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Digital Radio Mondiale (DRM);
Receiver Status and Control Interface (RSCI)

EBU
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Reference

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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

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Foreword

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NOTE: The EBU/ETSI JTC Broadcast was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC Broadcast became a tripartite body by including in the Memorandum of Understanding also CENELEC, which is responsible for the standardization of radio and television receivers. The EBU is a professional association of broadcasting organizations whose work includes the co-ordination of its members' activities in the technical, legal, programme-making and programme-exchange domains. The EBU has active members in about 60 countries in the European broadcasting area; its headquarters is in Geneva.

European Broadcasting Union
CH-1218 GRAND SACONNEX (Geneva)
Switzerland
Tel: +41 22 717 21 11
Fax: +41 22 717 24 81

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Introduction

In order to meet the need for a digital transmission system suitable for use in all of the bands below 30 MHz, the Digital Radio Mondiale (DRM) consortium was formed in early 1998. The DRM consortium is a non-profit making body that seeks to develop and promote the use of the DRM system worldwide. Its members include broadcasters, network providers, receiver and transmitter manufacturers and research institutes. More information is available from their website (http://www.drm.org/).

A large number of communication protocols have been developed to allow reliable exchange of data using a wide variety of different techniques. Some have relied on two-way communication to allow requests for re-tries of missing or corrupted messages, while others have relied on Forward Error Correcting (FEC) codes such as Reed Solomon to rebuild the original message. Unfortunately most of the protocols are tightly coupled to the application they were originally developed for, do not scale well in multicast networks or are unsuitable for use over the uni-directional circuits often found in distribution systems. When the development of a distribution protocol for Digital Radio Mondiale broadcasts was considered, none of the available protocols was deemed suitable and so it was decided to develop a general purpose, low-level, reliable communications protocol suitable for both uni-directional and bi-directional data links which would meet the needs of DRM but would also hopefully be flexible enough to meet the needs of other applications as well.

The Distribution and Communication Protocol (DCP) describes a common way to transport information over a variety of basic transport protocols like IP, serial line or file. It provides transport information, addressing information, fragmentation to handle limited basic transport protocols and forward error correction to deal with packet losses or packet corruption. The DCP protocol is application-independent and free to use for every organization and purpose. It is specified in ETSI TS 102 821 [2]. The actual content to be transported in DRM-specific protocols based on DCP (tailored to individual purposes) is defined in additional documents like the present one.

1 Scope

The present document defines the actual content to be transported in the DRM-specific protocol **Receiver Status and Control Interface (RSCI)** based on the generic and application-independent **Distribution and Communications Protocol (DCP)** [2]. The RSCI protocol covers the transport of receiver's status information (output protocol) in addition to the DRM multiplex as well as commands (control protocol) to control the receiver's behaviour. The available TAG items for the RSCI TAG layer within the DCP protocol are defined in the present document.

The present document has been revised to provide full support for the xHE-AAC audio codec.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

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The following referenced documents are necessary for the application of the present document.

[1] ETSI ES 201 980: "Digital Radio Mondiale (DRM); System Specification".

[2] ETSI TS 102 821: "Digital Radio Mondiale (DRM); Distribution and Communications Protocol (DCP)".

[3] ETSI TS 102 820: "Digital Radio Mondiale (DRM); Multiplex Distribution Interface (MDI)".

[4] ETSI TS 101 968: "Digital Radio Mondiale (DRM); Data applications directory".

[5] ETSI TS 102 358: "Digital Radio Mondiale (DRM); Specific Restrictions for the use of the Distribution and Communication Protocol (DCP)".

[6] Recommendation ITU-R P.1407: "Multipath propagation and parameterization of its characteristics".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI TR 101 290: "Digital Video Broadcasting (DVB); Measurement guidelines for DVB systems".

3 Definitions, symbols, abbreviations and convention

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

Alternative Frequency Switching (AFS): feature of the DRM multiplex, which allows receivers to automatically re-tune to a frequency offering more reliable reception without a break in the decoded audio

Application Framing (AF): layer of the DCP providing a logical grouping of a number of TAG items

byte: collection of 8 bits

cell: sine wave portion of duration T_s, transmitted with a given amplitude and phase and corresponding to a carrier position

NOTE: Each OFDM symbol is the sum of K such sine wave portions equally spaced in frequency.

Coordinated Universal Time (literally Universel Temps Coordonné) (UTC): time format counting in standard SI seconds with periodic adjustments made by the addition (or removal) of leap seconds to keep the difference between UTC and Astronomical Time less than ±0,9 s

NOTE: TAI and UTC were defined as having an initial offset of 10 seconds on January 1st 1972 (TAI prior to this date had a variable fractional offset to UTC as the two times did not use the same definition of the second). As at February 25th 2003 there have been 22 leap seconds, all positive, making TAI = UTC + 32.

Distribution and Communication Protocol (DCP): transport layer communications protocol providing fragmentation, addressing and/or reliable data transmission over error inserting channels using a Reed Solomon (RS) code to provide Forward Error Correction (FEC) as defined in ETSI TS 102 821 [2]

Fast Access Channel (FAC): channel of the multiplex data stream, which contains the information that is necessary to find services and begin to decode the multiplex

Global Position System (GPS): constellation of satellites providing accurate time and position information to receivers

GPS time: time signal broadcast by the GPS satellites using an epoch of January 6th 1980 with no leap seconds and a "week number" (actually a modulo-604 800 seconds number) that wraps every 1 024 weeks (approximately 19,7 years)

Greenwich Mean Time (GMT): historically the standard time for all international applications, now superseded by UTC

International Atomic Time (literally Temps Atomique International) (TAI): time format counting in standard SI seconds

NOTE: TAI and GPS Time have a constant offset of 19 seconds.

logical frame: contains MSC data of one stream during 400 ms (robustness modes A to D) or 100 ms (robustness mode E)

Main Service Channel (MSC): channel of the multiplex data stream which occupies the major part of the transmission frame and which carries all the digital audio services, together with possible supporting and additional data services

MDI packet: TAG packet containing those TAG items as defined in ETSI TS 102 820 [3]

mod: modulo operator

NOTE: $(x \bmod y) = z$, where $y > 0$, such that $x = qy + z$, q is an integer, and $0 \leq z < y$.

Modified Julian Date (MJD): date format based on the number of days since midnight GMT on 17th November 1858 AD

NOTE: Time can be represented as a fraction of a day, however as MJD is subject to leap seconds, the fractional part corresponding to an SI second is of variable size and hence complex to implement in a fixed width bit-field.

Multiplex Distribution Interface (MDI): protocol specification for the link between a DRM multiplexer and a DRM modulator carrying the description of a complete DRM multiplex in a way that reliable networks of transmitters can be constructed as defined in ETSI TS 102 820 [3]

multiplex frame: logical frames from all streams form a multiplex frame

NOTE: It is the relevant basis for coding and interleaving.

OFDM symbol: transmitted signal for that portion of time when the modulating amplitude and phase state is held constant on each of the equally-spaced carriers in the signal

Quality of Service in AM (QoSAM): European project to develop and validate real time tools for measurement and monitoring of service quality to insure the best achievable quality according to the propagation channel

Recommended Standard 232: interface between data terminal equipment and data communications equipment employing serial binary data interchange

reserved for future addition (rfa): bits with this designation are set to zero and receivers will ignore these bits

reserved for future use (rfu): bits with this designation are set to zero and receivers will check that these bits are zero in order to determine the valid status of the other fields in the same scope

Service Description Channel (SDC): channel of the multiplex data stream, which gives information to decode the services included in the multiplex

NOTE: The SDC also provides additional information to enable a receiver to find alternative sources of the same data.

short Id: short identifier assigned to a service and used as a reference in the SDC

NOTE: The short Id is assigned for the duration of the service and is maintained through multiplex reconfigurations.

SI second: SI base unit of time is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium 133 atom

stream Id: identifier of an MSC stream

NOTE: The short Id is the identifier of a *service*, which is linked by SDC application information data entity - type 5 (see ETSI ES 201 980 [1], clause 6.4.3.6) or SDC audio information data entity - type 9 (see ETSI ES 201 980 [1], clause 6.4.3.10) to an MSC *stream* identified by a stream Id.

TAG header: TAG item consists of header and value; the TAG header holds name and length of the TAG item

TAG item: DCP elemental type combining in a single logical data the name, length and value of the data

TAG length: length of the payload of a TAG item in bits

TAG name: name field within an individual TAG item used to identify an individual piece of information

TAG packet: collection of TAG items with a header carrying a cohesive and self-contained block of data

TAG value: payload of a TAG item

transmission frame: number of consecutive OFDM symbols (duration of 400 ms for robustness modes A to D or 100 ms for robustness mode E), whereby the first OFDM symbol contains the time reference/frame synchronization cells

transmission super frame: three consecutive transmission frames for robustness modes A to D (duration of 1 200 ms) or four consecutive transmission frames for robustness mode E (duration of 400 ms), whereby the first transmission frame contains the SDC block

World Geodetic System 1984 (WGS84): geodetic reference system used by GPS

NOTE 1: The origin of the WGS84 framework is the earth's centre of mass.

NOTE 2: GPS receivers compute and store coordinates in terms of WGS84, then if required transform to other datums when information is displayed.

xHE-AAC: MPEG Extended HE-AAC audio codec, an AAC superset for speech and music coding at very low bit rates

3.2 Symbols

For the purposes of the present document, the following symbols apply:

K	number of active carriers in the OFDM symbol
K_{max}	carrier index of the upper active carrier in the OFDM signal
K_{min}	carrier index of the lower active carrier in the OFDM signal
N_x	The value N is expressed in radix x

NOTE: The radix of x is decimal, thus $2A_{16}$ is the hexadecimal representation of the decimal number 42.

T_f	duration of a transmission frame
T_s	duration of an OFDM symbol
$\lceil x \rceil$	the smallest integral value numerically greater than x

NOTE: Sometimes known as the "ceiling" function or round towards plus infinity.

$\lfloor x \rfloor$	the largest integral value numerically less than x

NOTE: Sometimes known as the "floor" function or round towards minus infinity.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AAC	Advanced Audio Coding
AF	Application Framing

NOTE: A DCP protocol layer.

AFS	Alternative Frequency Switching
AM	Amplitude Modulation
ASCII	American Standard Code for Information Interchange
BE	Block Exponent
BER	Bit Error Rate
CELP	Code Excited Linear Prediction
CRC	Cyclic Redundancy Check
DC	Direct Current
DCP	Distribution and Communication Protocol
DMDI	DRM Multiplex Distribution Interface
DRM	Digital Radio Mondiale
ESC	Error Sensitivity Category
FAC	Fast Access Channel

NOTE: A DRM multiplex component.

FEC	Forward Error Correction
FF	File Framing

NOTE: A DCP Protocol Layer.

FFT	Fast Fourier Transformation
GMT	Greenwich Mean Time
GPS	Global Positioning System

GUI Graphical User Interface
HF High Frequency
HVXC Harmonic Vector eXcitation Coding
ICR Interference-to-Carrier Ratio
IF Intermediate Frequency
INR Interference-to-Noise Ratio
IP Internet Protocol
IQ Inphase and Quadrature component
ISR Interference-to-Signal Ratio
LSb Least Significant bit
LSB Least Significant Byte
MDI Multiplex Distribution Interface
MER Modulation Error Ratio
MJD Modified Julian Date
MPEG Moving Pictures Expert Group
MSb Most Significant bit
MSB Most Significant Byte
MSC Main Service Channel

NOTE: A DRM multiplex component.

NMEA National Marine Electronics Association
OFDM Orthogonal Frequency Division Multiplex
PC Personal Computer
PFT Protection, Fragmentation and Transport

NOTE: A DCP protocol layer.

PIR Power Impulse Response
PLA Protection Level A
PLB Protection Level B
PN Pilot Number
PO Pilot Offset
PRBS Pseudo Random Bit Sequence
PSD Power Spectral Density
QAM Quadrature Amplitude Modulation
QoSAM Quality of Service in AM
RF Radio Frequency
rfa reserved for future addition
rfu reserved for future use
RMC Recommended Minimum sentence C
RMS Root Mean Square

NOTE: = Square root of the mean squared value.

RS Reed Solomon
RS232 Recommended Standard 232
RSCI Receiver Status and Control Interface
RX_CTRL Receiver ConTRoL information
RX_STAT Receiver STATus information
SBR Spectral Band Replication
SDC Service Description Channel

NOTE: A DRM multiplex component.

SI International System of units
SN Symbol Number
SNR Signal-to-Noise Ratio
SR Symbol Repetition
TAI International Atomic Time

NOTE: Literally Temps Atomique International.

TAG/AF TAG/Application Framing

TCP Transmission Control Protocol

NOTE: IP based protocol.

UDP User Datagram Protocol

NOTE: IP based protocol.

UHS Unspecified High Sensitive
ULS Unspecified Less Sensitive
UTC Coordinated Universal Time

NOTE: Literally Universel Temps Coordonné.

WGS84 World Geodetic System 1984
WMER Weighted Modulation Error Ratio
xHE-AAC Extended High-Efficiency AAC

3.4 Convention

All numbers are decimal, thus the radix is 10, unless otherwise stated by N_x (see clause 3.2).

The order of bits and bytes within each description shall use the following notation unless otherwise stated:

- In figures, the bit or byte shown in the left hand position is considered to be first.
- In tables, the bit or byte shown in the left hand position is considered to be first.
- In byte fields, the Most Significant bit (MSb) is considered to be first and denoted by the higher number. For example, the MSb of a single byte is denoted "b7" and the Least Significant bit (LSb) is denoted "b0".
- In vectors (mathematical expressions), the bit with the lowest index is considered to be first.

4 System conception for DRM coverage monitoring

Current professional or monitoring DRM receivers are based on different architectures (see figure 4.1). To enable test equipment to be used for all of those receivers, the definition of a standardized interfacing protocol is necessary. To overcome the difficulties that the receiver implementations are based on different platforms a TCP/UPD/IP based approach is chosen.