

Review of Channel Management message

EUROCAE WG51/SG2 (VDL/4 MOPS)

1. Introduction

This note contains the results of a review of the channel management message. This is in response to an action from SG-2. There are two elements to this review; a number of clarifications to the CM message text (see section 3 below for details), and a two specific points raised and described below in Section 2.

2. Resolution of Specific Issues

(a) Issue relating to directed offset (do) and length fields encoding

It is inconsistent that the directed offset field in table 3-27 is one bit shorter than in Table 1-35. Why not make Table 1-35 one bit shorter for consistency. Making this minor restriction reduces the offset range to 4095 – surely enough for $M1 = 4500$ slots? If we make that change, then the do encoding should just call up Table 1-35.

The maximum burst length is 16 slots so the length field need only encode 16 states, for which four bits are required, not eight. Tables 1-26, 1-27, 1-29, 1-34 and 1-35 need to reflect this.

Resolution: Reduce the do field encoding by one bit (i.e. 12 bits) in the autotune reservation burst format (tables 1-34, 1-35) and provide a reference to this definition in table 3-27. Delete bits 4 to 8 of the length field in tables 1-26, 1-29 and 1-34 and set these bits as reserved. These changes are illustrated in extracts from the manual below.

Table 1-26. Unicast request reservation bit encoding

| Description | Octet | Bit number | | | | | | | |
|-------------------------------|-------|----------------------------|----------------------------|----------------------------|----------------------------|-----------------|-----------------|-----------------|-----------------|
| | | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| destination address (d) | n-8 | d ₂₄ | d ₂₃ | d ₂₂ | d ₂₁ | d ₂₀ | d ₁₉ | d ₁₈ | d ₁₇ |
| | n-7 | d ₁₆ | d ₁₅ | d ₁₄ | d ₁₃ | d ₁₂ | d ₁₁ | d ₁₀ | d ₉ |
| | n-6 | d ₈ | d ₇ | d ₆ | d ₅ | d ₄ | d ₃ | d ₂ | d ₁ |
| source/destination flag (sdf) | n-5 | ro ₁₂ | ro ₁₁ | ro ₁₀ | ro ₉ | sdf | d ₂₇ | d ₂₆ | d ₂₅ |
| response offset (ro) | n-4 | ro ₈ | ro ₇ | ro ₆ | ro ₅ | ro ₄ | ro ₃ | ro ₂ | ro ₁ |
| length (lg) | n-3 | res₈ | res₇ | res₆ | res₅ | lg ₄ | lg ₃ | lg ₂ | lg ₁ |
| priority (pr) | n-2 | 0 | 0 | 1 | 0 | pr ₄ | pr ₃ | pr ₂ | pr ₁ |

...

The length row only of table 1-27 is reproduced below for illustration.

...

Table 1-27. Unicast request reservation field encoding

| Subfield | Range | Encoding / Actions | Definitions |
|-------------|------------------------|--------------------|--|
| ... | ... | ... | ... |
| length (lg) | 0 to 255 15 | | lg is one less than the number of slots that are reserved for the response |
| ... | ... | ... | ... |

...

Table 1-29. Information transfer request reservation bit encoding

| Description | Octet | Bit number | | | | | | | |
|--|-------|----------------------------------|----------------------------------|---------------------------------|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| | | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| acknowledgement offset (ao) | n-10 | res | ao ₇ | ao ₆ | ao ₅ | ao ₄ | ao ₃ | ao ₂ | ao ₁ |
| length (lg) | n-9 | res g ₈ | res g ₇ | lg₆ es | lg₅ es | lg ₄ | lg ₃ | lg ₂ | lg ₁ |
| response offset (ro) | n-8 | ro ₈ | ro ₇ | ro ₆ | ro ₅ | ro ₄ | ro ₃ | ro ₂ | ro ₁ |
| | n-7 | ro ₁₂ | ro ₁₁ | ro ₁₀ | ro ₉ | f ₁₂ | f ₁₁ | f ₁₀ | f ₉ |
| frequency (f) destination address (d) | n-6 | f ₈ | f ₇ | f ₆ | f ₅ | f ₄ | f ₃ | f ₂ | f ₁ |
| | n-5 | d ₂₄ | d ₂₃ | d ₂₂ | d ₂₁ | d ₂₀ | d ₁₉ | d ₁₈ | d ₁₇ |
| | n-4 | d ₁₆ | d ₁₅ | d ₁₄ | d ₁₃ | d ₁₂ | d ₁₁ | d ₁₀ | d ₉ |
| | n-3 | d ₈ | d ₇ | d ₆ | d ₅ | d ₄ | d ₃ | d ₂ | d ₁ |
| | n-2 | 0 | 1 | 0 | 1 | 0 | d ₂₇ | d ₂₆ | d ₂₅ |

Table 1-34. Encoding of additional data in autotune reservation burst

| Description | Octet | Bit number | | | | | | | |
|---|-------|----------------------------------|----------------------------------|----------------------------------|------------------------------------|------------------|------------------|------------------|-----------------|
| | | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Directed timeout (dt) | n-11 | dt ₄ | dt ₃ | dt ₂ | dt ₁ | f ₁₂ | f ₁₁ | f ₁₀ | f ₉ |
| Frequency (f) | n-10 | f ₈ | f ₇ | f ₆ | f ₅ | f ₄ | f ₃ | f ₂ | f ₁ |
| Length (lg) | n-9 | res g ₈ | res g ₇ | res g ₆ | res g ₅ | lg ₄ | lg ₃ | lg ₂ | lg ₁ |
| Transmit control (trmt) | n-8 | res | res | trmt | res do ₁₃ | do ₁₂ | do ₁₁ | do ₁₀ | do ₉ |
| Directed offset (do) | n-7 | do ₈ | do ₇ | do ₆ | do ₅ | do ₄ | do ₃ | do ₂ | do ₁ |
| Override flag (or); receiver control (rcvr); nominal update rate (nr); pr_flag = 0 | n-6 | or | rcvr ₂ | rcvr ₁ | 0 | nr ₄ | nr ₃ | nr ₂ | nr ₁ |

In the tables below only the length and directed offset rows is reproduced for the purpose of illustration.

Table 1-35. Directed request reservation field encoding

| Subfield | Range | Encoding | Definitions |
|----------------------|--|-----------------|---|
| length (lg) | 0 to 255 15 | See Table 1-27 | lg is one less than the number of slots that are reserved |
| ... | ... | ... | ... |
| Directed offset (do) | 0 or 2 to 2 ¹³ 2 ¹² - 1 | do = 1: invalid | do = 0 implies directed rate reservation. do > 1 implies directed slot reservation. For do > 1, do = the first slot in which to transmit. |
| ... | ... | ... | ... |

Table 3-27. Header block field encoding

| Subfield | Encoding | Notes |
|----------------------|--|---|
| ... | | |
| Directed offset (do) | 0 or 2 to 2¹² - 1 do = 1: invalid (see table 1-35) | Do do = 0 implies directed rate reservation. do > 1 implies directed slot reservation. For do > 1, do = the first slot in which to transmit. |

(b) Parameter block encoding

In Table 3-41, CTRL parameter encodings may have changed and may thus require updating. Some fields have different lengths to equivalent CTRL parameters. There should be a $Q1_{min}$ and $Q1_{max}$ in the channel management parameter? One way ahead is to review the two relevant other CTRL parameters and then use precisely the same format for this block (ie add together the two parameters)

Resolution: Unlike the tables in §1.5, we have a definite Q1 parameter in this case (no min or max) to be encoded in the parameter block, hence the encoding of Q1 in this section appears correct and no change is required.

A review and cross-check of the maximum allowable value of each of the parameters in table 3-41 (against tables 1-9 & 1-17) shows that the Q2 parameters require 10 bits not 12 (as in the highlighted text below).

Verification of bits required for each field below (highlighted fields represent changes required):

| param | max no. states | no. bits req'd | bits now allocated in 3-41 |
|-------|----------------|----------------|----------------------------|
| Q1 | 15 | 4 | 4 |
| Q2a | 1000 | 10 | 12 |
| Q2b | 1000 | 10 | 12 |
| Q2c | 1000 | 10 | 12 |
| Q2d | 1000 | 10 | 12 |
| Q4 | 20 | 5 | 5 |
| V11 | 60 | 6 | 6 |
| V12 | 100 | 7 | 7 |
| TV11 | 16 | 4 | 4 |
| VS2 | 60 | 6 | 6 |
| VS4 | 100 | 7 | 7 |

See the text proposal beneath for modification to table 3-41.

Table 3-41. ~~Transmission parameter~~ Parameter block bit encoding

| Description | Octet | Bit number | | | | | | | |
|------------------|---------------------|--------------------------|--------------------------|--------------------------|------------------------------|--------------------------|--------------------------|--------------------------|------------------------------|
| | | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| <u>Q1, Q4</u> | <u>1</u> | <u>Q1₂</u> | <u>Q1₁</u> | res | <u>Q4₅</u> | <u>Q4₄</u> | <u>Q4₃</u> | <u>Q4₂</u> | <u>Q4₁</u> |
| Q2a | <u>2</u> <u>1</u> | Q2a ₈ | Q2a ₇ | Q2a ₆ | Q2a ₅ | Q2a ₄ | Q2a ₃ | Q2a ₂ | Q2a ₁ |
| | <u>3</u> | <u>Q2a₁₂</u> | <u>Q2a₁₁</u> | <u>Q2a₁₀</u> | <u>Q2a₉</u> | <u>Q2b₁₂</u> | <u>Q2b₁₁</u> | <u>Q2b₁₀</u> | <u>Q2b₉</u> |
| Q2b | <u>4</u> <u>2</u> | Q2b ₈ | Q2b ₇ | Q2b ₆ | Q2b ₅ | Q2b ₄ | Q2b ₃ | Q2b ₂ | Q2b ₁ |
| Q2c | <u>5</u> <u>3</u> | Q2c ₈ | Q2c ₇ | Q2c ₆ | Q2c ₅ | Q2c ₄ | Q2c ₃ | Q2c ₂ | Q2c ₁ |
| | <u>6</u> | <u>Q2e₁₂</u> | <u>Q2e₁₁</u> | <u>Q2e₁₀</u> | <u>Q2e₉</u> | <u>Q2d₁₂</u> | <u>Q2d₁₁</u> | <u>Q2d₁₀</u> | <u>Q2d₉</u> |
| Q2d | <u>7</u> <u>4</u> | Q2d ₈ | Q2d ₇ | Q2d ₆ | Q2d ₅ | Q2d ₄ | Q2d ₃ | Q2d ₂ | Q2d ₁ |
| | <u>5</u> | <u>Q2d₁₀</u> | <u>Q2d₉</u> | <u>Q2c₁₀</u> | <u>Q2c₉</u> | <u>Q2b₁₀</u> | <u>Q2b₉</u> | <u>Q2a₁₀</u> | <u>Q2a₉</u> |
| <u>Q1, Q4</u> | <u>6</u> | <u>Q1₃</u> | <u>Q1₂</u> | <u>Q1₁</u> | <u>Q4₅</u> | <u>Q4₄</u> | <u>Q4₃</u> | <u>Q4₂</u> | <u>Q4₁</u> |
| <u>V12</u> | <u>7</u> | <u>Q1₄</u> | <u>V12₇</u> | <u>V12₆</u> | <u>V12₅</u> | <u>V12₄</u> | <u>V12₃</u> | <u>V12₂</u> | <u>V12₁</u> |
| TV11min, TV11max | 8 | TV11 min ₄ | TV11 min ₃ | TV11 min ₂ | TV1 1 min ₁ | TV11 max ₄ | TV11 max ₃ | TV11 max ₂ | TV1 1 max ₁ |
| V11 | 9 | res | res | V11 ₆ | V11 ₅ | V11 ₄ | V11 ₃ | V11 ₂ | V11 ₁ |
| <u>V12</u> | <u>10</u> | res | <u>V12₇</u> | <u>V12₆</u> | <u>V12₅</u> | <u>V12₄</u> | <u>V12₃</u> | <u>V12₂</u> | <u>V12₁</u> |
| VS2 | <u>11</u> <u>10</u> | res | res | VS2 ₆ | VS2 ₅ | VS2 ₄ | VS2 ₃ | VS2 ₂ | VS2 ₁ |
| VS4 | <u>12</u> <u>11</u> | res | VS4 ₇ | VS4 ₆ | VS4 ₅ | VS4 ₄ | VS4 ₃ | VS4 ₂ | VS4 ₁ |

3. Text proposals for clarifications in the channel management message text (section 3.7.2 of the VDL Mode 4 Technical Manual)

3.7.2 Channel management ~~CTRL~~ Parameter

The channel management ~~CTRL~~ parameter shall be divided into component blocks as described in Table 3-25. If present, each component block shall appear in the channel management parameter in the order shown in Table 3-25.~~A station that matches a destination ID in a channel management CTRL parameter, or is contained in a defined region in a channel management CTRL parameter, shall not process subsequent channel management CTRL parameters with the same command set ID in the same CTRL. A station receiving a channel management CTRL parameter with a script that matches an active command set shall update the script duration but otherwise not modify its transmissions.~~

Note. If the destination block is an implied broadcast (dc = 0 per Table 3-27), it is considered to match the receiving station's ID.

Table 3-25. Component blocks of channel management ~~CTRL~~ parameter

| Blocks | Description |
|-------------------------------|--|
| Header block | Contains the CTRL header and the non-repetitive information for each of the sub-elements. |
| Destination block | Contains a list of zero or more destinations or a geographic region, along with the timeout and slot offset from the current slot to the start of the script (zero destinations included implies broadcast.) |
| Transmission definition block | Contains from 0 to 15 transmission definitions in an unordered list. Each definition describes a particular desired transmission (one not already specified in SARPs) and all relevant options. The location of a particular transmission block in this list defines an implicit pointer used in the script block (i.e., thereby specifying a particular message). |
| Frequency block | Contains from 1 to 7 frequencies in an ordered list and optional sleep parameters to use on each frequency. The location of a particular frequency block in this list defines an implicit pointer used in the script block (i.e., thereby specifying a particular frequency). |
| Parameter block | Contains QoS and other transmission parameters to use with the elements of this script. |
| Script block | Contains a repeat rate and from 1 to N script elements in an ordered list. Each script element consists of an optional repeat count, a frequency block pointer, and a transmission block pointer. |

3.7.2.1 Header block encoding

The channel management ~~CTRL~~ parameter header block shall appear first in the channel management parameter and be encoded as defined in Table 3-26 with subfield encodings as defined in Table 3-27.

Table 3-26. Header block bit encoding

| Description | Octet | Bit number | | | | | | | |
|---|-------------|-------------------|-------------------|-------------------|---|------------------|------------------|------------------|-----------------|
| | | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| CTRL parameter ID | <u>m+1</u> | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| CTRL length | <u>2m+1</u> | n ₈ | n ₇ | n ₆ | n ₅ | n ₄ | n ₃ | n ₂ | n ₁ |
| directed timeout (dt) | <u>m+23</u> | dt ₄ | dt ₃ | dt ₂ | dt ₁ | do ₁₂ | do ₁₁ | do ₁₀ | do ₉ |
| directed offset (do) | <u>m+34</u> | do ₈ | do ₇ | do ₆ | do ₅ | do ₄ | do ₃ | do ₂ | do ₁ |
| destination count (dc) | <u>m+45</u> | dc ₈ | dc ₇ | dc ₆ | dc ₅ | dc ₄ | dc ₃ | dc ₂ | dc ₁ |
| command set ID (csid), transmission definition count (tc) | <u>m+56</u> | csid ₄ | csid ₃ | csid ₂ | csid ₁ | tc ₄ | tc ₃ | tc ₂ | tc ₁ |
| frequency count (fc), script duration type (styp), script rate (sr) | <u>m+67</u> | fc ₃ | fc ₂ | fc ₁ | styp | sr ₄ | sr ₃ | sr ₂ | sr ₁ |
| transmit parameter count (pc) | <u>m+78</u> | res | res | pc ₆ | pc ₅ | pc ₄ | pc ₃ | pc ₂ | pc ₁ |
| script count (sc) | <u>m+89</u> | sc ₈ | sc ₇ | sc ₆ | <u>sc₅</u> <u>c₅</u> | sc ₄ | sc ₃ | sc ₂ | sc ₁ |

If the channel management parameter is included within a GSIF-DLPDU with the ucid subfield set to 2, the channel management parameter ID shall be omitted and no other parameter included in the GSIF.

Table 3-27. Header block field encoding

| Subfield | Encoding | Notes |
|------------------------------------|--|---|
| Directed timeout (dt) | See Table 1-35 | |
| Directed offset (do) | 0 or 2 to $2^{12} - 1$ do = 1: invalid | Do-do = 0 implies directed rate reservation. do > 1 implies directed slot reservation. For do > 1, do = the first slot in which to transmit. |
| Destination count (dc) | 0 : <u>destination block absent (see section 3.7.2.2.1)</u> <u>1 – 255 : number of octets in destination block</u> | Number of octets in the destination block. 0 implies broadcast. |
| Command set ID (csid) | 0-14 : valid csid identifiers 15 : cancel all prior commands (see section 3.7.2.5.1) | identifierID specifying this command (See Note 1) |
| transmission definition count (tc) | 0 : <u>transmission block absent</u> <u>1-15 : number of elements in the transmission definition block</u> | The number of elements in the transmission definition block. Te = 0 indicates no transmission blocks. |
| frequency count (fc) | 0 : no freq listed (csid = 15) 1-7 : number of frequencies | The number of elements in the frequency block. |
| script duration type (styp) | styp = 0: interpret sr as the number of times the entire script repeats per minute; styp = 1: interpret sr as the number of minutes until script repeats. | |
| script rate (sr) | 0-15. Interpreted based on styp. For styp = 0, sr is encoded per <u>nr in</u> Table 1-33. For styp = 1, sr is encoded as minutes between 2 (encoded as 0) and 17 minutes. | |
| transmit parameter count (pc) | 0 – 63 | Number of octets in the transmit parameter block. |
| script count (sc) | 1 (encoded as 0) – 256 | Number of octets in script block. |

Note 1.- The command set ID allows a ground station to uplink several (up to 15) separate commands to each aircraft or set of aircraft (including all aircraft in view) which are each processed separately. A transmission with csid = x overrides operations specified in a previous transmission with csid = x, but does not affect operations dictated by previous transmissions with csid \neq x. Hence a ground station can command multiple sets of messages (each set containing various types of transmissions), and the transmissions can have different report periods from one set to another. An example is a sequence of sync bursts on two or more frequencies defined by command set csid = 0, and a separate sequence of TCPs on the same or different frequency(ies) defined by command set csid = 1. The use of different command sets allows directed-slot operation for both command sets even though the two sets of commanded transmissions may have different burst lengths (e.g., one slot for sync bursts and two slots for TCPs).

The number of elements in the script (total number of transmissions over one repeat cycle) shall be designated NES. The number of transmissions per minute shall be designated NTM.

Note 3 -A repeat cycle can be less than a sub-multiple of one minute, exactly one minute, or multiple minutes.

Note 24.- The definition of the script block is provided in Section 3.7.2.9. The script consists of one or more single octet fields each referring to a single transmission and one or more two octet fields each referring to one or more transmissions (as defined in the repeat count subfield). If there are n single octet fields, m double octet fields and, for each double octet field, a number of transmissions p_m , then: $NES = n + \sum (m p_m)$ and $sc = n + 2m$ —can be greater than sc because of the repeat capability.

Note 35.- The length of a single channel management CTRL-parameter is limited to 255 bytes-octet because a single byte-octet CTRL length field is used in the CTRL parameter format.

Note 6.- The value of NTM is defined in Section 3.7.2.3.

3.7.2.2 Destination block encoding

The destination block shall consist of zero destinations (a broadcast), one or more addressed destinations, or a regional definition, as defined in the following sections.

3.7.2.2.1 Broadcast destination

If the destination count (dc) in the header block is zero, then the channel management CTRL parameter shall apply to all stations.

Note.- If the destination block is an implied broadcast (dc = 0 per Table 3-27), it is considered to match the receiving station's ID.

3.7.2.2.2 Addressed destination

If bit 8 of the first octet ~~1 of~~ in the destination block is a zero, then the destination block shall consist of one or more addresses per Table 3-28 with encodings defined in Table 3-29. If none of the addresses matches the receiver, then further processing of this parameter shall terminate.

Note.- Bit 8 of the first octet is used to indicate the start of the addressed destination block. If set to zero, the addressed destination block is present. If set to one a regional multicast block is present (see Section 3.7.2.2.3). Hence ~~The~~ the individual offset for the first destination in the addressed destination block is limited to 0-15 and not 0-31.

Table 3-28. Addressed destination block bit encoding

| Description | Octet | Bit number | | | | | | | |
|-------------------------|-------|------------------|------------------|------------------|------------------|------------------|-----------------|-----------------|-----------------|
| | | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| individual offset (ido) | 1 | ido ₅ | ido ₄ | ido ₃ | ido ₂ | ido ₁ | d ₂₇ | d ₂₆ | d ₂₅ |
| destination address (d) | 2 | d ₂₄ | d ₂₃ | d ₂₂ | d ₂₁ | d ₂₀ | d ₁₉ | d ₁₈ | d ₁₇ |
| | 3 | d ₁₆ | d ₁₅ | d ₁₄ | d ₁₃ | d ₁₂ | d ₁₁ | d ₁₀ | d ₉ |
| | 4 | d ₈ | d ₇ | d ₆ | d ₅ | d ₄ | d ₃ | d ₂ | d ₁ |

Table 3-29. Addressed destination block field encoding

| Subfield | Encoding | Notes |
|-------------------------|--|---------------------------------|
| individual offset (ido) | <u>0 –15 for the first address in the addressed destination block</u> 0-31 <u>otherwise</u> | See description of usage below. |
| destination address (d) | Per section 1.4.2.2 | |

3.7.2.2.2.1 Directed rate operations

If a mobile station receiving a channel management CTRLparameter with the directed individual offset (ido) is set equal to 0 in a destination block with the station's address, then the addressed stations shall operate in directed rate mode. The individual offset parameter ido shall be set to 0 on transmit for each addressed station.

A mobile station in receipt of a channel management CTRLparameter with destination count (dc) = 0 in the header block All stations that are not individually addressed shall operate in directed rate mode.

3.7.2.2.2.2 Directed slot operations

A mobile station receiving a channel management CTRLparameter with the individual offset (ido) not set equal to 0 in a destination block with the station's address If the

~~directed offset is not set equal to 0, then the addressed stations~~ shall operate in directed slot mode. The sum of the individual offset parameter ~~ido~~ for each addressed station and directed offset (do) subfield shall ~~be set to indicate~~ the number of slots by which the transmissions of that station are to be offset from ~~do after~~ the first slot of the CTRL command.

A station transmitting a channel management CTRL parameter containing one or more addressed destination blocks for which the directed offset is not set equal to 0 shall first ensure that the slots which will be used by addressed stations have first been reserved using block reservation protocols (see section 1.3.17) or ground quarantine (see section 1.3.6.4).

Note.- Directed slot operation is announced by setting bit 1 of octet 1 of the transmitted burst = 1.

3.7.2.2.3 Regional multicast

If bit 8 of ~~octet 1~~ the first octet of the destination block is a one, then the destination block shall instead consist of a regional multicast per Table 3-30 with encodings defined in Table 3-31. Stations operating in directed-slot mode from a previous channel management CTRL parameter, or from a directed request (see section 1.3.16), shall not process regional multicast commands. A station shall determine that it is in the defined region if Condition 1 is true and either Condition 2a or Condition 2b is true:

Condition 1: altitude compliance

- the station altitude (using baro altitude if available, otherwise geo altitude) is greater than or equal to the lower altitude and less than or equal to the upper altitude

Condition 2a: radial range compliance when there is at least one vertex k with radial k less than or equal to the station's radial from the center of the defined region

- the station distance from the center of the region, assuming a spherical Earth, is less than or equal to the distance k associated with the vertex k having greatest radial k less than or equal to the station's radial from the center of the defined region, or

Condition 2b: radial range compliance when there is no vertex with radial k less than or equal to the station's radial from the center of the defined region

- the station distance from the center of the region, assuming a spherical Earth, is less than or equal to the distance k_{vc} associated with the last vertex in the list.

If the station is not in the defined region, then further processing of this parameter shall terminate.

Note.- The (radial, range) pairs may be parsed in a clockwise direction around the defined center of the region. Each range applies at its associated radial, and in a clockwise direction until another radial is encountered.

Table 3-30. Regional multicast block bit encoding

| Description | | Octet | Bit number | | | | | | | |
|------------------------------|------------------------------|-------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| | | | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| vertex count (vc) | | 1 | 01 | res | lon ₁₄ | lon ₁₃ | vc ₄ | vc ₃ | vc ₂ | vc ₁ |
| center latitude (lat, lat4) | | 2 | lon ₈ | lon ₇ | lon ₆ | lon ₅ | lon ₄ | lon ₃ | lon ₂ | lon ₁ |
| | | 3 | lon ₁₂ | lon ₁₁ | lon ₁₀ | lon ₉ | lat ₁₂ | lat ₁₁ | lat ₁₀ | lat ₉ |
| center longitude (lon, lon4) | | 4 | lat ₈ | lat ₇ | lat ₆ | lat ₅ | lat ₄ | lat ₃ | lat ₂ | lat ₁ |
| | | 5 | lon ₄ ₄ | lon ₄ ₃ | lon ₄ ₂ | lon ₄ ₁ | lat ₄ ₄ | lat ₄ ₃ | lat ₄ ₂ | lat ₄ ₁ |
| lower altitude (lalt) | | 6 | lalt ₈ | lalt ₇ | lalt ₆ | lalt ₅ | lalt ₄ | lalt ₃ | lalt ₂ | lalt ₁ |
| upper altitude (ualt) | | 7 | ualt ₈ | ualt ₇ | ualt ₆ | ualt ₅ | ualt ₄ | ualt ₃ | ualt ₂ | ualt ₁ |
| vertex 1 | radial 1 (r ₁) | 8 | r _{1,8} | r _{1,7} | r _{1,6} | r _{1,5} | r _{1,4} | r _{1,3} | r _{1,2} | r _{1,1} |
| | distance 1 (d ₁) | 9 | d _{1,8} | d _{1,7} | d _{1,6} | d _{1,5} | d _{1,4} | d _{1,3} | d _{1,2} | d _{1,1} |
| vertex 2 (as needed) | radial 2 (r ₂) | 10 | r _{2,8} | r _{2,7} | r _{2,6} | r _{2,5} | r _{2,4} | r _{2,3} | r _{2,2} | r _{2,1} |
| | distance 2 (d ₂) | 11 | d _{2,8} | d _{2,7} | d _{2,6} | d _{2,5} | d _{2,4} | d _{2,3} | d _{2,2} | d _{2,1} |

Table 3-31. Regional multicast block field encoding

| Subfield | Encoding | Notes |
|------------------------------|---|--|
| Vertex count (vc) | 0: vertex 1 1- 15: vertex 2 to vertex 16 | Vertex k corresponds to radial k and distance k |
| center latitude (lat, lat4) | lat, lon, lat4, lon4 are CPR encoded per Section 4. | Sent using type=0, reference position is location of station transmitting this CTRL. |
| center longitude (lon, lon4) | | |
| lower altitude (lalt) | 0: alt = -1 500 feet | Station only matches the broadcast if its altitude (baro if available, otherwise geo) is between lower and upper altitudes. Altitude code 255 is not valid for lower altitude. |
| upper altitude (ualt) | 1: alt = -1 250 feet 2-254: 250ft linear increments up to 63 500 feet 255: no upper limit | |
| distance (d) | See table 3-32. | |
| radial (r) | due North coded as 0. Resolution is 360/256 degrees, linear | Vertex blocks are listed in monotonically increasing radial order (clockwise around center). |

Table 3-32. Vertex distance encoding

| Transmitted value of distance (decimal equivalent of field) | Within region if: |
|---|---------------------|
| 0 | distance < 0.5 nmi |
| 1 | distance < 1.0 nmi |
| | |
| 59 | distance < 29.5 nmi |
| 60 | distance < 30 nmi |
| 61 | distance < 31 nmi |
| | |
| 89 | distance < 59 nmi |
| 90 | distance < 60 nmi |
| 91 | distance < 62 nmi |
| | |
| 119 | distance < 118 nmi |
| 120 | distance < 120 nmi |
| 121 | distance < 124 nmi |
| | |
| 254 | distance < 656 nmi |
| 255 | distance < 660 nmi |

Note. – As indicated in Section 3.7.2.2.2.1, a station that matches the regional broadcast filter operates per the directed rate mechanism.

3.7.2.3 Channel management parameter reception procedures

Upon receipt of a channel management CTRL command that is determined to apply to the station due to an ID-address, broadcast or regional match, the station shall establish NTM streams. If styp = 0, then NTM shall equal NES * sf-sr (where sf-sr is the result of looking up the encoded sf-sr in Table 1-33). If styp = 1, then NTM shall equal NES / (2 + sr). If styp=1 and NES is not a multiple of (2 + sr), then periodic streams cannot be defined according to the indicated script, the message shall be judged invalid, and the entire CTRL parameter shall be discarded without further processing.

A station that matches a destination IDaddress in a channel management parameter, or is contained in a defined region in a channel management parameter, shall not process subsequent channel management parameters with the same command set ID (csid)in the same CTRL. A station receiving a channel management parameter with a script that

matches an active command set shall update the script duration but otherwise not modify its transmissions.

On receipt of a channel management ~~CTRL-command~~parameter containing in the destination block a matching destination address, the The receiving station shall update its reservation table and carry out the actions as specified in Table 3-33. The mth individual offset ido_m shall correspond to the mth destination address matching that of the receiving station.

Note.- The station is only required to update its reservation table with the reservations that require transmission by the station. Slot selections by other stations commanded in directed-rate mode are unknown at the time the command is processed. Reservations for other stations commanded in directed-slot mode are known in principle, but are required to be located in blocked or quarantined slots according to 3.7.2.2.2. Hence there is no operational need to record these reservations at the time the command is processed.

Table 3-33. Action on receipt of a channel management ~~CTRL~~parameter

| Directed offset (do) | Directed timeout (dt) | Action |
|----------------------|-----------------------|---|
| 0 | any | See Section 3.7.2.3.1. |
| 1 | any | Invalid |
| $do > 1$ | $dt < 15$ | Reserve the following slots for the destination to broadcast: for j equal to 0 to 3 and k equal to 0 to $NTM - 1$, the slots equal to truncate ($do + ido_m + (k * M1/NTM) + j * M1$) through ($lg + truncate (do + ido_m + (k * M1/NTM) + j * M1)$) after the first slot of the received burst |
| $do > 1$ | $dt = 15$ | Reserve the following slots for the destination to broadcast: for k equal to 0 to $NTM - 1$, the slots equal to truncate ($do + ido_m + (k * M1/NTM)$) through ($lg + truncate (do + (k * M1/NTM))$) after the first slot of the received burst |

Upon receipt of a burst containing an autotune reservation ($pr_flag = 0$), the station shall update its reservation table and carry out the actions as specified in Table 1-39.

3.7.2.3.1 ~~Response to~~ Action on receipt of a channel management CTRL parameter with do = 0

On receipt of an CTRL command with the mth destination address matching that of the receiving station and with the directed offset subfield (do) ~~If the directed offset subfield is~~ equal to 0, the ~~responder-receiving~~ station shall operate autonomously using the periodic broadcast procedures with the nominal periodic rate (V11) set to NTM ~~in the autotune reservation transmission~~ for the next $dt * M1$ slots, with the a/d bit set equal to 0. The nominal slots shall be spaced such that the nominal slot for the kth element identified in the script occurs

$$\text{truncate } ((k-1)*M1/NTM) \text{ slots}$$

after the nominal slot for the first element identified in the script. The first transmission made in accordance with the received channel management CTRL-parameter command shall occur within 4500 slots of the start of the received command.

~~3.7.2.2.23.7.2.3.2~~ 3.7.2.3.2 ~~Response to~~ Action on receipt of a channel management CTRL-parameter with do > 1

On receipt of an CTRL command with the mth destination address matching that of the receiving station and with the directed offset subfield (do) greater than 1, the responder station shall begin the transmission of the first script element at $T0_m$ slots after the first slot of the CTRL command where $T0_m = do + ido_m$. Subsequent transmission slots shall be spaced such that the slot for the kth element identified in the script occurs

$$\text{truncate } ((k-1)*M1/NTM) \text{ slots}$$

after the specified slot for the first element identified in the script. The a/d bit shall be set equal to 1.

~~3.7.2.2.33.7.2.3.3~~ 3.7.2.3.3 Setting of TV11 timer

Upon receipt of a channel management CTRL command the station shall set the TV11 timer (see Section 1.3.10.2.1) equal to the value of the directed timeout (dt) subfield for each of the slots indicated in the CTRL transmission. The responder station shall transmit in each of the reserved slots. Each response burst shall contain the periodic broadcast reservation field with the periodic offset (po) subfield set to 0 and the periodic timeout (pt) subfield set to $\min(3, TV11-1)$. After each transmission, the timer TV11 shall be decremented. When TV11 reaches zero, the responder shall not transmit a further response to the ~~directed-request channel management~~ CTRL-parameter. Upon cessation of directed transmissions, the responder shall resume default autonomous behaviour on the GSCs, reserving new slots as required.

~~3.7.2.2.43.7.2.3.4~~ 3.7.2.3.4 Sharing streams

If styp = 1, then the transmissions in successive minutes shall share streams with those script elements that are NTM (modulo NES) apart. If all of the elements that share a

stream are not transmitted on the same frequency, then the message shall be judged invalid and the entire CTRL-channel management parameter shall be discarded. If all of the elements that share a stream are not of the same length, then a basic sync burst shall be transmitted for all elements in that stream.

If a station receives a plea request, it shall use NTM as the default reporting rate for the frequency to construct the plea response.

3.7.2.4 Cancellation of channel management CTRL-parameter command

A station shall cancel a channel management CTRL-parameter command with known csid by transmitting a channel management CTRL-parameter with the directed timeout subfield set to 15, the directed offset (do) set to the offset from the first slot of the cancellation CTRL-channel management parameter to the first slot for which the reservation shall be cancelled, and all other subfields set to the same values as in the original channel management CTRL-parameter command to be cancelled.

A station shall cancel the set of all channel management CTRL-parameter commands for a station or set of stations by transmitting a channel management CTRL-parameter with csid = 15.

A receiving station that is commanded to cancel all reservations for sync burst transmission shall revert to default sync burst operations.

3.7.2.5 Cancellation of autonomous streams

If the responder was transmitting autonomously the VSS user data for which a channel management CTRL-parameter command was received, then it shall cancel its existing reservations in accordance with paragraph 1.3.10.5.9, and operate in accordance with the parameters of the CTRL-channel management parameter command.

3.7.2.5.1 Command set ID parameter

A station that receives a channel management-CTRL parameter with csid = 0 shall terminate any previous default sync burst operations and initiate operations in accordance with the current CTRL-channel management parameter.

A station that receives a channel management-CTRL parameter with csid matching a previously-received channel management-CTRL parameter shall terminate any previous operations commanded by the previous CTRL-channel management parameter and initiate operations in accordance with the current CTRL-channel management parameter.

A station that does not receive a new CTRL-channel management parameter block with csid = 0 within (dt * M1) slots, with dt as specified in the CTRL-channel management parameter block with csid = 0, shall revert to default sync burst operations.

A station that receives a new CTRL-channel management parameter block with csid = 15 shall cancel all reservations for transmission associated with the previously-received channel management-CTRL commands and revert to default sync burst operations.

A station that does not receive a new CTRL-channel management parameter block with csid > 0 within (dt * M1) slots, with dt as specified in the CTRL-channel management parameter block with csid > 0, shall terminate the operations indicated in the associated CTRL-channel management parameter block.

3.7.2.6 Transmission block encoding

3.7.2.6.1 Transmission-Pre-defined transmission block definitions in SARP

The ~~SARPs contain the~~ following ordered list of standard-pre-defined transmission blocks ~~(id = 0 through 15) which can~~ shall be referenced by the transmission definition index (txd) subfield (see table 3-43) in the script block when the non-standard definition (nsd) subfield (see table 3-43) is equal to 0~~id without explicitly describing the referenced formats in the uplink CTRL~~. If a station receives ~~an XID~~ a CTRL-channel management parameter containing a ~~standard~~-transmission definition index (id = 0 through 15)(txd) that it does not recognize, it shall transmit a basic sync burst.

Table 3-34. Pre-defined Transmission-transmission block definitions in SARPencoding

| Encoding for txd | Transmission definition |
|------------------|---|
| 0 | Sync burst with baro altitude, no sleep parameters, basic variable field, baro alt rate |
| 1 | Sync burst with geo altitude, no sleep parameters, basic variable field, geo alt rate |
| 2 | Sync burst with baro altitude, no sleep parameters, full position variable field, baro alt rate |
| 3 | Sync burst with baro altitude, no sleep parameters, aircraft data variable field |
| 4 – 15 | Reserved |

~~3.7.2.2.23.7.2.6.2~~ User-defined Transmission-transmission block definitions not predefined in SARP

~~The CTRL can contain explicit definitions of transmission blocks (i.e., if a desired transmission block is not predefined in Table 3-34).~~ Zero to fifteen such user-defined transmission blocks ~~can~~ shall be defined in the transmission block definition section (as indicated by the tc field (see table 3-27)). User-defined transmission blocks ~~and~~ shall be encoded as defined in Tables 3-35 and 3-37.

Table 3-35. ~~Syne burst~~User-defined synchronization burst transmission block bit encoding

| Description | Octet | Bit number | | | | | | | |
|----------------------------|-------|------------------|------------------|------------------|------------------|------------------|------------------------------------|-----------------------|------------------|
| | | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Boolean ID (id) | 1 | id ₄ | id ₃ | id ₂ | id ₁ | aux ₂ | b/g aux ₁ | Res b/g | 0 |
| ID-extension (if required) | 2 | id1 ₄ | id1 ₃ | id1 ₂ | id1 ₁ | id2 ₄ | id2 ₃ | id2 ₂ | id2 ₁ |

Table 3-36. ~~Syne burst~~User-defined synchronization burst transmission block field encoding

| Subfield | Encoding | Notes |
|------------------------------------|---|---|
| baro/geo selection (b/g) | b/g = 0: send baro b/g = 1: send geo | If the preferred altitude encoding is not available, then send the other if it is available. |
| variable field ID (and extensions) | Per Table 3-2 | Octet 2 is only included when necessary |
| Auxiliary selection (aux) | For those variable fields with a selection (e.g, basic, high dynamic, TCP), send selection = aux. | If the requested data is not available, but the alternate is, then send the alternate. As an example, for the basic variable field, aux=0 means send baro rate. |

If the mobile is travelling greater than 3069 knots (i.e., bit $gs_{12}=1$), then the mobile shall transmit a high dynamic variable field whenever it otherwise would have transmitted a basic, full position, or high resolution variable field.

Table 3-37. Non-sync burst transmission block bit encoding

| Description | Octet | Bit number | | | | | | | |
|---|-------|----------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| | | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| message ID (mid), more bit (mb) | 1 | mid₈ mb | mid ₇ | mid ₆ | mid ₅ | mid ₄ | mid ₃ | mid ₂ | mid ₁ |
| length (len), application specific (app) | 2 | app | app | app | app | len ₄ | len ₃ | len ₂ | len ₁ |

Note.— Octets 3 through len+2 are all application specific.

Table 3-38. Non-sync burst transmission block field encoding

| Subfield | Encoding | Notes |
|---------------------------------|--|--|
| Application specific data (app) | | Defined by the application specified by the message ID |
| Length (len) | 0-15 | Number of <u>bytes-octets</u> following the length (i.e., an application requiring only 4 bits of parameters would encode a 0 for length) |
| message ID (mid) | Per Table 1-6a | <u>Note that mid₁ equals 1 for all message types except the synchronisation burst – hence this bit distinguishes the format of table 3-35 from that of table 3-37</u> |
| <u>more-bit (mb)</u> | <u>mb = 0: octet 2 not included</u> <u>mb = 1: octet 2 (and possibly more follow)</u> | |

Whenever the mobile cannot transmit the requested information (either a new message ID, variable field, or other option was defined that the mobile does not understand or the mobile does not have the requested information), then the mobile shall transmit a sync burst with a basic variable field.

3.7.2.7 Frequency block encoding

Zero to seven frequencies are included in the frequency block section (as indicated by the fc field). A single frequency shall be encoded as defined in Table 3-39 with subfield encodings as defined in Table 3-40:

Table 3-39. Frequency block bit encoding

| Description | Octet | Bit number | | | | | | | |
|-------------|-------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|----------------|
| | | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| flags | 1 | sleep | auto | rcv | res | f ₁₂ | f ₁₁ | f ₁₀ | f ₉ |
| freq | 2 | f ₈ | f ₇ | f ₆ | f ₅ | f ₄ | f ₃ | f ₂ | f ₁ |

Table 3-40. Frequency block field encoding

| Subfield | Encoding | Notes |
|--------------------|---|--|
| Frequency (f) | Per Section 1.3.15.1 <u>Table 1-30</u> | |
| must receive (rcv) | rcv = 0: reception on this the <u>specified</u> frequency is optional rcv = 1: reception on this the <u>specified</u> frequency is mandatory | As the list is ordered in priority, a station receiving a list with a frequency with rcv=0 before a frequency with rcv=1 shall discard the entire CTRL <u>channel management</u> parameter. |
| Sleep and auto | Per section 3.4.3 | If the respective bit is set, then the respective block is appended per Section 3.4.3 |

The list of frequencies is ordered. A station with k available receivers shall monitor the first min(k, number of mandatory frequencies) frequencies in the frequency list.

3.7.2.7.1 Recommendation

A station with spare receivers should monitor the remaining frequencies in the list.

3.7.2.8 ~~Transmission-parameter~~Parameter block definition

The transmitting station shall transmit all of the streams defined in the script using the parameters defined in Table 3-41 with subfield encodings as defined in Section 1 for the appropriate variable. The receiving station shall use the first ~~transmit-parameter-count~~(pc) octets from Table 3-41 instead of the default values for those parameters. If pc is greater than the length of Table 3-41, then the receiving station shall ignore all octets beyond the length. These parameters shall be ignored for directed slot operations.

Note.— pc would be greater than the length of Table 3-41 if more parameters were added after the software was released.

Table 3-41. ~~Transmission-parameter-Parameter~~ block bit encoding

| Description | Octet | Bit number | | | | | | | |
|-------------------|------------------------|---------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| | | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Q1, Q4 | 1 | Q1₂ | Q1₁ | res | Q4₅ | Q4₄ | Q4₃ | Q4₂ | Q4₁ |
| Q2a | 2 <u>1</u> | Q2a ₈ | Q2a ₇ | Q2a ₆ | Q2a ₅ | Q2a ₄ | Q2a ₃ | Q2a ₂ | Q2a ₁ |
| | 3 <u>2</u> | Q2a ₁₂ | Q2a ₁₁ | Q2a ₁₀ | Q2a ₉ | Q2b ₁₂ | Q2b ₁₁ | Q2b ₁₀ | Q2b ₉ |
| Q2b | 4 <u>3</u> | Q2b ₈ | Q2b ₇ | Q2b ₆ | Q2b ₅ | Q2b ₄ | Q2b ₃ | Q2b ₂ | Q2b ₁ |
| Q2c | 5 <u>4</u> | Q2c ₈ | Q2c ₇ | Q2c ₆ | Q2c ₅ | Q2c ₄ | Q2c ₃ | Q2c ₂ | Q2c ₁ |
| | 6 <u>5</u> | Q2c ₁₂ | Q2c ₁₁ | Q2c ₁₀ | Q2c ₉ | Q2d ₁₂ | Q2d ₁₁ | Q2d ₁₀ | Q2d ₉ |
| Q2d | 7 <u>6</u> | Q2d ₈ | Q2d ₇ | Q2d ₆ | Q2d ₅ | Q2d ₄ | Q2d ₃ | Q2d ₂ | Q2d ₁ |
| Q1, Q4 | 7 | Q1₃ | Q1₂ | Q1₁ | Q4₅ | Q4₄ | Q4₃ | Q4₂ | Q4₁ |
| V12 | 8 | Q1₄ | V12₇ | V12₆ | V12₅ | V12₄ | V12₃ | V12₂ | V12₁ |
| TV11min, TV11max | 8 <u>9</u> | TV11min ₄ | TV11min ₃ | TV11min ₂ | TV11min ₁ | TV11max ₄ | TV11max ₃ | TV11max ₂ | TV11max ₁ |
| V11 | 9 <u>10</u> | res | res | V11 ₆ | V11 ₅ | V11 ₄ | V11 ₃ | V11 ₂ | V11 ₁ |
| V12 | 10 | res | V12₇ | V12₆ | V12₅ | V12₄ | V12₃ | V12₂ | V12₁ |
| VS2 <u>(nmi)</u> | 11 | res | res | VS2 ₆ | VS2 ₅ | VS2 ₄ | VS2 ₃ | VS2 ₂ | VS2 ₁ |
| VS4 | 12 | res | VS4 ₇ | VS4 ₆ | VS4 ₅ | VS4 ₄ | VS4 ₃ | VS4 ₂ | VS4 ₁ |

3.7.2.9 Script block definition

The channel management-~~CTRL~~ parameter script shall be encoded as defined in Table 3-42 with subfield encodings as defined in Table 3-43.

The script block shall contain one or more script elements. ~~There are~~ two types of script elements shall be as defined in Table 3-42. A transmitting station shall not transmit a script block with two consecutive octets having bits 6-8 equal to “111”. A receiving station shall discard a channel management-~~CTRL command parameter~~ containing a script block with two consecutive octets having bits 6-8 equal to “111”.

Table 3-42. Script block bit encoding

| Description | Octet | Bit number | | | | | | | |
|---|-------|-------------------|-------------------|-------------------|------------------|------------------|------------------|------------------|------------------|
| | | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| freq index (freq), transmission definition index (txd) | 1 | freq ₃ | freq ₂ | freq ₁ | nsd | txd ₄ | txd ₃ | txd ₂ | txd ₁ |
| | | | | | or | | | | |
| repeat count (rpt) | 1 | 1 | 1 | 1 | rpt ₅ | rpt ₄ | rpt ₃ | rpt ₂ | rpt ₁ |
| freq index (freq), non- standard definition (nsd), transmission definition index (txd) | 2 | freq ₃ | freq ₂ | freq ₁ | nsd | txd ₄ | txd ₃ | txd ₂ | txd ₁ |

Table 3-43. Script block field encoding

| Subfield | Encoding | Notes |
|-------------------------------------|---|---|
| frequency index (freq) | 0-6 : integer index into freq block 7 : repeat flag (second octet with freq index follows) | The offset from the beginning of the frequency list. (An encoding of 0 refers to the first element in the frequency block.) |
| non-standard definition (nsd) | nsd = 0: txd encoded as defined in SARPs per Table 3-34. nsd = 1: defined in CTRL txd indicates offset from beginning of transmission definition list (see Section 3.7.2.6.2) | |
| transmission definition index (txd) | 0-15 | The offset from the beginning of the transmission definition list (An encoding of 0 refers to the first element in the list.) |
| repeat count (rpt) | 3 (encoded as 0) to 34 | The number of times to repeat the frequency and (nsd, txd) listed in octet 2. |