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Edition 2.0 2021-02

INTERNATIONAL STANDARD

Radio data system (RDS) – VHF/FM sound broadcasting in the frequency range from 64,0 MHz to 108,0 MHz – Part 2: Message format: coding and definitions of RDS features

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Part 2: Message format: coding and definitions of RDS features

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RADIO DATA SYSTEM (RDS) – VHF/FM SOUND BROADCASTING IN THE FREQUENCY RANGE FROM 64,0 MHz TO 108,0 MHz –

Part 2: Message format: coding and definitions of RDS features

FOREWORD

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IEC 62106-2 has been prepared by technical area 1: Terminals for audio, video and data services and contents, of IEC technical committee 100: Audio, video and multimedia systems and equipment. It is an International Standard.

This second edition cancels and replaces the first edition published in 2018. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC 62106-2:2018:

a) Subclause 4.2.4 has been added;
b) Tables 1 and 13 have been modified;
c) The new function RDS2 file transfer has been added and it is detailed in Annex C; this uses a CRC-16, which is specified in Annex D.

The text of this International Standard is based on the following documents:

CDV	Report on voting
100/3464/CDV	100/3547/RVC

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

A list of all parts in the IEC 62106 series, published under the general title *Radio data system (RDS) – VHF/FM sound broadcasting in the frequency range from 64,0 MHz to 108,0 MHz*, can be found on the IEC website.

The language used for the development of this International Standard is English,

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

Since the mid-1980s, a fascinating development has taken place. Most of the multimedia applications and standards have been created or redefined significantly. Hardware has become extremely powerful with dedicated software and middleware. In the mid-1980s, Internet as well as its protocols did not exist. Navigation systems became affordable in the late 1990s, and a full range of attractive smartphones now exist. The computing power of all these new products is comparable with that of the mainframe installations in that era.

Listener expectations have grown faster than the technology. Visual experience is now very important, like the Internet look and feel. Scrolling text or delivering just audio is nowadays perceived as insufficient for FM radio, especially for smartphone users. New types of radio receivers with added value features are therefore required. RDS has so far proven to be very successful.

FM radio with RDS is an analogue-digital hybrid system, which is still a valid data transmission technology and only the applications need adaptation. Now the time has come to solve the only disadvantage, the lack of sufficient data capacity. With RDS2, the need to increase the data capacity can be fulfilled.

RDS was introduced in the early 1980s. During the introductory phase in Europe, the car industry became very involved and that was the start of an extremely successful roll-out. Shortly afterwards, RDS (RBDS) was launched in the USA [1, 2, 3, 4, 5][1] .

The RDS Forum has investigated a solution to the issue of limited data capacity. For RDS2, both sidebands around the RDS 57 kHz subcarrier can be repeated a few times, up to three, centred on additional subcarriers higher up in the FM multiplex while still remaining compatible with the ITU Recommendations.

The core elements of RDS2 are the additional subcarriers, which will enable a significant increase of RDS data capacity to be achieved, and then only new additional data applications will have to be created, using the RDS-ODA feature, which has been part of the RDS standard IEC 62106 for many years.

In order to update IEC 62106:2015 to the specifications of RDS2, IEC 62106 has been restructured as follows:

Part 1: Modulation characteristics and baseband coding

Part 2: RDS message format, coding and definition of RDS features

Part 3: Usage and registration of Open Data Applications ODAs

Part 4: Registered code tables

Part 5: Marking of RDS and RDS2 devices

Part 6: Compilation of technical specifications for Open Data Applications in the public domain

Part 9: RBDS – RDS variant used in North America

Part 10: Universal Encoder Communication Protocol UECP

The original specifications of the RDS system have been maintained and the extra functionalities of RDS2 have been added.

The presentation in Parts 1, 2 and 3 follows the OSI basic reference model for information processing systems [6].

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1 Numbers in square brackets refer to the Bibliography.

RADIO DATA SYSTEM (RDS) – VHF/FM SOUND BROADCASTING IN THE FREQUENCY RANGE FROM 64,0 MHz TO 108,0 MHz –

Part 2: Message format: coding and definitions of RDS features

1 Scope

This part of IEC 62106 defines the coding and definition of features for the Radio Data System (RDS).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62106 (all parts), *Radio Data System (RDS) – VHF/FM sound broadcasting in the frequency range from 64,0 MHz to 108,0 MHz*

ISO/IEC 10646, *Information technology – Universal Coded Character Set (UCS)*

ISO 14819 (all parts), *Intelligent transport systems – Traffic and travel information messages via traffic message coding*

3 Terms, definitions, abbreviated terms and conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62106-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.2 Abbreviated terms

For the purposes of this document, the abbreviated terms given in IEC 62106-1 and the following apply.

AF Alternative Frequency

NOTE 1 Alternative Frequencies are given in the form of lists (method A or B or mapped).

AID Application IDentification for ODAs

CI Country Identifier

CRC-16 16 bit Cyclic Redundancy Check

CT Clock Time

NOTE 2 In RDS, Clock Time includes the date.

DI Decoder Identification

ECC Extended Country Code

EG Extended Generic indicator

EON Enhanced Other Network information

eRT enhanced RadioText

EWS Emergency Warning System

NOTE 3 EWS was used in previous editions of IEC 62106. It can now be an ODA.

FH Function Header in group type C composed of FID and FN

FID Function Identifier

FN Function Number

hex hexadecimal

IH In-House application

NOTE 4 IH was used in previous editions of IEC 62106. It can now be an ODA.

ILS International Linkage Set indicator

LA Linkage Actuator

LI Linkage Indicator

LPS Long Programme Service name

lsb least significant bit or least significant byte

LSN Linkage Set Number

MS Music Speech switch

NOTE 5 MS was used in previous editions of IEC 62106. It is now obsolete.

msb most significant bit or most significant byte

ODA Open Data Application

ON Other Network

PI Programme Identification

PIN Programme Item Number

NOTE 6 PIN was used in previous editions of IEC 62106. It is now obsolete.

PS Programme Service name

PTY Programme Type

PTYI Programme Type Indicator

PTYN Programme Type Name

RFT RDS2 File Transfer protocol

rfu reserved for future use

RP Radio Paging

NOTE 7 RP was used in previous editions of IEC 62106. It is now obsolete.

RT RadioText

RT+ RadioText plus

TA Traffic Announcement

TDC Transparent Data Channel

NOTE 8 TDC was used in previous editions of IEC 62106. It can now be an ODA.

TMC Traffic Message Channel

TN Tuned Network

TP Traffic Programme

3.3 Notation and conventions

The notation and conventions given in IEC 62106-1 apply.

4 Message format

4.1 Design principles

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

a) The original single RDS data-stream (now referred to as data-stream 0) has been supplemented by three new RDS data-streams referred to as data-streams 1, 2 and 3. Data-stream 0 will continue to only carry group types A and B (referred to as legacy data). Data-streams 1, 2 and 3 will only carry a new group type C. Legacy data groups A and B can be carried on data-streams 1, 2 and 3, but first need to be packaged within a type C group, using a mechanism referred to as "tunnelling".

b) The mixture of different kinds of messages within any type A or B group is minimized. For example, 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.

c) Data that has to be acquired quickly for receiver operation and for which a short acquisition time is required, for example Programme Identification (PI), Programme Type (PTY), and Traffic Programme flag (TP) are transmitted frequently and are always transmitted in data-stream 0. In data-stream 0, these features are present in every group and occupy the same fixed positions. They can therefore be decoded without reference to any block outside the one which contains the information.

d) The Programme Service name (PS), a fundamental feature of RDS, is also always transmitted in data-stream 0, using a fixed group type – 0A or 0B for the short form, 15A for the longer (UTF-8, see ISO/IEC 10646) form. By having a fixed group type (i.e. not an ODA), the PS name can be decoded without reference to any other group.

e) For compatibility with existing receivers, other RDS features will continue to use fixed group types and be transmitted in data-stream 0. These include Slow-labelling (1A), Clock-time (4A), RadioText (2A or 2B), PTYN (10A), EON (14A and 14B) and TA status control bursts (15B).

f) The practice of allowing future applications to be defined by using an Open Data Application has been extended, and the data formatting has been made more flexible. In addition to an Open Data Application (see IEC 62106-3) using legacy group types A or B in data-stream 0 (see Table 2), a new group type C Open Data Application has been specified to allow greater data capacity in data-streams 1, 2 and 3.

g) Open Data Applications defined by group types A or B can be carried in any data-stream 0, 1, 2 and 3, although use of data-streams 1 – 3 requires the use of tunnelling.

h) Open Data Applications defined by group type C can only be carried in data-streams 1, 2 and 3. The essential core RDS features (PI, PTY, PS, etc.) will always be transmitted in data-stream 0 in every programme service using group types A or B.

i) The application identification AID which identifies an Open Data Application shall be sent at least once every 5 s.

j) There is no fixed rhythm of repetition of the various types of groups, i.e. there is ample flexibility to interleave the various kinds of messages to suit the needs of the user at any given time and to allow for future developments. However, on data-stream 0, the main RDS features need to use minimum repetition rates specified in Clause 8.

4.2 Group structure

4.2.1 Group type A structure

The group type A structure is illustrated in Figure 1. The main features are the following.

a) The first block in every group always contains a Programme Identification (PI) code.

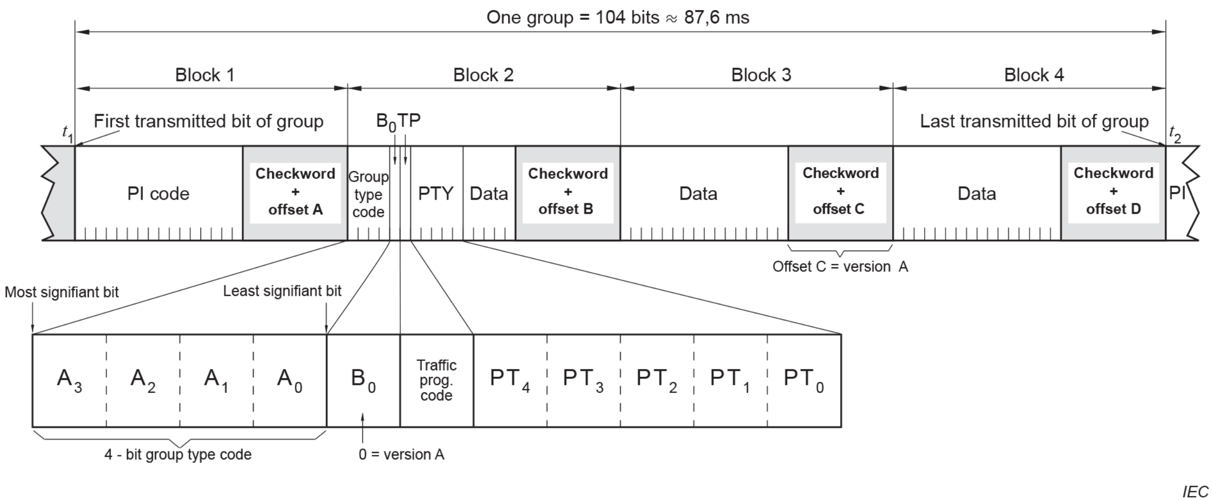
b) The first four bits of the second block of every group are allocated to a 4-bit code which specifies the application of the group. Groups will be referred to as 0 to 15 according to the binary weighting $A_3 = 8$, $A_2 = 4$, $A_1 = 2$, $A_0 = 1$. For each group (0 to 15) two 'versions' can be defined. The 'version' is specified by the fifth bit (B_0) of block 2 as follows:

c) $B_0 = 0$: Defines group type A. The PI code is inserted in block 1 only. This will be called version A, for example group type 0A, 1A, etc.

d) $B_0 = 1$: Defines group type B (see 4.2.2).

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

Within the group type A structure, 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 messages and to retain the advantages of the short (26-bit) block length.



NOTE 1 Block size = 26 bits.

NOTE 2 Checkword + offset 'N' = 10 bit added to provide error protection and block and group synchronization information (see IEC 62106-1).

NOTE 3 $t_1 < t_2$: block 1 of any particular group is transmitted first and block 4 last.

Figure 1 – Group type A structure

Group type A can be used directly in data-stream 0 and has an application data capacity of 37 bits. To use group type A in the upper data-streams 1, 2 and 3, the PI code in block 1 needs to be replaced by 0x0000 to re-define the group as type C utilizing the tunnelling mechanism (see 4.4.1).

4.2.2 Group type B structure

The group type B structure is illustrated in Figure 2. It is similar to the group type A structure with the following differences.

a) The first and third block in every group always contain the Programme Identification (PI) code.

b) The 'version' is specified by bit B_0 of block 2 as follows:

   B_0 = 0: Defines group type A (see 4.2.1).

   B_0 = 1: Defines group type B.

c) In addition to B_0 = 1 a special offset word (which is called C') is used in block 3 of version B groups. The occurrence of offset C' in block 3 of any group can be used to indicate directly that block 3 is a PI code, without any reference to the value of B_0 in block 2.

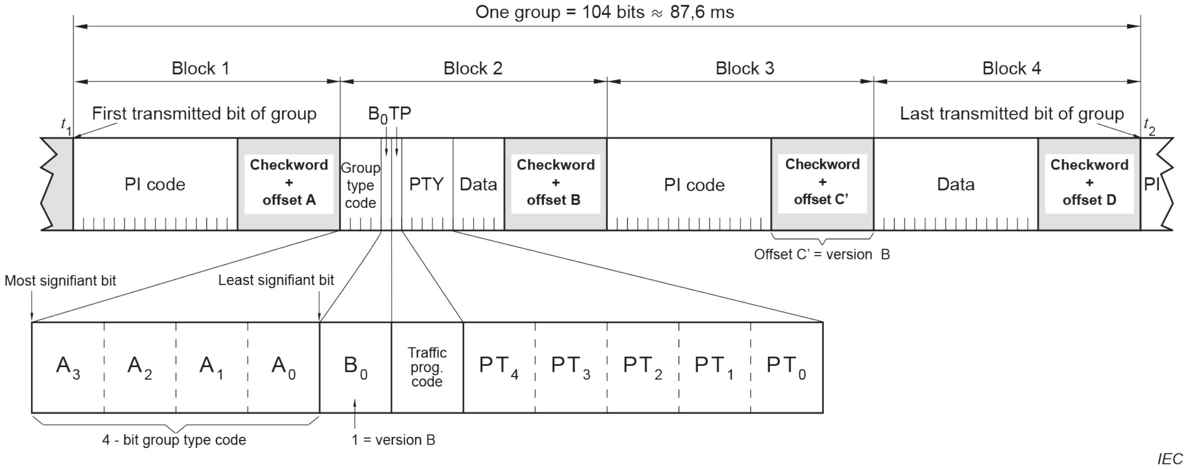
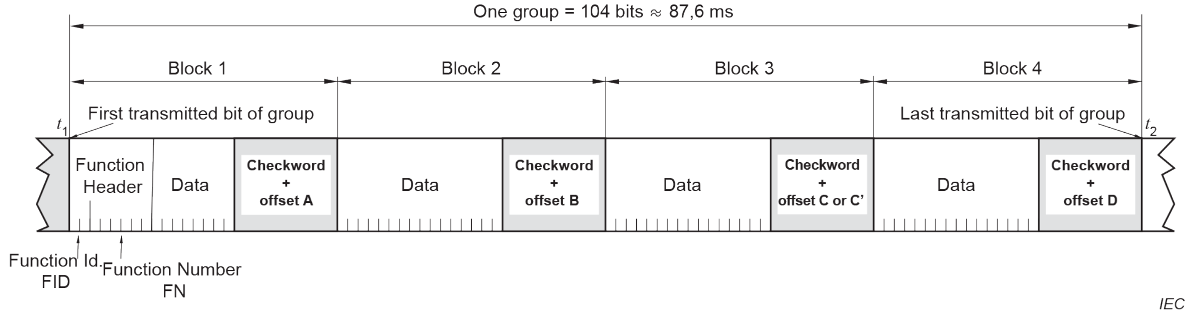


Figure 2 – Group type B structure

The group type B can be used directly in data-stream 0 and has an application data capacity of 21 bits. To use group type B in the upper data-streams 1, 2 and 3, the PI code in block 1 needs to be replaced by 0x0000 to re-define the group as type C utilizing the tunnelling mechanism (see 4.4.1). The PI code in block 3 will be left unchanged.

4.2.3 Group type C structure

The group type C structure is illustrated in Figure 3.



NOTE The Function Header (FH) fully determines the identification of the group.

Figure 3 – Group type C structure

The group type C can only be used on data-streams 1, 2 and 3 and has an application data capacity of 56 bits considered as a 7-byte contiguous data group.

The Function Header (FH) consists of two elements, see Table 1.

– Function Identifier (FID) (2 bits) indicates one of four types of usage (Functions) of the accompanying data contained in the group.
– Function Number (FN) (6 bits) indicates a sub-function of the main Function Identifier and allows for different features of each function. For a given Function Identifier, not all Function Numbers are defined. Undefined Function Numbers are reserved for future use.

Table 1 – Group type C Function Header definition

FID		FN						Meaning of Function Header (FH) FID and FN
b_{15}	b_{14}	b_{13}	b_{12}	b_{11}	b_{10}	b_9	b_8	
0	0	0	0	0	0	0	0	Legacy group type A or B transmission, see 4.4.1
0	0	1	0	y	y	y	y	RFT data group for ODA pipe yyyy, see Annex C 16 pipes/channels are available across data-streams 1 to 3
0	1	y	y	y	y	y	y	Group type C ODA channel, see 4.4.2 64 channels (6 bit: yyyyyy) are available across data-streams 1 to 3. Channels 0 to 15 are reserved for providing additional data. These 16 channels are reserved for ODAs that require additional data in the form of files. This additional data will be sent in FH=0010yyyy using the RFT protocol.
1	0	0	0	0	0	0	0	AID and channel number assignment for group type C ODAs, see 4.4.3
1	1	x	x	x	x	x	x	rfu

4.2.4 RFT ODA pipe/channel

Channel numbers 0 …15 are reserved for ODAs that use external data in the form of files, which are provided using the RFT protocol. The RFT data is transported using a pipe number that equals the ODA channel number.

The assignment of these ODAs will always use assignment method 1, allowing 4 bytes of additional data, see 4.4.3.

For the channel range 0 …15, the data in these bytes is organized in 16 variants, where the first eight variants are reserved for the RFT protocol and the other eight are free to be used by the ODA designer (see Annex C).

4.3 Group type A and B usage

Table 2 – Group type A and B usage

Group type	Group type code and version	Description
0A	0000 0	Basic tuning and switching information with Programme Service name
0B	0000 1	Basic tuning and switching information with Programme Service name
1A	0001 0	Slow labelling codes
1B	0001 1	Open Data Applications
2A	0010 0	RadioText
2B	0010 1	RadioText
3A	0011 0	Application Identification for ODA and 16 bits of ODA data
3B	0011 1	Open Data Applications
4A	0100 0	Clock-time and date
4B	0100 1	Open Data Applications
5A	0101 0	Open Data Applications
5B	0101 1	Open Data Applications
6A	0110 0	Open Data Applications
6B	0110 1	Open Data Applications
7A	0111 0	Open Data Applications
7B	0111 1	Open Data Applications
8A	1000 0	Open Data Applications: Traffic Message Channel or if TMC not used, any other ODA
8B	1000 1	Open Data Applications
9A	1001 0	Open Data Applications
9B	1001 1	Open Data Applications
10A	1010 0	Programme Type Name
10B	1010 1	Open Data Applications
11A	1011 0	Open Data Applications
11B	1011 1	Open Data Applications
12A	1100 0	Open Data Applications
12B	1100 1	Open Data Applications
13A	1101 0	Open Data Applications
13B	1101 1	Open Data Applications
14A	1110 0	Enhanced Other Networks information
14B	1110 1	Enhanced Other Networks information
15A	1111 0	Long Programme Service name
15B	1111 1	Fast switching information

4.4 Group type C usage

4.4.1 Transmitting legacy data using data-streams 1, 2 and 3

FID = 00

FN = 000000

All legacy data (any group type A or B) can be transmitted using the upper data-streams 1, 2 and 3 within the group type C structure.

The two bytes of block 1, traditionally representing the PI code, are both set to 0x00. This "deleted" PI code is always the same as the PI code simultaneously transmitted in block 1 of data-stream 0.

This process of transmitting legacy data using the upper data-streams 1, 2 and 3 is known as "tunnelling".

If the application software at the receiving end requires fully defined groups of type A or B, the PI code from data-stream 0 may be reinserted in block 1, replacing the two 0x00 bytes.

Figure 4 shows the tunnelling structure for group types A and B.

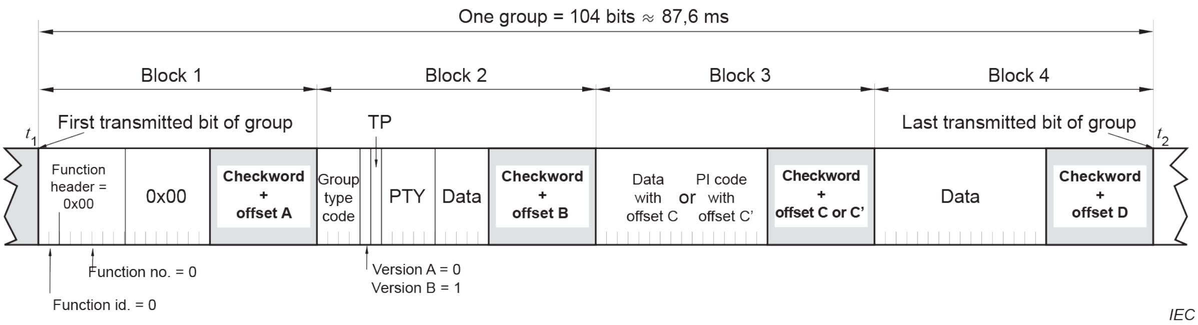


Figure 4 – Tunnelling structure for group types A and B

4.4.2 Transmitting group type C ODA data

FID = 01

FN = yyyyyy (0 … 63)

This Function Header allows group type C ODA data to be sent using channel yyyyyy (0 …63) indicated by the 6 bits of FN, 64 channels in total on data-streams 1, 2 and 3.

The ODA application data content is 7 bytes.

The channel number associates the accompanying 7 bytes of data with a particular AID of a group type C ODA. This is similar to the association made (using group 3A) between the group number and a particular AID of a legacy group type A or B ODA in data-stream 0. For group type C ODAs, the channel number is assigned to an AID as defined below in 4.4.3.

4.4.3 AID and channel number assignment for group type C ODAs

FID = 10

FN = 000000

Conventionally, using group type 3A, a specific ODA is assigned to a group number that is available for ODA use by providing the Application Identification (AID) number and the target group number. An example is 0xCD46 to group type 8A, meaning TMC data (AID=0xCD46) will be transmitted using group type 8A.

Block 3 of group type 3A is available, if required, for 16 bits of application data that belongs to the application which is being assigned.

In data-stream 0, only specific groups are available for ODA use (see Table 2).

Across data-streams 1, 2 and 3, there are in total 64 channels available for ODA use.

Four variants of FID = 10 and FN = 000000 are reserved to assign AIDs to channel numbers, see Table 3 and Table 4. Method 2, 3 or 4 from Table 3 will result in successive channel numbers using an auto-increment function.

Table 3 – Group type C assignment methods used to connect channel numbers with one or more AIDs

Method	Function Header	Variant + Channel id.	AID connection with data channel
	Block 1		Blocks 2, 3 and 4
1	10 000000	00 yyyyyy	Connect data channel yyyyyy with a 16-bit ODA AID in block 2 and provide in addition four application data bytes in blocks 3 and 4.
2	10 000000	01 yyyyyy	Connect two successive data channels (yyyyyy and yyyyyy+1) with a 16-bit ODA AID in block 2 and a second ODA AID in block 4, respectively, and provide in addition two application data bytes in block 3 for the first ODA.
3	10 000000	10 yyyyyy	Connect two successive data channels (yyyyyy and yyyyyy+1) with a 16-bit ODA AID in block 2 and a second ODA-AID in block 3, respectively, and provide in addition two application data bytes in block 4 for the second ODA.
4	10 000000	11 yyyyyy	Connect three successive data channels (yyyyyy, yyyyyy+1 and yyyyyy+2) with a 16-bit ODA AID in block 2, a second ODA AID in block 3 and a third ODA AID in block 4, respectively.

Table 4 shows the four methods described in Table 3 in more detail.

Table 4 – Assignment of up to three successive channel numbers to multiple AIDs

Block 1	Block 2	Block 3	Block 4
10 000000 00yyyyyy	AID	Data (for AID)	Data (for AID)
10 000000 01yyyyyy	AID1	Data (for AID1)	AID2
10 000000 10yyyyyy	AID1	AID2	Data (for AID2)
10 000000 11yyyyyy	AID1	AID2	AID3

EXAMPLE: When using method 4 in Table 3 and yyyyyy equals 0, then AID1 is connected with channel 0, AID2 with channel 1 and AID3 with channel 2.

5 Description of the RDS features

5.1 Alternative Frequencies list (AFs)

The list(s) of Alternative Frequencies give(s) information on the various transmitters broadcasting the same programme service 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 7.5.

5.2 Clock Time and date (CT)

Time and date codes 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 6.5 and Annex B. If MJD = 0, the receiver shall not update the day/date. 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 also used as time stamp by various RDS applications and thus it shall be accurate.

5.3 Dynamic PTY Indicator (PTYI) using DI

This flag is one of four DI flag options. It indicates if PTY codes are switched dynamically (see 7.4).

5.4 Extended Country Code (ECC)

RDS uses its own country codes, composed of a combination of a Country Identifier CI and an Extended Country Code ECC. The first most significant bits of the PI code carry the RDS Country Identifier. The four-bit coding structure only permits the definition of 15 different codes, 0x1 to 0xF. Since there are many more countries to be identified, some countries have to share the same CI code, which does not permit unique identification. Hence, there is the need to use the ECC which is transmitted in group type 1A variant 0, and only both codes together – the CI in bit b_{15} to b_{12} of the PI code and the ECC transmitted in group 1A – render a unique combination. The ECC is an 8-bit code. The codes to be used are given in IEC 62106-4.

5.5 Enhanced Other Networks information (EON)

This feature can be used to update the information stored in a receiver about programme services other than the one being received. Alternative Frequencies, the PS name, Traffic Programme and Traffic Announcement identification as well as Programme Type can be transmitted for each other service. The relation to the corresponding programme service is established by means of the relevant Programme Identification code.

5.6 Linkage information

Linkage information provides the means by which several programme services, each characterized by its own PI code, can be treated by a receiver as a single service during times when a common programme is carried. Linkage information also provides a mechanism to signal an extended set of related services (see Annex A).

5.7 Open Data Applications (ODAs)

Open Data Applications are a very effective and flexible way for adding additional applications to an RDS service. A number of different ODAs may exist on any service, subject to capacity. ODAs may be transmitted constantly, or only when required (e.g. an application which provides an alert in case of extreme weather conditions). Legacy 37-bit and 21-bit ODAs use a number of allocated group types A or B on data-stream 0 and can also be tunnelled via group type C on data-streams 1, 2 and 3. New higher capacity 56-bit (7-byte) ODAs exclusively use group type C on data-streams 1, 2 and 3. The legacy 37-bit and 21-bit ODAs use group type 3A for Application Identification (AID) and to indicate the allocated group carrying the ODA, whereas the new 56-bit (7-byte) ODA uses a special channel allocation mechanism utilizing group type C Function Header 10 000000 for Application Identification and to indicate which channel on data-streams 1, 2 and 3 carries the ODA. The AID identifies the application to the receiver in accordance with the registration details in the Open Data Applications directory (see IEC 62106-3).

5.8 Programme Identification (PI)

The Programme Identification (PI) is a code enabling the receiver to distinguish between audio programme content. The most important application of the PI code is to enable the receiver, in the event of bad reception, to switch automatically from the frequency used at that time to an alternative frequency. The criterion for the change-over to the new frequency would be the presence of a better signal having the same Programme Identification code. It follows therefore that the PI shall be allocated in such a way that it uniquely distinguishes each audio programme content from all others in the same area.

The actual values of the PI code have no direct use for the end consumer as it is not intended for direct display. Of importance, however, is that a methodology exists within a broadcast area (i.e. any given country) to ensure uniqueness of PI code allocations to programme services.

In Europe, for example, a pool of theoretical 65 536 unique values have been allocated firstly at international level, and thereafter at national and regional levels for allocation by the appropriate national authorities. Hence, there is a structure to PI code allocations widely used in Europe, which is described in 7.1.

The primary purpose of the PI code is to facilitate automatic tuning between different transmitters all carrying the same audio content. Or, in the case of a regional programme service structure, automatic tuning can be done to PI codes with a generic relationship differing from each other only in the second nibble. The physical location of the transmitter itself is immaterial in determining the PI code; it is the location of the origin of the audio programme that determines the value of the PI code to be used. Hence, transmitters broadcasting an international programme originating in one country and being relayed by transmitters in other countries would carry the same PI code, regardless of their locations; otherwise, automatic tuning between transmitters cannot occur. Additionally, as the relay transmitter will relay the RDS data, as well as the audio content, it is obvious that the PI code allocated to the transmitter at the head of the chain of transmitters will simply be re-broadcast by all transmitters in the relay chain.

As the PI code has a unique value in each area, it may be thought of as a primary key to which all other RDS parameters about a particular service are referenced. For this reason, the PI code appears in every RDS group type on data-stream 0, and it is the PI code which is used when referring to other programme services, as in EON.

Short-range transmitting devices connected to audio sources, when using RDS features, also require the use of a specific PI code (see 7.1.6).

The PI code element structure is defined in 7.1.

5.9 Programme Service name – (PS)

This is the label of the programme service consisting of eight alphanumeric characters coded with the basic RDS character set (see IEC 62106-4), which is displayed by RDS receivers in order to inform the listener what programme service is being received from the station to which the receiver is tuned. An example for a name is 'Radio 21'. The programme service name is not intended to be used for automatic search tuning and shall not be used for giving sequential information.

If a broadcaster wishes to transmit the Long Programme Service name, group 15A shall be used in addition.

The Programme Service name comprises eight characters and is static, identifying the name of the radio programme. It is the primary aid to listeners in programme service identification and selection. The use of PS to transmit text other than a single eight-character static Programme Service name is not permitted. RT or eRT shall be used for other programme-related information.

5.10 Long Programme Service name – (LPS)

The Long PS, using group type 15A, is an alternative to the PS. It allows use of more than eight characters (up to 32 bytes of UTF-8 coded characters). As UTF-8 coding is supported, the range of languages covered is increased. For backwards compatibility with existing RDS receivers, the PS shall also be transmitted using group type 0A or 0B. The use of LPS to transmit text other than a static Programme Service name is not permitted. RT or eRT shall be used for other programme-related information.

The Long PS is complementary information to the PS and it may be used to replace the PS on a display. While the acquisition of the PS is time critical (see Clause 8), the acquisition of the Long PS is not. The Long Programme Service name is static, identifying the name of the radio programme or station.

If fewer than 32 bytes are to be sent, then the LPS shall be terminated with control character 0x0D. All bytes following the control character shall be ignored by the receiver.

5.11 Programme Type (PTY)

This is an identification number to be transmitted with each programme item and which is intended to specify the current Programme Type within 32 possibilities (see IEC 62106-4). 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 programme items of the desired type. The last number, i.e. 31, is the alarm identification, which is intended to switch on the audio when a receiver is in a standby mode or muted.

5.12 Programme Type Name (PTYN)

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 characters of PTY that will be used during search or wait modes, but only to show in detail the programme type once tuned to a programme. If the broadcaster is satisfied with a default PTY name, it is not necessary to use additional data capacity for PTYN. The Programme Type Name is not intended to be used for automatic PTY selection, and shall not be used for giving sequential information.

5.13 RadioText (RT)

These are text transmissions with 64 characters at maximum, coded by using the basic RDS character set (see IEC 62106-4), addressed to receivers, which would be equipped with suitable display facilities. If a display with fewer than 64 characters is used to display the RadioText message, memory shall 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.

If fewer than 64 characters (32 characters if using group 2B) are to be sent, then the RT shall be terminated with control character 0x0D. All bytes following the control character shall be ignored by the receiver.

Control character 0x0A – line feed – may be inserted to indicate a preferred line break. If not used for the purpose of creating a line break, a receiver shall display a space character.

5.14 enhanced RadioText (eRT)

This is an ODA and an alternative to RadioText to enable text transmissions with 128 bytes at maximum, coded in UTF-8 and addressed to receivers, which would be equipped with suitable display facilities (see IEC 62106-6 for coding). As eRT is an ODA, it is thus compatible with receivers not using this feature. This feature supports a wider range of languages than RT.

If fewer than 128 bytes are to be sent, then the eRT shall be terminated with control character 0x0D. All bytes following the control character shall be ignored by the receiver.

Control character 0x0A – line feed – may be inserted to indicate a preferred line break. If not used for the purpose of creating line break, a receiver shall display a space character.

5.15 RadioText Plus (RT+ and eRT+)

This feature allows tagging specific elements of RadioText (RT and eRT) and permits, among many other possibilities, to improve the presentation on a display for both. The tagged RadioText elements can also be stored as a list that could be searched by the end user. A popular application is to list music titles and artist names. See IEC 62106-6 for the coding of these ODAs, one for RT and another one for eRT. Both ODAs are compatible with receivers not using this feature.

5.16 Traffic Programme identification (TP)

This flag indicates that the tuned programme service carries traffic announcements. The TP flag shall only be set on programmes which dynamically switch on the TA identification during Traffic Announcements. The signal shall be taken into account during automatic search tuning. For the coding, see 7.3.

5.17 Traffic Announcement identification (TA)

This is an on/off switching signal to indicate when a Traffic Announcement is on air, see also 6.9.

The signal can 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 programme service to another one carrying a Traffic Announcement, as signalled by EON, see 7.6.3 for further details.

After the end of the Traffic Announcement, the initial operating mode shall be restored.

5.18 Traffic Message Channel (TMC)

This feature is intended to be used for the coded transmission of traffic information (ALERT-C protocol). The coding for TMC shall be as in the ISO 14819 series. It is a set of ODAs, open or encrypted for conditional access. As TMC is an ODA, it is thus compatible with receivers not using this feature.

6 Coding of the group types

6.1 Groups of type 0A and 0B: Basic tuning and switching information with PS name

Figure 5 shows the format of type 0A groups.

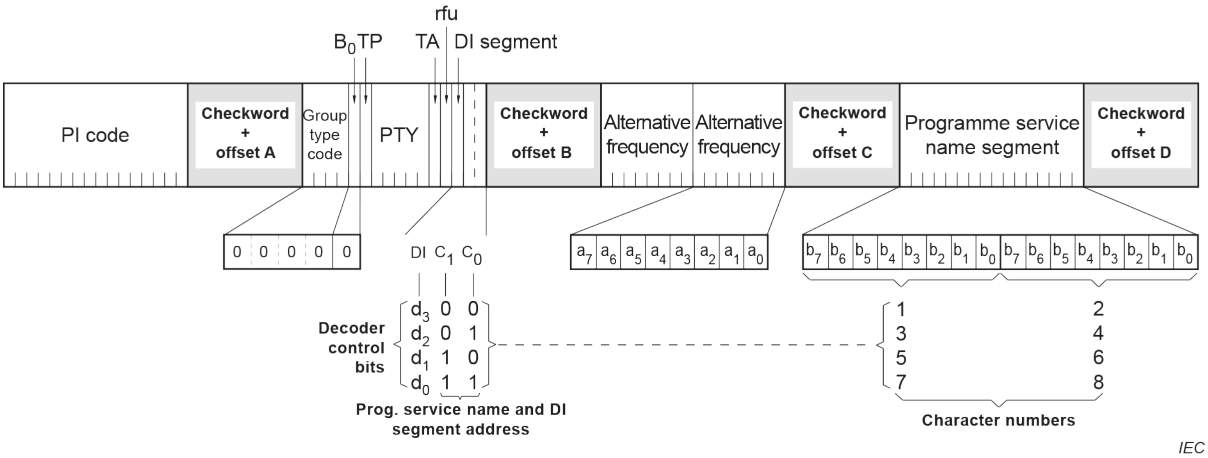


Figure 5 – Basic tuning and switching information – Group type 0A

Group type 0A is used for the transmission of PS, AF and PTYI.

Group type 0A uses two methods (A and B) for transmission of Alternative Frequencies (see 7.5).

The Programme Service name is transmitted as 8-bit characters as defined in the 8-bit basic RDS character code, see IEC 62106-4. Eight characters (including spaces) are used for each programme service network and are transmitted as a 2-character segment in each group type 0A. 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.

The dynamic PTY Indicator PTYI is encoded in the DI segment, bit d_3 (see Table 9).

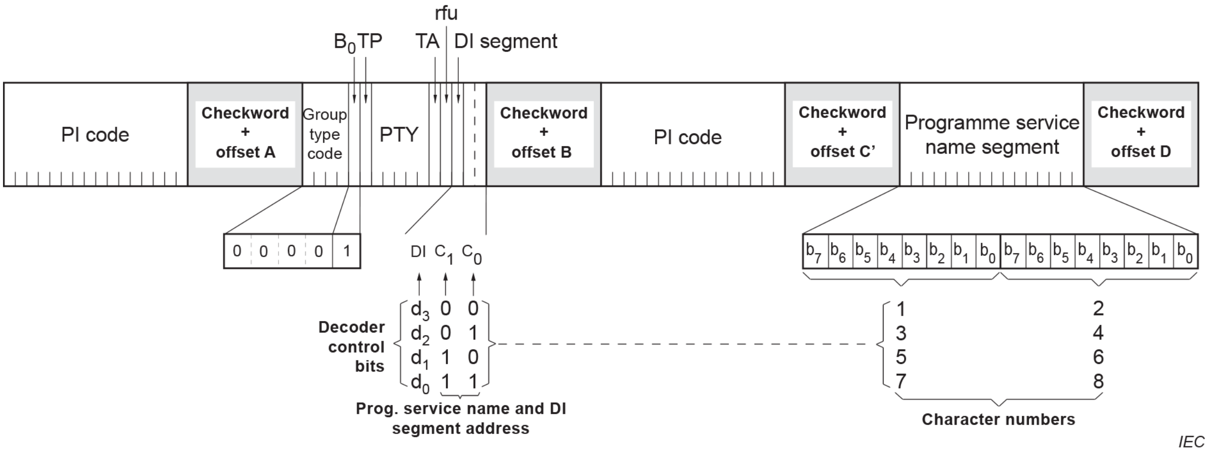
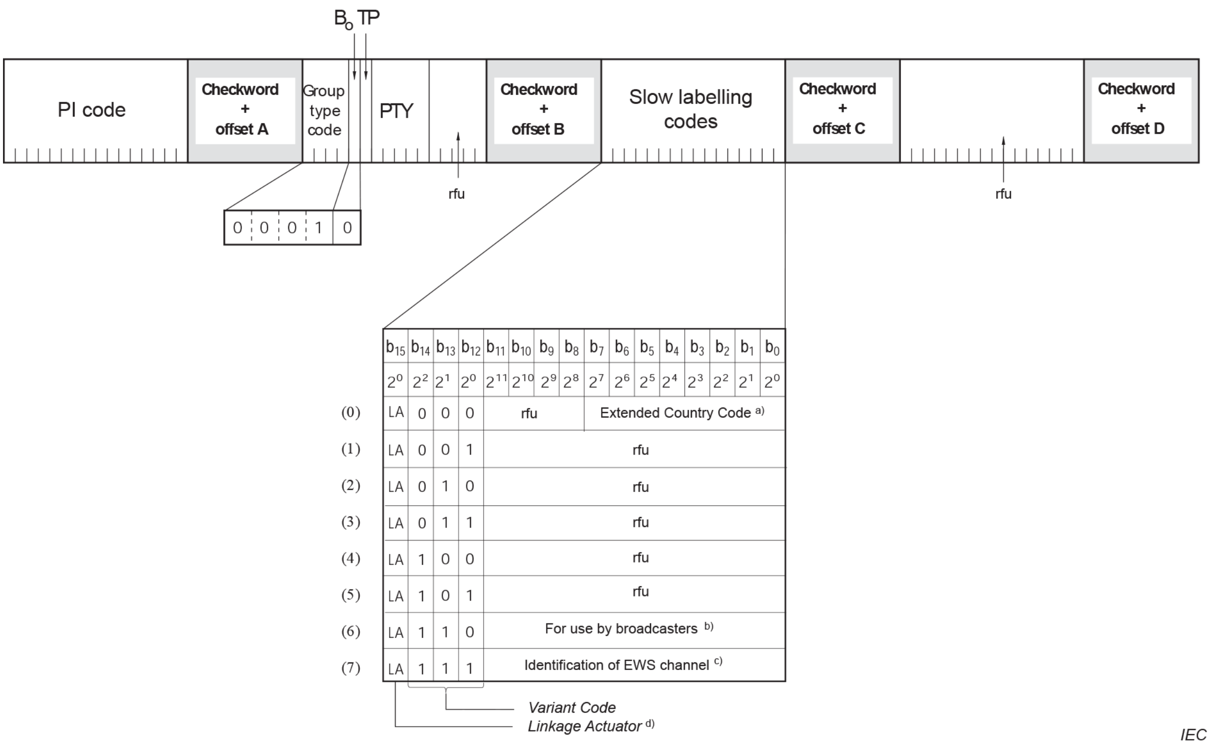


Figure 6 – Basic tuning and switching information – Group type 0B

Version B in Figure 6 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.

6.2 Group type 1A: Slow labelling codes

Figure 7 shows the format of group type 1A.



[a] Extended Country Codes are defined separately (see IEC 62106-4).

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

[c] For reasons of backwards compatibility, previously defined Emergency Warning Systems (EWS) may use this identifier. However, this identification should not be used when EWS is implemented as an ODA.

[d] The Linkage Actuator is defined in Annex A.

Figure 7 – Slow labelling codes – Group type 1A

6.3 Group type 2A and 2B: RadioText

Figure 8 shows the format of group type 2A.

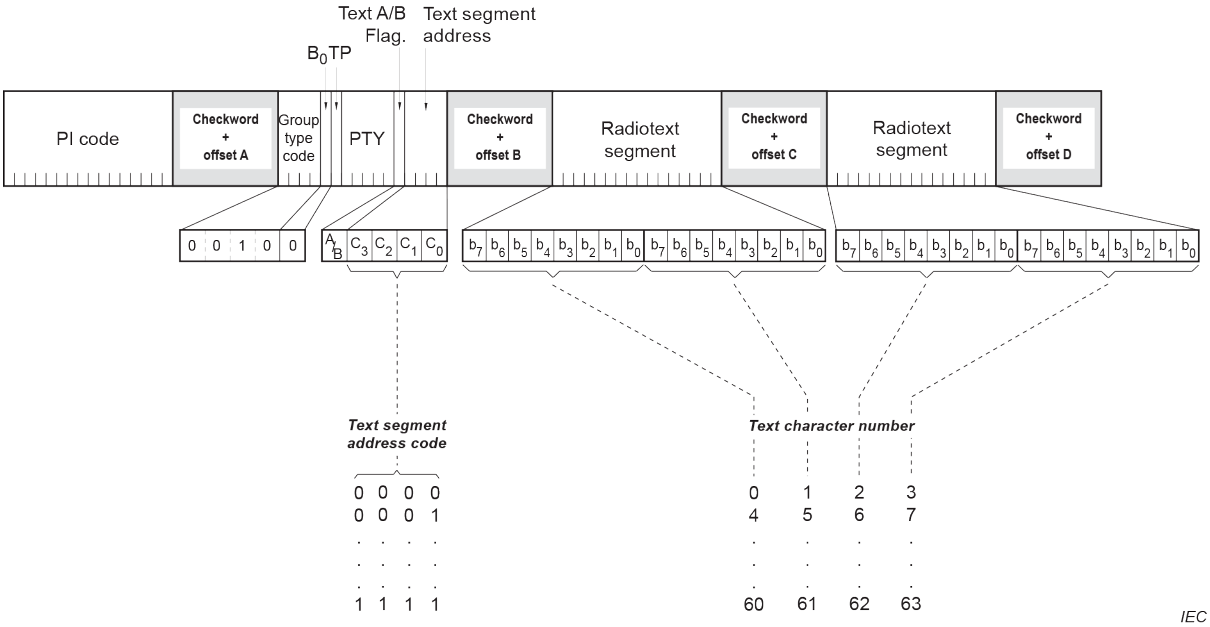


Figure 8 – RadioText – Group type 2A

The 4-bit text segment address (C_0...C_3) defines in the current text the position of the text segments contained in the third and fourth blocks. Since each text segment in type 2A groups comprises four characters, messages of up to 64 characters in length can be sent.

A new text shall start with binary segment address '0000'. The segment numbers shall be transmitted sequentially. The number of text segments is determined by the length of the message, and each message with fewer than 64 characters shall be ended by the code 0x0D – carriage return.

To ensure a no longer valid RadioText message is cleared from the display, the broadcaster should send a blank message only containing a 0x0D control character and toggle the A/B flag.

Control character 0x0A – line feed – may be inserted to indicate a preferred line break.

A space shall be substituted by the receiver for any unrecognized symbol or control character.

An important feature of group type 2 is the text A/B flag contained in the second block. The A/B flag indicates a new RT message content is starting with the message in which the A/B flag is toggled. The broadcaster shall toggle the flag whenever the content of the RT message changes.

It may be found from experience that all RadioText messages should be transmitted at least twice to ensure correct presentation on the display.

NOTE 1 RadioText is transmitted as 8-bit characters as defined in the 8-bit code-table of the basic RDS character set, see IEC 62106-4. The most significant bit (b_7) of each character is transmitted first.

NOTE 2 The addresses of the characters increase from left to right in the display.

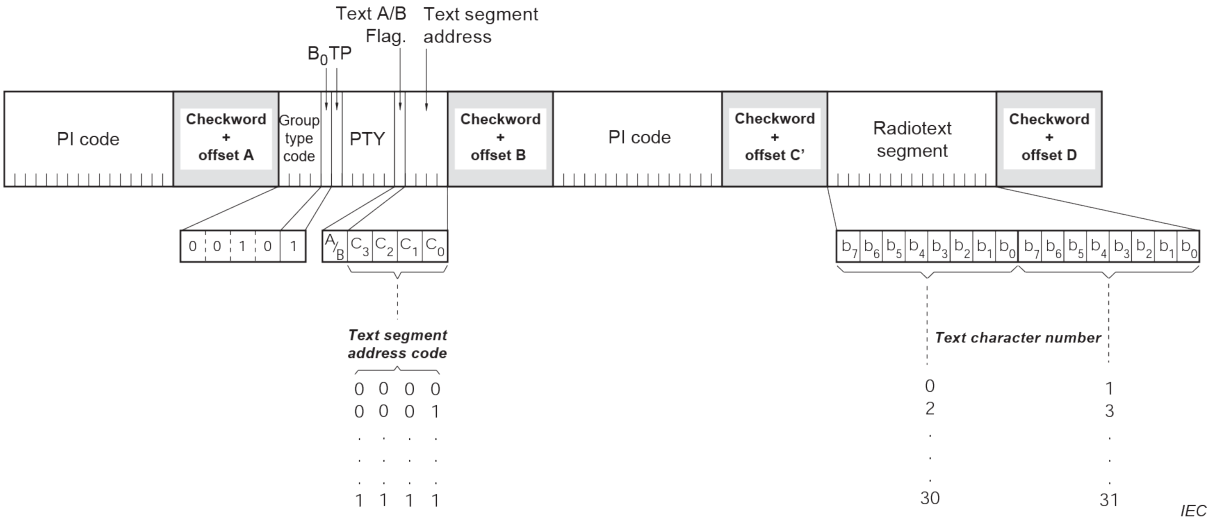


Figure 9 – RadioText – Group type 2B

Version B in Figure 9 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. With this version the number of RadioText characters is limited to 32.

6.4 Group type 3A: Application identification for any specific ODA using groups of type A or B

Figure 10 shows the format of type 3A groups. These groups are used to identify the Open Data Application in use, on an RDS transmission (see IEC 62106-3). The 3A group, identifying a specific ODA, shall be sent in the same data-stream where that specific ODA is being transmitted.

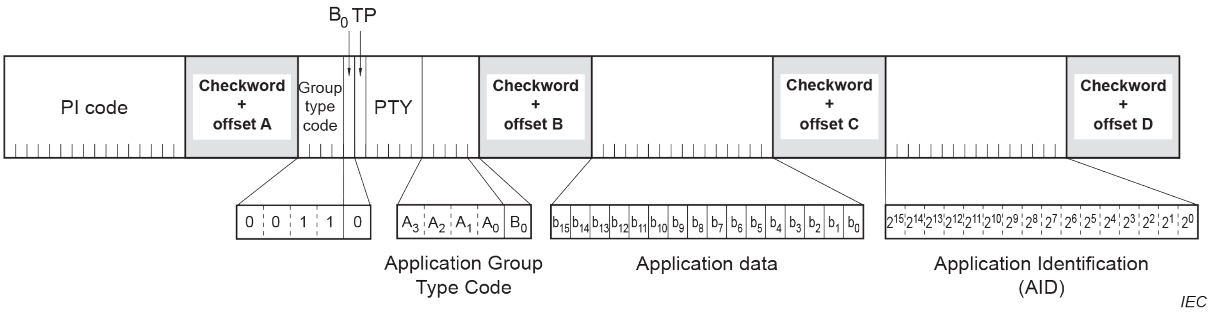


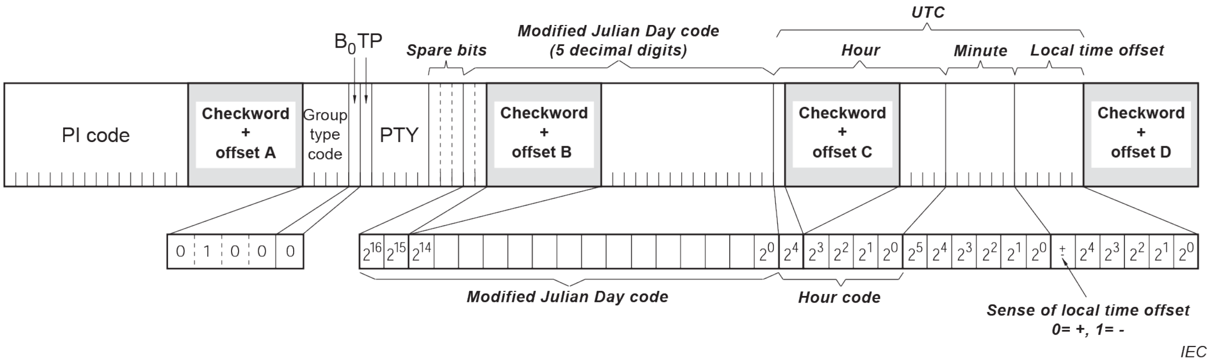
Figure 10 – Application identification for any specific ODA – Group type 3A

6.5 Group type 4A: Clock-Time and date

The transmitted Clock-Time and date shall be accurately set to UTC plus local offset time. If not possible, 4A groups shall not be transmitted.

Figure 11 shows the format of group type 4A.

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



The following considerations apply to this figure:

a) The local time is composed of Coordinated Universal Time (UTC) plus local time offset.

b) The local time offset is expressed in multiples of half hours within the range −15,5 h to +15,5 h and is coded as a six-bit binary number. '0' = positive offset (east of zero degrees longitude), and '1' = negative offset (west of zero degrees longitude).

c) The information relates to the epoch immediately following the start of the next group.

d) The clock time group is inserted so that the minute edge will occur within ±0,2 s of the end of the clock time group.

e) Minutes are coded six-bit binary numbers in the range 0 to 59. The spare codes are not used.

f) Hours are coded as five-bit binary numbers in the range 0 to 23. The spare codes are not used.

g) The date is expressed in terms of modified Julian Day and coded as a 17-bit binary number in the range 0 to 99 999. Simple conversion formulas to month and day, or to week number and day of week, are given in Annex B. Note that the modified Julian Day date changes at UTC midnight, not at local midnight.

h) Accurate CT based on UTC plus local time offset shall be implemented on the transmission where TMC is implemented.

Figure 11 – Clock-Time and date transmission – Group type 4A

6.6 Group type 10A: Programme Type Name PTYN

Figure 12 shows the format of group type 10A used for PTYN.

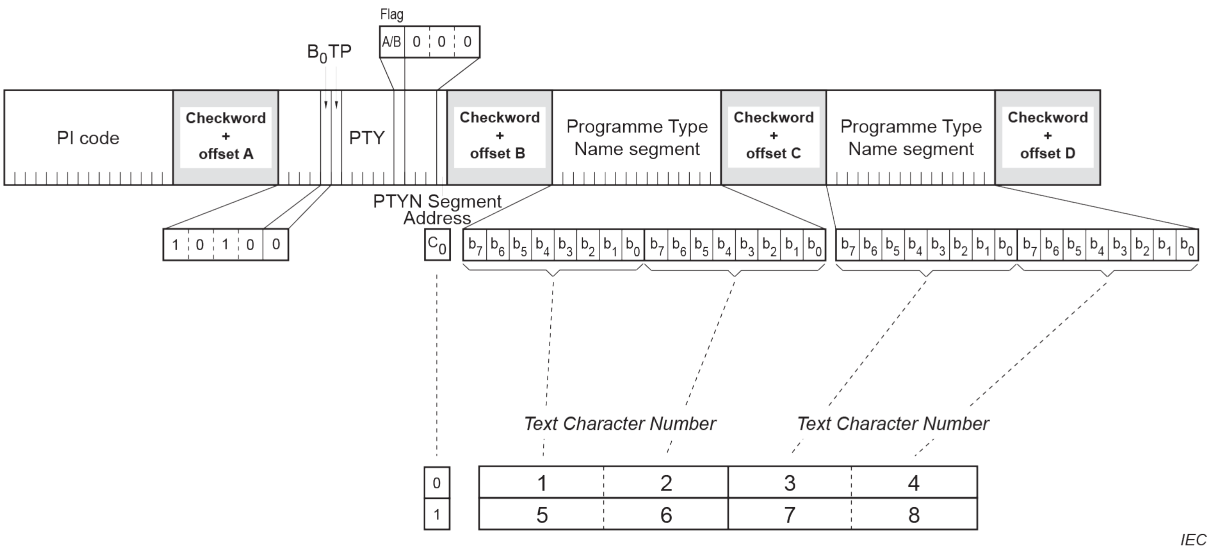


Figure 12 – Programme Type Name PTYN – Group type 10A

The A/B flag is toggled when PTYN during broadcast is being changed.

Programme Type Name (PTYN) (for display) is transmitted as 8-bit characters as defined in the 8-bit code; see codes for the basic RDS character set in IEC 62106-4. 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 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.

6.7 Group type 14A and B: Enhanced Other Networks information (EON)

The format of group type 14A and 14B is shown in Figure 13 and Figure 14. These groups are transmitted if Enhanced Other Networks information (EON) is implemented. The specification of the relevant protocol is given in 7.6.

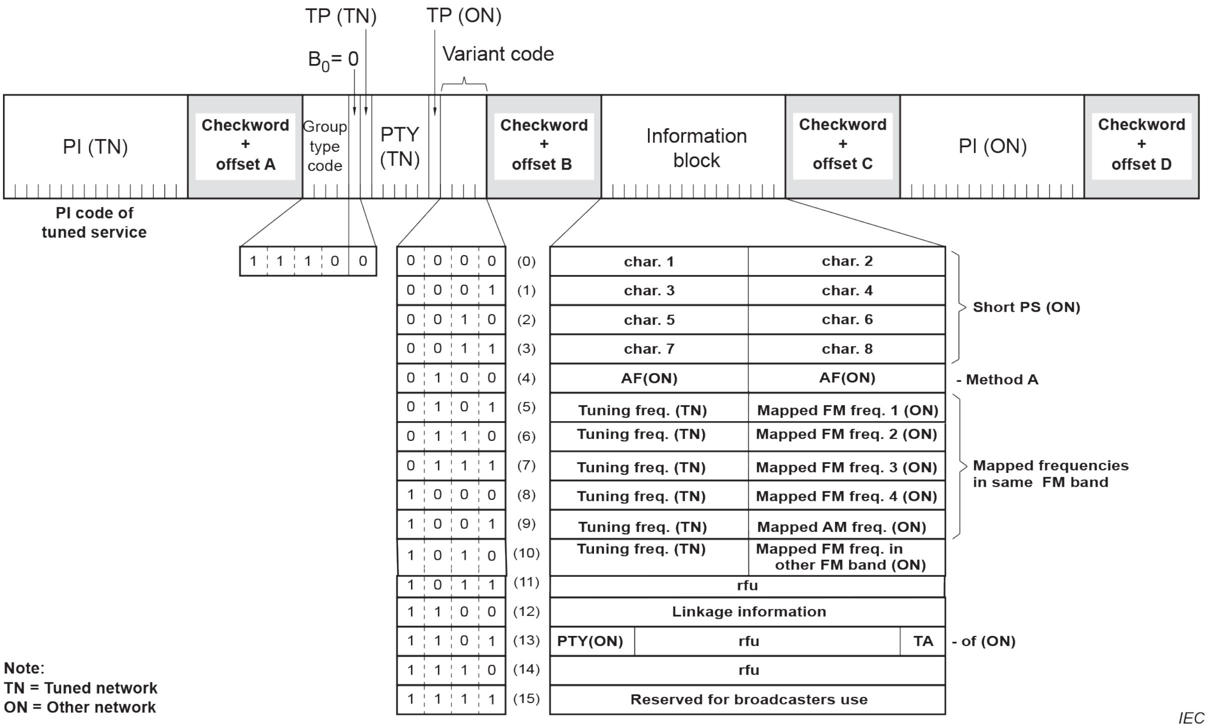


Figure 13 – Enhanced Other Networks information – Group type 14A

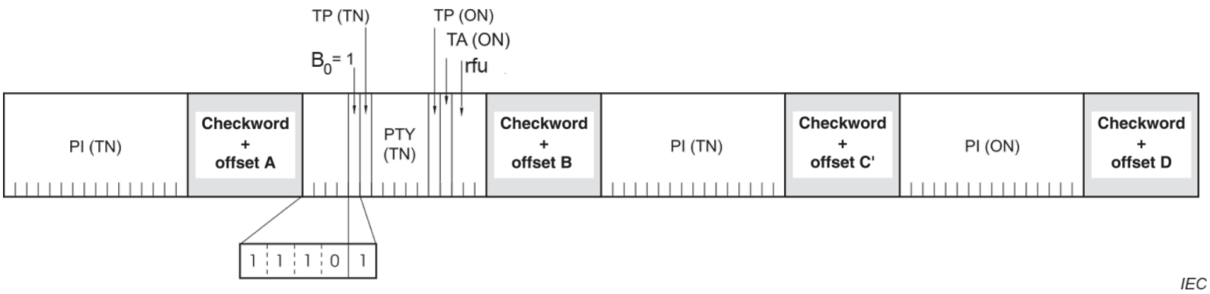


Figure 14 – Enhanced Other Networks information – Group type 14B

6.8 Group type 15A: Long Programme Service name – 32 bytes with UTF-8 coding

The group type 15A is to be used for up to 32-byte Long PS names as shown in Figure 15.

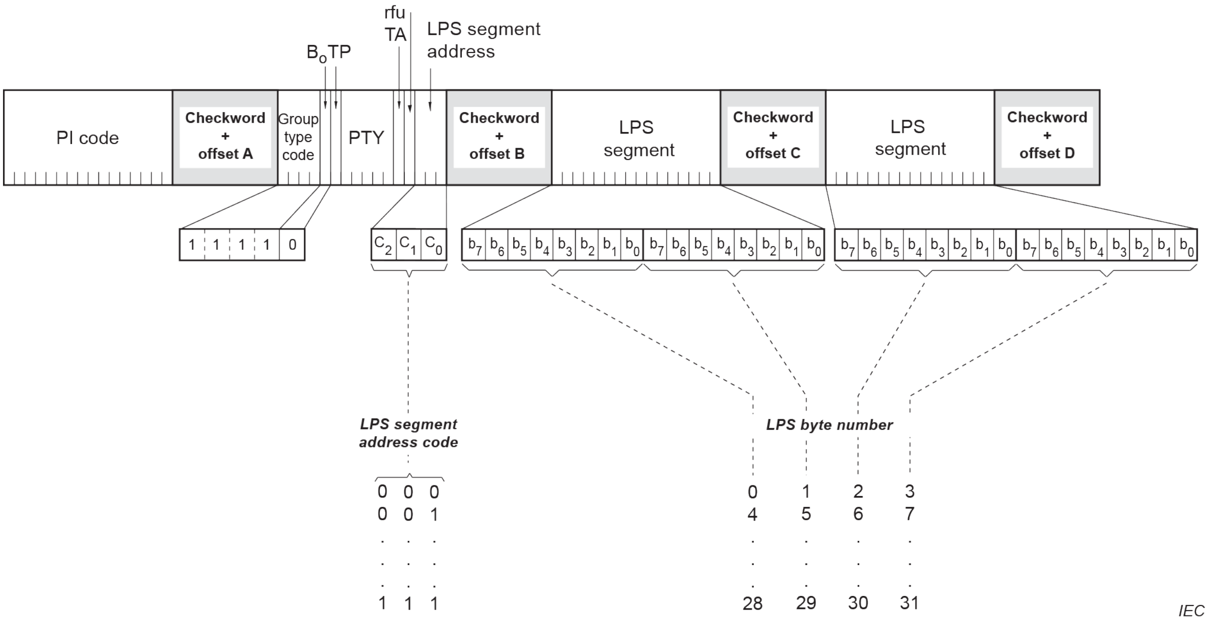


Figure 15 – Long PS, UTF-8 coded – Group type 15A

The Long Programme Service name is transmitted as a 4-byte segment. The 3-bit LPS segment address permits to transmit up to 32 bytes of UTF-8 coded characters. The addresses of the bytes increase from left to right in the display. The most significant bit of each character is transmitted first. The characters are always transmitted from left to right.

6.9 Group type 15B: Fast basic tuning and switching information

Figure 16 shows the group structure for fast tuning and switching information.

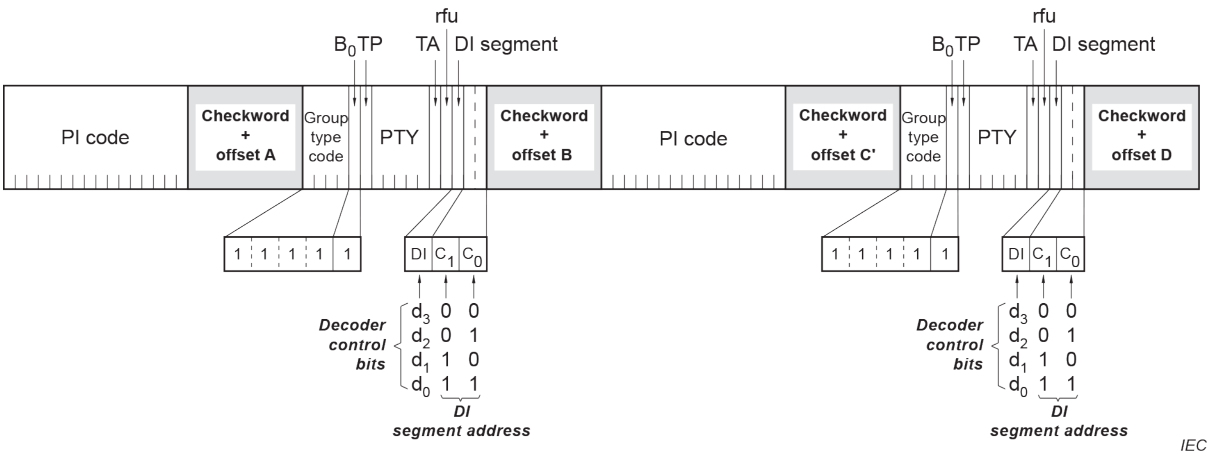


Figure 16 – Fast basic tuning and switching information – Group type 15B

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.

Transmission of 15B group bursts after changes of the TA status permits receivers to more easily identify the change. Therefore, group type 15B should always be transmitted up to about eight times immediately after each change of the TA (flag).

7 Coding of RDS features for control

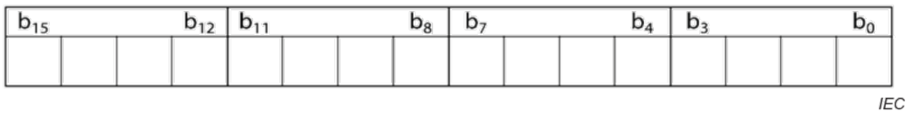
7.1 Programme Identification (PI) codes and Extended Country Codes (ECC)

NOTE Different rules apply for North-America, see IEC 62106-7.

7.1.1 PI structure

Figure 17 shows the PI code structure. For land-based transmitters, code assignments for bits b_{11} to b_0 should be decided by relevant authorities in each country individually.

PI codes shall be assigned in such a way that automatic search tuning to other transmitters radiating the same programme service can locate the same Programme Identification code, i.e. all 16 bits shall be identical. In cases where during a few programme hours a network is split to radiate different programmes, each of these programme services shall carry a different Programme Identification (PI) code, by using different coverage-area codes.



All codes are binary-coded hexadecimal (hex) numbers.

'Nibble 1'	Bits b_{15} to b_{12}	**Country Identifier (CI) code** For the 4-bit CI code, see IEC 62106-4. Code 0 shall not be used for country identification.
'Nibble 2'	Bits b_{11} to b_8	**Programme service in terms of area coverage** Codes are given in 7.1.4 and Table 5.
'Nibbles 3 and 4'	Bits b_7 to b_0	**Programme service reference number** Codes are given in 7.1.5 and in Table 6.

Figure 17 – PI code structure

7.1.2 Country Identifier (CI) codes: 'Nibble 1'

For the Country Identifier (CI) code tables, see IEC 62106-4.

7.1.3 Extended Country Codes (ECC)

Extended Country Codes shall be transmitted in group type 1A to render the Country Identifier CI code in bits b_{15} to b_{12} of the PI code unique. The Extended Country Code (ECC) is carried in variant 0 of group type 1A and consists of eight bits. This variant shall be transmitted at least once every minute.

The bit allocation of the ECC in group type 1A is given in Figure 7.

For ECC code tables, see IEC 62106-4.

7.1.4 Programme service in terms of area coverage (codes for fixed location transmitters only): 'Nibble 2'

Bits b_{11} to b_8:

L: (Local)	Local programme service transmitted via a single transmitter only during the whole transmitting time.
I: (International)	The same programme service is also transmitted in other countries.
N: (National)	The same programme service is transmitted across the country.
S: (Supra-regional)	The same programme service is transmitted across a large part of the country.
R1 to R12: (Regional)	The programme is available only in one location or region over one or more frequencies, and there exists no definition of its frontiers.

Hex-coding of 'Nibble 2' for bits b_{11} to b_8 is shown in Table 5.

Table 5 – Area coverage codes

Area coverage code	L	I	N	S	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12
Hex-coding	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

7.1.5 Programme reference number: 'Nibbles 3 and 4'

Coding of 'Nibbles 3 and 4' is shown in Table 6.

Table 6 – Programme service reference number codes

Bits b_7 to b_0:		
Decimal numbers	**Hex**	
0	00	Not used by fixed location transmitters. This code value is exclusively for use by low-power short range transmitting devices.
1 to 255	01 to FF	Used for fixed location transmitters exclusively: In order to clearly identify the different programme families, these codes should, in each country, be systematically assigned and generically linked to the programme families.

7.1.6 PI codes for low-power short range transmitting devices

Low-power short-range transmitting devices with RDS features should only transmit PI codes, structured as explained in Table 7.

Table 7 – PI codes for short range transmitting devices

Bits b_{15} to b_{12}	'Nibble 1'	Country code: A fixed (hex) value between 1 and F inclusive, i.e. any value except 0
Bits b_{11} to b_8	'Nibble 2'	Programme service in terms of area coverage: 1 (hex) when device uses an AF list or 0 (hex) when no AF list is used
Bits b_7 to b_0	'Nibbles 3 and 4'	Programme service reference number: 00 (hex)

7.2 Programme Type (PTY) codes

The applications of the 5-bit PTY codes are specified in IEC 62106-4. PTY codes 30 and 31 are control functions for a consumer receiver.

NOTE Different PTY codes are specified for North America, see IEC 62106-7.

7.3 Traffic Programme (TP) and Traffic Announcement (TA) codes

The coding to be used is as indicated in Table 8.

Table 8 – Codes for TP and TA

Traffic Programme code (TP)	Traffic Announcement code (TA)	Applications
0	0	This programme service does not carry Traffic Announcements nor does it refer, via EON, to a programme that does.
0	1	This programme service carries EON information about another programme which gives traffic information.
1	0	This programme service carries Traffic Announcements and may also carry EON information about other Traffic Announcements.
1	1	A Traffic Announcement is being broadcast on this programme service.

7.4 Decoder Identification (DI) and dynamic PTY Indicator (PTYI) codes

Table 9 indicates the meaning of bits d_0 to d_3. These four bits are used to flag different operating modes and the only flag d_3 used now is to indicate if PTY codes in the transmission are dynamically switched.

Table 9 – Meaning of bits d_0 to d_3

Settings	Meaning
Bit d_0, set to 0:	rfu
Bit d_0, set to 1:	rfu
Bit d_1, set to 0:	rfu
Bit d_1, set to 1:	rfu
Bit d_2, set to 0:	rfu
Bit d_2, set to 1:	rfu
Bit d_3, set to 0:	PTYI = 0: Static PTY
Bit d_3, set to 1:	PTYI = 1: Indicates that the PTY code on the tuned programme service is dynamically switched

7.5 Coding of Alternative Frequencies (AFs)

7.5.1 AF code tables

NOTE The following definition is for frequencies in the range of 87,6 MHz to 107,9 MHz. If VHF frequencies in the range 64,1 MHz to 107,9 MHz are to be used for AF coding, the ODA (AID 0x6365) using 9-bit long AF codes shall be used instead, see IEC 62106-6.

AFs in the frequency range 87,6 MHz to 107,9 MHz are coded using group 0A, see 6.1. Coding of AFs for EON is done in group type 14A, see 6.7.

In the following code tables, each 8-bit binary code represents a carrier frequency in Table 10, Table 12 and Table 13, or it represents a special meaning, as shown in Table 11.

Table 10 – VHF frequencies 87,6 MHz to 107,9 MHz 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 AF 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	One LF/MF frequency follows
251	1111 1011	Not assigned
:	:	:
255	1111 1111	Not assigned

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

Number	Binary code	Carrier frequency
LF 1 : : 15	0000 0001 : : 0000 1111	153 kHz : : 279 kHz
MF 16 : : : : 135	0001 0000 : : : : 1000 0111	531 kHz : : : : 1 602 kHz

Table 13 – MF code table – ITU region 2 (10 kHz spacing)

Number	Binary code	Carrier frequency
MF 17 : : : : 133	0001 0001 : : : : 1000 0101	540 kHz : : : : 1700 kHz

7.5.2 Use of Alternative Frequencies in group type 0A

7.5.2.1 General

To facilitate the automatic tuning process in a receiver, a number of AFs shall be transmitted. Ideally, the AF list shall only comprise frequencies of neighbouring 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.

AF coding for frequencies down to 64,1 MHz is supported by a separate ODA (see IEC 62106-6).

7.5.2.2 AF method A

Two AF codes are carried in block 3 of each group type 0A. The first byte in the transmitted list (codes 224 to 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:

	Example A		Example B		Example C	
First 0A:	#5	AF1	#4	AF1	#4	AF1
Second 0A:	AF2	AF3	AF2	AF3	AF2	AF3
Third 0A:	AF4	AF5	AF4	Filler	LF/MF follows	AF4

EXAMPLE A shows: a list of five VHF frequencies, where #5 is the number of the following frequencies, represented by code 229.

EXAMPLE B shows: a list of four VHF frequencies, where filler code is 205.

EXAMPLE C shows: a list of three VHF frequencies and 1 LF/MF frequency, where the code is 250 (LF/MF follows) followed by the AF4 frequency code.

7.5.2.3 AF method B

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

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 block.

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

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 pairs (up to 12) give the tuning frequency together with a valid AF.

– If the number of AFs of a station is greater than 12, the list shall be split into two or more lists. These lists are transmitted directly one after the other and the receiver shall 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 shall be separated by AF lists of other stations. The receiver may combine them or evaluate them separately.

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

– They are generally transmitted in ascending order, for example

89,3	99,5	or	99,5	101,8	$F_1 < F_2$

– In special cases they are transmitted in descending order, if they belong to different regions, or carry from time to time different programmes, for example

99,5	90,6	or	100,7	99,5	$F_1 > F_2$

In both the above examples, 99,5 MHz is the main tuning frequency.

EXAMPLES:

F_1	F_2	Commentary
# 11	89,3	Total number (11) of frequencies for tuning frequency (89,3) MHz
89,3	99,5	$F_2 > F_1$ hence 99,5 is an AF of tuned frequency 89,3, and is the same programme service
89,3	101,7	$F_2 > F_1$ hence 101,7 is an AF of tuned frequency 89,3, and is the same programme service
88,8	89,3	$F_2 > F_1$ hence 88,8 is an AF of tuned frequency 89,3, and is the same programme service
102,6	89,3	$F_2 < F_1$ hence 102,6 is an AF of tuned frequency 89,3, but is a regional variant of the programme service
89,3	89,0	$F_2 < F_1$ hence 89,0 is an AF of tuned frequency 89,3, but is a regional variant of the programme service

# 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 programme service
99,5	100,9	$F_2 > F_1$ hence 100,9 is an AF of tuned frequency 99,5, and is the same programme service
104,8	99,5	$F_2 < F_1$ hence 104,8 is an AF of tuned frequency 99,5, but is a regional variant of the programme service
99,5	89,1	$F_2 < F_1$ hence 89,1 is an AF of tuned frequency 99,5, but is a regional variant of the programme service

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 that carry a regional variant of the programme service during certain hours of the day shall be signalled by transmitting in the descending order. The PI codes to identify the different regional variants of the network or programme service shall differ only in the second element (bits 8 to 11) of the code using area codes R1 to R12, see 7.1.4.

If switching by the broadcaster of the second element of the PI Code to I, N or S occurs, this informs a receiver that now even AFs transmitted in descending order are carrying the same programme service and the receiver may freely allow switching to these AFs in addition to those transmitted in ascending order.

Even if the PI codes are static at all times, various receivers and customer-specific implementations exist that will, as a user option, permit the receiver to accept not only AFs from the same regional PI code, but also those from the different regional variants of the network or programme service.

7.5.2.4 Convention for identification of the AF method used

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

7.5.3 Use of AF codes in group type 14A

AF codes in group type 14A are used to refer to frequencies of other networks (see Figure 13). There are four options for transmitting this information.

a) Variant 4 uses AF method A coding to transmit up to 25 frequencies. The coding method is as described above for group type 0A. The PI code of the other network to which the AF list applies is given in block 4 of the group.
b) Variants 5, 6, 7, and 8 are used for the transmission of "mapped frequency pairs". These are 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.
c) 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.
d) Where it is necessary to map one tuning frequency to more than one VHF/FM frequency for the cross-referenced programme service (due to multiple use of the tuning frequency or because the cross-referenced programme service 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.
e) Variant 9 is used for the transmission of LF/MF mapped frequencies. AF code 250 is not used with the mapped AF method.
f) Variant 10 is used as follows:

   This variant is used for mapped AF coding for the other FM Band.

The mapped frequency codes are 8-bit codes. For Band II, these are obtained by deleting the msb and for Band I deduct 256 from the channel number, e.g. for 64,2 MHz use 258 − 256 = 2, thus the 8-bit channel number code being 0000 0010.

Here is an example to show how the AF coding will work with the Band extension – The AF code table has 512 entries in all. Values 0 to 255 are identical to current AF coding (Table 7 to Table 10).

Values 257 to 496 contain the frequencies 64,1 MHz to 88,0 MHz in a continuous list starting at code 257 through to code 496, in steps of 100 kHz.

Part of the list is shown in Table 14.

Table 14 – Example including AFs for the extended FM Band

Code	Frequency		Code	Frequency
117	99,2		373	75,7
118	99,3		374	75,8
119	99,4		375	75,9
120	99,5		376	76,0
121	99,6		377	76,1
122	99,7		378	76,2
123	99,8		379	76,3
124	99,9		380	76,4
125	100,0		381	76,5
126	100,1		382	76,6

EON variants 5, 6, 7, 8 are used when the tuned frequency and the mapped frequency are both in the same 'range' (Code range 0 to 255 OR 256 to 511).

EON variant 10 is used exclusively when the tuned frequency and the mapped frequency are in the opposite 'range' to each other, i.e. the other FM Band (which is likely to be rarer).

EXAMPLES:

Tuned frequency is 99,5, mapped frequency is 100,0. Variant 5 used with codes 120 and 125.

Tuned frequency is 75,8, mapped frequency is 76,6. Variant 5 used with codes 118 (374 − 256) and 126 (382 − 256).

Tuned frequency is 99,6, mapped frequency is 76,4. Variant 10 used with codes 121 and 124 (380 − 256).

Tuned frequency is 76,4, mapped frequency is 99,6. Variant 10 used with codes 124 (380 − 256) and 121.

The receiver knows what the tuned frequency is (i.e. if in the higher or lower band), so depending upon if variant 5 (or 6, 7, 8) or variant 10 is used, it knows in which 'range' the mapped frequency falls (variant 5 ,6, 7, 8 = same range; variant 10 = other range).

Variant 4 in Figure 13 can also be used (method A list) when all frequencies are in the same range.

7.6 Coding of Enhanced Other Networks information (EON)

7.6.1 General

The Enhanced Other Networks information consists of a collection of optional RDS features relating to other programme services, cross-referenced by means of their PI codes. Features which may be transmitted using EON for other programme services are: AF, PS, PTY, TA, TP and Linkage.

The format of the group type 14 is shown in 6.7. It has two versions: A and B.

Group type 14A is the normal form and shall be used for the background transmission of EON. The maximum cycle time for the transmission of all data relating to all cross-referenced programme services shall be less than 2 min. The A version has sixteen variants that 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 programme services. A broadcaster should choose the most appropriate AF method for each cross-referenced programme service.

Group type 14B is used to indicate a change in the status of the TA flag of a cross-referenced programme service.

7.6.2 Coding of frequencies for cross-referenced programme services in EON

Two AF methods exist for the transmission of AFs in the EON feature. Coding is described in 7.5.3.

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

7.6.3 Use of the TP and TA features with EON

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

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

Group type 14B is used to cause the receiver to switch to a programme service which carries a Traffic Announcement. When a particular programme 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 practical 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 receivers. Receivers shall use the TA flag in group types 0A or 15B of the programme service carrying the Traffic Announcements in order to switch back to the originally tuned programme service at the end of the received Traffic Announcement.

If a transmitter cross-references more than one Traffic Programme with different PI (ON) via the EON feature, the start time between two references, via type 14B groups, shall be at least 2 s.

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.

7.6.4 Use of PTY with EON

Changes to PTY (ON) are treated as follows: PTY (ON) on the other network cross-referenced programme service is signalled in group type 14A, variant 13. This variant, which causes dynamic switching, shall have a higher priority than other variants. Changes are signalled by a minimum of four and up to eight groups of type 14A, variant 13, transmitted within a maximum of 4 s, with the objective of causing rapid switching by the receiver to the other cross-referenced programme service.

NOTE Spreading groups of variants 13 over a four-second period avoids a contiguous burst of groups being lost due to multipath propagation.

A transmitter may cross-reference to more than one programme service with different PI (ON) codes via the EON feature.

8 Required main RDS feature repetition rates on data-stream 0

In order for RDS receivers to work well, the broadcaster shall transmit on data-stream 0 each group type at appropriate repetition rates, such that a receiver may receive all required parts of a feature within a certain time. For example, to receive and display a PS name requires four groups type 0A to be received, hence if display of PS is required within one second, a minimum repetition of four groups, type 0A per second is needed.

The required RDS main feature repetition rates for some of the features are indicated in Table 15 through Table 19. These tables can only be informative because each transmitter can have very different combinations of RDS features, which impact the repetition rates of each group. Also, factors such as the length of a RadioText message, and whether this is static, changes relatively infrequently, or is very dynamic and greatly affects the repetition rate required for these groups.

Similarly, a transmitter owned by a broadcaster operating multiple programme services will require RDS groups for EON data transmission to be reserved, and a programme service broadcasting TMC can be required to devote up to 25 % of its groups for this purpose.

It follows that it will not be possible to run a satisfactory service with TMC and fully dynamic RadioText on transmitters, which also cross-references several other networks, when using EON on data-stream 0 alone.

When Traffic Announcements are due for transmission, both group types 14B and 15B can be required to be sent to enable the receiver to take the correct actions. The burst of these groups will of course reduce the bandwidth of the regular transmission. These situations do not have to be taken into account when defining the number of groups per feature per time unit.

The same holds true for situations when an EWS system is in place and becomes active. These systems can temporarily take up to 75 % of the total bandwidth depending on the type of emergency.

Table 15 – Data-stream 0 group repetition rates: Transmitter not part of a multi-programme service network: no TMC and only 'basic' RDS features

Main features	Group type	Groups per minute[a]	%
Short Programme Service (PS) name, Alternative Frequency (AF) code pairs and Decoder Information (DI)	0A	270[b]	39
Extended Country Code (ECC)	1A	12	1,8
RadioText (RT) message	2A	402[c]	59
Clock Time (CT)	4A	1[d]	0,2

[a] Average number of groups per minute evenly spread in order to provide satisfactory performance under acceptable reception conditions. Note that 685 RDS groups per minute are transmitted on each data-stream.

[b] The PS name shall only be used for identifying the Programme Service and it shall not be used for other messages giving sequential information. In areas where the name of the station can only be represented using the Long PS and no regular AFs are used, the repetition rate of group 0A may be lowered.

[c] This rate allows a 64-character RadioText message to be transmitted twice completely in 5 s. Where a RadioText message changes less frequently, or is 'static', rates may be lowered.

[d] The RDS encoder inserts this group automatically at the top of each minute – therefore a group type 4A shall not be programmed into any group sequence.

Table 16 – Data-stream 0 group repetition rates: Transmitter part of a multi-programme service network: no TMC

Main features	Group type	Groups per minute[a]	%
Programme Service (PS) name, Alternative Frequency (AF) code pairs and Decoder Information (DI)	0A	240[b]	35
Extended Country Code (ECC)	1A	12	1,8
RadioText (RT) message	2A	192[c]	28
Clock Time (CT)	4A	1[d]	0,1
Enhanced Other Networks information (EON)	14A	240[e]	35

[a] Average number of groups per minute evenly spread in order to provide satisfactory performance under acceptable reception conditions. Note that 685 RDS groups per minute are transmitted on each data-stream.

[b] The PS shall only be used for identifying the Programme Service and it shall not be used for other messages giving sequential information. In areas where the name of the station can only be represented using the Long PS and no regular AFs are used, the repetition rate of group 0A may be lowered.

[c] This rate allows a 64-character RadioText message to be transmitted twice completely in 10 s. Where a RadioText message changes less frequently, or is 'static', rates may be lowered.

[d] The RDS encoder inserts this group automatically at the top of each minute – therefore a group type 4A shall not be programmed into any group sequence.

[e] This allocation of number of groups is entirely dependent upon the number of Other Networks being referenced, and the number of their Alternative Frequencies. The number of groups shall be chosen such that maximum cycle time for the transmission of all data relating to all cross-referenced programme services shall be less than 2 min.

Table 17 – Data-stream 0 group repetition rates: Transmitter not part of a multi-programme service network: with TMC

Main features	Group type	Groups per minute[a]	%
Programme Service (PS) name, Alternative Frequency (AF) code pairs and Decoder Information (DI)	0A	240[b]	35
Extended Country Code (ECC)	1A	12	1,8
RadioText (RT) message	2A	192[c]	28
Clock Time (CT)	4A	1[d]	0,1
ODA Identification	3A	12[e]	1,8
Traffic Message Channel (TMC)	8A	171[f]	25
'Spare'	any	57[g]	8,3

[a] Average number of groups per minute evenly spread in order to provide satisfactory performance under acceptable reception conditions. Note that 685 RDS groups per minute are transmitted on each data-stream.

[b] The PS shall only be used for identifying the Programme Service and it shall not be used for other messages giving sequential information. In areas where the name of the station can only be represented using the Long PS and no regular AFs are used, the repetition rate of group 0A may be lowered.

[c] This rate allows a 64-character RadioText message to be transmitted twice completely in 10 s. Where a RadioText message changes less frequently, or is 'static', rates may be lowered.

[d] The RDS encoder inserts this group automatically at the top of each minute – therefore a group type 4A shall not be programmed into any group sequence.

[e] A 3A group, identifying the presence of one or more Open Data Applications on this channel shall be sent at least once per 5 s.

[f] The number of 8A groups shown here is the maximum rate specified for TMC use in ISO 14819-1. This rate is commonly used on commercial RDS-TMC services worldwide.

[g] Once the group repetition rates shown in this table for the features listed have been met, some 'spare' group capacity still remains. This may be used for other features or to increase rates of the features to enhance reception of RadioText for example.

Table 18 – Data-stream 0 group repetition rates: Transmitter not part of a multi-programme service network: no TMC and with support for UTF-8 coded characters

Main features	Group type	Groups per minute[a]	%
Programme Service (PS) name, Alternative Frequency (AF) code pairs and Decoder Information (DI)	0A	60[b]	8,8
Extended Country Code (ECC)	1A	12	1,8
ODA Identification	3A	12[c]	1,8
Clock Time (CT)	4A	1[d]	0,1
Long PS name (LPS)	15A	342[e]	50
Available for ODA use	Any ODA	270[f]	39,4

[a] Average number of groups per minute evenly spread in order to provide satisfactory performance under acceptable reception conditions. Note that 685 RDS groups per minute are transmitted on each data-stream.

[b] Although Long PS name is used to provide a display of the Station Name in non-Latin characters using UTF-8, the 0A group is retained to provide DI and AF information as well as a shorter Latin-character set PS name for the benefit of older receivers.

[c] A 3A group, identifying the presence of one or more Open Data Applications on this channel, shall be sent at least once per 5 s.

[d] The RDS encoder inserts this group automatically at the top of each minute – therefore a group type 4A shall not be programmed into any group sequence.

[e] A 32-byte Long PS name will be transmitted once completely, in under 1,5 s at this repetition rate of the group type 15A.

[f] These groups are available for ODA use – possibly eRT, allowing text to be displayed in an extended character set using UTF-8 coding.

Table 19 – Data-stream 0 group repetition rates: Transmitter part of a multi-programme service network: with TMC

Main features	Group type	Groups per minute[a]
Short Programme Service (PS) name, Alternative Frequency (AF) code pairs and Decoder Information (DI)	0A	180[b]
Extended Country Code (ECC)	1A	12
RadioText (RT) message	2A	128[c]
Clock Time (CT)	4A	1[d]
ODA Identification	3A	12[e]
Traffic Message Channel (TMC)	8A	114[f]
Enhanced Other Networks (EON)	14A	238[g]

[a] Average number of groups per minute evenly spread in order to provide satisfactory performance under acceptable reception conditions. Note that 685 RDS groups per minute are transmitted on data-stream 0.

[b] The short PS shall only be used for identifying the programme service and it shall not be used for other messages giving sequential information. Because this transmitter carries TMC and EON, the 0A repetition rate has had to have been reduced from the ideal, although is still considered adequate.

[c] This rate allows a 64-character RadioText message to be transmitted twice completely in 15 s. Where a RadioText message changes less frequently, or is 'static', rates may be lowered.

[d] The RDS encoder inserts this group automatically at the top of each minute – a group type 4A shall not be programmed into any Group Sequence.

[e] A 3A group, identifying the presence of one or more Open Data Applications on this channel, shall be sent at least once per 5 s.

[f] The number of 8A groups shown here is two-thirds of the maximum specified for TMC use in ISO 14819-1. When EON is on the same transmitter, it will generally not be possible to provide TMC at the maximum rate.

[g] This allocation of number of groups is entirely dependent upon the number of Other Networks being referenced, and the number of their Alternative Frequencies. The number of groups shall be chosen such that maximum cycle time for the transmission of all data relating to all cross-referenced programme services shall be less than 2 min.

Annex A
(normative)

Method for linking RDS programme services – Linkage information – Group type 1A and 14A

A.1 General

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

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

Linkage information is conveyed in the following four data elements:

a) LA – Linkage Actuator (1 bit);
b) EG – Extended Generic indicator (1 bit);
c) ILS – International Linkage Set indicator (1 bit);
d) LSN – Linkage Set Number (12 bits).

This information is carried in group type 14A variant 12, block 3. It informs the receiver to which set of programme services any particular service, defined by PI (ON) carried in block 4 of the same group, belongs (see 6.7, Figure 13).

When linkage information regarding the tuned programme 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.

Usage	Bit allocation in Block 3															
Group type 1A	b_{15}	b_{14}	b_{13}	b_{12}	b_{11}	b_{10}	b_9	b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1	b_0
	LA															

Linkage Actuator

IEC

Figure A.1 – Structure of group type 1A, block 3

In order to achieve rapid de-linkage at the end of a common programme, the Linkage Actuator (LA) for the tuned network is also carried in group type 1A, as bit b_{15} of block 3 (see 6.2). This group type shall normally be transmitted at least once every 5 s, preferably more frequently when a change in status occurs.

The four data elements used to convey linkage information are defined in Clause A.2 to Clause A.5.

A.2 LA – Linkage Actuator

The LA bit as shown in Figure A.1, Figure A.2 and Figure A.3 is set to one to inform the receiver that the programme service (indicated by PI (ON) in block 4) is linked to the set of services described by LSN, the Linkage Set Number, at this particular 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.

A.3 EG – Extended Generic indicator

The EG bit as shown in Figure A.2 and Figure A.3 is set to one to inform the receiver that the programme service, defined in group type 14A, block 4 is a member of an Extended Generic set. Such a set comprises programme services that are related (e.g. by common ownership, or of 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 (in the range R1 to R12), Y is common to all such related services, and Z may assume any value.

A.4 ILS – International Linkage Set indicator

In the case of an international link, the indicator ILS bit as shown in Figure A.2 and Figure A.3 and carried in group type 14A variant 12, block 3, bit b_{12} will be set to one.

A.5 LSN – Linkage Set Number

This 12-bit number shown in Figure A.2 and Figure A.3 is carried in group type 14A variant 12, block 3. The LSN, when non-zero, is common to those programme services that 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 programme services either nationally or internationally.

– National link (ILS = 0)

Usage	Bit allocation in Block 3															
Group type 14A	b_{15}	b_{14}	b_{13}	b_{12}	b_{11}	b_{10}	b_9	b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1	b_0
National Link	LA	EG	X	0	Linkage Set Number (LSN)											

International Linkage Set (ILS) indicator
Extended Generic indicator
Linkage Actuator

IEC

Figure A.2 – Structure of group type 14A variant 12, block 3 (Linkage information) – National link

If two or more programme 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 programme services are carrying the same audio.

– International link (ILS = 1)

Usage	Bit allocation in Block 3															
Group type 14A	b_{15}	b_{14}	b_{13}	b_{12}	b_{11}	b_{10}	b_9	b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1	b_0
International Link	LA	EG	X	1	Linkage Set Number (LSN)											
					CI				LI							

Linkage Identifier
Country Identifier
International Linkage Set (ILS) indicator
Extended Generic indicator
Linkage Actuator

IEC

Figure A.3 – Structure of group type 14A variant 12, block 3 (Linkage information) – International link

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

a) Country Identifier (CI): Block 3, bits b_{11} to b_8 shall be the country code of one of the two (or more) participating countries. For example, if Switzerland and Italy share a programme, they shall choose either 0x4 or 0x5 for CI, and then agree on bits b_7 to b_0 for a unique Linkage Identifier (LI).

b) Linkage Identifier (LI): Bits b_7 to b_0 are used to relate programme services internationally, and shall be agreed between the countries concerned. Such services share the same CI and LI.

When two or more programme 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 programme services are carrying the same audio.

In Figure A.2 and Figure A.3, 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 programme services is considered to be valid only when the programme services are all linked with a common Linkage Set Number (LSN). No more than one LSN will apply to any given programme service at the same time. Interleaving of different LSNs relating to the same programme service, for example an active link and a future potential link, is not permitted. An active link between m programme services out of n potentially linked services ($m < n$) is considered valid only when the Linkage Actuators (LA) in the linkage words concerning those m services are set to one.

Annex B
(informative)

Conversion between time and date conventions

The types of conversion which may be required are summarized in the diagram as indicated in Figure B.1. This figure shows the conversion routes between the Modified Julian Date (MJD) and the Coordinated Universal Time (UTC). The five conversion routes indicated in the diagram as (a) to (e) are detailed in the corresponding formulae a) to e) below Table B.1.

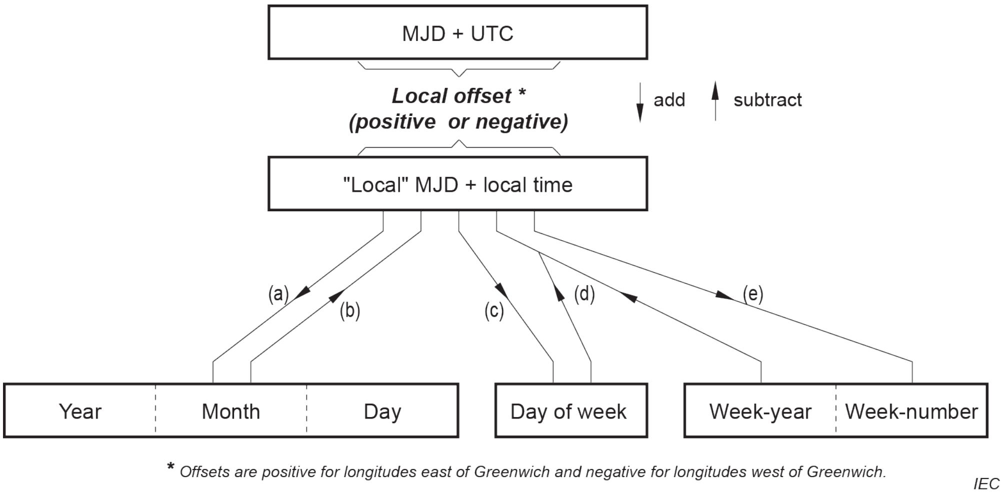


Figure B.1 – Conversion routes between Modified Julian Date (MJD) and Coordinated Universal Time (UTC)

The conversion between MJD + UTC and the "local" MJD + local time is simply a matter of adding or subtracting the local offset. This process may, of course, involve a "carry" or "borrow" from the UTC affecting the MJD. The other five conversion routes shown on the diagram are detailed in the formulae indicated in a) to e) below using the symbols given in Table B.1.

Table B.1 – Symbols used for time and date calculation

Symbol	Meaning
MJD	Modified Julian Day
UTC	Coordinated Universal Time
Y	Year from 1900 (e.g. for 2003, Y = 103)
M	Month from January (= 1) to December (= 12)
D	Day of month from 1 to 31
WY	"Week number" Year from 1900
WN	Week number according to ISO 8601
WD	Day of week from Monday (= 1) to Sunday (= 7)
K, L, M', W, Y'	Intermediate variables
×	Multiplication
int	Integer part, ignoring remainder
mod 7	Remainder (0 to 6) after dividing integer by 7

a) To find Y, M, D from MJD:

$Y' = \text{int} [(MJD − 15\,078{,}2) / 365{,}25]$

$M' = \text{int} \{ [MJD − 14\,956{,}1 − \text{int} (Y' × 365{,}25)] / 30{,}600\,1 \}$

$D = MJD – 14\,956 − \text{int} (Y' × 365{,}25) − \text{int} (M' × 30{,}600\,1)$

If $M' = 14$ or $M' = 15$, then $K = 1$; else $K = 0$

$Y = Y' + K$

$M = M' − 1 − K × 12$

b) To find MJD from Y, M, D:

If $M = 1$ or $M = 2$, then $L = 1$; else $L = 0$

$MJD = 14\,956 + D + \text{int} [(Y − L) × 365{,}25] + \text{int} [(M + 1 + L × 12) × 30{,}600\,1]$

c) To find WD from MJD:

$WD = [(MJD + 2) \bmod 7] + 1$

d) To find MJD from WY, WN, WD:

$MJD = 15\,012 + WD + 7 × \{ WN + \text{int} [(WY × 1\,461 / 28) + 0{,}41] \}$

e) To find WY, WN from MJD:

$W = \text{int} [(MJD / 7) − 2\,144{,}64]$

$WY = \text{int} [(W × 28 / 1\,461) − 0{,}007\,9]$

$WN = W − \text{int} [(WY × 1\,461 / 28) + 0{,}41]$

EXAMPLE:

MJD	= 45 218	W	= 4 315
Y	= (19)82	WY	= (19)82
M	= 9 (September)	WN	= 36
D	= 6	WD	= 1 (Monday)

NOTE These formulae are applicable between the inclusive dates: 1st March 1900 to 28th February 2100.

Annex C
(normative)

RDS2 File Transfer protocol RFT for files up to 163 kB

C.1 Group coding of the ODA-AID assignment groups

C.1.1 General principles

Data which belongs to an ODA shall be sent using the same pipe number as the channel number which is assigned to the ODA, e.g. if an ODA is assigned to channel 12, then the file data for that ODA can be found in pipe 12.

In total 16 channels/pipes (0-15) are reserved for this type of ODAs using external data in the form of files.

Assignment group and pipe data belonging to the same file should always share the same time window used for the file transfer so that these two kinds of data are "in sync".

The RFT uses only the AID assignment method 1, see 4.4.3.

The assignment group signals additional data, which may be required by the file for the respective ODA. Each assignment group of method 1 has four bytes to perform this task. Byte 1 carries the variant code (0…15). All variants, except variants 0 and 1, are free to be defined by the ODA designer.

C.1.2 Variant 0

Variant 0 is mandatory and carries the following five file associated parameters:

- $c_{15}..c_{12}$: Variant code: 4 bits (msb first)
- c_{11}: CRC-16 flag: this bit flags the presence of a CRC-16 code (see Annex D) in variant 1.
  1 = Yes, 0 = No
- $c_{10}..c_8$: File version, 3 bits (msb first)
- $c_7..c_2$: File ID, 6 bits (msb first)
- $c_1..c_0$, $d_{15}..d_0$: File size, 18 bits (msb first)

Variant 0 is entirely generated by RDS/RDS2 encoders.

Figure C.1 shows the AID assignment group for variant 0.

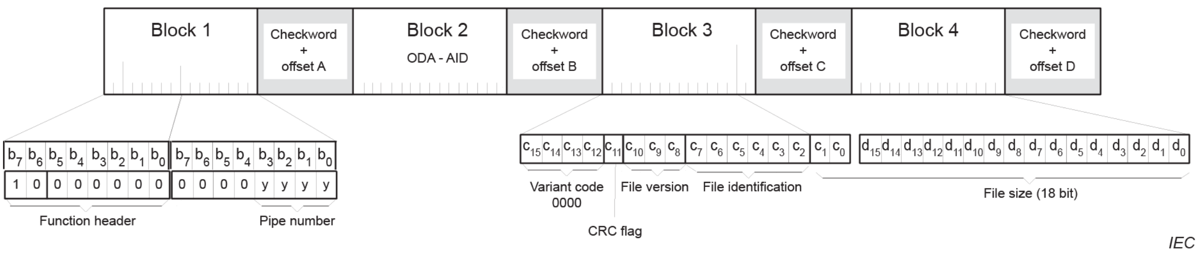


Figure C.1 – AID assignment group coding for variant 0

C.1.3 Variant 1

Variant 1 is used only and it is also mandatory, if a CRC-16 is present, as shall be indicated in variant 0.

Variant 1, CRC-mode 0 shall be entirely generated by RDS/RDS2 encoders. CRC-mode 7 is an automatic selection mode for RDS/RDS2 encoders based on file size. It shall be the default mode for RDS/RDS2 encoders in the absence of any other definition.

The coding of variant 1 is as follows:

– $c_{15}..c_{12}$: Variant code: 4 bits (msb first)

– $c_{11}..c_{9}$: CRC-mode, 3 bits (msb first)

000 (0) – CRC-16 calculated over the entire file

001 (1) – CRC-16 calculated over chunks of 16 groups, file size (bytes) ≤ 40 960

010 (2) – CRC-16 calculated over chunks of 32 groups, file size bytes > 40 960 and ≤ 81 920

011 (3) – CRC-16 calculated over chunks of 64 groups, file size (bytes) > 81 960

100 (4) – CRC-16 calculated over chunks of 128 groups, file size (bytes) > 81 960

101 (5) – CRC-16 calculated over chunks of 256 groups, file size (bytes) > 81 960

110 (6) – rfu

111 (7) – Automatic selection among mode 1 to 3, based on the file size appropriate for each of these three modes

For CRC mode = 111 (7), the chunk size is automatically selected by encoders of mode 1, 2 or 3, based on the file size. This is also the default CRC mode for encoders in the absence of any other definition. The CRC mode effectively transmitted in RDS data shall be mode 1, 2 or 3, as selected by the encoder.

– $c_{8}..c_{0}$: Chunk address, 9 bits (msb first)

– $d_{15}..d_{0}$: CRC-16 code, 16 bits (msb first)

The chunk size will influence the maximum file size to be transferred and the valid chunk address range, as shown in Table C.2.

Table C.2 – Relation between chunk size, max. file size and max.chunk address

Chunk size (in groups)	Max. file size (bytes)	Max. chunk address
16	40 960	0..511
32	81 920	0..511
64	163 840	0..511
128	163 840	0..255
256	163 840	0…127

An RFT data group chunk is defined to consist of 16 to a maximum of 256 data groups, where each group carries 5 bytes of file data, from 80 bytes (16 × 5) if mode = 1 is used, up to maximum of 1 280 bytes (256 × 5) if mode = 5 is used.

For the last RFT data group chunk, the CRC-16 is calculated on the remaining bytes.

Figure C.2 shows the AID assignment group for variant 1.

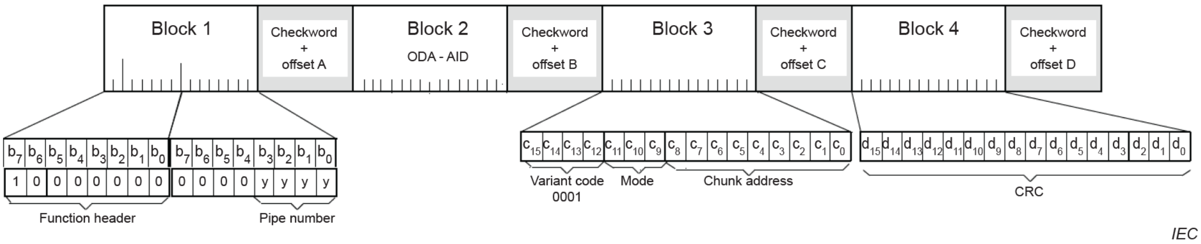


Figure C.2 – AID assignment group coding for variant 1

C.1.4 Variants 2 to 15

As shown in Figure C.3 variants 2 to 15 are free to be used by the ODA designer. Variants 2 to 7 are file related and variants 8 to 15 are for data of the ODA that are not file related. The encoder shall treat these variants differently. The assignment groups with file related variants shall be automatically inserted, just like variants 0 and 1 "in-sync" with the file to which they belong, i.e. within the time-interval during which the respective file is transmitted. The other variants, 8 to 15, are not related to a specific file and their assignment groups shall be transmitted using options specified at the encoder side (see IEC 62106-10[2]).

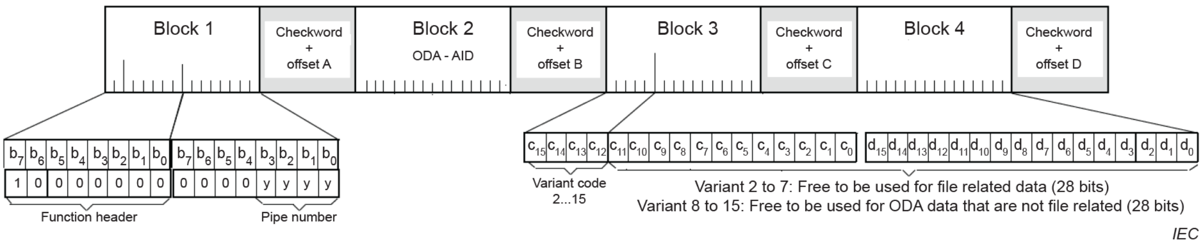


Figure C.3 – AID assignment group coding for variant 2 to 15

C.2 Coding of the RFT data group used to carry the file data bytes

The msb byte out of the possible eight is reserved to carry the FH, in this particular case composed of the FID ("00") and the FN, which comprises two fixed bits ("10") and the four-bit pipe number (range 0 to 15).

The payload of each data group comprises the toggle bit and a 15-bit segment address (msb first) which may be used as segment counter (from 0 to N-1, where N is the maximum number of groups being used for the file transfer). The data segments of 5 bytes are used for the file to be transferred, yielding a maximum file size of ($2^{15} \times 5$) = 163 840 bytes.

In the last group's data segment, the unused bytes shall be padded with zeros.

Figure C.4 shows the RFT data group.

2 Under preparation. Stage at the time of publication: IEC CDV 62106-10:2021.

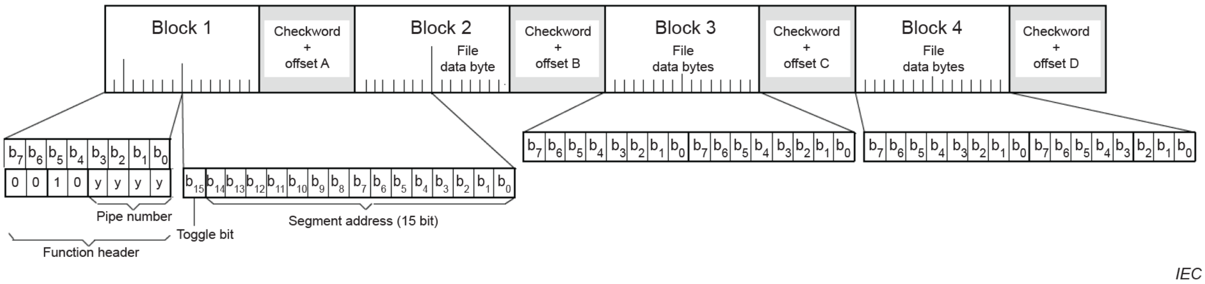


Figure C.4 – RFT data group

Toggle bit: the bit toggles when the content of the current RFT file sent over this pipe has changed. If only one file is sent several times over the same pipe with the same content, then the bit does not toggle. If two files are alternately repeated over this pipe, then the bit toggles each time the pipe begins to transmit the other file.

Annex D
(informative)

CRC-16 ITU-T/CCITT checkword calculation

D.1 General

CRC-16 is a cyclic redundancy check carried out on data to allow error checking to take place.

The field consists of four hexadecimal characters representing a 16-bit calculation. The divisor polynomial used to generate CRC-16 is:

$$x^{16} + x^{12} + x^{5} + 1$$

CRC-16 is initialized with a value of 0xFFFF and the four CRC-16 hex characters are formed from the INVERSE of the result of the CRC-16 calculation. The four most significant bits are represented by the first CRC-16 field character.

D.2 PASCAL listing of CRC-16-calculation routine

Type String is a Packed Array of Char with the zero'th element holding the length of the string.

SWAP is a library function which swaps the high- and low-order bytes of the argument e.g.

```
Var X:  Word;
Begin
   X:= SWAP ($1234)      [$3412]
End;
```

LO is a library function which returns the low-order byte of the argument e.g.

```
Var W:  Byte;
Begin
   W:= LO ($1234)     [$34]
End;
```

Function CRCvalue (StringToEval: String): Integer;

```
Var
Count:  Byte;
TempCRC: Word;
Begin
   TempCRC:= $FFFF;
   For Count:= 1 to LENGTH (StringToEval) do
   begin
      TempCRC:= SWAP (TempCRC) XOR ORD (StringToEval [Count]);
      TempCRC:= TempCRC XOR (LO (TEMPCRC) SHR 4);
      TempCRC:= TempCRC XOR (SWAP (LO (TempCRC)) SHL 4) XOR
                   (LO (TempCRC) SHL 5)
   end;
   CRCvalue:= TempCRC XOR $FFFF
End;  //Of function CRCvalue
```

D.3 C listing of the CRC-16 calculation routine

The function "crc16_ccitt( )" returns the CRC-16 value for a given array "data" of the length "len". As required by the specification, the CRC-16 calculation is initialized with 0xFFFF and its result is inverted before being returned.

```
   unsigned int crc16_ccitt (unsigned char* data, unsigned int len)
{
   unsigned int i, crc=0xFFFF;
      for ( i=0; i < len; i++ )
   {
      crc  = (unsigned char)(crc >> 8) | (crc << 8);
      crc ^= data[i];
      crc ^= (unsigned char)(crc & 0xff) >> 4;
      crc ^= (crc << 8) << 4;
      crc ^= ((crc & 0xff) << 4) << 1;
   }
   return ((crc ^= 0xFFFF) & 0xFFFF);
}
```

D.4 Fictitious example

The string of these 47 symbols

2D11123401 0105ABCD12 3F0XXXX110 6921249100 0320066

when transformed into the following sequence of 8-bit ASCII hexadecimal codes (bytes)

0x32	44	31	31	31	32	33	34	30	31	30	31	30	35	41	42	43	44	31	32	33	46	30	58	58	58	58
	31	31	30	36	39	32	31	32	34	39	31	30	30	30	33	32	30	30	36	36						

will yield the following CRC-16 checkword:

0x9723

NOTE The UECP specified in IEC 62106-10 uses the same CRC-16 type and the method of calculation applies, as detailed above.

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