

# ETSI TS 102 358 V1.1.1 (2005-01)

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*Technical Specification*

## **Digital Radio Mondiale (DRM); Specific Restrictions for the use of the Distribution and Communication Protocol (DCP)**

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European Broadcasting Union



Union Européenne de Radio-Télévision

EBU·UER



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Reference

DTS/JTC-DRM-09

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Keywords

broadcasting, digital, DRM, radio, MUX

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## Foreword

This Technical Specification (TS) has been produced by Joint Technical Committee (JTC) Broadcast of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECTrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

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.

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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 which 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 communications 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 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.

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# 1 Scope

The present document extends and regulates in detail some aspects of the generic and application-independent Distribution and Communication Protocol (DCP) to build a common basis for all DCP-based application protocols standardized within the scope of Digital Radio Mondiale (DRM) see ES 201 980 [1]. These DRM-specific application protocols comprise for example the Multiplex Distribution Interface (MDI), the Modulator Control Interface (MCI), the Service Distribution Interface (SDI), the Receiver Status and Control Interface (RSCI), and others.

**The definitions and restrictions to the DCP protocol given in the present document are mandatory for all DCP-based DRM application protocols.**

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# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

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

- [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] ANSI/TIA/EIA-232-F: "Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange".
- [5] IEEE 802.3-2002: "Information Technology - Telecommunication & Information Exchange Between Systems - LAN/MAN - Specific Requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications".
- [6] TIA-457 (9-pin SUB-D): Rescinded Sept., 1992; superseded by EIA-520B000 .
- [7] TIA/EIA-568-B (series): "Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements".

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# 3 Definitions, symbols, abbreviations and conventions

## 3.1 Definitions

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

**Byte:** collection of 8-bits

**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  $\pm 0,9$  seconds

NOTE: TAI and UTC were defined as having an initial offset of 10 seconds on January 1 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 25 February 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 errored channels using a Reed Solomon code to provide Forward Error Correction

**MDI Packet:** TAG packet containing those TAG Items as defined in TS 102 820 [3]

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

**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:** the payload of a TAG Item

## 3.2 Symbols

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

$N_x$                     The value "N" is expressed in radix "x". The radix of "x" shall be decimal, thus  $2A_{16}$  is the hexadecimal representation of the decimal number 42.

## 3.3 Abbreviations

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

AF	Application Framing (a DCP Protocol Layer)
AFS	Alternative Frequency Switching
ASI	Asynchronous Serial Interface
BER	Bit Error Ratio
BOOTP	Boot Protocol
CRC	Cyclic Redundancy Check
DCP	Distribution and Communication Protocol
DHCP	Dynamic Host Configuration Protocol
DRM	Digital Radio Mondiale
FAC	Fast Access Channel (DRM Multiplex Component)
FEC	Forward Error Correction
FF	File Framing (a DCP Protocol Layer)
GMT	Greenwich Mean Time
GPS	Global Positioning System
IP	Internet Protocol
ISO	International Organization for Standardization
LSb	Least Significant Bit
LSB	Least Significant Byte
MCI	Modulator Control Interface
MDI	Multiplex Distribution Interface
MFN	Multi-Frequency Network
MJD	Modified Julian Date
MPEG	Moving Picture Experts Group
MSb	Most Significant Bit
MSB	Most Significant Byte
MSC	Main Service Channel (DRM Multiplex component)
OFDM	Orthogonal Frequency Division Multiplexing
PFT	Protection, Fragmentation and Transport (a DCP Protocol Layer)
PRBS	Pseudo-Random Binary Sequence
RF	Radio Frequency
rfu	reserved for future use
RSCI	Receiver Status and Control Interface

SDC	Service Description Channel (DRM Multiplex component)
SDI	Service Distribution Interface
SFN	Single Frequency Network
SMFN	Synchronized Multi-Frequency Network
TAI	International Atomic Time (Temps Atomique International)
TCP	Transmission Control Protocol (IP-based protocol)
UDP	User Datagram Protocol (IP-based protocol)
UTC	Co-ordinated Universal Time (Universel Temps Coordonné)

## 3.4 Conventions

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 "b<sub>7</sub>" and the Least Significant bit (LSb) is denoted "b<sub>0</sub>".
- In vectors (mathematical expressions), the bit with the lowest index is considered to be first.

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# 4 DCP-based application protocols for DRM

## 4.1 Specified DRM application protocols

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 for to use for every organization and purpose. It is specified in document **Distribution and Communication Protocol (DCP)** (see 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, e.g.:

- **Multiplex Distribution Interface (MDI)** (see TS 102 820 [3]) covers the transport of data and commands from the DRM Multiplexer to the DRM Modulator.
- **Modulator Control Interface (MCI)** covers the remote signaling of commands and setups to the modulator and sender equipment.
- **Service Distribution Interface (SDI)** covers the transport of data and commands from the studio and other sources to the DRM Multiplexer.
- **Receiver Status and Control Interface (RSCI)** covers the transport of a receiver's status information in addition to the DRM multiplex as well as commands to control the receiver's behaviour.

## 4.2 Protocol Stack

The general protocol stack in use for all standardized DRM-specific protocols is outlined in figure 1 (using an example selection of currently standardized DCP-based DRM application protocols):

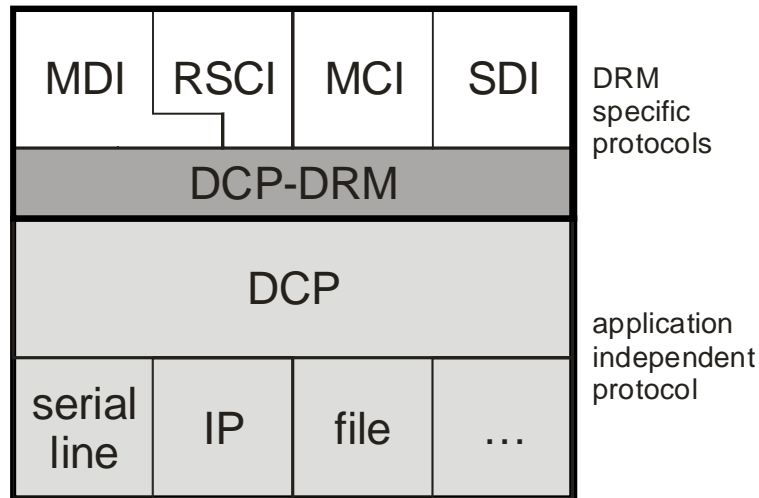


Figure 1: DRM Protocol Stack

The present document's position in this protocol stack is labelled "DCP-DRM" and marked by a dark grey background.

NOTE: the RSCI is a superset of the MDI protocol.

## 4.3 DRM Transmission Chain overview

Figure 2 gives an overview of the DRM transmission chain. It shows which connections are covered by which of the above protocols.

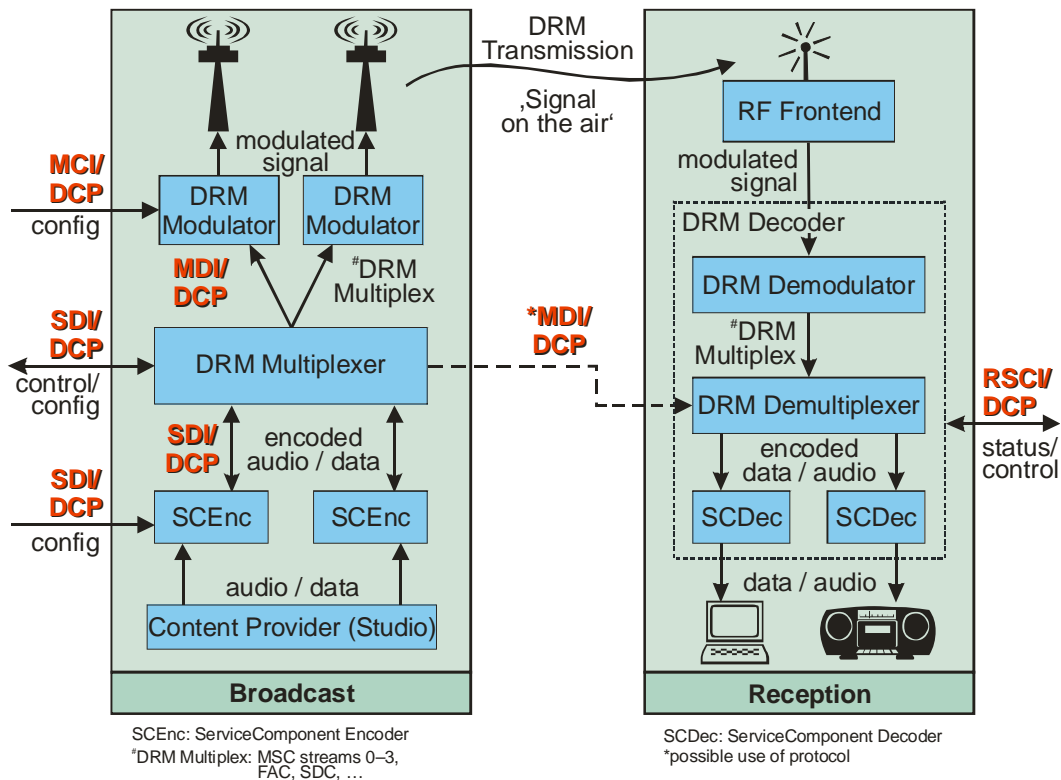


Figure 2: DRM Transmission Chain and its protocols



## 4.4 DRM Broadcast chain setup scenarios

Several overall scenarios for arranging the equipment in the broadcast chain can be achieved using the DRM-standardized protocols.

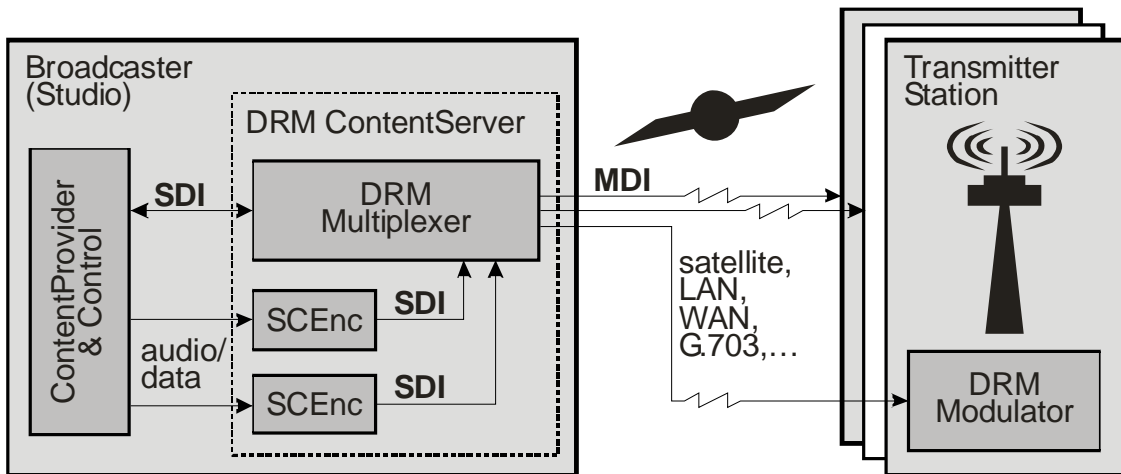


Figure 3: Broadcast Equipment Setup - compact version

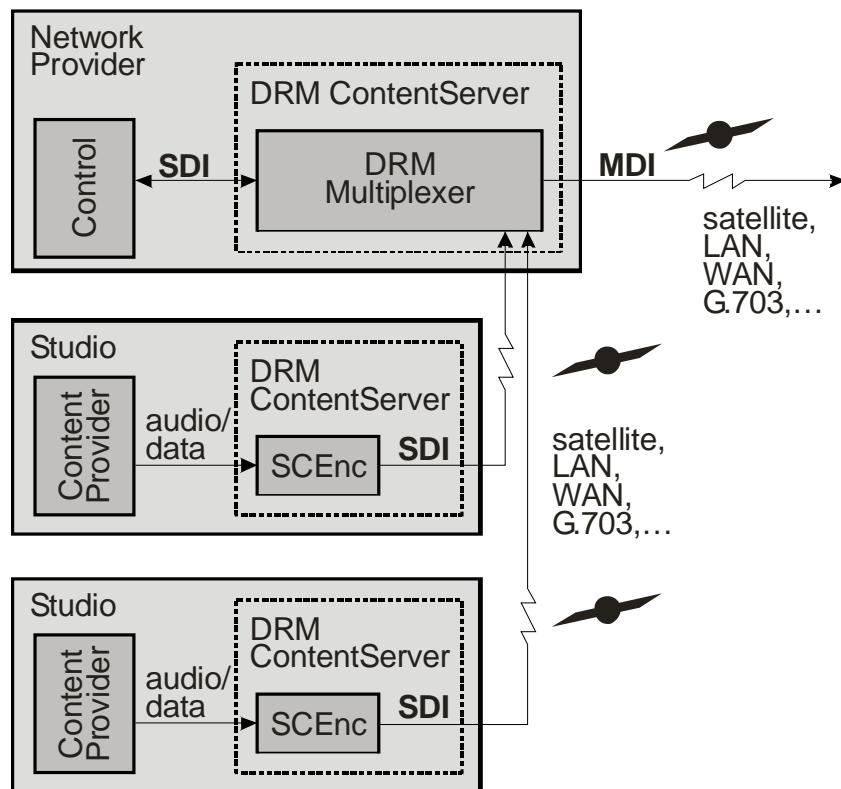


Figure 4: Broadcast Equipment Setup - network provider version

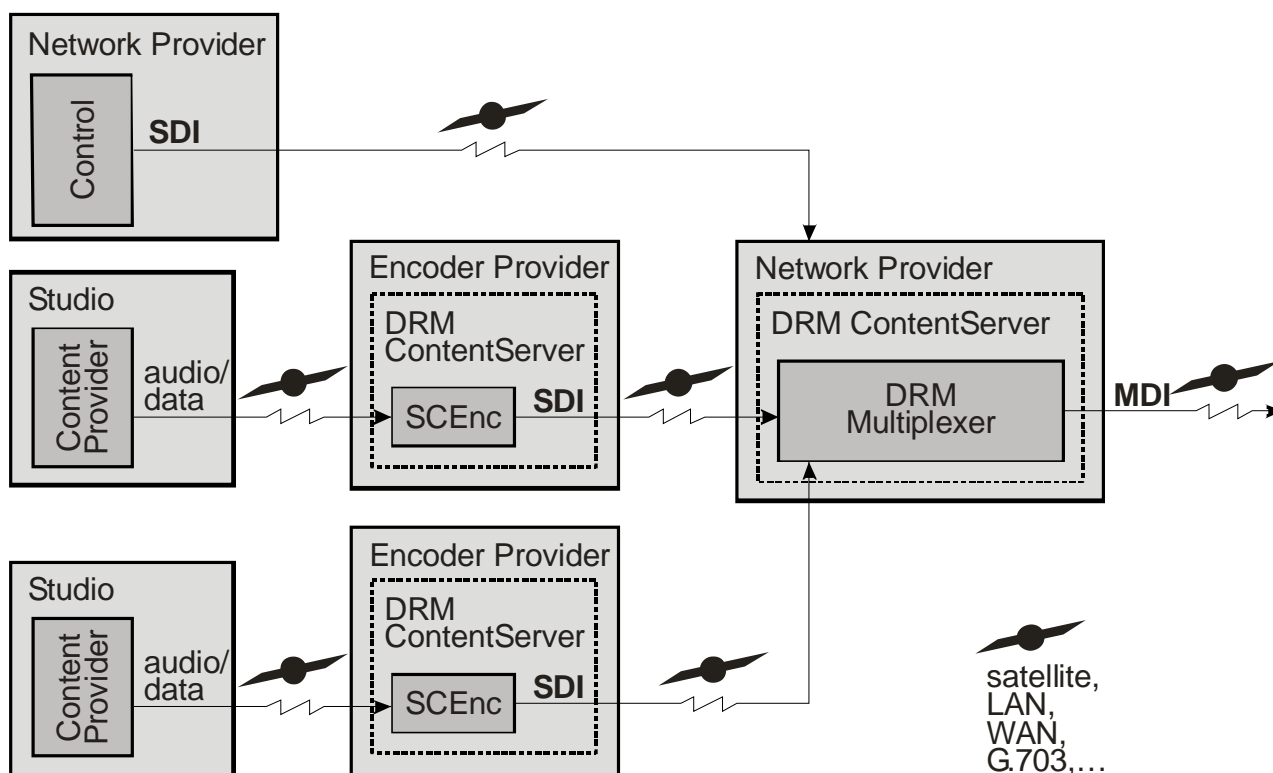


Figure 5: Broadcast Equipment Setup - distributed version

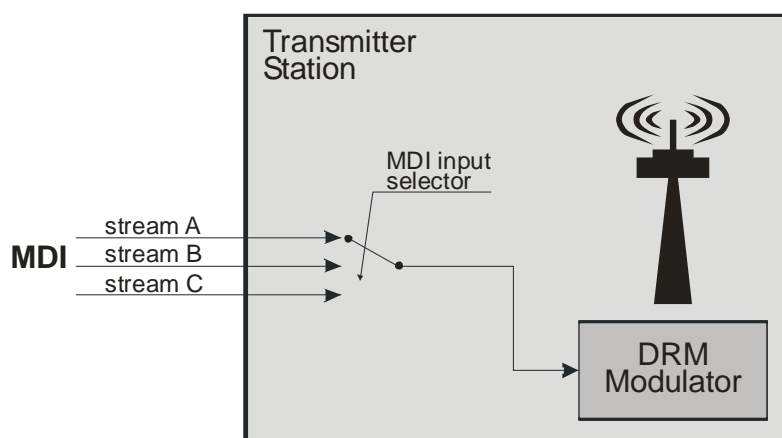


Figure 6: Broadcast Equipment Setup - Local MDI input selection

## 5 DRM-specific DCP Definitions and Restrictions

This clause lists all restrictions to the "Distribution and Communication Protocol" (DCP) TS 102 821[2] and several additional specifications, which shall apply to all DCP-based DRM-standardized application protocols.

**The definitions and restrictions to the DCP protocol given in this clause are mandatory for all DCP-based DRM application protocols.**

## 5.1 Special TAG Items

The support of all Special TAG Items defined in clause "Special TAG Items" of the DCP document TS 102 821 [2] is mandatory for all DCP-based application protocols standardized within the DRM Consortium.

The Control TAG Item "\*ptr" shall use the following revision numbering scheme for all DCP-based application protocols standardized within the DRM Consortium. An increment of the minor revision number only signals a fully backward-compatible change or extension of the protocol, while an increment of the major revision number signals a non-backward-compatible change to the protocol. As an example, a decoder which is capable of decoding protocol revision 4.2 may also safely decode revisions 4.3, 4.4, etc. However it shall not attempt to decode any protocol revision 5.0 or above.

NOTE: Backward-compatible extensions for all DCP-based DRM-standardized application protocols shall not comprise changes to existing TAG Items.

For all DCP-based application protocols standardized within the DRM Consortium all TAG Item Padding bits shall be set to 0.

For all DCP-based application protocols standardized within the DRM Consortium all TAG Value bytes of the Special TAG Item "\*dmy" shall be set to the value 0x00.

## 5.2 Proprietary TAG Items

Proprietary TAG Items may be sent within any TAG Packet carrying data of any DCP-based application protocol standardized for DRM (like MDI, MCI, SDI, RSCI, etc.) along with the TAG Items explicitly standardized for the application protocol in use.

Receiving devices are only required to interpret the TAG Items standardized for the individual DCP-based application protocol. Proprietary TAG Items may safely be ignored by any receiving device.

To prevent re-assignment of identical TAG Names for different purposes within application protocols standardized for DRM, the following rules apply to the names of TAG Items:

- TAG Names standardized for a certain DCP-based DRM application protocol (like MDI, MCI, SDI, RSCI, etc.) shall start with lowercase letters;
- Proprietary TAG Names shall start with an uppercase letter or numeric character;
- Some of these uppercase first letters of proprietary TAG Names are assigned to individual organizations;
- TAG names starting with the asterisk character "\*" belong to Control TAG Items, and are therefore independent of any particular application protocol (see clause 5.2.2 of TS 102 821 [2]).

The following list defines special letters to be used as first letters for proprietary TAG Names.

To prevent confusion within DCP-based application protocols for DRM, some of the letters are exclusively assigned for proprietary use by individual organizations.

**Table 1: Optional TAG Items**

TAG Name first letter (ASCII, uppercase)	To be used for proprietary TAG Items by
A	TDF Télédiffusion de France
B	BBC British Broadcasting Corporation
C	Coding Technologies
D	Deutsche Telekom, T-Systems
F	FhG Fraunhofer Gesellschaft
H	Harris
I	RIZ Transmitters Co.
M	VT Merlin Communications
R	Robert Bosch
S	Sony
T	Thales Broadcast and Multimedia
U, V, W, X, Y, Z	Freely available to be used by any DRM member
all other uppercase (!) letters	Reserved for future assignment to individual DRM members
0 to 9	Freely available to be used by any person or organization

NOTE: The Distribution and Communication Protocol DCP is explicitly free for any use by any person, organization or company. Therefore the exclusivity of proprietary TAG Name first letters from the preceding list only applies to TAG Names defined within one of the DRM-related protocols (like MDI, MCI, SDI, RSCI, etc.). If the DCP is used outside the scope of DRM, any TAG Name may obviously be used by anyone for any purpose.

### 5.3 DCP's AF Layer

The AF Header CRC, although optional in DCP, is mandatory for all DRM-standardized DCP-based application protocols. Therefore the AF Header's CRC flag ("CF") of the AR field must be enabled (set to 1).

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## 6 DCP Interface standards

To provide a defined hardware interface between DCP-capable DRM equipment from different manufacturers, minimum hardware input/output requirements are defined for certain types/categories of DRM equipment.

These hardware interface definitions are intended for both:

- **local connections** (direct connections);
- **remote connections** (only specifying the first and last piece of the data transport chain).

Every DCP-based application protocol standardized within the DRM consortium may specify its own set of recommended and/or mandatory hardware interfaces. This definition is given within the scope of the application protocol definition.

The present document therefore only specifies the range of possible hardware interfaces together with their recommended/required setup and configuration. The selection among these interfaces is up to the individual application protocol.

NOTE: Additional hardware interface specifications might be added in the future.

## 6.1 RS232

The RS232 standard specifies a serial connection. This connection will most probably be used locally.

The general characteristics of this protocol/hardware are as follows:

- Standardized as ANSI/TIA/EIA-232 [4];
- Cable length up to 50 metres (for any bitrate with low-capacitance cable: approx. 50pF/m);
- Several flow control options (off, XON/XOFF, hardware).

For DCP-based transmission protocols referencing the RS232 protocol as their recommended/mandatory hardware interface, the following settings and restrictions shall apply:

- Connector and pinout according to TIA-457 (9-pin SUB-D) [6];
- DTE (Data Terminal Equipment) presentation (female connector, Transmitted Data is an output).  
Note that all equipment has DTE presentation, irrespective of whether it might be considered a source or a sink of the particular application-layer protocol;
- Point-to-point full-duplex mode;
- Minimum supported bitrate must be at least 115 200 bps;
- 8N1 (8 data bits, no parity bit, 1 stop bit);
- No flow control.

## 6.2 Ethernet (IP over Ethernet)

The Ethernet network connection shall be used to transport IP packets (Internet Protocol over Ethernet).

This connection may be used for local and long-distance connection end-points. The following minimum requirements are designed to allow point-to-point or point-to-multipoint unidirectional transmission of a DCP stream in any of the scenarios outlined in clause 4.3 and 4.4.

**NOTE:** The DCP does not provide any security mechanisms. Security can be implemented in a number of layers. Minimally compliant implementations need not implement application or transport layer security and shall be compatible with network layer security implemented in external equipment, for example IPSEC or other tunnelling mechanisms.

For DCP-based transmission protocols referencing the IP over Ethernet protocol (to transport UDP datagrams) as their recommended/mandatory hardware interface, the following settings and restrictions shall apply.

### 6.2.1 Transport Layer

- The mapping of DCP packets to IP is specified in annex B of TS 102 821 [2] which mandates a 1 to 1 encapsulation of PFT or AF packets in UDP datagrams.
- All equipment shall support direct encapsulation of the UDP transport stream in IPv4 datagrams.
- All equipment sending DCP streams shall be configurable to set the destination UDP port number and to specify or identify the source UDP port.
- All equipment receiving DCP streams shall be configurable to set the listening UDP port number (destination UDP port). The source UDP port number (carried in received UDP packets) may be configurable as an additional filtering parameter or the equipment may receive from any source port.

## 6.2.2 Network Layer

- All equipment implementing an IP interface shall be capable of operating as an IPv4 host with configurable interface IP address, subnet mask and default gateway.
- All equipment sending DCP streams shall be configurable to set the destination IP address, which can be a unicast or a multicast IP address.
- Equipment receiving DCP streams may be configurable to set the source IP address as an additional filtering parameter or the equipment may receive from any source address.
- All equipment receiving DCP streams shall be configurable to listen on the IP address assigned to the network interface.
- All equipment receiving DCP streams shall be configurable to listen on a configurable IPv4 multicast IP address, in which case the equipment shall maintain membership of the specified multicast group using IGMP.

## 6.2.3 Link Layer

For DCP-based transmission protocols referencing the Ethernet protocol as their recommended/mandatory hardware interface, the following settings and restrictions shall apply:

- The interface shall be compatible with IEEE 802.3 [5] 10Base-T LANs using half-duplex multi-port repeaters (hubs);
- The interface should be compatible with IEEE 802.3u [5] 100Base-T LANs using half-duplex and/or full-duplex switches;
- The interface presentation shall be RJ-45 socket, MDI (Medium Dependent Interface) wired to Electronic Industry Association/Telecommunications Industry Association's Standard 568B [7];

Network adapters shall have a globally unique MAC address.

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## History

<b>Document history</b>		
V1.1.1	January 2005	Publication