INTERFACE CONTROL DOCUMENT (ICD)

OF

DISTRESS ALERT TRANSMITTER -

SECOND GENERATION (DAT-SG)

EMERGENCY MESSAGING WITH

ACKNOWLEDGEMENT via NavIC MESSAGING SERVICE

Version-1.2

February 2021

INDIAN SPACE RESEARCH ORGANIZATION

ISRO-IRNSS-ICD-DAT-1.2

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Preface

This document provides the interface details between Distress Alert Transmitter-Second Generation (DAT-SG) terminal and smartphone application for reception, processing and display of messages received using NavIC Messaging Service. DAT-SG terminal supports distress message transmission using UHFxC (DRT) transponder of INSAT/GSAT. It also receives emergency messages and acknowledgement of transmitted distress alerts via NavIC messaging service. These messages are forwarded by DAT-SG terminal over Bluetooth interface. A smartphone application can process this message data and present it to user in a suitable format.

The document addresses the type and data structure of the messages forwarded by DAT-SG. It is intended for use by smartphone application developers and provides information regarding reception and processing of message data for building suitable application.

Revision Record		
Version No.	**Description**	**Document Release Date**
1.0	First Release	April 2019
1.1	Updated Release with DAT-SG Message Structure	May 2020
1.2	1. Inclusion of IRNSS-1G satellite for NavIC Messaging service 2. Updated Section 1: Signal Overview 3. Updated Section 2: User Segment 4. Updated Section 3: PRN Codes 5. Updated Section 9: Distress Alert Packet	February 2021

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1. INTRODUCTION

This ICD defines the interface for the Distress Alert Transmitter - Second Generation (DAT-SG), that provides emergency messaging and acknowledgement via the NavIC Messaging Service. It provides information on the messaging service offered by ISRO utilizing NavIC Satellite to the DAT-SG service. It addresses the type and format of the packets that are exchanged between the DAT-SG terminal and the smartphone application. The messages received via the NavIC messaging service are forwarded by DAT-SG terminal over Bluetooth interface. A smartphone application can receive these messages over a Bluetooth interface and present them to the user in a suitable user interface.

The service is to be provided to users within the Indian region using the NavIC ground segment and the NavIC spacecraft constellation. The messages are broadcast in the L5 band frequency.

2. SCOPE OF THE DOCUMENT

The Signal and the Data Structure for DAT-SG messaging service specifies the interface between the NavIC satellite and the user segment for messaging service. The document provides necessary information for receiver design to decode the messages being transmitted by NavIC Satellite.

This document specifies the communication protocol details and data structure for messaging service of DAT-SG using NavIC Messaging Service. The document provides necessary information to smartphone application developers to receive and process the messages for development of suitable applications.

3. SIGNAL OVERVIEW

3.1 CARRIER FREQUENCY

The messaging service signals are broadcast in L5 band frequency. The carrier frequency and the bandwidth of transmission for the messaging service are shown in Table 1.

Table 1: Carrier Frequency and bandwidth

Signal	Carrier Frequency	Bandwidth
L5	1176.45 MHz	24 MHz (1164.45 -1188.45 MHz)

3.2 MODULATION SCHEME

The signal is BPSK (1) modulated on L5 band. The navigation data at data rate of 50symbols per second (1/2 rate FEC encoded) is modulo 2 added to PRN code chipped at 1.023 Mcps. The CDMA modulated code, modulates the L5 carrier at 1176.45MHz.

3.3 RECIEVED POWER LEVELS ON GROUND

3.3.1 Nominal Levels

Table 2 indicates the assured power levels of the signals received by a user receiver on ground. The received power on ground is measured at the output of an ideally matched RHCP 0 dBi user receiving antenna when the spacecraft elevation angle is higher than 5°.

Table 2: Nominal received power of signals

Signal	Signal Component	Nominal Received Power (dBW)
L5	BPSK(1)	-159.0

3.4 POLARIZATION CHARACTERISTICS

Signals are Right Hand Circularly Polarized. The antenna axial ratio does not exceed 2.0 dB.

4. USER SEGMENT

The User segment mainly consists of receivers capable of receiving signal at L5 band frequency.

Figure **1** specifies the radio frequency interface between space and user segments. The Spacecraft provides signals in L5 band.

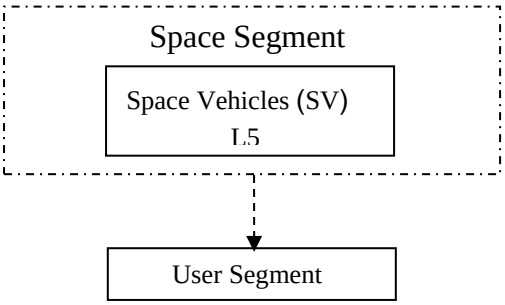

Figure 1: Space Segment Interface with User Segment

5. PRN CODES

The NavIC satellites utilize Gold codes for the signal. The codes are generated using Linear Feedback Shift Registers. The code lengths for the signal is listed in Table 3.

Table 3: Code lengths of signals

Code Length (ms)	No. of Chips
1 ms	1023

5.1 PRN CODES

The initial conditions for generation of PRN Codes for NavIC satellites are as given in Table 4. The length of each code is 1023 chips. The code is chipped at 1.023 Mcps.

5.1.1 Code Generation

For code generation, the two polynomials G1 and G2 are as defined below:

G1: $X^{10} + X^3 + 1$ and

G2: $X^{10} + X^9 + X^8 + X^6 + X^3 + X^2 + 1$

The G1 and G2 generators are realized by using 10 bits Maximum Length Feedback Shift Registers (MLFSR). The G1 register is initialized with all bits as '1'. The initial state of G2 register is provided in Table 4. G1 and G2 are XOR'ed for the generation of the final 1023 chip long PRN sequence. The time period of the PRN sequence is 1 millisecond.

Table 4: Code Phase assignment

PRN ID	Initial Condition for G2 Register	First 10 Chips in Octal2
1	1110100111	0130
2	0000100110	1731
3	1000110100	0713

4	0101110010	1215
5	1110110000	0117
6	0001101011	1624
7	0000010100	1753
8	0100110000	1317
9	0010011000	1547

Note: Currently PRN ID-1 and PRN ID -7 are being used for messaging service.

The Figure below shows the generation of PRN code.

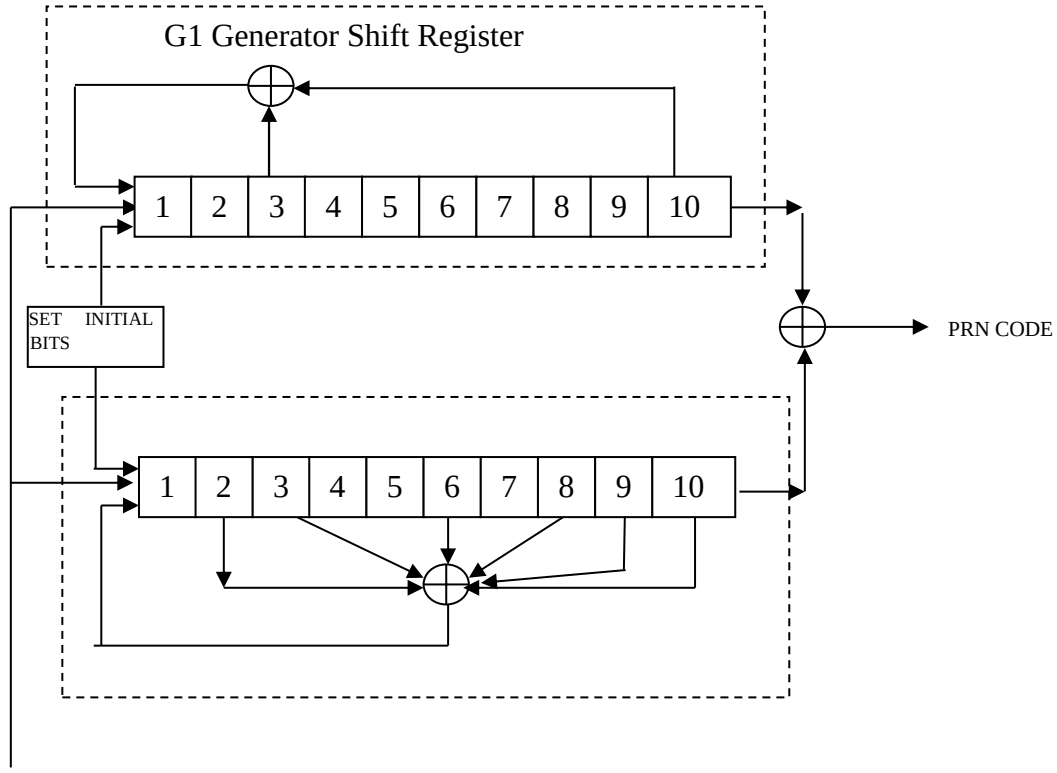

Figure 2: PRN Code Generator

6. DAT-SG Message Overview

6.1 DAT-SG Data Packet Types

DAT-SG sends the following data packets over Bluetooth interface:

- **Location Packet**: This message gives information about the location of the DAT-SG. These messages start with $GNGGA.
- **NavIC Broadcast Message Packet**: This type contains DAT-SG control room and INCOIS messages. These messages start with $PIRNSF
- **Distress Alert Packet**: This message contains DAT-SG distress packet. It is received whenever DAT-SG transmits distress packet. These messages start with $DATSG

6.2 NavIC Broadcast Message Packet

The messages broadcast by the NavIC satellites to DAT-SG fall under the following categories:

1. **Control Room Messages**: These messages are generated by DAT-SG control room. This type of message is depicted with **Message ID 41** in the message structure. They are of following types:
    a. **Emergency messages**: Messages like text and few pre-defined messages that the operator at control room can transmit to DAT-SG users.

    b. **Acknowledgement messages**: These messages are sent to acknowledge the receipt of distress alerts (sent by DAT-SG) at control room.

    One type of acknowledgement message is generated automatically whenever a distress alert is received at the control room. This message indicates to the DAT-SG user that distress alert sent by him has reached the control room.

    Another type of acknowledgement message is generated when the operator in control room manually clicks a button on DAT-SG NMS control panel. This conveys DAT-SG user that his distress is seen by the operator and rescue operation is initiated.

2. **INCOIS messages**: These messages contain information and warning messages generated by INCOIS viz.
    a. Potential Fishing Zones/TUNA-PFZ. This is depicted with **Message ID 20**
    b. High Waves, Cyclones and Tsunami alert messages. The warning messages are depicted with **Message ID 21**.

DAT-SG, upon receiving messages from NavIC messaging service, forwards them over Bluetooth interface. The smartphone should be connected to DAT-SG over Bluetooth for receiving these messages. In case when no messages are being uplinked by NavIC messaging service, the latest message will keep repeating. In this case, DAT-SG will also send the latest message repetitively to smartphone. The smartphone application shall put appropriate checks to display the latest received message only once.

6.2.1 NavIC Broadcast Message Packet Data Structure

6.2.1.1 Bit and Byte Ordering Criteria

The following bit and byte ordering criteria will be used while formatting the data:

- The most significant bit/byte is numbered as bit/byte 1
- The most significant bit/byte is transmitted first

6.2.1.2 FEC ENCODING

The sub-frame of 292 bits is rate 1/2 convolution encoded and clocked at 50 symbols per second. **Figure 3** depicts the convolution coding scheme

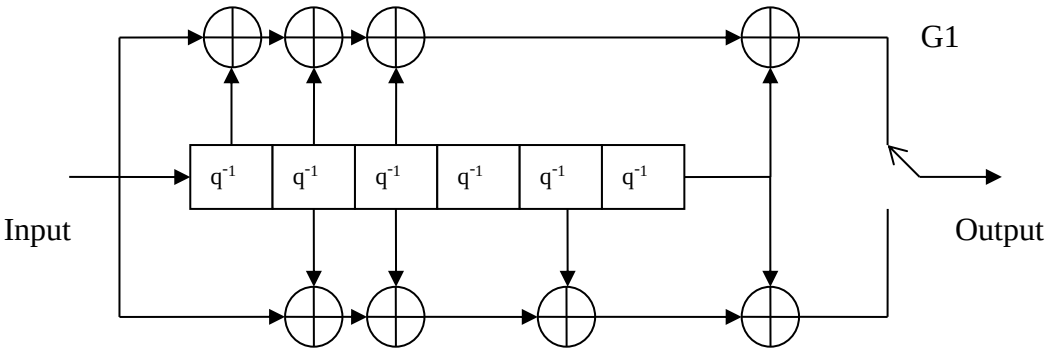

Figure 3: FEC Encoding

The convolution encoding for the data is performed as per the parameters given in Table 5.

Table 5: FEC encoding parameters

Parameter	Value
Coding Rate	½
Coding Scheme	Convolution
Constraint Length	7
Generator Polynomial	G1 = (171)o G2 = (133)o
Encoding Sequence	G1 then G2

Each sub-frame of 292 bits, after encoding, results in 584 symbols.

6.2.1.3 INTERLEAVING

The 584 symbols of FEC encoded data is interleaved using a block interleaver with n columns and k rows. Data is written in columns and then, read in rows.

Table **6** indicates the interleaving mechanism.

Table 6: Interleaving parameters

Parameter	Arrangement
Block Interleaver size	584
Block Interleaver Dimensions (*n* columns x *k* rows)	73 x 8

6.2.1.4 SYNC WORD

The Synchronization pattern for each of the sub-frame is 16 bit word. The Synchronization word is not encoded. The synchronization pattern allows the receiver to achieve synchronization to the sub-frame. The Sync pattern is EB90 Hex.

6.2.1.5 TAIL BITS

The tail bit field consists of 6 zero value bits enabling completion of the FEC decoding of each sub-frame in the user receiver.

6.2.1.6 CYCLIC REDUNDANCY CHECK (CRC)

The data signal contains parity coding according to the following conventions. CRC - 24Q polynomial shall be used for each Sub frame, applied on the first 262 bits of the sub-frame. Twenty-four bits of CRC parity will provide protection against burst as well as random errors with a probability of undetected error $\leq$ 2^{-24} = 5.96×10^{-8} for all channel bit error probabilities $\leq$ 0.5

The generator polynomial is given as

$$g(X) = \sum_{i=0}^{24} g_i X^i$$

g_i =1 for i equal to 0, 1, 3, 4, 5, 6, 7, 10, 11, 14, 17, 18, 23, 24

= 0 otherwise

The smartphone application shall check for CRC validity on the NavIC Broadcast messages ($PIRNSF) received from DAT-SG. The message shall be processed only if CRC is valid. Otherwise it should be discarded.

6.2.1.7 Message frame structure

Each message frame is 292 bits long. Each sub-frame ends with 24 bit CRC followed by 6 tail bits. This frame consists the 220 bits of DAT-SG message. The sub frame structure for satellite ID 1 and 7 is as given below:

1	**9**	**26**	**31**	**37**	**257**	**263**	**287**
TLM	**TOWC**	**RESERVED**	**MESSAGE ID**	**DAT-SG DATA**	**PRN ID**	**CRC**	**Tail**
8 BITS	17 BITS	5 BITS	6 BITS	220 BITS	6 BITS	24 BITS	6 BITS

Figure 4: Structure of message frame

The fields that need to be processed by smartphone application developer are**:**

- Message ID**:** Valid values are 41,20 ,21
- DAT**-**SG data**:** 220 bits of data
- CRC

6.2.1.8 Message ID

Each message frame has a 6-bit identifier that uniquely identifies the Message ID in the frame. Each messaging service broadcaster will be allocated a unique Message ID. The allocated message ID is to be used for decoding the relevant messages. **The NavIC Broadcast messages forwarded from DAT-SG via Bluetooth are message ID 41, 20 and 21**. The decoding of message ID 41 is explained in this document. The decoding of message ID 20, 21 can be done by using **"Signal-In-Space ICD for INCOIS Messages via Navic Messaging Service Version 1.1" available at www.isro.gov.in**.

6.2.1.9 Time of Week Count (TOWC)

The time of week counter (TOWC) indicates the number of 12 second counts at which the next subframe will begin. It is represented in 17 bits. The Time of Week Count (TOWC) value ranges from 1 to 50400 to cover one entire week. The Time Of Week (TOW) in seconds is obtained by multiplying TOWC with 12. The TOWC will have a value of 1 at week change over (Changeover from Saturday to Sunday). To derive current time the receiver shall subtract 12 from TOW. As the TOWC is always initialized at the beginning of week, the continuous time keeping if required, is to be done at the user receiver end. Refer Annexure 1 for additional information on computation of IST/UTC from TOWC.

If the user receiver needs absolute date-time, it is expected by user / application to provide the absolute date-time at start up giving details on week number; or year, month and day as part of user data.

6.2.1.10 Reserved

The bits 26 to 30 are reserved.

6.2.1.11 PRN ID

Each message in the subframe has a 6 bit PRN identifier that uniquely identifies the spacecraft transmitting the corresponding message. The PRN ID is allocated in Bit 257 - Bit 262 of subframe. PRN ID "1" indicated IRNSS 1A and PRN ID "7" indicates IRNSS 1G. Currently these two satellites are used for messaging.

6.2.1.12 Idle Pattern

When there is no valid data available on board for a given message ID, Idle Pattern containing alternating zeroes and ones is transmitted in the data part of the sub-frame. Idle pattern shall begin from bit 37, the first bit being a zero. When idle pattern is transmitted, the CRC will be corrupted for the corresponding sub-frame. If the application is checking the CRC before processing, this packet will be automatically ignored.

6.2.1.13 DAT-SG data

This contains the 220 bits of message data as further explained in Section 7. There are various types of messages that are sent by DAT-SG terminal to smartphone over Bluetooth. The details of each of these message types, their data format and decoding process for development of suitable smartphone application is given in the following sections.

7. Location Packet

The location packet ($GNGGA) is sent from DAT-SG terminal to the smartphone every second after the Bluetooth connection is established between smartphone and the terminal. The app should decode this GNGGA packet for location information. The application should check for **valid GNSS position fix in position quality indicator field** before processing this packet.

The general format for this type of message is:

$GNGGA,hhmmss.sss,llll.llll,a,yyyyy.yyyy,a,x,uu,v.v,w.w,M,x.x,M,,zzzz*hh<CR><L>

The description of each field is given in table below

Table 7: Description of GNGGA packet

Field	Name	Description
hhmmss.sss	UTC Time	UTC of position in hhmmss.sss format, (000000.000 ~ 235959.999)
llll.llll	Latitude	Latitude in ddmm.mmmm format. Leading zeros are inserted
a	N/S Indicator	'N' = North, 'S' = South
yyyyy.yyyy	Longitude	Longitude is dddmm.mmmm format. Leading zeros are inserted
a	E/W Indicator	'E' = East, 'W' = West
x	Position quality indicator	Position quality indicator 0: position fix unavailable 1: valid position fix, SPS mode 2: valid position fix, differential mode
uu	Satellites used	Number of satellites in use, (00~24)
v.v	HDOP	Horizontal dilution of precision, (00.0 ~ 99.9)
w.w	Altitude	Mean sea level altitude(-9999.9 ~ 17999.9) in meter
x.x	Geoidal Separation	In meter

zzzz	DGPS Station ID	Differential reference station ID, 0000 ~ 1023 NULL when DGPS not used
hh	Checksum	

Example :

Location Packet Example	**$GNGGA**,092709.000,**2301.3814,N,07230.8867,E**,2,**18**,0.7,56.2,M,-55.1,M,,0000*5E
Description	Provides latitude, longitude, number of satellites etc.

8. DAT-SG Acknowledgement and Emergency Messages (Control Room Messages)

This section describes the messages that are sent by DAT-SG control room. As shown in Figure 4, the DAT-SG message data will consist of 220 bits. The description of 220 bits is given in Table **8**.

Table 8: DAT-SG message structure (220 bits)

Field	Data and length	Size(in bits)	Bit Index	Remarks
Packet Header	Terminal Id	24	0-23	Unique terminal number
	Control Word	3	24-26	0x1: Emergency message 0x2: Manual acknowledgement message 0x3: Text message 0x4:System generated automatic acknowledgement message
	Message Length	5	27-31	Denotes the length (in bytes) of valid data present in data payload section
Data Payload	Data	184(23 bytes)	32-215	Data will contain different information pertaining to the type of control word • If Control word is 0x1, 1-byte emergency message code number will be present. Refer **Table 9** Control word 0x2 depicts

				manual acknowledgement message for the distress alert sent by DAT-SG. It is activated when user clicks on Acknowledge button on DAT-SG website • If control word is 0x3, max. 23 bytes of text message is present • Control word 0x4 depicts system generated auto acknowledgement message which is automatically sent when an alert is received at control centre
	Reserved	4	216-219	Reserved for future use

The message consists of packet header (32 bits) and data payload (188 bits). Packet header fields describe the message destination, message type and message length. The data payload is decoded based on the contents of packet header.

Packet header consists of the following fields:

- **Terminal Id**: This field is 24 bits long and denotes the destination terminal
- **Control Word**: This field is 3 bits long. It depicts the type of message. The following are the currently defined message types:
  - **Emergency message**: A few pre-defined emergency messages are listed in **Table 9**. Emergency message is depicted with control word **0x1.**

Table 9: Emergency message types

Sr. No	Emergency Message Code Number (Data payload field)	Description
1	0x01	Crossing the border
2	0x02	High Tide Expected
3	0x03	Cyclone
4	0x04	Heavy Rain
5	0x05	Terrorist attack
6	0x06	Tsunami

  - **Manual acknowledgement**: This message means that the operator in control room has seen the distress alert sent by the terminal and he is manually acknowledging the same. It is depicted with control word

0x2. This type of message is sent when the operator acknowledges the reception of distress alert and may indicate that rescue operation is initiated.

- **Text Message:** The control word for text message is **0x3**. This data payload contains text message of maximum 23 bytes. The length of text message can be derived from the Message Length field.
- **System generated automatic acknowledgement**: This message means that data reception software in control room has received the distress alert sent by the terminal. It is depicted with control word **0x4**. This message type will be sent each time a distress alert message is received at the control room.

- **Message Length:** This denotes the length of the data payload field in bytes. It should be checked only for **Text (control word: 0x3)** and **Emergency Message (control word 0x1)** types. For text message, message length should be max. **23**. For emergency message, this field should always be **1**.

Next 23 bytes of data contains the **data payload. It may be possible that entire 23 bytes may not contain valid data. The number of valid bytes should be first calculated using the message length field.** The last 4 bits of data are reserved for future use.

The examples for each type of message are given below.

All these messages have to be processed and displayed suitably on the smartphone application user interface.

8.1.1 Emergency Message

This message is used for emergency purpose. Its control word is 0x01.

Fields to be checked by application developer for decoding emergency message:

- Control word (0x1)
- Message Length (should be 1)
- Data payload (only first byte) for decoding the type of emergency message

An example of this message type is shown in Table 10. The 220 bits used for decoding of the message is highlighted in violet colour and message ID 41 is decoded using the 6 bits before the start of 220 bits.

Table 10: Example for Emergency Message

Emergency Message Example	**$PIRNSF**,1,4,8B,30,31,7**A**,**98,40,00,42,13,20,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00**,06,5A,A2,04,0*02
Description	Last nibble of first byte and first nibble of second byte is used to make a single byte in the **framed data** and that is used for decoding of the message
Message ID	**41** (A9: 10**101001** - **6 bits are used for message ID decoding which is '41' in DAT-SG service**)
Data	**220 bits will start from here and frame format is given in** Table **8** **Data:** **8,40,00,42,13,20,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00** **Framed Data:** **84,00,04,21,32,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,0**
Control Word	**1 - (it is decoded by first 3 bits 00100001 (21) in framed data)**
Message Length	**1 - (it is decoded by remaining 5 bits of byte 00100001(21) in framed data)**
Data payload	**Only 1 byte is used here, and value of the byte in the framed data is ascii hex of the integer in look up table given in Table 9** **0x32 is ascii of 0x02 which means "High Tide Expected" in DAT-SG**

8.1.2 Manual Acknowledgment Message

This message is used to deliver manual acknowledgement of the distress messages sent by the DAT-SG terminal. This message means that the operator in control room has seen the distress alert sent by the terminal and he is manually acknowledging the same. **It is depicted with control word 0x2**.

Fields to be checked by application developer for decoding manual acknowledgement message(rest of the fields may be ignored):

- Control word (0x2)

An example of the manual acknowledgement message packet is provided below:

Table 11: Example for Manual Acknowledgement Message

Manual Acknowledgment Example	**$PIRNSF**,1,4,8B,2D,DE,7**A**,**9F,FF,FF,F4,38,40,00,40,00,00,00,00,0 0,00,00,00,00,00,00,00,00,00,00,00,00,00,00**,07,24,5C,A0,0∗72
Description	Last nibble of first byte and first nibble of second byte is used to make a single byte in the **framed data** and that is used for decoding of the message An example is given below.
Message ID	**41 (**A9, 10**101001 - 6 bits are used for message ID decoding which is '41' in DAT-SG service)**
Data	**220 bits will start from here and frame format is in** Table **8** **Data:** **F,FF,FF,F4,38,40,00,40,00,00,00,00,00,00,00,00,00,00,00,00,00,0 0,00,00,00,00,00** **Framed Data:** **FF,FF,FF,43,84,00,04,00,00,00,00,00,00,00,00,00,00,00,00,00,00, 00,00,00,00,00,0**
Control Word	**0x2 - (it is decoded by first 3 bits of 010 00011 (43) in framed data)**

8.1.3 Text Message

This message is used for sending text message. It is depicted with control word 0x03 (refer Table **8**).

Fields to be checked by application developer for decoding text message:

- Control word (0x3)
- Message Length (max. 23)
- Data

The data payload contains text message of maximum 23 bytes. The length of text message can be derived from the message length field (refer Table **8**).

Example of text message is given in

Table **12**. The 220 bits used for decoding of the message is highlighted in violet colour and message ID 41 is decoded using the 6 bits before the start of 220 bits.

Table 12: Example for Text Message

Text Message Example	**$PIRNSF**,1,4,8B,30,0C,7**A**,**98,40,00,46,C4,86,56,C6,C6,F2,05,34,72,D4,44,15,40,00,00,00,00,00,00,00,00,00,00,00**,06,86,94,0C,1*7C
Description	Last nibble of first byte and first nibble of second byte is used to make a single byte in the **framed data** and that is used for decoding of the message (ref Table 1 for frame format for better understanding of the example).
Message ID	**41 (**A9:10**101001 - 6 bits are used for message ID decoding which is '41' in DAT-SG service)**
Data	**220 bits will start from here and frame format is in table 1** **Data:** **8,40,00,46,C4,86,56,C6,C6,F2,05,34,72,D4,44,15,40,00,00,00,00,00,00,00,00,00,00** **Framed Data:** **84,00,04,6C,48,65,6C,6C,6F,20,53,47,2D,44,41,54,00,00,00,00,00,00,00,00,00,00,0**
Control Word	**0x3 - (it is decoded by first 3 bits of 011**01100**(6C) in framed data)**

Message Length	12 **- (it is decoded by remaining 5 bits of the 01101100(6C) in framed data)**
Data payload	**Only message length number of bytes should be considered for making text data, so here only 12 bytes are considered. Rest of the bytes will contain zeroes** **48,65,6C,6C,6F,20,53,47,2D,44,41,54 - Hello SG-DAT** **This decoded text is to be displayed on the app.**

8.1.4 Auto Acknowledgment Message

This message is used for system generated auto acknowledgment. The control word is 0x04 (ref Table **8**). This message means that data reception software in control room has received the distress alert sent by the terminal. This message type will be sent each time a distress alert message is received at the control room.

Fields to be checked by application developer for decoding system generated auto acknowledgement message

- Control word (0x4)

An example of the emergency message packet is provided below. The 220 bits used for decoding of the message is highlighted in violet colour and message ID 41 is decoded using the 6 bits before the start of 220 bits.

Table 13: Example for Auto Acknowledgment Message

AutoAck Example	**$PIRNSF**,1,4,8B,30,19,7**A,9F,FF,FF,F8,38,40,00,40,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00**,05,90,BA,C8,0*70
Descri -ption	Last nibble of first byte and first nibble of second byte is used to make a single byte in the **framed data** and that is used for decoding of the message (ref Table 1 for frame format for understanding of the example).An example is given below.
Message ID	**41** (A9:10**101001** **- 6 bits are used for message ID decoding which is '41' in DAT-SG service**)
Data	**220 bits will start from here and frame format is in table 1** **Data:**

	F,FF,FF,F8,38,40,00,40,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,0 0,00,00 **Framed Data:** **FF,FF,FF,83,84,00,04,00,00,00,00,00,00,00,00,00,00,00,00,00,00, 00,00,00,00,00,0**
Control Word	**0x4 - (it is decoded by first 3 bits of 10000011 (83) in framed data)**

9. Distress Alert Packet (DAT-SG to Smartphone)

This message is the used for decoding of distress alert packet. When DAT-SG transmits distress packet to control room, the same packet is forwarded to mobile application. By this the user will get to know the terminal ID and the type of distress button that is pressed on DAT-SG terminal. The 112 bits format used for decoding of the distress alert type message and is given in table below.

Table 14: Description of Distress Alert Packet

Field	Bit Range	No of Bits	Remarks
TID (24 bits)	0	1	This value will be 1
	1-5	5	Nodal MRCC Id:- Chennai-0x1 Mumbai-0x2 Port Blair-0x3
	6-23	18	Terminal ID
Emergency (8bits)	24-31	8	Emergency Bits: 00000001 : Fire 00000010 : Medical 00000100 : Boat Sink 00001000 : Man overboard 00010000 : Test

			00100001 : All OK 00100010 : Terrorist Attack
Position data(57 bits)	32-59	28	27 bits - Latitude(ddmm.mmmm) (dd represented in 7 bits, mm in 6 bits & fractional mmmm in 14 bits) 1 bit - North/south
	60-88	29	28 bits - Longitude(dddmm.mmmm) ddd represented in 8 bits, mm in 6 bits & fractional mmmm in 14 bits 1 bit - East/west
Time	89-105	17	17 bits - Time (hhmmss.sss) (hh represented in 5 bits, mm in 6 bits & ss in 6 bits)
Reserved	106-111	6	Reserved

An example of the distress alert type message packet is provided below

Table 15: Example for distress alert packet

Type of Alert Message Example	**$DATSG,84,00,09,01,4B,39,35,77,8E,8D,58,A4,92,40**,0*0DA
Description	The 14 bytes (112 bits) highlighted in violet colour is used for decoding of the message (ref **Table 14**)
Data	**112 bits data is shown below** **Data:** **84,00,04,01,4B,39,35,77,8E,8D,58,A4,92,40**

10. PFZ and Warning Messages (INCOIS MESSAGES)

The decoding of **message ID 20, 21** can be done by using "**Signal-In-Space ICD for INCOIS Messages via Navic Messaging Service Version 1.1**" available at www.isro.gov.in.

ANNEXURE 1- Computation of Indian Standard Time (IST) using TOWC

The receiver shall compute time from TOWC value broadcast in the sub-frame. The time of week counter (TOWC) indicates the number of 12 second counts at which the next sub-frame will begin. The Time of Week Count (TOWC) value ranges from 1 to 50400 to cover entire week. Steps to compute time:

1. Read TOWC value from sub-frame data.
2. Multiply TOWC with 12 to obtain the Time Of Week (TOW) value in seconds.
   (The TOWC will have a value of 1 at 00:00:00 hrs, UTC on Sunday)
3. Subtract 12 seconds to compute the time of broadcast of the current sub-frame.
4. Compute the day, hours, minutes and seconds that has elapsed from Sunday, using the TOW value in seconds. This shall provide the time in UTC.
5. Add 5hrs 30 mins to the time computed in Step 4 to obtain the time in IST.
6. The user shall feed the year, month and date information as part of user data. As the TOWC is always initialized at the beginning of week, the continuous time keeping is required to be done at the user receiver end.

Example

TOWC value	= 24843
Time of week in Seconds	= 24843 x 12 seconds
	= 298116 seconds
Time of week at the start of current sub-frame	= 298116-12 seconds
	= 298104 seconds

Hence, No. of seconds elapsed since 00:00:00 hrs (UTC) on Sunday are 298104 seconds

No. of days elapsed from start of Sunday	= 298104 / 86400
	= 3.4502778 days (Wednesday)
Time of day	
Hours	= 0.4502778 x 24
	= 10.806667 hours
Minutes	= 0.806667 x 60
	=48.4 minutes
Seconds	= 0.4 x 60
	= 24 seconds
Time in UTC	=10:48:24 hrs

Time in IST = 10:48:24 + 05:30 hrs
= 16:18:24 hrs

Day & Time in IST : Wednesday, 16:18:24 hrs

ACRONYMS

CRC	Cyclic Redundancy Check
DAT-SG	Distress Alert Transmitter Second Generation
ICD	Interface Control Document
IRNSS	Indian Regional Navigation Satellite System
ISRO	Indian Space Research Organization
NavIC	Navigation Using Indian Constellation
PRN	Pseudo Random Noise
NMS	Network Management System