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**Specification of the radio broadcast data
system (RBDS)**

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FOREWORD

This standard was produced by the Radio Broadcast Data System (RBDS) Subcommittee of the National Radio Systems Committee (NRSC). It reflects input from broadcasters, receiver manufacturers, users and potential users of radio data system services. This standard is compatible with the international RDS standard IEC/CENELEC 62106 of which the technical specifications were initially developed within the European Broadcasting Union (EBU).

This standard includes all of the specifications of the IEC/CENELEC 62106 plus some additional features for the United States. The additional features include a placeholder for AM-band RDS information (Section 6), a specification for an in-receiver database system (Section 7 and Annex R), PI codes for North America (Annex D), PTY codes for North America (Annex F), a specification for MMBS radio paging (Annex P), a specification for an open data application for the US Emergency Alert System (Annex Q), and a specification for an Open Data Application for sending Program Associated Data (Annex U).

This Standard is a voluntary standard. Because its success is largely dependent on the radio listener's ability to use the same radio data system receiver in the same manner in any location, it is hoped that broadcasters and equipment manufacturers will comply with the spirit and the letter of this Standard.

The RBDS Subcommittee of the NRSC will consider removing Annexes P and R from NRSC-4-A during the next review of the standard unless there is evidence during that time that they are being used.

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0 Scope

The Radio Data System, RDS, is intended for application to VHF/FM sound broadcasts in the range 87.5 MHz to 108.0 MHz which may carry either stereophonic (pilot-tone system) or monophonic programs. The main objectives of RDS are to enable improved functionality for FM receivers and to make them more user-friendly by using features such as Program Identification, Program Service name display and where applicable, automatic tuning for portable and car radios, in particular. The relevant basic tuning and switching information shall therefore be implemented by the type 0 group (see 3.1.5.1), and it is not optional unlike many of the other possible features in RDS. A secondary objective of RDS, when implemented in conjunction with IBOC digital radio systems utilizing digital/analog blend is to provide for maximum commonality and harmonization among the program associated data (PAD) streams of the digital IBOC signal and PAD transported through an RDS subcarrier carried on the analog portion of the IBOC signal. This objective is addressed in Annex U.

1 Modulation characteristics of the data channel (physical layer)

The Radio Data System is intended for application to VHF/FM sound broadcasting transmitters in the range 87.5 to 108.0 MHz, which carry stereophonic (pilot-tone system) or monophonic sound broadcasts (see ITU-R Recommendation 450-2).

It is important that radio-data receivers are not affected by signals in the multiplex spectrum outside the data channel.

The system can be used simultaneously with the ARI system (see annex H), even when both systems are broadcast from the same transmitter. However, certain constraints on the phase and injection levels of the radio-data and ARI signals must be observed in this case (see 1.2 and 1.3).

The data signals are carried on a subcarrier which is added to the stereo multiplex signal (or monophonic signal as appropriate) at the input to the VHF/FM transmitter. Block diagrams of the data source equipment at the transmitter and a typical receiver arrangement are shown in figures 1 and 2, respectively.

1.1 Subcarrier frequency

During stereo broadcasts the subcarrier frequency will be locked to the third harmonic of the 19-kHz pilot-tone. Since the tolerance on the frequency of the 19-kHz pilot-tone is ± 2 Hz (see ITU-R Recommendation 450-2), the tolerance on the frequency of the subcarrier during stereo broadcasts is ± 6 Hz.

During monophonic broadcasts the frequency of the subcarrier will be $57 \text{ kHz} \pm 6 \text{ Hz}$.

1.2 Subcarrier phase

During stereo broadcasts the subcarrier will be locked either in phase or in quadrature to the third harmonic of the 19 kHz pilot-tone. The tolerance on this phase angle is $\pm 10^\circ$, measured at the modulation input to the FM transmitter.

In the case when ARI and radio-data signals are transmitted simultaneously, the phase angle between the two subcarriers shall be $90^\circ \pm 10^\circ$.

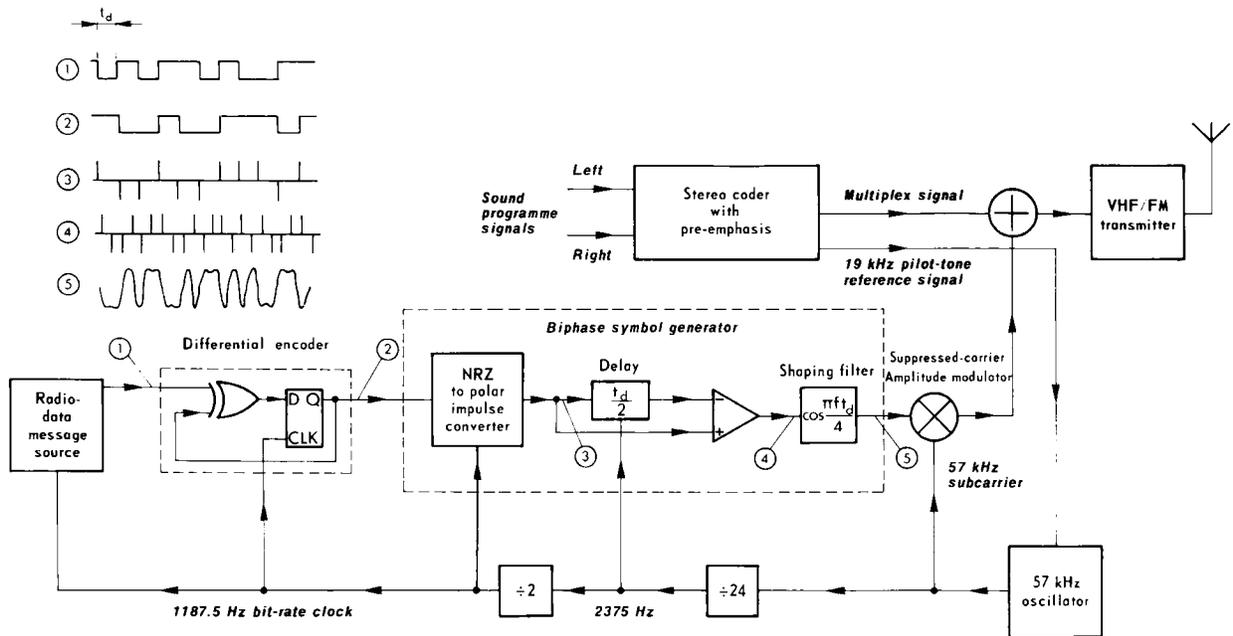


Figure 1: Block diagram of radio-data equipment at the transmitter

* The overall data-shaping in this decoder comprises the filter F_1 and the data-shaping inherent in the biphase symbol decoder. The amplitude/frequency characteristic of filter F_1 is, therefore, not the same as that given in figure 3.

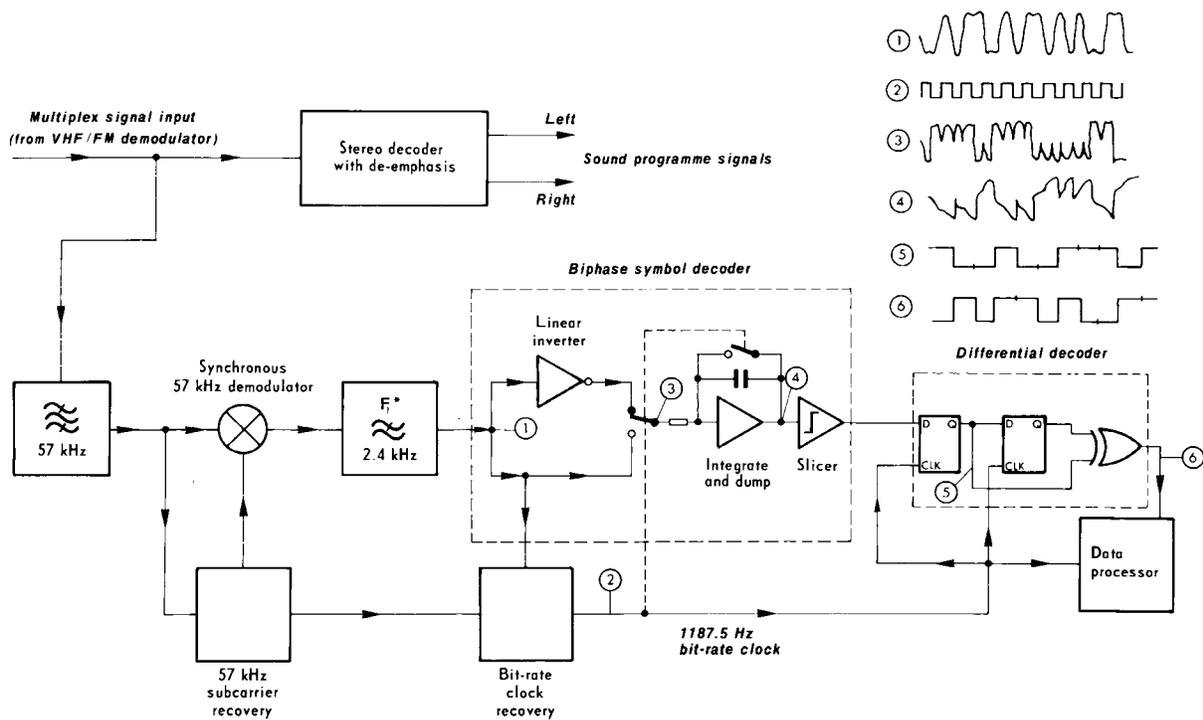


Figure 2: Block diagram of a typical radio-data receiver/decoder

1.3 Subcarrier level

The deviation range of the FM carrier due to the unmodulated subcarrier is from ± 1.0 kHz to ± 7.5 kHz. The recommended best compromise is ± 2.0 kHz². The decoder/demodulator should also operate properly when the deviation of the subcarrier is varied within these limits during periods not less than 10 ms.

In the case when ARI (see annex H) and radio-data signals are transmitted simultaneously, the recommended maximum deviation due to the radio-data subcarrier is ± 1.2 kHz and that due to the unmodulated ARI subcarrier should be reduced to ± 3.5 kHz.

The maximum permitted deviation due to the composite multiplex signal is ± 75 kHz.

1.4 Method of modulation

The subcarrier is amplitude-modulated by the shaped and biphase coded data signal (see 1.7). The subcarrier is suppressed. This method of modulation may alternatively be thought of as a form of two-phase phase-shift-keying (psk) with a phase deviation of $\pm 90^\circ$.

1.5 Clock-frequency and data-rate

The basic clock frequency is obtained by dividing the transmitted subcarrier frequency by 48. Consequently, the basic data-rate of the system (see figure 1) is 1187.5 bit/s ± 0.125 bit/s.

1.6 Differential coding

The source data at the transmitter are differentially encoded according to the following rules:

Table 1: Encoding rules

Previous output (at time t_{i-1})	New input (at time t_i)	New output (at time t_i)
0	0	0
0	1	1
1	0	1
1	1	0

where t_i is some arbitrary time and t_{i-1} is the time one message-data clock-period earlier, and where the message-data clock-rate is equal to 1187.5 Hz.

²

With this level of subcarrier, the level of each sideband of the subcarrier corresponds to half the nominal peak deviation level of ± 2.0 kHz for an "all-zeroes" message data stream (i.e. a continuous bit-rate sine-wave after biphase encoding).

Thus, when the input-data level is 0, the output remains unchanged from the previous output bit and when an input 1 occurs, the new output bit is the complement of the previous output bit.

In the receiver, the data may be decoded by the inverse process:

Table 2: Decoding rules

Previous input (at time t_{i-1})	New input (at time t_i)	New output (at time t_i)
0	0	0
0	1	1
1	0	1
1	1	0

The data is thus correctly decoded whether or not the demodulated data signal is inverted.

1.7 Data-channel spectrum shaping

The power of the data signal at and close to the 57 kHz subcarrier is minimized by coding each source data bit as a biphasis symbol.

This is done to avoid data-modulated cross-talk in phase-locked-loop stereo decoders, and to achieve compatibility with the ARI system. The principle of the process of generation of the shaped biphasis symbols is shown schematically in figure 1. In concept each source bit gives rise to an odd impulse-pair, $e(t)$, such that a logic 1 at source gives:

$$e(t) = -\delta(t) + \delta(t - t_d / 2)$$

and a logic 0 at source gives:

$$e(t) = \delta(t) - \delta(t - t_d / 2)$$

These impulse-pairs are then shaped by a filter $H_T(f)$, to give the required band-limited spectrum where:

$$H_T(f) = \begin{cases} \cos \frac{\pi f t_d}{4} & \text{if } 0 \leq f \leq 2/t_d \\ 0 & \text{if } f > 2/t_d \end{cases}$$

and here:

$$t_d = \frac{1}{1187.5} \text{ s}$$

The data-spectrum shaping filtering has been split equally between the transmitter and receiver (to give optimum performance in the presence of random noise) so that, ideally, the data filtering at the receiver should be identical to that of the transmitter, i.e. as given above in equation (3). The overall data-channel spectrum shaping $H_o(f)$ would then be 100% cosine roll-off.

The specified transmitter and receiver low-pass filter responses, as defined in equation (3) are illustrated in figure 3, and the overall data-channel spectrum shaping is shown in figure 4.

The spectrum of the transmitted biphas-coded radio-data signal is shown in figure 5 and the time-function of a single biphas symbol (as transmitted) in figure 6.

The 57 kHz radio-data signal waveform at the output of the radio-data source equipment may be seen in the photograph of figure 7.

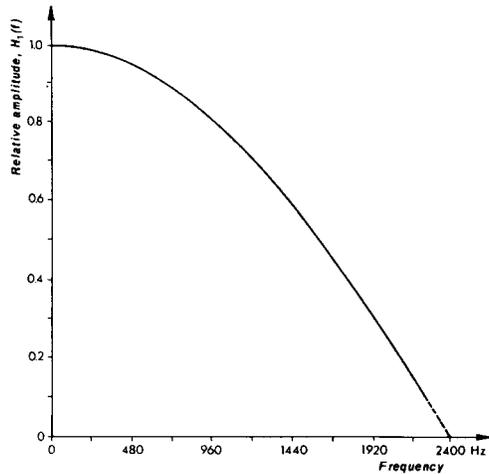


Figure 3: Amplitude response of the specified transmitter or receiver data-shaping filter

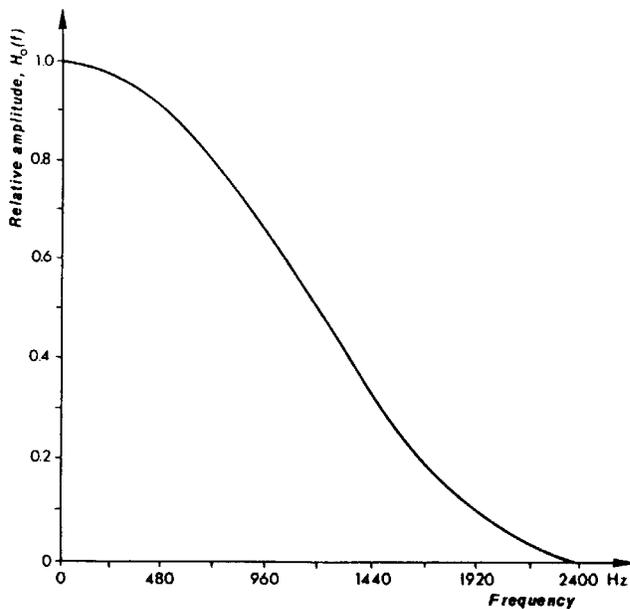


Figure 4: Amplitude response of the combined transmitter and receiver data-shaping filters

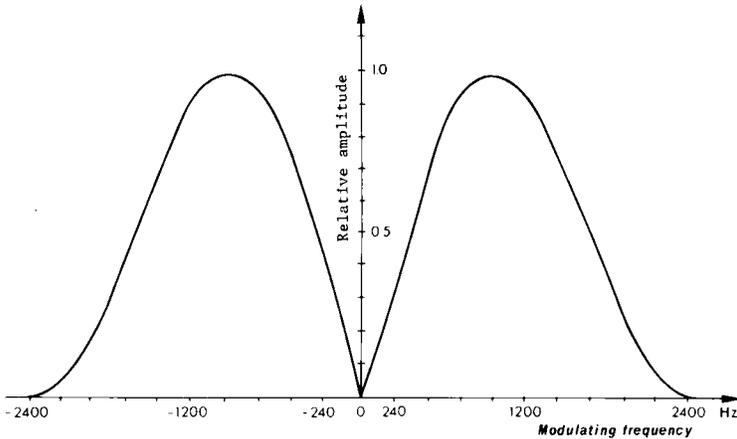
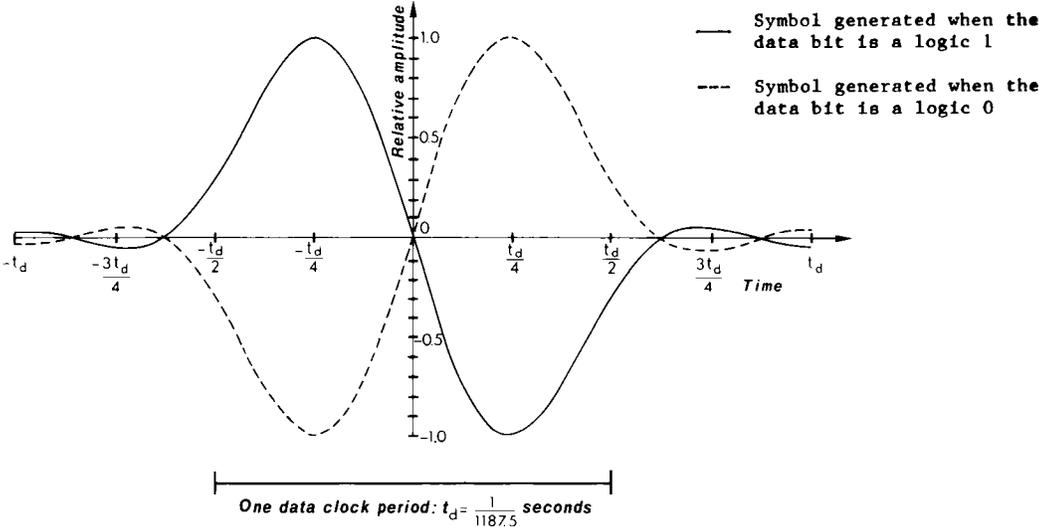


Figure 5: Spectrum of biphase coded radio-data signals



Figure

Time-function of a single biphase symbol

6:

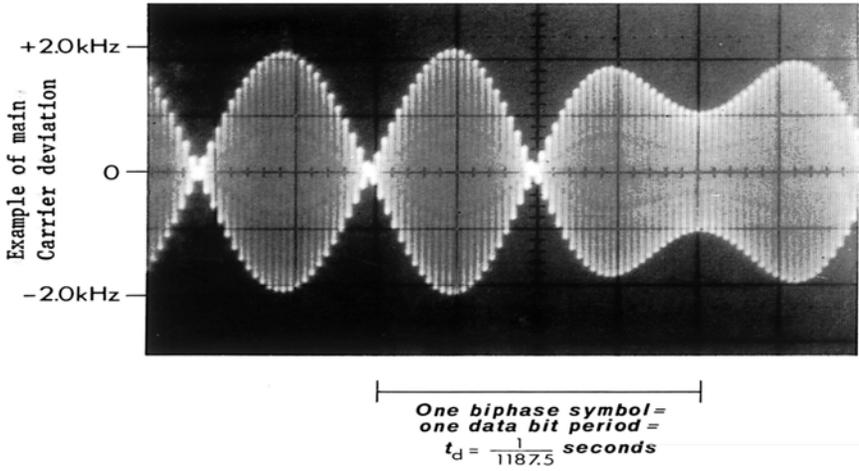


Figure 7: 57 kHz radio-data signals

2 Baseband coding (data-link layer)

2.1 Baseband coding structure

Figure 8 shows the structure of the baseband coding. The largest element in the structure is called a "group" of 104 bits each. Each group comprises 4 blocks of 26 bits each. Each block comprises an information word and a checkword. Each information word comprises 16 bits. Each checkword comprises 10 bits (see 2.3).

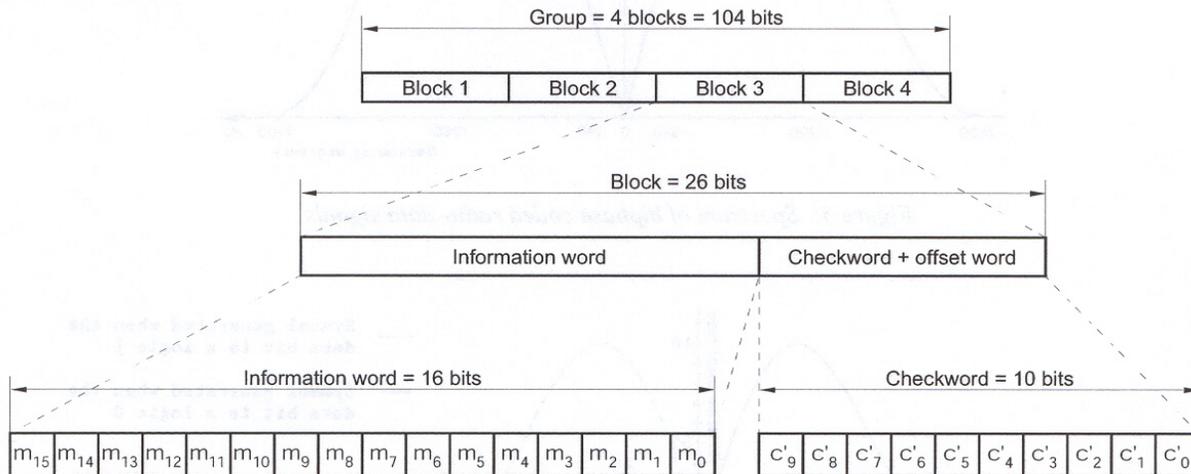


Figure 8: Structure of the baseband coding

For obtaining RDS information from an RDS/MMBS multiplex signal please reference annex P.

2.2 Order of bit transmission

All information words, checkwords, binary numbers or binary address values have their most significant bit (m.s.b.) transmitted first (see figure 9). Thus the last bit transmitted in a binary number or address has weight 2^0 .

The data transmission is fully synchronous and there are no gaps between the groups or blocks.

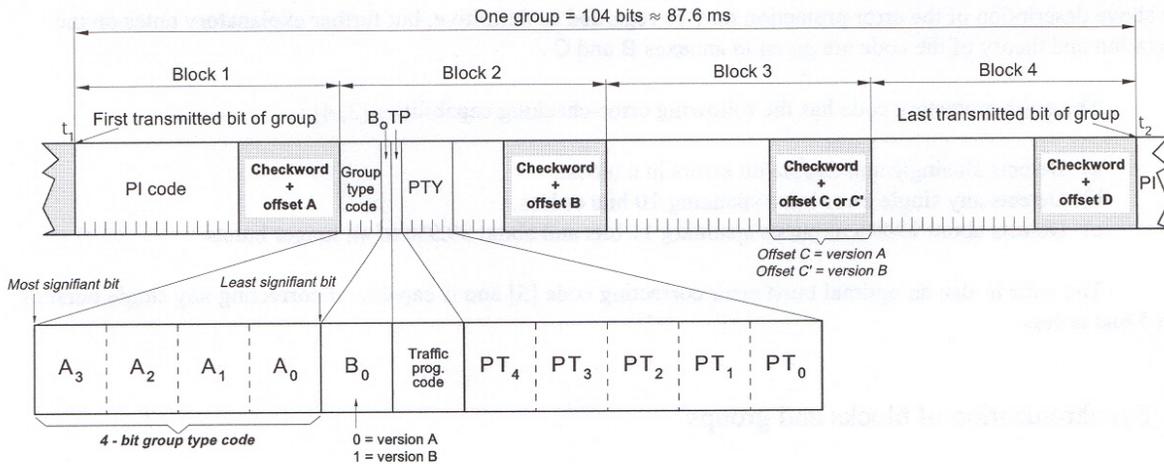


Figure 9: Message format and addressing

Notes to figure 9:

1. Group type code = 4 bits (see 3.1)
2. B_0 = version code = 1 bit (see 3.1)
3. PI code = Program Identification code = 16 bits (see 3.2.1.1 and annex D)
4. TP = Traffic Program Identification code = 1 bit (see 3.2.1.3)
5. PTY = Program Type code = 5 bits (see 3.2.1.2 and annex F)
6. Checkword + offset "N" = 10 bits added to provide error protection and block and group synchronization information (see 2.3 and 2.4 and annexes A, B and C)
7. $t_1 < t_2$: Block 1 of any particular group is transmitted first and block 4 last

2.3 Error protection

Each transmitted 26-bit block contains a 10-bit checkword which is primarily intended to enable the receiver/decoder to detect and correct errors which occur in transmission. This checkword (i.e. c'_9, c'_8, \dots, c'_0 in figure 8) is the sum (modulo 2) of:

- a) the remainder after multiplication by x^{10} and then division (modulo 2) by the generator polynomial $g(x)$, of the 16-bit information word,
- b) a 10-bit binary string $d(x)$, called the "offset word",

where the generator polynomial, $g(x)$ is given by:

$$g(x) = x^{10} + x^8 + x^7 + x^5 + x^4 + x^3 + 1$$

and where the offset values, $d(x)$, which are different for each block within a group (see 2.4) are given in annex A.

The purpose of adding the offset word is to provide a group and block synchronization system in the receiver/decoder (see 2.4). Because the addition of the offset is reversible in the decoder the normal additive error-correcting and detecting properties of the basic code are unaffected.

The checkword thus generated is transmitted m.s.b. (i.e. the coefficient of c'_9 in the checkword) first and is transmitted at the end of the block which it protects.

The above description of the error protection may be regarded as definitive, but further explanatory notes on the generation and theory of the code are given in annexes B and C .

The error-protecting code has the following error-checking capabilities [3, 4] :

- a) Detects all single and double bit errors in a block.
- b) Detects any single error burst spanning 10 bits or less.
- c) Detects about 99.8% of bursts spanning 11 bits and about 99.9% of all longer bursts.

The code is also an optimal burst error correcting code [5] and is capable of correcting any single burst of span 5 bits or less.

2.4 Synchronization of blocks and groups

The blocks within each group are identified by the offset words A, B, C or C' and D added to blocks 1, 2, 3, and 4 respectively in each group (see annex A).

The beginnings and ends of the data blocks may be recognized in the receiver decoder by using the fact that the error-checking decoder will, with a high level of confidence, detect block synchronization slip as well as additive errors. This system of block synchronization is made reliable by the addition of the offset words (which also serve to identify the blocks within the group). These offset words destroy the cyclic property of the basic code so that in the modified code, cyclic shifts of codewords do not give rise to other codewords [6, 7].

Further explanation of a technique for extracting the block synchronization information at the receiver is given in annex C.

**For obtaining RDS information from an RDS/MMBS multiplex signal the E offset word must be recognized
Please reference annex P.**

3 Message format (session and presentation layers)

3.1 Addressing

3.1.1 Design principles

The basic design principles underlying the message format and addressing structure are as follows:

- a) The messages which are to be repeated most frequently, and for which a short acquisition time is required e.g. Program Identification (PI) codes, in general occupy the same fixed positions within every group. They can therefore be decoded without reference to any block outside the one which contains the information.
- b) There is no fixed rhythm of repetition of the various types of group, i.e. there is ample flexibility to interleave the various kinds of message to suit the needs of the users at any given time and to allow for future developments.
- c) This requires addressing to identify the information content of those blocks which are not dedicated to the high-repetition-rate information.
- d) Each group is, so far as possible, fully addressed to identify the information content of the various blocks.
- e) The mixture of different kinds of message within any one group is minimized, e.g. one group type is reserved for basic tuning information, another for radiotext, etc. This is important so that broadcasters who do not wish to transmit messages of certain kinds are not forced to waste channel capacity by transmitting groups with unused blocks. Instead, they are able to repeat more frequently those group types which contain the messages they want to transmit.
- f) To allow for future applications the data formatting has been made flexible. For example, a number of group types (see table 6) may be used for Open Data Applications (see 3.1.4 and 4.9).

3.1.2 Principal features

The main features of the message structure have been illustrated in figure 9. These may be seen to be:

- 1) The first block in every group always contains a Program Identification (PI) code.
- 2) The first four bits of the second block of every group are allocated to a four-bit code which specifies the application of the group. Groups will be referred to as types 0 to 15 according to the binary weighting $A_3=8$, $A_2=4$, $A_1=2$, $A_0=1$ (see figure 9). For each type (0 to 15) two "versions" can be defined. The "version" is specified by the fifth bit (B_0) of block 2 as follows:
 - a) $B_0=0$: the PI code is inserted in block 1 only. This will be called version A, e.g. 0A, 1A, etc.
 - b) $B_0=1$: the PI code is inserted in block 1 and block 3 of all group types. This will be called version B, e.g. 0B, 1B, etc.

In general, any mixture of type A and B groups may be transmitted.

- 3) The Program Type code (PTY) and Traffic Program identification (TP) occupy fixed locations in block 2 of every group.

The PI, PTY and TP codes can be decoded without reference to any block outside the one that contains the information. This is essential to minimize acquisition time for these kinds of message and to retain the advantages of the short (26-bit) block length. To permit this to be done for the PI codes in block 3 of version B groups, a special offset word (which we shall call C') is used in block 3 of version B groups. The occurrence of offset C' in block 3 of any group can then be used to indicate directly that block 3 is a PI code, without any reference to the value of B_0 in block 2.

3.1.3 Group types

It was described above (see also figure 9) that the first five bits of the second block of every group are allocated to a five-bit code which specifies the application of the group and its version, as shown in table 3.

The group sequencing for a multiplex of RDS/MMBS is given in annex P.4.

Table 3: Group types

Group type	Group type code/version					Flagged in type 1A groups	Description
	A ₃	A ₂	A ₁	A ₀	B ₀		
0 A	0	0	0	0	0		Basic tuning and switching information only (see 3.1.5.1)
0 B	0	0	0	0	1		Basic tuning and switching information only (see 3.1.5.1)
1 A	0	0	0	1	0		Program Item Number and slow labeling codes only (see 3.1.5.2)
1 B	0	0	0	1	1		Program Item Number (see 3.1.5.2)
2 A	0	0	1	0	0		RadioText only (see 3.1.5.3)
2 B	0	0	1	0	1		RadioText only (see 3.1.5.3)
3 A	0	0	1	1	0		Applications Identification for ODA only (see 3.1.5.5)
3 B	0	0	1	1	1		Open Data Applications
4 A	0	1	0	0	0		Clock-time and date only (see 3.1.5.6)
4 B	0	1	0	0	1		Open Data Applications
5 A	0	1	0	1	0		Transparent Data Channels (32 channels) or ODA (see 3.1.5.8)
5 B	0	1	0	1	1		Transparent Data Channels (32 channels) or ODA (see 3.1.5.8)
6 A	0	1	1	0	0		In House applications or ODA (see 3.1.5.9)
6 B	0	1	1	0	1		In House applications or ODA (see 3.1.5.9)
7 A	0	1	1	1	0	Y	Radio Paging or ODA (see 3.1.5.10 and annex M)
7 B	0	1	1	1	1		Open Data Applications
8 A	1	0	0	0	0	Y	Traffic Message Channel or ODA (see 3.1.5.12)
8 B	1	0	0	0	1		Open Data Applications
9 A	1	0	0	1	0	Y	Emergency Warning System or ODA (see 3.1.5.13)
9 B	1	0	0	1	1		Open Data Applications
10 A	1	0	1	0	0		Program Type Name
10 B	1	0	1	0	1		Open Data Applications
11 A	1	0	1	1	0		Open Data Applications
11 B	1	0	1	1	1		Open Data Applications
12 A	1	1	0	0	0		Open Data Applications
12 B	1	1	0	0	1		Open Data Applications
13 A	1	1	0	1	0	Y	Enhanced Radio Paging or ODA (see annex M)
13 B	1	1	0	1	1		Open Data Applications
14 A	1	1	1	0	0		Enhanced Other Networks information only (see 3.1.5.19)
14 B	1	1	1	0	1		Enhanced Other Networks information only (see 3.1.5.19)
15 A	1	1	1	1	0		Defined in RBDS only
15 B	1	1	1	1	1		Fast switching information only (see 3.1.5.20)

The appropriate repetition rates for some of the main features are indicated in table 4:

Table 4: Main feature repetition rates

Main Features	Group types which contain this information	Appropriate repetition rate per sec.
Program Identification (PI) code	all	11.4 ¹
Program Type (PTY) code	all	11.4 ¹
Traffic Program (TP) identification code	all	11.4 ¹
Program Service (PS) name ⁴	0A, 0B	1
Alternative frequency (AF) code pairs	0A	4
Traffic announcement (TA) code	0A, 0B, 14B, 15B	4
Decoder identification (DI) code	0A, 0B, 15B	1
Music/speech (M/S) code	0A, 0B, 15B	4
Radiotext (RT) message	2A, 2B	0.2 ²
Enhanced other networks information (EON)	14A	up to 2 ³

¹ Valid codes for this item will normally be transmitted with at least this repetition rate whenever the transmitter carries a normal broadcast program.
² A total of 16 type 2A groups are required to transmit a 64 character radiotext message and therefore to transmit this message in 5 seconds, 3.2 type 2A groups will be required per second.
³ The maximum cycle time for the transmission of all data relating to all cross-referenced program services shall be less than 2 minutes.
⁴ PS must only be used for identifying the program service and it must not be used for other messages giving sequential information.

A total of four type 0A groups are required to transmit the entire PS name and therefore four type 0A groups will be required per second. The repetition rate of the type 0A group may be reduced if more capacity is needed for other applications. But a minimum of two type 0A groups per second is necessary to ensure correct functioning of PS and AF features. However, with EON receivers search tuning is affected by the repetition rate of type 0 groups (TP/TA, see 3.2.1.3). It must be noted that in this case transmission of the complete PS will take 2 seconds. However, under typical reception conditions the introduction of errors will cause the receiver to take 4 seconds or more to acquire the PS name for display.

The following mixture of groups is suitable to meet the repetition rates noted above.

Table 5: Group repetition rates

Group types	Features	Typical proportion of groups of this type transmitted
0A or 0B	PI, PS, PTY, TP, AF ¹), TA, DI, M/S	40%
1A or 1B	PI, PTY, TP, PIN	10%
2A or 2B	PI, PTY, TP, RT	15% ²
14A or 14B	PI, PTY, TP, EON	10%
Any other	Other applications	25%

¹ Type 0A group only
² Assuming that type 2A groups are used to transmit a 32-character radiotext message. A mixture of type 2A and 2B groups in any given message should be avoided (see 3.1.5.3)

3.1.4 Open data channel / Applications Identification

3.1.4.1 Use of Open Data Applications

Open Data Applications (ODA) are not explicitly specified in this standard. They are subject to a registration process and registered applications are listed in the EBU/RDS Forum - ODA Directory (see annex L), which references appropriate standards and normative specifications. These specifications may however be public (specification in the public domain) or private (specification not in the public domain). The terms public and private do not imply the degree of access to services provided by an application, for example a public service may include encryption.

An ODA may use type A and/or type B groups, however it must not be designed to operate with a specific group type. The specific group type used by the ODA in any particular transmission is signaled in the Applications Identification (AID) carried in type 3A groups (see 3.1.5.4). Table 6 shows the type A and type B groups that may be allocated to ODA. Group types not shown in table 6 are not available for ODA.

Table 6: ODA group availability signaled in type 3A groups

Group type	Application group type code	Availability for Open Data Applications
	00000	Special meaning: Not carried in associated group
3B	00111	Available unconditionally
4B	01001	Available unconditionally
5A	01010	Available when not used for TDC
5B	01011	Available when not used for TDC
6A	01100	Available when not used for IH
6B	01101	Available when not used for IH
7A	01110	Available when not used for RP
7B	01111	Available unconditionally
8A	10000	Available when not used for TMC
8B	10001	Available unconditionally
9A	10010	Available when not used for EWS
9B	10011	Available unconditionally
10B	10101	Available unconditionally
11A	10110	Available unconditionally
11B	10111	Available unconditionally
12A	11000	Available unconditionally
12B	11001	Available unconditionally
13A	11010	Available when not used for RP
13B	11011	Available unconditionally
	11111	Special meaning: Temporary data fault (Encoder status)

3.1.4.2 Open Data Applications - Group structure

Open Data Applications must use the format shown in figure 10 for ODA type A groups and in figure 11 for ODA type B groups.

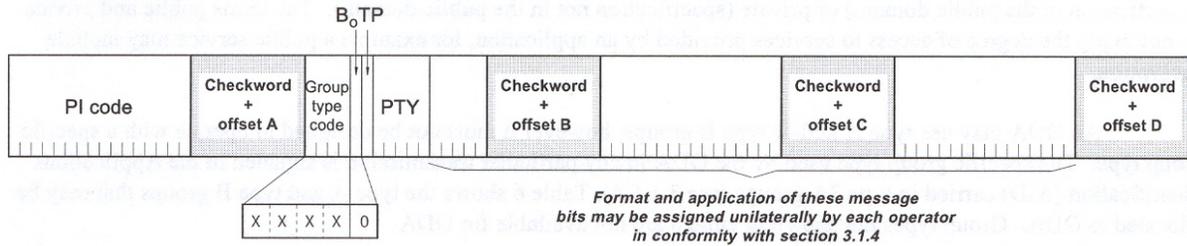


Figure 10: ODA type A groups

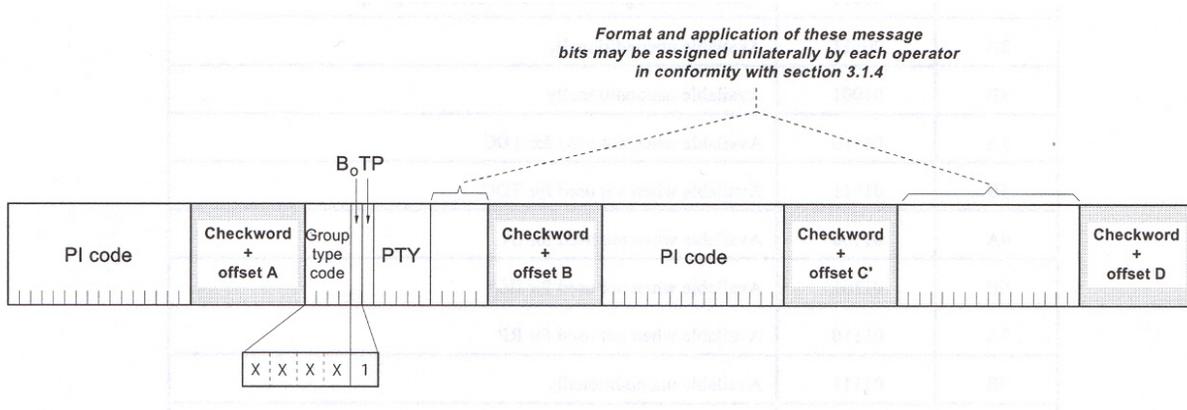


Figure 11: ODA type B groups

3.1.5 Coding of the Group types

3.1.5.1 Type 0 groups: Basic tuning and switching information

The repetition rates of type 0 groups must be chosen in compliance with 3.1.3.

Figure 12 shows the format of type 0A groups and figure 13 the format of type 0B groups.

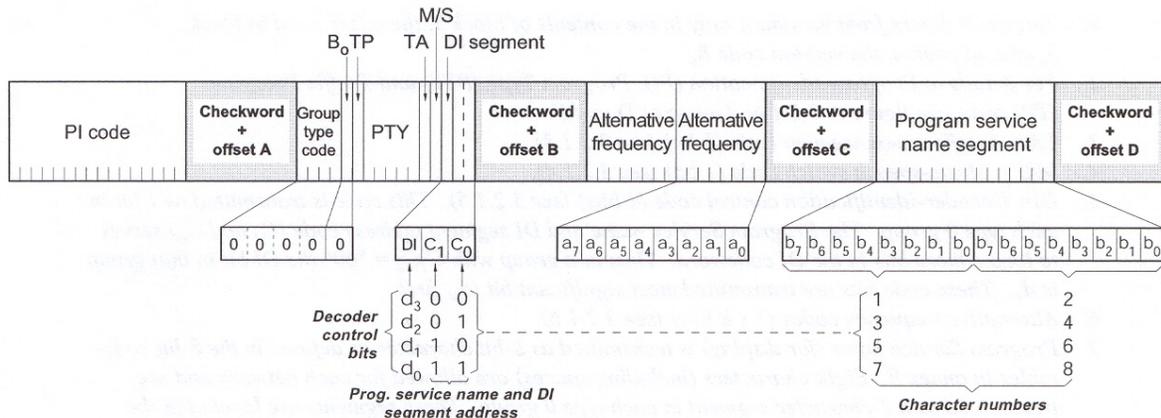


Figure 12: Basic tuning and switching information - Type 0A group

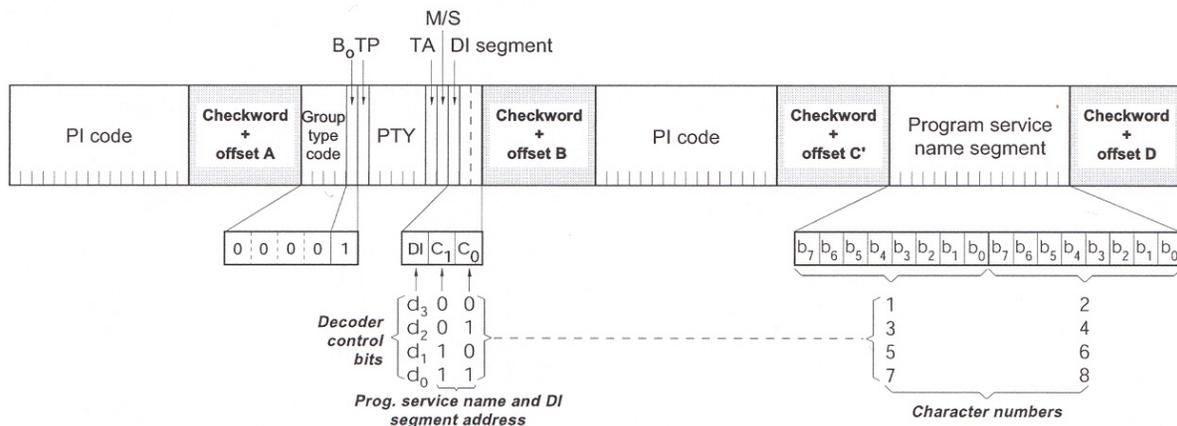


Figure 13: Basic tuning and switching information - Type 0B group

Type 0A groups are usually transmitted whenever alternative frequencies exist. Type 0B groups without any type 0A groups may be transmitted only when no alternative frequencies exist.

There are two methods (A and B) for transmission of alternative frequencies (see 3.2.1.6.2).

The Program Service name comprises eight characters. It is the primary aid to listeners in program service identification and selection. The Program Service name is to be used only to identify the station or station program. This text may be changed as required by the station, but shall not be scrolled or flashed or altered in a manner that would be disturbing or distracting to the viewer (i.e. not more frequently than once per minute).

Notes on Type 0 groups:

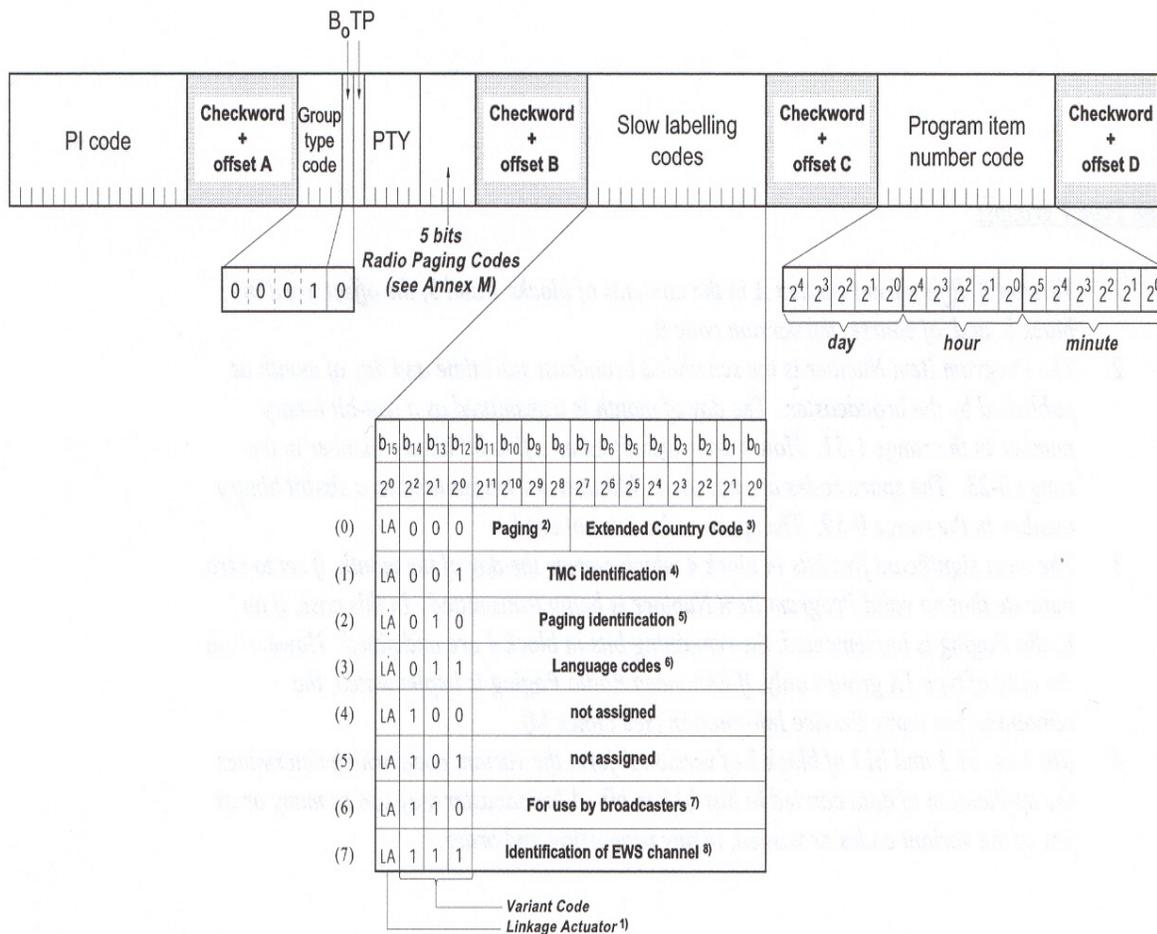
1. *Version B differs from version A only in the contents of block 3, the offset word in block 3, and, of course, the version code B_0*
2. *For details of Program Identification (PI), Program Type (PTY) and Traffic Program (TP) code, see figure 9, 3.2.1 and annexes D and F.*
3. *TA = Traffic announcement code (1 bit) (see 3.2.1.3).*
4. *M/S = Music-speech switch code (1 bit) (see 3.2.1.4).*
5. *DI= Decoder-identification control code (4 bits) (see 3.2.1.5). This code is transmitted as 1 bit in each type 0 group. The Program Service name and DI segment address code (C_1 and C_0) serves to locate these bits in the DI codeword. Thus in a group with $C_1C_0 = "00"$ the DI bit in that group is d_3 . These code bits are transmitted most significant bit (d_3) first.*
6. *Alternative frequency codes (2 x 8 bits) (see 3.2.1.6).*
7. *Program Service name (for display) is transmitted as 8-bit character as defined in the 8-bit code-tables in annex E. Eight characters (including spaces) are allowed for each network and are transmitted as a 2-character segment in each type 0 group. These segments are located in the displayed name by the code bits C_1 and C_0 in block 2. The addresses of the characters increase from left to right in the display. The most significant bit (b_7) of each character is transmitted first.*

3.1.5.2 Type 1 groups: Program Item Number and slow labeling codes

Figure 14 shows the format of type 1A groups and figure 15 the format of type 1B groups.

When a Program Item Number is changed, a type 1 group should be repeated four times with a separation of about 0.5 seconds. The unused bits in block 2 (type 1B only) are reserved for future applications.

Where Radio Paging is implemented in RDS, a type 1A group will be transmitted in an invariable sequence, regularly once per second, except at each full minute, where it is replaced by one type 4A group.



¹⁾ The Linkage Actuator is defined in the "Method for Linking RDS Program Services" (see 3.2.1.8.3).
²⁾ Normally set to zero except when used for the OPERator Code in Radio Paging with the Enhanced Paging Protocol, defined in annex M (see M.3.2.2 and M.3.2.4).
³⁾ Extended country codes are defined separately (see annex D).
⁴⁾ TMC system information is separately specified by the CEN standard ENV 12313-1 (see 3.1.5.12). This identification is not required if ODA is used for coding TMC.
⁵⁾ The Paging Identification is defined in the "Multi Operator / Area paging" section (see annex M).
⁶⁾ Language codes are defined separately (see annex J).
⁷⁾ The coding of this information may be decided unilaterally by the broadcaster to suit the application. RDS consumer receivers should entirely ignore this information.
⁸⁾ The Emergency Warning Systems (EWS) are defined separately (see 3.2.7).

Figure 14: Program Item Number and slow labeling codes - Type 1A group

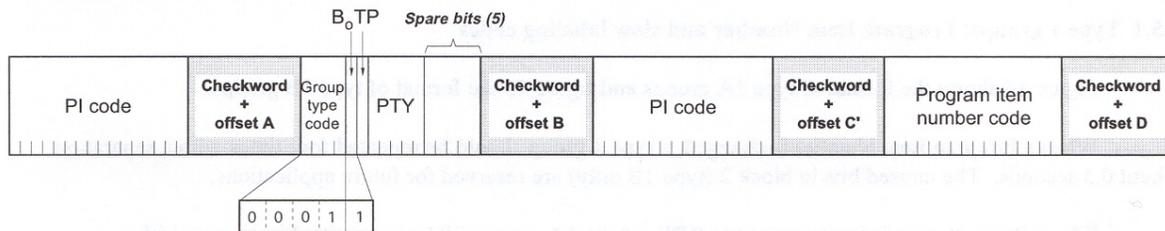


Figure 15: Program Item Number - Type 1B group

Notes on Type 1 groups:

1. Version B differs from version A in the contents of blocks 2 and 3, the offset word in block 3, and, of course, the version code B_0 .
2. The Program Item Number is the scheduled broadcast start time and day of month as published by the broadcaster. The day of month is transmitted as a five-bit binary number in the range 1-31. Hours are transmitted as a five-bit binary number in the range 0-23. The spare codes are not used. Minutes are transmitted as a six-bit binary number in the range 0-59. The spare codes are not used.
3. The most significant five bits in block 4 which convey the day of the month, if set to zero, indicate that no valid Program Item Number is being transmitted. In this case, if no Radio Paging is implemented, the remaining bits in block 4 are undefined. However, in the case of type 1A groups only, if Enhanced Radio Paging is implemented, the remaining bits carry Service Information (see annex M).
4. Bits b_{14} , b_1 3 and b_{12} of block 3 of version A form the variant code, which determines the application of data carried in bits b_{11} to b_0 . A broadcaster may use as many or as few of the variant codes as wished, in any proportion and order.

3.1.5.3 Type 2 groups: Radiotext

Figure 16 shows the format of type 2A groups and figure 17 the format of type 2B groups.

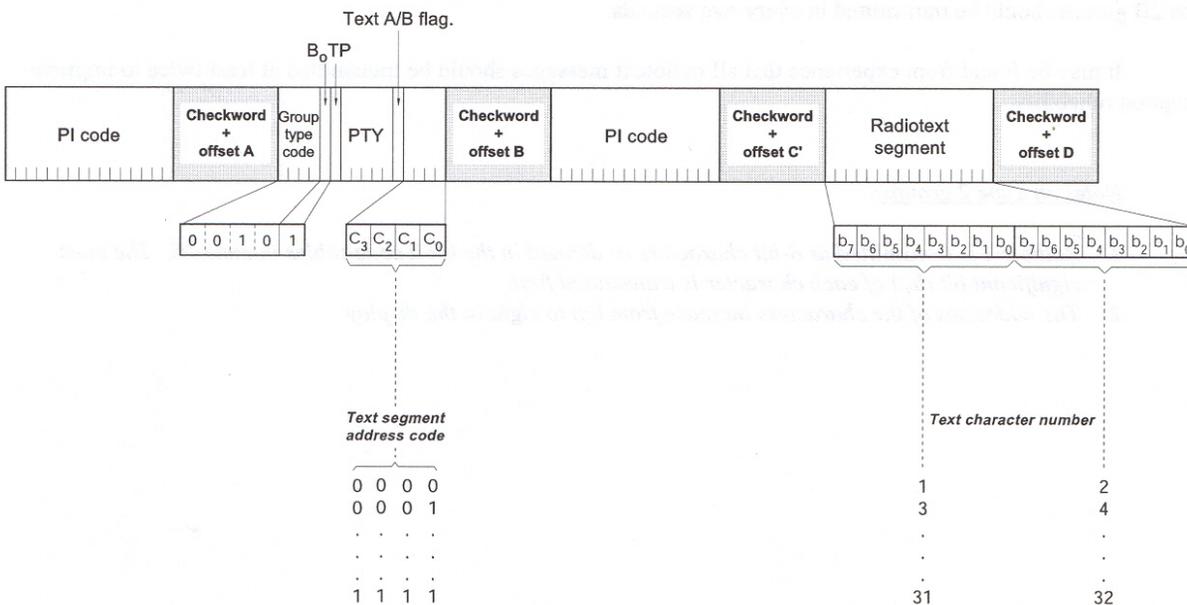
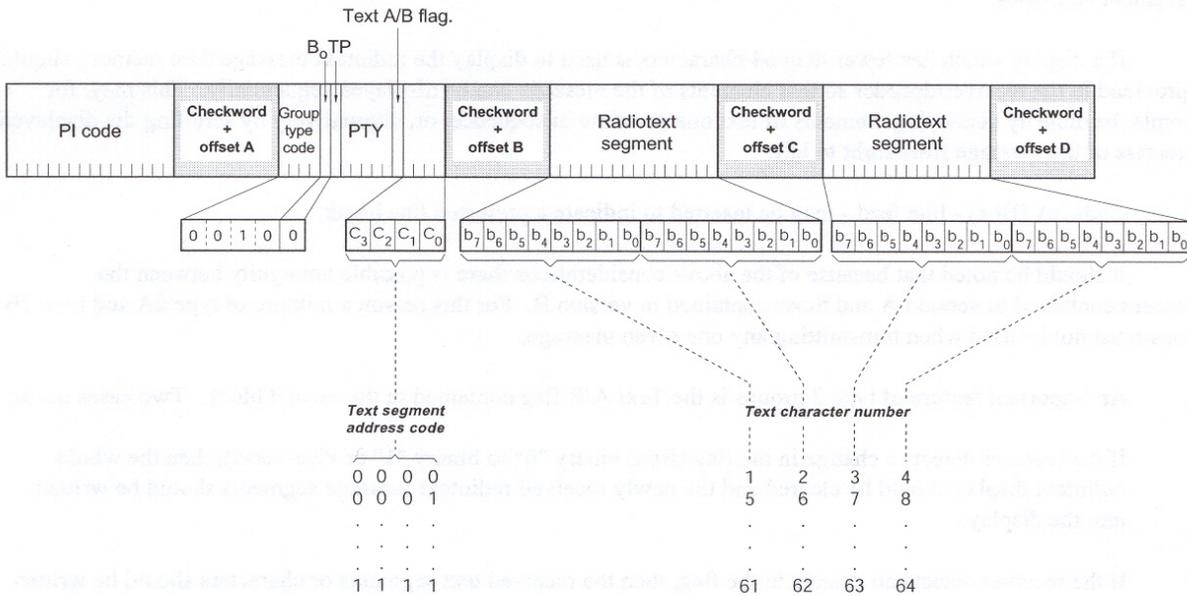


Figure 16: Radiotext - Type 2A group

Figure 17: Radiotext - Type 2B group

The 4-bit text segment address defines in the current text the position of the text segments contained in the third (version A only) and fourth blocks. Since each text segment in version 2A groups comprises four characters, messages of up to 64 characters in length can be sent using this version. In version 2B groups, each text segment comprises only two

characters and therefore when using this version the maximum message length is 32 characters.

A new text must start with segment address "0000" and there must be no gaps up to the highest used segment address of the current message. The number of text segments is determined by the length of the message, and each message should be ended by the code 0D (Hex) - carriage return - if the current message requires less than 16 segment addresses.

If a display which has fewer than 64 characters is used to display the radiotext message then memory should be provided in the receiver/decoder so that elements of the message can be displayed sequentially. This may, for example, be done by displaying elements of text one at a time in sequence, or, alternatively by scrolling the displayed characters of the message from right to left.

Code 0A (Hex) - line feed - may be inserted to indicate a preferred line break.

It should be noted that because of the above considerations there is possible ambiguity between the addresses contained in version A and those contained in version B. For this reason a mixture of type 2A and type 2B groups must not be used when transmitting any one given message.

- An important feature of type 2 groups is the Text A/B flag contained in the second block. Two cases occur:

If the receiver detects a change in the flag (from binary "0" to binary "1" or vice-versa), then the whole radiotext display should be cleared and the newly received radiotext message segments should be written into the display.
- If the receiver detects no change in the flag, then the received text segments or characters should be written into the existing displayed message and those segments or characters for which no update is received should be left unchanged.

When this application is used to transmit a 32-character message, at least three type 2A groups or at least six type 2B groups should be transmitted in every two seconds.

It may be found from experience that all radiotext messages should be transmitted at least twice to improve reception reliability.

Notes on Type 2 groups:

1. Radiotext is transmitted as 8-bit characters as defined in the 8-bit code-tables in annex E. The most significant bit (b_7) of each character is transmitted first.
2. The addresses of the characters increase from left to right in the display.

3.1.5.4 Type 3A groups: Application identification for Open data

Figure 18 shows the format of type 3A groups. These groups are used to identify the Open Data Application in use, on an RDS transmission (see 3.1.4).

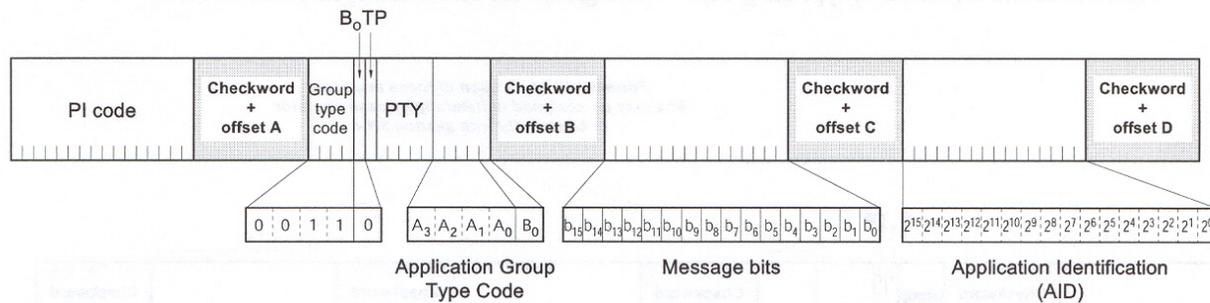


Figure 18: Application Identification for Open data - Type 3A group

The type 3A group conveys, to a receiver, information about which Open Data Applications are carried on a particular transmission and in which groups they will be found. The type 3A group comprises three elements: the Application Group type code used by that application, 16 message bits for the actual ODA and the Applications Identification (AID) code. Applications which actively utilize both, type A and B groups, are signaled using two type 3A groups.

The Application Group type code indicates the group type used, in the particular transmission, to carry the specified ODA. Table 6 specifies the permitted group types. The bit designation is as per figure 9, 4-bit for group type code and 1-bit for the group type version. Two special conditions may be indicated: 00000 - Not carried in associated group; 11111 - Temporary data fault (Encoder status) which means that incoming data to the encoder cannot be transmitted. The AID determines which software handler a receiver needs to use.

This supplements information carried in the type 1A group and permits groups specified in this standard for EWS, IH, RP and TMC to be re-allocated when these features are not used. This method of allocating and defining Open Data Applications in an RDS transmission allows the addition and subtraction of ODAs, without constraint or the need to await the publication of new standards.

For each group type addressed by the Application Group Type codes of a particular transmission, only one application may be identified as the current user of the channel.

The AID code 0000 (Hex) may be used to indicate that the respective group type is being used for the normal feature specified in this standard. Application Identification codes 0001 to FFFF (Hex) indicate applications as specified in the ODA Directory.

The ODA Directory specification associated with a particular AID code defines the use of type A and type B groups as follows:

- type A groups used alone (mode 1.1)
- type B groups used alone (mode 1.2)
- type A groups and type B groups used as alternatives (mode 2)
- type A groups and type B groups used together (mode 3)

It is important to note that the ODA Directory specification must not specify the actual type A and type B groups to be used, since these are assigned in each transmission by the type 3A group.

The AID feature indicates that a particular ODA is being carried in a transmission. Each application will have unique requirements for transmission of its respective AID, in terms of repetition rate and timing. These requirements must be detailed in the respective ODA specification. The specification must also detail the AID signaling requirements for such times when an application assumes or loses the use of a group type channel.

Some applications may not allow reconfiguration in this way.

3.1.5.5 Type 3B groups: Open Data Application

Figure 19 shows the format of type 3B groups. These groups are usable for Open Data (see 3.1.4).

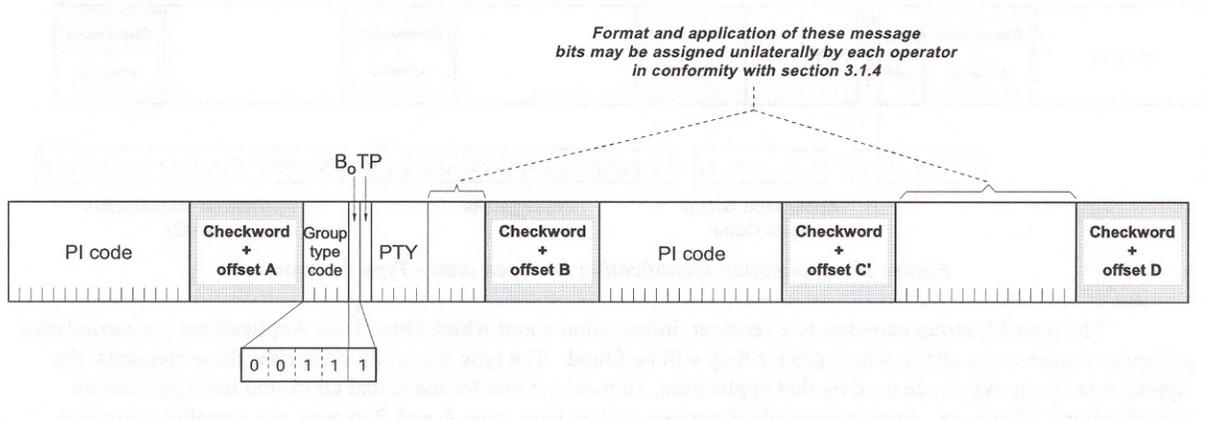


Figure 19: Open data - Type 3B group

3.1.5.6 Type 4A groups : Clock-time and date

The transmitted clock-time and date shall be accurately set to UTC plus local offset time. Otherwise the transmitted CT codes shall all be set to zero.

Figure 20 shows the format of type 4A groups.

When this application is used, one type 4A group will be transmitted every minute.

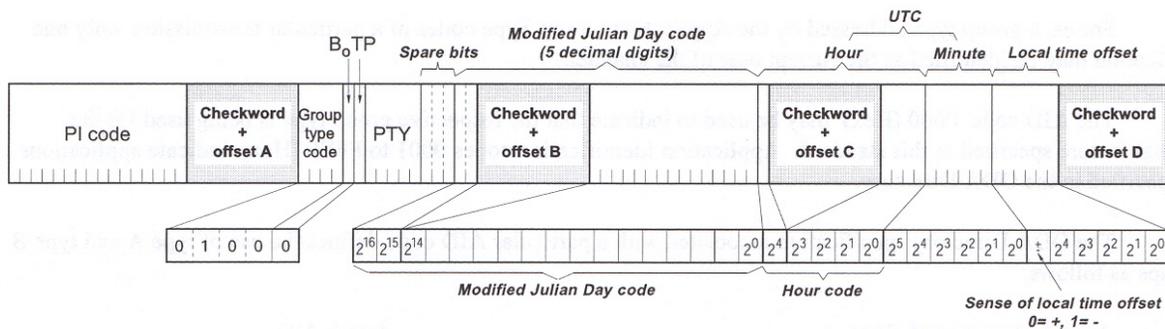


Figure 20: Clock-time and date transmission - Type 4A group

Notes on Type 4A groups:

1. The local time is composed of Coordinated Universal Time (UTC) plus local time offset.
2. The local time offset is **expressed in multiples of half hours** within the range -12 h to +12 h and is coded as a six-bit binary number. "0" = positive offset (East of zero degree longitude), and "1" = negative offset (West of zero degrees longitude).
3. The information relates to the epoch immediately following the start of the next group.

4. The Clock time group is inserted so that the minute edge will occur within ± 0.1 seconds of the end of the Clock time group.
5. Minutes are coded as a six-bit binary number in the range 0-59. The spare codes are not used.
6. Hours are coded as five-bit binary number in the range 0-23. The spare codes are not used.
7. The date is expressed in terms of Modified Julian Day and coded as a 17-bit binary number in the range 0-99999. Simple conversion formulas to month and day, or to week number and day of week are given in annex G. Note that the Modified Julian Day date changes at UTC midnight, **not** at local midnight.
8. Accurate CT based on UTC plus local time offset must be implemented on the transmission where TMC and/or Radio paging is implemented.

3.1.5.7 Type 4B groups: Open data application

Figure 21 shows the format of type 4B groups. These groups are usable for Open data (see 3.1.4).

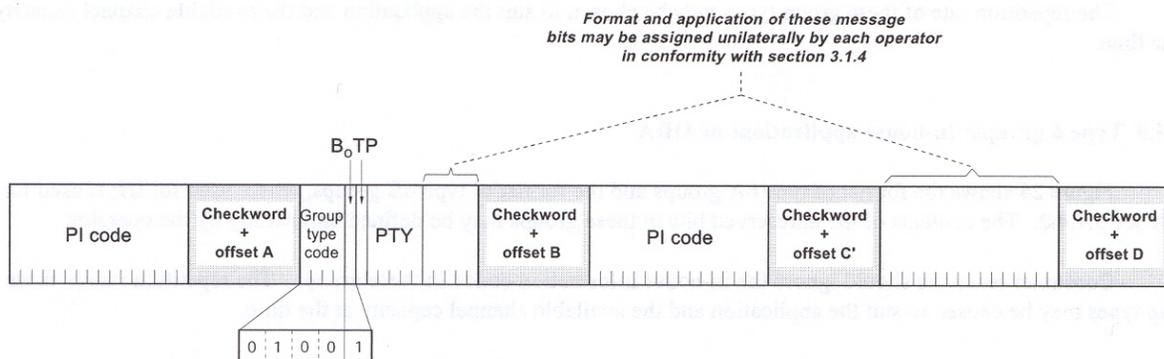
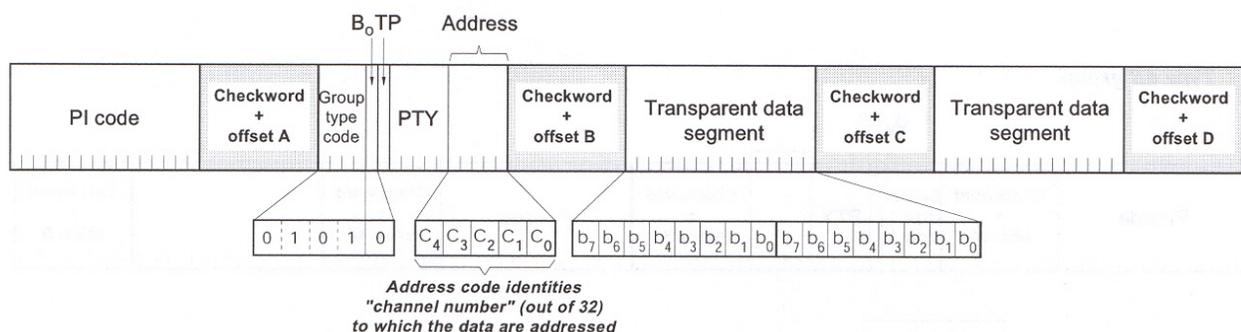


Figure 21: Open data - Type 4B group

3.1.5.8 Type 5 groups: Transparent data channels or ODA

Figure 22 shows the format of type 5A groups and figure 23 the format of type 5B groups, where used for TDC; if used for ODA see 3.1.4.2.

The 5-bit address-code in the second block identifies the "channel-number" (out of 32) to which the data contained in blocks 3 (version A only) and 4 are addressed. Unlike the fixed-format radiotext of type 2 groups, messages of any length and format can be sent using these channels. Display control characters (such as line-feed and carriage-return) will, of course, be



sent along with the data.

Figure 22: Transparent data channels - Type 5A group

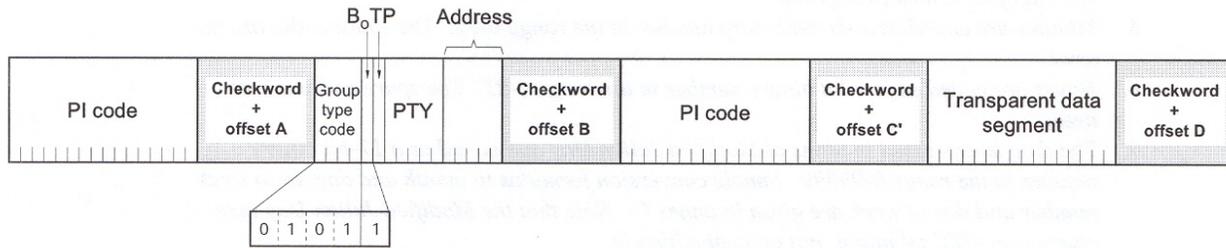


Figure 23: Transparent data channels - Type 5B group

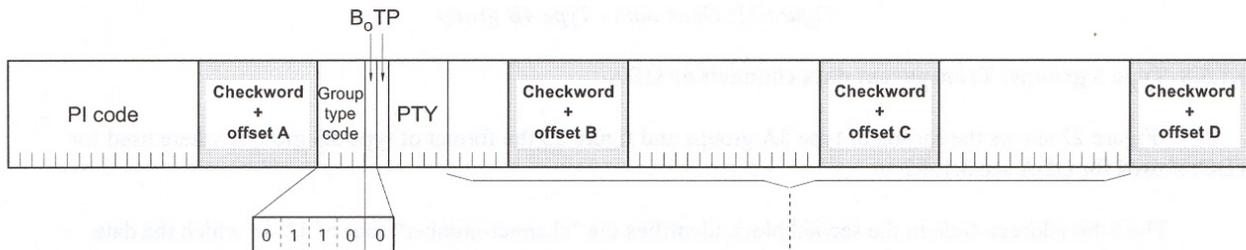
These channels may be used to send alphanumeric characters, or other text (including mosaic graphics), or for transmission of computer programs and similar data not for display. Details of implementation of these last options are to be specified later.

The repetition rate of these group types may be chosen to suit the application and the available channel capacity at the time.

3.1.5.9 Type 6 groups: In-house applications or ODA

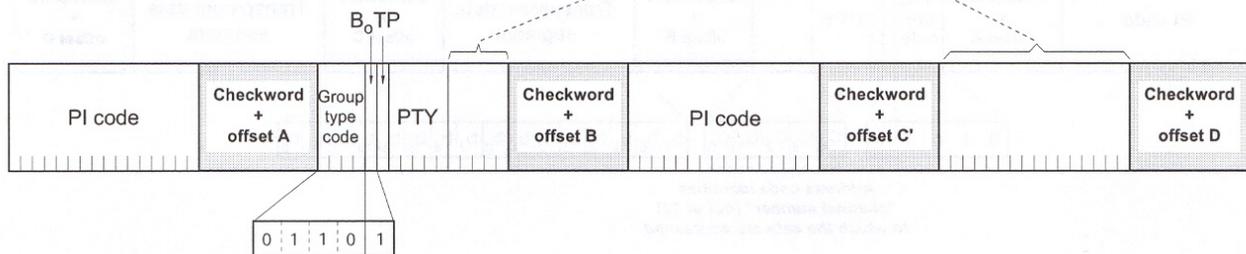
Figure 24 shows the format of type 6A groups and the format of type 6B groups, where used for IH; if used for ODA see 3.1.4.2. The contents of the unreserved bits in these groups may be defined unilaterally by the operator. Consumer receivers should ignore the in-house information coded in these groups. The repetition rate of these group types may

Type 6A group:



Format and application of these message bits may be assigned unilaterally by each operator

Type 6B group:



be chosen to suit the application and the available channel capacity at the time.

Figure 24: In-house applications - Type 6A and 6B group

3.1.5.10 Type 7A groups: Radio Paging or ODA

Figure 25 shows the format of type 7A groups, where used for Radio Paging; if used for ODA see 3.1.4.2. The specification of RP which also makes use of type 1A, 4A and 13A groups, is given in annex M.

For coding of MMBS radio paging please see annex P.

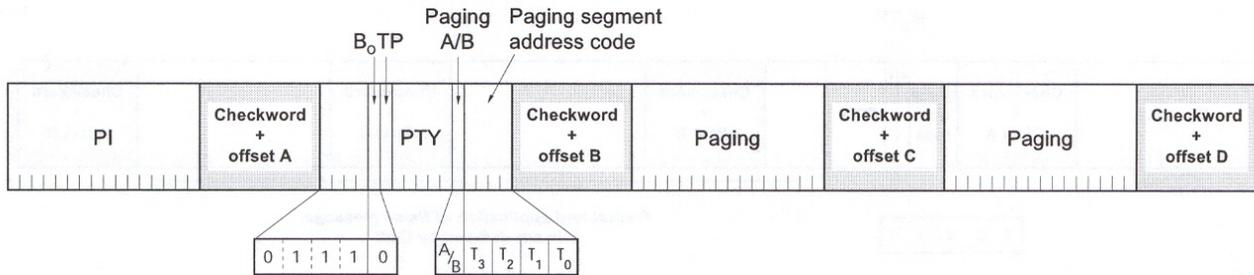


Figure 25: Radio Paging - Type 7A group

3.1.5.11 Type 7B groups: Open data application

Figure 26 shows the format of type 7B groups. These groups are usable for Open data (see 3.1.4).

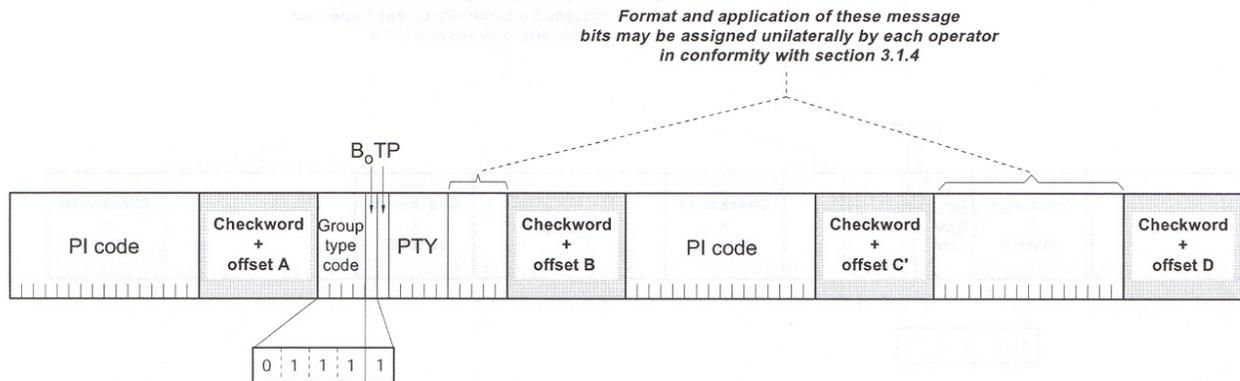


Figure 26: Type 7B group

3.1.5.12 Type 8 groups: Traffic Message Channel or ODA

Figure 27 shows the format of type 8A groups, where used for Traffic Message Channel (TMC); if used for ODA see 3.1.4.2. This group carries the TMC messages. The specification for TMC, using the so called ALERT C protocol also makes use of type 1A and/or type 3A groups together with 4A groups and is separately specified by the CEN standard ENV 12313-1.

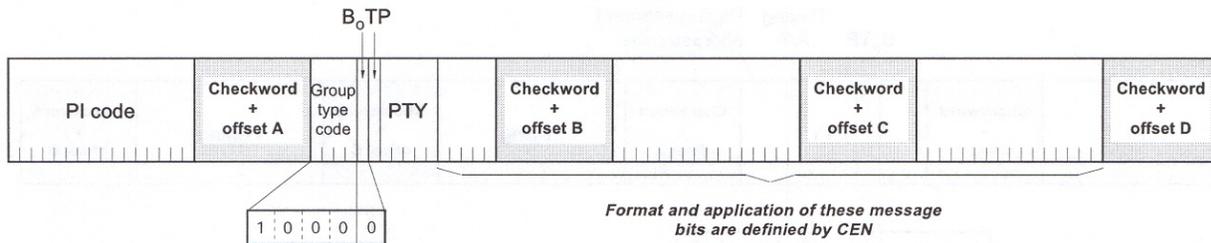


Figure 27: Traffic Message Channel - Type 8A group

Figure 28 shows the format of type 8B groups. These groups are usable for Open data (see 3.1.4).

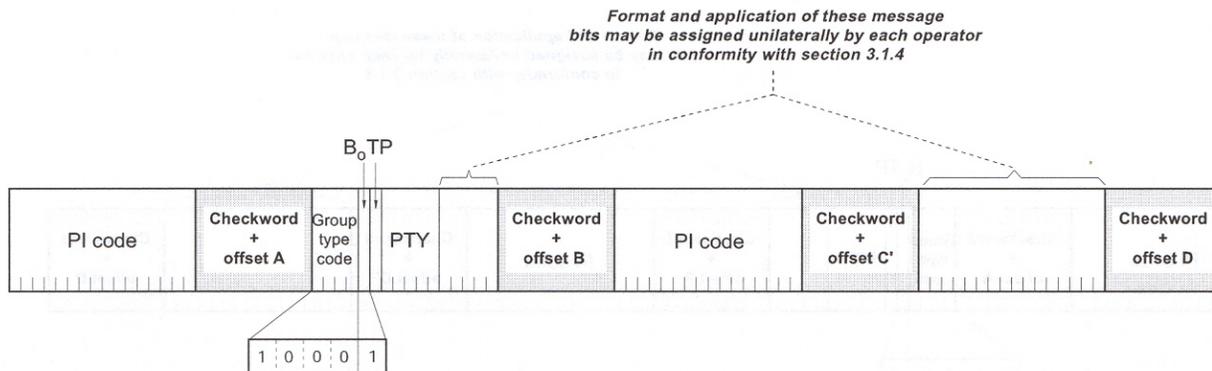


Figure 28: Open data - Type 8B group

3.1.5.13 Type 9 groups: Emergency warning systems or ODA

These groups are transmitted very infrequently, unless an emergency occurs or test transmissions are required. Figure 29 shows the format of type 9A groups where used for EWS; if used for ODA, see 3.1.4.2.

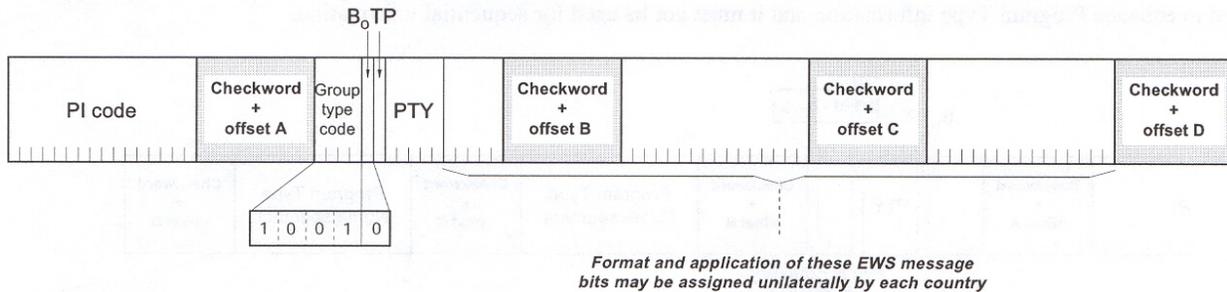


Figure 29: Allocation of EWS message bits - Type 9A group

Format and application of the bits allocated for EWS messages may be assigned unilaterally by each country. However the ECC feature must be transmitted in type 1A groups when EWS is implemented.

Figure 30 shows the format of type 9B groups. These groups are usable for Open data (see 3.1.4).

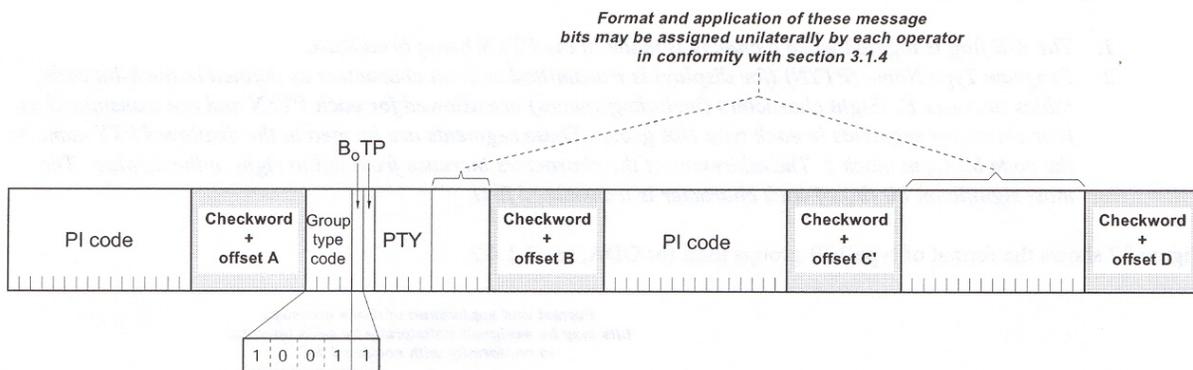


Figure 30: Open data - Type 9B group

3.1.5.14 Type 10 groups: Program Type Name (Group type 10A) and Open data (Group type 10B)

Figure 31 shows the format of type 10A groups used for PTYN.

The type 10A group allows further description of the current Program Type, for example, when using the PTY code 4: SPORT, a PTYN of “Football” may be indicated to give more detail about that program. PTYN must only be used to enhance Program Type information and it must not be used for sequential information.

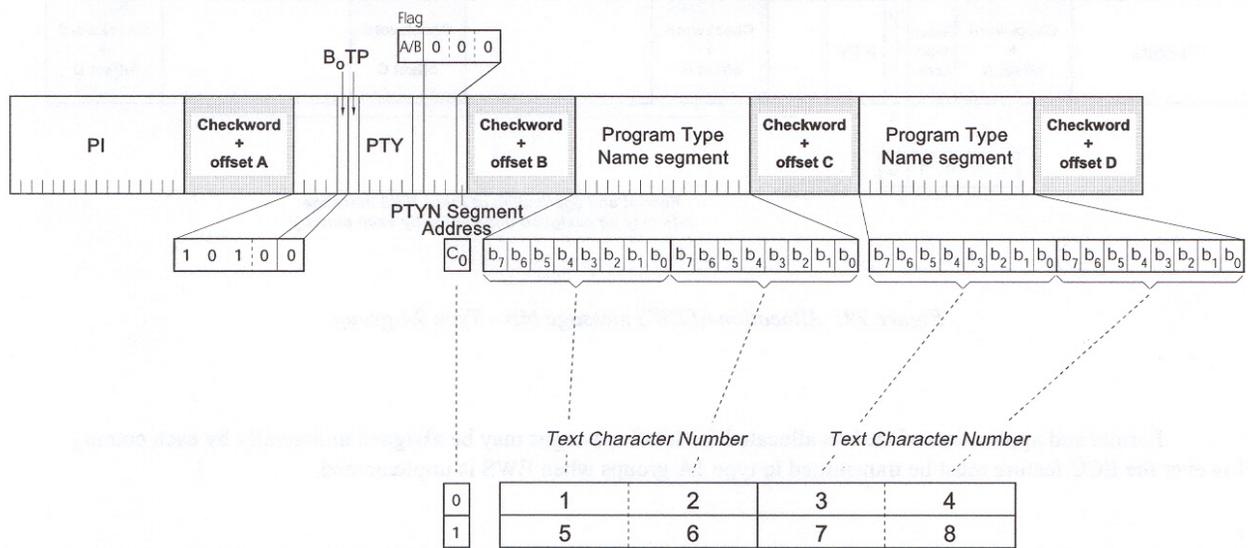


Figure 31: Program Type Name PTYN - Type 10A group

Notes on Type 10A groups:

1. The A/B flag is toggled when a change is made in the PTYN being broadcast.
2. Program Type Name (PTYN) (for display) is transmitted as 8-bit characters as defined in the 8-bit code tables in annex E. Eight characters (including spaces) are allowed for each PTYN and are transmitted as four character segments in each type 10A group. These segments are located in the displayed PTY name by the code bit C₀ in block 2. The addresses of the characters increase from left to right in the display. The most significant bit (b₇) of each character is transmitted first.

Figure 32 shows the format of type 10B groups used for ODA, see 3.1.4.2.

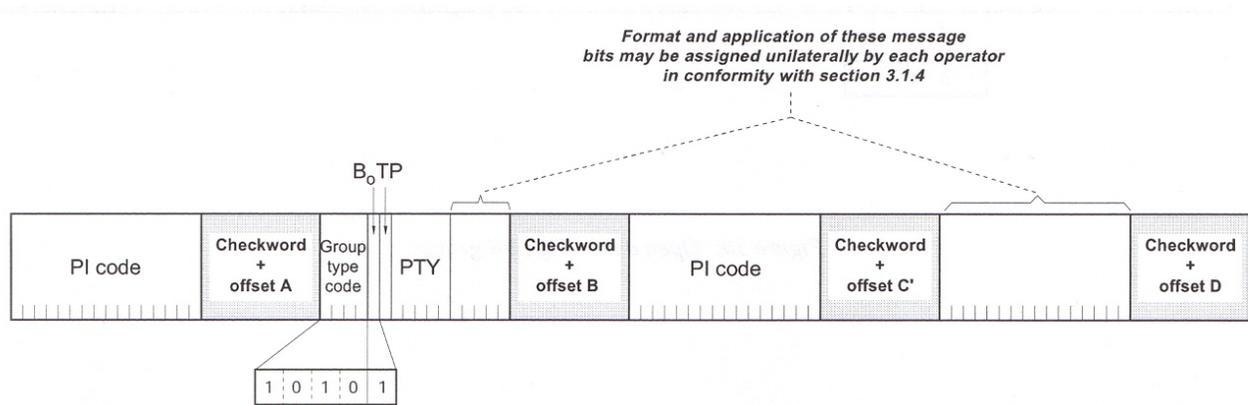


Figure 32: Open data - Type 10B group

3.1.5.15 Type 11 groups: Open Data Application

Figure 33 shows the format of type 11A and 11B groups. These groups are usable for Open data (see 3.1.4).

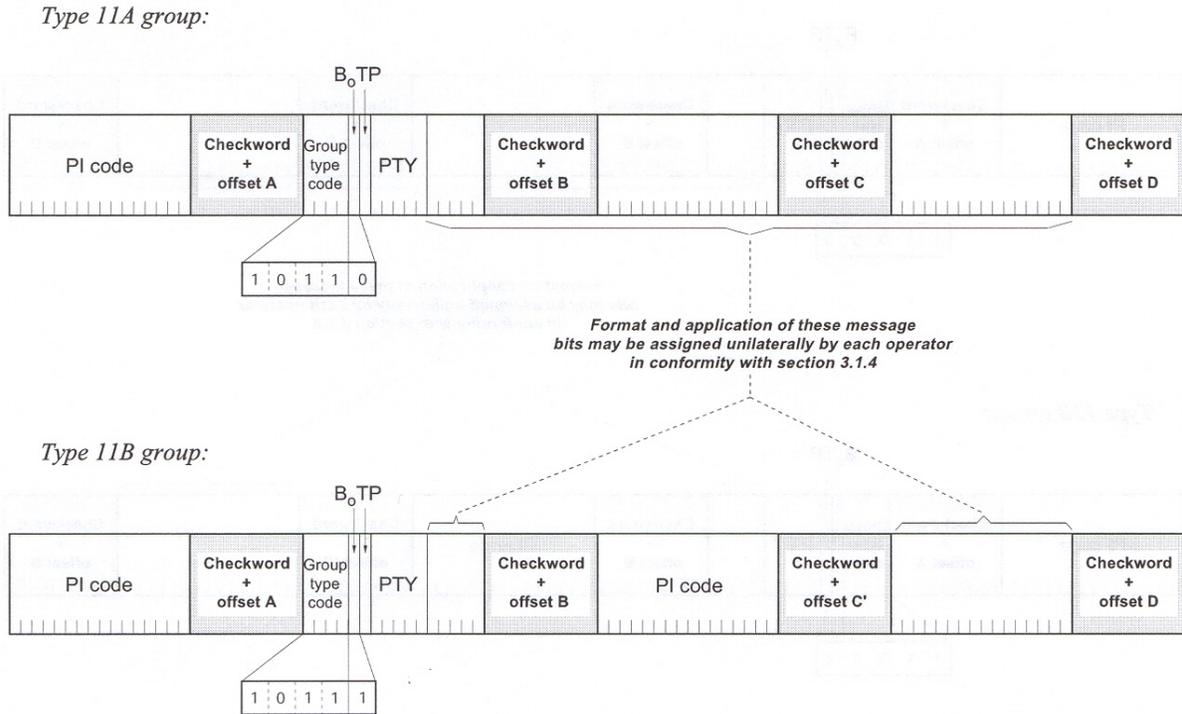


Figure 33: Open data - Type 11A and 11B groups

3.1.5.16 Type 12 groups: Open Data Application

Figure 34 shows the format of type 12A and 12B groups. These groups are usable for Open data (see 3.1.4).

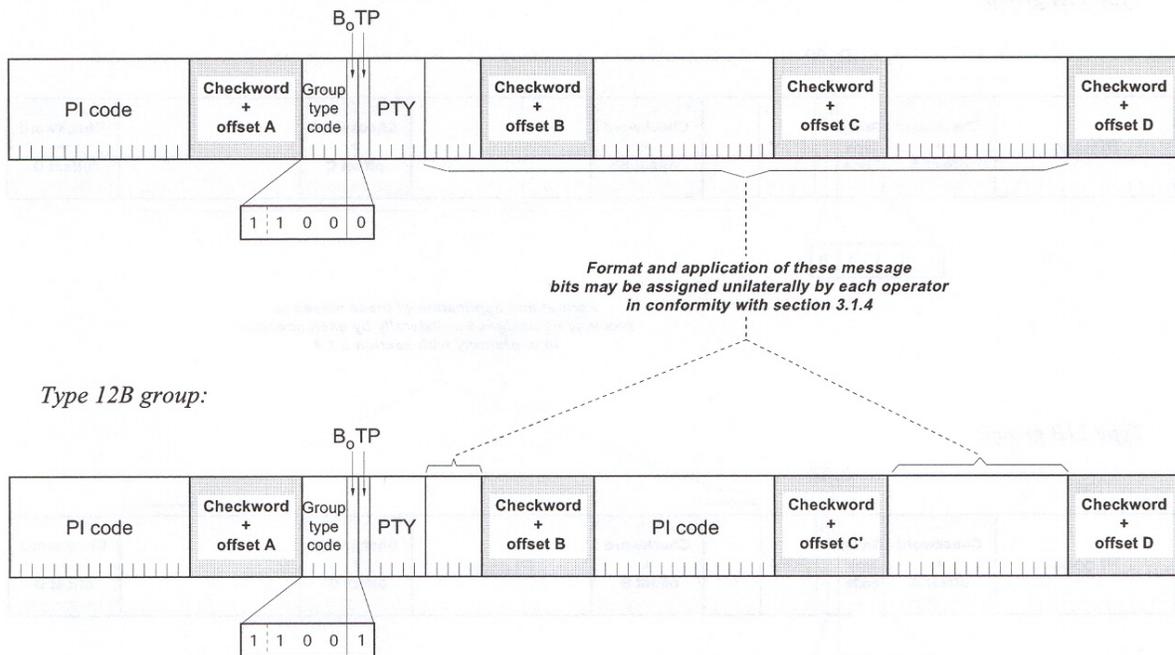


Figure 34: Open data - Type 12A and 12B groups

3.1.5.17 Type 13A groups: Enhanced Radio Paging or ODA

The type 13A group is used to transmit the information relative to the network and the paging traffic. Its primary purpose is to provide an efficient tool for increasing the battery life time of the pager.

Figure 35 shows the format of the type 13A group. These groups are transmitted once or twice at the beginning of every interval (after the type 4A group at the beginning of each minute or after the first type 1A group at the beginning of each interval).

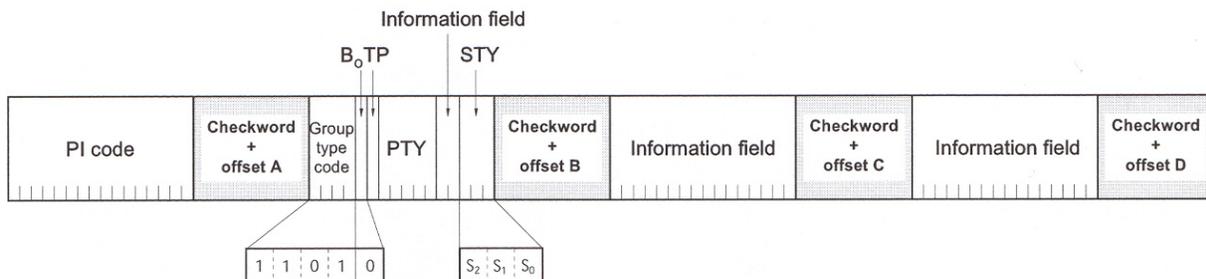


Figure 35: Enhanced Paging information - Type 13A group

The STY code (3 bits) denotes the different type 13A group sub types; there are 8 different sub types:

Table 7: STY codes

STY			Last bits of third block and fourth block of type 13A group
S ₂	S ₁	S ₀	
0	0	0	Address notification bits 24...0, when only 25 bits (one type 13A group) are used
0	0	1	Address notification bits 49...25, when 50 bits (two type 13A groups) are used
0	1	0	Address notification bits 24...0, when 50 bits (two type 13A groups) are used
0	1	1	Reserved for Value Added Services system information
1	0	0	Reserved for future use
...
1	1	1	Reserved for future use

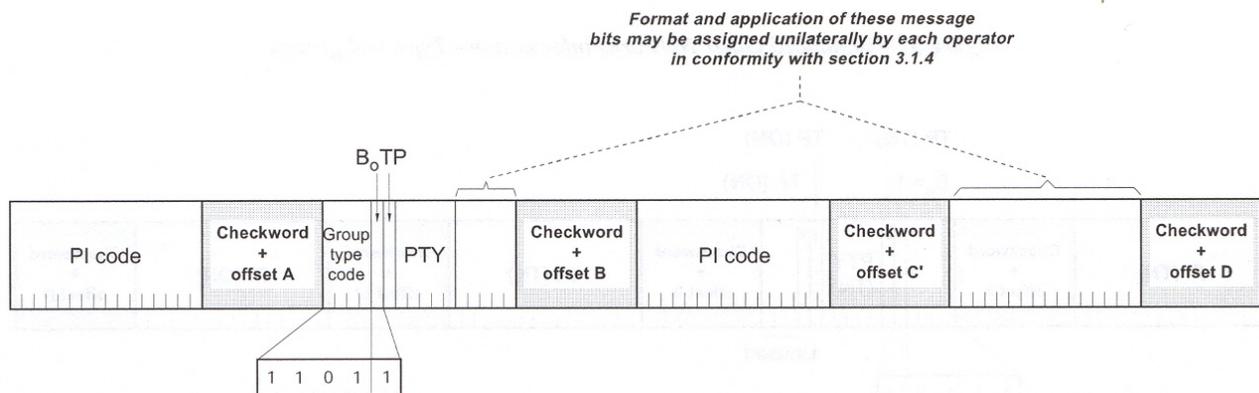
The specification of the relevant protocol is given in annex M, section M.3.

The type 13A group may be used for ODA when it is not used for Radio Paging, and its group structure is then as shown in 3.1.4.2.

3.1.5.18 Type 13B groups: Open Data Application

Figure 36 shows the format of type 13B groups. These groups are usable for Open data (see 3.1.4).

Figure 36: Open data - Type 13B group



3.1.5.19 Type 14 groups: Enhanced Other Networks information

Figures 37 and 38 show the format of type 14A and 14B groups. These groups are transmitted if Enhanced Other Networks information (EON) is implemented. The specification of the relevant protocol is given in 3.2.1.8.

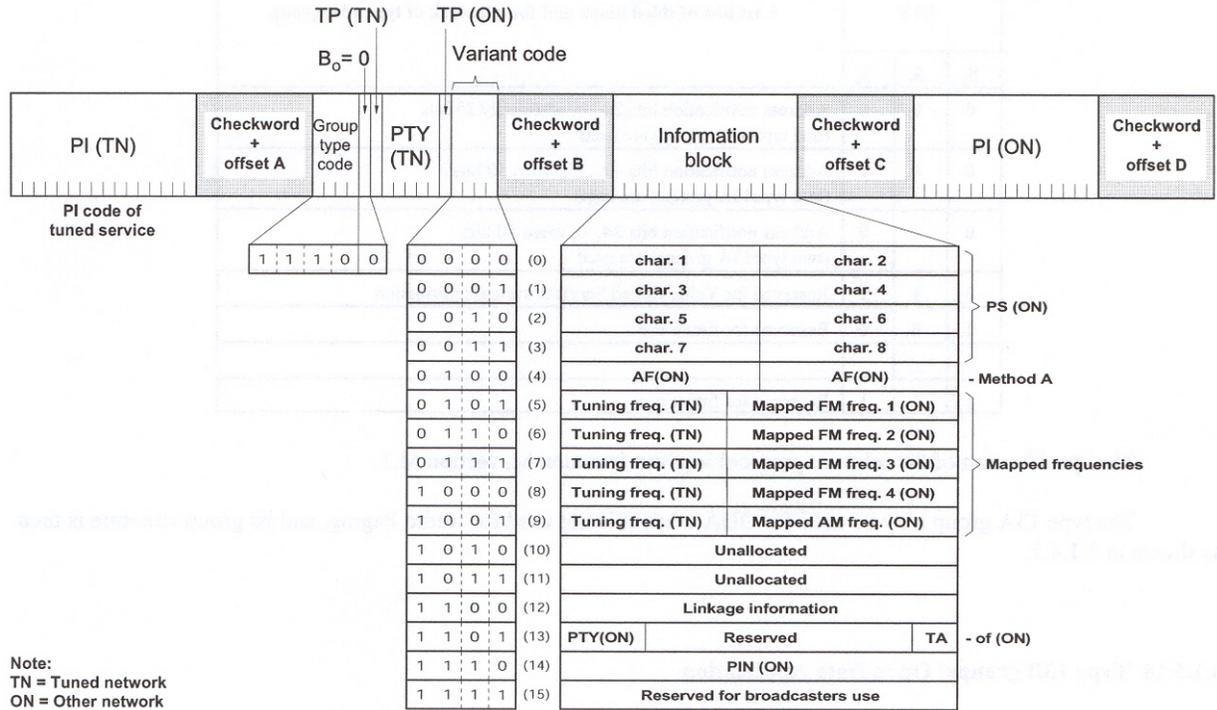


Figure 37: Enhanced Other Networks information - Type 14A groups

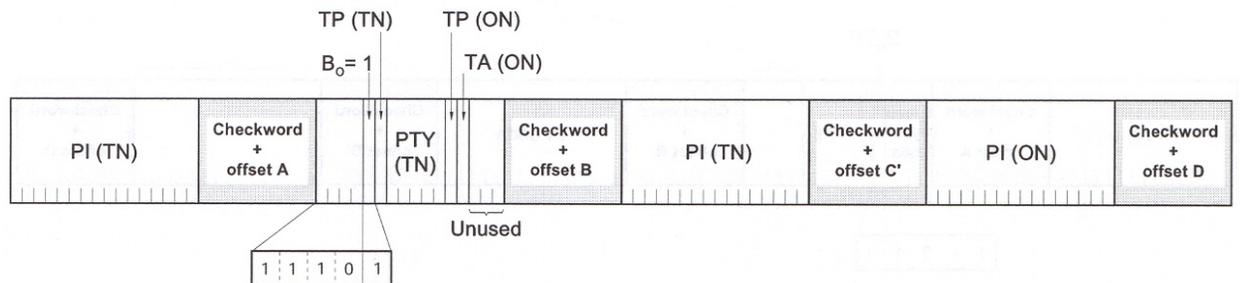


Figure 38: Enhanced Other Networks information - Type 14B groups

3.1.5.20 Type 15A groups

Type 15 groups: Fast basic tuning and switching information

Special note: Group type 15A as defined in Figure 39a is being phased out. Encoder manufacturers should eliminate this group type on new equipment no later than two years after the issuing date of this standard. Receiver manufacturers should eliminate recognition of this group type as soon as possible in all new equipment. After ten years following the issuing date of this standard, group type 15A will be available for reassignment. Reassignment shall be coordinated with the CENELEC RDS standard. The RDS standard currently has no definition for this group.

It is intended that type 15A groups should be inserted where it is desired to speed up acquisition time of the PS name. No alternative frequency information is included in 15A groups, and this group will be used to supplement type 0B groups. If alternate frequencies exist, type 0A will still be required.

It is intended that type 15B groups should be inserted where it is desired to increase the repetition rate of the switching information contained in block 2 of type 0 groups without increasing the repetition rate of the other information contained in these groups. No alternative-frequency information or program-service name is included in 15B groups, and this group will be used to supplement rather than to replace type 0A or 0B groups.

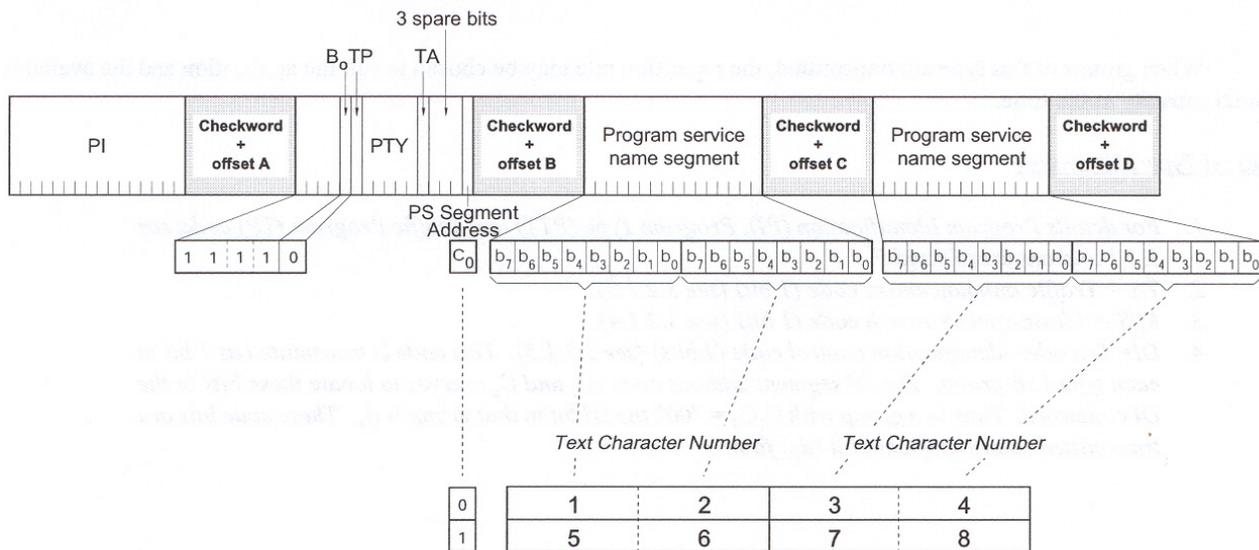


Figure 39a: Fast basic tuning and switching information - Group type 15A

Notes on Type 15A groups

1. Program service name (for display) is transmitted as 8-bit characters as defined in the 8-bit code-tables in annex E. Eight characters (including spaces) are allowed for each network and are transmitted as four character segments in each type 15A group. These segments are located in the displayed name by the code bit C₀ in block 2. The addresses of the characters increase from left to right in the display. The most significant bit (b₈) of each character is transmitted first.
2. For details Program Identification (PI), Program Type (PTY) and Traffic Program (TP) code, see 3.2.1 and annexes D and F.
3. TA = Traffic announcement code (1 bit) (see 3.2.1.3).

3.1.5.21 Type 15B groups: Fast basic tuning and switching information

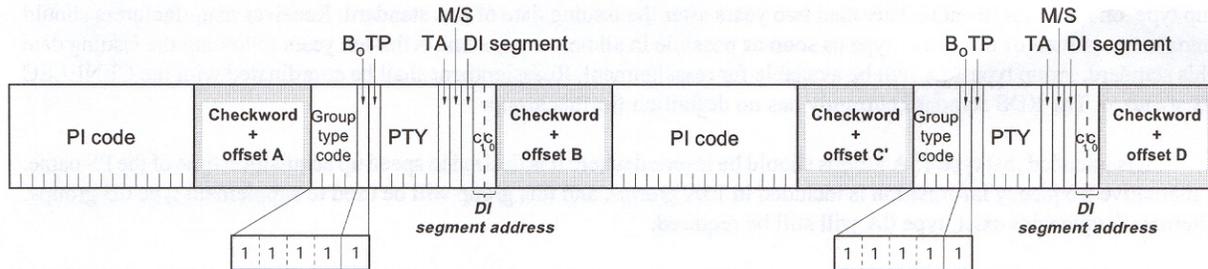


Figure 39b: Fast basic tuning and switching information - Type 15B group

When groups of this type are transmitted, the repetition rate may be chosen to suit the application and the available channel capacity at the time.

Notes on Type 15B groups

1. For details Program Identification (PI), Program Type (PTY) and Traffic Program (TP) code, see 3.2.1 and annexes D and F.
2. TA = Traffic announcement code (1 bit) (see 3.2.1.3).
3. M/S = Music-speech switch code (1 bit) (see 3.2.1.4).
4. DI = Decoder-identification control code (4 bits) (see 3.2.1.5). This code is transmitted as 1 bit in each type 15B group. The DI segment address code (C₁ and C₀) serves to locate these bits in the DI codeword. Thus in a group with C₁C₀ = "00" the DI bit in that group is d₃. These code bits are transmitted most significant bit (d₃) first.

3.2 Coding of information

A glossary of terms used in RDS applications is given in 4, which also explains the expected responses of a consumer receiver to the various codes.

3.2.1 Coding of information for control

3.2.1.1 Program Identification (PI) codes and Extended country codes (ECC)

The coding model for Program Identification information and Extended country codes is given in annex D.

3.2.1.2 Program Type (PTY) codes

The applications of the 5-bit Program type codes are specified in annex F. PTY codes 30 and 31 are control functions for a consumer receiver (see annex F).

3.2.1.3 Traffic Program (TP) and Traffic Announcement (TA) codes

The coding to be used is as follows:

Table 8

Traffic Program code (TP)	Traffic Announcement code (TA)	Applications
0	0	This program does not carry traffic announcements nor does it refer, via EON, to a program that does.
0	1	This program carries EON information about another program which gives traffic information.
1	0	This program carries traffic announcements but none are being broadcast at present and may also carry EON information about other traffic announcements.
1	1	A traffic announcement is being broadcast on this program at present.

3.2.1.4 Music/speech (M/S) switch code

This is a 1-bit code. A "0" indicates that speech, at present, is being broadcast and a "1" indicates that music, at present, is being broadcast. When the broadcaster is not using this facility the bit value will be set at "1".

3.2.1.5 Decoder identification and Dynamic PTY indicator / DI codes

These 4 bits are used to indicate different operating modes to switch individual decoders on or off and to indicate if PTY codes in the transmission are dynamically switched.

Table 9: Bit d₀ to d₃ meanings

Settings	Meaning
Bit d ₀ , set to 0:	Mono
Bit d ₀ , set to 1:	Stereo
Bit d ₁ , set to 0:	Not Artificial Head
Bit d ₁ , set to 1:	Artificial Head
Bit d ₂ , set to 0:	Not compressed
Bit d ₂ , set to 1:	Compressed ¹
Bit d ₃ , set to 0:	Static PTY
Bit d ₃ , set to 1:	Indicates that the PTY code on the tuned service, or referenced in EON variant 13, is dynamically switched.

¹) See CCIR Study Program 46A/10 (Dubrovnik, 1986)

3.2.1.6 Coding of alternative frequencies (AFs)

3.2.1.6.1 AF code tables

In the following code tables, each 8-bit binary code represents a carrier frequency, or it represents a special meaning as shown in Tables 10, 11 and 12.

Table 10: VHF code table

Number	Binary code	Carrier frequency
0	0000 0000	Not to be used
1	0000 0001	87.6 MHZ
2	0000 0010	87.7 MHZ
:	:	:
:	:	:
204	1100 1100	107.9 MHZ

Table 11: Special meanings code table

Number	Binary code	Special meaning
0	0000 0000	Not to be used
205	1100 1101	Filler code
206	1100 1110	Not assigned
:	:	:
223	1101 1111	Not assigned
224	1110 0000	No AF exists
225	1110 0001	1 AF follows
:	:	:
249	1111 1001	25 AFs follow
250	1111 1010	An LF/MF frequency follows
251	1111 1011	Not assigned
:	:	:
255	1111 1111	Not assigned

Table 12: LF/MF code table - for ITU regions 1 and 3 (9 kHz spacing)

Number	Binary code	Carrier frequency
LF 1	0000 0001	153 kHz
:	:	:
:	:	:
15	0000 1111	279 kHz
MF 16	0001 0000	531 kHz
:	:	:
:	:	:
:	:	:
:	:	:
135	1000 0111	1602 kHz

3.2.1.6.2 Use of Alternative Frequencies in type 0A groups

To facilitate the automatic tuning process in a receiver, a number of AFs should be transmitted. Ideally the AF list should only comprise frequencies of neighboring transmitters or repeaters. Two methods of transmitting AFs are possible. AF method A is used for lists up to 25 in number and AF method B is used for larger lists. AF method B is also used where it is required to indicate frequencies of generically related services.

3.2.1.6.3 AF method A

Two AF codes are carried in block 3 of each type 0A group. The first byte in the transmitted list (codes 224 - 249) indicates the number of frequencies in that list. This list will also include the frequency of the transmitter originating the list, if it has repeaters.

Examples of AF method A coding:

	Example A		Example B		Example C	
1st 0A:	#5	AF1	#4	AF1	#4	AF1
2nd 0A:	AF2	AF3	AF2	AF3	AF2	AF3
3rd 0A:	AF4	AF5	AF4	Filler	LF/MF follows	AF4

Example A shows: a list of 5 VHF frequencies, where #5 means number of frequencies following is 5 and is represented by code 229.

Example B shows: a list of 4 VHF frequencies, where Filler code is 205.

Example C shows: a list of 3 VHF frequencies and 1 LF/MF frequency, where LF/MF follows code is 250.

3.2.1.6.4 AF method B

Method B AF coding is used where the number of AFs used by a transmitter and its associated repeater stations exceed 25, or where it is required to indicate frequencies which belong to different regions which at times carry different programs.

Each transmitter and associated repeater stations broadcast the same set of different AF lists in sequence. The number of AF lists within a network is in general identical to the number of transmitters and repeater stations in the network so as to provide a unique list for each transmitting station. In this protocol the alternative frequencies for the VHF/FM transmitters are individually addressed by transmitting the tuning frequency paired with one alternative frequency within one block³.

Each list starts with a code giving the total number of frequencies within this list, followed by the tuning frequency for which the list is valid. All remaining pairs² (up to 12) give the tuning frequency together with a valid AF.

- If the number of AFs of a station is larger than 12, the list must be split into two or more lists. These lists are transmitted directly one after the other, and the receiver must combine the lists again.
- If a transmitter frequency is used more than once within a network the respective AF lists are transmitted separately. In order to indicate that these lists with the same tuning frequency belong to different stations, the lists must be separated by AF lists of other stations. The receiver may combine them or evaluate them separately.

³If the frequency referenced is for an LF/MF transmission, it occupies 2 AF codes, the first being code 250. Hence it cannot be referenced to its associated tuning frequency.

For the transmission of the frequency pairs within one block the following convention is used:

- They are generally transmitted in ascending order, e.g.



- In special cases they are transmitted in descending order, if they belong to different regions, or carry from time to time different programs, e.g.



In both the above examples 99.5 MHz is the tuning frequency.

Examples of a AF method B coding:

F ₁	F ₂	Commentary
# 11	89.3	Total number (11) of frequencies for tuning frequency (89.3)
89.3	99.5	F ₂ > F ₁ hence 99.5 is an AF of tuned frequency 89.3, and is the same program
89.3	101.7	F ₂ > F ₁ hence 101.7 is an AF of tuned frequency 89.3, and is the same program
88.8	89.3	F ₂ > F ₁ hence 88.8 is an AF of tuned frequency 89.3, and is the same program
102.6	89.3	F ₂ < F ₁ hence 102.6 is an AF of a regional variant of tuned frequency 89.3
89.3	89.0	F ₂ < F ₁ hence 89.0 is an AF of a regional variant of tuned frequency 89.3
# 9	99.5	Total number (9) of frequencies for tuning frequency (99.5)
89.3	99.5	F ₂ > F ₁ hence 89.3 is an AF of tuned frequency 99.5, and is the same program
99.5	100.9	F ₂ > F ₁ hence 100.9 is an AF of tuned frequency 99.5, and is the same program
104.8	99.5	F ₂ < F ₁ hence 104.8 is an AF of a regional variant of tuned frequency 99.5
99.5	89.1	F ₂ < F ₁ hence 89.1 is an AF of a regional variant of tuned frequency 99.5

Broadcasters using splitting of a network during certain hours of the day should use AF method B, and not AF method A. The lists should be static, i.e. the AFs included in the list, carrying a different program during certain hours of the day, shall be signaled by transmitting in the descending order. Their PI shall differ in the second element (bits 8 to 11) of the code and may also be static. To identify different regional networks or programs the PI area codes R1 to R12 shall be used (see annex D, D.4).

This convention will permit a receiver to use a regional on/off mode which, when a receiver is in the mode "regional off", will lead to the acceptance of the PI with the differing second element, and thus permit switching to a different regional network. This option can be deactivated by choosing the mode "regional on". Then only AFs having the same second element of the PI (i.e. the same program) will be used. This should also be the case for receivers without regional on/off mode. The switching of the second element of the PI to I, N, or S, respectively, informs a receiver that now even AFs transmitted in descending order carry the same program and the receiver should use this information to allow switching to these AFs.

3.2.1.6.5 Convention for identification of the AF methods used

The AF method used is not signaled explicitly, but can easily be deduced by receivers from the frequent repetition of the tuning frequency in the transmitted AF pairs in the case of AF method B.

3.2.1.6.6 Use of AF Codes in type 14A groups

AF codes in type 14A groups are used to refer to frequencies of other networks. There are two AF methods for transmitting this information.

Variant 4 utilizes AF method A coding to transmit up to 25 frequencies; the coding method is as described above for type 0A groups. The PI code of the other network to which the AF list applies is given in block 4 of the group.

Variant 5 is used for the transmission of “Mapped frequency pairs”. This is used to specifically reference a frequency in the tuned network to a corresponding frequency in another network. This is particularly used by a broadcaster that transmits several different services from the same transmitter tower with the same coverage areas.

The first AF code in block 3 refers to the frequency of the tuned network, the second code is the corresponding frequency of the other network identified by the PI code in block 4.

Where it is necessary to map one tuning frequency to more than one VHF/FM frequency for the cross-referenced program service (due to multiple use of the tuning frequency or because the cross-referenced program is receivable at more than one frequency within the service area associated with the tuning frequency), then variants 6, 7 and 8 are used to indicate second, third and fourth mapped frequencies, respectively.

LF/MF mapped frequencies are implicitly signaled by using variant 9. AF Code 250 is not used with the mapped AF method.

3.2.1.7 Program Item Number (PIN) codes

The transmitted Program Item Number code will be the scheduled broadcast start time and day of month as published by the broadcaster. For the coding of this information see 3.1.5.2.

If a type 1 group is transmitted without a valid PIN, the day of the month shall be set to zero. In this case a receiver which evaluates PIN shall ignore the other information in block 4.

3.2.1.8 Coding of Enhanced Other Networks Information (EON)

The enhanced information about other networks consists of a collection of optional RDS features relating to other program services, cross-referenced by means of their PI codes (see 3.2.1.1). Features which may be transmitted using EON for other program services are: AF (see 3.2.1.6.5), PIN (see 3.2.1.7), PS (see 3.2.2), PTY (see 3.2.1.2), TA (see 3.2.1.3), TP (see 3.2.1.3) and Linkage (see 3.2.1.8.3).

The format of the type 14 groups is shown in figures 37 and 38. It has two versions: A and B. The A version is the normal form and shall be used for the background transmission of Enhanced Other Networks information. The maximum cycle time for the transmission of all data relating to all cross-referenced program services shall be less than two minutes. The A version has sixteen variants which may be used in any mixture and order. Attention is drawn to the fact that two distinct options, namely AF method A and the Mapped Frequency Method, exist for the transmission of frequencies of cross-referenced program services (see 3.2.1.8.1). A broadcaster should choose the most appropriate AF method for each cross-referenced program service.

The B version of a type 14 group is used to indicate a change in the status of the TA flag of a cross-referenced program service (see 3.2.1.8.2 for more details).

3.2.1.8.1 Coding of frequencies for cross-referenced program services

Two AF methods exist for the transmission of AF's in the EON feature. Coding is described in 3.2.1.6.5.

A broadcaster may utilize the most appropriate AF method for each cross-referenced program service, but within the reference to any single service these two AF methods must not be mixed.

3.2.1.8.2 Use of the TP and TA features (Type 0, 15B and 14 groups)

For the tuned program service, the code TP=0 in all groups and TA=1 in type 0 and 15B groups indicates that this program broadcasts EON information which cross-references at least to one program service which carries traffic information. RDS receivers which implement the EON feature may use this code to signify that the listener can listen to the tuned program service and nevertheless receive traffic messages from another program service. RDS receivers which do not implement the EON feature must ignore this code. Program services which use the code TP=0, TA=1 must broadcast type 14 B groups (at the appropriate times) relating to at least one program service which carries traffic information, and has the flag TP=1.

The TA flag within variant 13 of a type 14A group is used to indicate that the cross-referenced service is currently carrying a traffic announcement. This indication is intended for information only (e.g. for monitoring by broadcasters) and must not be used to initiate a switch even if traffic announcements are desired by the listener. A switch to the cross-referenced traffic announcement should only be made when a TA=1 flag is detected in a type 14B group.

The type 14B group is used to cause the receiver to switch to a program service which carries a traffic announcement. When a particular program service begins a traffic announcement, all transmitters which cross-reference this service via the EON feature shall broadcast as many as possible of up to eight and at least four appropriate group 14B messages within the shortest practicable period of time (at least four type 14B groups per second).

At the discretion of the broadcaster, a sequence of type 14B groups may be transmitted also when the TA flag is cleared. This option is provided only to assist in the control of transmitters; receivers must use the TA flag in the type 0 or 15B groups of the service which carries the traffic announcements in order to switch back to the tuned program service at the end of the received traffic announcement.

If a transmitter cross-references to more than one traffic program with different PI(ON) via the EON feature, the start time between two references, via type 14B groups, must be two seconds or more.

Note: Some early RDS EON consumer receivers may need up to four correct type 14B groups for reliable functioning. Therefore it is recommended to broadcast as many as possible of up to eight type 14B groups, to ensure the detection of the switching under bad receiving conditions.

The mechanism described above for switching to and from cross-referenced traffic announcements is designed to avoid the delivery of incomplete traffic messages by receivers operating under adverse reception conditions.

3.2.1.8.3 Method for linking RDS program services (Type 1A and 14A groups) - Linkage information

Linkage information provides the means by which several program services, each characterized by its own PI code, may be treated by a receiver as a single service during times a common program is carried.

During such times each program service retains its unique identity, i.e. the program service must keep its designated PI code and its AF (Alternative Frequency) list(s), but may change program related features such as PS, PTY, RT, TP and TA to reflect the common program. With LA=1, a service carrying codes TP=1 or TP=0/TA=1 must not be linked to another service carrying the codes TP=0/TA=0.”

Linkage information is conveyed in the following four data elements:

- 1) LA - Linkage Actuator (1 bit)
- 2) EG - Extended Generic indicator (1 bit)
- 3) ILS - International Linkage Set indicator (1 bit)
- 4) LSN - Linkage Set Number (12 bits)

This information is carried in block 3 of variant 12 of type 14A groups, and informs the receiver to which set of program services any particular service, defined by PI (ON) carried in block 4 of the same group, belongs.

When linkage information regarding the tuned program service is transmitted, the PI code carried in block 4 of the group, PI (ON), will be identical to the PI code carried in block 1.

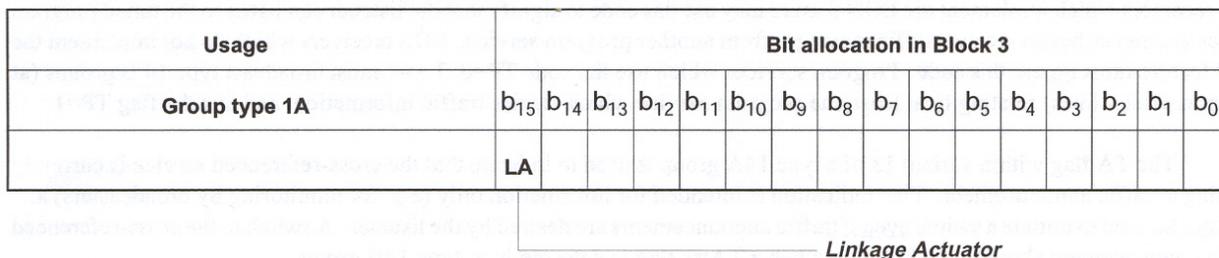


Figure 40: Structure of Block 3 of Type 1A groups

In order to achieve rapid de-linkage at the end of a common program, the Linkage Actuator (LA) for the tuned network is also carried in group type 1A, as bit b_{15} of block 3 (see 3.1.5.2). This group type should normally be transmitted at least once every 5 seconds, preferably more frequently when a change in status occurs.

The four data elements used to convey linkage information are defined as follows:

LA - Linkage Actuator (see figures 40, 41 and 42)

This bit is set to one to inform the receiver that the program service (indicated by PI(ON) in block 4) is linked to the set of services described by LSN, the Linkage Set Number, at the present moment. If this bit is set to zero, a potential future link is indicated, i.e. the link becomes active at some time in the future. The receiver may then use the linkage data to determine those services for which EON data might usefully be acquired.

EG - Extended Generic indicator (see figures 41 and 42)

This bit is set to one to inform the receiver that the program service, defined in block 4 of a type 14A group is a member of an extended generic set. Such a set comprises program services which are related (e.g. by common ownership, or a similar format) - but which do not necessarily carry the same audio.

An extended generic set is characterized by PI codes of the form WXYZ, where W is the common country code, X is the area code (and must lie in the range R1 to R12), Y is common to all such related services, and Z may assume any value.

ILS - International Linkage Set indicator (see figures 41 and 42)

In case of an international link, the indicator ILS (bit b_{12} of block 3 in variant 12 of group type 14A) will be set to one.

LSN - Linkage Set Number (see figures 41 and 42)

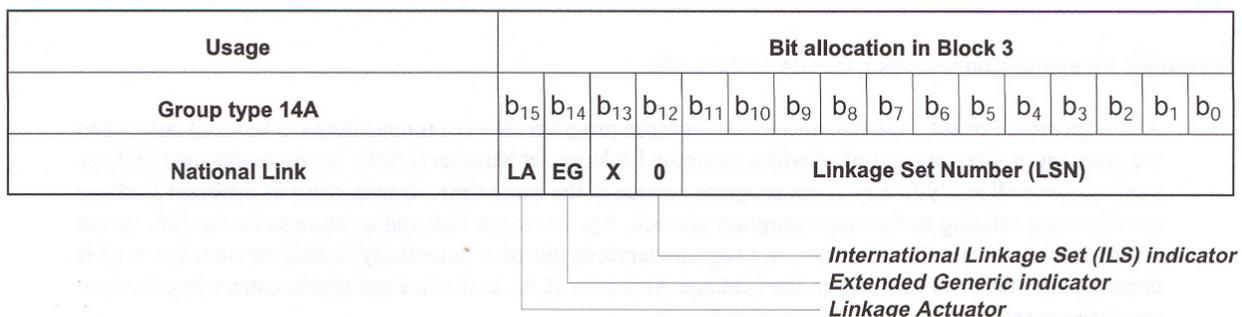
This 12 bit number is carried in block 3 of variant 12 of type 14A groups. The LSN, when non-zero, is common to those program services which may be linked together as a set according to the status of the Linkage Actuator, either active (LA=1) or potential (LA=0, i.e. the link becomes active at some time in the future).

The special case of LSN=0 is used as a default condition, and two or more services sharing LSN=0 are not linked.

The LSN may be used to link together two or more programs either nationally or internationally.

Figure 41: Structure of variant 12 of block 3 of type 14A groups (linkage information) - National link

- National link (ILS=0)



If two or more program services with the same country code carry the same non-zero LSN and their

respective LA bits are set to one, then the receiver may assume that the program services are carrying the same audio.

- International link (ILS=1)

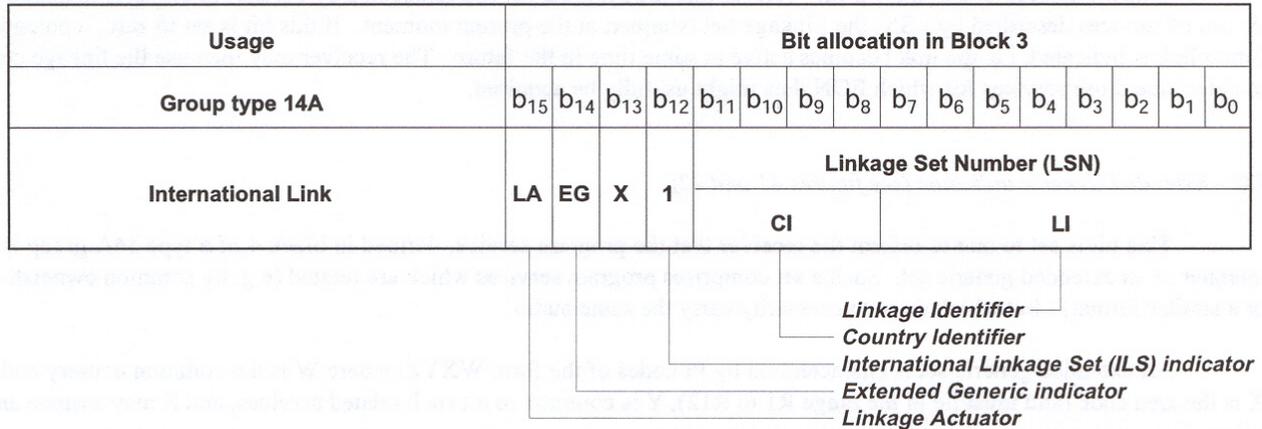


Figure 42: Structure of variant 12 of block 3 of type 14A groups (linkage information) - International link

In this case of an international link, the LSN is deemed to comprise two elements:

CI-Country Identifier: Bits b₁₁ to b₈ of block 3 shall be the country code of one of the two (or more) participating countries. For example, if Switzerland and Italy share a program, they shall choose either HEX 4 or 5 for CI, and then agree on bits b₇ to b₀ for a unique Linkage Identifier (LI).

LI-Linkage Identifier: Bits b₇ to b₀ are used to relate program services internationally, and shall be agreed between the countries concerned. Such services share the same CI and LI.

When two or more program services with the same or different country codes carry the same non-zero Linkage Set Number and their respective ILS and LA bits are set to one, then the receiver may assume that the program services are carrying the same audio.

In figures 41 and 42 the bit indicated by "X" is not assigned to the linkage application and may be assumed to be in either state.

Conventions for application regarding the use of the LSN:

A link (potential or active) between any two or more program services is considered to be valid only when the program services are all linked with a common Linkage Set Number (LSN). No more than one Linkage Set Number will apply to any given program service at the same time. Interleaving of different Linkage Set Numbers relating to the same program service, e.g. an active link and a future potential link, is not permitted. An active link between m program services out of n potentially linked services (m < n) is considered to be valid only when the Linkage Actuators (LA) in the linkage words concerning those m services are set to one.

3.2.2 Coding and use of information for display

Code tables for the displayed 8-bit text characters relating to the Program Service name, Radiotext, Program Type Name and alphanumeric Radio Paging are given in annex E.

The Program Service name comprises eight characters. It is the primary aid to listeners in program service identification and selection. The Program Service name is to be used only to identify the station or station program. This text may be changed as required by the station, but shall not be scrolled or flashed or altered in a manner that would be disturbing or distracting to the viewer (i.e. not more frequently than once per minute).

Radiotext messages potentially can be distracting to a car driver. For safety, manufacturers of car radios must ensure that display of Radiotext should only be available when specially enabled by the car user. The default mode should be set to off.

3.2.3 Coding of Clock Time and date

The transmitted clock-time and date shall be accurate; otherwise the transmitted CT codes shall all be set to zero.

In order to avoid ambiguity when radio-data broadcasts from various sources are processed at one point (e.g. reception from multiple time zones), and to allow calculations of time intervals to be made independent of time zones and summer-time discontinuities, the broadcast time and date codes will use Coordinated Universal Time (UTC) and Modified Julian Day (MJD). A coded local time-difference, expressed in multiples of half-hours is appended to the time and date codes.

Conversion between the Modified Julian Day date and UTC time codes and the various calendar systems (e.g. year, month, day, or year, week number, day of week) can be accomplished quite simply by processing in the receiver decoder (see annex G).

3.2.4 Coding of information for Transparent Data Channels⁴

The coding of this information may be decided unilaterally by the operator, to suit the application. Consumer RDS receivers may provide an output of it (e.g. as a serial data stream) for an external device (e.g. a home computer).

⁴MMBS coding may be used as an alternative to RDS coding. MBS messages are variable length ranging from 3 to 8 blocks. The MBS block is structured identically to the RDS block, except that the offset word E consist of all zeros. See annex P, table P.2 - MMBS message. The MMBS group consisting of MBS blocks is modulo-4 length, i.e. 0,4,8,-blocks. For a complete description of RDS/MMBS multiplex sequence, see annex P.

3.2.5 Coding of information for In House applications⁵

The coding of this information may be decided unilaterally by the broadcaster to suit the application. Consumer RDS receivers should entirely ignore this information.

3.2.6 Coding of Radio Paging (RP)⁶

Radio paging is described in detail in annex M.

3.2.6.1. Introduction

The Radio paging system explained here is also described in Specification No. 1301/A694 3798 (issued by Swedish Telecom Radio) [9].

The two Radio paging protocols in this standard are:

- Radio paging as described in annex M, section M.2 and,
- Enhanced Paging Protocol (EPP) as described in annex M, section M.3.

As the Enhanced Paging Protocol is an improvement of Radio paging, upwards compatibility is assumed.

Radio paging offers the following features:

- Radio paging:

- Support for a wide range of message types, including international paging calls,
 - It is possible to use simultaneously more than one program service (up to four) to carry the paging information.
 - This allows flexibility to meet peak demands for the transmission of paging codes,
 - Battery-saving techniques are employed.

- Enhanced Paging Protocol:

- Possibility to support multi operator and/or multi area paging services,
 - Increased battery life time,
 - Implementation of an international Radio paging service,
 - Pager's compatibility with the RBDS standard,
 - Extension of address range capability for a flexible management of a large number of pagers,
 - Increased reliability of the system,
 - Message labeling,
 - Extension of the range of message types.

⁵ Id.

⁶ Id.

3.2.6.2 Identification of paging networks

3.2.6.2.1 No paging on the network

As some fields of type 1A groups are used for paging, either basic or enhanced, and to avoid conflicts with other applications, the following rules must be respected by broadcasters/operators, when type 1A groups are transmitted:

- The 5 bits of the block 2 relative to the paging are set to zero.
- The 4 bits of the block 3 of type 1A group, variant 0, reserved for paging are set to zero.
- When no valid PIN is broadcast, all the five most significant bits of block 4 (day) shall be set to zero.
- Type 1A group, variant 2, shall not be transmitted.

3.2.6.2.2. Paging on the network

- Type 4A group⁷, Clock time and date (CT), is transmitted at the start of every minute.
- Type 1A groups are transmitted at least once per second. All the fields of type 1A groups allow the identification of the paging protocol level:

Radio Paging,
Enhanced Paging Protocol, or
Mixed.

The description of these protocols is detailed in the annex M.

- Type 7A group is used to convey the paging information.
- Type 13A group, which is used to transmit the information relative to the network and the paging traffic, is optional and used only in case of enhanced or mixed paging.

⁷The transmitted CT (see 3.1.5.6 and 3.2.3) must be accurate, otherwise the CT codes must all be set to zero.

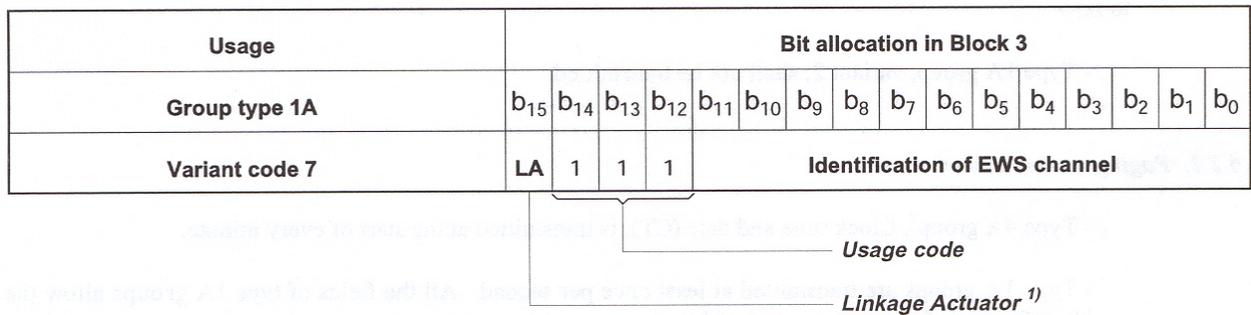
3.2.7 Coding of Emergency warning systems (EWS) ⁸

The information is carried by type 9A groups (see 3.1.5.13) and this service may be independent of the warning and alarm codes (PTY = 30 and PTY = 31).

The type 1A group identification is also required to operate this service, as follows:

Variant 7 in block 3 of the type 1A group (see figure 43) is used to identify the transmission that carries emergency messages to enable specific receivers, evaluating these messages to automatically tune to the corresponding channel. The repetition rate depends on the exact national implementation, but should normally not exceed one type 1A group every two seconds.

Figure 43: Structure of Variant 7 of Block 3 of type 1A groups



¹⁾ The Linkage Actuator is defined in the Method for Linking RDS Program Services (see 3.2.1.8.3)

(Identification of a program carrying EWS information)

⁸ See, supra note 3 (MMBS coding as an alternative to RDS coding)

4 Description of features

4.1 AF - Alternative Frequencies list

The list(s) of alternative frequencies give information on the various transmitters broadcasting the same program in the same or adjacent reception areas, and enable receivers equipped with a memory to store the list(s), to reduce the time for switching to another transmitter. This facility is particularly useful in the case of car and portable radios. Coding of alternative frequencies is explained in 3.2.1.6.2.

4.2 CT - Clock Time and date

Time and date codes should use Coordinated Universal Time (UTC) and Modified Julian Day (MJD). Details of using these codes, which are intended to update a free running clock in a receiver are given in 3.2.3 and annex G. If MJD = 0 the receiver should not be updated. The listener, however, will not use this information directly and the conversion to local time and date will be made in the receiver's circuitry. CT is used as time stamp by various RDS applications and thus it must be accurate.

4.3 DI - Decoder Identification and dynamic PTY indicator

These bits indicate which possible operating modes are appropriate for use with the broadcast audio and to indicate if PTY codes are switched dynamically.

4.4 ECC - Extended Country Code

RDS uses its own country codes (see annexes D and N). The first most significant bits of the PI code carry the RDS country code. The four bit coding structure only permits the definition of 15 different codes, 1 to F (hex). Since there are much more countries to be identified, some countries have to share the same code which does not permit unique identification. Hence there is the need to use the Extended Country Code which is transmitted in Variant 0 of Block 3 in type 1A groups and together with the country identification in bits b_{15} to b_{12} of the PI code render a unique combination. The ECC consists of eight bits.

4.5 EON - Enhanced Other Networks information

This feature can be used to update the information stored in a receiver about program services other than the one received. Alternative frequencies, the PS name, Traffic Program and Traffic Announcement identification as well as Program Type and Program Item Number information can be transmitted for each other service. The relation to the corresponding program is established by means of the relevant Program Identification (see 3.2.1.8). Linkage information (see 3.2.1.8.3), consisting of four data elements, provides the means by which several program services may be treated by the receiver as a single service during times a common program is carried. Linkage information also provides a mechanism to signal an extended set of related services.

4.6 EWS - Emergency Warning System

The EWS feature is intended to provide for the coding of warning messages. These messages will be broadcast only in cases of emergency and will only be evaluated by special receivers (see 3.2.7).

4.7 IH - In House application

This refers to data to be decoded only by the operator. Some examples noted are identification of transmission origin, remote switching of networks and paging of staff. The applications of coding may be decided by each operator itself.

4.8 M/S - Music Speech switch

This is a two-state signal to provide information on whether music or speech is being broadcast. The signal would permit receivers to be equipped with two separate volume controls, one for music and one for speech, so that the listener could adjust the balance between them to suit his individual listening habits.

4.9 ODA - Open Data Applications

The Open Data Applications feature (see 3.1.4) allows data applications, not previously specified in EN 50067, to be conveyed in a number of allocated groups in an RDS transmission. The groups allocated are indicated by the use of type 3A group which is used to identify to a receiver the data application in use in accordance with the registration details in the EBU/RDS Forum - Open Data Applications Directory, and the NRSC Open Data Applications Directory (see annex L).

4.10 PI - Program Identification

This information consists of a code enabling the receiver to distinguish between countries, areas in which the same program is transmitted, and the identification of the program itself. The code is not intended for direct display and is assigned to each individual radio program, to enable it to be distinguished from all other programs. One important application of this information would be to enable the receiver to search automatically for an alternative frequency in case of bad reception of the program to which the receiver is tuned; the criteria for the change-over to the new frequency would be the presence of a better signal having the same Program Identification code.

4.11 PIN - Program Item Number

The code should enable receivers and recorders designed to make use of this feature to respond to the particular program item(s) that the user has preselected. Use is made of the scheduled program time, to which is added the day of the month in order to avoid ambiguity (see 3.2.1.7).

4.12 PS - Program Service name

This is the label of the program service consisting of not more than eight alphanumeric characters coded in accordance with annex E, which is displayed by RDS receivers in order to inform the listener what program service is being broadcast by the station to which the receiver is tuned (see 3.1.5.1). An example for a name is "Radio 21". The Program Service name is not intended to be used for automatic search tuning and must not be used for giving sequential information.

4.13 PTY - Program TYpe

This is an identification number to be transmitted with each program item and which is intended to specify the current Program Type within 31 possibilities (see annex F). This code could be used for search tuning. The code will, moreover, enable suitable receivers and recorders to be pre-set to respond only to program items of the desired type. The last number, i.e. 31, is reserved for an alarm identification which is intended to switch on the audio signal when a receiver is operated in a waiting reception mode.

4.14 PTYN - Program TYpe Name

The PTYN feature is used to further describe current PTY. PTYN permits the display of a more specific PTY description that the broadcaster can freely decide (e.g. PTY=4: Sport and PTYN: Football). The PTYN is not intended to change the default eight characters of PTY which will be used during search or wait modes, but only to show in detail the program type once tuned to a program. If the broadcaster is satisfied with a default PTY name, it is not necessary to use additional data capacity for PTYN. The Program Type Name is not intended to be used for automatic PTY selection and must not be used for giving sequential information.

4.15 RP - Radio Paging

The RP feature is intended to provide radio paging using the existing VHF/FM broadcasts as a transport mechanism, thereby avoiding the need for a dedicated network of transmitters. Subscribers to a paging service will require a special pocket paging receiver in which the subscriber address code is stored.

The detailed coding protocols are given in annex M.

4.16 RT - RadioText

This refers to text transmissions coded in accordance with annex E, primarily addressed to consumer home receivers, which would be equipped with suitable display facilities (see 3.2.2).

4.17 TA - Traffic announcement identification

This is an on/off switching signal to indicate when a traffic announcement is on air. The signal could be used in receivers to:

- a) switch automatically from any audio mode to the traffic announcement;
- b) switch on the traffic announcement automatically when the receiver is in a waiting reception mode and the audio signal is muted;
- c) switch from a program to another one carrying a traffic announcement, according to those possibilities which are given in 3.2.1.3 or 3.2.1.8.2.

After the end of the traffic announcement the initial operating mode will be restored

4.18 TDC - Transparent Data Channels

The transparent data channels consist of 32 channels which may be used to send any type of data.

4.19 TMC - Traffic Message Channel

This feature is intended to be used for the coded transmission of traffic information. The coding is separately defined by a standard issued by CEN [prENV 12313] (see 3.1.5.12).

4.20 TP - Traffic Program identification

This is a flag to indicate that the tuned program carries traffic announcements. The TP flag must only be set on programs which dynamically switch on the TA identification during traffic announcements. The signal shall be taken into account during automatic search tuning.

4.21 Mobile Search (MBS) (Mobilsökning)

The Swedish Telecommunications Administration (Televerket) Specification for the Swedish Public Radio Paging System.

4.22 Modified MBS (MMBS)

MBS modified for time multiplexing with RDS.

5 Marking

Equipment using RDS features should be marked with one of the symbols given in annex K.

Europe - Copyright of these symbols is owned jointly by the European Broadcasting Union and the British Broadcasting Corporation. These organizations freely grant permission to use these symbols to all manufacturers of RDS equipment to be used on equipment conforming to this specification, in whole or in part, and upon literature and packaging relating to such products.

U.S.A. - Trademark of these symbols is owned by the National Association of Broadcasters on behalf on the National Radio Systems Committee. Manufacturers wishing to use these symbols must obtain certification that the products or equipment conform to this specification. Contact:

RDS Certification Program
c/o Consumer Electronics Association
2500 Wilson Boulevard
Arlington, VA. 22201

Phone: (703) 907-7500

6 AM RDS

This section is reserved for the inclusion of dynamic data transmission methods which will allow AM broadcast stations to transmit RDS data and dynamically participate in RDS features. The NRSC will study various AM RDS data transmission schemes, from time to time, as they are presented to the NRSC. The NRSC reserves the right to include material within this Section relevant to AM data systems that can co-exist with all aspects of this Standard.

7 In-Receiver Database System (I-RDS)

The material in Section 7 and Annex R is proprietary and requires the acquisition of a license from its owner for its implementation in hardware, firmware and/or software.

The in-receiver database system (I-RDS) permits the automatic identification of any station and offers format scanning in both AM and FM. (See Annex R for implementation details.)

7.1 Architecture

I-RDS consists of a database of information relating to radio stations stored in read-only memory (ROM) and of a database of contingent updating information stored in a random-access memory (RAM). The ROM and the RAM are accessed by the receiver's central processor unit (CPU).

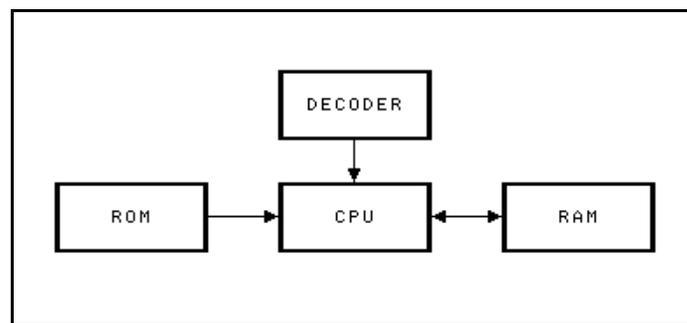


Figure 44 - Hardware architecture

The ROM database is burned-in during manufacture. The update data is collected by the RDS decoder from the open data application identified by AID code C563 and stored in the RAM.

The ROM database describes the AM and FM radio stations which are broadcasting in the continent in terms of:

- Call sign
- Frequency and band
- Format (usual PTY)
- RDS update capability
- City and state of license

In addition the ROM contains a description of a large number of cities in terms of:

- City and country (ISO2) or state (North America) abbreviation
- Latitude and longitude

The RAM database consists of updating data and the location (address) at which the ROM data it supersedes is located.

7.2 Automatic Identification and Updates

- While tuned to an RDS station, the receiver uses the RDS data available in the subcarrier.
- If the RDS station is also an update giving station, any relevant update can be collected from the open data application identified by AID code C563 and stored in the RAM.
- If tuned to any other (non-RDS) station -- whether in AM or FM, the receiver uses the ROM database, checking the RAM for updated information, if any.

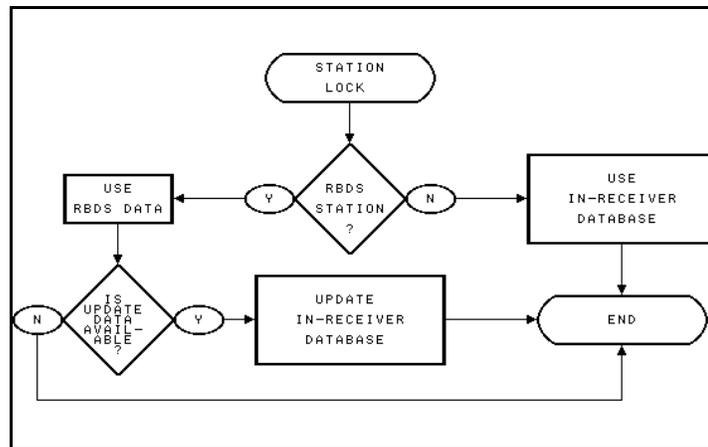


Figure 45 - RDS vs. I-RDS decision

7.3 PTY/Format Scanning

Although PTY (program type) and format mean essentially the same thing, they do adopt different meanings within RDS and I-RDS:

Within RDS, the PTY means the type of program which is currently being broadcast; whereas within I-RDS, the format of a station means the type of program which is generally broadcast by that station. As the RDS data is very dynamic, when the user initiates a PTY search, the RDS system must first scan the participating stations in the FM band to determine if the desired program type is being currently broadcast; whereas I-RDS can immediately find in the database if the desired format is available -- in either band.

Since there are advantages in both approaches, it is suggested that a switch be provided for the user to choose the preferred method.

7.4 Automatic/Manual Update

As mentioned above, part of the ROM data describing a station indicates whether that station is an update-giving station (Updating Station) or not. I-RDS is thus capable to tune itself to an Updating Station either automatically or on demand.

Several modes of update seeking can be offered in the receiver:

- Automatic update 1: When the receiver is turned off (preferred) and before going to sleep, it can immediately tune itself to the local Updating Station and load whatever update is relevant.
- Automatic update 2: When the receiver is turned on and before resuming normal operation.
- Automatic update 3: If a in-receiver clock is available, the receiver can wake up at a predetermined time (e.g., at 4:00 AM) and seek any relevant update.
- Automatic update 4: Whenever the receiver travels into new territory (see below), it can seek the Updating Station serving that new area and load any relevant update.
- Manual update: Whenever an Update key is actuated by the user.

7.5 Geographical Reference

For geographical reference, a continent is divided into a matrix of rectangles of $\frac{1}{2}$ degree latitude by $\frac{1}{2}$ degree longitude resolution. Each rectangle (Grid) is coded by a unique number which identifies both station location and the location of the receiver at any given time.

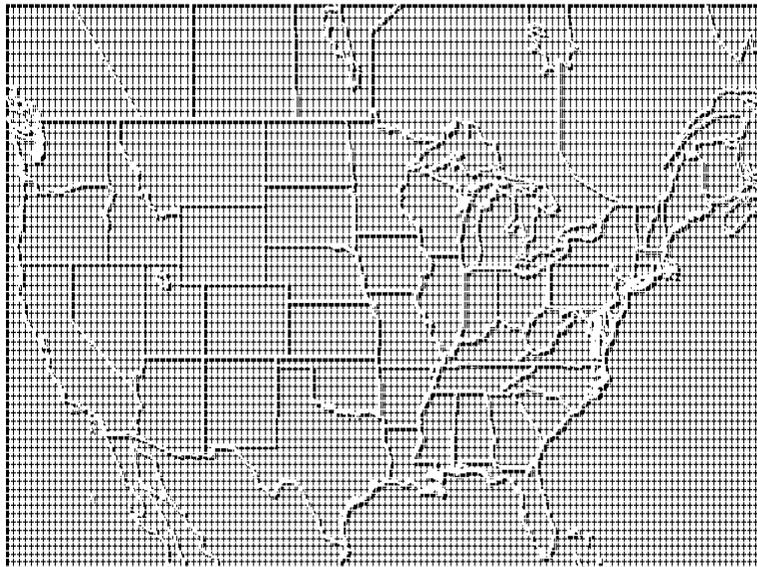


Figure 46 - Grid system

When searching the ROM for information on local radio stations, the processor typically first searches the Grid defined by the location of the receiver (e.g., Baltimore in Figure 47). Then it searches in the eight Grids directly contiguous to that location.

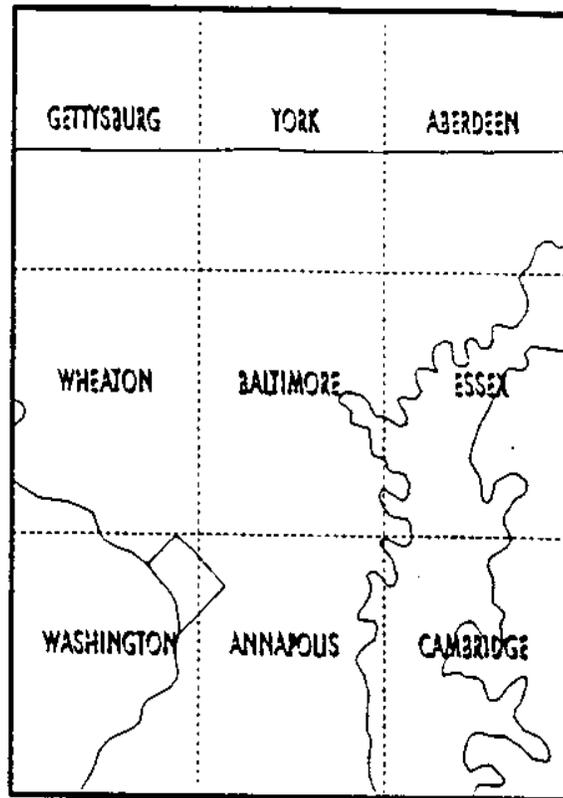


Figure 47 Nine-grid pattern example

Upon installation, the user must be able to pick the name of the city defining his or her location. This is achieved by scrolling through a displayed alphabetical listing of states, and then, likewise, through a list of cities within the state of interest. Each city is referenced in the ROM by its unique Grid number. This provides I-RDS with the center location of the nine-grid system as described above. Then, if the receiver travels outside of its original Grid, the user must be able to press one (or two) of four compass keys (i.e., N/E/S/W) to indicate the general direction of travel. In the absence of any RDS station in the area and given the grid resolution of $\frac{1}{2}$ degrees latitude and longitude, this direction entry may be needed at most every 30 miles or so.

A well designed system should provide feedback to the user upon the actuation of a compass key. This is achieved by displaying the largest city in the new grid as described in Figure R.9 and section R.12.5.

Note: Alternatively, it is possible to license an automatic positioning system which determines the receiver's location based on the active frequencies at that location. This system can be used both to automatically set the location of the receiver, upon installation, and to automatically track its movement while driving.

7.6 - I-RDS ROM Structure

A 2 megabit (256 kilobyte) ROM is required to store the in-receiver database.

As seen in the following figure, the database is composed of the following files:

- Header File
- Format File
- Map File
- State/Country File
- City File
- AM Band File
- FM Band File

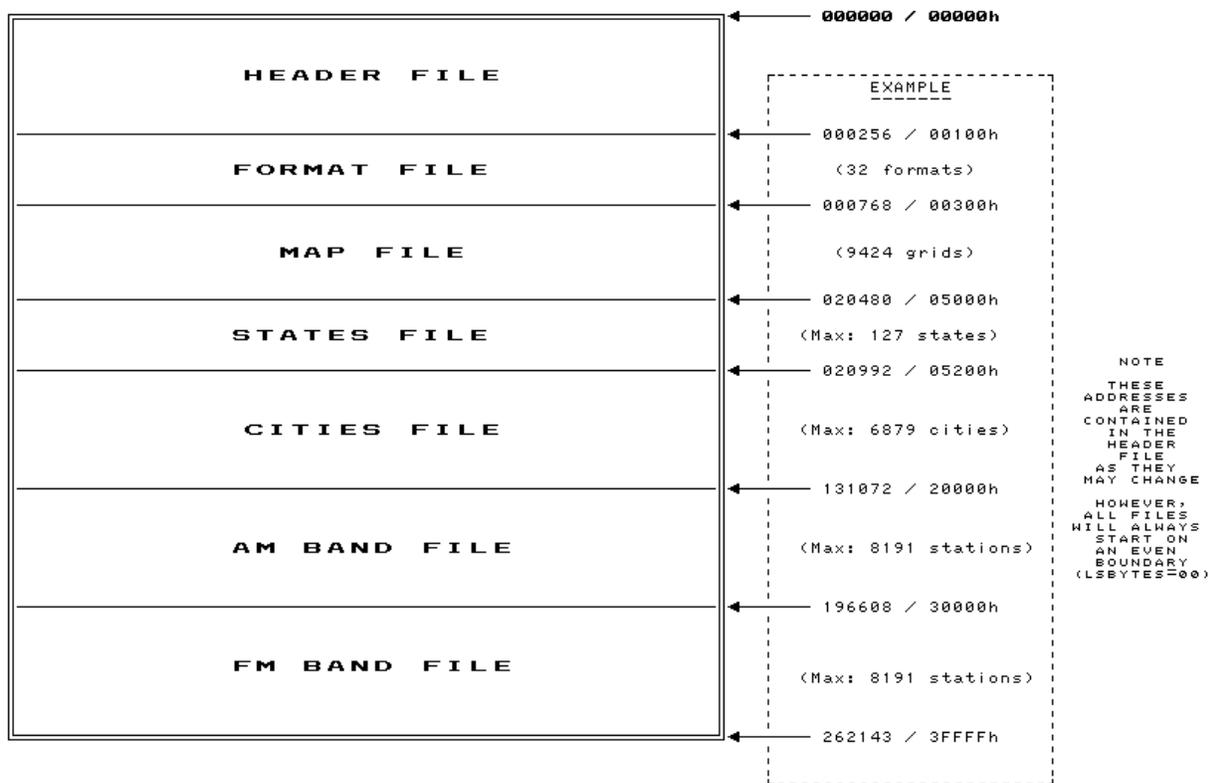


Figure 48 - 256 kilobyte ROM structure

The addresses shown in Figure 48 are contained in the Header File as they may change. However, all files will always start on an even boundary (L.S. Bytes = 00 or modulo 100hex).

All I-RDS files are discussed in detail in Annex R.

7.7 Update Transmissions

Updates can be stored manually or received automatically via the open data application identified by AID code C563. See section 3.1.4 for a description of the Open Data Application / Applications Identification. Figure 49 illustrates the five steps required before loading an update:

- Step 1: Lock onto an FM station
- Step 2: It must be an RDS station
- Step 3: Wait for a Group 3A - AID code C563
- Step 4: The ROM class number must match that of the receiver's
- Step 5: The update serial number must be different from any stored during previous updates.

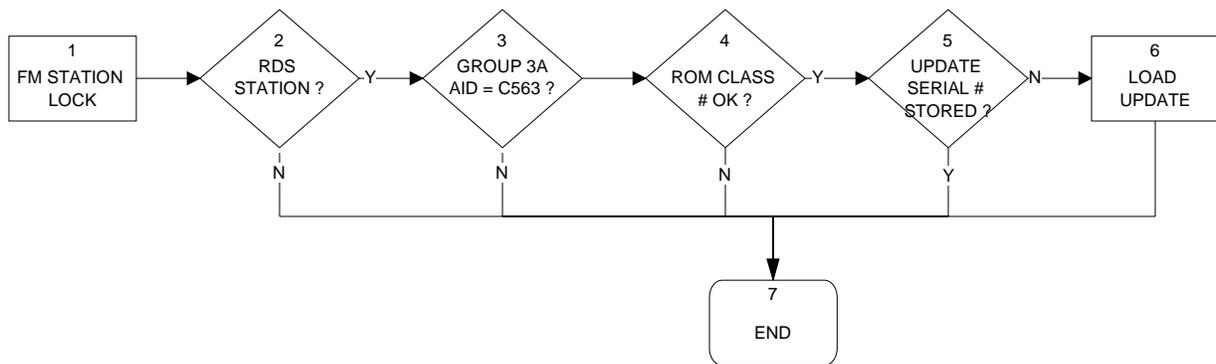


Figure 49 - Relevant Update Search

7.7.1 Transmission scope

Each update transmitted contains updates concerning the stations in the 1 to 81 grids surrounding the Updating Station (depending on the density of Updating Stations).

There are two kinds of updates:

- Total updates: These updates convey all changes that occurred in the region since the manufacture of the ROM.
- Partial updates: These updates convey all changes that occurred in the region since the previous partial update.

7.7.2 Transmission structure

The I-RDS data updates are obtained via the RDS open data application feature. I-RDS updates are signaled via an AID code equal to C563. This application operates in Mode 1.1, utilizing A type groups for update data transmission. Critical update information is also contained within Group 3A as outlined below.

7.7.3 Group 3A data structure

The following I-RDS specific information is contained within group 3A:

1. The I-RDS application identification code(AID), C563
2. The ROM class number to which the update is destined (5 bits)
3. The serial number of the update transmission (10 bits)
4. The scope flag of the update: partial or total (1 bit)

Figure 50 depicts the structure of I-RDS open data application; group type 3A.

3. Erase record (Channels 5-6) - Previously stored records may be entirely erased using this feature. ROM records are indicated by the address pointer only (Channel 5), while RAM records (Channel 6) are indicated by the ASCII call sign of the station to be deleted.

4. New record (Channels 7-9) - An entirely new record may be stored through this type of update. All the data required to establish a new record is contained within the new record update channels.

5. End of message, or EOM (Channel 31) - The hex code FF is transmitted at the end of the update. This may be utilized by the receiver in verifying the proper receipt of the entire update message.

Note: Channels 10-30 are reserved for future use. All unused bits shall be set to a logic 0.

DESCRIPTION	ADDRESS CODE (BLOCK 2)	BLOCK 3 DATA		BLOCK 4 DATA	
		BYTE 1	BYTE 2	BYTE 1	BYTE 2
UPDATE IDENTIFIER	0	GRID (14 bits)	COVERAGE (2 bits)	UPDATE LENGTH	
UPDATE DATA	1	POINTER		CHANNEL	UNUSED
	2	POINTER		BYTE 1, CALL SIGN	BYTE 2, CALL SIGN
	3	POINTER		BYTE 3, CALL SIGN	BYTE 4, CALL SIGN
	4	POINTER		UNUSED	FORMAT
ERASE ROM RECORD	5	POINTER		UNUSED	UNUSED
ERASE RAM RECORD	6	BYTE 1, CALL SIGN	BYTE 2, CALL SIGN	BYTE 3, CALL SIGN	BYTE 4, CALL SIGN
NEW RECORD	7	GRID		CHANNEL	FORMAT
	8	BYTE 1, CALL SIGN	BYTE 2, CALL SIGN	BYTE 3, CALL SIGN	BYTE 4, CALL SIGN
	9	CITY POINTER		UNUSED	
RESERVED FOR FUTURE USE	10-30	RESERVED			
EOM	31	FF	UNUSED	UNUSED	

Figure 51 - I-RDS Open Data Application group structure (Mode 1.1)

7.7.4.1 - Center Grid of updated region: The first 14 bits of block 3 (MSB → LSB) of channel 0 identifies the number of the Grid at the center of the region whose stations' data is being updated. (See sections 7.5, R.9 and R.12.5) This number ranges from 0 to 16383.

Note: 14 bits are required as the standard Grid system contains a total of 9424 Grids.

7.7.4.2 - Coverage index: The width of the area which is addressed by an update may vary. This is provided since the density of stations throughout the continent is not equal. Within a densely populated area with many stations, the update coverage may be kept small (e.g., 1 Grid -- a rectangular area with sides of about 34 miles), whereas a region with very few stations should permit the updating of a much larger geographical region (e.g., 81 Grids -- a rectangular area of sides of about 310 miles). This data is carried in the last two significant bits of block 3 of channel 0.

The coverage index is contained in the last two bits of block 3 of channel 0.. It can have the following values:

00 _b	=	0	=	1 Grid
01 _b	=	1	=	9 Grids (3 by 3)
10 _b	=	2	=	25 Grids (5 by 5)
11 _b	=	3	=	81 Grids (9 by 9)

7.7.4.3 - Update length: This 16-bit code indicates the length (in bytes) of the update message which is to be sent. This number ranges from 0 to 65535.

7.7.4.4 - Pointer: This 16-bit code contains a pointer which references the ROM address which is occupied by the record to be updated. All update data is preceded by such an address except for New Station data, Erase RAM record, and EOM which signifies the end of the update message.

Note 1: The pointer must be multiplied by 4 to get a real address. (See section R.13.1.3)

Note 2: The EOM mark (FF_{16}) can be used to double-check the integrity of the received update data message as it must correlate with the update length. (See section 7.7.4.3)

NRSC Document Improvement Proposal

If in the review or use of this document a potential change appears needed for safety, health or technical reasons, please fill in the appropriate information below and email, mail or fax to:

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