The Format of D-Star Slow Data

Version 0.2

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Introduction

The English D-Star specification mentions that for each frame of AMBE voice data, there are three bytes of data which is known as slow data, with an effective data rate is 1200bps. The specification of this data is not defined other than every twenty-first frame contains a three byte synchronisation vector. These three bytes are scrambled using the standard D-Star scrambler pattern but otherwise they have no error detection or correction applied to them.

Investigation of the format and contents of D-Star transmissions has been made by disassembling D-Star transmissions, and this document is taken from that. I must acknowledge that the help of the protocol dumps made by Denis Bederov, DL3OCK.

There are still a number of unanswered issues about the slow data, however these issues may not be important in practice, further tests and investigations are needed on these points.

The basic format of slow data is that is comprises blocks of six bytes, spread across two frames. These six bytes begin with a one byte header, the data of up to five bytes, and optionally filler bytes up to the end of the block. So far four message types have been identified and analysed. These message types are detailed below.

Header Data

In the absence of any other data types, the slow data is filled with copies of the radio header, without any interleaving or FEC, but including the checksum, forty-one bytes altogether. The header consists of its type (0x50) in the top half of the bytes, and the length of data in the current block in the bottom half. Unused bytes at the end of the last block are filled with ASCII ‘f’ characters, the length does not include this filler data. Typical data will look like (not including the AMBE data, or the synchronisation vector):

55 40 00 : U@.

00 44 42 : .DB

55 30 44 : U0D

46 20 20 : F__

55 42 44 : UBD

42 30 44 : B0D

55 46 20 : UF_

20 42 43 : _BC

55 51 43 : UQC

51 43 51 : QCQ

55 20 20 : U_

44 4f 36 : DO6

55 54 4f : UTO

42 20 20 : B_

55 20 20 : U_

20 20 45 : _E

51 26 66 : Q&f

66 66 66 : fff

Each block header is highlighted in red, the filler in blue, and the header checksum in green. Underscores have been added where space characters should be to make them more obvious.

GPS Data

GPS data may be embedded within D-Star slow data, it has a type of 0x30 and includes a length within each block header. It includes filler data at the end of the data which consists of ASCII 'f' characters, which are not included in the last length. The data is transmitted as either three sets, the first is the Fix Data (NMEA type $GPGGA), the second being Minimum Recommended Data (NMEA type $GPRMC), and the final being the free form text data, or in APRS format (type $$CRC). Typical data (excluding the AMBE audio data or the synchronisation vector) is shown below:

The $GPGGA Data

35 24 47 : 5$G

50 47 47 : PGG

35 41 2c : 5A,

32 31 30 : 210

35 37 34 : 574

33 2e 30 : 3.0

35 33 2c : 53,

35 32 33 : 523

35 30 2e : 50.

31 33 35 : 135

35 32 2c : 52,

4e 2c 30 : N,0

35 31 33 : 513

31 39 2e : 19.

35 39 38 : 598

37 31 2c : 71,

35 45 2c : 5E,

31 2c 30 : 1,0

35 36 2c : 56,

34 2e 32 : 4.2

35 2c 35 : 5,5

34 2e 36 : 4.6

35 2c 4d : 5,M

2c 34 31 : ,41

35 2e 31 : 5.1

2c 4d 2c : ,M,

35 2c 2a : 5,*

35 33 0d : 53.

31 0a 66 : 1.f

66 66 66 : fff

The $GPRMC Data

35 24 47 : 5$G

50 52 4d : PRM

35 43 2c : 5C,

32 31 30 : 210

35 37 34 : 574

34 2e 30 : 4.0

35 33 2c : 53,

41 2c 35 : A,5

35 32 33 : 523

30 2e 31 : 0.1

35 33 35 : 535

32 2c 4e : 2,N

35 2c 30 : 5,0

31 33 31 : 131

35 39 2e : 59.

39 38 37 : 987

35 30 2c : 50,

45 2c 30 : E,0

35 2e 30 : 5.0

30 2c 31 : 0,1

35 31 38 : 518

2e 37 2c : .7,

35 31 34 : 514

31 31 30 : 110

35 38 2c : 58,

31 2e 39 : 1.9

35 2c 45 : 5,E

2c 41 2a : ,A*

34 30 35 : 405

0d 0a 66 : ..f

The Free-Form Text

35 44 4c : 5DL

33 4f 43 : 3OC

35 4b 20 : 5K

20 2c 42 : ,B

35 4e 20 : 5N_

20 44 45 : _DE

35 4e 49 : 5NI

53 2a 39 : S*9

35 20 20 : 5__

20 20 20 : ___

35 20 20 : 5__

20 20 0d : __.

31 0a 66 : 1.f

66 66 66 : fff

The APRS $$CRC Data

35 24 24 : 5$$

43 52 43 : CRC

35 33 31 : 531

36 31 2c : 61,

35 44 4c : 5DL

33 4f 43 : 3OC

35 4b 3e : 5K>

41 50 49 : API

35 32 38 : 528

32 2c 44 : 2,D

35 53 54 : 5ST

41 52 2a : AR*

35 3a 2f : 5:/

32 31 31 : 211

35 32 33 : 523

34 68 35 : 4h5

35 32 33 : 523

30 2e 31 : 0.1

35 33 4e : 53N

2f 30 31 : /01

35 33 31 : 531

39 2e 39 : 9.9

35 38 45 : 58E

2d 30 32 : -02

35 37 2f : 57/

30 30 30 : 000

35 2f 44 : 5/D

65 6e 69 : eni

35 73 20 : 5s_

7a 75 20 : zu_

35 48 61 : 5Ha

75 73 65 : use

31 0d 66 : 1.f

66 66 66 : fff

Each block header is highlighted in red, and the filler in blue. Underscores have been added where space characters should be to make them more obvious.

Free-Form Text

Every D-Star radio is capable of sending free format text data of up to twenty characters to be displayed on the recipients' radio. Unlike most other slow data formats, which include a length, this format has a type (0x40) but no length, instead a serial number is added to each header, as the length is always five. This allows missing data to be detected. There is no error checking on that data so bit errors appear as corrupted characters on the display. If the text entered is less than twenty characters, it is padded with space characters up to a length of twenty characters. Typical data (excluding the AMBE audio data or the synchronisation vector) is shown below:

40 44 4c : @DL

33 4f 43 : 3OC

41 4b 20 : AK_

44 45 4e : DEN

42 49 53 : BIS

20 48 31 : _H1

43 33 20 : C3_

20 20 20 : ___

Each block header is highlighted in red. Underscores have been added where space characters should be to make them more obvious.

Code Squelch Data

When the code squelch is active, the transmitters code squelch data must be transmitted so that it can trigger the code squelch at the receiving end. This data format follows the standard in having a type (0xC0) and a length. Even though only one byte is needed for the data, two are used and the data is repeated, this gives a measure of data resiliency as both bytes should be the same. Typical data is shown below:

c2 19 19 : ...

66 66 66 : fff

Each block header is highlighted in red, and the filler in blue. It is important to note that the value of the code squelch is the hex representation of the decimal value as presented to the user. In the above example a code squelch value of 19 is transmitted as 0x19.

Data Interleaving

When there is more than one type of data to be transmitted in the slow data field then special rules are applied with respect to what order that data is transmitted.

These are examples of the data taken from dumps provided by DL3OCK. Each letter represents a six byte block specified as above, with the addition of the Filler type, which is six bytes of the letter 'F'. There are ten blocks between data re-sync points.

Key: A = APRS Data, C = Code Squelch, D= Data re-sync, G = GPS Data, H = Header, T = Text Message, F = Filler

None: H H H H H H H H H F D

H H H H H H H H H F D ....

Text: T T T T F

Text: T T T T F F F F F F D

H H H H H H H H H F D

H H H H H H H H H F D ....

Text + GPS: T G T G T G T G G G D

G G G G G G ... G G D

G H

Text + GPS: T G T G T G T G G G D

G G G G G G ... G G D

G G G G G G G G F F F D

H H H H H H H H H F D

G G G G G G G G G G D

G G G ....

Text + APRS: T A T A T A T A A A D

A A A A A A A A A A D

A H

Text + APRS: T A T A T A T A A A D

A A A A A A A A A A D

A H H H H H H H H H D

H H H H H H H H H F D

A A A A A A A A A A D

A A A A A A A F F F D

H H H H H H H H H F D

H H H H H H H H H F D

H H H H H H H H H F D

A A A A A A A A A A D

A A A A A A A F F F D

H H H H H H H H H F D ....

Squelch + Text + GPS: C G T G T G T G T G D

Squelch + Text + GPS: C G T G T G T G T G D

C G G G G G G G G G D

C G G G G G G G G G D

C G G G G G F