



BSI Standards Publication

Radio data system (RDS) – VHF/FM sound broadcasting in the frequency range from 64,0 MHz to 108,0 MHz

Part 10: UECP – Universal Encoder Communication Protocol

National foreword

This British Standard is the UK implementation of IEC 62106-10:2021.

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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INTERNATIONAL STANDARD

**Radio data system (RDS) – VHF/FM sound broadcasting in the frequency range
from 64,0 MHz to 108,0 MHz –
Part 10: UECP – Universal Encoder Communication Protocol**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 10: UECP – Universal Encoder Communication Protocol

FOREWORD

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International Standard IEC 62106-10 has been prepared by technical area 1: Terminals for audio, video and data services and content, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

This first edition, together with IEC 62106-1, IEC 62106-2, IEC 62106-3, IEC 62106-4, IEC 62106-5, IEC 62106-6 and IEC 62106-9, cancels and replaces IEC 62106:2015, and constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC 62106:2015:

- The Universal Encoder Communication protocol UECP adapted to support optional RDS2 is new.
- The section dealing with legacy RDS using data-stream 0 only is a transcription of an RDS Forum technical specification which was initially developed by the EBU and which was already in its 7th version [1]. Full backwards compatibility with previous versions was maintained, but RDS features no longer specified in IEC 62106-2 were deleted.

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

Draft	Report on voting
100/3643/FDIS	100/3688/RVD

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

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.

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 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, specifically 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 [2, 3, 4, 5, 6].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 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

NOTE 1 The Part numbers 7 and 8 will not be used.

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

Obsolete or unused functions from the original RDS standard have been deleted.

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 10: UECP – Universal Encoder Communication Protocol

1 Scope

This part of IEC 62106 describes the Universal Encoder Communication Protocol – UECP. The UECP has as its primary objectives to satisfy the need for harmonized RDS encoder communication protocols and to facilitate the interworking of various RDS systems components, such as RDS servers, data bridges and encoders, regardless of the supplier. Furthermore, a harmonised network environment and encoder model is being maintained to facilitate the interchange of component parts of RDS network systems. These harmonized models and a universal layered protocol are specified, based on the ISO/OSI recommendation. The UECP encompasses all current RDS features including any new developments using the ODA protocol.

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 62106-1, *Radio data system (RDS) – VHF/FM sound broadcasting in the frequency range from 64,0 MHz to 108,0 MHz – Part 1: Modulation characteristics and baseband coding*

IEC 62106-2:2021, *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 definition of RDS features*

IEC 62106-4, *Radio data system (RDS) – VHF/FM sound broadcasting in the frequency range from 64,0 MHz to 108,0 MHz – Part 4: Registered code tables*

ETSI EN 300 401, *Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers*

ETSI TS 101 756, *Digital Audio Broadcasting (DAB); Registered Tables*

ETSI TS 102 980, *Digital Audio Broadcasting (DAB); Dynamic Label Plus (DL Plus); Application specification*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms, definitions and abbreviated terms of IEC 62106-1, of IEC 62106-2 and the following 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

ADD	Destination address bytes (2 bytes)
AS	Assignment signalling (assign channel/pipe to AID) for RDS2
CRC-16	Cyclic Redundancy Check (2 bytes)
DAB	Digital Audio Broadcasting
DL	Dynamic Label (DAB)
DSN	Data Set Number
DVB-S	Digital Video Broadcasting via Satellite
ID	Identification
IP	Internet Protocol
GS	Group sequence
MEC	Message Element Code
MED	Message Element Data
MEL	Message Element data Length
MFL	Message Field Length
MSG	Message bytes
PSN	Programme Service Number
RFT	RDS2 File Transfer protocol
SQC	Sequence counter byte
STA	Start byte
STP	Stop byte
TCP	Transmission Control Protocol used on the Internet
UDP	User Datagram Protocol used on the Internet
UECP	Universal Encoder Communication Protocol

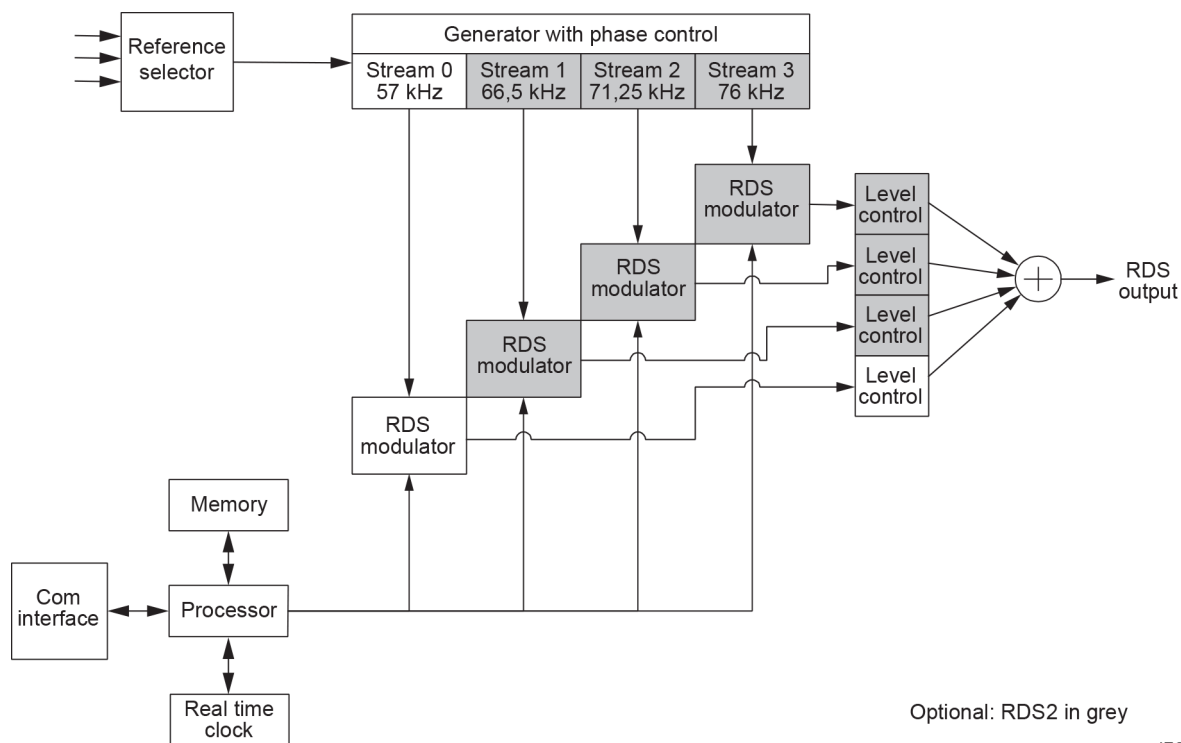
4 RDS encoder hardware model

A simplified model of an RDS encoder with data-stream 0 and three optional upper data-streams 1 – 3 is shown in Figure 1. The model does not include such obvious or necessary components as a power supply or control panel, but includes the blocks necessary to understand and develop the protocol itself.

These blocks are:

- Processor – the central processing unit of the encoder, usually a micro-processor, with access to input and output devices, the real-time clock, and memory.
- Memory – comprises ROM and RAM necessary for the operating software of the encoder, and appropriate RAM, NVRAM, and ROM for stored data.
- Real time clock – maintains the current time of day and calendar date. Used to generate type 4A groups (CT).

- Communication interface – UECP data using this specification is received from an RDS data server of the broadcaster or a transmission operator and transmitted using the serial communications interface. Alternatively, an IP interface may be used. The appropriate IP transmission methods are described in Annex B.
- RDS modulator – produces the RDS bi-phase signal, in accordance with IEC 62106-1.
- 57 kHz subcarrier – frequency and phase locked to the third harmonic of the selected 19 kHz pilot-tone reference source.
- 66,5 kHz subcarrier – frequency and phase locked to the third harmonic of the selected 19 kHz pilot-tone reference source and used to generate data-stream 1.
- 71,25 kHz subcarrier – frequency and phase locked to the third harmonic of the selected 19 kHz pilot-tone reference source and used to generate data-stream 2.
- 76 kHz subcarrier – frequency and phase locked to the third harmonic of the selected 19 kHz pilot-tone reference source and used to generate data-stream 3.
- Reference selector (optional): selects one source of the 19 kHz pilot-tone reference signal, out of a maximum of six, to lock to the internal 57 kHz oscillator. Each 19 kHz reference source corresponds to a specific level and phase adjustment of the produced output signal. When a specific reference source is selected via the Reference selector, the corresponding level and phase values are taken from a "reference entry table". This table comprises the following parameters: RDS output level for each of the data-streams (see IEC 62106-1).
- RDS subcarrier 0 phase relative to the pilot (see IEC 62106-1 for conditions to be met).
- Level and phase control: the level of each subcarrier and phase of subcarrier 0 shall be adjusted by the processor under the appropriate commands (see Annex A). The phase of subcarriers 1, 2, and 3 shall be phase locked to subcarrier 0 (see IEC 62106-1). The output level shall be set in the range 0 mV to 8 191 mV, and the phase in the range between 0° and 360° to lock to the internal 57 kHz oscillator. Level and phase of the RDS signal may depend of the 19 kHz pilot-tone reference signal. As up to six reference inputs may be used, level and phase are set on the "reference table entry", as mentioned under the item "Reference selector" above.



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Figure 1 – RDS encoder hardware model

5 RDS encoder software model

The encoder in accordance with the addressing method described in Clause 6 accepts messages, which are detailed in Clause 8. Applicability is further determined by optional fields within the message itself. This permits addressing of the structures shown in Figure 2:

- **Data sets:** an encoder will have one or more data sets identified by a unique DSN, each of which results in a particular RDS output. Each data set may refer to many programme services using the RDS-EON feature. Only one data set is responsible at any one time for the encoder's output and is known as the current data set. Data sets are addressed by the protocol as described in Clause 8.
- **Programme services:** all programme services are identified by a unique Programme Service Number PSN which is used to label data within RDS networks. In a network providing the EON feature, data for several programme services will be sent to an encoder, which can then identify that the data refers to one or more of the data sets and elements within the data sets used by that encoder. Programme services are addressed using the PSN by the protocol as described in Clause 8. There is a specific memory area in each data set for each programme service.
- **Buffers:** some information is buffered, for example ODAs, EWS and other free format groups. This means that the received information is placed in a queue awaiting transmission. It is possible to configure a buffer for cyclic transmission.

On the upper data-streams for RDS2, only C-type groups are used. For A and B type groups on the upper data-streams, C-type tunneling shall be used (see IEC 62106-2).

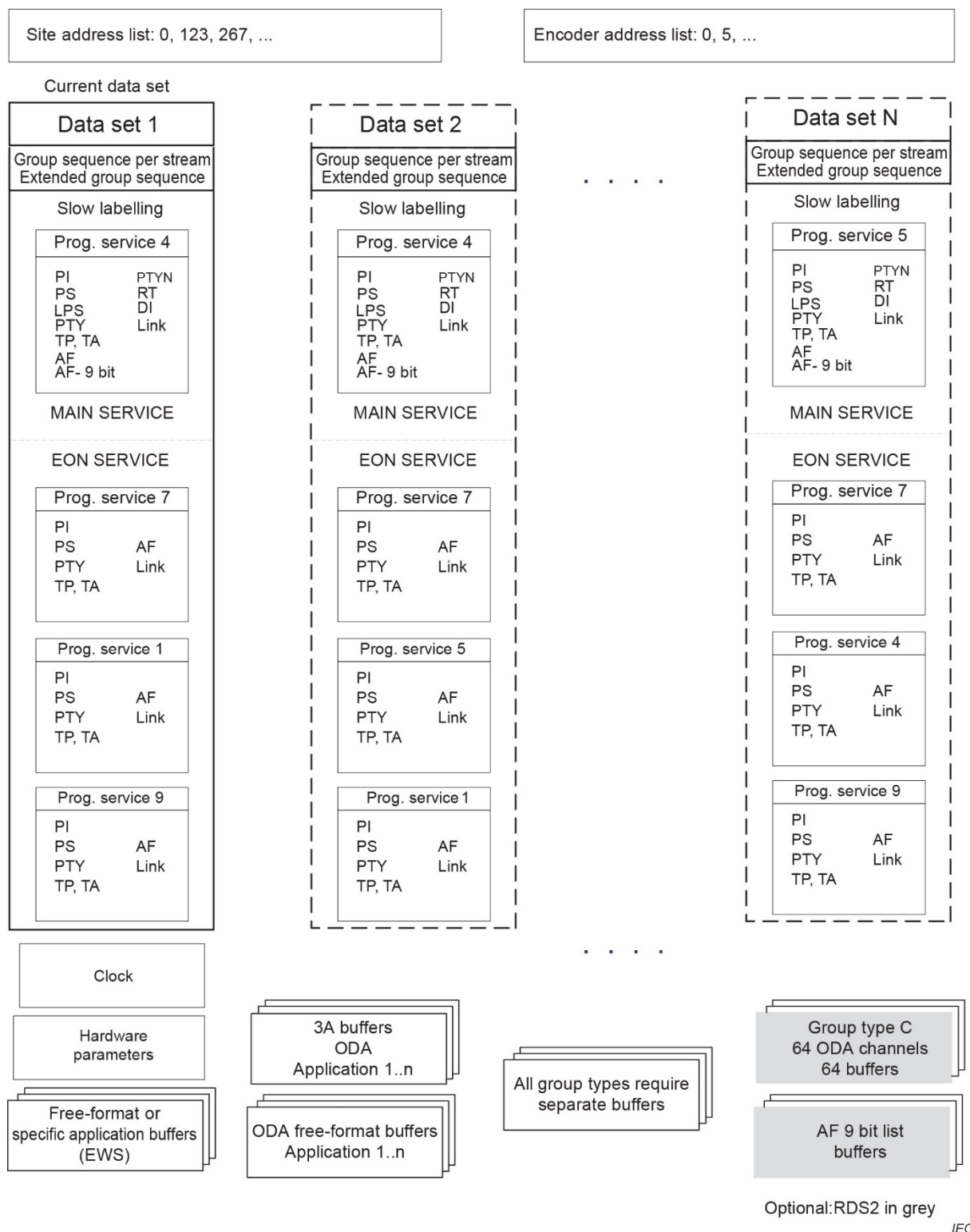


Figure 2 – RDS encoder software model

6 Destination addressing method

6.1 General

Communication to RDS encoders needs to be capable of many levels of addressing: to all encoders, to specific sets of encoders, or to a particular device. This may be accomplished by unique physical connections or by a suitable logical addressing method.

It is expected that many messages will be sent to all encoders. Thus, the global number of "0" is defined for both the site and encoder addresses. Messages bearing the global site address are deemed to be acceptable at all sites in the system. Messages bearing the global encoder address are deemed to be acceptable at all encoders at sites specified by the accompanying site address.

An encoder will have two destination address lists, one of acceptable site addresses and the other of acceptable encoder addresses; see Figure 2. The site address list includes "0" (the global site address), the unique site address and any additional site group addresses. The encoder address list includes "0" (the global encoder address), the unique encoder address and any additional encoder group addresses.

A message is acceptable to a particular encoder only if the site address is contained within its site address list and the encoder address is contained within its encoder address list.

The site and encoder addresses should be thought of as being entirely physical and are used only to address a certain "box" at a certain location; the functionality of the "box" is irrelevant in this context.

6.2 Site address

In defining an environmental model for the UECP the following assumptions are made:

- The data-stream will feed one or more transmitter sites. Each site will have a unique address, known as the site address (a number in the range 1 to 1 023). All encoders at a particular transmitter site share the same site address.
- An encoder will possess one or more site addresses. One of these shall be unique to the particular physical site location. Additional site addresses are permitted for a particular area, region, or country.

To clarify this concept, an example is given in Figure 3.

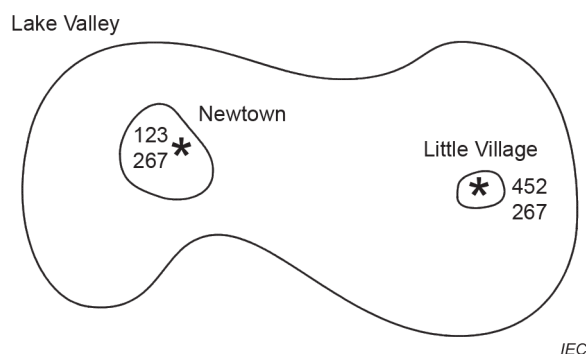


Figure 3 – Fictitious example of site addressing

All encoders at the NEWTOWN site have the unique site address "123". Other encoders in the system are not permitted to use this address. Encoders at the NEWTOWN site also have the site address "267", which is allocated to all encoders in the LAKE VALLEY area. Messages arriving at the NEWTOWN site with either of these two site addresses will be accepted. Messages arriving at the LITTLE VILLAGE site (address "452"), also in the LAKE VALLEY area, will not be accepted if they carry the NEWTOWN site address, but will be accepted if they carry either the LITTLE VILLAGE or the LAKE VALLEY site addresses.

6.3 Encoder address

Several RDS encoders are installed at each transmitter site, serving a number of programme services. Backup equipment is sometimes provided, sometimes not. A single backup encoder can even be provided for several programme services. Whatever the situation may be, each encoder at the site needs to be individually addressable. A second level of addressing is therefore introduced, the encoder address (a number in a range 1 to 63).

An encoder will possess one or more encoder addresses. One shall be unique to the encoder at that site. Additional encoder addresses may be assigned in accordance with the encoder's usage or manufacture. However, the site and encoder addresses are not intended to specify a particular radio service.

7 Transmission modes

7.1 General

The UECP protocol is designed to operate using serial communication.

The communication is always the same, regardless of which mode will be used. Whether the transmission mode is then taken as I2C, RS232, USB, UDP/TCP (see Annex B), or DVB-S (see Annex C), the transmitting device itself does not change the UECP protocol (see Clause 8).

7.2 Uni-directional mode

This mode is used on one-way communication links. Data is transmitted to one, a group, or all encoders. Response from the encoder is not possible.

7.3 Bi-directional mode, requested response

This mode uses a two-way communication link to transmit data to one, a group or all encoders. It allows the RDS server to request data, status, and error report from encoders.

7.4 Bi-directional mode, spontaneous response

A two-way communication link allows UECP software to transmit data to encoders and request data from encoders. Encoders are also able to spontaneously generate status and error messages. Such messages, their content and application are described in Annex A (MEC 0x18).

8 Protocol description

8.1 Data format

The data is transmitted byte by byte in asynchronous mode. In short it is: Start byte STA; then stuffed data bytes (as described in 8.2.3); then terminated by the end Stop byte STP.

8.2 Data link layer

8.2.1 General

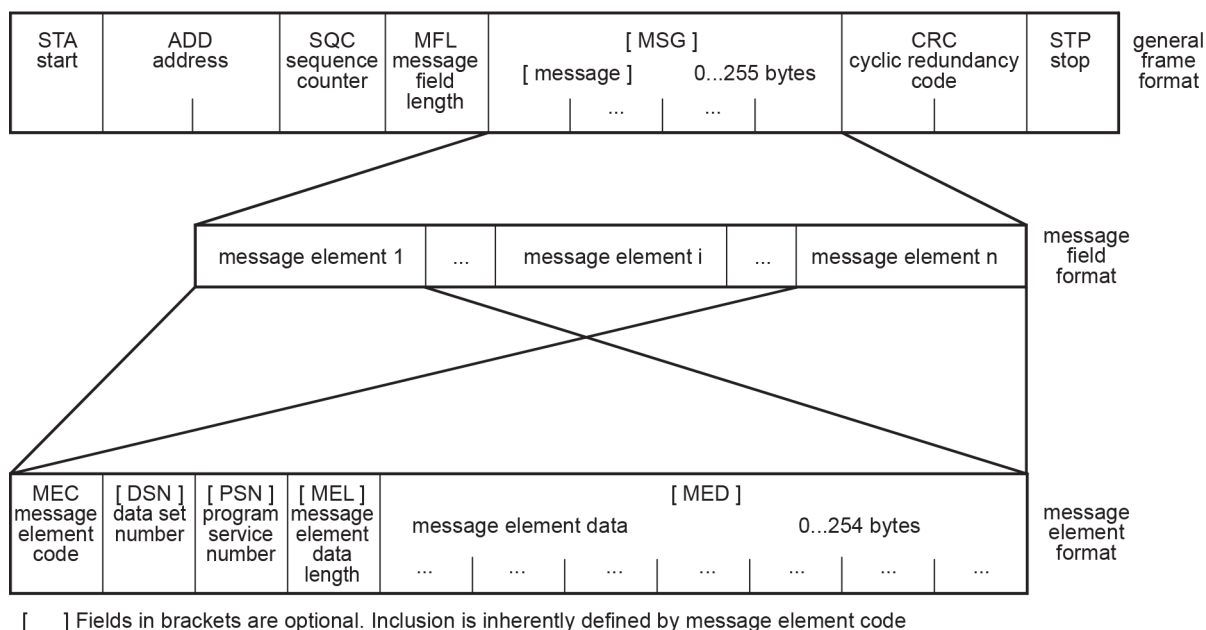
Update data comprises a stream of data-frames. A frame comprises a series of bytes, delimited by the two reserved bytes, STA (Start) and STP (Stop), which mark the beginning and end of the frame. Each frame contains a destination address (ADD), defining the set of encoders to which the message is being sent. A sequence counter (SQC) labels each separate record. The message itself is preceded by the MFL byte defining the message field length and it is followed by the two CRC-16 checkword bytes.

The Start and Stop bytes are uniquely defined and may not occur in any other field of a frame. In order to prevent this, a frame is byte-stuffed prior to transmission. Byte-stuffing transforms an occurrence of a reserved byte into two bytes (see 8.2.3). The reverse process is applied at reception, where byte-stuffed frames are converted prior to frame processing. Thus, although the Start and Stop bytes are reserved, messages may freely use bytes with any value. In cases where reserved byte values are present in the message, the transmitted message length will be increased. However, the message field length MFL is always defined in its unstuffed, shortest, state.

8.2.2 Data-frame

8.2.2.1 Data-frame format

Each data-frame has the format shown in Figure 4.



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Figure 4 – UECP data-frame format

Each data-frame has the format shown in Table 1.

Table 1 – UECP data-frame description

Field description	Descriptor	Field length
Start	STA	1 byte
Destination address	ADD	2 bytes
Sequence counter	SQC	1 byte
Message field length	MFL	1 byte
[Message]	[MSG]	0...255 bytes
CRC-16 checkword	CRC	2 bytes
Stop	STP	1 byte

The symbols [] indicate that this field is optional. When not included, the message field will be set to zero. Such a record may be used to indicate an idle line (not being used, but ready).

Frames are built in accordance with this structure, and then byte-stuffed prior to transmission. Byte-stuffing removes any occurrences of reserved bytes (0xFE for STA and 0xFF for STP) within the fields "ADD – Destination Address" to "CRC – Cyclic Redundancy Check" inclusively.

The message field length MFL is only one byte, thus limiting the length of the message to 255 bytes.

8.2.2.2 Start (STA)

A data record starts with the start byte (0xFE). This byte will not occur at any other point in a transmitted sequence (after byte-stuffing).

8.2.2.3 Address (ADD)

The address field comprises two elements, these are:

Site address	10 bits (most significant)
Encoder address	6 bits (least significant)

For a message to be acceptable to a particular encoder, both the site address and the encoder address shall be contained within the respective address lists of the encoder.

8.2.2.4 Site address

The site address defines the site, or group of sites to which this record is being sent.

0x000	=	All sites
0x001 – 0x3FF	=	Specific site or group of sites, as selected by encoder operator

Each encoder with duplex mode will acknowledge a series of site address codes. One shall be unique, i.e. common to all encoders at a particular location. Another may be common to all encoders in a certain area, and so on.

8.2.2.5 Encoder address

The encoder address defines to which encoder(s) at a particular site this record is being sent.

0x00	=	All encoders at the site
0x01 – 0x3F	=	Specific encoder or group of encoders, as selected by the encoder operator.

Each encoder with duplex mode will acknowledge a series of site address codes. One shall be unique, i.e. common to all encoders at a particular location. Another may be common to all encoders in a certain area, and so on.

8.2.2.6 Sequence counter (SQC)

The purpose of the Sequence counter in the UECP data-frame is to help data providers to improve their communication link with encoders. An encoder may identify less-than-perfect data communication between the RDS distribution server and the encoder, regardless of whether either a unidirectional protocol or bi-directional protocol is employed. In a perfect connection environment, UECP frames will arrive without any 'gaps' in the Sequence counter, each frame incremented by '1' from the preceding frame. Hence, when gaps are noted at the encoder by missing Sequence counter values, this will indicate that improvements should be made to the distribution system. When gaps are identified, frames with a non-consecutive SQC shall be accepted by the encoder. Additionally, where there is a one-to-one relationship between a server and an encoder and a bi-directional communication protocol is used, a possibility exists for the encoder with MEC 0x18 to signal a missing frame so that the server can thus resend it.

Broadcasters/Service providers shall either ensure that the Sequence counter value increments by 'one' from 1...255 and complete the sequence before restarting, or that optionally they send all UECF frames with the sequence counter set to '0', which will disable the sequence counter functionality completely.

8.2.2.7 Message field length (MFL)

This single byte informs the encoder of the number of bytes in the message field (0..255). This value is defined as that prior to byte-stuffing applied.

8.2.2.8 Message (MSG)

The message comprises 0 to 255 bytes of data. These bytes may freely take any value in the range 0x00 – 0xFF. Byte stuffing is applied afterwards.

8.2.2.9 Cyclic redundancy check (CRC-16)

The checkword field consists of two bytes (prior to byte-stuffing), which represent the result of a 16-bit cyclic redundancy check (CRC-16) calculation.

The divisor polynomial used to generate the CRC-16 is the ITU-T/CCITT polynomial

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

The CRC-16 calculation starts with the most significant bit of the field immediately following the start character and ends with the least significant bit of the character immediately preceding the first CRC-16 character, i.e. it ends with the least significant bit of the last byte of the message field. The CRC-16 is initialized to a value of 0xFFFF, and the two check bytes are formed from the inverse of the result. The eight most significant bits are represented by the first check field byte, and the eight least significant bits are represented by the second check field byte (see IEC 62106-2 for more detail regarding the CRC-16 calculation).

EXAMPLE 1:

MEC 0x02 is used to send a PS name with

„PS_RDS_ for DSN 3 (0x03) and PSN 6 (0x06) to encoder 18 (0x12) on site 837 (0x345).

MEC 0x02 is <02><03><06><20><50><53><20><52><44><53><20>

The SQC byte is set to 0x01.

The calculation of the CRC-16 based on this data is illustrated in Figure 5.

STA	ADD		SQC	MFL	MEC	DSN	PSN	PS character #1	PS character #2	PS character #3	PS character #4	PS character #5	PS character #6	PS character #7	PS character #8	CRC	STO
FE	D1	52	01	0B	02	03	06	20	50	53	20	52	44	53	20	25F4	FF
		Encoder = 0x12		Length = 11 bytes		Define a PS text				<Space>	P	S	<Space>	R	D	S	<Space>
		Site = 0x345															

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Figure 5 – UECF data frame with the CRC-16 for example 1 being 0x25F4

The corresponding UECF data-frame with the CRC-16 is

<FE><D1><52><01><0B><02><03><06><20><50><53><20><52><44><53><20><25><F4><FF>

EXAMPLE 2:

MEC 0x02 is used to send a PS name with

„PS_RDS_ for DSN 3 (0x03) and PSN 6 (0x06) to encoder 63 (0x3F) on site 1022 (0x3FE).

MEC 0x02 is <02><03><06><20><50><53><20><52><44><53><20>

The SQC byte is set to 0x00.

The calculation of the CRC-16 based on this data is illustrated in Figure 6.

NOTE The byte stuffing method is applied on ADD.

STA	ADD	SQC	MFL	MEC	DSN	PSN	PS character #1	PS character #2	PS character #3	PS character #4	PS character #5	PS character #6	PS character #7	PS character #8	CRC	STO	
FE	FD02	BF	00	0B	02	03	06	20	50	53	20	52	44	53	20	800C	FF

Encoder = 0x3F

Site = 0x3FE

Length = 11 bytes

Define a PS text

<Space>

P

S

<Space>

R

D

S

<Space>

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Figure 6 – UECF data frame with the CRC-16 for example 2 being 0x800C

The corresponding UECF data-frame with the CRC-16 is

<FE><FD><02><BF><00><0B><02><03><06><20><50><53><20><52><44><53><20><80><0C><FF>

8.2.2.10 Stop (STP)

A data record ends with the stop byte (0xFF). This byte will not occur at any other point in a transmitted sequence (after byte-stuffing).

8.2.3 Byte-stuffing method

The technique of byte-stuffing allows a byte-oriented protocol, such as this one, to preserve certain unique values for framing purposes, and yet allow conveyed messages to utilize the full byte range (0x00 to 0xFF). This is achieved by trapping reserved bytes in illegal fields and transforming them into legal byte pairs.

Byte values 0xFD, 0xFE, and 0xFF are trapped in the fields "Address" to "Cyclic Redundancy Check" and transformed into a pair of bytes as shown in Table 2.

Table 2 – Byte-stuffing method

Byte		Resultant byte pair
0xFD	transformed into	0xFD 00
0xFE	transformed into	0xFD 01
0xFF	transformed into	0xFD 02

Thus, the reserved bytes (0xFE and 0xFF) will never occur within these fields in a transmitted record and will only occur within the start and stop fields.

When a message is received, the reverse technique is used to transform two-byte sequences (always starting with 0xFD), into single bytes prior to the record being processed.

8.2.4 Message field format

8.2.4.1 Message structure

The message field, if non-zero in length consists of one or more message elements. Each message element has the structure as shown in Table 3.

Table 3 – Message structure

Field description	Descriptor	Field length
Message element code	MEC	1 byte
[Data set number]	[DSN]	0...1 byte
[Programme service number]	[PSN]	0...1 byte
[Message element data length]	[MEL]	0...1 byte
[Message element data]	[MED]	0...254 bytes
The symbols [] indicate that this field is optional. They are used, as required by the specific command, see Annex A.		

Several message elements may be packed together into one message field, subject to a maximum message field length of 255 bytes, as defined in 8.2.2.1. An individual message element shall not be split between different message fields.

The complete message field may be represented as follows:

[MEC,[DSN],[PSN],[MEL],[MED]], [MEC,[DSN],[PSN],[MEL],[MED]], ...

Fields and whole message elements shown in square brackets are optional. Message elements may be concatenated freely, subject to a maximum message field length of 255 bytes.

The maximum available length for a message element is 255 bytes. This inherently limits the message element data to 254 bytes. If the optional fields "Data Set Number", "Programme Service Number", and/or "Message element data length" are used, further reduction to the maximum message element data length will occur. For example, if all optional fields are employed, the maximum element data length will be 251 bytes.

8.2.4.2 Message element code (MEC)

The Message element code identifies a particular message, as defined in Annex A. The Message element code is within the range 0x01..0xFD. The codes 0x00, 0xFE and 0xFF are not permitted for defining a MEC, as they are used in this specification with a special meaning, always defined in the conventions for a specific command. A listing of all codes for MECs used is given in Annex E.

8.2.4.3 Data set number (DSN)

The data set number (DSN) permits a message to be targeted to the following within an encoder:

- a specific data set,
- the current data set,
- all data sets.

The DSN within a message element is chosen as shown in Table 4.

Table 4 – Data set number

Data set number (DSN)	Target
0	Current data set
1 to 253	Specific data set
254	All data sets except the current data set
255	All data sets

8.2.4.4 Programme service number (PSN)

The programme service number (PSN) permits a message element to operate a number of services within one or more data sets and the corresponding addressing is shown in Table 5.

Table 5 – Programme Service Number

Programme service number (PSN)	Target
0	Special PSN for main service of specified data set(s)
1 to,255	Specific service within data set(s)

8.3 Message codes

8.3.1 General

Message codes are described in Annex A and Annex G. Different classes of message are identified.

8.3.2 Remote and configuration commands

These commands permit the control of various functionality options of encoders or permit the request of messages from the encoders in a case of bi-directional transmission mode.

8.3.3 RDS messages

These messages are related to all the RDS features that have to be processed by an encoder.

8.3.4 Handling of RDS message bits declared "rfu"

Each bit from each group and block should be allowed to be used from the encoder point of view without any limitation. When IEC 62106-2 reads "rfu" (reserved for future use), this does not mean it is a forbidden bit or byte: it is just not specified yet.

To permit testing new possibilities using some of the "rfu" bits in whatever group, the encoder shall thus allow the user to do so and not block anything.

8.3.5 Status messages

These messages are used in bi-directional transmission mode to transmit information from an encoder to another device.

8.3.6 Specific messages

These types of messages are not allocated in this specification and concern specific and internal functionality that can be needed by encoder manufacturers. Specific codes are reserved for these types of message and should not be used for other features.

8.4 Description of data handling

The data is transmitted to the encoder using the specified commands described in Annex A, and stored in memory in accordance with the encoder software model, see Clause 5.

8.5 Group sequence configuration

8.5.1 Basic principles used

The encoder shall be informed about the order in which the group types used shall be transmitted and about the appropriate transmission rate for each transmitted group type.

A group sequence (GS) enables the broadcaster/transmission operator to specify an interval between two occurrences of the same group and a group sequence thus specified is always cyclic.

With this method, also the desired repetition rate for every group type is implicitly defined in a very flexible way for the broadcaster. There are, however, special transmission conditions, which are described in 8.5.5.

8.5.2 Group sequence determination

This is achieved with the "Group sequence" command, (MEC 0x16 for data-stream 0 or MEC 0x61 for the upper data-streams) which is treated by the encoder like a group enable command. When a specific group is encountered in the sequence, data relating to that type is transmitted, if available.

An example for defining the group sequence for data-stream 0 including the use of ODA application groups is given in Annex H.

8.5.3 Extended group sequence command

The extended group sequence commands (MEC 0x38 for data-stream 0, or MEC 0x83 for the data upper streams) enable alternative groups to be transmitted if the specific group type within the group sequence is not available. If no alternative group is specified, then the group type is not generated and thus effectively skipped. The next group type in the sequence is used instead.

8.5.4 Relative priority group sequence command

This command permits the alteration of the relative priority of ODA groups transmitted with immediate priority (MECs 0x43 for data-stream 0, or MEC 0x53 for the upper data-streams).

8.5.5 Special transmission conditions

8.5.5.1 Insertion of the type 4A group (CT)

The type 4A group is not allowed in the group sequence. If the CT function is set to "On" (see CT-on/off command MEC 0x19), a type 4A group is inserted automatically by the encoder at the edge of the minute.

During the insertion of a type 4A group, the specified group sequence is suspended and immediately continued thereafter. This action has the highest priority over any other event (e.g. inserting a type 14B group due to the change of the TA flag).

8.5.5.2 Insertion of type 14B group bursts

The type 14B group is not allowed in the group sequence. In order to turn "on" the TA flag for EON services, type 14B group bursts are inserted automatically by the encoder as controlled with the EON TA control command (MEC 0x15) interrupting the given group sequence as a consequence.

8.5.5.3 Insertion of type 15B group bursts

Similar to the insertion of type 14B group bursts, type 15B group bursts are inserted automatically by the encoder as controlled with the TA control command (MEC 0x2A) when the TA flag for the main service changes and are also not allowed in the group sequence.

8.6 Handling of ODA data

8.6.1 Using ODAs on data-stream 0

8.6.1.1 Basic principles

For any new RDS application using the Open Data Application (ODA) feature specified in IEC 62106-2, the coding method is either part of IEC 62106-6, or not at all part of the RDS standard. In both cases, an application is registered using the procedure described in IEC 62106-3 and when it concerns a public ODA showing exactly how the data should be transported in blocks 2, 3 and 4. An application identification code (AID) is assigned, using the 3A type group, so that each ODA has its unique AID, which is published in the ODA register.

When an ODA is transmitted by a transmission provider, the 3A groups inform the receiver in which group number and type the data for a specific application can be found. The AID which identifies an ODA shall be sent using the 3A group at least once every 5 s. The value to be chosen depends on the requirements of the ODA.

8.6.1.2 Special transmission modes

The transmission of data in accordance with the group sequence (MEC 0x16) and extended group sequence (MEC 0x38) does sometimes not offer the timing constraints necessary for certain ODA applications, and so two additional mechanisms have been specified to help ODA developers to increase the flexibility of the RDS resource allocation: "Burst mode" transmission (MEC 0x44), and "Spinning wheel" mode transmission (MEC 0x45).

To offer a flexible priority setting for different ODA applications, the ODA data (MEC 0x46) is sent to the encoder with one of the following priorities: "normal", "extremely urgent", or "immediate" transmission.

A group sent with "normal" priority will be added to the specified ODA data buffer for transmission in accordance with the group sequence. A group sent with "extremely urgent" priority will bypass the ODA data buffer and will be sent as soon as possible in accordance with the group sequence. A group sent for "immediate" transmission is immediately transmitted, irrespective of the group sequence, but respecting the higher priority for the 4A groups.

The relative priority setting (MEC 0x43) for different groups can also be configured in order to explicitly define the relative priority for groups competing to be transmitted outside of the group sequence: e.g. 14B, 15B and repetitions of ODA "Burst mode" groups.

8.6.2 Using ODAs on the upper data-streams 1 to 3

8.6.2.1 Assignment signalling

RDS2 is fully based on the usage of ODAs. On the upper data-streams, all data is organized as C-type groups. The principle behind using these ODAs is fully identical to using ODAs on data-stream 0, where each ODA has its own assignment group 3A to signal the presence of an ODA, identified through its AID code.

On the upper data-streams 1 to 3, an ODA channel in the range 0 to 63 is assigned by an assignment signalling group (AS). This AS group can carry additional data for the ODA in accordance with methods 1 to 4, as specified in IEC 62106-2.

Channel numbers 0..15 are reserved for ODAs using RFT. For this type of ODA, only assignment method 1 is used, where the additional data comes in the format of variants 0 to 15, whereby variants 0..7 are file-specific, and variants 8..15 are related to the ODA itself.

Two alternatives are specified to instruct the encoder to insert assignment groups:

– Alternative 1:

To assign a channel to an AID MEC0x50 is used. This MEC is used for methods 1..4, and with RFT, the not-file-specific variants 8..15. For the file-specific variants 0 to 7, MEC 0x57 is used to define variants 0 and 1, and variants 2 to 7 are defined using MEC0x58. For the transfer of the file data itself, MEC0x57 is used.

– Alternative 2:

MEC0x51 is used to assign a channel to an AID and to assign the additional data for methods 1..4, including the ODDAs which are using RFT. For the transfer of file data, MEC0x55 is used.

The broadcaster/transmission operator can decide to use either Alternative 1, or instead Alternative 2. The encoder will in both cases output the respective AS groups as specified in IEC 62106-2.

AS groups on the upper data-streams are not allowed in the group sequence definition, specified by MEC 0x61. They are inserted automatically by the encoder, thus interrupting the group sequence specified with MEC 0x61 for the respective data-stream(s) to be used by the ODA(s) in question. AS groups are always sent in the same stream in which the actual ODA data is sent.

The encoder will transmit variants 0 and 2 to 7 in the same time window during which the file to which these variants belong is transferred. Variant 1 has priority and is inserted into the GS immediately after the file chunk was transmitted to which this CRC belongs.

When the ODA uses external files, even if only occasionally, there can be a conflict for the automatic insertion caused by the AS group spacing chosen in MECs 0x50 and with external files in MECs 0x57/58 in the case of Alternative 1. The same can occur in Alternative 2 with the group spacing chosen in MECs 0x51 and 0x55. In both cases the respective AS group variants shall then always be inserted by the encoder in ascending order.

8.6.2.2 Special transmission modes

The transmission of ODA data requires signalling of the group sequences (MEC 0x61) and extended group sequences (MEC 0x83).

To offer the possibility of flexible priority settings for different ODA applications, the ODA data is sent to the encoder with one of the following priorities: "normal", "extremely urgent", or for "immediate" transmission.

ODA data sent for "immediate" transmission is immediately transmitted, irrespective of the group sequence, but respecting the higher priority on each active upper data-stream. The relative priority for C-type groups can be set by MEC 0x53.

For Alternative 1, burst mode (MEC 0x54) in the upper data-streams can be used only with ODA data groups (MEC 0x56). For AS groups, a different (non-customisable) burst mode can be used with MEC 0x50.

For Alternative 2, bursts defined by MEC 0x54 can be used with all ODA groups.

8.6.2.3 Tunnelling

All legacy data and ODAs designed for data-stream 0, using group types 0 to 15 with versions A or B, can be transmitted using the upper data-streams 1 to 3, being tunnelled within group type C, which is the only group type that can be used on the upper data-streams. The method to be used is specified in IEC 62106-2. To achieve this, the RDS2 encoder replaces the two bytes of the PI code in block 1 of each A or B group by two bytes of 0x00 each. In doing so, it encapsulates legacy A and B type in a C-type.

The group sequence on the upper data-streams 1 to 3 is set with MEC 0x61. Using this MEC, the transmission provider has to indicate in which sequence which A and B type groups shall be distributed on each of the data-streams 1 to 3.

8.6.2.4 Handling of RFT file transfers

To transfer files on the upper data-streams, the dedicated FID=00 is used with the FN=10yyyy that permits the identification with the four bits yyyy, 0 to 15, pipes that can be used to transfer files.

The technique used is specified in IEC 62106-2, which also states the maximum file size permitted (163 kB). Any given file that is to be transferred using the RFT protocol, shall be sent to the encoder using either MEC 0x57 (Alternative 1) or instead MEC 0x55 (Alternative 2) in UECF frames of maximum 244 file data bytes (Alternative 1) or 246 file data bytes (Alternative 2). This file data is stored in a dedicated buffer. The groups belonging to the same file are stored in the same specific buffer.

A toggle bit, managed by the encoder, is used to mark groups belonging to the same file in any given pipe. This is done to permit the transfer of a sequence of different files and to help the receiver to store the respective groups. Groups that all belong to the same file can thus be easily identified.

The broadcaster or transmission operator shall configure the encoder and shall decide which of the upper data-streams (MEC 0x61) and which channel/pipe is to be used for an ODA.

8.6.2.5 File sequence management

The RDS server determines when to send which file using MEC 0x59. When the file sequence is fixed as described in the example of the logo transmission in Annex I, the file sequencing can be pre-determined in the encoder using this MEC.

If the file sequence is variable, this is an application issue and not something for the encoder to handle.

Annex A (normative)

UECP message command repertoire

A.1 Message command format

The message description is made in accordance with Table A.1. The first column indicates the field name of the message that is detailed in the second column.

Table A.1 – Message command format

Field name	Byte definition		Comments
	MSB	LSB	
MEC			
[DSN]			
[PSN]			
[MEL]			
.MED			

[...], optional

Each element in Table A.1 represents one byte where the bits are numbered from 7..0 (from left to right). For transmission of a respective message, each byte is represented by two hex symbols whose permitted range is indicated in the respective element. The message structure used is explained in Clause 8. Symbol 00...XX or 0...X, 0...X specifies the range of the hex value that may be used.

The third column gives comment information of the context of the table. A hex symbol means that any hex value may be used. Any other information describes the nature of the data that is put in the table.

The coding of all RDS features is in the same format as used in IEC 62106-2, IEC 62106-3 or IEC 62106-6 and IEC 62106-9, unless otherwise specified.

A.2 Commands for A or B-type groups on data-stream 0

A.2.1 PI / MEC 0x01

Function: to set the PI code of the specified programme service(s) of the specified data set(s).

Format:

	MSB	LSB	
MEC	01		
DSN	00..FF		
PSN	00..FF		
MED	00..FF		PI (MSB)
MED	00..FF		PI (LSB)

Coding of PI is in accordance with IEC 62106-2.

Example: <01><00><01><C2><01>

Set PI code in current data set for programme service 1 to C201.

A.2.2 PS / MEC 0x02

Function: to set the PS name of the specified programme service(s) of the specified data set(s).

Format:

	MSB	LSB	
MEC	02		
DSN	00..FF		
PSN	00..FF		
MED	20..FE		PS character 1
MED	20..FE		PS character 2
MED	20..FE		PS character 3
MED	20..FE		PS character 4
MED	20..FE		PS character 5
MED	20..FE		PS character 6
MED	20..FE		PS character 7
MED	20..FE		PS character 8

Coding of PS is in accordance with IEC 62106-2.

Example: <02><00><02><52><41><44><49><4F><20><31><20>

Set PS in current data set for programme service 2 to >RADIO_1

A.2.3 Long PS / MEC 0x21

Function: to set the Long PS name of the specified programme service(s) of the specified data set(s). For the LPS the UTF-8 character coding is used.

Format:

	MSB	LSB	
MEC	21		
DSN	00..FF		
PSN	00..FF		
MEL	01..20		
MED	00..FE		First byte
MED	00..FE		Second byte
	:		
MED	00..FE		Last byte (32 maximum)

Coding of LPS is in accordance with IEC 62106-2. 0x0D is used to terminate the string if fewer than 32 bytes are used.

EXAMPLE 1: <21><00><02><0F><46><72><61><6E><63><65><20><4D><75><73><69><71><75><65> <0D>

Set LPS in current data set for programme service 2 to >France_Musique<

or

EXAMPLE 2: <21><00><02><0F><52><61><64><69><6F><20><4D><C3><BC><6E><63><68><65><6E><0D>

Set LPS in current data set for programme service 2 to >Radio_München<

NOTE Both above LPS examples are terminated with code <0D> because they are shorter than 32 bytes.

A.2.4 Data group for PTYI / MEC 0x04

Function: to set the decoder information and dynamic PTY indicator codes of the specified programme service(s) of the specified data set(s).

Format:

	MSB	LSB	
MEC	04		
DSN	00..FF		
PSN	00..FF		
MED	00..0A		Bit 0: reserved for future use, default = 0 Bit 1: reserved for future use, default = 0 Bit 2: reserved for future use, default = 0 Bit 3: dynamic PTY Indicator, 0=static or 1= dynamic

Coding of DI – PTYI is in accordance with IEC 62106-2.

EXAMPLE: <04><00><03><08>

Set DI/PTYI to dynamic PTY in current data set, for programme service 3.

A.2.5 TP – TA / MEC 0x03

Function: to set the traffic announcement and traffic programme bits.

Format:

	MSB	LSB	
MEC	03		
DSN	00..FF		
PSN	00..FF		
MED	00..03		Bit 0: TA Bit 1: TP

Coding of TA – TP is in accordance with IEC 62106-2.

EXAMPLE: <03><00><05><02>

Set on current data set TP = 1 and TA = 0, for programme service 5.

A.2.6 PTY / MEC 0x07

Function: to set the Programme Type information of the specified programme service on the specified data set(s).

Format:

	MSB	LSB	
MEC	07		
DSN	00..FF		
PSN	00..FF		
MED	00..1F		PTY

Coding of PTY is in accordance with IEC 62106-2.

EXAMPLE: <07><00><05><08>

Set PTY to 8 in current data set, programme service 5.

A.2.7 PTYN / MEC 0x3E

Function: to set the programme type name of the specified programme service on the specified data set(s).

Format:

	MSB	LSB	
MEC	3E		
DSN	00..FF		
PSN	00..FF		
MED	20..FE		PTYN character 1
MED	20..FE		PTYN character 2
MED	20..FE		PTYN character 3
MED	20..FE		PTYN character 4
MED	20..FE		PTYN character 5
MED	20..FE		PTYN character 6
MED	20..FE		PTYN character 7
MED	20..FE		PTYN character 8

Coding of PTYN is in accordance with IEC 62106-2.

EXAMPLE: <3E><00><02><46><6F><6F><74><62><61><6C><6C>

Set PTYN in current data set for programme service 2 to >Football<.

A.2.8 RT / MEC 0x0A

Function: to set RadioText.