivalent to the values in Table 1 with a leading zero added.

If the Prime Format is not Binary, this field shall be set to 111.

The remaining three binary values (100 through 110) are reserved for future use.

This value must be populated based on the specific user configured Binary Format for the prime or self-timed channel.

4.1.2.5 Prime Mode

The 3-bit Prime Channel Mode field confirms the DCP's mode of operation; i.e. Self-Timed, Random, [Dual], or Interrogate.

NOTE: This is a field in DADDS, but how to address it requires additional thought and discussion with NOAA and perhaps the DCS User Community.

Some/many DCPs/Transmitters are specifically designed to only have a one Self-Timed and one Random channel

4.1.2.6 Prime Time of First Transmission

The 17-bit Time of First Transmission is used for self-timed transmissions only. This field is broken down into one 5-bit subfield for the Hour, and two 6-bit subfields for the Minute and Second as shown in Table 3. The subfields are all in binary and concatenated or compacted (i.e. not byte aligned). The Hour field is the most significant bits (B16-B12), while the Second field is the least significant bits (B5-B0).

Table 3: Time of First Transmission Bit Mapping

B16-B12	B11-B6	B5-B0
Hour (0-23)	Minute (0-59)	Second (0-59)

This field must be populated based on the specific user configured Time of First Transmission in the DCP for the prime or self-timed channel. If the Prime Channel is not configured for self-timed operation, then this field should be filled with all 1's.

4.1.2.7 Prime Period or Interval

The 17-bit Period is used for self-timed transmission configuration; if the Prime Channels is used in Random mode, this value is the Random Interval. This field is broken down into one 5-bit subfield for the Hour, and two 6-bit subfields for the Minute and Second as shown in Table 4. The subfields are all in binary and concatenated or compacted (i.e. not byte aligned). The Hour field is the most significant bits (B16-B12), while the Second field is the least significant bits (B5-B0).

Table 4: Prime Period or Interval Bit Mapping

B16-B12	B11-B6	B5-B0
Hour (0-24)	Minute (0-59)	Second (0-59)

This field must be populated based on the specific user configured Self-Timed Period or Random Interval.

4.1.2.8 Prime Window

The Prime Window field is used for self-timed transmissions only. This field is an 8-bit unsigned integer in seconds multiplied by 2. The minimum window size is 1 second, and the maximum window size is 110 seconds, which correlate to field entries of 2 and 220, respectively.

This value must be populated by taking the user entered window for the prime channel and doubling it and representing as an integer, which provides a 0.5 second resolution.

4.1.3 Second Channel Section

The Second Channel fields for a DCP are specified by NOAA/NESDIS, but must be entered into the DCP/transmitter as necessary prior to deployment. The primary purpose of sending these fields is to check them against the corresponding NOAA/NESDIS populated fields in the DCS Platform Database Table (PDT). If a discrepancy is detected, both the user and NOAA personnel will be notified of the issue so mitigation and correction steps can be taken.

If no Second Channel is specified in the transmitter, send all fields/bytes in this section with all values/bits set to 0.

4.1.3.1 Second Channel

The Second Channel is the DCS channel assigned by NOAA/NESDIS to this DCP, which is typically, but not always, the DCP's Random channel.

DCS channel numbers range from 1-266 and 301-566. As such, this field is a 10-bit value. This value must be populated based on the user entered channel for the second channel.

If no Second Channel is specified in the transmitter, send this field as 0 and all fields/bytes remaining in the Prime Chanel Section with all values/bits set to 0.

4.1.3.2 Second BPS Rate

This is a 3-bit field representing the Second Rate assigned by NOAA, which is also a function of the channel assignment.

Currently the only two BPS rates used in the DCS are 300 and 1200, which are to be represented by binary values 000 and 001, respectively. The remaining binary values (010 through 111) are reserved for future use. This value must be populated based on the user entered rate for the second channel.

4.1.3.3 Second Format

Another 3-bit field, the Second Format field indicates the message format for the Second Channel.

Currently three formats have been defined: ASCII, Pseudo-Binary, or Binary. For ASCII, this field shall be set to 001; for binary, this field shall be set to 010; and for Pseudo Binary, this field shall be set to 011. All other binary values are reserved for future use. This value must be populated based on the user entered format for the second channel.

Note that while the Lat/Lon/TxID message must use the Binary format, this is distinct from the Second Format used on the Second Channel, which can be anyone of the three defined DCS formats.

4.1.3.4 Second Binary Format

The 3-bit field Second Binary Format field is an extension of the Second Format field when it indicates the message format is in Binary Format.

There are four subcategories of binary formats as shown in the Flag Word definition of Table 1; specifically, Open Binary (000), Compact Pseudo Binary (001), Compact Numeric ASCII (010), and Compact Alphanumeric ASCII (011). For this field the acceptable values are shown parenthetically in the previous sentence; note that these values are equivalent to the values in Table 1 with a leading zero added.

If the Second Format is not Binary, this field shall be set to 111.

The remaining three binary values (100 through 110) are reserved for future use.

This value must be populated based on the specific user configured Binary Format for the second or random channel.

4.1.3.5 Second Mode

The 3-bit Second Channel Mode field confirms the DCP’s confirms the DCP’s mode of operation; i.e. Random or Interrogate.

NOTE: This is a field in DADDS, but how to address it requires additional thought and discussion with NOAA and perhaps the DCS User Community, specifically with regard to how DCP's will handle interrogate with the Two Way system in place.

4.1.3.6 Second Unused Field

The single bit between the Second Mode and Second Interval fields is not used and shall be set to 0.

4.1.3.7 Second Interval

The 17-bit Interval specifies the Random Reporting Interval when the Second Channel is used in Random Mode. This field is broken down into one 5-bit subfield for the Hour, and two 6-bit subfields for the Minute and Second as shown in Table 7. The subfields are all in binary and concatenated or compacted (i.e. not byte aligned). The Hour field is the most significant bits (B16-B12), while the Second field is the least significant bits (B5-B0).

Table 5: Second Interval Bit Mapping

B16-B12	B11-B6	B5-B0
Hour (0-24)	Minute (0-59)	Second (0-59)

This field must be populated based on the specific user configured Random Interval.

4.1.4 Optional Flex Text Section

Up to a total of 280 bits (35 bytes) can be included in the Optional Flexible Text section, which can be utilized to report multiple pieces of optional information. Each piece of information, or field, is distinguished by special byte codes that concatenate a 3-bit field type identifier with a 5-bit length count as shown in Table 6. The field length value is one less then total number of bytes in the field; i.e. a binary value of 0-31 indicates 1-32 bytes.

Table 6: Optional Flex Type and Size Byte Mapping

B7	B6	B5	B4	B3	B2	B1	B0
Field Type ID			Field Size in Bytes (1-32)				

Presently only two field types have been defined, a Location field with an ID of 000 and Manufacturer Data field with an ID value of 100, both of which are to be determined by the DCP or transmitter itself. The Location shall be a user entered field that may be used to provide a descriptive name for the DCP site location. The Manufacture field is populated by the DCP and is solely determined by the manufacturer of the certified transmitter.

The primary purpose of sending these fields is to automatically populate optional fields in the DCS Platform Database Table (PDT).

Regardless of the field type, the data in the field must be encoded in Compact Alphanumeric ASCII (see Section 4.2).

The size of this section is variable and depends on the fields and data to be sent. If no Optional Text data is to be sent, then this entire section shall be eliminated and the message size/length truncated/reduced accordingly.

4.2 Compact Alphanumeric Fields

The fields specified above that are to be encoded in Compact Alphanumeric ASCII format usea subset of the ASCII characters shown in Table 7. The first column of Table 7 includes numeric digits and symbols. These characters are encoded as a 5-bit binary value with the most significant bit being 0. The next two sets show the additional 31 characters that can be represented in this character set; these include the uppercase letters and some additional symbols and special characters. This portion of the character set is defined using a 6-bit code that has the most significant bit set to 1. This variable size code set provides a total of 47 characters with the six bit all ones code as not assigned (N/A; i.e. not used or null).

With the exception of the lower case letters, any ASCII character encountered during the compaction sequence not defined in Table 7 shall be replaced with the Space character prior to encoding. It is permissible, but not required to convert the lower case letter to upper case prior to encoding.

Table 7: Compact Alphanumeric ASCII Character Set

ASCII Character	Binary Code	ASCII Character	Binary Code	ASCII Character	Binary Code
0	00000	A	100000	Q	110000
1	00001	B	100001	R	110001
2	00010	C	100010	S	110010
3	00011	D	100011	T	110011
4	00100	E	100100	U	110100
5	00101	F	100101	V	110101
6	00110	G	100110	W	110110
7	00111	H	100111	X	110111
8	01000	I	101000	Y	111000
9	01001	J	101001	Z	111001
space	01010	K	101010	cr/lf	111010
+	01011	L	101011	#	111011
,	01100	M	101100	=	111100
-	01101	N	101101	:	111101
. (dp)	01110	O	101110	;	111110
/	01111	P	101111	N/A	111111

During the translation process, the 5 or 6-bit codes are continuously packed together to form bytes.

As the data is received and parsed, the codes will be de-compacted and reverse translated. The de-compaction algorithm first requires the examination of the next un-compacted bit to determine how many total bits to extract from the bit stream (0 => 5 bits or 1 => 6 bits).

To ensure any trailing bits are not erroneously decoded, unused bits must be filled with ones (1). Since the six bit all ones code in Table 7 has been reserved and an all ones 5-bit code is not defined, the trailing bits of 1's are discarded.

5 Lat/Lon/TxID Message Examples

TBD